Austin Morris

TAXI & HIRE CAR

Series FL2, FL2D, FX4 & FX4D

Austin Morris

Workshop Manual

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(1958 - 1982)

TAXI & HIRE CAR

Series FL2, FL2D, FX4 & FX4D

INTRODUCTION

This Manual has been prepared to provide the service operator with the necessary information for the maintenance and repair of the Austin Taxi and Hire Car. The Manual serves not only as a ready-reference book for service supervision, but also covers items of procedure for the guidance of both the fully qualified and the less-experienced mechanic.

The following notes will simplify reference to the information the Manual contains.

Unit arrangement. The complete car is broken down into Sections, each Section having a letter reference.

Numbering of pages and illustrations. The pages and illustrations are numbered consecutively within each Section, and the Section title and letter, in addition to each page number, are shown on each page.

Service tools. Proper tools contribute largely to efficient, economic, and profitable repair. References have therefore been made to such tools throughout the Manual.

References. References to the left- or right-hand side in the Manual are made when viewing the vehicle from the rear. With the engine and gearbox assembly removed, the water pump end of the engine is referred to as the front.

Dimensions. The dimensions quoted are to design engineering specification. Alternative unit equivalents, shown in brackets following the dimensions, have been converted from the original specification.

During the period of running-in from new, certain adjustments may vary from the specification figures given in this Manual. These adjustments will be re-set by the Distributor or Dealer at the After Sales Service, and thereafter should be maintained at the figures specified in the Manual.

ABBREVIATIONS

amp. hr.	Ampere hours	**km.**	Kilometres
atm.	Atmospheres	**lb.**	Pounds
c.c.	Cubic centimetres	**lb./sq. in.**	Pounds per square inch
c.c./min.	Cubic centimetres per minute	**lb.ft.**	Pounds feet
cu. in.	Cubic inches	**lb.in.**	Pounds inches
ft.	Feet	**m.**	Metres
in.	Inches	**mm.**	Millimetres
kg.	Kilogrammes	**m.p.h.**	Miles per hour
kg./cm.^{2}	Kilogrammes per square centimetre	**r.p.m.**	Revolutions per minute
kg.m.	Kilogramme metres	**v**	Volts

SPECIFICATION

Purchasers are advised that the specification details set out in this Manual apply to a range of vehicles and not to any particular vehicle. For the specification of any particular vehicle Purchasers should consult their Distributor or Dealer.

The Manufacturers reserve the right to vary their specifications with or without notice, and at such times and in such manner as they think fit. Major as well as minor changes may be involved in accordance with the Manufacturer's policy of constant product improvement.

Whilst every effort is made to ensure the accuracy of the particulars contained in this Manual, neither the Manufacturer nor the Distributor or Dealer, by whom this Manual is supplied, shall in any circumstances be held liable for any inaccuracy or the consequences thereof.

REPAIRS AND REPLACEMENT

When replacement parts are required it is essential that only genuine BL and UNIPART parts are used.

Attention is particularly drawn to the following points concerning repairs and the fitting of replacement parts and accessories:

Safety measures embodied in the vehicle may be impaired if other than BL or UNIPART parts are fitted.

In certain territories, legislation prohibits the fitting of parts not to the vehicle manufacturer's specification.

Torque wrench setting figures given in the Workshop Manual must be strictly adhered to. Locking devices, where specified, must be fitted. If the efficiency of a locking device is impaired during removal it must be renewed.

Owners purchasing accessories while travelling abroad should ensure that the accessory and its fitted location on the vehicle conform to mandatory requirements existing in their country of origin.

The terms of the Vehicle Service Statement may be invalidated by the fitting of other than BL and UNIPART parts.

All BL and UNIPART parts have the full backing of the Vehicle Service Statement.

BL Cars Distributors and Dealers are obliged to supply only BL and UNIPART parts.

UNIPART

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CONTENTS

GENERAL DATA

FRYARA

DIESEL ENGINE

2·2-litre engine

Types	22E, 22EA, 22K, 22KA, 22EB, and 22KB.
Number of cylinders	4.
Bore	3·25 in. (82·6 mm.).
Stroke	4 in. (101·6 mm.).
Capacity	132·7 cu. in. (2178 c.c.).
Compression ratio	20 : 1.
Firing order	1, 3, 4, 2.
Maximum torque	89 lb. ft. (12·3 kg. m.) at 2,800 r.p.m.
Idling speed: (engine with 'in-line' injection pump)	500 r.p.m.
(engine with distributor injection pump)	600 r.p.m. (500 r.p.m. with pump Type DPA.3248050A)
Maximum governed speed	3,500 r.p.m.
Oversize bore: First	·010 in. (·254 mm.).
Second	·020 in. (·508 mm.).
Max.	·030 in. (·762 mm.).

2·52-litre engine

Type	25V.
Number of cylinders	4.
Bore	3·4995 to 3·5006 in. (88·887 to 88·915 mm.).
Stroke	4·000 to 4·005 in. (101·6 to 101·727 mm.).
Capacity	2520 c.c. (153·7 cu. in.).
Compression ratio	20·5 : 1
Firing order	1, 3, 4, 2.
Maximum torque	109 lb. ft. (15·06 kg. m.) at 2,000 r.p.m.
Idling speed	550 to 600 r.p.m.
Maximum governed light running speed	3,700 to 3,800 r.p.m.
Oversize bore: First	·010 in. (·254 mm.).
Second	·020 in. (·508 mm.).
Third	·030 in. (·762 mm.).
Maximum	·040 in. (1·016 mm.).

Crankshaft

Journal diameter	2·4785 to 2·4790 in. (62·953 to 62·967 mm.).
Crankpin diameter	2·2480 to 2·2485 in. (57·099 to 57·112 mm.).
Undersizes (journals and crankpins): First	·010 in. (·254 mm.).
Second	·020 in. (·508 mm.).
Third	·030 in. (·762 mm.).
Max.	·040 in. (1·016 mm.).
End-float (taken on thrust washers at centre main bearing)	·0005 to ·0045 in. (·013 to ·115 mm.).
Adjustment	Selective assembly of thrust washers.

Main bearings

Number	3.
Length: Front and centre	$1\frac{5}{8}$ in. (41·275 mm.).
Rear	$1\frac{7}{8}$ in. (47·625 mm.).
Running clearance	·002 to ·0035 in. (·051 to ·089 mm.).
Undersizes for reground journals: First	·010 in. (·254 mm.).
Second	·020 in. (·508 mm.).
Third	·030 in. (·762 mm.).
Max.	·040 in. (1·016 mm.).

Connecting rods

Length (centres)	7·999 to 8·001 in. (20·317 to 20·323 cm.).
Side-clearance	·008 to ·012 in. (·203 to ·305 mm.).
Small-end bush (inner diameter, reamed in position)	1·1255 to 1·1260 in. (28·588 to 28·600 mm.).

Big-end bearings

Length	·995 to 1·005 in. (25·273 to 25·527 mm.).
Inner diameter	2·2515 in. (57·188 mm.).
Running clearance	·002 to ·0035 in. (·051 to ·089 mm.).
Undersizes for reground crankpins: First	·010 in. (·254 mm.).
Second	·020 in. (·508 mm.).
Third	·030 in. (·762 mm.).
Max.	·040 in. (1·016 mm.).

Pistons (2·2-litre engine)

Material	Aluminium alloy.
Clearance at bottom of skirt	·004 to ·0046 in. (·102 to ·117 mm.).
Width of groove: First compression	·0975 to ·0985 in. (2·477 to 2·502 mm.).
Second and third compression	·0965 to ·0975 in. (2·451 to 2·477 mm.).
Oil control	·1885 to ·1895 in. (4·788 to 4·813 mm.).
Oversizes: First	·010 in. (·254 mm.).
Second	·020 in. (·508 mm.).
Third [Max. on early (linered) engines]	·030 in. (·762 mm.).
Fourth [Max. on later (non-linered) engines]	·040 in. (1·016 mm.).

Piston rings (2·2-litre engine)

Number	3 compression (1 chrome-plated, 1 plain, 1 taper), 2 oil control.
Width: Compression	·094 in. (2·39 mm.).
Oil control	·188 in. (4·78 mm.).
Gap (compression and oil control)	·009 to ·014 in. (·23 to ·36 mm.).

Pistons (2·52-litre engine)

Type	Aluminium alloy with solid skirt.
Clearance: Bottom of skirt	·0045 to ·0051 in. (·1143 to ·1295 mm.).
Top land	·0185 to ·0248 in. (·470 to ·630 mm.).
Width of groove: Top, Second, Third	·0963 to ·0973 in. (2·45 to 2·71 mm.).
Fourth	·190 to ·191 in. (4·83 to 4·85 mm.).
Oversizes: First	·010 in. (·254 mm.).
Second	·020 in. (·508 mm.).
Third	·030 in. (·762 mm.).
Maximum	·040 in. (1·016 mm.).

Piston rings (2·52-litre engine)

Number	2 compression (top—chrome-faced, second—taper-faced). 2 oil control (third—stepped scraper, fourth—slotted).
Gap (fitted): Top	·014 to ·019 in. (·355 to ·482 mm.).
Second, third and fourth	·010 to ·015 in. (·254 to ·381 mm.).

Gudgeon pins

Type	Fully floating.
Fit in piston	·0003 in. (·008 mm.) clearance to ·0001 in. (·003 mm.) interference.
Diameter	1·1248 to 1·1250 in. (28·569 to 28·575 mm.).
Length	3·000 to 3·015 in. (76·20 to 76·58 mm.).

Valves (2·2-litre engines)

Position	Overhead, push-rod-operated.
Lift	·39 in. (9·9 mm.).

Diameter: Head: Inlet	1·605 to 1·610 in. (40·77 to 40·89 mm.).
Exhaust	1·3215 to 1·3265 in. (33·566 to 33·693 mm.).
Stem: Inlet and exhaust	·34175 to ·34225 in. (8·680 to 8·693 mm.).
Stem to guide clearance: Inlet	·0015 to ·0025 in. (·038 to ·064 mm.).
Exhaust	·001 to ·002 in. (·025 to ·051 mm.).
Valve to rocker clearance	·012 in. (·31 mm.) cold.
Seat angle, inlet and exhaust	45°.

Valves (2·52-litre engine)

Lift	·39 in. (9·9 mm.).
Head diameter: Inlet	1·557 to 1·562 in. (39·54 to 39·67 mm.).
Exhaust	1·317 to 1·322 in. (33·45 to 33·58 mm.).
Stem diameter	·34175 to ·34225 in. (8·68 to 8·69 mm.).
Seat angle	45°.
Valve to rocker clearance (cold): Inlet	·012 in. (·305 mm.).
Exhaust	·015 in. (·38 mm.).
Valve stand-down	·020 to ·030 in. (·508 to ·762 mm.).

Valve guides

Length: Inlet	2·14 in. (54·36 mm.).
Exhaust	2·5 in. (63·5 mm.).
Fitted height above head	·734 to ·750 in. (18·64 to 19·05 mm.).
Diameter: Outside: Inlet and exhaust	·5635 to ·5640 in. (14·313 to 14·326 mm.).
Inside: Inlet (reamed in position)	·3438 to ·3443 in. (8·733 to 8·745 mm.).
Exhaust (reamed in position)	·3433 to ·3438 in. (8·720 to 8·733 mm.).

Valve springs

Free length: Inner	2·187 in. (55·55 mm.).
Outer	2·5 in. (63·5 mm.).
Fitted length: Inner	1·5 in. (38·1 mm.).
Outer	1·703 in. (43·26 mm.).
Pressure: Valve closed: Inner	23 to 25 lb. (10·43 to 11·34 kg.).
Outer	56·5 to 60·5 lb. (25·63 to 27·44 kg.).
Working coils: Inner	7½.
Outer	5½.
Wire diameter: Inner	·104 in. (2·64 mm.).
Outer	·156 in. (3·97 mm.).
Core diameter: Inner	·75 to ·765 in. (19·05 to 19·43 mm.).
Outer	1·125 to 1·140 in. (28·58 to 28·96 mm.).

Tappets

Type	Cylindrical.

Rockers

Bushes—inside diameter (reamed in position)	·8115 to ·8125 in. (20·61 to 20·64 mm.).
Bore of arm	·909 to ·910 in. (23·088 to 23·114 mm.).

Camshaft

Journal diameter: Front	1·78875 to 1·78925 in. (45·434 to 45·447 mm.).
Centre	1·74875 to 1·74925 in. (44·418 to 44·431 mm.).
Rear	1·62275 to 1·62325 in. (41·218 to 41·231 mm.).
End-float (taken on thrust plate at front end)	·003 to ·006 in. (·076 to ·152 mm.).

Camshaft bearings

Number	3.
Type	Steel-backed white metal.
Inner diameter (reamed in position): Front	1·79025 to 1·79075 in. (45·472 to 45·485 mm.).
Centre	1·75025 to 1·75075 in. (44·456 to 44·469 mm.).
Rear	1·62425 to 1·62475 in. (41·256 to 41·269 mm.).
Running clearance	·001 to ·002 in. (·025 to ·051 mm.).

Valve timing

Valve to rocker clearance timing check	·021 in. (·53 mm.).
Inlet valve: Opens	5° B.T.D.C.
Closes	40° A.B.D.C.
Exhaust valve: Opens	60° B.B.D.C.
Closes	5° A.T.D.C.

Distributor injection pump chain wheel bearing liner

Inside diameter, (finished in position)	1·75025 to 1·75075 in. (44·456 to 44·469 mm.).
Running clearance	·001 to ·002 in. (·025 to ·051 mm.).

Lubrication

System	Pressure.
Pump type	Eccentric rotor.
Pump rotor end-float	See Section A.36.
Pump rotor lobe clearance	See Section A.36.
External filter	Full-flow.
Oil pressure: Idling	15 lb./sq. in. (1·05 kg./cm.^{2}).
Normal running	45 to 50 lb./sq. in. (3·1 to 3·5 kg./cm.^{2}).
Relief valve spring: Free length	3 in. (7·62 cm.).
Operating pressure	50 to 55 lb./sq. in. (3·52 to 3·87 kg./cm.^{2}).

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PETROL ENGINE

Type	22Z and 22ZA.
Number of cylinders	4.
Bore	3·125 in. (79·4 mm.).
Stroke	4·375 in. (111·1 mm.).
Capacity	134·1 cu. in. (2199 c.c.).
Compression ratio	6·8 : 1.
Firing order	1, 3, 4, 2.
Maximum torque	116 lb. ft. at 1,700 r.p.m. (22Z).
	102 lb. ft. at 1,600 r.p.m. (22ZA).
Oversize bore: First	·010 in. (·254 mm.).
Second	·020 in. (·508 mm.).
Third	·030 in. (·762 mm.).
Max.	·040 in. (1·016 mm.).

Crankshaft

Journal diameter	2·4790 to 2·4795 in. (62·967 to 62·979 mm.).
Crankpin diameter	2·0000 to 2·0005 in. (50·8 to 50·813 mm.).
Undersizes (journals and crankpins): First	·010 in. (·254 mm.).
Second	·020 in. (·508 mm.).
Third	·030 in. (·762 mm.).
Max.	·040 in. (1·016 mm.).
End-float (taken on thrust washers at centre main bearing)	·002 to ·003 in. (·051 to ·076 mm.).

Main bearings

Number	3.
Type	Steel-backed white metal.
Length: Front and centre	1¾ in. (44·4 mm.).
Rear	2 in. (50·8 mm.).
Running clearance	·001 to ·0025 in. (·025 to ·063 mm.).
Undersizes for reground journals	See under **'Crankshaft'**.

Connecting rods

Length (centres)	8·1830 to 8·1875 in. (207·848 to 207·963 mm.).
Side-clearance	·008 to ·012 in. (·203 to ·305 mm.).

Big-end bearings

Type	Steel-backed white metal.
Length	1·226 to 1·236 in. (31·140 to 31·394 mm.).
Inner diameter	2·001 to 2·002 in. (50·825 to 50·850 mm.).
Running clearance	·0005 to ·002 in. (·0127 to ·0508 mm.).
Undersizes for reground crankpins	See under **'Crankshaft'**.

Pistons

Material	Aluminium alloy.
Clearance at bottom of skirt	·008 to ·014 in. (·020 to ·036 mm.).
Width of groove: Compression	·0957 to ·0967 in. (2·430 to 2·456 mm.).
Oil control	·1895 to ·1905 in. (4·813 to 4·838 mm.).
Oversizes	See under **'PETROL ENGINE'**.

Piston rings

Number	3 compression (1 plain, 2 taper), 1 oil control.
Width: Compression	$\frac{3}{32}$ in. (2·38 mm.).
Oil control	$\frac{3}{16}$ in. (4·76 mm.).
Gap (fitted): Compression	·009 to ·014 in. (·2286 to ·3556 mm.).
Oil control	·008 to ·012 in. (·2032 to ·3048 mm.).

Gudgeon pins

Type	Clamped.
Fit in piston	·0001 in. (·0025 mm.) clearance to ·0003 in. (·0076 mm.) interference.
Diameter	·8748 to ·8750 in. (22·22 to 22·225 mm.) clearance.
Length	2·75 in. (69·85 mm.).

Valves

Position	Overhead, push-rod-operated.
Lift	·340 in. (9·906 mm.).
Diameter: Head: Inlet	1·600 to 1·605 in. (40·64 to 40·767 mm.).
Exhaust	1·415 to 1·420 in. (35·941 to 36·068 mm.).
Stem: Inlet and exhaust	$\frac{11}{32}$ in. (8·731 mm.).
Stem to guide clearance: Inlet	·00155 to ·00255 in. (·039 to ·064 mm.).
Exhaust	·00105 to ·00205 in. (·027 to ·052 mm.).
Valve to rocker clearance	·012 in. (·30 mm.).
Seat angle	45°.

Valve guides

Length: Inlet	$2\frac{9}{64}$ in. (54·371 mm.).
Exhaust	$2\frac{53}{64}$ in. (71·834 mm.).
Fitted height above head	$\frac{11}{16}$ to $\frac{3}{4}$ in. (17·5 to 19 mm.).
Diameter: Outside: Inlet and exhaust	·5635 to ·5640 in. (14·312 to 14·325 mm.).
Inside: Inlet	·337 to ·338 in. (8·559 to 8·585 mm.).
Exhaust	·3433 to ·3438 in. (8·720 to 8·733 mm.).

Valve springs

Free length	$2\frac{11}{64}$ in. (55·166 mm.).
Fitted length	$1\frac{21}{32}$ in. (42·07 mm.).
Pressure: Valve closed	69 to 73 lb. (31·30 to 33·11 kg.).
Wire diameter	·176 in. (4·47 mm.).
Core diameter	1·125 to 1·140 in. (28·575 to 28·956 mm.).

Tappets

Type	Cylindrical.

Rockers

Bushes—inside diameter (reamed in position)	·8115 to ·8125 in. (20·61 to 20·64 mm.).
Bore of arm	·909 to ·910 in. (23·088 to 23·114 mm.).

Camshaft

Journal diameter: Front	1·78875 to 1·78925 in. (45·434 to 45·446 mm.).
Centre	1·74875 to 1·74925 in. (44·418 to 44·431 mm.).
Rear	1·62275 to 1·62325 in. (41·217 to 41·236 mm.).
End-float (taken on thrust plate at front end)	·003 to ·006 in. (·076 to ·152 mm.).

Camshaft bearings

Number	3.
Type	Steel-backed white metal.
Inner diameter (reamed in position): Front	1·79025 to 1·79075 in. (45·472 to 45·485 mm.).
Centre	1·75025 to 1·75075 in. (44·456 to 44·469 mm.).
Rear	1·62425 to 1·62475 in. (41·256 to 41·269 mm.).
Running clearance	·001 to ·002 in. (·025 to ·051 mm.).

Valve timing

Chain pitch and number of pitches	·375 in. (9·525 mm.); 62.
Valve to rocker clearance timing check	·021 in. (·533 mm.).
Inlet valve: Opens	5° B.T.D.C.
Closes	45° A.B.D.C.
Exhaust valve: Opens	40° B.B.D.C.
Closes	10° A.T.D.C.

Lubrication

System	Pressure.
Pump type	Eccentric rotor.
External filter	Full-flow Tecalemit or Purolator.
Oil pressure: Idling	15 lb./sq. in. (1·05 kg./cm.^{2}).
Normal running	50 lb./sq. in. (3·5 kg./cm.^{2}).
Release valve spring: Free length	3 in. (7·62 mm.).
Operating pressure	50 to 55 lb./sq. in. (3·52 to 3·87 kg./cm.^{2}).

IGNITION

Distributor	
Type	25D/4.
Rotation	Clockwise, looking on drive end.
Gap	·014 to ·016 in. (·356 to ·406 mm.).
Centrifugal control springs	Lucas No. 424629 (2 off).
Coil type	HA12.
Static ignition timing	6° B.T.D.C.
Stroboscopic ignition timing	9° B.T.D.C. at 600 r.p.m.
Dwell angle	57 to 63°
Sparking plug type	Champion XN8.
Gap	·025 in. (·63 mm.).

COOLING SYSTEM

Type: 2·2-litre engine	Thermo-siphon, pump and fan assisted.
2·52-litre engine	Pressurized, no-loss, pump and fan assisted.
Thermostat setting	Stamped on thermostat.

FUEL SYSTEM

(2·2-litre Diesel models with 'in-line' injection pump)

Lift pump	A.C.-Delco mechanical.
Injection pump	C.A.V. Type BPE.4A.65.U210.S6355EL or BPE.4A.65.U210.S6565EL.

Injectors	C.A.V.
Nozzle type	Pintaux BDN.12.SP.6A.
Nozzle holder type	BKB.35.S668.
Opening pressure	115 atmospheres.*
Governor	C.A.V. Type BEP/BMZ.80.A131.
Venturi	C.A.V. Type BEP/K42/42/111S.
Filter	C.A.V. Type F2/14.
Static injection timing	28° B.T.D.C.

(2·2-litre Diesel models with distributor type injection pump)

Injection pump	C.A.V. Type DPA.3243760A or DPA.3248050A.
Roller to roller dimension	1·988 in. (50·49 mm.).
Governor link length (DPA.3243760A)	2·087±·039 in. (53±1 mm.).
(DPA.3248050A)	2·067±·039 in. (52·5±1 mm.).
Injectors	C.A.V.
Nozzle type	Pintaux BDN.12.SPC.6290.
Nozzle holder type	BKB.35.S.5136 or BKB.35.S.5189.
Opening pressure	130 atmospheres.*
Main filter	C.A.V. bowl-less. Type FS5836020.
Static injection timing	28° B.T.D.C. (26° B.T.D.C. with pump Type DPA.3248050A).

Diesel models with 2·52-litre engine

Injection pump	C.A.V. type DPA.3249F520.
Roller to roller dimension	50·47 mm.
Governor link length	51·5 mm.±1·0 mm.
Injectors	C.A.V.
Nozzle type	BDN.O.SPC.6209.
Nozzle holder	BKB.35.S.5283.
Opening pressure	135 atmospheres.*
Main filter	C.A.V. with agglomerator. Type F.A.S. 583.
Static injection timing	23° B.T.D.C.

Petrol models

Fuel delivery	A.C.-Delco mechanical lift pump.	
Carburetter type (downdraught)	Zenith. 42 VIS or 30 VM6.	
	42 VIS.	30 VM6.
Choke tube	31 mm.	23 mm.
Main jet	102	95
P.T. bleed	4 mm.	—
Slow-running jet	55	45
Compensating jet	95	60
Pump jet	50	—
Full-throttle bleed	1·6 mm.	—
Needle seating	2·5 mm.	1·5 mm.
Progression jet	—	2×100

AIR CLEANER

Type: 2·2-litre engine	Oil bath.
2·52-litre engine	Dry with replaceable element.

TRANSMISSION

Type	Borg-Warner fully automatic with hydraulic converter coupling.
Ratios (without converter reduction): Low	2·308 : 1.
Intermediate	1·435 : 1.
High	1 : 1.
Reverse	2·009 : 1.
Torque converter ratio range	2·16 : 1 to 1 : 1.

* Add five atmospheres to the opening pressure when setting new injectors or after fitting new springs, to allow for settling of the components.

STEERING

Type	Cam and lever.
Steering gear ratio	20 : 1 (early models); 24 : 1 (later models).
Steering-wheel diameter	17 in. (43·2 cm.).
Camber angle	1°.
Castor angle	3°.
King pin inclination	6½°.
Toe-in	$\frac{1}{16}$ in. (1·6 mm.).
Steering idler end-float	0·001 to 0·006 in (0·0254 to 0·1524 mm).

FRONT SUSPENSION

Type	Independent, coil springs.
Free length	10·98 to 11·28 in. (27·9 to 28·7 cm.).
Mean coil diameter	4·245 in. (10·8 cm.).
Number of effective coils	7.
Working load	1,950 lb. (884 kg.).
Spring rate	577 lb./in. (103 kg./cm.).
Dampers (front)	Lever arm type.
Swivel pin end-float	0·001 to 0·006 in (0·0254 to 0·1524 mm).

REAR SUSPENSION

Type	Semi-elliptic.	
Spring details:		
Number of leaves	9.	10.
Width of leaves	2 in. (50·8 mm).	2 in. (50·8 mm.).
Working load	896 lb. (406 kg.).	1065 lb. (483 kg.).
Loaded camber	0·62 ± 0·25 in. (15·75 ± 6·35 mm.).	0·75 ± 0·25 in. (19·05 ± 6·35 mm.).
Dampers (rear)	Lever arm type.	

PROPELLER SHAFT

Type	Hardy Spicer tubular, open.
Overall length (between flange coupling faces)	53½ in. (1·36 m.).
Outside diameter	2½ in. (63·5 mm.).
Number of universal joints	2 needle-roller.

REAR AXLE

Type	Hypoid, three-quarter-floating.
Ratio: 2·2-litre engine	4·8 : 1 with automatic transmission; 5·125 : 1 with synchromesh gearbox.
2·52-litre engine	3·909 : 1 automatic and synchromesh.

ELECTRICAL EQUIPMENT

Diesel models (2·2-litre engine)

System	12-volt. Positive earth.
Charging system	Compensated voltage control.
Batteries: Number fitted	2, coupled in series.
Make	Lucas 6-volt.
Capacity (at 20-hr. rate)	138 amp.-hr.
Starter motor	Lucas M45G (solenoid-engaged).
Dynamo	Lucas C45PV6, C48, or C42.
Control box	RB310 or RB340.
Heater plugs	Type Lodge D18–1.2V or Champion AG4.

Diesel models (2·52-litre engine)	
System	12 volt. Negative earth.
Battery	12-volt Lucas CP13/11-8.
Capacity	68 amp.-hr.
Starter motor	Lucas M45G pre-engaged.
Alternator	Lucas 16ACR or 17 ACR.
Heater plugs	KLG GS103L, Champion AG32A or Champion AG50.
Petrol models	
Battery: Make	Lucas 12-volt, BT.11A.
Capacity	72 amp.-hr (at 20-hr. rate).
Wiring	Single-pole, positive earth.
Starter motor	Lucas M418G.
Dynamo	Lucas C42.
Control box	Lucas RB340.

BRAKES

Type	Girling hydraulic (front and rear).
Front	2 leading shoes.
Rear	Single leading shoe.
Drum size	11 in. (27·9 cm.).
Lining dimensions: Front	10·55 in. × 2·25 in. × $\frac{3}{16}$ in. (26·8 cm. × 5·7 cm. × ·5 cm.).
Rear	10·55 in. × 2·25 in. × $\frac{3}{16}$ in. (26·8 cm. × 5·7 cm. × ·5 cm.).
Lining area: Front	95 sq. in. (613 cm.^{2}).
Rear	95 sq. in. (613 cm.^{2}).

CHASSIS FRAME

Type	Conventional box frame of pressed-steel channel section, cross-braced for stiffness.

WHEELS

Type	Steel disc, well-base rim, 16 × 4J.

TYRES

Sizes: Taxi	5·75—16 cross-ply (6-ply) or 175—16 radial.
Hire Car	6·00—16 cross-ply (6-ply) or 185—16 radial.
Recommended pressures:	
Cross-ply tyres	2·2 bar, 32 lbf/in^2, 2·3 kgf/cm^2.
Radial tyres: 175—16	Front 2·4 bar, 35 lbf/in^2, 2·4 kgf/cm^2. Rear 2·2 bar, 32 lbf/in^2, 2·2 kgf/cm^2.
185—16	2·5 bar, 36 lbf/in^2, 2·5 kgf/cm^2.

TORQUE WRENCH SETTINGS

Differential bearing cap nuts	60 to 65 lb. ft. (8·3 to 9·0 kg. m.).
Crown wheel bolts	55 to 60 lb. ft. (7·6 to 8·3 kg. m.).
Crown wheel pinion shaft nut	140 lb. ft. (19·4 kg. m.).
Wheel nuts	65 lb. ft. (9·0 kg. m.).
Manifold nuts	22 lb. ft. (3·04 kg. m.).
Rocker bracket nuts	25 lb. ft. (3·46 kg. m.).
Rear spring 'U' bolt nuts	60 lb. ft. (8·3 kf. m.).
Diesel models	
Cylinder head nuts	75 lb. ft. (10·4 kg. m.).
Main bearing nuts	100 lb. ft. (13· 82 kg. m.).
Big-end bolts	50 lb. ft. (6·9 kg. m.).
Crankshaft pulley nut: With lock washer	75 lb. ft. (10·4 kg. m.).
Without lock washer	135 lb. ft. (18·7 kg. m.).
Flywheel bolts	50 lb. ft. (6·9 kg. m.).
Injection pump gear nut	46 lb. ft. (6·4 kg. m.).
Injector nuts	12 lb. ft. (1·7 kg. m.).
Fuel injector nozzle nuts	50 lb. ft. (7·0 kg. m.).

TORQUE WRENCH SETTINGS—*continued*

Fuel injection pump	
Gear nut	46 lb. ft. (6·4 kg. m.).
Delivery valve holder (in-line type)	30 lb. ft. (4·0 kg. m.).
Governor control cover stud (distributor type)	60 lb. in. (·69 kg. m.).
Governor control cover stud nut	40 lb. in. (·46 kg. m.).
Governor control bracket screw	21 lb. in. (·24 kg. m.).
Governor drive shaft screw	285 lb. in. (3·3 kg. m.).
Governor vent screw body	65 lb. in. (·75 kg. m.).
Distributor rotor screw	28 lb. in. (·32 kg. m.).
Cam advance screw	300 lb. in. (3·45 kg. m.).
Drive plate screw:	
Direct	160 lb. in. (1·85 kg. m.).
Indirect (ring spanner and torque adaptor centres at 2·6 in. [66 mm.])	140 lb. in. (1·61 kg. m.).
Indirect (ring spanner and torque adaptor centres at 5·0 in. [127 mm.])	115 lb. in. (1·32 kg. m.).
Transfer pump rotor	65 lb. in. (·75 kg. m.).
End plate set bolt	45 lb. in. (·52 kg. m.).
Hydraulic head locating fitting	350 lb. in. (4·05 kg. m.).
Advance unit housing cap nut	110 lb. in. (1·25 kg. m.).
Advance unit housing stud	60 lb. in. (·69 kg. m.).
Advance unit housing spring cap and end plug	250 lb. in. (2·9 kg. m.).
Hydraulic head locking screw	170 lb. in. (1·96 kg. m.).
High pressure outlet banjo pipe bolts	270 lb. in. (3·1 kg. m.).
Control and 'shut off' lever nuts	30 lb. in. (·34 kg. m.).
Fuel inlet connection	360 lb. in. (4·15 kg. m.).
Back leakage connection	140 lb. in. (1·6 kg. m.).

Petrol models

Cylinder head nuts	75 lb. ft. (10·4 kg. m.).
Big-end bolts	50 lb. ft. (6·9 kg. m.).
Main bearing nuts	100 lb. ft. (13·8 kg. m.).
Flywheel bolts	35 lb. ft. (4·8 kg. m.).

Automatic transmission (Model 35)

Converter to drive plate	25 to 30 lb. ft. (3·46 to 4·15 kg. m.).
Transmission case to converter housing; Oil pan to case; Front servo to case	8 to 13 lb. ft. (1·11 to 1·8 kg. m.).
Rear servo to case	13 to 27 lb. ft. (1·8 to 3·73 kg. m.).
Pump adaptor to front pump housing:	
No. 10 diameter screws	2 to 3 lb. ft. (·28 to ·41 kg. m.).
$\frac{5}{16}$ in. diameter screws	17 to 22 lb. ft. (2·35 to 3·04 kg. m.).
Pump adaptor to transmission case	8 to 18·5 lb ft. (1·11 to 2·55 kg. m.).
Rear pump to case:	
$\frac{1}{4}$ in. diameter screws	4 to 7 lb. ft. (·55 to ·97 kg. m.).
No. 10 diameter screws	1·7 to 3 lb. ft. (·23 to ·41 kg. m.).
Outer lever to manual valve shaft	7 to 9 lb. ft. (·97 to 1·24 kg. m.).
Pressure point on case	4 to 5 lb. ft. (·55 to ·69 kg. m.).
Oil pan drain plug	9 to 12 lb. ft. (1·24 to 1·66 kg. m.).
Oil tube collector to lower body; Governor line plate to lower body (includes rear pump strainer); Lower body end plate to lower body; Upper body end plates to upper body; Upper body to lower body; Valve bodies assembly to transmission case	1·7 to 2·5 lb. ft. (·23 to ·35 kg. m.).

Front pump strainer to lower body	
Rear pump strainer to lower body	1·7 to 2·5 lb. ft. (·23 to ·35 kg. m.).
Down-shift valve cam bracket to valve body	
Cover plate to governor body	
Rear band adjusting screw lock nut	25 to 30 lb. ft. (3·46 to 4·15 kg. m.).
Front band adjusting screw lock nut	15 to 20 lb. ft. (2·07 to 2·77 kg. m.).
Inhibitor switch lock nut	8 to 10 lb. ft. (1·11 to 1·38 kg. m.).
Filler tube connector adaptor to transmission case	9 to 10 lb. ft. (1·24 to 1·38 kg. m.).
Filler tube connector sleeve nut	17 to 18 lb. ft. (2·35 to 2·49 kg. m.).
Governor retaining screw (one-piece governor)	15 to 18 lb. ft. (2·07 to 2·49 kg. m.).

Automatic gearbox (Model 65)

Drive flange screw	45 lb. ft. (6·2 kg. m., 61 Nm).
Converter to drive plate bolts	28 lb. ft. (3·9 kg. m., 38 Nm).
Transmission case to converter housing bolts—upper	28 lb. ft. (3·9 kg. fm., 38 Nm).
Transmission case to converter housing bolts—lower	45 lb. ft. (6·2 kg. fm., 61 Nm).
Rear extension to transmission case bolts	45 lb. ft. (6·2 kg. fm., 61 Nm).
Oil pan to transmission case bolts	7 lb. ft. (1·0 kg. m., 9·5 Nm).
Front servo cover bolts	16 lb. ft. (2·2 kg. m., 22 Nm).
Rear servo cover bolts	16 lb. ft. (2·2 kg. m., 22 Nm).
Pump adaptor to housing screw	3 lb. ft. (0·4 kg. m., 4 Nm).
Pump adaptor to housing bolts	20 lb. ft. (2·8 kg. m., 27 Nm).
Pump adaptor to transmission case bolts	16 lb. ft. (2·2 kg. m., 22 Nm).
Pressure adaptor plug	7 lb. ft. (1·0 kg. m., 9·5 Nm).
Upper valve body to lower valve body screws	
Lower valve body to upper valve body screws	2·1 lb. ft. (0·3 kg. m., 2·8 Nm).
Oil tube and end plate to valve screws	
Valve bodies to transmission case bolts	7 lb. ft. (1·0 kg. m., 9·5 Nm).
Governor retaining bolt	17 lb. ft. (2·4 kg. m., 23 Nm).
Front/rear servo adjusting screw	5 lb. ft. (0·7 kg. m., 6·8 Nm).
Front/rear servo adjusting screw locknut	35 lb. ft. (4·8 kg. m., 47 Nm).
Centre support bolts	14 lb. ft. (1·9 kg. m., 19 Nm).
Starter inhibitor switch to transmission bolt	5 lb. ft. (0·7 kg. m., 6·8 Nm).

CAPACITIES

2·2-litre diesel engine (including filter)	11½ pints (6·5 litres).
2·52-litre diesel engine (including filter):	
with round section dipstick	11¼ pints (6·38 litres).
with flat section dipstick	12¼ pints (6·95 litres).
Petrol engine sump (including filter)	11½ pints (6·5 litres).
Engine oil filter	1¼ pints (·71 litre).
Fuel tank	12¾ gallons (52·3 litres).
Cooling system (with heaters) (petrol models)	21 pints (12·0 litres).
Cooling system, including heater (2·2-litre diesel models)	19½ pints (11·0 litres).
Cooling system, including heater (2·52-litre diesel models):	
Dry capacity	19 pints (10·8 litres).
Refill after draining	16½ pints (9·36 litres).
Expansion tank	1 pint (·57 litre).
Automatic transmission and converter:	
DG type	15 pints (8·5 litres).
35 type	11¼ pints (6·4 litres).
65 type (including oil cooler)	12½ pints (7·1 litres).
Synchromesh gearbox	3½ pints (2·3 litres).
Rear axle	3½ pints (2·3 litres).

GENERAL DIMENSIONS

	Taxi	*Hire Car*
Wheelbase	9 ft. $2\frac{5}{8}$ in. (2·81 m.).	9 ft. $2\frac{5}{8}$ in. (2·81 m.).
Track: Front	4 ft. 8 in. (1·42 m.).	4 ft. $8\frac{1}{2}$ in. (1·43 m.).
Rear	4 ft. 8 in. (1·42 m.).	4 ft. $8\frac{1}{2}$ in. (1·43 m.).
Length, overall	14 ft. $11\frac{7}{16}$ in. (4·56 m.).	14 ft. $11\frac{13}{16}$ in. (4·58 m.).
Width, overall	5 ft. $8\frac{5}{8}$ in. (1·74 m.).	5 ft. $8\frac{5}{8}$ in. (1·74 m.).
Height, overall, unladen	5 ft. $9\frac{1}{2}$ in. (1·76 m.).	5 ft. $9\frac{3}{4}$ in. (1·77 m.).
Ground clearance	$7\frac{1}{2}$ in. (·19 m.).	$5\frac{3}{4}$ in. (·15 m.).
Turning circle	25 ft. (7·62 m.).	25 ft. (7·62 m.).
Boot capacity	—	18 cu. ft. (14·11 m.^{3}).
Weight	$32\frac{3}{4}$ cwt. (1664 kg.).	33 cwt. (1677 kg.).

FRICTION CLUTCH

Diesel models

Make	Borg & Beck, hydraulically operated.
Type	Single dry plate.
Outside diameter	10 in. (25·4 cm.).
Total frictional area	78 sq. in. (503 cm.^{2}).
Thickness of friction lining	·15 in. (·38 cm.).
Release bearing	Ball race.
Number of thrust springs	12.
Identification colours of thrust springs	Light green.
Total axial spring pressure	1,260 to 1,380 lb. (572 to 626 kg.).
Minimum distance, thrust race to thrust plate	·10 in. (·25 cm.).
Thrust plate travel to fully released position	·50 to ·54 in. (1·27 to 1·37 cm.).

Petrol models

Make	Borg & Beck.
Type	Single dry plate.
Outside diameter	9 in. (22·8 cm.).
Total frictional area	65·8 sq. in. (424·5 cm.^{2}).
Thickness of friction lining	·150 in. (·381 cm.).
Release bearing	Ball race.
Number of thrust springs	9.
Thrust plate travel to fully released position	·42 to ·47 in. (1·067 to 1·194 cm.).

SYNCHROMESH GEARBOX

Ratios: Top	1·0 : 1.
Third	1·37 : 1.
Second	2·35 : 1.
First	4·05 : 1.
Reverse	5·168 : 1.
Bearing dimensions: Mainshaft rear ball bearing	$3\frac{1}{8}$ in.$\times 1\frac{1}{4}$ in.$\times \frac{7}{8}$ in. (7·937 cm.×3·175 cm.×2·222 cm.).
First motion shaft ball bearing	45 mm.×100 mm.×25 mm.
Mainshaft spigot needle rollers: Quantity	19.
Dimensions	39·8 mm.×4 mm.
Mainshaft second speed gear needle rollers: Quantity	33.
Dimensions	29·8 mm.×3·5 mm.
Mainshaft third speed gear needle rollers: Quantity	32.
Dimensions	29·8 mm.×3·5 mm.
Layshaft needle rollers, front and rear: Quantity	66 (33 each bearing).
Dimensions	39·8 mm.×3 mm.

SECTION A

THE DIESEL ENGINE

Section A.1

DESCRIPTION

The diesel engine is of the indirect injection type, with four cylinders.

The cylinder block and crankcase is a one-piece casting in high-quality cast iron, ensuring maximum rigidity and strength. Full-length water jackets are provided so that even cylinder temperatures and high wear resistance are assured.

The cylinder head carries the valve operating gear, inlet and exhaust valves, fuel injectors, and heater plugs. Large circulation passages are cast in the head, ensuring adequate cooling.

A quickly detachable rocker cover encloses the valve gear and embodies an oil filler.

The combustion chambers are the Ricardo Comet III type, and in conjunction with valves of large head diameter give maximum efficiency and easy air inlet and exhaust flow. Both the air inlet and exhaust manifolds are carried on the left-hand side of the cylinder head, and provision is made for connecting a vehicle heater.

The forged-steel camshaft is mounted in the left-hand side of the cylinder block and is supported by three white-metal bearings. The cam profiles are designed to prevent surge and to give quiet operation of the valve gear.

The timing chain is of the triple-roller type and drives the fuel injection pump. A jockey-type, oil-fed chain tensioner is fitted to engines having an 'in-line' injection pump. On engines with a distributor-type fuel injection pump a self-adjusting slipper-type chain tensioner is used.

The forged-steel, counterbalanced crankshaft is supported by three main bearings of generous dimensions to give adequate bearing surfaces in order to withstand the considerable loads experienced in diesel engines.

Crankshaft thrust washers, of steel-backed white metal, are fitted on each side of the centre main bearing.

The connecting rods are of 'H' section forged steel with renewable big- and small-end bearings.

The big-ends are diagonally split to permit the pistons and connecting rods to be withdrawn upwards through the cylinder bores.

Oil jet holes are drilled in the upper halves of the big-ends and these supply the cylinder walls with adequate lubrication. The small-ends are fitted with steel-backed bronze bushes.

Aluminium pistons of the solid-skirt type are fitted and a specially shaped crown is incorporated to suit the characteristics of the combustion chamber.

Compression and scraper rings are fitted, and the floating-type gudgeon pin is secured in position by means of circlips.

The inlet valves are of large head diameter to promote good charging, whilst the smaller exhaust valves can be easily cooled. Valve stem oil seals are fitted.

The oil pump is of the eccentric-rotor, non-draining type and is driven from the camshaft.

A full-flow oil filter is mounted on the side of the crankcase. The oil filler is located on the valve rocker cover, and a breather is connected to the air cleaner.

The C.A.V. fuel injection pump is flange-mounted on the rear of the engine front plate.

The fuel lift pump is an A.C.-Delco mechanical type and is operated by the camshaft. Fuel oil is delivered to the injection pump via a filter.

Pintaux-type fuel injection nozzles are used, and the leak-off pipes return any excess fuel to the inlet side of the filter.

The inlet manifold is of aluminium alloy and cast iron is used for the exhaust manifold. Both are mounted on the same side of the cylinder head.

A centrifugal water pump with fan blades attached to the pulley is mounted on the front of the cylinder block and is driven by the dynamo belt.

The cooling system is controlled by a thermostat in the cylinder head via inbuilt by-pass passages.

Section A.2

REMOVING AND REPLACING THE POWER UNIT

Disconnect the batteries.

Remove the bolt securing the bonnet stay to its bracket on the bonnet, remove the screws retaining the hinges to the bonnet, and detach the bonnet.

Disconnect the bottom hose from the radiator and drain the cooling system.

Disconnect the top hose from the radiator.

Disconnect the trunking and/or the breather hose from the air cleaner and remove the air cleaner assembly.

Disconnect the fog lamps (if fitted), the snap connectors at the left-hand side of the front of the vehicle and separate the wiring loom.

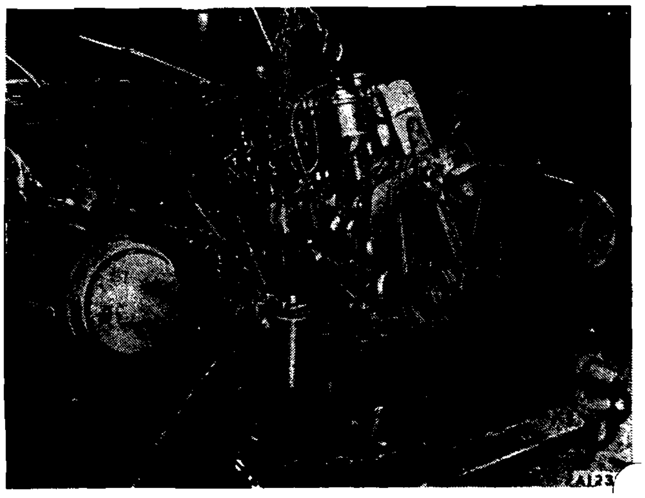


Fig. A.1
Removing the power unit

Disconnect the electrical cables from the control box, remove the screw at each side retaining the earth terminals and remove the wiring loom from the front frame assembly.

Remove the screws and nuts retaining the front frame cross brace to the body at each side, remove the three screws retaining the front frame uprights to the chassis, and lift out the front frame assembly complete with radiator.

Disconnect the heater hoses from the bottom radiator hose, and the heater hoses from the heater tap on the cylinder head.

Disconnect the cables from the starter motor, and the heater plug feed wire from the rear heater plug.

Disconnect the inhibitor switch wires at their snap connectors (automatic transmission).

Disconnect the throttle and stop controls from the fuel injection pump.

Disconnect the fuel feed pipe from the fuel lift pump.

Disconnect the flexible fuel return pipe at its union on the right-hand engine mounting bracket.

Disconnect the exhaust pipe from the manifold, and detach the exhaust pipe support clip from the gearbox bell housing.

Disconnect the flexible oil gauge pipe at its union with the steel pipe.

Raise one rear wheel, disconnect the propeller shaft from the gearbox, and lower the wheel.

With the vehicle raised, or over a pit, support the power unit with an overhead lift.

Detach the speedometer cable and taximeter drive cable (if fitted) from the gearbox.

Detach the manual change lever from the transmission cross-shaft (automatic transmission).

Remove the gear lever from the gearbox (synchromesh gearbox).

Prise out the gear change cross-shaft from its mountings against its rubber spring (automatic transmission).

Detach the gearbox rebound rubber support cross-member and the gearbox rear mountings from the chassis.

Detach the earth strap from the top of the left-hand front engine mounting.

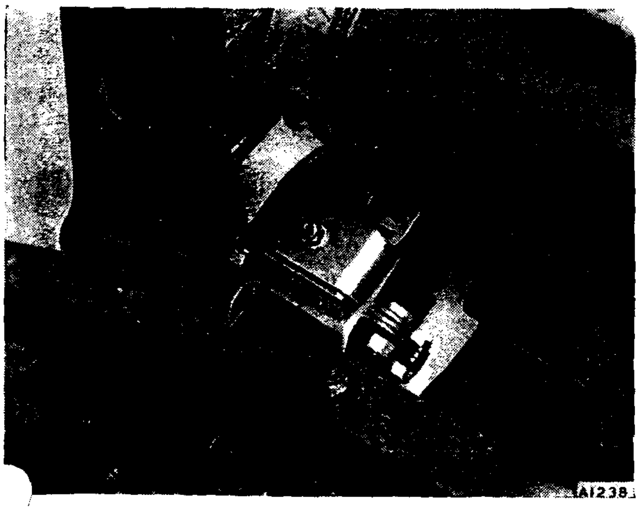


Fig. A.2

The left-hand front mounting of the power unit

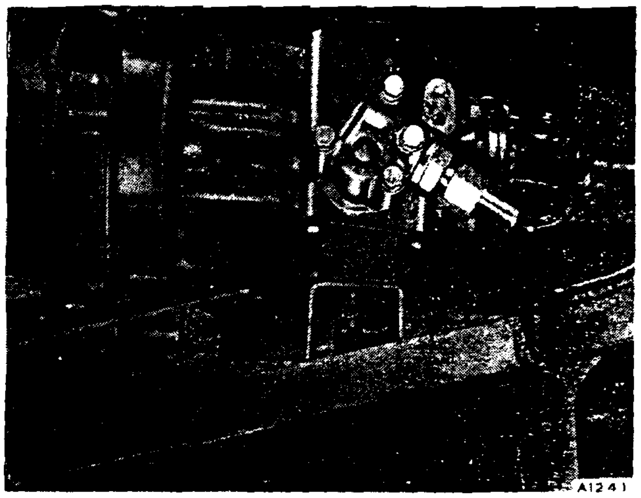


Fig. A.3

The left-hand rear mounting of the power unit

Remove the bonnet prop and bracket from the chassis and valance.

Release the front engine mountings from the chassis and remove the power unit from the vehicle.

Refitting is a reversal of the removal instructions. Ensure that the manual gear change rod (automatic transmission) is above the converter housing when replacing the engine in the chassis.

It will be necessary to bleed the fuel system after assembly is complete.

Section A.3

LUBRICATION SYSTEM

The oil supply is carried in the sump below the cylinder block and the filler cap is fitted on the valve rocker cover. The oil level indicator rod is on the right-hand side of the engine and is marked to indicate both the maximum and minimum levels.

An eccentric-rotor, non-draining-type oil pump, located in the left-hand side of the crankcase, is driven from the camshaft. Oil is drawn through a gauze strainer attached to the base of the pump and is delivered through drilled passages in the crankcase to a non-adjustable plunger-type relief valve located at the front of the engine on the right-hand side. From the relief valve oil is fed to a full-flow filter mounted on the right-hand side of the crankcase, and then to the main oil gallery, which is drilled in the right-hand side of the crankcase. Oil from the main gallery is supplied through drillings in the cylinder block and crankshaft to the main, big-end, and camshaft bearings. From the rear camshaft bearing oil at reduced pressure is fed through drilled passages in the cylinder block, cylinder head, and the valve rocker shaft to the valve rockers. Surplus oil returning to the sump from the valve rockers lubricates the tappets. From the front camshaft bearing oil is supplied to the timing chain through two bleed holes. Oil is fed to the timing chain tensioner through drilled passages in the front of the cylinder block, and on later engines to the injection pump chain wheel through an external oil pipe.

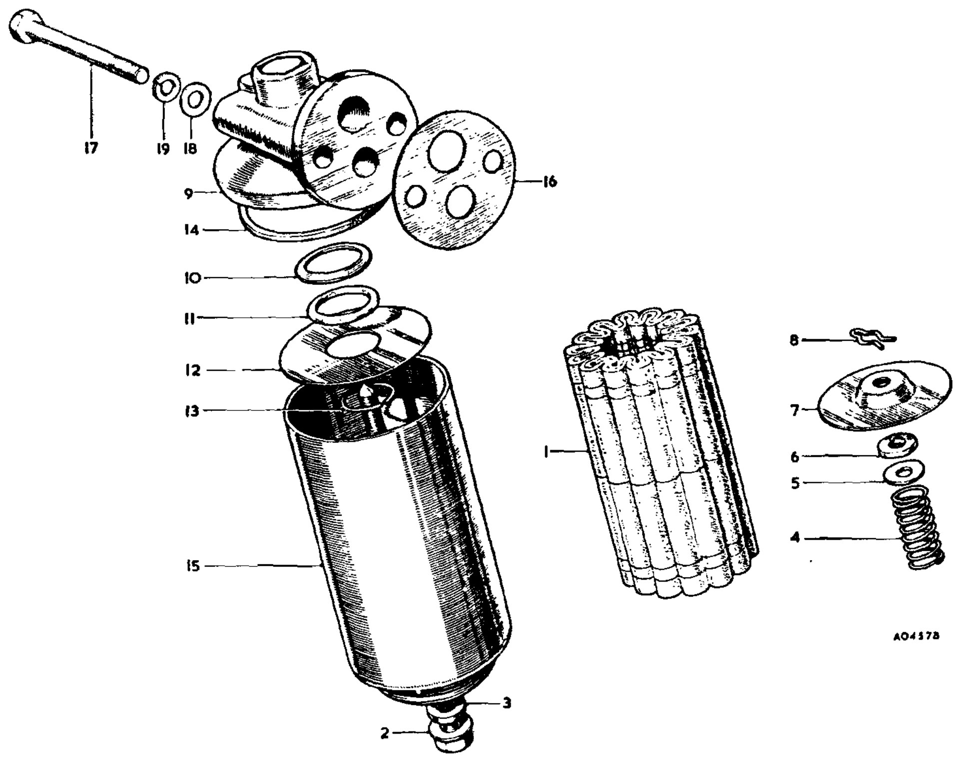


Fig. A.4
External oil filter components

1. Element.
2. Centre-bolt.
3. Washer—sealing (bottom).
4. Spring.
5. Washer (steel).
6. Washer (felt).
7. Plate—pressure.
8. Clip—spring.
9. Head assembly—filter.
10. Washer—dished.
11. Washer (felt).
12. Plate—clamping.
13. Spring—'C'.
14. Washer—sealing (top).
15. Container assembly.
16. Joint—filter to crankcase.
17. Screw—filter to crankcase.
18. Washer for bolt—plain.
19. Washer for bolt—spring.

Lubrication of the cylinder bores is effected by jet holes drilled in the connecting rod big-end bearings.

Section A.4

DRAINING THE SUMP

The sump should be drained and refilled with new engine oil at the intervals recommended in the Driver's Handbook. This operation should be carried out when the engine is hot, in which condition the oil will flow more readily and any sediment present will still be held in suspension.

To drain the sump arrange the car on a level platform, remove the plug from the base of the sump, and allow the oil to drain for at least 10 minutes before replacing the plug.

At every oil change a new external oil filter element should be fitted.

Section A.5

EXTERNAL OIL FILTER

The external filter is of the full-flow type, thus ensuring that all oil in the lubrication circuit passes through the filter before reaching the bearings.

Oil is passed through the filter from the pump at a pressure controlled at 50 lb./sq. in. (3·5 kg./cm.²) by the engine oil relief valve. This pressure will, of course, be somewhat higher until the oil reaches a working temperature. Some pressure is lost in passing the oil through the filter element; this will only be very slight with a new element, but will increase as the element becomes progressively contaminated by foreign matter removed from the oil.

Should the filter become completely choked due to neglect, a balance valve is provided to ensure that oil will still reach the bearings. This valve, set to open at a pressure difference of 15 to 20 lb./sq. in. (1·0 to 1·4 kg./cm.²), is non-adjustable and is located in the filter head casting. When the valve is opened unfiltered oil can by-pass the filter element and reach the bearings.

At the intervals recommended in the Driver's Handbook the filter element should be renewed as follows.

Release the filter bowl by unscrewing the central bolt which holds it to the filter head and withdraw the bowl complete with element. Remove and discard the old filter element; withdraw the circlip from the central securing bolt and dismantle the filter bowl. Wash the filter bowl and its components in petrol and allow to dry. Reassemble the filter bowl, ensuring that the felt washer fitted between the pressure plate and the pressure spring washer is in good condition and install a new filter element.

Check that the filter bowl sealing washer is positioned correctly in the filter head and reassemble.

After reassembly run the engine until the oil is thoroughly warm and then check the oil filter for leaks.

Section A.6

OIL PRESSURE RELIEF VALVE

The non-adjustable oil pressure relief valve is situated at the front, on the right-hand side of the cylinder block

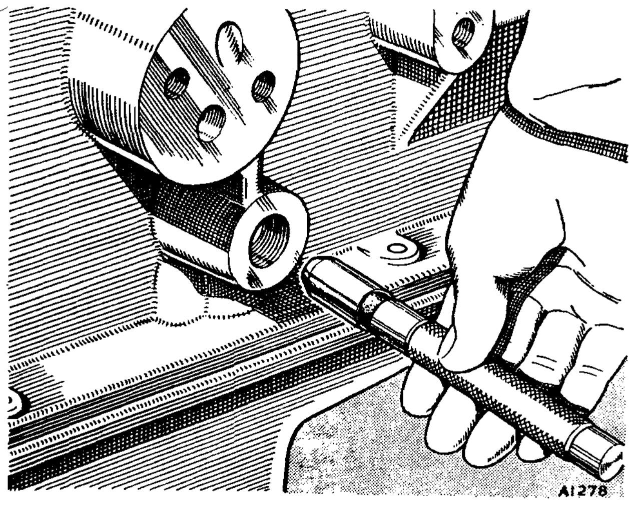


Fig. A.5
Lapping the oil relief valve with tool 18G 69

just below the external oil filter, and is held in position by a large hexagon nut sealed by a copper washer. The relief valve spring maintains a valve cup against a seating machined in the cylinder block.

During major overhauls or in the event of low oil pressure, when it is known that all other components of the engine are in good condition, the relief valve should be removed, using tool 18G 69, and examined to ensure that the cup is seating correctly and that the spring has not lost its tension. If the valve cup is scored or shows signs of wear it should be renewed.

The relief valve spring should be checked by measuring its free length; it should be renewed if it is below the specification given under '**GENERAL DATA**'.

The valve seating can be checked by applying 'engineer's' blue to the conical face of the valve and testing for continuous marking. Should the seating be damaged, the valve cup must be lapped in, using valve grinding-in tool 18G 69.

Section A.7

REMOVING AND REPLACING THE INLET AND EXHAUST MANIFOLDS

Disconnect the pneumatic governor vacuum pipe from the venturi on early engines, support the inlet manifold, and unscrew the four nuts which secure both the inlet and the exhaust manifolds to the cylinder head. Remove the inlet manifold complete.

The exhaust manifold and manifold gasket can be withdrawn after the two remaining nuts with plain washers securing it to the cylinder head have been removed.

Before reassembling, which is a reversal of the above procedure, remove all traces of the old gasket from the cylinder head and manifold joint faces and fit a new gasket.

Section A.8

REMOVING AND REPLACING THE CYLINDER HEAD

Remove the valve rocker assembly as described in Section A.9, withdraw the eight push-rods, storing them carefully so that they may be replaced in their original positions. One way of doing this is to punch eight small holes in a piece of cardboard, number the holes, and insert each push-rod into its corresponding hole in the card.

Disconnect the fuel feed pipes from the injectors and injection pump, remove the clamp and damper bushes and detach the pipes individually. Remove the injectors as described in Section C.

The fuel injection pump outlet unions must be sealed with sealing caps 18G 216 (see Section C) to prevent the ingress of foreign matter into the fuel system.

Remove the main fuel filter as described in Section C.

Slacken the 23 nuts and the two valve rocker cover studs securing the cylinder head a turn at a time in the order shown in Fig. A.6 until all load has been released. Remove the nuts, studs, and plain washers from the cylinder head studs and lift off the cylinder head and gasket.

To facilitate the breaking of the cylinder head joint tap each side of the cylinder head with a hide mallet or a hammer with a piece of wood interposed to take the blow.

When reassembling, which is a reversal of the above procedure, ensure that the surfaces of both the cylinder head and cylinder block are clean; it is not necessary to use jointing compound or grease for the gasket, one side of which is marked 'FRONT' and 'TOP' to facilitate correct replacement.

Tighten the cylinder head nuts and studs a quarter of a turn at a time in the order shown in Fig. A.6 with torque wrench 18G 372 set to break at the torque figure given under '**GENERAL DATA**'.

Replace the push-rods, ensuring that they are installed into the position from which they were originally taken,

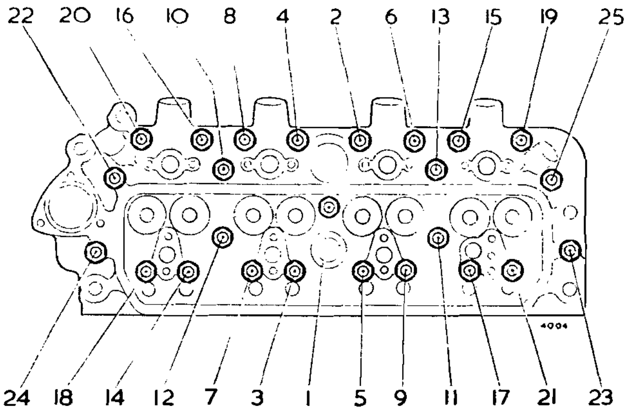


Fig. A.6
The order of slackening and tightening the cylinder head retaining nuts

refit the valve rocker shaft assembly, and check and adjust the valve rocker clearances as described in Section A.21.

Bleed the fuel system of air as described in Section C or Ca, start the engine, and allow it to run at a fast idling speed until it is thoroughly warm. Stop the engine, remove the valve rocker cover, retighten the cylinder head nuts and studs as described above, and check and adjust the valve rocker clearances if necessary.

bracket. Withdraw the split pin and plain and spring washers from each end of the valve rocker shaft and slide the rocker, brackets, distance pieces, spring washers, and spacing spring from the rocker shaft. Unscrew the plug from the front end of the rocker shaft; the plug in the rear end of the rocker shaft is a drive fit and should not normally be removed.

On later engines the plug in both ends of the rocker shaft is a drive fit and should not be removed.

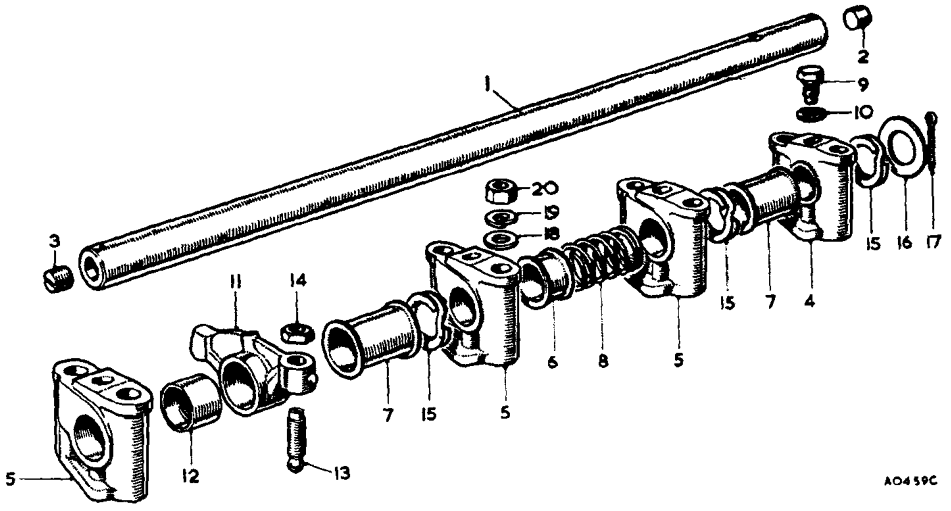


Fig. A.7

Valve rocker gear components

1. Shaft—valve rocker.
2. Plug—plain.
3. Plug—screwed (early engines).
4. Bracket—tapped.
5. Bracket—plain.
6. Piece—distance (centre).
7. Piece—distance (end).
8. Spring.
9. Screw—locating.
10. Lock washer for screw.
11. Rocker assembly—valve.
12. Bush.
13. Screw—tappet adjusting.
14. Locknut.
15. Washer—spring.
16. Washer—plain.
17. Pin—split.
18. Washer for studs.
19. Washer for studs—spring.
20. Nut for studs.

Section A.9

REMOVING AND REPLACING THE VALVE ROCKER SHAFT ASSEMBLY

Unscrew the two nuts securing the valve rocker cover, withdraw the engine lifting brackets, plain washers, cup washers, and sealing bushes, and lift off the valve rocker cover, taking care not to damage the cork gasket.

Unlock and slacken fully the valve rocker adjusting screws and remove the eight rocker shaft bracket securing nuts and plain and spring washers. Remove the valve rocker shaft complete with rocker springs and brackets.

Reassembly is a reversal of the above procedure, but before replacing the valve rocker cover check and adjust the valve rocker clearances as described in Section A.21.

Section A.10

DISMANTLING AND REASSEMBLING THE VALVE ROCKER SHAFT ASSEMBLY

Press back the locking washer and remove the rocker shaft locating screw from the rear rocker mounting

Thoroughly clean all components with paraffin, allow to dry, and then clear the oilways in the rear rocker bracket, rocker shaft, and valve rockers with compressed air.

When reassembling, commence with the rear bracket and secure the rocker shaft in position, ensuring that the dowel end of the locating screw properly engages the locating hole in the rocker shaft. The valve rocker and remaining rocker brackets should be assembled to the rocker shaft together with the spring washers, distance pieces, and spacing spring in the order shown in Fig. A.7.

Section A.11

REMOVING AND REPLACING THE ROCKER BUSHES

Remove and dismantle the rocker shaft as in Sections A.9 and A.10.

To remove and replace worn rocker bushes the use of Service tool 18G 21 is recommended; the bushes and the rockers can be very easily damaged by using improvised drifts. Place the rocker on the anvil and drive the worn bush out (Fig. A.8).

Place a new bush on the driver and position the bush with the butt joint at the top of the rocker bore and with the end of the oil groove picking up the oilway to the adjuster end of the rocker.

It will be necessary to drill the oil holes in the bush to coincide with the oilways in the rocker. The oil hole to the adjuster end can be drilled before the bush is fitted, extra care being taken to keep the holes of the bush and rocker in line during the pressing-in operation.

If the holes are drilled after fitting, the following procedure must be adopted. Remove the adjuster screw and use a No. 43 drill, ·089 in. (2·26 mm.), to drill out the end plug and to continue the oilway through the bush. Replug the end after this operation with a rivet (Part No. 5C 2436) and weld the plug into position. The oil hole in the top of the rocker barrel must be continued through the bush with a No. 47 drill, ·0785 in. (1·99 mm.).

Finally, burnish-ream the bush to the dimensions given under 'GENERAL DATA'.

Section A.12

REMOVING AND REPLACING A PISTON AND CONNECTING ROD

The pistons and connecting rods can be withdrawn only from the top of the cylinder block.

Remove the sump as described in Section A.34, the oil strainer as in Section A.37, and the cylinder head as in Section A.8.

Unlock and remove the big-end bearing cap bolts; withdraw the bearing cap; release the connecting rod from the crankpin journal and push the connecting rod and piston assembly upwards until the piston rings are clear of the cylinder bore. Withdraw the connecting rod and piston from the top of the cylinder block and refit the bearing cap.

The big-end bearings are offset in the connecting rods; the bearings of Nos. 1 and 3 connecting rods are offset towards the rear and those for Nos. 2 and 4 towards the front.

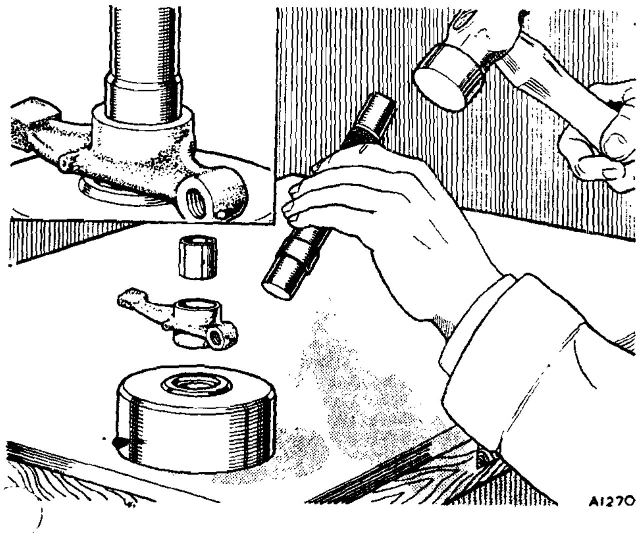


Fig. A.8
Fitting a valve rocker bush with tool 18G 21

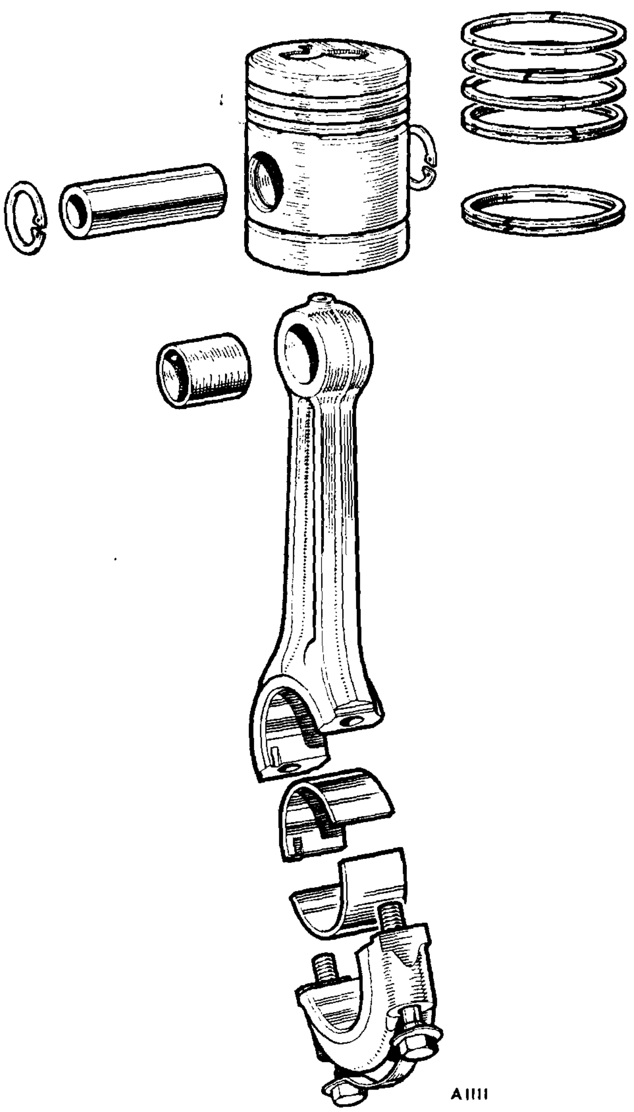


Fig. A.9
A piston and connecting rod assembly

When used parts are to be refitted it is essential that they are installed in their original positions. In order to ensure this, mark each bearing cap and connecting rod with the number of the cylinder from which it was removed.

Remove the cylinder bore glazing before fitting new rings.

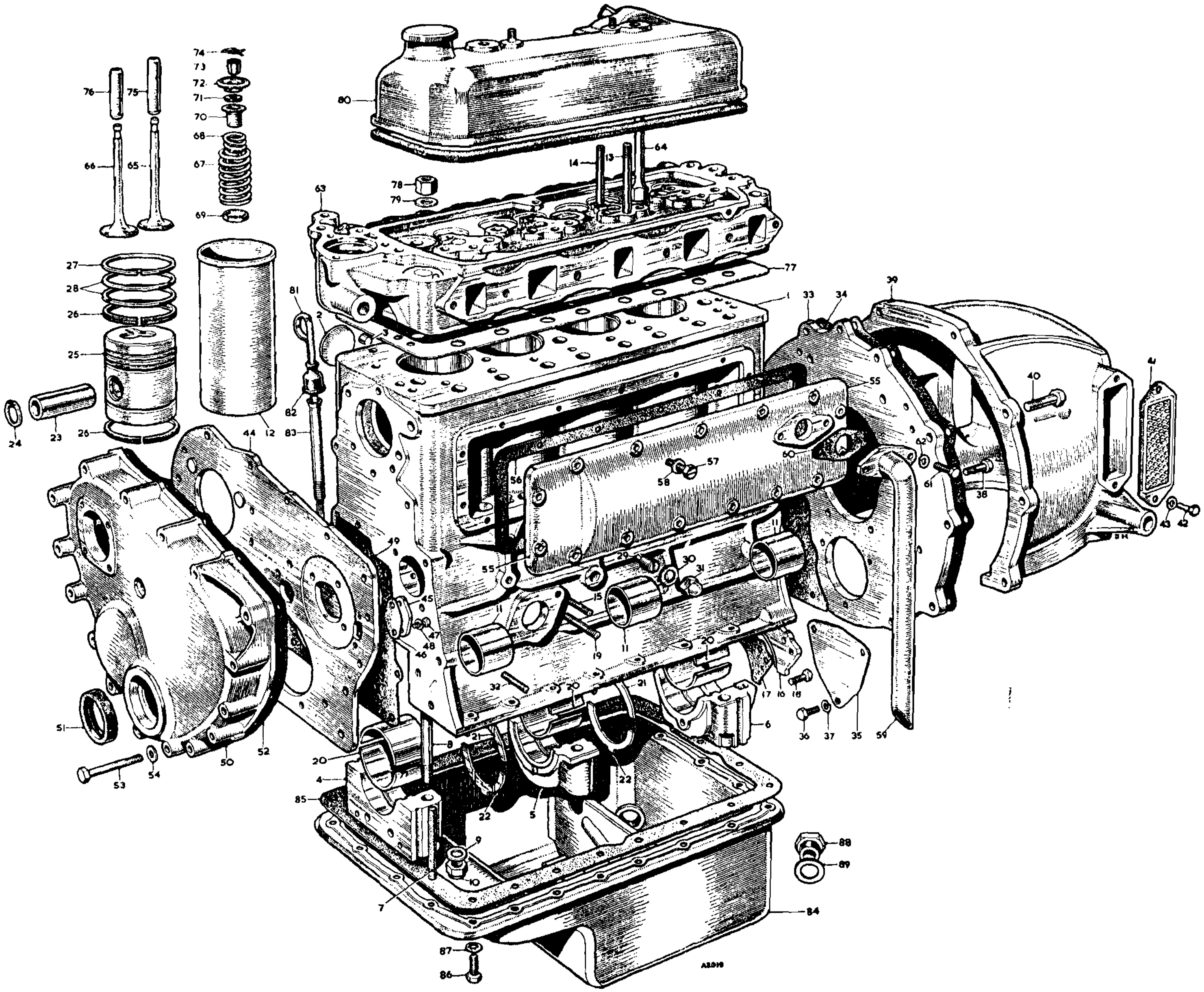
Before replacing the piston and connecting rod, which is a reversal of the above procedure, set the piston ring gaps at 180° to each other.

It is essential that the pistons and connecting rods are installed in their own cylinder bores and the same way round, i.e. the combustion cavity in the piston crown and the oil jet hole in the big-end bearing must be on the side of the engine opposite to the camshaft.

Use piston ring compressor 18G 55 A to facilitate the installation of the piston in the bore and to avoid the breaking of the piston rings.

Fit new lock washers and tighten the big-end bearing cap bolts with torque wrench 18G 372 set to break at the torque figure given under 'GENERAL DATA'.

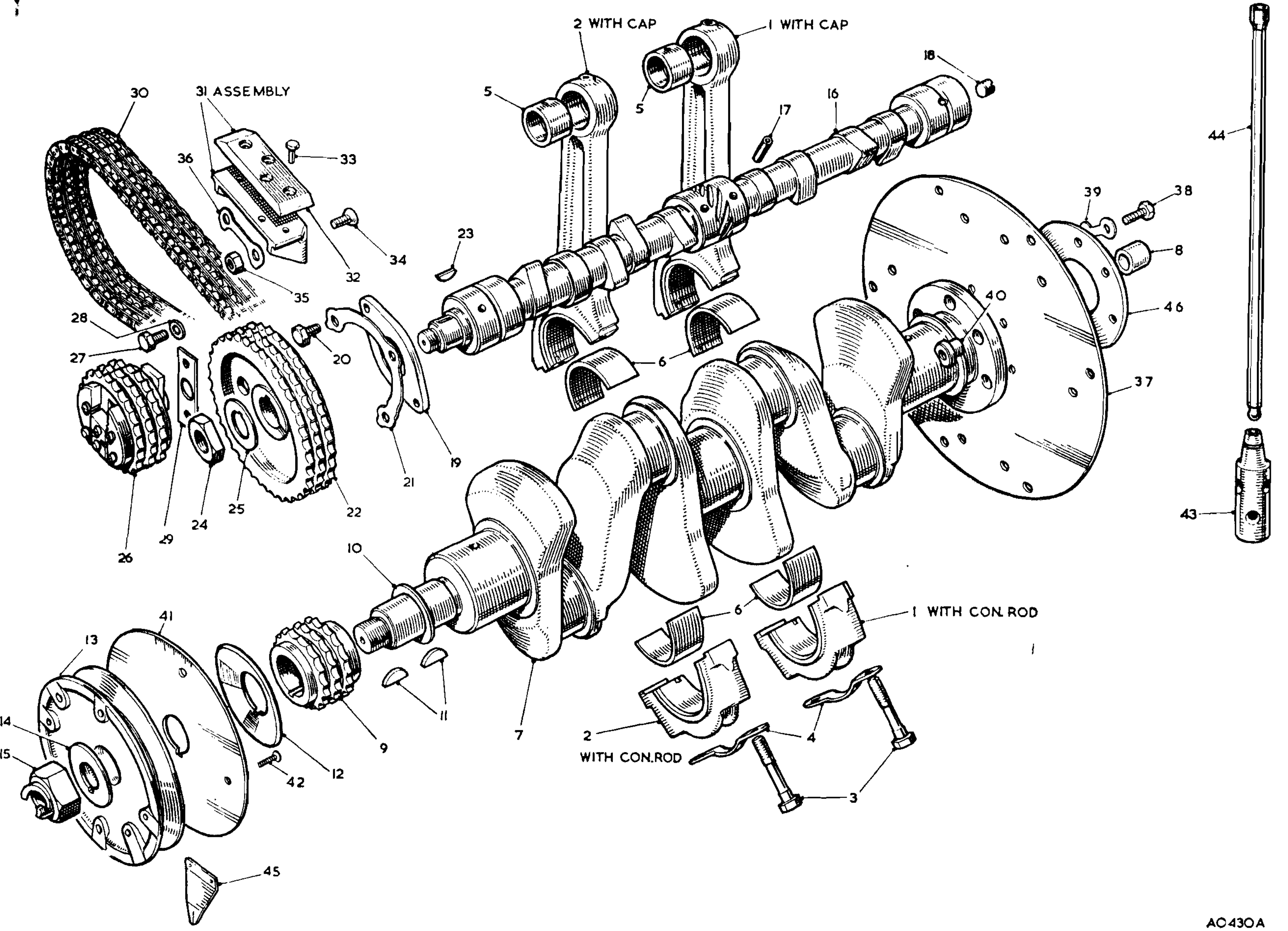
THE EXTERNAL COMPONENTS OF THE DIESEL ENGINE



KEY TO THE EXTERNAL COMPONENTS OF THE DIESEL ENGINE

No.	*Description*
1.	Block assembly—cylinder.
2.	Plug for cylinder block (welch).
3.	Plug for water gallery and oil passage.
4.	Cap—main bearing (front).
5.	Cap—main bearing (centre).
6.	Cap—main bearing (rear).
7.	Plug for front and rear main bearing caps.
8.	Stud for main bearing cap.
9.	Washer for stud (plain).
10.	Nut for stud.
11.	Liner for camshaft bearing.
12.	Liner—cylinder.
13.	Stud for valve rocker bracket (long).
14.	Stud for valve rocker bracket (short).
15.	Stud for fuel pump.
16.	Cover for crankcase (rear).
17.	Joint for rear cover.
18.	Set screw—rear cover to crankcase.
19.	Stud—dynamo bracket to crankcase.
20.	Bearing—main (standard).
21.	Washer—thrust (top).
22.	Washer—thrust (bottom).
23.	Gudgeon pin.
24.	Circlip for pin.
25.	Piston.
26.	Scraper rings.
27.	Compression ring No. 1.
28.	Compression rings Nos. 2 and 3.
29.	Locating screw for oil pump.
30.	Washer (fibre).
31.	Cap nut.
32.	Stud for engine mounting bracket.
33.	Rear mounting plate.
34.	Joint for rear plate.
35.	Cover for rear plate.
36.	Screw for cover.
37.	Washer—spring.
38.	Screw for rear plate.
39.	Converter housing.
40.	Bolt for converter housing.
41.	Air inlet cover.
42.	Screw for inlet cover.
43.	Washer—spring.
44.	Plate—front.
45.	Cover for riveting hole in front plate.
46.	Joint for cover.
47.	Set screw—cover to front plate.
48.	Washer for set screw (copper).
49.	Joint—front plate to crankcase.
50.	Cover assembly—front.
51.	Oil seal.
52.	Joint for front cover.
53.	Set screw—front cover and plate to crankcase.
54.	Washer for set screw.
55.	Cover—side.
56.	Joint for side cover.
57.	Set screw—side cover to crankcase.
58.	Washer for set screw (copper).
59.	Pipe—vent for crankcase.
60.	Joint for vent pipe.
61.	Set screw—vent pipe to side cover.
62.	Washer for set screw (spring).
63.	Cylinder head.
64.	Stud for valve rocker cover.
65.	Valve—inlet.
66.	Valve—exhaust.
67.	Spring—valve (outer).
68.	Spring—valve (inner).
69.	Collar—valve spring (bottom).
70.	Shroud and oil seal retainer (valve guide).
71.	Oil seal—valve.
72.	Cup—valve spring.
73.	Cotter—valve.
74.	Circlip—valve cotter.
75.	Valve guide—inlet.
76.	Valve guide—exhaust.
77.	Joint—cylinder head.
78.	Nut for cylinder head stud.
79.	Washer for nut (plain).
80.	Valve rocker cover.
81.	Oil level dipstick.
82.	Dust cover.
83.	Guide tube.
84.	Oil sump.
85.	Joint for sump.
86.	Set screw for sump.
87.	Washer.
88.	Drain plug.
89.	Washer (copper).

THE INTERNAL COMPONENTS OF THE DIESEL ENGINE



KEY TO THE INTERNAL COMPONENTS OF THE DIESEL ENGINE

No.	Description
1.	Rod—connecting (with cap)—Nos. 1 and 3 cylinders.
2.	Rod—connecting (with cap)—Nos. 2 and 4 cylinders.
3.	Set screw for connecting rod cap.
4.	Lock washer for set screw.
5.	Bush for connecting rod.
6.	Bearing for connecting rod.
7.	Crankshaft—bushed.
8.	Bush for crankshaft.
9.	Gear—crankshaft.
10.	Washer for gear (packing).
11.	Key for gear.
12.	Thrower for crankshaft (oil)—front.
13.	Pulley—crankshaft.
14.	Lock washer for starting nut.
15.	Nut—starting.
16.	Camshaft with oil feed nozzles.
17.	Nozzle—oil feed.
18.	Plug.
19.	Plate—camshaft locating.
20.	Set screw for locating plate.
21.	Lock washer—locating plate to crankcase.
22.	Gear—camshaft.
23.	Key for gear.
24.	Nut for gear.
25.	Lock washer for nut.
26.	Tensioner—timing chain.
27.	Set screw—tensioner to front plate.
28.	Lock washer for set screw.
29.	Shim for tensioner.
30.	Chain—timing.
31.	Damper for timing chain (vibration).
32.	Pad.
33.	Rivet—pad to damper.
34.	Screw—damper to front plate.
35.	Nut for screw.
36.	Lock washer—damper to front plate.
37.	Plate—drive.
38.	Bolt—backplate to drive plate.
39.	Lock washer for bolt.
40.	Nut for crankshaft flange.
41.	Disc—timing.
42.	Set screw—timing disc to crankshaft pulley.
43.	Tappet.
44.	Push-rod.
45.	Pointer for timing disc.
46.	Backplate for crankshaft.

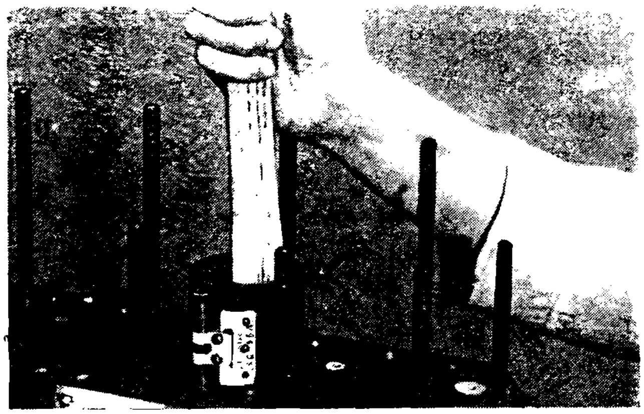


*Fig. A.*10
Inserting a piston with tool 18G 55 *A*

Section A.13

DISMANTLING AND REASSEMBLING A PISTON AND CONNECTING ROD

Remove the two circlips securing the gudgeon pin in its position and press the gudgeon pin out. Suitably mark the pistons and gudgeon pins to facilitate reassembly to their original connecting rods.

Check the gudgeon pin and connecting rod little-end bush for wear against the dimensions given under **'GENERAL DATA'**. If the little-end bush is worn it should be removed and a new bush installed, using a light press.

When installing a new little-end bush ensure that the oil holes in the bush are in line with the oil holes in the connecting rod and that the oil grooves in the bush are uppermost.

After installing, new little-end bushes must be finish-reamed to the dimension given under **'GENERAL DATA'**.

New gudgeon pins should be fitted to the pistons by selective assembly. The gudgeon pin should be a hard hand push-fit at a room temperature of 20° C. (68° F.).

NOTE.—**When reassembling the piston to the connecting rod ensure that the combustion cavity in the piston crown is on the same side of the connecting rod as the oil jet hole in the big-end bearing.**

Section A.14

REMOVING AND REPLACING THE PISTON RINGS

In the absence of a special piston ring expander a smoothly ground hacksaw blade or a disused ·020 in. (·50 mm.) feeler gauge may be used for this operation.

Raise one end of the ring out of its groove and insert the blade between the ring and the piston. Rotate the blade around the piston, applying slight upward pressure to the raised portion of the ring until it rests on the land above the ring grooves. The ring can then be eased off the piston. Do not remove or replace the rings over the piston skirt, but always over the top of the piston.

Before refitting the rings clean the grooves in the piston and remove any carbon deposit. Care must be taken not to remove any metal, or excessive side-play between the ring and the groove will result, with consequent increased oil consumption and loss of gas-tightness.

New rings must be tested in an unworn part of the cylinder bore to ensure that the ends do not butt together. The cylinder bore glazing should be removed before fitting new rings to a worn cylinder bore. Insert the piston into the cylinder bore, push the new ring onto the top of the piston to ensure that the ring is square with the cylinder bore, and measure the gap with a feeler gauge. The correct ring gaps are given under **'GENERAL DATA'**.

Section A.15

REMOVING AND REPLACING THE BIG-END BEARINGS

Remove the sump and the oil pump (Sections A.34 and A.35).

Unlock and remove the big-end bearing cap bolts; withdraw the bearing cap; detach the connecting rods from the crankshaft and extract the bearing liners.

As the bearings are of the shimless type it is essential that no attempt be made to adjust them. Worn bearings should always be renewed.

The bearing liners are located in their housings by a small tag on one side of each liner engaging a corresponding groove in the connecting rod and bearing cap. It should be noted that the bearings are fitted so that the tags are on the same joint edge of the bearing housing, although on opposite corners.

If used bearing liners are to be refitted it is essential that they are installed in their original positions, and each half-liner should be marked with its position in, and the number of, the connecting rod from which it

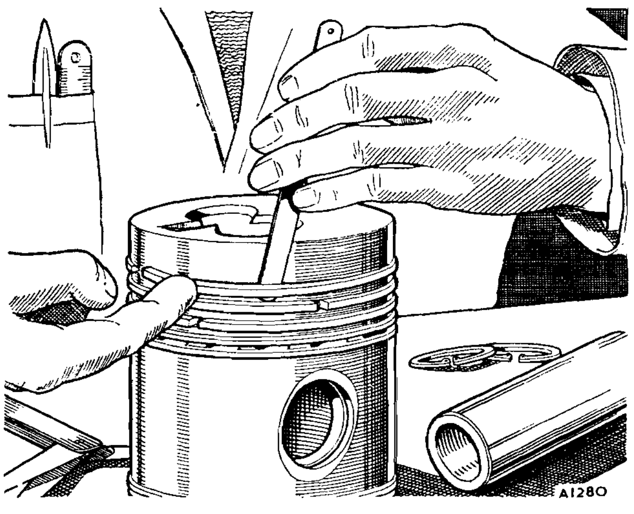


*Fig. A.*11
Method of removing the piston rings, using an old feeler gauge blade

was withdrawn. A centre-punch should not be used for this purpose.

Thoroughly clean the bearing liners, the bearing caps, and the housings in the connecting rods. Examine the bearing liners for wear, pitting, and picking up. Renew the bearing liners if necessary.

The connecting rod cap bolts should be tightened, using torque wrench 18G 372 set to break at the torque figure given under '**GENERAL DATA**'. Always renew the lock washers.

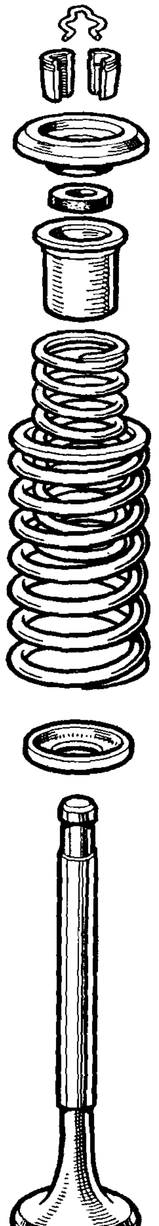


Fig. A.12
Order of assembly of valve and springs

Section A.16

REMOVING AND REPLACING THE VALVES

Remove the cylinder head as described in Section A.8. Compress each valve spring, using valve spring compressor 18G 45, and detach the two valve cap retainers and circlip if fitted from the stem of the valve. Release and

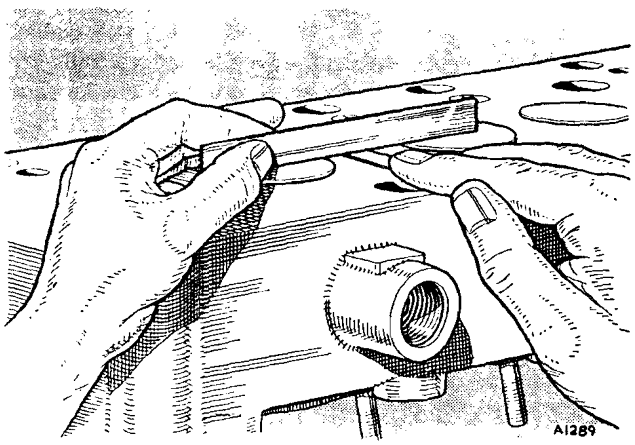


Fig. A.13
Checking the standing height of the valve face in relation to the cylinder head joint face

remove the valve spring compressor and remove the valve spring cap, valve oil seal retainer with seal, and the inner and outer valve springs.

Withdraw the valves from their guides, keeping them in their relative positions when removed from the engine to ensure replacement in their original valve guides. The valves are numbered on their heads 1 to 8, commencing from the front of the engine. If new valves are fitted they should be identified in a similar manner.

When reassembling, fit a new oil seal, chamfered side facing downwards (see Fig. A.12), to each valve. Do not refit the old seals or oil-tightness may be lost, with consequent increased oil consumption. It will be found that the new seals are more easily fitted if they are soaked in engine oil for a short time before use.

The 2·52-litre engine has a different type of valve oil seal, which fits over the top of the valve guide and can only be fitted one way.

NOTE.—**Owing to the limited clearance between the crowns of the pistons and the cylinder head joint face when the pistons are in the T.D.C. position, it is imperative that the valve heads do not stand proud of the cylinder head joint face more than ·003 in. (·076 mm.) when the valves are in the fully closed position. If new valves are fitted this dimension should be checked by placing a straight-edge across the face of the valve and measuring the clearance between the under side of the straight-edge and the cylinder face (Fig. A.13). When refitting used valves, check that they do not 'stand down' below the joint face of the cylinder head by more than ·010 in. (·25 mm.) on 2·2-litre engines, or ·020 to ·030 in. (·508 to ·762 mm.) on 2·52-litre engines, by placing a straight-edge across the cylinder head joint face and measuring the clearance between the under side of the straight-edge and the valve face.**

Section A.17

DECARBONIZING

Remove the cylinder head and gasket as described in Section A.8 and withdraw the valves as described in Section A.16. Plug the waterways in the cylinder head and block with clean rag.

If special equipment for decarbonizing is not available it will be necessary to scrape the carbon deposit from the piston crown and the cylinder head, using a blunt scraper. An odd length of copper tubing with the end flattened and filed up makes an ideal scraping tool which will not scratch.

A ring of carbon should be left round the periphery of the piston crown and the rim of carbon round the top of each cylinder bore should not be removed. An old piston ring sprung into the bore and resting on the top of the piston will facilitate this operation.

The cylinder head is next given attention. Remove the carbon deposit from the valves, valve ports, and cylinder head. Cleaning of the spherical combustion chamber in the cylinder head is not necessary as the heat generated during combustion is such as to prevent the build-up of carbon on the walls of the chamber. Any accumulation of carbon in the valve guides should be removed by dipping the valve stem in petrol or paraffin and oscillating it in the guide until it is free. Remove all traces of carbon dust with compressed air, or by the vigorous use of a tyre pump, and then clean thoroughly with paraffin and dry off.

Section A.18

VALVE-GRINDING

Operational efficiency of the compression-ignition engine depends largely on the maintenance of good compression; therefore contact between the valve faces and their seatings must be perfect.

Remove the valves as described in Section A.16 and clean them thoroughly. Examine the face of each valve for signs of pitting, any badly pitted valves being either renewed or refaced with a suitable grinder. For details of the valve seat angle see **'GENERAL DATA'**.

If the valve seats show signs of pitting or unevenness they should be trued by the use of the valve seat cutting tools illustrated at the end of the Section. When using these tools, which save lengthy and wasteful grinding in, care must be exercised to remove only as little metal as is necessary to ensure a true seat. Worn seats usually have a glass-hard surface, and glaze-breaking tools 18G 25 A and 18G 28 A should be used to prepare the seat surface for any recutting that may be necessary. Narrowing cutters 18G 25 B, 18G 25 C, 18G 28 B, and 18G 28 C should be used to maintain the valve seats at their correct widths as given under **'GENERAL DATA'**.

When grinding a valve onto its seating the valve face should be smeared lightly with a fine- or medium-grade carborundum paste and then lapped to its seat with grinding-in tool 18G 29. Avoid the use of excessive quantities of grinding paste and see that it remains in the region of the valve seating only.

A light coil spring placed under the valve head will assist considerably in the process of grinding. The valve should be ground to its seat with a semi-rotary motion and occasionally allowed to rise by the pressure of the light coil spring. This assists in spreading the paste evenly over the valve face and seat. It is necessary to carry out the grinding operation until a dull, even, mat surface, free from blemish, is produced on the valve seat and valve face.

On completion, the valve seat and ports should be cleaned thoroughly with a rag soaked in paraffin, dried, and then thoroughly cleaned by compressed air. The valves should be washed in paraffin and all traces of grinding paste removed.

Section A.19

REMOVING AND REPLACING THE VALVE GUIDES

Remove the cylinder head as described in Section A.8 and the appropriate valve and springs as described in Section A.16.

Suitably support the cylinder head with wooden blocks and drive the valve guide outwards from the exhaust or inlet port with a suitable drift. The drift should take the form of a hardened-steel punch ·5 in. (12·7 mm.) in diameter and not less than 5 in. (13 cm.) in length with a locating spigot ·312 in. (7·9 mm.) in diameter machined on one end for a length of 1 in. (2·54 cm.) to engage the bore of the guide.

New valve guides must be fitted in the same direction—that is, through the inlet or exhaust port—and driven outwards until they are ·750 in. (19·05 mm.) above the machined face of the valve spring seat (see [A], Fig. A.14).

Valve guides must be reamed in position to the dimension given under **'GENERAL DATA'**.

NOTE.—Valve guides with an outer diameter ·010 in. (·254 mm.) oversize are available for fitment where the normal fit has been impaired during the removal of an old guide.

Section A.20

REMOVING AND REPLACING THE TAPPETS

Remove the valve rocker assembly as described in Section A.9 and withdraw the push-rods, taking care to store them as described in Section A.8 so that they may be replaced in their original positions.

On early engines, detach the steady clip from the crankcase; remove the two set screws securing the crankcase vent pipe to the cylinder side cover and remove the vent pipe and its gasket.

Unscrew the 14 long and one short set screws with copper washers securing the cylinder side cover to the cylinder block and withdraw the side cover and its gasket.

Lift out the tappets from their guides in the cylinder block keeping them in their respective positions so that they may be replaced in their own guides.

New tappets must be fitted by selective assembly so that they just fall into their guides under their own weight when lubricated with engine oil.

When reassembling, which is a reversal of the above procedure, remove all traces of the old gasket from the joint faces of the cylinder block and cylinder side cover, fit a new gasket, and tighten the side cover securing screws evenly. The crankcase vent pipe gasket should be renewed if it is in any way suspect.

Section A.21

ADJUSTING THE VALVE ROCKER CLEARANCES

If the engine is to give its best performance and the valves are to retain their maximum useful life it is essential to maintain the correct valve rocker clearance.

The correct clearance for both inlet and exhaust valves when the engine is cold is given in 'GENERAL DATA', and as the engine has been designed to operate with this clearance no departure from it is permissible.

Provision for adjusting the valve clearance is made in the rocker arm by an adjustable screw and locknut.

The rocker adjusting screw is released by slackening the hexagon locknut with a spanner while holding the screw against rotation with a screwdriver. The valve clearance can then be set by carefully rotating the rocker screw while checking the clearance at the other end of the rocker with a feeler gauge. This screw is then relocked by tightening the hexagon locknut while again holding the screw against rotation.

It is important to note that while the clearance is being set the tappet of the valve being operated upon is on the back of its cam, i.e. opposite the peak.

As this cannot be observed accurately, the rocker adjustment is more easily carried out in the following order, and this also avoids rotating the crankshaft more than is necessary.

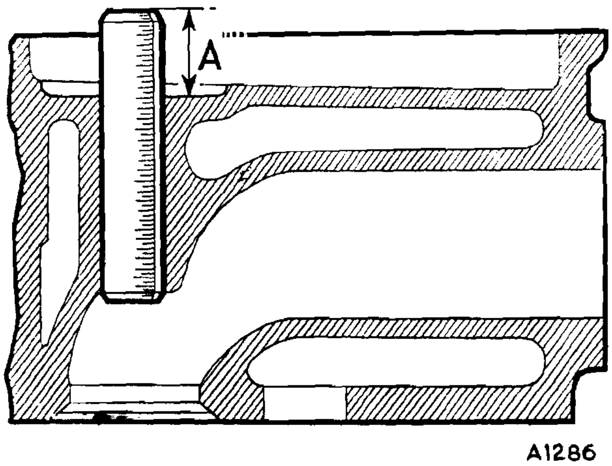


Fig. A.14
Location of a valve guide

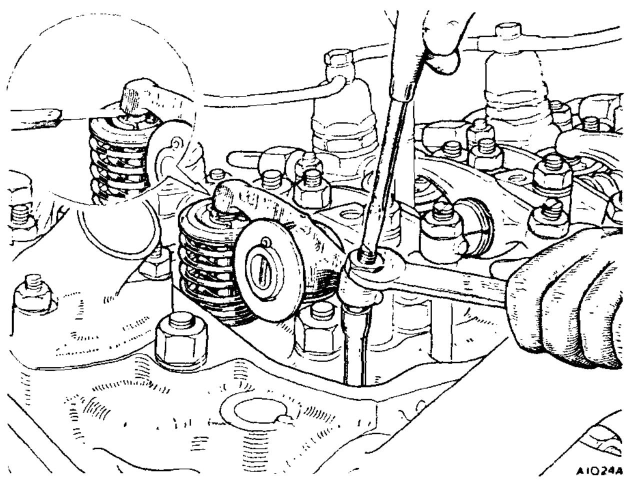


Fig. A.15
Checking and adjusting the tappet clearance

Adjust	No.	1	rocker	with	No.	8	valve	fully open.
,,	,,	3	,,	,,	,,	6	,,	,, ,,
,,	,,	5	,,	,,	,,	4	,,	,, ,,
,,	,,	2	,,	,,	,,	7	,,	,, ,,
,,	,,	8	,,	,,	,,	1	,,	,, ,,
,,	,,	6	,,	,,	,,	3	,,	,, ,,
,,	,,	4	,,	,,	,,	5	,,	,, ,,
,,	,,	7	,,	,,	,,	2	,,	,, ,,

Section A.22

VALVE-TIMING CHECK

Set the valve rocker clearance of No. 1 cylinder inlet valve to ·021 in. (·53 mm.) with the engine cold.

Rotate the crankshaft and determine the exact point at which No. 1 cylinder inlet valve is about to open. A clock gauge mounted on the cylinder head with its indicator in contact with the valve spring cap will facilitate this operation. If the valve timing is correct and in accordance with the valve-timing diagram (see Fig. A.16) the correct timing marks on the pointer or degree plate and crankshaft pulley will coincide.

NOTE.—**Reset the inlet valve clearance to ·012 in. (·31 mm.) when the timing check has been completed.**

Section A.23

REMOVING AND REPLACING THE TIMING CHAIN CASE

(Engine with 'In-line' Fuel Injection Pump)

Drain the cooling system and remove the radiator.

Unscrew and remove the four set screws and spring washers securing the fan blades to the water pump pulley.

Slacken the dynamo attachment bolts and nuts, pivot the dynamo towards the engine, and remove the dynamo and fan driving belt.

Press back the starting-handle dog locking washer and, using spanner 18G 96, unscrew the starting-handle dog from the crankshaft and withdraw the crankshaft pulley.

Unscrew and remove the securing bolts, nuts, set screws, and washers, and withdraw the timing chain case from the engine. Remove the oil thrower and withdraw the pulley key from the end of the crankshaft.

Extract the oil seal from the outside of the timing chain case. Remove the injection pump drive end cover plate, and press the chain wheel hub bearing outer race out of the chain case, using tool 18G 231 and adaptor 18G 231 H.

When reassembling, replace the oil thrower on the crankshaft with its concave side facing away from the engine, and fit a new gasket between the chain case and the engine front mounting plate. Install the chain case securing bolts and nuts and the set screws finger tight, and place alignment sleeve 18G 668 on the end of the crankshaft with its spigoted end engaging the oil seal bore in the timing chain case. Tighten the chain case securing bolts and nuts and the set screws, ensuring that the alignment sleeve is free to revolve on the crankshaft.

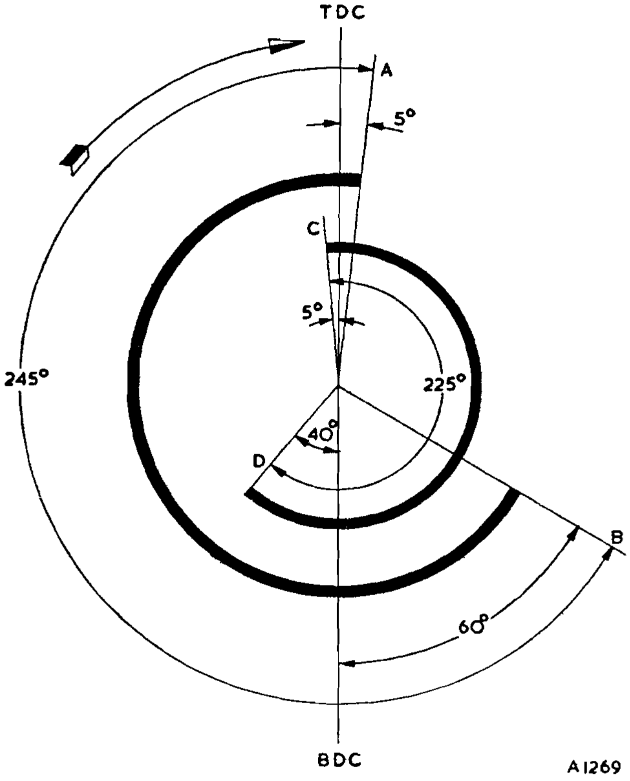


Fig. A.16

The valve-timing diagram

A. Exhaust valve closes. C. Inlet valve opens.
B. Exhaust valve opens. D. Inlet valve closes.

If the timing chain case is renewed the engine front plate must be removed and refitted as described in Sections A.32 and A.42 to ensure accurate alignment of the fuel injection pump drive.

Remove the alignment sleeve, install the pulley key in the crankshaft, and insert a new crankshaft oil seal into the timing chain case with the lip of the seal facing towards the engine.

Refit the crankshaft pulley, using 18G 16. Discard the lock washer and tighten the pulley nut to the torque figure given in 'GENERAL DATA'. Refit the drive belt and fan blades as described in Section B.

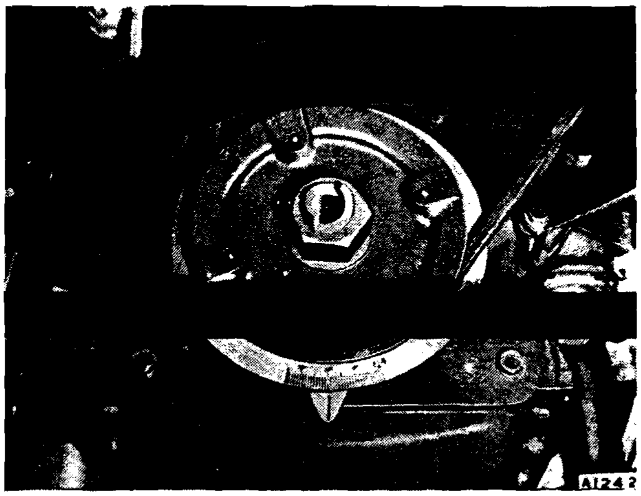


Fig. A.17

The degree plate on the crankshaft pulley

Install the radiator and fill the cooling system with water, adding anti-freeze solution if necessary.

Section A.24

REMOVING AND REPLACING THE TIMING CHAIN

(Engine with 'In-line' Fuel Injection Pump)

Remove the heater plugs to relieve the compression when turning the crankshaft by hand.

Fully slacken all the valve rocker adjusting screws or, if necessary, remove the valve rocker assembly as described in Section A.9 to ensure that throughout this operation the valves are always in the fully closed position. This is to prevent damage to the pistons and valves, which would otherwise foul each other when rotating either the crankshaft or camshaft with the timing chain removed.

Remove the timing chain case (see Section A.23 or A.43).

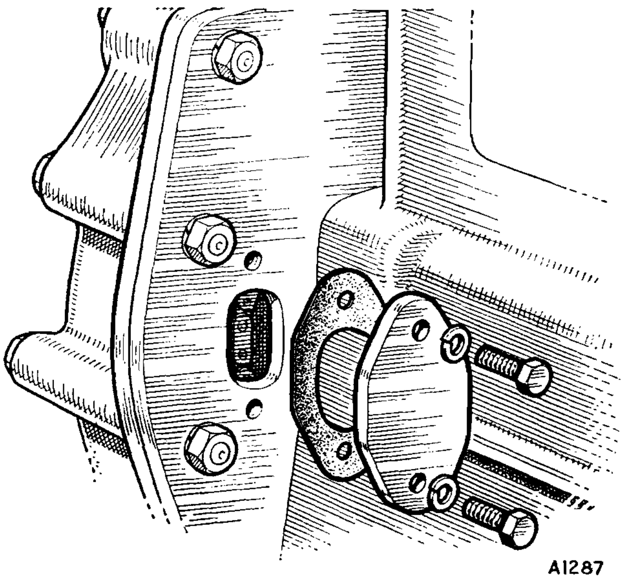


Fig. A.18

The timing chain riveting aperture

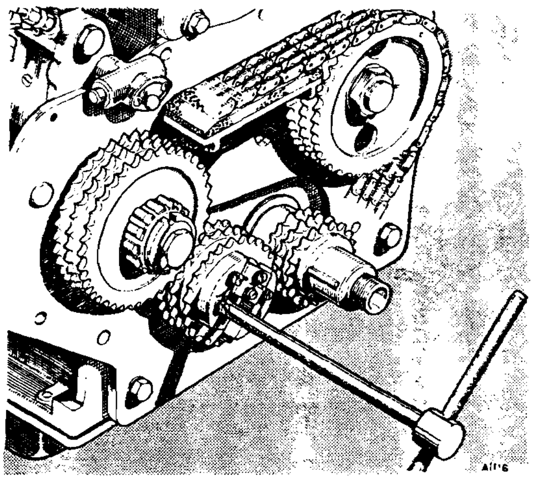


Fig. A.19
Removing the chain tensioner, using tool 18G 241

Unscrew the two set screws with spring washers and remove the cover-plate and gasket from the timing chain riveting aperture (see Fig. A.18) in the left-hand side of the engine front mounting plate.

Crank the engine until the timing chain riveting link, i.e. the bright link stamped with the manufacturer's name, is opposite the riveting aperture in the engine front plate.

NOTE.—The two other 'bright' links in the timing chain are stamped with the letter 'T'.

File the head from the riveting link bearing pins and then release the tension from the timing chain by squeezing together the chain tensioner pawl pins (see Fig. A.19), pushing the tensioner chain wheel over to the left as far as possible to compress the tensioner spring and wedging the tensioner in this position, using tool 18G 241.

Extract the riveting link from the timing chain through the aperture in the engine front mounting plate and remove the chain from the timing wheels.

Before refitting a used timing chain it should be tested for wear and stretch as follows:

(1) Degrease the chain. In the absence of special degreasing equipment the chain should be soaked in petrol for at least 24 hours, thoroughly cleaned to remove all oil and foreign matter, and then allowed to dry out completely.

(2) Place the chain on a clean bench and, working from the centre outwards, push all the links towards the centre to reduce the chain to its

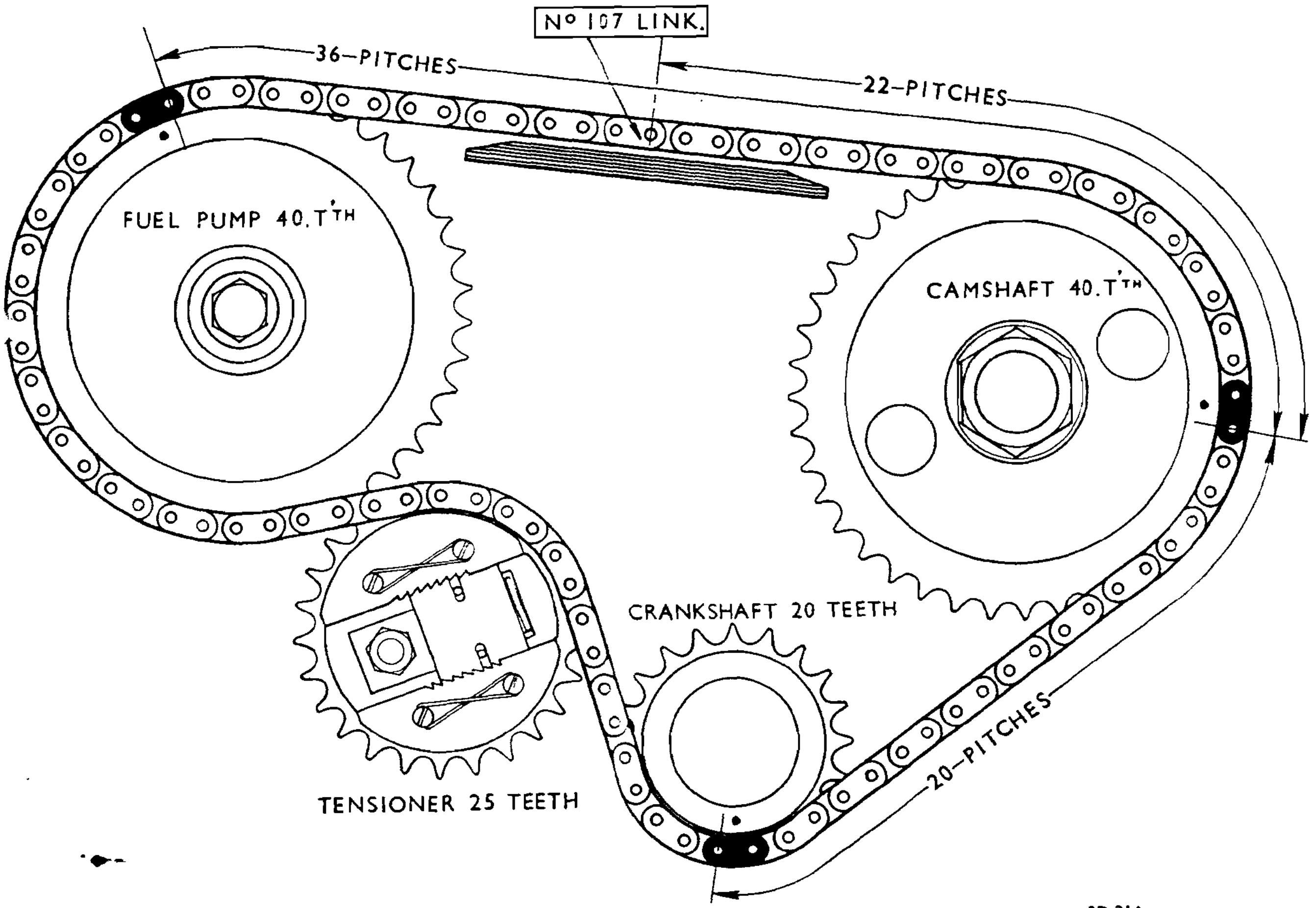


Fig. A.20
Timing chain drive, showing the position of the marked teeth and the bright links

minimum length. Measure the overall length of the chain by marking the bench at the ends of the chain.

(3) Extend the chain to its maximum length and measure the overall length.

(4) If the difference between the minimum and maximum lengths is greater than ·562 in. (14·3 mm.) the chain should be renewed.

(5) Should the chain be found to be serviceable, it should be re-oiled by immersion in a bath of clean, boiling engine oil and allowed to simmer for at least 30 minutes.

To facilitate the retiming of the engine valves and the fuel injection pump one tooth on each chain wheel, with the exception of the tensioner chain wheel, is marked with a 'dimple', which, on assembly, must engage the 'bright' links on the timing chain as shown in Fig. A.20.

Before assembling the timing chain turn the camshaft chain wheel until the tooth marked with a 'dimple' is in line with the centre of the riveting aperture in the engine front mounting plate, and turn the crankshaft and fuel injection pump chain wheels until the teeth marked with a 'dimple' are in the 6 o'clock and 11 o'clock positions respectively.

Place the timing chain in position on the chain wheels, ensuring that the two 'bright' links marked with the letter 'T' engage the teeth marked with a 'dimple' on the crankshaft and fuel injection pump chain wheels and that the ends of the chain are positioned on each side of the tooth marked with a 'dimple' on the camshaft chain wheel. Insert a new link, through the riveting aperture, into the ends of the chain, place the loose link plate onto the bearing pin necks, force the plate up to the shoulders with a hollow punch, and lightly rivet the bearing pin ends.

Remove tool 18G 241 from the chain tensioner, which will permit the tensioner spring to reassert itself and so impart the correct tension to the chain.

The valve and fuel injection pump timing is now correct, but in all cases where either the timing chain wheels or chain has been renewed the injection pump timing should be checked as described in Section C to ensure that spill cut-off occurs at 28° B.T.D.C.

Section A.25

REMOVING AND REPLACING THE TIMING CHAIN TENSIONER
(Engine with 'In-line' Fuel Injection Pump)

Remove the timing chain case and the timing chain as described in Sections A.23 and A.24.

The chain tensioner is secured to the cylinder block by two set screws, and is removed by dismantling.

Cut the locking wire and remove the six set screws securing the end plate and the two retaining plates to the tensioner slide block and shank; care must be taken not to lose the two pawls and the pawl spring. It is advisable

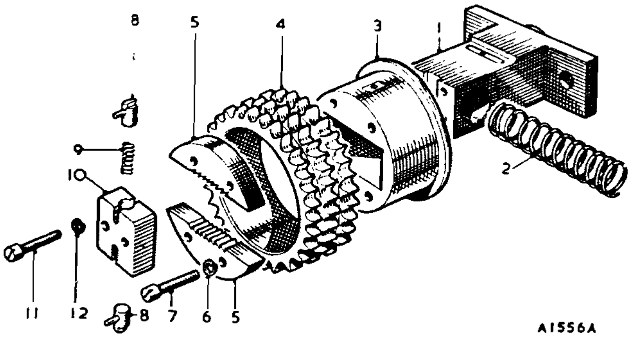


Fig. A.21

Timing chain tensioner components

1. Shank.	7. Set screws (plate to block)
2. Tension spring.	8. Pawls.
3. Slide block.	9. Pawl spring.
4. Chain wheel.	10. End plate.
5. Retaining plates.	11. Set screws (plate to shank).
6. Spring washer.	12. Spring washer.

to mark one of the retaining plates and its mating surface on the slide block to facilitate correct reassembly.

Withdraw the chain wheel, slide block, and spring from the tensioner shank.

Press back the lock washers; unscrew the securing screws and remove the tensioner shank and, if fitted, the tensioner aligning shims.

When reassembling, clean the oilways in the tensioner shank with compressed air and ensure that the retaining plates and pawls are assembled with the pawl and ratchet teeth facing in the directions shown in Fig. A.21, otherwise the tensioner restraint mechanism becomes inoperative.

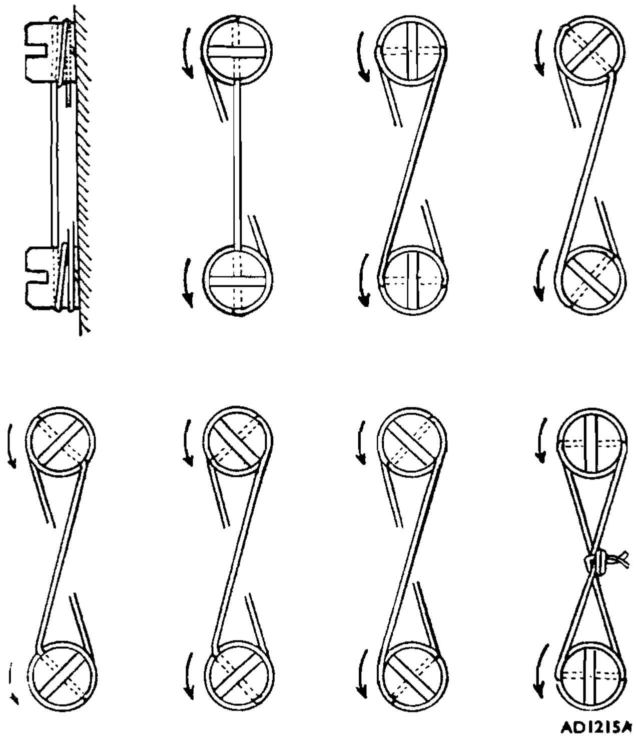


Fig. A.22

Method of locking the chain tensioner screws

After assembly rewire the six end plate and retaining plate securing screws so that any tendency for them to loosen will be prevented by the tension strand of the locking wire.

The correct procedure for locking the screws in various positions is shown in Fig. A.22 and is as follows. Wind each end of the wire twice round the heads of each pair of screws and underneath the tension strand in the direction indicated in Fig. A.22. Twist the loose ends of the wire together after passing them under the tension strand and turn the twisted end underneath the tension strand.

When installing a new chain tensioner or after removing the camshaft chain wheel align the tensioner chain wheel with the camshaft chain wheel as described in Section A.26, otherwise the original thickness of shims should be fitted between the tensioner shank and the cylinder block.

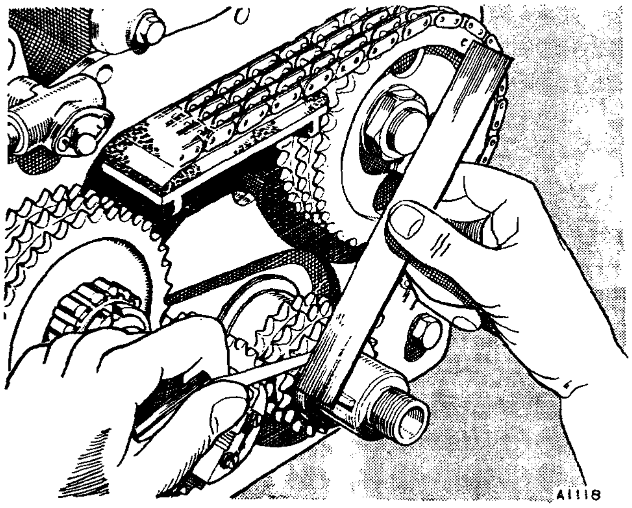


Fig. A.23
Checking the chain wheel alignment

Section A.26

TIMING CHAIN WHEEL ALIGNMENT

In all cases of timing chain wheel renewal and after the installation of a new camshaft or crankshaft the chain wheels must be checked for alignment with the camshaft chain wheel and adjusted where necessary by adding or removing shims.

To determine the thickness of the shims required to bring the crankshaft chain wheel into alignment place one end of a straight-edge across the face of the camshaft chain wheel so that its other end lies across the front face of the crankshaft chain wheel teeth as shown in Fig. A.23 and measure the clearance between the under side of the straight-edge and the front face of the crankshaft chain wheel teeth.

The thickness of the shims required for the timing chain tensioner on engines with an 'in-line' injection ump can be determined in a similar manner.

NOTE.—All engines are fitted with a self-aligning fuel injection pump chain wheel.

Section A.27

REMOVING AND REPLACING THE CAMSHAFT

Remove the sump and oil pump (Sections A.34 and A.35).

Remove the fuel lift pump (Section C).

Remove the valve rocker assembly, tappets, and push-rods (Sections A.9 and A.20) and the timing chain case (Section A.23 or A.43).

Unlock and remove the camshaft chain wheel nut, remove the timing chain (Section A.24 or A.44), and withdraw the camshaft chain wheel, using tool 18G 58.

Unscrew the two camshaft retaining plate set screws, and withdraw the retaining plate and camshaft.

Before reassembly, which is a reversal of the dismantling procedure, temporarily assemble the camshaft, retaining plate, and chain wheel, and check the camshaft end-float against the dimensions given under **'GENERAL DATA'** by measuring the clearance between the retaining plate and the camshaft front journal.

If the end-float is excessive the retaining plate should be renewed.

Section A.28

CAMSHAFT BEARINGS

If the camshaft bearing clearances are excessive new bearings must be fitted. Thinwall white-metal bearings are used, and removing and refitting are facilitated by the use of a special camshaft liner removing and replacing tool. New bearings must be reamed to give the correct running clearance (see **'GENERAL DATA'**) and the use of the special camshaft liner reamer tools is strongly recommended.

Removing the front and rear liners

Insert the small end of the adaptor 18G 124 F into the camshaft front liner from the inside of the cylinder block, thread the body of the tool onto the centre screw, and pass the screw through the adaptor from the front of the block. Place the slotted washer on the flat at the rear of the centre screw and insert the tommy-bar into the centre screw behind the slotted washer.

Tighten up the wing nut to withdraw the worn liner.

The rear liner is withdrawn by the same method, using the adaptor 18G 124 B and withdrawing the liner from the rear of the block.

Removing the centre liner

Insert the stepped pilot adaptor 18G 124 H into the camshaft liner front bore from the inside of the block and the adaptor 18G 124 D into the centre liner from the rear, small end first.

With the body of the tool positioned on the centre screw pass the screw through the pilot adaptor and the adaptor in the centre liner.

Place the slotted washer on the flat at the rear of the centre screw and insert the tommy-bar into the screw behind the slotted washer. Tighten the wing nut to withdraw the liner.

Replacing the front and rear liners

Place the new liner on the smallest diameter of the adaptor 18G 124 F and insert the adaptor into the camshaft front liner bore from the inside of the block, largest diameter first.

Line up the oil holes in the liner and the cylinder block and make certain that they remain correctly positioned during the whole operation.

Thread the body of the tool onto the centre screw and pass the screw through the adaptor located in the front liner from the front of the block.

Position the larger of the two 'D' washers on the centre screw with the cut-away portion turned away from the butt joint of the liner; this joint must be covered by the washer.

Place the slotted washer on the flat at the rear of the centre screw and insert the tommy-bar into the screw behind the slotted washer.

Tighten the wing nut to pull the liner squarely into position.

The rear liner is replaced by the same method, using the adaptor 18G 124 B and pulling the liner into position from the rear of the block.

Replacing the centre liner

Insert the stepped adaptor 18G 124 H into the camshaft front liner from the inside of the block.

Place a new centre liner on the small end of the adaptor 18G 124 D and position the adaptor in the centre liner bore from the rear, largest diameter first. Ensure that the oil holes in the liner and the cylinder block are lined up and remain so during the whole operation.

With the body of the tool positioned on the centre screw insert the screw through the pilot adaptor and the adaptor in the centre liner bore.

Position the larger of the two 'D' washers on the centre screw with the cut-away portion turned away from the butt joints of the liner; this joint must be covered by the washer.

Place the slotted washer on the flat of the centre screw and insert the tommy-bar into the screw behind the slotted washer. Tighten up the wing nut to pull the liner into position.

Reaming the front and rear liners

Insert the taper pilots 18G 123 M and 18G 123 Q into the centre and rear liners respectively.

Place the plain pilot 18G 123 L on the arbor, followed by the cutter 18G 123 E.

Pass the arbor through the front liner and the pilot located in the centre liner.

Place the cutter 18G 123 B on the arbor and push the arbor through the taper pilot in the rear liner.

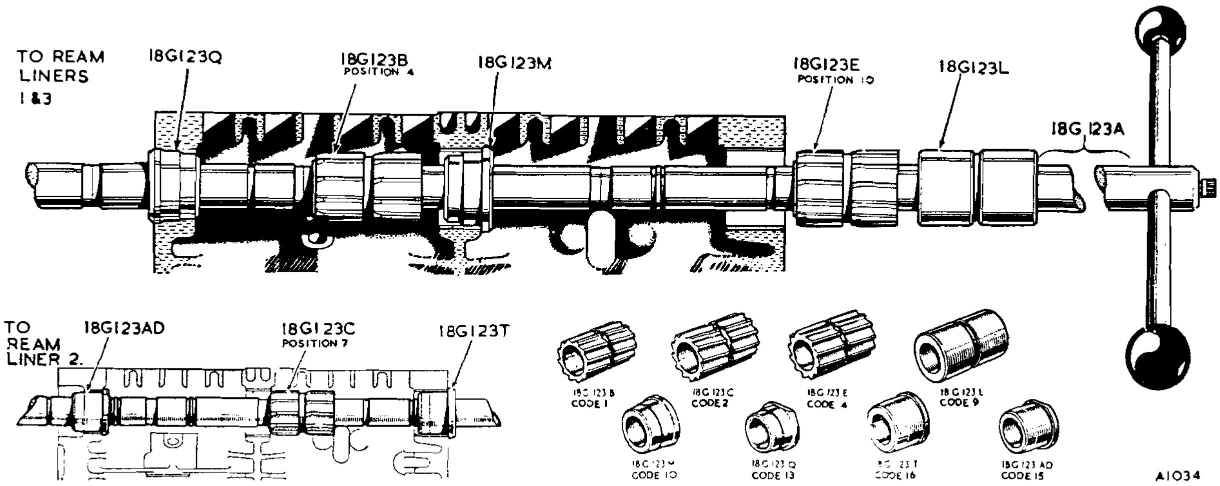


Fig. A.24
Cutters and pilots positioned for reaming the camshaft liners

Secure the cutters in their respective positions shown in Fig. A.24, ensuring that the cutter locating pins are engaged in the correct numbered hole provided in the arbor.

The cutter for the front liner will cut first with the arbor piloting in the centre and rear liners. Clear away the swarf frequently during the operation. The cutter for the rear liner will follow with the arbor piloting in the front and centre liners. Clear away all the swarf before the plain pilot is allowed to enter the front liner.

When the cut in the rear liner is finished, free the cutters and withdraw the arbor.

Reaming the centre liner

Set up for the second part of the operation by inserting the pilots 18G 123 T and 18G 123 AD in the front and rear liners.

Pass the arbor through the pilot in the front liner and place the cutter 18G 123 C on the arbor. Push the arbor through the centre liner and the pilot located in the rear liner.

Secure the cutter in the position shown in Fig. A.24, ensuring that the locating pin of the cutter engages the correct numbered hole in the arbor.

Ream the centre liner, release the cutter, and withdraw the arbor.

IMPORTANT.—It is essential that the cutter flutes are kept clear of swarf at all times during the cutting operation, preferably with air-blast equipment. The cutter should be withdrawn from the liner half-way through the cut and the swarf removed from the cutter and the liner.

Feed the reamer very slowly and keep the cutters dry.

The arbor should be lightly lubricated before assembling the cutters and pilots.

Section A.29

REMOVING AND REPLACING THE CRANKSHAFT

Remove the timing chain case (Section A.23 or A.43), timing chain (Section A.24 or A.44), crankshaft chain wheel (Section A.30), and engine front plate (Section A.32).

Remove the driving plate and gearbox mounting plate (Sections D and A.31).

If a synchromesh gearbox is fitted, remove the gearbox, clutch, flywheel, and flywheel housing (Sections DD, DDD, A.39, and A.40).

Remove the sump and oil pump (Sections A.34 and A.35).

Disconnect the connecting rods from the crankshaft as described in Section A.12 and mark the big-end bearings and bearing caps to facilitate reassembly to their correct journals. A punch should not be used for this purpose owing to the possibility of damage or distortion of the bearing.

Unscrew the six self-locking nuts and washers from the main bearing cap studs and, using tool 18G 42 A with adaptors 18G 42 B, or 18G 284 and 18G 284 AJ withdraw the main bearing caps and remove the lower halves of the crankshaft thrust washers from the centre main bearing. Lift the crankshaft out of its bearings and remove the upper halves of the crankshaft thrust washers.

Withdraw the bearing liners from the bearing caps and the housings in the crankcase. If used bearing liners are to be refitted it is essential that they are installed in their original positions, and each half-liner should be marked with its position in, and the number of, the bearing housing in the crankcase from which it was withdrawn.

In the case of a run bearing, the oilways in the crankshaft and cylinder block must be cleaned thoroughly with petrol or paraffin and then blown clean with compressed air. The oil pump and oil strainer should also be dismantled and cleaned (Section A.37) and the external oil filter element renewed (Section A.5) to ensure that all bearing metal is removed from the lubricating system.

Before reassembly check the crankshaft end-float against the dimensions given under 'GENERAL DATA'.

Thoroughly clean the thrust faces of the crankshaft centre main journal, bearing, and thrust washers and temporarily install them in the crankcase. Mount a clock gauge on the front end of the crankcase with its indicator resting on the front face of the crankshaft front main journal. Press the crankshaft as far as possible to the rear and, holding it in this position, zero the clock gauge. Now press the crankshaft forward as far as possible and note the reading on the clock gauge, the difference from zero being the amount of crankshaft end-float.

If necessary, renew the thrust washers, fitting them by selective assembly and ensuring that the oil grooves face outwards, towards the crankshaft webs.

When installing new bearings no scraping is required as the bearings are machined to give the correct diametrical clearance.

If a new or reconditioned crankshaft is installed do not forget to align the crankshaft chain wheel with the camshaft chain wheel as described in Section A.26.

Reassembly is a reversal of the dismantling procedure, noting the following points:

(1) Ensure that the sealing plugs fitted between the front and rear main bearing caps and the crankcase are in good condition.
(2) Coat the rear main bearing cap to cylinder block horizontal joint surface with 'Hylomar SQ 32/M' jointing compound.
(3) Renew the seal fitted in the base of the rear main bearing cap.
(4) Tighten the main bearing cap nuts to the figure given in the 'GENERAL DATA' Section.

Section A.30

REMOVING AND REPLACING THE CRANKSHAFT CHAIN WHEEL

Remove the timing chain case (Section A.23 or A.43) and timing chain (Section A.24 or A.44).

Draw the chain wheel off the crankshaft, using remover 18G 2, and withdraw the chain wheel aligning shims.

When reassembling fit the original thickness of shims between the chain wheel and crankshaft front main journal, except in the case of chain wheel renewal, when the new chain wheel must be aligned with the camshaft chain wheel as described in Section A.26.

Use replacing tool 18G 16 to drive the chain wheel into position.

Section A.31

REMOVING AND REPLACING THE GEARBOX MOUNTING PLATE

(Engine with Automatic Transmission)

Remove the driving plate (Section D) and the starter motor (Section L).

Unscrew and remove the 10 set screws and spring washers securing the mounting plate to the cylinder block.

Remove the mounting plate, using a hide mallet to ease it off the two locating dowels.

When reassembling renew the two gaskets to ensure an oiltight joint.

Section A.32

REMOVING AND REPLACING THE ENGINE FRONT PLATE

Remove the timing chain case (Section A.23 or A.43), the timing chain (Section A.24 or A.44), the camshaft chain wheel and camshaft retaining plate (Section A.27), the fuel injection pump (Section C or Ca), and the slipper-type timing chain tensioner (Section A.45).

Press back the lock washers, unscrew the five securing screws, and remove the front plate complete with the timing chain vibration damper.

Unlock and remove the two countersunk screws and nuts securing the timing chain vibration damper and remove the vibration damper and shim.

Replacing the engine front plate is a reversal of the above procedure, but accurate alignment of the 'in-line' fuel injection pump drive is essential, and the instructions given in Section A.42 should be followed.

Section A.33

OIL PRESSURE

Provided the oil filter element is clean and in good condition, the oil pressure during normal running and when the engine is idling should be in accordance with the figures given under **'GENERAL DATA'**. As the filter becomes choked the pressure registered on the oil gauge will become progressively less, and on an engine known to be in good condition a drop of between 10 to 15 lb./sq. in. below the normal pressure is an indication that the filter element has become choked and is being by-passed. This can be remedied by renewing the oil filter element.

However, should there be a noticeable drop in oil pressure, when it is known that the oil filter element is in a good and clean condition, the following points should be checked:

(1) Ensure that there is a good supply of the correct grade of oil in the engine sump.
(2) Check the oil pressure relief valve (see Section A.6).
(3) Check the operation of the oil pressure gauge by substitution.
(4) Ensure that the oil strainer in the engine sump is clean and not choked with foreign matter.
(5) Check the oil pump for correct operation and ensure that there is no air leakage between the pump cover and body (see Section A.35).
(6) Check that the working clearances of all bearings to which oil is supplied under pressure is not excessive (see 'GENERAL DATA').

Section A.34

REMOVING AND REPLACING THE SUMP

Drain the sump as described in Section A.4. Support the sump, remove the set screws which secure it to the crankcase, and detach the sump and its gasket from the engine.

It should be noted that the set screw securing the sump to the rear main bearing cap is provided with a copper washer, while the remaining screws have captive washers. This is to prevent an oil leak due to seepage past the thread as the tapped hole in the bearing cap breaks into the bearing oil return channel.

Before refitting the sump to the crankcase ensure that the sump gasket and the cork seal in the recess of the rear main bearing cap are in good condition. It is always advisable to fit a new sump gasket.

When fitting a new gasket clean the joint faces of the sump and crankcase, ensuring that all traces of the old gasket are removed. Smear both faces of the gasket with grease and position it on the sump joint face. Lift the sump into position, install the 22 securing screws, and tighten them evenly.

NOTE.—It is possible to install the sump with the shallow end positioned either at the front or rear of the engine. The correct position is with the shallow end of the sump at the front of the engine.

Section A.35

REMOVING AND REPLACING THE OIL PUMP

The oil pump is secured to the crankcase by one locating screw, which is inserted into the left-hand side of the crankcase from the outside. A dome nut and sealing washer are used to lock the locating screw and prevent an oil leak due to seepage past the threads.

Drain and remove the sump as described in Sections A.4 and A.34. Disconnect the oil delivery pipe from the crankcase and the base of the pump, unscrew the dome nut, and remove the locating screw from the side of the crankcase. The oil pump complete with oil strainer and pick-up can now be withdrawn from the crankcase.

Replacement is a reversal of the above procedure, but before replacing the dome nut and washer ensure that the locating screw is tight and properly engaged with the recess in the pump body. The pump does not need priming.

Section A.36

DISMANTLING AND REASSEMBLING THE OIL PUMP

Before dismantling the oil pump scribe a line across one side of the pump body and cover flanges to assist reassembly.

Remove the oil strainer and pick-up as described in

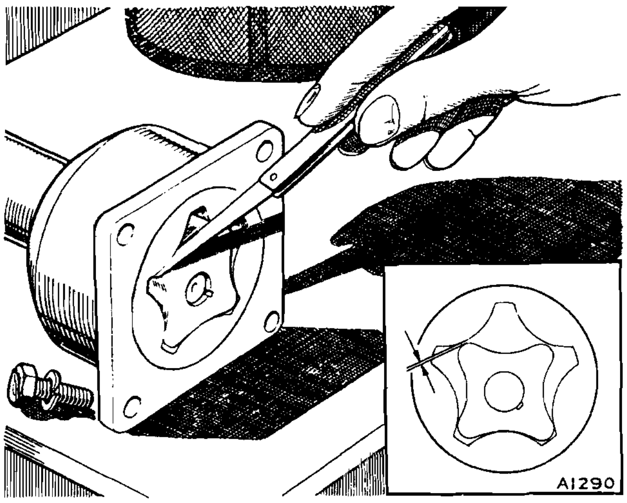


Fig. A.25
Checking the oil pump rotor clearance

Section A.37. Unscrew the four set screws from the base of the pump and remove the pump cover.

Withdraw the outer rotor, detach the inner rotor and its key from the pump spindle, and remove the spindle.

Thoroughly clean all parts in paraffin and inspect them for wear. The rotor end-float and lobe clearances should be checked as follows:

(1) Install the rotors in the pump body, place a straight-edge across the joint face of the pump body, and measure the clearance between the top face of the rotors and the under side of the straight-edge. The clearance should not exceed ·005 in. (·127 mm.). In cases where the clearance is excessive this may be remedied by careful lapping of the pump body face.

(2) With the rotors installed in the pump body measure the clearance between the rotor lobes when they are in the position shown in Fig. A.25. If the clearance is in excess of ·006 in. (·152 mm.) the rotors must be renewed.

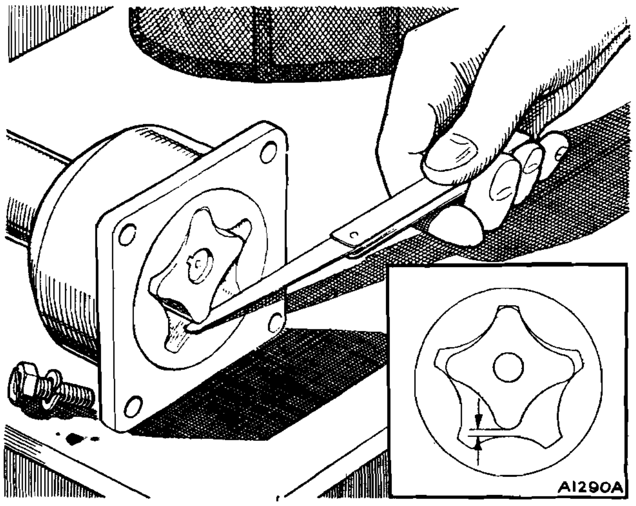


Fig. A.26
Checking the oil pump rotor clearance

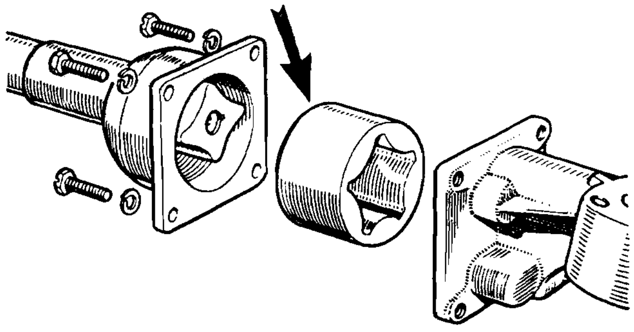


Fig. A.27
Assembly order of oil pump

(3) Repeat test (2) with the rotor lobes in the position shown in Fig. A.26, and if the clearance is in excess of ·008 in. (·203 mm.) renew the rotors.

Reassembly is a reversal of the dismantling procedure, noting the following points:

(1) Lubricate all parts with clean engine oil.

(2) Ensure that the outer rotor is installed in the pump body with its chamfered end (see Fig. A.27) at the driving gear end of the pump.

(3) After reassembling check the pump for freedom of action.

Section A.37

REMOVING AND REPLACING THE OIL STRAINER AND PICK-UP

The oil strainer and pick-up can be removed from the engine without removing the oil pump. Remove the sump as described in Section A.34. Unscrew the two set bolts with spring washers and detach the strainer and pick-up and gasket from the oil pump cover.

Dismantle the strainer by removing the centre-bolt, nut, and distance piece and clean the strainer gauze in a paraffin bath, using a stiff brush—never use rag.

When reassembling and installing the strainer and pick-up ensure that the locating tag on the strainer cover engages the slot in the strainer body and fit a new gasket between the strainer body and oil pump cover.

Section A.38

CYLINDER LINERS

Early engines

On early 2·2-litre engines fitted with cylinder liners as original equipment, should the condition of the cylinder liner bores be such that they cannot be cleaned up to accept standard oversize pistons, new liners should be fitted.

This operation may be carried out by the use of specialized proprietary equipment or with a power press using pilot adaptors to the dimensions shown in Fig. A.28. The press must be capable of 3 tons (3048 kg.) pressure to fit new liners, and 5 to 8 tons (5080 to 8128 kg.) to remove old liners.

To remove worn liners

Dismantle the engine and remove the cylinder head studs.

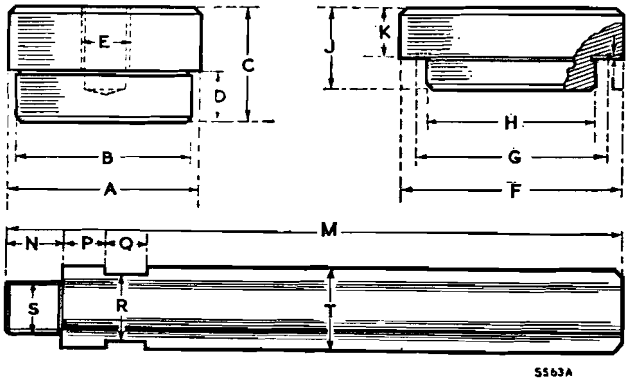


Fig. A.28

Cylinder liner pilots for 2·2-litre engines should be made to the dimensions given from case-hardening steel and case-hardened. The pilot extension should be made from 55-ton hardening and tempering steel hardened in oil and then tempered at a temperature of 550° C. (1,020° F.)

Pressing-out pilot

A. $3\frac{25}{64}{}^{+\cdot005}_{-\cdot0}$ in. ($86\cdot121^{+\cdot127}_{-\cdot0}$ mm.).
B. $3\cdot248^{+\cdot0}_{-\cdot005}$ in. ($82\cdot50^{+\cdot0}_{-\cdot127}$ mm.).
C. 1¾ in. (44·45 mm.).
D. ¾ in. (19·05 mm.).
E. ¾ in. B.S.W. thread.

Pressing-in pilot

F. 3⅝ in. (92·07 mm.).
G. 3¼ in. (82·55 mm.).
H. $3\cdot228^{+\cdot0}_{-.005}$ in. ($82\cdot0^{+\cdot0}_{-\cdot127}$ mm.).
J. 1¼ in. (31·75 mm.).
K. ¾ in. (19·05 mm.).
L. ·015 in. (·38 mm.).

Pilot extension

M. 14½ in. (36·83 cm.).
N. ⅞ in. (22·22 mm.).
P. ⅝ in. (15·87 mm.).
Q. ⅝ in. (15·87 mm.).
R. 1 in. (25·4 mm.) flats.
S. ¾ in. B.S.W. thread.
T. 1¼ in. (31·75 mm.).

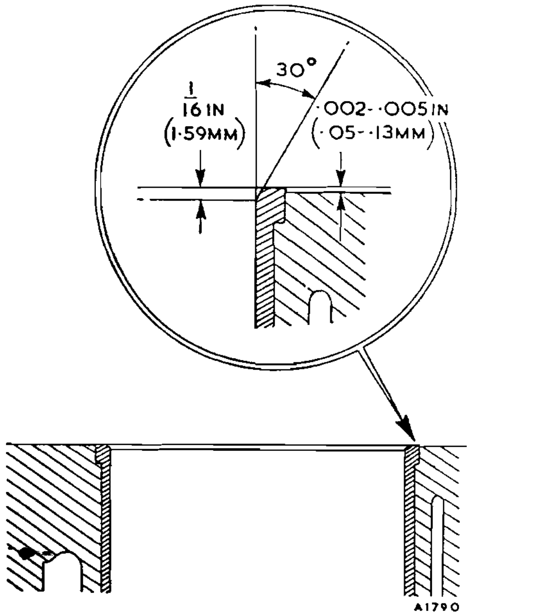


Fig. A.29

Fitting dimensions at the top face of the early type cylinder liner

Place the cylinder block face downwards on suitable wooden blocks on the bed of the press, making sure that there is sufficient space between the block and the bed of the press to allow the worn liner to pass down. Insert the pilot in the bottom of the liner and carefully press the liner from the bore.

To press in new liners

When fitted, the top face of the liner must stand ·002 to ·005 in. (·05 to ·13 mm.) proud and be parallel with the top face of the cylinder block. If, owing to damage, it is found necessary to grind the top face of the cylinder block, the liner flange recess in the top of the cylinder block must be recut to maintain the above dimension. The top face of the liner must not be machined. The dimensions of the recess are 3·531 to 3·536 in. (89·69 to 89·817 mm.) diameter by ·177±·001 in. (4·508±·025 mm.) deep with a radius at the bottom of its bore not exceeding ·010 in. (·254 mm.).

Thoroughly clean the inside of the bore and the outside of the liner. Stand the cylinder block upright on the bed of the press, insert the pilot guide in the top of the liner, and position the liner in the top of the bore. Make certain that the liner is square with the top of the block and that the ram of the press is over the centre of the pilot. Press the liner fully into the bore.

Each liner must be machined and honed to a finished diameter of 3·2495 to 3·2510 in. (82·537 to 82·575 mm.), but before honing, the top of the liner bore must be chamfered at an angle of 30° for a depth of $\frac{1}{16}$ in. (1·59 mm.).

Later engines

Later 2·2- and 2·52-litre (non-linered) engines can be fitted with service liners. Bore out the cylinder block to the following dimensions: 3·407 to 3·4075 in. (86·54 to 86·55 mm.) for the 2·2-litre engine or 3·642 to 3·6425 in. (92·555 to 92·5675 mm.) for the 2·52-litre engine. Press in the liners flush with the top face of the cylinder block and finish-bore the liners. The finished dimensions are 3·2495 to 3·251 in. (82·537 to 82·575 mm.) for 2·2-litre engines or 3·4995 to 3·501 in. (88·887 to 88·925 mm.) for 2·52-litre engines.

Section A.39

REMOVING AND REPLACING THE FLYWHEEL

(Engine with Synchromesh Gearbox)

Remove the gearbox (Section DD) and the clutch (Section DDD).

Crank the engine until the 1.4 zero mark on the degree plate of the crankshaft pulley coincides with the line scribed on the timing pointer secured to the engine below the pulley. The engine is now set with Nos. 1 and 4 pistons in the T.D.C. position and the 1/4 T.D.C. mark on the rear face of the flywheel will be at the top of the flywheel in a vertical position. This is to facilitate correct reassembly.

Unlock and remove the six bolts securing the flywheel and detach the flywheel from the crankshaft flange.

Replacement is a reversal of the foregoing procedure, tightening the flywheel bolts to the figure given under 'GENERAL DATA'.

Section A.40

REMOVING AND REPLACING THE FLYWHEEL HOUSING

(Engine with Synchromesh Gearbox)

Remove the gearbox (Section DD), the clutch (Section DDD), the flywheel (Section A.39), and the starter motor (Section L).

Unscrew and remove the 12 set screws and washers securing the flywheel housing to the crankcase.

Remove the flywheel housing, using a hide mallet to ease it off the two locating dowels.

Clean off all traces of the old gaskets from the crankcase and flywheel housing joint faces. Examine the joint face of the flywheel housing, especially in the area of the locating dowel holes, for burrs, which should be carefully removed with a scraper.

On 2·52-litre engines, examine the crankshaft oil seal in the housing and renew if necessary. Use tools 18G 134 and 18G 134 CQ to fit a new oil seal.

When reassembling, renew the two gaskets and fit the seal washers to the two screws which secure the flywheel housing to the rear main bearing cap.

Section A.41

REMOVING AND REPLACING THE FLYWHEEL STARTER RING

(Engine with Synchromesh Gearbox)

To remove the old starter ring from the flywheel drill holes through the flange of the gear and then split the gear, using a hammer and chisel, taking care not to damage the flywheel.

Make certain that the bore of the new ring and its mating surface on the flywheel are free from burrs and are perfectly clean.

To fit the new ring it must be heated to a temperature of 200 to 230° C. (392 to 446° F.). Do not exceed this temperature, otherwise the temper of the teeth will be adversely affected. The use of a thermostatically controlled furnace is recommended. Place the heated ring on the flywheel with the lead on the ring teeth uppermost.

The expansion will allow the ring to be fitted without force by pressing or tapping it lightly until the ring is hard against its register.

This operation should be followed by natural cooling, when the 'shrink fit' will be permanently established and no further treatment required.

Section A.42

REPLACING THE ENGINE FRONT PLATE

(Engine with 'In-line' Fuel Injection Pump)

When replacing the engine front plate accurate alignment of the fuel injection pump bore in the front plate with the bore for the chain wheel hub bearing in the timing chain case is essential, and the following assembly procedure, in which Hylomar SQ 32/M jointing compound is used to make the front plate to cylinder block joint, should be adopted.

Remove all traces of the old joint washer (early engines only) or jointing compound from the mating faces of the engine front plate and cylinder block, and ensure that the faces are clean and free from oil.

Secure the fuel injection pump to the engine front plate, and assemble the chain wheel and hub, and the roller bearing inner race to the injection pump, after first ensuring that the tapered end of the injection pump camshaft is free from burrs and bruises.

Refit the timing chain vibration damper and shim to the front plate.

Apply the unbroken ring of Hylomar SQ 32/M jointing compound to the cylinder block joint face only, following the contour of the displaced joint or jointing compound, and leave for 10 minutes. Fit the front plate assembly to the cylinder block, tightening the five securing screws finger tight only.

Offer up the timing chain case complete with roller bearing outer race but less the crankshaft oil seal to the front plate, and place alignment sleeve 18G 668 in position on the end of the crankshaft with its spigoted end engaging the oil seal bore in the timing chain case. Insert and tighten the four bolts and nuts in the positions shown in Fig. A.30 to secure the timing chain case, ensuring that the alignment sleeve is free to revolve on the crankshaft.

Tighten the two front plate lower securing bolts to hold the front plate in this position, and then remove the timing chain case and tighten the three remaining front plate securing bolts.

Refit the camshaft retaining plate, the chain wheel, and the timing chain (see Sections A.24 and A.27), and then install the timing chain case and the crankshaft pulley as described in Section A.23.

Check and adjust the fuel injection pump timing as described in Section C.

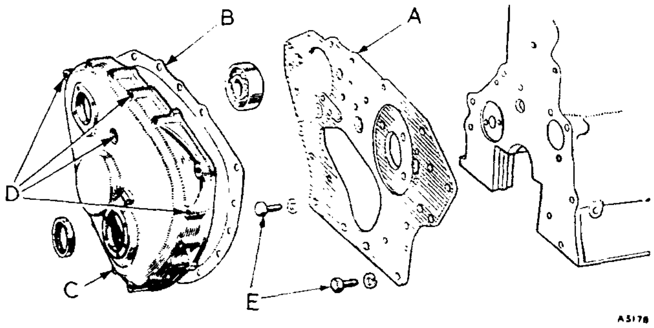


Fig. A.30

Engine front plate assembly details

A. Front plate
B. Chain case joint.
C. Timing chain case.
D. Positions for chain case locating bolts.
E. Front plate lower securing bolts.

Section A.43

REMOVING AND REPLACING THE TIMING CHAIN CASE
(Engine with Distributor-type Fuel Injection Pump)

Drain the cooling system and remove the radiator.

Unscrew and remove the four set screws and spring washers securing the fan blades to the water pump pulley

Slacken the dynamo attachment bolts and nuts, pivot the dynamo towards the engine, and remove the dynamo and fan driving belt.

Press back the starting-handle dog locking washer and, using spanner 18G 96, unscrew the starting-handle dog from the crankshaft and withdraw the crankshaft pulley

Unscrew and remove the securing bolts, nuts, set screws, and washers and withdraw the timing chain case from the engine. Remove the oil thrower from the end of the crankshaft.

Extract the oil seal from the outside of the timing chain case.

When reassembling, install a new oil seal in the timing chain case with the lip of the seal facing towards the engine. Lubricate the seal and the hub of the crankshaft pulley liberally with clean engine oil and install the crankshaft pulley in the timing chain case, rotating the pulley clockwise to enter the pulley into the oil seal.

Replace the oil thrower on the crankshaft with its concave side facing away from the engine and fit a new gasket to the timing chain case, using Hylomar SQ 32/M jointing compound on the joint face of the chain case.

Install the timing chain case and crankshaft pulley assembly, driving the pulley onto the crankshaft, using tool 18G 16.

Fit and tighten evenly the timing chain case securing bolts and nuts and set screws.

Discard the crankshaft pulley nut lock washer and reassemble the remaining components, reversing the removal sequence. Tighten the crankshaft pulley nut to the torque figure given in '**GENERAL DATA**'. Adjust the drive belt tension.

Section A.44

REMOVING AND REPLACING THE TIMING CHAIN
(Engine with Distributor-type Fuel Injection Pump)

Remove the heater plugs to relieve the compression when turning the crankshaft by hand.

Fully slacken all the valve rocker adjusting screws or, if necessary, remove the valve rocker shaft assembly as described in Section A.9 to ensure that throughout this operation the valves are always in the fully closed position. This is to prevent damage to the pistons and valves, which would otherwise foul each other when rotating either the crankshaft or camshaft with the timing chain removed.

Remove the fuel injection pump (Section Ca.7).

Remove the timing chain case as described in Section A.40.

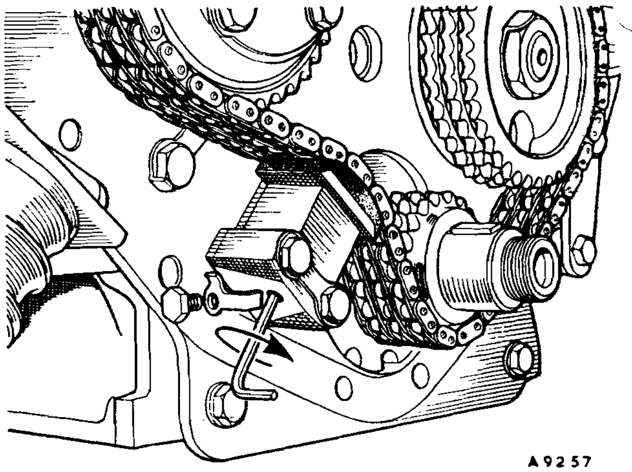


Fig. A.31
Setting the early type timing chain tensioner

Remove the fuel injection pump quill shaft.

With the early type tensioner, press back the locking tab and remove the plug from the base of the timing chain tensioner body. Insert a $\frac{1}{8}$ in. Allen key to engage the tensioner cylinder and turn the key in a clockwise direction to retract the tensioner slipper into the unloaded position.

With the later-type tensioner, detach the tensioner assembly as described in Section A.47.

Disconnect and remove the fuel injection pump chain wheel bearing oil feed pipe from the crankcase and the fuel injection pump chain wheel hub. Unscrew the countersunk screw securing the chain wheel hub to the engine front mounting plate; support the fuel injection pump chain wheel and withdraw the chain wheel hub rearwards from the mounting plate. The timing chain and the fuel injection pump chain wheel may now be withdrawn.

Replacement is a reversal of the foregoing procedure, noting the following points.

To facilitate retiming of the engine valves and the fuel injection pump one tooth on each chain wheel is marked with a 'dimple', the timing chain has three 'bright' links (two of which are marked with the letter 'T'), and the fuel injection pump chain wheel driving flange is provided with a master spline.

Before assembling the timing chain rotate the camshaft and the crankshaft chain wheels until the teeth marked with a 'dimple' are in the three o'clock and six o'clock positions respectively.

Place the timing chain and the fuel injection pump chain wheel in position, engaging the two 'bright' links marked with the letter 'T' with the teeth marked with a 'dimple' on the crankshaft and fuel injection pump chain wheels. The plain 'bright' link in the tinimg chain must engage the tooth marked with a 'dimple' on the camshaft chain wheel (see Fig. A.32).

Release the timing chain tensioner as described in Section A.45 or refit the later-type tensioner as described in Section A.47.

Check and adjust the fuel injection timing and replace the fuel injection pump as described in Section Ca.7.

Bleed the fuel system (Section Ca.5).

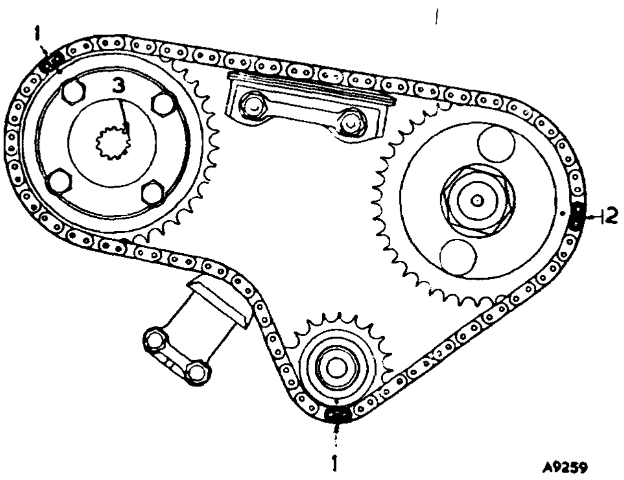


Fig. A.32

The camshaft and injection pump drive

1. Dimple marks and bright links stamped 'T'.
2. Dimple mark and plain bright link.
3. Master spline at two o'clock position.

Section A.45

REMOVING, DISMANTLING, AND REPLACING THE EARLY-TYPE TIMING CHAIN TENSIONER

Press back the locking washer and unscrew the plug from the base of the chain tensioner body. Insert a ⅛ in. (3·18 mm.) Allen key to engage the tensioner cylinder and turn the key in a clockwise direction to retract the tensioner slipper into the unloaded position (see Fig. A.31). Between a half and one full turn is all that is necessary. Unlock and remove the two set bolts and withdraw the tensioner assembly, tensioner back plate, and joint washer from the engine.

Withdraw the plunger and slipper assembly from the tensioner body and engage the lower end of the cylinder with the Allen key. Turn the key clockwise, holding the key and plunger securely until the cylinder and spring are released from inside the plunger.

Check the bore in the tensioner body for ovality. If ovality is greater than ·003 in. (·0762 mm.) when measured on diameters near the mouth of the bore, the complete chain tensioner should be renewed.

Inspect the slipper head for wear. If it is badly worn a new slipper head and cylinder assembly should be fitted to the existing body.

When the tensioner is in operation and the engine is running, oil from the lubrication system enters the spigot on the back face under pressure and lubricates the bearing surface through a hole in the slipper pad. The pad is held against the chain by the coil spring.

Should the chain stretch with use, the slipper plunger rises and the limiting peg, bearing on the top of the helical slot, rotates the cylinder until the next recess in the lower edge of the slot comes into line with the limiting peg and prevents the plunger returning to its original position and allowing the timing chain to become slack again.

When reassembling, insert the spring in the plunger and place the cylinder on the other end of the spring.

Compress the spring until the cylinder enters the plunger bore, engaging the helical slot with the peg in the plunger. Hold the assembly compressed in this position and engage the Allen key. Turn the cylinder clockwise until the end of the cylinder is below the peg and the spring is held compressed. Withdraw the key and insert the plunger assembly in the body. Replace the back plate and the joint washer and secure the assembly to the cylinder block.

Release the tensioner, by inserting and turning the Allen key in a clockwise direction, until the slipper head moves forward under spring pressure against the timing chain.

Do not attempt to turn the key anti-clockwise or force the slipper head into the chain by external pressure.

Secure the bolts with the locking plate, replace the bottom plug, and lock with the tab washer.

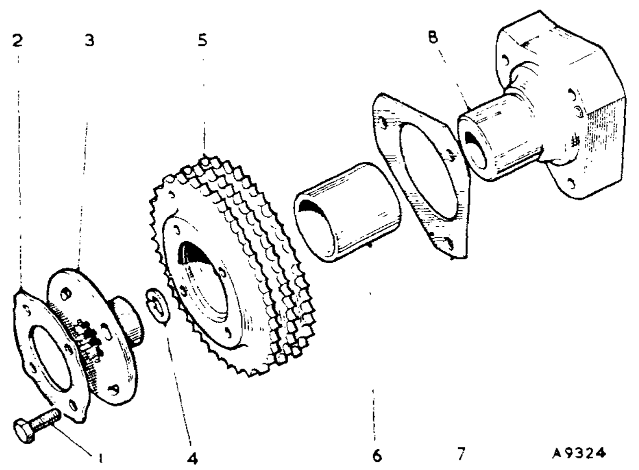


Fig. A.33

Distributor-type fuel injection pump drive components

1. Driving flange set screw.
2. Washer for flange.
3. Injection pump driving flange.
4. Circlip for flange.
5. Injection pump chain wheel.
6. Bearing liner.
7. Joint washer (hub to front plate).
8. Hub for chain wheel.

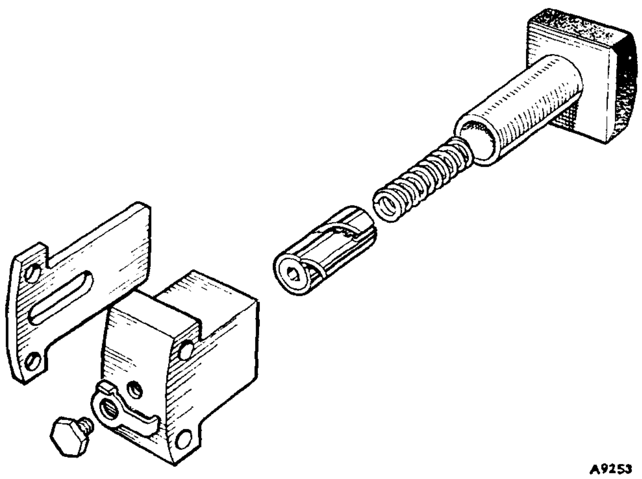


Fig. A.34

The chain tensioner components

Section A.46

VALVE SEAT INSERTS

(2·52-litre engines)

When valve seats are worn or damaged beyond repair, the cylinder head can be machined to accept valve seat inserts. Machine the head and fitted inserts to the dimensions given below.

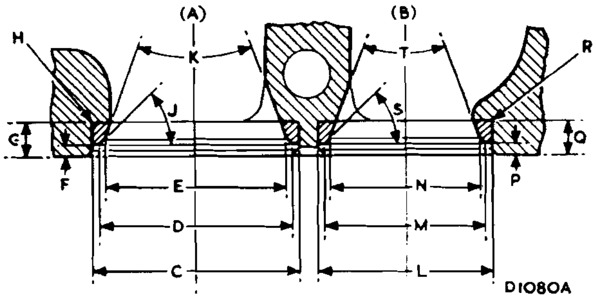


Fig. A.35

Machining dimensions for valve seat inserts

Inlet (A)		*Exhaust* (B)	
C.	1·6615 to 1·6625 in. (42·20 to 42·58 mm.).	L.	1·4215 to 1·4225 in. (36·11 to 36·13 mm.).
D.	1·540 to 1·545 in. (39·12 to 39·24 mm.).	M.	1·300 to 1·305 in. (33·02 to 33·15 mm.).
E.	1·46 in. (37·08 mm.).	N.	1·22 in. (30·99 mm.).
F.	·090 to ·095 in. (2·29 to 2·41 mm.).	P.	·090 to ·095 in. (2·29 to 2·41 mm.).
G.	·278 to ·281 in. (7·06 to 7·14 mm.).	Q.	·278 to ·281 in. (7·06 to 7·14 mm.).
H.	Max. radius ·015 in. (·38 mm.).	R.	Max. radius ·015 in. (·38 mm.).
J.	45°.	S.	45°.
K.	40°.	T.	40°.

Section A.47

TIMING CHAIN TENSIONER

(Later type)

Removing

Remove the timing cover.

Unlock and remove the tensioner securing screws.

Prise the tensioner assembly out of its register in the front engine plate. The slipper head is under spring tension and components could be lost if care is not taken.

Allow the spring loading against the slipper head to relax and withdraw the slipper head, spring and inner cylinder from the tensioner body.

Refitting

Refit the inner cylinder and spring into the cylinder of the slipper head so that the serrated helical slot in the inner cylinder engages with the peg in the slipper cylinder. Turn the inner cylinder clockwise against spring tension until the lower serration in the slot engages with the peg and retains the inner cylinder in the slipper cylinder with the spring compressed.

Refit the assembly in the tensioner body, and fit the tensioner to the engine.

Refit and lock up the securing screws.

Press the slipper head into the body against spring pressure, and release it smartly to disengage the inner cylinder and allow the spring to assert itself fully against the slipper head and timing chain.

Refit the timing cover.

Section A.48

VACUUM PUMP

Testing

(1) Disconnect the vacuum pump intake hose from the non-return valve on the servo unit.
(2) Connect a vacuum gauge to the vacuum pump intake hose.
(3) Run the pump at 1,000 rev/min and check that there is a minimum gauge reading of 550 mmHg (22 in Hg).
(4) If the gauge reading is below this figure the pump must be renewed.

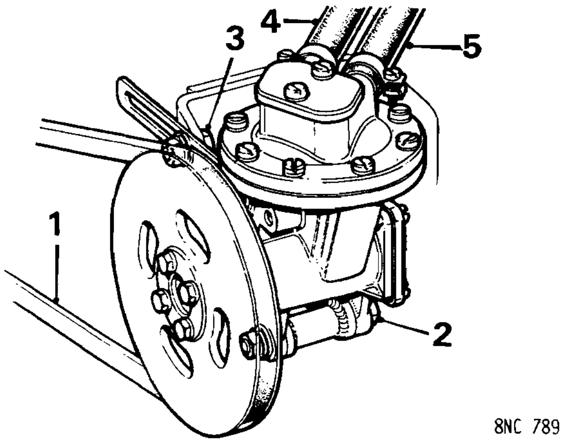


Fig. A.36

Vacuum pump

1. Drive belt.
2. Pivot bolt.
3. Adjusting link screw.
4. Outlet hose.
5. Inlet hose.

Removing

(1) Slacken the pump drive belt adjusting screw and the pump pivot bolt.
(2) Push the pump towards the engine and remove the drive belt.
(3) Slacken the clips and disconnect the inlet and outlet hoses from the pump.
(4) Remove the adjusting link screw and nut, with spring and plain washers.
(5) Remove the pump pivot bolt and nut, with spring and plain washers.
(6) Withdraw the pump from its mounting bracket.
(7) Remove the four screws with spring washers and detach the pulley from the pump.

(8) Remove the screw, with spring washer and spacer, securing the adjusting link to the pump body.

Refitting

(9) Reverse the procedure in (1) to (8), noting the following:

(*a*) A new pump must be primed before being run. Align the arrow on the flange with the rib on the pump body, remove the filler level plug on the rear face of the pump and inject 40 cm^3 of 10W/30 oil. Refit the plug after allowing any surplus oil to run out.

(*b*) Adjust the drive belt tension so that it is possible to depress the belt 6 to 13 mm (¼ to ½ in), at the midway point between the pulleys.

SERVICE TOOLS

18G 25*. Valve Seat Finishing Cutter (Exhaust)

18G 25 A*. Valve Seat Glaze Breaker (Exhaust)

18G 25 B*. Valve Seat Narrowing Cutter—Top (Exhaust)

18G 25 C*. Valve Seat Narrowing Cutter—Bottom (Exhaust)

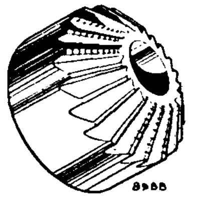
18G 28*. Valve Seat Finishing Cutter (Inlet)

18G 28 A*. Valve Seat Glaze Breaker (Inlet)

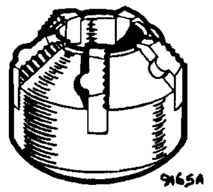
18G 28 B*. Valve Seat Narrowing Cutter—Top (Inlet)

18G 28 C*. Valve Seat Narrowing Cutter—Bottom (Inlet)

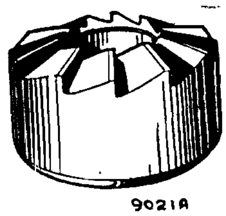
18G 27 B*. Fibre Box—Valve Seat Cutters



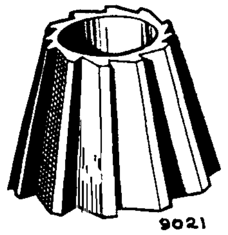
18G 25, 18G 28



18G 25 A, 18G 28 A

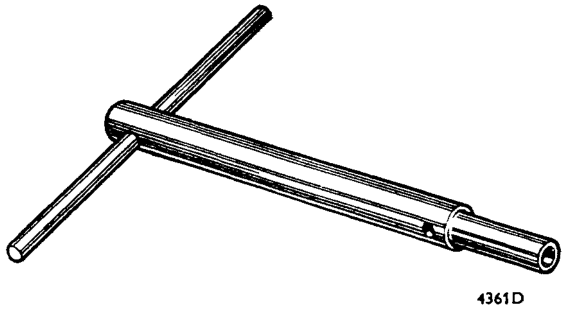


18G 25 B, 18G 28 B



18G 25 C, 18G 28 C

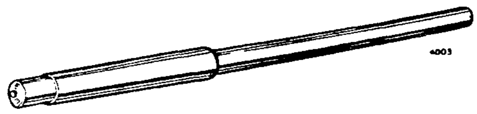
18G 27*. Valve Seat Cutter Handle



18G 27

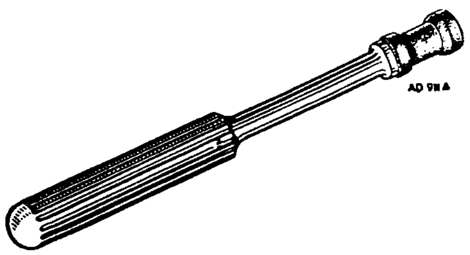
18G 174 D*. Valve Seat Cutter Pilot

The use of these tools will save lengthy and wasteful grinding in when the valve seats are badly pitted. The glaze breakers should be used to prepare worn seats, which usually have a glass-hard surface, before using the finishing cutters. Overwide seats may be returned to their original dimensions by careful use of the narrowing cutters.


18G 174 D

18G 29. Valve Grinding-in Tool

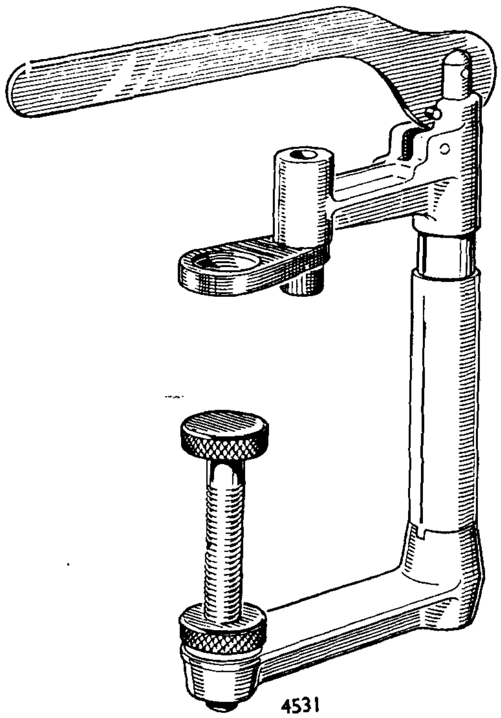
This suction-type tool has a handle of convenient length to enable it to be rotated backwards and forwards between the palms of the hands when grinding the valve faces and seats.



* No longer available, see page A.38.

18G 45. Valve Spring Compressor

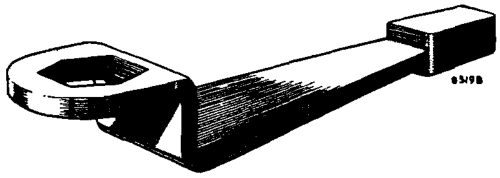
This tool is designed with a cam and lever action which is both positive and speedy. The adaptor ring which contacts the valve spring caps is specially shaped to facilitate the removal and replacement of the split collets. A screw adjustment is also provided.



18G 45

18G 96. Starting Nut Spanner

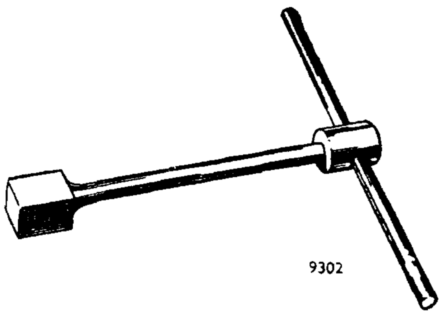
The robust construction of this special 'shock-type' spanner is conducive to long life. The design enables a jaw nut to be removed or replaced without the need for locking the crankshaft by improvised means, which may cause damage to components.



18G 96

18G 241. Timing Chain Tensioner Positioning Tool

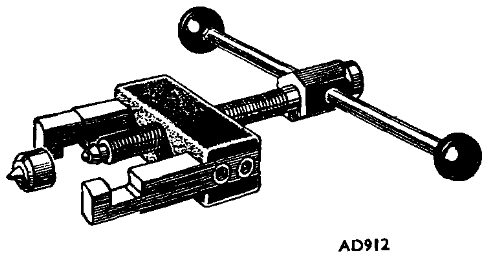
This tool holds the tensioner wheel in such a position that the maximum amount of slackness in the chain is available, at the same time leaving the operator with both hands free.



18G 241

18G 58. Camshaft Gear Remover

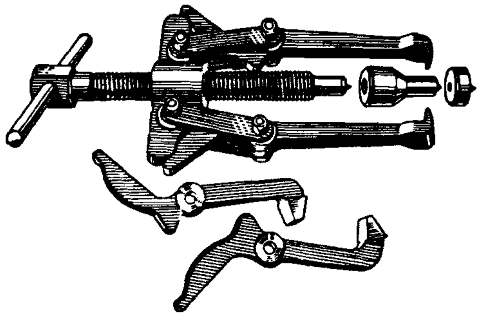
This tool will remove the chain wheel quickly and without damage. The centre drive screw incorporates a hardened-steel ball to reduce friction; a separate thrust pad is provided for insertion between the camshaft and ball when extra travel is required.



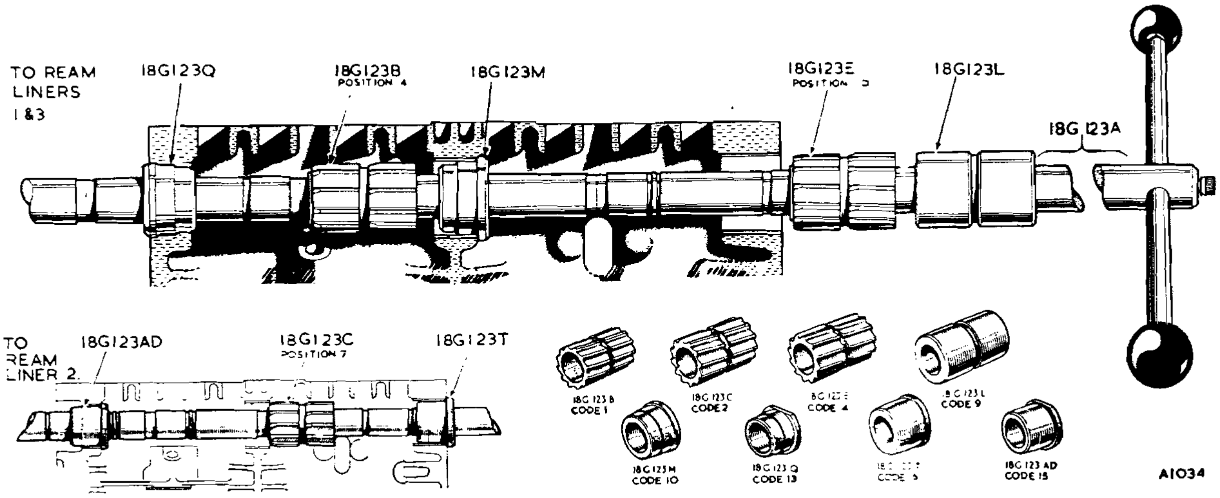
18G 58

18G 2. Crankshaft Gear, Pulley, and Propeller Shaft Flange Remover

A multipurpose tool with alternative legs readily interchangeable, one pair with thin, flat ends designed for removing the chain wheel and the other pair having tapered ends to engage the pulley grooves.



18G 2



18G 123 A

18G 123 A. Camshaft Liner Reamer (basic tool)

This tool is essential when reconditioning cylinder blocks, otherwise camshaft liners cannot be reamed in true and in consequence the clearance between the camshaft journal and the liner will be incorrect.

The cutters and pilots for use with this basic tool supplied separately.

18G 123 E. Camshaft Liner Reamer Cutter—Front

18G 123 B. Camshaft Liner Reamer Cutter—Rear

18G 123 L. Camshaft Liner Reamer Pilot—Front

18G 123 M. Camshaft Liner Reamer Pilot—Centre

18G 123 Q. Camshaft Liner Reamer Pilot—Rear

18G 123 C. Camshaft Liner Reamer Cutter—Centre

18G 123 T. Camshaft Liner Reamer Pilot—Front

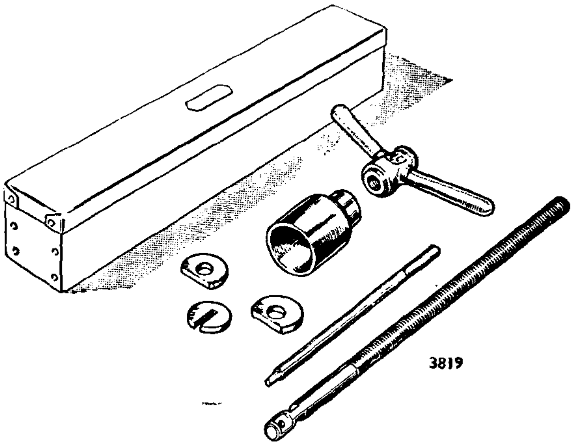
18G 123 AD. Camshaft Liner Reamer Pilot—Rear

18G 123 AL. Fibre Box—Camshaft Liner Reamer

These cutters and pilots are required for use with basic tool 18G 123 A to line-ream the front, centre, and rear camshaft liners.

18G 124 A. Camshaft Liner Remover and Replacer (basic tool)

Camshaft liners can be removed and replaced accurately and without the damage invariably associated with the use of improvised drifts. Adaptors for use with this basic tool are supplied separately.



18G 124 A

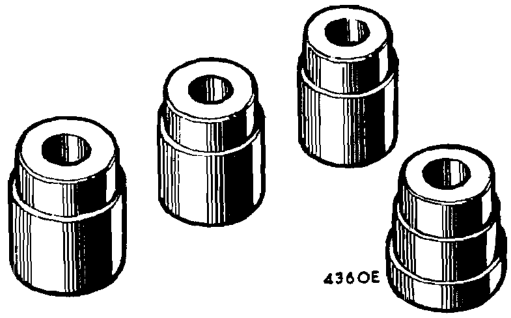
18G 124 F. Camshaft Liner Remover Adaptor—Front

8G 124 D. Camshaft Liner Remover Adaptor—Centre

18G 124 B. Camshaft Liner Remover Adaptor—Rear

18G 124 H. Camshaft Liner Remover Adaptor

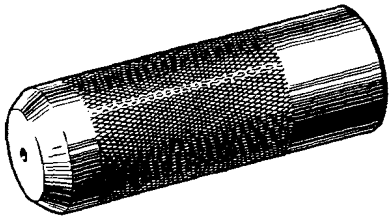
The adaptors 18G 124 F, 18G 124 D, and 18G 124 B are used in conjunction with the basic tool 18G 124 A to remove old and worn liners and to pilot new liners into position. Adaptor 18G 124 H is a pilot to be inserted into the front bearing when the centre liner is being removed or replaced.



18G 124 F, 18G 124 D, 18G 124 B, 18G 124 H

18G 16. Crankshaft Gear and Pulley Replacer

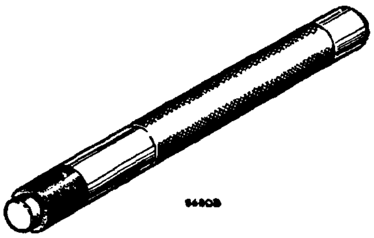
This tool is designed for driving on the crankshaft chain wheel and pulley.



18G 16

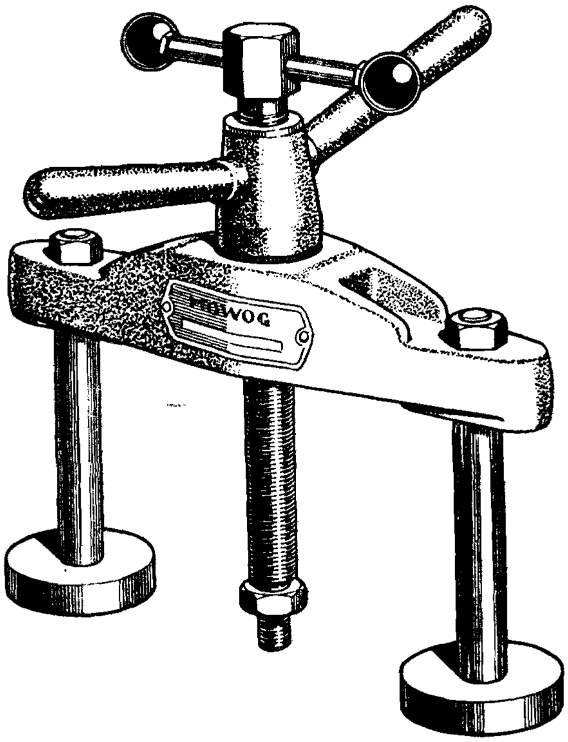
18G 69. Oil Pump Release Valve Grinding-in Tool

This tool is designed for the removal and grinding in of oil release valves. It consists of a knurled handle, knurled set screw, and rubber sleeve. Tightening the set screw expands the rubber plunger, which ensures that the tool is a tight fit when inserted into the hollow oil release valve.



18G 69

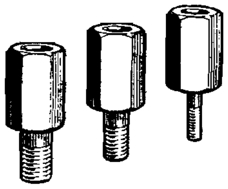
18G 42 A. Main Bearing Cap Remover (basic tool)



5291
18G 42 A

18G 42 B. Main Bearing Cap Remover Adaptors

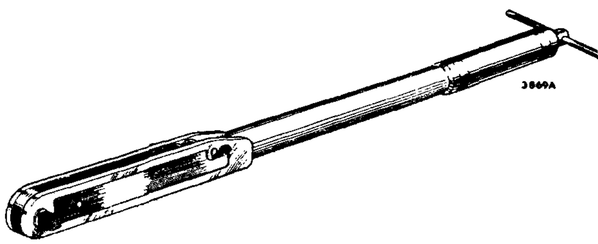
The frame has feet suitably spaced to locate on the crankcase flanges. The appropriate adaptor is screwed first onto the drive screw and then into the main bearing cap.



4470C
18G 42 B

18G 372. Torque Wrench (30 to 140 lb. ft.)

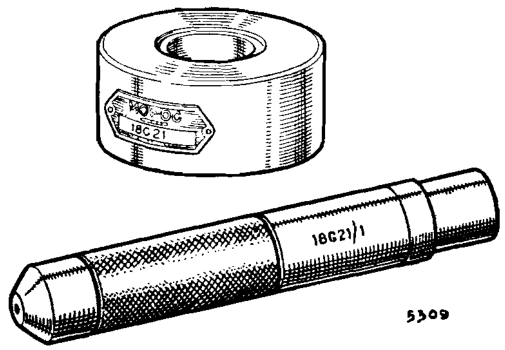
A universal torque wrench for use with standard sockets. This type of tool is essential if the recommended maximum torque for cylinder head studs, etc., is not to be exceeded.



18G 372

18G 21. Valve Rocker Bush Remover and Replacer

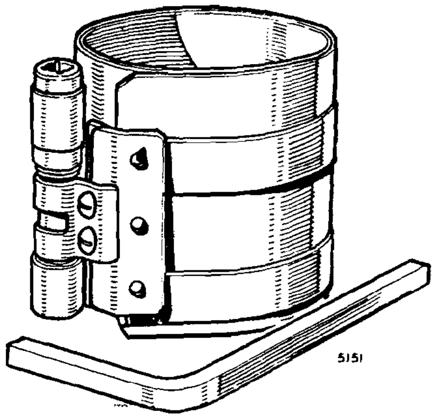
This tool, which consists of a driver and an anvil, makes the removal and replacement of rocker bushes a simple and safe operation.



5309
18G 21

18G 55 A. Piston Ring Compressor

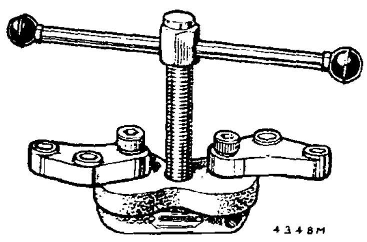
A clamping device to retain the piston rings and enable the piston to enter the cylinder bore with a minimum of pressure.



18G 55 A

18G 231. Gear and Pulley Remover (basic tool)

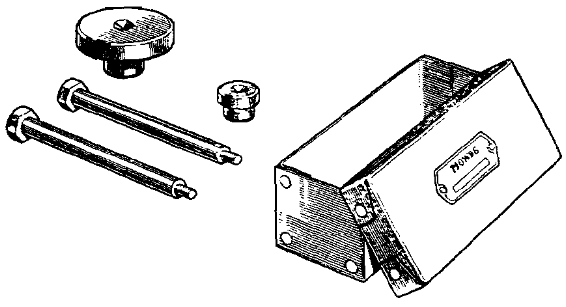
A basic tool which, when used with a variety of adaptors, covers a wide range of operations.



18G 231

18G 231 H. Timing Cover Remover Adaptors

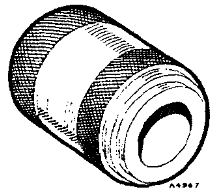
Used with basic tool 18G 231 to press out the fuel injection pump chain wheel bearing outer race from the timing case.



18G 231 H

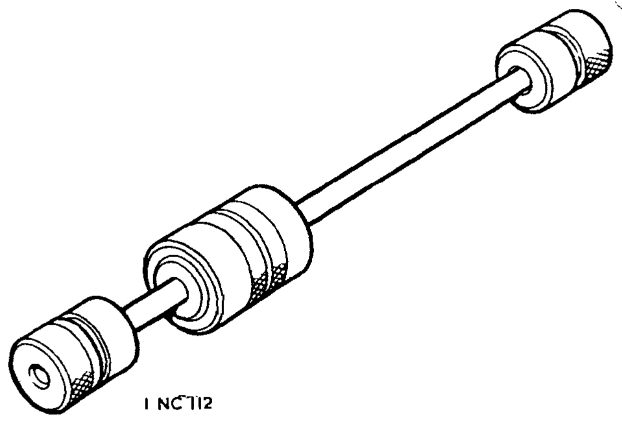
18G 668. Front Cover Alignment Sleeve

Facilitates alignment of the injection pump drive with the injection pump camshaft when reassembling the engine front plate and timing chain case. Its full use is described in Sections A.23 and A.42.



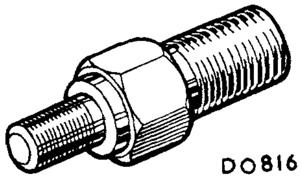
18G 668

18G 284. Impulse Extractor (basic tool)



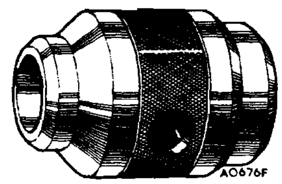
18G 284

18G 284 AJ. Main Bearing Cap Remover Adaptor



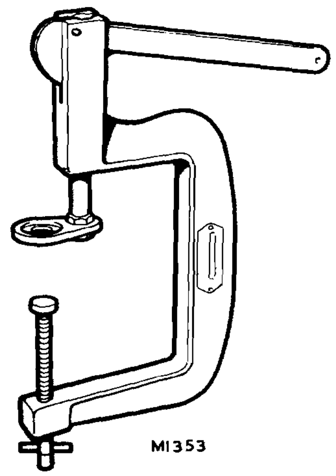
18G 284 AJ

18G 3. Engine Front Cover Locating Bush



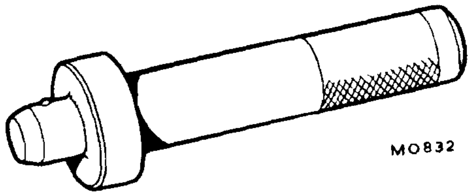
18G 3

18G 106. Valve Spring Compressor



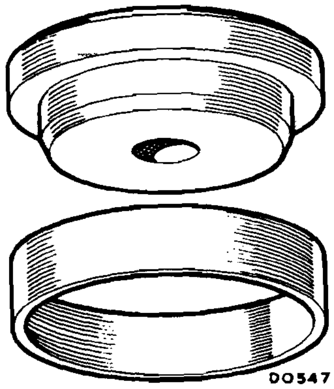
18G 106

18G 134. Bearing and Oil Seal Replacer (basic tool)



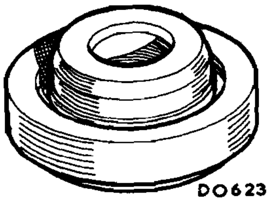
18G 134

18G 134 CQ. Oil Seal Replacer Adaptor



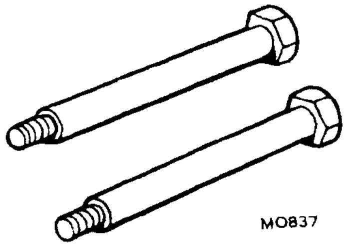
18G 134 CQ

18G 134 CR. Oil Seal Replacer Adaptor



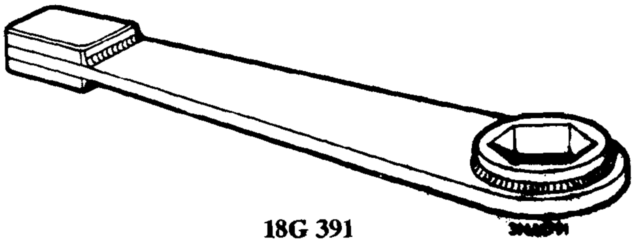
18G 134 CR

18G 231 B. Crankshaft Pulley Remover Adaptor



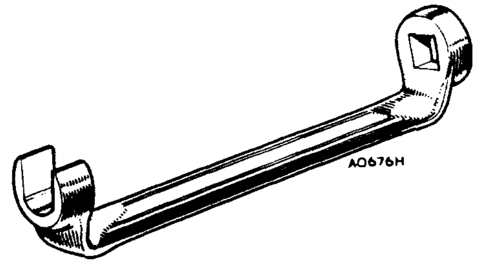
18G 231 B

18G 391. Starting Nut Spanner



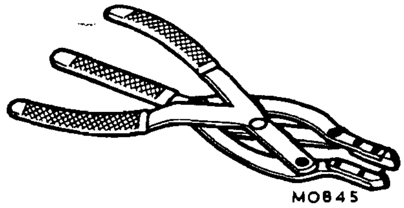
18G 391

18G 545. Cylinder Head Nut Spanner



18G 545

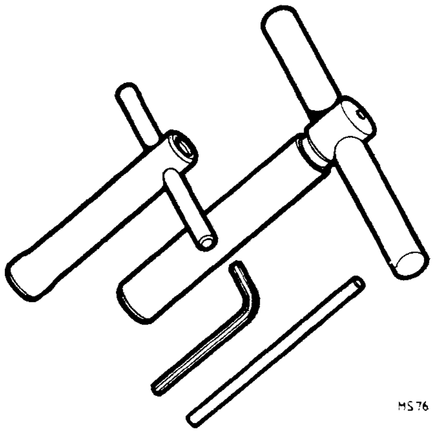
18G 1004. Circlip Pliers



18G 1004

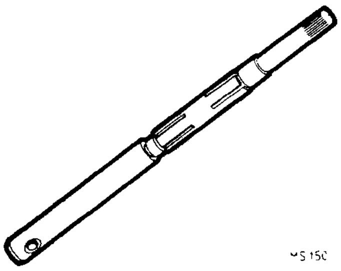
MS 76. Basic Handle Set

100-8 Tee wrench (use with MS 113 R and MS 120-7).
503 Tee wrench (use with all remaining cutters).
245 Puller pin.
240 Hexagon key wrench $\frac{1}{64}$ in.



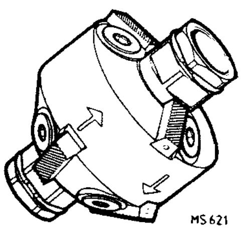
MS 76

MS 150-8·5. Expandable Pilot



MS 150

MS 621. Adjustable Cutter



MS 621

SECTION Aa

THE PETROL ENGINE

Section Aa.1

DESCRIPTION

The four-cylinder internal-combustion engine used in this vehicle is supported on the frame at four points: by two brackets on the engine front plate and bolted to the front cross-member and by a bracket on the gearbox extension and bolted to the cross-member which passes under the gearbox. The engine mountings are insulated at the front and rear to cushion vibrations.

The cylinder block and crankcase are cast in one piece for rigidity. The cylinders are water-jacketed the full length of the bore to provide efficient cooling.

The cylinder head, which carries the valves and rocker gear, is secured to the cylinder block by 11 studs and nuts and is completely water-jacketed.

The water pump is located on the front of the cylinder block by three studs and is driven by a 'V' belt from the crankshaft.

The camshaft is located in the crankcase and is driven by a duplex roller chain from the crankshaft. A synthetic rubber ring is fitted to the camshaft chain wheel, which ensures quiet running.

The crankshaft is supported by three main bearings, which are renewable.

Downdraught carburation with hot-spot vaporizer induction is used, feeding all four cylinders through a single manifold which is secured with the exhaust manifold to the left-hand side of the cylinder head.

Crankcase ventilation is provided by a pipe secured to the tappet cover on the left-hand side of the crankcase. A second pipe connects from the valve gear cover to the air cleaner.

The oil supply is contained in a pressed-steel sump, and a submerged rotor-type pump, driven from the camshaft by an inclined shaft, draws oil from the sump through a strainer and delivers it through a renewable-element-type pressure filter on the right-hand side of the engine. From the filter oil is forced through drilled passages to the camshaft and crankshaft bearings, the timing chain, and the overhead-valve rocker shaft. Any excess oil is by-passed back to the sump through a release valve situated behind the external oil filter in the crankcase.

Section Aa.2

ADJUSTMENTS IN THE VEHICLE

The purpose of the following adjustments is to maintain the performance of the engine at its maximum and consists of a series of cleaning, inspecting, and adjusting operations. The operations listed below are essential items of maintenance which may have to be accomplished during normal service with the engine in the vehicle.

Test the compression of each cylinder. If a compression gauge is not available a simple method is to remove three sparking plugs, leaving the remaining plug in the cylinder being tested. A general indication of the compression will be obtained when the engine is cranked by hand through at least two revolutions.

Clean the engine generally and lubricate at the recommended points.

Adjust the fan belt tension.

Remove the valve gear cover and check the cylinder head nuts to the recommended torque settings.

Check and adjust the valve to rocker clearances.

Make a visual inspection for evidence of cracked valve springs or scored valve stems.

Remove and clean the sparking plugs. Examine the insulation for damage. Ensure that the correct type of plug is being used. Adjust the points gap.

Test the plugs and renew any found to be unfit for service, using new gaskets. Check the high-tension cables for fractures and deterioration before refitting.

Remove the distributor head cover, clean it, and examine it for cracks and burned contacts. Inspect the contact points to determine whether new points are needed or cleaning and adjusting are necessary. Ensure that the carbon brush contacts the rotor arm and that the capacitor terminals are clean and securely tightened. Check the ignition timing.

Drain, clean, and refill the air cleaner.

Ensure that the fuel system is operating efficiently and clean all filters in the system. Check the carburetter manifold flange gasket for evidence of leakage, and adjust the carburetter if necessary.

Section Aa.3

REMOVING AND REPLACING THE POWER UNIT

Detach the bonnet from the bonnet hinges after removing the screws from the bonnet prop.

Disconnect the battery.

Disconnect the cables from the fog lamp (if fitted), the dynamo, starter, distributor and thermal transmitter.

Detach the cable harness from the radiator and supports.

Release the radiator blind cable from its chain, remove the two screws and springs supporting the blind, and withdraw the blind from the radiator.

Remove the air cleaner and intake trunking.

Drain the radiator and cylinder block.

Detach the water hoses from the engine, including the heater hose.

Remove the radiator complete with front frame.

Disconnect the heater pipes from the engine.

Disconnect the oil pressure pipe at its union with the flexible pipe.

Remove the gear change lever from the synchromesh gearbox.

Disconnect the carburetter choke control cable from the engine.

Remove the bonnet prop bracket.

Disconnect the throttle linkage.

Disconnect the propeller shaft from the gearbox.

Disconnect the speedometer drive (and taxi-meter drive) from the gearbox.

Remove the clutch slave cylinder from the gearbox.

Disconnect the exhaust pipe support clip from the gearbox and remove the three nuts from the manifold flange studs.

Fit engine lifting brackets to the rocker cover retaining studs, and, using a sling on the engine, take the weight by means of a lifting crane.

Remove the rear mounting bracket from the frame and gearbox.

Remove the rear support bracket bolts to release the rear end.

Disconnect the fuel pipe from the lift pump.

Disconnect the bonding cable from the engine front mounting.

Detach the bonnet prop and bracket from the valance and chassis.

Remove the bolts securing the front mounting brackets to the frame.

The power unit, which weighs approximately 625 lb. (329 kg.), may now be drawn out forwards as shown in Fig. A.1.

Replacement is a reversal of the above instructions, ensuring that the correct grades of oil are used for refilling and that the cooling system is replenished.

Section Aa.4

LUBRICATION SYSTEM

The rotor-type oil pump supplies lubricant under pressure to the engine oiling system. The pump is located in the crankcase so that the suction end, to which is attached a strainer, is submerged in oil in the sump.

Oil is pumped through the delivery pipe and a drilled passage to a renewable-element-type pressure filter situated on the right-hand side of the engine.

From the outlet side of the external filter oil is fed through drilled passages to the various bearings, the camshaft gear, and the overhead valve gear.

The cylinder bores are lubricated by means of a small jet hole in the top half of each connecting rod big-end.

Discharged oil from the rear main bearing drains back into the sump through a pipe attached to the bearing cap.

Discharged oil from the valve rocker chamber drains back to the sump via the push-rod holes.

Any excess pressure of oil is by-passed back to the sump through a release valve located between the pump and the external filter, being accessible from the exterior of the crankcase.

Section Aa.5

REMOVING AND REPLACING THE SUMP

First drain off the oil into a suitable container, then extract the set screws and washers, thus enabling the sump to be removed.

Detach the bottom of the strainer by removing the nut, washer, and distance piece. Take out the two set pins holding the strainer to the pump, so allowing the body of the gauze strainer to be removed. The pump and strainer can be swilled out with petrol or paraffin and thoroughly dried with a non-fluffy rag.

Inspect the two joint washers and renew if they are damaged in any way.

Reassembly is a reversal of the above procedure. Care, however, should be exercised with the strainer to ensure that the distance piece is correctly positioned and that the lip on the cover registers with the slot in the body side.

Section Aa.6

EXTERNAL OIL FILTER

An external full-flow filter is located on the right-hand side of the crankcase, between the oil pump and the main gallery.

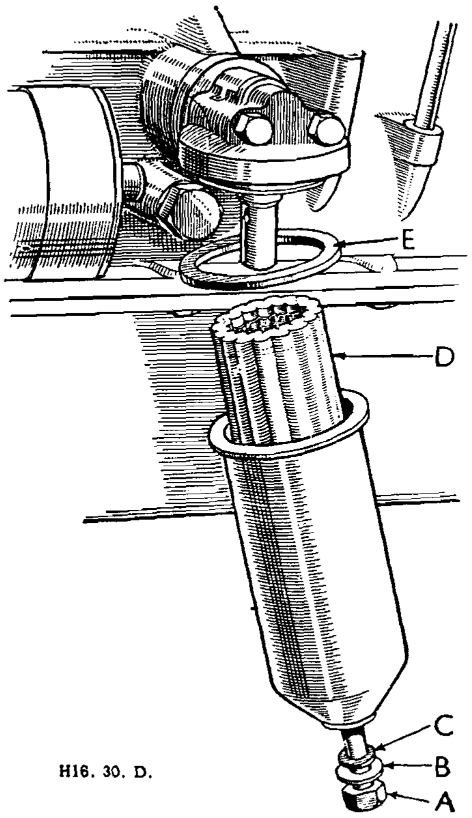


Fig. Aa.1

The oil filter (exploded)

A. Centre-bolt.
B. Washer.
C. Oil seal.
D. Element.
E. Joint ring.

Oil is passed to the filter from the oil pump at a pressure controlled at 50 to 55 lb./sq. in. (3·5 to 3·8 kg./cm.^{2}) by the oil release valve. Some pressure is lost in passing through the filter element; this will amount to very little with a new element, but will increase as the element becomes progressively contaminated by foreign matter removed from the oil.

Should the filter become completely choked, due to neglect, a balance valve is provided to ensure that oil will still reach the bearings. This valve, set to open at a pressure difference of 15 to 20 lb./sq. in. (1·0 to 1·4 kg./cm.^{2}), is non-adjustable and is located in the filter head casting. When the valve is opened unfiltered oil can by-pass the filter and so reach the bearings.

Therefore, to ensure that only filtered oil is delivered to the bearings it is necessary to renew the filter element at the recommended intervals as follows:

(1) Unscrew the centre-fixing bolt, and the container, complete with the element, can be removed.

(2) Withdraw the contaminated element and carefully cleanse the container of all foreign matter.

(3) Check the condition of the filter bowl sealing washer and renew if at all doubtful.

(4) After ensuring that no fibres from the cleansing operation have been left in the container put in a new element. Hold the centre-bolt in place and top up the case with oil before offering up the filter to its head. Tighten the centre-fixing bolt sufficiently to make an oiltight joint.

(5) Run the engine until the oil is thoroughly warm and check the filter for leaks.

It is recommended that the oil filter container should not be disturbed other than for the fitting of a new element; to do so invites the hazard of added contamination from dirt on the outside of the unit.

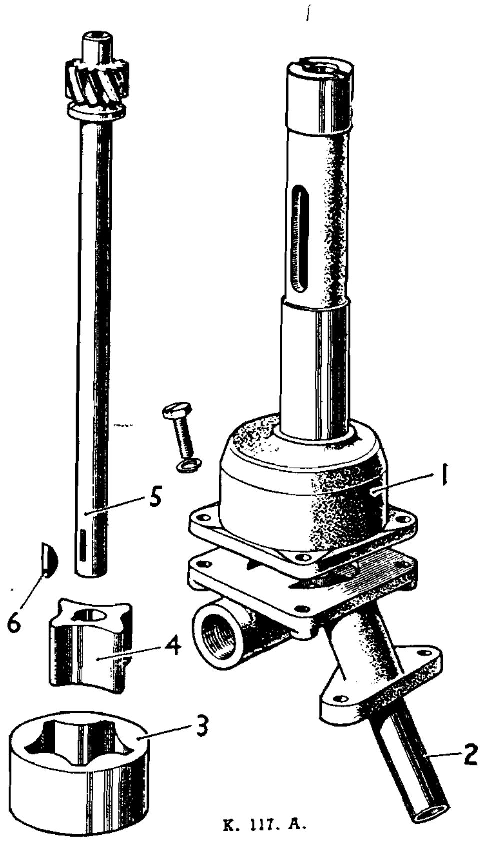


Fig. Aa.3

The oil pump

1. Pump body.
2. Intake pipe.
3. Outer rotor.
4. Inner rotor.
5. Drive shaft.
6. Woodruff key.

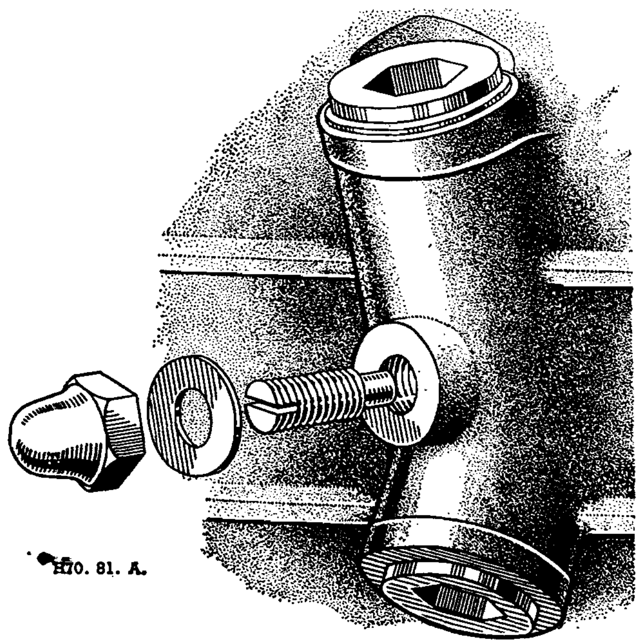


Fig. Aa.2

The oil pump locating screw

Section Aa.7

REMOVING AND REPLACING THE OIL PUMP

Drain and remove the sump and oil strainer.

Disconnect the oil feed pipe from the pump body to the crankcase.

From the left-hand side of the crankcase remove the oil pump cap nut, washer, and locating screw.

Withdraw the oil pump assembly downwards and out of the crankcase.

Replacement is a reversal of the above procedure, ensuring that the pump shaft is right home and the driving gear is meshed with the gear on the camshaft and that the locating screw is tight and properly engaged with the recess in the pump body.

Section Aa.8

DISMANTLING AND REASSEMBLING THE OIL PUMP

Remove the oil pump as previously described and proceed then as follows.

First, mark the flange and pump body to assist reassembly. Separate the body from the bottom flange.

he outer rotor can be lifted out of the body and the inner rotor pulled from the shaft. Take care not to lose the key from the shaft.

The outer rotor has one of its edges chamfered. It is of great importance that this chamfered edge should face away from the bottom cover. Failure to assemble in this way will result in the pump seizing up when the cover is tightened down. Insert the shaft through the hole in the base of the rotor body and place the inner rotor in position on the shaft. Ensure that the key is in position between the shaft and the inner rotor. Insert the outer rotor into the body over the inner rotor. Place the cover into position, tighten the set screws, and rotate the pump shaft to ensure that the pump revolves freely. Ensure that the markings on the flange and pump body register together.

Section Aa.9

OIL PRESSURE RELEASE VALVE

Excess pressure of oil is by-passed to the sump, the pressure being determined by a spring which is held in position by a plug and accessible from the outside of the crankcase. To remove proceed as follows:

(1) Remove the external oil filter body assembly.

(2) Remove the hexagon-headed plug, and the copper washer located immediately below the filter head.

(3) Remove the valve spring and withdraw the plunger, using tool 18G69.

Check that the plunger and seat are clean and undamaged and that the passages in the crankcase are clear. Tool 18G69 may be used to remove any burrs from the valve seating in the block.

heck the tension of the valve spring (see under 'GENERAL DATA'), and renew if necessary. Clean the hexagon-headed plug externally and internally.

Insert the plunger, conical end first, into the housing, followed by the spring.

Screw the hexagon-headed plug, with a new copper washer, fully home to ensure an oiltight joint. Install the external oil filter body assembly.

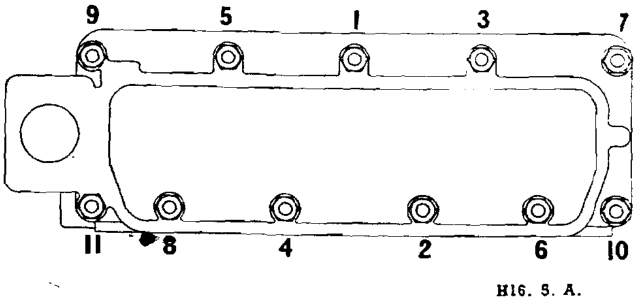


Fig. Aa.4
Cylinder head tightening sequences

Section Aa.10

REMOVING AND REPLACING THE INLET AND EXHAUST MANIFOLDS

The manifolds are held in position on the left-hand side of the engine by six nuts, four of which bear on steel clamps, the remaining two on studs which pass through the flange at each end of the exhaust manifold. There are four bolts which secure the inlet manifold to the exhaust manifold at the hot-spot joint.

The inlet and exhaust manifolds can be removed either as one unit or separately. First disconnect the air cleaner from the carburetter and the fuel pipe from the fuel pump and carburetter, then release the carburetter throttle and choke control, and the vacuum pipe to the distributor.

Detach the nut securing the drip tray drain tube to the crankcase. Detach the oil separator from the tappet cover and withdraw the separator upwards.

Disconnect the heater hoses from the heater tap on the cylinder head.

Remove the exhaust down pipe by unscrewing the three nuts at the flange. The manifold securing nuts should now be removed, when the manifold may be detached complete with the carburetter. Unscrew the four hot-spot bolts to separate the inlet from the exhaust manifold.

When refitting the manifolds see that the joint washers are in good condition, and tighten the securing nuts evenly to ensure good joints.

It is important that the four bolts which secure the inlet manifold to the exhaust manifold hot-spot are not tightened down until after all the manifold securing nuts have been tightened. Failure to observe this precaution may result in damage to the manifold securing flanges.

Section Aa.11

REMOVING AND REPLACING THE CYLINDER HEAD

Remove the bonnet as previously described.

Drain the cooling system.

Disconnect the air cleaner hose from the carburetter and the breather pipe from the valve rocker cover and then remove the rocker cover.

Disconnect the throttle linkage at the cross-shaft and the fuel pipe and the distributor vacuum control pipe from the carburetter.

Release the top water hose from the radiator and the by-pass pipe from the water pump.

Disconnect the high-tension cables from the sparking plugs and the wire to the thermal transmitter.

Remove the valve rocker shaft after first releasing the rocker adjusting screws and the rocker shaft oil feed pipe at the cylinder head. Withdraw the push-rods, taking care that the tappets are not lifted out of their guides by suction.

Remove the inlet and exhaust manifolds complete with the carburetter.

Working in the order shown in Fig. Aa.4, first slacken each cylinder head nut a quarter of a turn only, and subsequently unscrew each nut a further amount in the same order until loose.

Crank the engine by hand, when the compression in the cylinder head will probably be sufficient to break the joint and allow the head to be lifted off. On no account should a screwdriver or any similar tool be used as a wedge between the cylinder head and the block.

Remove the cylinder head joint washer.

Replacing the cylinder head assembly is a reversal of the removal procedure. For tightening the cylinder head stud nuts torque spanner 18G372 set to 65 lb. ft. (9 kg. m.) should be used whenever possible. The nuts should be tightened in the order shown in Fig. Aa.4. If there is any doubt about the condition of the cylinder head joint washer fit a new one with the side marked 'TOP' uppermost, after carefully and evenly smearing both sides of it with grease to make a good joint and prevent sticking when the head is again lifted.

Check the valve clearance after running the engine as the valves have a tendency to bed down. At the same time it is advisable to test the cylinder head nuts for tightness. Tightening the cylinder head nuts may affect valve clearances, although not usually enough to justify resetting.

Section Aa.12

REMOVING AND REPLACING THE ROCKER SHAFT

The valve rocker shaft on the cylinder head is hollow. It is supplied with oil by a pipe connection, and is drilled for lubrication to each rocker bearing.

This shaft is plugged at each end, one of these being screwed in order that the shaft may be cleaned internally.

Remove the air cleaner and rocker gear cover.

Slacken the rocker adjusting screws and release the oil feed pipe from the cylinder head.

Release the rocker bracket nuts and lift off the rocker gear.

Remove the split pin from the end of the shaft and, after carefully noting their relative positions, withdraw the washers, rockers, brackets, and springs. Replacement is a reversal of these operations.

Section Aa.13

REMOVING AND REPLACING THE PUSH-RODS

Take off the valve rocker cover and slacken the valve adjustment screw to its full extent. With the aid of a screwdriver, supported under the rocker shaft, depress the valve and slide the rocker sideways free of the push-rod. Withdraw the push-rod, taking care that the tappet is not lifted out of its guide.

In the case of the rocker at each end it is necessary to take out the split pins from the ends of the shaft.

The above sequence should be reversed when replacing push-rods and rockers.

Section Aa.14

REMOVING AND REPLACING THE TAPPETS

If the engine is in position, support the bonnet and remove the bonnet stay and platform. Detach the left-hand engine mounting from the chassis and engine and remove the mounting assembly. Release the breather hose from the crankcase emission control valve on the manifold, and detach the oil separator from the tappet cover.

Remove the rocker cover, slacken back the rocker adjustment screws, and withdraw the push-rods.

Remove the vent pipe and washer by undoing the two set screws securing it to the side cover.

Loosen the 15 set screws holding the cover and remove these with the cover and joint washer.

Withdraw the tappets upwards with finger and thumb.

When replacing the tappets reverse this procedure, ensuring that oiltight joints are made between the cylinder side cover and the block and at the vent pipe flange. If either joint washer is at all damaged it must be renewed.

Section Aa.15

REMOVING AND REPLACING THE ROCKER BUSHES

While the rocker gear is detached from the head check for play between the rocker shaft and the rocker arm bushes. If this is excessive new bushes should be fitted. To do this take out the split pin at the end of the shaft, when the plain and spring washers, rocker arms, and rocker shaft brackets may be removed.

The white-metal bush is best removed by using tool 18G21. The anvil is recessed to retain the rocker in position while the bush is gently knocked out by the drift.

The flange of the drift is also recessed to prevent the new split bush from opening when being driven into position. These new bushes are not supplied to a finished size: the internal diameter must be reamed to suit the shaft. Ream the bushes in position (split at the top) ·8115 to ·8125 in. (20·61 to 20·64 mm.). File and drill out the rivet in the rocker arm oilway. Drill oilways through the bush—top of rocker ·0785 in. (1·99 mm.), in arm of rocker ·089 in. (2·26 mm.). Plug the oilway in the rocker arm with a rivet and weld the head to the boss.

Section Aa.16

REMOVING AND REPLACING THE VALVES

With the cylinder head removed, use tool 18G45 to compress the spring. Take away the circlip, split cotters, and valve spring cup, so releasing the spring and allowing the valve to be removed.

When removing the valves, place them in a rack, thus enabling them to be paired up with their correct cylinders. The valve springs should be tested and their free length checked, the correct length being approximately $1\frac{25}{32}$ (5·42 cm.).

Remove all carbon accumulation from the valves and thoroughly clean them. Inspect the valve faces and seats, and if they are slightly pitted or rough grind them in, using tool 18G29. If the valves and seats show signs of extensive pitting or the faces are not flat the valves and seats should be refaced true with the guide, using the cutting tools listed at the end of this Section. Finally, grind them in by hand. When the valve faces and seatings are perfectly smooth thoroughly clean all parts, using petrol.

Before reassembly, which is a reversal of the operations for removal, smear the valve stems and guides with engine oil. This will obviate the possibility of the valves sticking before adequate lubrication from the oiling system reaches them.

Section Aa.17

REMOVING AND REPLACING THE VALVE GUIDES

The valve guides are of a one-piece design. They are pressed into the cylinder head to allow $\frac{11}{16}$ to $\frac{3}{4}$ in. (1·75 to 1·9 cm.) of the guide to protrude above the head, as shown at (B) in Fig. Aa.5.

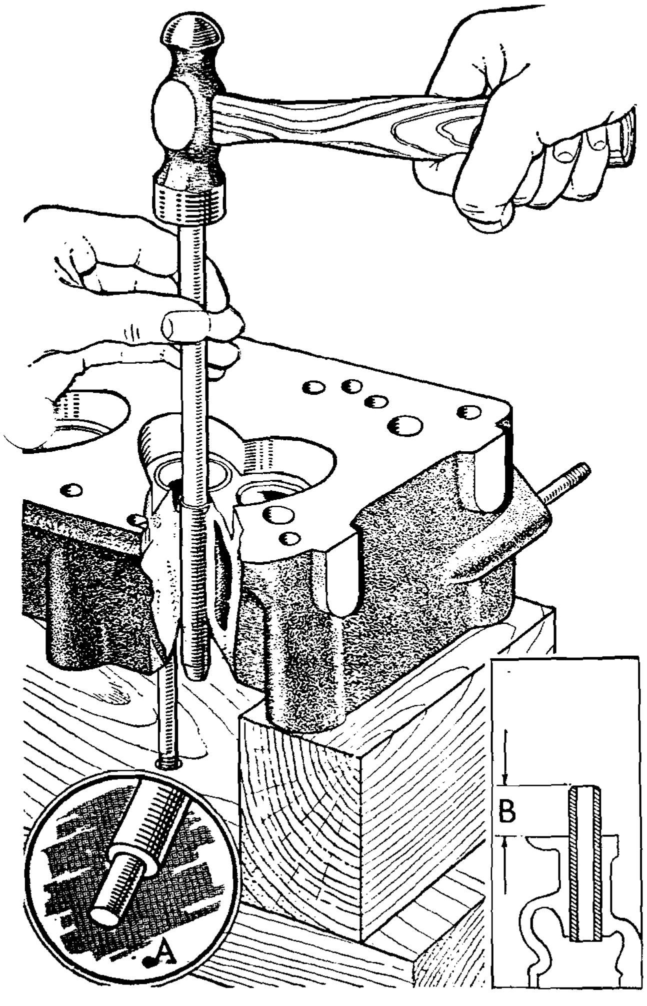


Fig. Aa.5

Fitting valve guides with a stepped drift (A)

To position each valve spring on the cylinder head a stepped pressed-steel seating collar is fitted over the part of the guide protruding from the cylinder head.

Valve guides should be tested for wear whenever valves are removed, and if excessive side-play is present a close check should be made of the valve stem and the guide. In the event of wear being noticeable the defective components should be renewed. If a valve is at fault the wear will be evident on the stem. It should be borne in mind that the valve stem and guide should be a running fit to avoid the possibility of an air leak.

If renewal is necessary due to wear, the valve guide may be driven out after removal of the valve, as shown in Fig. Aa.5.

The drift as shown at (A) in Fig. Aa.5 is stepped in order to ensure location and to obviate it slipping off the guide and damaging the port. Knock out the guide in the direction shown.

A new guide should be driven into position in the same direction—that is, inserting it through the valve seating and driving towards the top of the cylinder head.

NOTE.—**The exhaust valve guides are longer than the inlet guides, therefore they must be pressed into their correct ports.**

Section Aa.18

VALVE-GRINDING

For valve-grinding a little grinding paste should be smeared evenly on the valve face and the valve rotated backwards and forwards against its seat, advancing it a step at short intervals until a clean and unpitted seating is obtained. The cutting action is facilitated by allowing a light spring situated under the valve head to periodically lift the valve from its seat. This allows the grinding compound to repenetrate between the two faces after being squeezed out.

On completion, all traces of compound must be removed from the valve and seating. It is essential that each valve is ground in and refitted to its own seating.

It is also desirable to clean the valve guides; this can be done by dipping the valve stem in petrol or paraffin and moving it up and down in the guide until it is free.

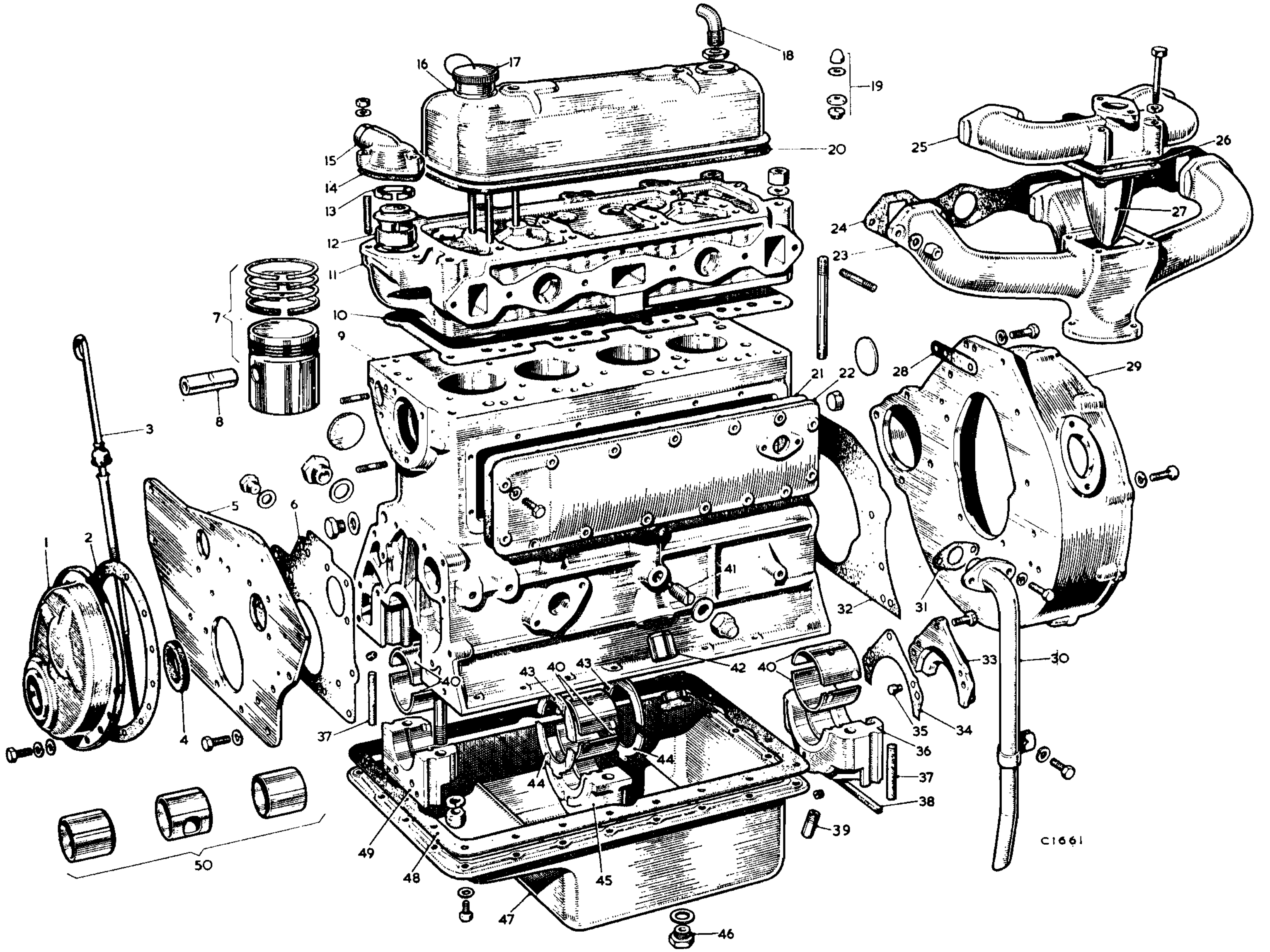
Section Aa.19

DECARBONIZING

Scrape off all carbon deposit from the cylinder head and ports. Clean the carbon from the piston crowns, care being taken not to damage the pistons and not to allow dirt or carbon deposit to enter the cylinder barrels or push-rod compartment.

When cleaning the top of the pistons do not scrape right to the edge as a little carbon left on the chamfer assists in keeping down oil consumption; with the pistons cleaned right to the edge or new pistons oil consumption is often slightly, though temporarily, increased.

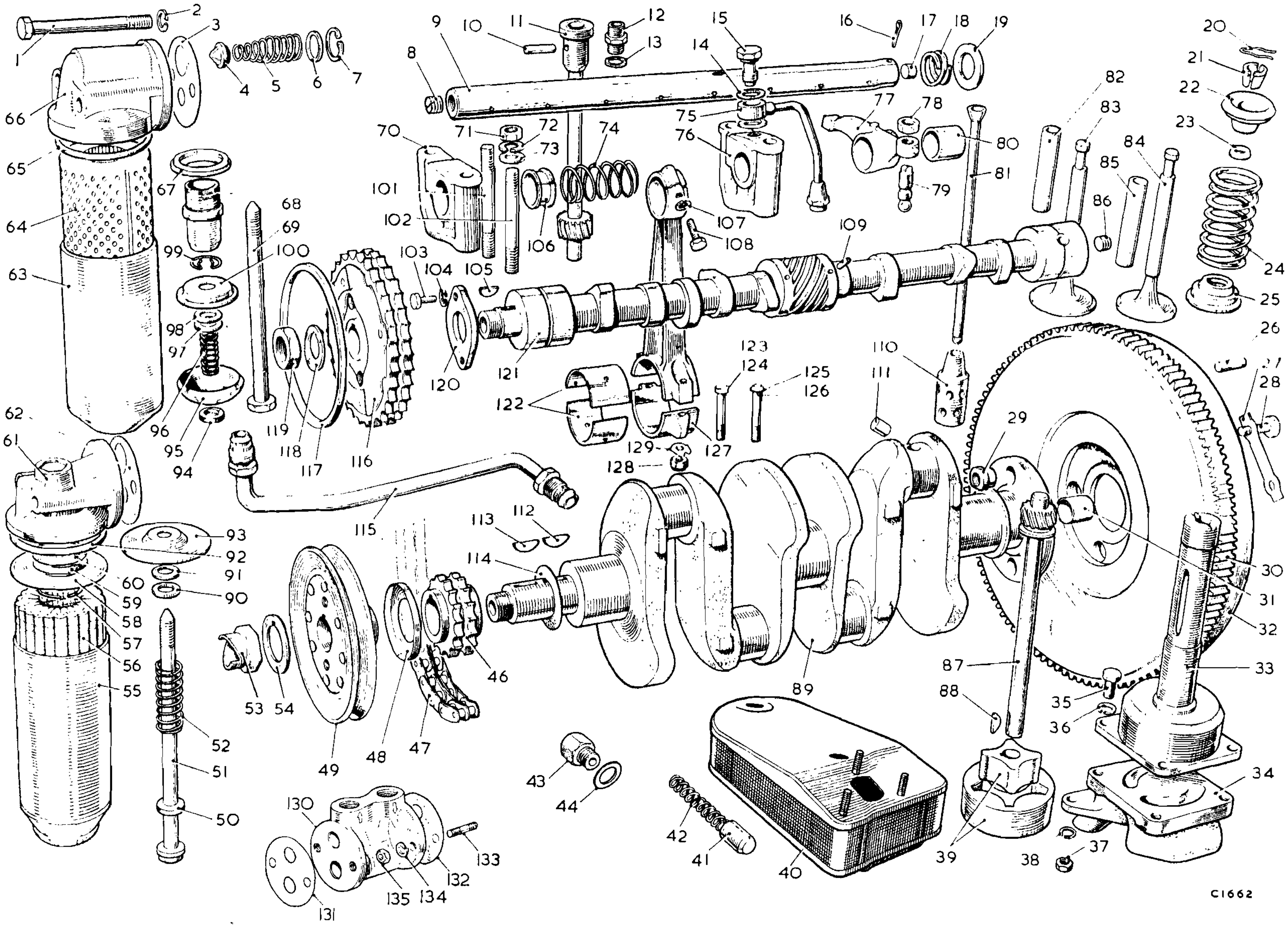
THE ENGINE EXTERNAL COMPONENTS



KEY TO THE ENGINE EXTERNAL COMPONENTS

No.	Description
1.	Cover—front.
2.	Washer—joint.
3.	Dipstick.
4.	Felt ring.
5.	Front plate—engine.
6.	Washer—joint.
7.	Piston and rings.
8.	Pin—gudgeon.
9.	Block—cylinder.
10.	Washer—joint.
11.	Cylinder head.
12.	Thermostat.
13.	Ring—retaining.
14.	Washer—joint.
15.	Outlet pipe—water.
16.	Cover—valve rocker.
17.	Pipe—vent.
18.	Cap—oil filler.
19.	Bracket—lifting.
20.	Cover joint—valve rocker.
21.	Washer—joint.
22.	Cover—side.
23.	Manifold—exhaust.
24.	Washer—joint.
25.	Manifold—inlet.
26.	Washer for hot-spot.
27	Assembly—hot-spot.
28.	Washer—joint.
29.	Housing—flywheel.
30.	Pipe—crankcase vent.
31.	Washer—joint.
32.	Washer—joint.
33.	Cover—rear.
34.	Washer—joint.
35.	Rear cover—dowel.
36.	Cap—rear main bearing.
37.	Plugs—front and rear main bearing cap.
38.	Cap joint—rear main bearing.
39.	Drain pipe.
40.	Bearings—main.
41.	Locating screw—oil pump.
42.	Bush—distributor driving spindle.
43.	Thrust washer (upper).
44.	Thrust washer (lower).
45.	Bearing cap—centre main.
46.	Drain plug—sump.
47.	Oil sump.
48.	Washer—joint.
49.	Bearing cap—front main.
50.	Liners—camshaft.

THE ENGINE INTERNAL COMPONENTS



KEY TO THE ENGINE INTERNAL COMPONENTS

No.	Description	No.	Description	No.	Description
1.	Bolt—filter to block.	47.	Chain—timing.	92.	Washer—joint.
2.	Washer—spring.	48.	Thrower—oil.	93.	Plate—pressure.
3.	Washer—joint.	49.	Pulley—crankshaft.	94.	Washer—sealing.
4.	Valve.	50.	Washer—sealing.	95.	Washer—reinforcing.
5.	Spring.	51.	Centre-bolt.	96.	Spring.
6.	Washer—valve.	52.	Spring—pressure.	97.	Washer—plain.
7.	Circlip.	53.	Starting-handle nut.	98.	Washer—felt.
8.	Plug—screwed.	54.	Washer—locking.	99.	Circlips.
9.	Shaft—rocker.	55.	Bowl—filter.	100.	Element guide (bottom).
10.	Peg for spindle.	56.	Element—filter.	101.	Stud—rocker bracket (long).
11.	Driving spindle—distributor.	57.	Circlip.	102.	Stud—rocker bracket (short).
12.	Union—oil feed pipe.	58.	Plate—clamping.	103.	Screw—locating plate.
13.	Union—washer.	59.	Washer—felt.	104.	Washer—spring.
14.	Washer—fibre.	60.	Washer—dished.	105.	Key for gear.
15.	Screw—locating.	61.	Head assembly.	106.	Distance piece.
16.	Split pin.	62.	Washer—joint.	107.	Washer—spring.
17.	Plug—plain.	63.	Bowl—filter.	108.	Bolt—clamping.
18.	Spring washer—double-coil.	64.	Element—filter.	109.	Nozzle—oil feed.
19.	Washer—plain.	65.	Washer—joint.	110.	Tappet.
20.	Cotter—circlip.	66.	Head assembly.	111.	Restrictor—oil.
21.	Cotter—valve.	67.	Element guide (top).	112.	Key for gear.
22.	Cup—valve spring.	68.	Centre tube.	113.	Key for pulley.
23.	Ring—valve packing.	69.	Centre-bolt.	114.	Washer—packing.
24.	Valve spring.	70.	Rocker bracket (plain).	115.	Pipe—oil delivery.
25.	Collar—valve spring.	71.	Nut for stud.	116.	Gear—camshaft.
26.	Dowel—flywheel to clutch.	72.	Washer—spring.	117.	Ring—rubber tensioner.
27.	Washer—locking.	73.	Washer—plain.	118.	Washer—locking.
28.	Bolt—flywheel to crankshaft.	74.	Spring—spacing.	119.	Nut—camshaft.
29.	Nut for bolt.	75.	Pipe—oil feed.	120.	Plate—locating.
30.	Gear—starter ring.	76.	Rocker bracket (tapped hole).	121.	Camshaft.
31.	Bush.	77.	Rocker arm.	122.	Bearing—big-end.
32.	Flywheel assembly.	78.	Locknut.	123.	Connecting rod.
33.	Body—oil pump.	79.	Screw—adjusting.	124.	Bolt—connecting rod.
34.	Bottom cover.	80.	Bush—rocker arm.	125.	Bolt—connecting rod (alternative).
35.	Screw—bottom cover.	81.	Push-rod.	126.	Peg for bolt.
36.	Washer—spring.	82.	Guide—inlet valve.	127.	Cap—connecting rod.
37.	Screw—oil strainer to pump.	83.	Valve—inlet.	128.	Tab washer for bolt.
38.	Washer—spring.	84.	Valve—exhaust.	129.	Simmonds nut for bolt.
39.	Rotors—inner and outer.	85.	Guide—exhaust valve.	130.	Adaptor.
40.	Strainer—oil.	86.	Plug for camshaft.	131.	Washer—joint.
41.	Valve—oil release.	87.	Shaft and gear.	132.	Washer—joint.
42.	Spring.	88.	Key for shaft.	133.	Stud.
43.	Adaptor—oil pressure switch.	89.	Crankshaft.	134.	Washer—spring.
44.	Washer for adaptor.	90.	Washer—plain.	135.	Nut for stud.
46.	Gear—crankshaft.	91.	Washer—felt.		

Section Aa.20

ADJUSTING THE VALVE ROCKER CLEARANCES

Lift off the valve cover after removing the flat cap nuts, two lifting brackets, and air cleaner.

Between the rocker arm and the valve stem there must be a clearance of ·012 in. (·30 mm.) for both inlet and exhaust valves, clearances being set with the engine cold.

If adjustment is necessary, slacken the locknut whilst continuously applying sufficient pressure to the adjusting screw with a heavy screwdriver, and raise or lower the adjusting screw in the rocker arm. Check the clearance with a feeler gauge.

Tighten the locknut when the adjustment is correct, but always check it again afterwards in case the adjustment has been disturbed during the locking process.

While the clearance is being set the tappet of the rocker being adjusted must be on the back of its cam, i.e. opposite the peak.

As this cannot be observed accurately, the rocker adjustment is more easily carried out in the following order, and this also obviates turning the engine over more than is necessary.

Adjust No. 1 rocker with No. 8 valve fully open.
" " 3 " " " 6 " " "
" " 5 " " " 4 " " "
" " 2 " " " 7 " " "
" " 8 " " " 1 " " "
" " 6 " " " 3 " " "
" " 4 " " " 5 " " "
" " 7 " " " 2 " " "

When replacing the valve cover take care that the joint washer (using a new one if necessary) is properly in place to ensure an oiltight joint.

Section Aa.21

REMOVING AND REPLACING A PISTON AND CONNECTING ROD

In order to withdraw the pistons the connecting rods have to be taken through the cylinder bores. The sump and cylinder head have, therefore, to be removed.

Remove the Simmonds nuts and tab washers securing the caps and bearings to the connecting rods. Remove the caps with the bottom half of the bearings.

Withdraw the pistons and connecting rods upwards through the cylinder bores after ensuring that the big-end bolts are still properly in position. The heads of the bolts are anchored in the connecting rod by a small peg. If these have been disturbed the big-end will not pass through the bore as the bolt head may have turned.

When replacing the pistons and connecting rods they must be fitted in the same cylinder bores and the same way round as when removed (see Fig. Aa.7 for order of assembling the connecting rods). Lubricate all bearing

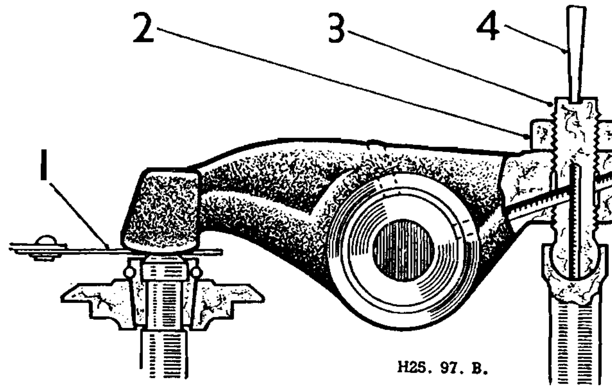


Fig. Aa.6

Checking valve to rocker clearance

1. Feeler gauge.
2. Locknut.
3. Adjuster.
4. Screwdriver.

surfaces with engine oil before commencing this operation.

Insert the big-end bolts into the connecting rods; position them correctly by locating the peg in the head of the bolt into the slot in the connecting rod. If new bolts are being fitted they must be machined or filed in position to the contour of the big-end, as any protrusion will foul the bore on assembly.

Compress the piston rings, using tool 18G55A, insert the connecting rods and pistons downwards through their respective cylinder bores, and fit the bearings and caps. Each half of the bearings is notched to fit the connecting rod and cap so that they are correctly positioned and prevented from turning. Ensure also that the oil jet holes in the connecting rod line up with the holes in the bearing shell to give free passage of oil.

Before fitting the cap check that the number stamped on the rod is the same as that on the cap.

Ensure that the connecting rod bolts are anchored correctly by the small pegs in the head of the bolts, and using new nuts, tighten them to a torque of 50 lb. ft.

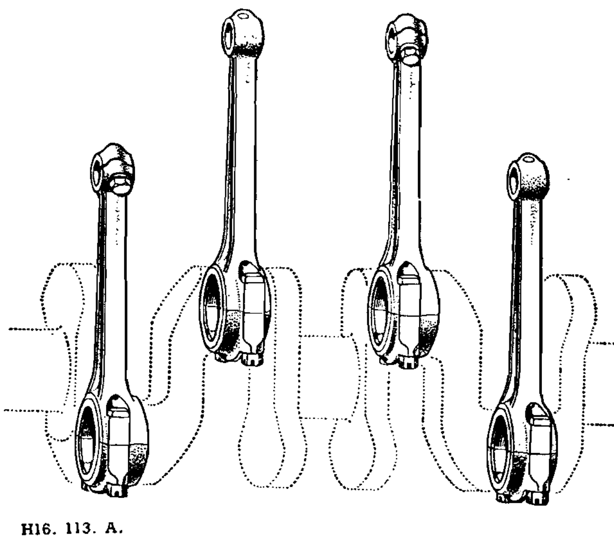


Fig. Aa.7

Connecting rod offsets

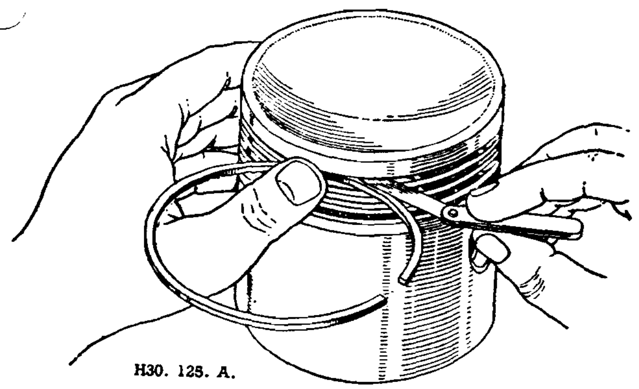


Fig. Aa.8
Checking piston ring and groove clearance

(6·91 kg. m.). Lock the nuts in position with new tab washers. Turn the crankshaft after fitting each rod to ısure that the bearing is not binding on the crankpin. Also check the side-clearance of each rod, as given under **'GENERAL DATA'**.

Refit the cylinder head assembly. Replace the sump and refill with the recommended grade of oil.

Section Aa.22

DISMANTLING AND REASSEMBLING A PISTON AND CONNECTING ROD

Remove the pistons from the connecting rods by unscrewing the clamp bolt from the small-end of the connecting rod (see Fig. Aa.9) and pushing out the gudgeon pin. Remove the rings from the pistons.

Scrape all accumulation of carbon off the piston heads and, using a piston ring groove-cleaning tool or an old ıg section, carefully scrape all carbon out of the ring óoves of the pistons. Clean the carbon out of the oil holes in the piston ring grooves.

Thoroughly clean all the dismantled parts in paraffin, examine all parts for wear and damage, and renew if necessary.

Piston rings should have a gap clearance (see under **'GENERAL DATA'**) when installed in the cylinder bores. If new rings are being installed each ring should be checked in the cylinder bore to determine whether its gap clearance is within the range specified. To do this use the bottom of a piston to insert the ring part way into the bore. The ring will thus be squared up in the bore for measurement of the gap clearance, as shown in Fig. Aa.10. To check the ring clearance in the piston grooves install the rings on the pistons and determine the clearances with a feeler gauge. If the piston ring grooves are worn excessively, as indicated when comparing the actual clearances with those given under **'ENERAL DATA'**, renew the rings and pistons.

NOTE.—The cylinder bore glazing should be removed before fitting new rings into a worn cylinder bore.

Gudgeon pins should be a hand-push fit in the piston. The fit can be checked after the rod has been assembled by holding the piston with the connecting rod in an approximately horizontal position. The weight of the large end of the connecting rod should be just insufficient to turn the gudgeon pin in the piston.

Thoroughly clean the bearing shells and the faces of the rods and caps. Blow out the oil passages in the connecting rods.

Examine the bearing shells for wear and pits, and renew if necessary. Bearings are prefinished with the correct diametrical clearance and do not require bedding in.

Alignment of the connecting rods should be checked on an alignment fixture. On no account must the rods or caps be filed.

Assemble the pistons to the connecting rods by the gudgeon pins, which are a hand-push fit in the pistons. The gudgeon pins are locked in position by the clamp bolts in the small-ends of the connecting rods to a torque of 35 lb. ft. (4·85 kg. m.).

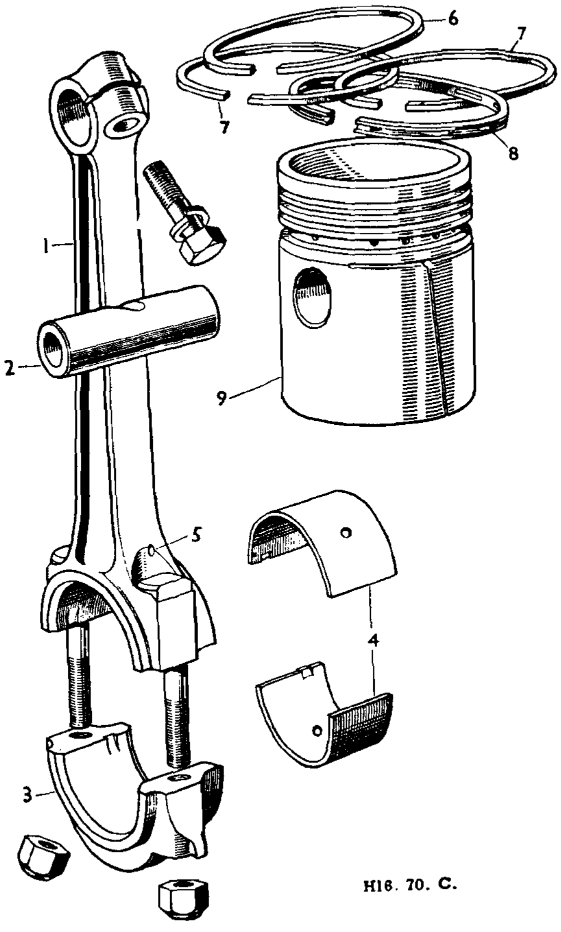


Fig. Aa.9
The piston and connecting rod assembly

1. Connecting rod.
2. Gudgeon pin.
3. Connecting rod cap.
4. Bearings.
5. Oil jet.
6. Top compression ring.
7. Lower compression ring.
8. Scraper ring.
9. Piston.

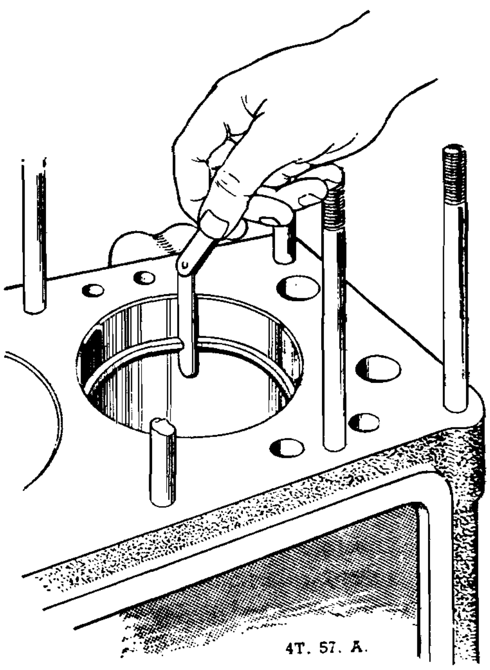


*Fig. Aa.*10
Checking the piston ring gap

Section Aa.23

REMOVING AND REPLACING THE MAIN BEARINGS AND CRANKSHAFT

The crankshaft is supported in the crankcase by three renewable main bearings of the steel-backed shell type. Crankshaft end-float is controlled by thrust washers fitted on both sides of the centre main bearing.

Remove the engine from the vehicle, and place it upside-down in a dismantling fixture.

Remove the sump and oil strainer, the timing chain, and the flywheel and housing.

Check the crankshaft end-float to determine whether the renewal of the thrust washers is necessary.

Remove the connecting rod bearing caps and shells, keeping the shells with their respective caps for correct replacement, and release the connecting rods from the crankshaft. The removal of the sparking plugs will facilitate the turning of the crankshaft.

Withdraw the main bearing caps complete with the bearing bottom shells. Caps and both bearing half shells should be kept together. The use of tools 18G42A and 18G42B, or 18G284 and 18G284AH, will assist in the removal of the bearing caps. The bottom halves of the two thrust washers will be removed with the centre main bearing cap and the oil sealing plugs removed with the front and rear bearing caps.

Remove the crankshaft, the two remaining halves of the thrust washers, and the top half-shells of the main bearings from the crankcase.

Inspect the crankshaft main journals and crankpins for wear, scores, scratches, and ovality. If necessary, the crankshaft may be reground to the minimum limits shown under 'GENERAL DATA'. Main bearings for reground crankshafts are available in sizes shown under 'GENERAL DATA'.

Clean the crankshaft thoroughly, ensuring that the connecting oilways between the journals and crankpins are clear. They can be cleaned out by applying a pressure gun containing petrol or paraffin. When clean, inject a thin oil in the same manner.

Thoroughly clean the bearing shells, caps, and housings above the crankshaft. Examine the bearing shells for wear and pitting, and look for evidence of breaking away or picking up. Renew the shells if necessary.

Bearings are prefinished with the correct diametrical clearance and do not require bedding in. New bearings should be marked to match up with the marking on the cap, and **on no account should they be filed to take up wear or reduce running clearance.**

Check the thrust washers for wear on their bearing surfaces, and renew if necessary to obtain the correct end-float.

Replacing the crankshaft and main bearings is a reversal of the removal procedure, noting the following points.

Ensure that the thrust washers are replaced the correct way round and locate the bottom half tab in the slot in the bearing cap.

The bearing shells are notched to fit the recesses machined in the housing and cap.

In the case of the front and rear main bearing caps install new oil sealing plugs.

The stamp markings on the bearing caps should be facing the camshaft.

Lubricate the bearings freely with engine oil.

Fully tighten the main bearing nuts to a torque of 80 lb. ft. (11·06 kg. m.).

Section Aa.24

REMOVING AND REPLACING THE TIMING CHAIN AND WHEELS

It is possible to obtain access to the chain and wheels without removing the engine from the vehicle.

Remove the radiator, fan belt, fan and fan pulley.

Tap back the tab washer and remove the starting-handle jaw nut from the crankshaft, using tool 18G96.

Withdraw the fan driving pulley from the crankshaft. The pulley is keyed but there is no taper fit and withdrawal will present no difficulty. Tool 18G2 can be used to advantage. Remove the timing chain cover complete with the felt oil seal. Note the distance pieces behind the timing plate. Remove the pulley key and oil thrower from the crankshaft.

Tap back the tab washer and remove the nut from the camshaft. Withdraw slightly the camshaft chain wheel. The wheel is keyed and withdrawal will present no difficulty. Tool 18G58 can be used to advantage. Withdraw slightly the crankshaft chain wheel, which is keyed the crankshaft. Tool 18G2 can be used to advantage. The timing chain, camshaft wheel, and crankshaft wheel can now be removed together.

Clean and examine the joint faces of the timing cover and front suspension plate. Examine the felt oil seal for signs of wear, hardening, or damage. If the slightest wear or damage is revealed it should be renewed.

Inspect the fan driving pulley for wear on the flanges and the chain wheels for broken or chipped teeth.

Examine the rubber tensioner ring fitted to the camshaft chain wheel. If worn, renew the wheel assembly. The rubber tensioner ring ensures quiet running by constantly taking up slack in the timing chain, and it should not be interfered with in any way (see Fig. Aa.12).

Inspect the chain for excessive wear or stretch.

Replacing the timing chain, wheels, and cover is a reversal of the removal procedure, but the following points should be carefully noted.

To facilitate retiming, the crankshaft and camshaft ɩain wheels are spot-marked, and the timing is correct when the spot on the camshaft wheel is in line with the spot on the crankshaft wheel at their closest position (2, Fig. Aa.11) and pistons 1 and 4 are at T.D.C. relative to the position of the crankshaft keys (1, Fig. Aa.11). Use drift 18G16 for installing the crankshaft pulley and chain wheel. There should be a clearance of ·003 to ·006 in. (·076 to ·152 mm.) between the camshaft wheel and the locating plate when the wheel is fully tightened to the camshaft. This clearance is given automatically by the camshaft locating plate and the camshaft shoulder, and will be within the limits given if there is no excessive wear on the components.

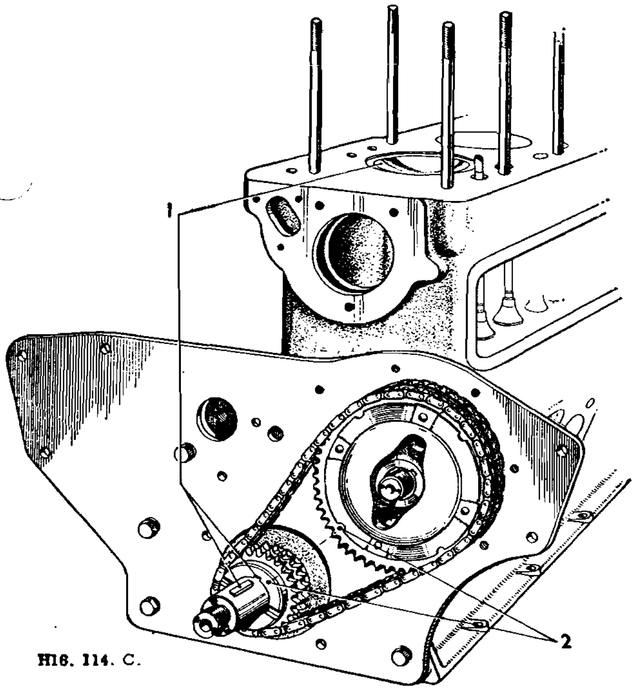


Fig. Aa.11

The timing gear and chain

1. Pistons 1 and 4 at T.D.C. with the relative positions of the crankshaft and camshaft keys.
2. The correct positions of the 'spots' on both timing gears.

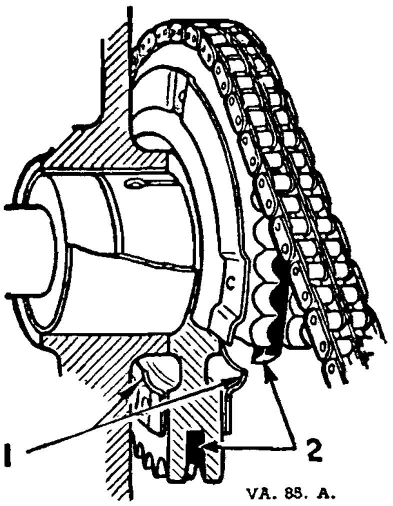


Fig. Aa.12

Oil catchers (1) feed a flow of oil to the chain on each side of the camshaft sprocket, and a synthetic rubber tensioner ring (2) ensures quiet running and takes up slack in the chain

Apply engine oil to the timing chain and wheels before installing the cover.

Fit a new joint washer between the chain cover and front suspension plate.

Fit new tab washers when locking the camshaft and crankshaft nuts.

Ensure that the crankshaft oil thrower is positioned correctly: the concave or hollow side must face towards the pulley. Use tool 18G3 to ensure that when refitting the chain cover the felt oil seal and cover are concentric to the crankshaft, thereby safeguarding against oil leakages and possible damage to the oil seal.

Section Aa.25

REMOVING AND REPLACING THE CAMSHAFT

To withdraw the camshaft first remove the sump and oil pump. Take out the distributor and driving spindle. Detach the fuel pump from its mounting.

Remove the timing gear complete, also the push-rods and tappets.

Undo the two set pins holding the locating plate, and draw the camshaft forward, rotating it slowly to assist withdrawal.

Inspect the cams and oil pump driving gear for excessive wear. If the camshaft is in order carefully replace it so as not to damage the white-metal bearings.

Section Aa.26

RENEWING THE CAMSHAFT BEARINGS

While the camshaft is removed it is advisable to check the bearing liners for damage and wear. If these are not in good condition they must be removed and new ones fitted.

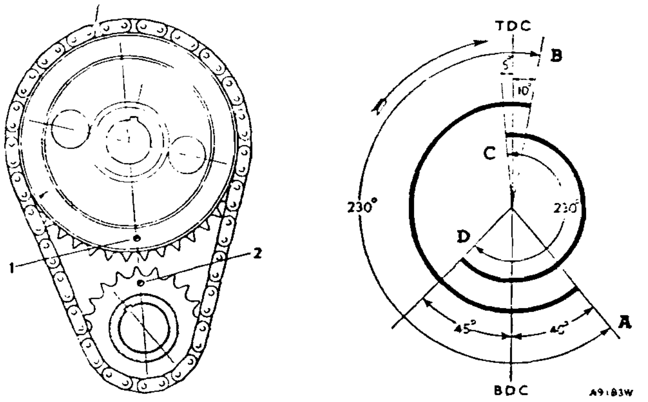


*Fig. Aa.*13

The diagram of valve timing, showing (1) *and* (2) *the relative positions of the timing marks on the sprockets,* (A) *and* (B) *exhaust valve open,* (C) *and* (D) *inlet valve open*

The old bearings can be removed and new ones refitted, using tool 18G124A.

This tool comprises a body with built-in thrust race, screw wing nut, stop plate, 'C' washer, and handle, and must be used in conjunction with the following adaptors:

Pilot, Code 5	.. .. ..	18G124F
Pilot, Code 3	.. .. ..	18G124D
Pilot, Code 1	.. .. ..	18G124B
Guide, Code 6	.. .. ..	18G124H

Removing the front and rear liners

Stand the cylinder block on a bench and insert the pilot, Code 5 for the front liner or Code 1 for the rear liner. Screw the wing nut a few threads onto the screw and pass the screw through the body so that the thrust race will abut against the wing nut.

Push the screw through the liner and pilot, slip the 'C' washer onto the flats provided, and insert the handle into the hole at the end of the screw to prevent the liner turning.

Oil the screw to reduce friction before turning the wing nut in a clockwise direction to withdraw the liner.

Removing the middle liner

To remove the middle liner insert pilot Code 3 into this liner and pilot Code 6 into the front liner housing. Pass the screw through the first pilot and liner, and finally through the second pilot. Slip the 'C' washer on the flats provided, and insert the handle into the hole at the end of the screw to prevent the liner from turning.

Turn the wing nut in a clockwise direction to withdraw the liner.

Replacing the liners

Replace the middle liner first.

Insert pilots Codes 6 and 3 into the housings at the front and middle liners respectively.

Pass the screw through both pilots and locate a new liner, chamfered edge foremost, on the end of the second pilot. Place the stop plate at the back of the liner and fit the 'C' washer to retain it in position. The handle assembled in the hole in the screw will prevent the liner turning when being pulled into position. Care must be taken to ensure that the oil holes in liner and cylinder block are in line, and that the flat on the stop plate is away from the split in the liner.

Turn the wing nut in a clockwise direction to pull the liner into position.

Now assemble the front and rear liners in position, using pilot Code 5 for the front and pilot Code 1 for the rear. If either of these liners is longer than its housing it should be fitted so that it is flush with the face of the block.

Reaming the liners

Before the camshaft can be reassembled the liners must be reamed in line in order to obtain the correct clearance between the shaft journals and their bearings. For this purpose use tool 18G123A, which comprises an arbor with tommy-bar and Allen key, and must be used with the following adaptors:

Pilot, Code 15	.. .. ..	18G123AD
Cutter, Code 1	.. .. ..	18G123B
Pilot, Code 13	.. .. ..	18G123Q
Pilot, Code 10	.. .. ..	18G123M
Cutter, Code 2	.. .. ..	18G123C
Pilot, Code 9	.. .. ..	18G123L
Pilot, Code 16	.. .. ..	18G123T
Cutter, Code 4	.. .. ..	18G123E

Each cutter, though in one piece, incorporates a roughing and a finishing cutter. It is therefore essential that the roughing portion enters the liner first. A peg is retained in the centre groove of each cutter by means of a spring clip and locates the cutter by engaging in a slot in the arbor.

The three camshaft liners must be reamed in two operations.

Insert the tapered pilots, Codes 10 and 13, from the rear of the block into Nos. 2 and 3 liners respectively. Place the plain pilot, Code 9, onto the arbor, followed by Code 4 cutter.

Pass the arbor through the front liner and the pilot, Code 10. Code 1 cutter can then be placed onto the arbor before it is pushed through the pilot in the rear liner. Locate the two cutters, Codes 4 and 1, in positions 10 and 4 respectively by turning them to the left so that the pegs engage in the holes provided. They will be in the correct positions when numbers 10 and 4 on the arbor are visible directly in front of the appropriate cutter.

Apply paraffin or thin oil to the cutters before commencing to ream by turning the tommy-bar at the end of the arbor in a clockwise direction. On no account must the operator attempt to force the cutter through the liner, otherwise it will seize.

Swarf should be cleared away at frequent intervals, particularly after the front liner has been reamed, so that the plain pilot, Code 9, can take the place of the first cutter. Continue the first part of the operation by reaming the rear liner in a similar manner. As the cutter passes through it will push out the tapered pilot.

Free the cutters by turning them to the right; withdraw the arbor and remove the pilots.

To commence the second operation place Code 16 pilot in the front liner and Code 15 pilot in the rear liner.

Pass the arbor through the front pilot and put Code 2 cutter onto the arbor before pushing it through the middle liner and the rear pilot. Locate the cutter in position 7 and apply paraffin or thin oil with a brush. Slowly turn the tommy-bar in a clockwise direction to ream the middle liner.

Free the cutter, withdraw the arbor, and remove the pilots. Clear away all swarf and apply oil to the liners before assembling the camshaft.

Section Aa.27

OVERHAULING THE CYLINDER BLOCK

Remove and dismantle the engine. Remove all studs unions, and screwed plugs, etc., if necessary.

If an expansion plug has blown, or leaks, remove the plug by drilling a hole in its centre and lever it out with a screwdriver or other suitable tool.

Scrape as much sediment as possible from the water passages and thoroughly swill out with a water hose.

Clean all joint washer surfaces.

Inspect for cracks and scores on joint washer surfaces.

It may be advisable to remove the ridge above the ring travel at the top of the cylinder bores before checking the fit of the pistons.

Wipe the cylinder bores clean and examine them for scores, out of round, and taper. If the cylinders are found to be out of round or excessively tapered when measured, they should be reconditioned.

If cylinder reconditioning is required determine accurately the amount of material to be removed (refer to **'GENERAL DATA'** concerning oversize pistons available).

Make sure that all traces of abrasives are cleaned from all parts of the cylinder block after the cylinder-reconditioning operation is completed.

Section Aa.28

REMOVING AND REPLACING THE FLYWHEEL AND HOUSING

The flywheel complete with starter ring is fastened to a flange on the rear of the crankshaft by four set bolts, which screw into four dowel-type nuts and are locked in position by two lock plates. The flywheel housing is secured to the crankcase by 12 set bolts and spring washers. To remove the flywheel after removing the engine from the vehicle proceed as follows.

Separate the gearbox from the engine and remove the clutch from the flywheel.

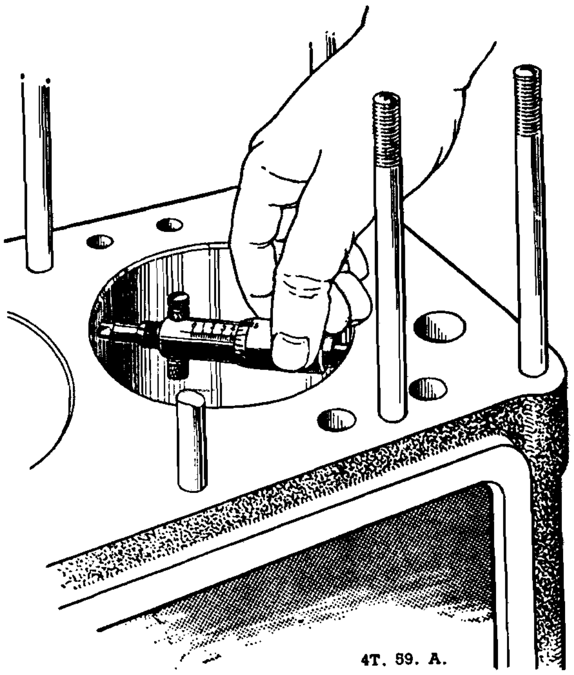


Fig. Aa.14
Measuring bore wear

Knock back the tabs of the lock plates, when the bolts can be unscrewed and the flywheel withdrawn.

Unscrew the eight set bolts and withdraw the engine rear plate.

Examine the flywheel teeth and friction face for excessive wear. If the teeth on the starter ring are damaged or badly worn a replacement flywheel with a new ring should be fitted.

Examine the engine rear plate for distortion and damage, clean the joint faces of the plate and crankcase, and check for scores.

Refit the engine rear plate to the crankcase, using a new joint washer. Tighten the securing bolts evenly and firmly.

Place the flywheel over the flange and flange nuts of the crankshaft so that the timing mark '1/4' is at T.D.C. when the first throw of the crankshaft is at T.D.C. The joint faces should be perfectly clean. Place the lock plates under the heads of the bolts, insert the bolts to engage with the dowel-type nuts, and tighten them in diagonal sequence. A torque spanner set to 50 lb. ft. (6·9 kg. m.) should be used when tightening the flywheel bolts.

Check the alignment of the flywheel by installing a dial test indicator on the engine rear plate so that the indicator button rides on the clutch face of the flywheel.

Crank the engine slowly to determine the amount of misalignment. This should not exceed ·003 in. (·076 mm.) as registered on the dial when the engine is turned through one complete revolution.

Finally, remove the dial test indicator and lock the nuts with the tabs of the lock plates.

Refit the clutch and gearbox.

Cylinder bore diameter before fitting liner	*Outside diameter of liner*	*Interference fit of liner in cylinder bore*	*Finish-bore diameter of liner after fitting*
3·2630 to 3·2635 in. (82·880 to 82·894 mm.)	3·2650 to 3·2657 in. (82·931 to 82·948 mm.)	·0015 to ·0027 in. (·038 to ·069 mm.)	3·1245 to 3·1260 in. (79·362 to 79·400 mm.)

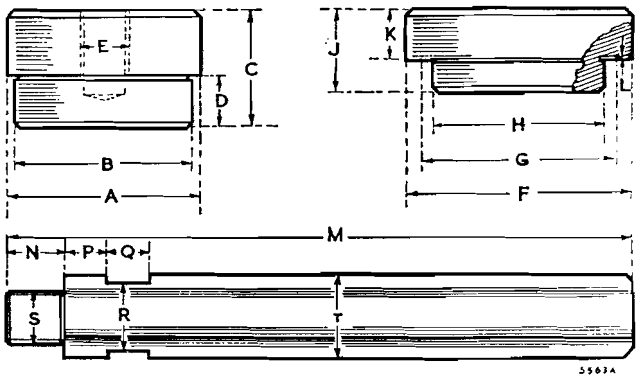


Fig. Aa.15

Cylinder liner pilot dimensions

Pressing-out pilot

A. $3\frac{15}{64}{}^{-.000}_{+.005}$ in. ($82{\cdot}153^{-.000}_{+.127}$ mm.).
B. $3{\cdot}123^{-}_{+}{\cdot}005$ in. ($79{\cdot}324^{-.127}_{+.000}$ mm.).
C. $1\frac{3}{4}$ in. (44·45 mm.).
D. $\frac{3}{4}$ in. (19·05 mm.).
E. $\frac{3}{4}$ in. B.S.W. thread.

Pressing-in pilot

F. $3\frac{5}{8}$ in. (92·075 mm.).
G. $3\frac{5}{16}$ in. (84·137 mm.).
H. $3{\cdot}108^{-.005}_{+.000}$ in. ($78{\cdot}943^{-.127}_{+.000}$ mm.).
J. $1\frac{1}{4}$ in. (31·75 mm.).
K. $\frac{3}{4}$ in. (19·05 mm.).
L. ·015 in. (·38 mm.).

Pilot extension

M. $10\frac{1}{2}$ in. (26·67 cm.).
N. $\frac{7}{8}$ in. (22·22 mm.).
O. $\frac{5}{8}$ in. (15·87 mm.).
P. $\frac{5}{8}$ in. (15·87 mm.).
R. Two flats, 1 in. (25·4 mm.) across.
S. $\frac{3}{4}$ in. B.S.W. thread.
T. $1\frac{1}{4}$ in. (31·75 mm.).

Section Aa.29

CYLINDER LINERS

Should the condition of the cylinder bores be such that they cannot be cleaned up to accept the recommended oversize pistons, it is possible that dry cylinder liners can be fitted. This operation may be carried out by the use of specialized proprietary equipment or with a power press using pilot adaptors to the dimensions shown in Fig. Aa.15. If liners have not previously been fitted, then the bores must be machined and honed to the dimensions given in the table.

Removing worn liners

Remove and dismantle the cylinder block. Place the cylinder block face downwards on suitable wooden supports on the bed of the press, ensuring that there is sufficient space between the block and the bed of the press to allow the worn liner to pass down. Insert the pilot with its extension into the bottom of the liner and carefully press the liner out of the bore.

Fitting new liners

Thoroughly clean the cylinder block and liner contacting surfaces. Stand the cylinder block face upwards on the bed of the press, insert the pilot into the top of the liner, and position the liner with its chamfered end in the top of the cylinder block bore. Ensure that the liner is square with the top of the block and that the ram of the press is over the centre of the pilot. Press the liner fully into the bore and flush with the top face of the block.

If a liner without connecting rod clearance slots is fitted, then slots must be milled in the bottom of the liner to suit the slots in the cylinder block bore.

Finally, bore and hone the liners to the dimensions given in the table.

Section Aa.30

FITTING FLYWHEEL STARTER RINGS

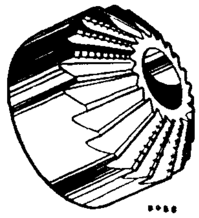
To remove the old starter ring from the flywheel flange split the ring with a cold chisel, taking care not to damage the flywheel. Make certain that the bore of the new ring and its mating surface on the flywheel are free from burrs and are perfectly clean.

To fit the new ring it must be heated to a temperature of 300 to 400° C. (572 to 752° F.), indicated by a light-blue surface colour. If this temperature is exceeded the temper of the teeth will be affected. The use of a thermostatically controlled furnace is recommended. Place the heated ring on the flywheel with the lead of the ring teeth uppermost. The expansion will allow the ring to be fitted without force by pressing or tapping it lightly until the ring is hard against its register.

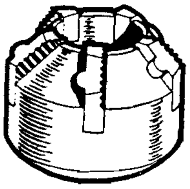
This operation should be followed by natural cooling, when the 'shrink fit' will be permanently established and no further treatment required.

SERVICE TOOLS

18G 28*. Valve Seat Finishing Cutter

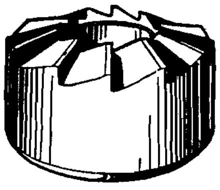


18G 28 A*. Valve Seat Glaze Breaker



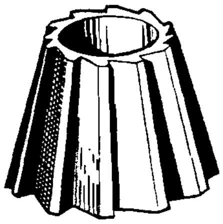
9165

18G 28 B*. Valve Seat Narrowing Cutter—Top



9021B

18G 28 C*. Valve Seat Narrowing Cutter—Bottom

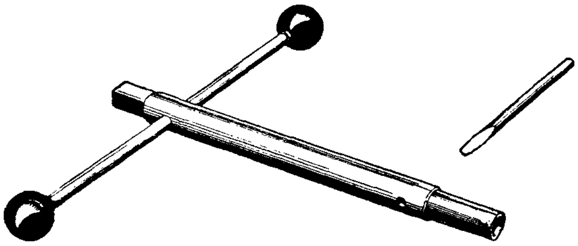


9021A

18G 174 D*. Valve Seat Cutter Pilot

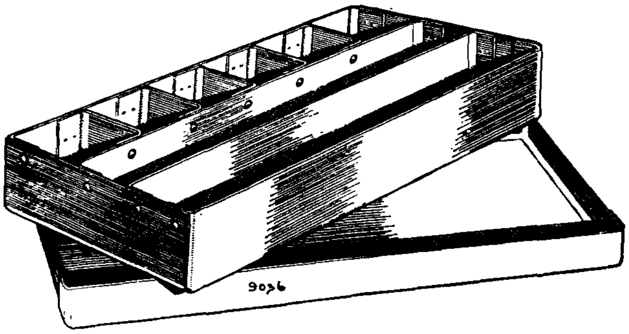
18G 27*. Valve Seat Cutter and Pilot Handle

The use of these tools will save lengthy and wasteful grinding when valve seats are pitted and also enable the width of the valve seats to be maintained at their original dimensions.



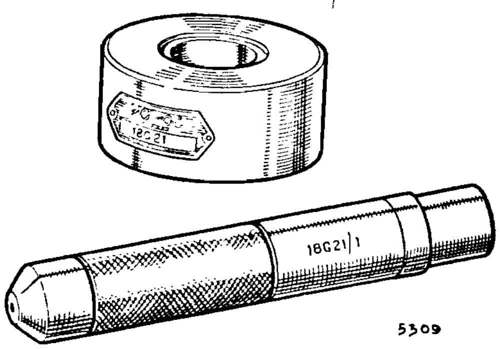
3862

18G 27 B. Fibre Box for Valve Seat Cutters



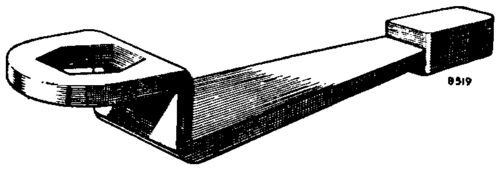
* No longer available, see page Aa.24.

18G21. Valve Rocker Bush Remover and Replacer
This tool, which consists of a driver and an anvil, makes the removal and replacement of rocker bushes a simple and safe operation.

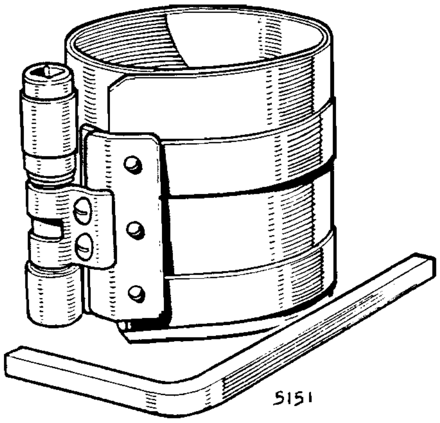


5309

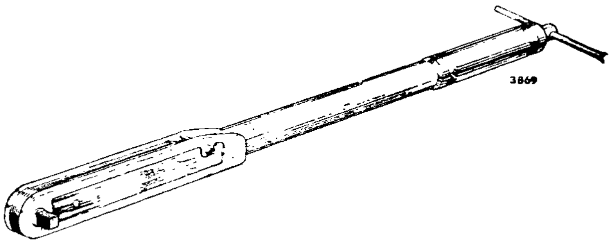
18G96. Starting Nut Spanner
The robust construction of this special 'shock-type' spanner is conducive to long life. The design enables a jaw nut to be removed or replaced without the need for locking the crankshaft by improvised means, which may cause damage to components.


8519

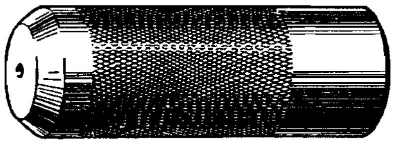
18G55A. Piston Ring Compressor
A clamping device to retain the piston rings and enable the piston to enter the cylinder bore with a minimum of pressure.


5151

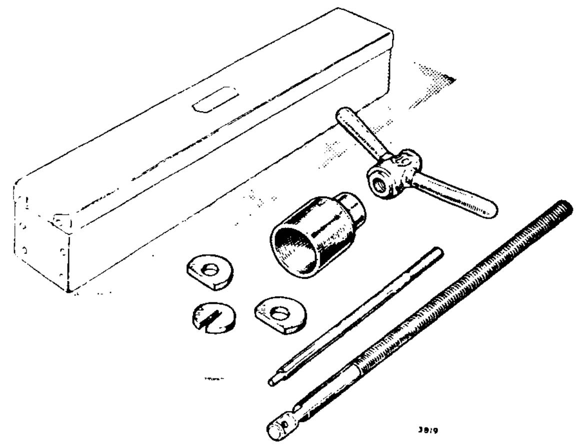
18G372. Torque Spanner—30 to 140 lb. ft. (4 to 20 kg. m.)


3869

18G16. Crankshaft Gear and Pulley Replacer
This tool is designed for driving on the crankshaft gear and pulley.


9245A

18G124A. Camshaft Liner Remover and Replacer (basic tool)
Camshaft liners can be removed and replaced without the damage invariably associated with the use of improvised drifts. Adaptors for use with this basic tool are obtainable separately.

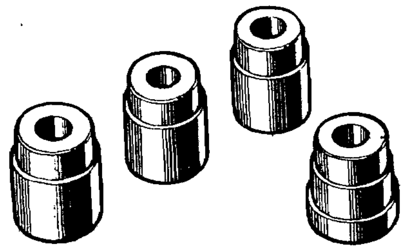


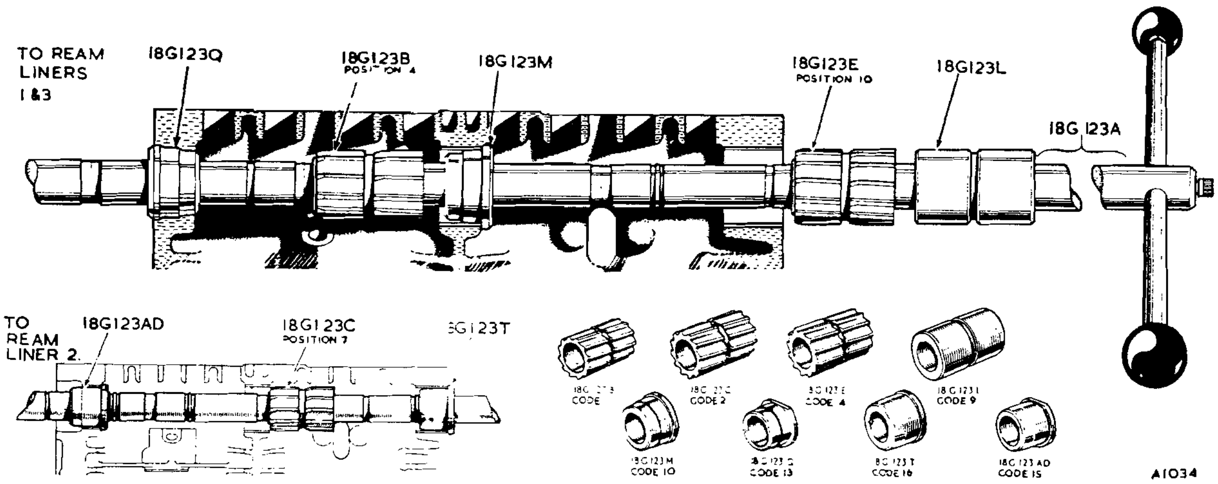
18G124B. Camshaft Liner Remover Adaptor

18G124D. Camshaft Liner Remover Adaptor

18G124F. Camshaft Liner Remover Adaptor

18G124H. Camshaft Liner Remover Adaptor


4360B



A1034

18G123A. Camshaft Liner Reamer (basic tool)
This is essential when reconditioning cylinder blocks, otherwise camshaft liners cannot be reamed in line, and in consequence the clearance between the camshaft journal and liner will be incorrect. The cutters and pilots for use with this basic tool are supplied separately.

18G123B. Camshaft Liner Reamer Cutter

18G123C. Camshaft Liner Reamer Cutter

18G123E. Camshaft Liner Reamer Cutter

18G123L. Camshaft Liner Reamer Pilot

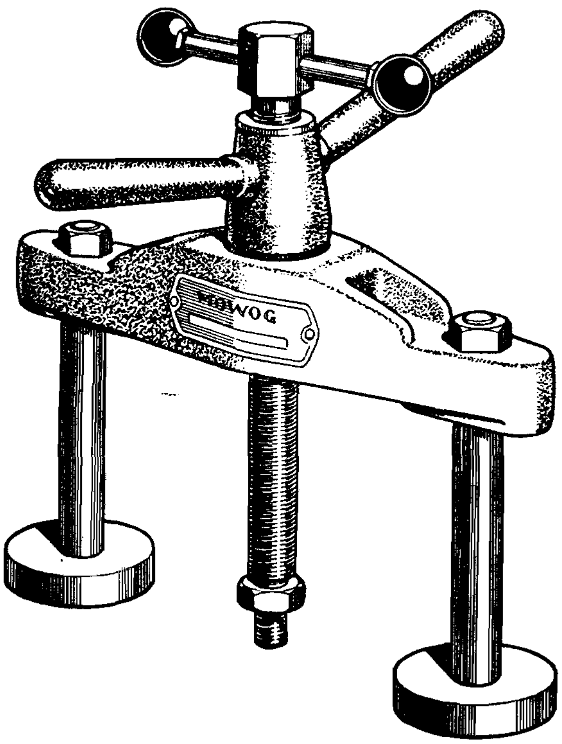
18G123M. Camshaft Liner Reamer Pilot

18G123Q. Camshaft Liner Reamer Pilot

18G123T. Camshaft Liner Reamer Pilot

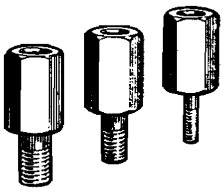
18G123AD. Camshaft Liner Reamer Pilot

18G42A. Main Bearing Cap Remover (basic tool)
The frame has feet suitably spaced to locate on the crankcase flanges. The adaptor 18G42B is screwed first onto the drive screw and then into the main bearing cap.

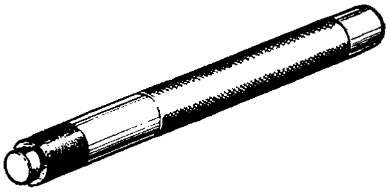


5291

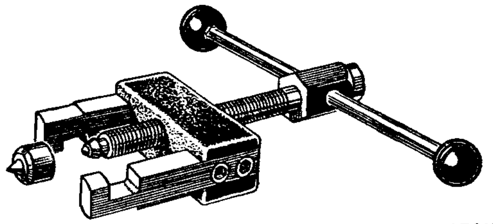
18G42B. Main Bearing Remover Adaptors


4470C

18G69. Oil Pump Release Valve Grinding-in Tool
This tool is designed for the removal and grinding in of oil release valves. It consists of a knurled handle, knurled set screw, and rubber sleeve. Tightening the set screw expands the rubber plunger, which ensures that the tool is a tight fit when inserted into the hollow oil release valve.


8680

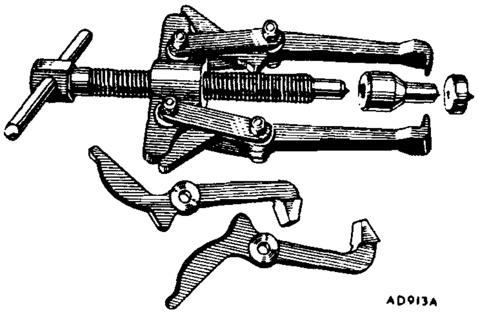
18G58. Camshaft Gear Remover
This tool will remove the gear quickly and without damage. The centre drive screw incorporates a hardened steel ball to reduce friction; a separate thrust pad is provided for insertion between the camshaft and the ball when extra travel is required.


AD912

18G2. Crankshaft Gear, Pulley, and Propeller Shaft Flange Remover

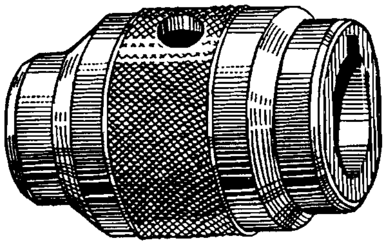
(Application—crankshaft gear and pulley removal.)

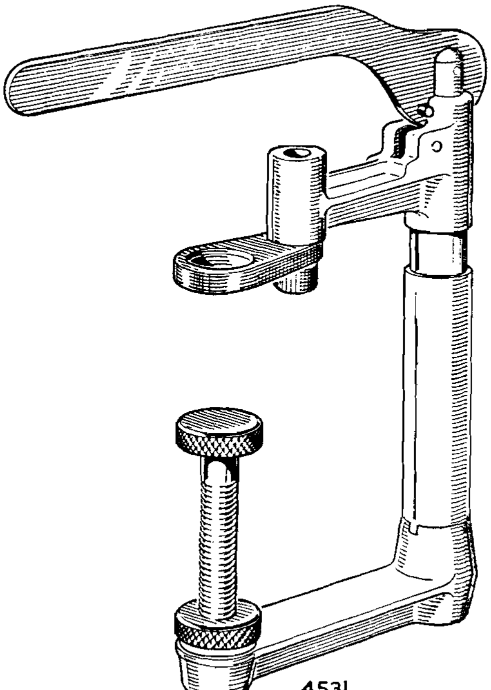
A multipurpose tool with alternative legs readily interchangeable, one pair with thin, flat ends designed for removing the chain wheel, and the other pair having tapered ends to engage the pulley grooves.


AD913A

18G3. Engine Front Cover Locating Bush

This tool ensures that the oil seal and cover are concentric with the crankshaft, thus safeguarding against oil leaks. The tool is double-ended to make its use applicable to crankshafts and front covers of different dimensions.


AD915


4531

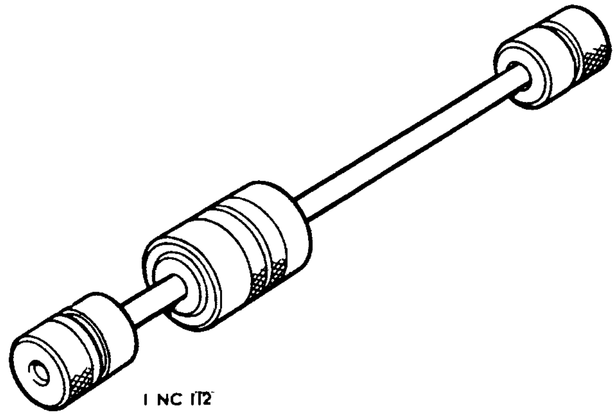
18G45. Valve Spring Compressor

This tool is designed with a cam and lever action which is both positive and speedy. The adaptor ring which contacts the valve spring caps is specially shaped to facilitate the removal and replacement of the split collets. A screw adjustment is also provided.

18G29. Valve Grinding-in Tool

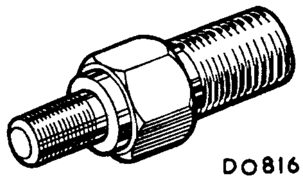
This suction-type tool has a handle of convenient length to enable it to be rotated backwards and forwards between the palms of the hands when grinding the valve faces and seats.

18G 284. Impulse Extractor (basic tool)



18G 284

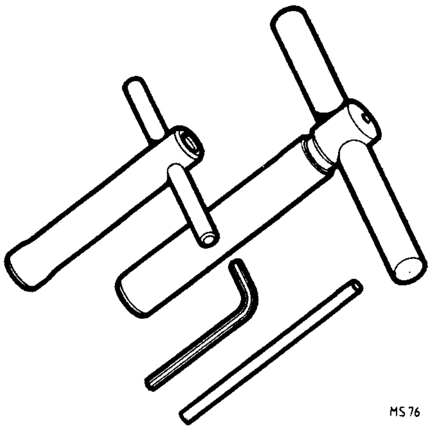
18G 284 AH. Bearing Cap Remover Adaptor



18G 284 AH

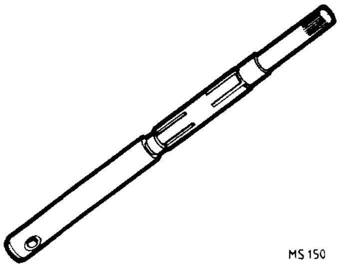
MS 76. Basic Handle Set

100-8 Tee wrench (use with MS 113 R and MS 120-7).
503 Tee wrench (use with all remaining cutters).
245 Puller pin.
240 Hexagon key wrench $\frac{5}{64}$ in.



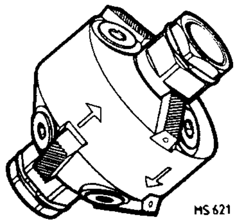
MS 76

MS 150-8·5. Expandable Pilot



MS 150

MS 621. Adjustable Cutter



MS 621

SECTION B

THE COOLING SYSTEM

(DIESEL MODELS)

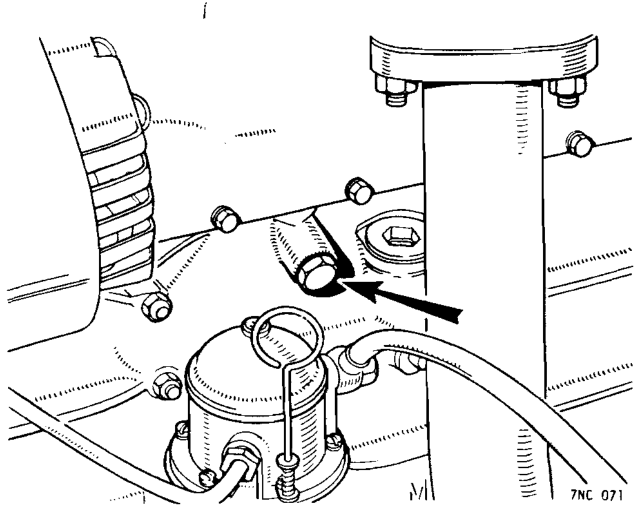


Fig. B.1
Cylinder block drain plug (2·52-litre engines)

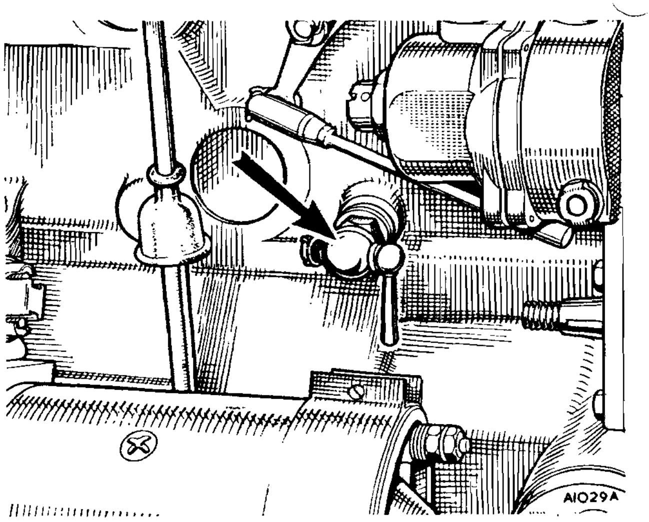


Fig. B.3
Cylinder block drain tap (2·2-litre engines)

Section B.1

DESCRIPTION

2·2-litre engines

The radiator incorporates an expansion chamber, which prevents the loss of water. When under operation the cooling water expands and rises, thus filling the expansion chamber.

The displaced air resulting from this escapes through a small overflow pipe connecting the top of the chamber with the bottom of the filler plug well. Should any further expansion take place, the water flows along this overflow pipe to the filler plug well, being drawn back into the radiator when the engine cools.

Topping up is only necessary very occasionally, to replace water lost through evaporation.

A drain tap is situated in the front of the bottom tank of the radiator.

2·52-litre engines

The radiator cap seals the radiator top tank and must not be removed when the engine is hot. The radiator filler neck is connected by a tube to an expansion tank situated on the wing valance. The radiator is completely filled with coolant and, as the temperature rises in the cooling system and the coolant expands, it spills into the expansion tank. On cooling down, the coolant is drawn back into the radiator from the expansion tank, thus maintaining a constant level in the cooling system. The cap fitted to the expansion tank has a pressure release valve incorporated to allow excess pressure in the system to escape, should this be necessary. No drain tap or plug is fitted to the radiator and the cylinder block drain plug is located on the left-hand side of the engine, just above the fuel lift pump. It is essential that the radiator and expansion tank caps are not interchanged, and coolant must be maintained to a depth of $2\frac{1}{2}$ in. (63·5 mm.) in the expansion tank.

On both types of system the coolant is circulated by a centrifugal impeller-type pump which is mounted on the front of the cylinder block and driven by a belt from the crankshaft.

A thermostat is installed in the outlet pipe, mounted on the front of the cylinder head, to retard the circulation of the water in the radiator until it has reached a predetermined temperature and so provide faster warming up of the engine.

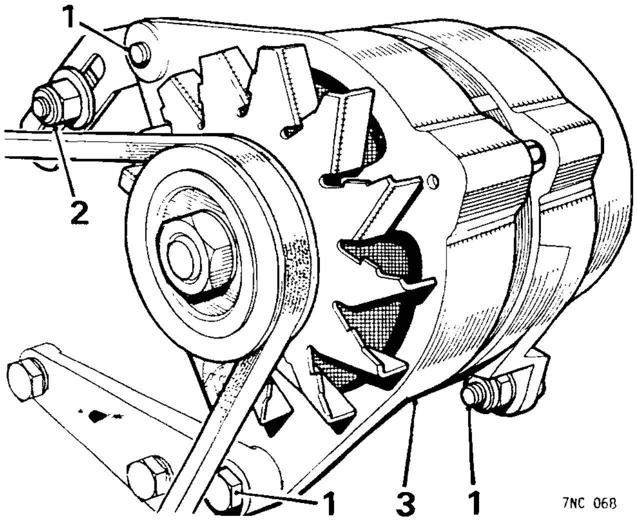


Fig. B.2
Drive belt adjustment (vehicles fitted with alternator)

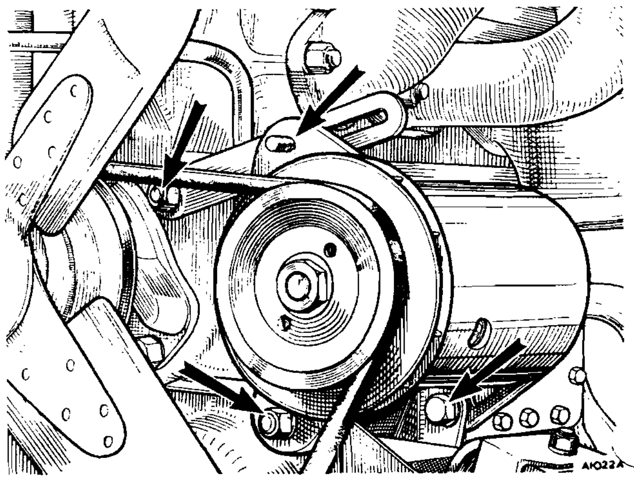


Fig. B.4
Drive belt adjustment (vehicles fitted with dynamo)

A drain tap is situated in the right-hand side of the cylinder block. Air is drawn through the radiator by a four-bladed fan which is mounted on the pump spindle.

Section B.2

ADJUSTMENTS IN THE VEHICLE

Vehicles fitted with dynamo

The purpose of the following adjustments is to maintain the performance of the fan, pump, and dynamo at their maximum, and it consists of moving the dynamo to adjust the tension of the belt. Proceed as detailed below.

Referring to Fig. B.4, slacken the two dynamo securing nuts and bolts, support the dynamo with one hand, and release the set bolt and the nut.

Using a hard hand pressure, press on the dynamo sufficiently to swing it away from the side of the cylinder block, thereby taking up any slackness in the belt.

The belt should be adjusted so that when the securing bolts and nut are finally locked up there is approximately ½ in. (13 mm.) lateral movement of the belt at the centre of the vertical run.

NOTE.—It is important that the fan belt is always run taut, as any slackness will cause slip and rapid wear of the belt.

Vehicles fitted with alternator

Use one of the following methods of checking the drive belt tension:

(*a*) Use a torque spanner and apply a load of 11·0 to 11·5 lbf. ft. (1·5 to 1·6 kgf. m.) in a clockwise direction to the alternator pulley retaining nut. If the belt tension is correct the belt will slip at this torque loading.

(*b*) Apply a load of 7·5 to 8·2 lbf. (3·3 to 3·6 kgf.) at right angles to the belt midway between pulleys. The belt should deflect 0·25 in. (6 mm.).

It is important that the belt tension is set correctly and if the correct tools are not available consult your Distributor or Dealer.

NOTE.—Fit a new belt with a moderate degree of tension, run the engine for five minutes at 1,000 r.p.m., stop the engine, then set the belt to the correct tension.

To adjust the belt tension slacken the pivot securing bolts (1, Fig. B.2) and the adjusting nut (2). Pivot the alternator away from the engine to increase the belt tension and tighten the adjusting nut. Leverage must only be applied against the drive end bracket (3). Tighten the pivot bolts and re-check the drive belt tension.

Section B.3

RADIATOR

To remove

Lift the bonnet.

Drain the cooling system.

Disconnect the inlet and outlet hose connections from the top and bottom of the radiator.

Detach the hose connecting the radiator filler neck to the expansion tank (2·52-litre models).

Disconnect the fog lamp cables, release the cables from the radiator, and move them to one side.

Release the radiator blind cable from its operating chain by removing the grub screw.

Remove the two screws and springs securing the blind, when the blind can be withdrawn.

Remove the six nuts and screws retaining the radiator to its support frame, remove the radiator drain tap, and withdraw the radiator upwards from the frame.

To view and overhaul

Inspect the radiator core for damage and test it for water leaks. Solder at the points where leakage occurs, or renew the core if necessary.

Inspect the drain tap for leaks, and renew it if necessary.

Inspect the hose connections for deteriorations, and renew them if necessary.

To install

Installation is a reversal of the procedure **'To remove'.**

Section B.4

THERMOSTAT

To remove

Drain the cooling system.

Disconnect the outlet and by-pass hoses from the outlet pipe.

Unscrew and remove the three nuts and plain washers from the water outlet pipe studs and remove the water outlet pipe and its gasket. Carefully prise out the thermostat retaining ring from its recess in the cylinder head and lift out the thermostat.

To view and overhaul

Test the thermostat opening temperature by immersing it in water at the temperature stamped on the thermostat. If the thermostat valve does not start to open, or the valve sticks in the fully open position, the thermostat should be renewed. No attempt should be made to repair the thermostat.

Clean the joint faces of the outlet pipe and the cylinder head.

To install

The installation of the thermostat is a reversal of the procedure **'To remove'.** Fit a new joint gasket between the outlet pipe and the cylinder head. In the case of an emergency the engine can be run with the thermostat removed.

Section B.5

FAN AND WATER PUMP ASSEMBLY (2·2-litre engines)

To remove

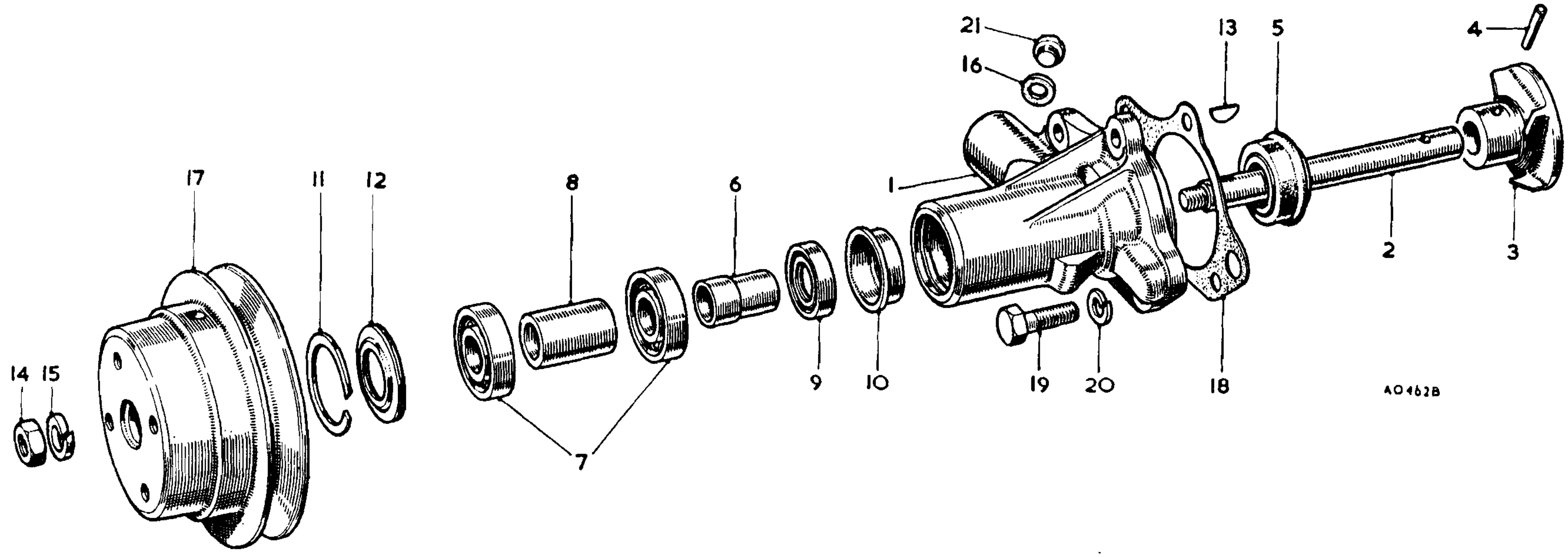
Remove the radiator.

Disconnect the inlet and by-pass hoses from the pump.

Slacken the dynamo securing bolts, swing the dynamo towards the cylinder block to release the tension of the belt, and remove the belt.

Remove the four bolts which secure the pump to the cylinder block and carefully withdraw the pump and fan assembly.

THE FAN AND WATER PUMP COMPONENTS



No.	Description	No.	Description	No.	Description
1.	Body.	8.	Distance piece for bearing.	15.	Washer for nut—spring.
2.	Spindle.	9.	Seal—oil.	16.	Washer for plug (fibre).
3.	Vane.	10.	Housing for seal.	17.	Pulley—fan and water pump.
4.	Taper pin.	11.	Ring—spring.	18.	Joint—water pump to crankcase.
5.	Seal.	12.	Retainer for bearing lubricant.	19.	Set screw—water pump to crankcase.
6.	Distance piece for vane.	13.	Key.	20.	Washer for set screw (spring).
7.	Bearing for spindle—ball.	14.	Nut for spindle.	21.	Plug—lubrication.

To dismantle

Remove the four set bolts and withdraw the fan blades from the pulley.

Remove the nut and spring washer from the front end of the water pump spindle; withdraw the pulley, using a suitable extractor, and remove the pulley key from the spindle.

Carefully remove any burrs from the spindle keyway and, using a hollow brass drift, drive the spindle and vane out of its bearings. Withdraw the vane distance piece and the water seal from the rear of the pump body.

Extract the bearing circlip from its groove in the front of the pump body; withdraw the dished grease retainer and, using tool 18G61, drive the bearings out of the pump body as follows.

Insert the driver (A) (Fig. B.5) into the rear bearing (D) and tap it downwards until the front bearing (E) and the distance piece (F) are released.

Position the dummy front bearing (B) in the pump body and screw the driver into the dummy bearing (Fig. B.6). The rear bearing is now aligned with the housing and may be gently tapped out.

Remove the bearing oil seal and its housing.

To view and overhaul

Clean all the dismantled pump parts.

Inspect the spindle for wear.

Inspect the seals for damage and wear. It is advisable to install new seals whenever the pump has been dismantled.

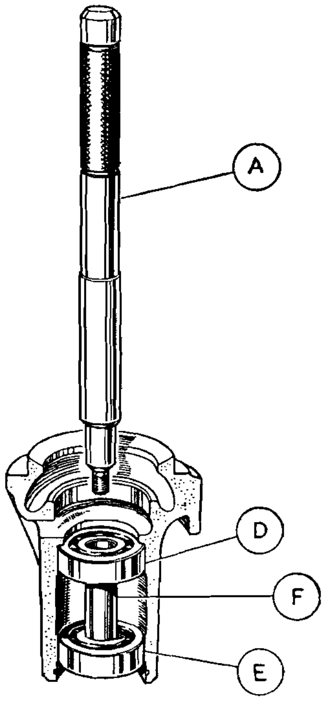


Fig. B.5

Water pump—removing the front bearing with tool 18G61

A. Drift. E. Front bearing.
D. Rear bearing. F. Distance piece.

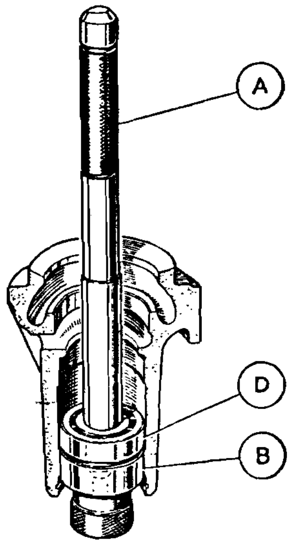


Fig. B.6

Water pump—removing the rear bearing with tool 18G61

A. Drift. B. Dummy front bearing.
D. Rear bearing.

Inspect the bearings for pits and scores. They should be renewed if evidence of excessive wear is detected. Coat the bearings with engine oil and wrap them in a clean cloth or paper until required for reassembly.

If the bearings do not fit properly in their operating positions renew the parts as required.

Inspect the fan belt carefully for stretching, uneven wear, or frayed fabric, and renew the belt if required.

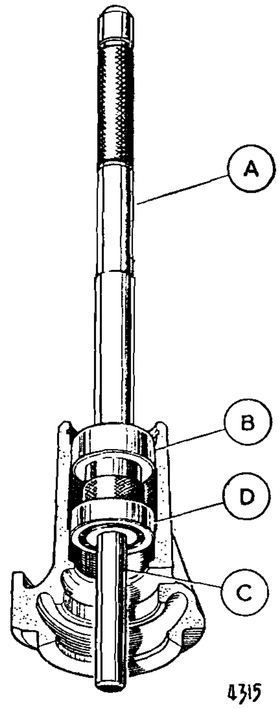


Fig. B.7

Water pump—installing the bearings with tool 18G61

A. Drift. C. Pilot.
B. Dummy front bearing. D. Rear bearing.

To reassemble

Reassembly is a reversal of the dismantling procedure, but to install the rear bearing assemble tool 18G61, thread the bearing onto the pilot as shown in Fig. B.7, and gently drive the bearing into its housing.

Repack the bearings with the recommended grease.

To install

The installation of the fan and pump assembly is a reversal of the procedure 'To remove'. Particular note should be made of the following.

Install a new joint gasket between the pump body and the cylinder block.

Adjust the fan belt.

Section B.6

DRAINING AND FLUSHING THE SYSTEM

To drain the system

When the car is to be stored the entire cooling system should be drained to protect against corrosion and, in certain instances, freezing. To drain the system proceed as follows.

With the car standing on level ground open the cylinder block and radiator drain taps or detach the bottom hose from the radiator when a drain tap is not fitted.

If the system contains anti-freeze solution it may be drained into clean containers, strained, and preserved for re-use.

Insert a length of wire into the open taps to disturb any sediment, etc., that may block the flow.

To prevent the possibility of operating the car with the system drained make sure that a suitable notice is placed on the car, or other suitable precautions taken.

To flush the system

If an inhibitor is not used the cooling system should be drained, cleaned, and flushed at intervals depending upon the local water conditions. Do not use strong caustic or acid solutions for cleaning purposes because they have a detrimental effect on various parts of the system. To clean and flush the system proceed as follows.

Drain the system completely as described above.

With a hose pipe, or fresh quantities of clean water, flush the system through until water issuing from the drain taps appears to be clean.

Allow the system to drain completely, then close the drain taps.

Fill the system with clean water (or anti-freeze solution) slowly, to allow air to escape past the thermostat valve, up to the level of the bottom of the filler neck threads.

Replace the filler cap by turning it approximately 90° in a clockwise direction.

Section B.7

COLD WEATHER PRECAUTIONS

When frost is expected, or when the car is to be used in very low temperatures or stand idle in an unheated place, care should be taken to prevent damage to the cylinder block and radiator. In these circumstances the water in the cooling system must be suitably mixed with an anti-freeze solution, as it is difficult to drain the cooling system completely.

We recommend the use of **Unipart universal anti-freeze.** If Unipart universal is not available any anti-freeze conforming to Specification B.S. 3151 or B.S. 3152 may be used. Anti-freezes to these specifications are compatible with Unipart universal and can be used with it. Unipart universal should not be mixed with other universal anti-freezes.

The overall anti-freeze concentration should not fall below 30% by volume, to ensure that the anti-corrosion properties of the coolant are maintained.

The anti-freeze solution should be made up in the following proportions:

2·2-litre engines

Anti-freeze	*Commences to freeze*		*Frozen solid*		*Amount of Anti-freeze*			
					Petrol models		*Diesel models*	
%	°C.	°F.	°C.	°F.	*Pints*	*Litres*	*Pints*	*Litres*
33⅓	−19	−2	−36	−33	7	4·0	6½	3·7
50	−36	−33	−48	−53	10½	6·0	9¾	5·5

2·52-litre diesel engine

Solution	*Commences to freeze*		*Frozen solid*		*Amount of Anti-freeze (including heater)*		
%	°C.	°F.	°C.	°F.	*Pints*	*U.S. pints*	*Litres*
33⅓	−19	−2	−36	−33	6½	7¾	3·6
50	−36	−33	−48	−53	9½	11½	5·4

On vehicles fitted with a separate expansion tank in the cooling system, ¼ pint (·3 U.S. pints, ·14 litre) of undiluted anti-freeze must be added to the water in the expansion tank. This amount is not included in the amounts of anti-freeze quoted in the above tables.

It is advisable for cars with an anti-freeze solution in the cooling system to have an identification mark on the header tank of the radiator.

The following precautions are necessary on cars so marked.

Make sure that the strength of the mixture is, in fact, up to that instructed on the container of the particular anti-freeze solution used.

The strength of the mixture must be maintained by topping up with the anti-freeze solution as necessary when the system is hot. Topping up with water alone tends to reduce the degree of protection provided.

Anti-freeze can remain in the system for two winters. Check the specific gravity of the solution at the beginning of the second winter and, if necessary, add anti-freeze to adjust the strength of the solution. Drain the system at the end of the second winter and refill with fresh coolant or anti-freeze solution as weather conditions require.

It is recommended that anti-freeze be used all the year round to assist in the prevention of sludge in the cooling system.

If the cooling system has to be emptied run the contents into clean containers, strain, and use again.

If for any reason the coolant is lost and the system is filled with water **remove the identification mark from the radiator header tank.**

In extreme cold conditions use a greater proportion of anti-freeze solution. Consult your local agent for the correct quantity.

Section B.8

WATER PUMP ASSEMBLY

(2·52-litre diesel engine)

Removing

Remove the radiator.

Disconnect the inlet hose from the pump.

Slacken the dynamo securing bolts, swing the dynamo towards the engine and remove the fan belt.

Remove the four screws retaining the pump to the cylinder block and detach the pump assembly.

Dismantling

Remove the screws retaining the fan and pulley to the water pump hub and detach the fan and pulley.

Press the hub from the bearing spindle and press the bearing assembly out of the water pump body.

Press the vane from the bearing spindle and remove the seal assembly.

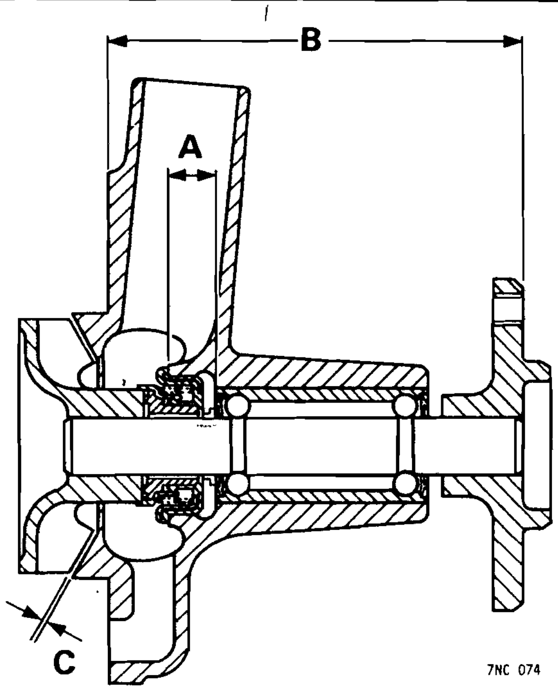


Fig. B.8

The 2·52-litre diesel engine water pump

A = ·528 to ·538 in. (13·4 to 13·65 mm.).
B = 4·334 to 4·354 in. (110·10 to 110·60 mm.).
C = ·025 to ·035 in. (·635 to ·900 mm.).

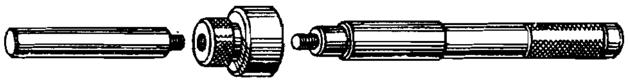
Reassembling

Examine the bearing assembly and water seal for wear or damage, and renew as necessary. Renew the fan pulley hub. Press the bearing assembly into the pump body to the dimension illustrated (Fig. B.8).

Support the bearing spindle and press on a new hub to the correct dimension (see Fig. B.8). Refit the water seal, support the bearing spindle and press on the vane to give the clearance illustrated in Fig. B.8.

SERVICE TOOLS

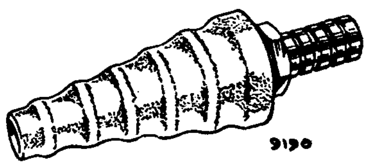
18G61. Water Pump Bearing Remover and Replacer



18G61

18G187. Radiator Reverse-flush Adaptors

The adaptors should be used in pairs.



18G187

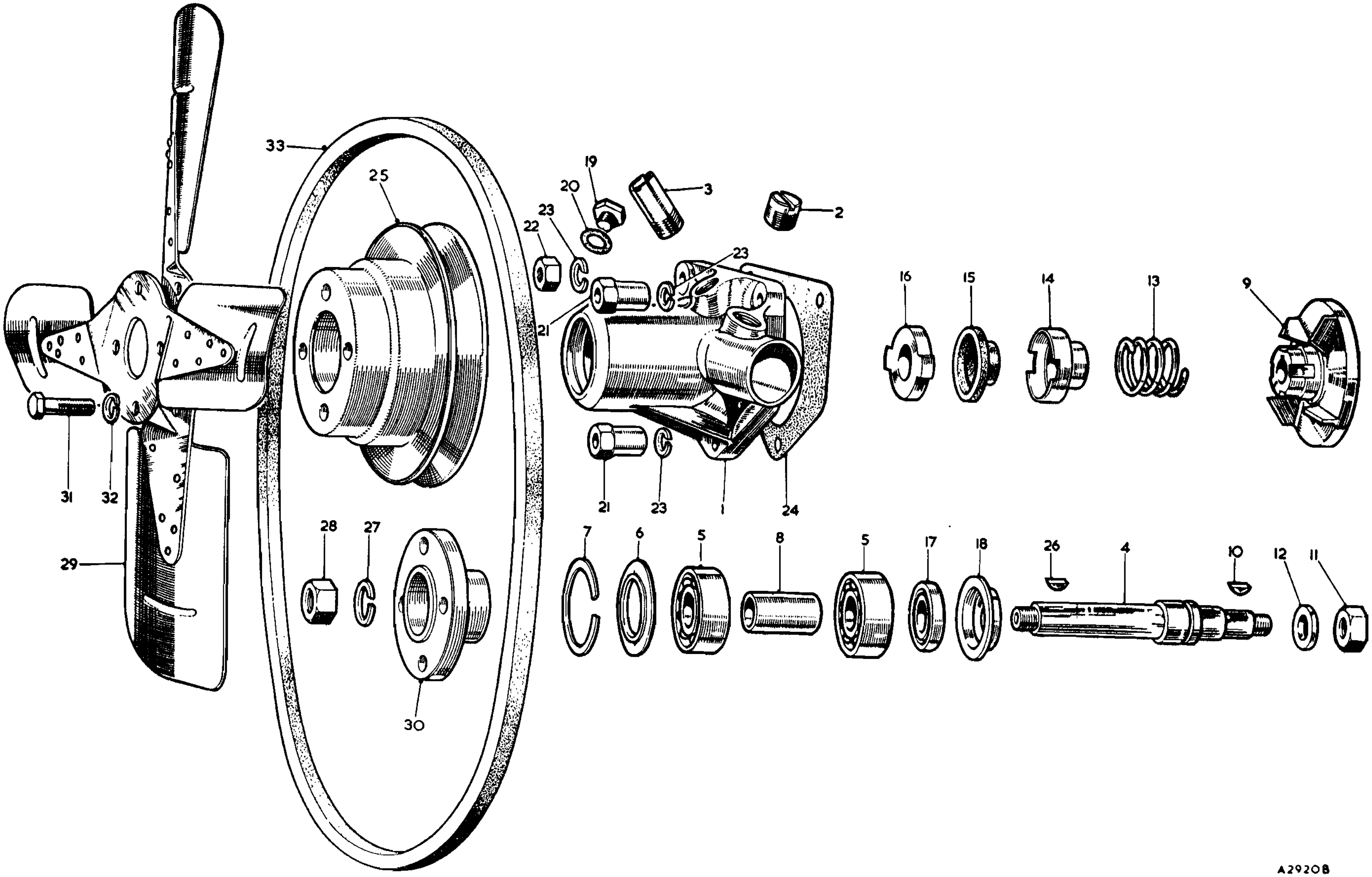
SECTION Ba

THE COOLING SYSTEM

(PETROL MODELS)

For all other information of the Cooling System for petrol models refer to Section B.

THE WATER PUMP COMPONENTS



KEY TO THE WATER PUMP COMPONENTS

No.	*Description*	*No.*	*Description*	*No.*	*Description*
1.	Water pump body.	12.	Fibre washer.	23.	Spring washer.
2.	Plug—heater connection.	13.	Gland spring.	24.	Joint washer.
3.	Adaptor for by-pass.	14.	Locating cup.	25.	Pulley.
4.	Spindle.	15.	Rubber seal.	26.	Key for hub.
5.	Bearing for spindle.	16.	Sealing ring.	27.	Spring washer.
6.	Grease retainer.	17.	Oil seal.	28.	Nut—hub to spindle.
7.	Spring ring.	18.	Oil seal housing.	29.	Fan blades.
8.	Distance piece.	19.	Lubricant plug	30.	Hub for pulley.
9.	Vane.	20.	Fibre washer.	31.	Screw—fan to pulley.
10.	Key for vane.	21.	Shouldered nut.	32.	Spring washer.
11.	Nut—vane to spindle.	22.	Plain nut.	33.	Fan belt.

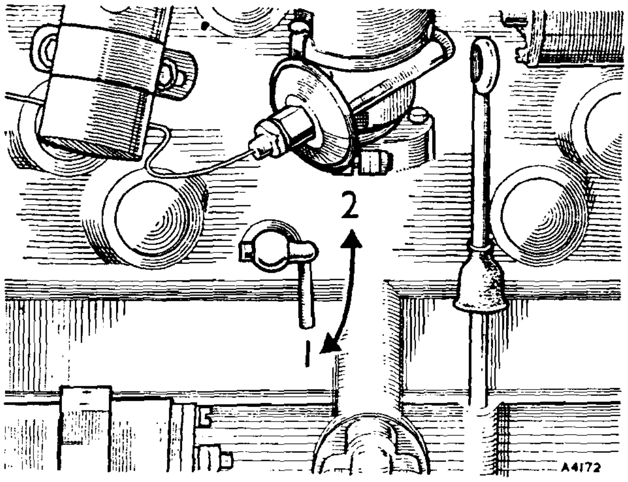


Fig. Ba.1
The cylinder block drain tap
1. Closed. 2. Open.

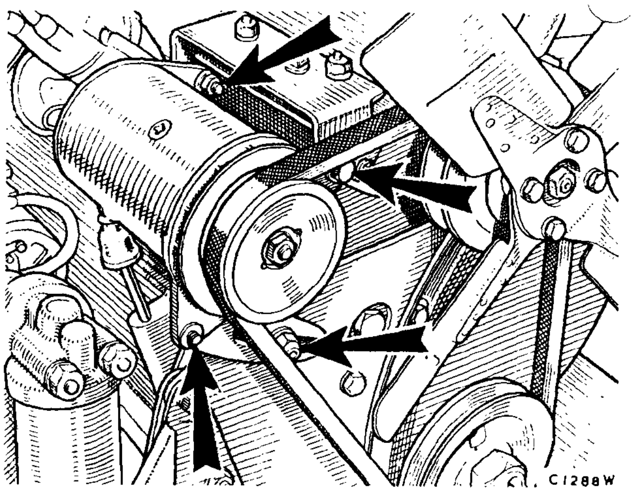


Fig. Ba.2
The dynamo mounting points which must be slackened for belt tension adjustment

Section Ba.1

ADJUSTMENTS IN THE VEHICLE

The instructions given in Section B.2 are to be followed. On the petrol engine the dynamo adjustment is located on the right-hand side.

Section Ba.2

THERMOSTAT

The instructions given in Section B.4 are to be followed. with the exception that, when testing, the opening temperature should read 73° C. (164° F.).

SECTION C

THE FUEL SYSTEM

(Diesel Models With 'In-line' Injection Pump)

Section C.1

FUEL LIFT PUMP

Description

The A.C.-Delco fuel lift pump is mounted on the side of the crankcase and is operated mechanically from an eccentric on the engine camshaft. A hand priming lever permits pumping a supply of fuel through the fuel filter to the injection pump for bleeding the system whenever any component has been dismantled or disconnected.

As the engine camshaft revolves the eccentric lifts the pump rocker arm, which pulls the pull-rod together with the diaphragm downwards against the spring pressure, thus creating a vacuum in the pump chamber.

Fuel drawn from the tank enters into the sediment chamber and then passes through the filter gauze, and the suction valve, into the pump chamber. On the return stroke the spring pressure pushes the diaphragm upwards, forcing the fuel from the chamber through the delivery valve and port to the fuel filter.

When the fuel filter is full a pressure is created in the pump chamber. This pressure will hold the diaphragm downward against the spring pressure, and it will remain in this position until the fuel filter requires further fuel. The rocker arm operates the connecting link and allows an idling movement of the rocker arm when there is no movement of the fuel pump diaphragm.

A spring keeps the rocker arm in constant contact with the eccentric, thus eliminating noise.

To remove

Support the fuel pipes to prevent them from turning and unscrew the two bolts which secure the pipes to the

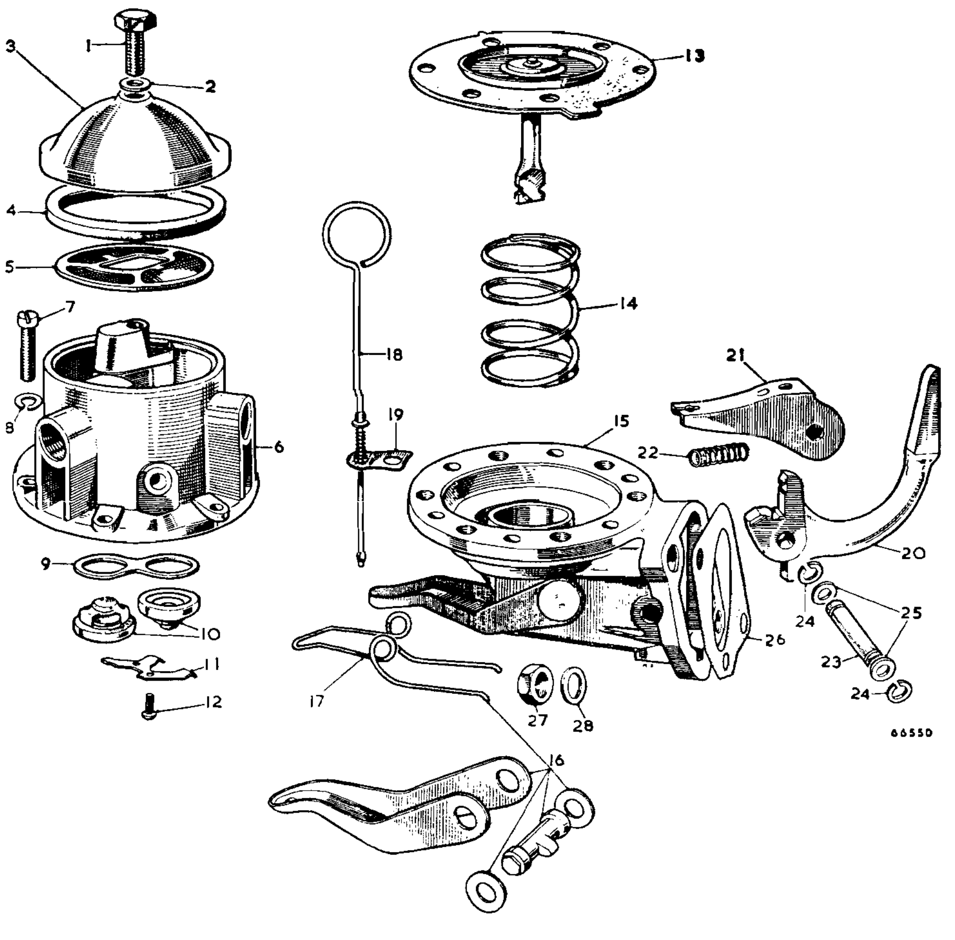


Fig. C.1
Fuel lift pump components

1. Screw for upper casting.
2. Washer for screw.
3. Cover.
4. Gasket for upper casting.
5. Screen—filter.
6. Upper casting.
7. Screw for upper casting.
8. Washer for screw.
9. Gasket.
10. Valve assembly.
11. Plate—valve retaining.
12. Screw—valve retaining.
13. Diaphragm assembly.
14. Spring—diaphragm.
15. Body and hand primer assembly.
16. Priming set.
17. Priming spring.
18. Primer pull-rod.
19. Plate—guide (priming lever).
20. Arm—rocker.
21. Link.
22. Spring for rocker arm.
23. Pin for rocker arm.
24. Clip for rocker pin.
25. Washer for rocker pin.
26. Joint—pump to crankcase.
27. Nut for pump stud (in block).
28. Washer for stud.

el lift pump. Take care not to lose the fibre washers positioned on each side of the banjo-type unions.

Remove the two nuts and spring washers which secure the pump to the crankcase and withdraw the pump complete with its gasket.

To dismantle

Before dismantling thoroughly clean the exterior of the pump and scribe a mark across the upper to lower half body joint flanges for guidance when reassembling.

Remove the set bolt and fibre washer securing the domed cover to the lift pump body; detach the dome cover and its cork sealing ring and lift off the filter gauze.

Unscrew the set screws and separate the two halves of the pump body.

Release the valve retaining plate from the upper half of the pump body by removing the two securing screws ıd lift out the inlet and outlet valves. Carefully remove the valve gasket.

Lightly press the centre of the diaphragm downwards to take the weight of the return spring; turn the diaphragm assembly clockwise through an angle of 90° to release the diaphragm pull-rod from the operating link fork and withdraw the diaphragm assembly and its return spring.

Remove the retaining clips from the ends of the rocker arm pin and press the pin out of the body, which will release the rocker arm, rocker arm distance washers, rocker arm springs, and link.

Detach the spring from the priming lever and body assembly.

Further dismantling of the body is not advisable as the priming lever is secured to its spindle by riveting.

To reassemble

Before reassembling thoroughly clean all components in paraffin and blow the cavities clean with compressed air.

Check the body castings for cracks and, using a straight-edge, ensure that the diaphragm and engine mounting flanges are true. If they are found to be distorted they may be lapped to restore their flatness.

Examine the two valve assemblies for signs of wear and renew them if they are not in perfect condition.

Very little wear should be tolerated on the rocker arm pin and rocker linkage. Slight wear on the working face of the rocker arm which engages the camshaft is permissible, but if it exceeds ·010 in. (·25 mm.) the rocker arm should be renewed.

The diaphragm spring seldom requires renewing, but should it be necessary, ensure that the new spring bears the same identification colour as the original spring.

Reassembly is a reversal of the dismantling procedure, ting the following.

To install the valves, first place a new gasket in position and then insert the outlet valve, spring end foremost, into its port. The inlet valve cannot be installed incorrectly owing to a restriction in the port.

The rocker arm pin should be a tap fit in the body and if, due to wear, it is freer than this the holes in the body may be closed by peening to restore the fit.

When installing the diaphragm and pull-rod assembly ensure that the upper end of the diaphragm return spring is centred properly in the diaphragm lower protector washer and place the diaphragm in the pump body with its locating tab in the 11 o'clock position (see Fig C.2). Press the diaphragm downwards and turn it anti-clockwise through an angle of 90° to engage the slots in the pull-rod with the link fork. This will place the pull-rod in the correct working position and at the same time align the holes in the diaphragm with those in the pump body flange.

To assemble the two pump body sub-assemblies push the rocker arm towards the pump body until the diaphragm is level with the body joint flange. Place the

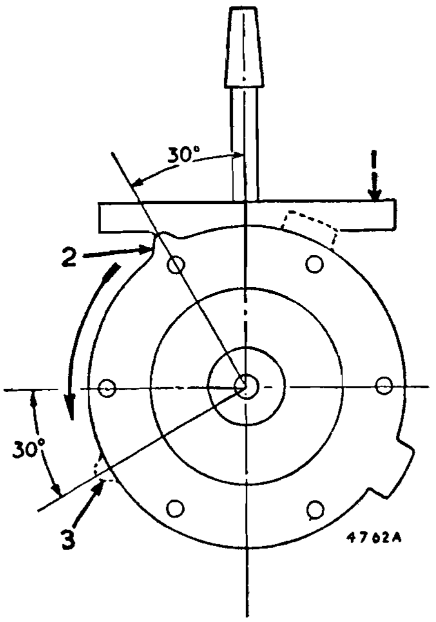


Fig. C.2

1. Pump mounting flange.
2. Initial position of diaphragm locating tab.
3. Final position of diaphragm locating tab.

upper half of the pump in position, ensuring that the marks scribed on the joint flanges during dismantling coincide, and install the body securing screws finger-tight. Push the rocker arm towards the pump body to position the diaphragm at the bottom of its stroke. With the diaphragm held in this position tighten the body securing screws in a diagonal sequence.

To test

In the absence of special test equipment the assembled pump should be tested before installation on the engine as follows.

Immerse the pump in a bath of clean paraffin and flush it through by operating the rocker arm six to eight times. Remove and empty the pump; seal the suction side of the pump, placing a finger firmly over the inlet union (marked 'IN') and operate the rocker arm several times. Upon removal of the finger from the inlet union a distinct sucking noise should be heard, denoting that the pump has developed a reasonable degree of suction.

In a similar manner seal the delivery side of the pump (marked 'OUT') and press the rocker arm inwards to charge the pumping chamber with air. If the pump is in good condition the air in the pumping chamber should be held under compression for two or three seconds. Finally, repeat this test, but immediately the pumping chamber is charged with air immerse the pump in a bath of clean paraffin and inspect the diaphragm clamping flanges for signs of air leakage.

To install

Before installing the pump, which is a reversal of the procedure to remove, lubricate the rocker arm and the rocker arm pin with clean engine oil.

Renew the gasket between the pump and the cylinder block, and to facilitate the fitting of the pump crank the engine to bring the eccentric on the camshaft into the extreme released position so that its small side will contact the rocker arm.

After installation bleed the fuel system of air as described in Section C.2; start the engine and check the pump and its fuel line connections for leaks. After correcting any leaks the fuel system must be re-bled.

Section C.2

FUEL FILTER

Construction and operation

The fuel filter, which is mounted on the front right-hand side of the cylinder head, is of the cross-flow type, the inlet and outlet unions being carried on the cover. A cap nut, retained in the cover by a circlip, carries a bleed plug, thus permitting the filter to be air-vented after completing any maintenance on the fuel system.

The renewable paper element is contained in a thin metal canister and is located on the central fixing stud of the pressed-steel bowl by a metal locating sleeve. At each end of the element central core is a sealing ring which, under the pressure of the element spring, effectively excludes unfiltered fuel from the clean side of the element. A leak-off union, positioned at the highest point on the filter cover, prevents excessive pressure being built up inside the filter and also provides automatic air-venting of the filter during service. The large rubber ring in the filter head effects a seal between the body and cover, these two parts being secured together by the cap nut and centre-fixing stud. A drain plug in the base of the filter bowl allows the fuel to be drained from the filter prior to dismantling.

Fuel from the lift pump enters the filter bowl via the inlet port and surrounds the filter element. As the element central core is sealed at each end the only passage for the fuel is through the element to the outlet port in the filter head.

The element should be renewed at the intervals recommended in the Driver's Handbook unless the engine misfires or runs in an erratic manner owing to fuel starvation due to a choked element, when the element must be renewed irrespective of the distance run.

To remove and dismantle the fuel filter

Unscrew the air bleed plug to allow air to enter the filter, remove the drain plug from the base of the filter bowl, and drain the fuel from the filter into a suitable receptacle.

Disconnect the fuel inlet and outlet pipes and the fuel leak-off pipe from the filter head, taking care not to lose the sealing washers positioned on each side of the banjo-type unions.

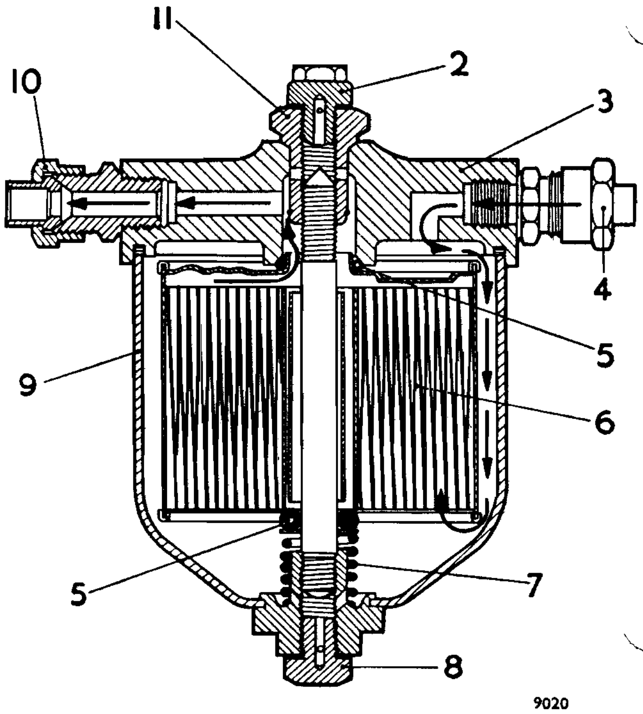


Fig. C.3

Fuel filter

2.	Air vent plug.	7.	Pressure spring.
3.	Cover.	8.	Drain plug.
4.	Inlet connection.	9.	Filter body.
5.	Oil seal.	10.	Outlet connection.
6.	Paper element.	11.	Cap nut.

Unscrew the two large bolts securing the filter to the cylinder head and withdraw the filter from the engine.

Unscrew the cap nut, separate the head from the filter bowl, and withdraw the element complete with its upper sealing ring.

Remove the element locating sleeve from the filter bowl fixing stud and withdraw the element lower sealing ring, plain washer, and pressure spring.

Detach the filter bowl sealing ring from the recess in the filter head. If necessary, remove the cap nut from the filter head after prising off its retaining clip.

Servicing the fuel filter

Thoroughly clean the outside of the filter head and bowl. Slacken the air bleed plug to allow air to enter the filter; release the drain plug in the base of the filter bowl and drain the fuel from the filter into a suitable receptacle.

Unscrew the cap nut to release the filter bowl and withdraw the bowl complete with filter element.

Remove and discard the old element—no attempt should be made to clean a paper element—and scoop out any appreciable sediment in the bowl, taking care not to allow any sediment to foul the clean portion of the bowl fixing stud above the lower sealing ring.

Install a new element complete with upper sealing ring into the filter bowl. Ensure that the sealing ring is in good condition and correctly positioned on the filter element and reassemble the bowl to the filter head.

Tighten the cap nut and drain plug and bleed the fuel system of air (see below).

To reassemble and install the fuel filter

Before reassembling, which is a reversal of the dismantling procedure, wash all components (except the filter element, which is not intended to be cleaned and should be renewed) in petrol. Allow the components to dry, ensure that the drain holes in the filter bowl and drain plug are clean, and remove all traces of sediment, using a dry air blast to clear the ports in the filter head.

Install the reassembled filter on the cylinder head and reconnect the fuel and leak-off pipes, ensuring that the washers positioned on each side of the banjo-type unions are in good condition and will make a fueltight seal.

Finally, bleed the fuel system as described below.

To eliminate air from the fuel system (bleeding)

One possible cause of the engine failing to start or of erratic engine acceleration is that air may have entered the fuel system either through a leaking joint, the fuel tank being allowed to become empty, or any part of the system being dismantled. It is imperative that no air is present in the fuel system and that there is no leakage at any joint or union.

Although bleeding the fuel system is quite a simple operation, care should be exercised to obviate the casual handling which this operation frequently receives. In all cases of fuel filter or fuel line attention cleanliness is most essential to the efficiency and life of the engine.

When bleeding becomes necessary ensure that an adequate supply of fuel is in the tank and then proceed as follows.

First bleed the fuel filter; slacken the bleed plug (see Fig. C.4) on the filter head and then operate the priming lever on the fuel lift pump until the fuel flowing from the bleed plug is free from air bubbles. Immediately this occurs tighten the bleed plug.

Secondly, bleed the fuel injection pump; slacken the bleed tap on the pump (see Fig. C.5) and again operate the priming lever on the fuel lift pump until the fuel flowing from the bleed tap is free from air bubbles, then tighten the tap.

Finally, bleed the fuel injector feed pipes. Start the engine and allow it to idle; then, dealing with each pipe in turn, slacken the union nut at the injector nozzle holder end of the pipe sufficiently to allow the fuel to seep past the threads without frothing. Immediately the fuel flowing from the pipe is free from air bubbles tighten the union nut.

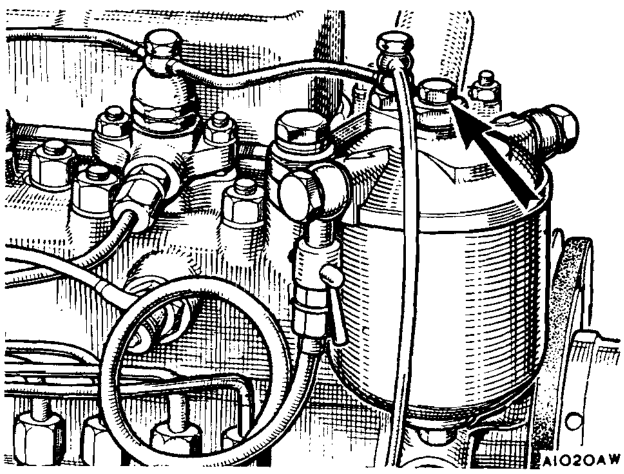


Fig. C.4
The fuel filter air bleed plug

Section C.3

INJECTION PUMP

Description

The pump is of the camshaft-operated, spring return, plunger type employing one pumping unit for each cylinder of the engine. Barrels, plungers, valves, and seatings are of highly ground steel finished to fine limits and each pair should be regarded as inseparable and not interchangeable.

The pump is flange-mounted to the engine timing case and is driven from the camshaft via a sprocket and endless triplex chain tensioned by a jockey-type tensioner.

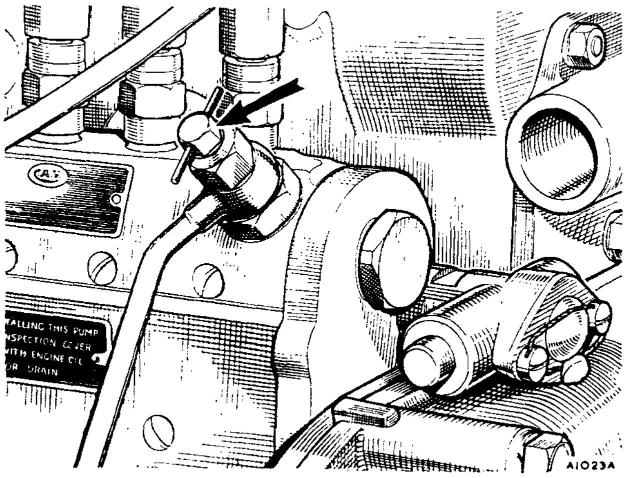
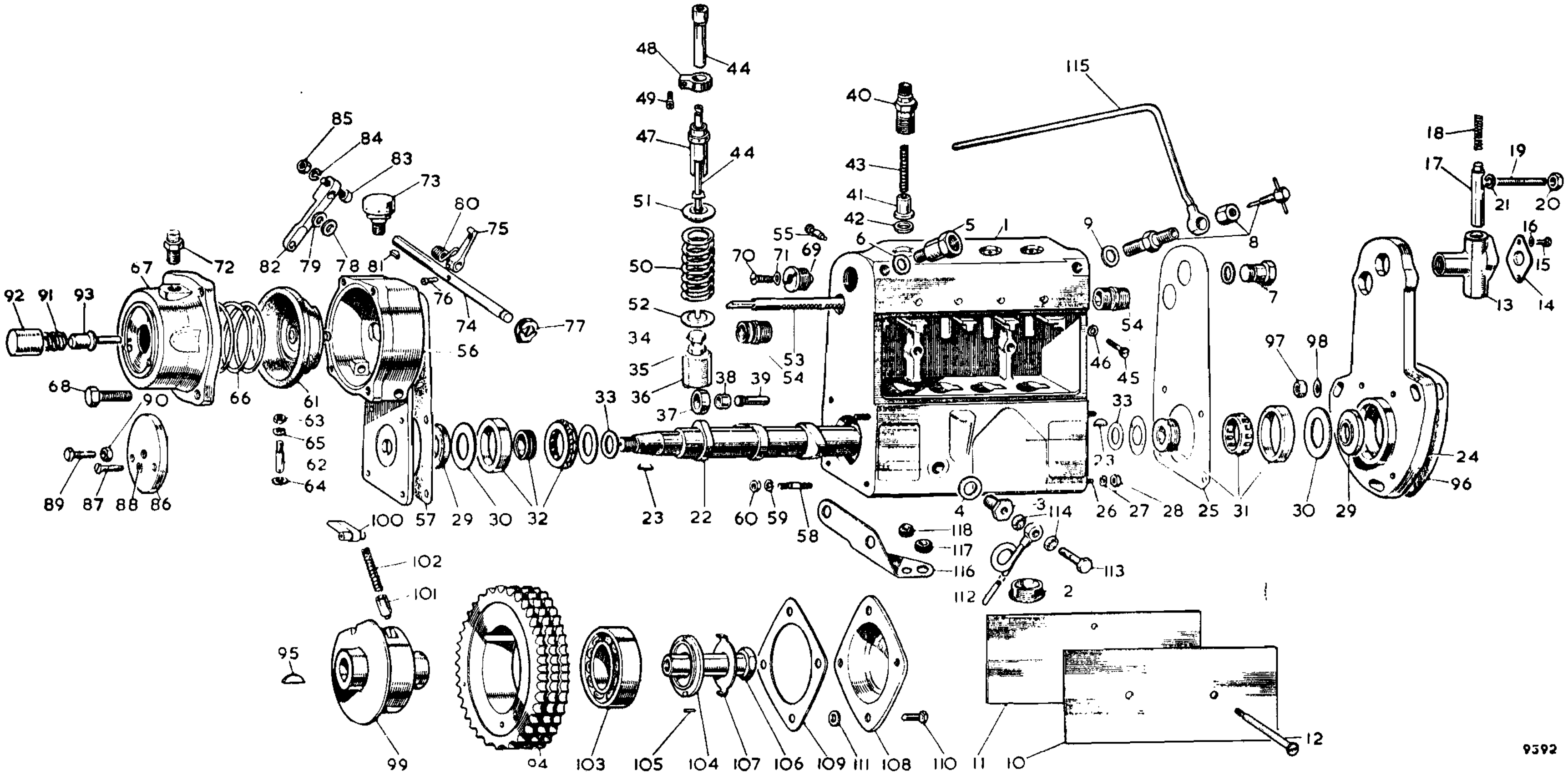


Fig. C.5
The fuel injection pump air bleed tap

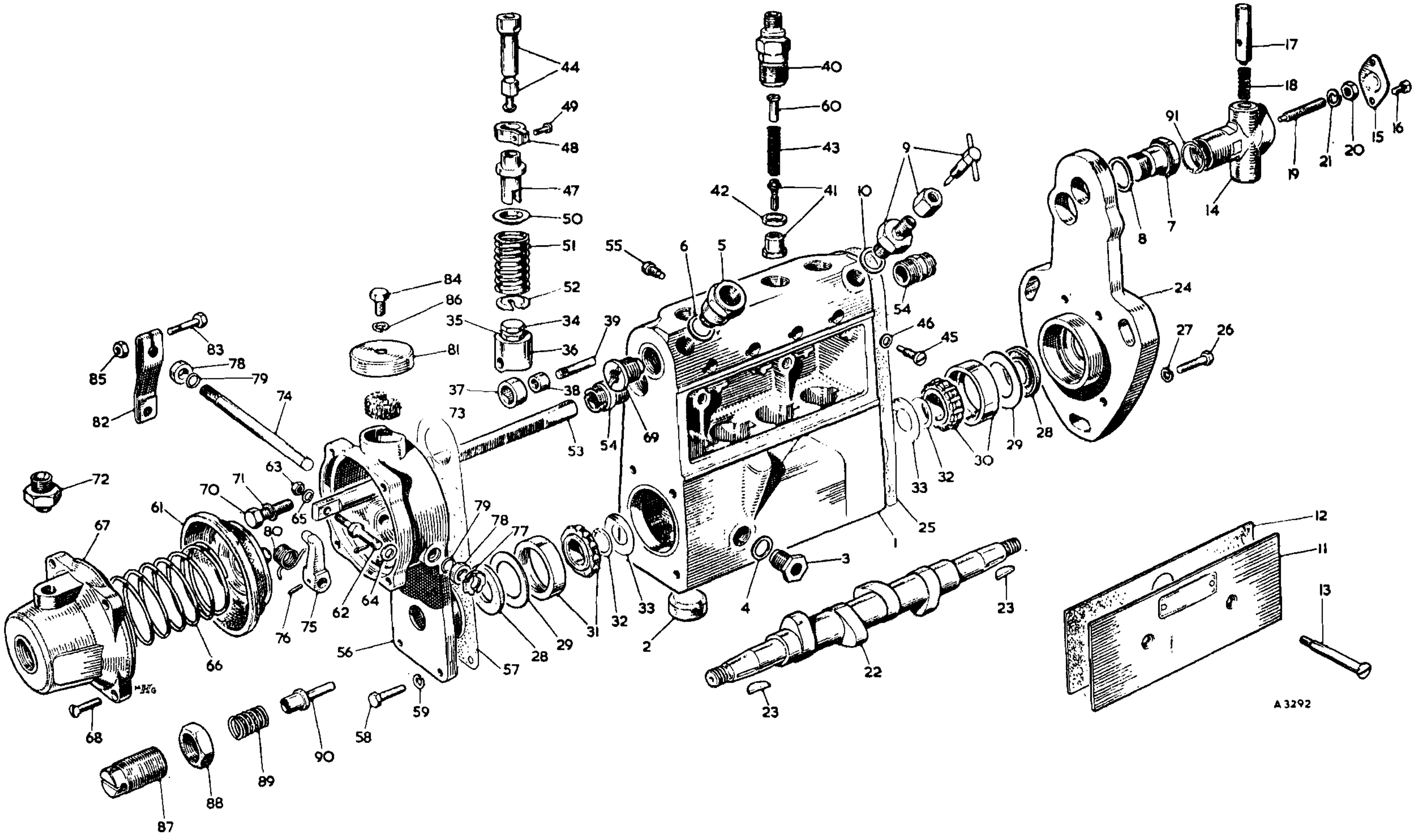
THE 'IN-LINE' FUEL INJECTION PUMP (EARLY TYPE) COMPONENTS



KEY TO THE 'IN-LINE' FUEL INJECTION PUMP (EARLY TYPE) COMPONENTS

No.	Description
1.	Body—injection pump.
2.	Plug—base sealing.
3.	Body—oil drain level.
4.	Washer for body—joint.
5.	Adaptor—inlet connection.
6.	Joint for adaptor.
7.	Plug—inlet closing.
8.	Cock—air vent.
9.	Washer for vent cock—joint.
10.	Cover—inspection.
11.	Joint for cover.
12.	Screw—cover to pump body.
13.	Body—excess fuel device.
14.	Cover for body.
15.	Screw—cover to body.
16.	Washer for screw.
17.	Plunger.
18.	Spring—plunger.
19.	Stud—stop.
20.	Locknut.
21.	Washer for locknut—spring.
22.	Camshaft.
23.	Key for camshaft.
24.	Endplate for bearing.
25.	Joint for plate.
26.	Stud—plate to body.
27.	Washer for stud—spring.
28.	Nut for stud.
29.	Seal for endplate—oil.
30.	Shim for oil seal.
31.	Bearing—roller.
32.	Bearing—ball.
33.	Shim for camshaft.
34.	Tappet.
35.	Locknut for tappet.
36.	Guide—tappet.
37.	Roller—tappet.
38.	Bush for tappet.
39.	Pin for roller.
40.	Holder—delivery valve.
41.	Valve—delivery.
42.	Washer for delivery valve—joint.
43.	Spring—valve.
44.	Elements—barrel and plunger assembly.
45.	Pin—barrel locking.
46.	Cup for pin—sealing.
47.	Sleeve—control.
48.	Quadrant—regulating—toothed.
49.	Screw for quadrant.
50.	Spring—plunger.
51.	Plate—spring—upper.
52.	Plate—spring—lower.
53.	Rod—control.
54.	Bush for control rod.
55.	Screw—locating.
56.	Housing—governor.
57.	Joint for governor housing.
58.	Stud—governor housing.
59.	Washer for stud—spring.
60.	Nut for stud.
61.	Diaphragm.
62.	Pin—diaphragm.
63.	Nut for pin.
64.	Washer for pin—plain.
65.	Washer for pin—spring.
66.	Spring—main.
67.	Cover—diaphragm.
68.	Screw—housing to cover.
69.	Bush—fixing.
70.	Screw for bush.
71.	Washer for screw—spring.
72.	Union—venturi connection.
73.	Breather—governor housing.
74.	Spindle—governor housing.
75.	Pawl for spindle.
76.	Pin—pawl fixing.
77.	Clip—spring.
78.	Washer—spindle.
79.	Washer—spindle—sealing.
80.	Spring for pawl.
81.	Key for spindle.
82.	Lever—manual control.
83.	Screw for lever.
84.	Washer for screw.
85.	Nut for screw.
86.	Cap for diaphragm cover—end.
87.	Screw—end cap to cover.
88.	Washer for screw.
89.	Screw—tension.
90.	Locknut for screw.
91.	Spring—idling.
92.	Sleeve for spring.
93.	Pin—control.
94.	Gear—injection pump.
95.	Key for gear.
96.	Joint—injection pump to front plate.
97.	Nut for pump flange.
98.	Washer for nut.
99.	Hub—injection pump gear.
100.	Pawl—injection pump gear.
101.	Plunger for hub.
102.	Spring for plunger.
103.	Bearing for pump—roller.
104.	Collar for bearing—clamping.
105.	Pin—locating.
106.	Nut—injection pump gear to spindle.
107.	Lock washer for nut.
108.	Cover—front bearing.
109.	Joint for cover.
110.	Screw—bearing cover to front cover.
111.	Washer for screw (fibre).
112.	Pipe—drain—injection pump cam box.
113.	Pin for banjo of pipe.
114.	Washer for pin (copper).
115.	Pipe for injection pump—air.
116.	Bracket for pipes.
117.	Grommet for drain pipe.
118.	Grommet for drain pipe.

THE 'IN-LINE' FUEL INJECTION PUMP (LATER TYPE) COMPONENTS



KEY TO THE 'IN-LINE' FUEL INJECTION PUMP (LATER TYPE) COMPONENTS

No.	*Description*
1.	Pump body.
2.	Closing plug.
3.	Oil drain level body.
4.	Joint washer.
5.	Inlet connection adaptor.
6.	Joint washer.
7.	Inlet closing plug.
8.	Joint washer.
9.	Air bleed tap.
10.	Joint washer.
11.	Inspection cover.
12.	Joint for cover.
13.	Screw for cover.
14.	Excess fuel device body.
15.	Cover for body.
16.	Screw for cover.
17.	Plunger—excess fuel.
18.	Spring for plunger.
19.	Maximum fuel stop screw.
20.	Locknut.
21.	Spring washer.
22.	Camshaft.
23.	Key to camshaft.
24.	Bearing end plate.
25.	End plate joint.
26.	Screw for end plate.
27.	Spring washer.
28.	Bearing oil seal.
29.	Shim for oil seal.
30.	Roller bearing.
31.	Ball bearing.
32.	Shim for bearing.
33.	Washer for camshaft.
34.	Tappet screw.
35.	Locknut for tappet.
36.	Tappet body.
37.	Roller for tappet.
38.	Bush for roller.
39.	Pin for roller.
40.	Delivery valve holder.
41.	Delivery valve.
42.	Joint washer.
43.	Valve spring.
44.	Barrel and plunger.
45.	Barrel locking screw.
46.	Washer for screw.
47.	Control sleeve.
48.	Regulating quadrant.
49.	Screw for quadrant.
50.	Spring plate (upper).
51.	Plunger spring.
52.	Spring plate (lower).
53.	Control rod.
54.	Bush for rod.
55.	Locating screw for rod.
56.	Governor housing.
57.	Joint for housing.
58.	Screw for housing.
59.	Spring washer.
60.	Delivery valve spring peg.
61.	Diaphragm.
62.	Connecting pin for diaphragm.
63.	Nut for pin.
64.	Plain washer.
65.	Spring washer.
66.	Main spring.
67.	Diaphragm cover.
68.	Screw for cover.
69.	Bush—fixing.
70.	Set screw for housing.
71.	Spring washer.
72.	Suction pipe union.
73.	Breather filter pad.
74.	Stop lever spindle.
75.	Pawl for spindle.
76.	Fixing pin for pawl.
77.	Clip for spindle.
78.	Washer for spindle.
79.	Seal for spindle.
80.	Spring for pawl.
81.	Breather filter cover.
82.	Stop lever.
83.	Screw for lever.
84.	Screw for breather filter.
85.	Nut for stop lever screw.
86.	Spring washer.
87.	Adjusting screw.
88.	Locknut.
89.	Damper valve spring.
90.	Control spring.
91.	Shim for excess fuel device.

The pump has its own integral camshaft and contains the element assemblies, comprising barrels, plungers, springs, and delivery valves, each element serving one cylinder of the engine (see Fig. C.6). These components are of high-quality steel and the working surfaces are lapped together to ensure efficient operation at high speeds and pressures. Whenever servicing of the pump is carried out, therefore, it is essential that delivery valves are replaced on their correct seatings and plungers mated to the particular barrels from which they were removed.

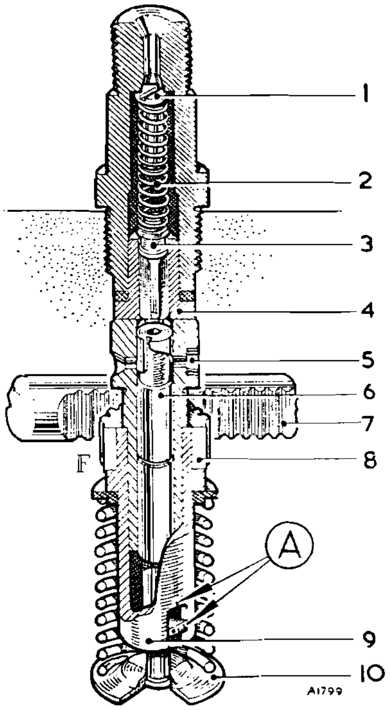


Fig. C.6

Injection pump element

1. Spring peg.
2. Delivery valve spring.
3. Delivery valve.
4. Delivery valve seat.
5. Barrel.
6. Plunger.
7. Control rod.
8. Quadrant.
9. Sleeve.
10. Spring plate—lower.

A. Plunger and sleeve assembly marks.

To control the quantity of fuel delivered per stroke each plunger is provided with a vertical channel (see Fig. C.6) extending from its top face to a helical groove. By altering the position of the groove in relation to the ports in the element barrel the effective pumping stroke is correspondingly increased or decreased.

When the pump plunger is at B.D.C. position, as shown in (*a*), Fig. C.7, fuel can enter the barrel from the pump suction chamber via the inlet ports. As the plunger rises under the influence of its cam fuel is pushed back through the inlet ports until the plunger reaches position (*b*), when the top land of the plunger has closed both ports. Fuel is now trapped in the space between the plunger and spring-loaded delivery valve. The pressure exerted upon the fuel by the still-rising plunger causes the delivery valve to open against its spring and allows fuel to enter the pipe connecting the delivery valve to the injector on the engine. This pipe is, however, already full of fuel. and the incoming charge causes a sudden rise in pressure, which lifts the injector nozzle valve off its seatings and allows fuel to be sprayed into the engine combustion chamber.

When the plunger reaches the position shown at (*c*) the upper edge of the helical groove uncovers the 'spill' port in the barrel and fuel above the plunger is by-passed to the suction chamber by way of the vertical channel. The consequent reduction in pressure above the plunger causes the delivery valve and the injector nozzle valve to close under the action of their springs.

From the foregoing it will be seen that the distance travelled between positions (*b*) and (*c*) is the effective pumping portion of the plunger stroke. In order to increase or reduce the quantity of fuel pumped per stroke the distance between (*b*) and (*c*) can be altered by rotating the plunger in its barrel to align a higher or lower portion of the upper edge of the helical groove to the spill port. Compare diagrams (*c*), (*d*), and (*e*), which show approximate positions of the helical groove for full load, half-load, and idling, respectively.

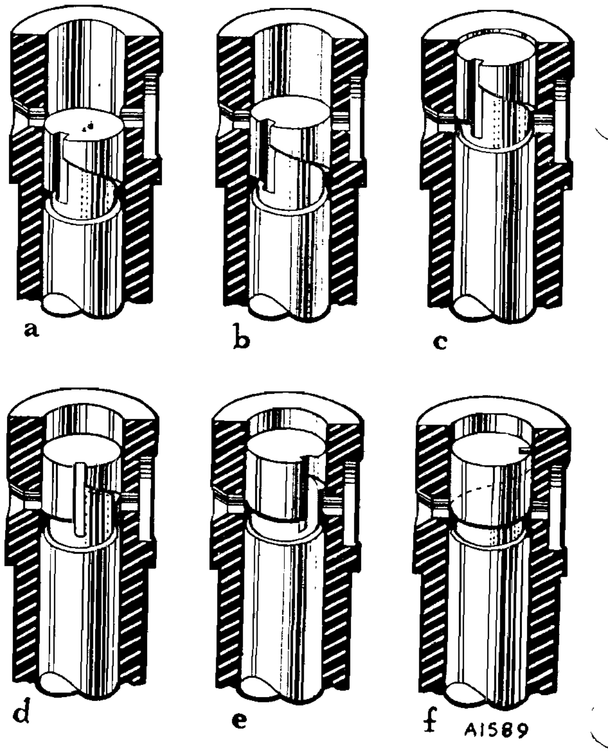


Fig. C.7

Illustrating the plunger action

The plunger is rotated by means of a toothed quadrant (8) (Fig. C.6) clamped to a sleeve (9) having a slot which engages with the lug, or toe, of the plunger. The quadrant (8) meshes with a rack on the control rod (7) which runs the whole length of the pump and also engages the quadrants of the other pumping elements. The movement of the control rod causes all the plungers to rotate in unison.

When the control rod is in the engine stopped position the vertical channel of each plunger is opposite the right-hand port of the barrel (*f*) (Fig. C.7), and fuel is by-passed to the suction chamber if the engine is turned.

The delivery valve, shown in Fig. C.8, is a mitre-faced valve provided with a collar and having four longitudinal grooves cut into its stem. When the valve lifts from its seat during the delivery stroke of the pump plunger,

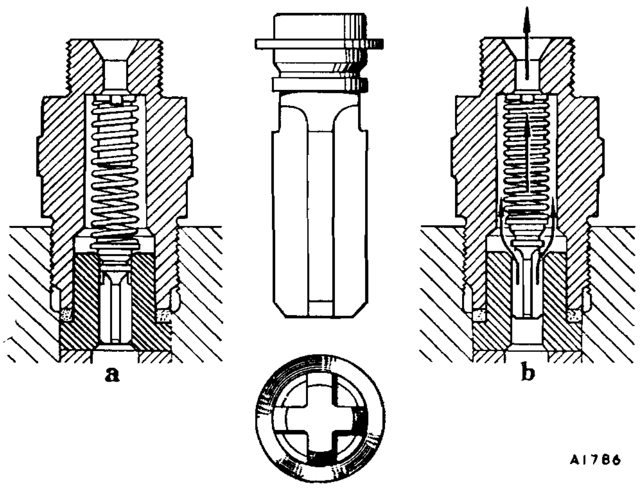


Fig. C.8

Injection pump delivery valve

(*a*) Valve closed. (*b*) Valve open.

fuel passes through the grooves in the stem and over the valve face into the pipe connected to the injector. Upon completion of the injection pump delivery stroke the pressure beneath the delivery valve decreases rapidly and the valve returns to its seat. In doing so, the collar beneath the valve face acts as a piston and by increasing the space in the delivery pipe effects a sudden reduction in pressure. This causes the injector nozzle valve to snap onto its seating and terminate the spray of fuel without dribble.

Lubrication of the pump camshaft and bearings, after initially filling the camshaft chamber with engine oil, is maintained by back-leakage of fuel oil past the pump plungers during the running of the engine. Any excess of lubricant is drained off via the leak-off plug and pipe on the side of the pump to maintain the correct oil level.

The governor is designed to control the output of the fuel injection pump and is detailed on page C.15.

An excess fuel device is fitted to the injection pump at the opposite end to the governor, its function being to allow extra fuel for starting under very cold conditions. The device is sealed and the seal should not be broken unless the pump is being dismantled.

Referring to Fig. C.9, a hole has been drilled in the control rod and a spring-loaded plunger with an adjustable screw regulates the amount of fuel required. When the engine is at rest the control rod of the pump is held hard against the maximum fuel stop screw under the influence of the governor diaphragm spring. If the plunger is now pressed into its housing against its spring the control rod will move past the normal maximum fuel position when the stop screw is in line with the hole in the control rod. The screw is reduced in diameter to allow entry into the hole in the end of the control rod.

When the engine is started the control rod, under the action of the governor, will be pulled towards the idling position and so allow the plunger, carrying the stop screw, to take up its normal maximum fuel position.

To remove the pump

Disconnect the fuel feed and delivery pipes from the injection pump.

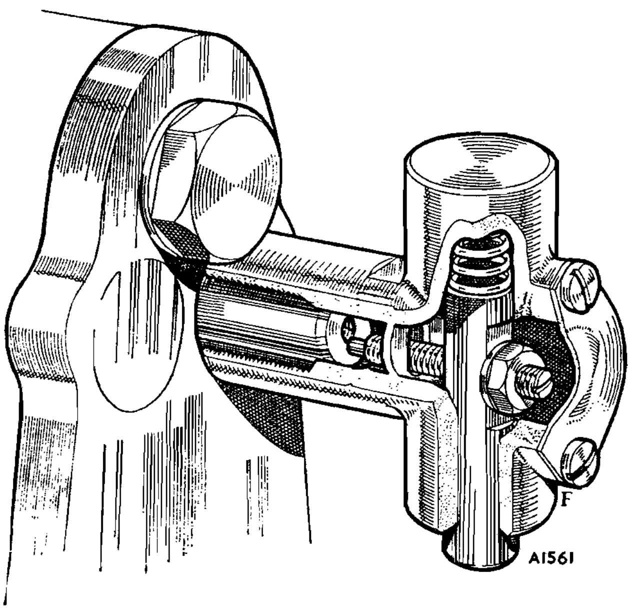


Fig. C.9

Injection pump excess fuel device

Remove the fuel bleed pipe and the oil level pipe.

Disconnect the suction pipe and the stop control cable from the governor.

Remove the three nuts securing the injection pump flange to the timing chain case; screw tool 1F 8337 into the chain wheel hub to separate the hub from the injection pump camshaft and remove the pump (Fig. C.10). As the pump drive incorporates a free-wheeling device, the injection pump camshaft can be prevented from turning during this operation with tool 18G 521.

To dismantle and reassemble

Remove the governor as described on page C.16 and unscrew the excess fuel device from the opposite end of the pump.

Remove the inspection cover.

Unscrew the delivery valve holders and remove the spring pegs, springs, and delivery valves. Using tool 18G 237, withdraw the delivery valve seats and washers.

NOTE.—The valves and seatings are matched pairs and must be kept together. If trouble is experienced after they have been cleaned and rubbed together the faulty pair must be renewed.

Turn the camshaft, and as each tappet reaches the T.D.C. position insert a tappet holder 18G 550 A under the head of each tappet adjusting screw. Remove the eight nuts with spring washers and withdraw the bearing end plates complete with outer races and oil seals. The camshaft can now be withdrawn with the two bearing inner races and adjusting shims attached.

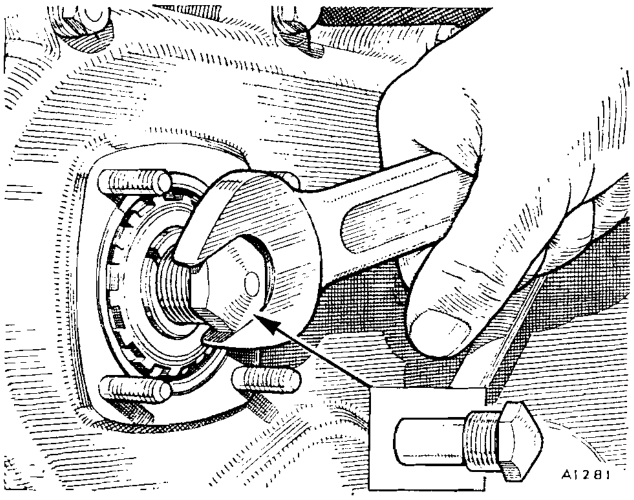


Fig. C.10
Releasing the injection pump with tool 1F 8337

NOTE.—The driving end of the camshaft is marked with a notch to ensure correct reassembly. Reversal of the camshaft will give a different injection order.

Extract the bearing outer races, using tools 18G 500 and 18G 500 A.

Draw the bearing inner races off the camshaft with remover 18G 12 A and adaptor 18G 12 D.

Remove the closing plugs from the base of the pump, using tool 18G 513 A to remove the screwed type fitted to early pumps or tool 18G 518 A to drive out the press-in type fitted to later pumps. Using holder 18G 547, press the tappet assemblies upwards, remove the tappet holders, and withdraw the tappets through the closing plug apertures. Using plunger forceps 18G 526, withdraw the plungers, lower spring plates, and plunger springs in a similar manner.

NOTE.—The pump barrel and plunger units must be kept together so that there is no possibility of the plungers being assembled to barrels other than those from which they were originally taken.

Remove the barrel locking screws and washers and push the barrels out from below, using a fibre or soft brass drift.

Withdraw the quadrants, control sleeves, and upper spring plates through the inspection aperture.

NOTE.—The quadrants should be kept locked to their sleeves during removal. If a quadrant screw is loosened, realign the scribed lines on the quadrant and sleeve before tightening.

To view and overhaul

Wash all the components thoroughly in clean Shell Calibration Fluid 'C'. Cotton waste, rags, or cloth wipers of any kind must not be used.

Examine the plunger surface and barrel bore for signs of wear or abrasions. If any wear is evident the barrel and plunger must be renewed as an assembly. The surfaces of these parts must never at any time be touched with a file, scraper, or other hard tool, or any abrasive compound. Ensure that the plunger spill grooves are completely free by blowing out with compressed air. The inlet and spill ports in the barrels should be cleared in the same way.

Inspect the delivery valves and seatings. They should be perfectly smooth and flat. If trouble is experienced after they have been cleaned and rubbed together they should be renewed together. A file, scraper, other hard tool, or abrasive should not be used on the delivery valves and seatings.

Inspect the plunger and valve return springs for fractures, and if they are below the length of new counterparts they should be renewed as a set.

If the pump is to be recalibrated due to the fitting of new parts, etc., then delete the scribed lines from the quadrants and sleeves.

Check the control rod in its bushes. Worn bushes may be removed and new ones replaced, using tool 18G 516, and reamed in line with tool 18G 517.

Inspect the cam surfaces for signs of scoring and wear. Renew the camshaft if necessary.

The bearings should be spun round in a bath of paraffin to clear any foreign matter. Inspect the balls, rollers and races for signs of wear, pits, or scoring; renew them if necessary.

Clean, and inspect the oil seals for wear or damage. If the slightest damage is revealed, especially on the lip, it must be renewed.

To reassemble

Immediately before reassembly all components should be thoroughly rinsed in clean Shell Calibration Fluid 'C'. The cleansing fluid should be allowed to drain off and the parts smeared with engine lubricating oil. Cotton waste, rags, or cloth wipers of any kind must not be used.

Install the barrels, observing that the slot is nearest the hole provided for the locking screw, and lock in position.

Refit the control rod and check for freedom of movement. Leave the control rod in its mid-position by aligning the centre-pop marks on the rod with the ends of the pump housing.

With the control rod in this position mesh each control quadrant, complete with sleeve, with the control rod so that the clamp screw of the quadrant lies parallel with the control rod. Assemble the upper spring plates.

Assemble the lower spring plates and springs to the plungers and insert the plungers into the correct barrels, using forceps 18G 526. Ensure that the lug, or toe, of the plungers is located in the slot of the control sleeve with the marks on the lug and sleeve lined up to the front.

Insert the tappet assembly, using holder 18G 547, and press the spring upwards until a tappet holder 18G 550 A can be located under the head of the adjusting screw. Repeat the assembly outlined for each pumping element.

Press a serviceable oil seal into each bearing housing with its lip facing inwards when in the fitted position. Press or drive the bearing outer races into their housings, thick edge foremost, using replacer 18G 134 with adaptor 18G 134 AA to ensure correct alignment. The bearing inner races can be fitted to the camshaft, using adaptor 18G 12 D with remover 18G 12 A.

With the notched end of the camshaft at the driving end of the pump assemble the camshaft into the pump body so that the end-play when the two bearing housings are bolted in position is from ·002 to ·004 in. (·05 to ·10 mm.). The use of tool 18G 538 A will enable the end-float to be measured accurately. If any components have to be renewed adjust the end-play by inserting or removing an equal thickness of shims between the camshaft shoulders and each bearing, otherwise the original thickness of shims should be fitted. Pack the ball bearings with grease before final assembly.

NOTE.—A different firing order is obtained by reversing the camshaft in the pump housing, i.e. the normal firing sequence is 1, 3, 4, 2, and when reversed the sequence becomes 1, 2, 4, 3.

Remove the tappet holders from beneath the tappet adjusting screws and replace the closing plugs in the base of the pump body.

Smear the mitre joint face of the closing plugs with white lead or other sealing compound and tighten with tool 18G 513 A (early pumps).

Later-type pumps are fitted with the press-in-type closing plug, which is driven into position using the flanged end of tool 18G 518 A. Always renew the press-in-type closing plug to ensure oil-tightness.

Replace the delivery valve seatings in the pump housing. Insert the delivery valves, springs, and spring pegs. Replace the delivery valve holders and washers and tighten down to a torque of 30 lb. ft. (4·0 kg. m.).

Install the governor (see page C.16) and refit the excess fuel device.

Fill the camshaft chamber with engine lubricating oil to the level of the oil level plug aperture and replace the inspection cover.

To phase the pump

Adjustment of the phase angle of the pump is effected by raising or lowering the plunger in its barrel by means of the adjusting screw in the tappet assembly. Particular care must be taken during this adjustment not to raise the screw to a point where the top of the plunger strikes the under side of the delivery valve when the plunger is at the top of its stroke, otherwise considerable damage may result.

IMPORTANT.—For the purpose of standardization elements on all C.A.V. injection pumps are counted in numerical order, reading from left to right looking on the inspection cover. This rule applies in the following instructions, and the order in which elements should be adjusted will be 4, 2, 1, 3.

Adjust the phase angle as follows.

Remove the inspection cover.

Secure the injection pump complete with governor to a suitable test bench fitted with a graduated disc and pointer or some other means of measuring the angular position of the camshaft.

Remove No. 4 delivery valve holder, delivery valve, spring, and spring peg.

Assemble plunger head clearance gauge set 18G 538 A, using the appropriate adaptor and ensuring that the indicator extension is central and does not foul the bore of the adaptor. Screw the assembled gauge into the position normally occupied by No. 4 delivery valve holder until it is held tight against the delivery valve holder joint washer.

Turn the camshaft slowly until No. 4 element plunger is at T.D.C. and zero the dial gauge. During this operation watch the dial gauge, and should it reach the limit of its travel before the plunger is at T.D.C., slacken the locknut, unscrew the bracket and gauge two or three turns, and retighten the locknut.

Insert a suitable lever under the head of the tappet screw and gently lever it upwards until the head of the plunger can be felt to touch the under side of the valve guide. Note the dial gauge reading, the difference from zero being the plunger head clearance. This clearance must be between ·018 and ·022 in. (·45 and ·55 mm.). If necessary, correct by raising or lowering the tappet adjusting screw, using spanners 18G 514.

Tighten the tappet locknut and re-check the clearance.

Remove the gauge from No. 4 element and replace the delivery valve holder. Do not replace the delivery valve, spring, and spring peg. Connect the test pipe 18G 233 to the valve holder.

Connect the pump inlet to the fuel supply of the test bench.

Turn the camshaft until No. 4 element is at B.D.C. and turn on the fuel. The fuel will now flow from the suction chamber of the pump into No. 4 element barrel and out through the test pipe. As the remaining elements have their valves in position, no fuel can flow through them.

Turn the camshaft in the same direction as when fitted to the engine (clockwise looking on the driving end) until No. 4 plunger begins to rise. As the plunger closes the barrel ports the flow of fuel from this test pipe will gradually diminish. When this occurs turn the camshaft very slowly so that the exact point at which the flow ceases can be ascertained. This is the 'point of port closure'.

NOTE.—Take particular care to see that the plunger is rising at this point and not descending, otherwise a false reading will be obtained.

Remove the test pipe and delivery valve holder. Wash No. 4 delivery valve, spring, and peg in clean fuel and install them in the pump. Replace the delivery valve holder and fully tighten it down to a torque of 30 lb. ft. (4·0 kg. m.). The camshaft is now set on No. 4, to which all adjustments are co-related, and the remaining elements must be set to inject at their correct intervals.

Remove the delivery valve holder, spring, spring peg, and valve (not the seat) from No. 2 element, this being next in the firing sequence. Replace the delivery valve holder, fit the test pipe, and turn on the fuel. The fuel will now flow through this element.

Turn the camshaft through approximately 90° and check the point of port closure for this element. This should be within $90\pm\frac{1}{2}°$ of No. 4 element; if in excess of this figure adjustment must be made to the tappet screws. If the point of port closure is found to be early the adjusting screw must be lowered, or if late it must be raised. Lock the nut after each adjustment.

After correctly adjusting the phasing turn the camshaft until this No. 2 plunger is at T.D.C. and check that the head clearance is within $\cdot02\pm\cdot002$ in. ($\cdot5\pm\cdot05$ mm.). On No. 4 element the clearance is set before phasing, whereas on the remaining elements adjustment is made for phasing and the head clearance checked afterwards.

Deal with the remaining elements in their firing sequence as in the two preceding paragraphs, adjusting the points of port closure to the correct intervals and checking the head clearance.

Finally, return to No. 4 element and re-check this setting. If there is any discrepancy to the original setting, then the phasing operation must be checked again throughout.

To calibrate the pump

This adjustment is made to balance the output of each element so that the correct quantity is delivered to each engine cylinder.

Injection pumps are accurately adjusted before leaving the Factory, but wear on elements, quadrants, etc., may necessitate some slight alteration to the original setting after a long period in service, in which case it will be necessary to make adjustments as follows.

Check that the scribed lines on the quadrants and sleeves are in register and that the clamp screws are tight, then delete the scribed lines (this should be done when the pump is dismantled). This will reduce the amount of adjustment to be made and also prevent confusion when fresh lines indicating the new adjustment are scribed.

Mount the pump complete with governor on a power-driven test machine fitted with suitable measuring glasses. Link up the drive and connect the fuel supply.

Remove the excess fuel device. This will allow the control rod, under the influence of the governor spring, to come to its maximum open position and allow it to be clamped at the openings given in the table below.

Connect the pump outlets to a matched set of test nozzles type BDN.12.SD.12 in nozzle holders type BKB.50.SD.533b (formerly BKB.50.SD.19b) set at 175 atmospheres, using the pipes supplied with the best bench.

Turn on the fuel, slacken the bleed tap, and allow the fuel to flow until it is free from air bubbles. Tighten the bleed tap.

Carry out tests and readjust as found necessary to conform to the figures given in the following table:

Test	Pump r.p.m.	Number of strokes	*Delivery limits at control rod openings (c.c.)*			
			6 mm.	*Spread*	*9 mm.*	*Spread*
1	1,000	200	—	—	6·8 to 7·4	·5
2	200	200	1·3 to 2·2	·3	—	—
3	1,750	200	—	—	7·0 to 8·0	·6

To make adjustments of output pull the control rod to the fully open position. This will allow the quadrant clamping screws to be slackened so that the necessary movement to the regulating sleeves can be made. To increase the fuel delivery on any line the sleeve must be turned in a clockwise direction with a suitable pin inserted in the holes provided. This operation must be carried out very carefully as the amount of movement required will be very small.

When the new adjustment has been made make sure that all clamping screws are tight, then scribe new lines across the quadrants and sleeves to indicate the new adjustment.

Refit the excess fuel device.

Set the maximum fuel output so that the average delivery is within 7 to 7·2 c.c. per 200 strokes at 1,000 r.p.m. This adjustment is carried out in the following manner: remove the cover from the excess fuel device to expose the adjusting screw, slacken the locknut, and turn the screw in an anti-clockwise direction to increase the output or in a clockwise direction to decrease the output. This operation is carried out with the excess fuel device plunger in its 'out' position. Tighten the locknut, replace the cover, and seal the securing screws, using sealing pliers 18G 541.

To refit the pump

In view of the 20 : 1 compression ratio of the engine and the consequent difficulty of rotating the crankshaft, a degree plate, fitted to the crankshaft pulley, with a corresponding pointer on the timing case, is provided to facilitate ease of timing.

Timing the injection pump so that the spill cut-off occurs at 28° B.T.D.C. is a simple operation and must be carried out accurately, otherwise the engine performance will not be up to standard.

With the timing chain wheel and chain assembled in their correct relationship to each other, rotate the crankshaft until the 28° timing mark coincides with the timing pointer on the timing case.

Having set the crankshaft in position, offer the injection pump to the engine, ensuring that the key is positioned correctly in the drive end of the pump camshaft. Bolt the pump to the rear face of the timing case, but only tighten down the securing nuts finger-tight so that the pump body can be rotated about the camshaft axis. Connect up the main fuel pipe from the filter to the injection pump.

Insert the sleeve nut with its lock washer in position under the head into the centre of the pump drive chain wheel, and screw onto the camshaft of the pump. The camshaft may be held during this operation with tool 18G 521 mounted on the opposite end of the camshaft. Ascertain which piston is on its compression stroke and remove the applicable element delivery valve holder, valve, spring, and spring peg from the injection pump. Replace the delivery valve holder and connect test pipe 18G 233 to the element outlet.

Slacken the bleed plug on the fuel filter head, and by means of the priming lever on the fuel lift pump, pump up the fuel until it flows free from air bubbles from the bleed plug, which must be immediately tightened. The lift pump priming lever must be operated throughout the timing operation. Slacken the bleed tap on the fuel injection pump casing and proceed in a similar manner.

Rotate the injection pump about the axis of its camshaft so that it moves towards the engine to the fullest extent of its adjustment; fuel will now be flowing from the test pipe. Rotate the injection pump slowly away from the engine, and as the inlet port is progressively closed by the plunger the flow of fuel issuing from the test pipe will gradually diminish. Turn the pump very slowly in the final stages; the instant of 'inlet port closure' (spill cut-off) will be observed when there is no drip of fuel from the test pipe for a period of 14 to 15 seconds. This is the correct position for the pump and the spill cut-off is now timed to occur when the pistons are at 28° B.T.D.C. on their compression strokes.

NOTE.—As the injection pump drive incorporates a free-wheeling device, it is imperative that the free-wheel pawl is held hard against its drive during this operation. This is best achieved by turning the camshaft with tool 18G 521, so taking up any free movement between the pawl and its drive.

Secure the injection pump in this position. Remove the test pipe and replace the delivery valve, spring, and spring peg after washing them in clean fuel oil. Reconnect all piping and controls and bleed the fuel system of air.

Ensure that the pump camshaft chamber is filled to the correct level with engine oil and start the engine. If the engine does not idle smoothly, or if surge is apparent, adjust the slow-running speed as described in Section C.4.

Section C.4

PNEUMATIC GOVERNOR

Description

The governor is mounted to the rear of the injection pump and, in conjunction with the venturi (throttle unit), uses the suction created in the engine induction system to control the amount of fuel delivered to the engine. Connection between the venturi (mounted on the air inlet manifold) and governor is made by an external pipe, directly connected to the diaphragm cover.

The diaphragm spring tends to keep the control rod in the maximum fuel position and is supported between the cover and two metal plates attached to the diaphragm. A lever connected to a spring-loaded pawl is provided for stopping the engine and is operated by the stop control mounted under the instrument panel.

The throttle valve in the throttle unit (venturi) is actuated by the accelerator and controls the air flow to the engine. The resistance offered by the throttle valve alters the velocity of the air through the throat of the throttle unit (venturi), and thus the movement of the accelerator varies the pressure drop in the pitot tube of the throttle unit (venturi). The suction pipe leading from the pitot tube communicates these variations in pressure to the governor diaphragm cover, which is sealed from the governor housing by the diaphragm. The housing side of the diaphragm is subjected to atmospheric pressure through a breather, and therefore a pressure difference will always exist between the two sides of the diaphragm when the engine is running. Movement of the diaphragm due to this difference in pressure is conveyed to the injection pump by the diaphragm spindle which is connected to the control rod.

The venturi butterfly valve has a circular portion removed from it, and when the valve is in the closed position this allows air to flow through the auxiliary venturi and so create a depression in the pitot tube. This depression is communicated to the diaphragm cover and the diaphragm is drawn towards the idling position until its centre spindle contacts the spring-loaded plunger of the damping valve mounted on the rear of the diaphragm cover. Any further movement of the diaphragm tends to compress the damping valve spring until the point of balance between the depression in the diaphragm cover and the damping valve spring is reached. The position of the damping valve relative to the diaphragm can be adjusted, thus enabling any oscillation of the diaphragm when the engine is idling to be reduced to a minimum, so preventing 'hunting' or surging of the engine at idling speeds.

When the butterfly valve is moved towards the open position the immediate result is to decrease the air velocity in the venturi, with a consequent pressure increase in the diaphragm cover. This increase in pressure allows the diaphragm spring to move the diaphragm and pump control rod towards the maximum fuel position and increase the amount of fuel delivered to the engine by the injection pump. As the engine speed rises the increasing air velocity in the venturi produces a gradual pressure drop in the diaphragm cover which draws the diaphragm and pump control rod towards the damping valve against the pressure of the diaphragm spring. This movement of the diaphragm and pump control rod reduces the amount of fuel delivered to the engine and limits the engine speed relative to the butterfly valve opening.

Operation of the stop control lever actuates the pawl inside the governor which moves the diaphragm and control rod rearwards against the pressure of the diaphragm spring until the diaphragm spindle makes contact with the damping valve plunger. When this position is reached further movement of the stop lever compresses the damping valve spring and the diaphragm and control rod are moved past the idling position to cut off the fuel delivery from the injection pump to the engine.

To dismantle the governor

Unscrew the four diaphragm cover securing screws, detach the cover from the governor housing, and withdraw the diaphragm spring. It is advisable to hold the diaphragm cover in position when removing the screws as the diaphragm spring may suddenly force the cover away from the diaphragm housing.

Release the diaphragm outer rim from the diaphragm housing and then actuate the engine stop lever on the injection pump. This will move the diaphragm and pump control rod rearwards and so provide access to the pin connecting the diaphragm spindle to the pump control

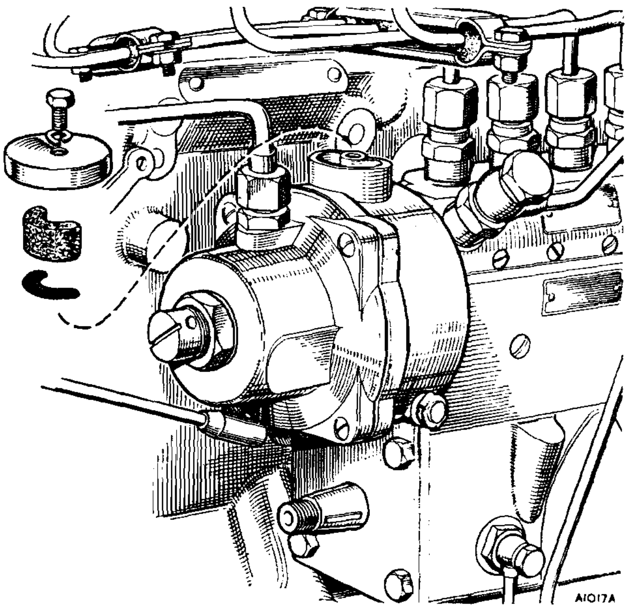


*Fig. C.*11

The governor breather filter

rod. Withdraw the split pin and plain washer from the connecting pin, and by moving the diaphragm spindle sideways separate the diaphragm assembly from the pump control rod.

To dismantle the damping valve remove the valve adjusting screw and locknut from the diaphragm cover and withdraw the spring and valve plunger.

To service the governor

The pneumatic governor is designed to give lasting service without attention or lubrication. Before assembly the diaphragm, which is made of specially prepared leather, is soaked in neat's-foot oil and during service is maintained in a pliant condition by fuel oil mist which reaches the diaphragm via a machined hole in the injection pump casing.

However, if the engine is operated continuously in very dusty conditions the governor breather filter pad may become choked, resulting in sluggish operation of the governor. When these conditions exist the filter pad should be cleaned and re-oiled at regular intervals as follows.

Unscrew the bolt securing the breather filter to the top of the diaphragm housing, remove the filter cover, and lift out the filter pad (Fig. C.11).

Wash the filter pad thoroughly in petrol to remove the dirt and oil and allow it to dry. When dry immerse the pad in clean engine oil and allow it to drain for approximately half an hour before reassembling.

To reassemble the governor

Before reassembling the governor inspect the diaphragm for signs of perishing or cracks and ensure that the diaphragm cover and housing joint faces are free from burrs and will make an airtight joint.

If the diaphragm is at all suspect it should be renewed. New diaphragms must be soaked in neat's-foot oil or castor oil for 24 hours before fitting.

After reassembling, which is a reversal of the dismantling procedure, the diaphragm should be tested for leakage as follows.

Move the stop lever on the injection pump to the 'stop' position; seal the diaphragm cover by placing a finger over the vacuum pipe union on the top of the cover and then release the stop lever. If the diaphragm is in a sound condition, and provided that the suction pipe union, diaphragm cover, and housing joints are airtight, the pump control rod should remain stationary in the 'stop' position. Should the pump control rod move towards the maximum fuel position, this indicates that a leakage is occurring at the diaphragm, which should be renewed.

The vacuum pipe should be tested for leaks in exactly the same way as the diaphragm, except that the governor end is connected to the union on the diaphragm cover and a finger applied to the venturi end of the pipe.

WARNING.—In no circumstances should the engine be run without the venturi or inlet manifold or air filter in position or with the vacuum pipe disconnected as this will allow the engine to exceed its maximum governed speed with consequent serious damage to the engine.

To adjust the governor

Two adjustable stop screws (see Fig. C.12), which limit the opening and closing of the throttle unit (venturi) butterfly valve, are used to set the engine maximum and idling speeds. Engine 'surge' at idling speed is controlled by adjusting the position of the governor damper valve.

Before carrying out the following adjustments it is imperative that the air cleaner is correctly serviced and fitted, and the engine run until it has attained its normal operating temperature (this is most important as there may be an appreciable difference between the engine speed for a given throttle opening when the engine is hot and when the engine is cold). Also, the governor damper valve must be retracted to prevent it interfering with the action of the governor during the operation of setting the engine maximum light running speed. This is essential as the permissible maximum light running speed must be achieved with a minimum of fuelling and a maximum of throttle opening if the engine is to develop full power under load.

Maximum and idling speed adjustment

Slacken the locknut, unscrew the governor damper screw six to eight full turns, and secure in this position. Adjust the maximum speed stop screw on the throttle unit (venturi) to give a maximum engine light running speed of 3,800 r.p.m., as shown on a tachometer, thus giving a maximum governed speed under load of 3,500 r.p.m. Lock the stop screw with the locknut, and to discourage unauthorized adjustment seal the screw with wire and lead seal, using sealing pliers 18G 541.

Slacken the governor damper screw locknut, and adjust the damper screw until the engine is running free from surge. Tighten the locknut to secure the damper screw in this position. Check the engine idling speed, using a tachometer, and if necessary adjust the idling stop screw on the throttle unit (venturi) to give an idling speed of between 500 and 550 r.p.m. The adjustment for surge and idling are rather sensitive, and it may be necessary to readjust both the governor damper screw and idling stop screw to attain the required standard of idling without surge.

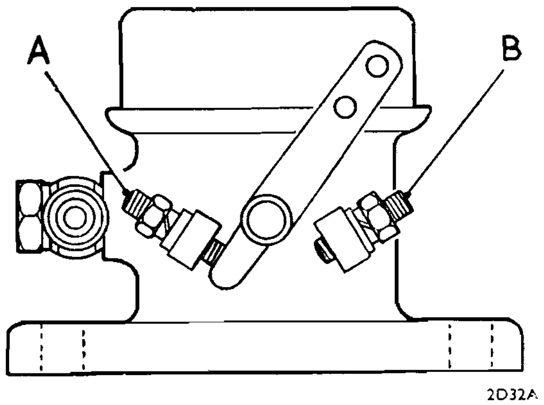


Fig. C.12

The venturi stop screws

A. Maximum speed stop. B. Idling stop.

Section C.5

ALTITUDE SETTINGS

Before an engine leaves the Factory both the fuel pump calibrations and the governor settings are adjusted for sea-level conditions. If an engine is to be operated above zero altitude further adjustments are necessary. Reference to the schedule below will show the variations in maximum fuel output which are considered adequate for the altitudes indicated.

When an engine is operated at an altitude greater than that for which it is governed its maximum governed speed will increase. To obviate the possibility of excessive r.p.m. during the operation of resetting the governed speed slacken the locknut and screw in the maximum stop screw on the venturi to its fullest extent. Continue the operation as described in Section C.4.

Altitude	*Maximum fuel output for 200 strokes at 1,000 pump r.p.m.*
0 to 2,000 ft. (0 to 600 m.)	7·0 to 7·2 c.c.
2,000 to 4,000 ft. (600 to 1200 m.)	6·6 to 6·8 c.c.
4,000 to 6,000 ft. (1200 to 1800 m.)	6·2 to 6·3 c.c.
6,000 to 8,000 ft. (1800 to 2400 m.)	5·7 to 5·9 c.c.
8,000 to 10,000 ft. (2400 to 3000 m.)	5·3 to 5·5 c.c.
10,000 to 12,000 ft. (3000 to 3600 m.)	4·9 to 5·0 c.c.

Section C.6

FUEL INJECTORS

Description

The 2·2-litre diesel engine is fitted with a special injection nozzle known as the Pintaux type which has been developed primarily to give easy starting from cold. A feature of this nozzle is that on cold starting it directs the fuel spray through an auxiliary hole to the hottest zone of the combustion chamber.

In operation, the pressure in the annulus builds up during the pump delivery, lifting the needle from its seating and permitting a flow of fuel into the annulus below the seat from which the auxiliary hole leads. The needle is extended below the seat to fit into the comparatively large-diameter pintle hole. At starting speeds the needle is not lifted sufficiently to clear the pintle hole and the bulk of the fuel is therefore discharged through the auxiliary or starting hole. At normal running speeds, when the pressure in the fuel system is higher, the needle is withdrawn from the pintle hole in the normal manner. A small proportion of fuel continues

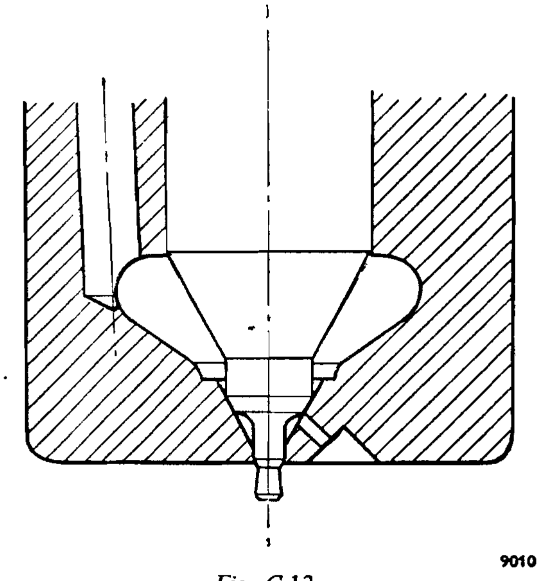


Fig. C.13

The C.A.V. Pintaux nozzle

to be discharged through the auxiliary hole, which prevents carbon formation therein and does not affect engine performance adversely.

Nozzle-testing

If the injector nozzles are to be tested correctly or it is desired to adjust the opening pressure, then the use of nozzle-testing machine 18G 109 A is necessary.

A fuel which does not affect the skin of the person handling the injectors, such as Shell Calibration Fluid 'C', should be used; the oil has about the same viscosity as diesel oil and also prevents stickiness of the needle after long periods of injector storage.

Before using this testing machine ensure that the fuel tank is full. There is no necessity for air-venting as the pump is self-priming.

Before removing an injector from the testing machine close the check valve to prevent damage to the pressure gauge, which may result from a sudden drop in pressure.

WARNING.—It cannot be stressed too strongly that when a nozzle is spraying the nozzle holder must be turned away from the operator.

1. *Testing for spray*

In order to test this type of nozzle for spray it is necessary to use a special test adaptor, 18G 109 B, which is connected between the injector testing machine and the injector under test. The adaptor consists of an additional nozzle holder fitted with a special nozzle, and a modified cap nut, into which the injector under test is fitted. The adaptor assembly is used to simulate high rates of injection so that the main spray can be observed.

Attach adaptor 18G 109 B to the testing machine and set to an opening pressing of 220 atmospheres. A fine spray formation from the test adaptor must not be expected in view of its special nozzle.

Now screw the Pintaux injector to be tested into the test adaptor; close the check valve to cut off the pressure gauge and operate the test machine several times to expel any air.

(*a*) *Auxiliary spray*. With the pressure gauge out of circuit operate the testing machine slowly at about 60 strokes a minute; it is possible to cut out the main spray almost entirely and produce only the auxiliary spray. When this condition has been achieved the auxiliary spray can be observed. This should be well formed and free from splits and distortions, although there may be present a slight central core, which may be disregarded.

(*b*) *Main spray*. Operating the hand lever more rapidly —at about 140 strokes per minute—the main spray can be observed. The same remarks apply to its formation as in (*a*) above.

2. *Seat tightness test*

Remove the test adaptor and connect the injector under test direct to the injector testing machine. Open the check valve and set the nozzle to an opening pressure of 115 atmospheres as described in paragraph (4).

Depress the lever of the testing machine until a pressure of 105 atmospheres is obtained. Hold this pressure for 10 seconds and examine the nozzle seat for dryness. Reject if wet. If in doubt, maintain this pressure for a period of 60 seconds, when the diameter of the wet spot on a piece of blotting-paper held below the nozzle tip must not exceed ½ in. (13 mm.).

3. *Back-leakage test*

The pressure gauge of the injector testing machine must be in circuit and the injector under test set to open at between 160 and 170 atmospheres as described in paragraph 4.

Operate the lever of the testing machine until the gauge registers a pressure of 160 atmospheres. Release the lever and time the pressure drop from 150 to 100 atmospheres. For a nozzle in good condition this time should not be less than six seconds nor greater than 40 seconds, using Shell Calibration Fluid 'C' at a temperature of 10 to 21° C. (50 to 70° F.). At higher temperatures a somewhat lower figure may be obtained.

When carrying out this test ensure that no leakage occurs at the lapped joint of the valve. If leakage at the lapped joint is suspected, do not overtighten the cap nut in an effort to rectify, but remove the nozzle and re-examine the pressure faces for signs of dirt or surface imperfections. Clean thoroughly, and if all appears in order replace the components and re-test. If the pressure drop time is still low, this indicates excessive leakage past the lapped portion of the valve. Nozzles not passing the above test should be renewed complete.

4. *To check and adjust the nozzle opening pressure*

After carrying out the foregoing tests the Pintaux nozzle must be set to open at a pressure of 115 atmospheres as follows:

(*a*) Remove the injector from the testing machine.
(*b*) Remove the injector cap nut and copper joint washer.
(*c*) Release the locknut and turn the spring cap nut clockwise to increase or anti-clockwise to reduce the opening pressure.
(*d*) Lock the spring cap nut and re-check the nozzle opening pressure on the testing machine.
(*e*) Repeat operations (*c*) and (*d*) until the correct opening pressure of 115 atmospheres is obtained.
(*f*) Refit the injector cap nut and joint washer.

Fault diagnosis and rectification

The first symptoms of nozzle trouble usually manifest themselves under one or more of the following occurrences:

(1) Cylinder knock. (2) Engine overheating.
(3) Loss of power. (4) Smoky (black) exhaust.
(5) Increased fuel consumption.

It should not be immediately assumed that the nozzles are faulty, for such features as incorrect engine valve timing, leaking valves, incorrect pump timing, dirty or damaged fuel filters, wrong fuel or water in fuel, defective engine lubrication, or incorrect fuel pump maximum fuel setting may give rise to similar symptoms.

With all other possible causes eliminated, the particular nozzle giving trouble can usually be determined by

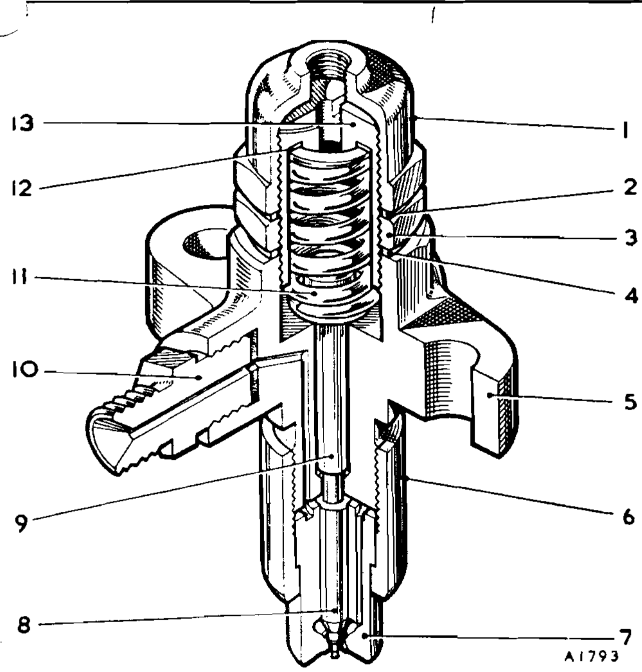


Fig. C.14

A fuel injector

1. Injector cap nut.
2. Cap nut washer.
3. Locknut.
4. Locknut washer.
5. Nozzle holder.
6. Nozzle nut.
7. Nozzle body.
8. Nozzle valve.
9. Spindle.
10. Inlet union.
11. Spring.
12. Washer.
13. Spring cap nut.

releasing the piping union nut on each nozzle holder in turn while the engine is running and listening to the idling performance of each of the other cylinders.

To test a doubtful nozzle remove the injector as described below and refit to its fuel feed pipe so that the nozzle is pointing outwards, away from the engine. Slacken the unions of the other nozzle fuel feed pipes (to prevent fuel being sprayed into the cylinders). Using the starter, turn the engine until the suspect nozzle sprays into the air. If the spray is unduly wet or streaky, or obviously to one side, or the nozzle dribbles, renew the complete unit (nozzle and nozzle holder).

NOTE.—**The nozzle holder must be turned away from the operator and the hands must not be allowed to come into contact with the fuel spray, as the injection pressure will cause oil to penetrate the skin with ease.**

To remove

Nozzles should be removed from the engine and examined at regular intervals, the frequency of attention being as recommended in the Driver's Handbook.

Disconnect the injector feed pipe and all the injector leak-off unions.

Remove the two nuts securing the injector to the cylinder head and withdraw the injector, using tool 18G 491 A. Immediately plug the hole in the cylinder head to prevent the ingress of foreign matter.

If the injectors are to be removed for any length of time the fuel feed unions should be sealed with sealing caps 18G 216.

The nozzle should then be wrapped in greaseproof paper.

To dismantle

As in the case of injection pump dismantling, absolute cleanliness is essential, therefore the same facilities must be available and the same precautions taken for injector maintenance as those described at the beginning of the Section for the injection pump.

Fit the injector in the dismantling fixture 18G 388 and secure in a vice.

Unscrew the injector cap nut and remove the copper joint washer.

Release the locknut and unscrew the spring cap nut.

Remove the copper joint washer, spring, and spindle.

If the complete dismantling of the nozzle holder and nozzle is being carried out remove the fuel inlet union (early injectors only).

Unscrew the nozzle nut, using spanner 18G 210, which is used in conjunction with a standard ratchet wrench. Remove the nozzle body, taking care not to let the needle valve drop out.

NOTE.—**The nozzle components are mated and must always be kept together.**

To view and overhaul

Nozzles

All the tools required for the cleaning operations set out in the following paragraphs are contained in cleaning kit 18G 487.

Remove any carbon from the valve, using the brass wire brush, and polish with a piece of soft wood. Use considerable care when cleaning the needle valve as a scratch or a burr may cause leakage or spray distortion. All polished surfaces should be relatively bright and should not appear 'blue' due to overheating.

Using the wire brush, remove all loose carbon from the outside of the nozzle. Clear the pintle orifice by passing a suitably sized probe down the nozzle bore

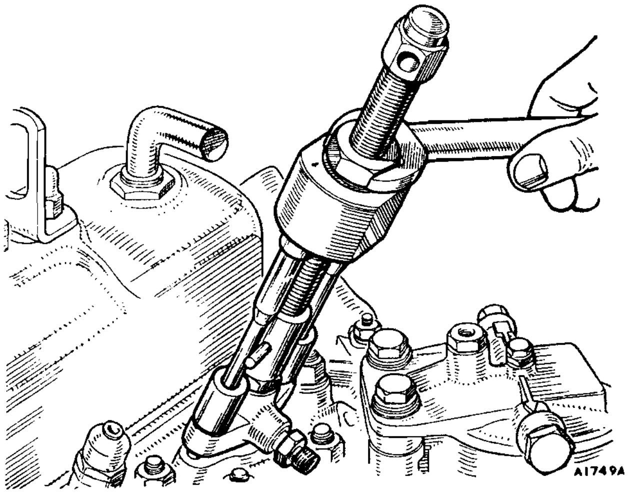


Fig. C.15

Withdrawing an injector nozzle, using tool 18G 491 *A*

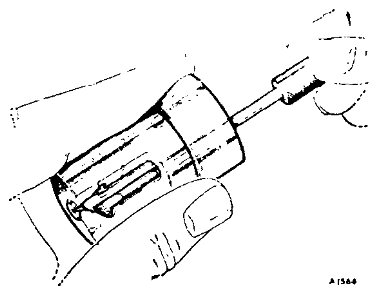


Fig. C.16
Cleaning the carbon from the fuel gallery

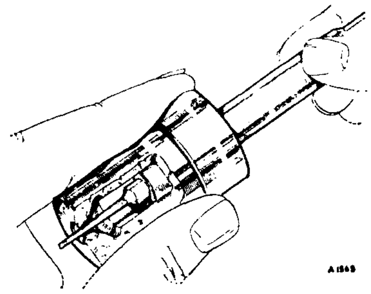


Fig. C.17
Clearing the pintle orifice

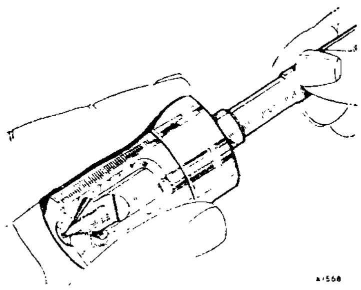


Fig. C.18
Cleaning the nozzle seating

until it protrudes through the orifice. Rotate the probe until all the carbon is removed.

Insert the special groove scraper until the nose locates in the fuel gallery (see Fig. C.16). Press hard against the side of the cavity and rotate to clear away all carbon deposit.

Clean the pintle orifice by passing a suitably sized probe down the nozzle bore until it protrudes through the orifice (see Fig. C.17). Rotate the probe until all the carbon is removed.

With the seat scraper clean all carbon from the valve seating (Fig. C.18) by rotating and pressing the tool onto the seating.

Clear the auxiliary spray hole by use of the probing tool fitted with the appropriate size cleaning wire (Fig. C.19). The wire should be fitted into the tool so that it protrudes only approximately $\frac{1}{16}$ in. (1·6 mm.) to give maximum resistance to bending. Extreme care must be exercised to obviate the danger of wires breaking in the hole, as broken particles are extremely difficult to remove.

Clean out the small feed channel bores, as shown in Fig. C.20, with a drill or wire of ·067 in. (1·7 mm.) diameter.

Ensure that the lapped pressure faces on the upper end of the nozzle are clean, perfectly smooth, and free from burrs.

Assemble the nozzle into adaptor 18G 109 E with the nozzle end towards the small thread connection (see Fig. C.21). Attach the adaptor to testing machine 18G 109 A and operate the pumping lever several times. This forces oil through the spray holes in the reverse direction and flushes out the gallery and internal passages to remove any loose carbon.

In cases where the carbon build-up is particularly hard this may be softened in the following manner, thereby reducing time: prepare a 10 per cent. solution of caustic soda with a detergent added by dissolving 2 oz. (56·7 gm.) of caustic soda in 1 pint (·57 litre) of water and add ½ oz. (14·2 gm.) of an ordinary washing detergent. Place the nozzle bodies in the liquid and bring it to the boil for a minimum of 1 hour and not more than 1½ hours. Care must be taken not to allow the water to evaporate too much, because if the percentage of caustic soda rises above 15 per cent. the surface of the guide bore and seal may be roughened, making it impossible to service the injectors correctly. Remove the nozzle bodies from the solution, wash them in running water, and then immerse them in a de-watering oil such as Shell Ensis 254. Remove the surplus oil by draining or compressed air.

The carbon may now be removed, using the standard tools provided in the cleaning kit, or in some cases blown clean with compressed air.

If the nozzle is blued, or the seating has a dull circumferential ring, indicating wear or pitting, the complete unit should be set aside for special attention. (See under **'Nozzle reclamation'**.)

Nozzle holders

Wash all the components in clean paraffin. Examine the spring for signs of weakness, rusting, or fracture. Ensure that the ends are perfectly square. The spindle should be perfectly smooth and straight. Examine the recessed end of the spindle which accommodates the top of the nozzle valve; the recess should be perfectly clear and free from abnormal wear. Clear out the feed hole in the nozzle holder, using an air jet; the copper seating of the feed pipe union must be in good condition.

Examine the bottom pressure facing of the nozzle holder, which should be perfectly smooth and flat.

To reassemble

Thoroughly wash the nozzle body and needle valve in Shell Calibration Fluid 'C' and test the fit of the valve in

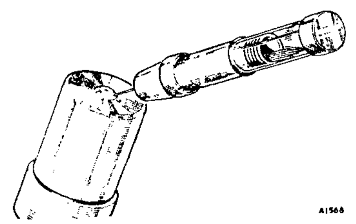


Fig. C.19
Clearing the auxiliary spray hole

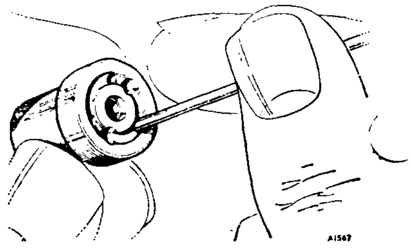


Fig. C.20
Cleaning the feed channel bores

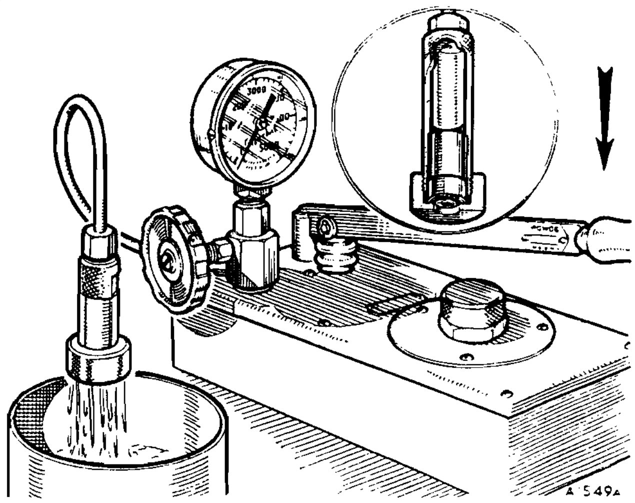


Fig. C.21

Reverse-flushing an injector nozzle with testing machine 18G 109 A and adaptor 18G 109 E. Shown inset is a sectioned adaptor with a nozzle in position

the nozzle body. The valve should just fall into position under its own weight when lubricated with fuel oil.

Immerse both in a bowl of clean Shell Calibration Fluid 'C' and assemble under the liquid.

Thoroughly wash the nozzle holder and component parts in Shell Calibration Fluid 'C'.

Mount the nozzle holder in fixture 18G 388 and secure in the vice. Make sure that the pressure faces of the holder and nozzle body are perfectly clean. Place the nozzle assembly in position on the holder, ensuring that the dowels locate in the holes.

Fit the nozzle nut and tighten carefully, using spanner 18G 210, which is used in conjunction with a standard ratchet. **Do not overtighten this nut,** since distortion and subsequent seizure of the nozzle may result.

Reassemble the spring and spindle, using a smear of grease to prevent rusting. Replace the spring cap nut, locknut, and copper joint washer.

Fit the cap nut with its copper joint washer.

Test the injector for spray and opening pressure as described on page C.18, and, if the nozzle is to be stored, lightly smear it with grease before packing.

To install

Thoroughly clean the aperture in the cylinder head. Replace the copper sealing washer.

Place the injector in position in the cylinder head; fit the securing nuts and tighten evenly to a torque of 12 lb. ft. (1·6 kg. m.).

Connect the fuel feed pipe and leak-off unions.

Nozzle reclamation

Clean the nozzles in the normal manner. If they are then not satisfactory it is probably due to faulty seats caused by scoring or wear. The fundamental requirements of the nozzle operation are:

(1) Oil-tight seating.

(2) Correct angular fitment of the nozzle body and nozzle valve seat.

(3) Good fitting of the valve in the body; it must be able to move perfectly freely, yet not permit excessive back-leakage of fuel oil.

(4) The clearance between the pintle and the spray hole must not be excessive. If the nozzle is taken out and the pintle end reversed and inserted in the orifice or spray hole, it should not tilt at a greater angle than about 20° from the centre-line of the body.

Assuming correct adjustment of opening pressure, a nozzle lacking the conditions required in (1), (2), or (4) will have a distorted or wet spray, leaking seat, etc., when tested on a nozzle-testing machine. If (3) is leaking, then the valve will either stick open or an excessive amount of oil will leak back from the nozzle holder leak-off connection. This will also be shown by the rapid return of the needle in the pressure gauge of the nozzle-testing machine.

If the clearance between the needle and body, and/or pintle and orifice, is excessive, then the nozzle should be scrapped. Similarly, units must be scrapped if damage has been sustained at the pintle end or lapped face of the nozzle body or the needle valve. Finally, the appearance of fuel abrasion at the top of the seat core may render the nozzle unrepairable. This sometimes has the effect of rounding off the seat angle: thus lapping becomes ineffective.

Assuming that it has been determined that the nozzle is dribbling or spraying badly due to lack of quality (1) or (2) above, then the seat should be relapped as follows:

(1) A lap of suitable diameter according to size of nozzle should be selected. It should be noted that the nozzle bore varies slightly in diameter, and it is necessary to choose a lap which will fit the nozzle body in the same manner as the needle valve. This will ensure concentricity of the body seat after lapping. As a guide it will be found that new laps have a marking indicating a variation in diameter, but the operator will be able to determine the correct fit by feel.

(2) Mount the lap in the lathe of the nozzle grinding and lapping machine and grind the conical tip to the correct nozzle seat angle of 59°. Remove the extreme tip of the lap to prevent damage to the pintle hole.

(3) Fit the lap into the lapping chuck of the machine and apply a coating of tallow to the lap guide surface for lubrication purposes. With a matchstick apply a fine speck of lapping paste to the conical tip of the lap.

NOTE.—Take care to keep all lapping paste off the sides (i.e. restrict it to the extreme tip) as otherwise the bore of the body will be increased and thus too much clearance will exist between the valve and body, causing excessive back-leakage.

(4) Start the machine and slide the nozzle carefully over the rotating lap, ensuring that the lapping paste does not contact the bore of the nozzle. Oscillate the nozzle over the lap, using short strokes, and engage the lap with the nozzle seat at the end of each stroke. The lap should not remain in contact with the nozzle seat for more than five seconds at a time.

(5) After 30 seconds withdraw the nozzle; clean the lap and examine its conical tip, which will have a mat surface where it has made contact with the nozzle seat. In the early stages of lapping the width of this mat surface will probably be narrow or may have a bright ring in the middle, which indicates the extent of the wear on the nozzle seat.

(6) Continue lapping as above, examining the lap every 30 seconds, until a mat surface over the majority of the lap conical tip is obtained.

NOTE.—The lap must be refaced, as described in paragraph (2), after every 1½ minutes of lapping time.

(7) Thoroughly clean the nozzle by reverse-flushing; dry out with compressed air and examine its seating through a nozzle microscope. The seat must be free from scores and pitting.

(8) Examine the needle valve conical tip under the nozzle microscope for scoring and pitting. If wear is evident the valve tip must be refaced on the nozzle grinding and lapping machine.

(9) Ensure that the grinding-wheel has been dressed and is perfectly true. To prevent damage to the pintle when refacing a Pintaux needle valve dress the edge of the grinding-wheel which will be adjacent to the pintle to an angle of 45°.

(10) Mount the needle valve in the lathe of the machine and reface the valve conical tip at the correct angle, i.e. 60°.

NOTE.—Remove only the absolute minimum of material; sufficient to change the colour of the valve tip is all that is necessary, otherwise the needle lift will be affected. As a guide, there must be no sparks or audible hiss from the grinding-wheel when carrying out this operation.

(11) In the event of the needle being a tight fit in the nozzle body, due to slight distortion or deposits on the valve guide surface, it is possible to restore the fit, using the adjustable collet provided as part of the equipment supplied with the nozzle grinding and lapping machine.

(12) Mount the needle valve in the lapping chuck and apply a very small quantity of fine lapping paste to the valve guide surface. Start the machine and thread the lapping collet over the rotating valve. Oscillate the collet over the valve guide surface, and after every 10 to 15 seconds of lapping time clean the valve and test it for correct fit in the nozzle body. A correctly fitting needle valve will just slide into the nozzle body under its own weight when lubricated with fuel oil.

(13) Using a suitably adapted dial gauge, check the needle lift, which should be ·032 to ·038 in. (·80 to ·95 mm.).

If the needle lift is found to be in excess of these limits it can be restored by lapping the top face of the nozzle body on a surface lapping plate.

When lapping the nozzle face extreme care must be taken not to tilt the nozzle, as this face makes a high-pressure joint with the nozzle holder and must therefore be true and at right angles to the nozzle axis.

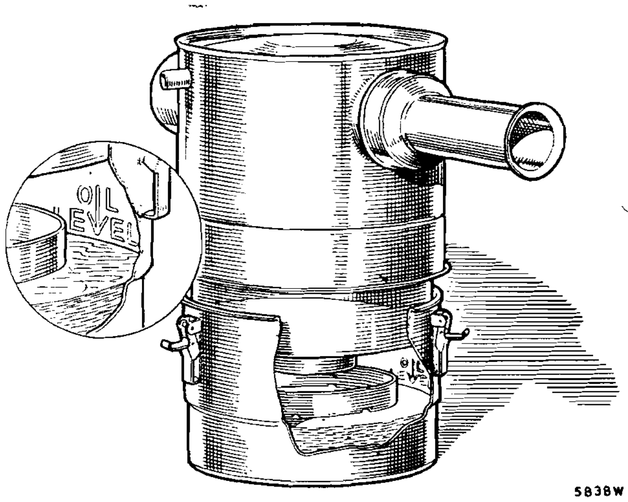


Fig. C.22

The oil-bath-type air cleaner

(14) Reassemble, test, and set the injector nozzle as described on pages C.18, C.19, C.20, and C.21.

It will be found that, owing to the lowering of the seating in the nozzle body, that it is impracticable to reclaim a nozzle more than three times.

Section C.7

AIR CLEANER

To remove and dismantle

Drain, clean, and refill the air cleaner at the recommended intervals. These periods must be reduced if excessive sludge accumulates in the base of the cleaner. Sludge must not be allowed to exceed ½ in. (13 mm.) in depth. Proceed as follows.

Release the two rubber hoses from the air cleaner.

Remove the bolts securing the air cleaner to its supports, and withdraw it. taking care to avoid spilling the oil.

To view and overhaul

Wash the filter element thoroughly in petrol and allow it to dry out.

Empty the container base and clean out all oil and sludge.

Refill the container with new engine oil up to the level indicated.

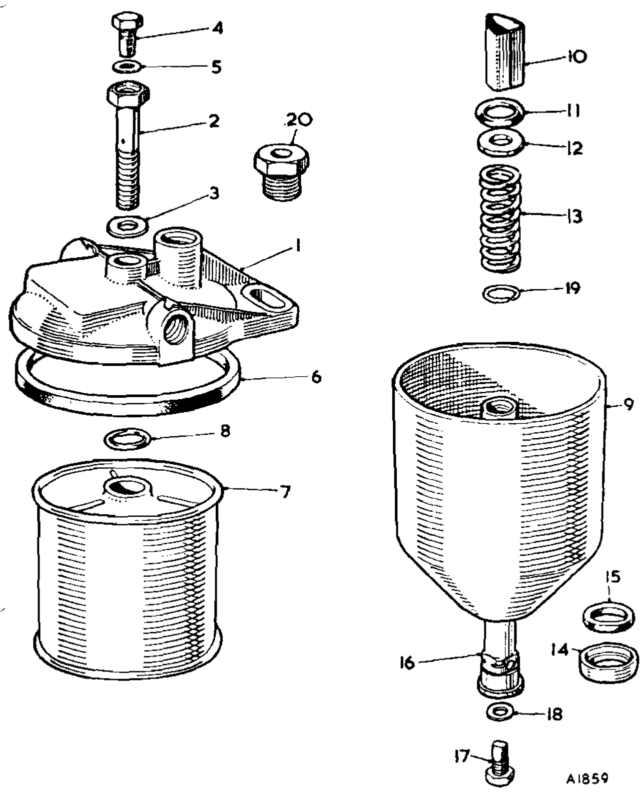


Fig. C.23

Modified fuel filter

1.	Filter head.	11.	Sealing ring—lower.
2.	Vent bolt.	12.	Washer.
3.	Washer for vent bolt.	13.	Spring.
4.	Vent screw.	14.	Base cup.
5.	Washer for screw.	15.	Sealing ring.
6.	Joint for head.	16.	Centre-bolt.
7.	Element.	17.	Drain plug.
8.	Sealing ring—top.	18.	Washer for plug.
9.	Body.	19.	Circlip for centre-bolt.
10.	Locating sleeve.	20.	Adaptor—leak-off pipe.

NOTE.—Never overfill the base, which will reduce engine performance, or underfill the base, which will reduce cleaning efficiency.

To reassemble and install

Reassembly and installation of the air cleaner is a reversal of the procedure **'To remove and dismantle'**.

Section C.8

FUEL TANK

Remove the screws securing the petrol tank filler neck and gauge unit covers inside the luggage boot and remove the covers.

Disconnect the gauge cable from the tank unit.

Slacken the two clips on the filler neck hose and withdraw the filler cap extension.

Pull the hose from the tank.

Remove the drain plug and empty the tank.

Disconnect the exhaust tail pipe support and move the pipe to one side.

Disconnect the two fuel pipes at the unions each located on the front end of the tank.

Remove the two bolts and packing washer from each of the tank side mountings and withdraw the tank rearwards.

Replacement is a reversal of the above instructions.

Section C.9

FUEL TANK GAUGE UNIT

Remove the inspection cover from the centre of the luggage boot floor.

Disconnect the cable from the tank unit.

Unscrew the six screws securing the gauge unit in the top of the tank.

Extract the gauge unit, taking particular care not to bend the float arm as the unit is withdrawn.

Before replacing the gauge unit ensure that all traces of the old gasket are removed from both the tank and the unit. Always use a new gasket and apply Heldite or a similar jointing compound to each of the screws and on both sides of the gasket, thus reducing distortion of the flange when tightening the screws.

Section C.10

MODIFIED FUEL FILTER

A modified fuel filter C.A.V. Type F2B9 is installed on later engines. This filter is, in general construction and operating principle, the same as the original filter, and the description and maintenance instructions are as detailed in Section C.2, noting the following:

(1) The centre-bolt is located in the filter body by means of a circlip, the seal between the bolt and the body being made with a rubber seal ring and cup washer.

(2) The cap nut and bleed plug are replaced by a vent bolt and vent screw. When bleeding the filter the vent screw should be unscrewed until the flats on the threaded portion of the screw are visible.

Section C.11

MAIN FUEL FILTER

(Bowl-less Type)

Construction and operation

A C.A.V. bowl-less-type main fuel filter was introduced at Engine Nos. 22E/A/D2815 and 22K/U/D424. This filter is of the cross-flow type and comprises three main components; the head and base castings, and a canister containing the paper filter element.

The filter components are held together by a split bolt arrangement, comprising a centre stud mounted in the filter base and a threaded bolt, which passes through the filter head to screw into the centre stud.

Synthetic rubber rings located in the filter head and base castings effect a seal between the outer rims of the element and the head and base castings. An 'O' ring located in an annular groove in the centre boss of the filter head, and over which the centre tube of the element fits, seals the dirty side of the filter from its clean side.

The head casting is provided with two inlet, two outlet, and a single vent connection. As only one inlet, one outlet, and the vent connection are required for this application the remaining two connections are fitted with sealing plugs and washers.

A passage in the filter head connects the filter inlet connection to the centre tube of the filter element. As the upper end of the centre tube is sealed, fuel at lift pump pressure passes down the centre tube into the base casting and then upwards through the filter element to the outlet connection in the filter head.

An auxiliary pipe connects the vent connection on the top of the filter head to the injector leak-off pipe, providing continuous air-venting of the filter during operation.

The paper element is not intended to be washed or cleaned in any way, and should be renewed at the recommended intervals.

To remove and dismantle the fuel filter

Thoroughly clean the outside of the filter.

Disconnect the fuel inlet and outlet pipes and the fuel leak-off pipe from the filter head, taking care not to lose the sealing washer positioned on each side of the banjo-type unions.

Unscrew the two bolts and nuts securing the filter to the mounting bracket on the cylinder head and withdraw the filter from the engine.

Unscrew the retaining bolt and sealing washer from the centre of the head casting and detach the base casting from the filter.

Remove the filter element, using a twisting movement to release the element from the head casting. Withdraw the three sealing rings from their locations in the head and base castings.

Unscrew and remove the two sealing plugs and washers from the head casting.

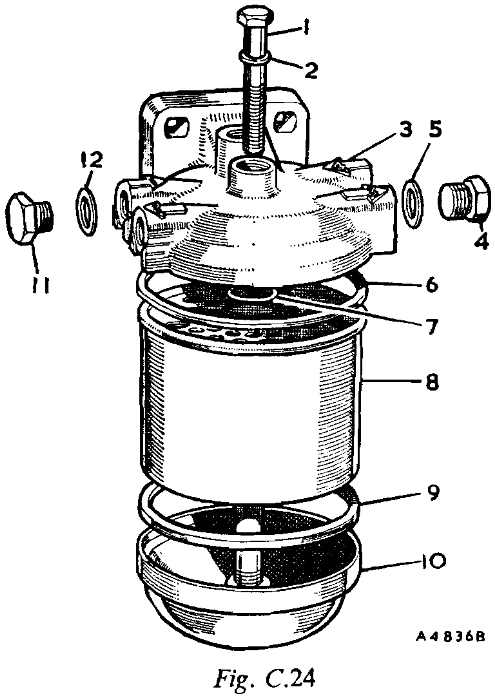


Fig. C.24

Main fuel filter (bowl-less type)

1.	Centre-bolt.	7.	'O' ring.
2.	Copper washer.	8.	Element.
3.	Filter head.	9.	Sealing ring.
4.	Blanking plug.	10.	Base.
5.	Copper washer.	11.	Blanking plug.
6.	Sealing ring.	12.	Copper washer.

Servicing the fuel filter

Thoroughly clean the outside of the filter.

Support the filter base casting and unscrew the retaining bolt with copper seal washer located in the centre of the filter head casting. Detach the base casting and, using a twisting movement, separate the element from the head casting. Remove the three sealing rings from their locations in the head and base castings.

Wash the base casting in petrol, and when dry remove any residue.

Reassemble, using a new element and sealing rings, fitting the element with its strengthened rim uppermost.

After reassembly bleed the fuel filter and the fuel injection pump as described in Section C.2, noting that the leak-off pipe union bolt on the filter head is also the filter air bleed point.

To reassemble and install the fuel filter

Before reassembling wash the filter head and base castings and the sealing plugs and washers in petrol, and allow them to dry. Do not use cotton waste or cloth wipers to dry them. Ensure that no residue is left in the passages in the head casting by blowing them clear with compressed air.

Assemble the sealing plugs and washers to connections Nos. 1 and 3 in the head casting.

Fit new sealing rings to the head casting, ensuring that they are properly located in their grooves. Assemble a new element, strengthened rim uppermost, to the head casting, using a twisting movement to seat it on the seals.

Place the base casting in position, using a new sealing ring to make the joint between the element and the casting, and secure the assembly with the retaining bolt and washer.

Refit the reassembled filter to its mounting bracket on the cylinder head, and reconnect the fuel and leak-off pipes, ensuring that the washers positioned on each side of the banjo-type unions are in good condition and will make a fuel-tight joint.

Finally, bleed the fuel system as described in Section C.2, noting that the leak-off pipe union bolt on the filter head is also the filter air bleed point.

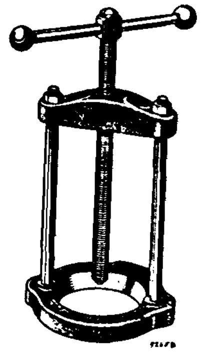
SERVICE TOOLS

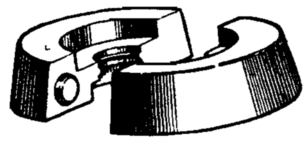
18G 12 A. Bearing Remover (basic tool)

This remover is a basic tool which, when used with a variety of adaptors, has numerous applications.

18G 12 D. F.I. Pump Ball and Roller Bearing Inner Race Remover Adaptor

Used in conjunction with basic tool 18G 12 A this adaptor enables the camshaft bearing inner races to be removed and replaced without damage to either camshaft or races.





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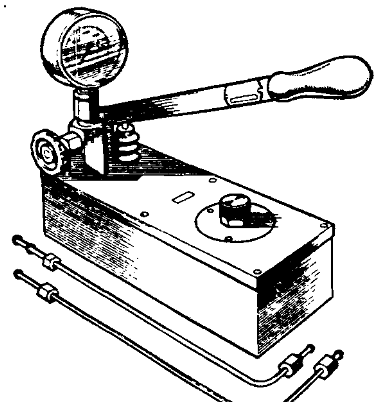
18G 12 A 18G 12 D

18G 109 A. Injector Nozzle-testing Machine

This machine is essential if injector nozzles are to be tested correctly or if it is desired to adjust the opening pressure.



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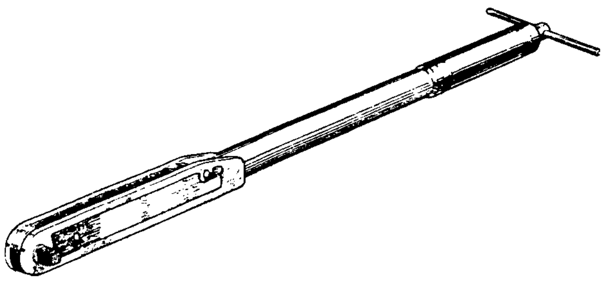
18G 109 A

18G 372. Torque Wrench—30 to 140 lb. ft. (4 to 20 kg. m.)

A universal torque wrench for use with standard sockets.

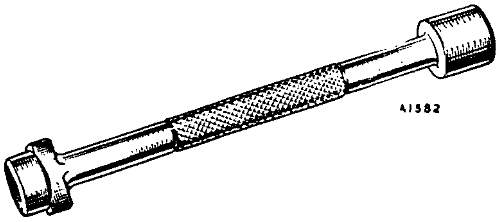


3869A

18G 372

18G 518 A. F.I. Pump Closing Plug Remover and Replacer

This tool facilitates the removal and accurate replacement of the 'knock-in'-type closing plugs fitted in the base of the later-type pump.

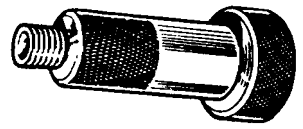


41582

18G 518 A

18G 109 E. Injector Nozzle Reverse-flush Adaptor

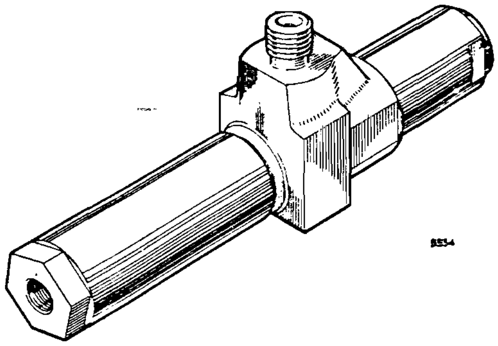
After the injector nozzle has been scraped internally to remove carbon deposits it should be flushed clean with the aid of this adaptor, which fits onto nozzle-testing machine 18G 109 A. Operation of the testing machine will force fuel oil through the nozzle spray holes in a reverse direction, thus removing all loose carbon.



18G 109 E

18G 109 B. Pintaux Nozzle-testing Adaptor

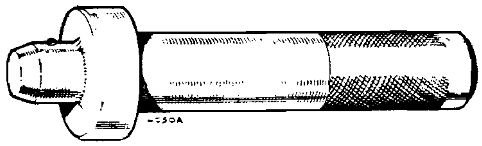
When testing Pintaux nozzles it is essential that a high rate of injection is obtained to determine the quality and form of atomization for both the main and auxiliary sprays. This is achieved by interposing test adaptor 18G 109 B, set to open at 220 atmospheres, between the nozzle under test and testing machine 18G 109 A.



18G 109 B

18G 134. Bearing and Oil Seal Replacer (basic tool)

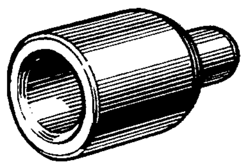
When used with a variety of adaptors this basic tool has numerous applications.



18G 134

18G 134 AA. F.I. Pump Camshaft Bearing Outer Race Replacer Adaptor

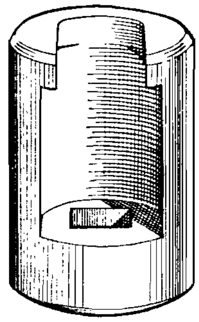
This adaptor, used in conjunction with basic tool 18G 134, enables the camshaft bearing outer races to be driven into their housings squarely and without damage.



18G 134 AA

18G 210. Injector Nozzle Nut Spanner

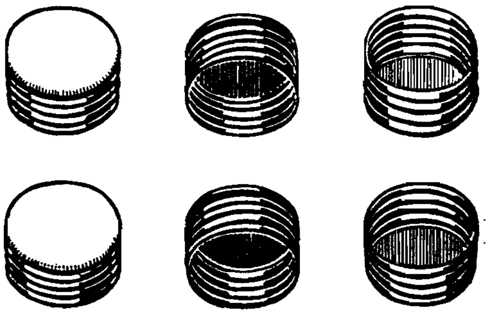
This spanner is designed to fit the flats on the injector nozzle nut and is used in conjunction with a standard ratchet wrench.



18G 210

18G 216. F.I. Pump Outlet Sealing Caps—set of 6

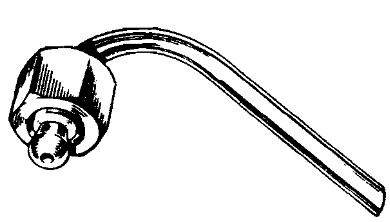
To prevent the ingress of foreign matter into the pump and injector nozzle feed unions when not in use.



18G 216

18G 233. F.I. Pump Spill Test Pipe

The use of this pipe enables the phasing of the injection pump to be carried out with great accuracy, since it is possible to determine the exact point of spill cut-off.

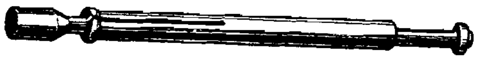


9195

18G 233

18G 237. F.I. Pump Delivery Valve Guide Remover

Due to the slight expansion of the fibre sealing washer round the delivery valve guide these guides can be difficult to remove without the aid of this remover. It is of the expanding type and protrudes below the lower face of the valve guide into the element barrel. The turning of the camshaft will eject the tool together with the valve guide.

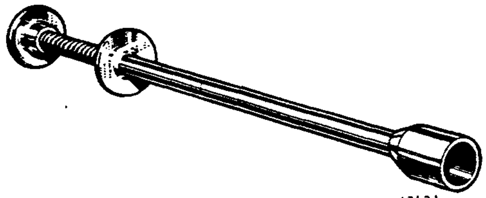


AD967

18G 237

18G 526. F.I. Pump Plunger Forceps

The forceps facilitate the removal and replacement of the element plungers via the holes in the base of the pump. This tool is spring-loaded and thumb-operated. The jaws grip the base of the plungers, enabling their withdrawal and replacement to be carried out without damage.

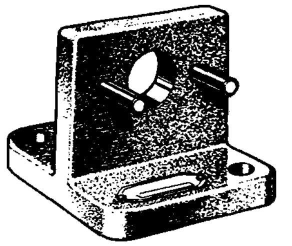


4362J

18G 526

18G 388. Injector Nozzle Dismantling Fixture

The fixture is designed for use either screwed to a bench or clamped in a vice. It holds the injector nozzle in a suitable working position during dismantling and reassembling.

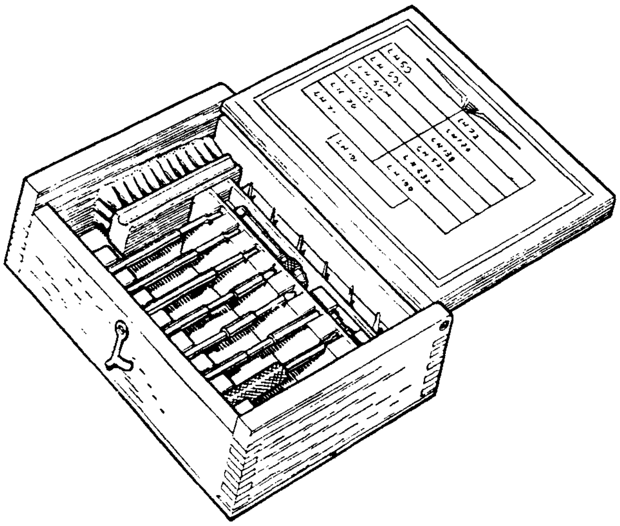


4362D

18G 388

18G 487. Injector Nozzle Cleaning Kit

This is a case containing a wire brush for removing carbon from the nozzle and valve, scrapers for cleaning the internal passages, and a probing tool which holds the steel wire for cleaning the spray holes in the nozzle. Replacement wires are available under Part No. 18G 487B.

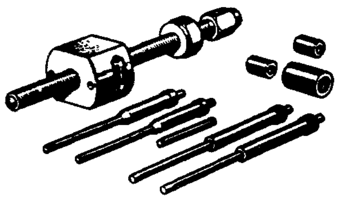


4470F

18G 487

18G 491 A. Injector Nozzle Remover

Supplied complete with two sets of adaptors, this tool will remove the most obstinate injector without damage. It can be used with the engine in or out of the car.

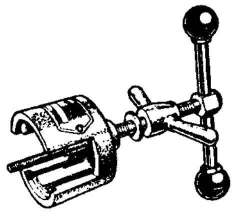


4462J

18G 491 A

18G 500. F.I. Pump Bearing Outer Race Remover (basic tool)

This basic tool, together with adaptor 18G 500 A is designed to remove the camshaft bearing outer races. It is an expanding tool which grips the race from the under side and pulls it out of the camshaft bearing housing without coming into contact with the bearing face, thus eliminating any possibility of damage.



18G 500

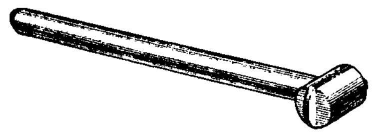
18G 500 A. F.I. Pump Bearing Outer Race Remover Adaptor

For use with 18G 500 to remove both ball and roller bearing outer races.

18G 500 A

18G 513 A. F.I. Pump Closing Plug Remover and Replacer

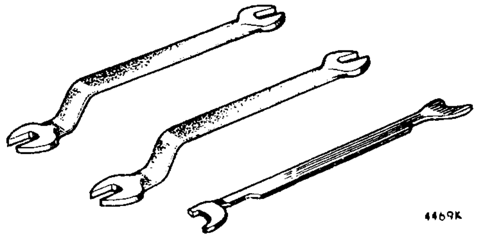
A tool of robust design with sufficient leverage to ensure that the closing plugs are fully tightened, thus preventing any possibility of loosening during service with the consequent serious damage to the pump due to oil leakage.



18G 513 A

18G 514. F.I. Pump Tappet Spanners—set of 3

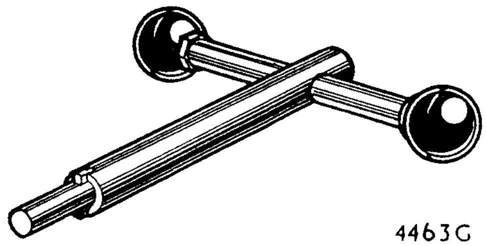
These spanners are of special design and are essential when raising or lowering the tappet adjusting screw during phasing.



18G 514

18G 516 F.I. Pump Control Rod Bush Remover and Replacer

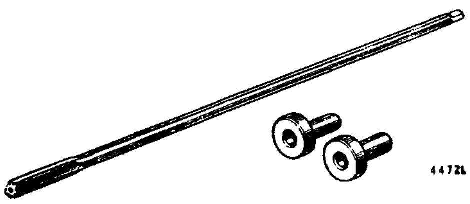
This tool is provided with a spigot which ensures that it is properly centralized, thus enabling the control rod screwed bushes to be removed and replaced without damage to the pump body.



18G 516

18G 517. F.I. Pump Control Rod Bush Reamer Set

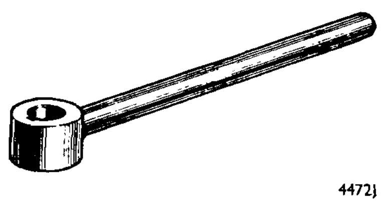
This tool is essential when renewing the control rod bushes. The small pilot is inserted into one unreamed bush and the opposite bush reamed. The large pilot is then inserted into the newly reamed bush and the bush in the other end is reamed. In each case the reamer is operated by drawing it through the bushes towards the operator.



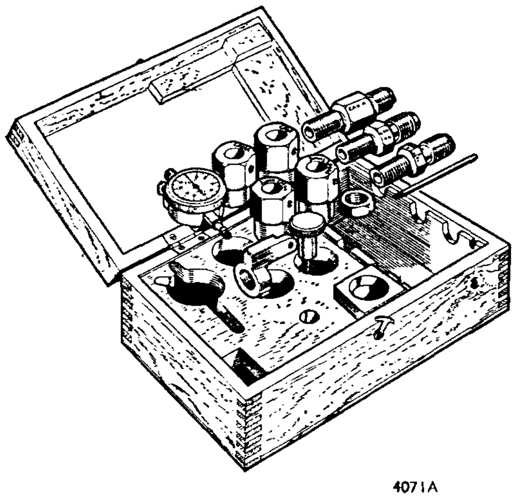
18G 517

18G 521. F.I. Pump Camshaft Holding Tool

A sturdily constructed tool to prevent the pump camshaft from rotating while removing or replacing the chain sprocket nut. It locates on the rear end of the pump camshaft and registers on the key fitted to the camshaft.



18G 521



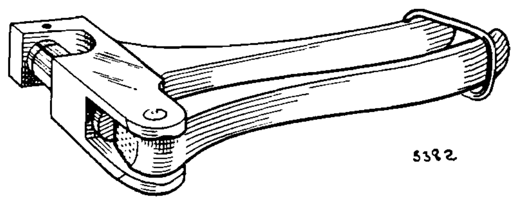
18G 538 A

18G 538 A. (formerly 18G 538). F.I. Pump Camshaft End-float and Plunger Head Clearance Gauge Set

This gauge set is supplied complete with adaptors.

18G 541. F.I. Pump and Venturi Sealing Pliers

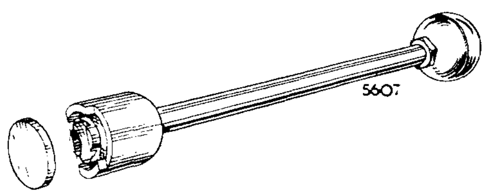
For use when resealing the venturi and injection pump with wire and lead seal after final adjustments have been made to the maximum speed and maximum fuel stop screws. Wires and lead seals are obtainable in packs of 36 (Part No. 58G 444).



18G 541

18G 547. F.I. Pump Tappet Holder

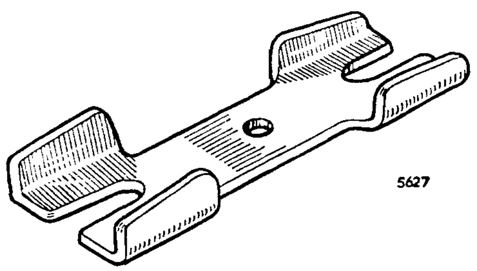
This tool facilitates the removal and replacement of the tappets through the closing plug holes in the base of the fuel injection pump. Its magnetic base is contoured to the tappet roller, thus enabling the tappet to be turned when locating the guide peg into its slot in the pump body. It is also used to exert pressure upon the tappet to compress the plunger spring when inserting holders 18G 550 A under the tappet heads.



18G 547

18G 550 A. F.I. Pump Tappet Wedges—set of 6

Used to hold the tappets clear of the cams whilst removing or replacing the injection pump camshaft. They are inserted under the heads of the tappet screws, either by turning the camshaft to bring each tappet to its uppermost position or, when reassembling, by exerting pressure on the tappet base with tool 18G 547.

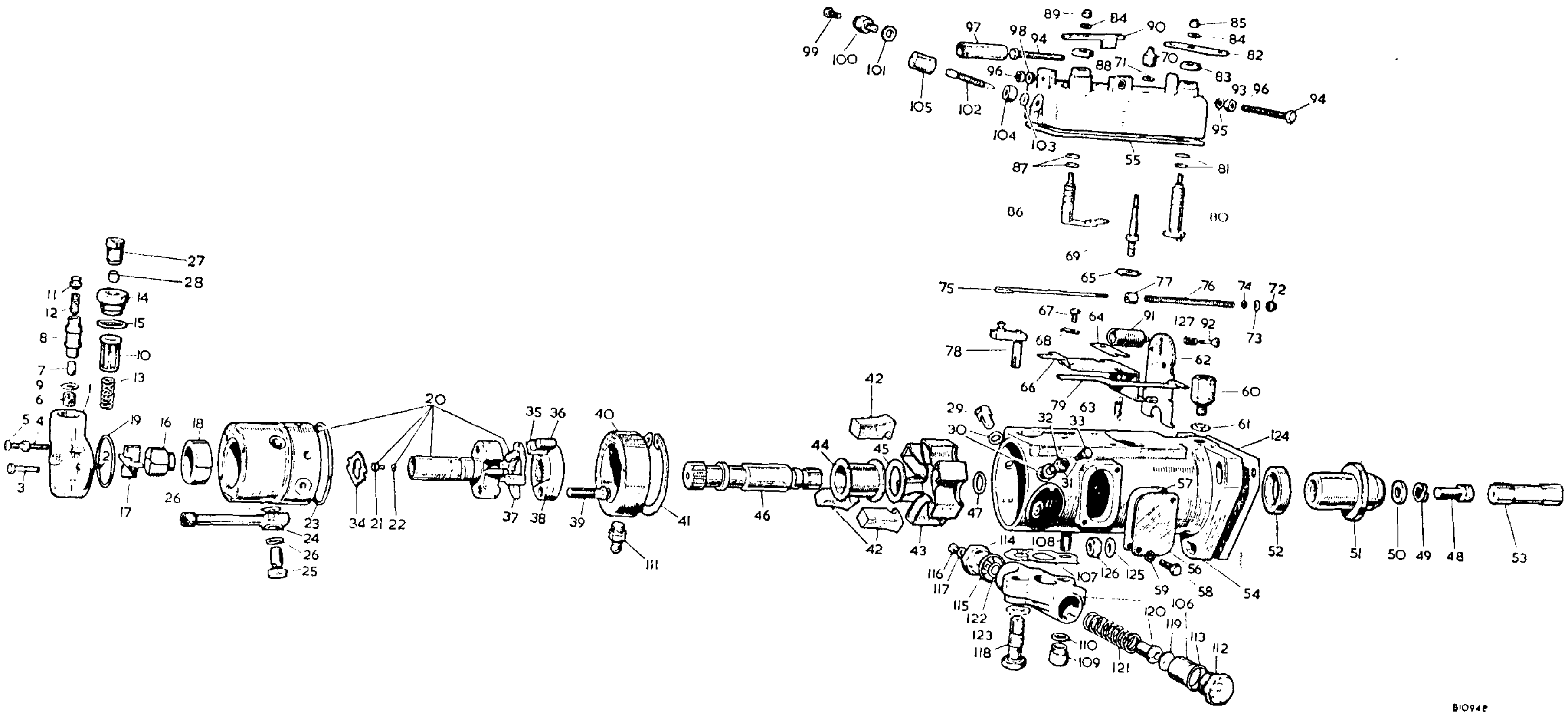


18G 550 A

SECTION Ca

THE FUEL SYSTEM
(Diesel Models With Distributor-type Injection Pump)

THE DISTRIBUTOR-TYPE FUEL INJECTION PUMP COMPONENTS



KEY TO THE DISTRIBUTOR-TYPE FUEL INJECTION PUMP COMPONENTS

No.	*Description*
1.	End plate.
2.	Locating pin.
3.	Screw for end plate.
4.	Stud for end plate.
5.	Nut for stud.
6.	Piston retaining spring.
7.	Regulating piston.
8.	Regulating sleeve.
9.	Washer for sleeve.
10.	Filter.
11.	Regulating plug.
12.	Regulating spring.
13.	Sleeve retaining spring.
14.	Inlet connection.
15.	Washer for inlet connection.
16.	Transfer pump rotor.
17.	Transfer pump blade.
18.	Transfer pump liner.
19.	Transfer pump seal.
20.	Hydraulic head and rotor assembly.
21.	Rotor plug.
22.	Washer for plug.
23.	Hydraulic head seal.
24.	Banjo pipe.
25.	Bolt for banjo pipe.
26.	Washer for bolt.
27.	Fuel feed pipe connection.
28.	Olive for fuel feed pipe.
29.	Hydraulic head locking screw.
30.	Washer for screw.
31.	Hydraulic head vent screw assembly.
32.	Vented locking screw for hydraulic head.
33.	Vent screw.
34.	Adjusting plate (bottom).
35.	Roller shoe.
36.	Roller.
37.	Adjusting plate (top).
38.	Drive plate.
39.	Drive plate screw.
40.	Cam ring.
41.	Locating circlip for cam ring.
42.	Governor weight.
43.	Retainer for governor weights.
44.	Thrust sleeve.
45.	Thrust washer.
46.	Drive shaft.
47.	Drive shaft seal.
48.	Drive shaft screw.
49.	Spring washer for screw.
50.	Support washer.
51.	Drive hub.
52.	Drive hub seal.
53.	Quill shaft.
54.	Pump housing.
55.	Gasket for control cover.
56.	Cover-plate.
57.	Gasket for cover-plate.
58.	Screw for cover-plate.
59.	Washer for screw (shakeproof).
60.	Drain connection.
61.	Washer for connection.
62.	Governor arm.
63.	Spring for governor arm.
64.	Keep plate.
65.	Tab washer.
66.	Control bracket.
67.	Screw for bracket.
68.	Tab washer for screw.
69.	Stud for control cover.
70.	Nut for stud.
71.	Washer for stud.
72.	Linkage nut.
73.	Pivot ball washer.
74.	Linkage washer.
75.	Linkage hook.
76.	Linkage spring.
77.	Spring retainer.
78.	Metering valve.
79.	Shut-off bar.
80.	Shut-off shaft.
81.	Seal for shut-off shaft.
82.	Shut-off lever.
83.	Dust cap for shaft.
84.	Washer for shaft.
85.	Nut for shaft.
86.	Throttle shaft.
87.	Seal for throttle shaft.
88.	Dust cap for shaft.
89.	Nut for shaft.
90.	Throttle arm.
91.	Governor spring.
92.	Guide for idling spring.
93.	Control cover.
94.	Adjusting screw.
95.	Washer for adjusting screw.
96.	Locknut for screw.
97.	Locking sleeve.
98.	Adaptor for sleeve.
99.	Vent screw.
100.	Vent screw body.
101.	Washer for vent screw body.
102.	Adjustment screw for metering valve
103.	Washer for nut.
104.	Locknut.
105.	Sealing cap.
106.	Automatic advance device housing and piston.
107.	Gasket for housing.
108.	Stud for housing.
109.	Cap nut for stud.
110.	Washer for cap nut.
111.	Cam advance screw.
112.	Piston plug.
113.	Seal for plug.
114.	Piston spring cap.
115.	Seal for cap.
116.	Screw for cap.
117.	Washer for screw.
118.	Head locating bolt.
119.	Slide washer.
120.	Maximum advance stop.
121.	Spring for stop.
122.	Shim washer for spring.
123.	Washer for head locating bolt.
124.	Joint washer for pump mounting flange.
125.	Washer for nut.
126.	Nut for injection pump mounting bolt.
127.	Idling spring.

Section Ca.1

DESCRIPTION OF THE MAIN FUEL FILTER

This filter is the same as the one described in Section C.11.

The head casting is provided with two inlet, two outlet, and a single vent connection. One outlet connection is not required and is fitted with a sealing plug, while the second inlet connection allows fuel oil surplus to the injection pump requirements to return to the dirty side of the filter. This connection is fitted with a non-return valve to ensure that unfiltered fuel cannot find its way into the injection pump body.

Section Ca.2

REMOVING AND REPLACING THE FUEL FILTER

Follow the instructions given in Section C.11 but after replacing the fuel filter, bleed the fuel system as described in Section Ca.5.

Section Ca.3

DISMANTLING AND REASSEMBLING THE FUEL FILTER

Follow the instructions given in Section C.11, but when reassembling check the operation of the non-return valve.

Assemble the sealing plug and washer to (outlet) connection No. 3 and the non-return valve to (inlet) connection No. 1 in the head casting.

Section Ca.4

RENEWING THE FUEL FILTER ELEMENT

The filter element should be renewed as described in Section C.11 and the fuel system should then be air-vented as described in Section Ca.5.

Section Ca.5

AIR-VENTING (BLEEDING) THE FUEL SYSTEM

The following procedure should be used to air-vent the fuel system after first ensuring that there is an adequate supply of fuel in the tank:

(1) Ensure that the fuel cut-off tap is turned on then slacken the blanking plug and the union screw on the filter head.

(2) Slacken the union nut at the fuel injection pump end of the feed pipe and the two air bleed screws on the fuel injection pump.

(3) Slacken the union at the injection end of the four high pressure pipes.

(4) Operate the lift pump and when the fuel issuing from the blanking plug is free from air bubbles, tighten the plug.

(5) Continue operating the lift pump until the fuel issuing from the union screw, union nut and the two bleed screws is free from air bubbles, closing each point in turn.

(6) Operate the starter motor and when the fuel issuing from at least two of the high pressure pipes is free from air bubbles, tighten all four union nuts.

(7) Start the engine and allow it to run until it is firing on all cylinders.

After renewing the main fuel filter element, **providing the engine is not cranked during this operation,** it is only necessary to bleed the fuel filter at the two points on the filter head and the union nut on the fuel injection pump by operating the lift pump before starting the engine.

WARNING.—Lubrication of the injection pump mechanism is effected by fuel oil under pressure, therefore no attempt should be made to bleed the fuel system by towing the vehicle in gear as this may result in serious damage to the injection pump.

Section Ca.6

DESCRIPTION OF THE FUEL INJECTION PUMP

The injection pump is a single-cylinder, opposed-plunger, inlet-metering, distributor-type pump fitted with a mechanical flyweight-type governor and a hydraulically operated automatic advance mechanism. The pump is flange-mounted on the rear of the engine front mounting plate and is driven by the timing chain. A splined quill shaft, having a master spline at each end

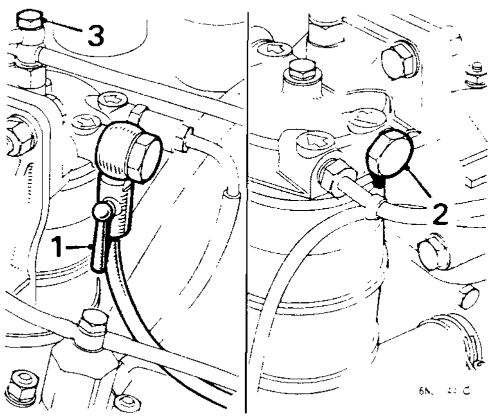


Fig. Ca.1

Main fuel filter air bleed points

1. Fuel cut-off tap. 2. Blanking plug. 3. Union screw.

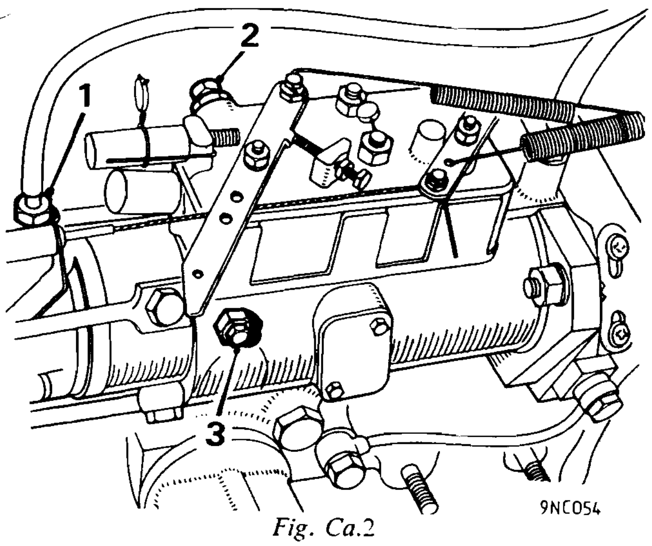


Fig. Ca.2

Fuel injection pump air bleed points

1. Union nut. 2. Air bleed screw. 3. Air bleed screw.

to ensure correct location, transmits the drive from the chain wheel to the injection pump drive hub.

A central rotating member forms the pumping and distributing rotor, and this is driven by the drive hub through a splined drive shaft on which is mounted the governor flyweight assembly.

Mounted on the outer end of the pumping and distributing rotor is a sliding-vane-type transfer pump. This pump raises the fuel pressure to an intermediate level, and as its capacity is many times the maximum requirements of the injection pump a regulating valve, housed in the pump end plate, allows excess fuel to be by-passed back to the suction side of the transfer pump.

The pressure regulating valve, in addition to regulating the pressure of the fuel from the transfer pump, also provides a means of by-passing the transfer pump when priming the injection pump. Referring to Fig. Ca.3, it will be seen that the valve is cylindrical and contains a small 'free' piston, the travel of which is limited by two light springs. When priming the injection pump, fuel at lift pump pressure enters the central port in the regulating valve sleeve and moves the 'free' piston against the pressure of the piston retaining spring to uncover the priming port in the lower end of the valve sleeve. The priming port is connected by a passage in the end plate to the delivery side of the transfer pump, thus enabling the fuel to by-pass the stationary transfer pump and prime the injection pump.

When the injection pump is in operation fuel at transfer pressure enters the lower end of the valve sleeve, forcing the 'free' piston upwards against the regulating spring. As the engine speed increases, the transfer pressure rises, moving the piston against the pressure of the regulating spring to progressively uncover the regulating port in the valve sleeve and allow a metered flow of fuel to by-pass back to the inlet side of the transfer pump.

The transfer pressure, therefore, is controlled by a balance between the regulating spring pressure and the requirements of the injection pump at any moment.

The pumping and distributing rotor revolves, and is a close fit, in the stationary hydraulic head. The pumping section of the rotor has a transverse bore containing twin opposed pumping plungers. These plungers are operated by means of a cam ring, carried in the pump housing, through rollers and shoes which slide in the rotor. The cam ring has four internal lobes operating in diagonally opposite pairs. The opposed plungers have no return springs but are moved outwards by fuel under pressure from the transfer pump, the flow of fuel and outward displacement of the plungers being determined by the setting of the metering valve and the speed at which the pump is rotating. As a result the rollers, which operate the plungers, do not follow the contour of the internal cam ring entirely, but will contact the cam lobes at points which will vary according to the amount of plunger displacement.

The automatic light load advance mechanism operates by rotating the cam ring within the pump body. A ball-ended lever, screwed into the cam ring, is operated by a piston, one side of which is spring-loaded, sliding in a cylinder. The other side of the piston is subjected to fuel at transfer or drain pressure, according to engine load, which is admitted to the cylinder through the hollow locating bolt and a port in the cylinder wall. The pressure of fuel is controlled by the rotary and endwise movement of the metering valve.

Machined in the surface of the metering valve is a helical groove. A vertical flat extends upwards from the helical groove and protrudes beyond the hydraulic head.

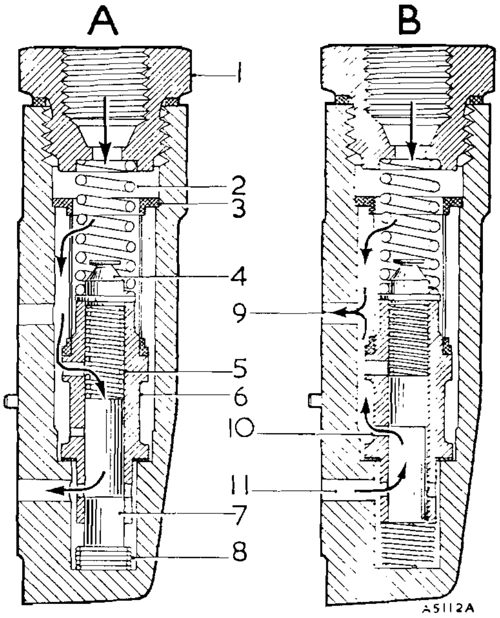


Fig. Ca.3

Section through the end plate and regulating valve

A. Priming.
B. Regulating.
1. Inlet connection.
2. Sleeve retaining spring.
3. Nylon filter.
4. Sleeve guide plug.
5. Regulating spring.
6. Regulating sleeve.
7. Regulating piston.
8. Piston retaining spring.
9. Fuel passage to transfer pump inlet.
10. Regulating port.
11. Fuel passage to transfer pump outlet.

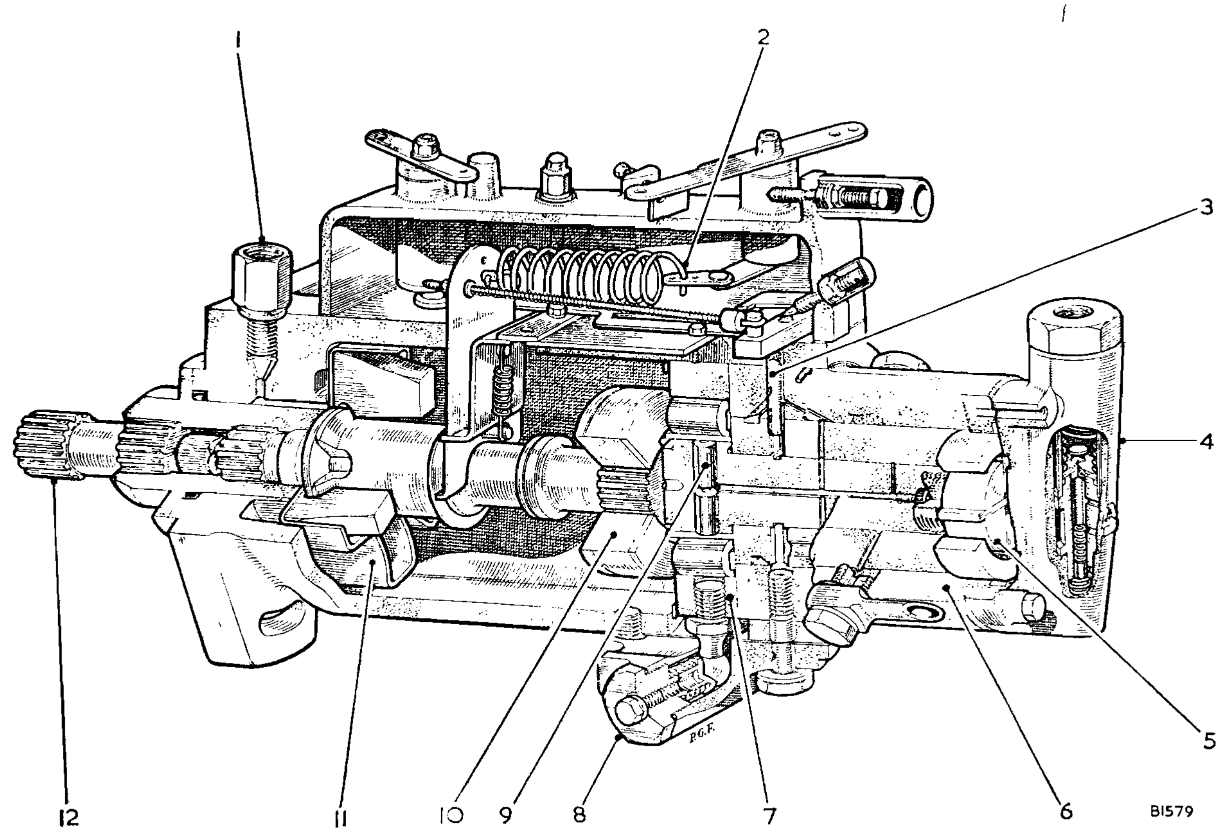


Fig. Ca.4
Section through the fuel injection pump

1. Back-leakage connection.
2. Governor spring.
3. Metering valve.
4. End plate and regulating valve.
5. Transfer pump.
6. Hydraulic head.
7. Cam ring.
8. Automatic advance device.
9. Pumping plunger.
10. Drive plate.
11. Governor weight assembly.
12. Quill shaft.

This flat is open to fuel at drain pressure in the governor housing.

In the surface at the lower end of the metering valve is machined a flat, the upper edge of which is of the same pitch as the helical groove. This flat is open to fuel at transfer pressure.

The width of the land between the helical groove and the flat at the lower end of the metering valve is slightly less than the diameter of the timing port in the metering valve chamber in the hydraulic head. The timing port, which is situated opposite the metering port, is connected by a passage in the hydraulic head and the hollow locating bolt to the port in the advance cylinder.

When the metering valve is in the full-load position the helical groove in the valve is aligned with the timing port in the hydraulic head and fuel at drain pressure is applied to the advance piston. As the drain pressure is insufficient to overcome the piston spring pressure the cam ring is held in the fully retarded position.

Under light-load conditions the metering valve is moved to the low fuelling position, aligning the flat at the lower end of the metering valve with the timing port. The advance piston is now subject to fuel at transfer pressure, and the piston and cam ring move to the fully advanced position.

The under side of the metering valve is subject to fuel at transfer pressure which tends to force the valve upwards. This upward movement of the valve is controlled by an adjustable stop screw, which sets the relative positions of the helical groove, the flat on the lower end of the valve, and the timing port so that light-load advance is obtained at the required engine speed.

Machined on each lobe of the cam ring, immediately after the peak of the cam, is a retraction curve. Under running conditions, when the injection cycle is completed the distributing port in the rotor and the outlet port on the hydraulic head are still in partial alignment with each other. As the plunger rollers move off the peaks of the cams the retraction curves allow the plungers to move slightly outwards. This movement of the plungers effects a sudden reduction of pressure in the injection line, so preventing secondary injection and allowing the injector nozzle needle valve to snap onto its seating to terminate the spray of fuel into the combustion chamber without 'dribble'. When starting the engine the metering valve is in the full-load position and the advance piston is subject to fuel at drain pressure. As drain pressure not sufficient to overcome the pressure of the advance piston return spring, the piston and the cam ring remain in the fully retarded position.

The distributor part of the rotor has a central axial passage which connects the pumping space between the plungers with the four inlet ports and single distributing port drilled radially in the rotor. The radial hole at the outer end of the rotor is the distributing port, and, as the rotor turns, this port is aligned successively with the outlet ports in the hydraulic head, from which the injectors are fed via external high-pressure pipes. The inlet or charging ports are equally spaced around the rotor at an intermediate position, and, as the rotor turns, these are aligned successively with the inlet or metering port in the hydraulic head. This port admits fuel to the rotor under control of the metering valve, which is mechanically governed.

The mechanical governor is of the flyweight type, the weights being held in a retainer, which is clamped between the injection pump drive hub and the drive shaft and rotates with these components as a single unit. The weights are a sliding fit in the retainer pockets and are so shaped that, when under the influence of centrifugal force, they pivot about one edge. A thrust sleeve, which is a sliding fit on the injection pump drive shaft, is moved axially by the flyweights. Movement of the thrust sleeve is transmitted by means of the governor arm and the spring-loaded hook link to rotate the metering valve. The governor arm pivots about a fulcrum on the control bracket and is held in contact with the thrust sleeve by spring tension. Connection between the governor arm and the throttle arm and shaft assembly is made through the governor spring and the idling spring and its guide.

A shut-off bar, operated by an external lever, rotates the metering valve to close the metering port.

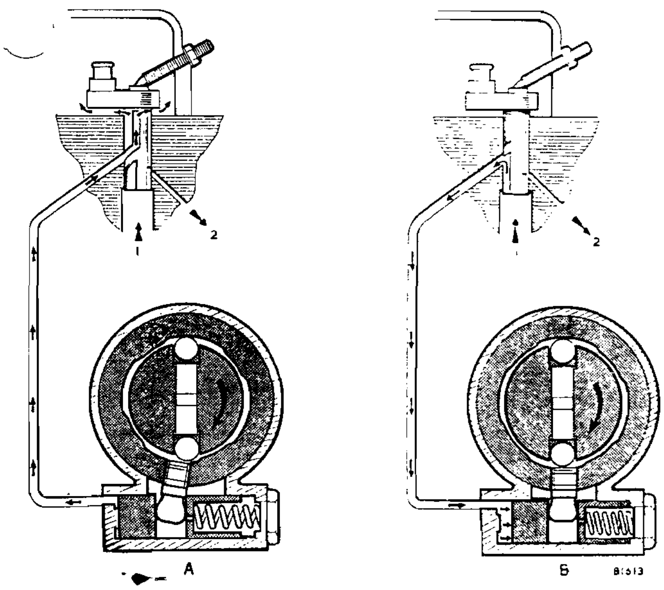


Fig. Ca.5

Light-load advance device

A. Full load.
B. Low load.

1. Transfer pressure.
2. To pumping element.

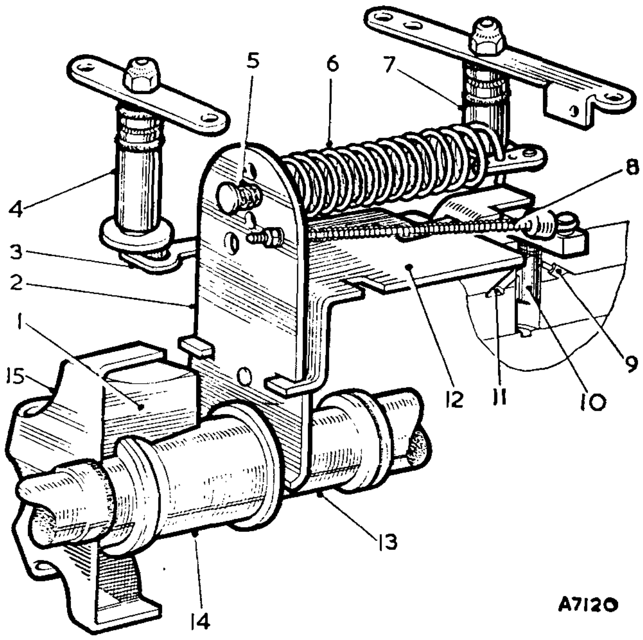


Fig. Ca.6

Mechanical governor

1. Governor weight.
2. Governor arm.
3. Shut-off bar.
4. Shut-off shaft.
5. Idling spring.
6. Governor spring.
7. Throttle shaft.
8. Linkage hook.
9. Metering port.
10. Metering valve.
11. Timing port.
12. Control bracket.
13. Drive shaft.
14. Thrust sleeve.
15. Weight retainer.

The metering valve is provided with a vertical slot along which fuel passes at transfer pressure into the metering port. The valve is situated in a chamber in the hydraulic head, into which the diagonally drilled metering port opens, and rotation of the valve varies the effective area of the metering port to regulate the flow of fuel to the pumping and distributing rotor.

When the throttle arm is moved to give increased speed, the light idling spring is compressed as the guide is drawn through the governor arm and the governor spring is tensioned. Tension of the governor spring acting upon the governor arm and thrust sleeve resists movement of the governor flyweights. As the engine speed increases, the increasing centrifugal force moves the flyweights outwards, overcoming the governor spring tension to move the governor arm and the metering valve towards the closed position. When the selected speed has been attained it will be maintained by governor action. Should the engine speed fall, the flyweights will move inwards, causing an increase of fuelling which restores the selected engine speed.

When the throttle arm is in the idling position the governor spring is untensioned and governing action is controlled by the light idling spring.

In operation fuel at lift pump pressure enters the pump through the connection on the pump end plate and passes through a fine nylon gauze filter to the inlet side of the transfer pump.

From the transfer pump the fuel passes through a passage in the hydraulic head to an annular groove surrounding the rotor, and thence to the metering valve. The position of the metering valve depends upon the setting of the throttle arm which varies the governor spring pressure on the governor arm. Any variation in pump speed is accompanied by an increase or decrease in transfer pressure, which assists in regularing the flow of fuel into the pumping section of the rotor. The volume of fuel passing into the pumping element is thus controlled by the transfer pressure, the position of the metering valve, and the time during which an inlet port in the rotor is aligned with the metering port in the hydraulic head.

When one of the rotor inlet ports is aligned with the metering port in the hydraulic head, fuel at metering pressure flows into the rotor and forces the pumping plungers apart, the amount of plunger displacement being governed by the quantity of fuel which can flow into the rotor while the ports are aligned. As the rotor turns, the inlet port is cut off and the pump plungers begin to be forced inwards by their rollers bearing on a pair of cam lobes. This causes an immediate rise in pressure, and as the single distributor port in the rotor comes into register with an outlet port in the hydraulic head the plungers force the fuel up the central bore of the rotor and out to the respective injector.

The maximum amount of fuel delivered at one charge is controlled by limiting the maximum outward movement of the plungers. In Fig. Ca.7 is shown an end-on view of the rotor, and it will be seen that the cam rollers are carried in shoes which bear against the ends of the plungers. The roller shoes, which slide in slots in the rotor, have specially shaped projecting 'ears' which

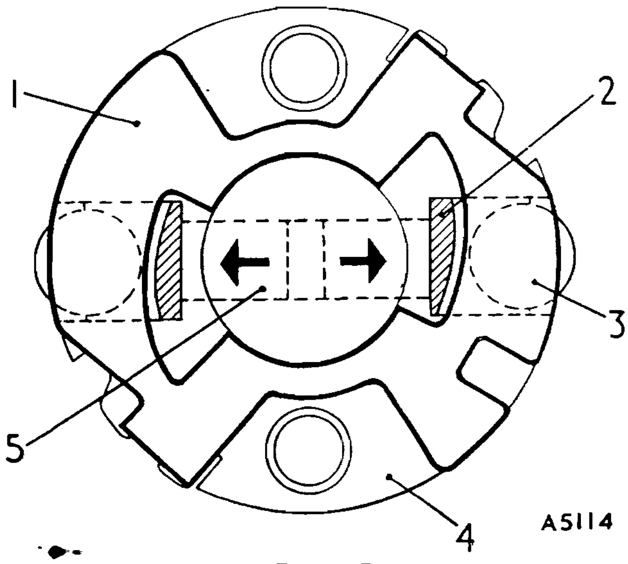


Fig. Ca.7

Maximum fuel adjustment

1. Top adjusting plate.
2. Roller shoe ear.
3. Roller.
4. Pumping end of rotor.
5. Pumping plunger.

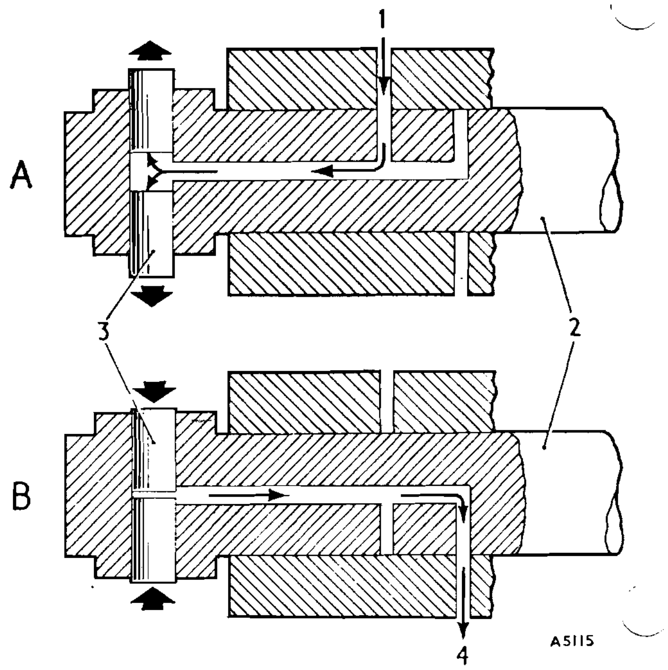


Fig. Ca.8

The injection cycle

A. Inlet stroke.
B. Injection stroke.
1. Fuel inlet.
2. Pumping and distributing rotor.
3. Pumping plungers.
4. Fuel to injector.

engage eccentric slots in the top and bottom adjusting plates. Two lugs on the top adjusting plate engage slots in the bottom adjusting plate to locate the plates one to the other.

The top adjusting plate is clamped to the rotor by the drive plate, the adjusting plate being cut away in the areas of the drive plate securing screws to permit adjustment of the plates by rotation. The maximum outward travel of the pump plungers is limited by the 'ears' of the roller shoes coming into contact with the curved slot sides in the adjusting plates. As the slots are eccentric rotation of the adjusting plates relative to the rotc provides a means of adjusting the maximum plunger stroke.

Section Ca.7

REMOVING AND REPLACING THE FUEL INJECTION PUMP

Thoroughly clean the outside of the injector pump body, and then disconnect the throttle, stop and kick-down (if fitted) controls. Disconnect the fuel feed and return pipes from the pump.

Disconnect the high pressure pipes from the pump and the injectors, remove the clamp and damper bushes and detach the pipes individually from the engine. Seal the pump outlet unions with sealing caps 18G 216 to prevent the ingress of foreign matter.

Unscrew the three nuts with plain washers securing the injection pump flange to the rear of the engine front pla and draw the pump rearwards to disengage it from the engine. Withdraw the quill shaft from inside the injection pump chain wheel hub.

Before replacing the fuel injection pump it is necessary to set the static injection timing.

To ensure correct timing relationship between the injection pump and the engine the injection pump driving hub, the quill shaft, and the driving flange of the injection pump chain wheel are provided with master splines; also, a timing mark, is scribed on the fuel injection pump mounting flange and an adjustable timing pointer is secured to the flange of the chain wheel hub.

Before fitting the injection pump to the engine the position of the timing pointer on the flange of the chain wheel hub should be checked, using timing gauge 18G 698, and reset if necessary.

A degree plate, fitted to the crankshaft pulley, with a corresponding pointer on the timing case, is provided to facilitate ease of timing.

Initial adjustment of the injection timing is provided for in the injection pump driving flange, the holes for the bolts which secure it to the chain wheel being elongated.

Crank the engine until the appropriate timing mark coincides with the timing groove on the crankshaft pulley. Ensure that No. 1 piston is on its compression stroke.

Remove the injection pump chain wheel cover-plate from the front of the timing chain case and note the position of the master spline in the pump driving flange, which should now be in the seven o'clock position as seen from the front of the engine.

Insert injection timing gauge 18G 698 through the chain wheel hub, engaging the splined end of the gauge with the internal splines of the pump driving flange. The master spline will allow the gauge to engage the driving flange in one position only. Turn the gauge by hand (undue force is not necessary) in a clockwise direction, as seen from the rear of the engine, to take up any backlash in the injection pump drive mechanism. Hold the gauge in this position, slacken the two securing screws, and move the timing pointer to align it with the 'ot on the edge of the gauge. Should the movement required to line up the timing pointer be appreciable, then initial adjustment should be made by altering the position of the injection pump driving flange relative to the chain wheel. This adjustment is made by slackening the four bolts securing the driving flange to the chain wheel and carefully turning the driving flange the required amount by means of the timing gauge. Tighten the driving flange securing screws and carry out final adjustment of the timing pointer as described previously and then remove the timing gauge.

NOTE.—After every occasion of injection pump removal or attention to the crankshaft, camshaft, and timing gear the position of the timing pointer should be checked, and reset, if necessary, as described above.

Fit the injection pump quill shaft into the driving flange.

Rotate the injection pump drive hub and position the master spline in the drive hub at seven o'clock, when 'oking on the drive end of the pump. This will facilitate the engagement of the quill shaft splines with the drive hub.

Place a new joint washer in position on the engine front plate and offer up the injection pump to the engine. Engage the pump drive hub with the quill shaft and retain the pump in position by fitting the securing nuts and washers finger tight. Rotate the injection pump to align the timing mark on the pump mounting flange with the timing pointer. Tighten the three nuts to secure the injection pump in this position.

Refit the high-pressure pipes, and the fuel feed and drain pipes. Connect the throttle and shut-off controls and ensure that both controls have their full range of movement.

Bleed the fuel system as described in Section Ca.5.

Maximum and idling speed adjustments

After fitting either a new or overhauled injection pump the engine maximum light running speed and the idling speed must be checked, and adjusted if necessary. Before making either of these adjustments it is imperative that the engine air cleaner is correctly serviced and fitted.

Run the engine until it has attained its normal running temperature—**this is most important**. Ensure that the shut-off control is in the fully open position and remove the locking sleeve from the maximum speed adjusting screw.

Using a tachometer to check the engine speed, adjust the maximum speed stop screw to give a maximum light running speed of 3,700 r.p.m., thus giving a maximum road governed speed of 3,500 r.p.m. Tighten the locknut. Fit the locking sleeve and seal it with wire and a lead seal, using sealing pliers 18G 541.

Adjust the idling stop screw to give an idling speed of 600 r.p.m. and tighten the locknut.

Section Ca.8

DISMANTLING AND REASSEMBLING THE FUEL INJECTION PUMP

Dismantling and servicing of the fuel injection pump should only be carried out by specially trained personnel,

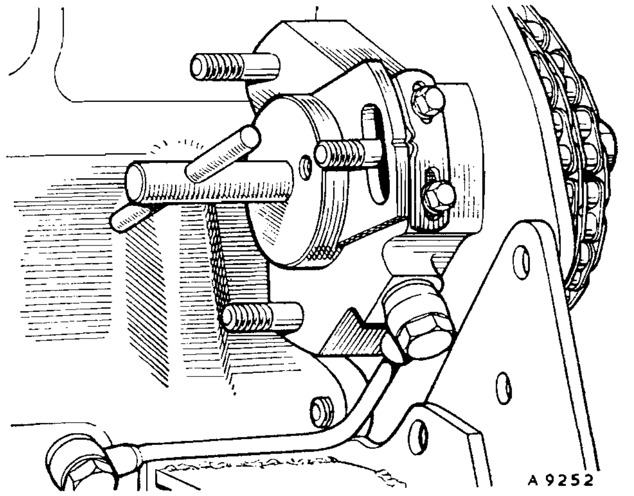


Fig. Ca.9

Checking the position of the injection pump timing pointer, using timing gauge 18G 698 and the Service tools and special test equipment referred to in the following instructions should be available. The workshop in which these operations are carried out should be absolutely clean and the atmosphere free from dust or dirt. It is also recommended that components are immersed in clean Shell Calibration Fluid 'C' immediately after they are dismantled from the main assembly to protect them from possible damage and corrosion and to prevent the ingress of foreign matter.

Abrasives should never be used for cleaning as the resulting damage would seriously impair both the efficiency and the working life of the pump. The components should be washed in clean Shell Calibration Fluid 'C', but they must not be wiped with cotton waste, rags, or cloth wipers of any kind.

Cut the sealing wire, remove the cover-plate and joint washer from the side of the pump housing, and drain the fuel oil from the pump.

Withdraw the quill shaft from the drive hub and mount the pump on assembly base 18G 633 A secured in a vice.

Remove the banjo pipes from the hydraulic head. Unscrew the self-locking nuts with plain washers and remove the shut-off lever and throttle arm from their shafts. Remove the dust cover from each shaft. Cut the locking wire, unscrew the two control cover securing nuts, and remove the two flat washers. Press the throttle shaft downwards and withdraw the control cover complete with shut-off shaft and adjusting screws. Remove and discard the control cover to pump housing gaskets.

Press back the locking tabs and unscrew the two control cover studs and the small set screw securing the control bracket to the pump housing. Remove the keep plate and tab washers, then lift the complete control bracket assembly together with the metering valve and shut-off bar from the pump housing. Remove the shut-off bar from the control bracket. Disconnect the metering valve from the linkage hook and protect its precision-ground surface by immersing it in a bath of Shell Calibration Fluid 'C'. Unscrew the self-locking nut and remove the nylon pivot washer to release the linkage hook from the governor arm. Disconnect the throttle shaft link from the governor spring and remove and discard the two 'O' seals from the throttle shaft. Disconnect the governor spring from the idling spring guide and withdraw the guide and spring from the governor arm. Remove the governor arm spring to release the governor arm from the control bracket.

Turn the pump upside-down and slacken both the spring cap and the end plug in the advance device housing until the pressure of the maximum advance stop spring inside the advance device housing is relieved. Unscrew the cap nut and the head locating bolt, both of which have aluminium and rubber sealing washers. and remove the advance device housing. Unscrew and remove the advance screw from the cam ring. Remove and discard the advance device housing gasket.

Unscrew the end plug and the spring cap, noting the adjusting shim inside the cap. Withdraw the spring, stop, slide washer, and piston from inside the advance device housing. Remove and discard the 'O' seals from the spring cap and end plug.

Slacken the fuel inlet connection and then remove the screws and studs securing the end plate to the hydraulic head. Carefully remove the carbon vanes from their slots in the transfer pump rotor and withdraw the transfer pump liner.

Unscrew the fuel inlet connection and carefully withdraw the components of the regulating valve from the end plate in the following order: sleeve retaining spring, nylon filter, regulating plug, regulating spring, valve sleeve with piston and joint washer, and lastly the piston retaining spring.

Hold the drive hub with drive shaft screw assembly tool 18G 659 and, using box spanner 18G 634 in conjunction with a standard ratchet wrench, slacken the transfer pump rotor. The word 'OFF' and an arrow etched on the exposed face of the rotor indicate the direction in which the rotor is unscrewed.

Unscrew and remove the two hydraulic head locking screws, one of which carries an air vent valve, and carefully withdraw the hydraulic head and distributing rotor assembly from the pump housing. Remove the 'O' seal from the groove in the periphery of the hydraulic head.

Unscrew the transfer pump rotor, taking care not to allow the pumping and distributing rotor assembly to fall out from the hydraulic head.

Stand the hydraulic head assembly on the bench with the drive plate uppermost. Hold the drive plate with assembly spanner 18G 641 and unscrew the two drive plate securing screws. Remove the drive plate, lift off the top adjusting plate, and withdraw the rollers and roller shoes from the pumping and distributing rotor.

Withdraw the rotor from the hydraulic head and remove the bottom adjusting plate. Refit the rotor to the hydraulic head, and to protect the working surface immerse the assembly in a bath of clean Shell Calibration Fluid 'C'.

Withdraw the cam ring from the pump housing, noting the arrow etched on the visible face of the cam ring. The arrow is to assist when reassembling, and its direction corresponds with the direction of pump rotation, as shown on the pump nameplate.

Compress the cam ring locating circlip, using circlip pliers 18G 1004, and withdraw the circlip from inside the pump housing.

Hold the drive hub with drive shaft screw assembly tool 18G 659 and, using torque adaptor 18G 664 and a standard socket wrench, unscrew the drive shaft screw from inside the drive hub, reversing the procedure shown in Fig. Ca.12. The splined drive shaft complete with governor weights assembly may now be withdrawn from inside the pump housing.

Remove and discard the 'O' seal from the drive shaft and remove the weight retainer, weights, thrust washer and sleeve from the drive shaft.

Withdraw the drive hub from inside the pump housing and remove the spring washer and support washer from their location inside the drive hub. The washers are removed by turning them end on inside the drive hub and withdrawing them along the master spline. Two flats are machined on the outside diameter of the support washer to facilitate this operation.

Remove the drive hub oil seal from the pump housing, using oil seal extractor tool 18G 658.

Wash all components thoroughly in clean Shell Calibration Fluid 'C'. Cotton waste, rags, or cloth wipers must not be used to wipe the components. If necessary, unscrew the plug with sealing washer, using rotor plug spanner 18G 652, and blow out the internal passages in the pumping and distributing rotor with compressed air. Coat the threads of the plug with Araldite and refit and tighten the plug to 28 lb. in. (·32 kg. m.).

Push out the pumping plungers, one at a time, for inspection, noting that the end of the plunger which has been in contact with the roller shoe is polished and should be replaced in this position. Examine the working surface of the plungers and the plunger bore in the pumping and distributing rotor for wear and abrasions. The bore of the hydraulic head and its mating surface in the rotor should also be examined for wear and scoring. Should any of these parts be worn, the pumping and distributing rotor and hydraulic head, which are mated assemblies, must be renewed as a unit.

Some injection pumps are fitted with hydraulic heads having an oversize metering valve bore and an oversize metering valve to suit. Oversize metering valves, which are identified by a machined groove, are available, but only hydraulic heads having a standard-size metering valve bore are supplied as replacements. Injection pumps fitted with oversize metering valves are identified by the number 6·375 etched upon the hydraulic head between the outlet connections adjacent to the metering valve bore.

Inspect the plunger rollers for flats and the cam ring lobes for signs of wear. Test the roller shoes in their

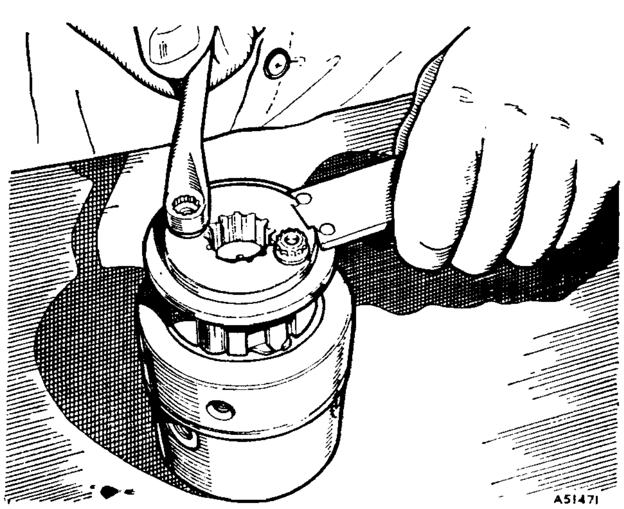


*Fig. Ca.*10
Holding the drive plate with spanner 18*G* 641 *when unscrewing the drive plate securing screws*

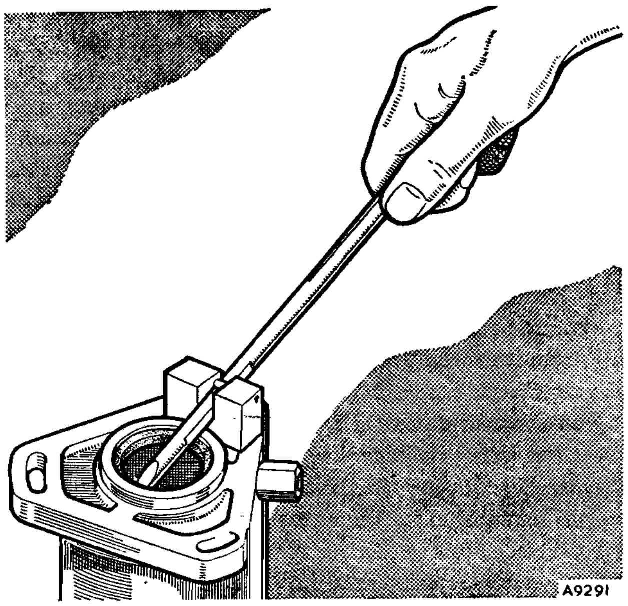


*Fig. Ca.*11
Removing the drive hub oil seal, using oil seal extractor 18*G* 658

guides in the pumping and distributing rotor for correct action and freedom of movement.

Check the drive shaft splines for wear, assemble the drive shaft to the drive plate, and ensure that there is no excessive radial movement between the drive shaft and plate.

Test the fit of the vanes in their slots in the transfer pump rotor. The vanes should be a sliding fit when lubricated with fuel oil.

Inspect the bore of the regulating valve sleeve for wear and ensure that the valve piston can move freely along the whole length of the sleeve bore.

Inspect all springs for fractures and check them against new counterparts for length. Weak or fractured springs should be renewed. Check the governor weight retainer, thrust washer, and thrust sleeve against new counterparts for signs of wear.

When reassembling, thoroughly rinse all components in freshly filtered clean Shell Calibration Fluid 'C' and assemble all parts wet.

Fit a new drive hub oil seal to the pump housing, driving it onto its seat with oil seal guide 18G 663. Insert oil seal inspection plug 18G 660 into the oil seal. A correctly fitted oil seal will show a continuous black line when viewed through the flange end of the oil seal inspection plug.

Fit the support washer and spring washer into the drive hub. Remove the oil seal inspection plug and pass the drive hub through the seal, seating the drive hub flange against the pump housing.

Place the governor weight retainer on plate 18G 662 and pass locating pin 18G 661 through the weight retainer to locate in the plate so that the weight retainer is trapped between the plate and the shoulder of the locating pin. Place the weights, equally spaced, in position on the weight retainer.

The slot in each weight should be uppermost and nearest the locating pin (Fig. Ca.13). Each weight should be aligned with a pocket in the weight retainer and with its inner end against the locating pin. Place the thrust washer and thrust sleeve on the locating pin and resting on the governor weights. The thrust sleeve must be fitted with the flange having the projection uppermost. Exert downward pressure on the thrust sleeve and the assembly will enter the weight retainer. Withdraw the locating pin and remove the assembly from the plate. Slide the assembly onto the drive shaft. Fit protection cap 18G 657 over the drive shaft splines and fit a new 'O' seal in the machined groove on the shaft. Insert the drive shaft and weight assembly into the pump housing and engage the drive shaft splines with the splines in the drive hub. Fit the drive shaft screw, and, holding the drive hub with drive shaft screw assembly tool 18G 659, tighten the drive shaft screw to the figure given in 'GENERAL DATA', using torque adaptor 18G 664 and torque wrench 18G 537 (Fig. Ca.12).

Compress the cam ring locating circlip, using circlip pliers, 18G 1004, and seat it against the shoulder in the bore of the pump housing. Place the cam ring in position against the circlip. The direction of the arrow on the visible face of the cam ring must conform with the direction of pump rotation as marked on the pump nameplate. Fit the cam advance screw finger tight to locate the cam ring and check the ring for freedom of movement in the pump housing.

If the hydraulic head and pumping and distributing rotor are renewed, ensure that the direction of the arrow

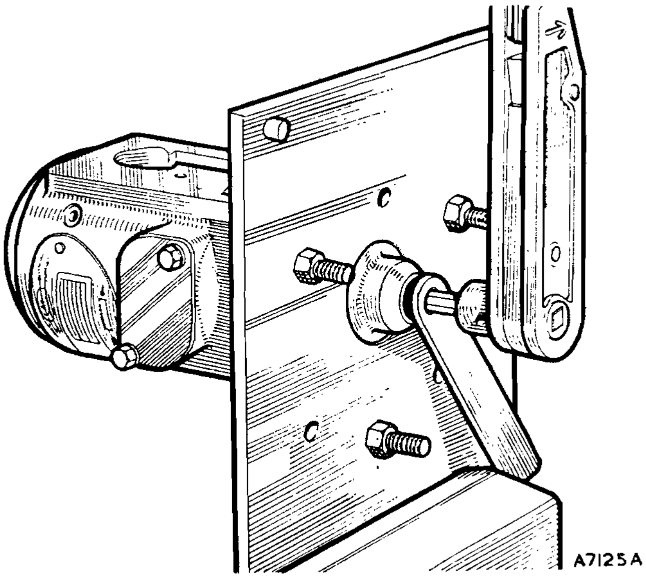


*Fig. Ca.*12

Holding the drive hub with drive shaft screw assembly tool 18*G* 659 *while tightening the drive shaft screw with torque adaptor* 18*G* 664 *and torque wrench* 18*G* 537

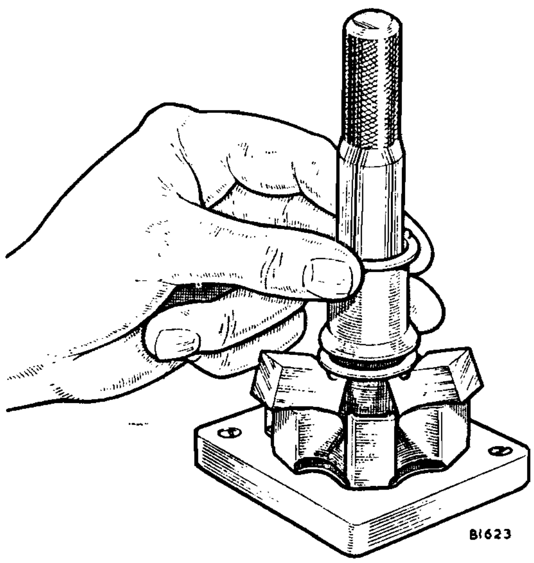


*Fig. Ca.*13

Assembling the governor weights, thrust washer, and thrust sleeve into the weight retainer, using Service tools 18*G* 661 *and* 18*G* 662

stamped on the periphery of the pumping end of the rotor corresponds with the pump rotation, as indicated on the pump nameplate.

Withdraw the pumping and distributing rotor complete with plungers from the hydraulic head. Place the top adjusting plate in its correct position on the rotor—that is, with the slot in the periphery of the adjusting plate aligned with the scribed mark on the periphery of the pumping end of the rotor (Fig. Ca.14).

Fit the drive plate to the rotor with its relieved face next to the top adjusting plate. The slot in the periphery of the drive plate must be in line with the scribe mark on the periphery of the rotor (Fig. Ca.14). Tighten the drive plate securing screws lightly to hold the top adjusting plate in position on the rotor. Invert the assembly so that the distributing end of the rotor is uppermost. Slide the rollers into their shoes and insert the roller and shoe assemblies into their guides in the rotor, ensuring that the contour of the roller shoe ears conforms with the contour of eccentric slots in the top adjusting plate. Assemble the bottom adjusting plate to the rotor with the contour of the eccentric slots in the adjusting plate conforming to the contour of the roller shoe ears and the slots in the periphery of the bottom adjusting plate engaging the lugs on the top adjusting plate. Fit the assembly of the pumping and distributing rotor to the hydraulic head and fit and lightly tighten the transfer pump rotor. Stand the assembly of the hydraulic head and the pumping and distributing rotor on the bench with the pumping end of the rotor uppermost.

Fit relief valve timing adaptor 18G 653 A, preset at 15 atmospheres, to high-pressure outlet 'V' on the hydraulic head and connect up the whole assembly to injector nozzle testing machine 18G 109 A (Fig. Ca.15).

Operate the handle of the test machine and turn the pumping and distributing rotor in the normal direction of rotation until the pumping plungers are forced outwards to the maximum fuel position. Set the roller-to-roller dimension, using a micrometer, to the dimension given in **'GENERAL DATA'**. Move the adjusting plates (clockwise to increase and anti-clockwise to decrease the dimension) with maximum fuel adjusting probe 18G 656. Tighten the drive plate securing screws to the figure given in **'GENERAL DATA'**, using torque wrench 18G 537. This setting is approximate, final adjustment being made with the pump mounted on a power-driven test machine (see Section Ca.9). The drive plate is held, when tightening the securing screws, with assembly drive plate spanner 18G 641. Disconnect the test machine and the hydraulic adaptor from the hydraulic head.

Fit a new oil seal into its groove in the machined periphery of the hydraulic head.

Turn the pump drive shaft in the pump housing and position the master spline at 12 o'clock. Align the master spline in the drive plate with the metering valve bore in the hydraulic head. Lubricate the periphery of the hydraulic head and the bore of the pump housing liberally with clean Shell Calibration Fluid 'C'. Hold the hydraulic head assembly square with the axis of the pump housing and, with the metering valve bore at 12 o'clock, push the hydraulic head into the pump housing. Rotate the drive shaft slightly to assist the engagement of the shaft with the drive plate.

Insert the two hydraulic head locking screws, leaving them finger tight and ensuring that the screw with the vent valve is fitted immediately above the pump nameplate.

Mount drive shaft screw assembly tool 18G 659 in the splined drive hub and, using torque wrench 18G 536 and assembly box spanner 18G 634, tighten the transfer pump rotor to the figure given in **'GENERAL DATA'**.

Fit the transfer pump liner and insert the carbon vanes into the slots in the transfer pump rotor.

Ensure that the transfer pump liner locating peg is in position 'C' in the pump end plate.

Insert the piston retaining spring into the regulating valve bore in the end plate, ensuring that it is properly seated in the bottom of the bore. Fit a new seal washer

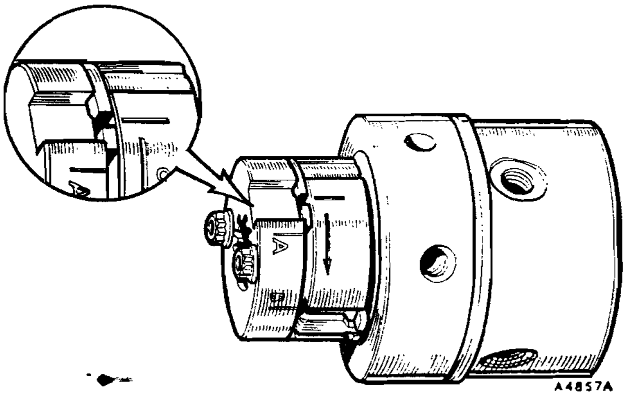


*Fig. Ca.*14

Assembly the top adjusting plate and the drive plate with the slots in their peripheries aligned with the scribed mark on the pumping end of the rotor

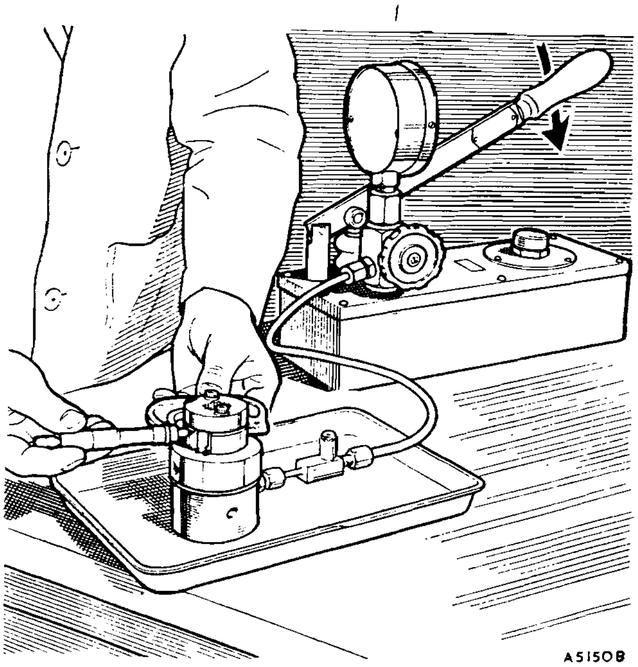


*Fig. Ca.*15

Setting the roller-to-roller dimension, using a micrometer and Service tools 18G 109 *A and* 18G 653 *A*

to the small-diameter end of the regulating valve sleeve and insert the valve piston into the sleeve. Insert the regulating spring into the large-diameter end of the valve sleeve. Place the regulating plug on the top of the sleeve with its spigoted end engaging the sleeve bore. Fit the sleeve retaining spring onto the guide. Pass the nylon filter, small-diameter end leading, over the spring and regulating plug onto the shoulder of the valve sleeve. Insert this assembly, valve sleeve first, into the bore of the end plate and secure it in position with the fuel inlet connection and washer.

Position a new oil seal in its recess in the upper face of the hydraulic head and fit the assembled end plate to the head, engaging the locating peg on the inner face of the

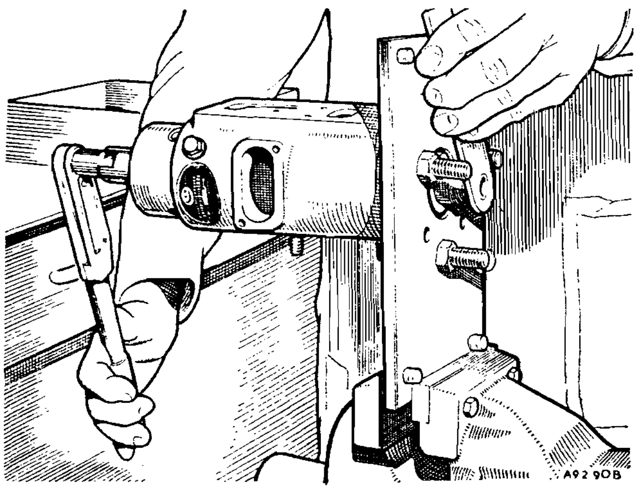


*Fig. Ca.*16

Tightening the transfer pump rotor, using torque wrench 18G 536 *and Service tools* 18G 659 *and* 18G 634 end plate with the slot in the periphery of the transfer pump liner. The end plate securing screw holes are unequally spaced to ensure correct assembly of the end plate to the hydraulic head. Tighten the set screws and studs to the torque figure given in 'GENERAL DATA', using torque wrench 18G 536. Tighten the fuel inlet connection to the torque figure in 'GENERAL DATA', using torque wrench 18G 537.

Tighten the cam ring advance screw to the figure given in 'GENERAL DATA', using torque wrench 18G 372. Check the cam ring for freedom of movement.

Place a new advance device housing gasket in position on the pump housing with the flat of the 'D'-shaped hole at the drive hub end of the pump. To ensure satisfactory sealing this gasket should be assembled dry. Assemble the advance device housing to the pump housing, using new rubber and aluminium sealing washers for the head locating bolt and cap nut. Using torque wrench 18G 537, tighten the head locating bolt, the cap nut, and the two head locking screws to the figures given in 'GENERAL DATA'. Check the cam ring for freedom of movement.

Fit new 'O' seals to the light-load advance piston plug and the spring cap, using protection cap 18G 640 to pass the seals over the threads.

Insert the slide washer and piston, in that order, into the advance device housing on the side where the fuel oil drilling enters the piston bore. Screw in the piston plug. Insert the maximum advance stop, and spring, in that order, into the remaining open end of the advance unit housing and screw in the cap. Tighten the piston plug and spring cap to the torque figures given in 'GENERAL DATA', using torque wrench 18G 537.

Insert the metering valve into the metering valve bore in the hydraulic head.

Engage the governor arm with the control bracket and connect the governor arm spring to both components.

Fit the assembly governor arm and control bracket to the pump housing. The lower end of the governor arm should engage the outside face of the thrust sleeve flange. Place the keep plate in position with its open end towards the shut-off bar. Fit new tab washers with their pointed tabs towards the governor arm. Secure the keep plate in position with the two governor control cover studs. Fit the small screw and tab washer at the metering valve end of the control bracket. Tighten the control cover studs to the torque figure given in 'GENERAL DATA', using torque wrench 18G 536. Lock the studs in position by bending up the pointed tabs. Tighten the small screw to the torque figure given in 'GENERAL DATA', and lock it with the tab washer.

Assemble the spring retainer, spring, and fibre washer onto the governor linkage hook, in that order. Pass the threaded end of the linkage hook through the governor arm. Fit the pivot ball washer onto the linkage hook and screw on the linkage nut about three turns. Press back the spring retainer and attach the linkage hook to the metering valve. The hook end should turn towards the metering valve.

Set the internal dimension between the metering valve

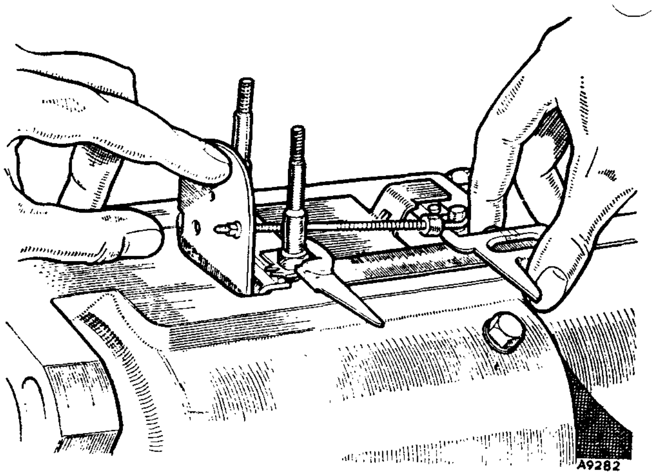


Fig. Ca.17

Setting the internal dimension between the metering valve lever pin and the control cover stud with the vernier held parallel to the axis of the pump

lever pin and its nearest control cover stud to the length given in 'GENERAL DATA', using a vernier gauge as shown in Fig. Ca.17. Adjustment is made by slackening or tightening the hook linkage nut. During this operation light pressure should be applied to the governor arm in the direction of the metering valve and the vernier gauge should be held parallel to the pump axis.

Locate the idling spring on the idling spring guide. Insert the guide into hole No. 2 in the governor arm (Fig. Ca.6) and connect the governor spring to the idling spring guide.

Insert the plain end of the shut-off bar into the slot in the control bracket and position the shut-off bar under the tab of the control cover stud locking washer.

Using protection cap 18G 564, fit the lower 'O' seal to the shut-off shaft. Fit the upper 'O' seal, using protection cap 18G 665. Pack the groove between the 'O' seals with Shell Alvania No. 2 grease. Press the shut-off shaft into its bore in the control cover. The peg which engages the shut-off bar should be close to the inside edge of the control cover, and should be left projecting slightly above the control cover face.

Place a new control cover gasket in position on the pump housing, ensuring that the locating tabs of the gasket engage the slots under the keep plate. To ensure satisfactory sealing this gasket should be soaked in Shell Calibration Fluid 'C' before assembly.

Fit new lower and upper 'O' seals to the throttle shaft, using protection caps 18G 654 and 18G 665. Pack the groove between the 'O' seals with Shell Alvania No. 2 grease. Connect the free end of the governor spring to hole No. 2 (2·2-litre engine) or hole No. 1 (2·52-litre engine) in the throttle shaft link (Fig. Ca.6).

Press the throttle shaft into its bore in the control cover. Place the control cover in position on the control cover studs. Ensure that the shut-off shaft peg engage the shut-off bar and pull the shut-off shaft fully home as the control cover is lowered onto the gasket. Fit new sealing washers on the control cover studs and fit and tighten the stud nuts to the torque figures given in **'GENERAL DATA'**, using torque wrench 18G 536. Place the dust caps on the throttle and shut-off shafts. Fit the throttle arm and the shut-off lever to their respective shafts and secure them in place with their nuts and washers.

Section Ca.9

TESTING AND ADJUSTING THE FUEL INJECTION PUMP

After overhaul the fuel injection pump must be checked functionally, and the maximum fuel output adjusted if necessary. These tests and adjustments are carried out on a power-driven test bench embodying the necessary vacuum and pressure gauges and equipment to test the fuel transfer pump and a graduated glass to measure the injection pump back-leakage. In addition, the tools mentioned in the following paragraphs are also required.

NOTE.—The following precautions must be observed when testing the pump:

(1) Ensure that the power-driven test bench is set to run in the direction of rotation of the injection pump, as indicated by the arrow on the pump nameplate. Serious damage may be caused to the pump if it is run in the reverse direction.

(2) Ensure that the fuel flow at the pump inlet is not less than 1,000 c.c./min. If this flow cannot be obtained, a maximum feed pressure of 2 lb./sq. in. (·15 kg./cm.^{2}) is permissible.

(3) Do not run the pump for long periods at high speed with low fuel output.

(4) Do not run the pump for long periods with the shut-off control in the closed position.

After checking the direction of rotation mount the pump on the test bench and connect up the drive. Fit radial connections to the hydraulic head in place of the banjo pipes. Using high-pressure pipes 6 mm. × 2 mm. × 865 mm. (34 in.) long, connect the radial connections to a matched set of test nozzles. The test nozzles should be Type BDN.12.SD.12 mounted in nozzle holders Type BKB.50.SD.533b (formerly BKB.50.SD.19b) and set to open at 175 atmospheres.

Ensure that the pump throttle arm has the full range of movement by unscrewing fully the idling and maximum speed stop screws.

Remove the hydraulic head locking screw, not the one incorporating the vent valve, and connect the pressure gauge by means of a flexible pipe to transfer pressure adaptor 18G 636, which is screwed into the head locking screw hole.

Connect the feed pipe, preferably of the transparent type, to the fuel inlet connection on the injection pump end plate. The vacuum gauge should be fitted, by means of a 'T' coupling, to the feed pipe.

Connect the inlet connection on the measuring-glass to the drain connection on the pump housing and the drain cock on the measuring-glass to the return pipe on the test bench by means of flexible pipes.

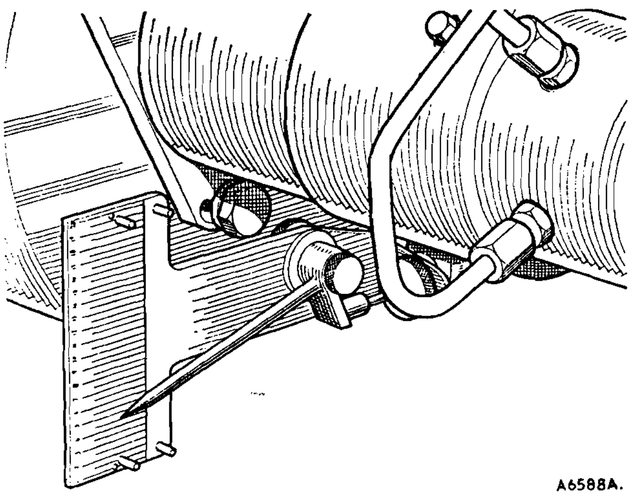


*Fig. Ca.*18

Checking the automatic advance device, using advance gauge 18*G* 638 *B*

Remove the small set screw from the centre of the advance unit housing spring cap and assemble automatic advance gauge 18G 638 B to the spring cap with the degree scale and pointer uppermost and the scale set to zero.

Throughout the following operations and tests the pump throttle and shut-off levers must be in the fully open position, except where stated otherwise.

The pump and the feed pipe must now be filled and primed as follows:

(1) Connect the fuel feed pipe to the drain connection on the pump housing.

(2) Open both of the vent screws on the injection pump.

(3) Turn on the gravity feed. When test oil free from air bubbles flows from the vent screw on the hydraulic head, close this vent screw. Wait till the test oil flowing from the vent screw in the governor control housing is free from air bubbles, then close this vent screw also.

(4) Rotate the pump drive through 180° and repeat operations (2) and (3).

(5) Fit the feed and return pipes to their respective connections.

(6) Slacken the high-pressure pipe unions at the injector end.

(7) Start the test machine and run at 100 r.p.m. until oil free from air bubbles issues from the injector pipe connections.

(8) Tighten the injector pipe connection while the test machine is running.

The following tests are designed to check, in turn, each of the separate functions of the injection pump. Before, however, making these individual tests a general check should be carried out to ensure oil-tightness of all joint washers, oil seals, and pipe connections while the pump is running and when stationary.

(1) Transfer pump vacuum test

Start the test machine and run the pump at 100 r.p.m.

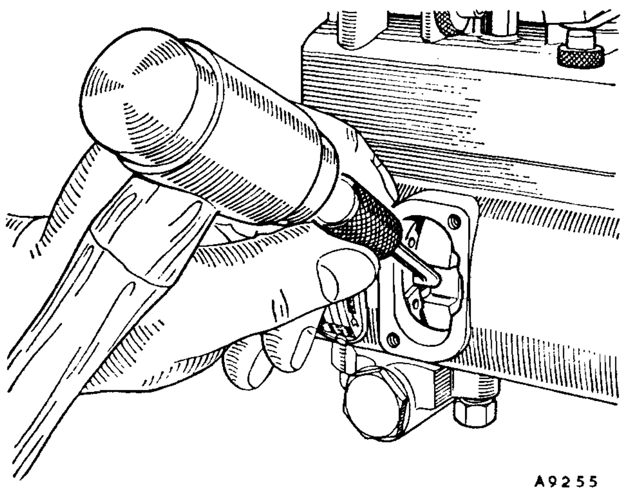


Fig. Ca.19
Adjusting the maximum fuel setting, using Service tool 18G 656

Turn the test oil feed cock to the 'off' position and note the depression registered on the vacuum gauge. This should build up to 16 in. (406 mm.) Hg within 60 seconds maximum. Check the fuel feed pipe unions for air leaks, indicated by the presence of air bubbles in the pipe line. If necessary, tighten the feed pipe unions and carry out a further test.

NOTE.—**Do not run the pump for periods exceeding 60 seconds with the test oil supply turned off.**

After the vacuum test is completed turn on the test oil supply, and with the pump running at 100 r.p.m. air-vent the pump by means of the vent valve on the hydraulic head locking screw.

(2) Transfer pump pressure

With the pump running at 100 r.p.m. note the pressure registered on the pressure gauge which should read 12 lb./sq. in. (·8 kg./cm.^{2}).

(3) Transfer pump pressure

Increase the pump speed to 800 r.p.m., when a pressure of 32 to 44 lb./sq. in. (2·3 to 3·1 kg./cm.^{2}) should be registered on the pressure gauge.

(4) Fuel delivery setting

Run the pump at 800 r.p.m., and after slackening the locknut alter the metering valve adjustment screw till a zero reading is obtained on the automatic advance gauge. Tighten the locknut and re-check the advance reading. Fit the shut-off lever adjustment tool 18G 697 to the fuel pump and adjust the shut-off lever to obtain an average fuel delivery of 3·6 to 4·4 c.c. per 200 shots. Ensure that the advance gauge still shows a zero reading.

(5) Advance setting

Run the pump at 800 r.p.m. Slacken the metering valve adjustment screw locknut and alter the adjustment screw to obtain an advance reading of 1¾ to 2¼°. Tighten the locknut and re-check the advance reading.

(6) Fuel delivery check

Without altering any of the adjustments, check that the fuel delivery at 800 r.p.m. is 3·6 to 4·4 c.c. per 200 shots. Remove the shut-off lever adjustment tool.

(7) Advance check

Run the fuel pump at 800 r.p.m. Move the shut-off lever to the fully closed position and check that the advance reading is 3½ to 4½°. Fit and seal the metering valve adjustment screw sealing cap with wire and a lead seal, using sealing pliers 18G 541.

NOTE.—**If for any reason it is found necessary to tighten or slacken the governor control cover cap nuts, the settings made at (4) and (5) will be disturbed, and operations (4), (5), (6), and (7) should be repeated.**

(8) Back-leakage

Set the shut-off lever fully open and the throttle arm fully closed. Run the pump at 1,000 r.p.m. and measure the back-leakage through the graduated measuring-glass. The back-leakage should be 5 to 50 c.c. per 100-shot cycle.

(9) Maximum fuel setting

NOTE:—Throughout this test the advance gauge must show a zero reading.

Run the pump at 1,000 r.p.m. with both controls in their fully open position, when the average delivery for 200 shots from all four test injectors should be $6{\cdot}9 \pm {\cdot}1$ c.c. In arriving at this figure compare the delivery from all injectors to ensure that the difference in output from any two does not exceed ·6 c.c. Before taking a reading the test oil in the measuring-glasses should be allowed to settle for 15 seconds and the measuring-glasses should be allowed to drain for 30 seconds before a fresh test is made.

To adjust the pump output stop the test bench and turn the test oil feed cock to the 'off' position. Remove the cover-plate from the side of the pump

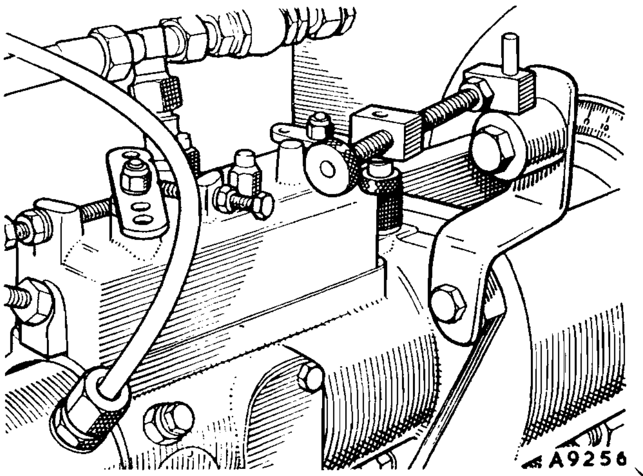


Fig. Ca.20
The shut-off lever adjuster 18G 697 mounted on the fuel injection pump and test bench

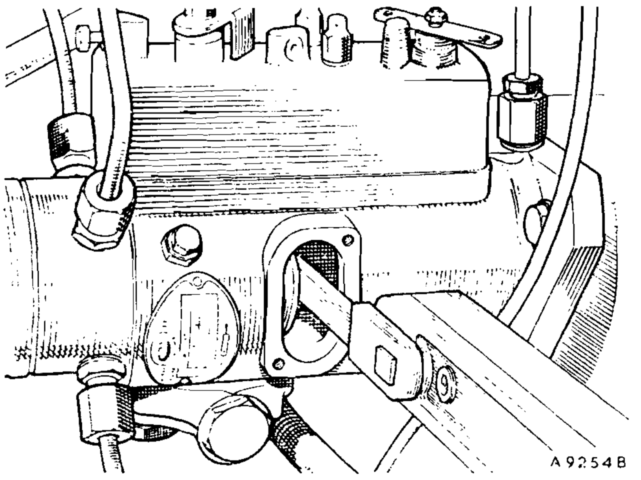


Fig. Ca.21
Tightening the drive plate screws, using torque wrench 18G 537 and torque adaptor 18G 655A

housing to provide access to the interior of the pump. Slacken the two drive plate securing screws sufficiently to permit movement of the adjusting plates. Turn the pump drive until the slots in the peripheries of the drive plate and the top adjusting plate are visible through the aperture in the pump housing. Engage the end of the maximum fuel adjusting probe 18G 656 in the slot in the top adjusting plate and tap the tool with a light hammer to move the plate in the required direction. The adjusting plate is turned in the same direction as the normal direction of the pump rotation to increase the maximum output. Movement of the adjusting plate in the opposite direction will decrease the maximum output. This operation must be carried out very carefully as the amount of movement required will be very small. Tighten the drive plate securing screws to the torque figure given in '**GENERAL DATA**', using tools 18G 537, and 18G 655A. While tightening the screws the torque wrench must be in line with the spanner (Fig. Ca.21). After making this adjustment replace the cover-plate and carry out the complete filling and priming operation. Re-check the fuel delivery and, if necessary, re-adjust the pump output.

(10) Fuel delivery

Decrease the pump speed to 100 r.p.m. and check the output. The average delivery for 200 shots under these conditions should not be less than that obtained when setting the pump maximum fuel output minus 1·5 c.c. When carrying out this test use 30 seconds' measuring-glass draining time and allow the test oil to settle for 15 seconds before taking a reading.

(11) Cut-off test

With the shut-off lever held in the fully closed position run the pump at 200 r.p.m. The average delivery for 200 shots, with the throttle arm in the fully open position, should not exceed 1·0 c.c.

(12) Throttle operation

Run the fuel pump at 200 r.p.m. with the throttle arm in the fully closed position. The average delivery with the shut-off lever fully open should not exceed 1·0 c.c. per 200 shots.

(13) Fuel delivery check

With both controls fully open run the fuel pump at 1,650 r.p.m. and record the average delivery per 200 shots.

(14) Governor setting

Increase the pump speed to 1,850 r.p.m. and set the throttle arm by means of the maximum speed adjustment screw to give a maximum average delivery of 1·0 c.c. per 200 shots. No line should exceed 1·8 c.c. Tighten the adjustment screw locknut.

(15) Fuel delivery check

Reduce the pump speed to 1,650 r.p.m. and re-check the fuel delivery. The average delivery now should not be less than that recorded in operation (13) minus ·4 c.c. per 200 shots.

(16) Timing setting

This setting is made, after all the foregoing tests have been completed, with the pump removed from the power-driven test bench.

It should be noted that, unlike the 'in-line' fuel injection pump, which has a static commencement of injection point, the point at which commencement of injection occurs in the distributor-type fuel injection pump varies according to the fuel requirements of the engine. The timing of the distributor-type pump is carried out with the pumping plungers set to delivery maximum fuel on No. 1 injection line and with the plunger rollers in contact with the cam lobes: therefore, after all occasions of pump overhaul or adjustment to the pump output it is imperative that the pump timing is checked, and the timing mark on the pump flange re-marked if necessary.

Remove the cover-plate from the side of the pump housing and the four radial connections from the hydraulic head. Connect injector nozzle testing machine 18G 109 A to outlet 'V' on the hydraulic head to means of relief valve timing adaptor 18G 653 A. The relief valve must be set to operate at 30 atmospheres.

Turn the pump drive hub in the normal direction of rotation until the timing mark 'E' on the drive plate becomes visible through the aperture in the side of the pump housing. Operate the handle of the test machine to apply a pressure of 30 atmospheres to the pump. This will force the pumping plungers outwards to the limit of their travel as the drive hub is turned. Continue turning the drive hub in the normal direction of rotation until resistance is encountered. With the pump held in this position mount flange marking gauge 18G 648 A, preset to 86°, on the pump quill shaft. Check that the timing mark on the pump flange lies along the scribing guide on the flange marking gauge. If necessary, delete the old timing mark and scribe a new mark by drawing a scribing tool along the guide on the flange marking gauge.

Disconnect the pump from the test machine and fit the banjo pipes to the hydraulic head. Refit the cover-plate to the side of the fuel pump housing and seal the securing screws with wire and a lead seal, using sealing pliers 18G 541.

Maximum and idling speed adjustments

These adjustments are carried out after the pump has been installed on the engine, and are detailed in Section Ca.7.

Section Ca.10

ALTITUDE SETTINGS

Each vehicle leaves the Factory with its maximum fuel setting adjusted for sea-level conditions. If the vehicle is to be operated continuously above sea-level, adjustment of the injection pump is necessary to set the maximum fuel delivery to conform with the figures given in the following table.

Altitude	*Maximum fuel output for 200 shots at 1,000 pump r.p.m.*	
	2·2-litre diesel engine	*2·52-litre diesel engine*
0 to 2,000 ft. (0 to 600 m.)	6·8 to 7·0 c.c.	8·8 to 9·0 c.c.
2,000 to 4,000 ft. (600 to 1200 m.)	6·4 to 6·6 c.c.	8·3 to 8·5 c.c.
4,000 to 6,000 ft. (1200 to 1800 m.)	6·0 to 6·2 c.c.	7·7 to 7·9 c.c.
6,000 to 8,000 ft. (1800 to 2400 m.)	5·6 to 5·8 c.c.	7·2 to 7·4 c.c.
8,000 to 10,000 ft. (2400 to 3000 m.)	5·1 to 5·3 c.c.	6·6 to 6·8 c.c.
10,000 to 12,000 ft. (3000 to 3600 m.)	4·7 to 4·9 c.c.	6·1 to 6·3 c.c.

Section Ca.11

FUEL INJECTORS

Follow the instructions given in Section C.6, noting the following points.

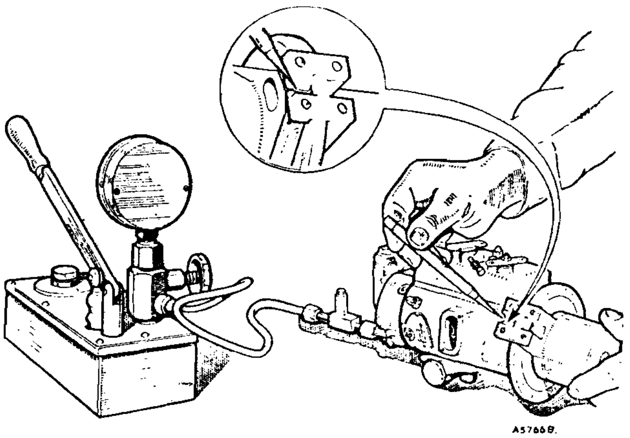


Fig. Ca.22

Scribing the timing mark on the fuel injection pump mounting flange, using Service tool 18G 648 A

(1) When testing the injectors for spray and adjusting the injectors for service the nozzle opening pressure should be set to 130 atmospheres for 2·2-litre engines and 135 atmospheres for 2·52-litre engines.

(2) The needle lift should be ·029 to ·035 in. (·75 to ·90 mm.) for 2·2-litre engines and ·6 to ·75 mm. for 2·52-litre engines.

Section Ca.12

LIFT PUMP

Follow the instructions given in Section C.1, but after replacing the lift pump bleed the fuel system as described in Section Ca.5.

Section Ca.13

MODIFIED INJECTION PUMP
(Type DPA.3248050A)

This pump is as described in Section Ca.6 but with various detail modifications to improve engine governing and the addition of an anti-stall device. The modifications include a governor spring, idling spring, and maximum advance stop spring of new load rates. Other modifications incorporated in this pump are to the metering valve, quill shaft, and banjo pipes.

The anti-stall device consists of an adjusting screw, which protrudes from the drive end of the control cover, and a locknut. In operation the inner end of the adjusting screw contacts the governor arm to act as a stop. The effect of this is to prevent the governor from reducing the metering area below the position permitted by the anti-stall screw. Therefore, adjustment of the anti-stall screw should only be carried out as described in Section Ca.13 under '**Maximum and idling speed adjustments**'.

Removing and replacing

Follow the instructions in Section Ca.7 noting that the correct injection timing for this pump is 26° B.T.D.C.

Maximum and idling speed adjustments

After fitting either a new or overhauled injection pump, adjust the engine maximum light running speed as described in Section Ca.7. Then proceed as follows to adjust the idling speed and anti-stall device:

(1) With the engine stopped unscrew the anti-stall screw until it is out of contact with the governor arm.

(2) Start the engine, ensure that it is at its normal running temperature, and adjust the idling stop screw to set the engine speed at between 450 and 500 r.p.m.

(3) Screw in the anti-stall screw carefully until a slight speed increase is noticed, then unscrew one third of a turn and lock in position with the locknut.

(4) Readjust the idling stop screw to set the idling speed at 500 r.p.m. and tighten the idling stop screw locknut.

(5) Test the anti-stall screw setting by running the engine at about 3,000 r.p.m. and then releasing the throttle:

(*a*) If the engine stalls the pump is underdamped and the anti-stall screw should be screwed in slightly, relocked, and the setting retested.

(*b*) If the engine deceleration is slow or sluggish the pump is overdamped and the anti-stall screw should be screwed out slightly, relocked, and the setting retested.

(6) Check that the engine stops when the shut-off lever is operated.

NOTE.—**After every adjustment of the anti-stall screw nsure that the engine idling speed is controlled by the idling stop screw and not by the anti-stall screw.**

Dismantling and reassembling

Follow the instructions in Section Ca.8 noting that this pump is fitted with four governor weights.

Testing and adjusting

Mount the pump on a test bench and fill and prime the pump as described in Section Ca.9. Check the oil-tightness of all joint washers, oil seals, and pipe connections with the pump running and when stationary. Then proceed with the following tests, noting that the pump throttle arm and shut-off lever must be in the fully open position except where stated otherwise.

(1) *Transfer pump vacuum test*

Start the test machine and run the pump at 100 r.p.m.

Turn the test oil feed cock to the 'off' position and note the depression registered on the vacuum gauge. This should build up to 16 in. (406 mm.) Hg within 60 seconds maximum. Check the fuel feed pipe unions for air leaks, indicated by the presence of air bubbles in the pipe line. If necessary, tighten the feed pipe unions and carry out a further test.

NOTE.—**Do not run the pump for periods exceeding 60 seconds with the test oil supply turned off.**

After the vacuum test is completed turn on the test oil supply, and with the pump running at 100 r.p.m., air vent the pump by means of the vent valve on the hydraulic head locking screw.

(2) *Transfer pump pressure*

With the pump running at 100 r.p.m. note the pressure registered on the pressure gauge, which should read 11 lb./sq. in. (·8 kg./cm.^{2}).

(3) *Transfer pump pressure*

Increase the pump speed to 1,300 r.p.m. when a pressure of 43 to 54 lb./sq. in. (2·9 to 3·8 kg./cm.^{2}) should be registered on the pressure gauge.

(4) *Fuel delivery setting*

Run the pump at 1,300 r.p.m. and after slackening the locknut alter the metering valve adjustment screw till a zero reading is obtained on the automatic advance gauge. Tighten the locknut and recheck the advance reading. Fit shut-off lever adjustment tool 18G 697 to the fuel pump and adjust the shut-off lever to obtain an average fuel delivery of 6·2 to 7·0 c.c. per 200 shots.

Ensure that the advance gauge still shows a zero reading.

(5) *Advance setting*

Run the pump at 1,300 r.p.m. Slacken the metering valve adjustment screw locknut and alter the adjustment screw to obtain an advance reading of 1¾ to 2¼°. Tighten the locknut and re-check the advance reading.

(6) *Fuel delivery check*

Without altering any of the adjustments check that the fuel delivery at 1,300 r.p.m. is 6·2 to 7·0 c.c. per 200 shots. Remove the shut-off lever adjustment tool.

(7) *Advance check*

Run the fuel pump at 1,300 r.p.m. Move the shut-off lever to the fully closed position and check that the advance reading is 3½ to 4½°. Fit and seal the metering valve adjustment screw sealing cap with wire and a lead seal, using sealing pliers 18G 541.

NOTE.—**If for any reason it is found necessary to tighten or slacken the governor control cover cap nuts the settings made at (4) and (5) will be disturbed, and operations (4), (5), (6), and (7) should be repeated.**

(8) *Back-leakage*

Set the shut-off lever fully open and the throttle arm fully closed. Run the pump at 1,000 r.p.m.

and measure the back-leakage through the graduated measuring-glass. The back-leakage should be 5 to 50 c.c. per 100 shot time cycle.

(9) *Maximum fuel setting*

NOTE.—Throughout this test the advance gauge must show a zero reading.

Run the pump at 1,000 r.p.m. with both controls in their fully open position, when the average delivery for 200 shots from all four test injectors should be $6{\cdot}9 \pm {\cdot}1$ c.c. In arriving at this figure compare the delivery from all injectors to ensure that the difference in output from any two does not exceed ·6 c.c. Before taking a reading the test oil in the measuring-glasses should be allowed to settle for 15 seconds and the measuring-glasses should be allowed to drain for 30 seconds before a fresh test is made.

To adjust the pump output, stop the test bench and turn the test oil feed cock to the 'off' position. Remove the cover-plate from the side of the pump housing to provide access to the interior of the pump. Slacken the two drive plate securing screws sufficiently to permit movement of the adjusting plates. Turn the pump drive until the slots in the peripheries of the drive plate and the top adjusting plate are visible through the aperture in the pump housing. Engage the end of the maximum fuel adjusting probe 18G 656 in the slot in the top adjusting plate and tap the tool with a light hammer to move the plate in the required direction. The adjusting plate is turned in the same direction as normal pump rotation to increase the maximum output. Movement of the adjusting plate in the opposite direction will decrease the maximum output. This operation must be carried out very carefully as the amount of movement required will be very small. Tighten the drive plate securing screws to the torque figure given in 'GENERAL DATA', using tools 18G 537 and 18G 655 A. While tightening the screws the torque wrench must be in line with the spanner (Fig. Ca.21). After making this adjustment replace the cover-plate and carry out the complete filling and priming operation. Re-check the fuel delivery and, if necessary, re-adjust the pump output.

(10) *Fuel delivery*

Decrease the pump speed to 100 r.p.m. and check the output. The average delivery for 200 shots should now be not less than that obtained when setting the pump maximum fuel output minus 1·5 c.c. When carrying out this test use 30 seconds measuring-glass draining time and allow the test oil to settle for 15 seconds before taking a reading.

(11) *Cut-off test*

With the shut-off lever held in the fully closed position run the pump at 200 r.p.m. The average delivery for 200 shots, with the throttle arm in the fully open position should not exceed ·8 c.c.

(12) *Throttle operation*

With the throttle arm in the fully closed position unscrew the anti-stall screw until it is out of contact with the governor arm and tighten the locknut. Run the pump at 200 r.p.m. with the throttle arm still fully closed. The average delivery with the shut-off lever fully open should not exceed 1·0 c.c. per 200 shots.

(13) *Fuel delivery check*

With both controls fully open run the fuel pump at 1,630 r.p.m. and record the average delivery per 200 shots.

(14) *Governor setting*

Increase the pump speed to 1,850 r.p.m. and set the throttle arm by means of the maximum speed adjustment screw to give a maximum average delivery of 1·0 c.c. per 200 shots. No line should exceed 1·8 c.c. Tighten the adjustment screw locknut.

(15) *Fuel delivery check*

Reduce the pump speed to 1,630 r.p.m. and re-check the fuel delivery. The average delivery now should not be less than that recorded in operation (13) minus ·4 c.c. per 200 shots.

(16) *Timing setting*

This setting is made, after all the foregoing tests have been completed with the pump removed from the power-driven test bench.

It should be noted that, unlike the 'in-line' fuel injection pump, which has a static commencement of injection point, the point at which commencement of injection occurs in the distributor-type fuel injection pump varies according to the fuel requirements of the engine. The timing of the distributor type pump is carried out with the pumping plungers set to deliver maximum fuel on No. 1 injection line and with the plunger rollers in contact with the cam lobes: therefore, after all occasions of pump overhaul or adjustment to the pump output it is imperative that the pump timing is checked, and the timing mark on the pump flange remarked if necessary.

Remove the cover plate from the side of the pump housing and the four radial connections from the hydraulic head. Connect injector nozzle testing machine 18G 109 A to outlet 'V' on the hydraulic head by means of relief valve timing adaptor 18G 653 A. The relief valve should be set to operate at 30 atmospheres.

Turn the pump drive hub in the normal direction of rotation until the timing mark 'E' on the drive plate becomes visible through the aperture in the side of the pump housing. Operate the handle of the test machine to apply a pressure of 30 atmospheres to the pump. This will force the pumping plungers outwards to the limit of their travel as the drive hub is turned. Continue turning the drive hub in the normal direction of rotation until resistance is encountered. With the pump held in this position mount flange marking gauge 18G648A, pre-set to 86°, on the pump quill shaft. Check that the timing mark on the pump flange lies along the scribing guide on the flange marking gauge. If necessary delete the old timing mark and scribe a new mark by drawing a scribing tool along the guide on the flange marking gauge.

Disconnect the pump from the test machine and fit the banjo pipes to the hydraulic head. Refit the cover-plate to the side of the fuel pump housing and seal the securing screws with wire and lead seal, using sealing pliers 18G 541.

Altitude settings

Follow the instructions in Section Ca.10.

Section Ca.14

AIR CLEANER (Oil Bath Type)

Removing

(1) Release the clips and detach the air inlet tube and the breather hose from the air cleaner body.
(2) Remove the screws retaining the air cleaner assembly to the left-hand valance.
(3) Lift out the air cleaner assembly.

Refitting

(4) Reverse the procedure in (1) to (3).

Section Ca.15

AIR CLEANER (Dry Type)

Removing

(1) Remove the drive screw retaining the air intake hose clip to the radiator frame.
(2) Release the clip and detach the breather hose from the air cleaner intake.
(3) Remove the central wing nut, detach the air cleaner top cover and remove the element.
(4) Release the air cleaner body from its support bracket.
(5) Lift off the air cleaner body and intake hose as an assembly. Note the rubber air seal between the cleaner body and the intake manifold on the engine.

Refitting

(6) Reverse the procedure in (1) to (5).

Section Ca.16

INJECTION PUMP (2·52-litre diesel engine)

The pump is as described in Sections Ca.6 and Ca.13, but with a type number DPA 3249F520 and the setting code stamped on the pump nameplate.

Later engines are fitted with a modified pump. This pump is as described above, but with a type number DPA 3342F110 and having two springs fitted to the linkage hook instead of a single spring.

Removing and replacing

Refer to the instructions given in Section Ca.7, noting that a degree plate is not fitted to the crankshaft pulley. Use the following procedure to set the static injection timing:

Before fitting the injection pump to the engine the position of the timing pointer on the flange of the chain wheel hub should be checked using timing gauge 18G 698 and timing pin AMK 9990, and reset if necessary. Initial adjustment of the injection timing is provided for in the injection pump driving flange, the holes for the bolts which secure it to the chain wheel being elongated.

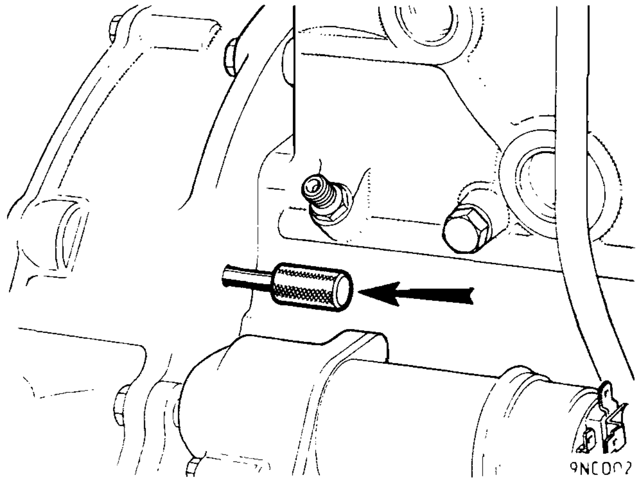


Fig. Ca.23

Setting Nos. 1 and 4 pistons in the 23° B.T.D.C. position, using timing pin AMK 9990

Crank the engine until the inlet valve for No.1 cylinder is closing. Insert timing pin AMK 990 through the reamed hole in the flywheel housing just above the starter motor, and while maintaining hand pressure on the head of the timing pin, crank the engine slowly until the pin engages the timing hole in the flywheel. This will set No.1 piston at 23° B.T.D.C. on its compression stroke.

Secure the injection pump in the position described by tightening the three nuts then remove the timing pin AMK 9990.

Test plan for pumps DPA 3249F520 and DPA 3342F110: Setting code A45/1200/4/3700

Test No.	*Description*	*R.P.M.*	*Requirements*	*Remarks*
1.	Transfer pump vacuum	100	16 in. (406 mm.) Hg within 60 seconds	Fuel supply turned off. After test, air-vent from hydraulic vent screw at 100 r.p.m.
2.	Transfer pressure	100	11 lb./sq. in. (·8 kg./cm.^{2}) minimum	
3.	Transfer pressure	1,200	58 to 78 lb./sq. in. (4·1 to 5·5 kg./cm.^{2})	
4.	Advance position	1,200	$1\frac{1}{2}°$ to 2°	Use metering valve adjustment screw to obtain this reading.
5.	Advance position	1,800	$3\frac{3}{4}°$ to $4\frac{1}{4}°$	Metering valve adjustment as in test 4. Shut-off lever fully closed. Lock valve adjustment screw and seal it using tool 18G 541.
6.	Back leakage	1,200	3 to 50 c.c. for 100 stroke time cycle	Throttle lever fully closed.
7.	Maximum fuel delivery	1,200	9·0 $^{+0}_{-0{\cdot}2}$ c.c. average. Spread between lines not to exceed 1·0 c.c.	Adjust output by moving adjusting plate relative to drive plate with tool 18G 656. Tighten drive plate screws to correct torque with tool 18G 655 A.
8.	Fuel delivery check	100	Average as test 7 minus 3·2 c.c.	This is a minimum delivery figure.
9.	Cut-off operation	200	Average delivery 0·8 c.c. maximum	Shut-off lever fully closed.
10.	Throttle operation	200	Average delivery 1·0 c.c. maximum	Throttle lever fully closed and anti-stall screw unscrewed and locked.
11.	Fuel delivery check	1,650	Record delivery	
12.	Governor setting	1,850	Average delivery 1·8 c.c. maximum. No line to exceed 2·5 c.c.	Set throttle lever with maximum speed adjustment screw. Lock stop screw.
13.	Fuel delivery check	1,650	Average delivery as in test 11 minus 0·4 c.c.	This is a minimum figure. Throttle set as in test 12.
14.	Governor setting	1,850	Average delivery of 1·8 c.c.	Set throttle with maximum speed adjustment screw. Lock stop screw.
15.	Timing			Adaptor 18G 653 A (set at 30 atmospheres) connecting 18G 109 A to outlet 'V'. Apply fuel pressure, rotate drive hub with tool 18G 648 A (set at 86°) and mark pump flange with scriber.

Maximum and idling speed adjustments

Follow the instructions given in Section Ca.13.

Dismantling and reassembling

Refer to the instructions given in Section Ca.13 and Section Ca.8.

Testing and adjusting

Conditions for test

1. The test equipment must be set to drive the pump in the direction of rotation indicated on the pump nameplate.
2. Fuel available at the injection pump inlet must be 1000 c.c./min. flow minimum, or 2 lb./sq. in. (·15 kg./cm.^{2}) pressure maximum.
3. Test injectors must be a matched set with type BDN.12.SD.12 nozzles operating at 175 atmospheres.
4. Injector pipes should be 6 mm.$\times$2 mm.$\times$34 in. (865 mm.) long.
5. The injection pump throttle and shut-off levers must be in the fully open position except where otherwise stated.
6. All fuel delivery figures are for 200 shots.
7. Allow 30 seconds glass draining time and 15 seconds settling time when taking fuel delivery readings.
8. The maximum fuel delivery given in the test plan is for sea-level conditions. For continuous use above sea-level see Section Ca.10 for maximum fuel settings.

Section Ca.17

MAIN FUEL FILTER (Later type)

Later types of fuel filter have a transparent base. Whenever water can be seen in the transparent base, remove the plug in the bottom of the hose and drain off the water. Refit the plug. Renew the filter element as described in Section C.11 and bleed the fuel system as described in Section Ca.5.

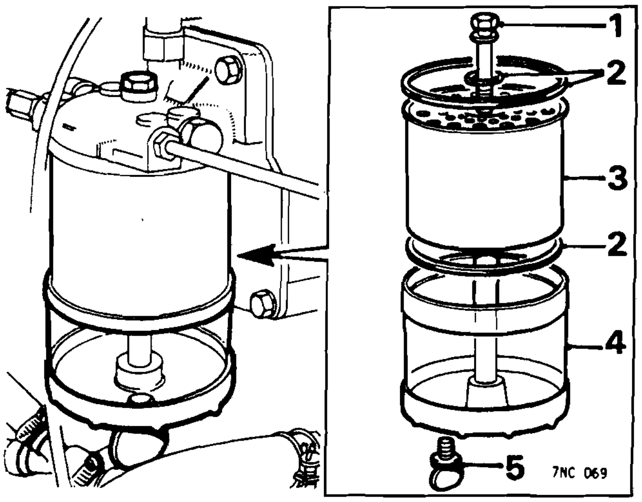


Fig. Ca.24

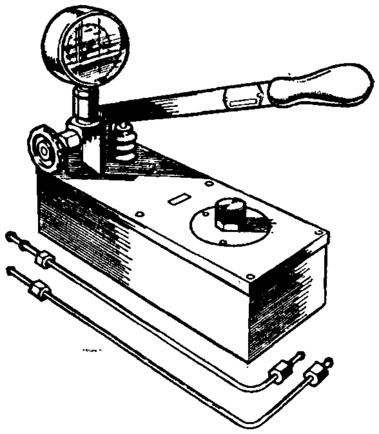
Main fuel filter (later type)

1. Centre bolt.
2. Sealing rings.
3. Element.
4. Transparent base.
5. Drain plug.

SERVICE TOOLS

18G 109 A. Injector Nozzle Testing Machine

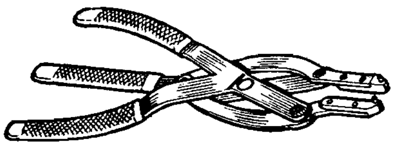
This machine is essential if injector nozzles are to be tested correctly or if it is desired to adjust the opening pressure. It is also required, when reassembling the fuel injection pump, to set the roller-to-roller dimension and the timing.


3899A

18G 109 A

18G 1004. Circlip Pliers

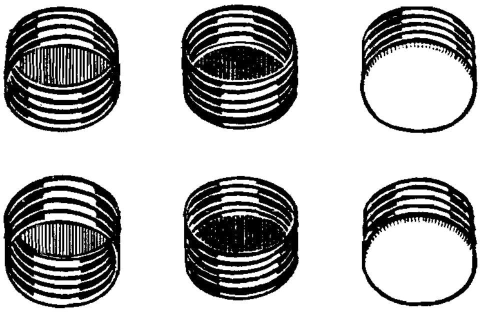
These pliers will remove small circlips of both the internal and external type. The points are detachable, and five different sets, complete with instructions, are supplied with each pair of pliers.


4346D

18G 1004

18G 216. F.I. Pump Outlet Sealing Caps—set of 6

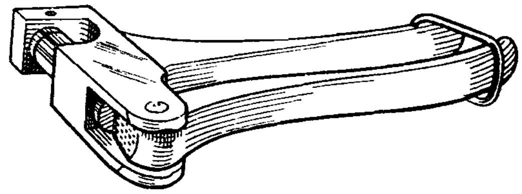
To prevent the ingress of foreign matter into the pump outlet and the injector nozzle feed unions when not in use.


AD1248

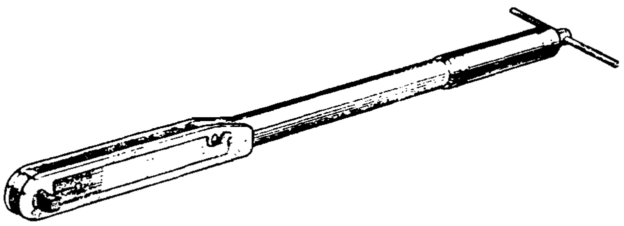
18G 216

18G 541. Venturi and F.I. Pump Sealing Pliers

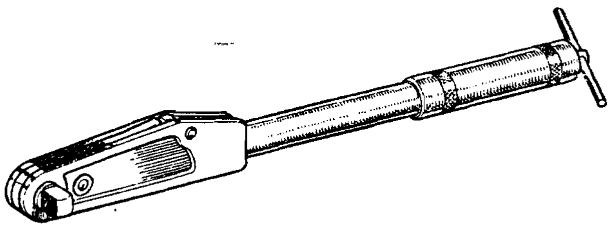
For use when resealing the fuel injection pump with wire and lead seal after testing and adjusting. Wires and lead seals are available in packs of 36 under Part No. 58G 444.


5362

18G 541


3869A
18G 372

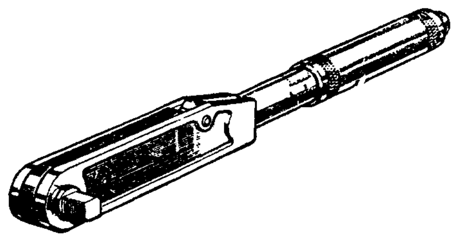
18G 372. Torque Wrench—30 to 140 lb. ft. (4 to 20 kg. m.)


4037
18G 536

18G 536. Torque Wrench—20 to 100 lb. in. (300 to 1200 kg. m.)

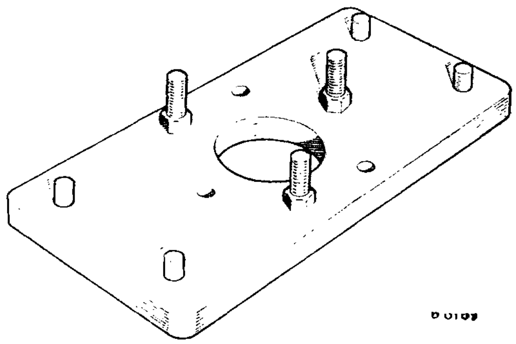
18G 537. Torque Wrench—10 to 50 lb. ft. (2 to 7 kg. m.)

These torque wrenches are for use with standard sockets and are essential if the recommended torque for the various bolts, nuts, and fittings on the fuel injection pump and injectors is not to be exceeded.


4464K
18G 537

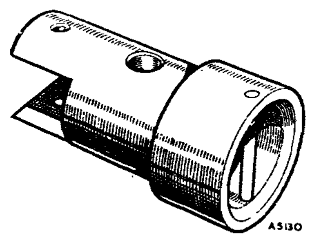
18G 633 A. DPA Assembly Base

Held in the jaws of a bench vice, this tool provides a mounting face to which the injection pump can be rigidly secured during dismantling and assembling operations.


D 0109
18G 633 A

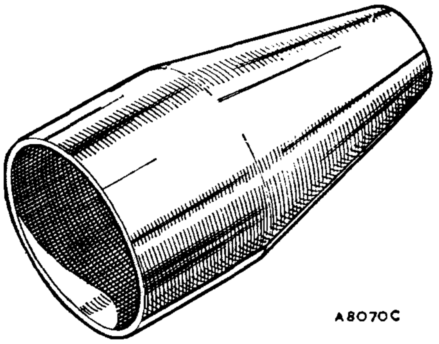
18G 634. Assembly Box Spanner

Used in conjunction with a torque wrench when tightening the fuel injection pump transfer pump rotor. It fits over the transfer pump rotor and engages one of the vane slots.


A5130
18G 634

18G 657. Protection Cap for Mechanical Drive Shaft

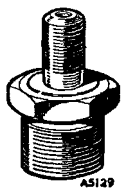
Facilitates the fitting of the 'O' seal to the distributor injection pump drive shaft and eliminates the possibility of damage when passing the seal over the shaft splines.



18G 657

18G 636. Transfer Pressure Adaptor

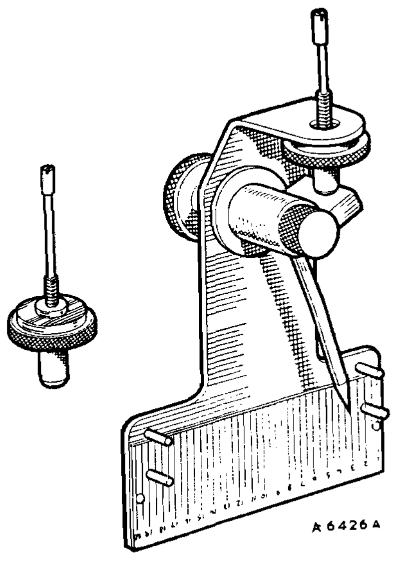
Fitted into the fuel injection pump hydraulic head after removal of the head locking screw not fitted with a vent valve. A pipe from the pressure gauge, mounted on the test machine, is coupled to the adaptor to convey test oil at transfer pressure to the gauge.



18G 636

18G 638 B (formerly 18G 638 A). Automatic Advance Gauge

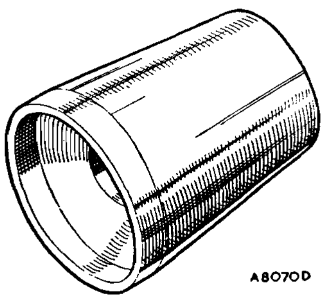
Assembled to the injection pump after removing the small plug from the automatic advance device spring cap. This gauge, which is graduated in degrees, is used when testing the pump to measure the angular movement of the cam ring.



18G 638 B

18G 640. Protection Cap for Automatic Advance Plug

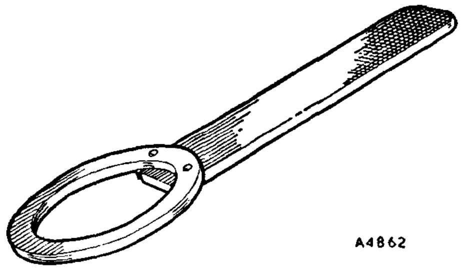
For passing the 'O' rings over the threaded portions of the fuel injection pump automatic advance device end plug and spring cap.



18G 640

18G 641. Assembly Drive Plate Spanner

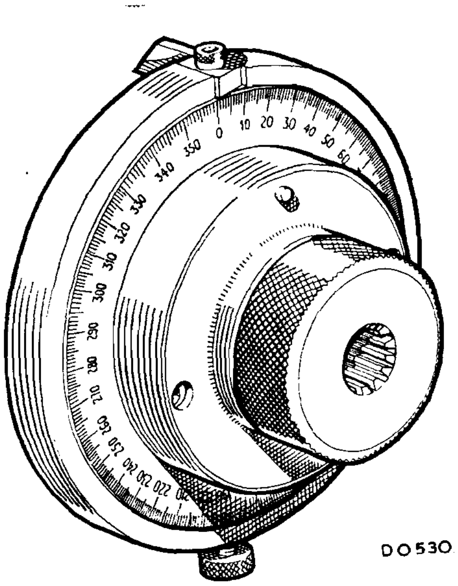
A special ring spanner with an internal tongue which engages the slot in the periphery of the drive plate. The drive plate is held with this spanner when slackening and tightening the drive plate screws during dismantling and assembling of the injection pump.



18G 641

18G 648 A. Universal Flange Marking Gauge

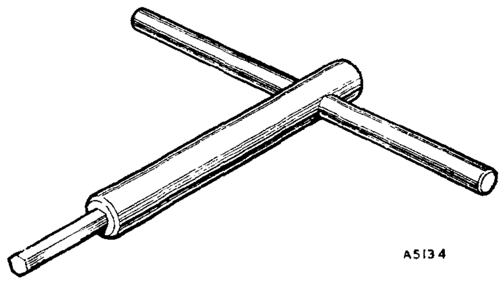
With this tool the timing mark scribed on the fuel injection pump flange can be checked and, if necessary, re-marked by passing a scriber along the scribing guide on the tool. Prior to use, the tool must be set to 86°.



18G 648 A

18G 652. Rotor Plug Spanner

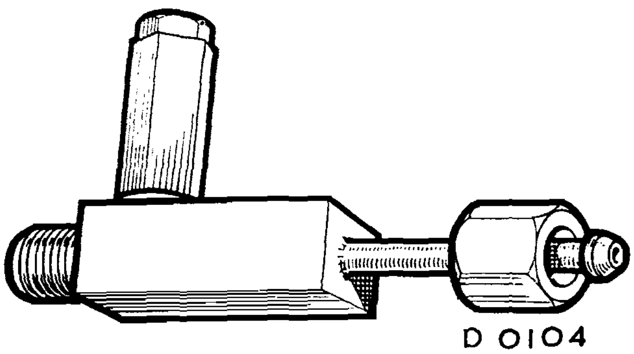
A 'T'-handled spanner for unscrewing the socket-headed plug from the end of the fuel injection pump pumping and distributing rotor.



18G 652

18G 653 A. Relief Valve Timing Adaptor

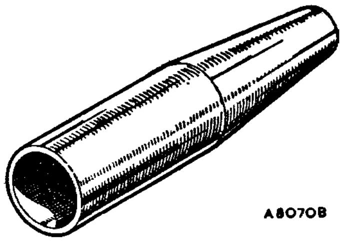
Connected to high-pressure outlet unions 'V' and 'X' on the hydraulic head, this adaptor is used in conjunction with testing machine 18G 109 A when setting the fuel injection pump roller-to-roller dimension and the internal timing.



18G 653 A

18G 654. Protection Cap for Shut-off Spindle

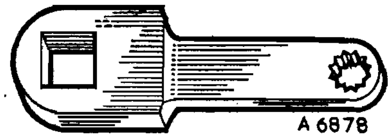
Facilitates the fitting of the 'O' ring into its groove in the fuel injection pump shut-off spindle.



18G 654

18G 655A. Drive Plate Screw Torque Adaptor

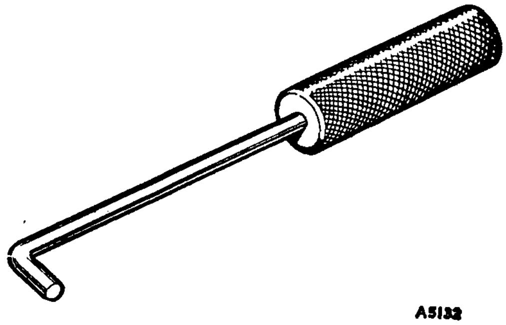
Used in conjunction with torque wrench 18G 537 to tighten the drive plate securing screws after adjustment of the fuel injection pump maximum fuel output during testing.



18G 655A

18G 656. Maximum Fuel Adjusting Probe

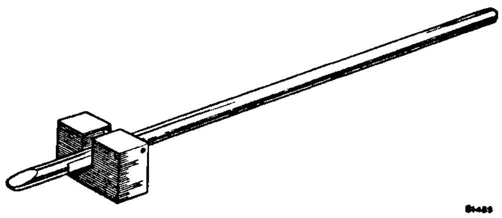
A light drift, which engages the slot in the top adjusting plate and is tapped with a light hammer to move the adjusting plate in relation to the rotor when setting the injection pump maximum fuel output.



18G 656

18G 658. Oil Seal Extractor

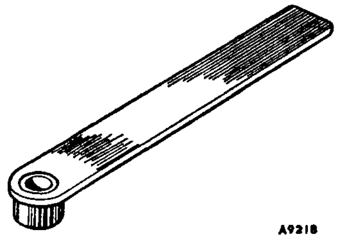
The drive hub oil seal can be extracted easily with this tool and without any damage being done to the injection pump flange.



18G 658

18G 659. Drive Shaft Screw Assembly Tool

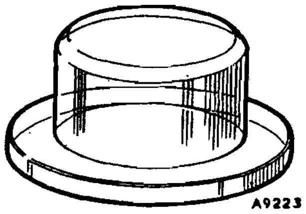
This tool fits the splines in the drive hub and is used to hold the drive hub while the drive shaft screw is being tightened or slackened.



18G 659

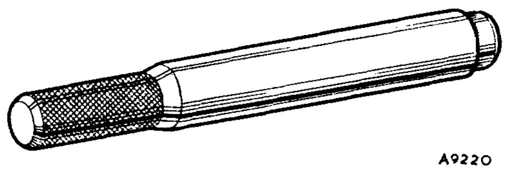
18G 660. Oil Seal Inspection Plug

A transparent plug which, when fitted into the drive hub oil seal, is used to inspect the area of contact between the oil seal and the drive hub.



18G 660

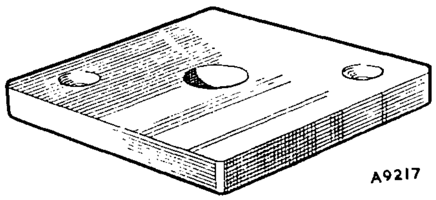
18G 661. Locating Pin



18G 661

18G 662. Plate

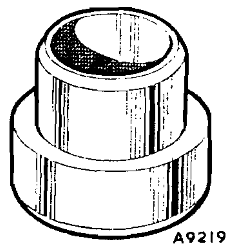
The locating pin and plate are used together to locate the governor weight retainer while the governor weights, thrust washer, and thrust sleeve are assembled.



18G 662

18G 663. Oil Seal Guide

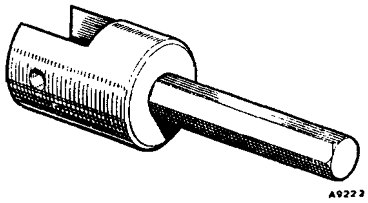
A tool which enables the drive hub oil seal to be fitted correctly and without damage.



18G 663

18G 664. Torque Adaptor

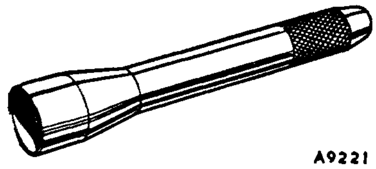
The boss of tool 18G 659 is bored so that this tool asses through it to engage the drive shaft screw when ismantling and reassembling.



18G 664

18G 665. Protection Cap for Throttle and Shut-off Shafts

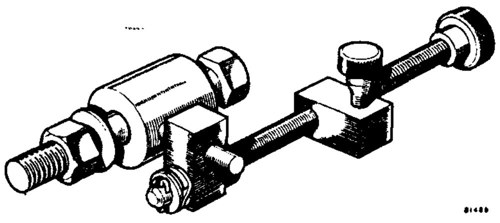
To enable the 'O' seals to be fitted to the throttle and shut-off shaft without damage.



18G 665

18G 697. Shut-off Lever Adjuster

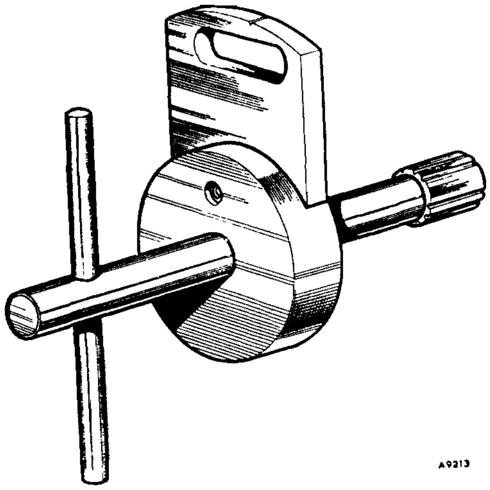
Used when testing the injection pump as described in Section Ca.9.



18G 697

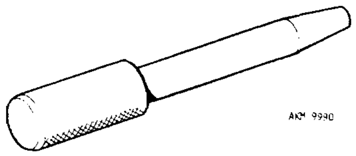
18G 698. Injection Timing Gauge

An essential tool for checking and setting the injection timing pointer on the injection pump drive hub. Its full use is described in Section Ca.7.



18G 698

AMK 9990. Timing Pin



AMK 9990

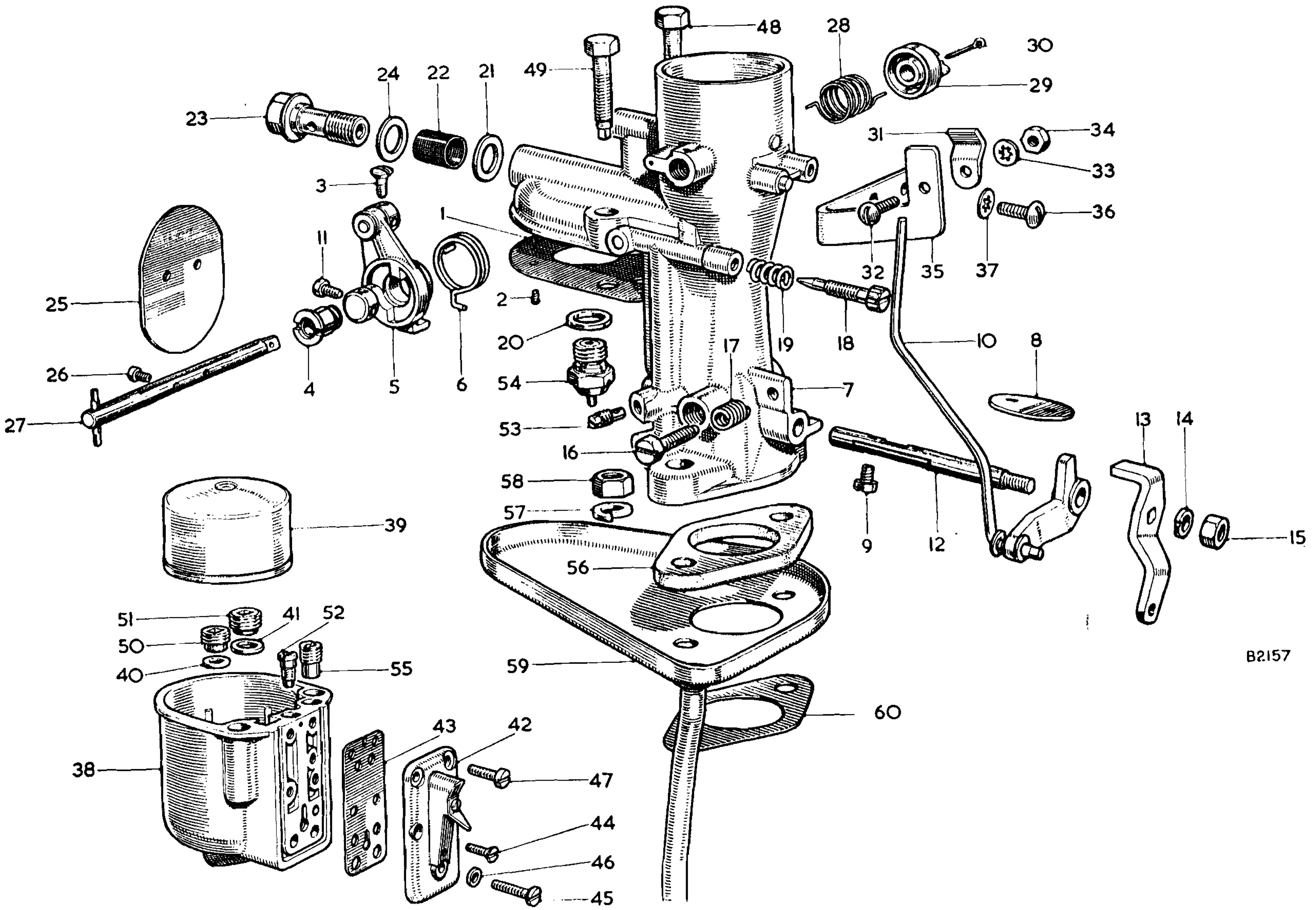
SECTION Cb

THE FUEL SYSTEM

(PETROL MODELS)

For all other information of the Fuel System for petrol models refer to Section C.

THE ZENITH (30 VM6) CARBURETTER COMPONENTS



KEY TO THE ZENITH (30 VM6) CARBURETTER COMPONENTS

No.	Description	No.	Description	No.	Description
1.	Bowl gasket.	21.	Fibre washer.	41.	Fibre washer.
2.	Gasket screw.	22.	Filter gauze.	42.	Emulsion block.
3.	Strangler lever swivel screw.	23.	Inlet union.	43.	Emulsion block gasket.
4.	Strangler lever bearing.	24.	Fibre washer.	44.	Screw (short).
5.	Strangler lever assembly.	25.	Strangler flap.	45.	Screw (long).
6.	Strangler lever spring.	26.	Strangler flap screw.	46.	Washer.
7.	Carburetter barrel.	27.	Strangler spindle.	47.	Screw (instrument head).
8.	Throttle.	28.	Automatic spring.	48.	Bowl screw (plain).
9.	Throttle screw.	29.	Spring carrier.	49.	Bowl screw (jet key type).
10.	Interconnecting linkage.	30.	Split pin.	50.	Main jet.
11.	Interconnecting linkage screw.	31.	Strangler control bracket clip.	51.	Compensating jet.
12.	Throttle spindle.	32.	Screw for clip.	52.	Slow-running jet.
13.	Throttle lever.	33.	Shakeproof washer.	53.	Progression jet.
14.	Spring washer.	34.	Nut for clip.	54.	Needle and seating.
15.	Throttle lever nut.	35.	Strangler control bracket.	55.	Screw over capacity well.
16.	Throttle stop screw.	36.	Control bracket screw.	56.	Insulating washer.
17.	Throttle stop screw spring.	37.	Shakeproof washer.	57.	Spring washer.
18.	Air regulating screw.	38.	Carburetter bowl.	58.	Carburetter securing nut.
19.	Air regulating screw spring.	39.	Float.	59.	Carburetter drip tray.
20.	Needle seating washer.	40.	Fibre washer.	60.	Drip tray joint washer.

Section Cb.1

CARBURETTER (30 VM6)

Description

The carburetter fitted is of the Zenith downdraught type incorporating the principle of main and compensating jets. Petrol from the pump passes through the inlet union filter and needle seating into the float-chamber, and as the float rises with the level of the petrol it closes the needle valve, thus regulating the inflow of fuel.

The float-chamber contains the main jet, compensating jet, capacity well, and the slow-running jet. Petrol flows through the main and compensating jets and rises in the capacity well. From the jets it flows along two separate channels into a common main channel in the emulsion block attached to the float-chamber. This main channel has its outlet in a nozzle which projects into the choke tube.

The capacity well is in direct contact with both the atmosphere and the main channel in the emulsion block.

Starting

To obtain an easy start from cold the combined throttle and choke control on the instrument panel should be pulled out to its fullest extent and the engine should be given a few turns by means of the starting-handle to free the moving parts. The self-starter may then be used, and when the engine is running the choke should be gradually released.

In cold weather it may be necessary to hold the choke control out for a few minutes while the engine warms up,

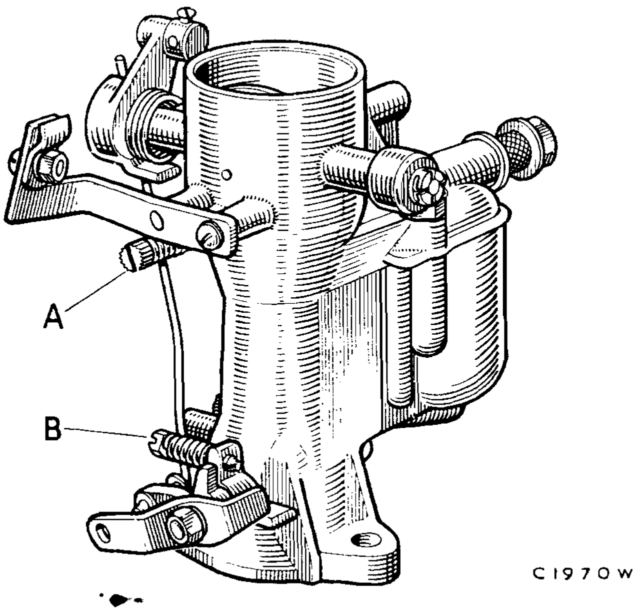


*Fig. Cb.*1

30 *VM*6 *carburetter*

A. Air regulating screw. B. Throttle stop screw.

but it should be released as soon as possible to avoid an over-rich mixture.

Choke setting

If difficulty in starting the engine is experienced ascertain that the choke flap in the carburetter is closing properly and, if necessary, adjust the control wire. Also make sure that the choke flap opens fully when the control knob is released, as if it sticks in a partially closed position it will adversely affect the running of the engine and increase fuel consumption.

Minor adjustments

If the engine does not idle as slowly as desired, turn the stop screw to the left to close the throttle slightly.

A weak mixture may also affect slow-running. This can be remedied by turning the air regulating screw in a clockwise direction to enrich the mixture. But do not make the mixture too rich or the engine will 'hunt', or tend to choke when slow-running while warm.

There are no adjustable parts in the carburetter except for the throttle and air regulating screws already mentioned, and these should not be reset unless it is absolutely necessary.

Cleaning

The bowl of the carburetter should be removed occasionally for cleaning. Take out the two slotted retaining bolts and the bowl will drop down into the hand. On turning the bowl upside-down the float will fall out, revealing the main and compensating jets in the bottom of the bowl.

Remove the jets by fitting into them the squared end of one of the retaining bolts and using a spanner or screwdriver on the other end.

Jets should be cleaned by washing them in petrol and blowing through them either by means of a tyre pump or with the mouth. Never attempt to clear a choked jet by using wire.

The pipe connection from the petrol pump should be dismantled and the filter thoroughly cleaned in petrol. When reassembling, ensure that the fibre washers on both sides of the union are correctly replaced.

Jet sizes

Do not alter the jets unless it is certain that other parts of the engine, such as sparking plugs, ignition, and valves are in good order, and that piston compression is good.

Zenith jet sizes normally run in 5s, the higher the number the larger the jet.

Dismantling

Release the slow-running jet and the screw over the capacity well by means of a screwdriver, due care being taken not to damage them.

When five screws are taken out of the emulsion block it can be detached along with its gasket.

Use a suitable box spanner or socket to remove the needle and seating, washer and deflector. The progression jet, which is situated on the outside of the carburetter next to the vacuum advance pipe elbow, can also be taken out with a screwdriver.

Detach the two screws from the choke flap, slacken the screw in the choke spindle cam, and ease the cam off the spindle. Draw the choke spindle through the choke flap, then lift out the flap.

Next remove the throttle butterfly securing screws. Note that when the throttle is fully closed, the two small depressions in the throttle are away from the progression drilling. Draw out the throttle.

Unscrew the throttle operating lever nut, extract the split pin in the choke spindle cam follower, and lift away the interconnecting assembly and washers.

The choke tube can now be pushed out of the carburetter bore after releasing its locating screw to finally detach the air regulating screw and throttle stop screw.

Section Cb.2

CARBURETTER (42 VIS)

The carburetter fitted is of the Zenith downdraught type, which embodies an accelerating pump and economy device. A fully automatic strangler flap interconnected with the throttle is also incorporated for starting purposes.

This strangler promotes rapid warming up after the initial engine firing has been obtained.

Accelerating pump

The object of this pump is to overcome any tendency to lag in acceleration; this may be apparent when a carburetter is adjusted to give low petrol consumption at normal driving speeds. In order to obtain economical running at such speeds and yet ensure a faultless acceleration, a controlled and measured supply of mixture is necessary when the throttle is opened suddenly. This is provided by the accelerator pump.

In the interests of fuel economy, during the summer months, the owner can alter the carburetter setting by shortening the pump stroke, i.e. moving the pump control link rod to the lower hole in the throttle lever. However, if cold weather is encountered, the owner must be prepared for 'flat-spots' on acceleration under these conditions.

Adjustment

The carburetter settings have been selected as most suitable for the engine after extensive experimental work. Consequently very little adjustment to the carburetter should be needed. Adjustments should only be made when absolutely necessary. The setting of the slow-running mixture and the idling speed of the engine are the only likely alterations needed, apart from an occasional cleaning of its jets, float-chamber bowl, and filter gauze.

When trouble with the running of the engine is experienced do not assume that it is always due to the carburetter. Check all other possible causes of trouble—such as sparking plugs, ignition equipment, and condition of valves—before making alteration to the carburetter.

Dismantling of the carburetter

Before dismantling, ensure that all parts, the hands, and the bench are clean. The hand should be placed beneath the bowl during this operation so that on removal of the retaining bolts it will drop into the hand.

The jets should be removed occasionally and thoroughly cleaned. One of the retaining bolts is squared at the end to fit into the jet covers and jets. This facilitates their removal when used in conjunction with a suitable spanner.

Cleaning the jets

When cleaning the jets do not pass anything through them—such as wire—that is likely to damage the carefully calibrated orifices. The most satisfactory and efficient method is to blow through them with air, free from moisture, and wash with clean petrol. This should remove any obstruction and will leave the jets undamaged. The sizes of all jets are clearly numbered—the larger the jet the greater the number. The slow-running jet is provided with a screwdriver slot to enable it to be removed. This applies also to the screw in the capacity tube.

Float

If there have been signs of flooding the float may be suspected. Remove the float and immerse in boiling water, when rising bubbles will indicate the exact location of a puncture. When the petrol inside has thus been evaporated seal the puncture with a spot of solder. This is essentially a temporary expedient, as the extra weight of solder may cause a difference in petrol level in the bowl. Fit a new float at the earliest opportunity.

Emulsion block

The emulsion block is held to the side of the bowl by five screws. Particular care should be taken to avoid damage to the washer beneath the block in the event of removal. When replacing, insert the bottom screw first and then tighten all five evenly.

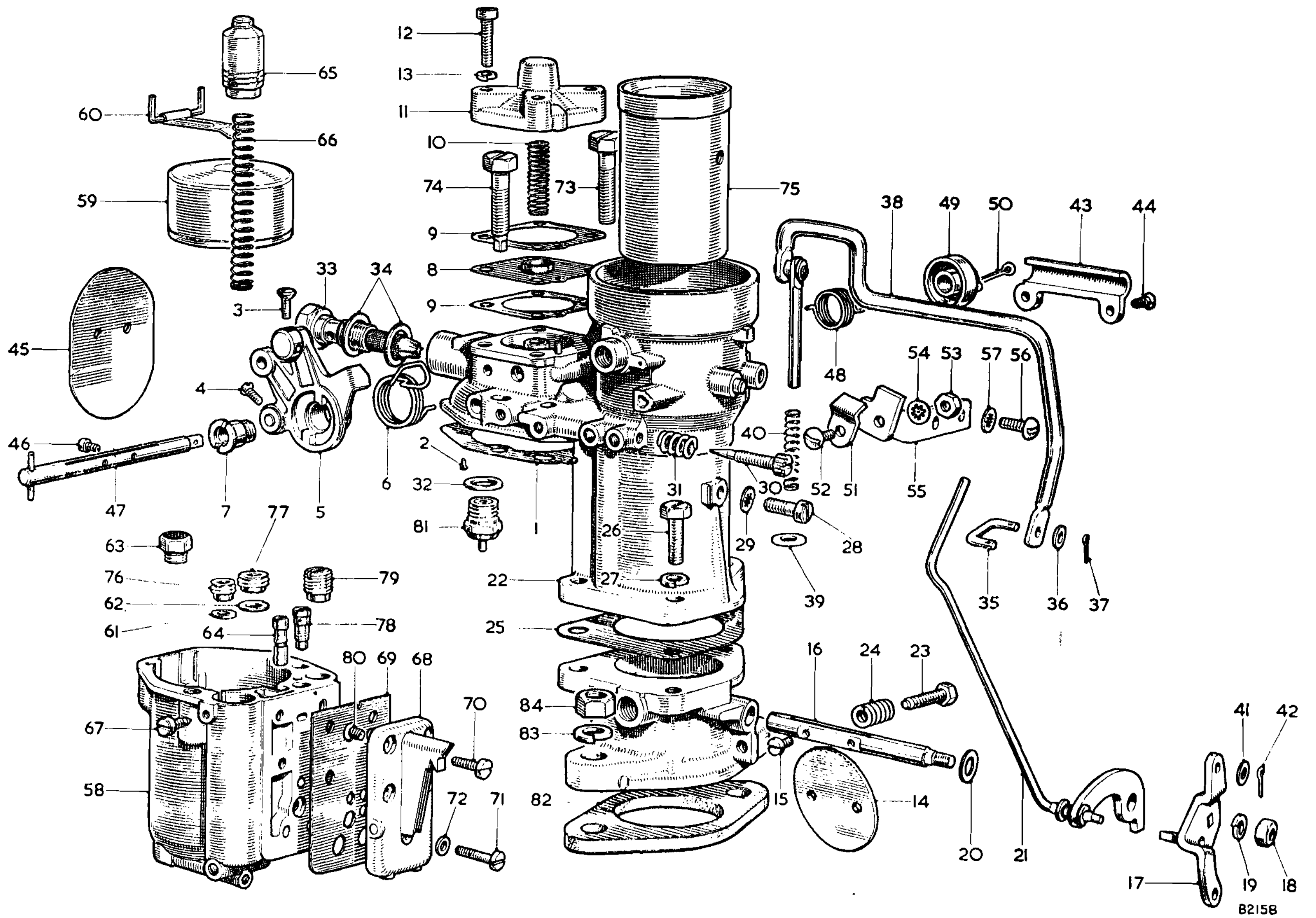
The progression jet is removed by a screwdriver, the jet cover having been first removed; make sure that the latter is replaced after inspection.

Slow-running adjustment

The stop screw determines the speed of slow-running. To increase the slow-running speed the stop screw must be turned in a clockwise direction. If turned anti-clockwise a slower 'tick-over' will be obtained.

The richness of the slow-running mixture is controlled by the air regulating screw. Should the engine refuse to 'tick' over for any length of time or stall on deceleration, the slow-running jet may be choked and should be cleaned. After examination reset the slow-running by means of the throttle stop screw and the air regulating screw. If the engine is inclined to hunt when running slowly the mixture is too rich and must be weakened by

THE ZENITH (42 VIS) CARBURETTER COMPONENTS



KEY TO THE ZENITH (42 VIS) CARBURETTER COMPONENTS

No.	*Description*
1.	Bowl gasket.
2.	Gasket screw.
3.	Strangler wire screw.
4.	Interconnecting linkage screw.
5.	Strangler lever assembly.
6.	Strangler lever spring.
7.	Strangler lever bearing.
8.	Diaphragm assembly.
9.	Diaphragm gasket.
10.	Economy spring.
11.	Economy valve cover.
12.	Cover screw.
13.	Spring washer.
14.	Throttle.
15.	Throttle screw.
16.	Throttle spindle.
17.	Throttle lever.
18.	Throttle spindle nut.
19.	Spring washer.
20.	Plain washer.
21.	Interconnecting linkage.
22.	Throttle body assembly.
23.	Throttle stop screw.
24.	Throttle stop screw spring.
25.	Throttle body gasket.
26.	Throttle body screw.
27.	Spring washer.
28.	Choke tube screw.
29.	Shakeproof washer.
30.	Air regulating screw.
31.	Air regulating screw spring.
32.	Needle seating washer.
33.	Inlet union and filter.
34.	Fibre washer.
35.	Pump link.
36.	Pump link washer.
37.	Split pin.
38.	Pump lever and rod assembly.
39.	Pump rod washer.
40.	Pump rod spring.
41.	Pump link washer.
42.	Split pin.
43.	Bearing plate.
44.	Bearing plate screw.
45.	Strangler flap.
46.	Strangler flap screw.
47.	Strangler spindle and pin.
48.	Automatic spring.
49.	Spring carrier.
50.	Split pin.
51.	Strangler wire clip.
52.	Clip screw.
53.	Clip screw nut.
54.	Shakeproof washer.
55.	Strangler control bracket.
56.	Bracket screw.
57.	Shakeproof washer.
58.	Carburetter bowl.
59.	Float.
60.	Float arm.
61.	Fibre washer.
62.	Fibre washer.
63.	Pump check valve.
64.	Ball valve assembly.
65.	Pump piston.
66.	Piston spring.
67.	Stop screw.
68.	Emulsion block.
69.	Emulsion block gasket.
70.	Screw (short).
71.	Screw (long).
72.	Plain washer.
73.	Bowl screw (plain).
74.	Bowl screw (jet key type).
75.	Choke tube.
76.	Main jet.
77.	Compensating jet.
78.	Slow-running jet.
79.	Screw over capacity well.
80.	Pump jet.
81.	Needle and seating.
82.	Insulating washer.
83.	Spring washer.
84.	Carburetter securing nut.

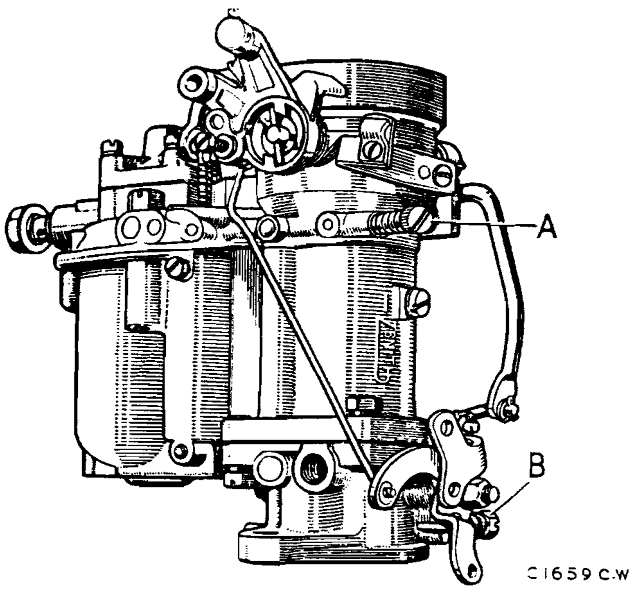


Fig. Cb.2

42 VIS carburetter

A. Air regulating screw. B. Throttle stop screw.

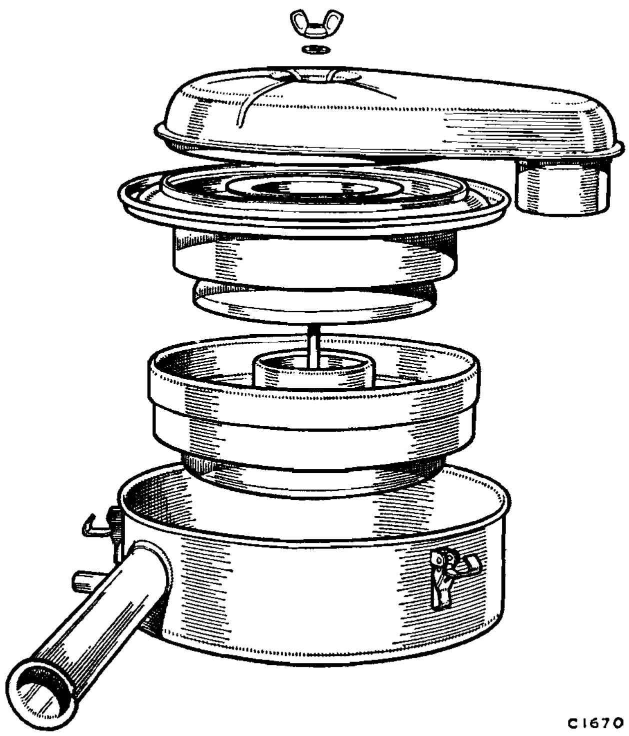


Fig. Cb.3

The air cleaner

turning the air regulating screw in an anti-clockwise direction. The best position for this screw from the point of view of pick-up is within three turns of the fully home position. Check by speeding up the engine and releasing the accelerator pedal quickly. If the engine stalls, the slow-running adjustment is not correct and the idling speed should be slightly increased to a point where the sudden release of the throttle after accelerating allows the engine to settle to an even 'tick over'. Do not expect a new engine which is tight in its bearings to idle perfectly.

It must be borne in mind that factors other than the carburetter—such as non-airtight joints, worn valve guides, valves not seating, contact points incorrectly set, ignition too far advanced, and incorrect setting of sparking plug gaps—can have considerable influence on 'slow-running' when the engine is out of gear, with the car stationary. Such details should always be given consideration when the slow-running is irregular. The carburetter alone should not be suspected.

Filter

Petrol is filtered on entering the carburetter and the gauze should be thoroughly cleaned from time to time. To remove this item, unscrew the petrol connection, taking care not to damage the union or strain the petrol pipe and take the filter from its seating. The gauze can then be washed out with petrol. Care should be taken on reassembling to see that the fibre washers on both sides of the petrol pipe connections are correctly placed.

General

Swill out the bowl of the carburetter occasionally with clean petrol to remove any sediment that may be present.

Under normal conditions no other attentions or adjustments should be necessary. Once correctly set many thousands of miles of satisfactory running should be obtained.

Should the vehicle be used in very hot climates or at very high altitudes, a slightly weaker setting may be used, or, alternatively, if used in very cold climates, larger jets may be necessary.

Advice on this question will readily be given on application.

Section Cb.3

AIR CLEANER

To remove and dismantle

To remove and dismantle the air cleaner follow the instructions contained in Section C.7; see also Fig. Cb.3.

SECTION D

THE AUTOMATIC TRANSMISSION

(Model DG)

For additional information refer to the Supplementary Section SB at the end of the Manual.

Section D.1

REMOVING THE TRANSMISSION AND CONVERTER (Model DG)

These instructions should be used in conjunction with those given in Section SB(h).1 of the Supplement, and where the instructions conflict, then the following instructions take precedence.

Disconnect the accelerator control rod from the venturi.

Drain the cooling system and disconnect the water feed pipe from the heater on the scuttle. This is to allow for movement of the power unit.

Disconnect the oil pressure gauge flexible pipe.

Disconnect the gear selector cross-shaft by releasing the rear rod and prising out the shaft from its spherical bearing on the frame against the pressure of the rubber bush.

Disconnect the exhaust pipe front support and from the manifold flange.

Raise the car on the hydraulic lift or other medium so as to give working space below the car.

Disconnect the selector rod from the gearbox.

Disconnect the front end of the propeller shaft and slide it backwards to the end of its splines.

Support the power unit with hook slings on the engine lifting brackets, and remove the bolts securing the gearbox support brackets to the frame and the bolts securing the support member to the frame.

Remove the selector cross-shaft from the bell housing.

Remove the accelerator control rod from the gearbox by unscrewing the rod from the gearbox lever connection.

Disconnect the speedometer cable (and taxi-meter cable) from the gearbox.

Drain the oil from the engine, converter, and gearbox.

Support the gearbox on a suitable adjustable lift as illustrated in Fig. D.1. It is absolutely imperative that no strain is put on the gearbox or converter, and it is for this reason that the type of lift illustrated is strongly recommended.

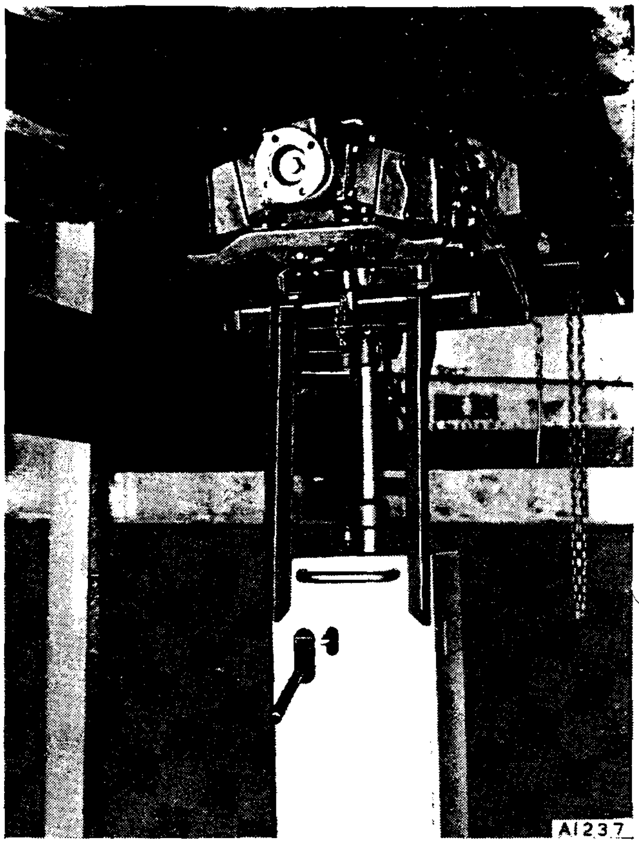


Fig. D.1

The use of an adjustable lift is necessary for the removal and replacement of the automatic transmission

Section D.2

REFITTING THE CONVERTER AND TRANSMISSION (Model DG)

Follow the refitting instructions laid down in Section SB(h).2 in conjunction with the reversal of the instructions given in Section D.1. It cannot be too strongly stressed that the use of the type of lift illustrated in Fig. D.1 is recommended as the alignment of the converter and gearbox is vitally important.

SECTION Da

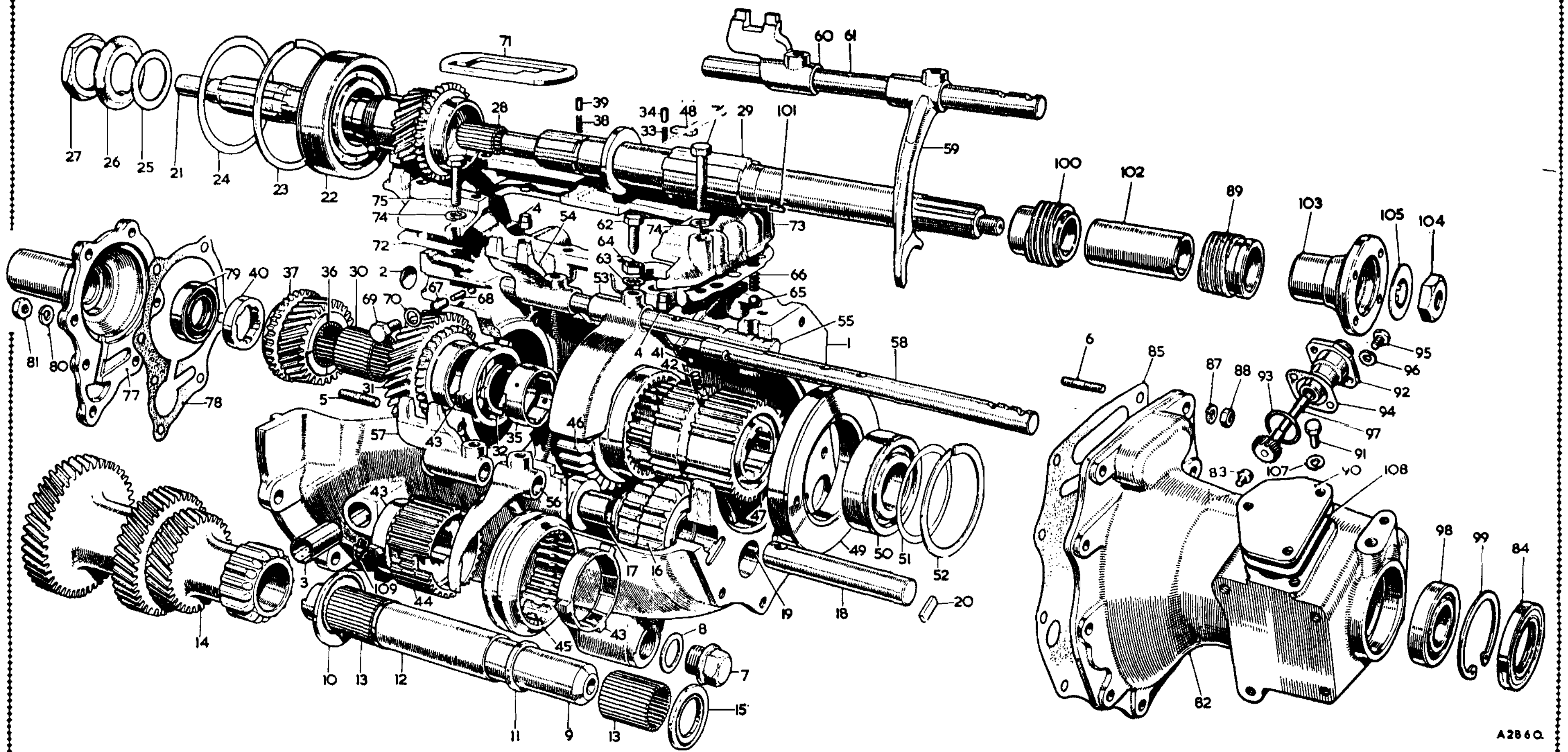
THE SYNCHROMESH GEARBOX

Section

SECTION Da

THE SYNCHROMESH GEARBOX

THE SYNCHROMESH GEARBOX COMPONENTS



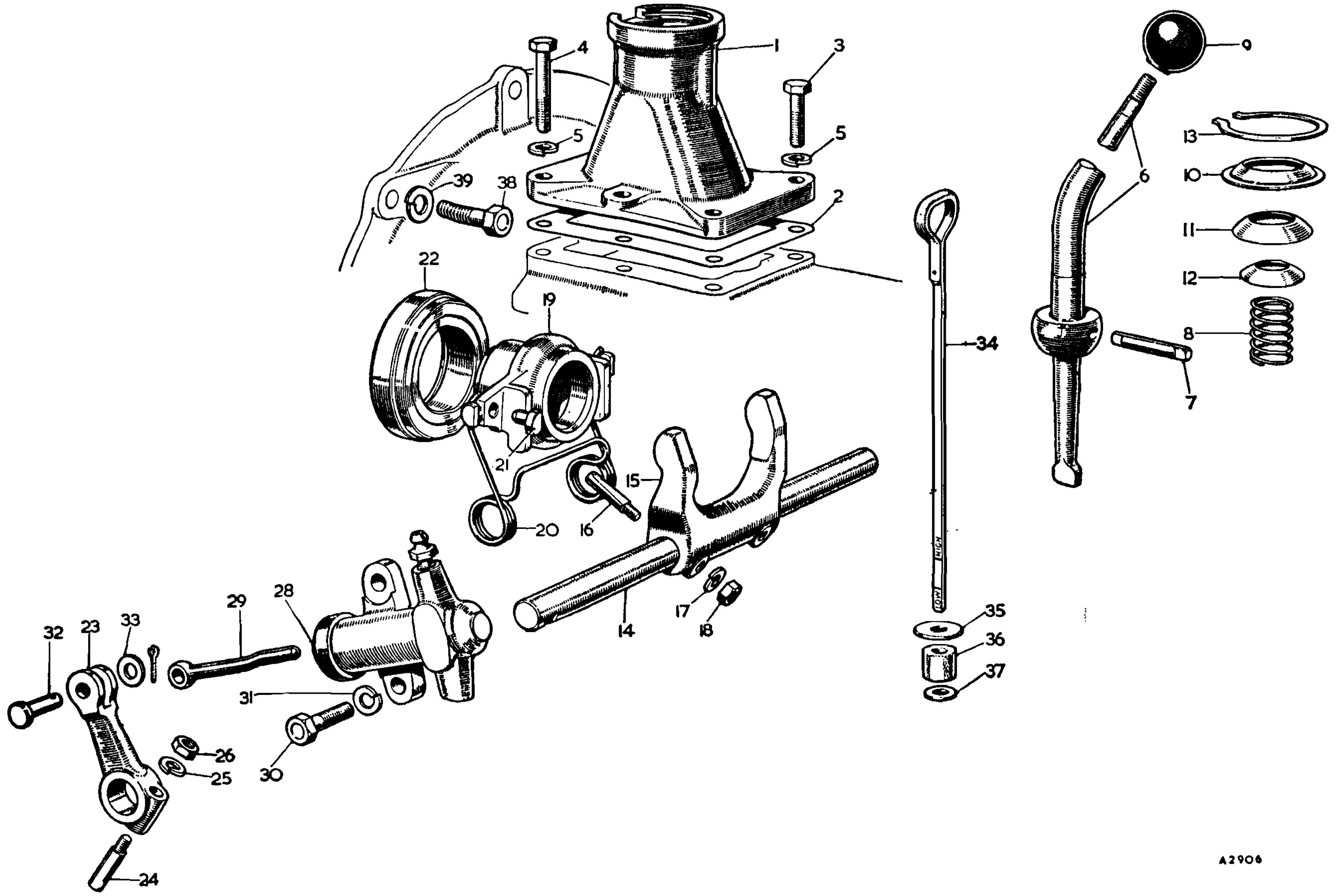
KEY TO THE SYNCHROMESH GEARBOX COMPONENTS

No.	Description
1.	Casing assembly.
2.	Plug—welch.
3.	Bush—clutch operating.
4.	Dowel for top cover.
5.	Stud for front cover.
6.	Stud for rear cover.
7.	Plug—oil drain.
8.	Washer for drain plug.
9.	Layshaft.
10.	Washer—layshaft front (thrust).
11.	Washer for layshaft roller.
12.	Spacer for roller.
13.	Roller for layshaft (needle).
14.	Lay gear.
15.	Washer—layshaft rear (thrust).
16.	Gear—reverse.
17.	Bush for gear.
18.	Shaft for reverse gear.
19.	Plug for shaft.
20.	Key—gear to shaft.
21.	Shaft—1st motion.
22.	Bearing—1st motion shaft (ball).
23.	Ring for bearing (spring).
24.	Shim—bearing.
25.	Washer for shaft.
26.	Washer for nut (locking).
27.	Nut for shaft.
28.	Roller—1st motion shaft.
29.	Shaft—3rd motion.
30.	Roller—2nd speed gear.
31.	Gear—2nd speed.
32.	Washer for 2nd speed gear.
33.	Spring for plunger.
34.	Plunger for collar.
35.	Collar—2nd speed gear (locking).
36.	Roller for 3rd speed gear.

No.	Description
37.	Gear—3rd speed.
38.	Spring for lock plate.
39.	Plunger for lock plate.
40.	Lock plate for fixed hub.
41.	Ball for sliding hub.
42.	Spring—sliding hub.
43.	Interceptor.
44.	Dog—striking—3rd and 4th speed.
45.	Hub—sliding—3rd and 4th speed.
46.	Gear—1st speed—sliding.
47.	Hub—1st and 2nd speed—sliding.
48.	Key—2nd speed—hub to locking collar.
49.	Housing for centre bearing.
50.	Bearing—centre—3rd motion shaft.
51.	Shim for centre bearing.
52.	Ring for bearing (spring).
53.	Fork—1st and 2nd speed selector.
54.	Jaw—1st and 2nd speed selector.
55.	Rod—fork—1st and 2nd speed.
56.	Fork—3rd and 4th speed selector.
57.	Jaw—3rd and 4th speed selector.
58.	Rod—fork—3rd and 4th speed.
59.	Fork—reverse gear selector.
60.	Jaw—reverse selector.
61.	Rod—reverse fork.
62.	Screw—fork and jaw to rod.
63.	Washer (shakeproof).
64.	Nut (lock).
65.	Ball (detent).
66.	Spring (detent).
67.	Plunger—interlock.
68.	Pin—interlock.
69.	Plug—interlock pin hole.
70.	Joint washer for plug.
71.	Gate—change speed.
72.	Joint washer—top cover to casing.

No.	Description
73.	Cover (top).
74.	Washer for set screw (spring).
75.	Set screw for top cover.
76.	Set screw for top cover.
77.	Cover—front.
78.	Joint washer—cover to gearbox case.
79.	Seal for front cover (oil).
80.	Washer for stud in casing (spring).
81.	Nut for stud.
82.	Cover—rear.
83.	Button for speedometer pinion (thrust).
84.	Seal for rear cover (oil).
85.	Joint washer—rear cover to casing.
87.	Washer for stud (rear cover to casing).
88.	Nut for stud (rear cover to casing).
89.	Taximeter drive wheel.
90.	Cover-plate—gearbox rear cover.
91.	Set screw—cover-plate.
92.	Bush—speedometer pinion.
93.	Seal—oil.
94.	Joint washer for bush.
95.	Set screw for bush.
96.	Washer (spring).
97.	Pinion—speedometer.
98.	Bearing—rear (3rd motion shaft).
99.	Circlip for bearing.
100.	Wheel—speedometer.
101.	Key for wheel.
102.	Distance piece—3rd motion shaft.
103.	Flange for 3rd motion shaft.
104.	Locknut for flange.
105.	Lock washer for nut.
107.	Washer for set screw (spring).
108.	Joint washer for cover-plate.
109.	Nipple for shaft (grease).

THE SYNCHROMESH GEARBOX COMPONENTS



KEY TO THE SYNCHROMESH GEARBOX COMPONENTS

No.	*Description*
1.	Turret—change speed lever.
2.	Joint washer—turret to top cover.
3.	Set screw for turret.
4.	Set screw for turret and top cover.
5.	Washer for set screws (spring).
6.	Lever—change speed.
7.	Pin for lever—fulcrum.
8.	Spring.
9.	Knob.
10.	Cover—dust (outer).
11.	Cover—dust (inner—large).
12.	Cover—dust (inner—small).
13.	Ring—dust cover retaining.
14.	Shaft—clutch operating.
15.	Fork—clutch withdrawal.
16.	Pin for fork (cotter).
17.	Washer for cotter pin (spring).
18.	Nut for cotter pin.
19.	Housing—clutch withdrawal.
20.	Spring—fork to housing.
21.	Button—thrust.
22.	Bearing—clutch throw-out.
23.	Lever—clutch cross-shafts.
24.	Pin—cotter.
25.	Washer for cotter pin (spring).
26.	Nut for cotter pin.
28.	Cylinder—clutch operating.
29.	Push-rod for cylinder.
30.	Set screw.
31.	Washer for set screw (spring).
32.	Pin (clevis)—cross-shaft lever to push-rod.
33.	Washer for clevis pin.
34.	Dipstick.
35.	Washer (top).
36.	Ring (felt).
37.	Washer (bottom).
38.	Set screw—gearbox to flywheel housing.
39.	Washer (spring).

Section Da.1

REMOVING AND REFITTING THE GEARBOX

(1) Remove the gear lever retaining circlip from the gearbox turret and detach the gear lever.
(2) Drain the oil from the gearbox.
(3) Raise one rear wheel until it can be turned, unlock and remove the bolts securing the propeller shaft to the gearbox and rear axle flanges and detach the propeller shaft.
(4) Detach the clutch slave cylinder feed pipe at either end and remove the pipe.
(5) Detach the clutch slave cylinder from the gearbox casing.
(6) Remove the speedometer cable from the gearbox.
(7) Remove the taximeter drive cable (if fitted) from the gearbox.
(8) Disconnect the exhaust pipe from the exhaust manifold.
(9) Slacken the exhaust pipe support bracket clip on the pipe.
(10) Support the engine forward of the gearbox bell housing.
(11) Support the gearbox.
(12) Remove the rebound rubber support cross-member at the rear of the gearbox.
(13) Detach the gearbox mounting rubbers from the chassis.
(14) Lower the engine and gearbox to allow the gearbox turret to clear the cab floor.
(15) Remove the gearbox mounting rubbers from the gearbox.
(16) Remove the bolts securing the gearbox bell housing to the engine.
(17) Withdraw the gearbox from the engine.

Refitting

(18) Engage a gear to enable the primary shaft to be turned by the propeller shaft flange to line up the primary shaft and clutch plate splines.
(19) Reverse the procedure in (1) to (17).
(20) Bleed the clutch slave cylinder.

Section Da.2

DISMANTLING THE GEARBOX

The gearbox is removed from the engine by taking out the bolts from the bell housing flange, when the box can be drawn off. The flywheel housing stays in position on the engine.

With the gearbox on the bench the dismantling procedure is as follows.

Drain the oil from the box and place the gears in neutral.

Remove the cotter pin from the clutch operating arm and take out the two set pins which secure the operating cylinder to the side of the bell housing. Remove the operating arm and cylinder complete.

Disengage the release bearing spring and remove the bearing with its housing.

Release the cotter pin nuts and tap the cotters out of the withdrawal fork. Push the fork pivot shaft out of the bell housing and collect the fork and spring.

Within the bell housing remove the seven nuts on studs which secure the gearbox front cover. Remove the cover and paper joint washer. Any shims fitted to control first motion shaft end-float must be removed.

Withdraw the speedometer drive (and taxi-meter drive, if fitted), remove the propeller shaft flange using tools 18G 34 A and 18G 2, then remove the end cover.

Remove the gear lever turret and the gearbox top cover. Note the three springs and balls under the rear end of the cover.

Take out the set pins which secure the selectors and forks to the rods. Retrieve the star washers fitted below the set pin heads. Pull the selector rods rearwards out of the box and collect the selectors and forks. Remove the selector balls if still in position.

Remove the small interlock plunger from the central selector rod. The large plungers for the other two rods will stay in position and can be removed by tilting the box.

Remove the lay gear shaft by tapping out of the box from front to rear.

Tap the reverse gear shaft rearwards out of the box and retrieve the key. The reverse gear will now lie in the bottom of the box.

Remove the mainshaft rearwards out of the box and retrieve the reverse gear from the bottom of the box.

Using a suitable soft drift, remove the first motion shaft forward from the box complete with its bearing.

Remove the lay gears from the bottom of the box and retrieve the thrust washers.

Section Da.3

DISMANTLING AND REASSEMBLING THE MAINSHAFT

When the mainshaft is out of the gearbox it can be dismantled as follows.

Secure the shaft in a vice, using lead jaws. Slide the third and top synchronized sleeve off the mainshaft, together with the third speed synchronizer ring.

Depress the third speed locking ring plunger and rotate the locking ring until it is free to be drawn off the shaft.

Remove the spring and plunger and draw the third gear off the shaft.

Remove the third gear needle rollers from the shaft.

Remove the tailshaft roller bearing using tool 18G 2, the taximeter drive gear and key, the spacer tube and the speedometer drive gear and key.

Reverse the position of the shaft in the vice and remove the mainshaft bearing, using a suitable extractor.

Slide the first gear and synchronizer assembly off the shaft, followed by the second gear synchronizing ring.

Depress the plunger securing the locking key and slide the key off the shaft.

Again depress the plunger, rotate the second gear locking ring, and rotate the ring until it is free to be drawn off the shaft.

Remove the plunger and spring and lift out the two halves of the thrust ring. Lift off the second gear.

Remove the needle rollers from the shaft.

Mount the shaft vertically in a vice with the rear end uppermost.

Using grease, position the needle rollers for the second gear so that they rest on the shaft flange. Slide the second gear into position over the rollers.

The thrust ring, which is in two halves, must now be positioned on top of the needle rollers.

NOTE.—The tags on the thrust ring locate in recesses on the under side of the locking ring, the fitting of which is described next.

Position the spring plunger in the hole in the shaft and slide the locking ring (recesses leading) onto the shaft. Use a suitable tool to depress the plunger whilst the ring passes over it. Ensure that the tags on the thrust ring locate in the recesses of the locking ring. Rotate the locking ring a small amount to allow the plunger to locate into a groove in the ring.

The locking key must now be fitted between the shaft and locking ring. Use a suitable tool to depress the plunger whilst the key is slid into position. Ensure that the plunger, when released, passes through the hole in the key.

Reverse the position of the shaft in the vice.

Using grease, position the needle rollers for the third gear and slide the gear into position.

Fit the third gear spring and plunger and slide the locking ring into position, using a suitable tool to depress the plunger. Rotate the locking ring to lock it in position.

Take the shaft as now assembled out of the vice and reverse its position. Fit the synchronizer ring and slide the first gear and synchronizer as an assembly onto the shaft. The synchronizer will only fit in one position because one spline is cut back to allow it to fit over the locking key.

Remove the shaft from the vice and fit the third and top synchronizer sleeve together with the third speed synchronizer ring onto the shaft.

NOTE.—The fourth speed synchronizing ring is best positioned on the first motion shaft in the box during re-assembly, as detailed in the next section.

Section Da.4

REASSEMBLING THE GEARBOX

Refit the needle-roller bearings and position the lay-gear in the bottom of the box with the thrust washers held in position with grease. Support the thrust washers and laygear with a pilot shaft.

NOTE.—Four thicknesses of thrust washers are available and they should be used so that ·003 to ·004 in. (·076 to ·102 mm.) end-play is present at the laygear.

Position the reverse gear in the bottom of the box—the shaft is fitted later.

With its bearing in position on the shaft, drift the first motion shaft into position in the box.

Using grease, place the needle-roller bearings around the front end of the mainshaft. Temporarily secure the rollers with wire or an elastic band. Insert the mainshaft through the opening in the rear of the box. Gently position the forward end of the shaft into the first motion shaft, taking care not to displace the needle rollers. Before pushing the mainshaft fully home remove the wire or elastic band from round the rollers.

Carefully drift the rear bearing housing into position, ensuring that it remains square with the rear face of the gearbox.

Drive the rear bearing onto the shaft and into the bearing housing until the bearing circlip fits flush into the housing recess.

Fit the reverse shaft and its key. Tap the shaft fully home and ensure that the key locates properly into the recess for it in the rear face of the gearbox.

Turn the gearbox upside-down and drift in the lay-shaft from the front of the box. The cutaway on the front end of the layshaft must be lined up to allow the front cover to seat properly.

Position the first and second speed fork in the box with the lug facing forward and fit the rod through the fork. Fit the selector on the rod. Do not at this stage finally secure the fork or selector.

Fit the large interlock plunger through the centre hole in the forward end of the box so that it takes up a position between the centre and right-hand holes.

Position the third and fourth speed fork in the box with the lug facing rearward and insert the rod through the centre hole in the rear part of the box and through the fork. Fit the selector on the rod before pushing the rod fully home. Fit the small interlock plunger into the hole in the rod. Do not finally secure the fork or selector.

Fit the second large interlock plunger in the same manner as the first. In this case, however, the plunger takes up its position between third and fourth and reverse rod holes at the front of the gearbox.

Position the reverse fork in the box and insert the rod. When the rod has passed through the fork, position the selector and push the rod fully home.

Secure the selectors and forks with their taper set pins. Ensure that the serrated washers are in position and that the locknuts are tight.

Fit the blanking plug into the interlock plunger drilling.

Fit the gearbox front cover, using a new joint washer if necessary.

NOTE.—Refit the same number of shims as found on dismantling the cover so that the first motion shaft bearing is nipped in its housing.

Refit the speedometer drive gear key, and the speedometer drive gear, with its longest spigot facing forwards. Fit the spacer tube, taximeter drive gear key and the taximeter drive gear, with its spigot facing towards the rear.

Refit the gearbox rear end cover, using a new joint washer if necessary. Refit the speedometer drive (and taxi-meter drive if fitted).

Note that the speedometer pinion bush should be fitted with the flat on the flange facing downwards and at an approximate angle of 45° to the front of the vehicle on the Taxi gearbox, and in the reverse position on the Hire Car gearbox.

Push the withdrawal fork pivot shaft into the bell housing. Position the spring and withdrawal fork and secure to the shaft with the two cotter pins and nuts.

Slide the withdrawal bearing and housing out of the spigot which is formed on the gearbox front cover.

NOTE.—The withdrawal bearing housing must be packed with recommended grease before it is slid into position.

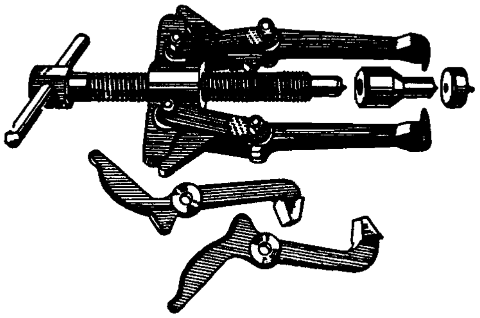
Finally, position the free ends of the withdrawal fork spring in the trunnion grooves of the housing.

Install the selector rod balls and springs. The top cover and gear change lever is fitted as an assembly after the gearbox and engine have been refitted to the chassis. Refill the gearbox with recommended oil.

SERVICE TOOLS

18G 2. Crankshaft Gear, Pulley, and Propeller Shaft Flange Remover

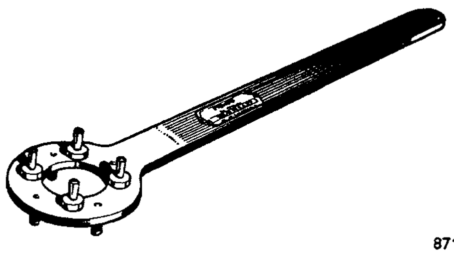
A multipurpose tool consisting of:
(1) Extractor (basic tool).
(2) Alternative pair of legs (for pulleys).
(3) Short thrust pad.
(4) Long thrust pad.



18G 2

18G 34 A. Bevel Pinion Flange Wrench

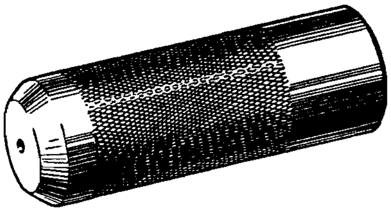
This wrench prevents the rotation of the driving flange when releasing or tightening the flange securing nut. The pegs of the holding wrench fit into the bolt holes of the flange.



18G 34 A

18G 1. Crankshaft Gear, Pulley, and Propeller Shaft Flange Replacer

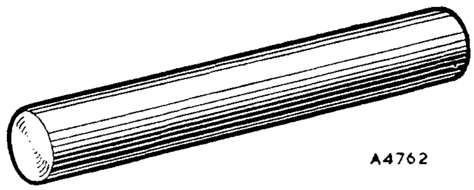
This tool can be used for driving on the driving flange if necessary.



18G 1

18G 618. Dummy Layshaft

For use as a pilot to line up the gears and retain thrust washers and needle bearings prior to inserting the layshaft proper.

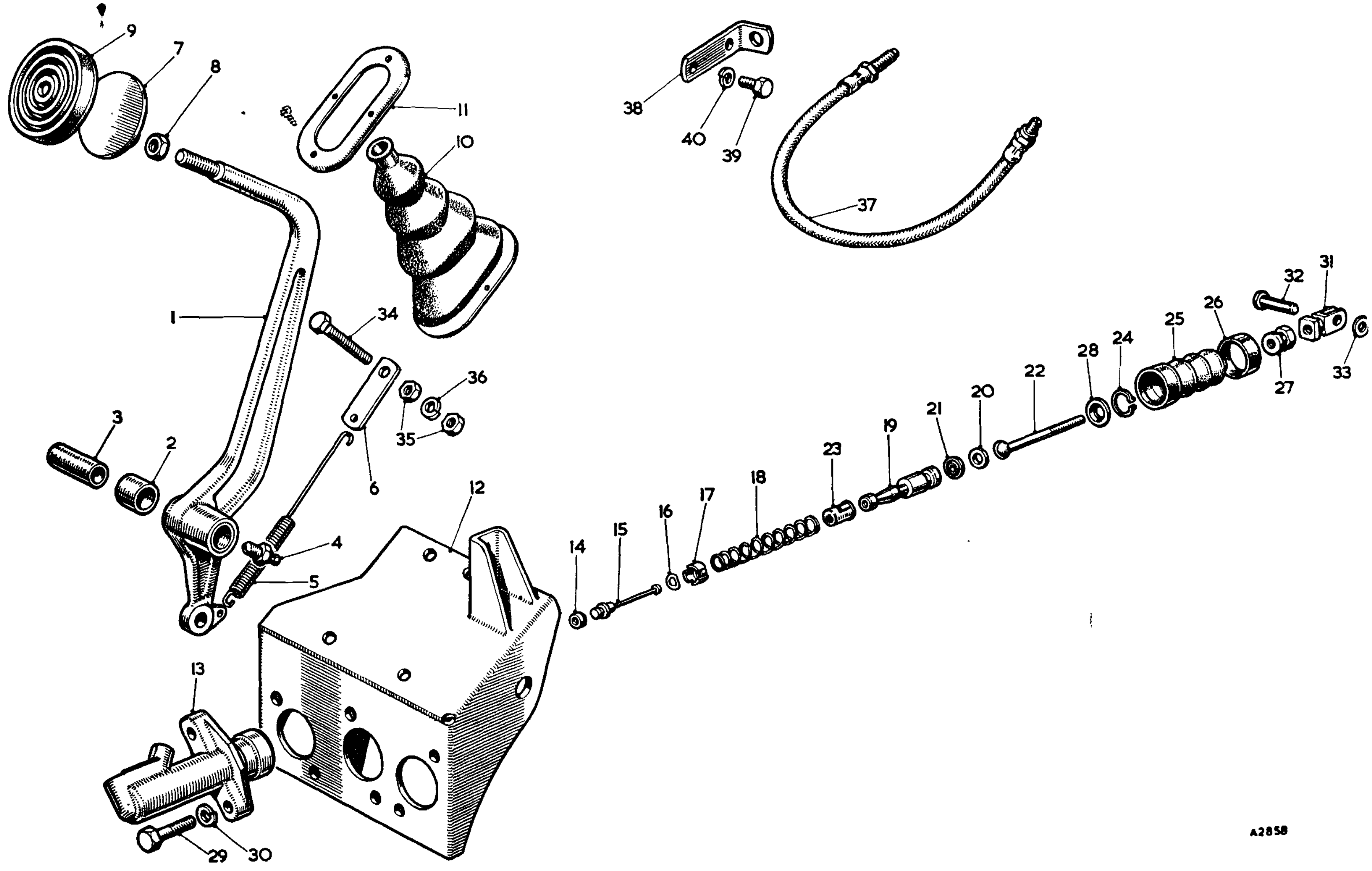


18G 618

SECTION Db

THE CLUTCH

THE CLUTCH PEDAL AND MASTER CYLINDER COMPONENTS



KEY TO THE CLUTCH PEDAL AND MASTER CYLINDER COMPONENTS

No.	*Description*	*No.*	*Description*	*No.*	*Description*
1.	Lever assembly—clutch pedal.	14.	Seal for valve.	27.	Nut—retaining—dust cover.
2.	Bush.	15.	Stem—valve.	28.	Washer—retaining.
3.	Sleeve—bearing.	16.	Washer for valve stem (spring).	29.	Screw—master cylinder to bracket.
4.	Greaser for pedal lever.	17.	Spacer—valve.	30.	Washer for screw (spring).
5.	Spring—pedal return.	18.	Spring.	31.	Fork—master cylinder to clutch pedal.
6.	Plate—return spring anchor.	19.	Piston.	32.	Pin for fork (clevis).
7.	Pad for pedal.	20.	Taper seal.	33.	Washer for pin.
8.	Nut—pad to lever.	21.	Seal for piston.	34.	Screw—pedal stop.
9.	Rubber for pedal pad.	22.	Push-rod.	35.	Nut for screw.
10.	Excluder—draught.	23.	Retainer—push-rod (retaining).	36.	Washer for screw (spring).
11.	Ring—draught excluder retaining.	24.	Circlip.	37.	Hose—clutch slave cylinder.
12.	Bracket—brake and clutch pedal support.	25.	Boot.	38.	Bracket for hose.
13.	Body.	26.	Band—boot retaining.	39.	Screw for bracket.
				40.	Washer for screw (spring).

Section Db.1

DESCRIPTION OF THE CLUTCH

The friction-type clutch used with the synchromesh gearbox is of the single-dry-plate type consisting of a driven plate assembly, a cover assembly, and a ball release bearing.

The driven plate assembly is of the flexible-centre type in which the splined hub is indirectly attached to a disc which transmits the power and over-run through a number of coil springs held in position by retaining wires. Two friction linings are riveted to the disc.

The cover assembly consists of a pressed-steel cover and a cast-iron pressure plate loaded by thrust springs. Mounted on the pressure plate are three release levers which pivot on floating pins retained by eyebolts. Adjustment nuts are screwed onto the eyebolts and secured by staking. Struts are interposed between the lugs on the pressure plate and the outer ends of the release levers. Anti-rattle springs load the release levers, and retainer springs connect the release lever plate.

The release ball bearing is pressed out of the withdrawal housing, which is located by the operating forks and the fork retaining spring.

As the clutch is hydraulically operated no adjustment is needed to the clutch pedal.

The clutch is operated from a master cylinder by means of a suspended pedal. A slave cylinder mounted on the side of the gearbox is coupled to the clutch operating shaft.

When pressure to the clutch pedal is applied the piston of the master cylinder displaces the fluid in the cylinder and, via a pipe-line, in turn moves the piston of the slave cylinder, pushing against the lever of the clutch shaft.

Section Db.2

REMOVING AND REPLACING THE MASTER CYLINDER

Attach a rubber tube to the slave cylinder bleeder screw, lower the end of the tube into a clean receptacle, release the bleeder screw one turn, and pump the clutch pedal until no further fluid enters the container.

Disconnect the pipes from the master cylinder.

Disconnect the pedal return spring, and the pivot pin from the push-rod.

Remove the two nuts and bolts securing the master cylinder to its bracket and withdraw the master cylinder from the car.

Replacement is a reversal of the removal procedure.

Refill the reservoir with **UNIPART Universal Brake Fluid** or other brake fluids having a minimum boiling-point of 260°C. (500°F.) and complying with FMV SS 116 DOT 3 or S.A.E. J1703c specification. **DO NOT use any other type of fluid.**

Bleed the system as described in Section Db.5.

Section Db.3

DISMANTLING AND REASSEMBLING THE MASTER CYLINDER

The mechanism of the clutch master cylinder is similar to that of the brake master cylinder except that the former has no check valve. See Section K for details except the operation of bleeding the system (see Section Db.5).

Section Db.4

DISMANTLING AND REASSEMBLING THE SLAVE CYLINDER

The slave cylinder is of simple construction, consisting of an alloy body, piston with seal, spring, bleed screw, and ball, the open end of the cylinder being protected by a rubber dust cover. The cylinder is mounted on the side of the gearbox and held in position by set pins.

Remove the rubber dust cap from the bleed nipple, attach a bleed tube, open the bleed screw three-quarters of a turn, and pump the clutch pedal until all the fluid has been drained into a clean container. Unscrew the pressure pipe union at the cylinder and remove the cylinder securing bolts. The slave cylinder can now be removed.

Remove the rubber cover and blow out the piston and seal. The spring can also be removed. Examine all parts, especially the seal, and renew if worn or damaged.

Place the seal into the stem of the piston, with the back of the seal against the piston, replace the springs with the small end on the stem, smear well with the recommended fluid, and insert into the cylinder. Replace the rubber dust cover and mount the cylinder in position on the side of the gearbox. Secure the cylinder with the bolts and screw in the pipe union. Connect up the linkage, and bleed the system (see Section Db.5).

Section Db.5

BLEEDING THE CLUTCH SYSTEM

Remove the bleed screw dust cap at the slave cylinder, open the bleed screw approximately three-quarters of a turn, and attach a tube, immersing the open end into a clean receptacle containing a small amount of the

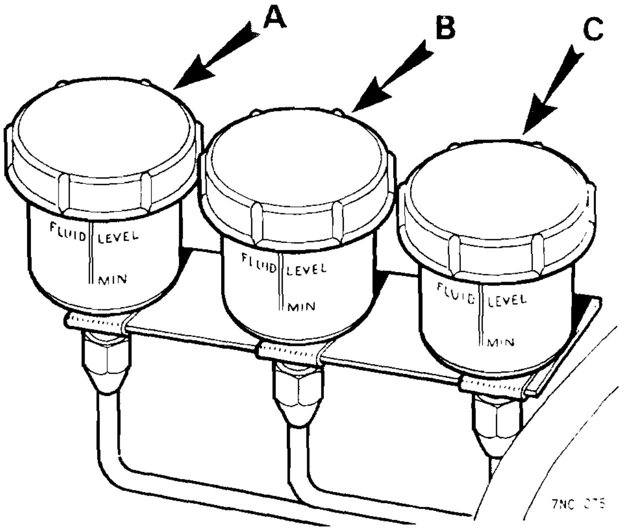
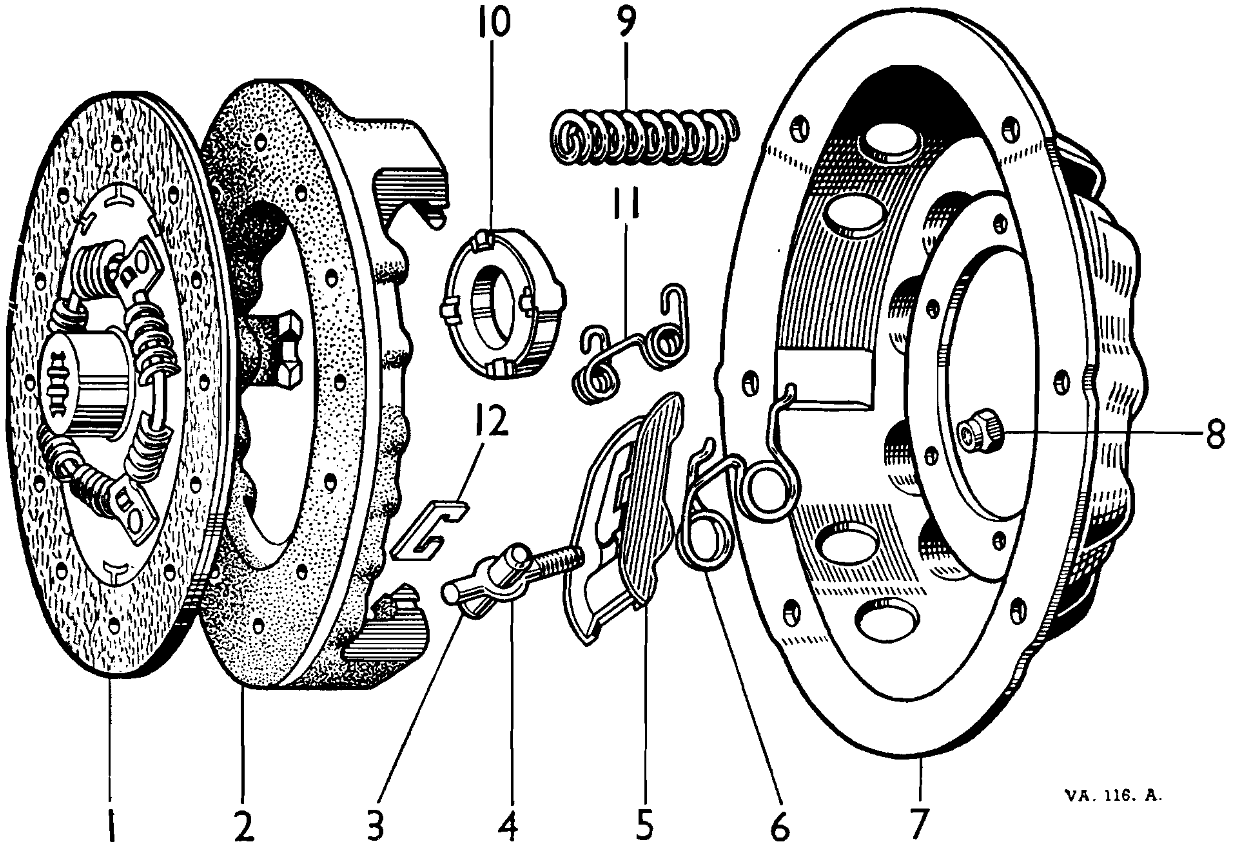


Fig. Db.1
The front brake (A), *rear brake* (B) *and clutch* (C) *fluid reservoir filler cap*

THE CLUTCH COMPONENTS



No.	Description
1.	Clutch driven plate with linings and damper springs.
2.	Pressure plate.
3.	Pin for release levers.
4.	Eyebolt for release lever.
5.	Pressure plate release levers.
6.	Anti-rattle spring for release lever.
7.	Clutch cover.
8.	Nut for eyebolt.
9.	Pressure spring.
10.	Plate for release levers.
11.	Retainer spring for release lever.
12.	Strut.

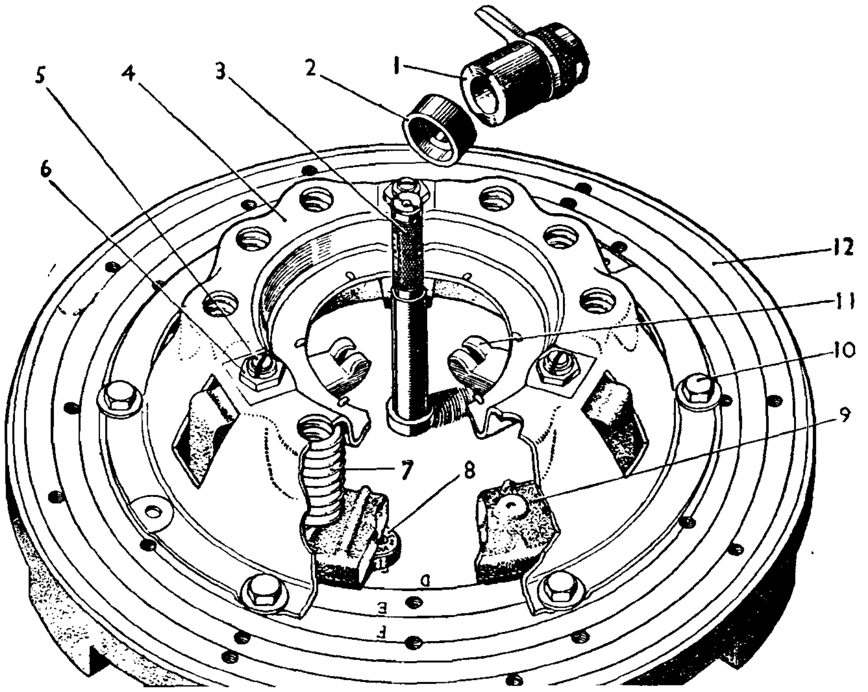


Fig. Db.2
Method of using tool 18*G* 99*A*

1. Height finger.
2. Distance piece.
3. Centre pillar.
4. Clutch cover.
5. Eyebolt.
6. Eyebolt locknut.
7. Pressure spring.
8. Spacing washer.
9. Pressure plate.
10. Set bolt.
11. Release lever.
12. Base plate.

recommended fluid. Fill the master cylinder reservoir ([A] Fig. Db.1) with **Unipart 410 or 550 Brake Fluid** or a fluid conforming to Specification S.A.E. J1703c, and by using slow, full strokes, pump the clutch pedal until the fluid entering the container is free from air bubbles. On a down stroke of the pedal screw up the bleed screw, remove the bleed tube, and replace the dust cap.

Section Db.6

REMOVING AND REPLACING THE CLUTCH

To gain access to the clutch it is first necessary to remove the gearbox from the engine.

Slacken the clutch cover securing screws a turn at a time by diagonal selection until the spring pressure is relieved. Then remove the screws completely and lift the clutch assembly away from the flywheel. Finally, remove the driven plate assembly.

NOTE.—**The release levers are correctly set on assembly. Interference with this setting, unless new parts have to be fitted, will throw the pressure plate out, causing judder.**

When refitting the clutch place the driven plate on the flywheel with the longer chamfered splined end of the driven plate hub towards the gearbox. The driven plate should be centralized by using tool 18G 554 which fits the splined bore of the driven plate hub and the pilot bearing of the flywheel.

The clutch cover assembly can now be secured to the flywheel by means of the holding screws, tightening them a turn at a time by diagonal selection. There are two dowels in the flywheel to locate in the clutch cover. Remove the clutch centralizer after these screws are fully tightened.

Section Db.7

DISMANTLING, ASSEMBLING, AND GAUGING THE CLUTCH

By using tool 18G 99 A the clutch can be quickly dismantled, reassembled, and adjusted to a high degree of accuracy.

The tool comprises the following parts: base plate, centre pillar, spacing washers, distance pieces, height finger, actuating mechanism, set screws, speed brace, and metal box. As this tool is universal, a chart indicating the particular parts to be used for particular types of clutch will be found on the inside of the lid of the box.

With a 9 in. (22·8 cm.) clutch, select three spacing washers (code 3) and place them over the code letter 'D' on the base plate.

With a 10 in. (25·4 cm.) clutch, select three spacing washers (code 3) and place them over code letter 'E' on the base plate.

Now place the clutch on the three spring washers so that the holes in the cover coincide with the tapped holes in the plate, insert the set screws provided, and tighten them, a little at a time, by diagonal selection until the cover is firmly attached to the base plate at all possible points. This is most important if the best results are to be achieved.

Mark the cover, pressure plate lugs, and release levers with a centre-punch so that the parts can be reassembled in their relative positions in order to maintain the balance of the clutch.

Detach the release lever plate from the retaining springs and remove the three eyebolt nuts or adjusting nuts.

Slowly release the pressure on the springs, unscrewing by diagonal selection the set screws securing the cover to the base plate. The cover can then be lifted to expose all components for inspection.

The release levers, eyebolts, struts, and springs should be examined for wear and distortion. Renew these parts if necessary, bearing in mind that the thrust springs must only be renewed in sets.

Clean all parts and lubricate the bearing surfaces of the levers, eyebolts, etc., sparingly with grease.

Place the pressure plate over the three spacing washers on the base plate with the thrust springs in position on the pressure plate.

Assemble the release lever, eyebolt, and pin, holding the threaded end of the eyebolt and the inner end of the lever as close together as possible. With the other hand insert the strut in the slots on the pressure plate lug sufficiently to allow the plain end of the eyebolt to be inserted into the hole in the pressure plate.

Move the strut upwards into the slot in the pressure plate lug and over the ridge on the short end of the lever and drop it into the groove formed in the latter. Fit the other two levers in a similar manner.

Place the cover over the assembled parts, ensuring that the anti-rattle springs are in position and that the tops of the thrust springs are directly under the seats in the cover. In addition, the machined portions of the pressure plate lugs must be directly under the slots in the cover through which they have to pass.

Compress the pressure springs by screwing down the cover to the base plate by using the special set screw placed through each hole in the cover. Tighten the screws, a little at a time, by diagonal selection to prevent distortion to the cover. The eyebolts and pressure plate lugs must be guided through the holes in the cover at the same time.

Screw the nuts into the eyebolts.

Screw the centre pillar into the base plate and slip the distance piece—code 7 for 9 in. (22·8 cm.) clutch and 8 for 10 in. (25·4 cm.) clutch—over the pillar, plus shims or a washer of a thickness of ·055 in. (1·40 mm.), followed by the cam-shaped height finger. Adjust the height of the release levers by screwing or unscrewing the eyebolt nuts until the height finger, when rotated, just contacts the highest point on the tip of the release levers.

Replace the height finger and pillar by the clutch actuating mechanism and actuate the clutch several times by operating the handle. This will enable the parts to settle down on their knife-edges. Replace the height finger and distance piece and readjust the height of the release levers. Finally, repeat the procedure to make quite sure the release levers are seating properly, and gauge again.

Secure the eyebolt nuts and fit the release lever plate on the tips of the release levers, then secure by means of the three retaining springs.

Release the set screws, a little at a time, by diagonal selection, and remove the clutch assembly from the base plate.

Section Db.8

REFACING THE CLUTCH DRIVEN PLATE

If a new complete clutch driven plate is not available new linings may be fitted to the old driven plate in the following manner. Each rivet should be removed by using a $\frac{5}{32}$ in. (4 mm.) diameter drill. The rivets should not be punched out.

Rivet one new facing in position, then, if the correct tool is not available, use a blunt-ended centre-punch to roll the rivet shanks securely against the plate.

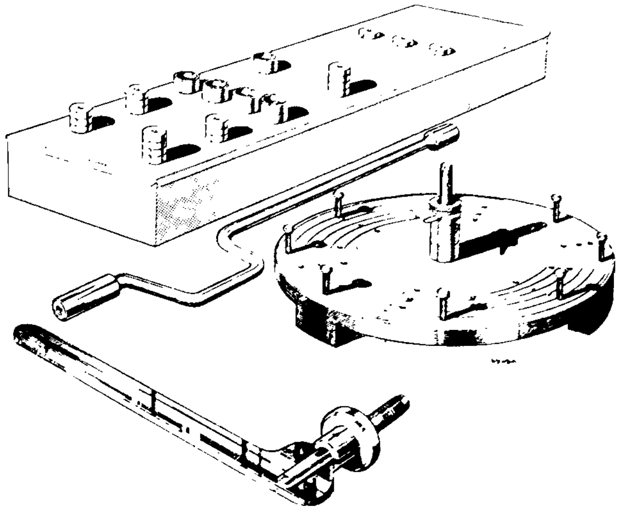
The second facing should then be riveted on the opposite side of the plate with the clearance holes over the heads already formed in fitting the first facing.

The plate should then be mounted on a mandrel between centres and checked for 'run-out' as near the edge as possible; if the error is more than ·015 in. (·38 mm.) press over the high-spots until it is true within this figure.

It is important to keep friction facings free from oil or grease.

SERVICE TOOLS

18G 99 A. Clutch Assembly Gauging Fixture

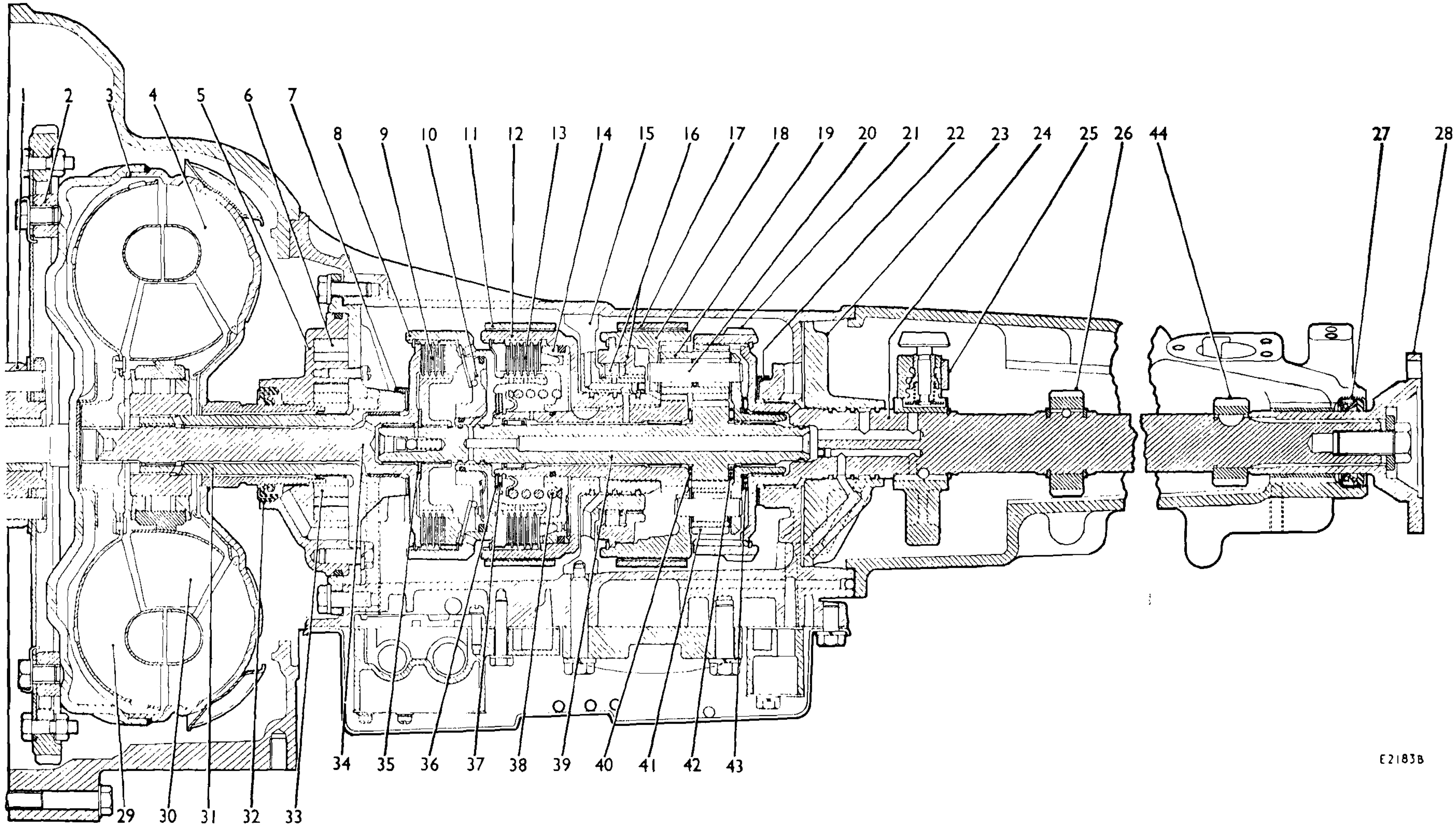


SECTION Dc

THE AUTOMATIC TRANSMISSION

(TYPE 35)

THE AUTOMATIC TRANSMISSION (LONGITUDINAL SECTION)



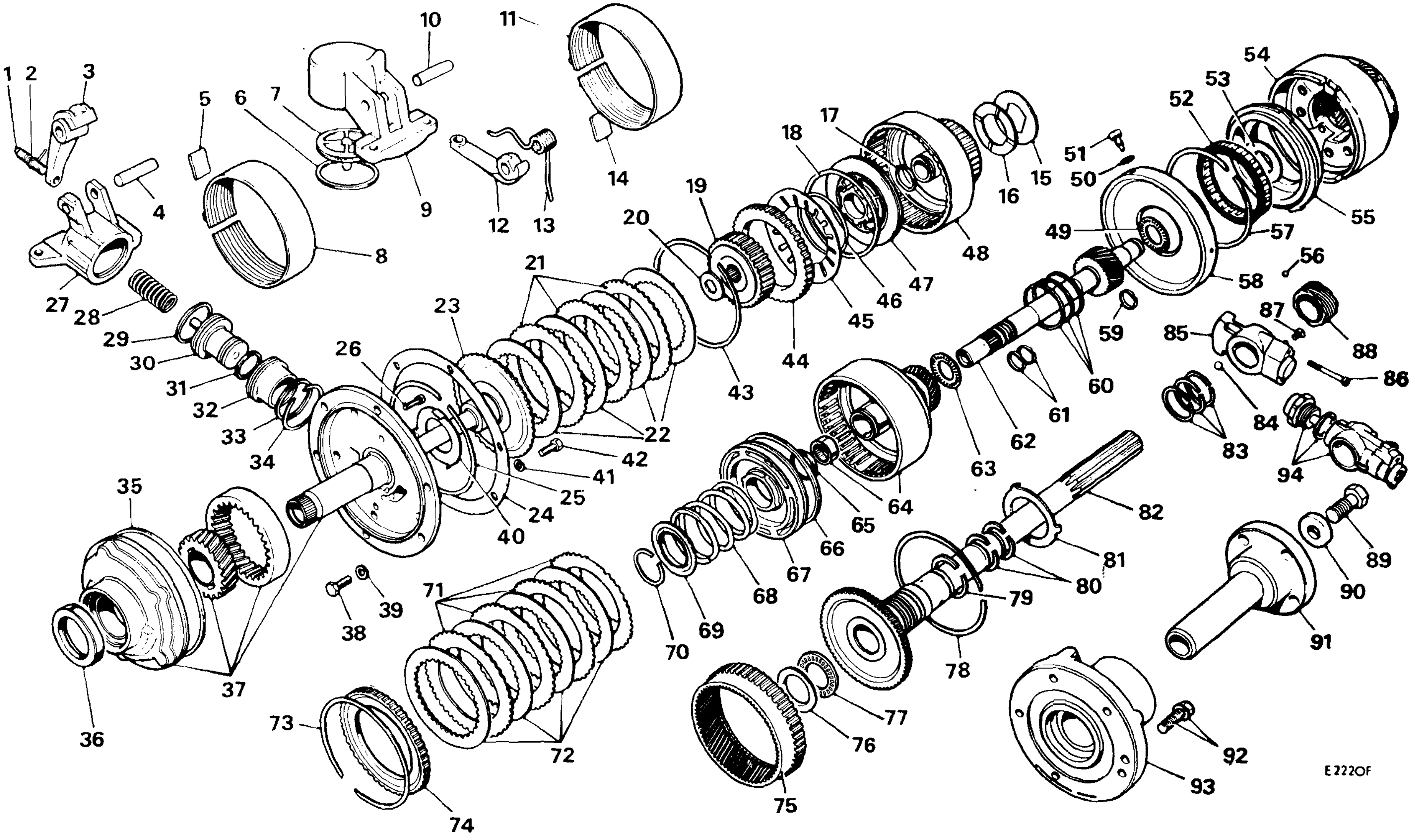
KEY TO THE AUTOMATIC TRANSMISSION (LONGITUDINAL SECTION)

No.	*Description*
1.	Engine crankshaft.
2.	Converter drive plate.
3.	Converter.
4.	Impeller.
5.	Pump housing.
6.	Pump outer member.
7.	Thrust washer.
8.	Front clutch housing.
9.	Front clutch plates.
10.	Front clutch piston.
11.	Front brake band.
12.	Front drum assembly.
13.	Rear clutch plates.
14.	Rear clutch piston.
15.	Centre support.

No.	*Description*
16.	One-way clutch.
17.	Rear brake band.
18.	Planet carrier.
19.	Planet pinion—long.
20.	Pinion shaft.
21.	Ring gear.
22.	Thrust washer.
23.	Rear plate adaptor or rear pump.
24.	Driven shaft.
25.	Governor assembly.
26.	Speedometer drive gear.
27.	Rear oil seal.
28.	Driving flange.
29.	Turbine.
30.	Stator.

No.	*Description*
31.	Converter support.
32.	Front oil seal.
33.	Pump inner member.
34.	Input shaft.
35.	Thrust washer.
36.	Thrust washer (bronze).
37.	Thrust washer (steel).
38.	Rear clutch spring.
39.	Forward sun gear.
40.	Needle thrust washer.
41.	Planet pinion—short.
42.	Needle thrust washer.
43.	Needle thrust washer.
44.	Taximeter drive gear.

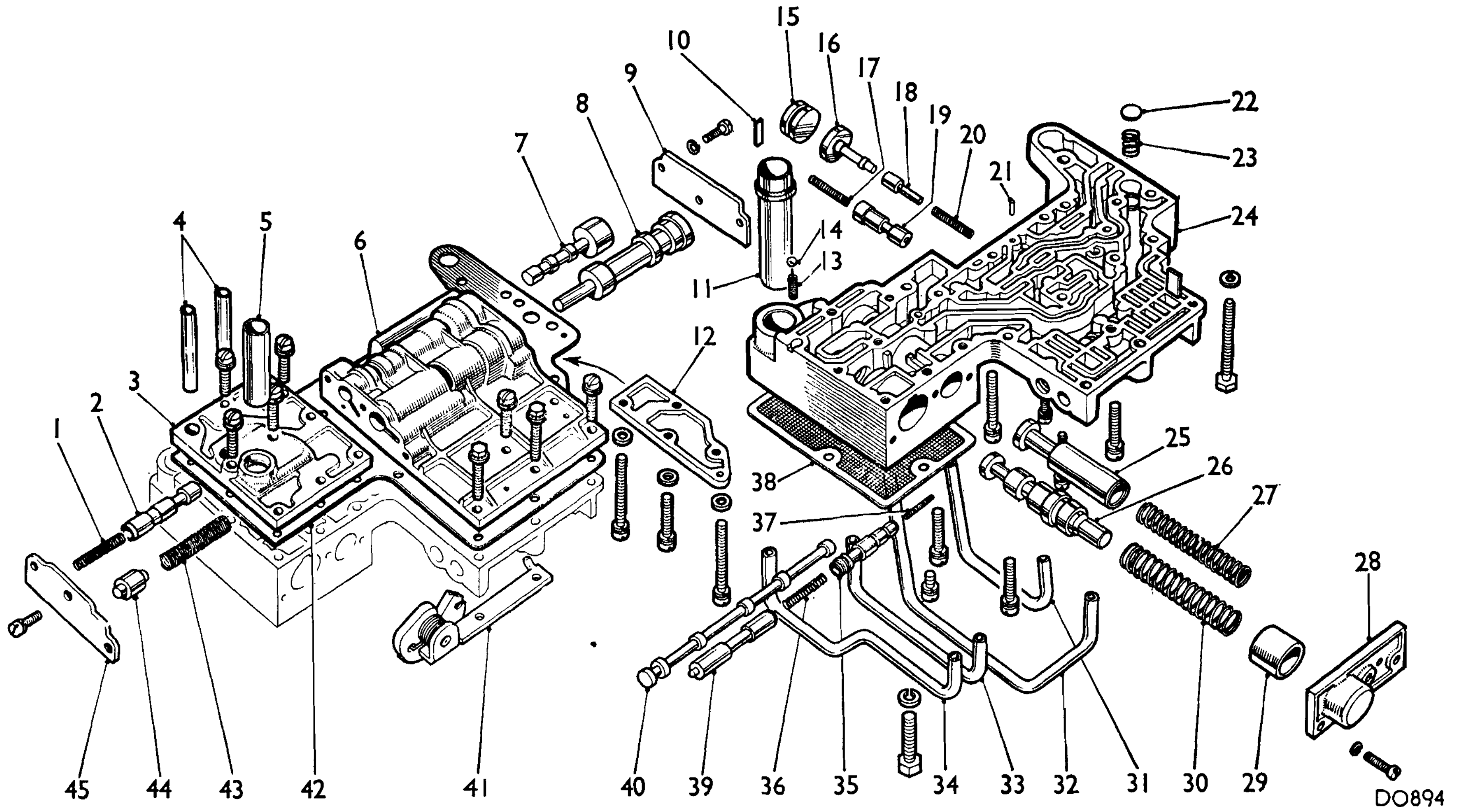
AUTOMATIC TRANSMISSION (GEARBOX INTERNAL COMPONENTS)



KEY TO AUTOMATIC TRANSMISSION (GEARBOX INTERNAL COMPONENTS)

No.	*Description*
1.	Front servo adjuster.
2.	Locknut for adjuster.
3.	Front servo lever.
4.	Pivot pin for lever.
5.	Strut for front servo.
6.	'O' ring for rear servo piston.
7.	Rear servo piston.
8.	Front brake band.
9.	Rear servo body.
10.	Pivot pin for rear servo lever.
11.	Rear brake band.
12.	Rear servo lever.
13.	Rear servo spring.
14.	Strut for rear servo.
15.	Front clutch thrust washer.
16.	Front clutch thrust washer.
17.	'O' ring.
18.	Front clutch sealing ring.
19.	Front clutch hub.
20.	Thrust washer.
21.	Front clutch plates—outer.
22.	Front clutch plates—inner.
23.	Input shaft assembly.
24.	Gasket for converter support.
25.	Circlip.
26.	Screw.
27.	Front servo body.
28.	Spring.
29.	Piston seal.
30.	Front servo piston.
31.	Piston seal.
32.	Front servo sleeve.
33.	Oil sealing ring.
34.	Circlip.
35.	'O' ring.
36.	Front oil seal.
37.	Pump assembly.
38.	Bolt for pump.
39.	Washer for bolt.
40.	Input shaft thrust washer.
41.	Washer for bolt.
42.	Bolt for pump.
43.	Front clutch snap ring.
44.	Distance piece for front clutch.
45.	Spring for front clutch.
46.	Bearing ring for spring.
47.	Piston for front clutch.
48.	Front clutch housing.
49.	Needle thrust bearing.
50.	Lock washer for bolt.
51.	Centre support bolt.
52.	One-way clutch assembly.
53.	Needle thrust bearing plate.
54.	Planet gear and rear drum assembly.
55.	One-way clutch outer race.
56.	Speedometer gear drive ball.
57.	Snap-ring.
58.	Centre support.
59.	Output shaft oil sealing ring.
60.	Sealing rings—rear clutch.
61.	Oil sealing rings—sun gear.
62.	Forward sun gear.
63.	Needle thrust bearing.
64.	Front drum assembly.
65.	Rear clutch piston seal—inner.
66.	Rear clutch piston seal—outer.
67.	Rear clutch piston.
68.	Spring for rear clutch.
69.	Seat for spring.
70.	Snap ring.
71.	Rear clutch plates—outer.
72.	Rear clutch plates—inner.
73.	Snap-ring.
74.	Pressure plate for rear clutch.
75.	Ring gear.
76.	Needle thrust bearing plate.
77.	Needle thrust bearing.
78.	Snap-ring.
79.	Oil sealing ring.
80.	Oil sealing rings.
81.	Driven shaft thrust washer.
82.	Driven shaft.
83.	Oil sealing rings.
84.	Governor drive ball.
85.	Governor assembly.
86.	Screw for governor valve.
87.	Screw for governor cover.
	(84.–87.) Removable valve type governor.
88.	Speedometer drive gear.
89.	Bolt for drive flange.
90.	Washer for bolt.
91.	Drive flange.
92.	Screw.
93.	Rear adaptor plate.
94.	One-piece governor.

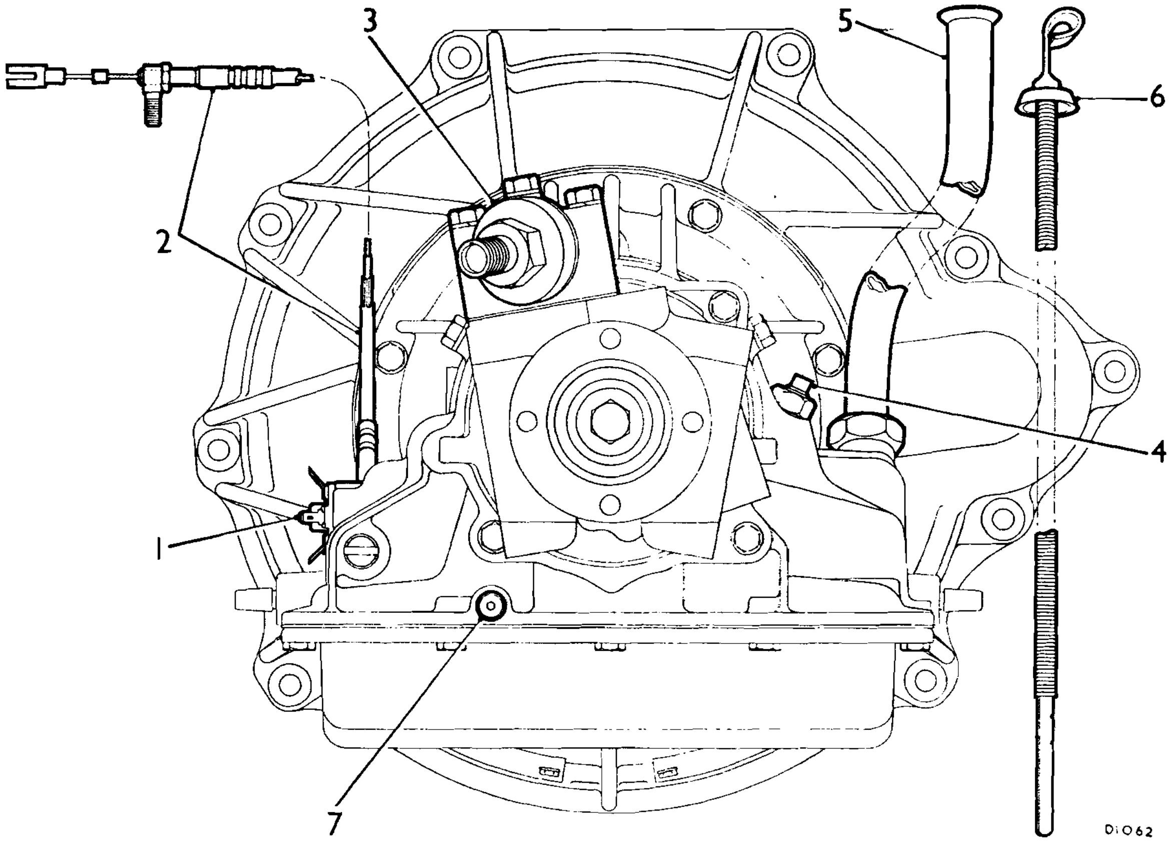
THE AUTOMATIC TRANSMISSION (VALVE BODIES COMPONENTS)



KEY TO THE AUTOMATIC TRANSMISSION VALVE BODIES COMPONENTS

No.	*Description*	*No.*	*Description*	*No.*	*Description*
1.	Spring—1–2 shift valve.	16.	Modulator valve.	31.	Rear servo tube.
2.	Plunger—1–2 shift valve.	17.	Spring—servo orifice control valve.	32.	Rear clutch tube.
3.	Oil tube collector.	18.	Modulator valve plug.	33.	Front servo apply tube.
4.	Converters oil tube.	19.	Servo orifice control valve.	34.	Front servo release tube.
5.	Pump outlet tube.	20.	Spring—modulator valve.	35.	Throttle valve.
6.	Upper valve body.	21.	Modulator valve retainer dowel.	36.	Spring—throttle valve.
7.	Valve—1–2 shift.	22.	Pump check valve.	37.	Spring—throttle valve return.
8.	Valve—2–3 shift.	23.	Spring—pump check valve.	38.	Oil strainer.
9.	Rear end plate.	24.	Lower valve body.	39.	Down-shift valve.
10.	Servo orifice control valve stop.	25.	Secondary regulator valve.	40.	Manual control valve.
11.	Pump inlet tube.	26.	Primary regulator valve.	41.	Down-shift and throttle valve cam assembly.
12.	Governor line plate.	27.	Spring—secondary regulator valve.	42.	Separating plate.
13.	Check valve spring.	28.	Lower body end plate.	43.	Spring—2–3 shift valve.
14.	Check valve ball.	29.	Primary regulator valve sleeve.	44.	Plunger—2–3 shift valve.
15.	Modulator valve retainer.	30.	Spring—primary regulator valve.	45.	Front end plate.

THE AUTOMATIC TRANSMISSION (EXTERNAL COMPONENTS)



No.	*Description*
1.	Switch—inhibitor.
2.	Throttle valve control assembly.
3.	Taximeter drive take-off assembly.
4.	Rear servo adjusting screw.
5.	Tube—fluid filler and breather.
6.	Rod—oil dipper.
7.	Line pressure check point.

Section Dc.1

DESCRIPTION

The automatic transmission incorporates a fluid torque converter coupling in place of the usual flywheel and clutch. The converter is coupled to a hydraulically operated planetary gearbox which provides three forward ratios and reverse. All forward ratios are automatically engaged in accordance with accelerator position and speed of the car.

Over-riding control with appropriate engine braking is available for the first and second gear ratios by manual selection of 'L'.

Section Dc.2

SELECTOR

Operation of the automatic transmission is controlled by a selector mounted beneath the steering-wheel. The position of the lever is indicated by a pointer and a quadrant, the quadrant being marked with the following five positions, 'L', 'D', 'N', 'R', 'P'. A stop plate is provided to prevent direct selection of 'P', 'R', or 'L' from either 'N' or 'D'; 'D' may be instantly engaged from 'N'.

Before engaging 'L', 'R', or 'P' pull the hand lever knob outwards. Before disengaging 'P' pull the hand lever knob outwards. Do not engage 'R' or 'P' while the vehicle is in motion.

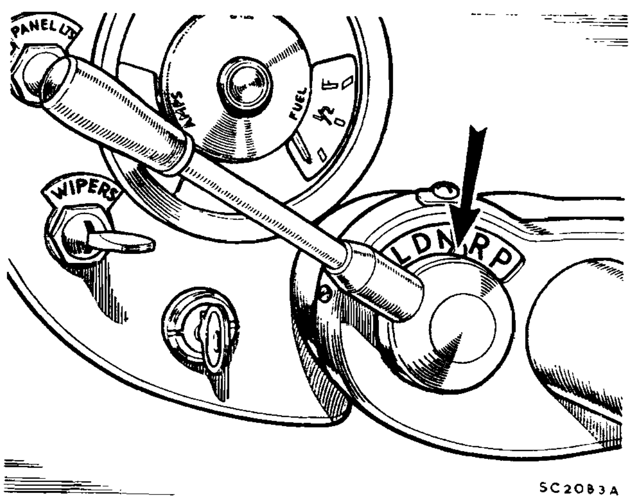


Fig. Dc.1
The selector lever and pointer

'P' (park)

In the park position no engine power is transmitted to the rear wheels. The gearbox is locked mechanically by a parking pawl engaging a gear on the driven shaft.

Use of the park position is recommended whenever the car is parked or when the engine is to be run for tuning or adjustment.

DO NOT select 'P' when the vehicle is moving.

'R' (reverse)

This position provides a reverse ratio with full engine braking. DO NOT select 'R' when the vehicle is moving forward.

'N' (neutral)

In the neutral position no engine power is transmitted to the rear wheels. The hand brake must be applied when the selector is at 'N' and the vehicle is at rest.

'D' (drive)

The position for all normal driving. This position covers a range of three ratios, all of which are engaged automatically and progressively up and down according to the vehicle speed and the position of the accelerator. Provided the vehicle speed is below a preset maximum, down-changes may be effected by fully depressing the accelerator past a detent mounted on the toeboard (kick-down).

'L' (lock-up)

Provides over-riding control for the first or second gear ratios with appropriate engine braking.

When starting from rest with the selector in 'L' the transmission starts in first gear and will remain locked in that gear irrespective of road speed and accelerator position. This gear provides maximum engine braking.

When the transmission is in the 'D' range the selection of 'L' will immediately give second gear ratio at road speeds over 5 m.p.h. (8 km.p.h.) or first gear ratio at road speeds under 5 m.p.h. (8 km.p.h.), with engine braking. First gear may also be obtained by fully depressing the accelerator (kick-down at speeds up to 12 m.p.h. (19·3 km.p.h.)).

Section Dc.3

DRIVING PROCEDURE

A starter inhibitor switch embodied in the gearbox ensures that the starter will only operate when the selector is in the 'P' or 'N' position. With 'N' selected, apply the hand or foot brake before starting the engine.

NOTE.—**Always select 'P' and apply the hand brake before attempting to start the engine when standing outside the vehicle, also when tuning or adjusting the engine.**

When the engine has been started from cold, stalling will be avoided if the idling speed is increased slightly until the engine has warmed up. The more apparent transmission engagement under these conditions is not detrimental to the car or to the transmission.

Normal driving

After starting the engine, release the accelerator, apply the foot brake, and move the selector lever to the appropriate forward or reverse position. Release the brake and depress the accelerator.

With the selector in 'D', all forward ratios up or down will be automatically and progressively engaged as the speed of the vehicle increases or decreases: thus, all ratio changes are automatically made to suit the speed of the vehicle as well as the torque demand.

Minimum accelerator pressure will result in low-speed up-changes. If the accelerator is depressed up to the detent the up-changes will occur at higher road speeds; depressing the accelerator past the detent will produce up-changes at maximum road speeds.

Irrespective of the accelerator position, starts from rest are always smooth, but the usual delicacy of accelerator control is necessary on slippery surfaces and for maximum fuel economy.

Increased acceleration

When a lower gear ratio is required for rapid overtaking or hill-climbing, kick-down changes are fully under the driver's control except that the maximum down change speeds for the 3–2, 3–1, and 2–1 gear ratios are preset to give optimum performance without overspeeding the engine. Kick-down does not operate at speeds above 26 to 30 m.p.h. (42 to 48 km.p.h.) for a 3–2 change and 12 to 15 m.p.h. (19 to 24 km.p.h.) for a 2–1 change.

Engine braking

When descending steep hills use the foot brake to reduce the road speed to below 40 m.p.h. (64 km.p.h.), when 'L' may be selected. The transmission will instantly change to second gear and thus provide appropriate engine braking. See ' "L" (lock-up)' for first gear kick-down when maximum engine braking is required.

When the descent has been made, select 'D' and proceed as for normal driving.

Hill ascent

When ascending long, steep hills, particularly in hot weather, it may be advisable to select 'L' to assist in engine cooling.

Driving on soft surfaces

When the rear wheels fail to grip a surface due to snow, mud, or sand the vehicle may be rocked backwards and forwards by alternately selecting 'R' and 'D' with a small throttle opening.

Stopping

To stop the vehicle release the accelerator and apply the brakes in the normal way.

Parking

Stop the vehicle, select 'P', and apply the hand brake as an additional precaution.

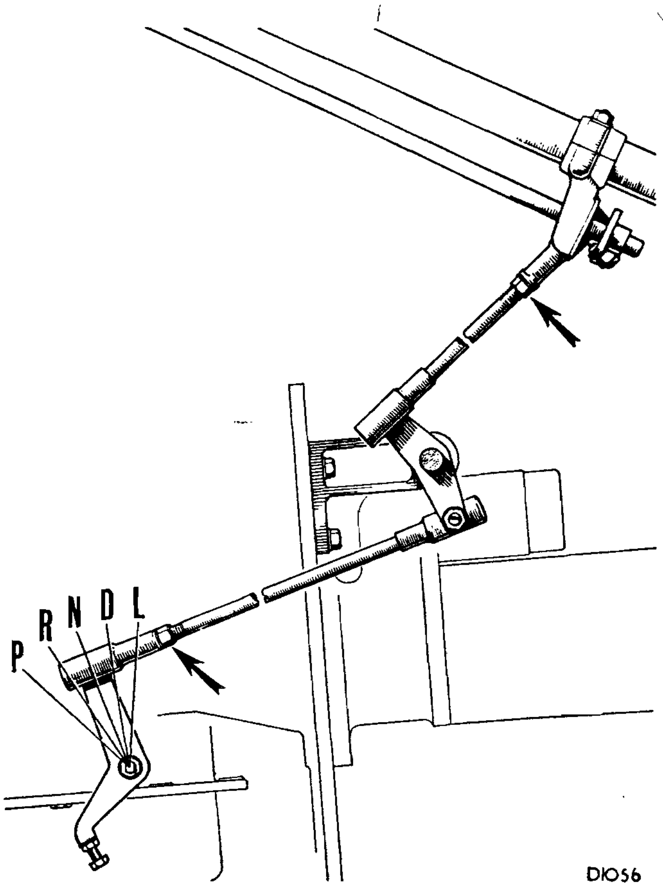


Fig. Dc.2
The selector linkage and control rod adjustment

Section Dc.4

MAINTENANCE

Checking fluid level

The markings on the dipstick are calibrated for the fluid level with the transmission at normal running

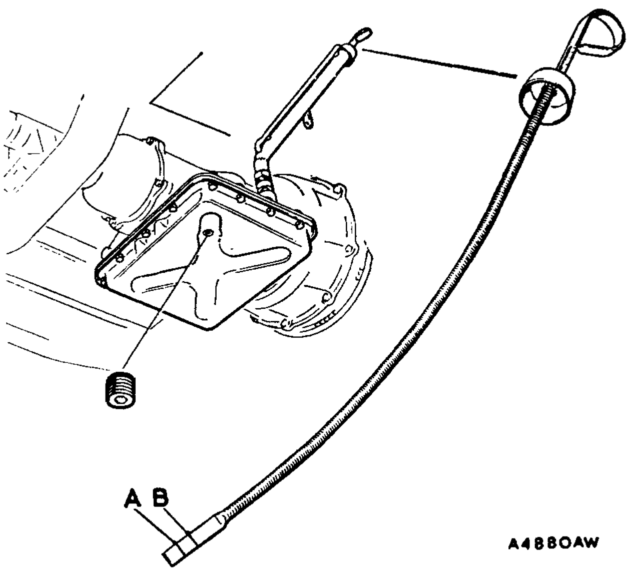


Fig. Dc.3
The drain plug and dipstick, showing
A. 'MIN' mark. B. 'MAX' mark.

temperature. If for any reason the level is checked when the transmission is cold, the correct level will be $\frac{5}{16}$ in. (8 mm.) below the 'MAX' mark.

It is essential that only Automatic Transmission Fluid is used for topping up, and scrupulous cleanliness observed. Check the fluid level as follows:

(1) Drive the car onto a level surface with the engine and transmission at normal running temperature.

(2) Select 'P' (Park), apply the hand brake and allow the engine to idle for two minutes.

(3) Switch off the engine.

(4) Withdraw the dipstick from the filler tube, wipe it clean with paper or non-fluffy cloth. Insert the dipstick fully and withdraw it immediately.

(5) If necessary, add fluid through the filler tube to bring the level to the 'HIGH' mark. The difference between the 'LOW' and 'HIGH' marks on the dipstick is 1 pint (1·2 U.S. pints; ·60 litre). **Do not overfill.**

(6) After topping up, re-check the level, operations 2 to 5.

Refilling after draining

(6) The quantity of fluid required when refilling will depend on the amount still remaining in the torque converter, which can be up to 5 pints (6 U.S. pints; 2·8 litres).

IMPORTANT.—Do not re-use fluid showing signs of contamination.

Towing for recovery

NOTE.—The car cannot be tow-started.

(7) If the transmission is operating satisfactorily the car may be towed with the selector at 'N' after ensuring that the fluid is at the correct level, for distances up to 40 miles (64 km.) at a speed not exceeding 30 m.p.h. (48 km.p.h.). If the transmission is inoperative or if there is reason to suspect a fault or damage, or the towing distance or speeds exceeds the limits given, the propeller shaft must be disconnected, or alternatively, the car towed with the rear wheels clear of the ground.

Section Dc.5

ROAD TEST PROCEDURE

In order to ascertain the precise nature of a fault it is first essential to thoroughly investigate the effect. The following test procedure must be carried out in its entirety before referring to 'FAULT DIAGNOSIS' (Section Dc.8).

Preliminary checks

(1) Check the fluid level (Section Dc.4), and top up if necessary.

(2) Check the adjustment of the down-shift and throttle cable as described in Section Dc.9.

(3) Fully depress the accelerator pedal to the kick-down position and check that the throttle lever is fully open.

Stationary tests

(4) Check the operation of the starter inhibitor switch; the starter should only operate when the selector is in 'P' or 'N'.

(5) With the engine idling and the brakes applied check that forward drive is obtained when 'D', and 'L' are selected and reverse drive is obtained when 'R' is selected.

(6) With 'P' selected check that the selector lever is trapped by the gate.

(7) Stall the transmission in 'L' and 'R' as described in Section Dc.7 and check for slip and clutch squawk.

NOTE.—Do not stall for longer than 10 seconds.

Driving tests

(8) Select 'D', release the brakes and accelerate with minimum throttle opening. Check the 1–2 and 2–3 shift speeds against the table.

NOTE. At minimum throttle openings the shifts may be difficult to detect.

(9) Stop and restart, using full-throttle acceleration, i.e. pedal at detent. Check 1–2 and 2–3 shift speeds against the table.

(10) At 35 m.p.h. (56 km.p.h.) in third gear, depress the accelerator to the full throttle position; the car should accelerate in third gear and should not down-shift to second.

(11) At 45 m.p.h. (72 km.p.h.) in third gear, depress the accelerator through the kick-down position; the transmission should down-shift to second gear.

(12) At 15 m.p.h. (24 km.p.h.) in third gear, depress the accelerator to the kick-down position; the transmission should down-shift to first gear.

(13) Stop and restart using forced throttle or kick-down acceleration. Check 1–2 and 2–3 shift speeds against the table.

(14) At 40 m.p.h. (64 km.p.h.) in third gear, release the accelerator and select 'L'. Check for 3–2 down-shift and engine braking, also the 2–1 roll-out down-shift and engine braking.

(15) Stop, and with 'L' selected use full throttle to accelerate to 45 m.p.h. (72 km.p.h.). Check for 1–2 shift speed clutch slip and squawk.

(16) At 25 m.p.h. (40 km.p.h.) in 'L', release the accelerator. Check the 2–1 down-shift speed and for full engine braking.

(17) Stop, and with 'L' selected use full throttle to accelerate up to 35 m.p.h. (56 km.p.h.). Check for no up-shift, clutch slip and squawk.

(18) Stop, select 'R', reverse using full throttle if possible. Check for no slip or clutch squawk.

(19) Stop facing downhill on a gradient and select 'P', release the brakes and check that the parking pawl holds the car; re-apply the brakes before disengaging the parking pawl. Repeat the test with the car facing uphill; check that in both cases the selector is trapped by the gate in the 'P' position.

(20) Re-check the fluid level.

(21) Check for transmission leaks.

Section Dc.6

CONVERTER FAULT DIAGNOSIS

Torque converter faults can only be correctly determined when road test findings, transmission performance, engine condition, and stall test results have all been considered.

Slipping stator (stator free-wheel slipping)

(1) Inability to pull away on steep gradients.

(2) Poor acceleration from rest.

(3) Stall test reading LOW.

Seized stator (stator free-wheel seized—unusual fault)

(1) Reduced maximum speed in all gears, pronounced in top ratio.

(2) Severe overheating of converter and transmission.

(3) Stall test reading NORMAL.

Transmission slip (selected gear components slipping)

(1) If the fault is apparent in both 'L' and 'R' it is usually due to low pressure.

(2) If the fault is present in only one position a faulty component is the most likely cause.

(3) Stall test reading HIGH.

Section Dc.7

STALL TEST

Stall speed is the maximum speed attainable at forced throttle (kick-down) with the converter turbine held stationary.

IMPORTANT.—Duration of stall must not exceed 10 seconds.

(1) Apply the hand brake and chock the wheels.

(2) Run the engine until the normal operating temperature of the transmission is reached.

(3) Select 'P' and check the transmission fluid level—Section Dc.4.

(4) Apply the foot brake, select 'L' or 'R' (as required for test elimination), depress the accelerator pedal to the kick-down position for not more than 10 seconds and note the highest r.p.m. reading on the instrument.

(5) Check the reading obtained against the following chart, and refer to Section Dc.8 for '**FAULT DIAGNOSIS**'.

R.P.M.	*Condition indicated*
Under 1,250	Slipping stator
1,150 to 1,340	NORMAL
Over 1,340	Transmission slip

	Up-shifts				*Down-shifts*					
	1–2		2–3		3–2		3–1		2–1	
Condition	*m.p.h.*	*km.p.h.*	*m.p.h.*	*km.p.h.*	*m.p.h.*	*km.p.h.*	*m.p.h.*	*km.p.h.*	*m.p.h.*	*km.p.h.*
'D' selected										
Minimum throttle	7–10	11·3–16·1	11–14	17·7–22·5	—	—	—	—	—	—
Full throttle	12–15	19·3–24·1	31–35	49·9–56·3	—	—	—	—	—	—
Forced throttle (kick-down)	18–22	28·9–35·4	35–40	56·3–64·4	26–30	41·8–48·3	12–15	19·3–24·1	—	—
'L' selected										
No throttle	—	—	—	—	Above 5	8	Below 5	8	—	—
Forced throttle (kick-down	—	—	—	—	—	—	—	—	Below 9–10	14·5–16
'D' to 'L' No throttle and full throttle	Above 9 m.p.h. (14·5 km.p.h.) '2nd ratio' engaged. Below 9 m.p.h. (14·5 km.p.h.) '1st ratio' engaged.									

NOTES.—1. Speeds quoted are true m.p.h. and may not necessarily agree with speedometer readings.

2. On selecting 'L' from 'D' the maximum safe road speed to prevent over-acceleration of the engine is 35 m.p.h. (56 km.p.h.).

3. Converter stall speed 1,250 r.p.m.

4. Rear axle ratio 4·8 : 1 (5·75—16 tyres).

Section Dc.8

FAULT DIAGNOSIS

Test number	*Fault*	*Check/rectify*
(4)	Starter will not operate in 'P' or 'N'	19
	Starter operates in all selector positions	20
(5)	Excessive bump on engagement of 'D', 'L', or 'R'	4, 3
(7)	Stall speed high:	
	with slip and squawk in 'L'	2, 3, 5, 6, 7, 11, 17
	with slip and squawk in 'R'	2, 3, 12, 17
	Stall speed up to 600 r.p.m. low	23
	Stall speed more than 600 r.p.m. low	21
(8) (9) (13)	No drive in 'D'	1, 2, 3, 16
	No drive in 'D', or 'L'	1, 2, 3, 13, 11, 16
	No drive in 'D', 'L', or 'R'	1, 2, 3, 13, 11, 16, 17
	Delayed or no 1–2 shift	3, 14, 13, 5, 6
	Slip on 1–2 shift	2, 3, 5, 6, 7, 13
	Delayed or no 2–3 shift	3, 14, 13, 5, 6, 12
	Delayed or no 2–3 shift but normal in 'R'	3, 14, 13, 5, 6
	Slip or engine run-up on 2–3 shift	2, 3, 5, 13, 12
	Bumpy gear shift	3
	Drag in 'D'	8
	Drag or binding on 2–3 shift	5, 6
(9) (13)	Slip, squawk or judder on full-throttle take-off in 'D'	1, 2, 3, 13, 11
	Loss of performance and overheating in 'D'	21
(11)	Transmission down-shifts too easily	3
(11) (12)	Transmission will not down-shift	3, 13, 14
(14)	No 3–2 down-shift or engine braking	1, 5, 6, 7, 12
	No 2–1 down-shift or engine braking	8, 9, 10
(15)	Slip, squawk or judder on take-off in 'L'	1, 2, 3, 13, 11
	Transmission up-shifts to top ratio	3
(16)	No 2–1 down-shift or engine braking	8, 9, 10
(17)	Slip, squawk or judder on take-off in 'L'	1, 2, 3, 13, 11
	Transmission up-shifts	1
(18)	Slip, squawk or judder on take-off in 'R'	1, 2, 3, 13, 12
	Slip but no judder on take-off in 'R'	
	when engine braking is available in 'L'	1, 2, 3
	when no engine braking in 'L'	1, 2, 3, 8, 9, 10
	Drag in 'R'	5
	No drive in 'R'	
	when engine braking is available in 'L'	1, 2, 3, 13, 12
	when no engine braking in 'L'	1, 2, 3, 8, 13, 9, 10, 12
(19)	No 'P'	1, 15
General	Screech or whine, increasing with engine speed	17
	Grinding or grating noise from gearbox	18
	Knocking noise from torque converter	22
	At high speeds, transmission down-shift to '2nd ratio' and back	12

OPERATIONS KEY TO ACTION

1. Check manual linkage adjustment.
2. Check fluid level.
3. Check adjustment of down-shift and throttle valve cable, using line pressure gauge and tachometer.
4. Reduce engine idle speed.
5. Check adjustment of front band.
6. Check front servo seals and fit of tubes.
7. Check front band for wear.
8. Check adjustment of rear band.
9. Check rear servo seal and fit of tubes.
10. Check rear band for wear.
11. Examine front clutch and seals, also forward sun gear shaft sealing rings. Verify that cup plug in driven shaft is not leaking or dislodged
12. Examine rear clutch, check valve, and seals. Check fit of tubes.
13. Strip and clean valve bodies.
14. Strip and clean governor valve.
15. Examine parking pawl, gear, and internal linkage.
16. Examine one-way clutch.
17. Strip and examine pump and drive tangs.
18. Strip and examine gear train.
19. Adjust starter inhibitor switch inwards.
20. Adjust starter inhibitor switch outwards.
21. Replace torque converter.
22. Examine torque converter drive plate for cracks or fracture.
23. Check engine performance.

Section Dc.9

PRESSURE TEST—DOWN-SHIFT VALVE CABLE

The following test is essential to determine the correct adjustment of the down-shift and throttle cable.

The effects of cable maladjustment are given in Section Dc.8, '**FAULT DIAGNOSIS**'.

(1) Check that the crimped stop on the down-shift valve inner cable just contacts the abutment on the outer cable.

(2) Remove the line pressure take-off blanking plug and fit adaptor 18G 677 B.

(3) Connect a line pressure gauge to the transmission, and a tachometer to the engine, and position these instruments to be easily read from the driving seat.

(4) Apply the hand brake and chock the wheels.

(5) Select 'N' and run the engine until normal operating temperature is reached.

(6) With the engine running at correct idle speed check that a line pressure of 55 to 65 lb./sq. in. is registered on the instrument.

(7) Apply the foot brake, select 'D', increase the engine speed to 1,000 r.p.m. when a pressure reading of 90 to 100 lb./sq. in. should be registered.

(8) If the pressure reading is less than the figure given, reset the cable adjuster so that the effective length of the outer cable is increased. If the reading is higher, readjust to decrease the effective length of the outer cable.

Section Dc.10

ADJUSTMENTS

Under normal operating conditions no periodic adjustments are required.

Starter inhibitor and reverse light switch

IMPORTANT.—Apply the brakes and chock the wheels before checking and adjusting the switch. The car may move off if the starter is operated with the selector in one of the drive positions.

Checking

(1) Verify that the switch is at fault by disconnecting and shorting the leads of each circuit ('1' and '3' terminals are for the starter, '2' and '4' for the reverse lights). Check that each circuit functions regardless of the selector position.

Adjusting

(2) Loosen the switch locknut, using tool 18G 679.

(3) Connect a test bulb and battery across the starter terminals and another across the reverse light terminals.

(4) Select 'D' or 'L'.

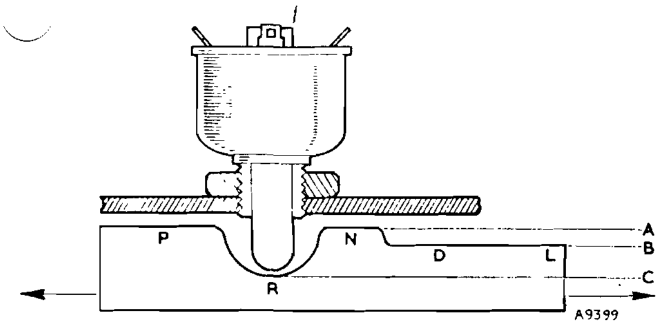


Fig. Dc.4

Starter inhibitor and reverse light switch

A. Starter operative. B. Starter inoperative.
C. Starter inoperative, reverse light on.

(5) Fully unscrew the switch from the casing, then screw it in until the reverse light contacts open. Mark the position of the switch relative to the casing.

(6) Screw the switch in until the starter inhibitor makes contact and mark the switch position.

(7) Unscrew the switch to the midway point between the two markings.

(8) Tighten the switch locknut and re-connect the wiring.

(9) Check that the switch functions correctly; if the starter operates in any position other than 'P' or 'N', renew the switch.

Down-shift and throttle valve cable

(10) Carry out the instructions given in Section Dc.9, (1) to (8).

anual selector linkage

(11) Carry out the instructions given in Section Dc.2.

Front brake band

(12) Drain the gearbox, noting that a quantity of fluid will remain in the converter.

(13) Remove the screws securing the gearbox oil pan and remove the pan.

(14) Slacken the front servo adjusting screw locknut, move the servo lever outwards and place a spacer of ·250 in. (6·35 mm.) thickness between the adjusting screw and the servo piston pin.

(15) Using tool 18G 678 with torque screwdriver 18G 681, tighten the adjusting screw to a torque of 10 lb. in. (·115 kg. m.).

(16) Tighten the adjusting screw locknut to the torque figure given in **'GENERAL DATA'.**

(17) Refit the oil pan and fill the gearbox with fluid to the correct level.

Rear brake band

(18) Slacken the locknut on the external adjusting screw

(19) Using a torque wrench tighten the adjusting screw to a torque of 10 lb. ft. (1·4 kg. m.) then back off the screw one complete turn.

(20) Tighten the locknut to the torque figure given in **'GENERAL DATA'.**

Section Dc.11

AIR PRESSURE TEST

Air pressure may be used to check that the clutch and brake bands are operating. These checks can be made with the gearbox installed in the car or on the bench.

(1) Drain the transmission, noting that a quantity of fluid will remain in the torque converter.

(2) Remove the valve bodies assembly—Section Dc.15, (1) to (6).

Front clutch and governor feed

(3) Apply air pressure into passage (1) of the casing, noting a thump, indicating that the clutch is functioning; maintain air pressure for several seconds to check for leaks. If the transmission has been removed:

(*a*) Verify the clutch operation by turning the input shaft while applying the air pressure.

(*b*) Remove the extension housing, rotate the output shaft so that governor weight is at the bottom of the assembly, and check that the weight moves inwards when air pressure is applied.

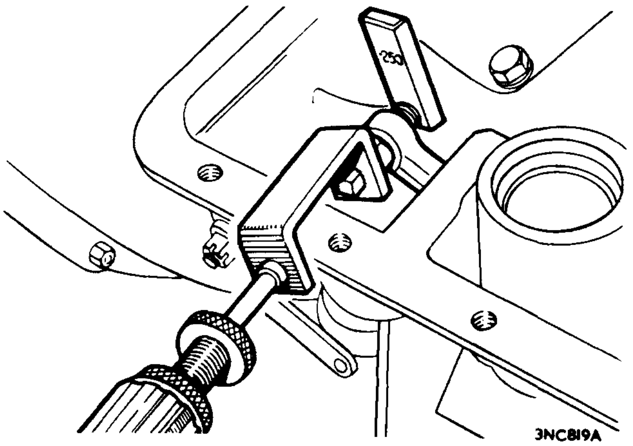


Fig. Dc.5

Adjusting the front brake band using tool 18*G* 678 *and* 18*G* 681

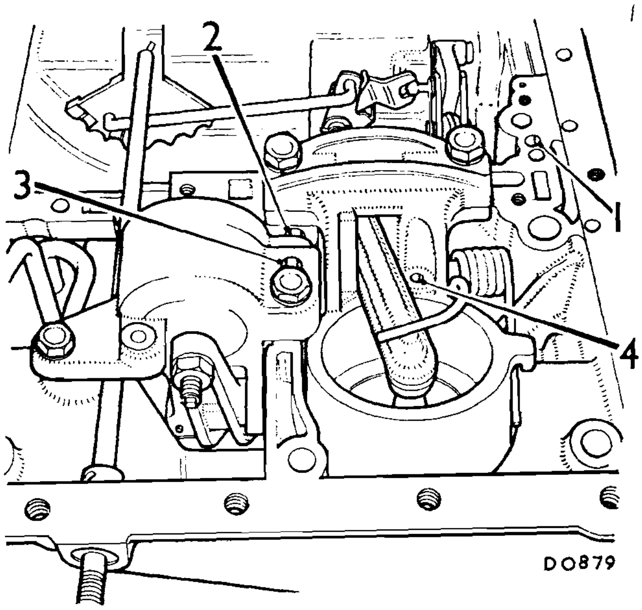


Fig. Dc.6

Air pressure check feed locations

1. Front clutch and governor.
2. Rear clutch.
3. Front servo.
4. Rear servo.

Rear servo

(4) Apply air pressure into passage (2) in the casing web and check for thump, indicating that the clutch has applied. If the transmission has been removed turn the input shaft to verify clutch operation. Maintain air pressure for several seconds to check for leaks.

Front servo

(5) Apply air pressure to the tube location (3) and observe the movement of the piston pin.

Rear servo

(6) Apply air pressure to the tube location (4) and observe the movement of the servo lever.

Conclusions

(7) If the clutch and bands operate satisfactorily with air pressure, faulty operation of the transmission indicates malfunction of the hydraulic control system which will necessitate removing and overhauling the valve bodies assembly.

Section Dc.12

TRANSMISSION ASSEMBLY AND CONVERTER

NOTE.—The normal operating temperature of the fluid is between 100 and 115° C. (212 and 239° F.) approximately. To avoid the possibility of scalding, extreme caution must be exercised when draining a transmission which has recently been operating. For capacity refer to vehicle 'GENERAL DATA'.

Removing

(1) Disconnect the battery.
(2) Disconnect the kick-down cable from its lever on the injection pump, and detach the cable abutment from its bracket on the pump.
(3) Raise the vehicle.
(4) Jack up one rear wheel, remove the propeller shaft, then lower the wheel.
(5) Detach the speedometer cable and taximeter cable (if fitted) from the transmission.
(6) Detach the electrical cables from the inhibitor switch.
(7) Remove the retaining nut and detach the manual lever from the transmission cross-shaft.
(8) Detach the exhaust pipe from the engine manifold, and disconnect the suppport clip from the converter housing.
(9) Drain the transmission fluid.
(10) Remove the rebound rubber support cross-member from the chassis.
(11) Support the engine forward of the converter housing.
(12) Remove the bolt securing the oil filler tube support bracket to the engine back plate.
(13) Unscrew the gland nut securing the oil filler tube to the union in the transmission case, and detach the oil filler tube.
(14) Release the gearbox mountings from the chassis.
(15) Lower the power unit and detach the mountings from the gearbox.
(16) Remove the bolts retaining the starter motor to the engine back plate.
(17) Support the transmission assembly with a transmission jack.
(18) Remove the bolts securing the converter housing to the engine back plate, noting the position of the two dowel bolts.
(19) Withdraw the transmission assembly.
(20) Remove the rubber plug in the engine back plate to give access to the converter retaining bolts.

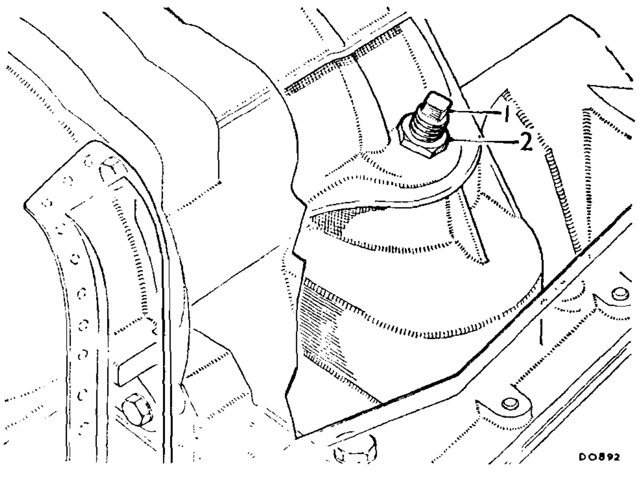


Fig. Dc.7

The rear band adjuster (1) *and locknut* (2)

(21) Unlock and remove the four bolts retaining the converter to the drive plate, rotating the crankshaft to bring each bolt in line with the access hole in turn.
(22) Detach the converter assembly.

Refitting
(23) Reverse the procedure in (1) to (22) noting that the front pump driving tangs in the converter must line up with the slots of the gear in the transmission assembly before refitting the transmission assembly.

Section Dc.13

TRANSMISSION ASSEMBLY

Removing
(1) Follow the instructions (1) to (15) in Section Dc.12.
(2) Support the transmission assembly with a transmission jack.
(3) Remove the bolts retaining the transmission assembly to the converter housing.
(4) Withdraw the transmission assembly.

Refitting
(5) Reverse the procedure in (1) to (4) noting that the driving slots in the front pump gear must line up with the driving tangs in the converter before refitting the assembly.

Section Dc.14

TAXIMETER DRIVE, SPEEDOMETER DRIVE AND GOVERNOR ASSEMBLY

Removing
(1) From inside the cab remove the access panel on the rear left-hand side of the gearbox tunnel.
(2) Remove the screw retaining the taximeter drive cable locking bracket and detach the bracket.
(3) Disconnect the taximeter drive cable and the speedometer drive cable.
(4) Remove the propeller shaft.
(5) Remove the rebound rubber support cross-member.
(6) Support the power unit and remove the bolts retaining the gearbox mountings to the chassis.

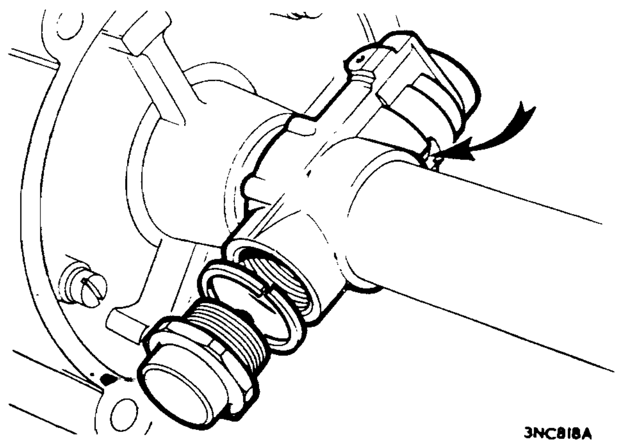


Fig. Dc.8
The one-piece governor

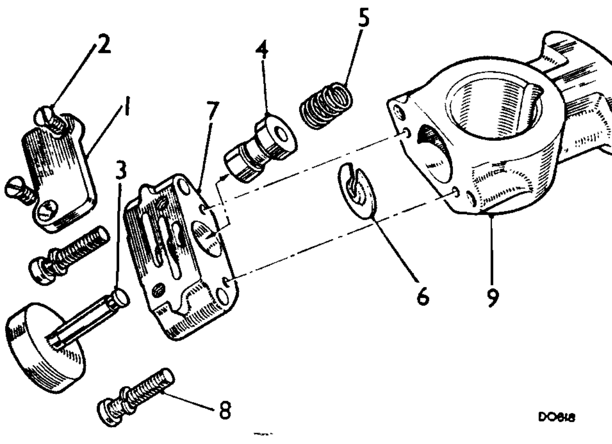


Fig. Dc.9
The governor components (removable valve type)

1. Cover-plate.
2. Screws for cover-plate.
3. Valve.
4. Valve weight.
5. Valve spring.
6. Valve retainer.
7. Valve body.
8. Screws for valve body.
9. Counter-weight.

(7) Lower the power unit and detach the mountings from the gearbox.
(8) Remove the three screws retaining the taximeter drive housing to the gearbox rear extension and detach the drive assembly.
(9) Remove the speedometer drive housing assembly from the rear extension.
(10) Use tool 18G 34 A and remove the propeller shaft drive flange from the rear of the gearbox.
(11) Remove the screws retaining the gearbox rear extension to the transmission casing and detach the rear extension.
(12) Withdraw the taximeter drive gear, and remove the drive key from the shaft.

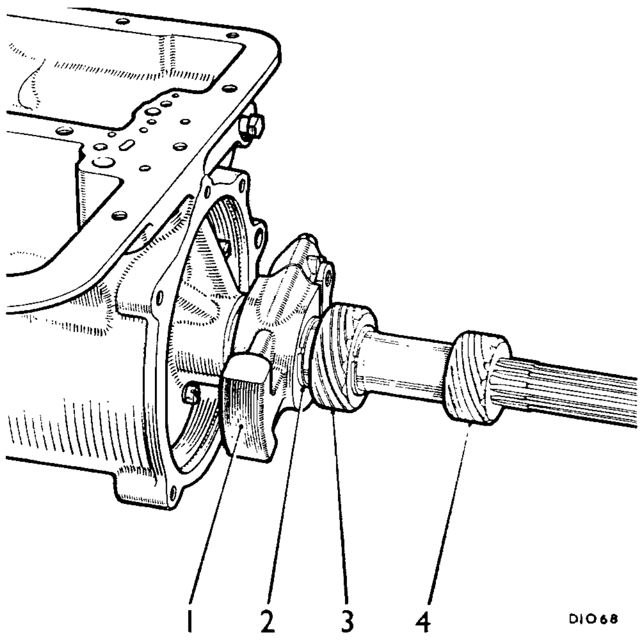


Fig. Dc.10
Governor, taximeter, and speedometer drive gear

1. Governor assembly.
2. Circlip—governor (if fitted).
3. Speedometer drive gear.
4. Taximeter drive gear.

(13) Use tool 18G 1004 and points 18G 1004 J to remove the front speedometer drive gear retaining circlip.
(14) Remove the drive gear and its driving ball.
(15) Use tool 18G 1004 with points 18G 1004 J to remove the rear speedometer drive gear circlip and the governor assembly retaining circlip (if fitted).
(16) Withdraw the governor assembly and its driving ball (removable valve type).
Remove the securing screw and lock washer retaining the one-piece governor (Fig. Dc.8) and detach the governor.

Dismantling

NOTE. Later one-piece governor assemblies cannot be dismantled and must be renewed as an assembly.

(17) Unscrew the cover-plate retaining screws and remove the plate.
(18) Unscrew the two screws securing the valve body assembly to the counter-weight and remove the counter-weight. Check that the oilways of both components line up with each other.
(19) Remove the governor weight retainer and withdraw the weight, valve, and spring.

Inspection

(20) Check the valve, weight and body bore for scores; renew scored components if the scores cannot be removed by polishing.
(21) Clean out the oilways and passages.

Reassembling

(22) Reverse the dismantling procedure in (17) to (19), ensuring that the valve and governor weight move freely.

Refitting

(23) Reverse the removing procedure in (1) to (16), noting that the governor is fitted to the output shaft with the cover plate of the removable valve type governor, or the oilway indicated in Fig. Dc.8 of the one-piece governor, facing away from the gearbox.
Refit the securing screw and lock washer of the one-piece governor, ensuring that its ball end registers in the hole in the shaft, and tighten the screw to its correct torque tightness (see **'GENERAL DATA'**). **DO NOT OVERTIGHTEN.**

Section Dc.15

VALVE BODIES ASSEMBLY

Removing

(1) Drain the gearbox, unscrew the oil pan retaining screws and remove the pan.
(2) Remove the magnet from the rear servo securing bolt.
(3) Remove the rear servo, rear clutch, front servo apply and release tubes, by carefully levering them from their push-fit connections.
(4) Detach the down-shift cable from the valve cam.
(5) Remove the three valve bodies assembly retaining bolts.
(6) Lift the valve bodies assembly, disengaging the manual control valve from the rod. Note that the pump tubes and the converter tubes may come away with the valve bodies assembly as it is removed, the tubes can be easily withdrawn from their connections.

Dismantling

(7) Remove the four screws retaining the pump oil strainer and remove strainer.
(8) Remove the two long and six short screws retaining the oil tube plate and remove the plate.
(9) Unscrew the two screws securing the cam assembly to the valve bodies and remove the cam assembly.
(10) Remove the two short screws, from the upper side of the valve bodies assembly.
(11) Remove the six screws (five short, one long), from the under-side of the valve bodies assembly.
(12) Remove the upper valve body from the separator plate and lower body.
(13) Unscrew the three screws securing the front end cover and remove the cover.
(14) Unscrew the three screws securing the rear end cover and remove the cover.
(15) Withdraw the 2–3 shift valve, valve spring, and plunger from the rear end orifice.
(16) Withdraw the 1–2 shift valve from the rear end orifice.
(17) Remove the 1–2 shift valve spring and valve plunger from the front end orifice.
(18) Unscrew the four screws securing the governor line plate, remove the plate, taking care to hold the separating plate against the lower valve body to prevent the valve springs coming free and being misplaced.
(19) Carefully remove the separating plate from the lower valve body assembly.
(20) Remove the pump check valve (disc) and spring, the converter check valve (ball) and spring, the manual control valve, and the down-shift valve and spring.
(21) Withdraw the throttle valve stop plate and remove the throttle valve, spring and valve spring retainer.
(22) Unscrew the three lower valve body end plate retaining screws and remove the end plate.
(23) Remove the primary regulating valve spring, valve sleeve and valve.
(24) Remove the secondary regulating valve spring and valve.
(25) Remove the servo orifice control valve stop, valve spring and valve.
(26) Remove the dowel retaining the modulator valve retainer, withdraw the retainer, modulator valve, valve plug and spring.

Inspection

(27) Clean all parts in cleaning solvent and dry with compressed air.
(28) Check all fluid passages for obstruction.
(29) Inspect the valve, bores, and mating surfaces for burrs and scores.
(30) Check the springs against the table given below.

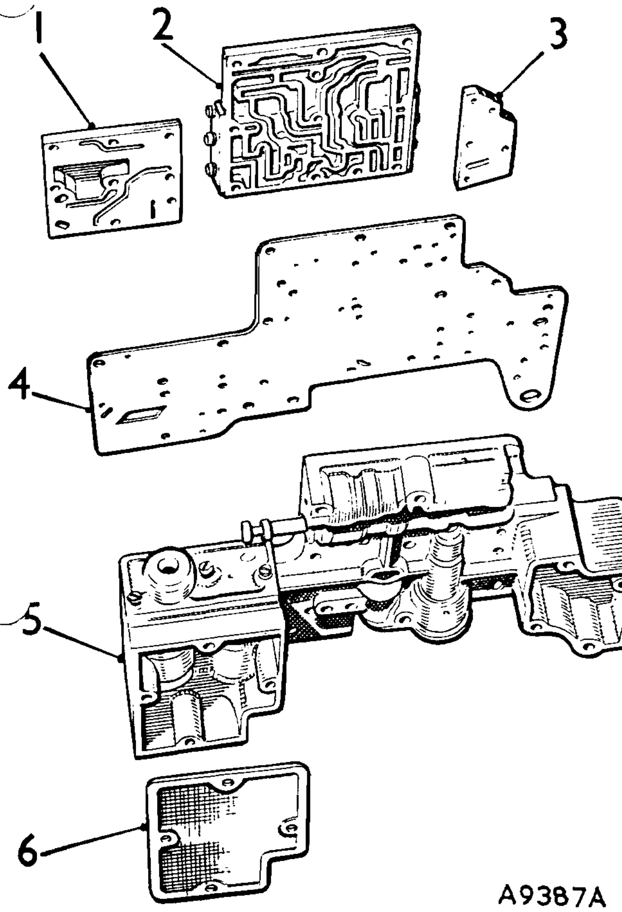


*Fig. Dc.*11

The valve bodies separated

1. Oil tube collector.
2. Upper valve body.
3. Governor line plate.
4. Separating plate.
5. Lower valve body.
6. Pump oil strainer.

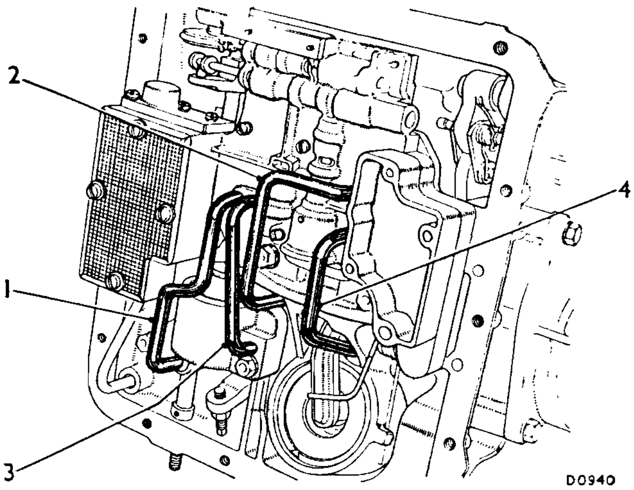


*Fig. Dc.*13

Location of the oil tubes

1. Front servo release.
2. Rear clutch.
3. Front servo apply.
4. Rear servo.

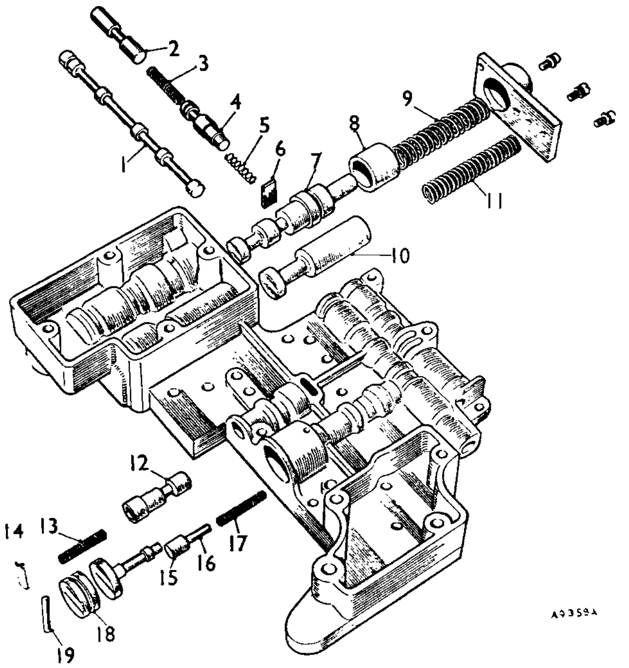


*Fig. Dc.*14

The lower valve body

1. Manual control valve.
2. Down-shift valve.
3. Spring—down-shift valve.
4. Throttle valve.
5. Spring—throttle valve.
6. Retainer.
7. Primary regulator valve.
8. Sleeve—primary regulator valve.
9. Spring—primary regulator valve.
10. Secondary regulator valve.
11. Spring—secondary regulator valve.
12. Servo orifice control valve.
13. Spring—servo orifice control valve.
14. Retainer.
15. Modulator valve.
16. Plug—modulator valve.
17. Spring—modulator valve.
18. Retainer.
19. Dowel pin.

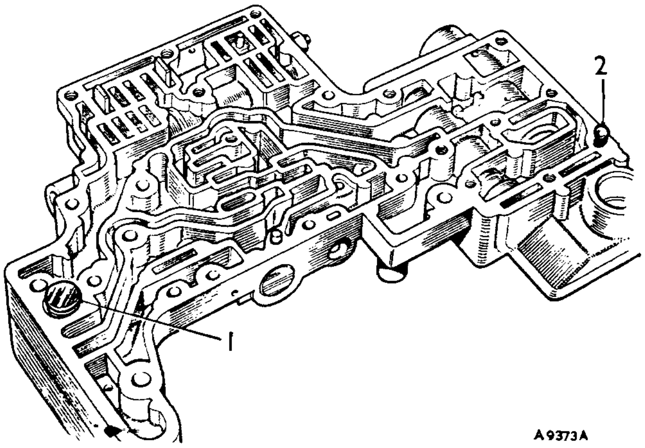


*Fig. Dc.*12

The check valves in the lower valve body

1. Pump check valve.
2. Converter outlet check valve.

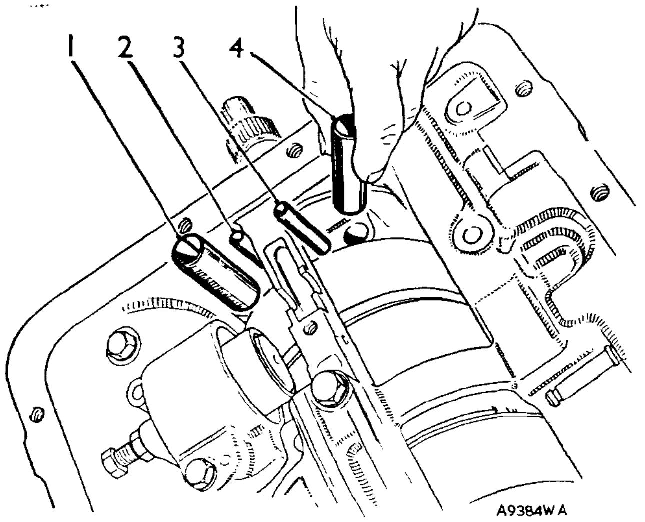


Fig. Dc.15

Location of the pump and converter oil tubes

1. Pump inlet.
2. Converter outlet.
3. Converter inlet.
4. Pump outlet.

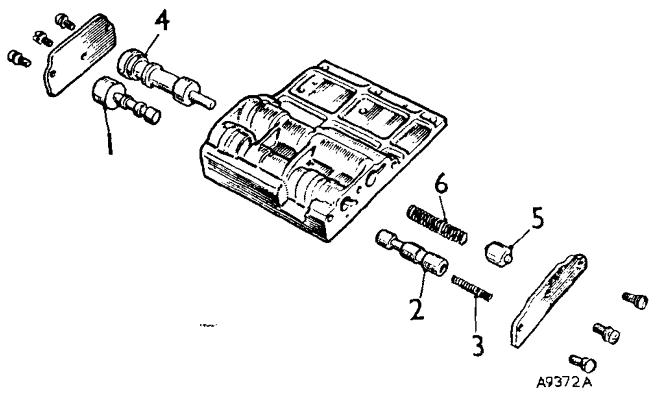


Fig. Dc.16

The upper valve body

1. 1–2 shift valve.
2. 1–2 valve plunger.
3. 1–2 valve spring.
4. 2–3 shift valve.
5. 2–3 valve plunger.
6. 2–3 valve spring.

Spring	*No. of coils*	*Wire diameter*	*Free length*	*Spring rate*
Primary regulator valve ..	15	·056 in. (1·42 mm.)	2·850 in. (72·4 mm.)	9·3 to 8·4 lb. at 1·090 in. (4·2 to 3·8 kg. at 27·69 mm.)
(Alternative)	14½	·054 in. (1·37 mm.)	2·850 in. (72·4 mm.)	9·3 to 8·4 lb. at 1·090 in. (4·2 to 3·8 kg. at 27·69 mm.)
Secondary regulator valve ..	21½	·650 in. (16·51 mm.)	2·594 in. (65·9 mm.)	11·25 to 9·75 lb. at 1·937 in. (5·1 to 4·4 kg. at 48·2 mm.)
Throttle valve	19½	·032 in.	1·175 to 1·185 in.	4·04 to 3·66 lb. at ·750 in.
(Alternative)	18	(·81 mm.)	(29·84 to 30·1 mm.)	(1·8 to 1·6 kg. at 19·05 mm.)
Throttle valve return	28	·018 in.	·807 in.	·65 to ·55 lb. at ·593 in.
(Alternative)	25	(·45 mm.)	(20·5 mm.)	(·29 to ·25 kg. at 15·06 mm.)
Servo orifice control valve ..	25	·024 in. (·6 mm.)	1·213 in. (30·81 mm.)	1·27 to 1·39 lb. at ·75 in. (·46 to ·47 kg. at 19·05 mm.)
Modulator valve	17	·024 in. (·52 mm.)	1·005 in. (25·5 mm.)	1·01 to 1·13 lb. at ·754 in. (·46 to ·51 kg. at 19·15 mm.)
1—2 shift valve	13½	·024 in. (·52 mm.)	1·094 in. (27·8 mm.)	1·8 to 2·1 lb. at ·5 in. (·82 to ·95 kg. at 12·7 mm.)
2—3 shift valve	22½	·036 in. (·91 mm.)	1·59 in. (40·4 mm.)	1·47 to 1·33 lb. at 1·178 in. (·67 to ·6 kg. at 29·92 mm.)

Reassembling

(31) Reverse the dismantling procedure in (7) to (26), noting the following points:

(*a*) Lubricate all the components with an approved automatic transmission fluid.

(*b*) Check that all the valves move freely in their bores.

(*c*) Ensure that the upper and lower valve bodies and the separating plate are correctly aligned before fitting and tightening all the screws.

(*d*) Tighten the screws evenly to the torque figures given in '**GENERAL DATA**'.

Refitting

(32) Reverse the removing procedure in (1) to (6), noting the following points:

(*a*) Ensure that the pump pressure and converter tubes are correctly located.

(*b*) Refill the transmission with one of the recommended automatic transmission fluids.

Section Dc.16

FRONT SERVO

Removing

(1) Drain the gearbox, unscrew the oil pan retaining screws and remove the pan.

(2) Withdraw the tubes connecting the front servo to the valve bodies.

(3) Unscrew the two servo securing bolts, lift out the servo and remove the strut from the operating lever.

Dismantling

(4) Remove the snap-ring retaining the piston.

(5) Withdraw the piston sleeve, piston and piston ring.

(6) Remove the piston from its sleeve.

(7) If necessary, the lever pivot can be pressed from the servo body and the lever removed.

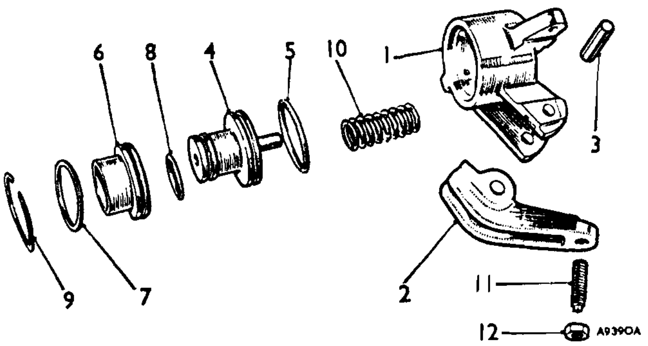


*Fig. Dc.*17

The front servo

1.	Body.	7.	Oil sealing ring.
2.	Lever.	8.	'O' ring.
3.	Lever pivot pin.	9.	Snap-ring.
4.	Piston.	10.	Spring.
5.	'O' ring.	11.	Adjusting screw.
6.	Sleeve.	12.	Locking nut.

Inspection

(8) Examine the 'O' rings and oil sealing ring for signs of deterioration or damage; renew the rings as necessary.

(9) Examine the piston, sleeve and body bore for cracks, scratches and wear.

Reassembling

(10) Reverse the dismantling procedure in (4) to (7) ensuring that the piston and lever move freely.

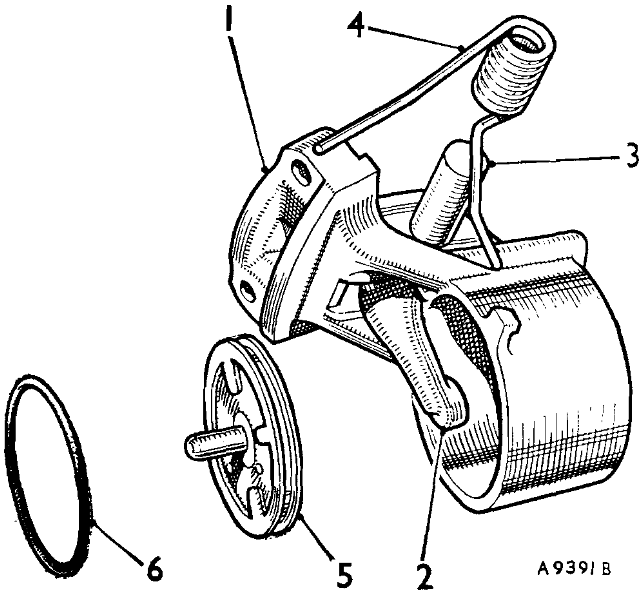


*Fig. Dc.*18

The rear servo

1.	Body.	4.	Lever spring.
2.	Lever.	5.	Piston.
3.	Lever pivot pin.	6.	Oil sealing ring.

Refitting

(11) Reverse the removing procedure in (1) to (3), noting the following points:

(*a*) To assist refitting, petroleum jelly may be used to stick the strut to the lever.

(*b*) After refitting, adjust the front brake band as described in Section Dc.10, (12) to (17).

Section Dc.17

REAR SERVO

Removing

(1) Drain the gearbox, unscrew the oil pan retaining screws and remove the pan.

(2) Withdraw the rear servo, rear clutch and front servo apply tubes.

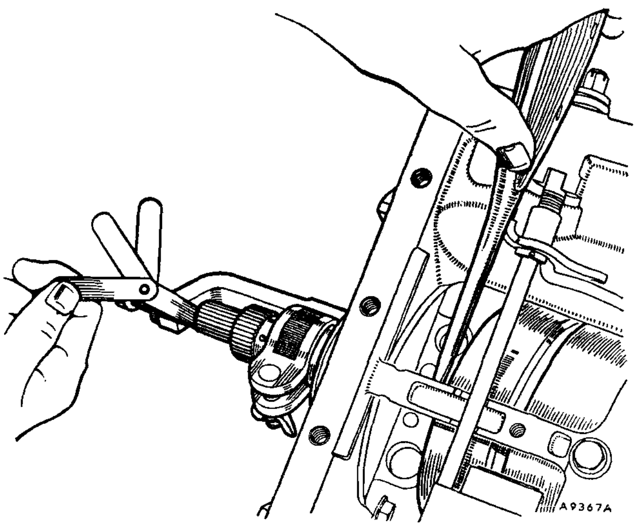


*Fig. Dc.*19

Using tool 18*G* 674 *to check the gear train end-float*

(3) Remove the two rear servo securing bolts, noting that the front bolt is dowelled for the centre support location.

(4) Lift out the servo assembly and remove the strut from the operating lever.

Dismantling

(5) Disengage and release the return spring.

(6) Withdraw the piston assembly.

(7) If necessary, the lever pivot pin can be pressed from the servo body and the lever removed.

Inspection

(8) Examine the 'O' ring for signs of deterioration or damage; renew the ring if necessary.

(9) Examine the piston and bore for cracks, scratches and wear.

Reassembling

(10) Reverse the dismantling procedure in (5) to (7).

Refitting

(11) Reverse the removing procedure in (1) to (4), noting the following points:

(*a*) To assist refitting, petroleum jelly may be used to stick the strut to the lever.

(*b*) After refitting, adjust the rear brake band as described in Section Dc.10, (18) to (20).

Section Dc.18

FRONT PUMP

Removing

(1) Remove the transmission assembly—Section Dc.13.

(2) Invert the transmission assembly and support it in tool 18G 673.

(3) Unscrew the oil pan retaining screws and remove the pan.

(4) Remove the valve bodies assembly—Section Dc.15, (1) to (6).

(5) Before dismantling the transmission any further and to enable any thrust washer wear to be compensated for on reassembly, the gear-train end-float should be checked as follows:

(*a*) Clamp tool 18G 674 to the converter support shaft.

(*b*) Gently lever the gear train forward and adjust the screw of the tool until it just contacts the end of the input shaft.

(*c*) Using the minimum pressure, lever the front clutch back, and measure the gap between the tool screw and the end of the input shaft. The permissible end-float is ·010 to ·030 in. (·254 to ·762 mm.).

(6) Withdraw the pump inlet and outlet tubes and the converter tubes.

(7) Unscrew the six pump retaining bolts and withdraw the pump assembly.

(8) Remove the input shaft thrust washer.

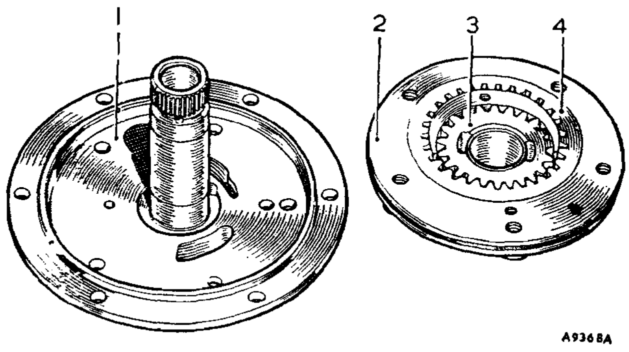


Fig. Dc.20

The pump components

1. Pump adaptor and converter support.
2. Body and bush assembly.
3. Driving gear.
4. Driven gear.

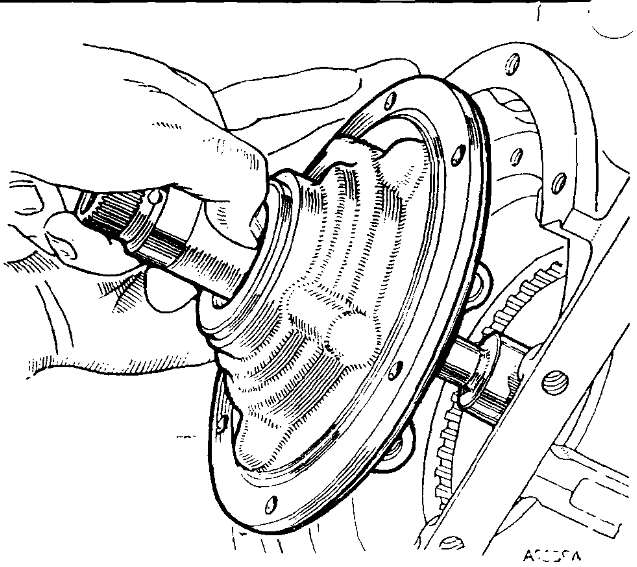


Fig. Dc.21

Withdrawing the pump assembly

Dismantling

(9) Remove the five bolts securing the pump body to the converter support.

(10) Remove the locating screw.

(11) Withdraw the pump body from the converter support.

(12) Mark the face of the drive and driven gears for correct reassembly and remove the gears.

Inspection

(13) Examine the 'O' ring body seal for signs of deterioration; renew the seal if necessary.

(14) Examine the converter support oil seal in the pump body for signs of wear or deterioration; renew the seal if necessary, ensuring that the new seal is fitted fully into the housing.

(15) Examine the pump body and gear teeth for scores and excessive wear; light scores may be removed by polishing with a very fine abrasive cloth.

Reassembling

(16) Reverse the dismantling procedure in (9) to (12), ensuring that the drive and driven gears are assembled correctly to their dismantling marks.

Refitting

(17) Reverse the removing procedure in (1) to (8), noting the following points:

(*a*) If the end-float measured in (5) (*c*) exceeds the limit given, a new input shaft thrust washer must be fitted, or, if necessary, a complete new set of thrust washers.

(*b*) Use petroleum jelly to stick the input shaft thrust washer to the pump adaptor to assist refitting.

(*c*) Refit the pump assembly to the casing using a new gasket.

(*d*) Tighten the pump securing bolts to the torque figure given in '**GENERAL DATA**'.

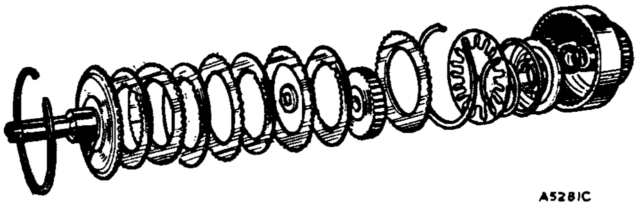


Fig. Dc.22
The front clutch components

Section Dc.19

FRONT CLUTCH

Removing

(1) Remove the transmission assembly—Section Dc.13.
(2) Remove the pump assembly—Section Dc.18, (2) to (8).
(3) Withdraw the input shaft and front clutch assembly.
(4) Remove the bronze and steel thrust washer.

Dismantling

(5) Carefully lever out the snap-ring and withdraw the input shaft assembly.
(6) Remove the clutch hub thrust washer.
(7) Withdraw the clutch hub.
(8) Remove the four inner (fibre) and three outer clutch plates; retain the plates in their removal order for reassembly.

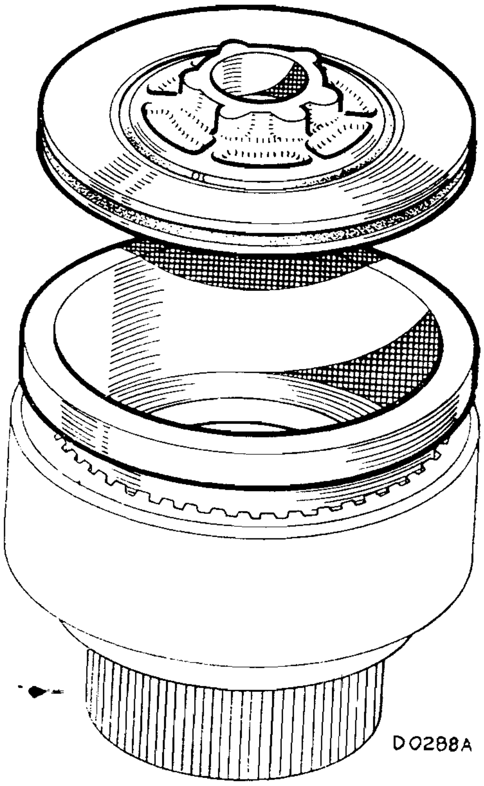


Fig. Dc.23
Using tool 18G 1107 *to refit the front clutch piston*

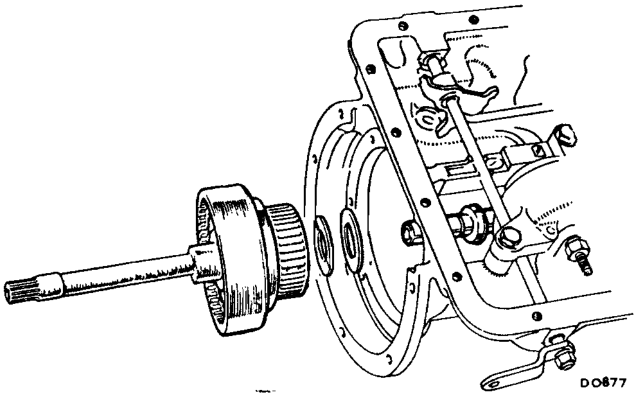


Fig. Dc.24
Fitting order for the thrust washers and front clutch

(9) Remove the clutch distance piece.
(10) Remove the dished piston spring retaining circlip and remove the spring.
(11) Withdraw the piston; apply air pressure to the feed orifice to assist.
(12) Remove the snap ring and sealing ring from the piston.
(13) Remove the 'O' ring from the clutch housing boss.

Inspection

(14) Examine the sealing ring and 'O' rings for signs of deterioration or wear; renew them as necessary.
(15) Check the friction plates for wear and burning; burnt or worn plates must be replaced as a set, not individually.

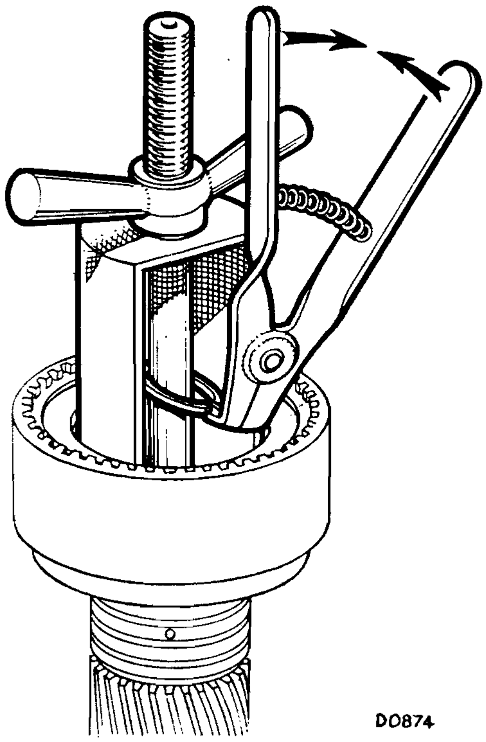


Fig. Dc.25
Using tool 18G 1016 *and* 18G 675 *to remove the rear clutch piston*

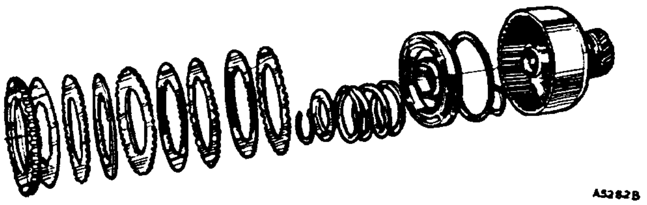


Fig. Dc.26
The rear clutch components

(16) Check the steel plates for distortion. If the distortion exceeds ·015 in. (·38 mm.) the plates must be renewed as a set.

Reassembling

(17) Reverse the dismantling procedure in (5) to (13), noting that tool 18G 1107 should be used to refit the piston.

Refitting

(18) Reverse the removing procedure in (1) to (4).

Section Dc.20

REAR CLUTCH

Removing

(1) Remove the transmission assembly—Section Dc.13.
(2) Remove the pump assembly—Section Dc.18, (2) to (8).
(3) Remove the front clutch—Section Dc.19, (3) to (4).
(4) Remove the front servo—Section Dc.16, (1) to (3).
(5) Remove the front brake band.
(6) Withdraw the rear clutch assembly together with the forward sun gear.

Dismantling

(7) Remove the two oil rings from the front of the sun gear shaft and withdraw the sun gear assembly rearwards from the clutch.
(8) Remove the rear oil ring and the needle-roller thrust bearing from the forward sun gear.
(9) Remove the three oil rings from the rear of the clutch assembly.
(10) Lever the snap-ring from the front of the clutch drum and withdraw the pressure plate, the four inner (fibre) plates, and the four outer plates. Retain the plates in their removal order for reassembly.
(11) Using tool 18G 1016, compress the piston spring.
(12) Remove the retaining circlip, using tool 18G 675 or 18G 1004 and 18G 1004 J, and withdraw the seat and spring.
(13) Remove the piston by shocking the drum on a soft surface.
(14) Remove the piston seal.

Inspection

(15) Examine the piston and drum seals for signs of deterioration or wear; renew the seals if necessary.
(16) Check the friction plates for wear and burning; burnt or worn plates must be replaced as a set, not individually.
(17) Check the steel plates for wear. The plates are coned ·010 to ·020 in. (·03 to ·05 mm.); renew the plates in sets only.
(18) Examine the ring seals and internal bush for excessive wear or damage.
(19) Examine the needle-roller thrust bearings for wear and damage.

Reassembling

(20) Reverse the dismantling procedure in (7) to (14), noting the following points:
   (*a*) Refit the piston into the drum using tool 18G 702.
   (*b*) Ensure that if the original clutch plates are being refitted they are in their dismantled positions, and that the coning on the steel plates is facing the same direction.

Refitting

(21) Reverse the removing procedure in (1) to (6).

Section Dc.21

CENTRE SUPPORT AND PLANET GEARS

Removing

(1) Remove the transmission assembly—Section Dc.13.

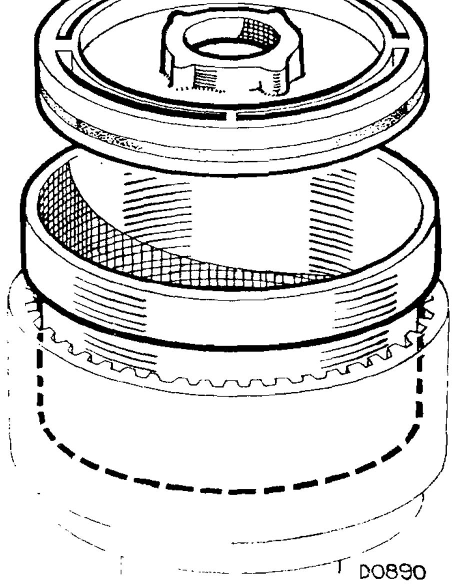


Fig. Dc.27
Using tool 18G 702 to refit the rear clutch piston

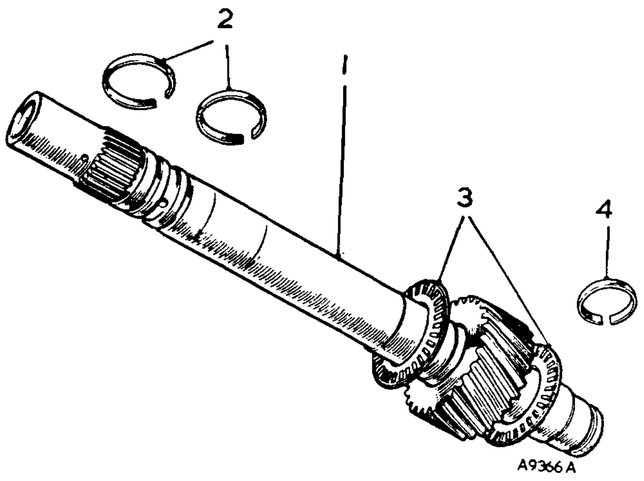


Fig. Dc.28

Forward sun gear components

1. Forward sun gear assembly.
2. Front clutch sealing rings.
3. Needle thrust washer.
4. Governor feed sealing ring.

(2) Remove the pump assembly—Section Dc.18, (2) to (8).
(3) Remove the front clutch—Section Dc.19, (3) to (4).
(4) Remove the front servo—Section Dc.16, (1) to (3).
(5) Remove the rear clutch—Section Dc.20, (5) to (6).
(6) Remove the rear servo—Section Dc.17, (2) to (4).
(7) Unscrew the two remaining centre support locating bolts.
(8) Drift the front servo stop from the casing.
(9) Withdraw the centre support and planet gears from the casing.

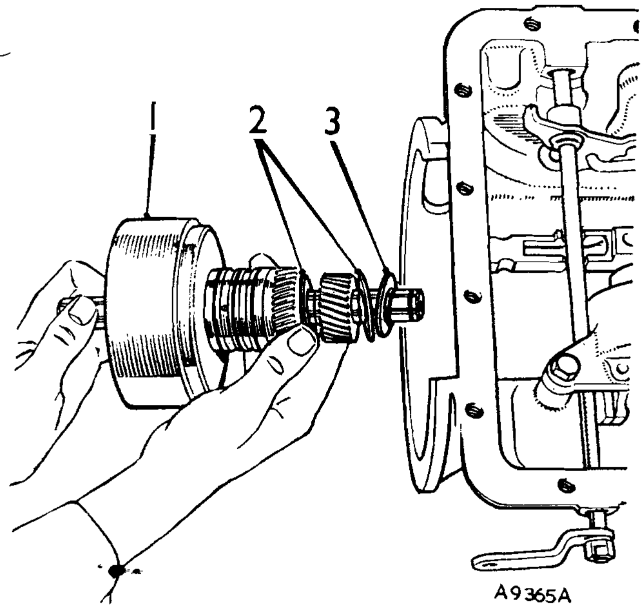


Fig. Dc.29

Fitting the rear clutch and forward sun gear

1. Rear clutch.
2. Needle thrust washers.
3. Needle thrust bearing plate.

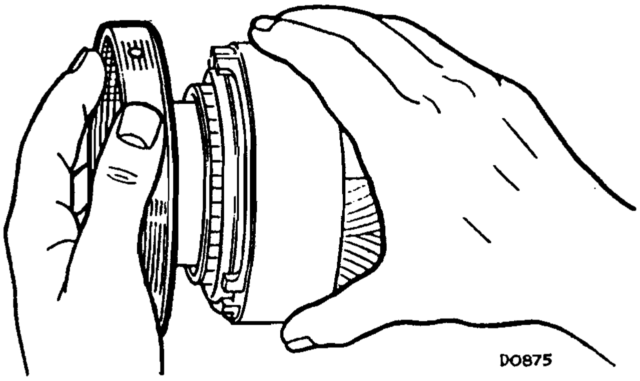


Fig. Dc.30

Assembling the one-way clutch, planet gears and centre support

(10) Remove the bearing washer and needle-roller thrust bearing fitted between the gear carrier and the driven shaft.

Dismantling

(11) Withdraw the centre support from the planet gear carrier, turning the support to relax the one-way clutch.
(12) Ease the one-way clutch from the outer race.
(13) Lever out the outer race retaining circlip and remove the outer race.

Inspection

(14) Examine the gears for worn or damaged teeth. Check the fit of the gear carrier pins.
(15) Inspect the bearing washer and needle-roller thrust bearing for wear and damage.

Reassembling

(16) Reverse the dismantling procedure in (11) to (13), noting that the one-way clutch is fitted with the lip on the outer cage uppermost.

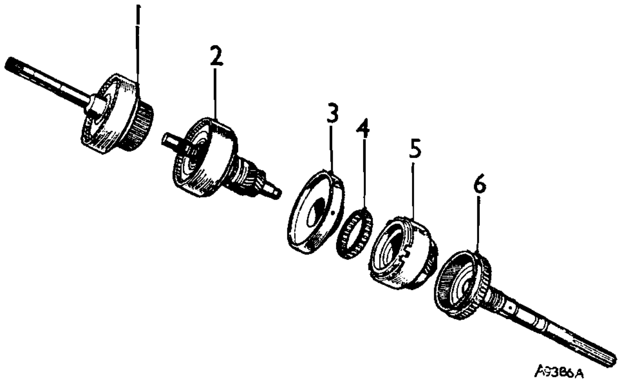


Fig. Dc.31

The gear train components

1. Input shaft and front clutch assembly.
2. Rear clutch and forward gear assembly.
3. Centre support.
4. One-way clutch.
5. Planet gears and rear drum assembly.
6. Driven shaft and ring gear assembly.

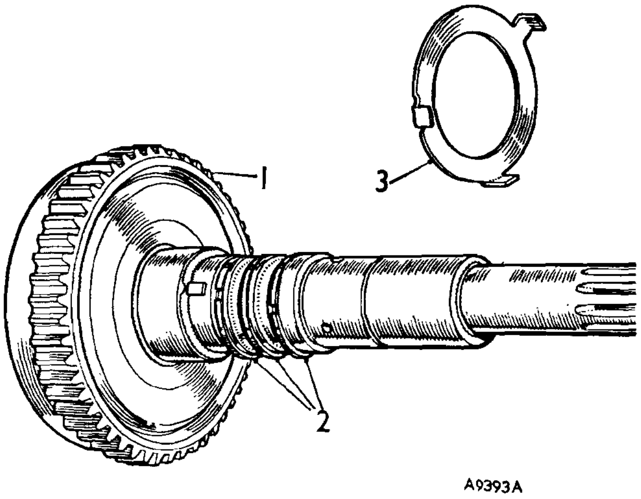


Fig. Dc.32
The driven shaft

1. Ring gear and driven shaft. 2. Oil sealing rings. 3. Thrust washer.

Refitting

(17) Reverse the removing procedure in (1) to (10), noting that the thrust bearing washer is fitted with its lip towards the rear.

Section Dc.22

DRIVEN SHAFT AND RING GEAR

Removing

(1) Remove the transmission assembly—Section Dc.13, (1) to (5).

(2) Remove the pump assembly—Section Dc.18, (2) to (8).

(3) Remove the front clutch—Section Dc.19, (3) to (4).

(4) Remove the front servo—Section Dc.16, (1) to (3).

(5) Remove the rear clutch—Section Dc.20, (5) to (6).

(6) Remove the rear servo—Section Dc.17, (2) to (4).

(7) Remove the governor assembly and speedometer drive—Section Dc.14, (2) to (7).

(8) Remove the centre support and planet gears—Section Dc.21, (7) to (10).

(9) Withdraw the rear brake band.

(10) Withdraw the driven shaft and ring gear assembly.

Dismantling

(11) Remove the thrust washer and the three oil sealing rings from the shaft.

(12) Lever the snap-ring from the ring gear and withdraw the shaft from the gear.

Inspection

(13) Examine the sealing rings for signs of deterioration or wear.

(14) Check the ring gear and shaft splines for wear or damage.

Reassembling

(15) Reverse the dismantling procedure in (11) and (12).

Refitting

(16) Reverse the removing procedure in (1) to (10), noting that the tabs of the driven shaft washer fit into the recesses in the boss of the casing.

Section Dc.23

MANUAL VALVE SHAFT AND LEVER

Removing

(1) Remove the valve bodies assembly—Section Dc.15, (1) to (6).

(2) Withdraw the parking brake link retaining clip from the parking pawl end of the link and detach the link from the torsion lever.

(3) Remove the roll pin retaining the locating collar to the shaft.

(4) Slide the shaft away from the inhibitor switch and remove the detent ball and spring.

(5) Slide the manual valve detent lever away from its retaining pin and remove the pin.

(6) Withdraw the shaft and remove the collar, manual valve detent lever and lever spring.

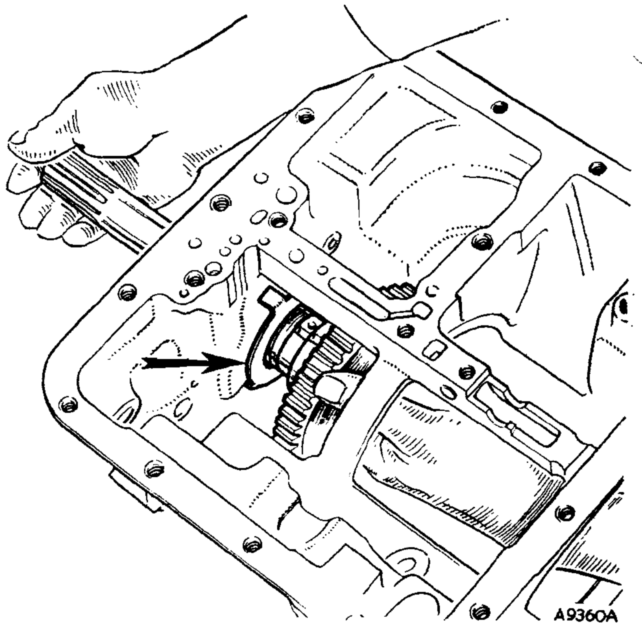


Fig. Dc.33
Fitting the driven shaft assembly. Note the position of the thrust washer (arrowed)

Inspection

(7) Examine the shaft and levers for excessive wear and damage.

(8) Check the detent spring for loss of tension.

Refitting

(9) Reverse the removing procedure in (1) to (6).

Section Dc.24

REAR PUMP (if fitted)

Removing

(1) Remove the taximeter drive, speedometer drive and governor assembly—Section Dc.14.

(2) Remove the five screws retaining the rear pump assembly to the transmission casing.

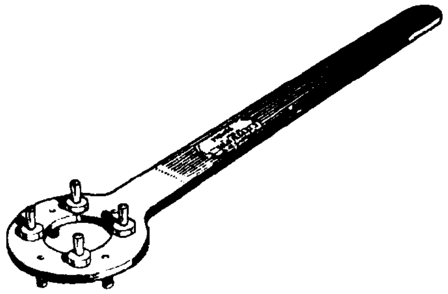
(3) Detach the pump assembly, rear pump plate, and the pump drive key.

Refitting

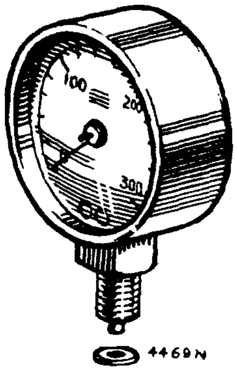
(4) Reverse the procedure in (1) to (3).

(*For* 'SERVICE TOOLS' *see page Dc.*28)

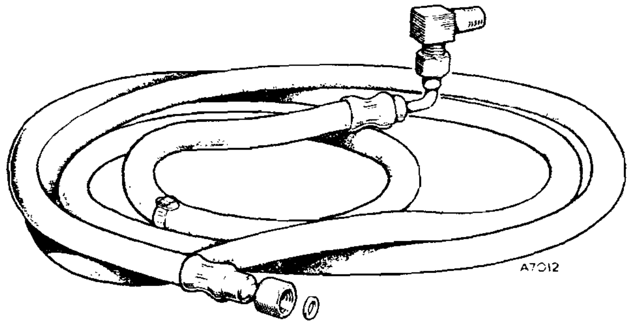
SERVICE TOOLS



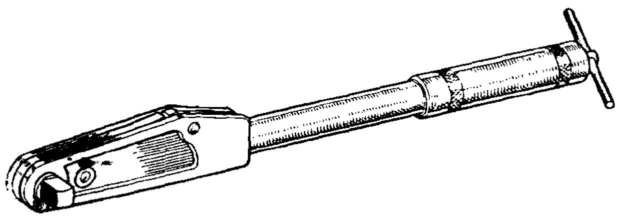
18G 34 A. Propeller Shaft Flange Wrench



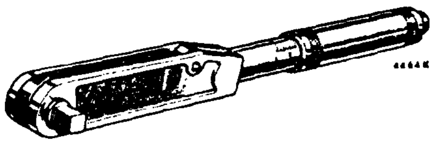
18G 502 A. Hydraulic Pressure Gauge



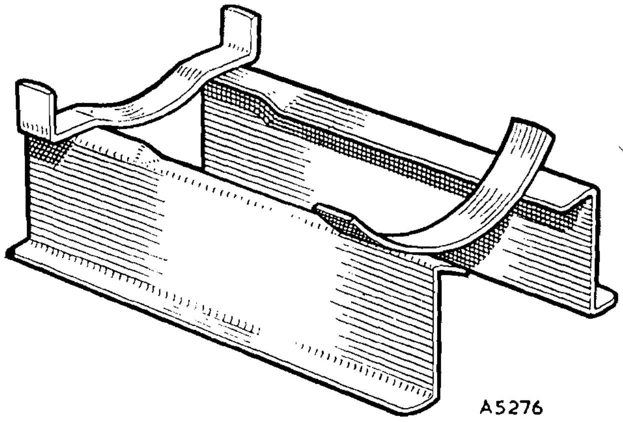
18G 502 K. Pressure Hose (8 ft.) with Adaptor
For use with 18G 502 A above.



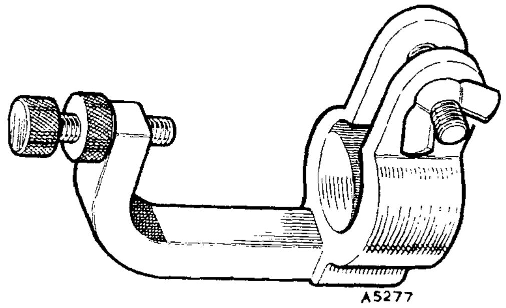
18G 536. Torque Wrench—20 to 100 lb. in. (300 to 1200 g. m.)



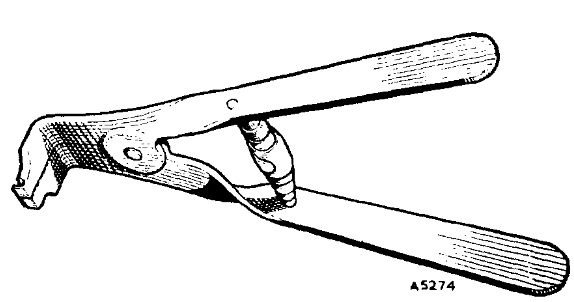
18G 537. Torque Wrench—10 to 50 lb. ft. (2 to 7 kg. m.)



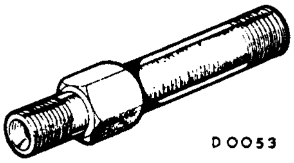
18G 673. Gearbox Cradle



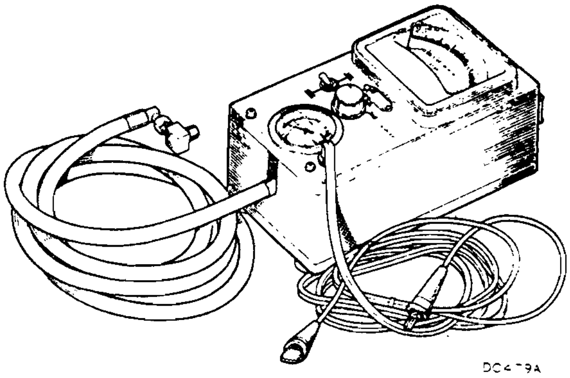
18G 674. Gear Train End-float Checking Tool



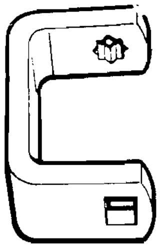
18G 675. Snap-ring Pliers



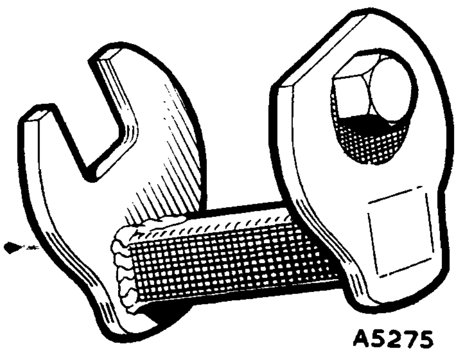
18G 677 B. Adaptor—Pressure Test



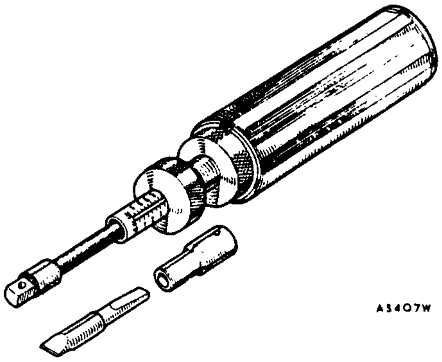
18G 677 Z. Pressure Test and Tachometer Equipment—Petrol models only



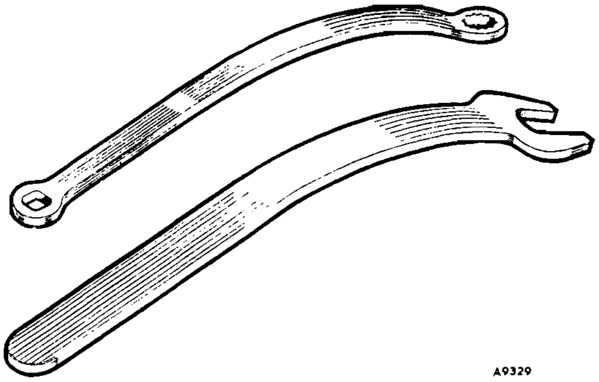
18G 678. Adaptor—Front Servo Adjuster



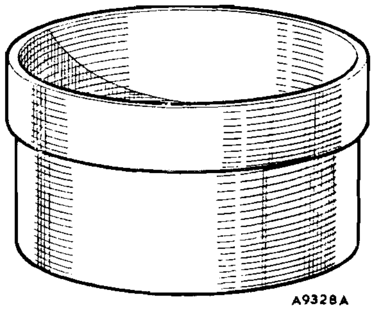
18G 679. Inhibitor Switch Locknut Spanner



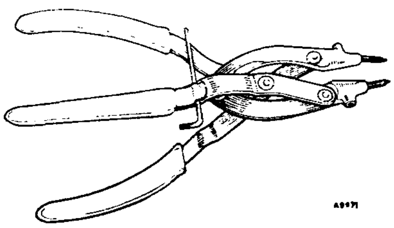
18G 681
18G 681 A
18G 681 B
Torque Screwdriver Set—0 to 40 lb. in. (0 to 400 gm. m.)



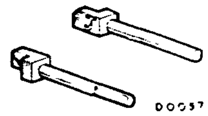
18G 701. Rear Band Adjusting Tools



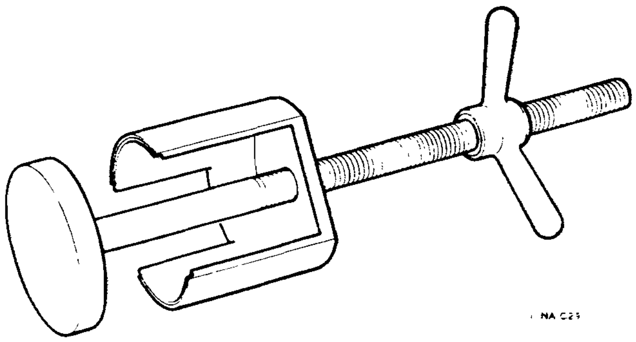
18G 702. Rear Clutch Piston and Seal Replacer



18G 1004. Circlip Pliers—Basic Tool
Alternative: 18G 675 Snap-ring Pliers.

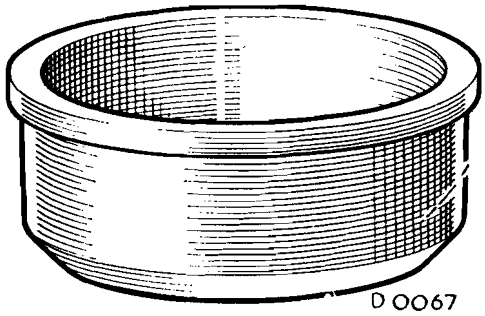


18G 1004 J. Circlip Plier Points



18G 1016. Clutch Spring Compressor—Rear

Alternative: 18G 676. Clutch Spring Compressor—Rear.



18G 1107. Front Clutch Piston and Seal Replacer

SECTION Dd

Borg Warner (BG)

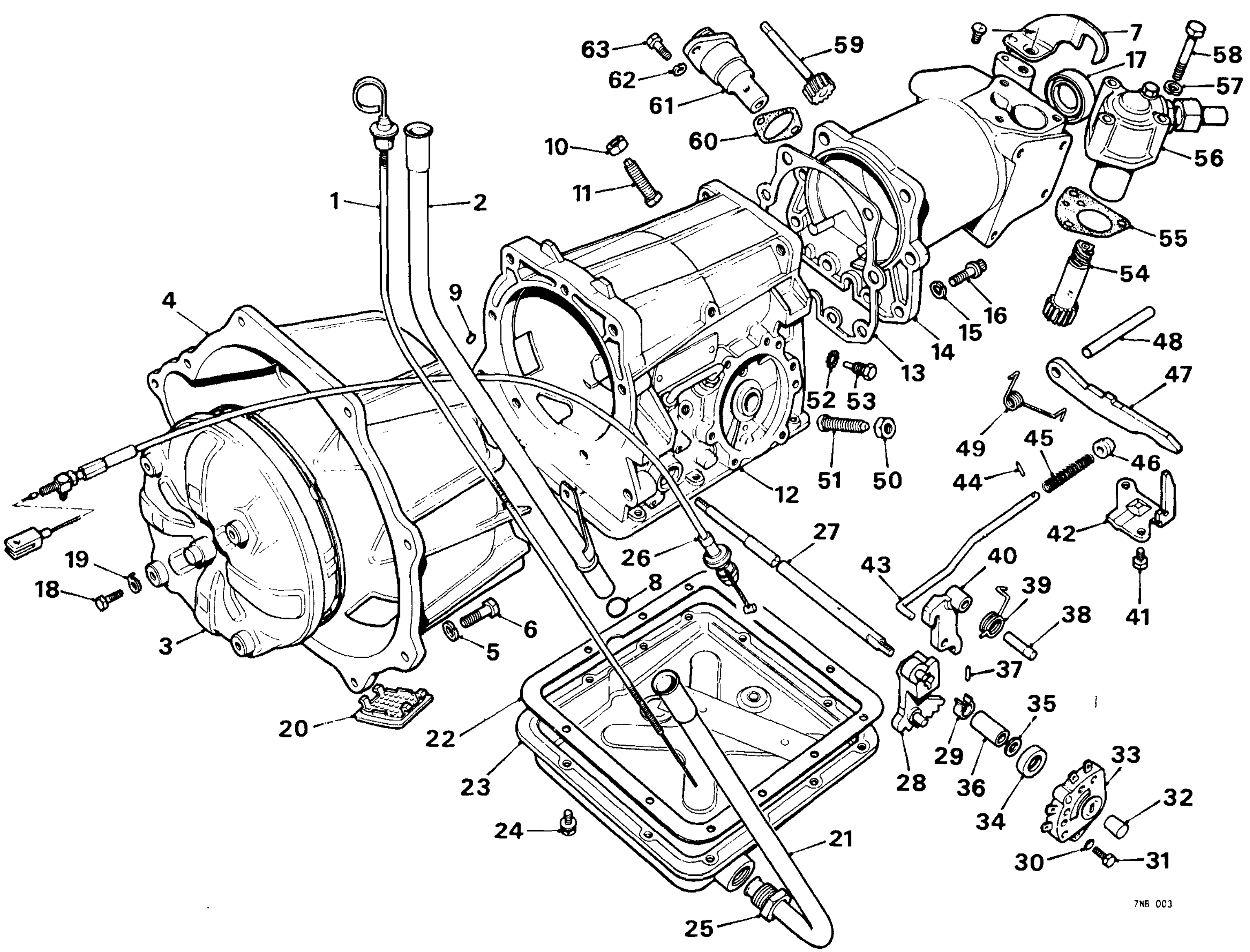
THE AUTOMATIC GEARBOX

(in one CAB)!

(TYPE 65)

	Section

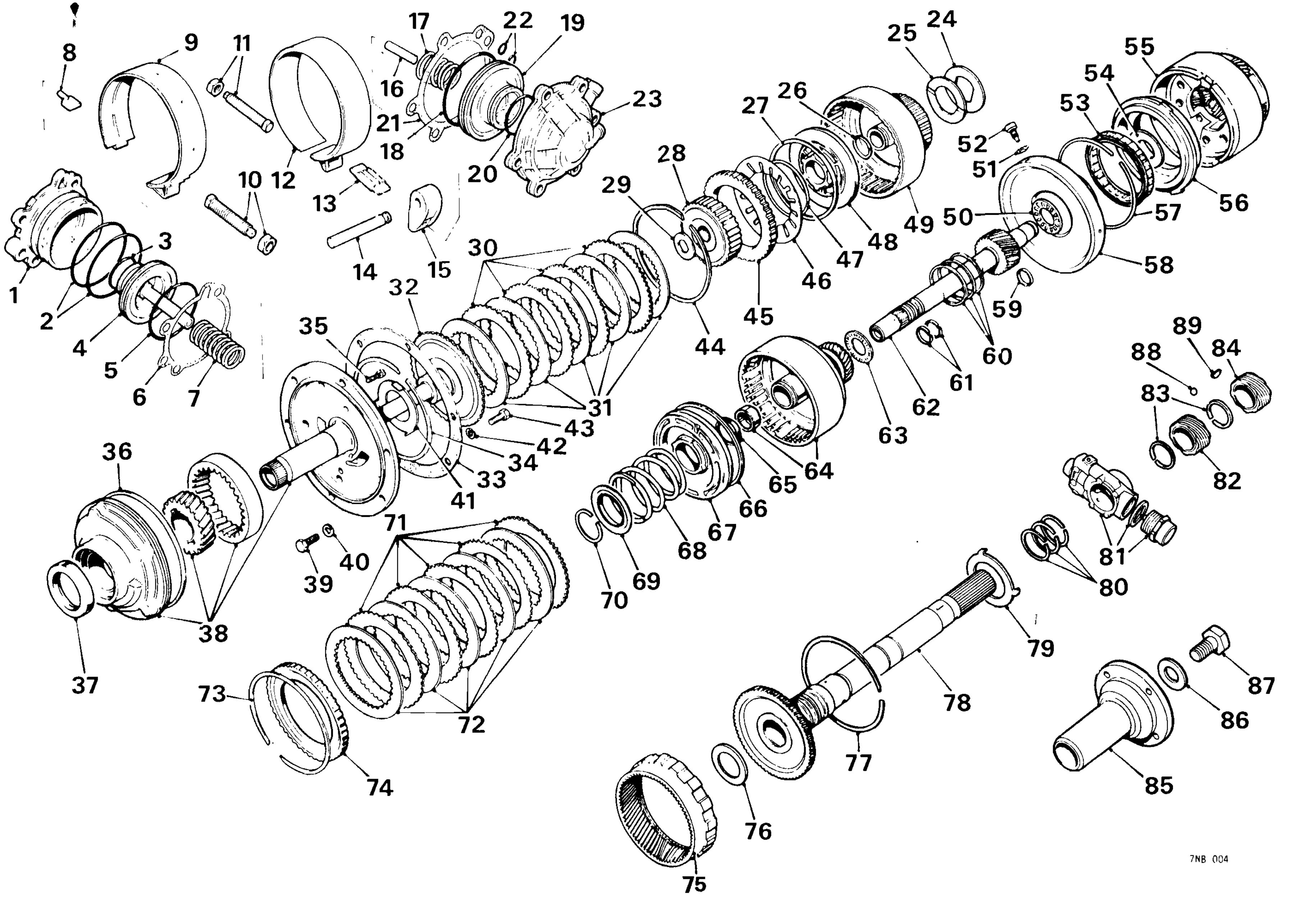
THE AUTOMATIC GEARBOX EXTERNAL COMPONENTS



KEY TO THE AUTOMATIC GEAROX EXTERNAL COMPONENTS

No.	Description	No.	Description	No.	Description
1.	Dipstick.	22.	Gasket for oil pan.	43.	Parking brake rod.
2.	Filler tube—upper.	23.	Oil pan assembly.	44.	Pin for cam.
3.	Converter assembly.	24.	Bolt for oil pan.	45.	Spring for rod.
4.	Converter housing.	25.	Lower filler tube gland nut.	46.	Parking pawl cam.
5.	Spring washer for bolt.	26.	Down-shift cable assembly.	47.	Parking pawl.
6.	Bolt for housing.	27.	Manual control shaft.	48.	Pin for parking pawl.
7.	Locking bracket for taximeter drive.	28.	Manual detent lever.	49.	Spring for parking pawl.
8.	'O' ring for manual control shaft.	29.	Spring clip for shaft.	50.	Locknut for adjusting screw.
9.	'O' ring for filler tube.	30.	Washer for bolt.	51.	Front brake band adjusting screw.
10.	Locknut for adjusting screw.	31.	Bolt for starter inhibitor switch.	52.	Lock washer for bolt.
11.	Rear brake band adjusting screw.	32.	Thread protector.	53.	Centre support locating bolt.
12.	Case assembly.	33.	Starter inhibitor switch.	54.	Shaft—taximeter drive.
13.	Gasket for extension housing.	34.	Oil seal for shaft.	55.	Joint washer.
14.	Rear extension housing.	35.	Washer for shaft.	56.	Housing assembly—taximeter gear.
15.	Spring washer for bolt.	36.	Spacer for shaft.	57.	Spring washer for bolt.
16.	Bolt for extension housing.	37.	Pin for shaft.	58.	Bolt for housing assembly.
17.	Rear oil seal.	38.	Pin for pawl lever.	59.	Speedometer pinion.
18.	Bolt for converter.	39.	Spring for pawl lever.	60.	Joint washer.
19.	Lock washer for bolt.	40.	Parking pawl lever.	61.	Housing for speedometer pinion.
20.	Stoneguard.	41.	Bolt for cam plate.	62.	Spring washer for bolt.
21.	Filler tube—lower.	42.	Cam plate.	63.	Bolt for speedometer pinion housing.

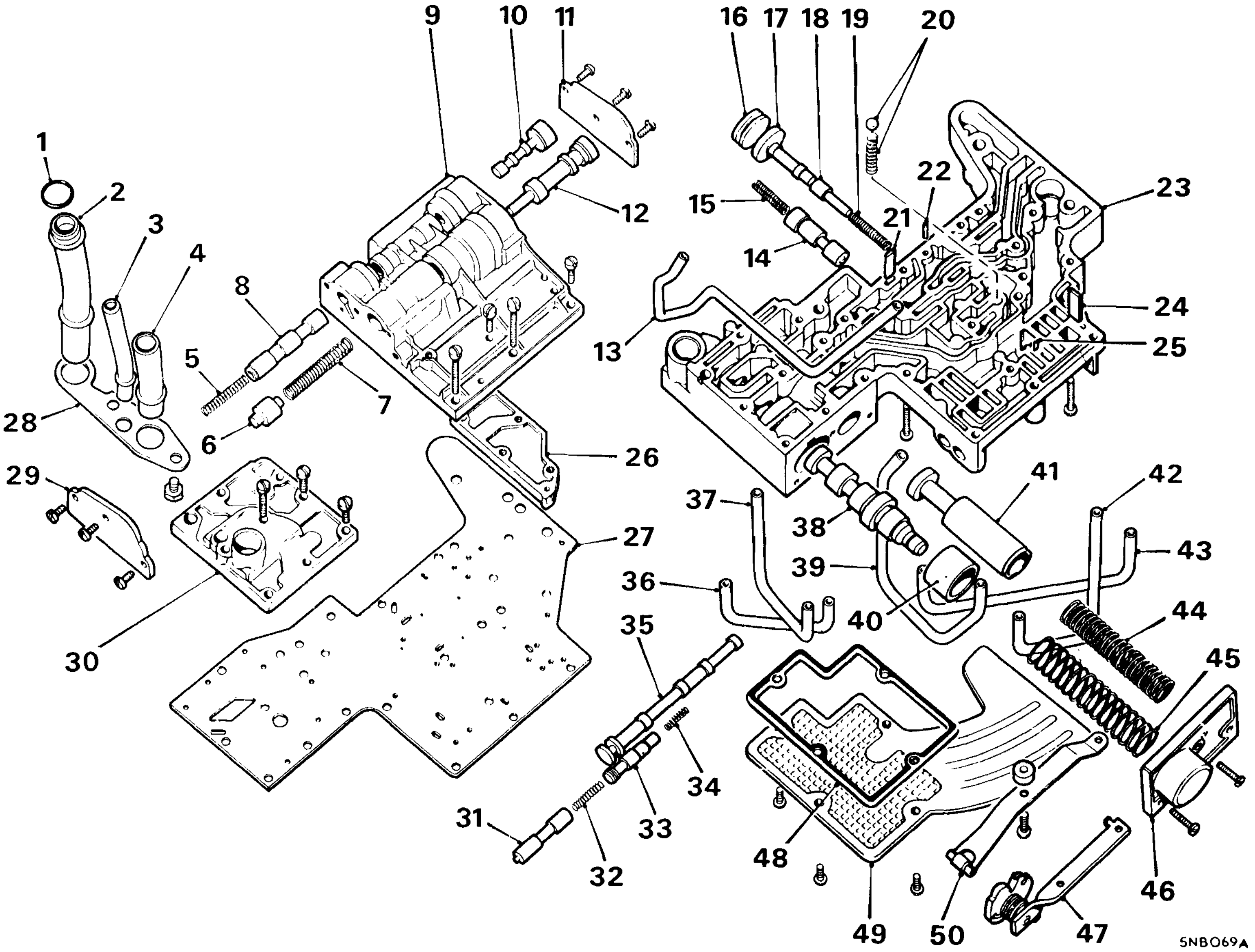
THE AUTOMATIC GEARBOX INTERNAL COMPONENTS



KEY TO THE AUTOMATIC GEARBOX INTERNAL COMPONENTS

No.	Description	No.	Description	No.	Description	No.	Description
1.	Front servo cover.	23.	Rear servo cover.	45.	Distance piece for front clutch	67.	Rear clutch piston.
2.	'O' rings for cover.	24.	Front clutch thrust washer.	46.	Spring for front clutch.	68.	Spring for rear clutch.
3.	'O' ring for piston.	25.	Front clutch thrust washer.	47.	Bearing ring for spring.	69.	Seat for spring.
4.	Front servo piston.	26.	'O' ring for clutch housing.	48.	Piston for front clutch.	70.	Snap-ring for seat.
5.	'O' ring for piston	27.	Front clutch sealing ring.	49.	Front clutch housing.	71.	Rear clutch plates—outer.
6.	Gasket for cover.	28.	Front clutch hub.	50.	Needle thrust bearing—heavy duty.	72.	Rear clutch plates—inner.
7.	Spring for piston.	29.	Thrust washer.	51.	Lock washer for bolt.	73.	Snap-ring for rear clutch.
8.	Strut for front servo.	30.	Front clutch plates—outer.	52.	Centre support locating bolt.	74.	Pressure plate for rear clutch.
9.	Front brake band.	31.	Front clutch plates—inner.	53.	One-way clutch assembly.	75.	Ring gear.
10.	Adjusting screw and locknut.	32.	Input shaft assembly.	54.	Needle thrust bearing plate.	76.	Needle thrust bearing assembly.
11.	Adjusting screw and locknut.	33.	Gasket for converter support.	55.	Planet gear and rear drum assembly.	77.	Snap-ring for output shaft.
12.	Rear brake band.	34.	Front clutch snap-ring.	56.	One-way clutch outer race.	78.	Output shaft.
13.	Strut for rear servo.	35.	Screw for pump.	57.	Snap-ring for one-way clutch.	79.	Output shaft thrust washer.
14.	Pin for servo lever.	36.	Sealing ring for pump.	58.	Centre support.	80.	Output shaft sealing rings.
15.	Rear servo lever.	37.	Front oil seal.	59.	Out put shaft sealing ring.	81.	Governor assembly.
16.	Push-rod for piston.	38.	Pump assembly.	60.	Rear clutch sealing rings.	82.	Speedometer drive gear.
17.	Spring for piston.	39.	Bolt for pump.	61.	Sun gear sealing rings.	83.	Circlips for speedometer drive gear.
18.	'O' ring for piston.	40.	Washer for bolt.	62.	Forward sun gear.	84.	Taximeter drive gear.
19.	Rear servo piston.	41.	Input shaft thrust washer.	63.	Needle thrust bearing.	85.	Drive flange.
20.	'O' ring for piston.	42.	Washer for bolt.	64.	Front drum and reverse sun gear assembly.	86.	Plain washer.
21.	Gasket for cover.	43.	Bolt for pump.	65.	Rear clutch piston seal—inner.	87.	Bolt for drive flange.
22.	'O' rings for cover.	44.	Front clutch snap-ring.	66.	Rear clutch piston seal—outer.	88.	Speedometer gear drive ball.
						89.	Taximeter gear drive key.

THE AUTOMATIC GEARBOX VALVE BODIES COMPONENTS



KEY TO THE AUTOMATIC GEARBOX VALVE BODIES COMPONENTS

No.	Description	No.	Description	No.	Description
1.	'O' ring for suction tube.	18.	Modulator valve spacer.	34.	Throttle valve return spring.
2.	Suction tube to pump.	19.	Modulator control valve spring.	35.	Manual control valve.
3.	Converter feed tube.	20.	Check valve ball and spring.	36.	Front servo release tube.
4.	Feed tube from pump.	21.	Servo orifice control valve stop.	37.	Front servo apply tube.
5.	1–2 shift valve spring.	22.	Dowel pin for plug.	38.	Primary regulator valve.
6.	2–3 shift valve plunger.	23.	Lower valve body.	39.	Rear clutch feed tube.
7.	2–3 shift valve spring.	24.	Throttle valve stop.	40.	Primary regulator valve sleeve.
8.	1–2 shift valve plunger.	25.	Throttle valve plate.	41.	Secondary regulator valve.
9.	Upper valve body.	26.	Governor line plate.	42.	Rear servo feed tube.
10.	1–2 shift valve.	27.	Separating plate.	43.	Rear servo feed tube.
11.	Rear end plate.	28.	Tube locating plate.	44.	Secondary regulator valve spring.
12.	2–3 shift valve.	29.	Front end plate.	45.	Primary regulator valve spring.
13.	Converter return tube.	30.	Oil tube collector.	46.	End plate.
14.	Servo orifice control valve.	31.	Down-shift valve.	47.	Down-shift cam assembly.
15.	Servo orifice control valve spring.	32.	Throttle valve spring.	48.	Oil strainer gasket.
16.	Modulator valve plug.	33.	Throttle valve.	49.	Oil strainer.
17.	Modulator control valve.			50.	Detent spring.

Section Dd.1

MAINTENANCE

Checking fluid level

NOTE: It is essential that only Automatic Transmission 'G' Fluid is used in this gearbox.

(1) With the vehicle on level ground apply the hand brake and select the 'P' (Park) position.
(2) Run the engine until normal operating temperature is reached.
(3) With the hand brake and foot brake firmly applied and with the engine running at idling speed, move the selector lever through all the gear positions two or three times, pausing for about 10 seconds in each position.
(4) Select 'P' (Park) and with the engine still running at idling speed, remove the dipstick and wipe the blade with a piece of clean paper or non-fluffy cloth.
(5) Re-insert the dipstick fully and withdraw it immediately, then check the fluid level indication. This should be between the 'MAX' and 'MIN' markings of the 'COLD' scale on the dipstick blade.
If the vehicle has been run for five miles or more just prior to checking, the level should be between the 'MAX' and 'MIN' markings on the 'HOT' scale.
NOTE: Some dipsticks are only marked with a 'COLD' scale, and in such cases the fluid level must be checked and topped up in the cold condition.
(6) Top-up the gearbox with fluid if necessary, then repeat the procedure in 3 to 6 until the fluid level is correct.

The difference between the 'MAX' and 'MIN' marks on either scale is approximately 1 pint (1·2 U.S. pints, 0·6 litre).

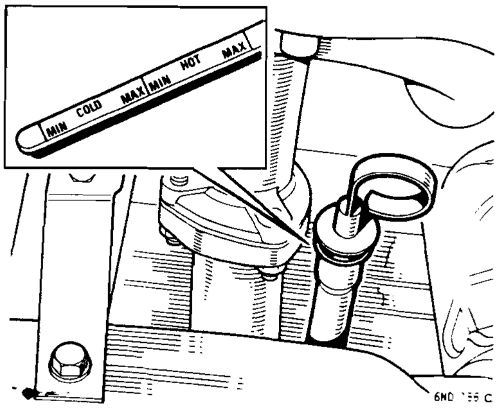


Fig. Dd.1

The filler tube and dipstick, showing 'HOT' and 'COLD' markings

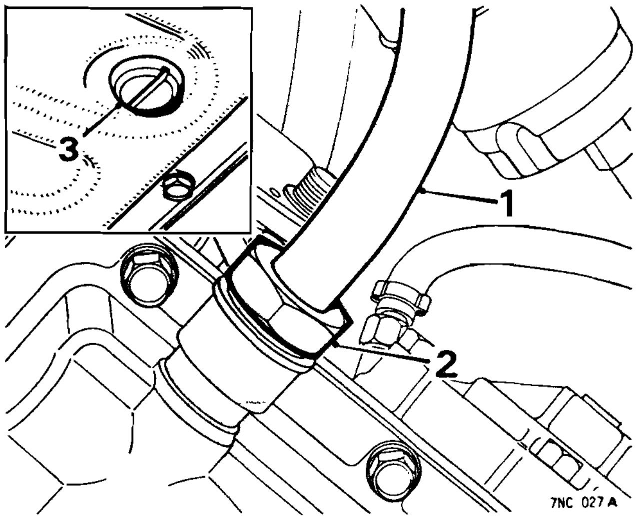


Fig. Dd.2

1. Filler tube 2. Gland nut

Draining and refilling

(1) Select 'P' and apply the hand brake.
(2) Remove the drain plug from the oil pan and drain the fluid from the gearbox. If a drain plug is not fitted, unscrew the filler tube gland nut and remove the filler tube from the oil pan. Remove the oil pan to complete the draining process.
NOTE: The torque converter and oil cooler will still be full of fluid.
(3) Refit the drain plug or oil pan and filler tube, using a new gasket.
(4) Raise the bonnet and wipe clean around the dipstick handle and filler orifice.
(5) Refill the gearbox with new Automatic Transmission 'G' Fluid only to the 'MAX' mark of the 'COLD' scale on the dipstick: approximately 2½ pints (1·3 litres, 3 U.S. pints) or 4 pints (2·3 litres, 4·8 U.S. pints) if the gearbox has been dismantled.
(6) With the vehicle on level ground apply the hand brake and select the 'P' (Park) position.
(7) Run the engine until normal operating temperature is reached.
(8) With the hand brake and foot brake firmly applied and with the engine running at idling speed, move the selector lever through all the gear positions two or three times, pausing for about 10 seconds in each position.
(9) Select 'P' (Park) and with the engine still running at idling speed, remove the dipstick and wipe the blade with a piece of clean paper or non-fluffy cloth.
(10) Re-insert the dipstick fully and withdraw it immediately, then check the fluid level indication. This should be between the 'MAX' and 'MIN' markings of the 'COLD' scale on the dipstick blade.
(11) Top-up the gearbox with fluid if necessary, then repeat the procedure in 8 to 11 until the fluid level is correct.

The difference between the '**MAX**' and '**MIN**' marks on either scale is approximately 1 pint (1·2 U.S. pints, 0·6 litre).

Section Dd.2

SERVICE REQUIREMENTS

(1) Fully road test and diagnose faults before dismantling an automatic gearbox. Use the test procedure given in Section Dd.8, and adjust as necessary. Re-test after rectification.

(2) High standards of cleanliness are essential: Clean the outside of the casing with paraffin prior to the removal of any components. Rags and cloth must be clean and lint-free, preferably nylon.

(3) Prior to assembly, clean all parts in chlorinated industrial solvent only. Renew all defective components. Lubricate all components in Automatic Transmission fluid. **DO NOT assemble dry.**

(4) Use new joint washers. Where jointing compound is required use Hylomar SQ32M, Hermatite, Well-seal or an equivalent.

(5) Retain thrust washers and bearings with petroleum jelly; do not use grease.

(6) Tighten screws, bolts and nuts to the recommended torque figure.

(7) For all operations where access is required beneath the vehicle, it should be on a lift, over a pit or the front raised on stands.

(8) Oil cooler: Flush out the cooler and connecting hoses wherever a unit is overhauled due to component failure.

(9) **Service parts are available only from LEYLAND CARS Service and Parts, through authorized Distributors and Dealers.**

Borg-Warner Limited do not supply service parts.

Section Dd.3

EXAMINATION OF COMPONENTS

Transmission case and servo castings	Check for cracks and obstructions in passages.
Pump	Check for scoring and excessive wear.
Shafts	Check bearing and thrust faces for scoring.
Clutch plates	Check for warping, scoring, overheating and excessive wear.
Bands	Check for scoring, overheating and excessive wear.
Drums	Check for overheating and scoring.
Gears	Check teeth for chipping, scoring, wear and condition of thrust faces.
Uni-directional clutch and races	Check for scoring, overheating and wear.
Valve block and governor	Check for burrs, crossed or stripped threads and scored sealing faces.
Impeller hub and pump drive gear	Check for piittng and wear. Ensure good contact.
Thrust washers	Check for burrs, scoring and wear.
White metal bushes	Check for scoring and loss of white metal.
Lip seals	Check for cuts, hardening of rubber, leakage past outer diameter.
Rubber 'O' rings and seals	Check for hardening, cracking, cuts or damage
Sealing rings	Check fit in groove and wear (evident by lip overhanging the groove).

Section Dd.4

DESCRIPTION

The automatic transmission is coupled to the engine by a torque converter. The hydraulically operated gearbox provides three forward ratios and reverse. All forward ratios are automatically engaged in accordance with the selector and accelerator positions and the speed of the vehicle.

Engine braking is available in the following selector/ratio conditions: **L—1** and **2**, **D—2** and **3**, **R**, Reverse.

Section Dd.5

MECHANICAL SYSTEM

Torque converter

The hydraulic torque converter provides a means of obtaining additional engine torque when starting from rest and accelerating in first and second ratios. Torque multiplication occurs whilst the stator is stationary, and is 1 : 1 when the stator rotates at the same speed as the impeller and turbine.

Clutches

The hydraulically operated clutches connect the converter to the gear set. In forward ratios the front clutch is applied; in reverse and '3' the rear clutch is applied.

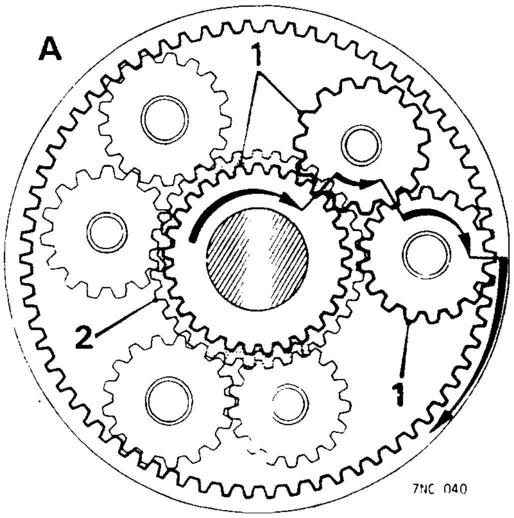


Fig. Dd.3

The gear set—FORWARD: 'A' (first and second ratio)

1. Forward sun gear, short and long pinions
2. Reverse sun gear

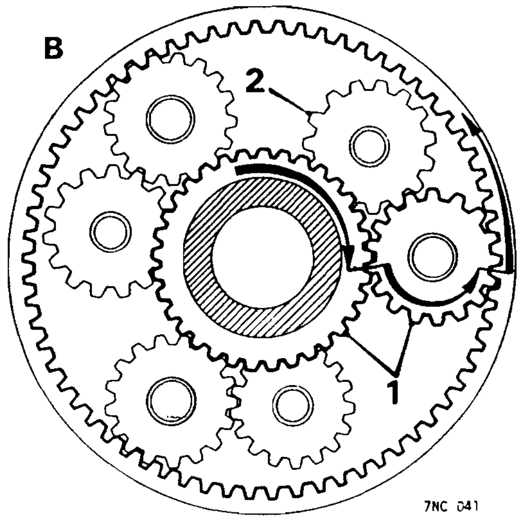


Fig. Dd.4

The gear set—REVERSE: 'B'

1. Reverse sun gear and long pinions
2. Short pinions and forward sun gear

Bands

The servo-operated bands hold elements of the gear set stationary to provide gear ratios. In **'L'** and **'R'** the rear band holds the pinion carrier stationary to provide the ratio. The front band holds the reverse sun gear stationary to provide second ratio.

One-way clutch

The one-way clutch is used in the first ratio of **'D'** to prevent the pinion carrier from turning opposite to engine rotation; and by allowing the gear set to free-wheel, ensures smooth changes from first to second ratio.

Gear set

FORWARD: 'A' (first and second ratios)

Power enters through the forward sun gear, the short and long pinions cause the ring gear to rotate in the same direction as the sun gear.

(1) Driving: Forward sun gear, short and long pinions.
(2) Idling: Reverse sun gear.

REVERSE: 'B'

Power enters through the reverse sun gear, the long pinions cause the ring gear to rotate in the opposite direction to the sun gear.

(1) Driving: Reverse sun gear and long pinions.
(2) Idling: Short pinions and forward sun gear.

1-L

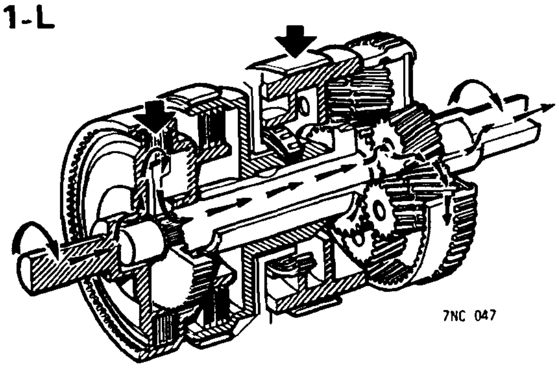


Fig. Dd.5

Mechanical power flow in '1–L'

Power flow

First ratio ('L' *selected*)

Front clutch engaged, connecting converter to forward sun gear. Rear band applied, holding planet carrier stationary. Planet pinions drive ring gear with a speed reduction of 2·39 : 1 and reverse sun gear idles. On over-run, ring gear and planets drive forward sun gear and converter, giving engine braking.

First ratio ('D' *selected*)

Front clutch engaged. One-way clutch prevents planet carrier from being driven in opposite direction to engine rotation. Planet pinions drive ring gear with a speed reduction of 2·39 : 1. On over-run, one-way clutch permits gear set to free-wheel.

Second ratio

Front clutch engaged. Front band applied, holding reverse sun gear stationary. Combined rotations of planet pinions and carrier drive ring gear with a speed reduction of 1·45 : 1.

1-D

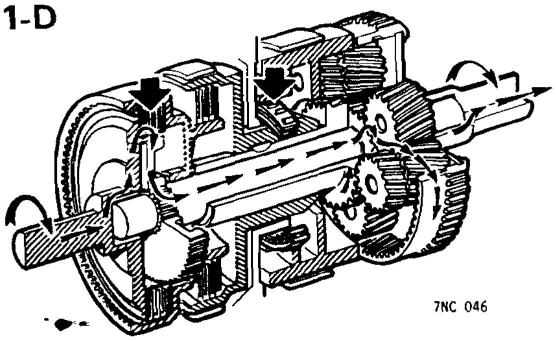


Fig. Dd.6

Mechanical power flow in '1–D'

2

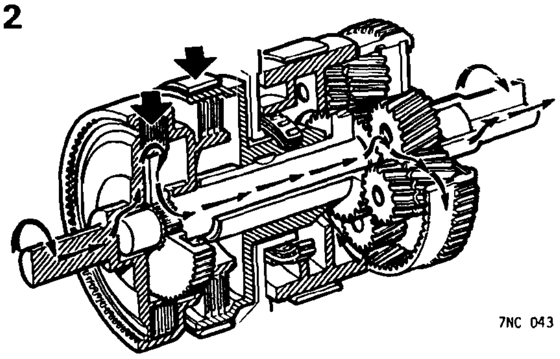


Fig. Dd.7

Mechanical power flow in '2'

Third ratio

Front clutch engaged. Rear clutch engaged, connecting converter to reverse sun gear. Both sun gears rotate in unison, causing planet carrier and ring gear to revolve without a speed reduction and so provide a 'direct' ratio of 1 : 1.

3

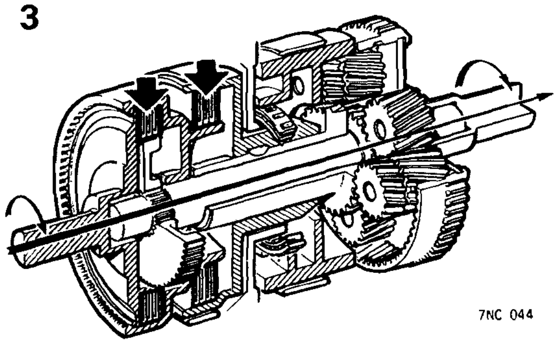


Fig. Dd.8

Mechanical power flow in '3'

Reverse ratio

Rear clutch engaged and rear band applied. Planet pinions drive ring gear in opposite direction to engine rotation with a speed reduction of 2·09 : 1.

R

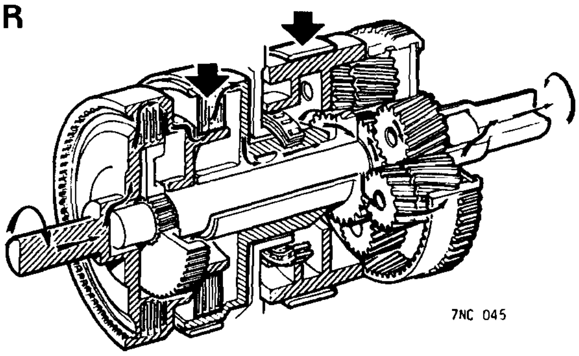


Fig. Dd.9

Mechanical power flow in '*R*'

Section Dd.6

HYDRAULIC SYSTEM

The transmission is controlled hydraulically via the valve bodies assembly under the combined influence of the driver, using the selector lever and throttle pedal, and a governor, sensitive to road speed, on the driven shaft.

Pump (S)

The pump, through regulator valves, supplies the hydraulic and lubrication requirements of the converter and transmission.

Manual valve (P)

Moving the selector to 'D', 'L', 'P' or 'R' moves the manual valve which directs fluid to (or exhausts from) appropriate valves, clutches or bands.

Down-shift and throttle valves (T, U)

The down-shift cam is connected by cable to the fuel injection pump throttle lever. Movement of the down-shift valve modifies throttle valve pressure; thus a pressure is produced which relates to engine torque and vehicle speed.

Full movement of the down-shift valve (throttle in 'kick-down' position) produces up-changes at pre-set maximum road speeds, or provides a down-change at speeds approximately 5 m.p.h. (8 km/h) below the maximum, according to governor pressure.

Governor (R)

The governor regulates pressure in accordance with the road speed of the vehicle. This pressure affects the points at which the ratio changes occur.

Circuit No.	Name of pressure	From—To
1	Line pressure	Pump Primary regulator valve Manual control valve Throttle valve
2	Governed pressure	Governor Modulator valve 1–2 shift valve 2–3 shift valve Servo orifice control valve
3	Directed line pressure	Manual control valve 2–3 shift valve
5	Directed line pressure	Manual control valve Front clutch and governor feed 1–2 shift valve
6	Directed line pressure	Manual control valve 1–2 shift valve
7	Directed line pressure	Manual control valve 2–3 shift valve
8	Modulated throttle pressure	Modulator valve Primary regulator valve (piston end)
9	Throttle pressure	Throttle valve Modulator valve Primary regulator valve (spring end) 2–3 shift valve plunger
9a	Throttle pressure controlled by modulator valve	Modulator valve Throttle valve
10	Shift valve plunger pressure	Shift valve plunger 2–3 shift valve 1–2 shift valve
10a	Shift valve plunger pressure	Shift valve plunger 1–2 shift valve
11	Forced throttle pressure	Down-shift valve 1–2 shift valve 2–3 shift valve
13	Line pressure	1–2 shift valve Rear servo apply
15	Line pressure	2–3 shift valve Rear clutch and front servo release
19	Line pressure	1–2 shift valve Front servo apply
21	Converter pressure	Primary regulator valve Secondary regulator valve and converter
23	Lubrication pressure	Secondary regulator valve
24	Exhaust	Secondary regulator valve Pump suction

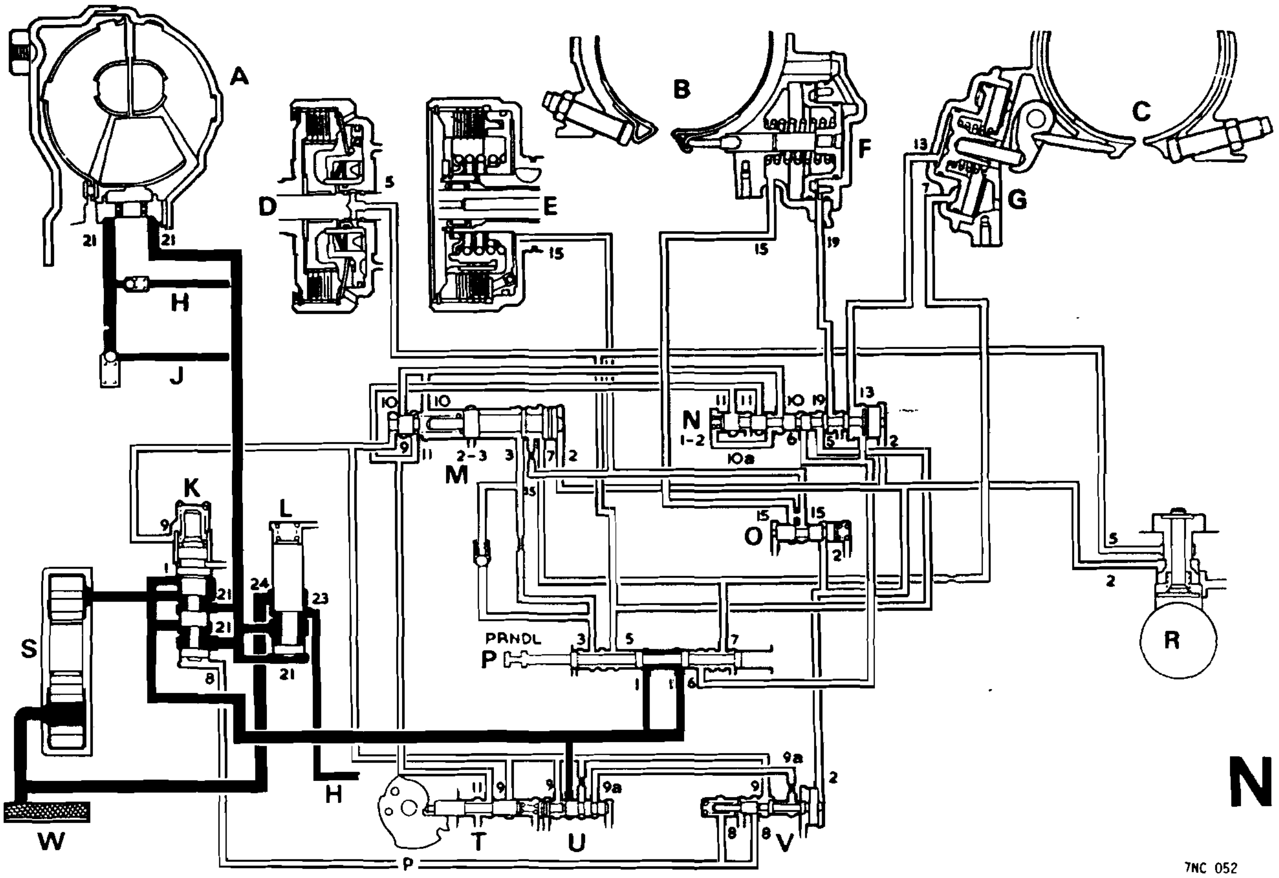


*Fig. Dd.*10

Hydraulic circuits—operation in neutral (engine idling)

A. Converter
B. Front band
C. Rear band
D. Front clutch
E. Rear clutch
F. Front servo
G. Rear servo
H. Lubrication
J. To oil pan
K. Primary regulator valve
L. Secondary regulator valve
M. 2–3 shift valve
N. 1–2 shift valve
O. Servo orifice control valve
P. Manual valve
R. Governor
S. Pump
T. Down-shift valve
U. Throttle valve
V. Modulator valve
W. Strainer

The numbers refer to circuits listed under **'HYDRAULIC SYSTEM'**

Section Dd.7

TEST EQUIPMENT

Connecting

(1) Stop the engine and remove the blanking plug from the line pressure take-off point, using adaptor CBW 547A-50-4 or 18G 1277.
(2) Fit the adaptor 18G 677 B to the pressure point.
(3) Connect the pressure gauge pipe of 18G 677 ZC to the adaptor.
(4) Position and connect the tachometer 18G 677 ZC where it can be read from the driver's seat:
  (*a*) Connect the Red connector to '—' terminal of the coil.
  (*b*) Connect the black connector to the engine (earth).
  (*c*) Switch to '× 100' or '× 1000' as required.
  (*d*) Switch to '4 cyl'.

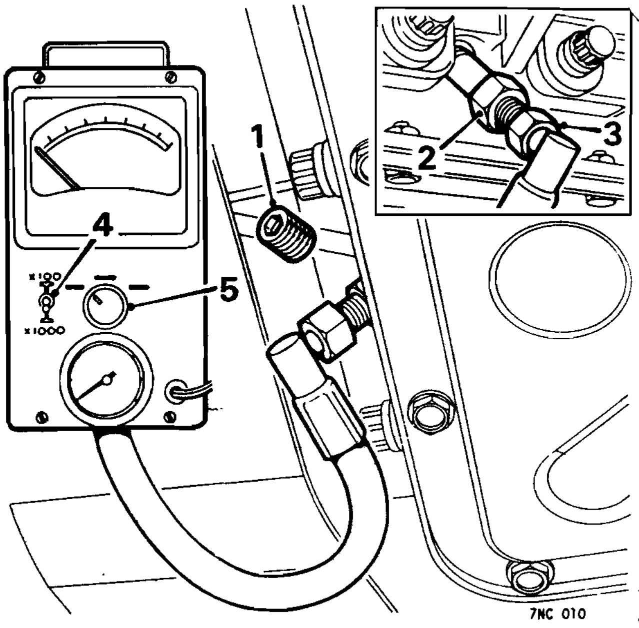


*Fig. Dd.*11

Connecting test equipment 18*G* 677 *ZC*

1. Blanking plug
2. Adaptor 18G 677-1
3. Pressure gauge pipe
4. '× 100' '× 1000' switch
5. '4 cyl'-'6 cyl' switch

Section Dd.8

TEST PROCEDURE

Connect test equipment 18G 677 ZC to the engine and gearbox as described in Section Dd.7 and position the equipment inside the vehicle where it can be read from the driver's seat.

Carry out this test procedure completely, in the order given, noting:

Tests 1 to 7: Rectify any fault as it is found before proceeding to the next test.
Tests 8 to 12: It may be possible to complete these tests, noting any faults in order to rectify them after the tests. However, it must be noted that this could allow one fault to mask another.

TEST	FAULT	RECTIFICATION
1. Check the fluid level.	a. Incorrect level.	1a. Correct the level, see Section Dd.1.
2. Check the throttle with the pedal fully depressed.	a. Throttle not fully open.	2a. Adjust the cable.
3. Apply the brakes, then check that the starter will operate only when 'P' and 'N' are selected.	a. Starter will not operate in 'P' and 'N'.	3a. Check the inhibitor switch and circuit for continuity.
	b. Starter operates in all positions.	3b. Check the inhibitor switch and circuit for short circuiting.
4. Check the adjustment of the selector cable, see Section Dd.10.	a. Linkage incorrectly adjusted	4a. Adjust the cable, see Section Dd.10.

TEST	FAULT	RECTIFICATION
5. Position the vehicle on a slope, select **'P'** and release the brakes. Repeat this test with the vehicle facing in the opposite direction.	a. The parking pawl fails to hold the vehicle in one or both positions.	5a. Repair the parking pawl mechanism as necessary.
6. If possible, run the engine to obtain normal operating temperature. Stop the engine and disconnect the down-shift cable from the fuel injector pump. Chock the wheels, apply the brakes and run the engine at idle speed. Select **'D'** and check the pressure registered on the gauge. Stop the engine.	a. The pressure is below 55 lbf/in² (3·8 kgf/cm²).	6a. Check: i. Blocked oil strainer. ii. Worn or damaged valve block assembly. iii Leaking or damaged oil suction tube. iv. Leaking governor or supply line. v. Worn or damaged oil pump. vi. Leaking front clutch or supply line.
	b. The pressure is above 70 lbf/in² (4·9 kgf/cm²).	6b. Check that the crimped stop on the kick-down inner cable is contacting the adjuster; if it is, check the valve block assembly.
7. Connect the down-shift cable. Run the engine at idle speed with **'D'** selected and, if necessary, adjust the cable to obtain the same pressure as in Test 6. Increase the idle speed by 500 rev/min and, if necessary, adjust the down-shift cable to give a pressure increase of 20 to 25 lbf/in² (1·4 to 1·7 kgf/cm²). Return the engine speed to idle and check that the pressure has returned to that in Test 6.	a. The required pressure increase cannot be obtained. b. Insufficient pressure drop at idle speed.	7a. Check the valve block assembly. 7b. Check the valve block assembly.
8. Remove the chocks from the wheels and release the brakes. Select **'L'** and drive forward on light throttle. Release the throttle and check for engine braking.	a. No forward drive. b. Forward drive but no engine braking.	8a. Check the front clutch and its supply line. 8b. Check and adjust the rear brake band; if correct, check the rear servo and its supply line via the 1–2 shift valve.
9. Select **'D'** from rest and drive forward on light throttle.	a. No forward drive.	9a. Renew the one-way clutch.

TEST	FAULT	RECTIFICATION
10. Select 'D' and accelerate from rest using light throttle. Up-shifts should occur at the following speeds: 1–2 up-shift at 8 to 13 m.p.h. (13 to 21 km/h).	a. Up-shifts occur at incorrect speeds in one or both checks.	10a. Check: i. The valve block. ii. The governor. iii. The governor supply and delivery lines.
2–3 up-shift at 10 to 15 m.p.h. (16 to 24 km/h).	b. No 1–2 up-shift in one or both checks.	10b. Check and adjust the front brake band; if correct, check the front servo and its supply line. If that is also correct, check: i. The valve block. ii. The governor. iii. The governor supply and delivery lines.
Repeat this test using kick-down. Up-shifts should now occur at: 1–2 up-shift at 15 to 27 m.p.h. (24 to 43 km/h). 2–3 up-shift at 38 to 47 m.p.h. (61 to 75 km/h).	c. No 2–3 up-shifts in one or both checks.	10c. Check: i. The valve block. ii. The governor. iii. The governor supply and delivery lines. iv. The rear clutch and its supply line.
11. Select 'R' and reverse the vehicle from rest using full throttle.	a. Transmission slip.	11a. Check and adjust the rear brake band; if correct, check the rear servo and its supply line via the manual control valve.
12. Chock the wheels, apply the brakes, select 'L' and depress the throttle pedal fully for not more than 10 seconds. Note the highest rev/min obtained. Repeat this procedure with 'R' selected.	a. A reading outside the range 1,600 to 1,800 rev/min in one or both positions.	12a. See Section Dd.9.

Section Dd.9

STALL TEST

The maximum engine speed obtained in test 13 of 'TEST PROCEDURE, Section Dd.8' is an indication of the engine, converter, and gearbox condition. Check the engine speed obtained in test 12 of the test procedure against the following table:

Rev/Min	*Indication*
Below 1100	Stator slip (defective converter)
1300 to 1500	Engine power down
1600 to 1800	Satisfactory
Over 2000	Transmission slip

Section Dd.10

ADJUSTMENTS

Down-shift cable

Checking

(1) Chock the wheels and apply the hand brake.
(2) Disconnect the down-shift inner cable from the fuel injection pump, pull the inner cable, then release it; the cable should return under the influence of the down-shift cam return spring. If the cable does not return, find and correct the fault.
(3) Connect test equipment 18G 677 ZC to the engine and gearbox as described in Section Dd.7.
(4) Run the engine until the gearbox reaches normal

operating temperature. Apply the brake, select **'D'** and allow the engine to run at its correct idle speed.

(5) Check the fluid pressure which should be 55 to 70 lbf/in² (3·8 to 4·9 kgf/cm²).

(6) Re-connect the down-shift cable and ensure that the pressure remains as in 5.

(7) Increase the engine speed by 500 rev/min and note the pressure increase which should be 20 to 25 lbf/in² (1·4 to 1·7 kgf/cm²).
If the pressure increase is incorrect, adjust the cable.

Adjusting

(8) Slacken the locknut and adjust the outer cable to give the correct pressure increase at idle speed plus 500 rev/min. Tighten the locknut.

(9) Reduce the engine speed to idle and ensure that the pressure drops by 20 to 25 lbf/in² (1·4 to 1·7 kgf/cm²).
NOTE: If the correct pressure cannot be obtained at both speed settings, see Section Dd.8.

(10) Stop the engine and disconnect test equipment 18G 677 ZC.

(11) With the cable correctly adjusted (as already described) the cable stop should be just out of contact with the end of the adjuster. If the stop is loose on the cable, position it correctly and crimp it into position.

Selector cable

Checking

(1) Position the selector lever at 'N' and start the engine.

(2) Select **'D'**, release the brakes and drive forward. As the vehicle moves forward, select 'N'. Disconnection of the drive should be felt as 'N' is selected.

(3) Stop the vehicle, select **'R'** and drive backwards. As the vehicle moves backwards, select 'N'. Disconnection of the drive should be felt as 'N' is selected.

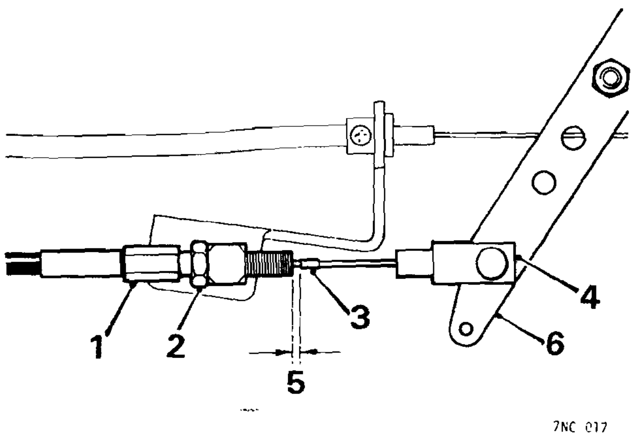


*Fig. Dd.*12

Down-shift cable adjustment

1. Cable adjuster
2. Locknut
3. Cable stop
4. Cable fork end
5. Clearance
6. Throttle lever

(4) If the drive is felt to disconnect as 'N' is selected from both directions, the gear selector cable adjustment is correct.

Adjusting

(5) Stop the engine, apply hand brake and select **'N'**.

(6) Slacken the selector cable locknuts.

(7) Disconnect the inner cable from the gearbox selector lever.

(8) Check that the gearbox selector lever is in the neutral position (third position from fully forward).

(9) Adjust the cable by means of the locknuts until the hole in the yoke end lines up with the hole in the lever. Tighten the locknuts.

(10) Fit the clevis pin and secure with a new split pin.

(11) Ensure that the engine will only start with 'N' or 'P' selected.

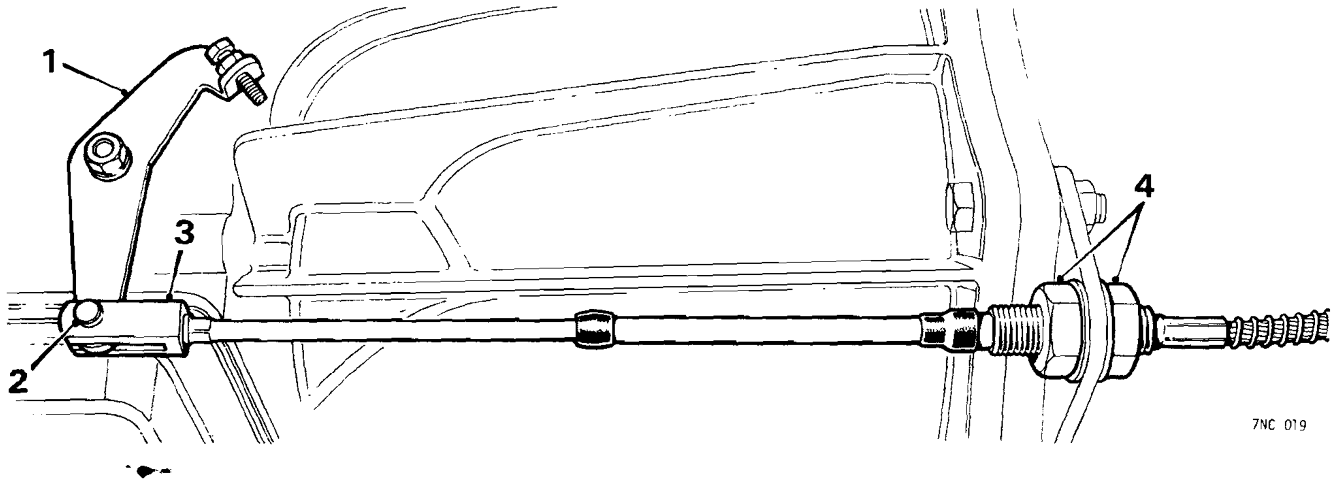


*Fig. Dd.*13

Selector cable adjustment

1. Selector lever
2. Clevis pin
3. Cable fork end
4. Locknuts

Front brake band

(12) Slacken the locknut.

(13) Tighten the adjusting screw to 40 lbf in (0·46 kgf m) using CBW 61A/2 and back off three-quarters of a turn.
NOTE: When using a torque wrench direct, tighten the screw to 5 lbf ft (0·7 kgf m) before backing off.

(14) Tighten the locknut to 24 lbf ft (3·3 kgf m) using CBW 61A/1.
NOTE: When using a torque wrench direct, tighten the locknut to 35 lbf ft (4·8 kgf m).

Rear brake band

(15) Slacken the locknut.

(16) Tighten the adjusting screw to 40 lbf in (0·46 kgf m) using CBW 61A/2 and back off three-quarters of a turn.
NOTE: When using a torque wrench direct, tighten the screw to 5 lbf ft (0·7 kgf m) before backing off.

(17) Tighten the locknut to 24 lbf ft (3·3 kgf m) using CBW 61A/1.
NOTE: When using a torque wrench direct, tighten the locknut to 35 lbf ft (4·8 kgf m).

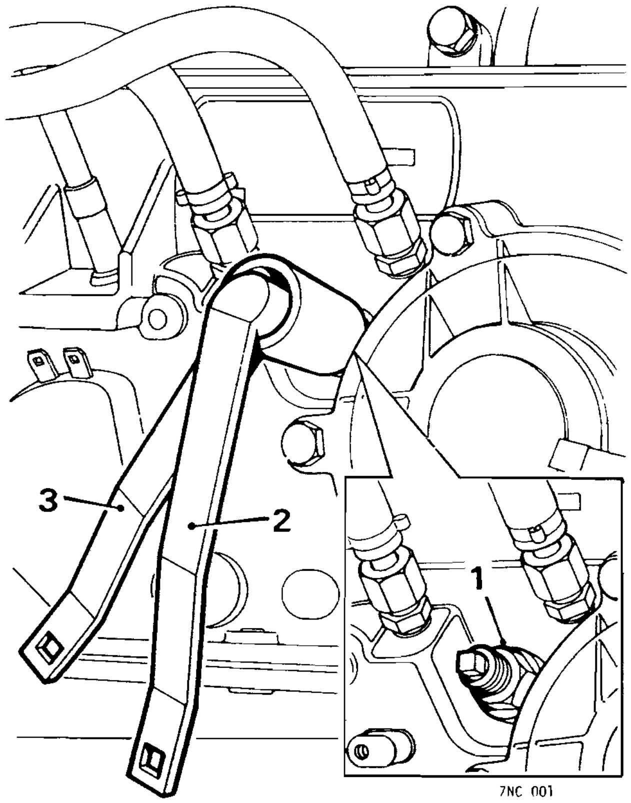


Fig. Dd.14

Front brake band adjustment

1. Locknut 2. Service tool CBW 61A/2 3. Service tool CBW 61A/1

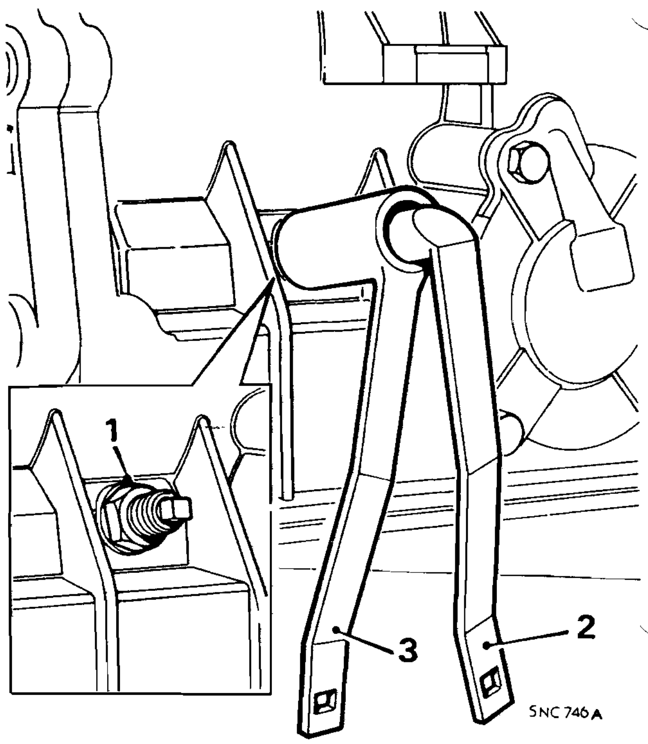


Fig. Dd.15

Rear brake band adjustment

1. Locknut 2. Service tool CBW 61A/2 3. Service tool CBW 61A/1

Section Dd.11

AIR PRESSURE CHECKS

Air pressure checks can be made on the gearbox assembly to determine whether the clutches and brake bands are operating. These checks can be made with the transmission in the car or on the bench, using a high pressure air-line. Remove the oil pan, the valve body and oil tubes.

Front clutch and governor feed

(1) Apply air pressure to the passage (1, Fig. Dd.16). Listen for a thump, indicating that the clutch is functioning. With the unit on a bench, verify by rotating the input shaft with air pressure applied. Keep air pressure applied for several seconds to check for leaks in the circuit.
If the extension housing has been removed, rotate the output shaft so that the governor weight is at the bottom of the assembly. Verify that the weight moves inwards with air pressure applied.

Rear clutch

(2) Apply air pressure to the passage (2). With the unit on the bench, verify that the clutch is functioning by turning the input shaft. Keep air pressur

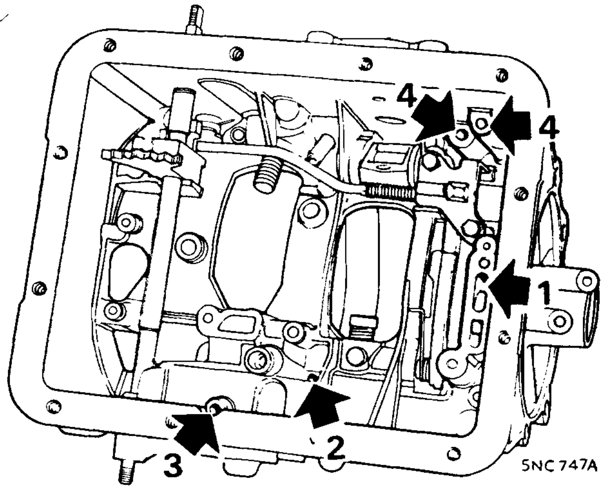


*Fig. Dd.*16

Air pressure checks

1. Front clutch and governor feed
2. Rear clutch
3. Front servo
4. Rear servo

applied for several seconds to check for leaks; then release the pressure and listen for a thump indicating that the clutch has released.

Front servo

(3) Apply air pressure to the apply tube location (3). Observe the movement of the piston pin.

Rear servo

(4) Apply air pressure to the tube locations (4). Observe the movement of the servo lever.

Section Dd.12

TRANSMISSION ASSEMBLY AND CONVERTER

NOTE: The normal operating temperature of the fluid is between 80 and 110°C. (212 and 239°F.) approximately. To avoid the possibility of scalding, extreme caution must be exercised when draining a transmission which has recently been operating. For capacity refer to vehicle 'GENERAL DATA'.

Removing

(1) Disconnect the battery.
(2) Disconnect the kick-down cable from its lever on the fuel injection pump, and detach the cable abutment from its bracket on the pump.
(3) Detach the electrical leads from the starter motor.
(4) Withdraw the dipstick.
(5) Raise the vehicle.
(6) Disconnect the selector cable from the lever on the gearbox.
(7) Remove the bolt securing the selector cable bracket to the engine back plate.
(8) Remove the bolt securing the upper filler tube to the engine back plate and withdraw the upper filler tube from the lower filler tube.
(9) Support the lower filler tube, slacken the gland nut securing it to the oil pan and allow the fluid to drain. Remove the lower filler tube.
(10) Jack up one rear wheel, remove the propeller shaft, then lower the wheel.
(11) Detach the speedometer cable and taximeter cable (if fitted) from the transmission.
(12) Detach the electrical cables from the inhibitor switch.
(13) Disconnect the oil cooler pipes from the transmission casing.
(14) Detach the exhaust pipe from the engine manifold, and disconnect the support clips from the converter housing and from the rubber mounting, forward of the silencer.
(15) Remove the rebound rubber support cross-member from the chassis.
(16) Support the engine forward of the converter housing.
(17) Release the gearbox mountings from the chassis.
(18) Lower the power unit and detach the mountings from the gearbox.
(19) Remove the bolts retaining the starter motor to the engine back plate.
(20) Support the transmission assembly with a transmission jack.
(21) Remove the bolts securing the converter housing to the engine back plate, noting the position of the two dowel bolts.
(22) Withdraw the transmission assembly.
(23) Remove the rubber plug in the engine back plate to give access to the converter retaining bolts.
(24) Unlock and remove the four bolts retaining the converter to the drive plate, rotating the crankshaft to bring each bolt in line with the access hole in turn.
(25) Detach the converter assembly.

Refitting

(26) Reverse the procedure in (1) to (25), noting the following points:
   (*a*) The pump driving tangs in the converter must line up with the slots of the gear in the transmission assembly before refitting the transmission assembly.
   (*b*) The upper bend of the gearbox breather pipe must be a minimum of 12 in (30·5 cm) above the gearbox outlet.

Section Dd.13

TAXIMETER DRIVE, SPEEDOMETER DRIVE AND GOVERNOR ASSEMBLY

Removing

(1) From inside the cab remove the access panel on the rear left-hand side of the gearbox tunnel.
(2) Remove the screw retaining the taximeter drive cable locking bracket and detach the bracket.
(3) Disconnect the taximeter drive cable and the speedometer drive cable.
(4) Remove the propeller shaft.
(5) Detach the exhaust pipe from the engine manifold, and disconnect the support clips from the converter housing and from the mounting rubber forward of the silencer.
(6) Detach the oil cooler return pipe from the clip on the chassis, just forward of the flexible hose.
(7) Remove the rebound rubber support cross-member.
(8) Support the power unit and remove the bolts retaining the gearbox mountings to the chassis.
(9) Lower the power unit and detach the mountings from the gearbox.
(10) Remove the three screws retaining the taximeter drive housing to the gearbox rear extension and detach the drive assembly.
(11) Remove the speedometer drive housing assembly from the rear extension.
(12) Use tool 18G 1205 and remove the propeller shaft drive flange from the rear of the gearbox.
(13) Remove the screws retaining the gearbox rear extension to the transmission casing and detach the rear extension.
(14) Withdraw the taximeter drive gear, and remove the drive key from the shaft.

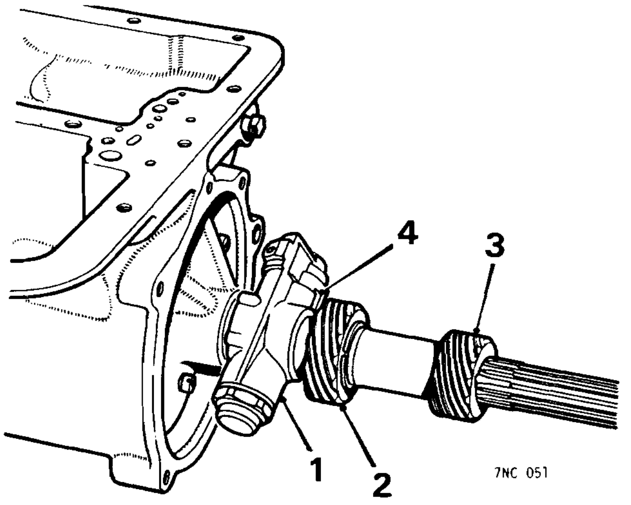


Fig. Dd.17

Governor, taximeter, and speedometer drive gear

1. Governor assembly
2. Speedometer drive gear
3. Taximeter drive gear
4. Governor oilway

(15) Use tool 18G 1004 and points 18G 1004 J to remove the front speedometer drive gear retaining circlip.
(16) Remove the drive gear and its driving ball.
(17) Use tool 18G 1004 with points 18G 1004 J to remove the rear speedometer drive gear circlip.
(18) Remove the governor securing screw and lock washer and withdraw the governor assembly.

Dismantling

(19) Pull off the retainer and withdraw the weight.
(20) Withdraw the stem, spring and valve from the governor body.

Reassembling

(21) Reverse the procedure in (19) and (20), ensuring that the governor weight moves freely.

Refitting

(22) Reverse the removing procedure in (1) to (18), noting that the governor is fitted to the output shaft with the oilway facing away from the gearbox. Refit the governor securing screw and lock washer ensuring that its ball end registers in the hole in the shaft, and tighten the screw to its correct torque tightness (see **'GENERAL DATA'**). **DO NOT OVERTIGHTEN.**

Section Dd.14

VALVE BODIES COMPONENTS

Removing

(1) Remove the filler tube gland nut and drain the transmission casing.
(2) Unscrew the oil pan retaining screws and remove the oil pan and joint washer.
(3) Remove the starter inhibitor switch.
(4) Remove the magnet and carefully pull out the oil connector tubes.
(5) Disconnect the down-shift cable from the cam.
(6) Remove the three bolts retaining the valve bodies assembly and lift out the assembly.

Dismantling

(7) Unscrew the two screws securing the down-shift cam assembly and remove the cam assembly.
(8) Remove the four screws and detach the oil strainer and gasket.
(9) Remove the detent spring screw, move the detent spring aside and remove the spacer.
(10) Take out the eight upper valve body screws and remove the upper valve body.
(11) Take out the eight oil tube collector screws and remove the oil tube collector.
(12) Remove the four screws securing the governor line plate.

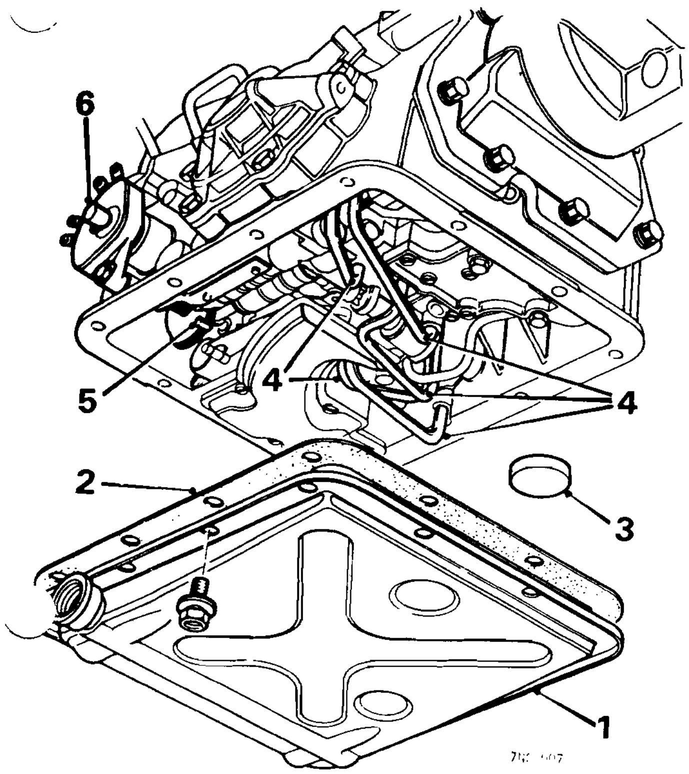


*Fig. Dd.*18

1. Oil pan
2. Gasket
3. Magnet
4. Oil connector pipes
5. Down-shift cable
6. Starter inhibitor switch

(13) Remove the governor line plate and the separating plate.
(14) Remove the check valve ball and spring.
(15) Remove the servo orifice control valve spring and stop.
(16) Withdraw the servo orifice control valve.
(17) Tap out the dowel pin, applying light pressure to the plug.
(18) Withdraw the modulator plug and valve.
(19) Withdraw the modulator valve spacer and spring.
(20) Remove the throttle valve stop and return spring.
(21) Remove the throttle valve plate and withdraw the manual control valve.
(22) Withdraw the down-shift valve, throttle valve spring and throttle valve.
(23) Slacken progressively the three screws securing the end plate and carefully remove the end plate.
(24) Remove the primary regulator valve spring and withdraw the sleeve and primary regulator valve.
(25) Remove the secondary regulator valve spring and withdraw the secondary regulator valve.
(26) Unscrew the three screws and remove the front end plate from the upper valve body.
(27) Unscrew the three screws and remove the rear end plate from the upper valve body.
(28) Withdraw the 2–3 shift valve, spring and plunger.
(29) Withdraw the 1–2 shift valve, spring and plunger.

Inspection

(30) Clean all parts in cleaning solvent; dry by blowing with compressed air.
(31) Check all fluid passages for obstructions. Inspect valves, bores, mating surfaces for burrs or scoring.

Reassembling

(32) Lubricate all components in clean Automatic Transmission 'G' Fluid.
(33) Reverse the procedure in 7 to 29, noting:
   (*a*) Verify that all the valves move freely in their bores.
   (*b*) Tighten all the screws evenly to 2·1 lbf ft (0·3 kgf m).
   NOTE: Fit all the governor line plate, oil collector plate and upper valve body screws finger tight before finally tightening them to the correct torque figure.
   (*c*) Use a new oil strainer joint washer if necessary.
(34) Later down-shift brackets with elongated screw holes must be adjusted to give correct gap between the throttle valve and the exhaust port.
   NOTE: It is essential that the fixing screw heads are fitted against the bracket and that the nuts are fitted between the casting lugs on the upper valve body.
   (*a*) Disconnect the down-shift cable from the cam; ensure that the cam returns fully so that the flat section is against the down-shift valve.
   (*b*) Slacken the two fixing screws until the bracket can be moved away from the valve block to enlarge the gap in the throttle valve exhaust port.

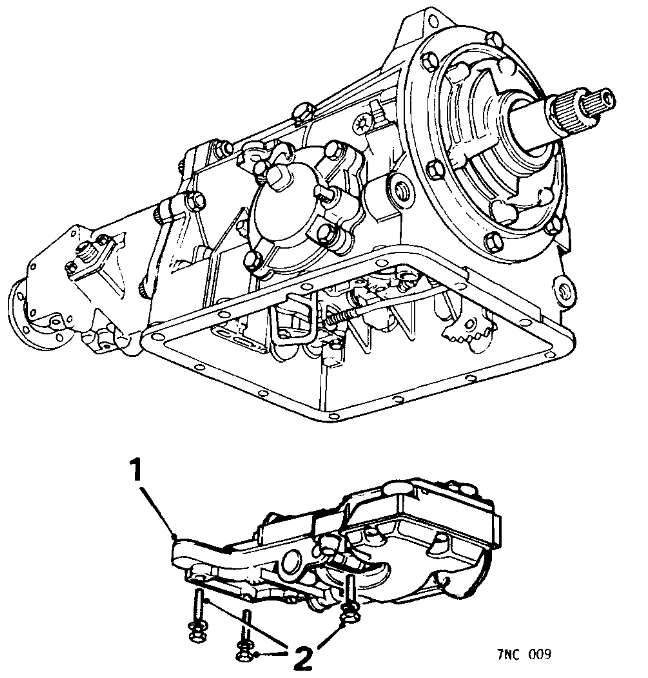


*Fig. Dd.*19

1. Valve bodies assembly 2. Retaining screws

(c) Insert a 1 mm feeler gauge between the heel of the cam and the down-shift valve and slide the bracket towards the valve block until the gap between the throttle valve and the exhaust port just closes.
(d) Tighten the screws and verify that the down-shift valve bears correctly on the cam.
(e) Remove the feeler gauge and the throttle valve will move forwards to give the correct clearance between the valve and the exhaust port.

Refitting

(35) Reverse the procedure in 1 to 6, noting:
(a) Ensure that the oil tubes are not distorted when refitting the valve bodies assembly.
(b) Tighten the valve bodies assembly screws to 7 lbf ft (1·0 kgf m).
(c) Ensure that the oil pipes are pushed fully into place.
(d) Attach the magnet to the valve bodies assembly, under the rear servo pipes.

Refill the gearbox with new Automatic Transmission 'G' Fluid and check the level, see Section Dd.1.

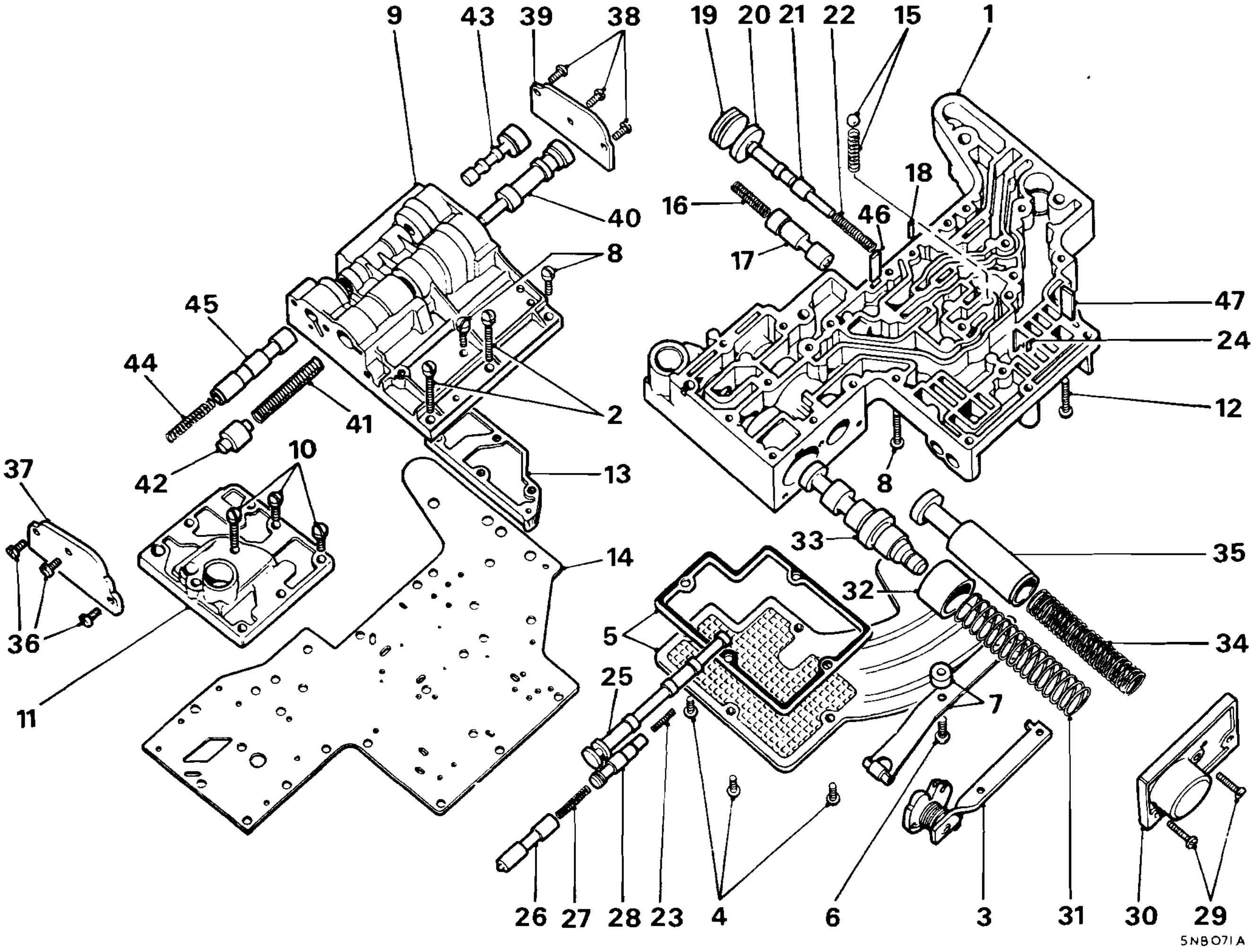


Fig. Dd.20

The valve bodies components

1. Lower valve body
2. Down-shift cam screws
3. Down-shift cam assembly
4. Oil strainer screws
5. Oil strainer and gasket
6. Detent spring screw
7. Detent spring and spacer
8. Upper valve body screws
9. Upper valve body
10. Oil tube collector screws
11. Oil tube collector
12. Governor line plate screws
13. Governor line plate
14. Separating plate
15. Check valve ball and spring
16. Servo orifice control valve spring
17. Servo orifice control valve
18. Dowel pin
19. Modulator valve plug
20. Modulator valve
21. Modulator valve spacer
22. Modulator valve spring
23. Throttle valve return spring
24. Throttle valve plate
25. Manual control valve
26. Down-shift valve
27. Throttle valve spring
28. Throttle valve
29. End plate screws
30. End plate
31. Primary regulator valve spring
32. Primary regulator valve sleeve
33. Primary regulator valve
34. Secondary regulator valve spring
35. Secondary regulator valve
36. Front end plate screws
37. Front end plate
38. Rear end plate screws
39. Rear end plate
40. 2–3 shift valve
41. 2–3 shift valve spring
42. 2–3 shift valve plunger
43. 1–2 shift valve
44. 1–2 shift valve spring
45. 1–2 shift valve plunger
46. Servo orifice control valve stop
47. Throttle valve stop

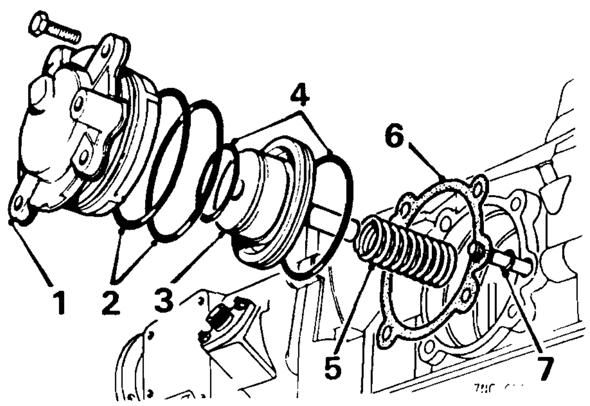


Fig. Dd.21

The front servo

1. Servo body
2. 'O' rings for body
3. Servo piston
4. 'O' rings for piston
5. Spring for piston
6. Joint washer
7. 'O' ring for cross-shaft

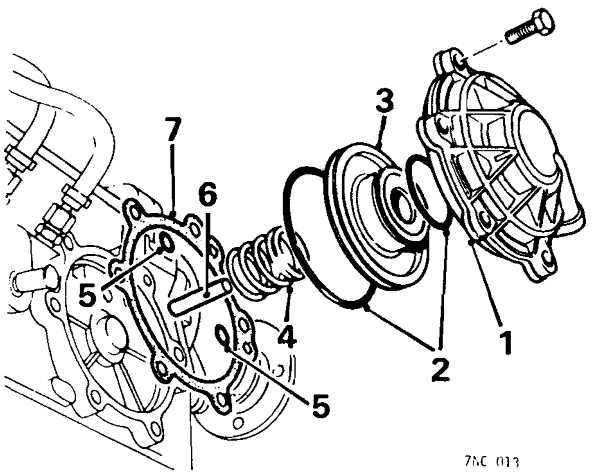


Fig. Dd.22

The rear servo

1. Servo body
2. 'O' rings for piston
3. Servo piston
4. Spring for piston
5. 'O' rings for body flange
6. Push-rod
7. Joint washer

Section Dd.15

FRONT SERVO

Removing

(1) Remove the selector lever from the gearbox.
(2) Take precautions against fluid spillage.
(3) Remove the four screws securing the servo to the gearbox.
(4) Withdraw the servo assembly, spring and joint washer.
(5) Remove the spring from the piston.
(6) Withdraw the piston from the servo body.
(7) Remove the 'O' rings from the piston.
(8) Remove the 'O' rings from the body.
(9) Remove the 'O' ring from the cross-shaft.

Inspection

(10) Check the 'O' rings for signs of deterioration or damage; renew the rings as necessary.

Refitting

(11) Reverse the procedure in 1 to 9 as necessary, noting:
  (*a*) Lubricate the components before refitting.
  (*b*) With the cross shaft and its cover bore clean, apply a small quantity of Lithium base grease into the cross shaft bore of the cover.
  (*c*) Wipe off any grease on the gasket face of the cover; ensuring that the face is clean.
  (*d*) Use a new joint washer and tighten the cover screws to 16 lbf ft (2·2 kgf m).
  (*e*) Wipe off any excess grease on the protruding end of the cross shaft.
  (*f*) Check the fluid level, see Section Dd.1.

Section Dd.16

REAR SERVO

Removing

(1) Take precautions against fluid spillage.
(2) Remove the six screws securing the servo cover to the gearbox.
(3) Withdraw the servo assembly and joint washer together with 'O' rings, spring and push-rod.
(4) Remove the spring and push-rod from the piston.
(5) Remove the joint washer and 'O' rings from the body flange.
(6) Withdraw the piston from the servo body.
(7) Remove the 'O' rings from the piston.

Inspection

(8) Check the 'O' rings for signs of deterioration or damage; renew the rings as necessary.

Refitting

(9) Reverse the procedure in 1 to 7 as necessary, noting:
  (*a*) Lubricate the components before refitting.
  (*b*) Use a new joint washer and tighten the lower screws to 16 lbf ft (2·2 kgf m).
  (*c*) Check the fluid level, see Section Dd.1.

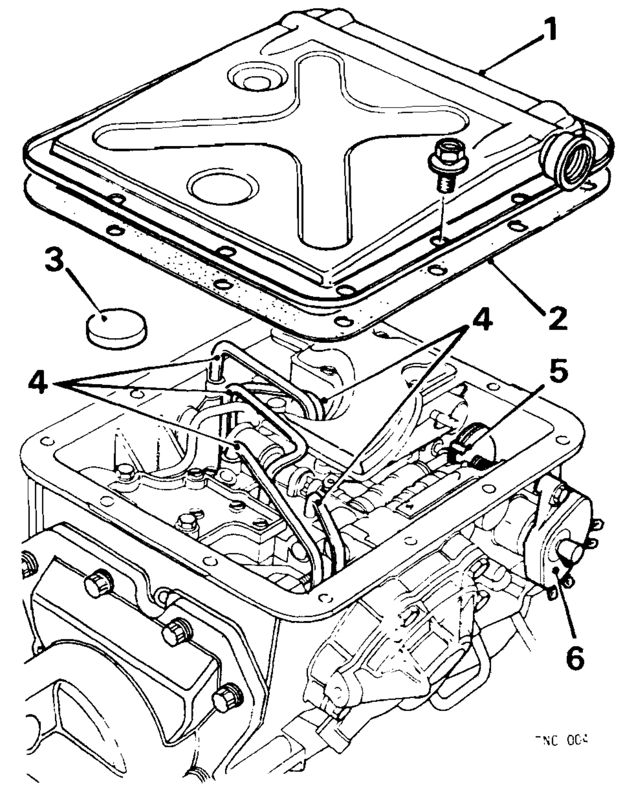


Fig. Dd.23

1. Oil pan
2. Gasket
3. Magnet
4. Oil collector pipes
5. Down-shift cable
6. Starter inhibitor switch

Section Dd.17

PUMP

Removing

(1) Remove the gearbox, see Section Dd.12.
(2) Wash the exterior of the unit in clean paraffin, invert it and place on bench cradle CBW 60.
(3) Remove the starter inhibitor switch.
(4) Unscrew the four bolts and remove the torque converter housing.
(5) Unscrew the oil pan retaining screws and remove the oil pan and joint washer.
(6) Remove the magnet and carefully pull out the oil connector tubes.
(7) Disconnect the down-shift cable from the cam.
(8) Remove the three screws retaining the valve bodies assembly and lift out the assembly.
(9) Unscrew the two bolts, remove the oil tube locating plate and pull out the oil tubes. (Note the 'O' ring on the pump suction tube.)
(10) Unscrew the five pump retaining bolts and withdraw the pump assembly.
(11) Remove the input shaft thrust washer.

Dismantling

(12) Unscrew the five bolts and spring washers securing the pump body to the stator support.
(13) Take out the locating screw and spring washer.
(14) Separate the stator support from the pump body assembly.
(15) Mark the outside faces of the gears to facilitate correct assembly and remove the gears.
(16) Remove the sealing ring and oil seal from the pump body.

Inspection

(17) Check the pump body, the stator support and the gear teeth for scores and excessive wear; remove light scores with very fine abrasive cloth.

Reassembling

(18) Press in a new seal flush with the face of the pump body.
(19) Fit a new sealing ring to the pump body and lubricate with petroleum jelly, ensuring that all mating surfaces are clean and free from burrs.
(20) Fit the gears to the pump body.
(21) Lightly lubricate the gears.

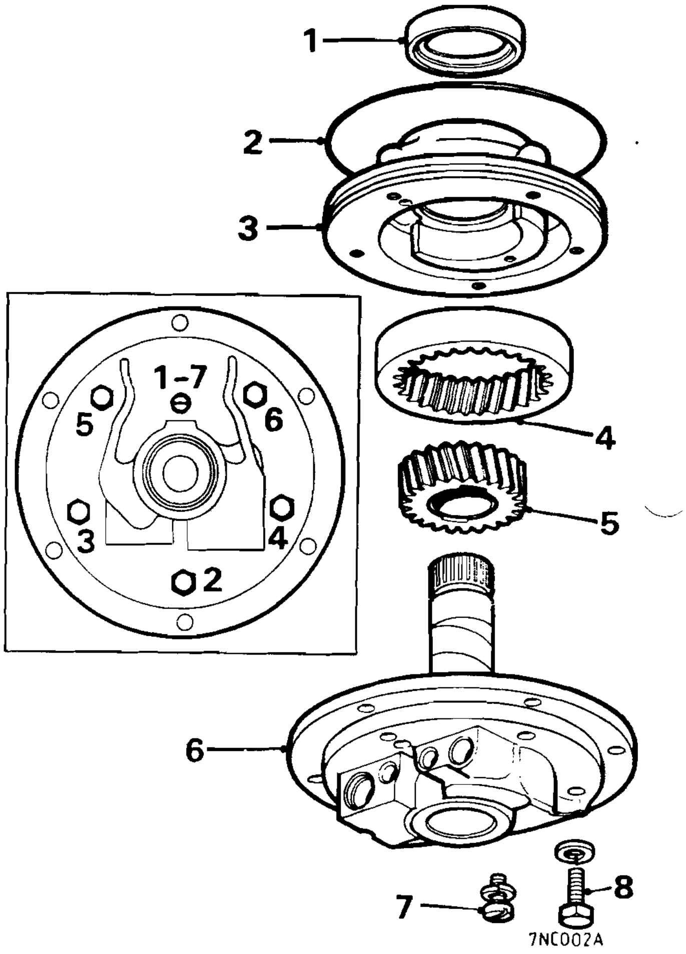


Fig. Dd.24
The pump components

1. Oil seal
2. Sealing ring
3. Pump body
4. Driven gear
5. Driving gear
6. Stator support
7. Locating screw
8. Pump body screw

Inset: Screw tightening sequence

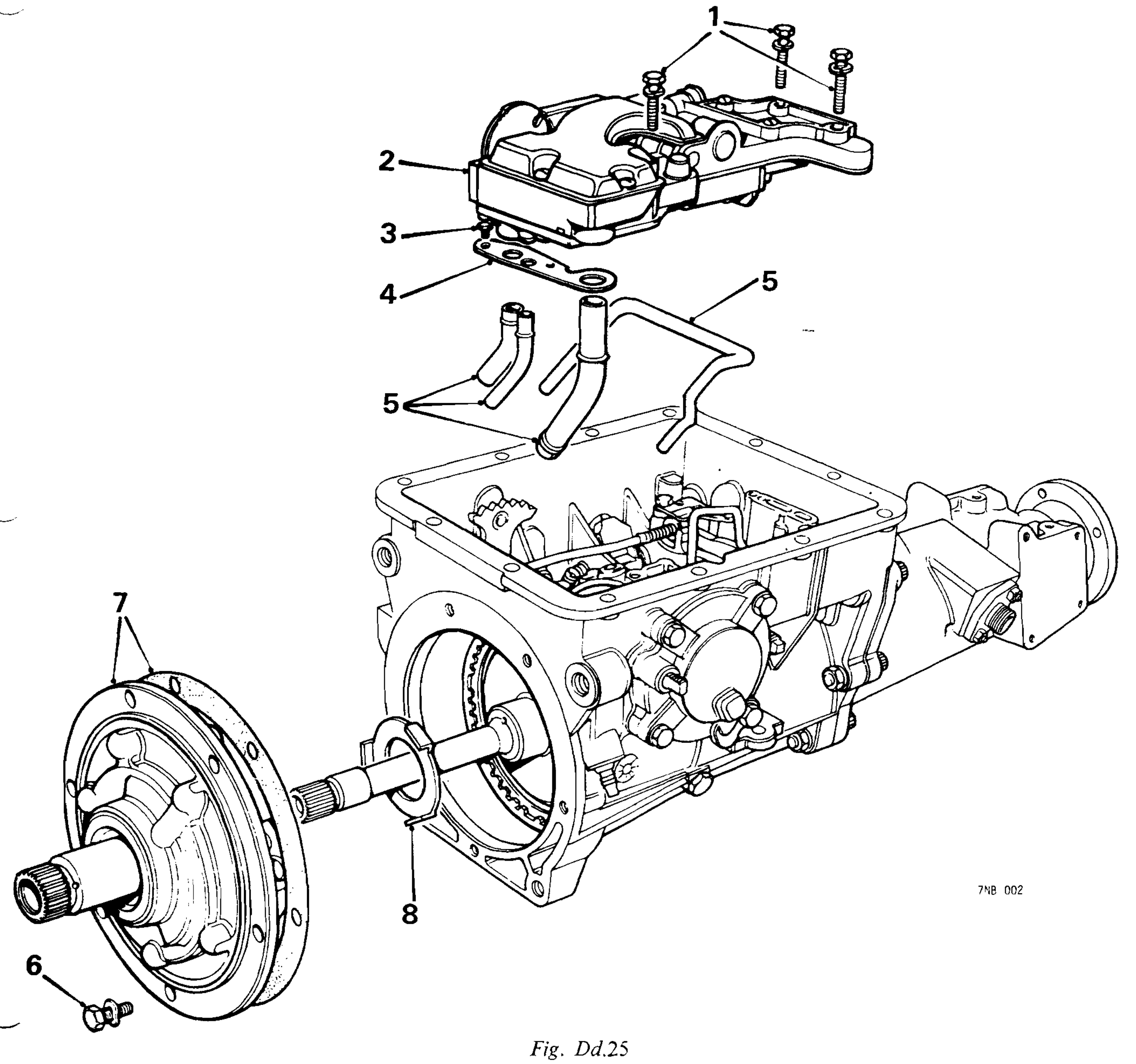


Fig. Dd.25

1. Screw for valve bodies assembly
2. Valve bodies assembly
3. Screw for oil tube locating plate
4. Oil tube locating plate
5. Oil tubes
6. Pump retaining bolt
7. Pump and gasket
8. Thrust washer

(22) Fit the stator support to the pump body, with the pump body in position below the stator to prevent the gears dropping out. The pump body must locate squarely, with the sealing ring just entering the stator support.

(23) Fit the screw, bolts and spring washers. Do not tighten fully.

(24) Turn the assembly over so that the pump body is uppermost and ensure that the gears drop against the stator support and are free to rotate.

(25) Press the pump squarely into the stator support.

CAUTION: The bolts and screw must not be used to draw the pump body and stator support together.

(26) Tighten the screw to 3 lbf ft (0·41 kgf m) and the bolts to 20 lbf ft (2·8 kgf m) in the sequence illustrated and check that the pump driven gear is free to rotate.

Refitting

(27) Reverse the procedure in 1 to 11, noting:

(*a*) Retain the thrust washer on the pump using petroleum jelly.

(*b*) Use a new joint washer and tighten the pump bolts to 16 lbf ft (2·2 kgf m).

(*c*) Ensure that the oil tubes are not distorted when refitting the valve body.

Refill the gearbox with new Automatic Transmission 'G' Fluid and check the level, see Section Dd.1.

Section Dd.18

PUMP OIL SEAL

Removing

(1) Remove the gearbox, see Section Dd.12.
(2) Remove the oil seal, using 18G 389 or 7657 and CBW 200.

Refitting

(3) Smear the new seal with Automatic Transmission 'G' Fluid and fit. Refit the gearbox, see Section Dd.1.

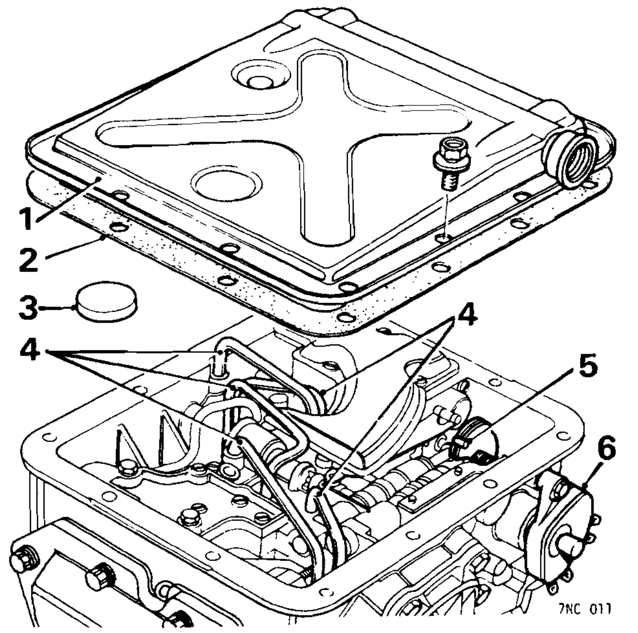


Fig. Dd.26

1. Oil pan
2. Gasket
3. Magnet
4. Oil collector pipes
5. Down-shift cable
6. Starter inhibitor switch

Section Dd.19

FRONT BRAKE BAND

Removing

(1) Remove the gearbox, see Section Dd.12.
(2) Wash the exterior of the unit in clean paraffin, invert it and place on a bench cradle CBW 60.
(3) Remove the starter inhibitor switch.
(4) Unscrew the four bolts and remove the torque converter housing.
(5) Unscrew the oil pan retaining screws and remove the oil pan and joint washer.
(6) Remove the magnet and carefully pull out the oil connector tubes.
(7) Disconnect the down-shift cable from the cam.
(8) Remove the three screws retaining the valve bodies assembly and lift out the assembly.
(9) Unscrew the two bolts, remove the oil tube locating plate and pull out the oil tubes. (Note the 'O' ring on the pump suction tube.)
(10) Unscrew the five pump retaining bolts and withdraw the pump assembly.
(11) Remove the input shaft thrust washer.
(12) Withdraw the input shaft and front clutch assembly.
(13) Remove the two thrust washers.
(14) Withdraw the rear clutch and forward sun gear.
(15) Squeeze together the ends of the front brake band and remove it together with the strut.

Refitting

(16) Retain the heavy duty needle thrust washer in the planet carrier, using petroleum jelly.
(17) Squeeze together the ends of the front brake band and fit it in position together with the strut.
(18) Refit the rear clutch and forward sun gear assembly.
(19) Using petroleum jelly, stick the thrust washers to the rear clutch assembly (phosphor bronze towards the front clutch).
(20) Reverse the procedure in 1 to 12, noting:
   (*a*) Using petroleum jelly, stick the thrust washer to the pump assembly.
   (*b*) Use a new joint washer and tighten the pump bolts to 16 lbf ft (2·2 kgf m).
   (*c*) Ensure that the oil tubes are not distorted when refitting the valve bodies assembly.
   (*d*) Adjust the front brake band, see Section Dd.10.
(21) Refill the gearbox with new Automatic Transmission 'G' Fluid and check the level, see Section Dd.1.

Section Dd.20

REAR BRAKE BAND

Removing

(1) Remove the gearbox, see Section Dd.12.
(2) Wash the exterior of the unit in clean paraffin, invert it and place on a bench cradle CBW 60.
(3) Remove the starter inhibitor switch.
(4) Unscrew the four bolts and remove the torque converter housing.
(5) Unscrew the oil pan retaining screws and remove the oil pan and joint washer.
(6) Remove the magnet and carefully pull out the oil connector tubes.
(7) Disconnect the down-shift cable from the cam.
(8) Remove the three screws retaining the valve bodies assembly and lift out the assembly.
(9) Unscrew the two bolts, remove the oil tube locating plate and pull out the oil tubes. (Note the 'O' ring on the pump suction tube.)
(10) Unscrew the five pump retaining bolts and withdraw the pump assembly.
(11) Remove the input shaft thrust washer.
(12) Withdraw the input shaft and front clutch assembly.
(13) Remove the two thrust washers.
(14) Withdraw the rear clutch and forward sun gear.
(15) Squeeze together the ends of the front brake band and remove it together with the strut.

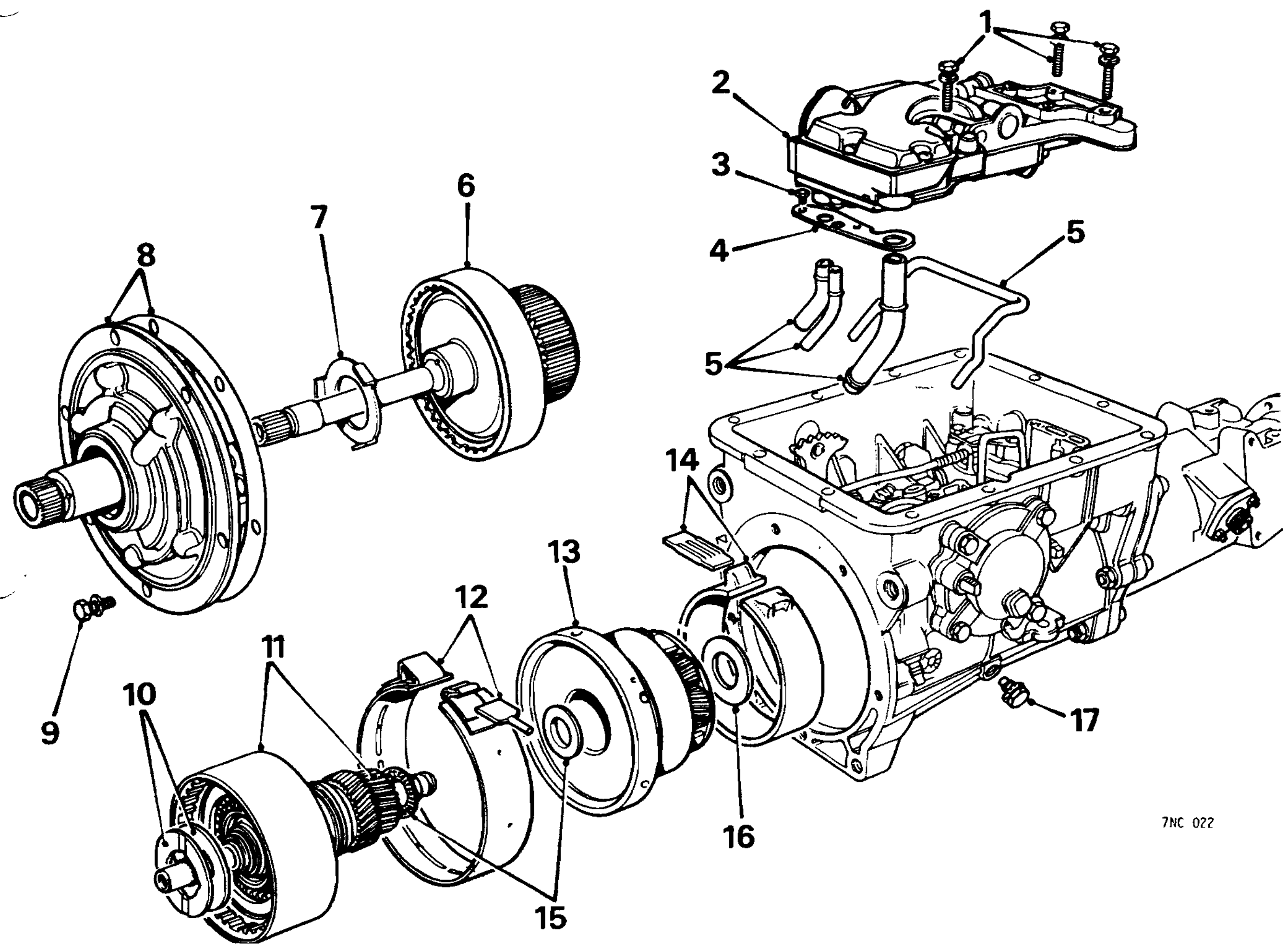


Fig. Dd.27

The front/rear brake band

1. Screws for valve bodies assembly
2. Valve bodies assembly
3. Screw for oil tube locating plate
4. Oil tube locating plate
5. Oil tubes
6. Front clutch
7. Thrust washer
8. Pump and gasket
9. Pump retaining bolt
10. Thrust washers
11. Rear clutch and forward sun gear
12. Front brake band and strut
13. Centre support/planet gear assembly
14. Rear brake band and strut
15. Heavy duty needle thrust washer and bearing plate
16. Needle thrust washer assembly
17. Centre support locating bolt

(16) Unscrew the three centre support locating screws.

(17) Withdraw the centre support/planet gear assembly and needle thrust washer assembly.

(18) Squeeze together the ends of the rear brake band, tilt and withdraw it from the casing together with the strut.

Refitting

(19) Refit the rear brake band and strut.

(20) Retain the needle thrust washer assembly, backing plate to the planet carrier, using petroleum jelly.

(21) Locate the bearing plate (lip facing to the rear) and heavy duty needle thrust washer in the planet carrier, using petroleum jelly to retain them in position.

(22) Refit the centre support and planet gear assembly, ensuring that the oil holes in the centre support are aligned with those in the casing.

(23) Fit and tighten the locating bolts with washers to 14 lbf ft (1·9 kgf m). The washers act as a seal and must be fitted with their flat face against the casing.

(24) Squeeze together the ends of the front brake band and fit it in position together with the strut.

(25) Refit the rear clutch and forward sun gear assembly.

(26) Using petroleum jelly, stick the thrust washers to the rear clutch assembly (phosphor bronze towards the front clutch).

(27) Reverse the procedure in 1 to 12, noting:

(*a*) Using petroleum jelly, stick the thrust washer to the pump assembly.

(*b*) Use a new joint washer and tighten the pump bolts to 16 lbf ft (2·2 kgf m).

(*c*) Ensure that the oil tubes are not distorted when refitting the valve bodies assembly.

(*d*) Adjust the front and rear brake bands, see Section Dd.10.

(28) Refill the gearbox with new Automatic Transmission 'G' Fluid and check the level, see Section Dd.1.

Section Dd.21

FRONT CLUTCH

Removing

(1) Remove the gearbox, see Section Dd.12.
(2) Wash the exterior of the unit in clean paraffin, invert it and place on a bench cradle CBW 60.
(3) Remove the starter inhibitor switch.
(4) Unscrew the four bolts and remove the torque converter housing.
(5) Unscrew the oil pan retaining screws and remove the oil pan and joint washer.
(6) Remove the magnet and carefully pull out the oil connector tubes.
(7) Disconnect the down-shift cable from the cam.
(8) Remove the three screws retaining the valve bodies assembly and lift out the assembly.
(9) Unscrew the two bolts, remove the oil tube locating plate and pull out the oil tubes. (Note the 'O' ring on the pump suction tube.)
(10) Unscrew the five pump retaining bolts and withdraw the pump assembly.
(11) Remove the input shaft thrust washer.
(12) Withdraw the input shaft and front clutch assembly.
(13) Remove the two thrust washers.

Dismantling

(14) Remove the snap-ring and withdraw the input shaft.
(15) Remove the clutch hub thrust washer.
(16) Remove the clutch hub.
(17) Take out the inner and outer friction plates; retain the plates in their removal order.
(18) Remove the clutch pressure plate.
(19) Remove the snap ring and withdraw the clutch spring and spring bearing.
(20) Withdraw the piston. (If necessary, blank off the bores of the clutch drum and apply a compressed air-line to the piston valve hole.)
(21) Remove the seal from the piston.
(22) Remove the 'O' ring from the clutch housing.

Inspection

(23) Renew the rubber oil seals. Check that the piston one-way valve will operate.

NOTE: If the rear clutch is not being overhauled, check the sealing rings on the forward sun gear shaft for wear, and renew if necessary.

(24) Check the inner and outer plates for wear and overheating. If necessary, renew the plates as a set.

Reassembling

(25) Reverse the procedure in 14 to 22, noting:
(*a*) Lubricate the piston using Automatic Transmission 'G' Fluid and refit into the drum, using 18G 1107.
(*b*) Refit the inner and outer clutch plates in alternate sequence.

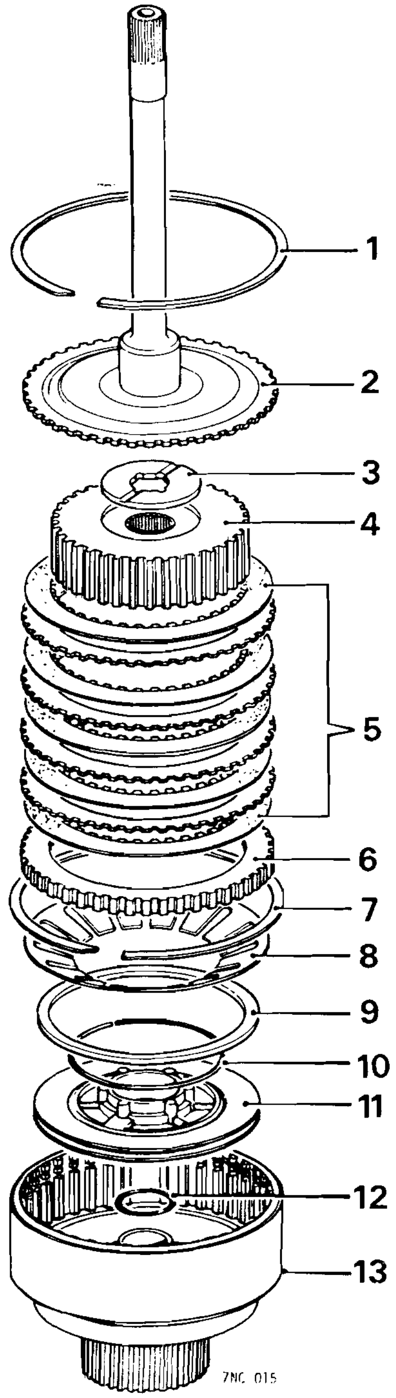


*Fig. Dd.*28
The front clutch components

1. Snap-ring
2. Input shaft
3. Thrust washer
4. Hub
5. Inner and outer friction plates
6. Pressure plate
7. Snap-ring
8. Spring
9. Seal
10. Spring bearing
11. Piston
12. 'O' ring
13. Clutch housing

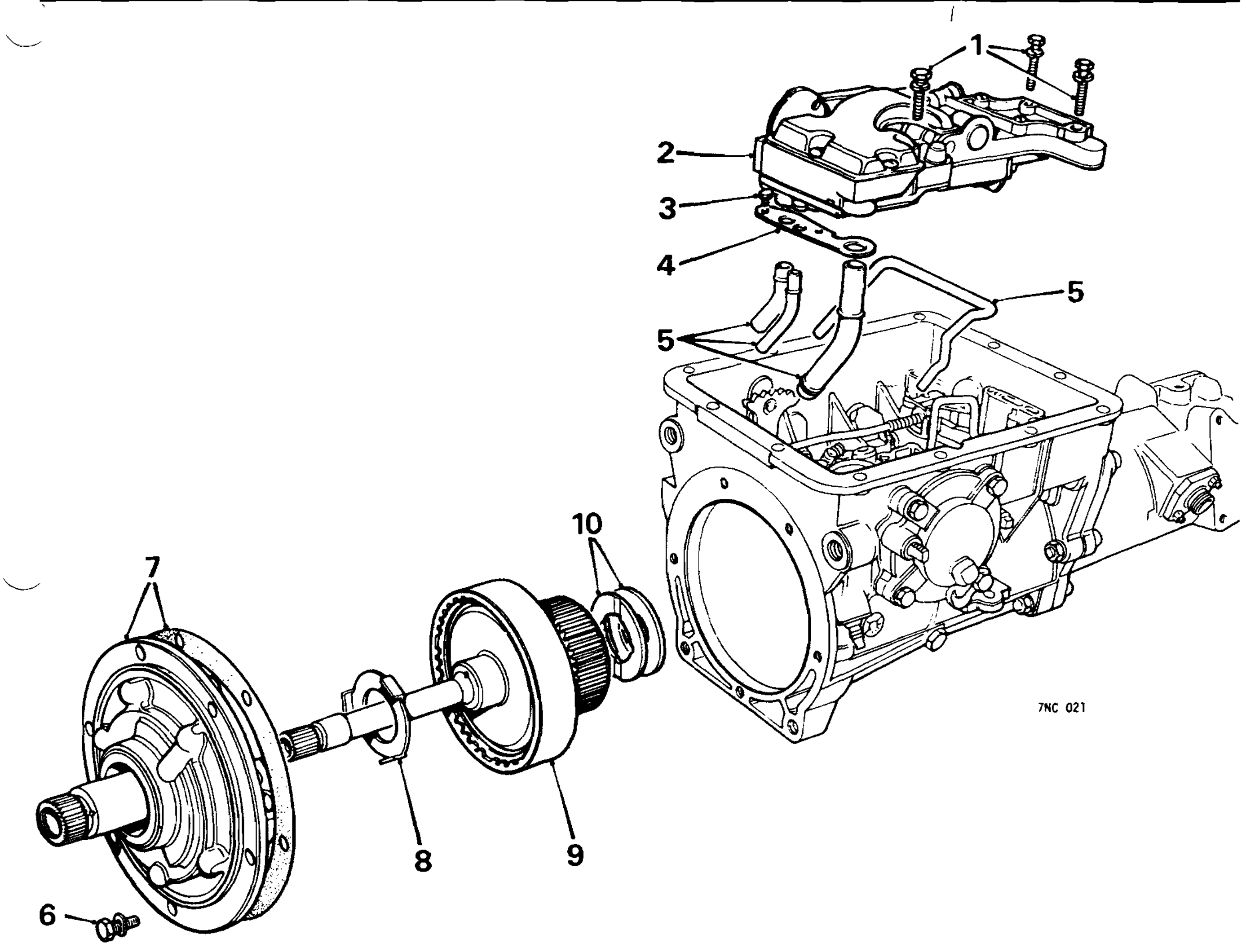


*Fig. Dd.*29

The front clutch

1. Screws for valve bodies assembly
2. Valve bodies assembly
3. Screw for oil tube locating plate
4. Oil tube locating plate
5. Oil tubes
6. Pump retaining bolt
7. Pump and gasket
8. Thrust washer
9. Front clutch
10. Thrust washers

Refitting

(26) Using petroleum jelly, stick the thrust washers to the rear clutch assembly (phosphor bronze towards the front clutch).

(27) Reverse the procedure in 1 to 12, noting:

(*a*) Using petroleum jelly, stick the thrust washer to the pump assembly.

(*b*) Use a new joint washer and tighten the pump bolts to 16 lbf ft (2·2 kgf m).

(*c*) Ensure that the oil tubes are not distorted when refitting the valve bodies assembly.

(28) Refill the gearbox with new Automatic Transmission 'G' Fluid and check the level, see Section Dd.1.

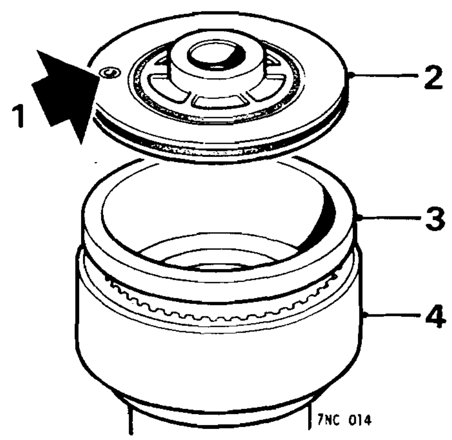


*Fig. Dd.*30

Using tool 18G 1107 *to refit the front clutch piston*

1. One-way valve
2. Piston
3. Service tool 18G 1107
4. Clutch housing

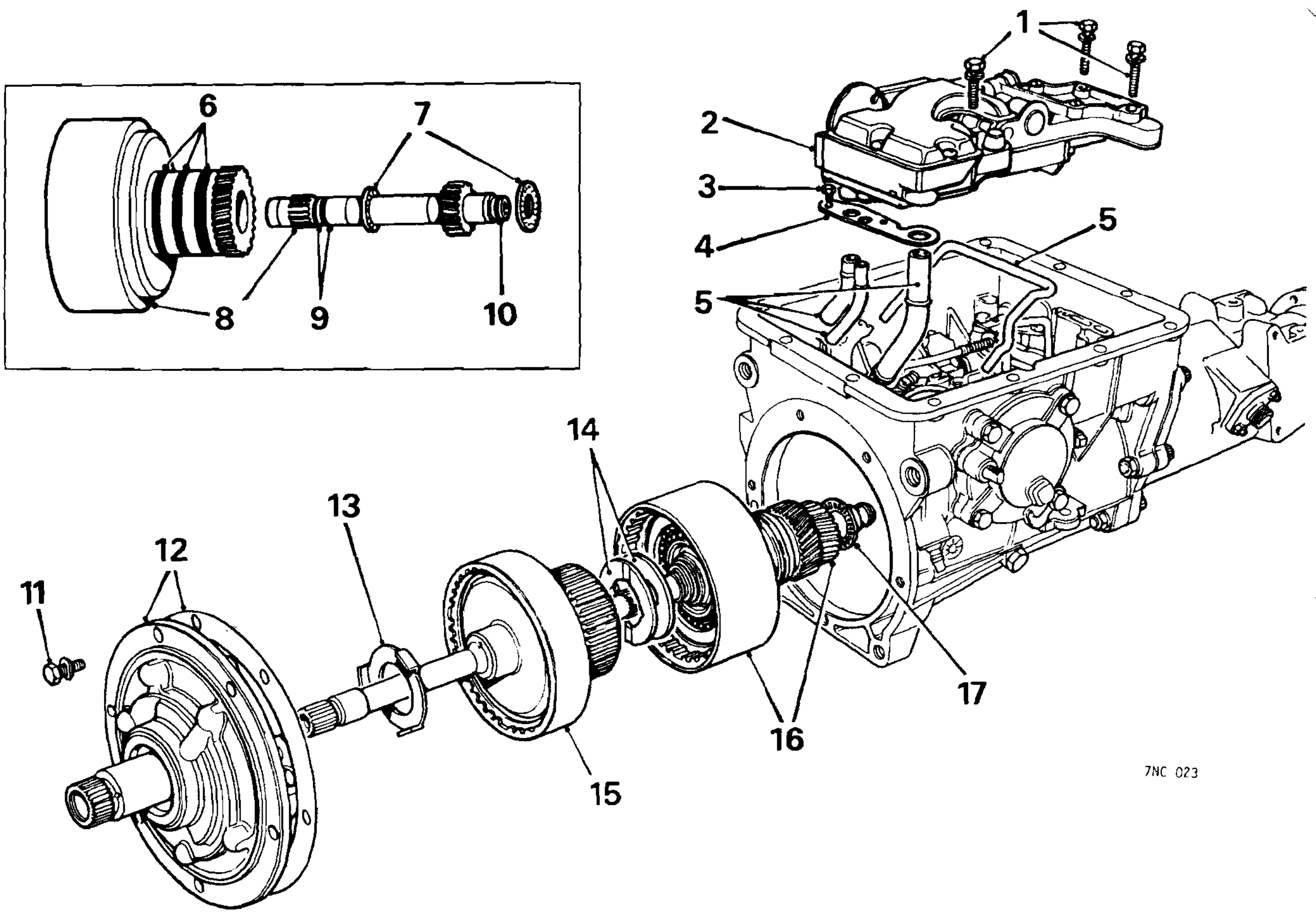


*Fig. Dd.*31

The rear clutch

1. Screws for valve bodies assembly
2. Valve bodies assembly
3. Screw for oil tube locating plate
4. Oil tube locating plate
5. Oil tubes
6. Sealing rings
7. Needle thrust washers
8. Rear clutch and forward sun gear
9. Sealing rings
10. Sealing ring
11. Pump retaining bolt
12. Pump and gasket
13. Thrust washer
14. Thrust washers
15. Front clutch
16. Rear clutch and forward sun gear
17. Heavy duty needle thrust washer

Section Dd.22

REAR CLUTCH

Removing

(1) Remove the gearbox, see Section Dd.12.
(2) Wash the exterior of the unit in clean paraffin, invert it and place on a bench cradle CBW 60.
(3) Remove the starter inhibitor switch.
(4) Unscrew the four bolts and remove the torque converter housing.
(5) Unscrew the oil pan retaining screws and remove the oil pan and joint washer.
(6) Remove the magnet and carefully pull out the oil connector tubes.
(7) Disconnect the down-shift cable from the cam.
(8) Remove the three screws retaining the valve bodies assembly and lift out the assembly.
(9) Unscrew the two bolts, remove the oil tube locating plate and pull out the oil tubes. (Note the 'O' ring on the pump suction tube.)
(10) Unscrew the five pump retaining bolts and withdraw the pump assembly.
(11) Remove the input shaft thrust washer.
(12) Withdraw the input shaft and front clutch assembly.
(13) Remove the two thrust washers.
(14) Withdraw the rear clutch and forward sun gear.
(15) Separate the forward sun gear assembly from the rear clutch.

Dismantling

(16) Remove the snap-ring and withdraw the clutch pressure plate.
(17) Remove the inner and outer friction plates; retain the plates in their removal order.
(18) Using 18G 1016 as shown, compress the spring and remove the spring seat circlip using 18G 1004 and 18G 1004 J.

(19) Remove the spring seat and spring, then withdraw the piston.
(20) Remove the rubber sealing ring from the piston.
(21) Remove the rubber 'O' ring from the reverse sun gear hub.

Inspection

(22) Renew the rubber oil seals. Check that the piston one-way valve will operate.
(23) Check the inner and outer plates for wear and overheating. The outer plates are coned. If necescary, renew the plates as a set. Ensure that the plate kit contains the same number of plates as the set removed.
(24) Check the ring seals and the drum bearing for wear and damage.
(25) Check the forward sun gear shaft spigot bearing for wear and damage.

Reassembling

(26) Reverse the procedure in 16 to 21, noting:
 (*a*) Lubricate the piston using Automatic Transmission 'G' Fluid and refit into the drum using 18G 702.
 (*b*) Refit the inner and outer clutch plates in alternate sequence and with the coning in the same direction.

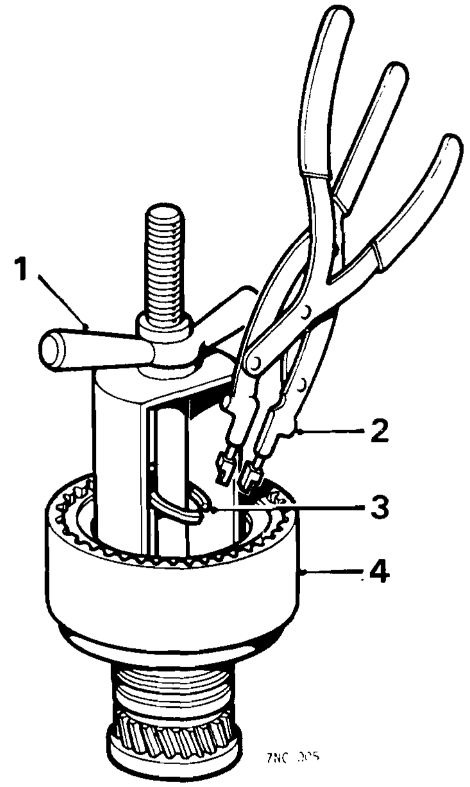


*Fig. Dd.*32

Using tools 18G 1016 *and* 18G 1004 *to remove the rear clutch piston*

1. Service tool 18G 1016
2. Service tool 18G 1004
3. Spring seat circlip
4. Clutch housing

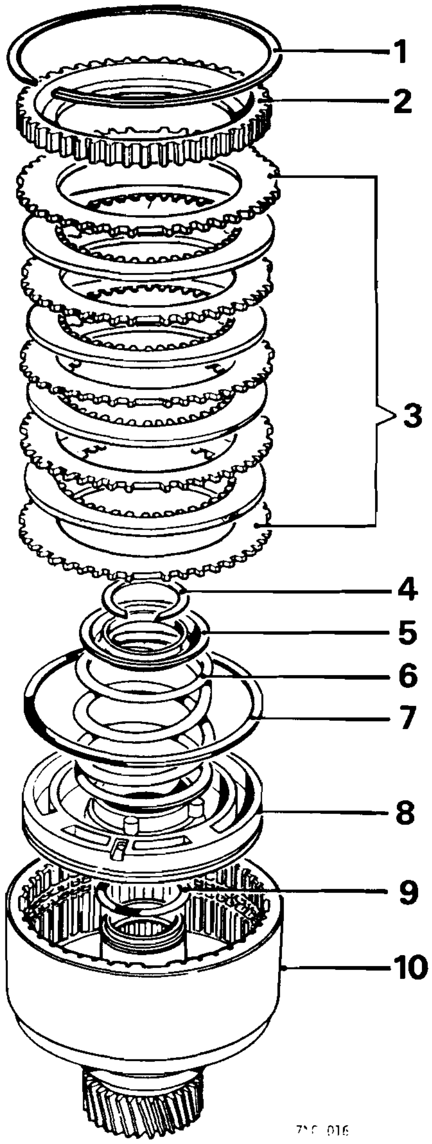


*Fig. Dd.*33

The rear clutch components

1. Snap-ring
2. Pressure plate
3. Inner and outer friction plates
4. Spring seat circlip
5. Spring seat
6. Spring
7. Sealing ring
8. Piston
9. 'O' ring
10. Clutch housing

 (*c*) Fit the plates into the rear clutch with a steel outer plate against the piston.
 (*d*) Fit the snap-ring to the correct groove:
 Three groove drum—centre groove.
 Two or three groove drum with distance piece fitted between the pressure plate and front friction plate—outer groove.

Refitting

(27) If necessary, fit new sealing rings to the sun gear shaft, front clutch and governor feeds.
(28) Check the needle thrust washers, and renew if necessary.
(29) Retain the heavy duty needle thrust washer in the planet carrier, using petroleum jelly.

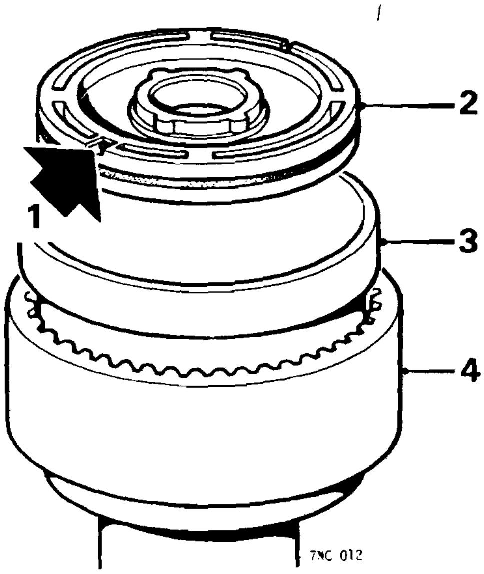


Fig. Dd.34

Using tool 18G 702 to refit the rear clutch piston

1. One-way valve
2. Piston
3. Service tool 18G 702
4. Clutch housing

(30) Assemble the forward sun gear and needle thrust washer to the rear clutch.
(31) Refit the rear clutch and forward sun gear assembly.
(32) Using petroleum jelly, stick the thrust washers to the rear clutch assembly (phosphor bronze towards the front clutch).
(33) Reverse the procedure in 1 to 12, noting:
  (*a*) Using petroleum jelly, stick the thrust washer to the pump assembly.
  (*b*) Use a new joint washer and tighten the pump bolts to 16 lbf ft (2·2 kgf m).
  (*c*) Ensure that the oil tubes are not distorted when refitting the valve bodies assembly.
(34) Refill the gearbox with new Automatic Transmission 'G' Fluid and check the level, see Section Dd.1.

Section Dd.23

PLANET GEARS AND CENTRE SUPPORT

Removing

(1) Remove the gearbox, see Section Dd.12.
(2) Wash the exterior of the unit in clean paraffin, invert it and place on a bench cradle CBW 60.
(3) Remove the starter inhibitor switch.
(4) Unscrew the four bolts and remove the torque converter housing.
(5) Unscrew the oil pan retaining screws and remove the oil pan and joint washer.
(6) Remove the magnet and carefully pull out the oil connector tubes.
(7) Disconnect the down-shift cable from the cam.
(8) Remove the three screws retaining the valve bodies assembly and lift out the assembly.
(9) Unscrew the two bolts, remove the oil tube locating plate and pull out the oil tubes. (Note the 'O' ring on the pump suction tube.)
(10) Unscrew the five pump retaining bolts and withdraw the pump assembly.
(11) Remove the input shaft thrust washer.
(12) Withdraw the input shaft and front clutch assembly.
(13) Remove the two thrust washers.
(14) Withdraw the rear clutch and forward sun gear.
(15) Squeeze together the ends of the front brake band and remove it together with the strut.
(16) Unscrew the three centre support locating screws.
(17) Withdraw the centre support/planet gear assembly and needle thrust washer assembly.
(18) Separate the centre support from the planet gear assembly.
(19) Withdraw the uni-directional clutch.
(20) Remove the retaining circlip and detach the uni-directional clutch outer race.

Inspecting

(21) Check the gears for wear or damaged teeth; check the fit of the gear carrier pins.
(22) Check the condition of the uni-directional clutch.

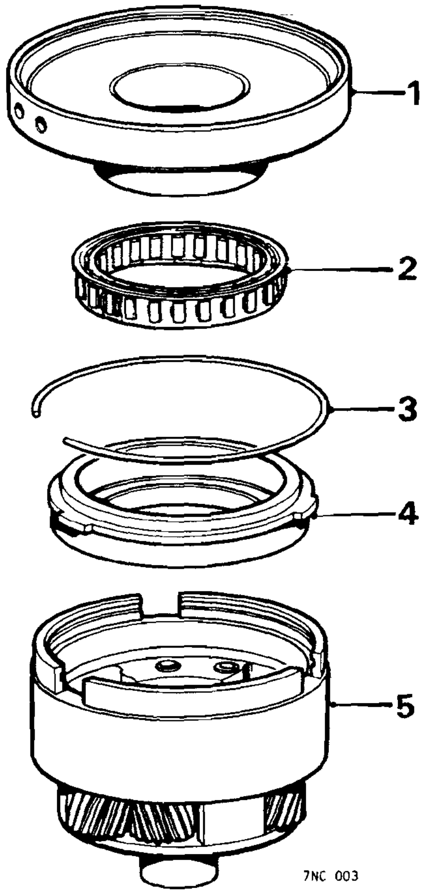


Fig. Dd.35

The uni-directional clutch

1. Centre support
2. Uni-directional clutch
3. Retaining wire
4. Uni-directional clutch outer race
5. Planet gear assembly

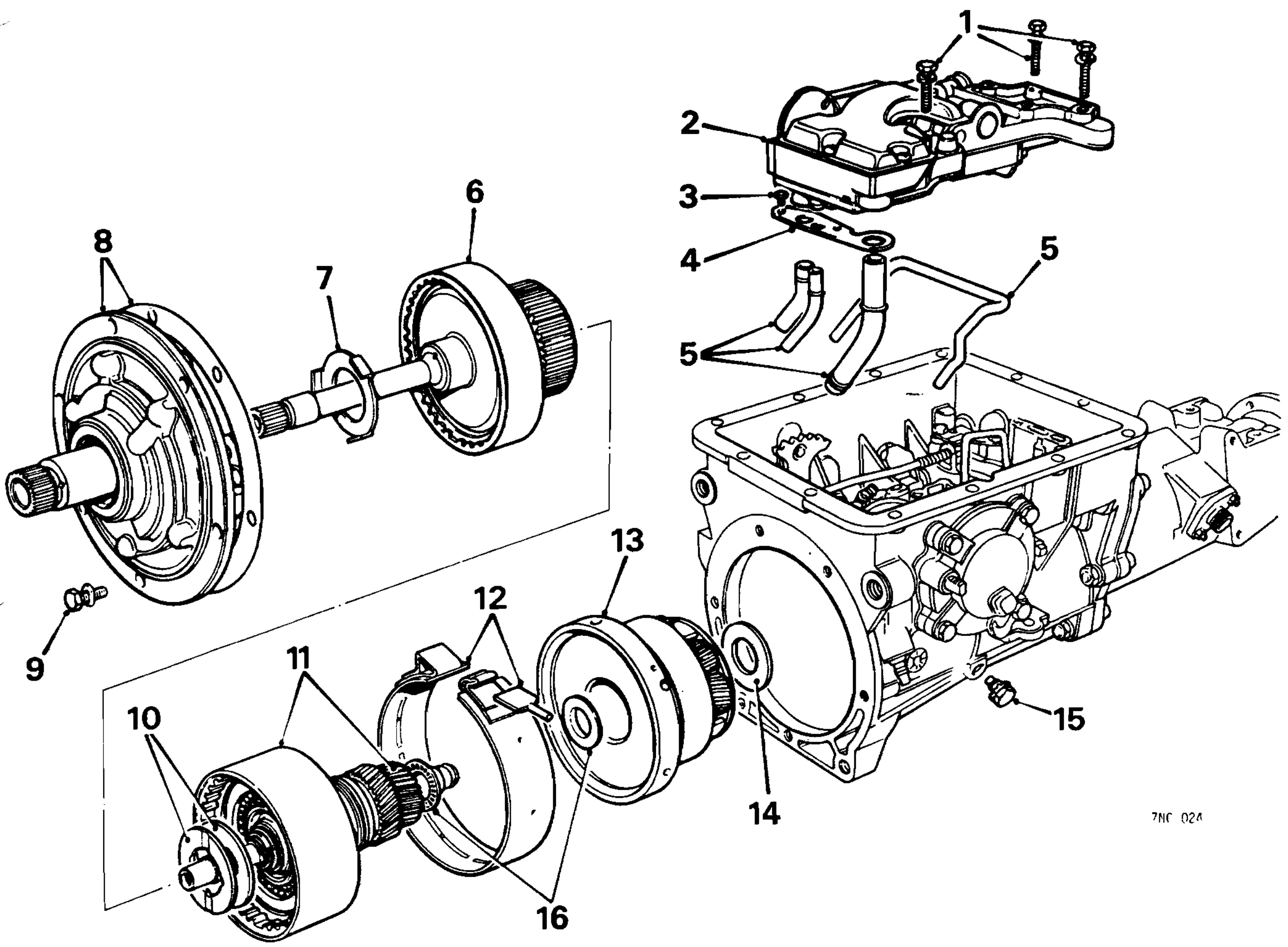


Fig. Dd.36

The planet gears and centre support

1. Screws for valve bodies assembly
2. Valve bodies assembly
3. Screw for oil tube locating plate
4. Oil tube locating plate
5. Oil tubes
6. Front clutch
7. Thrust washer
8. Pump and gasket
9. Pump retaining bolt
10. Thrust washers
11. Rear clutch and forward sun gear
12. Front brake band and strut
13. Centre support/planet gear assembly
14. Needle thrust washer assembly
15. Centre support locating bolt

Refitting

(23) Fit the uni-directional clutch outer race to the planet gear carrier and secure with the circlip.
(24) Refit the uni-directional clutch.
(25) Assemble the centre support and the planet gear carrier.
(26) Retain the needle thrust washer assembly, backing plate to the planet carrier, using petroleum jelly.
(27) Locate the bearing plate (lip facing to the rear) and heavy duty needle thrust washer in the planet carrier, using petroleum jelly to retain them in position.
(28) Refit the centre support and planet gear assembly, ensuring that the oil holes in the centre support are aligned with those in the casing.
(29) Fit and tighten the locating bolts with washers to 14 lbf ft (1·9 kgf m). The washers act as a seal and must be fitted with their flat face against the casing.
(30) Squeeze together the ends of the front brake band and fit it in position together with the strut.
(31) Refit the rear clutch and forward sun gear assembly.
(32) Using petroleum jelly, stick the thrust washers to the rear clutch assembly (phosphor bronze towards the front clutch).
(33) Reverse the procedure in 1 to 12, noting:
 (*a*) Using petroleum jelly, stick the thrust washer to the pump assembly.
 (*b*) Use a new joint washer and tighten the pump bolts to 16 lbf ft (2·2 kgf m).
 (*c*) Ensure that the oil tubes are not distorted when refitting the valve bodies assembly.
 (*d*) Adjust the front and rear brake bands, see Section Dd.10.
(34) Refill the gearbox with new Automatic Transmission 'G' Fluid and check the level, see Section Dd.1.

Section Dd.24

OUTPUT SHAFT AND RING GEAR

Removing

(1) Remove the gearbox, see Section Dd.12.
(2) Wash the exterior of the unit in clean paraffin, invert it and place on a bench cradle CBW 60.
(3) Remove the starter inhibitor switch.
(4) Unscrew the four bolts and remove the torque converter housing.
(5) Unscrew the oil pan retaining screws and remove the oil pan and joint washer.
(6) Remove the magnet and carefully pull out the oil connector tubes.
(7) Disconnect the down-shift cable from the cam.
(8) Remove the three screws retaining the valve bodies assembly and lift out the assembly.
(9) Unscrew the two bolts, remove the oil tube locating plate and pull out the oil tubes. (Note the 'O' ring on the pump suction tube.)
(10) Unscrew the five pump retaining bolts and withdraw the pump assembly.
(11) Remove the input shaft thrust washer.
(12) Withdraw the input shaft and front clutch assembly.
(13) Remove the two thrust washers.
(14) Withdraw the rear clutch and forward sun gear.
(15) Squeeze together the ends of the front brake band and remove it together with the strut.

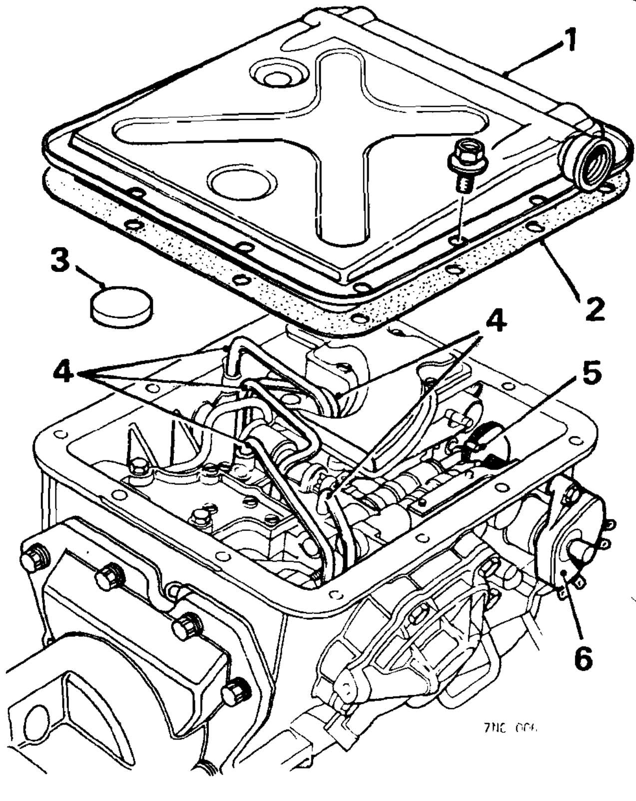


*Fig. Dd.*37

1. Oil pan
2. Gasket
3. Magnet
4. Oil collector pipes
5. Down-shift cable
6. Starter inhibitor switch

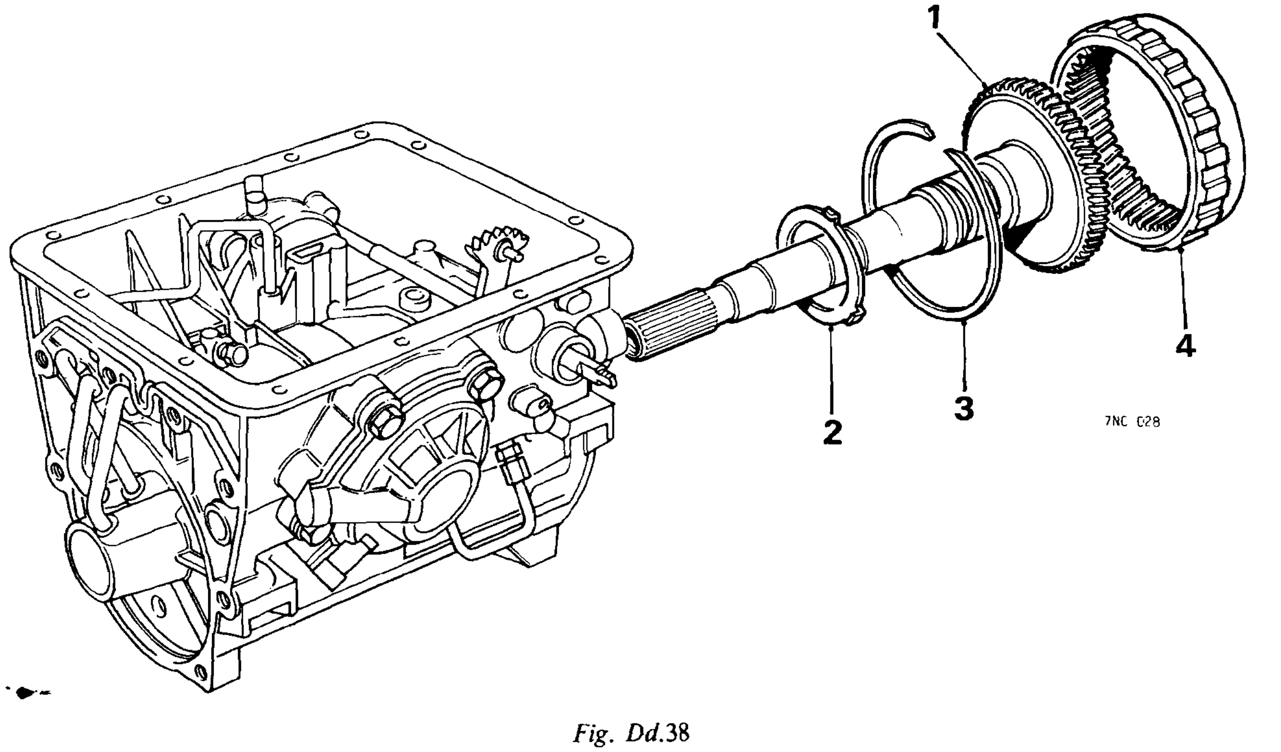


*Fig. Dd.*38

The output shaft and ring gear

1. Output shaft 2. Thrust washer 3. Snap-ring 4. Ring gear

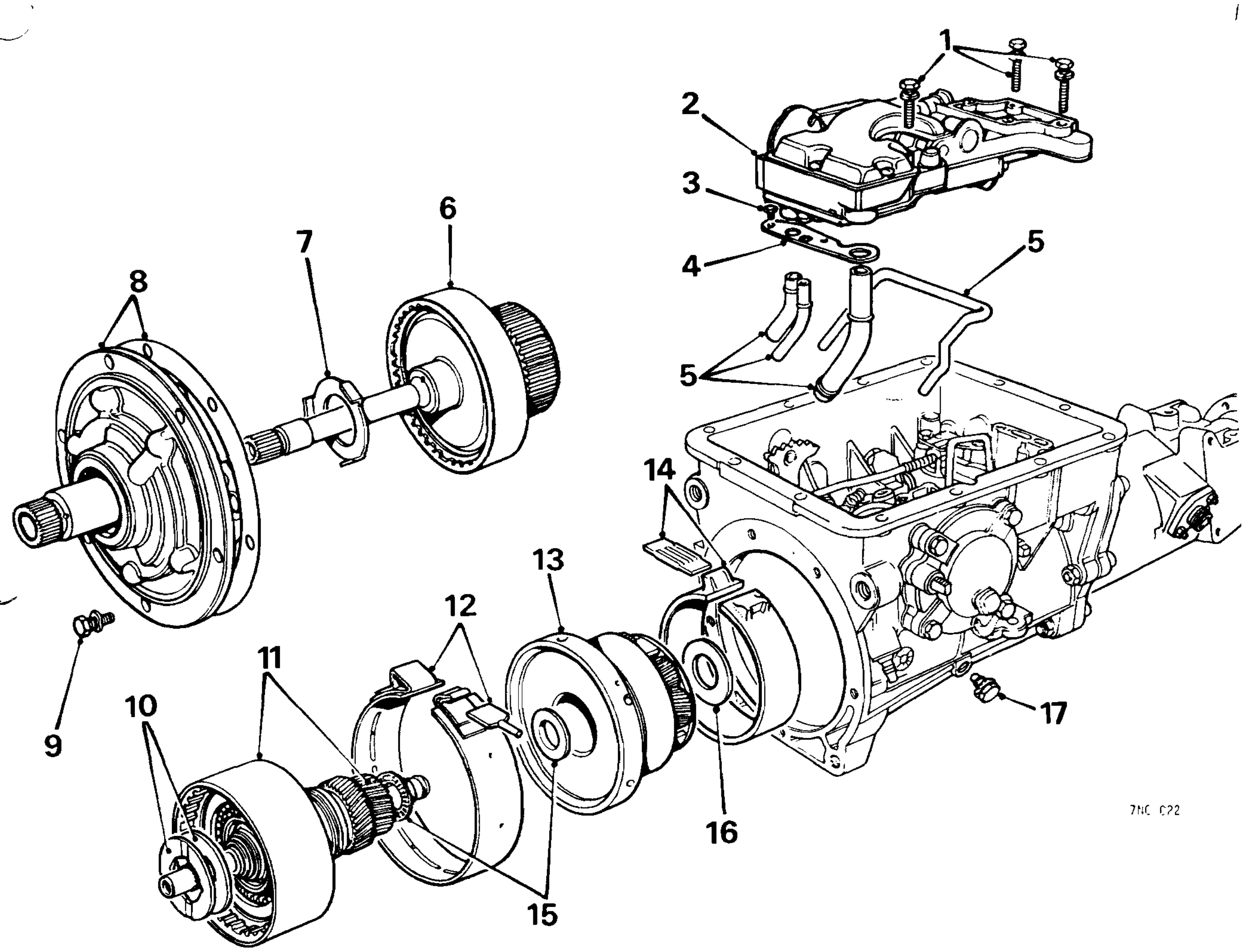


Fig. Dd.39

The rear brake band

1. Screws for valve bodies assembly
2. Valve bodies assembly
3. Screw for oil tube locating plate
4. Oil tube locating plate
5. Oil tubes
6. Front clutch
7. Thrust washer
8. Pump and gasket
9. Pump retaining screw
10. Thrust washers
11. Rear clutch and forward sun gear
12. Front brake band and strut
13. Centre support/planet gear assembly
14. Rear brake band and strut
15. Heavy duty needle thrust washer and bearing plate
16. Needle thrust washer assembly
17. Centre support locating bolt

(16) Unscrew the three centre support locating screws.
(17) Withdraw the centre support/planet gear assembly and needle thrust washer assembly.
(18) Squeeze together the ends of the rear brake band, tilt and withdraw together with the strut.
(19) Using 18G 1205 to retain the flange, unscrew the bolt.
(20) Withdraw the flange, using 18G 2 if necessary.
(21) Remove the screws and detach the taximeter gear housing from the rear extension.
(22) Remove the speedometer pinion housing from the rear extension.
(23) Unscrew the eight bolts and withdraw the rear extension and gasket.
(24) Withdraw the taximeter drive gear and key from the shaft.
(25) Use 18G 1004 and 18G 1004 J to remove the front speedometer drive gear retaining circlip.
(26) Remove the speedometer drive gear and its driving ball.
(27) Use 18G 1004 and 18G 1004 J to remove the rear speedometer drive gear circlip.
(28) Remove the governor securing screw and lock washer and withdraw the governor assembly.
(29) Withdraw the output shaft assembly and remove the thrust washer.
(30) Remove the snap-ring and detach the annulus from the output shaft.

Refitting

(31) Fit the output shaft to the annulus and secure with the snap-ring.
(32) Fit new sealing rings to the output shaft if necessary.
(33) Using petroleum jelly, stick the output shaft thrust washer in position with its tabs against the casing so that one tab is at the top (with the gearbox inverted).

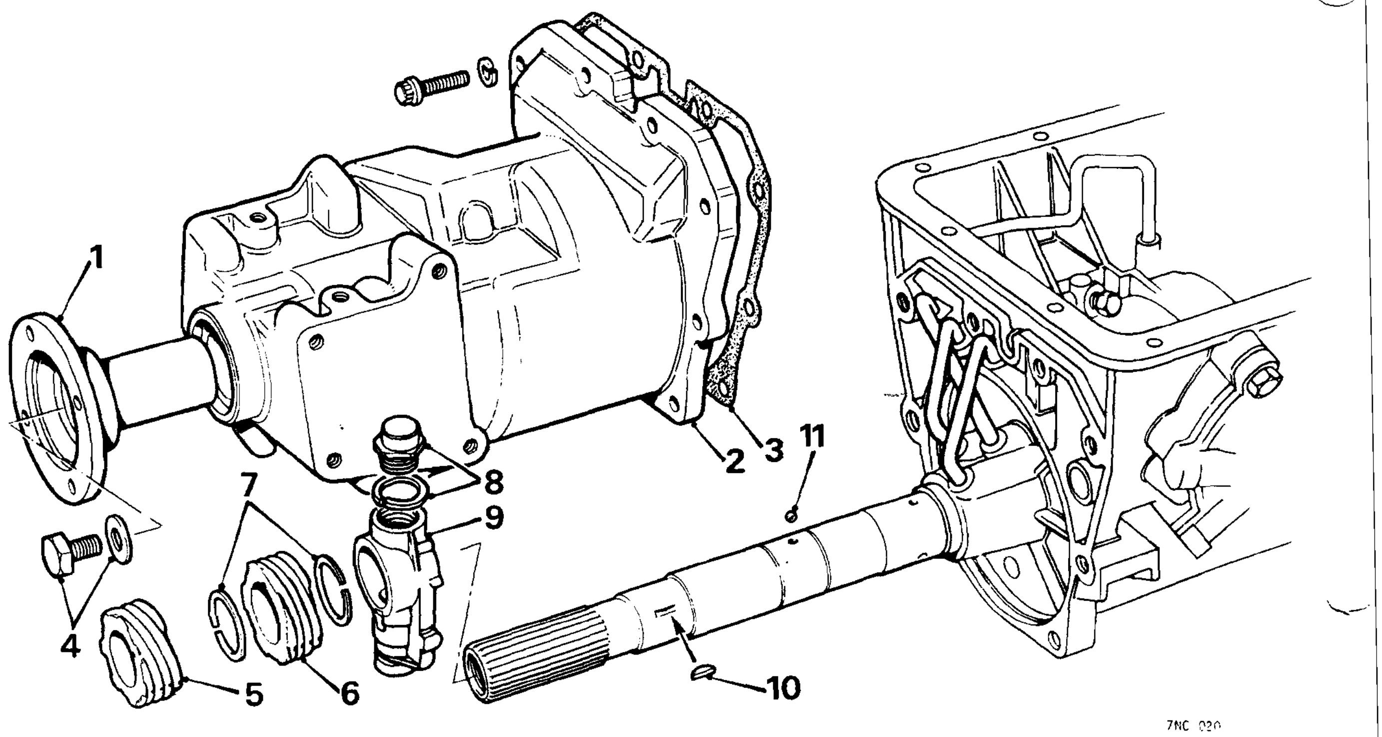


*Fig. Dd.*40

The rear extension

1. Drive flange
2. Rear extension
3. Gasket
4. Bolt and washer for flange
5. Taximeter drive gear
6. Speedometer drive gear
7. Circlips
8. Governor securing screw and lock washer
9. Governor assembly
10. Taximeter drive gear key
11. Speedometer drive gear ball

(34) Install the output shaft assembly.
(35) Reverse the procedure in 19 to 28, using a new rear extension joint washer.
(36) Refit the rear brake band and strut.
(37) Retain the needle thrust washer assembly, backing plate to the planet carrier, using petroleum jelly.
(38) Locate the bearing plate (lip facing to the rear) and heavy duty needle thrust washer in the planet carrier, using petroleum jelly to retain them in position.
(39) Refit the centre support and planet gear assembly, ensuring that the oil holes in the centre support are aligned with those in the casing.
(40) Fit and tighten the locating bolts with washers to 14 lbf ft (1·9 kgf m). The washers act as a seal and must be fitted with their flat face against the casing.
(41) Squeeze together the ends of the front brake band and fit it in position together with the strut.
(42) Refit the rear clutch and forward sun gear assembly.
(43) Using petroleum jelly, stick the thrust washers to the rear clutch assembly (phosphor bronze towards the front clutch).
(44) Reverse procedure in 1 to 12, noting:
  (*a*) Using petroleum jelly, stick the thrust washer to the pump assembly.
  (*b*) Use a new joint washer and tighten the pump bolts to 19 lbf ft (2·64 kgf m).
  (*c*) Ensure that the oil tubes are not distorted when refitting the valve bodies assembly.
  (*d*) Adjust the front and rear brake bands, see Section Dd.10.
(45) Refill the gearbox with new Automatic Transmission 'G' Fluid and check the level, see Section Dd.1.

Section Dd.25

INPUT SHAFT END-FLOAT

Checking

(1) Remove the gearbox, see Section Dd.12.
(2) Wash the exterior of the unit in clean paraffin, invert it and place on bench cradle CBW60.
(3) Remove the starter inhibitor switch.
(4) Unscrew the four bolts and remove the converter housing.
(5) Unscrew the oil pan retaining screws and remove the oil pan and joint washer.
(6) Remove the magnet and carefully pull out the oil connector tubes.
(7) Disconnect the down-shift cable from the cam.
(8) Remove the three screws retaining the valve bodies assembly and lift out the assembly.

(9) Clamp CBW 87 to the converter support shaft.
(10) Gently lower the gear train forward and adjust the screw of the tool until it just contacts the end of the input shaft.
(11) Lever the gear train back, using light pressure, and measure the gap produced between the tool and the end of the shaft. The permissible end-float is 0·010 to 0·030 in (0·25 to 0·76 mm). Fit a new thrust washer if the end-float is excessive.

Refitting

(12) Reverse the procedure in 1 to 8, noting:
 (*a*) Use a new joint washer and tighten the oil pan screws to 7 lbf ft (1·0 kgf m).
 (*b*) Refill the gearbox with new Automatic Transmission 'G' Fluid and check the level, see Section Dd.1.

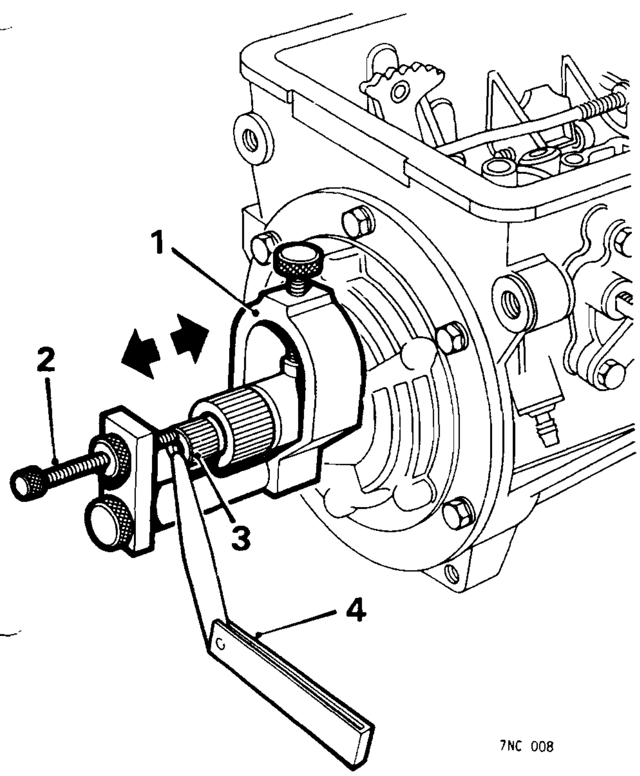


*Fig. Dd.*41

Using tool CBW 87 to check the input shaft end-float

1. Service tool CBW 87
2. Adjuster screw
3. Input shaft
4. Feeler gauge

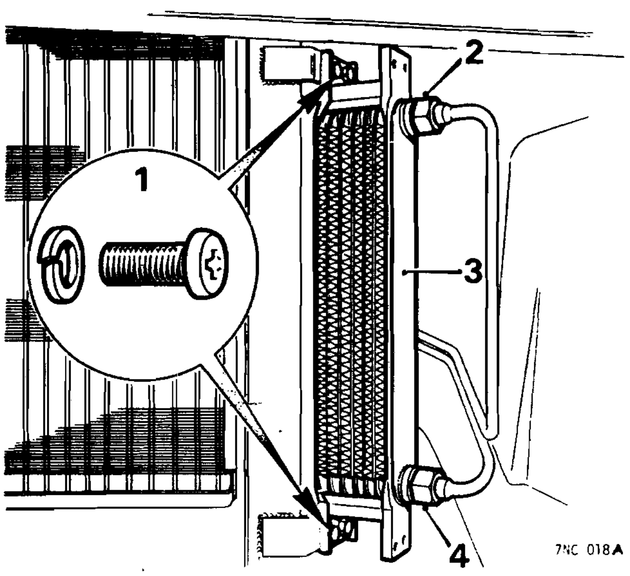


*Fig. Dd.*42

The oil cooler

1. Oil cooler retaining screws
2. Upper pipe union nut
3. Oil cooler
4. Lower pipe union nut

Section Dd.26

OIL COOLER

Removing

(1) Disconnect the battery.
(2) Drain the cooler by disconnecting the lower pipe union nut.
(3) Disconnect the oil cooler upper pipe union nut.
(4) Remove the four retaining screws with spring washers and lift off the oil cooler.

Refitting

(5) Reverse the procedure in 1 to 8, tightening the oil cooler pipe union nuts to 9 lbf ft (1·24 kgf m).
 NOTE: If oil seepage occurs, further tightening of the pipe union nuts should only be carried out with the boss of the oil cooler connection held securely.
(6) Top up the gearbox using new Automatic Transmission 'G' Fluid, see Section Dd.1.

Section Dd.27

EXTERNAL OIL FILTER

NOTE: The oil filter must be changed after the first 6,000 miles (10000 km) and subsequently only after a major gearbox failure or overhaul.

Removing

(1) Unscrew the tube nuts at either end of the filter.
(2) Remove the nut and bolt securing the filter mounting bracket to the chassis.
(3) Detach the mounting bracket from the filter.

Refitting

(4) Fit the mounting bracket to the new filter and attach the bracket to the chassis, tightening the nut and bolt finger tight.
(5) Connect the pipes to the filter, holding the hexagons on the filter body securely while tightening the tube nuts.
(6) Fully tighten the mounting bracket nut and bolt.
(7) Top up the gearbox using new Automatic Transmission 'G' Fluid, see Section Dd.1.
(8) Check the filter connections for leaks.

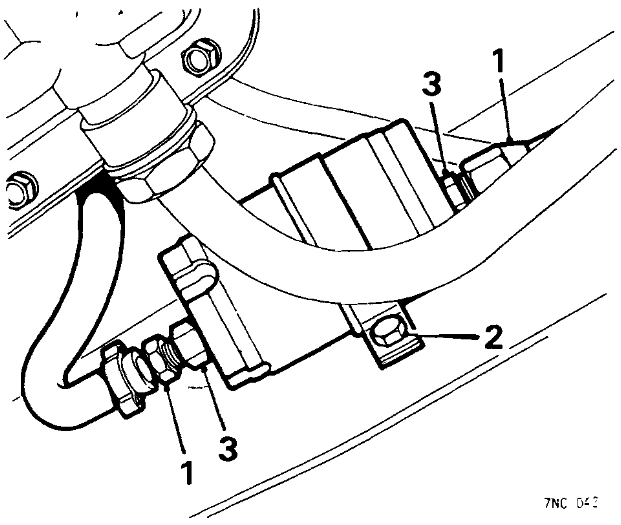
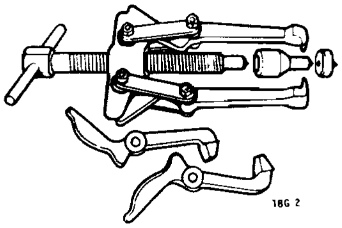


Fig. Dd.43

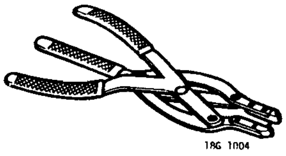
The external oil filter

1. Tube nuts
2. Mounting bracket nut and bolt
3. Hexagons on filter body

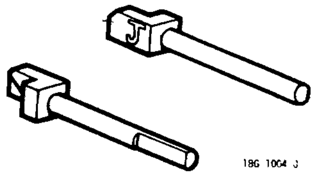
SERVICE TOOLS



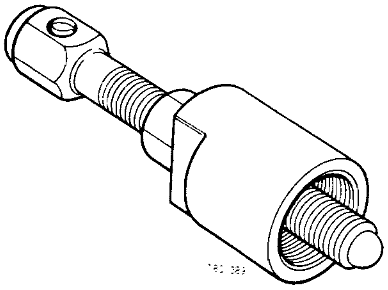
18G 2 Crankshaft Gear, Pulley and Propeller Shaft Flange Remover



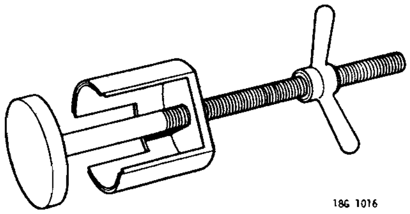
18G 1004 Circlip Pliers



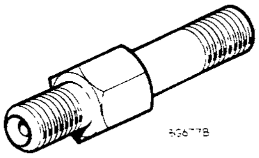
18G 1004 J Circlip Plier Points



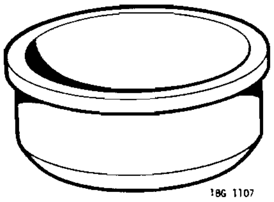
18G 389 Gearbox Rear Oil Seal Remover—Basic Tool
Alternative Tool 7657



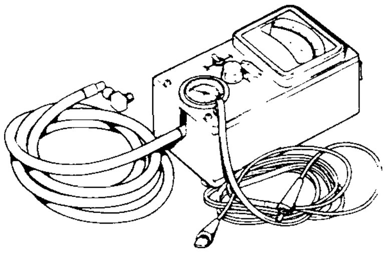
18G 1016 Clutch Spring Compressor



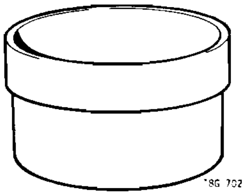
18G 677 B Adaptor—Pressure Test



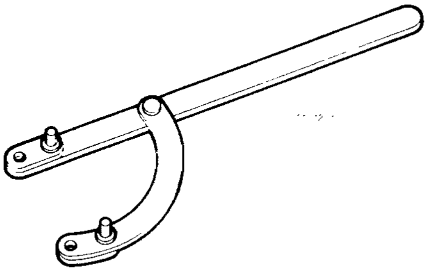
18G 1107 Front Clutch Piston and Seal Replacer



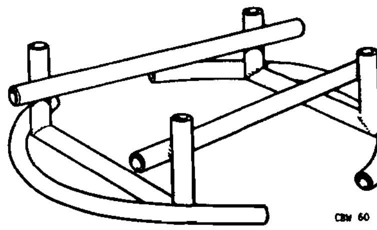
18G 677 ZC Pressure Test Equipment



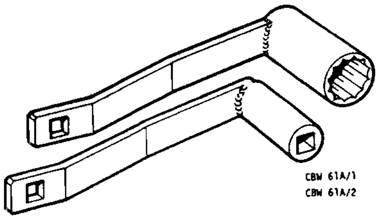
'G 702 Rear Clutch Piston and Seal Replacer



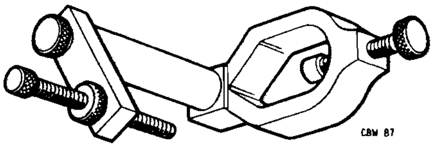
18G 1205 Propeller Shaft Flange Wrench



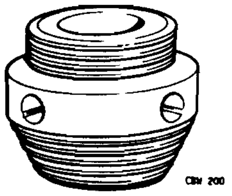
CBW 60 Bench Cradle



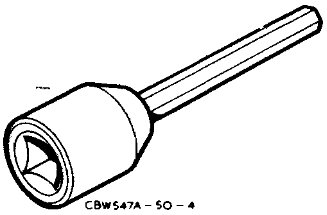
CBW 61A/1 } Front/Rear Servo Adjuster
CBW 61A/2 } and Locknut Adaptor



CBW 87 End-float Checking Gauge



CBW 200 Pump Oil Seal Remove Adaptor



CBW 547A–50–4 Pressure Take-off Remover Adaptor
Alternative Tool 18G 1277

SECTION E

THE PROPELLER SHAFT

Section

Section E.1

DESCRIPTION

The propeller shaft is the tubular type with Hardy Spicer type needle-bearing universal joints. Variations due to engine and axle movement are provided for by a sliding joint on the splined end of the shaft.

The sliding joint male and female members are marked in order that the splines can be reassembled in the original position. This is essential to ensure the correct relative position of the yokes of the universal joints and to avoid shaft vibrations.

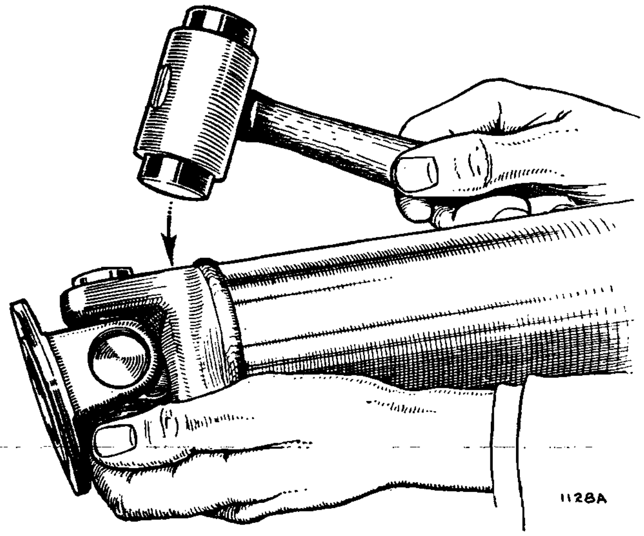


Fig. E.1
Apply light blows to the yoke after removing the circlip

Section E.2

TESTING FOR WEAR

Wear on the thrust faces is ascertained by testing the lift in the joint either by hand or with the aid of a length of wood suitably pivoted.

Any circumferential movement of the shaft relative to the flange yokes indicates wear in the needle-roller bearings, or in the splined shaft in the case of the forward joint.

Section E.3

REMOVING THE PROPELLER SHAFT

Remove the four nuts and bolts from the flange coupling at each end of the propeller shaft, slide the shaft into the sliding joint, and remove the assembly rearwards and downwards from the vehicle.

Section E.4

DISMANTLING THE PROPELLER SHAFT

Unscrew the dust cap from the sliding sleeve and remove the gasket, washer, sliding sleeve, and dust cap.

Remove the enamel and dirt from the snap-rings and bearing faces. Remove all the snap-rings by pinching their ears together with a pair of thin-nosed pliers and prising them out with a screwdriver.

If a ring does not slide out of its groove readily tap the end of the bearing race slightly to relieve the pressure against the ring. Remove the lubricator from the journal and, holding the joint in one hand, tap the radius of the yoke lightly with a copper hammer (Fig. E.1). The bearing should begin to emerge; turn the joint over and finally remove with the fingers. If necessary, tap the bearing race from inside with a small-diameter bar (Fig. E.2), taking care not to damage the bearing face, or grip the needle-bearing race in a vice and tap the flange yoke clear.

Be sure to hold the bearing in a vertical position, and when free remove the race from the bottom side to avoid dropping the needle rollers.

Repeat this operation for the opposite bearing.

Rest the two exposed trunnions on wood or lead blocks to protect their ground surfaces, and tap the top lug of the flange yoke to remove the bearing race.

Turn the yoke over and repeat the operation.

Section E.5

EXAMINING AND CHECKING FOR WEAR

The parts most likely to show signs of wear after long usage are the bearing races and the spider journals.

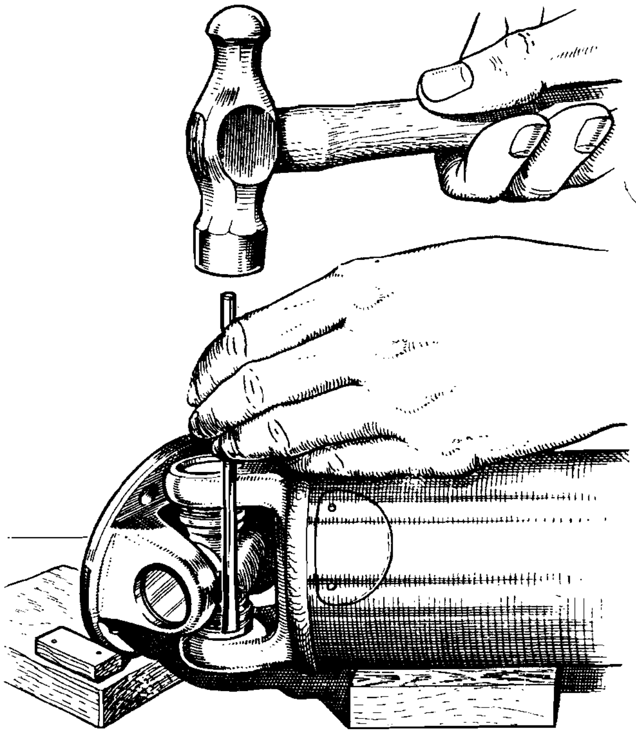


Fig. E.2
When dismantling a universal joint the bearings may be tapped out with a small-diameter rod as shown. Take care not to damage the roller races

ould looseness, load markings, or distortion be observed, the affected part must be renewed complete; no oversized journals or races are provided.

It is essential that the bearing races are a light drive fit in the yoke trunnions. In the event of wear taking place in the yoke cross-holes, rendering them oval, the yokes must be renewed. In case of wear in the cross-holes in the fixed yoke, which is part of the tubular shaft assembly, it should be replaced by a complete tubular shaft assembly.

Section E.6

REASSEMBLING THE PROPELLER SHAFT

See that all the drilled holes in the journals are thoroughly cleaned out and free of grease.

Assemble the needle rollers in the bearing races and fill with grease. Should difficulty be experienced in retaining the rollers under control, smear the walls of the races with grease to retain the needle rollers in position while reassembling.

Insert the spider in the flange yoke, ensuring that **the lubricator boss is fitted away from the yoke.** Using a soft-nosed drift, about $\frac{1}{32}$ in. (·8 mm.) smaller in diameter than the hole in the yoke, tap the bearing into position. Repeat this operation for the other three bearings. Replace the circlips and be sure that these are firmly located in their grooves. If the joint appears to bind, tap lightly with a wooden mallet: this will relieve any pressure of the bearings on the ends of the journals.

It is always advisable to replace the cork gaskets and the gasket retainers on the spider journals by means of a tubular drift shown in Fig. E.3. The spider journal shoulders should be shellacked prior to fitting the retainers to ensure a good oil seal.

Thread the dust cap over the splined shaft.

Assemble the sliding sleeve on the propeller shaft, making sure that the splines are lubricated **and that the arrow marks on the shaft and sleeve are in line.** This is particularly important so that the yokes on the universal joints will be in the same plane, otherwise excessive vibration will result.

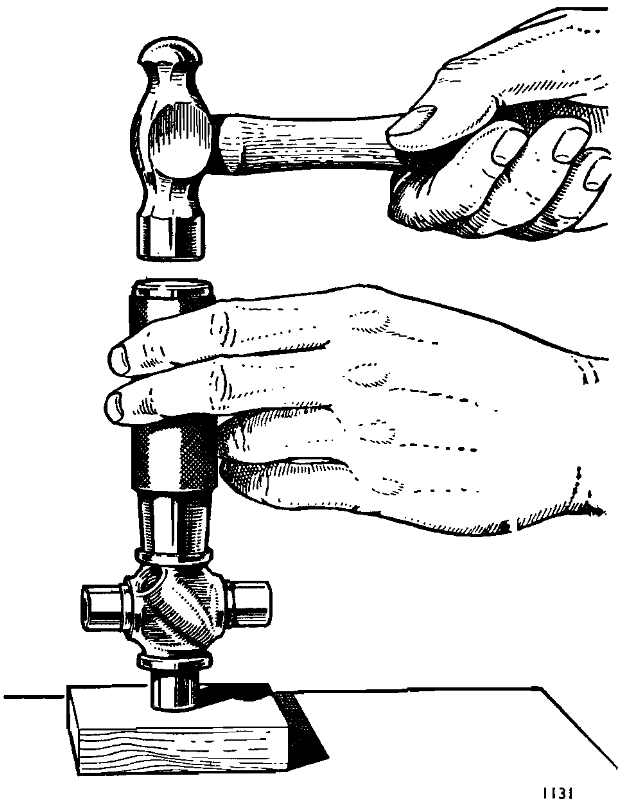


Fig. E.3

When replacing the gasket retainer use should be made of a hollow drift to tap it into place without damage

Install a new gasket and the metal washer and screw up the dust cap on the sliding sleeve.

Section E.7

REPLACING THE PROPELLER SHAFT

Wipe the faces of the flanges clean and place the propeller shaft in position on the car. Ensure that the flange registers engage correctly, and that the joint faces bed down evenly all round. Insert the bolts and tighten the nuts.

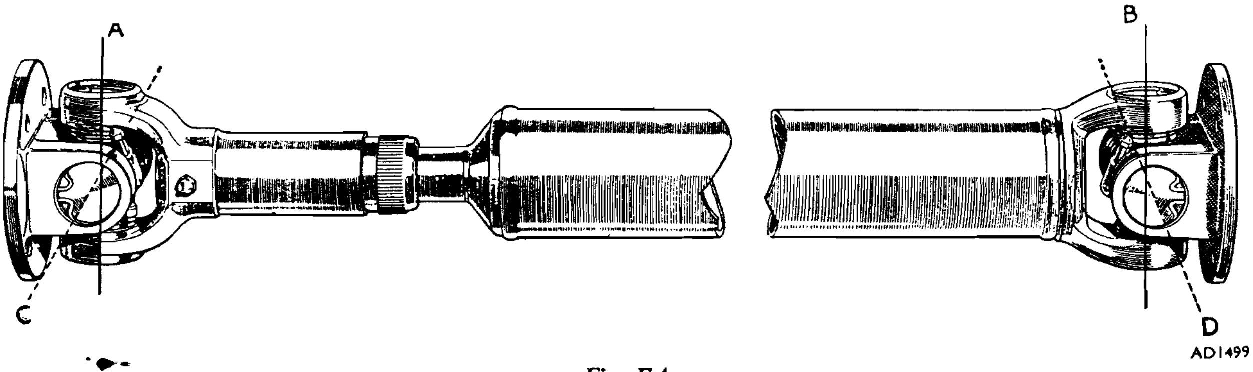


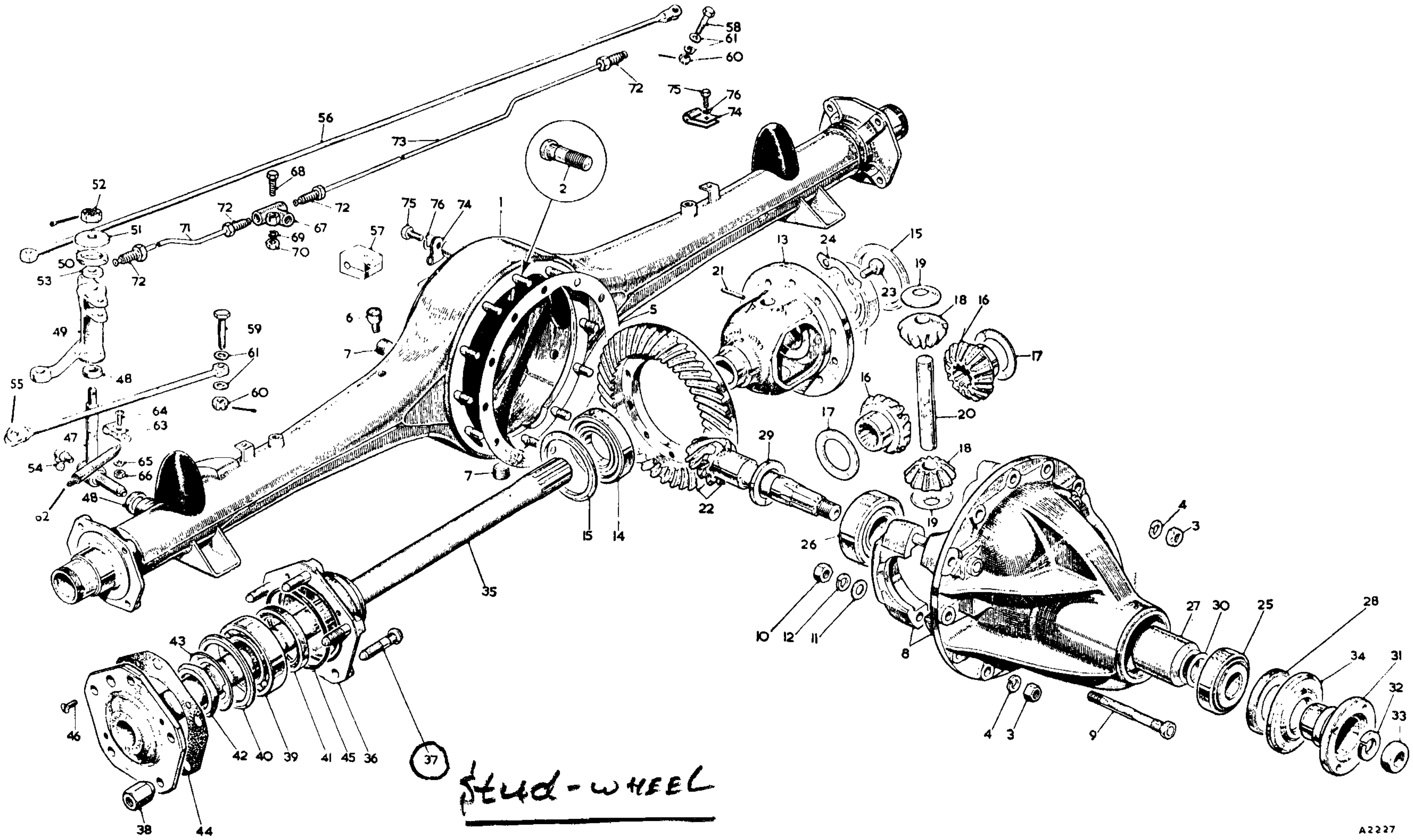
Fig. E.4

Propeller shaft layout. (A) *must be in alignment with* (B), *and* (C) *in alignment with* (D)

SECTION F

THE REAR AXLE AND REAR SUSPENSION

THE REAR AXLE COMPONENTS



Stud-wheel

N.B ZIE E-MAIL.
m.v.g. HANS.

KEY TO THE REAR AXLE COMPONENTS

No.	*Description*
1.	Case assembly.
2.	Bolt—differential carrier.
3.	Nut—axle case bolt.
4.	Washer—spring—axle case bolt.
5.	Joint to axle case.
6.	Breather assembly.
7.	Plugs—drain and filler.
8.	Carrier assembly.
9.	Bolt—serrated—cap.
10.	Nut for bolt.
11.	Washer for bolt—plain.
12.	Washer for bolt—spring.
13.	Cage—differential.
14.	Bearing—differential.
15.	Washer—bearing packing.
16.	Gear.
17.	Washer—thrust gear.
18.	Pinion.
19.	Washer—thrust pinion.
20.	Pin—pinion.
21.	Peg—pinion pin.
22.	Crown wheel and pinion.
23.	Bolt to cage.
24.	Washer for bolt—lock.
25.	Bearing—pinion—outer.
26.	Bearing—pinion—inner.
27.	Distance piece.
28.	Seal—oil.
29.	Washer—pinion thrust.
30.	Shim—outer bearing.
31.	Flange—universal joint.
32.	Washer—spring—to pinion.
33.	Nut to pinion.
34.	Cover—dust.
35.	Shaft—axle.
36.	Hub assembly.
37.	Stud—wheel.
38.	Nut—wheel stud.
39.	Bearing.
40.	Spacer—bearing.
41.	Seal—oil.
42.	Nut—bearing retaining.
43.	Washer for bearing retaining nut.
44.	Joint—shaft to hub.
45.	Seal—oil—ring.
46.	Screw—shaft to hub.
47.	Carrier for balance lever.
48.	Ring—felt (large).
49.	Lever—balance.
50.	Felt ring for balance lever.
51.	Cup for felt.
52.	Nut.
53.	Washer.
54.	Lubricator.
55.	Rod—cross—R.H.
56.	Rod—cross—L.H.
57.	Ferrule for cross-rod.
58.	Pin—joint—wheel end.
59.	Pin—joint—lever end.
60.	Nut for joint pin.
61.	Washer for joint pin.
62.	Spring—pull-off.
63.	Clip for spring on brake rod.
64.	Screw for clip.
65.	Washer for screw (spring).
66.	Nut for screw.
67.	Connection—3-way.
68.	Screw—3-way connection to axle case.
69.	Washer for screw—spring.
70.	Nut for screw.
71.	Pipe—3-way connection to R.H. brake.
72.	Nut—tube.
73.	Pipe—3-way connection to L.H. brake.
74.	Clip—L.H. brake pipe to axle case.
75.	Screw for clip.
76.	Washer for screw.

Section F.1

DESCRIPTION

The rear axle is of the three-quarter-floating type incorporating hypoid final reduction gears. The axle shafts, pinion, and differential assemblies can be withdrawn without removing the axle from the vehicle.

The wheel bearing outer races are located in the hubs, and the inner races are mounted on the axle tube and secured by nuts and lock washers. Wheel studs in the hubs pass through the brake-drums and axle shaft driving flanges. Brake-drums are located on the hub flange by two countersunk screws in each.

The differential and pinion shaft bearings are preloaded, the amount of preload being adjustable by shims and spacers. The position of the pinion in relation to the crown wheel is determined by a spacing washer. The backlash between the gears is adjustable by spacers.

The semi-elliptic leaf springs provided for rear suspension are secured beneath the rear axle by 'U' bolts.

The front ends of the springs are anchored in flexing rubber bushes, while the rear ends are mounted in similar bushes in swinging shackles.

Section F.2

REMOVING AND REPLACING THE AXLE

Raise the rear of the car and place suitable stands under the frame forward of the rear springs.

Remove the road wheels and release the hand brake.

Disconnect the flexible brake hose at the union on the chassis side-member.

Disconnect the brake cable from the relay lever.

Support the axle on a stand or trolley jack.

Disconnect the exhaust tail pipe support.

Remove the left-hand-side brake-drum to give more body clearance.

Disconnect the rear end of the propeller shaft from the rear axle.

Unscrew the 'U' bolt nuts and locknuts, release the dampers from the axle, and lower the axle to the ground.

Replacement is a reversal of the removal procedure, but it will be necessary to bleed the brakes to make sure that no air remains in the system.

Section F.3

IMPORTANT POINTS CONCERNING AXLE ATTENTION

Dismantling the differential and pinion assembly and the renewal of these parts is not advised unless it is absolutely necessary and unless you are equipped with the necessary checking gauges and the full range of distance washers and spacers from which to select the required new sizes. Consideration in this case should be given to the advisability of fitting a Service replacement axle.

Dismantling for examination and cleaning is permissible, provided care is taken to refit the distance pieces and spacers in exactly the same locations.

The following parts may be renewed without the aid of special calculations and checking gauges:

(1) The internal parts of the differential housing.

(2) A crown wheel and pinion having markings identical to the originals.

(3) A differential housing having markings identical to the original.

(4) A pinion carrier having markings identical to the original.

The following parts may be renewed with the aid of special calculations and checking gauges:

(5) A crown wheel and pinion having markings different to the originals.

(6) A differential housing having markings different to the original.

(7) A pinion carrier having markings different to the original.

(8) The differential housing bearings.

(9) The bevel pinion taper-roller bearings.

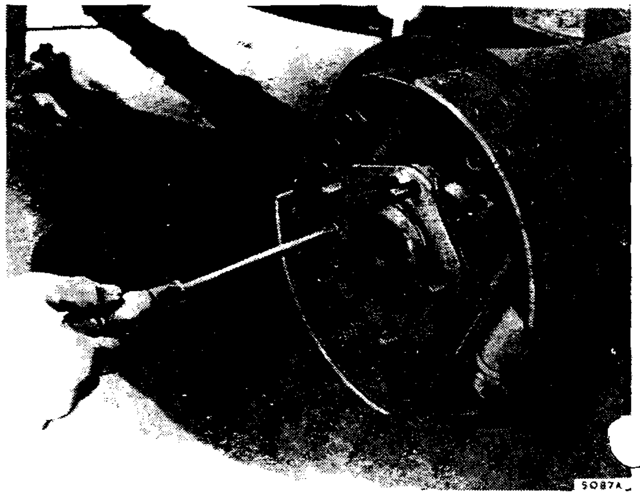


Fig. F.1

Remove the two countersunk screws and withdraw the shaft by gripping the flange

Section F.4

REMOVING AND REPLACING A BRAKE-DRUM AND AXLE SHAFT

Jack up the car and remove the wheel.

Release the hand brake.

Unscrew and remove the two countersunk drum locating screws and tap the drum from the hub. It may be necessary to slacken off the brake adjustment slightly if the shoes hold the drum.

Unscrew the countersunk locating screw in the axle shaft driving flange (Fig. F.1).

Withdraw the axle shaft by gripping the flange or carefully prising it with a screwdriver. If the latter method is used the paper washer may be damaged and must then be renewed when reassembling.

To replace the shaft and drum reverse the above sequence of operations.

Section F.5

REMOVING AND REPLACING A HUB

Remove the brake-drum and axle shaft as detailed in Section F.4.

Remove the hub bearing spacer.

Knock back the tab of the axle tube nut locking washer and unscrew the nut, using tool 18G258 (Fig. F.2). The left-hand axle tube nut has a left-hand thread.

Tilt the lock washer to disengage the key from the slot in the threaded portion of the axle tube and remove the washer.

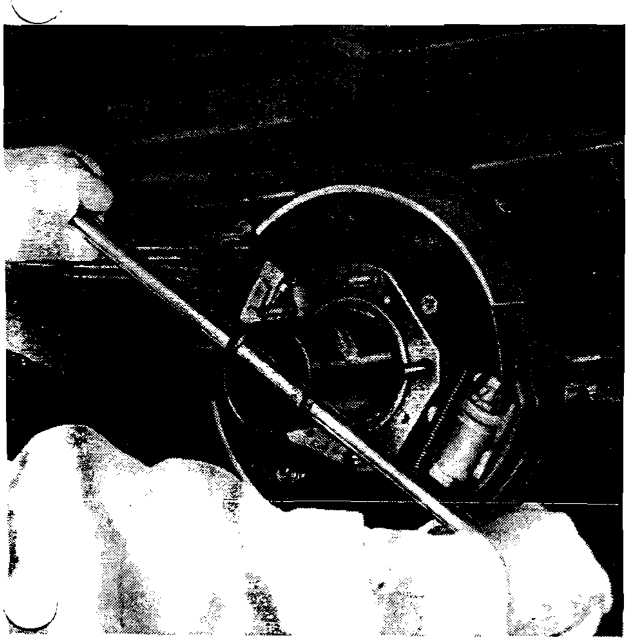


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Fig. F.2

Removing the hub nut with tool 18G258

The hub can now be withdrawn, using tools 18G304, 18G304B, and 18G304K (Fig. F.3). The bearing and oil seal will be withdrawn with the hub.

Drive out the oil seal and bearing from the hub.

Discard the oil seal.

When reassembling soak a new oil seal in engine oil and fit it with its sealing edge towards the wheel bearing, using tools 18G134 and 18G134AQ. Drive the wheel bearing into the hub, using tools 18G134 and 18G134K (Fig. F.4), ensuring that it butts up against the shoulder in the hub. The bearing is not adjustable and is replaced in one operation.

Pack the bearing with a recommended grade of bearing grease.

Refit the hub to the axle tube.

Refit the axle tube lock washer and nut. Fully tighten the nut and lock in position.

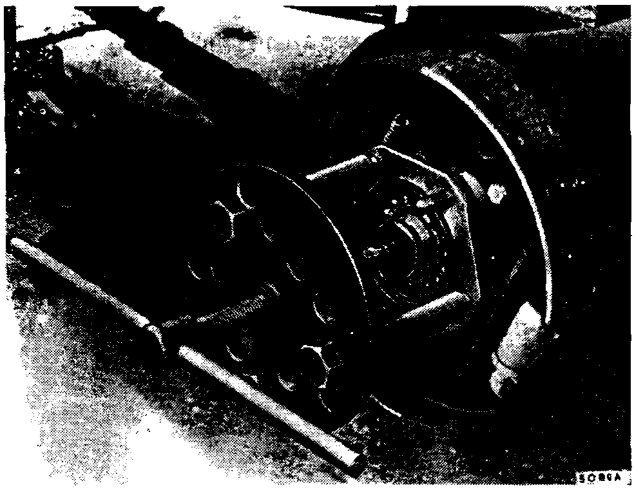


Fig. F.3

Withdrawing the hub, using tools 18G304, 18G304B, and 18G304K

Refit the hub bearing spacer. It is essential that the outer face of the spacer should protrude from ·001 to ·004 in. (·025 to ·091 mm.) beyond the outer face of the hub with the paper washer fitted. This ensures that the bearing is gripped tightly between the abutment shoulder in the hub and the driving flange of the axle shaft.

Refit the axle shaft, using a new joint gasket, and insert the screw locating the shaft flange to the hub.

Replace the brake-drum, securing it with the two screws to the hub.

Replace the wheel.

Section F.6

RENEWING THE PINION OIL SEAL

Disconnect the rear end of the propeller shaft from the rear axle.

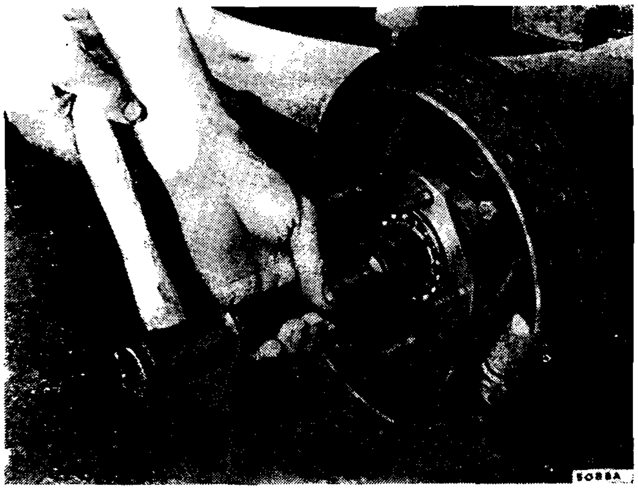


Fig. F.4

Fitting the bearing into the hub, using tools 18G134 and 18G134K

Knock back the lock washer tab and unscrew the pinion nut whilst holding the driving flange with wrench 18G34A. Remove the driving flange complete with end cover, using tool 18G2 if necessary.

Extract the oil seal from the casing.

Press a new seal into the casing, with the edge of the sealing ring facing inwards, using tools 18G134 and 18G134AQ.

Replace the driving flange and end cover, taking care not to damage the edge of the oil seal, and tighten the nut with torque wrench 18G372 to a reading of 140 lb. ft. (19·4 kg. m.).

Reconnect the propeller shaft.

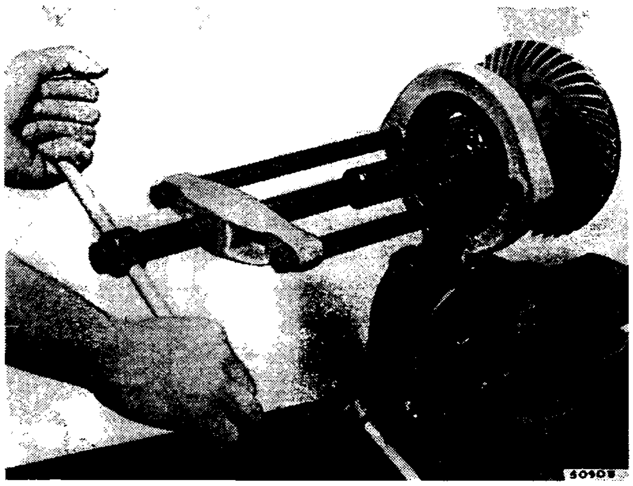


Fig. F.5

Removing the differential bearings, using tools 18*G*47*C and* 18*G*47*AD*

Section F.7

REMOVING AND DISMANTLING THE DIFFERENTIAL AND PINION

Before removing the differential and pinion assembly the instructions given in Section F.3 should be carefully studied.

The differential and pinion assembly can be removed with the rear axle *in situ* as follows.

Drain the oil from the axle.

Disconnect and support the rear end of the propeller shaft.

Withdraw the axle shafts sufficiently to clear the differential assembly (see Section F.4).

Remove the nuts and spring washers securing the differential and pinion carrier to the axle.

Withdraw the assembly from the axle case studs.

Mark the differential bearing caps so that they can be replaced in their original positions. Remove the two nuts and spring washers from each and withdraw the caps and the differential assembly from the carrier.

Remove the differential bearings from the housing, using extractor 18G47C in conjunction with adaptor 18G47AD (Fig. F.5).

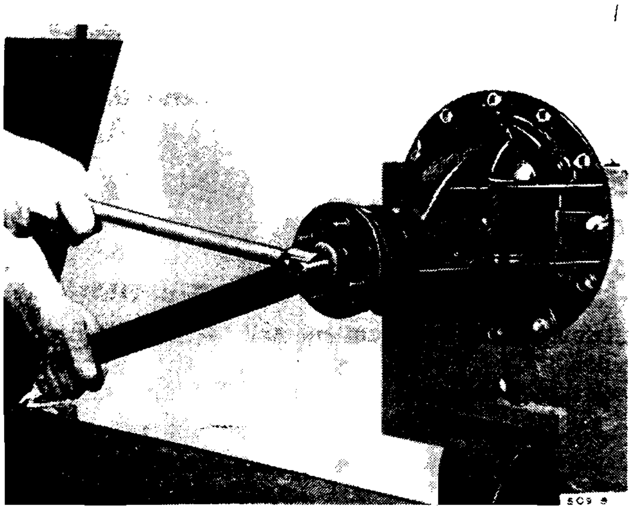


Fig. F.6

Use the special flange wrench 18*G*34*A to hold the flange against rotation when removing the pinion nut*

Knock back the tabs of the locking plates and take out the bolts securing the crown wheel to the differential housing.

Tap out the tapered dowel pin locating the differential pinion pin, removing any metal peened over, if necessary.

Remove the pinion pin, pinions, wheels, and thrust washers.

Knock back the lock washer tab and unscrew the pinion nut whilst holding the driving flange with wrench 18G34A (Fig. F.6). Remove the driving flange complete with end cover, using tool 18G2 if necessary.

Drive the pinion shaft towards the rear. It will carry with it the inner race and rollers of the rear bearing, leaving the outer race and the complete front bearing in position.

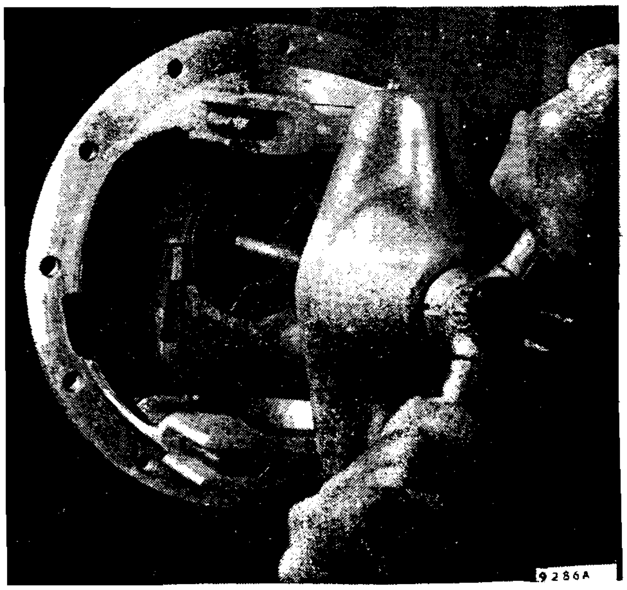


Fig. F.7

Removing the pinion bearing outer races, using tools 18*G*264, 18*G*264*D, and* 18*G*264*H*

Remove the oil seal and the inner race of the front bearing with the fingers and withdraw both outer races with extractor 18G264 and adaptors 18G264D and 18G264H (Fig. F.7).

Slide off the pinion distance piece and shims.

Withdraw the rear bearing inner race from the pinion shaft, using extractor 18G285 (Fig. F.8). This will release the spacing washer against the pinion head.

Section F.8

ASSEMBLING, SETTING, AND REPLACING THE DIFFERENTIAL AND PINION

To select a new driving pinion spacer

The pinion spacer controls the position of the pinion in relation to the axis of the crown wheel, and it is fitted between the head of the pinion and its rear bearing.

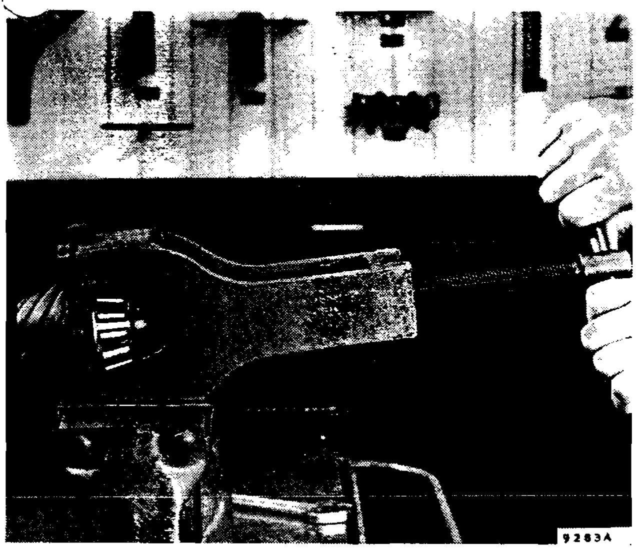


Fig. F.8

Removing the pinion rear bearing inner race, using tool 18G285

Adjustment of the pinion position is made by varying the thickness of the spacer, which is available in a range of thicknesses between ·208 and ·222 in. (5·28 and 5·64 mm.) in steps of ·002 in. (·05 mm.).

If the pinion or crown wheel is worn it is essential to renew **both**, as pinions and crown wheels are matched in pairs.

All driving pinions are marked on their heads, denoting the deviation, plus or minus, in thousandths of an inch, from standard. The serial number, also marked on the pinion head, will be the same as the serial number of the crown wheel.

If the new pinion to be fitted has a different marking to the original, or if the pinion shaft taper-roller bearings and distance piece are renewed, then the pinion must be set accurately in its housing. To do this the pinion spacer will have to be renewed, and is selected by the following calculations and procedure:

(1) Install the pinion bearing outer races in the housing, using tool 18G264 with adaptors 18G264D and 18G264H.

The thicker edges of the races should face in towards each other and should fit tightly and squarely against the shoulders in the housing.

(2) Smooth off the pinion head with an oil-stone, taking care not to erase any variations in pinion head thickness etched on the pinion.

(3) If the original pinion is being refitted or if the new pinion has the same mark on its head, fit a spacer of the same size as the original as a starting-point. If the markings differ, any increase in dimension must be **subtracted** from the thickness of the original spacer. Any decrease in dimension must be **added** to the thickness of the original spacer.

Example:

(*a*) An old pinion stamped +2 and a new pinion stamped +4. The new spacer will be ·002 in. (·05 mm.) **less** than the thickness of the old.

(*b*) An old pinion stamped +4 and a new pinion stamped +2. The new spacer will be ·002 in. (·05 mm.) **greater** than the thickness of the old.

(*c*) An old pinion stamped −2 and a new pinion stamped +2. The new pinion spacer will be ·004 in. (·10 mm.) **less** than the thickness of the old.

(4) Having selected a spacer by the above means, say, ·214 in. (5·44 mm.) thick, fit it to the pinion shaft with its chamfer towards the pinion head.

(5) Fit the inner race and roller assembly of the rear bearing onto the pinion shaft, using tool 18G285, and position the shaft in the housing, engaging the rear bearing inner and outer races.

(6) Install the inner race and roller assembly of the front bearing on the pinion shaft.

NOTE.—**At this stage the bearing distance piece, oil seal, and shims are omitted, as preload of the bearings is ascertained later in the procedure.**

(7) Fit the universal joint flange. Holding the flange with wrench 18G34A, tighten the nut gradually until a preload figure of 13 to 15 lb. in. (·150 to ·173 kg. m.) is obtained by checking with tool 18G207. Rotate the shaft a number of times to seat the bearings.

(8) Using the setting block provided with tool 18G191B, adjust the clock gauge to read zero on the machined step marked 'C'. Ensure that the knurled screw of the gauge is fully tightened, otherwise inaccurate readings will be obtained (Fig. F.9).

(9) Ensure that the pinion head and the differential case bearing bores are clean.

(10) Place the magnet in position on the pinion head.

(11) Move the clock arm until the foot of the gauge rests on the centre of one differential bearing bore and retighten the knurled screw. Take the maximum depth reading and note the greatest variation from zero (see Fig. F.10). Make a similar check on the other bore.

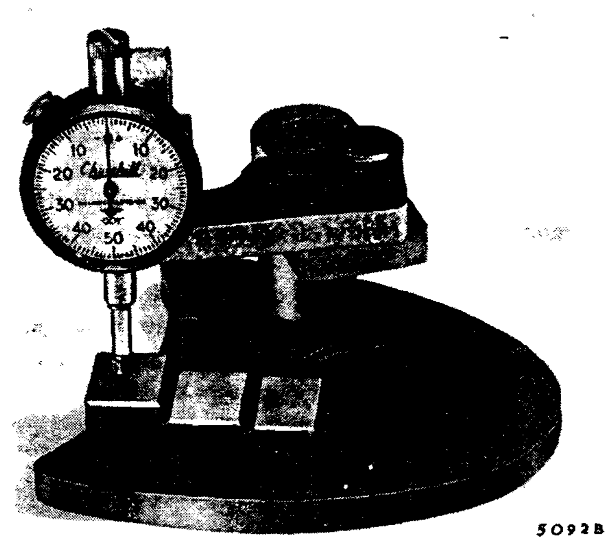


Fig. F.9
Set the gauge to zero on the step 'C' before gauging as illustrated in Fig. F.10

(12) Add the variations of the two bores together and divide by two, thus obtaining a mean reading. If this reading is within ±·001 in. (·025 mm.) of the zero setting, the spacer fitted is of the corrected thickness, as there is a permissible tolerance of ±·001 in. (·025 mm.).

(13) A larger positive reading indicates that the spacer is not thick enough and must be **increased** by the amount of the reading. A larger negative reading indicates that the spacer is too thick and must be **decreased** by the amount of the reading.

Fig. F.10
The tool in position on the pinion head, with the gauge indicating a variation from the standard setting

Examples:

(*a*) If the clock gauge gives a mean reading of +·002 in. (·05 mm.) with a spacer of ·214 in. (5·44 mm.) thickness fitted to the shaft, then a spacer thickness of ·214 in.+·002 in. (5·44 mm.+·05 mm.) = ·216 in. (5·49 mm.) is needed.

(*b*) If a mean reading of −·002 in. (·05 mm.) is obtained with a spacer of ·214 in. (5·44 mm.) thickness fitted to the shaft, then a spacer thickness of ·214 in.−·002 in. (5·44 mm. −·05 mm.) = ·212 in. (5·38 mm.) is needed.

(14) Remove the checking fixture and withdraw the pinion as previously described.

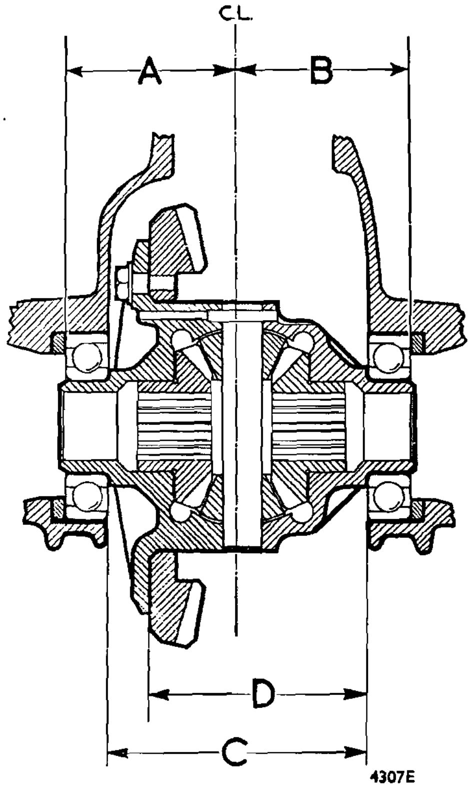


Fig. F.11
The dimensions referred to in the instructions for differential setting

To select a differential bearing spacer

The differential bearings must be preloaded, and this is done by 'pinching' them to the extent of ·002 in. (·05 mm.) on each bearing, the 'pinch' being obtained by varying the thickness of the bearing spacer fitted between each bearing outer race and its register in the bearing cap.

In making the necessary calculations, machining tolerances and variations in bearing width must be taken into account. Machining variations are stamped on the component **in thousandths of an inch,** while bearing width variations must be measured with the aid of tool 18G191B.

The dimensions involved in preloading the differential bearings are described below, and it is emphasized that it is the variation from nominal on each dimension which the important factor referred to in the formula used.

Referring to Fig. F.11, the dimensions are:

A. From the centre-line of the differential to the bearing outer register on the crown wheel side of the differential housing.

Variation—stamped on the housing near the bearing bore.

B. From the centre-line of the differential to the bearing outer register on the right-hand side of the differential housing.

Variation—stamped on the housing near the bearing bore.

C. From the bearing inner register on one side of the housing to the bearing inner register on the opposite side.

Variation—stamped on the housing.

D. From the rear face of the crown wheel to the bearing inner register on the opposite side.

Variation—stamped on the housing.

To calculate the thickness of a spacer for the **crown wheel side bearing** the formula is:

A+D−C+·1815 in. (4·610 mm.).

Each variation stamped on the differential housing or carrier is followed by the letter to which it refers. Substitute the variations for the letters in the formula. The result of the formula gives the thickness of the spacer required to compensate for machining variations and to give the necessary pinch **with bearings of standard width.**

Examples:

(1) If A = +1, D = +2, and C = +1, then ·001 in.+·002 in.−·001 in.+·1815 in. = 1835 in. (·0254 mm.+·0508 mm.−·0254 mm.+4·610 mm. = 4·66 mm.).

(2) If A = +3, D = +1, and C = +6, then ·003 in.+·001 in.−·006 in.+·1815 in. = ·1795 in. (·0762 mm.+·0254 mm.−·1524 mm.+4·610 mm. = 4·559 mm.).

Having calculated the thickness of the spacer by this rmula, the **width of the bearing** must be checked as follows.

Rest the bearing on the small surface plate of tool 18G191B, with the inner race over the recess, thrust face downwards (see Fig. F.13).

Place the magnet on the surface plate and set the dial indicator to zero on the step marked 'C' of the small gauge block (see Fig. F.12). This is the width of a standard bearing. Transfer the indicator to the plain surface of the bearing inner race and, holding the race down against the bearings, note the reading on the dial (see Fig. F.13). A **negative** reading shows the additional amount to be **added** to the spacer thickness calculated by the formula; a **positive** reading shows the amount to be **subtracted.**

To calculate the bearing spacer thickness for the **right-hand bearing** the formula is:

B−D+·1825 in. (4·634 mm.).

Example:

If B = +3 and D = +2, then ·003 in.−·002 in.+·1825 in. = ·1835 in. (·0762 mm.−·0508 mm.+4·634 mm. = 4·66 mm.).

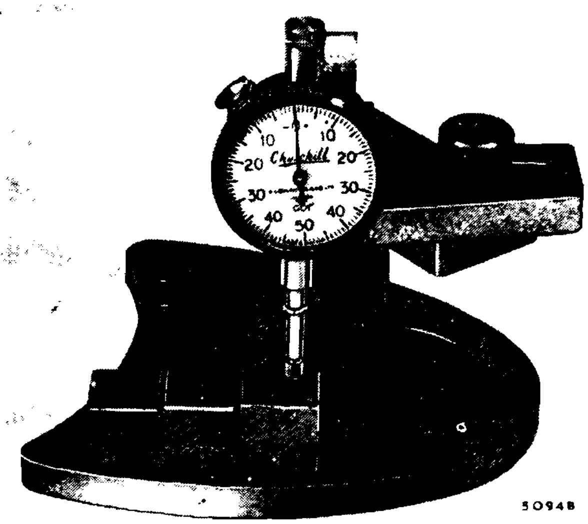


Fig. F.12

Set the gauge to zero on the step 'C' before gauging as illustrated in Fig. F.13

Having ascertained the thickness of the right-hand spacer by this means, check the width of the right-hand bearing in the manner described for the crown wheel side bearing, and choose a spacer accordingly, which vary in thickness by ·002 in. (·05 mm.) each between ·175 and ·193 in. (4·45 and 4·90 mm.).

Great care must be taken during the following operations to ensure absolute cleanliness, as particles of dirt will cause discrepancies in measurements which might affect the final position of the crown wheel and pinion.

Lubricate all components with the recommended grade of hypoid transmission oil. A new oil seal must be soaked in engine oil.

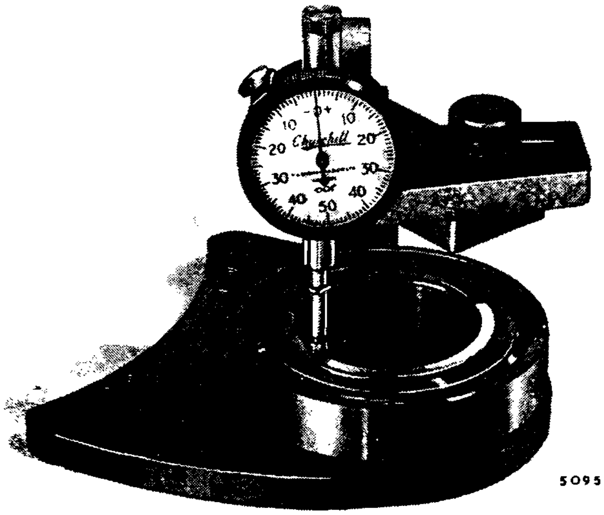


Fig. F.13

The gauge in position on the bearing with the dial indicating a variation from the standard bearing width

These lubricating operations are important, as possible damage is thus avoided when the reassembled axle is first operated.

To reassemble proceed as follows:

(1) Fit the selected spacer with its chamfer towards the pinion head.
(2) Fit the pinion bearing outer races if they have been removed for any purpose.
(3) Fit the inner race and roller assembly of the rear bearing onto the pinion shaft, using tool 18G285 (Fig. F.14), and position the shaft in its housing, engaging the bearing in its outer race.
(4) Replace the pinion bearing distance piece.
(5) The pinion bearing preload of 16 to 18 lb. in. (·184 to ·207 kg. m.) with the oil seal in position must now be determined by the selection of shims, which vary in thicknesses of ·002 in. (·05 mm.)

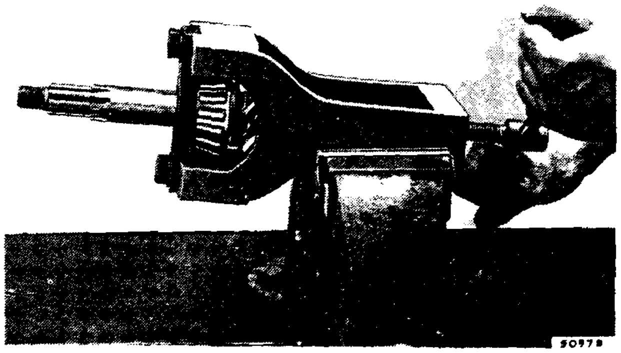


Fig. F.14
Refitting the pinion rear bearing inner race, using service tool 18*G*285

each between ·004 and ·012 in. (·102 and ·305 mm.) plus ·020 and ·030 in. (·508 and ·762 mm.), to be fitted between the bearing distance piece and the outer bearing. As a starting-point fit a shim of ·008 to ·012 in. (·203 to ·305 mm.) to the pinion shaft and refit the outer bearing inner race. Fit a new oil seal and replace the dust cover, driving flange, a new lock washer, and the pinion shaft nut. Tighten the nut gradually with torque wrench 18G372 to 140 lb. ft. (19·4 kg. m.) whilst holding the flange with wrench 18G34A. As the correct torque wrench figure is approached check the pinion bearing preload frequently with tool 18G207 (Fig. F.15) to ensure that it does not exceed the maximum 18 lb. in. (·207 kg. m.). The preload must be checked while the pinion is rotating slowly at constant speed. If the bearing preload is too great a thicker shim must be added; if the preload is too low the thickness of the shim must be reduced.

(6) Having determined and fitted the correct thickness of shim, secure the pinion nut with its lock washer.
(7) Install the differential wheels in the housing with their flat thrust washers in position.

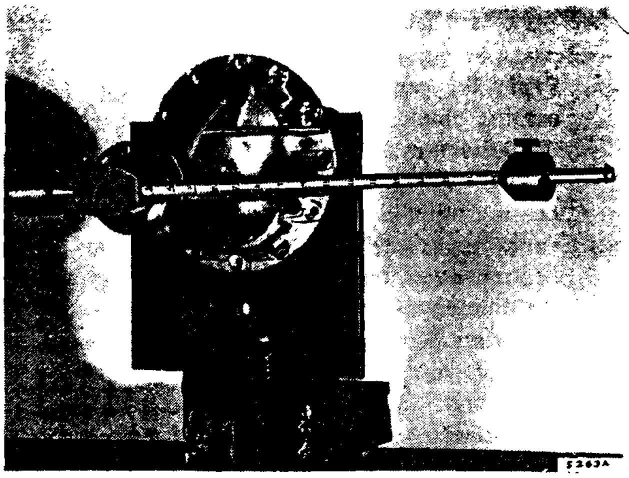


Fig. F.15
Checking the pinion bearing preload, using tool 18*G*207

(8) Install the differential pinions in the housing with their spherical thrust washers in position. Rotate the pinions until they and their thrust washers register with the pinion pin holes in the differential housing. If new pinion thrust washers are fitted it is necessary to ensure that they are properly bedded in, as otherwise it may be difficult to locate the pinions.
(9) Insert the pinion pin through the differential housing, thrust washers, and pinions. Check the backlash between the pinions and differential wheels. This should not exceed ·005 in. (·127 mm.). Adjust the backlash by the use, in pairs, of thrust washers of different thickness. Do not use a washer of one thickness for one pinion and a washer of another thickness under the opposing pinion. Insert the taper dowel pin into the housing, peening over the metal around the entry hole.

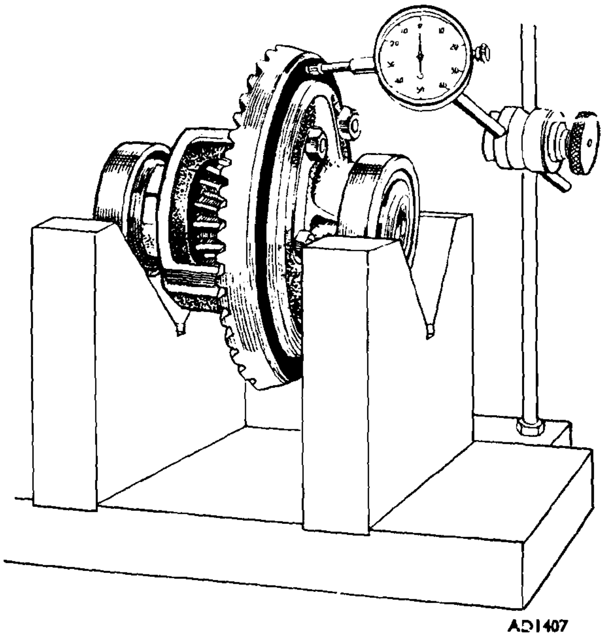


Fig. F.16
Method of checking the crown wheel run-out

(10) Test the assembly by revolving the differential wheels with the fingers inserted in the splines.

(11) Ensure that the mating surfaces of the crown wheel and the differential housing flange are perfectly clean and free from burrs. Assemble the crown wheel to the differential housing with new locking plates under the heads of the set bolts. Tighten the set bolts to a torque wrench reading of 55 to 60 lb. ft. (7·6 to 8·3 kg. m.), but do not lock the bolts until the following check has been carried out.

Spin the assembly on a roller fixture with a dial gauge registering against the back face of the crown wheel (Fig. F.16). The maximum permissible error in alignment is ·002 in. (·051 mm.). If the error is in excess of this figure, reassemble the crown wheel in a different position and check once more. Check in several positions before discarding a crown wheel which runs out of true.

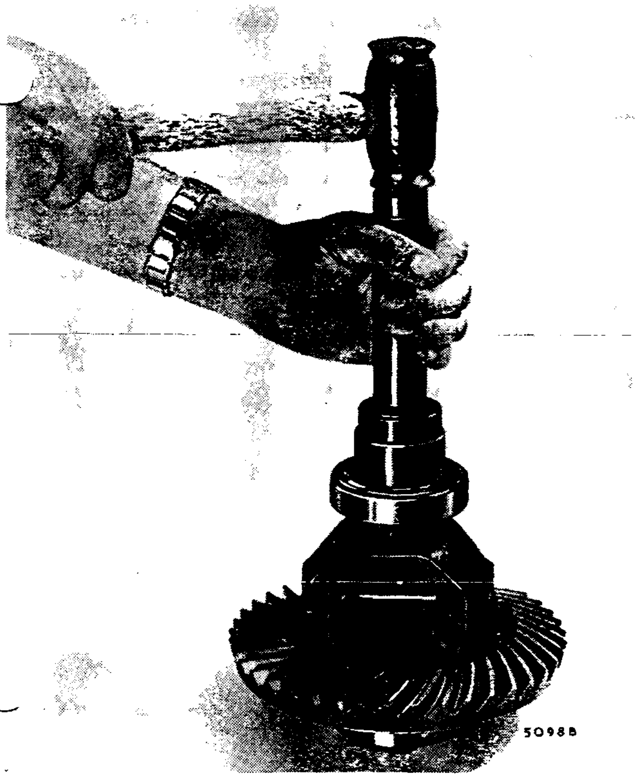


Fig. F.17
Refitting a differential bearing, using tools 18G134 and 18G134K

(12) When the alignment is correct, lock the crown wheel set bolts in position by turning up the tabs of the locking plates.

(13) Drive the differential bearings onto the differential housing bosses, with their thrust faces outwards, using tools 18G134 and 18G134K (Fig. F.17). Place the selected spacer of the correct thickness, calculated as previously described, against each bearing outer race, and position the differential assembly and spacers in the carrier, meshing the crown wheel and pinion. Replace the bearing caps in their original positions, tightening the securing nuts down gradually and evenly to a torque wrench reading of 60 to 65 lb. ft. (8·3 to 9·0 kg. m.).

(14) Mount the dial indicator of tool 18G191B on the magnet bracket so that an accurate measurement of crown wheel backlash can be taken (Fig. F.18). The recommended backlash is etched on the crown wheel. To decrease backlash, **increase** the thickness of the differential bearing spacer on the crown wheel side, at the same time **decreasing** the thickness of the spacer on the opposite side **by the same amount.** To increase the backlash **reduce** the thickness of the bearing spacer on the crown wheel side, at the same time **increasing** the thickness of the spacer on the opposite side **by the same amount.** Thus the crown wheel is moved into or out of mesh as necessary, and the **combined thickness** of the two bearing spacers remains unaltered. A tolerance of ·002 to −·001 in. (·051 to −·025 mm.) on the backlash stamped on the crown wheel is permissible as long as a minimum of ·006 in. (·152 mm.) or a maximum of ·012 in. (·304 mm.) is not exceeded.

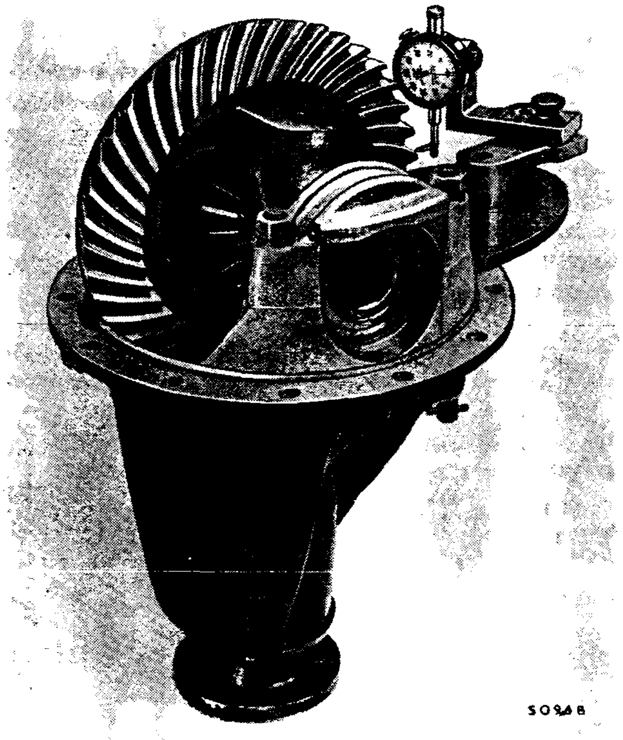


Fig. F.18
Checking the crown wheel backlash with tool 18G191B

(15) When the backlash is satisfactory remove the checking equipment.

The installation of the assembly is a reversal of the procedure given in Section F.7. Fit a new joint washer between the differential and pinion assembly and the axle case. Fill the axle with the recommended quantity of **hypoid** transmission oil.

Section F.9

REMOVING AND REPLACING THE REAR SPRINGS

Using jacks, support under the rear axle and the chassis frame to relieve the springs of the weight of the car and axle.

Remove the 'U' bolt nuts and locknuts, thus releasing the 'U' bolts and dampers.

Adjust the jacks until the spring is just free of the spring seat on the axle.

NOTE.—A packing piece is fitted between the axle spring seat and the left-hand spring.

Disconnect the exhaust tail pipe support to give more clearance.

Remove the nuts from the shackle pins and drive out the pins, using a copper drift.

The spring is now free to be removed.

Replacement of the spring is a reversal of the above procedure. Before replacing the spring inspect the shackle pins, bushes, and plates for wear and replace with new parts where necessary. Lubricate the rear spring front pin, when refitting, to prevent corrosion. Ensure that the rubber pads are positioned correctly and that the head of the spring centre-bolt registers with the spring bracket on the axle case.

Tighten the 'U' bolt nuts to the correct torque figure (see 'GENERAL DATA') with the spring in a flat condition.

NOTE.—Before tightening the spring bolts it is essential that the normal working load be applied to the springs so that the flexing rubber bushes are deflected to an equal extent in both directions during service. Failure to take this precaution will inevitably lead to early deterioration of the bushes.

Section F.10

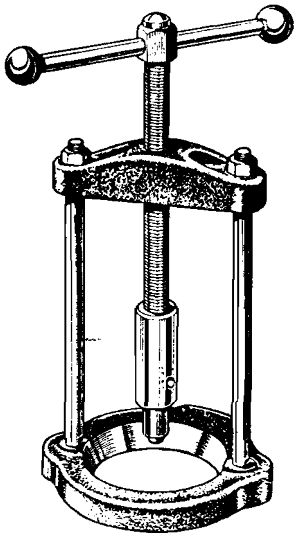
AXLE ASSEMBLY (Later Models)

Some later axles have a modified differential case, gear wheels and differential pinions. These axles do not have thrust washers on the differential gear wheels and pinions, and backlash between the differential gear wheels and pinions must not exceed 0·007 in (0·178 mm). It is permissible to assemble the gear wheels and pinions without backlash providing the torque required to rotate one of the gear wheels does not exceed 5 lbf ft (0·7 kgf m).

SERVICE TOOLS

18G47C. Differential Bearing Remover (basic tool)

This standardized basic tool used in conjunction with adaptor 18G47R permits easy and safe withdrawal of the differential bearings.

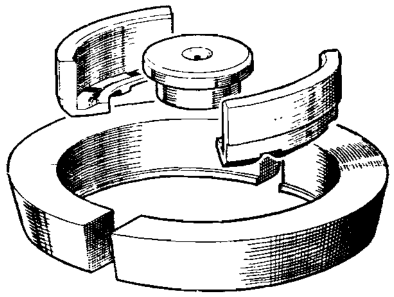


8721

18G47C

18G47AD. Differential Bearing Remover Adaptor

For use with basic tool 18G47C.

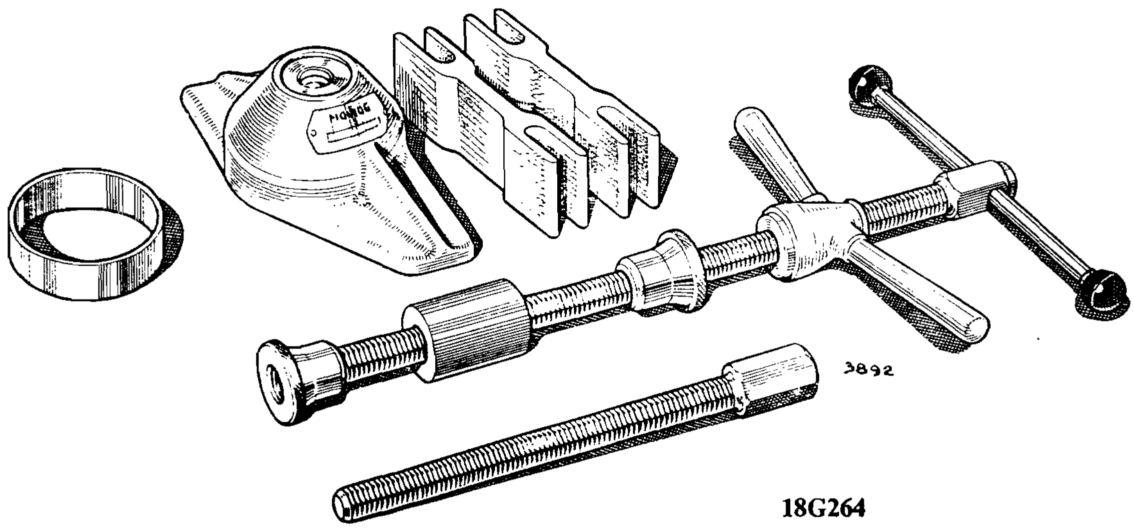


9309

18G47AD

18G264. Bevel Pinion Bearing Outer Race Remover (basic tool)

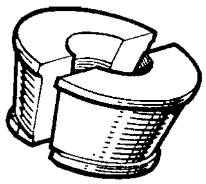
Comprising a body, centre screw with extension and tommy-bar, wing nut, guide cone, and two distance pieces. A plain ring is also included to serve as a pilot when the rear bearing outer races are being replaced.



18G264

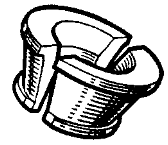
18G264D and 18G264H. Bevel Pinion Bearing Outer Race Remover Adaptors—Rear and Front

Use in conjunction with basic tool 18G264.



A1045

18G264D

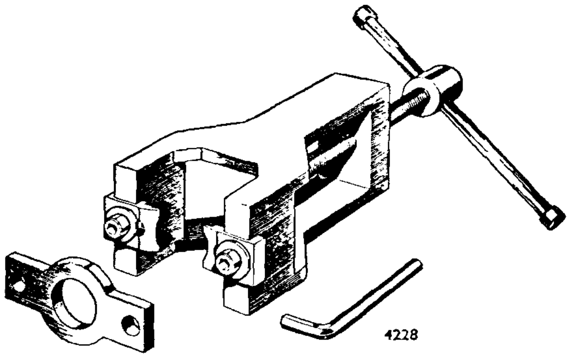


A1045C

18G264H

18G285. Bevel Pinion Bearing Inner Race Remover and Replacer

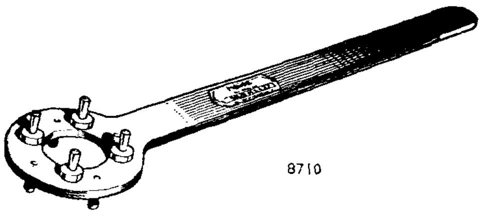
A tool which is essential when withdrawing or replacing the inner bearing race on the pinion shaft.



18G285

18G34A. Bevel Pinion Flange Wrench

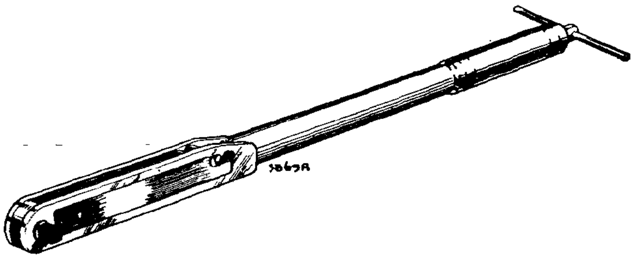
This wrench prevents the rotation of the bevel pinion flange when releasing or tightening the flange securing nut. The pegs of the holding wrench fit into the bolt holes of the flange.



18G34A

18G372. Torque Wrench (30 to 140 lb. ft.)

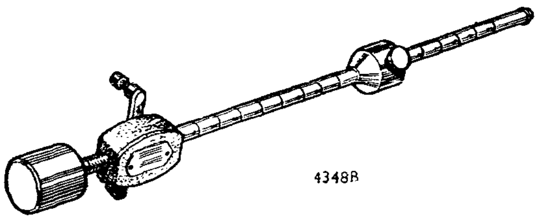
This type of tool is essential if the recommended maximum torque for the bevel pinion flange securing nut is not to be exceeded. This tool is used with a standard-type socket and in conjunction with the flange holding wrench 18G34A.



18G372

18G207. Bevel Pinion Bearing Preload Gauge

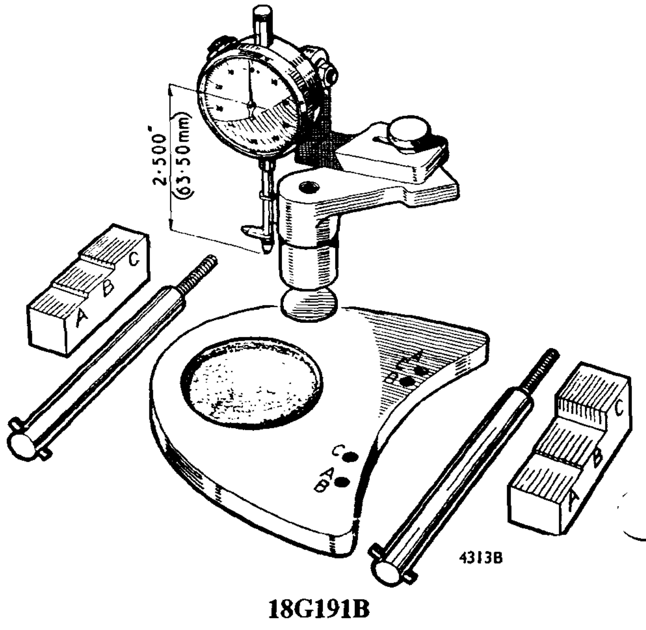
The movable arms of the tool are located in opposite holes of the bevel pinion flange and the weight moved along the rod to the poundage required.



18G207

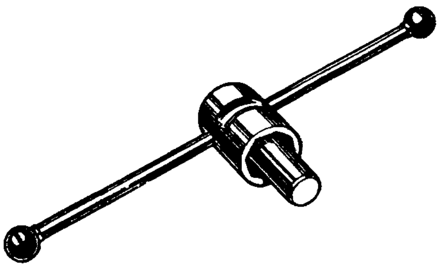
18G191B. Bevel Pinion and Differential Bearing Setting Gauge

Correct assembly and adjustment of the pinion and differential gear is impossible without this special tool.



18G191B

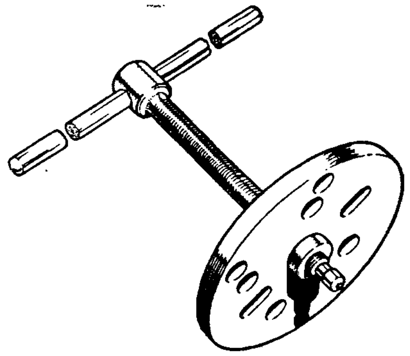
18G258. Rear Hub Nut Spanner



4344C
18G258

18G304. Front and Rear Hub Remover (basic tool)

The remover 18G304 is a basic tool for use with various adaptor bolts supplied separately. Screw the adaptor bolts 18G304B onto the wheel studs and insert the thrust pad 18G304K into the axle tube. The hub can then be removed by screwing up the centre screw against the thrust pad.



8251
18G304

18G304B. Bolt Adaptor—$\frac{7}{16}$ in. UNF.

18G304K. Hub Remover Thrust Pad

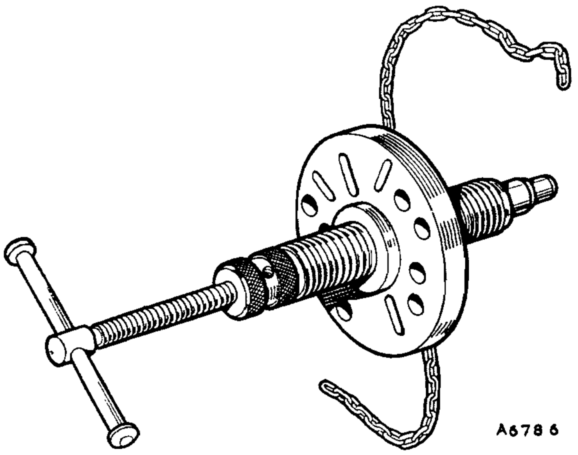
For use with basic tool 18G304.

8251
18G304B

8251
18G304K

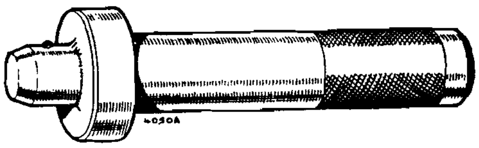
18G304Z. Front and Rear Hub Remover (basic tool)

The remover 18G304Z is a hydraulic version of 18G304. A safety chain is included and should be **used** always. No extra leverage must be employed and striking of the hydraulic ram should be avoided.



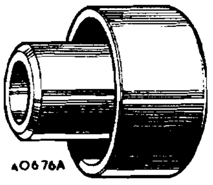
A678 6
18G304Z

18G134. Bearing and Oil Seal Replacer (basic tool)



18G134

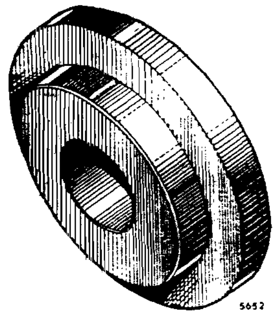
18G134K. Rear Hub Bearing Remover Adaptor



18G134K

18G134AQ. Rear Hub Oil Seal Replacer Adaptor

For use with detachable handle 18G134.

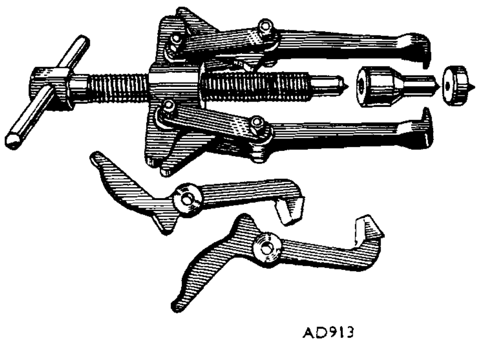


18G134AQ

18G2. Crankshaft Gear, Pulley, and Propeller Shaft Flange Remover

A multipurpose tool consisting of:

(1) Extractor (basic tool).
(2) Alternative pair of legs (for pulleys).
(3) Short thrust pad.
(4) Long thrust pad.

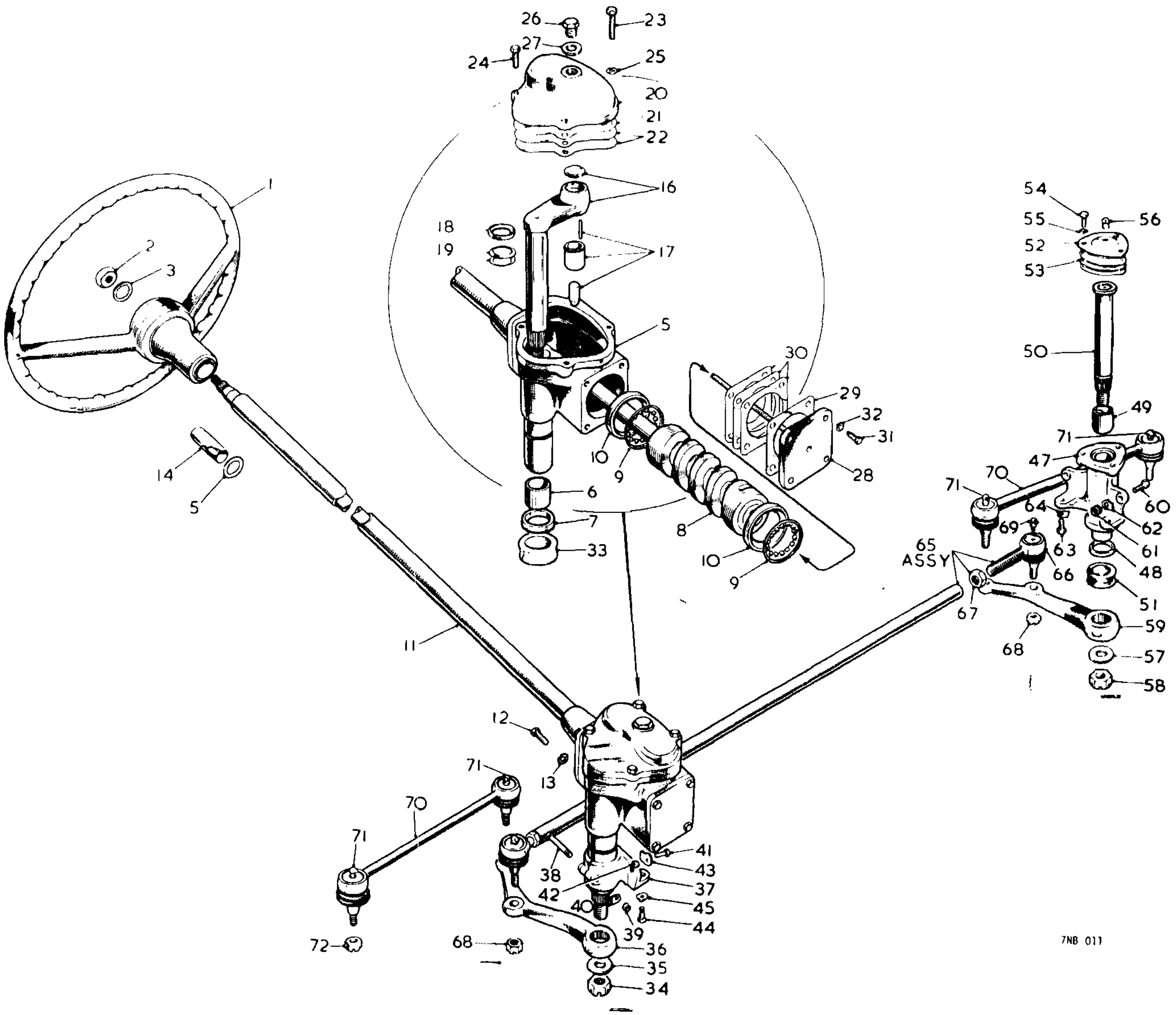


18G2

SECTION G

THE STEERING GEAR

THE STEERING GEAR COMPONENTS



KEY TO THE STEERING GEAR COMPONENTS

No.	Description
1.	Wheel—steering.
2.	Nut for steering-wheel.
3.	Washer for nut—shakeproof.
4.	Gear assembly—steering.
5.	Box assembly—steering.
6.	Bush.
7.	Seal—oil.
8.	Column with cam—inner.
9.	Cage assembly—ball.
10.	Cup for ball cage.
11.	Column with socket—outer.
12.	Screw—socket to steering-box.
13.	Washer for screw—spring.
14.	Washer (felt).
15.	Washer—support—for felt.
16.	Shaft assembly—rocker.
17.	Roller assembly—cam.
18.	Washer—thrust.
19.	Washer—Belleville.
20.	Cover—side.
21.	Joint for side cover.
22.	Shim for side cover.
23.	Screw for side cover—top.
24.	Screw for side cover—bottom.
25.	Washer for screw—spring.
26.	Plug—oil filler.
27.	Washer for oil filler plug.
28.	Cover—end.
29.	Joint for end cover.
30.	Shim for end cover.
31.	Screw for end cover.
32.	Washer for screw—spring.
33.	Seal—dust for steering lever.
34.	Nut—lever to steering gear.
35.	Washer for nut.
36.	Lever—side- and cross-rod on steering-box.
37.	Bracket—steering-box.
38.	Bolt—steering-box to bracket.
39.	Nut for bolt.
40.	Washer for bolt—lock.
41.	Bolt—bracket to frame.
42.	Nut for bolt.
43.	Washer for bolt—lock.
44.	Bolt—bracket to frame.
45.	Washer for bolt—lock.
47.	Body for idler gear.
48.	Seal.
49.	Bush.
50.	Shaft—idler.
51.	Seal—dust.
52.	Cover for idler body.
53.	Joint for cover.
54.	Screw—cover to body.
55.	Washer for screw—spring.
56.	Plug—oil filler.
57.	Washer for shaft.
58.	Nut for shaft.
59.	Lever—side- and cross-rod.
60.	Bolt—idler gear to frame.
61.	Nut for bolt.
62.	Washer for bolt—lock.
63.	Bolt—idler to frame.
64.	Washer for bolt—lock.
65.	Rod assembly—cross.
66.	End assembly.
67.	Nut (lock).
68.	Nut for ball pin.
69.	Lubricator.
70.	Rod assembly—side.
71.	Lubricator.
72.	Nut for ball pin.

Section G.1

DESCRIPTION

The steering gear is a self-contained unit consisting of a cam and roller which takes the form of a worm mounted on ball bearings in the steering gearbox integral with the steering-mast. The rocker shaft is mounted in the steering gearbox in plain bearings; a lever integral with the shaft carries a conical peg which engages with the cam. As the peg does not bottom in the cam groove, adjustment for wear can be effected by the removal of shims provided.

All the working parts are immersed in oil.

A double lever, secured by a castellated nut and cotter pin, is splined to the lower end of the shaft. This lever is connected to a similar lever on the steering idler at the opposite side of the car by an adjustable track-rod. Short draglinks connect the double levers to the steering-arms at each side.

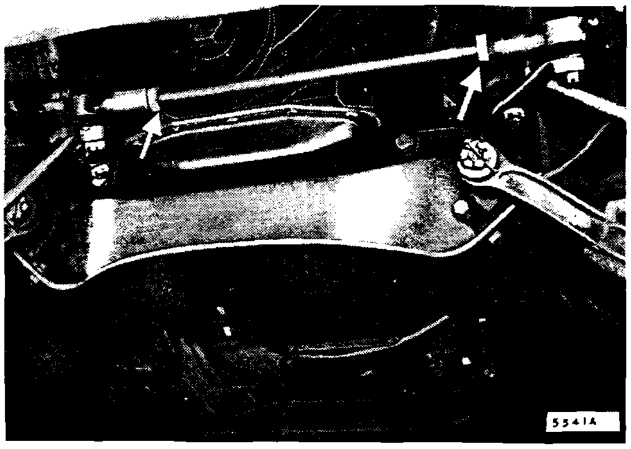


Fig. G.1
The arrows indicate the track-rod locknuts

Section G.2

ADJUSTING THE TRACK

The track-rod is threaded right-hand at one end and left-hand at the other, so that turning the rod in the required direction effects the correct setting after releasing the locknuts (Fig. G.1).

To check and adjust the alignment of the front wheels it is advisable to use a trammel, and with the tyres correctly inflated, proceed as follows:

(1) Turn the front wheels to the straight-ahead position and set both pointers of the alignment trammel against the inner rims of the wheels at centre height in front of the car ([A], Fig. G.2). Mark the points of contact of the pointers on the wheel rims, lock the trammel pointers, and withdraw the trammel.

(2) Move the car forward so that the wheels make exactly half a revolution.

(3) Place the trammel at the rear of the wheels so that one pointer registers with the mark on one of the wheel rims ([B], Fig. G.2); the pointer on the other end should then be $\frac{1}{16}$ in. (1·6 mm.) away from the mark on the other wheel rim. This can be checked by measurement or preferably with a $\frac{1}{16}$ in. (1·6 mm.) gauge plate.

(4) If the alignment is incorrect, slacken the nuts securing both ball joint assemblies to the track-rod and rotate the rod until the required alignment is obtained.

Section G.3

ADJUSTING THE GEAR
(Early Models)

Remove the side cover-plate and add or remove shims as necessary until there is no free movement of the gear when in the straight-ahead position.

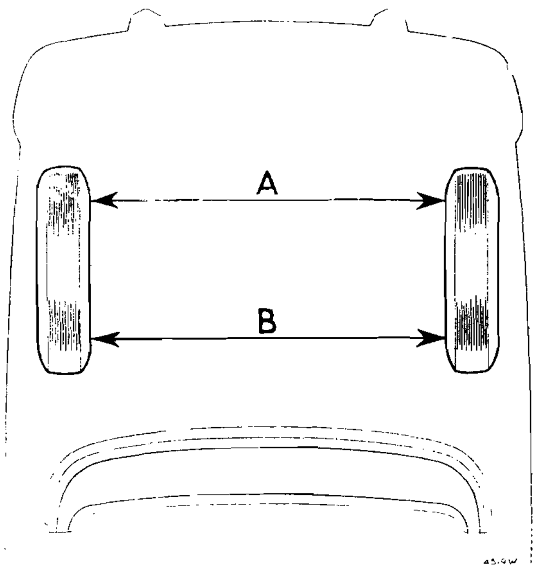


Fig. G.2
The dimension (A) should be $\frac{1}{16}$ in. (1·6 mm.) smaller than dimension (B), this being the amount of toe-in required

It should be noted that, as wear in use is usually greater in the straight-ahead position than on lock, provision is made for this in the design of the cam and it will be found that there is a slight end-play towards each lock. It is essential, therefore, that adjustment should be made in the straight-ahead position to avoid the possibility of tightness.

Steering cam bearing adjustment should be carried out to eliminate all perceptible end-play, and this operation is described in Section G.5.

Section G.4

REMOVING AND REPLACING THE STEERING GEAR

Remove the three grub screws in the steering-wheel hub and take out the horn button.

Disconnect the horn wire at the snap fastener at the bottom of the steering box and withdraw the wire from the steering-column. Remove the central retaining nut and pull the steering-wheel from its splines. On early vehicles the steering-wheel is held to the hub with three bolts, which must be removed before the hub can be withdrawn.

Remove the screws and detach the trim panel from the fascia below the steering-column.

Remove the two nuts retaining the hydraulic reservoir bracket to the wing valance.

Remove the split pins and nuts and detach the two ball joints from the rocker shaft lever.

Remove the split pin and retaining nut, mark the relative positions of the rocker shaft lever and the splines on the rocker shaft, then detach the lever from the shaft.

Unlock and remove the bolt clamping the steering box support bracket to the steering box.

Unlock and remove the bolts and screws retaining the steering box bracket to the chassis, and withdraw the bracket downwards.

Manœuvre the steering box and column assembly from the body.

When replacing the steering reverse the above procedure, but do not tighten the bolts securing the steering gearbox to its bracket and to the chassis until after the column has been correctly positioned inside the car.

Use new locking washers and note that the column clamps are dowelled.

Section G.5

DISMANTLING AND ASSEMBLING THE STEERING GEAR

Remove the plug from the top cover and drain the oil.

Remove the top cover-plate.

Turn the steering gear over and, with the top face suitably supported, tap out the rocker shaft, using a soft-metal drift.

On early vehicles the follower peg is held in position in the rocker shaft by a split metal ring, on removal of which the follower peg complete with its bearing can be dismantled.

On later vehicles the follower peg and bearing cannot be dismantled and must be renewed as a unit with the rocker shaft.

Remove the end cover.

Stand the complete unit upright with the steering gearbox uppermost; by bumping the end on a block of wood on the floor the worm with its ball bearings will be displaced. The complete inner column can now be removed from the casing through the open end of the steering gearbox.

Using a piece of strong hooked wire, extract the felt bush at the top of the column, the hook pulling on the under side of the bush. To fit a new bush smear with Hypoid oil and simply press into place.

Adjusting shims should be fitted behind the end cover so that there is no end-play on the column; at the same time they should not be preloaded, otherwise damage to the ball races may well occur.

Replace the follower peg and its bearing, following in turn with the rocker shaft, ensuring that the shaft is a good fit in its housing and the oil seal at the lower end of the trunnion is making good contact. Adjust the gear as detailed in Section G.3.

For the remainder of the assembly reverse the dismantling procedure.

Refill the steering gear with the recommended oil.

Section G.6

REMOVING AND REPLACING A DRAGLINK

The draglinks are held in position by a ball joint and castellated nut, locked with a split pin at either end.

To remove the links withdraw the split pins, remove the nuts, and carefully tap out the ball joints, using tool 18G 1063. When removing the ball joints from either end always support the levers to which they are attached to prevent any shock being transmitted to the steering gear, where damage may be caused.

Replacement is a reversal of the above instructions.

Section G.7

REMOVING AND REPLACING THE DOUBLE LEVERS

These are held to the steering gear rocker shaft and the steering idler gear respectively by a castellated nut and split pin. After removal of the nut and split pin the double levers can be withdrawn from their splined shafts, using tool 18G75A.

Never attempt to lever or hammer the double levers from their locations, otherwise serious damage to the steering gear may well ensue.

Reverse the above instructions for replacement.

Section G.8

REMOVING AND REPLACING THE IDLER

Disconnect the draglink and track-rod from the idler double lever.

Remove the bolts securing the idler to the frame and withdraw the unit from the car.

The refitting of the idler is generally a reversal of the removal procedure, but care should be taken to ensure that it is secured firmly against the chassis frame.

Section G.9

DISMANTLING AND ASSEMBLING THE IDLER

The top cap of the idler is secured to the body by three set screws with a joint washer between the cap and body. Lubrication is by the removal of the plug in the cap and injecting oil into the body.

Internally the body has a recess in the head and a plain bore right through. Two bronze bush bearings, with internal oil grooves, are pressed into the body—one at the top, the other at the bottom.

The idler shaft can be removed by hand once the body top cap has been released. The flange of the idler shaft locates in the recess within the body head and two highly finished portions of the shaft rotate within the bronze bushes. At the lower end the shaft has splines for the location of the double lever, which in turn is retained by a castellated nut and split pin. The idler shaft is drilled to take oil to the bearing bushes. Use tool 18G75A to withdraw the double lever.

Adjust the end-float (see 'GENERAL DATA') of the idler shaft by means of the gaskets under the top cover.

After reassembly refill the idler with the recommended oil.

Section G.10

ADJUSTING THE GEAR
(Later Models)

A modified adjustment has been applied to the rocker arm which takes the form of an adjusting screw and locknut (see Fig. G.3).

To remove backlash proceed as follows:

(1) Slacken the locknut and screw in the adjusting screw.

(2) Check for backlash by exerting a light pressure on the upper end of the steering-box arm alternately in both directions while an assistant turns the steering-wheel slowly from lock to lock.

It will be noticed that the amount of slackness is not constant, there being less slackness in the centre than in the full lock position.

If slackness appears at all positions of the steering-box arm the adjusting screw should be screwed in further. The correct adjustment is such that a 'tight spot' will barely be apparent as the steering-wheel is moved past the centre position with no backlash at the steering-arm.

At this point tighten the adjusting screw locknut.

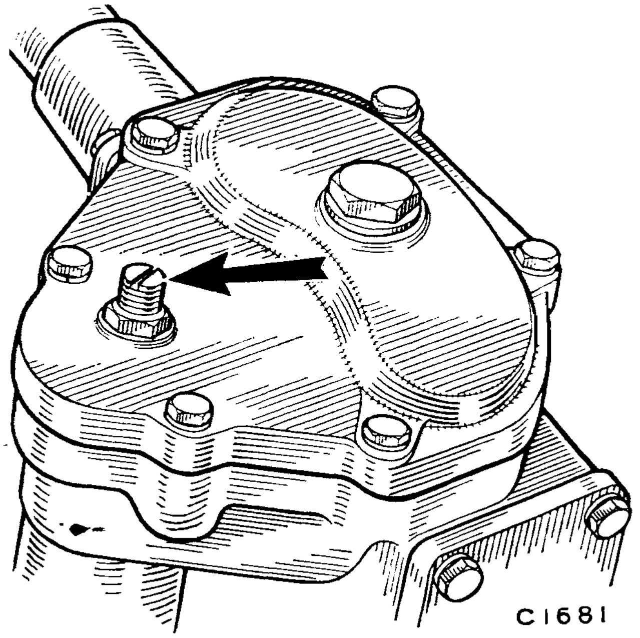


Fig. G.3
Rocker shaft adjustment (later models)

Section G.11

STEERING-COLUMN LOCK
(Later Models)

Removing

(1) Disconnect the battery.

(2) Remove the screws securing the ends of the instrument cowl to the lower fascia panels.

(3) Remove the screws securing the lower fascia panels to the bulkhead and lift out the panels.

(4) Remove the screws securing the bulkhead finisher to the bulkhead and lift out the finisher.

(5) Remove the two screws securing the stop control to the steering-column lock and secure the control to one side.

(6) Disconnect the master/starter switch wires at the blade connectors.

(7) Drill out the steering-column lock shear bolts from below, using an extended $\frac{5}{16}$ in. or 8 mm. drill, and remove the lock.

NOTE.—This method will destroy the threads in the lock body. If the original lock is to be refitted, the steering-column should be removed (see Section G.13).

Refitting

(8) Reverse the procedure in 1 to 6, noting the following:

(*a*) Make sure that the new lock is correctly located on the steering-column before shearing the heads of the new shear bolts.

(*b*) Reconnect the master/starter switch wires at their blade connectors, noting that the brown and red wire from the switch connects to the brown and yellow wire on the harness (diesel models).

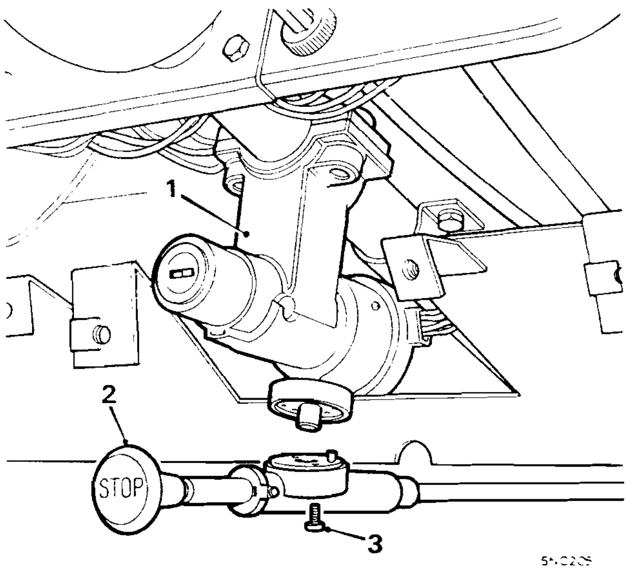


Fig. G.4
Removing the steering-column lock (later models)

1. Lock assembly.
2. Stop control.
3. Retaining screw—stop control.

Section G.12

STEERING-COLUMN BUSHES
(Later Models)

Top bush
Removing

(1) Prise the pad from the centre of the steering-wheel.
(2) Remove the screws securing the direction indicator switch cover to its mounting brackets and remove both halves of the cover.
(3) Remove the steering-wheel retaining nut and lock washer.
(4) Pull the steering-wheel from the inner column, using tool 18G 70.
(5) Remove the two screws securing the direction indicator switch to the steering-column and detach the switch from the column.
(6) Note the position of the direction indicator switch striker in the inner column, slacken the locknut and unscrew the striker from the column.
(7) Straighten the retaining tag in the end of the outer column.
(8) Fit tool 18G 1191 into the top bush and pull the bush from the column.

Refitting

(9) Reverse the procedure in 1 to 8, noting the following:
  (*a*) Smear the inside surface of the bush and fill the grooves with graphite grease.
  (*b*) Using tool 18G 1191, drive the bush, chamfered end first, into the outer column, ensuring that the shouldered slot in the lower edge engages the detent in the outer column.
  (*c*) Check the operation of the direction indicator switch before fitting the cover.
  (*d*) Refit the steering-wheel with the road wheels in the straight-ahead position.

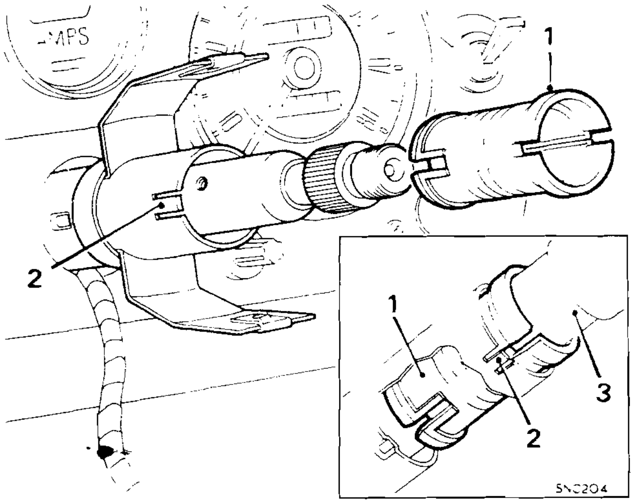


Fig. G.5
Removing the steering-column top bush (later models)

1. Bush.
2. Retaining tag.
3. Service tool 18G 1191.

Bottom bush
Removing

(1) Mark the relative positions of the inner column and upper universal joint and remove the clamp bolt.
(2) Remove the screws securing the direction indicator switch cover to its mounting brackets and remove both halves of the cover.
(3) Straighten the retaining tags in the ends of the outer column.
(4) Pull the inner column clear of the universal joint and move the lower column to one side.
(5) With the steering-wheel held in position, fit tool 18G 1191 into the bottom and pull the bush from the column.

Refitting

(6) Reverse the procedure in 1 to 5, noting the following:
  (*a*) Smear the inside surface of the bush and fill the grooves with graphite grease.
  (*b*) Using tool 18G 1191, drive the bush, chamfered end first, into the outer column, ensuring that the shouldered slot in upper edge engages the detent in the outer column.

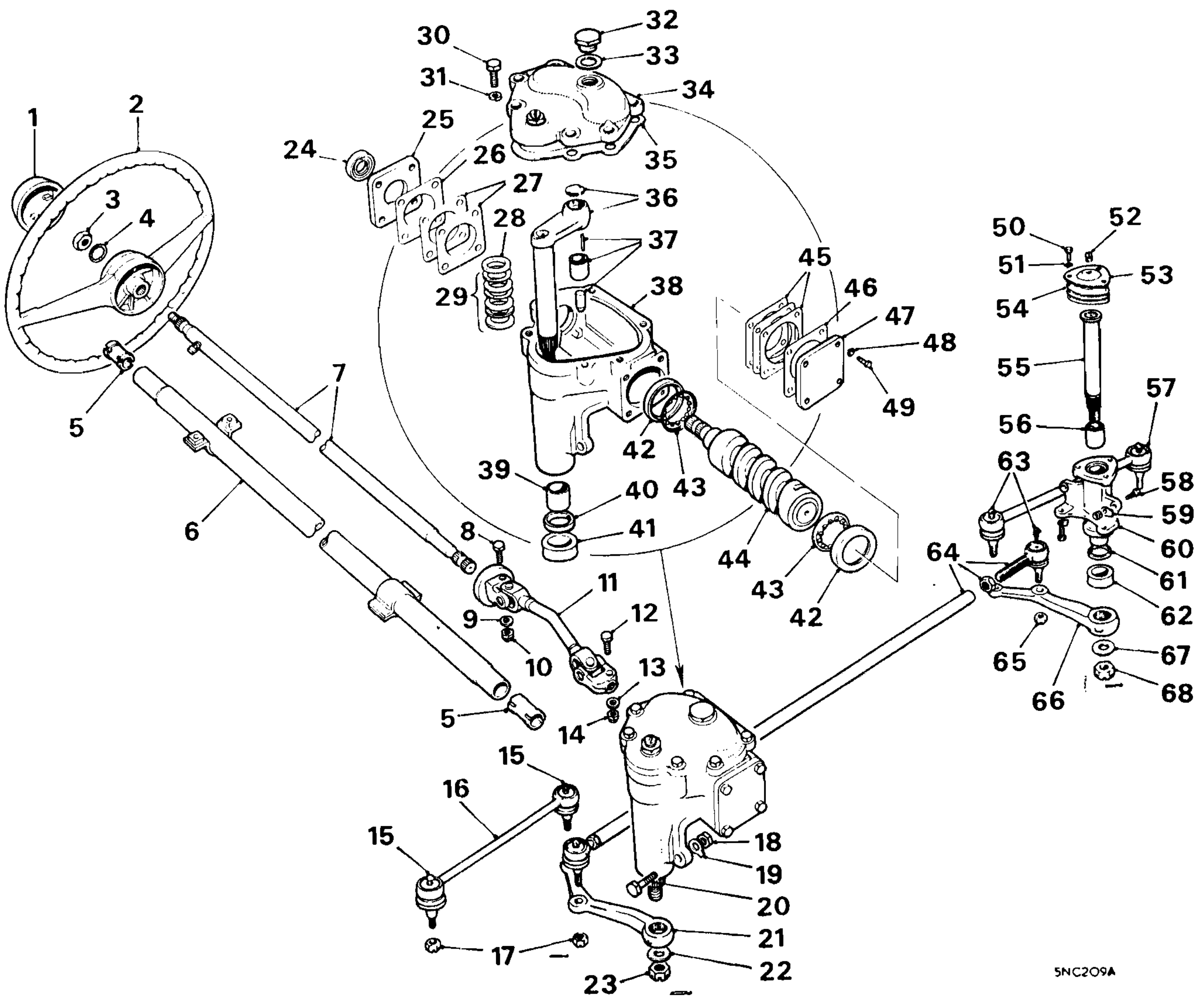
Section G.13

STEERING-COLUMN
(Later Models)

Removing

(1) Disconnect the battery.
(2) Prise the pad from the centre of the steering-wheel.
(3) Remove the two screws securing the direction indicator switch cover to its mounting brackets and remove both halves of the cover.
(4) Remove the steering-wheel retaining nut and lock washer.
(5) Pull the steering-wheel from the inner column, using tool 18G 70.
(6) Remove the screws securing the ends of the instrument cowl to the lower fascia panels.
(7) Remove the screws securing the lower fascia panels to the bulkhead and lift out the panels.
(8) Remove the screws securing the bulkhead finisher to the bulkhead and lift out the finisher.
(9) Mark the relative positions of the inner column and upper universal joint and remove the clamp bolt.
(10) Remove the two bolts securing the clamp to the steering-column frame mounting bracket and remove the clamp.
(11) Remove the four bolts securing the reaction bracket to the bulkhead and remove the bracket.
(12) Remove the screws securing the steering-column seal retaining plate to the bulkhead and pass the seal and plate down over the reaction clamp on the column.

THE STEERING GEAR COMPONENTS (Later models)



KEY TO THE STEERING GEAR COMPONENTS (Later models)

No.	*Description*	*No.*	*Description*	*No.*	*Description*
1.	Steering-wheel pad.	24.	Oil seal.	47.	End cover.
2.	Steering-wheel.	25.	End cover.	48.	Washer.
3.	Nut for steering-wheel.	26.	Joint.	49.	Screw for end cover.
4.	Washer—shakeproof.	27.	Shim.	50.	Screw for idler body cover.
5.	Bush.	28.	Thrust washer.	51.	Washer.
6.	Steering-column—outer.	29.	Washer—Belleville.	52.	Plug—oil filler.
7.	Steering-column—inner.	30.	Bolt for top cover.	53.	Cover—idler body.
8.	Clamp bolt.	31.	Washer for top cover.	54.	Joint for cover.
9.	Washer for clamp bolt.	32.	Plug—oil filler.	55.	Idler shaft.
10.	Nut for clamp bolt.	33.	Washer for oil filler plug.	56.	Bush.
11.	Steering-column—lower.	34.	Top cover.	57.	Rod assembly—side.
12.	Clamp bolt.	35.	Joint for top cover.	58.	Mounting bolt.
13.	Washer for clamp bolt.	36.	Shaft assembly—rocker.	59.	Nut and lock washer.
14.	Nut for clamp bolt.	37.	Roller assembly—cam.	60.	Body for idler gear.
15.	Lubricator.	38.	Box assembly—steering.	61.	Seal.
16.	Rod assembly—side.	39.	Bush.	62.	Seal—dust.
17.	Nut for ball pin.	40.	Seal—oil.	63.	Lubricator.
18.	Nut for mounting bolt.	41.	Seal—dust.	64.	Rod assembly—cross.
19.	Lock washer for mounting bolt.	42.	Cup for ball cage.	65.	Nut for ball pin.
20.	Mounting bolt.	43.	Ball cage assembly.	66.	Lever—side- and cross-rod.
21.	Lever—side- and cross-rod.	44.	Cam.	67.	Washer.
22.	Washer.	45.	Shim.	68.	Nut for shaft.
23.	Nut.	46.	Joint.		

(13) Raise the bottom end of the steering-column to face the rubber bush from the frame mounting bracket and remove the bush, plate and seal from the column.
(14) Remove the two screws securing the stop control to the steering-column lock and secure the control to one side.
(15) Remove the two bolts securing the steering-column to the bulkhead mounting bracket.
(16) Remove the two screws securing the instrument panel centre-piece to the instrument panel.
(17) Disconnect the direction indicator/headlamp flasher switch wires at the multi-connector and at the single blade connector.
(18) Disconnect the master/starter switch wires at the blade connectors.
(19) Remove the steering-column from the vehicle.

Dismantling

(20) Remove the two screws securing the direction indicator/headlamp flasher switch to the steering-column.
(21) Release the clip securing the switch cover mounting brackets to the steering-column and detach the brackets, switch, and instrument panel centre-piece from the column.
(22) Straighten the retaining tag at the top end of the steering-column.
(23) With the steering lock disengaged, extract the inner column and top bush from the top end of the outer column.
(24) Straighten the retaining tag at the bottom end of the steering-column and extract the bottom bush.
(25) Extract the shear bolts, using a proprietary tool, and remove the steering-column lock assembly and clamp plate.

Reassembling

(26) Refit the steering-column lock, using new shear bolts.
(27) Smear the inside surface of the bushes and fill the grooves with graphite grease.
(28) Fit the bottom bush to the column, chamfered end first, ensuring that the shouldered slot in the end of the bush engages the detent in the outer column. Bend down the retaining tag.
(29) Open the split in the top bush sufficiently to pass the bush, chamfered end first, past the switch striker on the inner column.
(30) Fit the inner column into the outer column and drive the top bush into position, ensuring that the shouldered slot in the end of the bush engages the detent in the outer column. Bend down the retaining tag. Check that both tags are clear of the inner column.
(31) Refit the direction indicator switch cover brackets, the direction indicator switch, and instrument panel centre-piece to the steering-column.

Refitting

(32) Reverse the procedure in 1 to 19, noting the following:
 (*a*) The brown and red wire from the master/starter switch connects to the brown and yellow wire on the harness (diesel models).
 (*b*) Check the operation of the direction indicator switch before fully tightening the steering-column mounting bolts.
 (*c*) Refit the steering-wheel with the road wheels in the straight-ahead position.

Section G.14

STEERING BOX
(Later Models)

Removing

(1) Unlock and remove the nut securing the steering lever to the rocker shaft.
(2) Mark the relative positions of the lever and shaft and withdraw the lever, using tool 18G 75 A.
(3) Mark the relative positions of the steering shaft and lower universal joint and remove the clamp bolt.
(4) Unlock and remove the steering box mounting bolts.
(5) Lift the steering box, turn towards the radiator and pull forward to disengage the steering shaft from the universal joint and remove the steering box.

Dismantling

(6) Remove the side cover and drain off the oil.
(7) Withdraw the rocker shaft.
(8) Remove the top cover, joint washer, and shims if fitted.
(9) Extract the steering shaft and cam and upper bearing assembly.
(10) Remove the bottom cover, shims, joint washer, and lower bearing assembly.

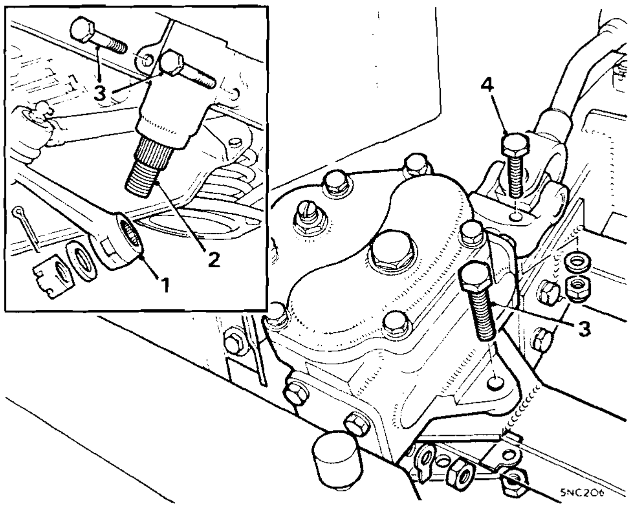


Fig. G.6
Removing the steering box (later models)

1. Steering lever. 3. Mounting bolt.
2. Rocker shaft. 4. Clamp bolt.

Inspection

(11) Examine all components for wear or damage, and renew as necessary.

(12) Press out the rocker shaft bushes and oil seal from the steering box if renewal is necessary.

(13) Fit new bushes and machine ream to size (see **'GENERAL DATA'**).

(14) Fit a new oil seal.

Reassembly

(15) Reverse the procedure in 6 to 10, noting the following:

(*a*) Set the steering shaft and cam to the correct pre-load (see **'GENERAL DATA'**) prior to fitting the top cover oil seal and rocker shaft.

(*b*) Adjust the rocker shaft to give the correct torque (see **'GENERAL DATA'**) at the steering-wheel in the straight-ahead position without any extraneous loading on the rocker shaft.

Refitting

(16) Reverse the procedure in 1 to 5, noting the following:

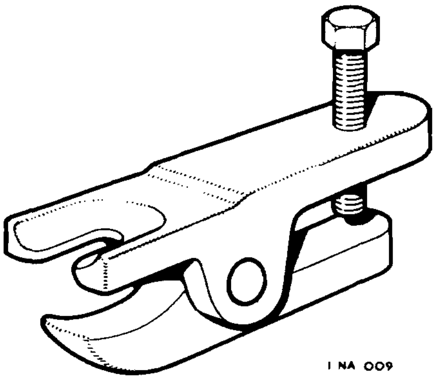
(*a*) Use new tab washers for the steering box mounting bolts.

(*b*) Tighten the steering lever nut to the correct torque tightness (see **'GENERAL DATA'**), and secure using a new split pin.

(*For* **'SERVICE TOOLS'** *see page G.*12)

SERVICE TOOLS

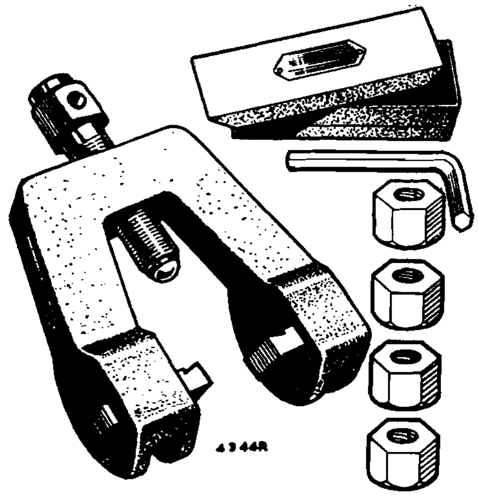
18G 1063. Steering Ball Joint Separator



18G 1063

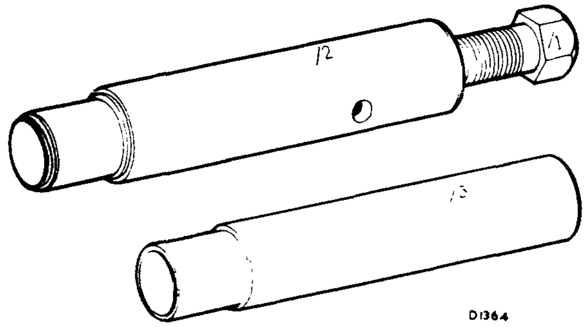
18G75A. Steering Arm Remover

Thread protectors are provided with this tool, and the steel claws are adjustable by means of a key.



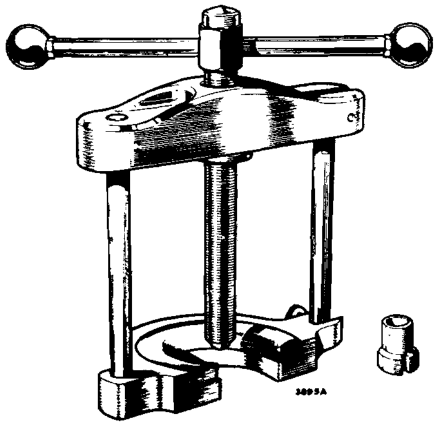
18G75A

18G 1191. Steering-column Bush Remover Replacer



18G 1191

18G 70. Steering Wheel Remover



18G 70

SECTION H

THE FRONT SUSPENSION

Section H.1

DESCRIPTION

To facilitate repair after accidental damage and to simplify servicing, the front cross-member complete with the front suspension units is attached by four main bolts to the chassis. The four chassis bolts are on rubber packing pieces, which considerably reduces body noises and steering-wheel rattles excited by road irregularities.

The two independent suspension units are of wishbone construction. Road shocks are absorbed by low-periodicity coil springs mounted between the upper and lower linkages, the springs being controlled by double-acting dampers on the upper linkages.

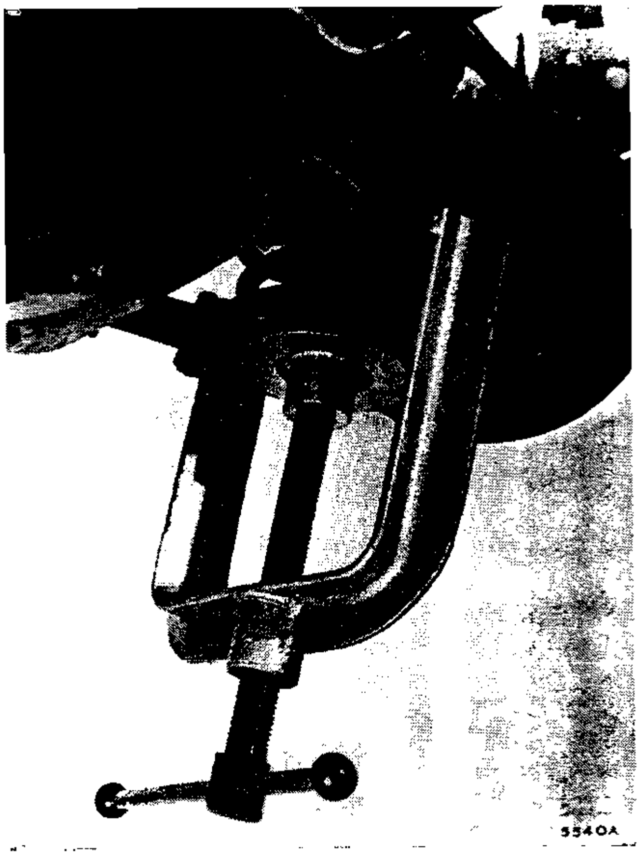


Fig. H.1
Compressing the coil spring with tool 18G37

Section H.2

REMOVING AND REPLACING A COIL SPRING

Jack up the side of the car from which the spring is to be removed and place a stand under the frame side-member to the rear of the suspension assembly.

In the absence of tool 18G 37 or 18G 693 two slave bolts will be needed to release the compression from the coil spring. These bolts must be at least 4 in. (10 cm.) long threaded their entire length, and the same diameter as the four nuts and bolts securing the spring plate to the lower wishbone arm. Remove two which are diagonally opposite to each other and replace with the previously prepared slave bolts, screwing the nuts down hard onto the wishbone arms.

Remove the other two short bolts and unscrew the nuts from the slave bolts, each a little at a time until the spring is fully extended, and the bolts together with the spring plate and spring can be removed.

NOTE.—On some models spacers are fitted between the spring seat and the suspension lower links.

When the spring has been removed it should be checked for free length (see **'GENERAL DATA'**), and if there is any excess variation from nominal the spring should be renewed.

Replacement of the coil spring is a reversal of the above procedure.

Section H.3

REMOVING AND REPLACING THE SUSPENSION UNIT

Jack up the front of the car, placing stands under the frame cross-member, and remove the road wheels.

Disconnect the two draglinks from the steering-arms.

Disconnect the two flexible brake hoses from the feed pipes.

Position a movable lifting jack under the suspension to just support the unit and remove the four chassis mounting nuts and washers.

Lower the jack and suspension unit to clear the mounting studs, when the unit can be withdrawn from under the car.

Replacement is a reversal of the above procedure, but additionally the brakes will require bleeding.

Section H.4

DISMANTLING AND REASSEMBLING THE SUSPENSION UNIT

The top wishbone arms are connected at their narrowest point by a clamping bolt. Unscrew the nut and remove the washer and bolt. Then remove the split pin and castellated nut from the upper trunnion fulcrum pin on the outer end of the top wishbone arms.

The forward arm of the top wishbone is secured to the shock absorber spindle by a clamping bolt. Slacken the clamping bolt and partially withdraw the arm.

The trunnion fulcrum pin can now be withdrawn and the shock absorber removed complete with the top wishbone arms.

Withdraw the rubber bearing from each end of the upper trunnion. These bearings fit into a groove in the swivel pin and MUST be taken out before the swivel pin can be removed.

Remove the split pin and castellated nut from the top of the swivel pin. Remove the upper trunnion and washers and lift off the swivel pin, stub axle, and hub assembly. Detach the cork washer from the lower end of the swivel pin.

The outer bearing of the lower wishbone can now be dismantled.

Slacken the nut on each of the cotters located in the ends of the lower wishbone arms, screw out the threaded bushes, and detach the arms. Unscrew the nut located in the centre of the lower trunnion and tap out the cotter.

Withdraw the fulcrum pin and remove the sealing washer from each end of the trunnion.

The suspension unit is now dismantled and worn or damaged parts can be renewed.

First fit the screwed fulcrum pin into the lower trunnion at the bottom end of the swivel pin, ensuring that it is centralized, and then secure it with its cotters.

Fit a new sealing ring into the recess at either side of the lower trunnion and fit the lower wishbone arms into position. Grease the screwed bushes, and screw them into position. Screw the bushes fully home, then unscrew each bush one flat of the hexagon. Tighten the retaining cotters.

For the rest of the assembly reverse the dismantling procedure, selecting the appropriate thrust washers to give the correct swivel pin end-float (see 'GENERAL DATA').

Fig. H.2

General view of the suspension unit

Section H.5

REMOVING AND REPLACING A BRAKE-DRUM AND HUB

Jack up the car on the side from which the hub is to be removed.

Remove the road wheel.

Remove the hub cap with tool 18G 49 (early vehicles) or prise out the hub cap (later vehicles).

Remove the split pin, castellated nut, and flat washer from the stub axle.

The brake-drum can be removed independently of the hub by the removal of the two countersunk screws.

Withdraw the hub, using tools 18G220, 18G220A, and 18G220D. The two bearings, distance piece, and oil seal will also be withdrawn in this operation.

Lever out the oil seal, which should be discarded.

Remove the inner race of the larger bearing, shims, and distance piece from the hub.

Remove the outer race of the outer bearing with tools 18G260 and 18G260E.

Remove the outer race of the inner bearing with tools 18G260 and 18G260F.

Replace the outer race of the outer bearing with tools 18G134 and 18G134AM.

Replace the outer race of the inner bearing with tools 18G134 and 18G134AJ.

Pack the hub with the recommended grease but leave the space between the bearings and the hub cap free of grease. Insert the distance piece and refit the original shims in order to maintain the correct end-float to between ·002 and ·004 in. (·05 and ·10 mm.).

Fit a new oil seal.

Refit the bearing nut and tighten it to a torque figure of 60 to 80 lb. ft. (8·3 to 11·0 kg. m.), at the same time ensuring that the hub turns freely without binding.

If the rebuilt hub incorporates any new parts (other than oil seals) the end float must be re-checked. Using a suitably mounted dial gauge, take a reading from the centre of the hub cap by gripping the brake-drum at diametrically opposite points and moving the hub to and fro axially. The hub must be kept stationary about the swivel axle, otherwise a false reading may be obtained.

Refit the hub cap, brake-drum, and wheel, and remove the jacks.

Section H.6

REMOVING AND REPLACING A BRAKE-PLATE ASSEMBLY

Remove the brake-drum and hub as detailed in Section H.5.

Disconnect the brake pipe from the wheel cylinder.

If the desired attention can be given without disconnecting the flexible brake pipe the brake-plate assembly can be hung on a suitable portion of the frame to take the load off the flexible pipe.

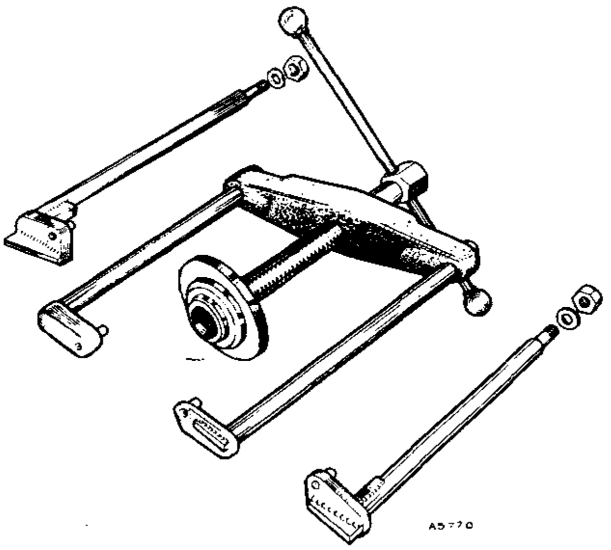
Remove the three nuts and one hexagon screw retaining the brake backplate, and take off the backplate complete with brake-shoes and wheel cylinders.

Reverse the above instructions for replacing and bleed the brakes.

SERVICE TOOLS

18G 693 (supersedes 18G 37). Front Suspension Spring Compressor

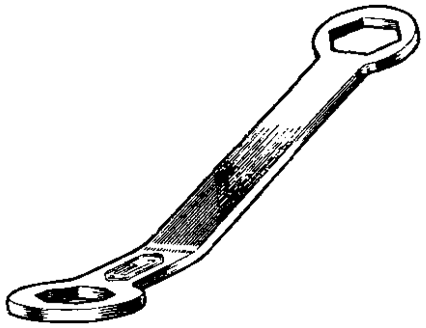
The spring compressor thrust pad is ball-mounted to assist in lining up the spring and spring seat.



18G 693

18G49. First Motion Shaft Nut Spanner

This sturdy spanner provides ample leverage to move the tightest nut. The 15° set prevents fouling the mud-wing.



9166

18G49

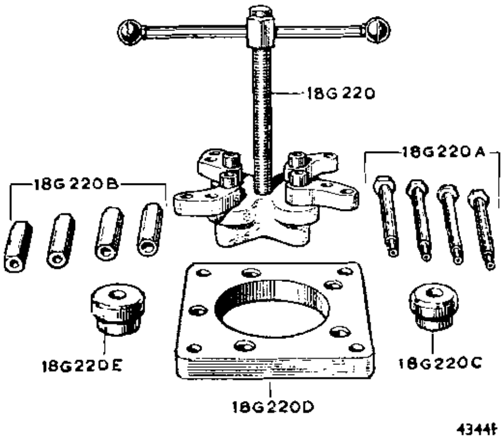
18G220. Front and Rear Hub Remover (basic tool)

The remover is a basic tool used for numerous applications. When used with the adaptor bolts 18G220A and adaptor ring 18G220D the most difficult hub can be withdrawn with ease and without damage.

18G220A. Hub Remover Adaptors

18G220D. Hub Remover Adaptor Ring

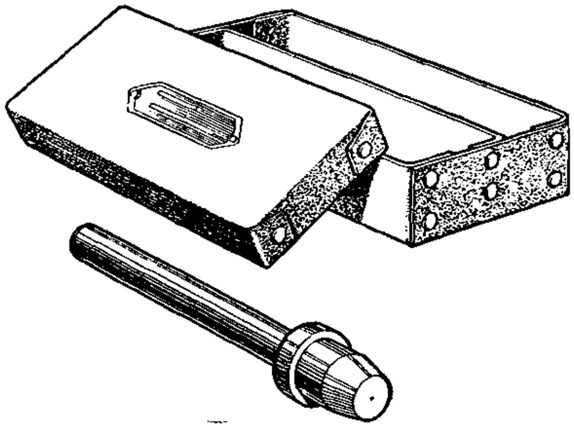
For use with basic tool 18G220.



18G220
18G220A
18G220D

18G260. Front Hub Bearing Outer Race Remover (basic tool)

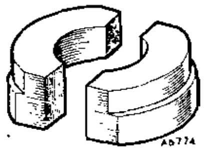
This remover with adaptors 18G260F and 18G260E will ensure easy extraction of the race from the hub.



18G260

18G260F. Front Hub Inner Bearing Outer Race Remover Adaptor

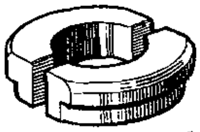
For use with basic tool 18G260.



18G260F

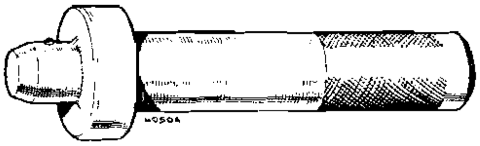
18G260E. Front Hub Bearing Outer Race Remover Adaptor

For use with basic tool 18G260.



18G260E

18G134. Bearing and Oil Seal Replacer (basic tool)



18G134

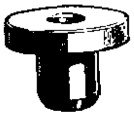
18G134AM. Differential Bearing Inner Race Replacer Adaptor

For use with detachable handle 18G134.

18G134AM

18G134AJ. Differential Oil Seal and Housing Replacer Adaptor

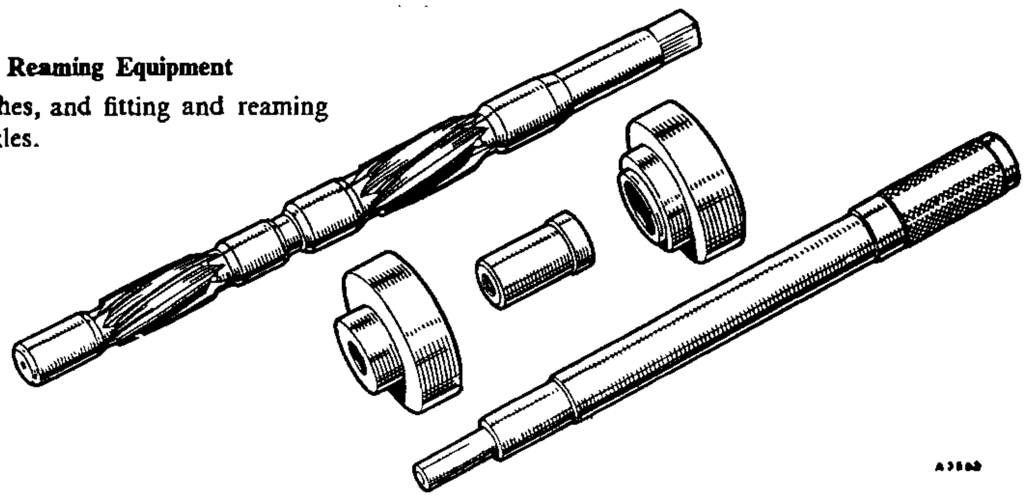
For use with detachable handle 18G134.



18G134AJ

18G604. Swivel Axle Bush Reaming Equipment

For removing old bushes, and fitting and reaming new bushes to the swivel axles.



18G604

SECTION J

THE HYDRAULIC DAMPERS

Section J.1

DESCRIPTION

The hydraulic dampers are Armstrong double-acting, resistance being offered to the compression and to the recoil of the road springs.

All the working parts of the dampers are submerged in oil and no adjustment is required or provided for. The dampers are carefully set before dispatch, using special equipment, and any attempt to dismantle the piston assembly will seriously affect the performance of the damper.

A faulty damper should be returned to the makers for attention.

Section J.2

TESTING

If there is any doubt that the road springs are adequately damped the condition of the springs and the tyre pressures should also be considered, as these have an appreciable bearing on the results obtained.

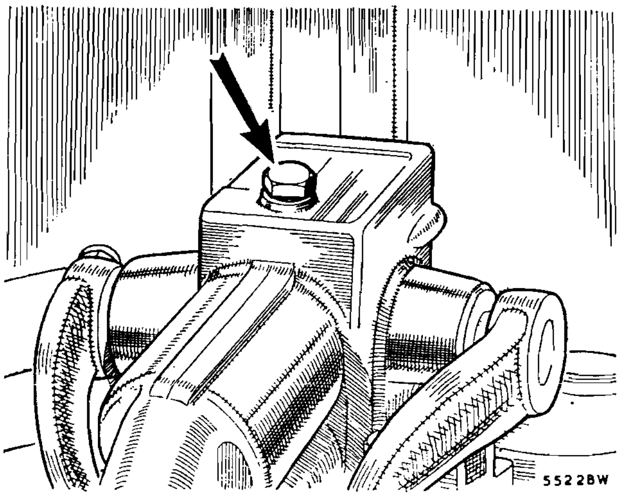


Fig. J.1

A front damper filler plug

If the hydraulic dampers do not appear to function satisfactorily an indication of their resistance can be obtained by carrying out the following check.

Remove the dampers from the car.

Hold them in a vice and move the lever arm up and down through its complete stroke. A moderate resistance throughout the full stroke should be felt; if, however, the resistance is erratic, or free movement in the lever is noted, lack of fluid is indicated, or there may be air in front of the piston. The free movement should not exceed ⅛ in. (3 mm.) at the outer end of the arm.

If the addition of fluid (added to the level given in Section J.3) and working the arm over its full range of travel a number of times give no improvement a new damper should be fitted.

Too much resistance, i.e. when it is not possible to move the lever arm slowly by hand, indicates a broken internal part or a seized piston; in such cases the damper should be changed for a new or reconditioned one.

Section J.3

TOPPING UP WITH FLUID

The dampers may be replenished in position, provided that the tops have been thoroughly cleaned to ensure that when the filler plug is extracted no dirt falls into the filler orifice.

This is most important, as it is absolutely vital that no dirt or foreign matter should enter the operating chamber.

The rear dampers are accessible through inspection holes in the rear boot.

The use of Armstrong Super (Thin) Shock Absorber Fluid in the Armstrong dampers is recommended. (If this fluid is not available any good-quality mineral oil to

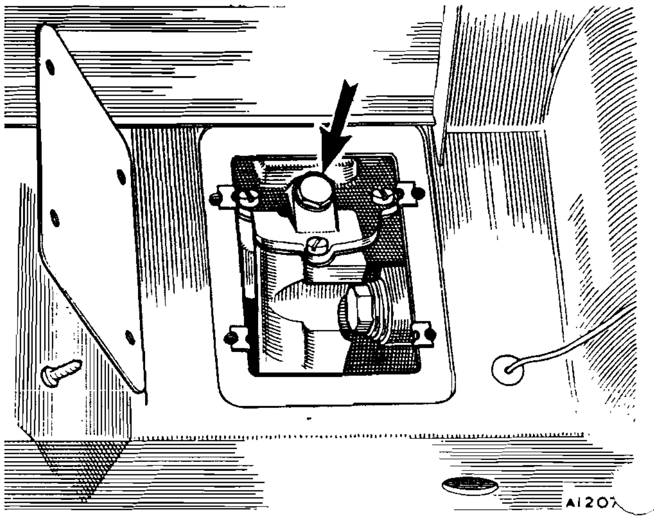


Fig. J.2

A rear damper filler plug

Specification S.A.E. 20/20W should be used, but this alternative is **not** suitable for low-temperature operation.)

Fluid should be added to the level of the bottom of the filler plug hole.

When fluid has been added the damper arm should be worked throughout its full stroke (by rocking the car) before the filler plug is replaced to expel any air that might be present in the operating chamber.

Section J.4

REMOVING AND REPLACING A FRONT DAMPER

Raise the front of the car and remove the road wheel. Place a stand beneath the front cross-member to support the car in the unlikely event of the jack slipping. Place a further jack beneath the outer end of the lower wishbone arm and raise it until the damper arms are clear of their rebound rubbers on the top of the wishbone arms.

Extract the split pin and castellated nut from the upper trunnion fulcrum pin and take out the pin.

On removing the four set screws and spring washers the damper may be removed from its mounting on the front suspension cross-member assembly.

When handling dampers that have been removed from the car it is essential to keep the assemblies upright as far as possible, otherwise air may enter the operating chamber, resulting in free movement.

Replacement is a reversal of the removing procedure, but before fitting the upper trunnion fulcrum pin, work the damper arms a few times through their full travel to expel any air which may have found its way into the operating chamber.

Section J.5

REMOVING AND REPLACING A REAR DAMPER

Release the anti-roll bar from the damper lever by removing the 'U' bolt and set bolt.

Release the damper arm link from the axle and the bolts securing the damper to the frame, when the damper can then be withdrawn from underneath the car.

When handling dampers that have been removed from the car for any purpose it is important to keep the assemblies upright as far as possible, otherwise air may enter the operating chamber, resulting in free movement.

Replacement of the dampers is carried out in the reverse way to the above procedure. Before fitting the damper arm link to the axle it is advisable to work the damper arm through its full range of movement to expel any air which may have found its way into the operating chamber.

SECTION K

THE BRAKING SYSTEM

Section K.1

DESCRIPTION

The brakes on all four wheels are hydraulically operated by a foot pedal directly connected to the master cylinders (1st type), a single-acting master cylinder (2nd type), or a tandem master cylinder (3rd type), in which the hydraulic pressure of the brake operating fluid is generated.

The pressure generated in the master cylinders is transmitted with equal and undiminished force to all wheel cylinders simultaneously. This moves each wheel cylinder piston outwards, expanding the brake-shoes and thus producing automatic equalization and efficiency in direct proportion to the effort supplied at the pedal.

In the rear drums a single wheel cylinder operated both hydraulically and mechanically floats on the backplate and operates the brake-shoes, giving one leading shoe and one trailing shoe in each direction of rotation, and provides adequate braking in reverse.

The hand brake is mounted on the floor of the car convenient to the driver. It is of the conventional ratchet and pawl type, operating on the rear wheels only by means of rods, a compensator mounted on the rear axle, and transverse rods to the brake-shoe levers.

Two leading shoes in each front assembly are expanded by individual, single-acting hydraulic cylinders connected by tubing and bolted to the backplate. Each shoe pivots and slides on one of the cylinders with its opposite end in contact with the piston of the cylinder diametrically opposite. Two pull-off springs are fitted, each connected from one shoe to the backplate.

An adjuster controls the movement of each shoe without interfering with its normal braking function.

Two shoes, one leading and one trailing, are expanded in each rear assembly by a single-acting hydraulic cylinder and piston assembly floating on the backplate. Two springs are fitted and connected between the shoes. The shoes are not fixed but are able to slide on their abutments and centralize in the drum. At the cylinder end the leading shoe is located in a slot in the piston while the trailing shoe rests in a slot formed in the cylinder body; at the adjuster ends they rest in slots in the adjuster links. The shoes are supported by adjustab' steady posts screwed into the backplate. Inclined inne faces on the adjuster links bear on the inclined faces of the adjuster wedge, which has a finely threaded spindle

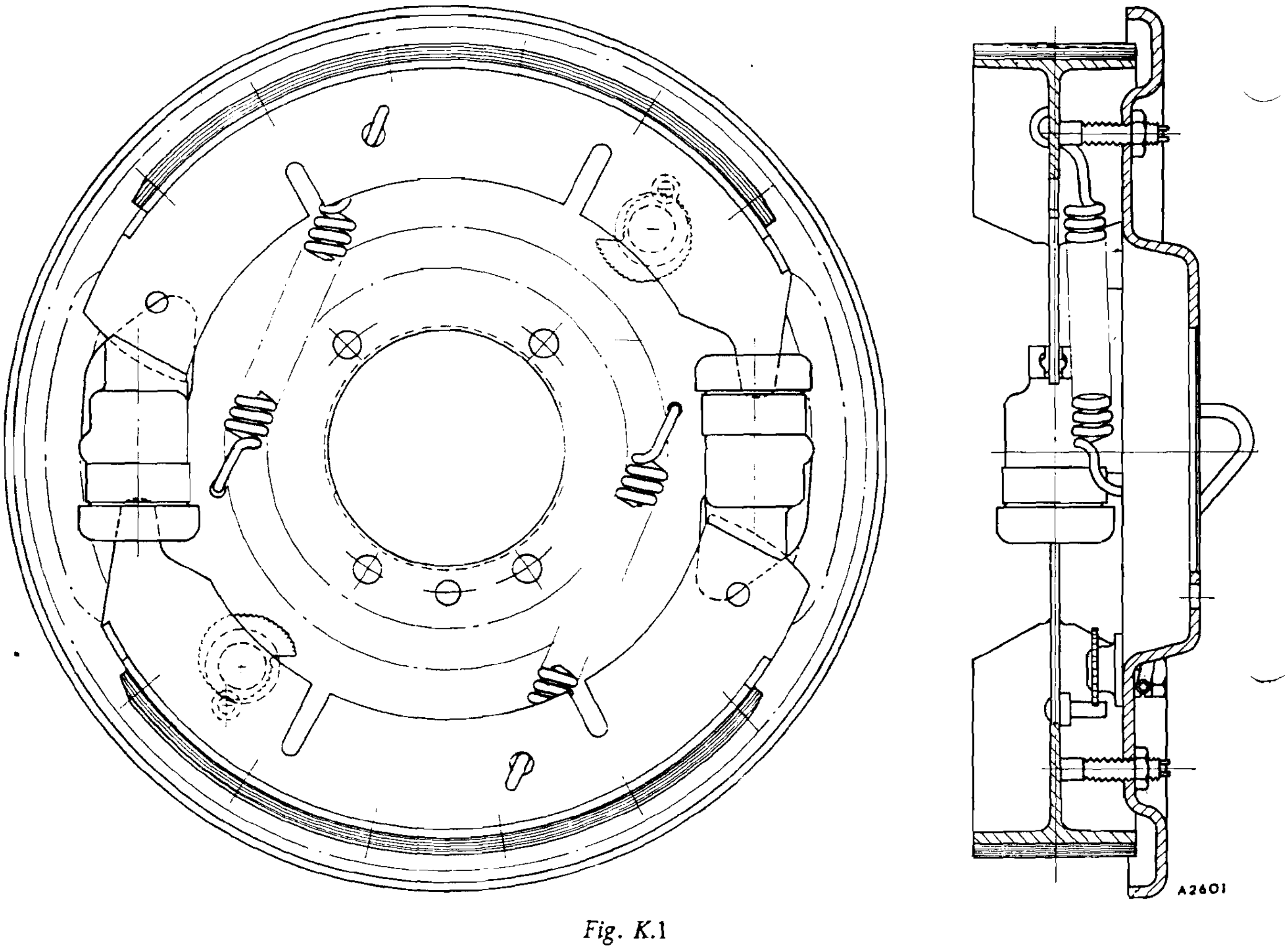


Fig. K.1
A front brake assembly

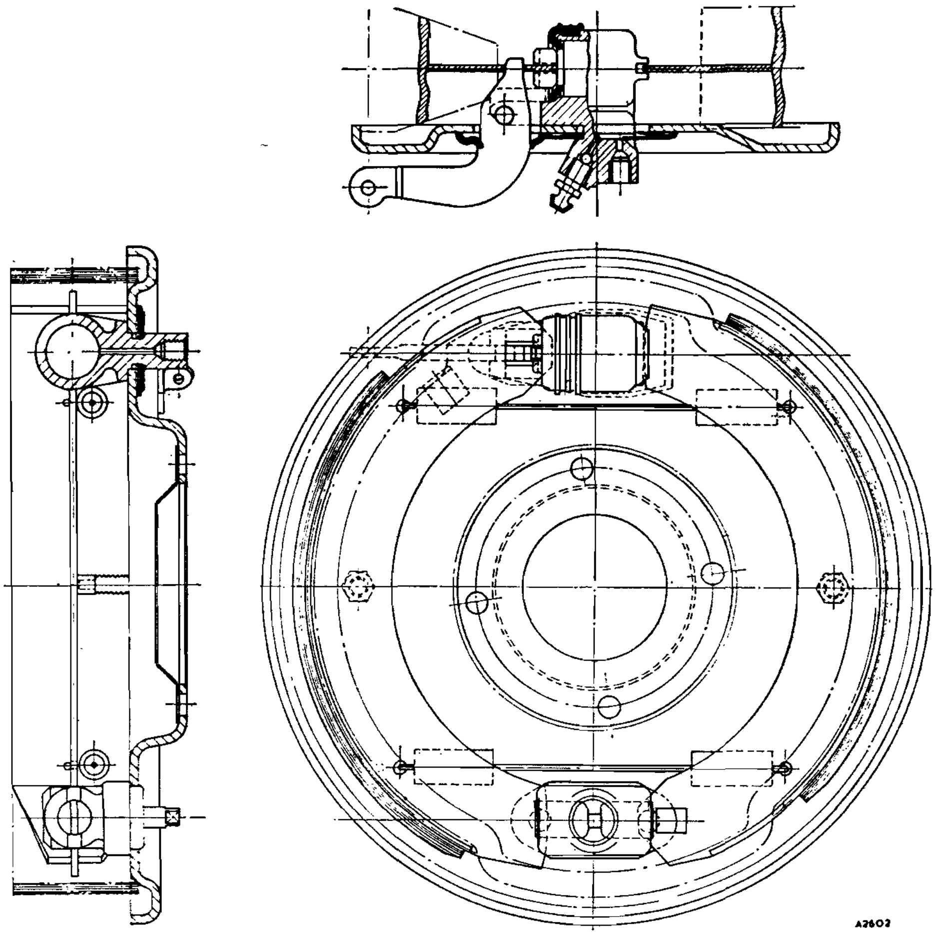


Fig. K.2
A rear brake assembly

and a squared end projecting through the backplate. Rotating the spindle therefore will expand the shoes or allow them to come together under the influence of the return springs.

The hand brake lever is pivoted in the cylinder body, and when operated the lever tip expands the leading shoe independently of the hydraulic piston and the pivot moves the cylinder body to apply the trailing shoe.

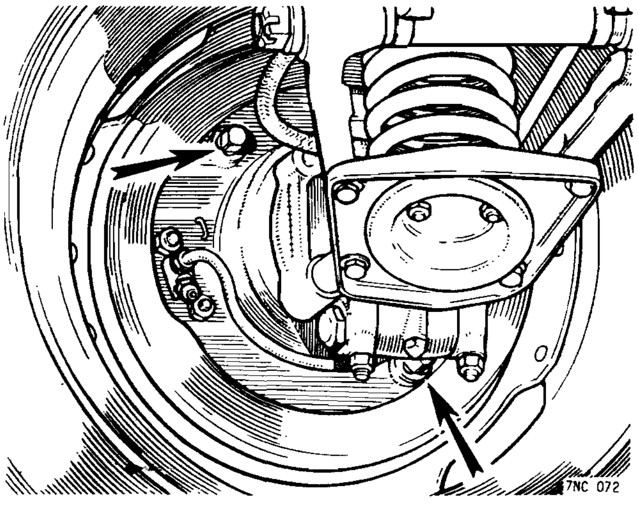


Fig. K.3
The front brake-shoes are adjusted independently by the two square-headed bolts indicated

IMPORTANT.—**Always exercise extreme cleanliness when dealing with any part of the hydraulic system.**

Do not handle any rubber or internal parts with greasy hands or greasy rags, and clean all parts with the recommended brake fluid from clean containers; do not use a container that has been washed with trichlor-ethylene.

Examine all seals, hoses, and other parts for damage when overhauling the system and renew any damaged or unserviceable component.

Do not refill the reservoir with dirty fluid when bleeding the system; use new fluid from a sealed container.

Do not allow paraffin, petrol, or trichlor-ethylene to contact any part of the system.

Section K.2

ADJUSTING THE BRAKE-SHOES

Front

Jack up the wheel or wheels requiring adjustment.

Turn one of the square-headed adjuster bolts in a clockwise direction until the drum is locked against rotation and then slacken off just enough to free the drum (two 'clicks'). Repeat the adjustment with the other shoe.

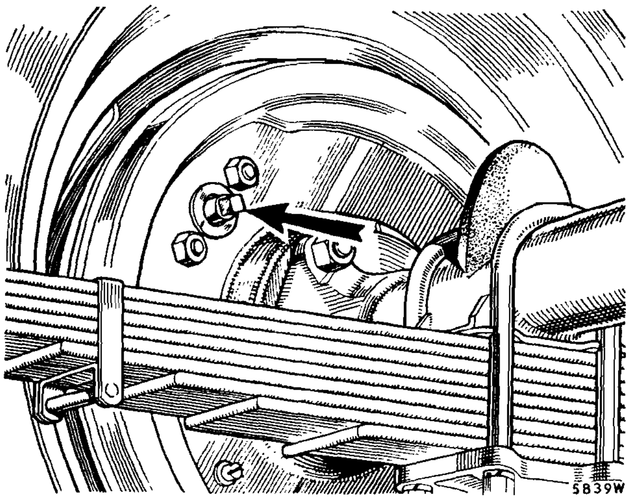


Fig. K.4

The rear brake-shoes are adjusted by the squared end of the wedge-type adjuster indicated

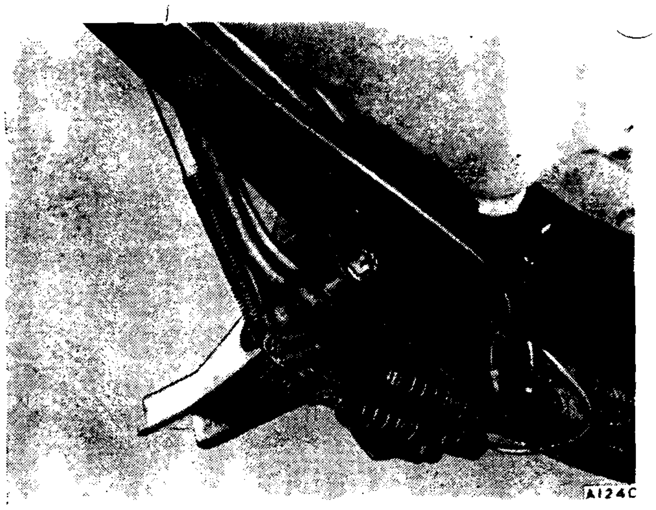


Fig. K.5

The brake pedal and master cylinders

Rear

Jack up the wheel or wheels to be adjusted.

Apply a few drops of oil to the adjuster stem to prevent seizure of the threads.

Rotate the squared adjuster screw in a clockwise direction until the drum is locked and then slacken off enough to free the drum (two 'clicks').

Adjustment of the shoes in the manner indicated also automatically adjusts the hand brake, and no separate adjustment is required.

Section K.3

TWIN MASTER CYLINDERS (Type C.V.)

Removing and replacing

Connect bleeder tubes to one of the front and one of the rear wheel bleeder screws, lower the end of the tubes into clean receptacles, release the bleeder screws one turn, and pump the brake pedal until no further fluid enters the containers.

Disconnect the two pipes from the master cylinder which is to be removed.

Disconnect the balance lever from the housing on the master cylinder push-rod by removing the split pin and thrust blocks.

Remove the two nuts and bolts attaching the master cylinder to its support plate and withdraw the master cylinder from the car.

When refitting reverse the removal procedure and ensure that the balance lever is free and lubricated.

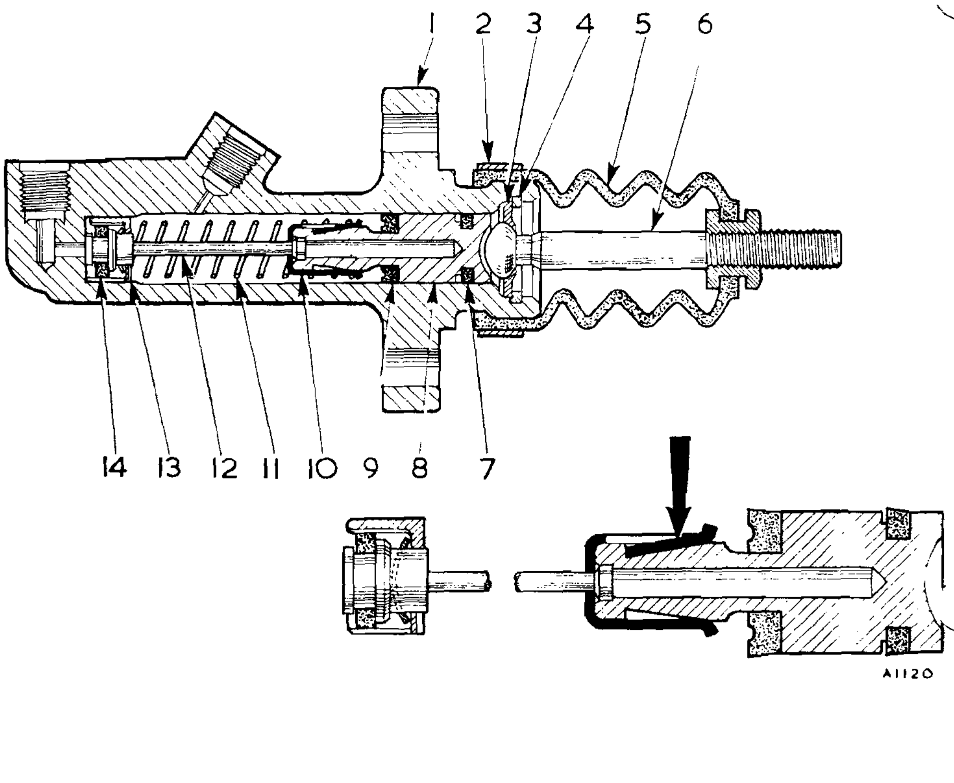
Bleed the system as described in Section K.8.

Fig. K.6

Master cylinder assembly (type C.V.)

1. Body.
2. Retainer for boot.
3. Retaining washer.
4. Circlip.
5. Boot.
6. Push-rod.
7. Taper seal.
8. Piston.
9. Seal.
10. Retainer for spring.
11. Spring.
12. Valve stem.
13. Valve spacer.
14. Valve seal.

The arrow indicates the thimble leaf.



Dismantling

Release the dust cover and remove the circlip; the push-rod and dished washer can then be removed.

Remove the plunger assembly complete.

Lift the thimble leaf over the shouldered end of the plunger (Fig. K.6).

Depress the plunger return spring to allow the valve stem to slide through the elongated hole of the thimble and release the spring tension.

Remove the thimble, spring, and valve complete; detach the valve spacer, taking care of the spacer spring washer located under the valve head. Remove the seal from the valve head. Examine all parts for wear and distortion and renew where necessary.

Use only clean brake fluid for cleaning.

Assembling

Assembly is mainly a reversal of the dismantling procedure, but note the following.

Make sure that the flat side of the valve seal is correctly seated on the valve head.

Locate the spring washer with the domed side against the under side of the valve head.

The legs of the valve spacer must face towards the valve seal.

Replace the plunger return spring centrally on the spacer, insert the spring, and depress until the valve stem engages through the elongated hole of the thimble. Make sure that the stem is correctly located in the centre of the thimble. Check that the spring is still central on the spacer.

Fit the plunger seal with the flat of the seal against the face of the plunger.

Assemble the tapered rubber seal (if fitted) onto the plunger with the smaller diameter towards the push-rod end of the plunger.

Insert the reduced end of the plunger into the thimble until the thimble leaf engages under the shoulder of the plunger; press home the leaf (Fig. K.6).

Smear the assembly with the recommended fluid and insert the assembly into the cylinder bore. Do not damage the seals as they are pushed into position.

Refit the push-rod, circlip, and rubber dust cover.

Refill the tank with UNIPART 410 or 550 Brake Fluid; alternatively use a brake fluid conforming to Specification S.A.E. J1703c. DO NOT use any other type of brake fluid.

Bleed the system as described in Section K.8.

Section K.4

REMOVING AND REPLACING BRAKE-SHOES

Front

Jack up and remove the wheel and brake-drum.

Lift the trailing end of a shoe from the abutment on the wheel cylinder and the leading end from the piston of the opposite cylinder: detach the spring and shoe. Repeat with the other shoe. Prevent the pistons from falling out of the cylinders by the use of rubber bands or wire.

Wash all dust from the backplate assembly and drum with Girling cleaning fluid or denatured alcohol; allow to dry.

WARNING.—Do not use an air line to blow dust from the brake assemblies. Asbestos dust from brake linings can be a serious health risk if inhaled.

Before refitting the shoes lightly smear the steady posts and both ends of the shoes with Girling White Brake Grease, but take care to keep all grease from the rubber parts and pistons, and from the linings.

Fit the shoes. The shorter hook of each spring must be connected to a brake shoe. Fit the brake drum and adjust as detailed in Section K.2.

If replacement brake-shoes are fitted or if there is any sign of uneven wear across the surface of the linings it will be necessary to adjust the steady posts.

Slacken the locknut at the rear of the backplate and unscrew the post about three or four turns.

Apply the brakes hard and then rotate the post in a clockwise direction until it contacts the shoe web; hold the post and tighten the locknut.

Renew front brake-shoe and lining assemblies as a complete set.

Rear

Jack up and remove the wheel and brake-drum; it may be necessary to slacken off all the adjustment in order to fit replacement shoes. Note that the lining of the leading shoe is fitted towards the trailing end and that of the trailing shoe towards the leading end. Both springs are connected between the shoes. Apply the hand brake partially to detach the rear shoe.

The instructions for fitting the rear brake-shoes follow in general those for the front.

Section K.5

REMOVING AND REPLACING A WHEEL CYLINDER

Front

Jack up and remove the wheel, drum, and shoes.

Disconnect the bridge pipe unions from the cylinder.

Unscrew the two securing nuts and remove the cylinder(s).

When refitting, tighten the wheel cylinder nuts to a torque wrench reading of 5 to 7·5 lb. ft. (·69 to 1·03 kg. m.).

After refitting bleed the brakes.

Rear

Jack up the wheel and remove the wheel, drum, and shoes.

Disconnect the pipe from the union, the rod at the hand brake lever, and remove the rubber boot from the rear of the backplate.

With a screwdriver prise the retainer and spring plates apart and tap the retaining plate from below the neck of the wheel cylinder.

Withdraw the hand brake lever from between the backplate and wheel cylinder.

Remove the spring plate and distance pieces, and finally the cylinder from the backplate.

To refit, smear the backplate and cylinder with Girling

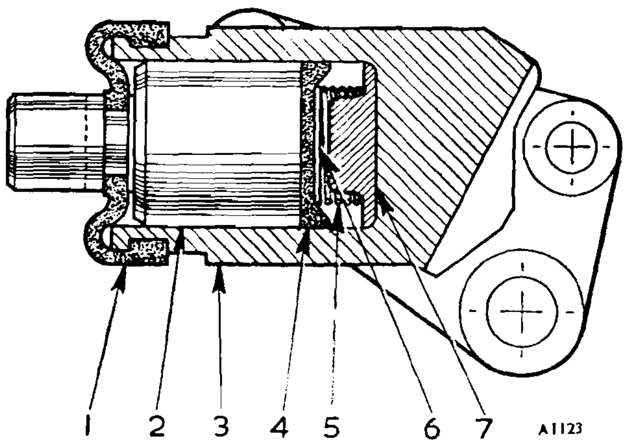


Fig. K.7

A front wheel cylinder

1. Dust cover.
2. Piston.
3. Body.
4. Seal.
5. Spring.
6. Seal support.
7. Spring support.

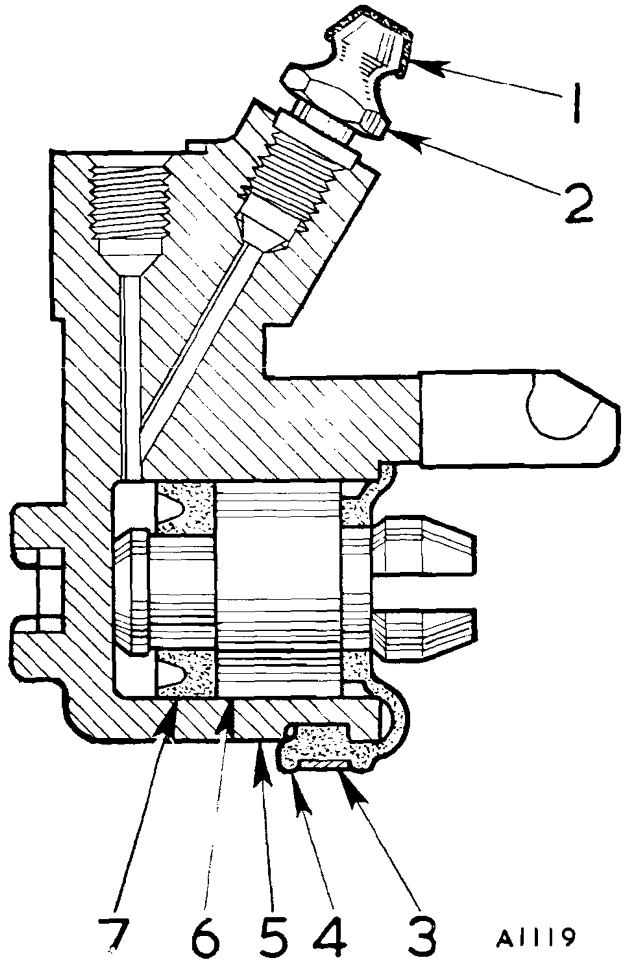


Fig. K.8

A rear wheel cylinder

1. Cover for bleeder screw.
2. Bleeder screw.
3. Retainer for dust cover.
4. Dust cover for piston.
5. Body.
6. Piston.
7. Seal.

White Brake Grease and mount the cylinder onto the backplate with the neck through the large slot. Replace the distance piece between the cylinder neck and the backplate with the open end away from the hand brake location; the two cranked lips must also be away from the backplate.

Replace the hand brake lever. Locate the retaining plate between the distance piece and the spring plate (open end towards the hand brake lever) and tap into position until the two cranked lips of the spring plate locate in the retaining plate.

Fit the rubber cover. Connect the pipe to the union and the rod to the hand brake lever. Replace the shoes, drum, and wheel.

Bleed and adjust the brakes.

Section K.6

DISMANTLING AND ASSEMBLING A WHEEL CYLINDER

Front

Remove the cylinder as detailed in Section K.5.

Remove the rubber dust cover; the piston seal, spreader, and spring can be extracted by air pressure.

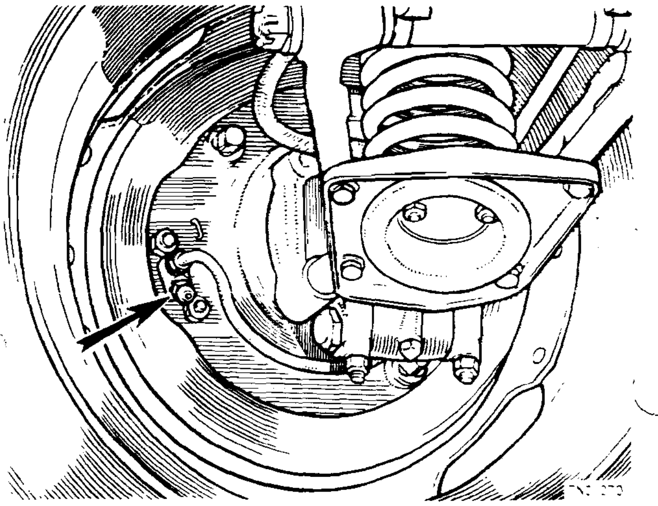


Fig. K.9

The front brake bleeder screw is indicated by the lower left-hand-side arrow

Rear

Remove the cylinder as detailed in Section K.5.

Remove the spring clip and rubber dust cover.

Blow out the piston and seal.

Replacement in both front and rear cylinders is a reversal of the dismantling procedure.

Section K.7

REMOVING A FLEXIBLE HOSE

Do not attempt to release a flexible hose by turning either end with a spanner; it should be removed as follows.

Unscrew the metal pipe line union nut from its connection to the hose.

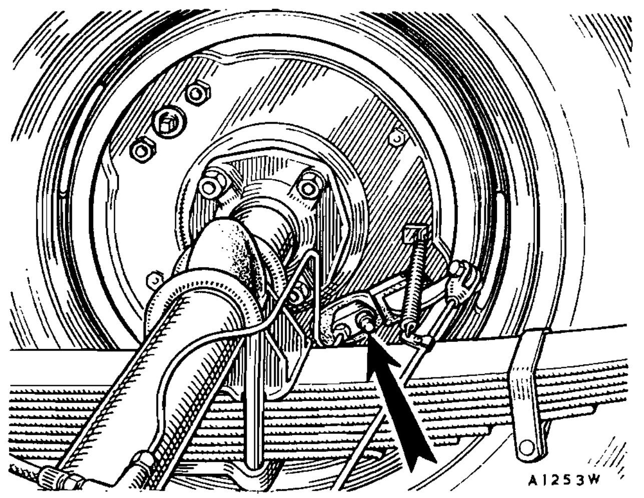


Fig. K.10
The rear brake bleeder screw

Hold the hexagon on the flexible hose and remove the locknut securing the flexible hose union to the bracket.
Unscrew the flexible hose from the cylinder end.

Section K.8

BLEEDING THE SYSTEM
(Expelling Air)

Bleeding the system is not a routine maintenance job, and should only be necessary when some portion of the hydraulic equipment has been disconnected or the fluid drained off, or if the fluid has been allowed to fall so low that air has entered the master cylinder.

Fill the master cylinder reservoirs with **UNIPART Universal Brake Fluid** or other brake fluids having a minimum boiling-point of 260°C. (500°F.) and complying with FMV SS 116 DOT 3 or S.A.E. J1703c specification. **NOT use any other type of fluid.**

During the bleeding operation maintain the fluid level in the reservoir to within ½ in. (13 mm.) below the bottom

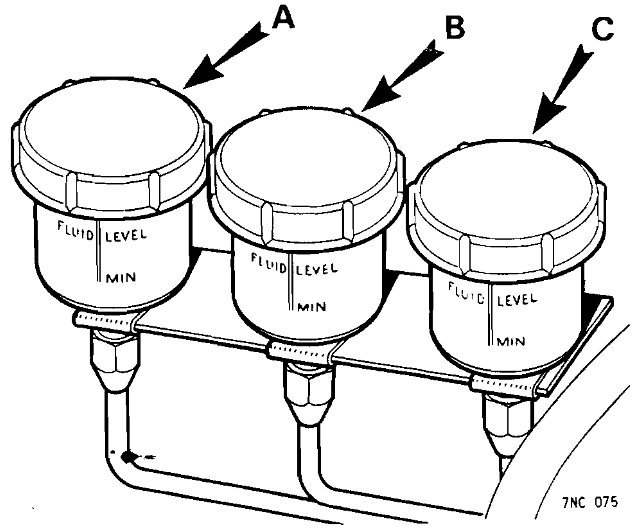


Fig. K.11
The front brake (A), *rear brake* (B) *and clutch* (C) *fluid reservoir filler caps*

of the filler neck and ensure that all union and pipe connections are tight and leakproof.

NOTE.—Pressure-bleeding methods are not recommended. For pressure-bleeding to be successful it must be accompanied by manual bleeding.

Rear brakes

Scotch the wheels and release the hand brake fully. Check that the wheel cylinder is free to slide, and turn the adjuster clockwise until the shoes are fully locked on the drum. The wheel cylinder piston will then be pushed into the bore with the minimum of air to be expelled.

Front brakes

Slacken off the adjusters to allow the shoe springs to push the pistons into the wheel cylinder bore, leaving the minimum amount of space for air or fluid.

Commence bleeding on the rear brakes, starting with the wheel cylinder farthest away from the master cylinder. Clean off all dirt from around the bleed nipple and remove the protective rubber cap. Fit the bleed tube over the nipple and immerse the free end in a clean jar containing a little fluid. Unscrew the nipple about three-quarters of a turn and commence bleeding with a fairly fast full stroke of the brake pedal, allowing the pedal to fly back unassisted. Repeat this procedure until it is apparent that all air has been excluded, closing the nipple during the last slow pedal application. At no time during the bleeding operation must the fluid level fall to a point where air may be drawn into the system.

Repeat with each wheel cylinder in turn, finishing with the cylinder situated nearest the master cylinder.

If the bleeding of any cylinder continues without clearing the air bubbles it may be that air is being drawn into the system via the bleed nipple threads. In these cases the bleed nipple should be tightened at the end of each downward stroke, allowing the pedal to return before reopening.

Never use fluid which has just been bled from the system for topping up the supply tank; it must be discarded. Tighten the bleed nipples to a torque wrench reading of 4 to 4·5 lb. ft. (·5 to ·6 kg. m.) and replace the dust seal on all nipples.

Readjust the brakes to obtain the correct shoe-to-drum clearance.

Section K.9

HAND BRAKE

The hand brake operates the rear brake-shoes through rods, a compensator mounted on the rear axle, and transverse rods to the wheel cylinder levers. Do not attempt to adjust the brakes by interfering with the rods.

Slackness in the hand brake mechanism may be removed as follows:

(1) Adjust the brake-shoes as detailed in Section K.2.
(2) Slacken the locknuts on one of the rods and turn the rod in a clockwise direction until the hand

brake is hard on when the lever is pulled up three or four notches.

(3) Check that the drums are free to rotate when the hand brake is off. Tighten the rod locknuts after the correct setting has been obtained.

Section K.10

PREVENTIVE MAINTENANCE

To safeguard against the possible effects of wear or deterioration it is recommended that:

1. Disc brake pads, drum brake linings, hoses, and pipes should be examined at intervals no greater than those laid down in the Driver's Handbook.
2. Under normal operating conditions brake fluid should be changed completely every 18 months or 18,000 miles (30000 km.) whichever is the sooner.
3. All fluid seals in the hydraulic system and all flexible hoses should be renewed every 3 years or 36,000 miles (60,000 km.) whichever is the sooner. At the same time the working surfaces of the pistons and bores of the master cylinder, wheel cylinders, and other slave cylinders should be examined and new parts fitted where necessary.

Care must be taken always to observe the following points:

(*a*) At all times use the recommended brake fluid.

(*b*) Never leave fluid in unsealed containers. It absorbs moisture quickly and this can be dangerous if used in this condition.

(*c*) Fluid drained from the system or used for bleeding is best discarded.

(*d*) The necessity for absolute cleanliness throughout cannot be over-emphasized.

Section K.11

TANDEM MASTER CYLINDER (Type T.V.C.V.)

Removing and replacing

Remove the three screws retaining the mud shield to the chassis and the pedal bracket.

Remove the bundy pipes from the rear inlet and two side outlets, placing a container to catch the fluid as it drains. Remove the two screws retaining the front inlet flange and separate the flange assembly from the master cylinder. Note the rubber sealing ring in the master cylinder.

Remove the clevis pin securing the push-rod to the brake pedal.

Remove the two screws retaining the master cylinder to the bracket, noting the captive nut in the top hole of the master cylinder flange. Detach the master cylinder.

Replacing is a reversal of the removing procedure. Check that the push-rod has a $\frac{1}{32}$ in. (0·8 mm.) free travel after refitting, and adjust if necessary. Bleed the brakes.

Dismantling

Pull back the rubber dust cover from the master cylinder, remove the circlip retaining the push-rod assembly and detach the assembly.

Remove the nut securing the tipping valve, press in the primary plunger and remove the tipping valve. Apply low air pressure to the rear fluid inlet to assist in the removal of the internal components of the master cylinder.

Compress the spring on the secondary plunger assembly between the plunger and the valve and prise up the retaining leaf on the spring retainer to release the spring.

Remove the seals from the valve, secondary plunger and primary plunger.

Examine all parts for wear or damage and renew as necessary. If the bore of the master cylinder is at all suspect because of scoring or wear, renew the master cylinder as an assembly.

Re-assembling is the reversal of the dismantling procedure, lubricating all parts with the recommended brake fluid.

When re-assembling the secondary plunger, spring, spring retainer and valve assembly, compress the spring between the valve and plunger until it is almost coil-bound. Check that the spring retainer is fully seated against the plunger, and depress the leaf of the retainer, ensuring that it is straight and firmly located behind the plunger head, as shown in section in Fig. K.12.

Tighten the tipping valve retaining screw to a torque tightness of 35 to 40 lbf. ft. (48 to 55 kg. m.).

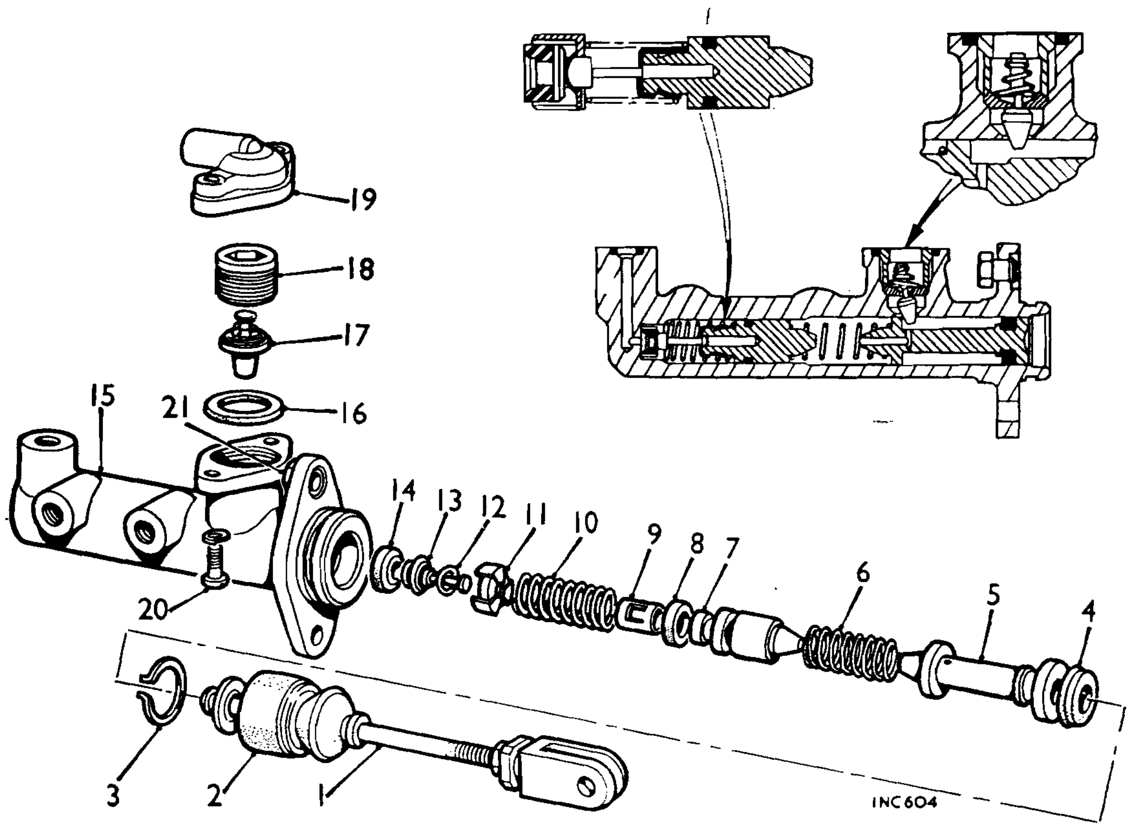


*Fig. K.*12
The tandem master cylinder components (type T.V.C.V.)

1. Push-rod.	8. Secondary seal.	15. Cylinder body.
2. Rubber boot.	9. Spring retainer.	16. Sealing ring.
3. Circlip.	10. Secondary spring.	17. Tipping valve.
4. Primary seal.	11. Valve spacer.	18. Valve retaining screw.
5. Primary plunger.	12. Spring washer.	19. Front inlet.
6. Intermediate spring.	13. Valve.	20. Retaining screw.
7. Secondary plunger.	14. Valve seal.	21. Captive nut.

Section K.12

REMOVING AND REPLACING THE HAND BRAKE LEVER ASSEMBLY

Removing

(1) Remove the four nuts retaining the driver's seat frame to the floor and detach the seat assembly.
(2) Unsnap the press-stud fasteners and remove the gaiter from the hand brake operating lever.
(3) Unscrew the fasteners retaining the floor carpet.
(4) Push the hand-brake lever forwards and slide the carpet up to clear the hand brake lever mounting.
(5) Remove the clevis pin retaining the brake operating rod to the hand brake side lever.
(6) Unlock and remove the nut retaining the side lever to the hand brake lever, and detach the side lever.
(7) Unlock and remove the screw retaining the R.H. pivot bracket to the chassis.
(8) Remove the three nuts and bolts and the spacers retaining the R.H. bracket and the ratchet to the L.H. bracket.
(9) Remove the R.H. bracket from the hand brake pivot.
(10) Withdraw the hand brake lever assembly from the L.H. bracket.
(11) Unlock and remove the two screws retaining the L.H. bracket to the chassis, and detach the bracket.

Replacing

(12) Reverse the procedure in (1) to (11).

Section K.13

PRESSURE DIFFERENTIAL WARNING ACTUATOR (P.D.W.A.)

Removing

(1) Disconnect the wiring plug from the switch.
(2) Remove the two brake pipes from the bottom face of the actuator, placing a container to catch the fluid as it drains.
(3) Remove the two brake pipes from the top face of the actuator.
(4) Remove the actuator assembly which is secured by a single screw to the chassis. Plug the ends of the brake pipes.

Dismantling

(5) Remove the electrical switch.
(6) Remove the end plug and discard its gasket.
(7) Withdraw the piston assembly and both sleeves and 'O' rings from the valve body.
(8) Remove the two circlips from the piston and discard the circlip and 'O' rings.

Inspection

(9) Clean all components, except the electrical switch, in Girling cleaning fluid or methylated spirit.
(10) Examine the valve bore, sleeves, and piston. If any of them are worn or damaged, renew the valve assembly.
(11) Connect the wiring to the electrical switch and actuate the switch plunger to test the switch operation and warning light circuit.

Reassembling

CAUTION: Immerse all components, except the electrical switch, in clean brake fluid and assemble them wet.

(12) Fit new circlips to the pistons.
(13) Fit the sleeves to the pistons and ensure that they slide freely on it.
(14) Fit new 'O' rings to the piston.
(15) Fit the piston assembly into the valve body and push it fully home, then carefully push the outer 'O' ring in until it abuts its sleeve.
(16) Fit a new gasket to the end plug and screw in the end plug to a torque of 38 lb. ft. (5·2 kg. m.).
(17) Move the piston until both sleeves are equally positioned in relation to the switch port.
(18) Screw in the switch to a torque of 3 lb. ft. (0·5 kg. m.).

Refitting

(19) Reverse the procedure in (1) to (4).
(20) Bleed the brake hydraulic system.

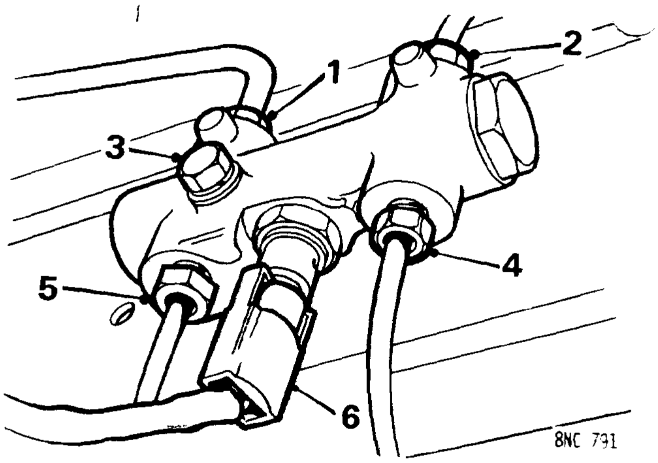


Fig. K.13
Pressure differential warning actuator

1. To brakes—front.
2. To brakes—rear.
3. Retaining screw.
4. From master cylinder—front.
5. From master cylinder—rear.
6. Wiring plug.

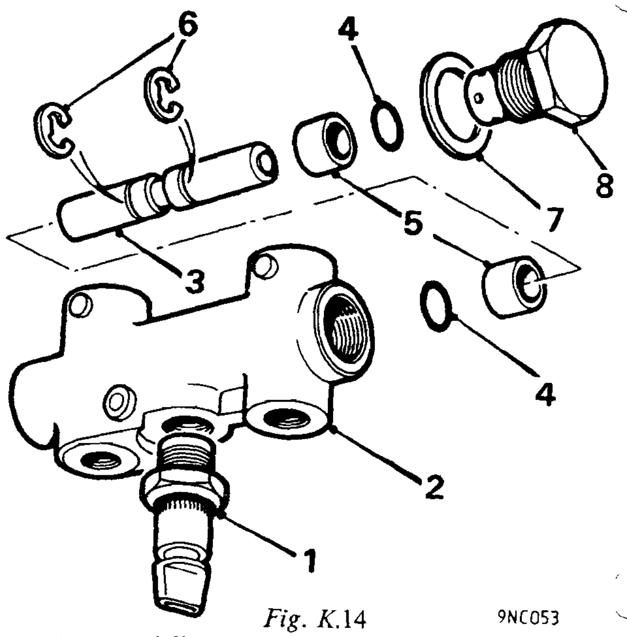


Fig. K.14 9NC053
Pressure differential warning actuator components

1. Switch.
2. Body.
3. Piston.
4. 'O' rings.
5. Sleeves
6. Circlips.
7. Gasket.
8. End plug.

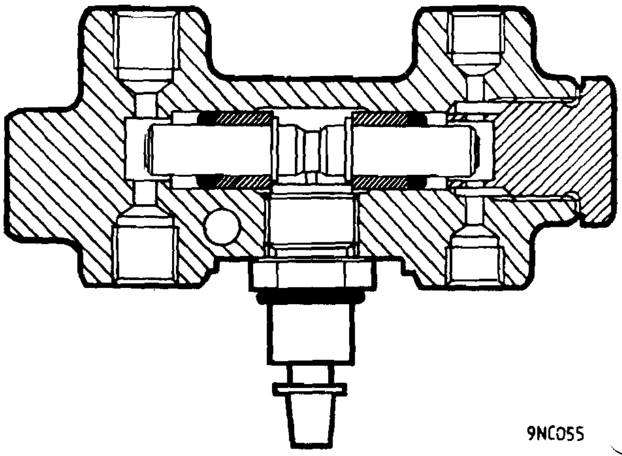


Fig. K.15
Section through the pressure differential warning actuator

Section K.14

VACUUM SERVO

Removing

(1) Slacken the clip and disconnect the hose from the non-return valve on the servo unit.
(2) Disconnect the brake fluid inlet and outlet pipes from the hydraulic body of the servo unit. Plug the ends of the brake pipes.
(3) Remove the three screws and spring washers securing the servo to the mounting bracket.
(4) Remove the servo unit from the vehicle.

Refitting

(5) Reverse the procedure in (1) to (4).
(6) Bleed the brake hydraulic system.

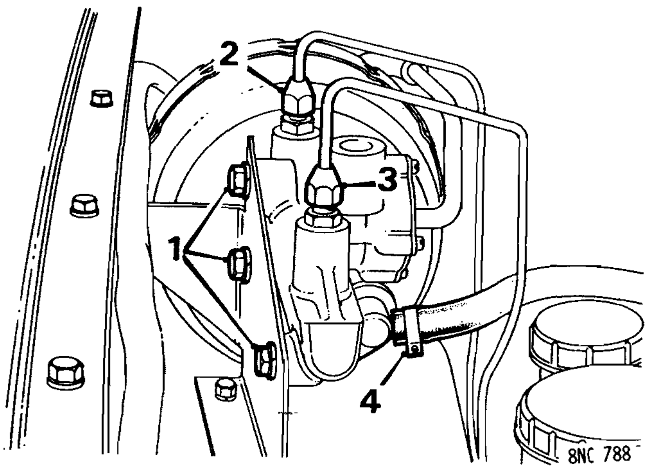


Fig. K.16

Vacuum servo

1. Securing screws.
2. Inlet pipe.
3. Outlet pipe.
4. Vacuum hose.

Section K.15

TANDEM MASTER CYLINDER (Type A.S.A.S.)

Removing

(1) Remove the three screws retaining the mud shield to the chassis and the pedal bracket.
(2) Remove the pipes from the two side outlets, placing a container to catch the fluid as it drains.
(3) Slacken the clips and disconnect the two inlet hoses from the adaptors on top of master cylinder, placing a container to catch the fluid as it drains.
(4) Remove the clevis pin securing the push-rod to the brake pedal.
(5) Remove the two screws retaining the master cylinder to the bracket.
(6) Detach the master cylinder.

Dismantling

(7) Remove the two adaptors and lever out the seals from the top of the master cylinder.
(8) Push the plunger fully down the bore and withdraw the secondary plunger stop pin.
(9) Pull back the rubber dust cover from the master cylinder, remove the circlip retaining the push-rod assembly and detach the assembly.
(10) Withdraw the primary plunger assembly.
(11) Tap the master cylinder on a soft or wooden surface to remove the secondary plunger assembly.
(12) Remove the secondary plunger spring, seal retainer, recuperating seal and washer.
(13) Remove the seal from the secondary plunger. Keep the plunger and its spring together at all times.
(14) Use a 2·5 mm Allen key to unscrew the spring retaining bolt from the primary plunger.

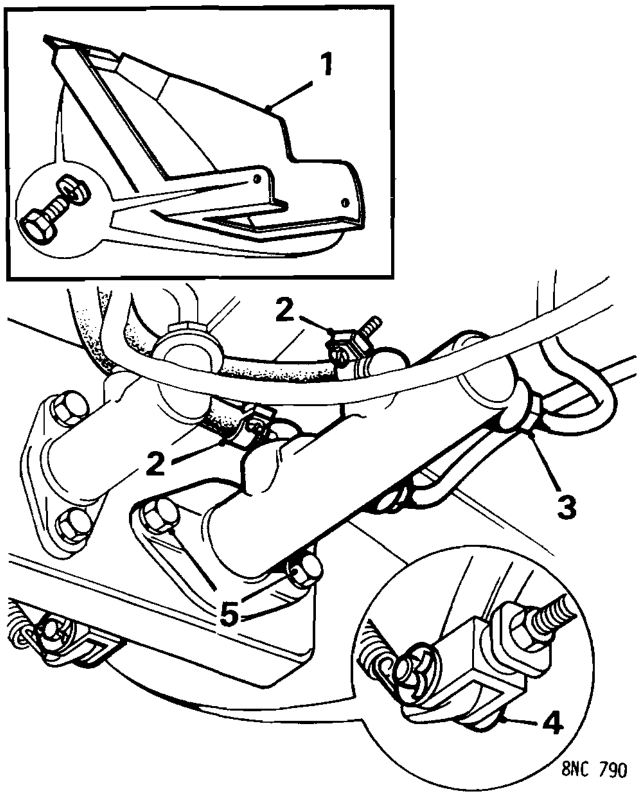


Fig. K.17

Tandem master cylinder (type A.S.A.S.)

1. Mud shield.
2. Inlet hoses.
3. Outlet pipes.
4. Clevis pin.
5. Retaining screws.

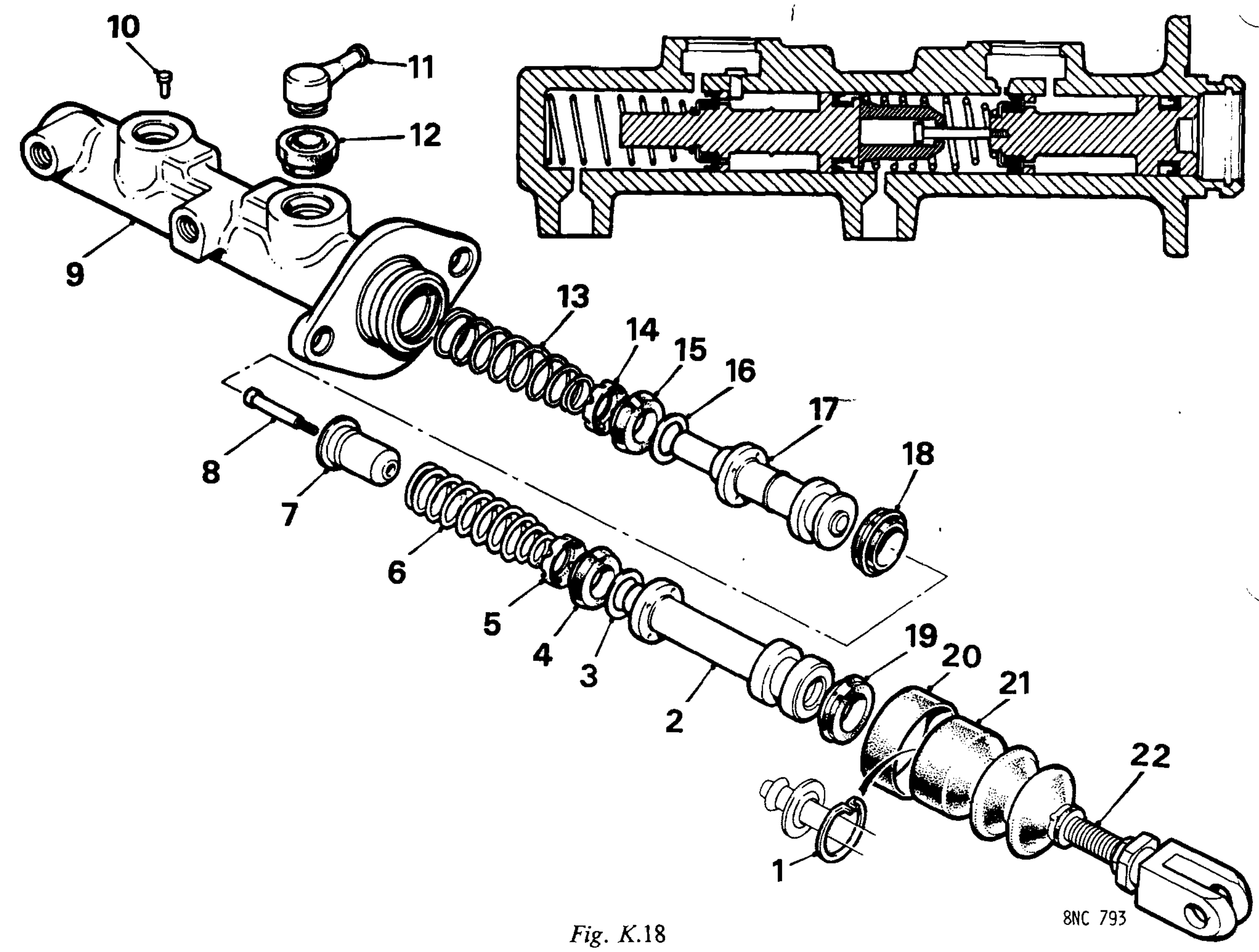


*Fig. K.*18

Tandem master cylinder (type A.S.A.S.)

1. Circlip.
2. Primary plunger.
3. Washer.
4. Recuperating seal.
5. Seal retainer.
6. Primary spring.
7. Spring retainer.
8. Retaining bolt.
9. Cylinder body.
10. Secondary plunger stop pin.
11. Adaptor.
12. Seal.
13. Secondary spring.
14. Seal retainer.
15. Recuperating seal.
16. Washer.
17. Secondary plunger.
18. Seal.
19. Seal.
20. Retaining band.
21. Rubber boat.
22. Push rod assembly.

(15) Remove the spring retainer, primary plunger spring, seal retainer, recuperating seal and washer.

(16) Remove the seal from the primary plunger. Keep the plunger and its spring together at all times.

Inspection

(17) Clean all the components in unused brake fluid and dry with a lint-free cloth.

(18) Examine the cylinder bore and plungers for scoring or wear; if at all suspect. fit a new master cylinder.

Reassembly

(19) Lubricate the cylinder bore and plungers with generous amounts of unused brake fluid, especially when fitting the plunger assemblies.

(20) Fit a new seal to the secondary plunger with the lip of the seal facing towards the primary spring.

(21) Fit the washer, new recuperating seal, seal retainer and spring to the secondary plunger.

(22) Fit a new seal to the primary plunger with the lip of the seal facing towards the primary spring.

(23) Fit the washer, new recuperating seal and seal retainer to the primary plunger.

(24) Secure the spring and spring retainer to the primary plunger with the retaining bolt, tightening the bolt to a torque of 2 to 3 Nm (1·5 to 2·2 lbf ft).

(25) Fit a new dust cover to the push-rod, smearing the sealing areas with rubber grease.

(26) Carefully insert the secondary plunger assembly into the cylinder bore with a circular rocking motion and slowly push the plunger down th bore to avoid damaging the seals.

(27) Repeat the fitting procedure with the primary plunger; fit the push-rod, circlip and dust cover.

(28) Using the push-rod, slowly press the plunger down the bore and fit the secondary plunger stop pin.
(29) Lubricate the new seals with unused brake fluid and fit them to the inlet ports.
(30) Lubricate the adaptors with unused brake fluid and gently press them into position.

Refitting

(31) Reverse the procedure in (1) to (6), noting the following:
  (*a*) Check that the push-rod has 0·8 mm ($\frac{1}{32}$ in) free travel after fitting. Adjust if necessary.
  (*b*) Bleed the brake hydraulic system.

Section K.16

BLEEDING THE SYSTEM

Follow the procedure given in Section K.8 of the Workshop Manual with the exception of the following:

(*a*) During the bleeding operation maintain the fluid level in each compartment of the reservoir to within 13 mm ($\frac{1}{2}$ in) of the top of the reservoir. Top up the fluid level to 3·2 mm ($\frac{1}{8}$ in) above the compartment divider when bleeding has been completed.

(*b*) Commence bleeding on the **front brakes** at the wheel cylinder farthest from the master cylinder. Finish bleeding on the rear brakes at the wheel cylinder nearest to the master cylinder.

(*c*) Unscrew the nipple about three-quarters of a turn and commence bleeding with a slow, full stroke of the pedal, allowing the pedal to return slowly. Repeat this procedure after a pause of three or four seconds until it is apparent that all air has been excluded, closing the nipple during a downward stroke of the pedal.

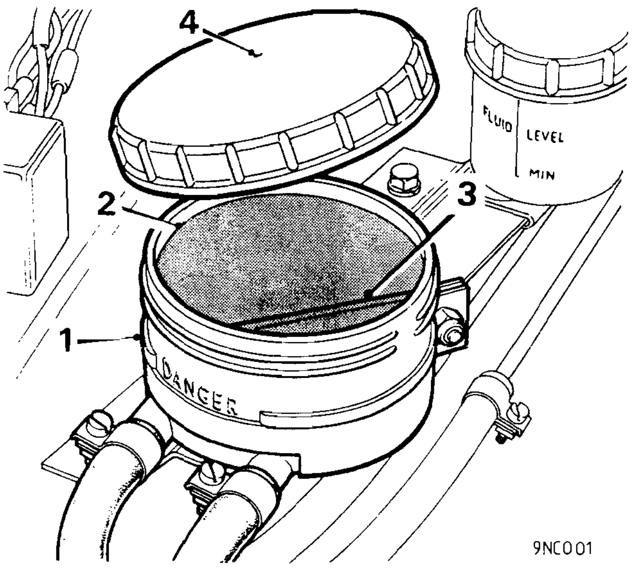


Fig. K.19

Brake fluid reservoir (single)

1. Brake fluid reservoir.
2. Fluid level.
3. Compartment divider.
4. Breather hole.

SECTION L

THE ELECTRICAL EQUIPMENT

Section L.1

DESCRIPTION

The 12-volt electrical equipment incorporates compensated voltage control for the charging circuit.

Battery details may be found in **'GENERAL DATA'**.

The dynamo or alternator is mounted on the left of the cylinder block and driven by an endless belt from the crankshaft pulley. A rotatable mounting enables the belt tension to be adjusted.

The voltage control unit (if fitted) adjustment is sealed and should not normally require attention. The fuses are carried in holders mounted in an accessible position on the front mudwing valance.

The starter motor is mounted on the right-hand side of the engine unit and operates on the converter or flywheel ring gear through the usual sliding pinion device.

The headlamps employ the double-filament dipping system. Both lamps are fitted with double-filament bulbs or light units, both dipping either vertically or to the left according to the regulations existing in the country concerned.

Section L.2

BATTERY MAINTENANCE

In order to keep the batteries in good condition a periodical inspection must be made: the cell specific gravity should be checked and the electrolyte should be topped up if necessary.

Topping up

Examine the level of the electrolyte in each cell and add distilled water as required to bring the level of the electrolyte in each cell just above the separators.

NOTE.—Do not use tap-water and do not use a naked light when examining the condition of the cells. Wipe away all dirt and moisture from the top of the battery.

Testing the condition of the batteries

At the recommended periods examine the condition of the batteries by taking hydrometer readings. There is no better way of ascertaining the state of charge of a battery. The hydrometer contains a graduated float on which is indicated the specific gravity of the acid in the cell from which the same is taken.

The specific gravity readings and their indications are as follows:

Climates normally below 27° *C.* (80° *F.*)

1·270 to 1·290	Cell fully charged.
1·190 to 1·210	Cell about half-discharged.
1·110 to 1·130	Cell completely discharged.

Climates frequently above 27° *C.* (80° *F.*)

1·210 to 1·230	Cell fully charged.
1·130 to 1·150	Cell about half-discharged.
1·050 to 1·070	Cell completely discharged.

These figures are given assuming an electrolyte temperature of 16° C. (60° F.). If the temperature of the electrolyte exceeds this ·002 must be added to hydrometer readings for each 2·7° C. rise to give the true specific gravity. Similarly, ·002 must be subtracted from hydrometer readings for every 2·7° C. below 16° C.

The readings of all the cells should be approximately the same. If one cell gives a reading very different from the rest it may be that the electrolyte has been spilled or has leaked from the cell or there may be an internal fault. In this case it is advisable to have the battery examined by a battery specialist. Should a battery be in a low state of charge, it should be recharged by taking the car for a long daytime run or by charging from an external source of D.C. supply at a current rate of 6·5 amps. until the cells are gassing freely.

After examining the battery wipe the top of the battery to remove all dirt and moisture.

Storage

If a battery is to be out of use for any length of time it should first be fully charged and then given a freshening charge about every fortnight.

A battery must never be allowed to remain in a discharged condition as this will cause the plates to become sulphated.

Initial filling and charging

The specific gravity of the electrolyte necessary to fill a new battery which has been supplied dry and the specific gravity at the end of the charge are as follows:

Climate	*S.G. of filling acid* (*corrected to* 16° *C.* [60° *F.*])	*S.G. at end of charge* (*corrected to* 16° *C.* [60° *F.*])
Normally below 27° C. (80° F.)	1·260	1·270 to 1·290
Frequently over 27° C. (80° F.)	1·210	1·210 to 1·230

The electrolyte is prepared by mixing distilled water and concentrated sulphuric acid 1·840 S.G. The mixing must be carried out in a lead-lined tank or a suitable glass or earthenware vessel. Steel or iron containers must **not** be used. The acid must be added slowly to the water while the mixture is stirred with a glass rod. **Never add the water to the acid,** as the severity of the resulting chemical reaction may give dangerous consequences.

Heat is produced by the mixture of acid and water, and the electrolyte should, therefore, be allowed to cool before it is poured into the battery, otherwise the plates, separators, and moulded container may become damaged.

The temperature of the filling-in acid, battery, and charging room should be above 0° C. (32° F.).

To produce electrolyte of the correct specific gravity:

To obtain specific gravity (corrected to 16° *C.* [60° *F.*])	*Add* 1 *part by volume of* 1·840 *S.G. acid to distilled water by volume as below*
1·260	3·2 parts
1·210	4·3 parts

Carefully break the seals in the filling holes and half-fill each cell in the battery with dilute sulphuric acid solution of the appropriate specific gravity (according to temperature) (see table above). The quantity of electrolyte required to half-fill a two-volt cell is ½ pint (·28 litre). Allow to stand for at least six hours, then complete the filling of the cells by the addition of more diluted acid of the same specific gravity as before until the level reaches the bottom of the filling holes, and allow the battery to stand for at least another two hours before commencing the first charge.

Charge at a constant current of 4·5 amps. until the voltage and temperature-corrected specific gravity readings show no increase over five successive hourly readings. This period is dependent upon the length of time the battery has been stored since manufacture, and will be from 48 to 80 hours, but usually not more than 60.

Throughout the charge the acid must be kept level with the tops of the separators in each cell by the addition of acid solution of the same specific gravity as the original filling-in acid.

Maximum permissible electrolyte temperature during charge

Climates normally below 27° C. (80° F.) .. .. 38° C. (100° F.).

Climates normally above 27° C. (80° F.) .. .. 49° C. (120° F.).

At the end of the first charge, i.e. when specific gravity and voltage measurements remain substantially constant, carefully check the specific gravity in each cell to ensure that it lies within the limits specified. If any cell requires adjustment the electrolyte above the plates must be siphoned off and replaced either with acid of the strength used for the original filling in, or distilled water, according to whether the specific gravity is too low or too high respectively. After such adjustment the gassing charge should be continued for one or two hours to ensure adequate mixing of the electrolyte. Re-check, repeating the procedure, if necessary, until the desired result is obtained.

Section L.3

TESTING THE DYNAMO

To test on vehicle when dynamo is not charging

(1) Make sure that belt slip is not the cause of the trouble. It should be possible to deflect the belt approximately ½ in. (13 mm.) at the centre of its longest run between two pulleys with moderate hand pressure. If the belt is too slack tightening is effected by slackening the two dynamo suspension bolts and then the bolt of the slotted adjustment link. A gentle pressure on the dynamo will enable the correct tension to be applied to the belt, and all three bolts should then be tightened firmly.

(2) Check that the dynamo and control box are connected correctly. The larger terminal carries the main output and the smaller terminal the field current. Check the earth connections of the control box.

(3) After switching off all lights and accessories disconnect the cables from the dynamo terminals.

(4) Connect the two terminals with a short length of wire.

(5) Start the engine and set to run at normal idling speed.

(6) Clip the negative lead of a moving-coil-type voltmeter, calibrated 0–20 volts, to one dynamo terminal and the other lead to a good earthing point on the dynamo yoke.

(7) Gradually increase the engine speed, when the voltmeter reading should rise rapidly and without fluctuation. Do not allow the voltmeter reading to reach 20 volts. Do not race the engine in an attempt to increase the voltage. It is sufficient to run the dynamo up to a speed of 1,000 r.p.m.

If there is no reading check the brush gear.

If the reading is low (approximately 1 volt) the field winding may be faulty.

If the reading is approximately 6 volts the armature winding may be faulty.

If the dynamo is in good order remove the link from the terminals and restore the original connections.

Section L.4

REMOVING AND REPLACING THE DYNAMO

Remove the air cleaner (diesel only) and disconnect the dynamo leads from the dynamo terminals.

Slacken the two bolts attaching the dynamo to the cylinder block, the screw securing the adjusting link to the dynamo, and the nut securing the adjusting link to the engine. Pivot the dynamo towards the engine and remove the fan belt from the dynamo pulley. Remove the two bolts securing the dynamo to the engine and the screw securing the adjusting link to the dynamo, then detach the dynamo. Note the distance piece between the engine mounting points and the dynamo, one at each point on the diesel engine, and one at the rear mounting point on the petrol engine.

Replacement of the dynamo is an exact reversal of this procedure.

Section L.5

DISMANTLING AND REASSEMBLING THE DYNAMO

Remove the securing nut and take off the drive pulley.

Remove the Woodruff key from the commutator shaft.

Unscrew and remove the two through-bolts and take off the commutator end bracket. The driving end bracket together with the armature and its ball bearing can now be lifted out of the yoke. Unless the ball bearing is damaged or requires attention it need not be removed from the armature. Should it be necessary to remove the bearing, the armature must be separated from the end bracket by means of a hand press.

Reassembly of the dynamo is a reversal of the dismantling procedure except that when assembling the

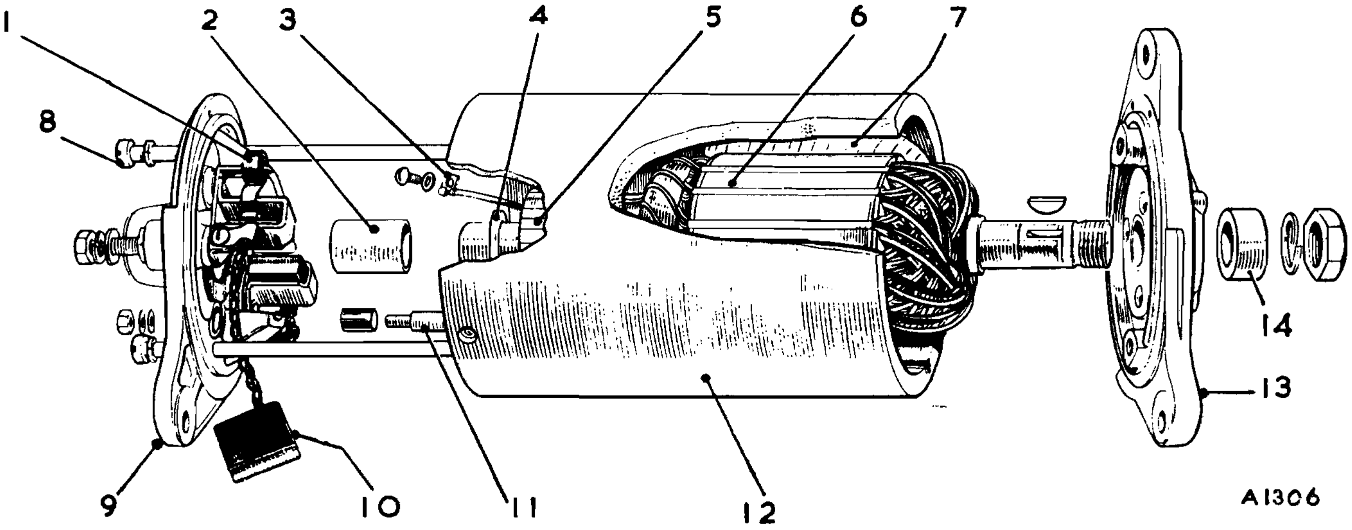


*Fig. L.*1

Dynamo components

1. Brush spring.
2. Bush.
3. Field coil terminal.
4. Thrust collar.
5. Commutator.
6. Armature.
7. Field coil.
8. Through-bolt.
9. Commutator end bracket.
10. Brush set.
11. Field terminal post.
12. Yoke.
13. Driving end bracket.
14. Distance collar.

commutator end bracket the brushes must first be held clear of the commutator by partially withdrawing them from their boxes until each brush is trapped in position by the side pressure of its spring. The brushes can be released onto the commutator by a small screwdriver or similar tool when the end bracket is assembled to within about ½ in. (13 mm.) of the yoke. Before closing the gap between the end bracket and the yoke see that the springs are in correct contact with the brushes.

If the end bracket has been removed from the armature in dismantling, press the bearing end bracket onto the armature shaft, taking care to avoid damaging the end plate and armature winding.

Add a few drops of oil through the hole in the armature end cover.

Section L.6

SERVICING THE DYNAMO

Brushes

Test if the brushes are sticking. Clean them with petrol and, if necessary, ease the sides by lightly polishing with a smooth file. Replace the brushes in their original positions.

Test the brush spring tension with a spring scale if available. The correct tension is 25 to 33 oz. (709 to 936 gm.). Fit a new spring if the tension is low.

If the brushes are worn so that the flexible lead is exposed on the running face new brushes **must** be fitted. Brushes are preformed, so that bedding to the commutator is unnecessary.

Commutator

A commutator in good condition will be smooth and free from pits or burned spots. Clean the commutator with a petrol-moistened cloth. If this is ineffective carefully polish with a strip of fine glass-paper while rotating the armature. To remedy a badly worn commutator mount the armature (with or without the drive end bracket) in a lathe, rotate at high speed, and take a light cut with a very sharp tool. Do not remove more metal than is necessary. Polish the commutator with very fine glass-paper. Undercut the insulation between the segments to a depth of $\frac{1}{32}$ in. (·8 mm.) with a hacksaw blade ground down to the thickness of the insulation.

Field coils

Test the field coils, without removing them from the dynamo yoke, by means of an ohmmeter. The reading on the ohmmeter should be approximately 6·0 ohms. If this is not available connect a 12-volt D.C. supply with an ammeter in series between the field terminal and the dynamo yoke. The ammeter reading should be approximately 2 amps. If no reading is indicated the field coils are open-circuited and must be renewed.

When fitting field coils carry out the procedure outlined below, using an expander and wheel-operated screwdriver:

(1) Drill out the rivet securing the field coil terminal block assembly to the yoke, and remove the field coil connections.

(2) Remove the insulation piece which is provided to

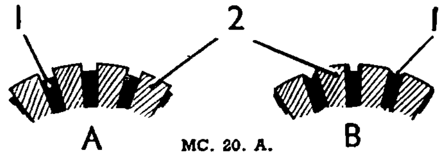


*Fig. L.*2

Undercutting the commutator. (A) *is correct and* (B) *is incorrect*

1. Insulation. 2 Segments.

prevent the junction of the field coils from contacting the yoke.

(3) Mark the yoke and pole-shoes in order that they can be refitted in their original positions.

(4) Unscrew the two pole-shoe retaining screws by means of the wheel-operated screwdriver.

(5) Draw the pole-shoes and coils out of the dynamo yoke and lift off the coils.

(6) Fit the new field coils over the pole-shoes and place them in position inside the yoke. Take care to ensure that the taping of the field coils is not trapped between the pole-shoes and the yoke.

(7) Locate the pole-shoes and field coils by lightly tightening the fixing screws.

(8) Insert the pole-shoe expander, open it to the fullest extent, and tighten the screws.

(9) Finally, tighten the screws by means of the wheel-operated screwdriver and lock them by caulking.

(10) Replace the insulation piece between the field coil connection and the yoke.

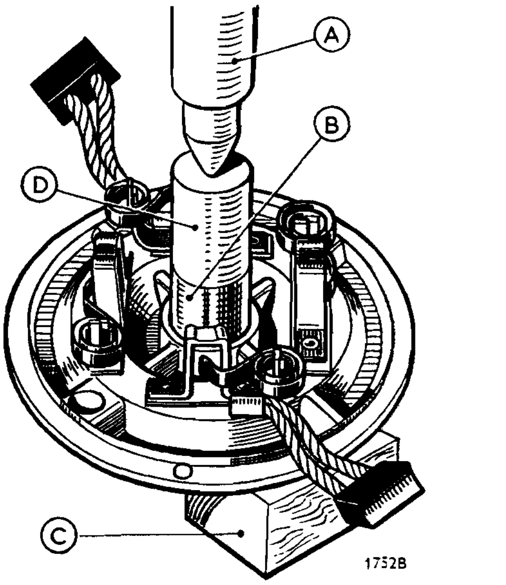


Fig. L.3

Fitting a new bush to the commutator end bracket

A. Hand press. C. Supporting block.
B. Bearing bush. D. Shouldered mandrel

(11) Refit the field coil connections to the field coil terminal tags and re-rivet the block assembly to the yoke.

Armature

The testing of the armature winding requires the use of a voltage drop-test and growler. If these are not available the armature should be checked by substitution. No attempt should be made to machine the armature core or to true a distorted armature shaft.

Bearings

Bearings which are worn to such an extent that they will allow side-movement of the armature shaft must be replaced by new ones.

To fit a new bearing at the commutator end of the dynamo proceed as follows:

(1) Remove the old bearing bush by screwing an $\frac{11}{16}$ in. (17·5 mm.) tap into the bush for a few turns and pull out the bush with the tap. Screw the tap squarely into the bush to avoid damage to the bracket.

(2) Insert the felt ring and aluminium disc into the bearing housing, then press the new bearing bush into the end bracket, using a shouldered mandrel of the same diameter as the shaft which is to fit in the bearing.

Before fitting the new bearing bush allow it to stand completely immersed in thin engine oil for 24 hours to fill the pores of the bush with lubricant.

The ball bearing at the driving end is renewed as follows:

(1) Drill out the rivets which secure the bearing retaining plate to the end bracket and remove the plate.

(2) Press the bearing out of the end bracket and remove the corrugated washer, felt washer, and oil-retaining washer.

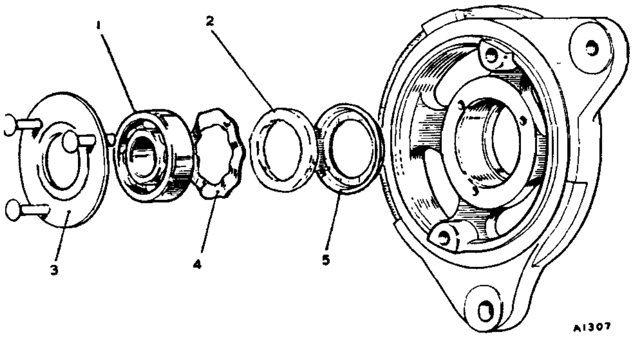


Fig. L.4

Dynamo driving end bracket components

1. Ball bearing.
2. Felt washer.
3. Retaining plate.
4. Corrugated washer.
5. Oil-retaining washer.

(3) Before fitting the replacement bearing see that it is clean and pack it with a high-melting-point grease.

(4) Place the oil-retaining washer, felt washer, and corrugated washer in the bearing housing in the end bracket.

(5) Locate the bearing in the housing and press it home by means of a hand press.

(6) Fit the bearing retaining plate. Insert the new rivets from the inside of the end bracket and open the rivets by means of a punch to secure the plate rigidly in position.

Section L.7

TESTING THE STARTER

To test on vehicle

Switch on the lamps and operate the starter control. If the lights go dim, but the starter is not heard to operate, an indication is given that current is flowing through the starter windings but that the starter pinion is meshed permanently with the geared ring on the converter. This was probably caused by the starter being operated while the engine was still running. In this case the starter must be removed from the engine for examination.

Should the lamps retain their full brilliance when the starter switch is operated, check that the switch is functioning. If the switch is in order examine the connections at the batteries, starter switch, and starter, and also check the wiring between these units. Continued failure of the starter to operate indicates an internal fault, and the starter must be removed from the engine for examination.

Sluggish or slow action of the starter is usually caused by a poor connection in the wiring which produces a high resistance in the starter circuit. Check as described above.

Damage to the starter drive is indicated if the starter is heard to operate but does not crank the engine.

Section L.8

REMOVING AND REPLACING THE STARTER

Disconnect the earth cable from the battery to prevent possible short-circuiting and detach the heavy and light cables from the terminals on the base of the starter solenoid.

Unscrew the three nuts securing the motor and withdraw the motor forward and away from the engine.

Replacement is a reversal of the foregoing procedure. If, however, a replacement motor is to be fitted or in the event of the driving end bracket being renewed during overhaul the pinion out-of-mesh clearance must be checked when assembling the starter to the engine. The clearance should be ·032 to ·219 in. (·8 to 5·6 mm.) between the leading edge of the starter pinion and the engine starter ring gear.

Section L.9

DISMANTLING AND REASSEMBLING THE STARTER

Disconnect the copper link from the lower terminal on the solenoid and the yoke of the starter motor. Unscrew the two bolts with the spring washers securing the solenoid to the starter driving end bracket and withdraw the solenoid, carefully disengaging the solenoid plunger from the starter drive engagement lever.

Remove the cover band, hold back the brush springs, and withdraw the brushes from their holders.

Unscrew the two through-bolts and withdraw the commutator end bracket and the yoke. Extract the rubber seal from the drive end bracket; slacken the engagement lever pivot pin locknut and unscrew the pin. The drive end bracket can now be withdrawn.

Remove the washer from the end of the armature shaft extension and slide off the drive assembly complete with engagement lever.

If necessary, dismantle the drive assembly as described in Section L.11.

The intermediate bracket and brake assembly can be withdrawn from the armature shaft extension after its retaining ring has been removed.

Reassembly is a reversal of the dismantling procedure but the following points must be noted.

(1) Lubricate the intermediate bracket bearing with Ragosine Molypad molybdenized non-creep oil.

(2) Before fitting the drive assembly lightly smear the armature shaft and pack the space between the bearings inside the helical splined sleeve with a bentonite-based grease such as Ragosine Bentone. If at any time the operation of the drive assembly becomes sluggish it should be removed and the bearings cleaned and lubricated as above.

(3) The fitting of the solenoid unit to the drive end bracket can be facilitated by easing the drive assembly forward along the armature shaft. It must be fitted so that the copper link between the solenoid and the starter is connected to the solenoid terminal marked 'STA'.

(4) With the starter motor completely assembled, but before tightening the engagement lever pivot pin locknut, set the pinion movement as follows.

Connect the small centre terminal on the solenoid unit by way of a switch to a 6-volt supply and connect the other side of the supply to one of the solenoid fixing bolts (see Fig. L.6).

Close the switch (this throws the drive assembly forward into the engaged position) and measure the distance between the pinion sleeve and the washer on the armature shaft extension, which should be ·020 to ·030 in. (·50 to ·76 mm.).

This measurement must be made with the pinion pressed lightly towards the armature to take up any play in the engagement linkage.

To adjust, slacken the eccentric pivot pin locknut, rotate the pivot pin clockwise or anti-clockwise until the correct setting is obtained, and then tighten the locknut.

It should be noted that the arc of the pivot pin adjustment is 180°, and the head of the arrow marked on the pivot pin must be set only between the heads of the arrow on the drive end bracket casting (see Fig. L.6).

Section L.10

SERVICING THE STARTER

Brush gear

(1) Temporarily assemble the commutator end bracket to the armature, and with the brushes held in position on the commutator by the brush springs check the tension of the brush springs, using a spring balance. The correct tension is 30 to 40 oz. (850 to 1134 gm.). The springs must be renewed if

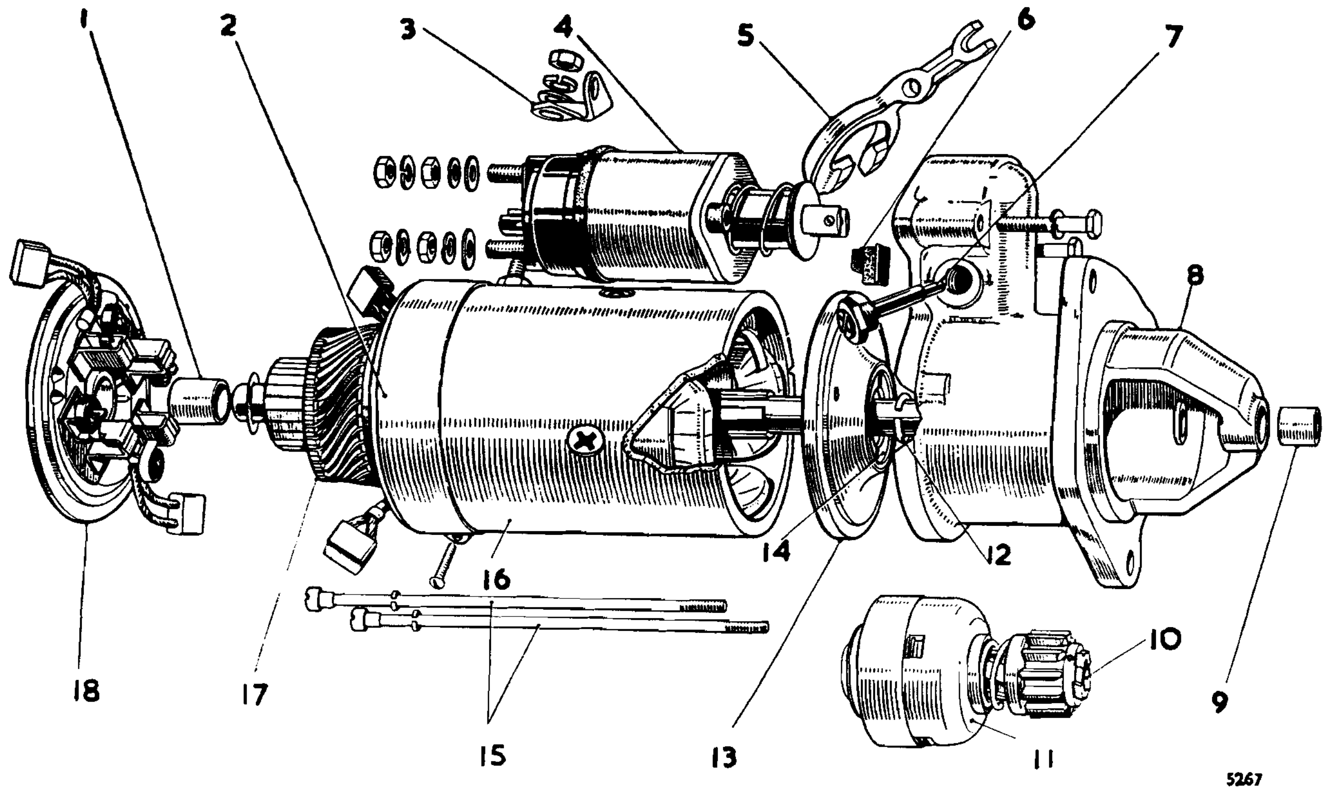


Fig. L.5

Starter motor components

1. Bearing bush.
2. Cover band.
3. Copper link.
4. Solenoid.
5. Engagement lever.
6. Rubber seal.
7. Eccentric pivot pin.
8. Drive end bracket.
9. Bearing bush.
10. Pinion sleeve bearing.
11. Drive assembly.
12. Retaining ring.
13. Intermediate bracket.
14. Centrifugal brake-shoes.
15. Through-bolts.
16. Yoke.
17. Armature.
18. Commutator end bracket.

their tension has dropped below 25 oz. (708 gm.).

(2) If the brushes are worn to, or approaching, $\frac{5}{16}$ in. (8 mm.) in length or if the flexible connector is exposed on the running face they must be renewed. Two of the brushes are connected to the brush holders on the commutator end bracket and two are connected to tappings on the field coils.

To renew the brushes release the flexible connectors from the brush holders on field coil tappings, using a hot soldering-iron, and secure the flexible connections of the new brushes in position by soldering. New brushes are preformed so that bedding to the commutator is unnecessary.

(3) Check the brush holders for security on the commutator end bracket and, using a mains supply of 110 volts and a test lamp, test the insulation of the two brush holders that are insulated from the commutator end bracket. Connect the test lamp between the end bracket and each brush holder in turn. If the lamp lights the insulation is faulty and the end bracket must be renewed.

Commutator

A commutator in good condition will be burnished and free from pits or burned spots. Clean the commutator with a petrol-moistened cloth. Should this be ineffective,

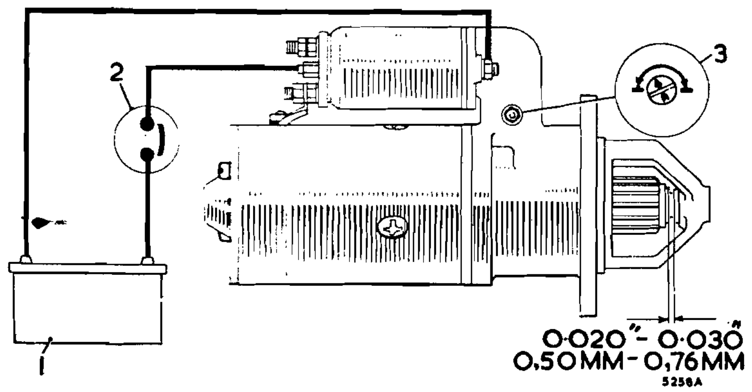


Fig. L.6

Setting the pinion movement limit

1. 6-volt battery.
2. Switch.
3. Eccentric pivot pin.

spin the armature and polish the commutator with fine glass-paper; remove all abrasive dust with a dry air blast. If the commutator is badly worn mount the armature between centres in a lathe, rotate at high speed, and make a light cut with a very sharp tool. Do not remove more metal than is necessary. Finally, polish with very fine glass-paper. The **insulators** between the commutator segments **must not be undercut.**

Field coils—testing and renewing

(1) Test the field coils for continuity, using a 12-volt test lamp and battery connected between the insulated terminal on the yoke and each of the brushes connected to the field coils in turn. If the test lamp does not light an open circuit in the field coils is indicated and the field coils must be renewed. When carrying out this test ensure that both brushes and their flexible connectors do not make contact with the yoke.

(2) Test the field coils for insulation from the starter yoke. Ensure that the brushes and their flexible connectors are clear of the yoke and connect a 110-volt A.C. test lamp between the terminal post and a clean part of the yoke. Lighting of the test lamp indicates that the field coils are earthed to the yoke and must be renewed.

(3) To renew the field coils unscrew the four pole-shoe retaining screws, using a wheel-operated screwdriver, and withdraw the inter-coil connector to yoke insulation piece. Withdraw the field coils and pole-shoes from the yoke and separate the shoes from the coils.

Assemble the new field coils to the pole-shoes and position them inside the yoke. Insert the pole-shoe retaining screws and partially tighten them, at the same time ensuring that the field coil taping is not trapped between the pole-shoes and the yoke. Replace the insulation piece and, with the pole-shoe held in position with a pole-shoe expander, fully tighten the pole-shoe retaining screws, using a wheel-operated screwdriver.

Armature

A visual examination should be made for conductors which have lifted from the commutator risers, indicating overspeeding. In this event the drive clutch should be checked to ensure that it is disengaging correctly when the engine fires.

If signs of fouling between the armature core and the pole-shoe faces are apparent the armature shaft should be checked for distortion and the bearings in the end brackets checked for wear.

A damaged armature must in all cases be renewed, and no attempt should be made to machine the armature core or to true a distorted armature shaft.

To make a thorough check on the condition of the armature the use of a volt-drop test or a 'growler' is essential. However, the armature insulation can be checked by connecting a 110-volt A.C. test lamp between the armature shaft and each commutator segment in turn. If the test lamp lights when contact is made with the commutator segment the armature insulation is faulty and the armature must be renewed.

In the absence of the above equipment a suspect armature should be checked by substitution after ensuring that the fault is not caused by solder which has run due to overheating, short-circuiting the commutator segments.

Bearings

The armature shaft is supported by three bearings. The commutator and driving end brackets each carry porous bronze bushes, whilst the intermediate bracket carries an indented bronze bearing.

Bearings which are worn to such an extent that they will allow excessive side-play of the armature shaft must be renewed as follows.

In the case of the commutator end bracket, this is best removed by screwing an $\frac{11}{16}$ in. (17·5 mm.) tap squarely into the bush and then withdrawing the tap complete with bush. The driving end and intermediate bracket bushes may be pressed out.

Before installing, new porous bronze bushes must be immersed in clean engine oil (S.A.E. 30/40) for a period of 24 hours. In an emergency this period may be shortened by heating and maintaining the oil at a temperature of 212° F. (100° C.) for two hours and then allowing

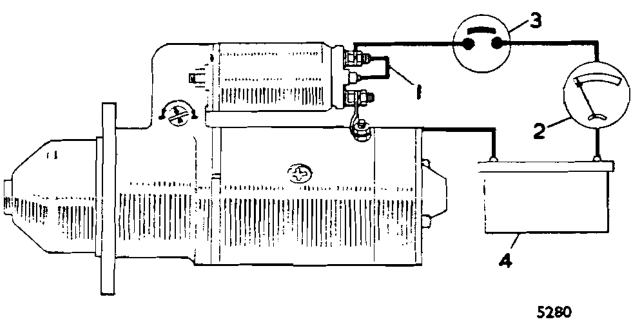


Fig. L.7

Measuring the light running current

1. Connecting link.
2. Ammeter.
3. Switch.
4. 12-volt battery.

the oil to cool before removing the bush. New bushes should be pressed into position, using a shouldered, highly polished mandrel ·0005 in. (·013 mm.) greater in diameter than the shaft which is to run in the bush. Porous bronze bushes must not be reamed after installation as the porosity of the bush will be impaired.

The intermediate bracket indented bronze bearing should be lubricated with Ragosine Molypad molybdenized non-creep oil after installation.

Bench testing

The following tests on the reassembled starter motor should be carried out, using a fully charged 12-volt battery of a capacity of 138 amp.-hr. at the 20-hr. rate.

(1) With the starter motor securely clamped in a vice and connected to a 12-volt battery check the light

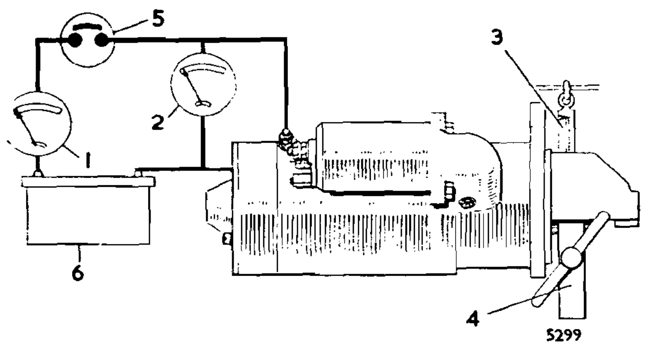


Fig. L.8

Measuring lock torque and lock current

1. Ammeter.
2. Voltmeter.
3. Spring balance.
4. Torque arm pinion clamp.
5. Switch.
6. 12-volt battery.

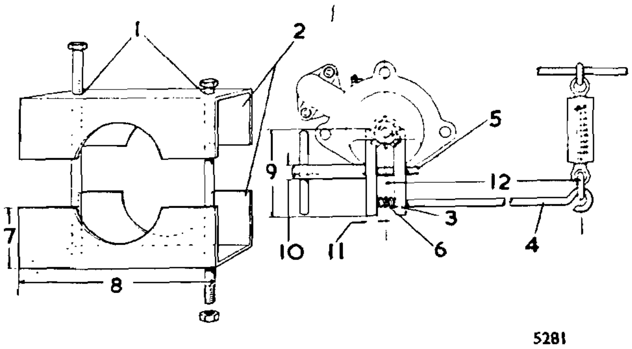


Fig. L.9

Apparatus for measuring lock torque

1. ½ in. (12·7 mm.) diameter holes.
2. 3 in. (76 mm.) channel iron machined to suit yoke.
3. ⅜ in. (9·5 mm.) clearance.
4. ⅜ in. (9·5 mm.) mild-steel rod.
5. ⅜ in. B.S.F. thread.
6. Spring.
7. 3 in. (76 mm.).
8. 10 in. (25 cm.).
9. 3 in. (76 mm.).
10. ⅝ in. (16 mm.).
11. ⅜ in. (9·5 mm.).
12. 12 in. (30·5 cm.).

running current, which should read 90 amps. at 8,000 to 9,000 r.p.m. (see Fig. L.7).

(2) Carry out a lock torque test (see Fig. L.8). (If a constant voltage supply is used it is important to regulate the voltage at the starter terminal to 6·4 volts when testing.) The lock torque should be 32·5 lb. ft. (4·49 kg. m.) with 900 amps. at 6·4 terminal volts.

(3) Torque at 1,000 r.p.m. should be 15·5 lb. ft. (2·14 kg. m.) with 570 amps. at 8·8 terminal volts.

Section L.11

DISMANTLING AND REASSEMBLING THE STARTER DRIVE

The drive assembly is mounted on the armature shaft extension with the clutch driving sleeve splined to the shaft. When the starter switch is operated the engagement lever pushes the drive assembly along the shaft to engage the pinion with the converter ring gear.

The pinion is carried on a helically splined sleeve which is cleated to the barrel unit containing the plate clutch assembly. In the event of tooth-to-tooth engagement the forward movement of the pinion ceases while the helical-splined sleeve continues to be pushed forward.

This causes the pinion to rotate relative to the ring gear, and as soon as the pinion teeth become aligned for meshing the compressed cushion spring slides the pinion into mesh with the starter ring gear.

Torque from the armature shaft is transmitted to the driving pinion through the plate clutch assembly. The clutch is engaged by pressure from the moving member, which rides up the helical splines on the driving sleeve to clamp the clutch plates together. Immediately the engine fires the torque direction is reversed and the moving member releases its pressure on the clutch plates to disengage the drive assembly from the armature shaft.

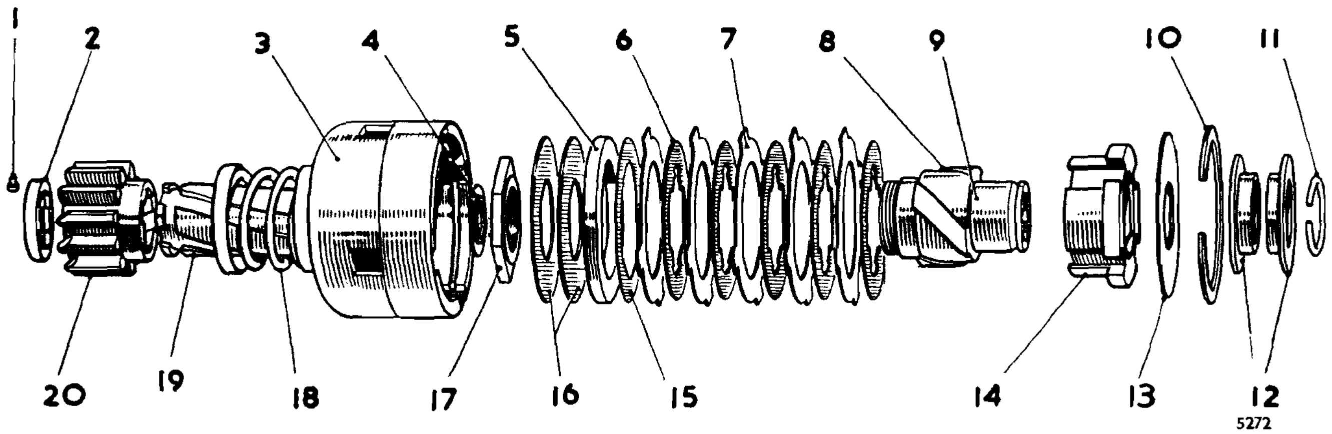


Fig. L.10

Starter drive

1. Rivet.
2. Pinion retaining ring.
3. Barrel unit.
4. Thrust washer.
5. Backing ring.
6. Clutch plates—inner.
7. Clutch plates—outer.
8. Helical splines.
9. Driving sleeve.
10. Circlip.
11. Lock ring.
12. Engagement bush.
13. Retaining washer.
14. Moving member.
15. Shim.
16. Pressure plates.
17. Ring nut.
18. Cushion spring.
19. Helical splined sleeve.
20. Pinion.

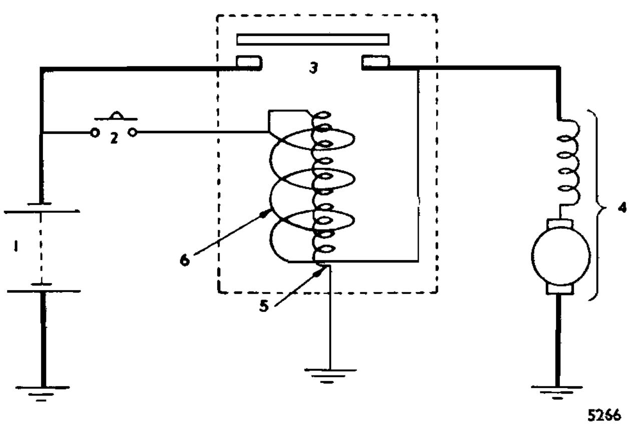


Fig. L.11

Solenoid circuit

1. Battery.
2. Starter push.
3. Contacts.
4. Starter motor.
5. Hold-on coil.
6. Closing coil.

The clutch is shim-set to slip at between two and three times normal starting torque, thus providing overload protection for the starter motor in the event of the engine backfiring.

Remove the lock ring from the driving sleeve and withdraw the two halves of the engagement bush. Extract the clutch retaining circlip from the barrel unit and withdraw the driving sleeve with clutch unit. The clutch assembly can now be dismantled by removing all the remaining parts, with the exception of the two pressure plates, from the driving sleeve.

To remove the two pressure plates, which are secured to the driving sleeve by a ring nut, slide the driving sleeve onto the splined armature shaft and clamp the armature in a vice fitted with soft-metal jaw plates. File away the peened rim of the ring nut; unscrew the ring nut and remove the pressure plates.

Finally, punch out the rivet which secures the pinion retaining ring to the helically splined sleeve and withdraw the retaining ring, pinion, and cushion spring and cup washers.

Before reassembling check the tension of the pinion cushion spring. A load of 11 lb. (5 kg.) is required to compress a spring in good condition to $\frac{7}{8}$ in. (22·2 mm.) and 16 lb. (7·3 kg.) to compress it to $\frac{1}{2}$ in. (12·7 mm.).

When reassembling secure the pressure plates to the driving sleeve, using a new ring nut, and peen the rim over the notch in the driving sleeve to lock the nut in position.

After reassembly check and adjust the clutch slipping torque to 1,200 to 1,500 lb. in. (13·8 to 17·3 kg. m.) as follows.

Assemble the drive assembly to the splined armature shaft and clamp the armature in a vice fitted with soft-metal jaw plates. Apply an anti-clockwise torque to the pinion, using a suitable torque wrench fastened to the pinion teeth. If the clutch slips when the torque applied is below the above limits it must be dismantled and shims added until an acceptable figure is obtained. Conversely, shims must be removed if the clutch does not slip when the torque applied exceeds the above limits.

Section L.12

STARTER SOLENOID

Dismantling and reassembling

Unscrew the two smaller nuts on the moulded cover; unsolder the wires attached to the terminal strips and

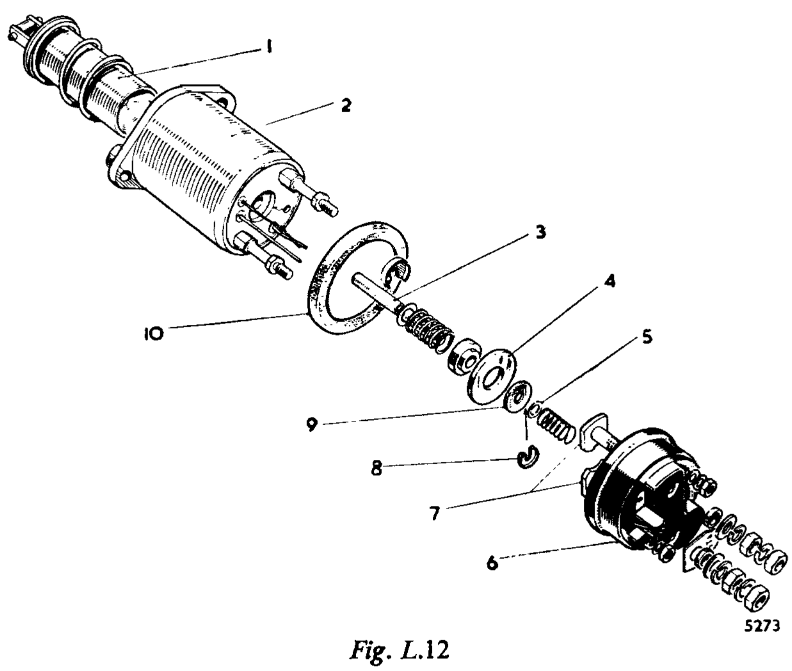


Fig. L.12

Solenoid components

1. Plunger.
2. Solenoid unit.
3. Push-rod.
4. Moving contact disc.
5. Plain washer.
6. Moulded cover.
7. Terminal studs.
8. Cup washer.
9. Fibre washer.
10. Rubber sealing washer.

lift off the moulded cover. Remove the nuts from the two large terminal studs and withdraw the studs from the moulded cover.

Remove the push-rod assembly from the solenoid body; take off the plain washer, slotted cup washer, and fibre washer and remove the moving contact disc from the push-rod. Reassembling is a reversal of the dismantling procedure.

Electrical testing

Carry out the following tests with the solenoid cold and with the plunger return spring removed. Use two lengths of 44/·012 cable connected to a 4-volt D.C. supply.

(1) Closing coil. Connect the supply between the solenoid terminal marked 'STA' and the small terminal on the moulded cover. A current of 24 to 28 amps. should pass.

(2) Hold-on coil. Connect the supply between the solenoid body and the small terminal on the moulded cover. A current of 5·1 to 5·8 amps. should pass.

If a constant voltage supply is not available check the coil resistances, using an accurate method of low-resistance measurement such as the Wheatstone bridge.

(1) Connect the measuring instrument as in para. (1) above. The closing coil resistance should be between ·144 and ·166 ohm.

(2) Connect the measuring instrument as in para. (2) above. The hold-on coil resistance should be between ·688 and ·792 ohm.

Mechanical testing

(1) Check the spring pressure to close the solenoid contacts. This should be 3 to 5 lb. (1·36 to 2·27 kg.).

(2) Test the spring pressure required to push the plunger home. This should be 9·5 to 14·5 lb. (4·30 to 6·58 kg.).

(3) The movement of the plunger to close the contacts must be between ·116 and ·189 in. (2·95 and 4·80 mm.).

(4) The total plunger movement must be between ·263 and ·273 in. (6·68 and 6·93 mm.).

If the solenoid is proved to be faulty by the above tests it should be renewed. The only permissible repair that may be carried out is the replacement as a set of the fixed contact studs and moving contact disc.

Section L.13

CONTROL BOX

The control box houses the dynamo voltage regulator unit and the cut-out. Although combined structurally, the regulator and the cut-out are electrically separate. Both are accurately adjusted during assembly, after which the cover should not be removed unnecessarily.

Section L.14

HEATER PLUGS

To assist starting under cold conditions a heater plug is installed in each combustion chamber in the cylinder head.

When starting the engine under cold conditions operate the heater plug switch for approximately 15 seconds before operating the starter switch. Immediately the engine fires release the starter switch.

WARNING.—Operation of the heater plugs while the engine is running will result in their rapid destruction, due to the elements overheating. This is caused by the 'blow-lamp' effect on the elements during the engine compression strokes.

Apart from ensuring that the exterior of the heater plugs are kept clean and the electrical connections are tight, the plugs require no attention during service. Cleaning of the plug element is unnecessary as the heat generated during combustion is sufficient to keep it free from deposits.

In the event of failure a faulty plug must be renewed. Disconnect the cables from the plug and, using a suitable spanner, slacken the plug two or three turns. Using a compressed-air line, blow the area surrounding the plug clear of dirt and then remove the plug and its sealing washer. The aperture in the cylinder head should be plugged immediately with clean rag to prevent the ingress of foreign matter into the combustion chamber and cylinder.

When refitting ensure that the sealing washer is in good condition and will make a gastight joint.

Section L.15

WINDSCREEN WIPER

Normally the windscreen wiper will not require any servicing apart from the occasional renewal of the rubber blades.

Should any trouble be experienced, first check for loose connections, worn insulations, etc., before dismantling the motor.

Commutator dirty

Remove the connecting leads to the terminals and withdraw the three screws securing the cover at the commutator end. Lift off the cover. Clean the commutator with a cloth moistened with petrol and carefully remove any carbon dust from between the commutator segments.

Brush lever stiff or brushes not bearing on commutator

Check that the brushes bear freely on the commutator. If they are loose and do not make contact a replacement tension spring is necessary. The brush levers must be free on their pivots. If they are stiff they should be freed by working them backwards and forwards by hand and by applying a trace of thin machine oil. Packing shims are fitted beneath the legs of the brush to ensure that the brushes are central and that there is no possibility of the brush boxes fouling the commutator. If the brushes are considerably worn they must be replaced by new ones.

Motor operates but does not transmit motion to spindles

Remove the cover of the gearbox. A push-pull motion should be transmitted to the inner cable of the flexible rack. If the cross-head moves sluggishly between the guides lightly smear a small amount of medium-grade engine oil in the groove formed in the die-cast housing. When overhauling, the gear must be lubricated by lightly packing the gearbox with grease.

Thrust screw adjustments

The thrust screw is located on the top of the cross-head housing. To adjust, slacken the locknut, screw down the thrust screw until it contacts the armature, and then turn back a fraction of a turn. Hold the thrust screw with a screwdriver and tighten the locknut.

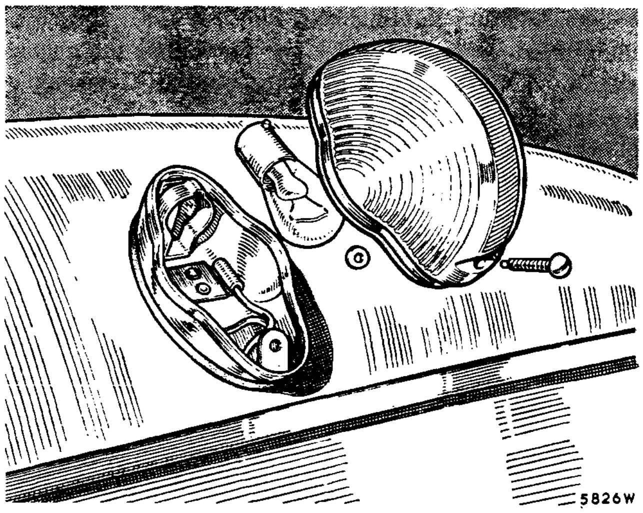


Fig. L.13
A flashing indicator

Section L.16

HORN(S)

If a horn becomes uncertain in its action, first ascertain that the trouble is not due to a faulty connection or blown fuse. The circuit is fed from the fuse box to one horn terminal, and then from the other horn terminal to the horn-push switch to earth when the push is depressed. A faulty horn should be renewed as it is not a practical proposition to overhaul this type of instrument.

Section L.17

FLASHING DIRECTION INDICATORS

The flashing direction indicators are operated by a hand-actuated time switch on the fascia panel through a flasher unit to the bulbs in the roof lamps In the event of failure carry out the following procedure:

(1) Check bulbs for broken filaments.
(2) Refer to the wiring diagram and check over flasher circuit connections.
(3) Check that terminal 'B' on the flasher is at 12 volts with respect to earth.
(4) Connect together terminals 'B' and 'L' at the flasher unit and operate the direction indicator switch.

If the flasher bulbs light, the flasher unit is defective and must be renewed.

If the bulbs do not work, the switch or circuit is defective and a further check must be made.

A single bayonet-fixing bulb is fitted and the cover may be removed after unscrewing the small retaining screw.

Section L.18

HEADLAMPS

The headlamps are built into the wings and are fitted with double-filament bulbs. The design is such that the bulb is correctly positioned in relation to the reflector, and no focusing is required when a replacement bulb is fitted.

The double-filament bulbs are controlled by a foot-operated dipping switch deflecting both headlamp beams downwards to avoid dazzle.

The light units consist of a lamp glass, reflector, and a back-shell. The light unit is located to the front wing by three spring-loaded attachment screws in a domed shield attached to the wing. The back of the lamp is therefore sealed to give complete protection.

A dust- and weather-excluding rubber is fitted in the recess of the rim of the light unit and a plated rim is fitted over this to complete the weather-sealing.

To remove the light unit for bulb replacement unscrew

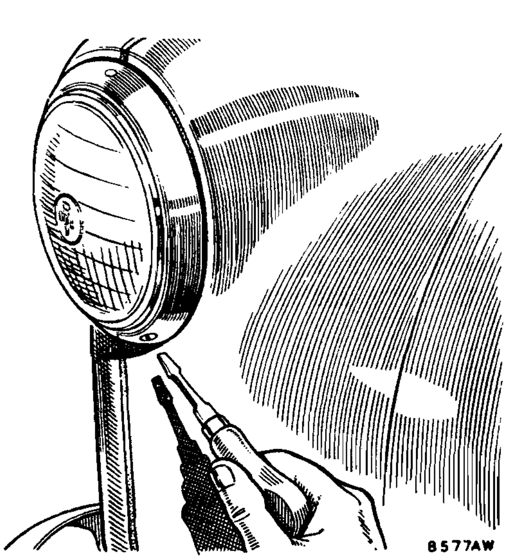


Fig. L.14
Removing the headlamp rim

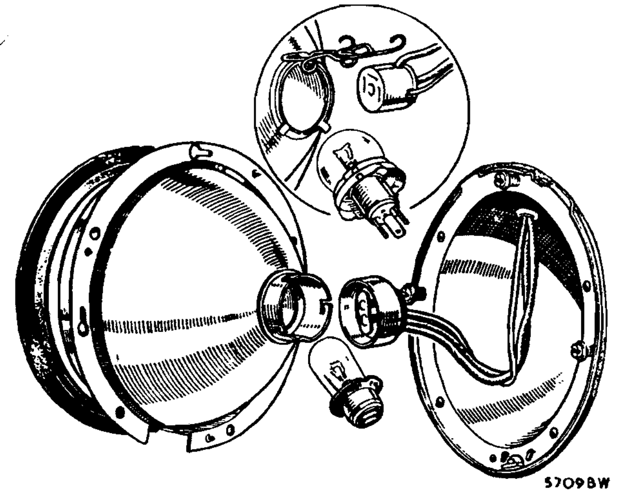


Fig. L.15

Headlamp dismantled, showing alternative fittings

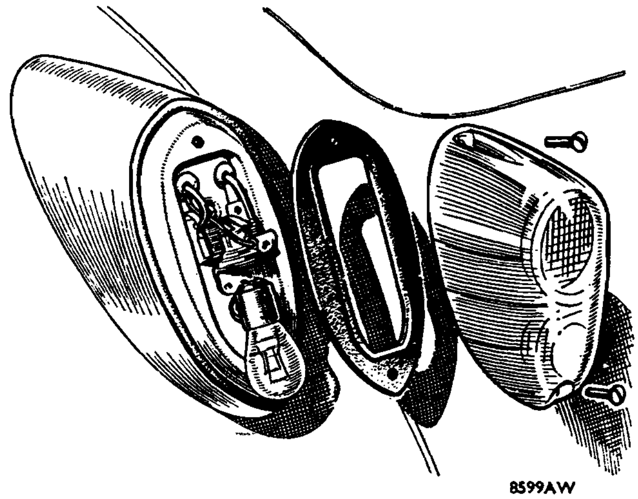


Fig. L.17

A stop and tail lamp

the retaining screw at the bottom of the plated lamp rim and lift the rim away from the dust-excluding rubber.

Remove the dust-excluding rubber, which will reveal the three spring-loaded screws. Press the light unit inwards against the tension of the springs and turn it in an anti-clockwise direction until the heads of the screws can pass through the enlarged ends of the keyhole slots in the lamp rim.

This will enable the light unit to be withdrawn sufficiently to give attention to the wiring and bulbs.

Twist the back-shell anti-clockwise and pull it off. Withdraw the bulb from the holder

Insert the replacement bulb in the holder, making sure that the slot in the periphery of the bulb flange engages the projection in the holder.

Engage the projections on the back-shell with the slots of the holder, press it on, and twist it clockwise until it engages with its catch.

Position the light unit so that the heads of the adjusting screws coincide with the enlarged ends of the attachment slots. Push the light unit towards the wing to compress the springs and turn the unit to the right as far as it will go—that is, approximately ½ in. (13 mm.).

The lamps should be set so that the main driving beams are parallel with the road surface or in accordance with local regulations.

If vertical adjustment is required this is achieved by turning the screw at the top of the lamp in the necessary direction.

Horizontal adjustment can be effected by using the adjustment screws on each side of the light unit (see Fig. L.16).

Replace the dust-excluding rubber on the light unit rim with its flanged face forward and refit the plated rim.

Section L.19

TAIL AND STOP LAMPS

The tail lamps are of the double-filament type, the second filament giving a marked increase in brilliance when the brakes are applied.

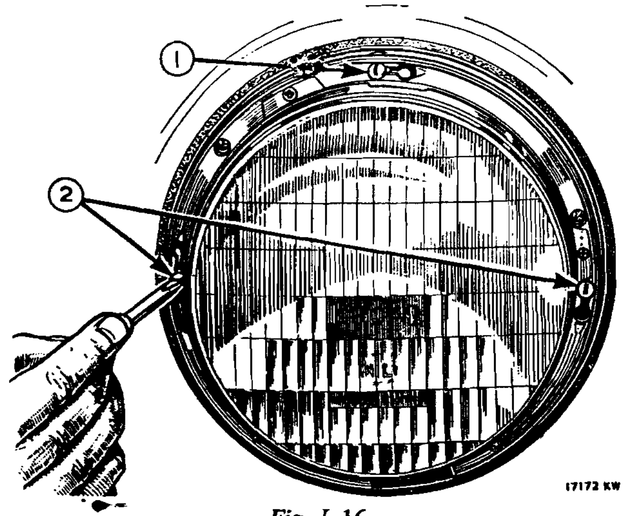


Fig. L.16

The headlamp setting screws

1. Vertical setting adjusting screw.
2. Horizontal setting adjusting screws.

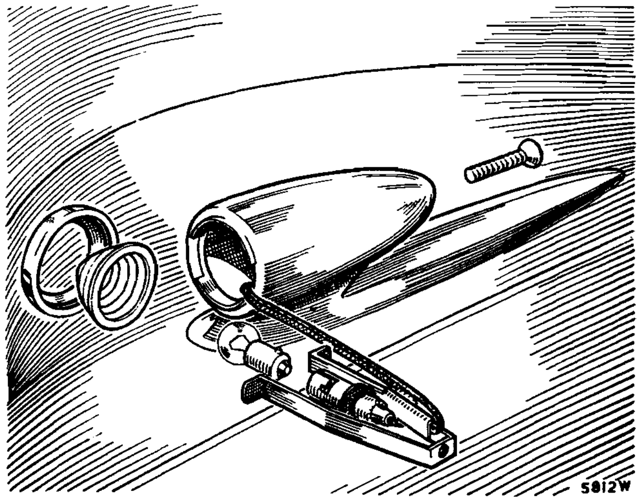


Fig. L.18

A sidelamp

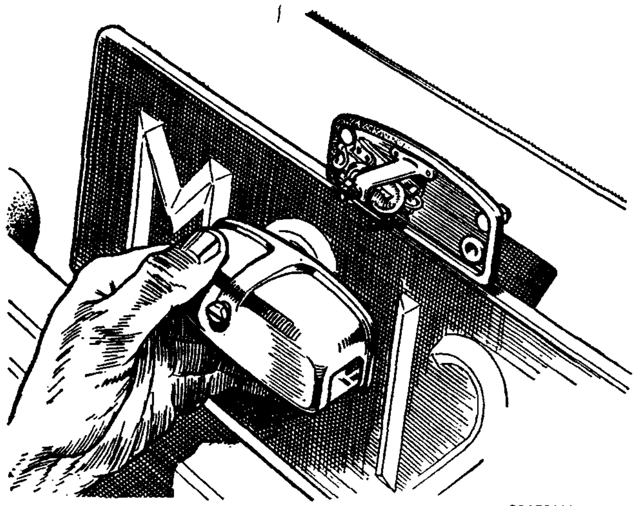


Fig. L.19
Number-plate lamp

Each lamp cover is secured by two screws and the bulb is accessible after the cover and rubber seal are removed.

The bulb must be fitted one way only and has offset bayonet pegs to ensure this.

Section L.20

SIDELAMPS

To reach the bulb remove the screw from the rear of the lamp body and pull forward the glass and rim. Remove the glass and rim by squeezing the two metal strips of the body together; the bulb will then be readily accessible.

Section L.21

NUMBER-PLATE LAMP

The number-plate is illuminated by a separate lamp and the domed cover is removed for bulb replacement by slackening the screw and withdrawing the cover.

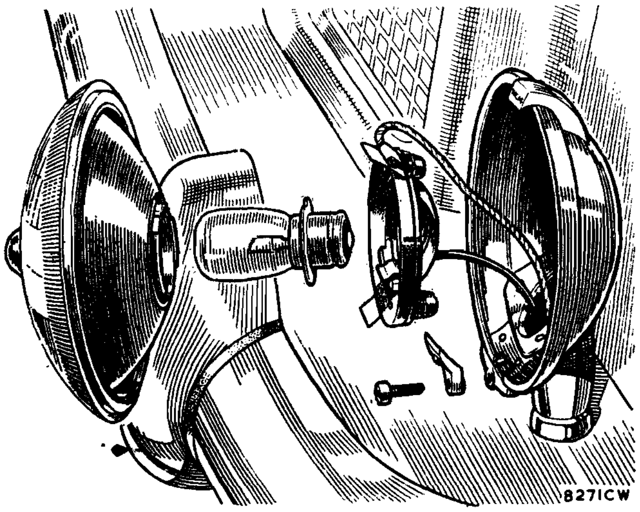


Fig. L.20
Fog lamp

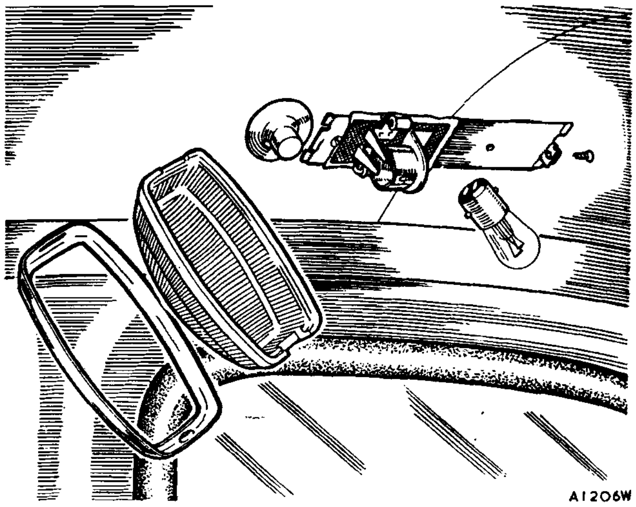


Fig. L.21
An interior lamp

Section L.22

FOG LAMP

Remove the screw from the bottom of the lamp rim and lift off the light unit. Unscrew the contact unit from the rear of the light unit and lift out the bulb for renewal.

Section L.23

INTERIOR LAMPS

A single bayonet-fixing bulb is fitted and the glass and bezel may be removed after screwing the small retaining screw out of the bezel.

An automatic switch is fitted to each door pillar.

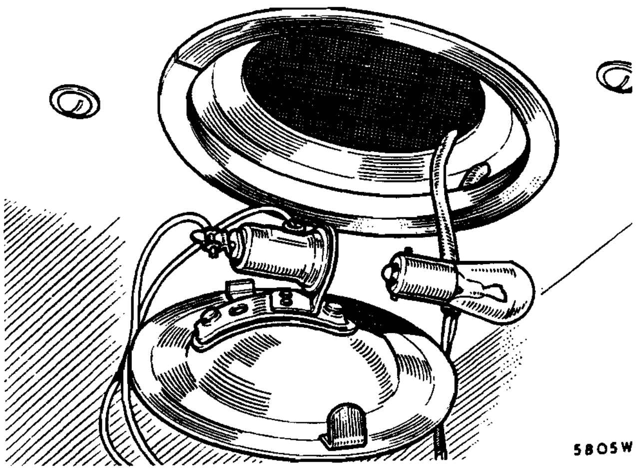


Fig. L.22
Taxi 'Hire' lamp

Section L.24

FUSES

There are two fuseboxes located under the bonnet, the front one protecting the side, tail, head, and fog lamps, and the rear one protecting the horn, regulator, and the auxiliaries which are connected through the master switch (stop lamps, heaters, etc.). The units which are protected by each fuse can readily be identified by referring to the wiring diagram.

A blown fuse is indicated by the failure of all the units protected by it, and is confirmed by examination of the fuse, which can easily be withdrawn from the spring clips. If it has blown the fused state of the wire will be visible inside the glass tube. Before renewing a blown fuse inspect the wiring of the units that have failed for evidence of a short circuit or other faults which may have caused the fuse to blow and remedy the cause of the trouble.

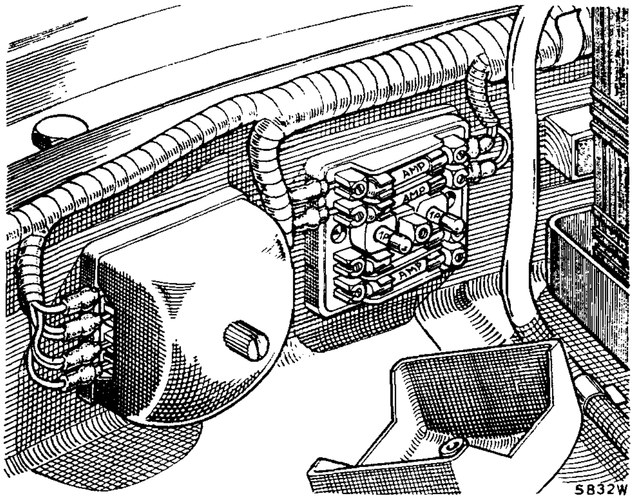


Fig. L.23
The fuseboxes

Spare fuses are provided in the fuseboxes and it is important to use only the correct replacement fuse. The fusing value is marked on a coloured paper slip inside the glass tube of the fuse.

Section L.25

LOCATION AND REMEDY OF FAULTS

Although every precaution is taken to eliminate possible causes of trouble failure may occasionally develop through lack of attention to the equipment or damage to the wiring. The following pages set out the recommended procedure for a systematic examination to locate and remedy the causes of some of the more usual faults encountered.

The sources of trouble are by no means always obvious, and in some cases a considerable amount of deduction from the symptoms is needed before the cause is disclosed.

For instance, the engine might not respond to the starter switch; a hasty inference would be that the starter motor is at fault. However, as the motor is dependent on the batteries it may be that the batteries are exhausted.

This in turn may be due to the dynamo failing to charge the batteries, and the final cause of the trouble may be, perhaps, a loose connection in some part of the charging circuit.

If, after carrying out an examination, the cause of the trouble is not found the equipment should be checked by the nearest Lucas Service Depot or Agent.

DYNAMO CHARGING CIRCUIT

1. Batteries in low state of charge

(*a*) This state will be shown by lack of power when starting, poor light from the lamps, and the hydrometer readings below 1·200. It may be due to the dynamo not charging or giving low or intermittent output. The warning light will not go out if the dynamo fails to charge, or will flicker on and off in the event of intermittent output.

(*b*) Examine the charging and field circuit wiring, tighten any loose connections, or renew any broken cables. Pay particular attention to the battery connections.

(*c*) Examine the dynamo driving belt; take up any undue slackness by swinging the dynamo outwards on its mounting after slackening the attachment bolts.

(*d*) Check the regulator setting, and adjust if necessary.

(*e*) If, after carrying out the above, the trouble is still not cured, have the equipment examined by a Lucas Service Depot or Agent.

2. Batteries overcharged

This will be indicated by burnt-out bulbs, very frequent need for topping up the batteries, and high hydrometer readings. Check the charge reading with an ammeter when the car is running. It should be of the order of only 3 to 4 amps.

If the ammeter reading is in excess of this value it is advisable to check the regulator setting, and adjust if necessary.

STARTER MOTOR

1. Starter motor lacks power or fails to turn engine

(*a*) See if the engine can be turned over by hand. If not, the cause of the stiffness in the engine must be located and remedied.

(*b*) If the engine can be turned by hand first check that the trouble is not due to a discharged battery.

(*c*) Examine the connections to the batteries, starter, and starter switch, making sure that they are tight and that the cables connecting these units are not damaged.

(*d*) It is also possible that the starter pinion may have jammed in mesh with the ring gear, although this is by no means a common occurrence.

(*e*) Check that the starter clutch is not slipping, and adjust by shimming if necessary.

2. Starter operates but does not crank the engine

This fault will occur if the starter clutch is slipping, or if the pinion of the starter drive is not allowed to move along the screwed sleeve into engagement with the ring gear due to dirt having collected on the screwed sleeve. Remove the starter, re-shim, or clean the sleeve carefully with paraffin.

3. Starter pinion will not disengage from the ring gear when the engine is running

Stop the engine and see if the starter pinion is jammed in mesh with the ring gear. If the pinion persists in sticking in mesh have the equipment examined at a Service Depot.

LIGHTING CIRCUITS

1. Lamps give insufficient illumination

(*a*) Test the state of charge of the batteries, recharging them if necessary from an independent electrical supply.

(*b*) Check the setting of the lamps.

(*c*) If the bulbs are discoloured as the result of long service they should be renewed.

2. Lamps light when switched on but gradually fade out

As paragraph 1 (*a*).

3. Brilliance varies with speed of car

(*a*) As paragraph 1 (*a*).

(*b*) Examine the battery connections, making sure that they are tight, and renew any faulty cables.

Section L.26

DYNAMO
(Type C48)

Certain versions of the Taxi and Hire Car engine are fitted with a C48 35-amp. dynamo. This dynamo is similar in construction and operation to the standard dynamo except for the armature, which is supported at each end by a ball race. Also, the yoke is provided with windows, sealed during operation by a cover band, to facilitate dismantling.

When servicing this dynamo follow the instructions contained in Sections L.3 to L.6, noting the following:

(1) The brush spring tension when new is 25 oz. (708 gm.). In service it is permissible for the tension to fall to 18 oz. (510 gm.). New springs must be fitted if the tension is low.

(2) The commutator end bearing outer race is a sliding fit in its housing in the commutator end bracket, while the inner race is a press fit on the armature shaft and is secured by a set screw, tab washer, and retaining cup. After removal of the set screw, tab washer, and retaining cup the bearing may be withdrawn by means of a hand press or extractor. When reassembling the bearing to the armature the inner race of the bearing must be supported.

(3) The driving end bearing is secured with a retaining plate and four set screws, the ends of which are caulked over on the outer face of the driving end bracket. Removal of the four screws will release the retaining plate bracket. Before reassembling, the bearing should be cleaned and repacked with high-melting-point grease.

(4) After reassembly mount the dynamo on a power-driven test bench and check the dynamo performance, which should be as follows:

Cutting-in speed ..	750 to 850 r.p.m. at 13 dynamo volts.
Maximum output ..	35 amperes at 1,450 to 1,650 r.p.m. at 13·5 dynamo volts with a resistance load of ·385 ohm.
Field resistance ..	6·0 ohms.

Section L.27

SEALED-BEAM LIGHT UNIT

To change a sealed-beam light unit remove the rim. Remove the three retaining screws securing the inner light rim and remove the rim assembly. Pull the unit forward and disconnect the three-pin socket to release it from the back-shell.

When refitting the light unit ensure that the registers moulded on the rear edge of the unit engage in the slots on the back-shell.

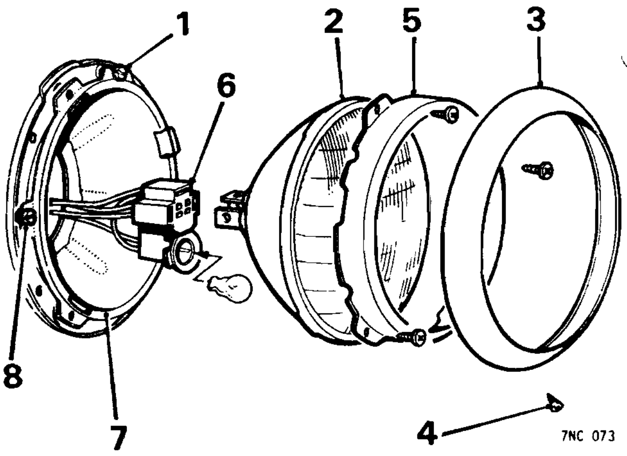


Fig. L.24

The sealed-beam light unit

1. Vertical adjustment screw.
2. Light unit.
3. Front rim.
4. Front rim fixing screw.
5. Light unit rim.
6. Three-pin socket.
7. Seating rim.
8. Horizontal adjusting screw.

Section L.28

DYNAMO
(Type C42)

The servicing instructions given in Sections L.3 to L.6 are applicable to the Type C42 dynamo which is fitted to certain versions of the 2·2-litre diesel engine, but the following points should be noted:

(1) The through-bolts fitted to this dynamo are non-magnetic, and if they are renewed the replacements must be of non-ferrous material.

(2) If the brushes are worn below the minimum permissible length of ¼ in. (6 mm.) new brushes must be fitted and bedded to the commutator.

(3) Brush spring tension with a commutator diameter of 1·485 in. (37·72 mm.) is 33 oz. (936 gm.) maximum with new brushes. Minimum permissible spring tension with brushes worn to ¼ in. (6 mm.) is 16 oz. (454 gm.).

(4) The commutator is of fabricated construction and may be skimmed, providing its finished diameter will not be less than 1·385 in. (35·18 mm.).

(5) The segment insulators should be undercut to a depth of ·020 to ·035 in. (·508 to ·9 mm.) ensuring that the width of the slots is ·023 to ·030 in. (·6 to ·762 mm.). It is important that the insulating material is cleared from the sides of each slot to a minimum depth of ·015 in. (·381 mm.)

(6) When measuring the resistance of the field coils the ohmmeter reading should be 4·5 ohms. If a 12-volt D.C. supply is used the ammeter reading should be 2·5 amps.

(7) When refitting the bearing retaining plate, the new rivets should be inserted from the outside of the end bracket.

(8) The dynamo performance should be as follows when checked on a power driven test bench:

Cutting-in speed ..	1,250 r.p.m. (max.) at 13 dynamo volts
Maximum output ..	30 amperes at 2,200 r.p.m. (max.) at 13·5 dynamo volts with a resistance load of ·45 ohm
Field resistance ..	4·5 ohms.

Section L.29

BATTERY MAINTENANCE

Boost charging and arc welding

Always disconnect the battery earth lead when boost charging, or arc welding on the body. Considerable damage may be done to electrical components, particularly those incorporating semi-conductors, if the ignition/master switch is turned while the battery remains connected to the vehicle electrical system.

Section L.30

REPLACEMENT BULBS

	Watts	*Part No.*
Headlamp, left dip (all R.H.D. except Sweden)	50/40	BFS 414
Headlamp, vertical dip (all L.H.D. Europe, except France)	45/40	BFS 410
Headlamp, vertical dip (France only—yellow)	45/40	BFS 411
Headlamp, vertical dip (Sweden only)	45/40	BFS 410
Headlamp, right dip (all L.H.D. except Europe and U.S.A.)	50/40	BFS 415
Sealed beam unit	60/45	GLU 131
Pilot bulb	5	GLB 501
Fog lamp	48	BFS 323
Sidelamps	6	BFS 989
Flasher direction indicators	21	BFS 382
Stop and tail lamps	21/6	BFS 380
Rear number-plate lamp	6	BFS 989
Interior lamp	21	BFS 382
Direction indicator warning lamp	2·2	BFS 987
Ignition/master switch warning lamp	2·2	BFS 987
Main-beam warning lamp	2·2	BFS 987
Panel lamps	2·2	BFS 987

Section L.31

ALTERNATOR PRECAUTIONS

Polarity. Ensure that the correct battery polarity is maintained at all times; reversed battery or charger connections will damage the alternator rectifiers.

Battery connections. The battery must never be disconnected while the engine is running.

Testing semi-conductor devices. Never use an ohmmeter of the type incorporating a hand-driven generator for checking the rectifiers or the transistors.

NOTE.—The battery fitted to later vehicles equipped with an alternator is wired negative to earth.

Section L.32

TESTING THE ALTERNATOR CHARGING CIRCUIT

Before attempting any tests the following points must be checked and rectified where necessary.

(1) The drive belt tension must be correct.
(2) Battery terminals clean and tight.
(3) Battery condition: the electrolyte specific gravity readings must be consistent.
(4) Cables and terminals in the charging circuit in good condition.

Test the circuit as follows:

Test	*Procedure*	*Remarks*
1. To check that battery voltage is reaching the alternator	Remove the cable connector from the alternator. Connect the negative side of a voltmeter to earth. Switch on the master/starter switch. Connect the positive side of the voltmeter to each of the alternator cable connectors in turn.	(*a*) If battery voltage is not available at the 'IND' cable connector, check the no-charge warning lamp bulb and the warning lamp circuit for continuity. (*b*) If battery voltage is not available at the main charging cable connector, check the circuit between the battery and the alternator for continuity. (*c*) If battery voltage is available at the cable connectors mentioned in (*a*) and (*b*), proceed with Test 2.
2. Alternator test	Re-connect the cable connector to the alternator. Disconnect the brown cable from the starter solenoid terminal. Connect an ammeter between the cable and the solenoid terminal. Connect a voltmeter across the battery terminals. Run the engine at 6,000 alternator r.p.m. and wait until the ammeter reading is stable.	(*a*) If a zero ammeter reading is obtained, remove and overhaul the alternator. (*b*) If an ammeter reading below 10 amp. and a voltmeter reading between 13·6 and 14·4 volts is obtained, and the battery is in a low state of charge, check the alternator performance on a test bench. The alternator output should be 34 amperes (16 ACR) or 36 amperes (17 ACR) at 14 volts at 6,000 alternator r.p.m. (*c*) If an ammeter reading below 10 amp. and a voltmeter reading below 13·6 volts is obtained, remove the alternator and renew the voltage regulator. (*d*) If an ammeter reading above 10 amp. and a voltmeter reading above 14·4 volts is obtained, remove the alternator and renew the regulator.

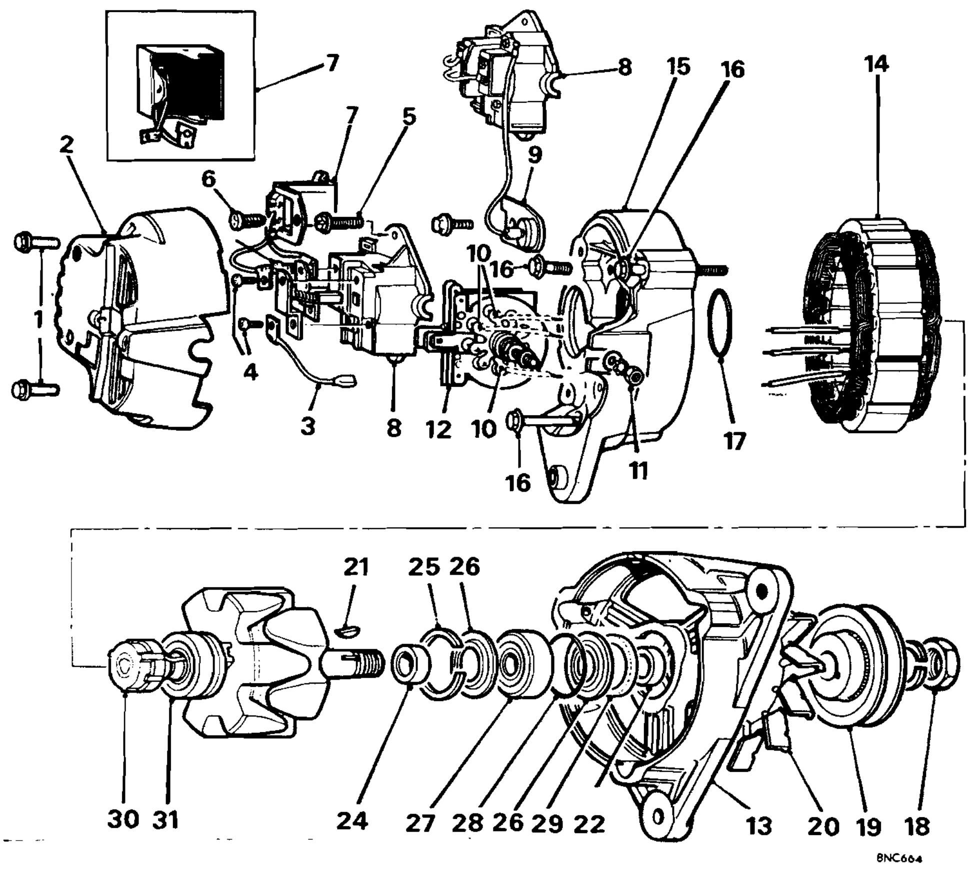


Fig. L.25

The components of the alternator

1. Screws for end cover.
2. End cover.
3. Lead and terminal.
4. Screws for brush assemblies.
5. Screws for brush holder and regulator assembly.
6. Screw retaining regulator.
7. Regulator.
8. Brush holder.
9. Surge protection device.
10. Diodes.
11. Nut retaining rectifier.
12. Rectifier pack.
13. Drive-end bracket.
14. Lamination pack.
15. Slip-ring end bracket.
16. Through-bolt.
17. 'O' ring.
18. Nut for pulley.
19. Pulley.
20. Fan.
21. Key for pulley.
22. Distance piece.
23. Rotor.
24. Distance piece.
25. Circlip.
26. Bearing cover-plates.
27. Bearing.
28. 'O' ring.
29. Felt ring.
30. Slip ring.
31. Bearing.

Section L.33

ALTERNATOR (16ACR)

Removing

(1) Disconnect the battery.
(2) Remove the connector and wires from the alternator.
(3) Slacken the two bolts retaining the alternator to the engine, the screw securing the adjusting link to the alternator, and the nut securing the adjusting link to the engine.
(4) Push the alternator towards the engine and remove the driving belt from the alternator pulley.
(5) Remove the two bolts securing the alternator to the engine, the screw retaining the adjusting link to the alternator, and detach the alternator.

Dismantling

(6) Remove the two set screws retaining the end-cover and detach the cover.
(7) Detach the cable from the terminal blade on the outer of the three rectifier plates.
(8) If fitted, remove the screw retaining the surge protection device to the drive end bracket.
(9) Note the fitted position and colour of the electrical leads and remove the four screws to release the two brush assemblies from the brush holders.

(10) Remove the three set screws to release the brush holder and regulator assembly from the slip-ring end bracket.
(11) Remove the screw to release the regulator assembly from the brush holder.
(12) Using a pair of pliers as a thermal shunt to avoid overheating the diodes, unsolder each of the three stator cables in turn from the rectifier.
(13) Slacken the nut to release the rectifier assembly from the slip-ring end bracket.
(14) Mark the drive-end bracket, the stator lamination pack, and the slip-ring end bracket to assist re-assembly.
(15) Remove the through-bolts and withdraw the slip-ring end bracket and the stator lamination pack.
(16) Remove the 'O' ring from inside the slip-ring end bracket.
(17) Remove the nut and withdraw the pulley and fan from the rotor shaft.
(18) Remove the pulley key and withdraw the distance piece from the rotor shaft.
(19) Press the rotor out of the drive-end bracket.
(20) Withdraw the distance piece from the drive-end of the rotor shaft.
(21) Remove the circlip to release the bearing, bearing cover plates, 'O' ring and felt washer from the drive-end bracket.

Inspection

(22) Check the bearings for wear and roughness; if necessary re-pack the bearings with Shell Alvania RA grease. To renew the slip-ring end bearing, unsolder the two field connections from the slip-ring and withdraw the slip-ring and the bearing from the rotor shaft. Reassemble, ensuring that the shielded side of the bearing faces the slip-ring assembly. Use Frys' H.T.3 solder to remake the field connectors to the slip-ring.
(23) Clean the surfaces of the slip-ring, removing any traces of burning with fine glass-paper.
(24) Check the field winding insulation, connecting a 110-volt A.C. supply and a 15-watt test lamp between one of the slip-rings and one of the rotor lobes.
(25) Check the resistance or current flow using an ohmmeter or an ammeter and a 12-volt current supply. The resistance should be 4·11 to 4·54 ohms (16 ACR) or 3·04 to 3·36 ohms (17 ACR) and the current flow should be 3 amperes.
(26) Check the stator windings for continuity, connecting a 12-volt D.C. supply and a 36-watt test lamp between any two of the stator cables, then repeating the test, using the third cable in place of one of the first two.
(27) Check the stator winding insulation, connecting a 110-volt A.C. supply and a 15-watt test lamp between any one of the three stator cables and the stator lamination pack.
(28) Check the nine rectifying diodes, connecting a 12-volt D.C. supply and a 15-watt test lamp between each diode pin and its associated heat sink in the rectifier pack in turn, and then reverse the test equipment connections. Current should flow in one direction only. Renew the rectifier assembly if a diode is faulty. Ensure that the correct, as original, replacement is fitted.
(29) Check the brush length and brush spring tension. The minimum brush length is 0·2 in. (5 mm.) of brush protruding beyond the brush box moulding. The spring pressure is 9 to 13 oz. (225 to 369 gm.) when the brush face is pushed in flush with the face of the brush box. Renew the brushes and springs if they do not conform to this specification.

Reassembling

(30) Reverse the procedure in (6) to (21), noting:
   (*a*) If the regulator has been renewed ensure that the correct, as original, or equivalent alternative replacement is fitted.
   (*b*) Support the inner track of the bearing when refitting the rotor to the drive-end bracket.
   (*c*) Use 'M' grade 45–55 tin–lead solder to remake the stator to rectifier pack connections, using a pair of pliers as a thermal shunt to avoid overheating of the diodes.
   (*d*) Tighten the alternator pulley nut to 25 lbf. ft. (3·46 kgf. m.).
(31) Mount the alternator on a test bench and check its output. This should be 34 amperes (16 ACR) or 36 amperes (17 ACR) at 14 volts at 6,000 alternator r.p.m.
(32) Refit the alternator.

Section L.34

STARTER MOTOR (Later models)

On later models the starter motor incorporates a roller clutch drive assembly. Check that the roller clutch takes up the drive instantaneously in one direction and revolves freely in the other direction. Ensure that the drive assembly moves freely along the armature shaft helices.

Lubricate the moving parts of the drive assembly with Shell SB 2628 grease (temperate and cold climates); Shell Retinax A grease (hot climate).

Section L.35

STOP LIGHT SWITCH

Removing

(1) Disconnect the battery.
(2) Remove the two screws securing the cover to the chassis.
(3) Disconnect the wiring from the terminal blades on the rear of the switch.
(4) Depress the brake pedal and remove the rubber dust cover from the switch.
(5) Remove the front locknut and withdraw the switch from its mounting bracket.

Refitting

(6) Reverse the procedure in (1) to (5), noting the following:
   (*a*) Position the switch in the mounting bracket so that the terminal blades are set diagonally to prevent them fouling the switch cover.
   (*b*) Adjust the switch locknuts until the plunger is depressed sufficiently to open the switch contacts with the brake pedal released.

CAUTION: Ensure that the switch is not acting as a brake pedal stop.

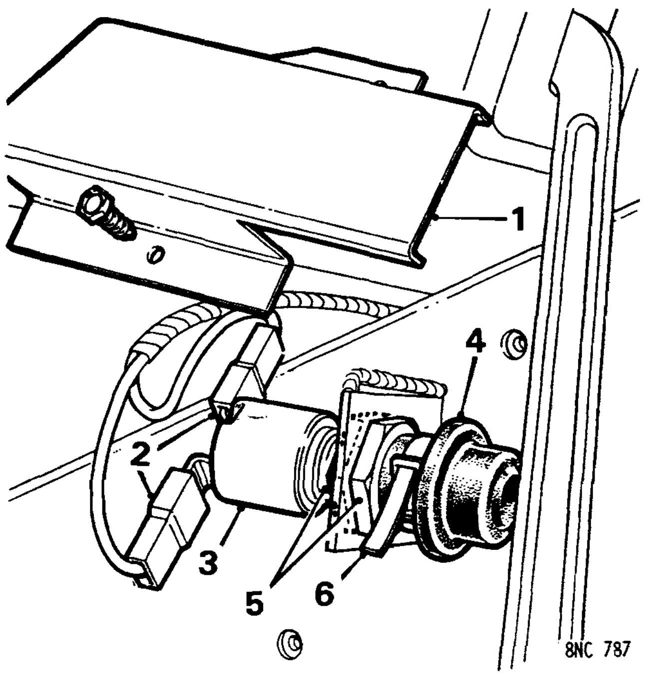
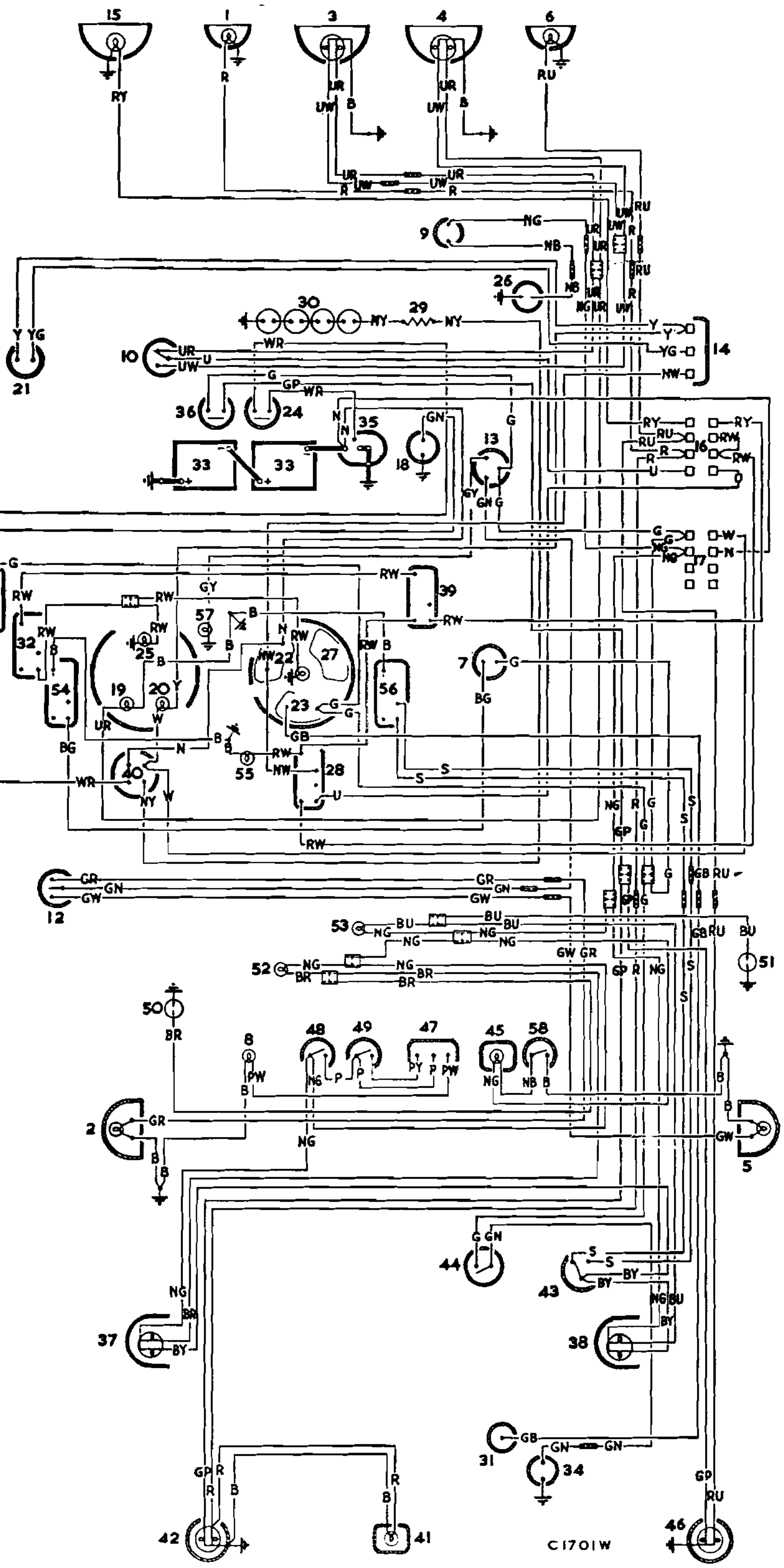


Fig. L.26

Stop light switch

1. Switch cover.
2. Wiring connections.
3. Stop light switch.
4. Dust cover.
5. Rear locknut.
6. Front locknut.

WIRING DIAGRAM (R.H.D.)



KEY TO THE WIRING DIAGRAM (R.H.D.)

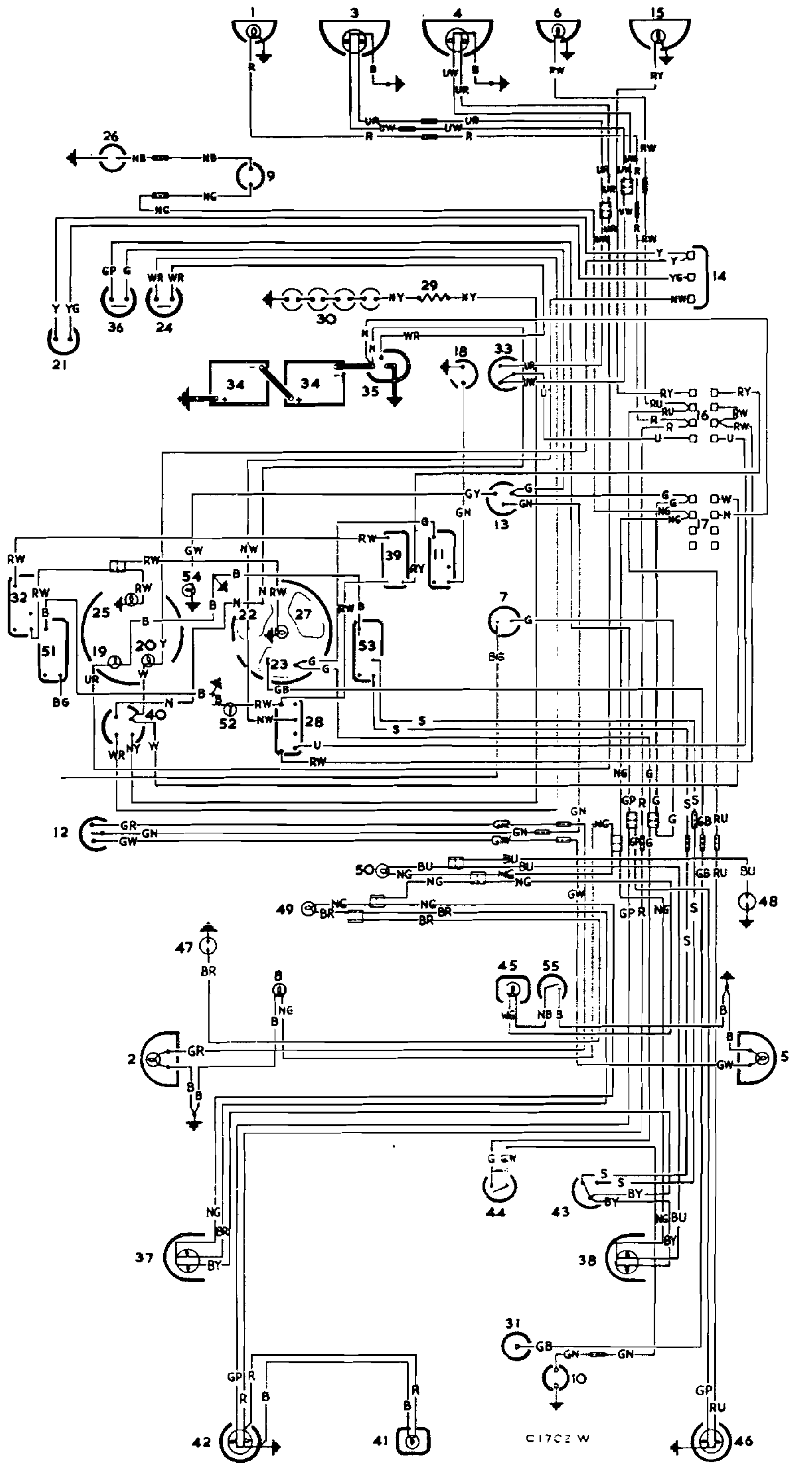
No.	*Description*	*No.*	*Description*
1.	L.H. sidelamp.	30.	Heater plugs.
2.	L.H. flasher lamp.	31.	Tank unit.
3.	L.H. headlamp.	32.	Panel lamp switch.
4.	R.H. headlamp.	33.	Two 6-volt batteries.
5.	R.H. flasher lamp.	34.	Passenger compartment heater.
6.	R.H. sidelamp.	35.	Starter and solenoid.
7.	Wiper motor.	36.	Stop lamp switch.
8.	'Hire' sign.	37.	L.H. interior light (passenger compartment).
9.	Horn.	38.	R.H. interior light (passenger compartment).
10.	Dip switch.	39.	Fog lamp.
11.	Heater switch.	40.	Starter and heater plug switch.
12.	Flasher lamp switch.	41.	Number-plate lamp.
13.	Flasher unit.	42.	L.H. stop and tail lamps.
14.	Control box.	43.	Interior light switch (passenger compartment).
15.	Fog lamp.	44.	Heater switch (passenger compartment).
16.	Fuse unit.	45.	Interior light (driver's compartment).
17.	Fuse unit.	46.	R.H. stop and tail lamp.
18.	Heater motor.	47.	Meter junction box.
19.	Main-beam warning lamp.	48.	First meter switch.
20.	No-charge warning lamp.	49.	Second meter switch.
21.	Dynamo.	50.	L.H. door switch.
22.	Ammeter.	51.	R.H. door switch.
23.	Fuel gauge.	52.	L.H. door warning light.
24.	Safety switch.	53.	R.H. door warning light.
25.	Speedometer.	54	Screen wiper switch.
26.	Horn-push.	55.	Gear indicator illumination.
27.	Oil gauge.	56.	Passenger compartment interior light switch (driver-controlled).
28.	Lighting switch.	57.	Direction indicator warning lamp.
29.	Resistance.	58.	Driver's compartment interior light switch.

CABLE COLOUR CODE

B. Black.	L.G. Light Green.	S. Slate.
U. Blue.	P. Purple.	W. White.
N. Brown.	R. Red.	Y. Yellow.
G. Green.		

When a cable has two colour code letters the first denotes the main colour and the second denotes the tracer colour.

WIRING DIAGRAM (L.H.D. EXCEPT N. AMERICA)



KEY TO WIRING DIAGRAM (L.H.D.)

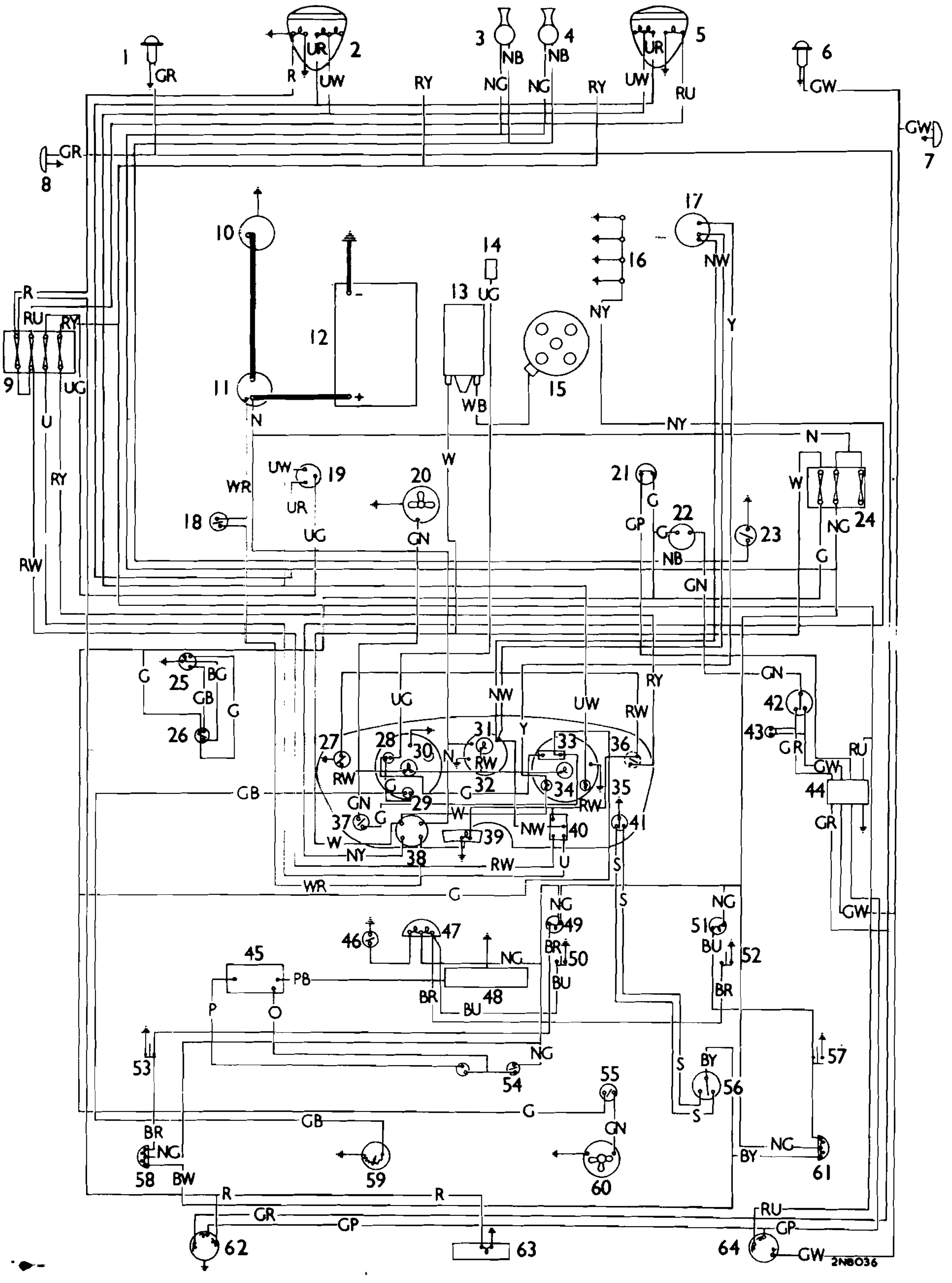
No.	*Description*	*No.*	*Description*
1.	L.H. sidelamp.	28.	Lighting switch.
2.	L.H. flasher lamp.	29.	Resistance.
3.	L.H. headlamp.	30.	Heater plugs.
4.	R.H. headlamp.	31.	Tank unit.
5.	R.H. flasher lamp.	32.	Panel lamp switch.
6.	R.H. sidelamp.	33.	Dip switch.
7.	Wiper motor.	34.	Two 6-volt batteries.
8.	'Hire' sign.	35.	Starter and solenoid.
9.	Horn.	36.	Stop lamp switch.
10.	Passenger compartment heater.	37.	L.H. interior light (passenger compartment).
11.	Heater switch.	38.	R.H. interior light (passenger compartment).
12.	Flasher lamp switch.	39.	Fog lamp switch.
13.	Flasher unit.	40.	Starter and heater plug switch.
14.	Control box.	41.	Number-plate lamp.
15.	Fog lamp.	42.	L.H. stop and tail lamps.
16.	Fuse unit.	43.	Interior light switch (passenger compartment)
17.	Fuse unit.	44.	Heater switch (passenger compartment).
18.	Heater motor.	45.	Interior light (driver's compartment).
19.	Main-beam warning lamp.	46.	R.H. stop and tail lamp.
20.	No-charge warning lamp.	47.	L.H. door switch.
21.	Dynamo.	48.	R.H. door switch.
22.	Ammeter.	49.	L.H. door warning light.
23.	Fuel gauge.	50.	R.H. door warning light.
24.	Safety switch.	51.	Screen wiper switch.
25.	Speedometer.	52.	Gear indicator illumination.
26.	Horn-push.	53.	Passenger compartment interior light switch (driver-controlled).
27.	Oil gauge.	54.	Direction indicator warning light.
		55.	Driver's compartment interior light switch.

CABLE COLOUR CODE

U.	Blue.	P.	Purple.	W.	White.
N.	Brown.	R.	Red.	Y.	Yellow.
B.	Black.	L.G.	Light Green.	S.	Slate.
G.	Green.				

When a cable has two colour code letters the first denotes the main colour and the second denotes the tracer colour.

WIRING DIAGRAM (Earlier models with 2·52 engine)



KEY TO WIRING DIAGRAM (Earlier models with 2·52 engine)

No.	*Description*	*No.*	*Description*
1.	Left-hand front flasher lamp.	33.	Voltage stabilizer.
2.	Left-hand headlamp.	34.	Main beam warning light.
3.	Horn (Hire car only).	35.	No-charge warning light.
4.	Horn.	36.	Fog lamp switch (if fitted).
5.	Right-hand headlamp.	37.	Heater switch.
6.	Right-hand front flasher.	38.	Master/starter switch.
7.	Left-hand repeater flasher.	39.	Gear selector indicator (Automatic only).
8.	Right-hand repeater flasher.	40.	Main lighting switch.
9.	Lighting fuses.	41.	Passenger's interior light switch.
10.	Starter motor.	42.	Trafficator switch.
11.	Starter solenoid.	43.	Trafficator warning light.
12.	Battery.	44.	11RA relay.
13.	Ignition coil (Petrol).	45.	Taximeter (Taxi only).
14.	Thermometer unit.	46.	Driver's interior light.
15.	Distributor (Petrol).	47.	Driver's interior light.
16.	Heater plugs (Diesel).	48.	Hire sign (Taxi only).
17.	Alternator.	49.	Left-hand door warning light.
18.	Neutral interlock switch (Automatic).	50.	Left-hand front door switch.
19.	Headlamp dipper switch.	51.	Right-hand door warning light.
20.	Driver's heater.	52.	Right-hand front door switch.
21.	Stop light switch.	53.	Left-hand rear door switch.
22.	Flasher unit.	54.	Taximeter switch (Taxi only).
23.	Horn switch.	55.	Heater switch.
24.	Fuse box.	56.	Passenger compartment interior light switch.
25.	Windscreen wiper motor.	57.	Right-hand rear door switch.
26.	Wiper motor switch.	58.	Passenger compartment interior light.
27.	Panel light switch.	59.	Fuel gauge tank unit.
28.	Temperature gauge.	60.	Passenger compartment heater.
29.	Fuel gauge.	61.	Passenger compartment interior light.
30.	Instrument illumination bulb.	62.	Left-hand stop/tail/flasher lamp.
31.	Ammeter illumination bulb.	63.	Number-plate lamp.
32.	Ammeter.	64.	Right-hand stop/tail/flasher lamp.

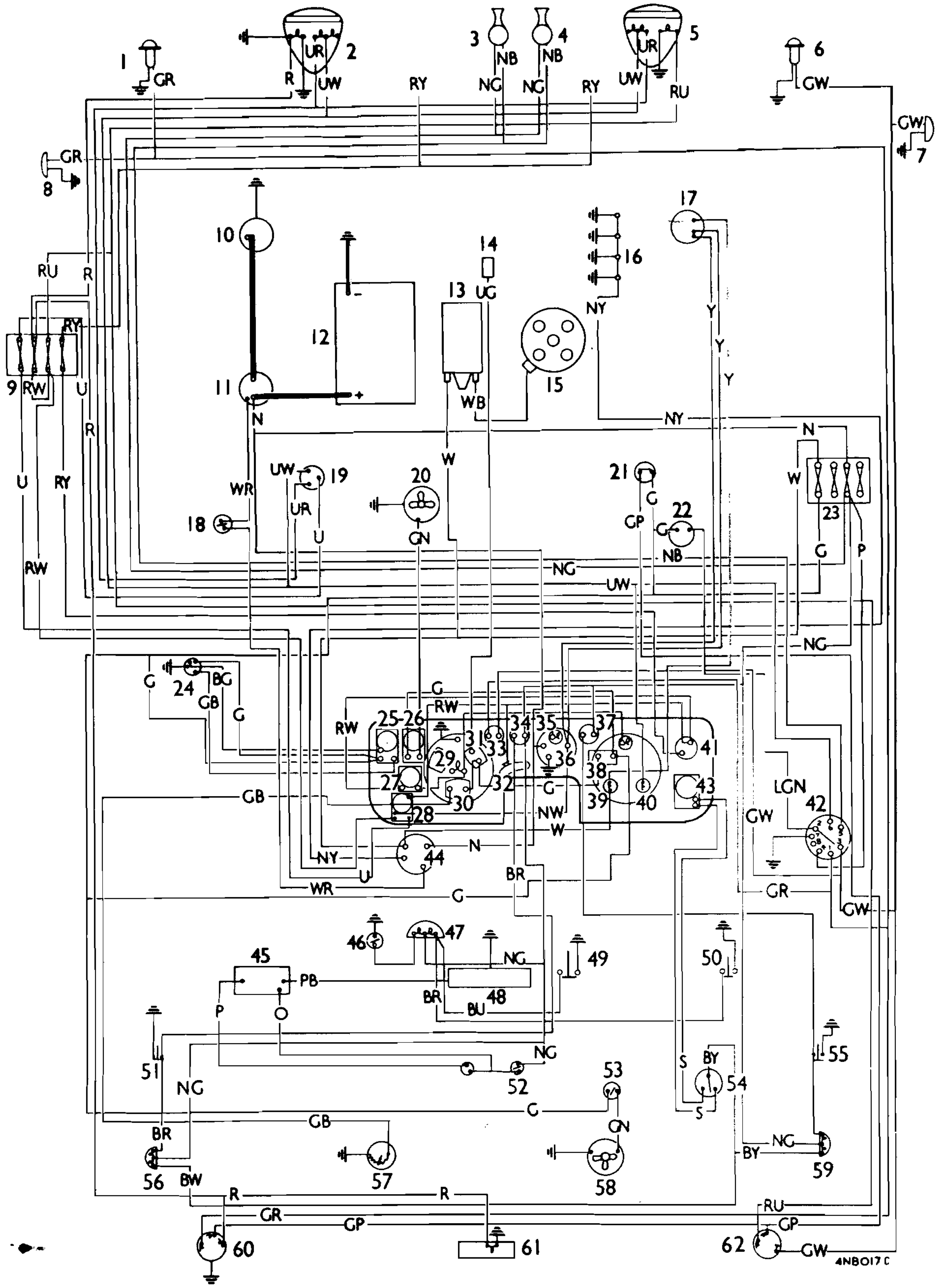
CABLE COLOUR CODE

B.	Black.	G.	Green.	W.	White.
U.	Blue.	P.	Purple.	Y.	Yellow.
N.	Brown.	R.	Red.		

When a cable has two colour code letters, the first denotes the main colour and the second denotes the tracer colour.

WIRING DIAGRAM

(Later models up to 1977 with 2.52 engine)



KEY TO WIRING DIAGRAM

(Later models up to 1977 with 2.52 engine)

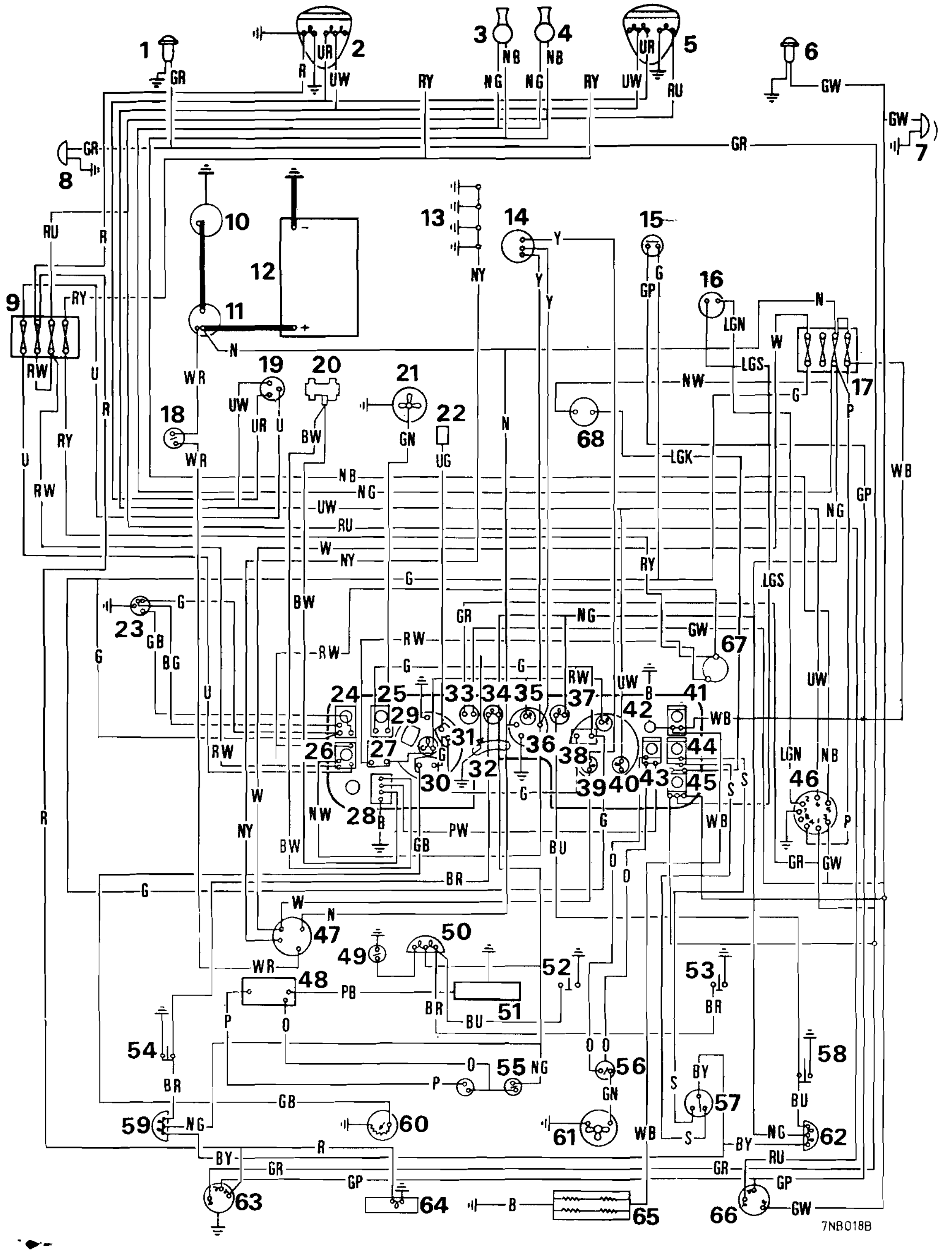
No.	*Description*
1.	Left-hand front flasher lamp.
2.	Left-hand headlamp.
3.	Horn (Hire car only).
4.	Horn.
5.	Right-hand headlamp.
6.	Right-hand front flasher lamp.
7.	Left-hand repeater flasher.
8.	Right-hand repeater flasher.
9.	Lighting fuses.
10.	Starter motor.
11.	Starter solenoid.
12.	Battery.
13.	Ignition coil (Petrol).
14.	Thermometer unit.
15.	Distributor (Petrol).
16.	Heater plugs (Diesel).
17.	Alternator.
18.	Neutral interlock switch (Automatic transmission).
19.	Headlamp dipper switch.
20.	Driver's heater.
21.	Stop light switch.
22.	Flasher unit.
23.	Fuse box.
24.	Windscreen wiper motor.
25.	Windscreen wiper switch.
26.	Heater switch.
27.	Panel light switch.
28.	Main lighting switch.
29.	Instrument illumination bulb.
30.	Fuel gauge.
31.	Temperature gauge.
32.	Gear selector indicator (Automatic only).
33.	Flasher warning light.
34.	Left-hand door warning light.
35.	Ammeter illumination bulb.
36.	Ammeter.
37.	Right-hand door warning light.
38.	Voltage stabilizer.
39.	High-beam warning light.
40.	No-charge warning light.
41.	Fog lamp switch (if fitted).
42.	Indicator, headlamp flasher and horn switch.
43.	Passenger interior light switch.
44.	Master/starter switch.
45.	Taximeter (Taxi only).
46.	Driver's interior light switch.
47.	Driver's interior light.
48.	Hire sign (Taxi only).
49.	Left-hand front door switch.
50.	Right-hand front door switch.
51.	Left-hand rear door switch.
52.	Taximeter switch (Taxi only).
53.	Heater switch.
54.	Passenger compartment interior light switch.
55.	Right-hand rear door switch.
56.	Passenger compartment interior light.
57.	Fuel gauge tank unit.
58.	Passenger compartment heater.
59.	Passenger compartment interior light.
60.	Left-hand stop/tail/flasher lamp.
61.	Number-plate lamp.
62.	Right-hand stop/tail/flasher lamp.

CABLE COLOUR CODE

B. Black.	G. Green.	W. White.
U. Blue.	P. Purple.	Y. Yellow.
N. Brown.	R. Red.	

When a cable has two colour code letters the first denotes the main colour and the second denotes the tracer colour.

WIRING DIAGRAM (1977 models onwards)



KEY TO WIRING DIAGRAM (1977 models onwards)

No.	Description
1.	Left-hand front flasher lamp.
2.	Left-hand headlamp.
3.	Horn (Hire car only).
4.	Horn.
5.	Right-hand headlamp.
6.	Right-hand front flasher lamp.
7.	Left-hand repeater flasher.
8.	Right-hand repeater flasher.
9.	Lighting fuses.
10.	Starter motor.
11.	Starter solenoid.
12.	Battery.
13.	Heater plugs.
14.	Alternator.
15.	Stop light switch.
16.	Flasher unit.
17.	Fusebox.
18.	Neutral interlock switch (Automatic transmission).
19.	Headlamp dipper switch.
20.	Brake pressure failure switch (on pressure differential warning actuator).
21.	Driver's heater.
22.	Thermometer unit.
23.	Windscreen wiper motor.
24.	Windscreen wiper switch.
25.	Heater switch.
26.	Main lighting switch.
27.	Panel light switch.
28.	Brake failure warning lamp and test switch.
29.	Instrument illumination bulb.
30.	Fuel gauge.
31.	Temperature gauge.
32.	Gear selector indicator (Automatic only).
33.	Flasher warning light.
34.	Left-hand door warning light.
35	Ammeter illumination bulb.
36.	Ammeter.
37.	Right-hand door warning light.
38.	Voltage stabilizer.
39.	High-beam warning light.
40.	No-charge warning light.
41.	Heated rear window switch (if fitted).
42.	Heated rear window warning light.
43.	Passenger compartment heater over-ride switch.
44.	Passenger interior light switch.
45.	Hazard warning switch.
46.	Indicator, headlamp flasher and horn switch.
47.	Master/starter switch.
48.	Taximeter (Taxi only).
49.	Driver's interior light switch.
50.	Driver's interior light.
51.	Taxi sign (Taxi only).
52.	Left-hand front door switch.
53.	Right-hand front door switch.
54.	Left-hand rear door switch.
55.	Taximeter switch (Taxi only).
56.	Heater switch.
57.	Passenger compartment interior light switch.
58.	Right-hand rear door switch.
59.	Passenger compartment interior light.
60.	Fuel gauge tank unit.
61.	Passenger compartment heater.
62.	Passenger compartment interior light.
63.	Left-hand stop/tail flasher lamp.
64.	Number-plate lamp.
65.	Heated rear window element (if fitted).
66.	Right-hand stop/tail/flasher lamp.
67.	Fog lamp (if fitted).
68.	Hazard warning unit.

CABLE COLOUR CODE

B. Black.	G. Green.	W. White.
U. Blue.	P. Purple.	Y. Yellow.
N. Brown.	R. Red.	

When a cable has two colour code letters the first denotes the main colour and the second denotes the tracer colour.

SECTION M

THE WHEELS AND TYRES

(TUBELESS TYRES)

Section M.1

TYRE MAINTENANCE

Even tyre wear is promoted by changing the positions of the tyres on the car at the recommended intervals. The spare tyre should be brought into use with the others.

Attention should be paid to the following points with a view to obtaining the maximum service from the tyre equipment of the vehicle.

Test the pressures of the tyres regularly by means of a suitable gauge and restore any air lost. It is not sufficient to make a visual inspection of the tyre for correct inflation. Inflate the spare wheel tyre to the correct pressure.

Keep the treads free from grit and stones and carry out any necessary repairs. Clean the wheel rims and keep them free from rust. Paint the wheels if necessary.

Keep the brakes adjusted correctly and in good order. Fierceness or uneven action has a destructive effect upon the tyres.

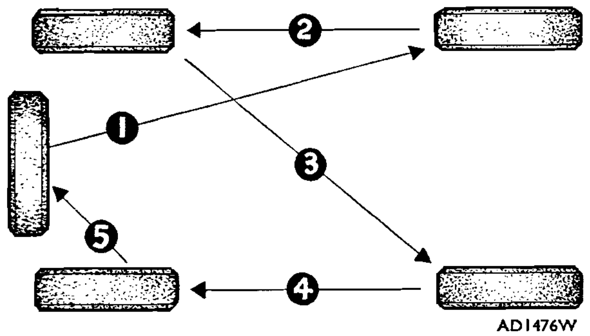


Fig. M.1

Change the wheels round to regularize tyre wear

Misalignment is a very costly error. Suspect it if rapid wear of the front tyres is noticed and correct the fault at once.

Should the tyres get oily, petrol should be applied sparingly and wiped off at once.

Avoid under- and over-inflation.

Avoid kerbing and other causes of severe impact.

Have any damage repaired immediately.

Remove tyres when smooth for remoulding.

Section M.2

VALVES

A mushroom-headed rubber valve is used with tubeless tyres. The valve is secured in the wheel by a small stepped flange on the rubber valve and by the pressure of air inside the tyre.

A simple but effective tool (Fig. M.3) for fitting the valve can be made up from a 7 in. (18 cm.) length of ½ in. (13 mm.) steel bar or 13 S.W.G. steel tubing.

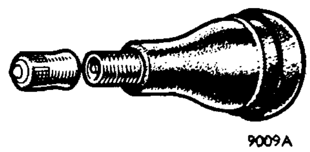


Fig. M.2

Valve for tubeless tyres

Using a letter 'S' (8·83 mm.) drill, in one end drill a hole to a depth of approximately ⅝ in. (16 mm.).

Obtain an ordinary valve dust cap and solder the cap in the drilled hole.

The opposite end of the tool requires a hole drilling about ½ in. (13 mm.) from the end to accept a short piece of ¼ in. (6 mm.) diameter rod to provide a handle.

To fit the valve with the aid of the tool first liberally coat the rubber valve and the perimeter of the valve hole in the wheel with soapy water. Insert the valve into the hole and screw on the special tool. A sharp pull will seat the valve correctly.

The valves may be tested for airtightness by rotating the wheel until the valve is at the top and inserting the end of the valve in a small container of water. If bubbles appear the seating is faulty and the valve interior should be replaced with a new one.

It is advisable to change the valve interiors every 12 months.

Valve caps, in addition to preventing dirt entering the valve, form a secondary air seal and should always be fitted.

Section M.3

REMOVING AND REPLACING A WHEEL

Remove the hub cover by inserting the flattened end of the wheelbrace in the recess provided adjacent to the securing lobes. Employ a twisting motion to the tool, not a levering movement.

Slacken the five nuts securing the road wheel to the hub. Lift the vehicle with the jack, remove the nuts, which have right-hand threads, and lift the wheel from the hub.

Refitting a wheel is a reversal of these instructions, but ensure that the wheel nuts are fitted with the tapered side towards the wheel and tighten them in the order illustrated to a torque wrench setting of 65 lb. ft. (9·0 kg. m.).

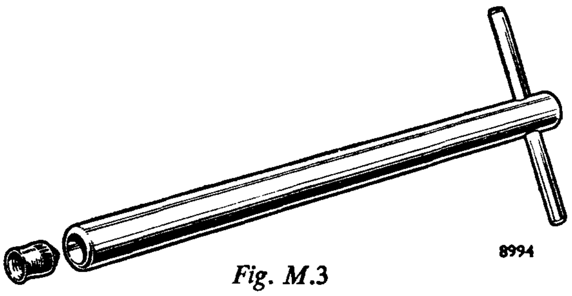


Fig. M.3

Simple tool for fitting tubeless tyre valves

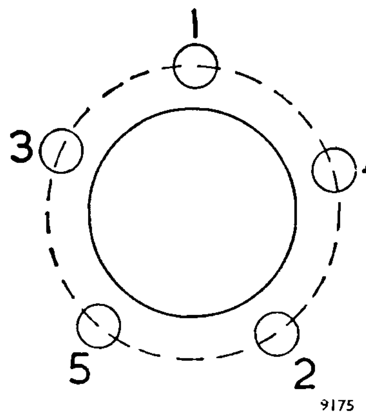


Fig. M.4

Order of tightening the wheel nuts

Section M.4

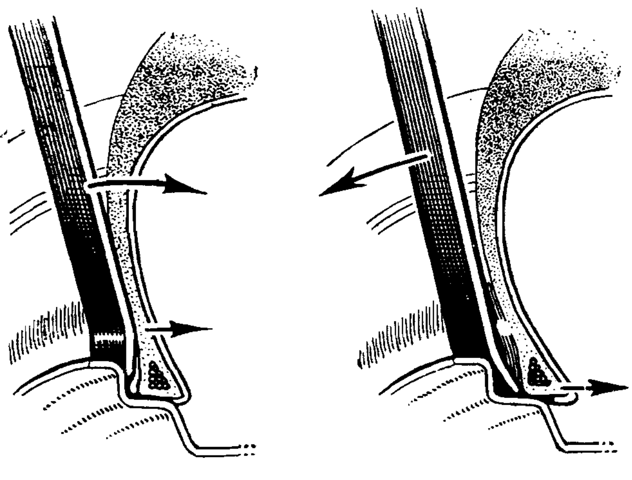
TYRE REMOVAL

Remove the valve interior to completely deflate the tyre.

Push both cover edges into the well-base of the wheel, and at a point diametrically opposite lever the cover edge over the rim of the wheel, using two levers at intervals of 6 in. (15 cm.) apart. Continue working round the wheel until the cover on one side is completely free.

NOTE.—**Do not attempt to stretch the edges of the tyre cover over the rim edge and only use thin, narrow levers in good condition without rust or burrs. Do not widely space the levers.**

Force is entirely unnecessary and is detrimental, as it tends to damage the wire edges. Fitting or removing is quite easy if the tyre edges are carefully adjusted into the rim base; if found difficult, the operation is not being performed correctly.



1. Insert lever between bead and rim, with curved end against tyre. Press lever towards tyre.
2. Insert second lever in space between lever and rim, with curved end outwards, and pull lever away from tyre. Repeat at intervals round tyre until bead is free. Several circuits of tyre may be necessary.

Fig. M.5

The tyres have wired edges and no attempt must be made to stretch them. If the cover fits tightly on the rim seating it should be freed by using the tyre levers as indicated

Stand the tyre and wheel upright, keeping the bead in the base of the rim. Lever the bead over the rim flange and at the same time push the cover away from the wheel with the other hand.

Section M.5

TYRE BALANCE

In order to obtain good steering it is of importance to ensure that the wheels with tyres fitted are in good balance. To assist this the tyre manufacturers are now marking their tyres with a white spot in the neighbourhood of the bead at the lightest point of the cover. When fitting tyres to the wheels ensure that they are assembled with the white spot on the cover in line with the valve.

Fig. M.6

Removing the first bead of the tyre from the wheel

Special balance weights, which cover a range from $\frac{1}{2}$ to $3\frac{1}{2}$ oz. (14·2 to 99 gm.) in steps of $\frac{1}{2}$ oz. (14·2 gm.) are obtainable for attachment to the wheel rim.

Their use is advised to maintain the correct balance for the wheels, which must be within 12 in. oz. (·85 cm. kg.).

The balance weights are fitted to the outside rim of the wheel.

Section M.6

TYRE-FITTING

The tubeless tyre relies primarily on a good air seal between the tyre bead and the rim, and also between the rim and the valve. Great care is therefore necessary to avoid the slightest damage to the tyre bead, and the following instructions are of great importance.

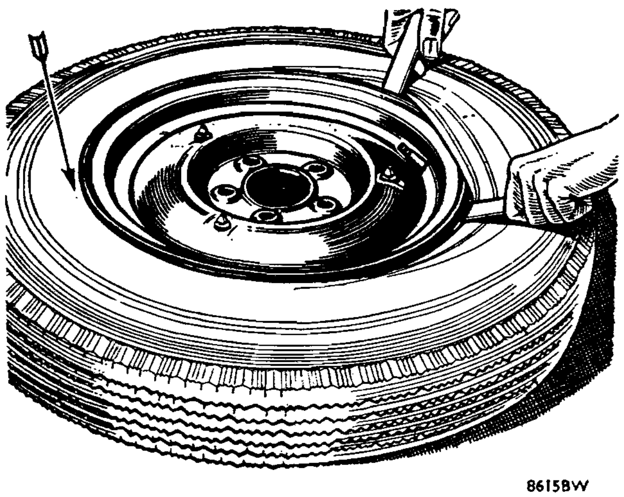


Fig. M.7
Fitting a tyre on the wheel

Rim preparation

(1) Remove any visible dents in the flange by careful hammering.
(2) Clean the flange and rim seat with steel wool, emery, or other cleaning medium and remove all foreign matter, rust, rubber, etc. Paint need not be removed but irregularities in the surface should be smoothed out. In extreme cases of rusting it may be necessary to use a wire brush or a file.
(3) File or buff away any high-spot at the butt-weld joint.
(4) Wipe the flange and bead seat with a water-moistened cloth.

Before fitting moisten the beads of the tyre, the rim flange, and the tyre levers with water; **do not use petrol.** Mount the tyre on the rim and push one edge of the cover over the edge of the rim; continue working round the tyre towards the valve position. The portion of the tyre first fitted should be kept pushed into the well-base of the wheel rim and then no difficulty will be encountered in fitting the last portion of the cover. Do not forget that the white balance spot on the tyre must be in line with the valve position.

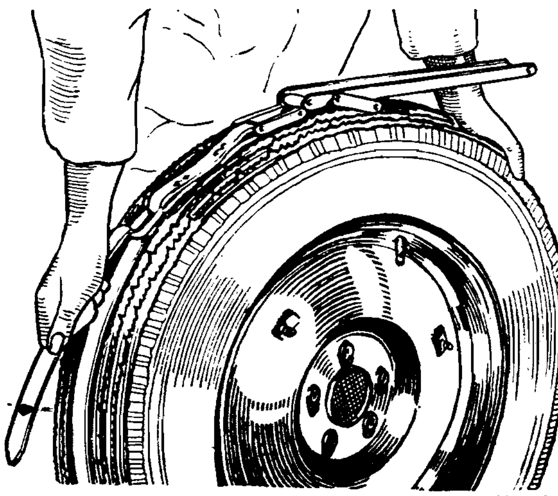


Fig. M.8
The use of a tourniquet to seal the beads

Before inflation bounce the crown of the tyre on the ground at various points to snap home the beads of the tyre against the rim of the wheel and provide a partial seal.

With the wheel in an upright position inflate the tyre. If a seal cannot be obtained at the first rush of air bounce the tyre again with the air-line attached. In cases of difficulty apply a tourniquet of strong cord around the circumference of the tyre and tighten. When a seal is obtained inflate until the beads are completely forced against both rim flanges. Remove the air-line, insert the valve interior, and inflate to 50 lb./sq. in. (3·5 kg./cm.^{2}) for testing.

Allow the tyre to stand for a few minutes so that any free air trapped between the flange and the bead clinch can escape. Test the complete assembly in a water tank, paying special attention to the areas at the beads, valve, and wheel rivets.

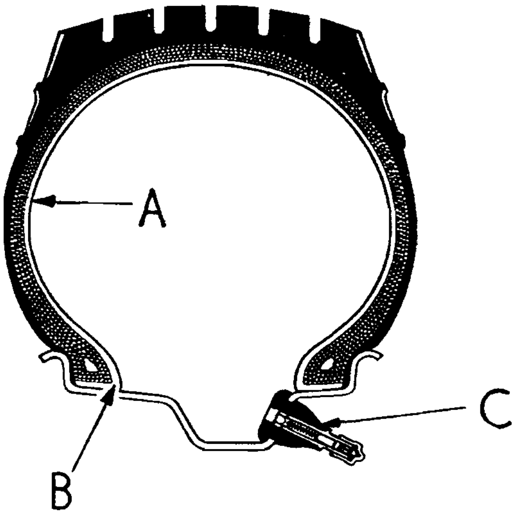


Fig. M.9
A section through a tubeless tyre

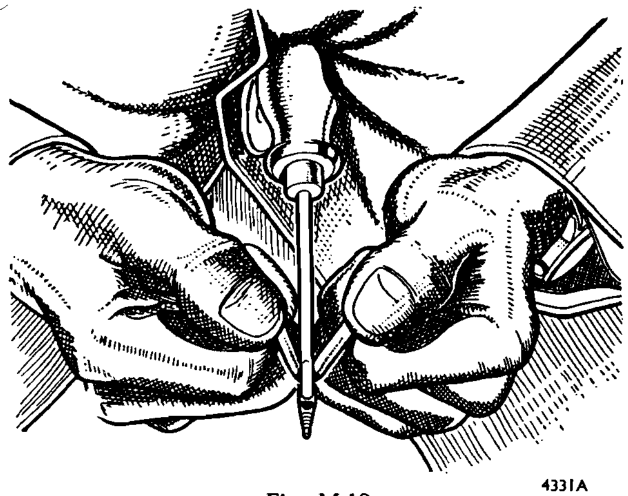
A. Air-retaining liner. B. Rubber air seal.
C. Rubber-sealed valve.

Sealing leaks located during testing

Loss of air may occur at any or all of the following points:

(1) The area of the bead seat, showing as a leak at the top of the flange.
This is normally due to a high-spot on the rim and can usually be cured by holding the bead away from the rim to allow further cleaning.
(2) The wheel rivets. In this case, and in extreme cases of leakage in the area of the bead seat (1), it is necessary to remove the tyre. Before doing so mark the position of the leak on the tyre and rim.
Loss of air at the rivets can be cured by peening over the rivet heads.
(3) The base of the valve or its interior. Provided the valve is correctly fitted, this may be due only to dirt under the valve seat. Clean the area of the valve seat on the wheel and fit a new valve interior.

Inflate the tyre to the correct pressure before fitting the wheel assembly to the vehicle and driving.



4331A

Fig. M.10

Rolling the plug into the needle eye

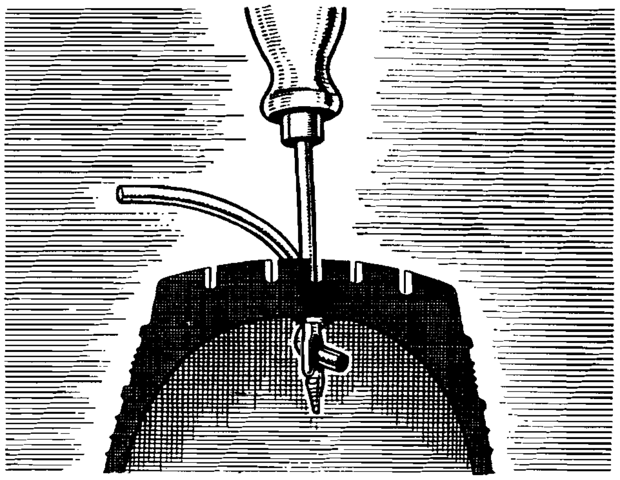


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Fig. M.12

The inserted plug prior to withdrawing the needle

Section M.7

REPAIRING TYRES

Penetrations

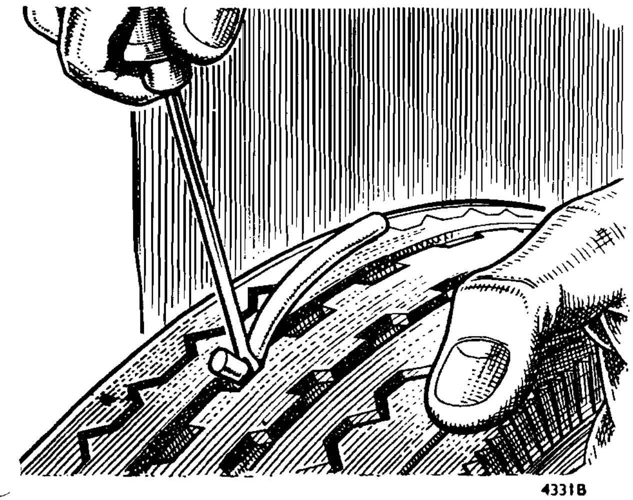
Normally a tubeless tyre will not leak as the result of penetration by a nail or other puncturing object, provided that it is left in the tyre. It is necessary to examine the tyres at the recommended intervals and to withdraw such objects at a time when loss of air pressure will cause least inconvenience.

Use of plugging kit—location and preparation

The insertion of a plug to repair a puncture in a tubeless tyre must be regarded as a temporary measure and a permanent vulcanized repair must be made as soon as possible.

If a hole fails to seal mark the spot and extract the puncturing object, taking note of the direction of penetration. If the tyre is leaking and the puncturing object cannot be located by sight it is necessary to immerse the inflated tyre in water.

Dip the plugging kit needle into the flask of solution and insert it into the hole in the tyre, following the same direction as the penetration.



4331B

Fig. M.11

Inserting the plug and needle through the hole in the tyre

Repeat the operation until the hole is well lubricated with solution.

Repair

Select a plug about twice the diameter of the puncturing object, stretch it, and roll it into the eye of the needle ¼ in. (6 mm.) from the end (Fig. M.10). After dipping the plug into the solution insert the needle into the hole and push the plug through the tyre (Figs. M.11 and M.12).

Withdraw the needle and cut off surplus plug about ⅛ in. (3 mm.) from the surface of the tread (Fig. M.13). The tyre can now be inflated and used immediately. More severe injuries which are outside the scope of simple puncture repair methods are dealt with in nearly the same way as similar injuries to conventional covers.

If the tyre deflates on the road following an unusually large penetration a tube can be fitted to enable the owner to remain on the road until it is convenient for the necessary repairs to be carried out. (The valve used for the tubeless tyre must be removed before the fitting of the tube.)

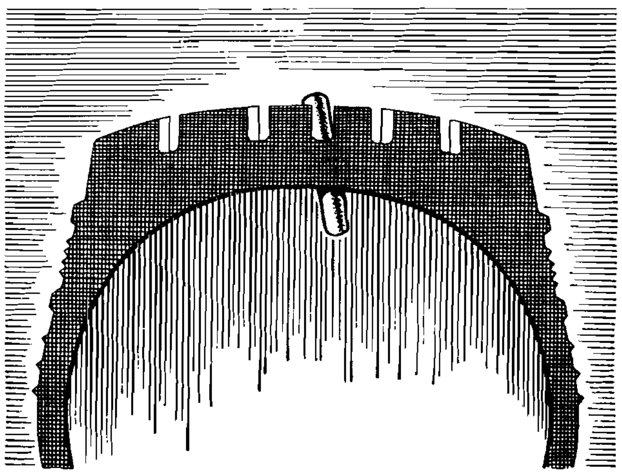


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Fig. M.13

Plug inserted in tyre and cut off to the correct length

SECTION O

THE BODY

Section O.1

REMOVING AND REPLACING THE WINDSCREEN GLASS

Extract the rubber locking filler strip from the rubber channel surrounding the window glass.

Remove the broken pieces of the window from the groove of the rubber sealing strip.

The sealing strip should be removed for inspection, any particles of glass removed, and if the sealing strip is damaged in any way it should be renewed.

The installation of the sealing strip and locking filler requires the use of tools 18G468 and 18G468A.

Lubricate the edge of the window frame with a soap-and-water solution before fitting the seal.

Fit the seal round the frame and cut off to length.

Place the window glass into the rubber channel (commencing at the lower corner and using the installation tool), lift the channel lip over the window, and gradually work the window into position.

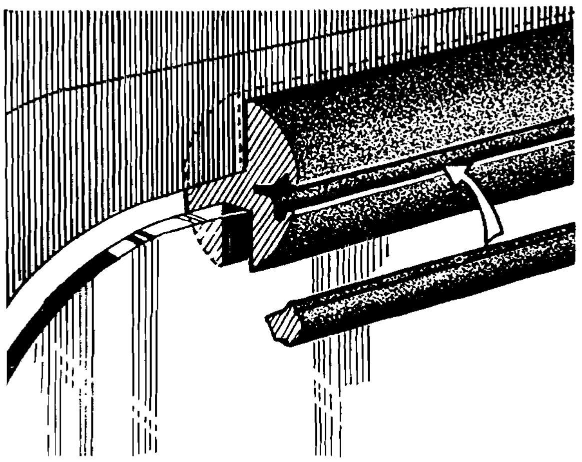
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Fig. O.1

Section of windscreen glass and seal

Apply the soap-and-water solution to the locking filler strip channel, thus assisting the filler strip installation.

Using the installation tool and eye, thread the locking filler strip through the handle and eye. Insert the tool into the filler strip channel, hold the end of the filler in position with the thumb, and start to draw the tool along the channel, feeding the filler through the handle and eye into the channel. A slight agitating side-to-side movement will assist in rounding the corners. After making the complete circuit the tool is removed and the filler strip cut off, allowing an overlap so that, on forcing both ends in position, this results in the joint being under pressure.

Section O.2

REMOVING AND REPLACING THE BACK-LIGHT

Follow the instructions in general given in Section O.1.

Section O.3

REMOVING AND REPLACING FRONT DOOR GLASSES

Push the inner escutcheon clear of the shank of the interior handle and push out the exposed pin to release the handle.

Remove the trim panel.

Remove the wooden battens.

Remove the bolts securing the lock mechanism and withdraw it.

Remove the steady for the control arm and the window stop.

Remove the two vertical channels (one screw at the bottom of the front channel and two screws for the rear channel).

Remove the quarter-light complete, when the window can be withdrawn.

Replace by reversing these instructions.

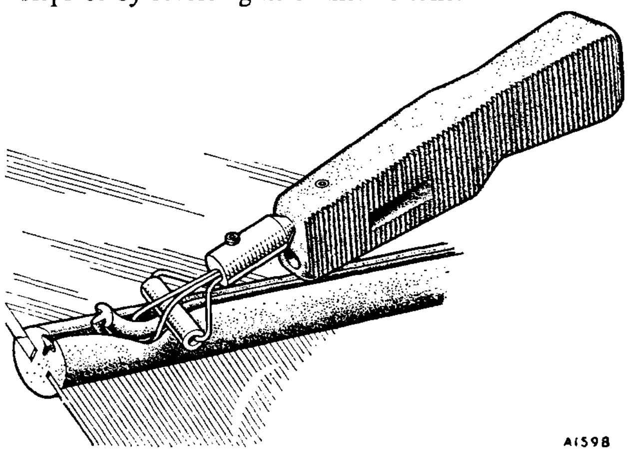
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Fig. O.2

Method of using tools 18G468 and 18G468A

Section O.4

REMOVING AND REPLACING REAR DOOR GLASSES

Push the inner escutcheon clear of the shank of the interior handle and push out the exposed pin to release the handle.

Remove the trim panel.

Remove the two vertical channels (a screw at the bottom of each); the removal of the rim moulding will facilitate this operation.

Remove the bottom cover-plate and batten.

Disconnect the door lift mechanism from the bottom of the window.

Carefully knock off the glass lifting channel and draw the glass downwards and out of the door casing.

Replace by reversing these instructions.

Section O.5

ADJUSTING THE DOOR STRIKER

Adjustment of the striker position is only necessary when the striker itself has been renewed. Do not interfere with its setting otherwise. Positioning is carried out by a process of trial and error—proved by checking the door closing action and the position of the door when closed.

Slacken off the striker screws just enough to allow the striker to be tapped into a slightly different position and retighten the screws.

Section O.6

MAINTENANCE OF BODYWORK AND UPHOLSTERY

It is advisable to wash the coachwork of the car with an abundant quantity of water to remove all traces of dust, mud, and traffic film. Polish the paintwork frequently with a good-quality car polish free from abrasive.

Wash the chromium parts frequently with soap and warm water, and when the dirt has been removed polish the surface with a clean dry cloth, or a chamois-leather, until bright. Metal polishes, or abrasives of any sort, must not be used on chromium, but a good-quality metal polish may be used on stainless steel. An occasional application of wax polish will help to preserve the finish.

When cleaning windscreens it is advisable to use methylated spirits (denatured alcohol) to remove tar spots and other stains. It has been found that the use of some silicone- and wax-based polishes for this purpose can be detrimental to the windscreen wiper blades.

The upholstery of the car should be cleaned periodically by wiping over with a damp cloth; a little neutral soap may be used if necessary. Neither detergents, caustic soaps, nor spirits of any kind must be used. Accumulations of dirt, if left too long, eventually work into the pores of the leather, giving a soiled appearance.

Section O.7

REMOVING AND REPLACING THE HEATER UNIT

Drain the water from the cooling system.

Slacken the clips and remove both water hoses from the heater unit.

Disconnect the electrical feed cable from the motor.

Remove the five bolts securing the heater unit to the engine bulkhead and manœuvre the unit from the car.

Reassembly instructions are a reversal of the above, but ensure that the seal on the engine bulkhead is in good condition before refitting the unit.

After filling the cooling system check all connections on the heater for leaks after running the engine for a few minutes.

On some cars a heater is fitted in the rear compartment and secured by two nuts under the passenger's seat, which, when removed, allows the heater to be withdrawn upwards after releasing also the hose clips and cable.

Section O.8

BODY REPAIR PROCEDURE

When using the jack care must be taken to use it in the correct positions to rectify the fault or misalignment.

With a suitable oxy-acetylene outfit (Section O.10) almost any type of repair can be effected. The initial outlay need only be small, and, considering the wide range of operations covered, there should be no hesitation in deciding that the kit must figure as part of the equipment of your repair shop.

Rectification of buckled panels

It is of paramount importance to return the damaged portion of the body to its original position before deciding whether replacement panels are necessary or not.

With the use of a body jack this method enables a buckled or damaged structure to be returned to its original relative position without straining the surrounding metal, which would be the inevitable result if the damaged portion were pounded by means of a hammer. At this stage a decision can be reached as to whether any damaged panel is to be repaired or renewed.

Spoon for removal of small dents

To remove small dents a spoon which is made from a coarse-cut file, specially shaped and having the teeth intact, is used in conjunction with a suitably shaped dolly block (Fig. O.3).

The use of a hammer to remove small dents is to be deprecated, as hammer-blows tend to stretch the surrounding metal, giving rise to further complications. It is for this reason that the spoon is recommended, as by its use a depression can be raised to its original level without stretching.

On panel work such as doors, or where inside reinforcements prevent the use of a dolly block, a hole can be punched or drilled through the inside panel and a suitable drift pin, about ½ in. (13 mm.) in diameter, used in conjunction with the spoon in place of the dolly block.

Sharper dents or a dent or collection of dents covering a large area will require the use of heat, a dolly, and a spoon in the following manner.

Fig. O.3
Removing a dent by tapping with a spoon; a dolly is held below the dent

Fig. O.5
Heating the damaged area before tapping with a mallet

With the welding torch heat a small area at the outside of the collection of dents, then, holding the dolly below, hammer the raised portion with a wooden mallet. When the metal cools remove the dolly and place a large handful of wet asbestos over the heated area to prevent the heat spreading. Continue to heat and tap, working from the outside of the damaged area, until something like the original contour and level is attained.

Lightly file the surface to show up the high-spots and remove these with the dolly and spoon without further heating.

Take care when using the file not to thin the metal more than is necessary to show up the high-spots.

Alternate checking by filing and raising with the dolly block and spoon will eventually produce a flat and clean surface without weakening the metal unduly, provided excessive filing is avoided. Care should be exercised to reduce filing to a minimum as otherwise the thickness of the panel will be seriously reduced.

On completion, the surface may be tinned and any small indentations filled with plumber's solder.

Preservation of paintwork

A special spoon, having the teeth removed and its surface planished and polished, is required to enable small dents to be removed without damage to paintwork. Where it is possible to preserve paintwork when rectifying comparatively large dents a sandbag should be placed against the painted surface of the panel and the dent removed from the under side by the use of a wooden mallet. A suitable sandbag for this operation may be made from a leather oval bag 8 in. (20 cm.) long, 6 in. (15 cm.) wide, and 4 in. (10 cm.) thick which is packed tightly with sand.

Stretched panels

Stretched panels which are liable to cause drumming can be rectified by local shrinking. A liberal heap of wet asbestos is placed over the stretched panel at the point of greatest resiliency, and a hole just large enough to apply

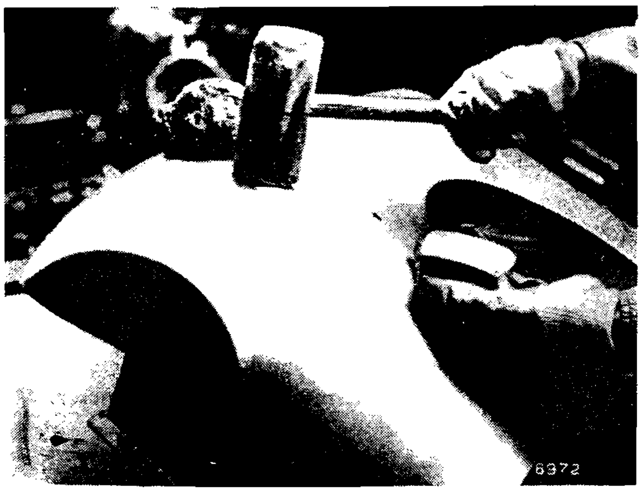


Fig. O.4
A dolly block and mallet

Fig. O.6
Cooling the damaged area with wet asbestos

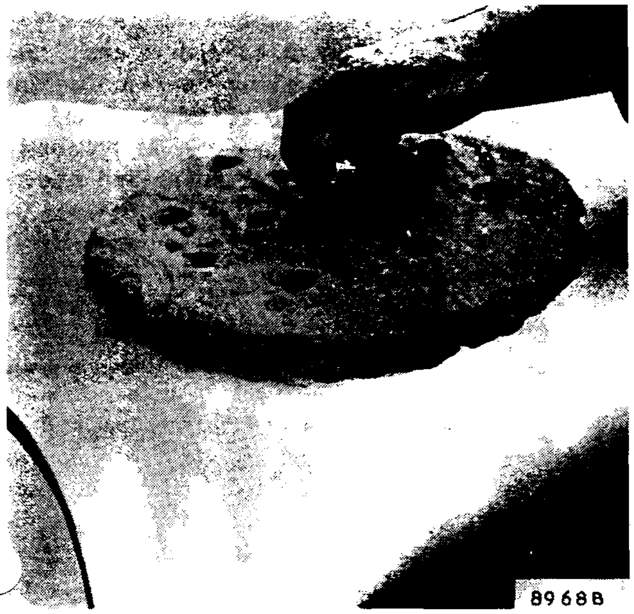


Fig. O.7
Piercing holes in the wet asbestos prior to heating

the flame of the oxy-acetylene torch is made with a finger through the centre of the asbestos. The portion of the panel which is visible is heated to a cherry-red colour and is afterwards cooled off by the wet asbestos which surrounds it. For large panels it may be necessary to repeat this operation several times at different locations over the area.

Where a panel is stretched over a fairly extensive area and produces what is known as an 'oilcan' effect the following shrinking method should be used to restore the original contour.

Mix a quantity of wet asbestos sufficient to cover the 'amaged area with a thickness as shown in Fig. O.7. Press the asbestos down firmly to ensure that no air is trapped below, as it is important to confine the applied heat to the points of application.

Fig. O.8
Heating a stretched panel through holes in the asbestos

With a finger pierce a series of holes in the asbestos extending to the surface of the metal. Direct the flame of the welding torch to one of the holes near the perimeter of the asbestos and heat the metal to cherry red, remove the torch, and immediately press the surrounding asbestos into the hole (Fig. O.8).

Carry out the same procedure with the remaining holes, working around the asbestos and inwards towards the centre. When the asbestos is removed the surface is cleaned up in the usual manner.

Patching

It is frequently more economical to patch an extensively damaged panel than to renew the entire assembly. This type of repair does not in the least weaken the surrounding structure, as a patch which is correctly gas-welded in position is equal in strength to the original structure. A patch can be introduced so efficiently that it is impossible to trace its presence.

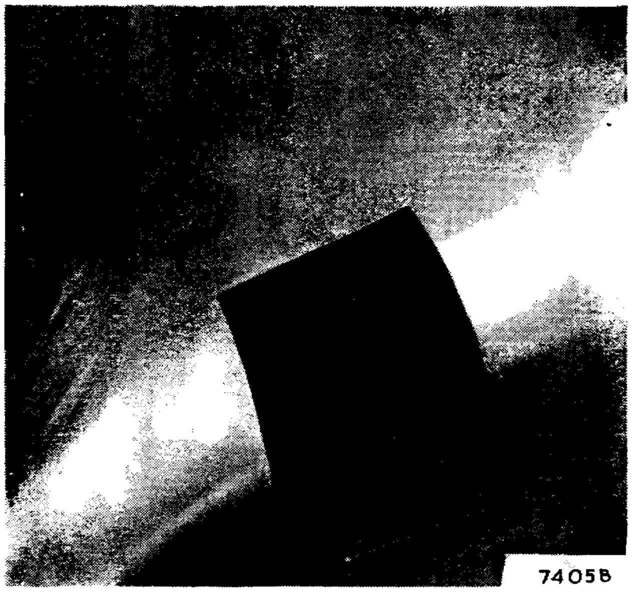


Fig. O.9
A damaged panel with piece removed for patching

The damaged portion of the panel should be cut out with a cold chisel or, if possible, by means of a hacksaw. The edges of the opening should then be filed until an even contour is obtained (Fig. O.9).

The patch to be fitted should preferably be cut from sheet metal of similar gauge and specification to that being repaired. First, it is rough-shaped to the contour of the panel, after which it is fitted to the opening to allow a clearance on all sides equal to the gauge of the metal.

In all probability, particularly during welding operations, difficulty will be experienced in holding the patch in place. This can be overcome satisfactorily by welding one or two short pieces of welding wire to act as convenient handles.

The patch is now fastened at intervals of 2 to 3 in. (5 to 8 cm.) to the panel by means of gas-weld tacks (Fig. O.10). During the tacking operation it should be reshaped to the panel to ensure that the contour is correct.

To prevent expansion and possible buckling of the surrounding panel during the welding operation a liberal quantity of wet asbestos must be placed on the panel round the patch, approximately ¼ in. (6 mm.) away from the joint (Fig. O.11). The joint is now gas-welded between the tacks, whilst precautions are taken to keep the patch to the correct contour by using a suitable dolly block and bumping hammer. On completion, any excrescences in the welding are removed by filing and, after straightening with the dolly block and bumping hammer, the patching is finally finished by tinning and solder-filling as described in Section O.10.

Patch forming

Where it is necessary to 'form' a patch from the flat sheet to any particular contour a wooden or lead raising block is generally employed. The raising block should

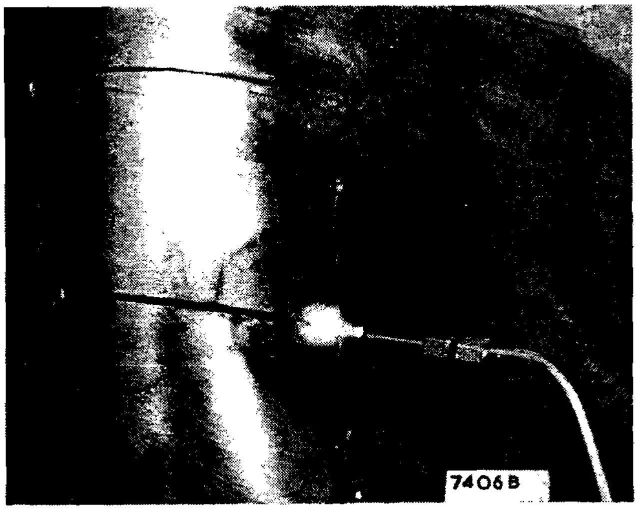


Fig. O.10
The formed patch held in position by gas-weld tacks

have several elliptical depressions of varying depths and diameters.

The patch is placed over the selected depression and is raised by hammering with the ball-peen end of a hammer, starting from the outer edges and gradually working towards the centre. A mistake frequently made is to strike too hard whilst raising the centre, with the result that the curve is of greater depth than that required.

Repair of beadings and mouldings

Where difficulty is experienced in straightening or renewing a beading, moulding, or corner the original contour may be obtained by careful tinning and filling with plumber's solder. The finished work will be equal in appearance and equal in strength, whilst the substitution of soldering for straightening, or renewing, will save the necessity for removing inside trimmings, etc.

Filing

It should be clearly understood that in every case filing must be reduced to a minimum owing to the thinness of the material. Wrinkles or ridges should be removed by the spoon or dolly block, as previously explained, and finished finally by tinning and solder-filling.

Replacing panels

In cases of extreme damage it will be found more economical to remove the damaged portions and replace them with new panels which are obtainable from BL Cars Service.

Owing to the fact that damage is usually localized, it will only infrequently be found necessary to remove a complete panel or unit. In the great majority of cases the damaged portion can be removed and a corresponding part cut from a replacement unit and located in position by gas-welding.

Fig. O.11
Surround the joint with wet asbestos to prevent buckling during welding

Section O.9

WELDING METHODS

Spot-welds

The units to be joined are pressed together between two copper electrodes through which an electric current of low voltage and high amperage is passed. The resistance of the steel to the electric current raises the metal to welding temperature and the pressure between the electrodes produces complete fusion. The resulting joint is as strong as the surrounding structure, and a correctly made spot-weld will not break or become loose by vibration.

Spot-welds cannot be broken satisfactorily by inserting a cold chisel or lever between the two panels. Each weld must be carefully drilled in the centre, using a drill approximately $\frac{3}{16}$ in. (4·76 mm.) in diameter. There is no necessity to drill through both panels as it is sufficient if the point of the drill merely penetrates the second panel. The weld is finally broken by inserting a thin, sharp, cold chisel between the joint and tapping it lightly.

On panels where the spot-welds are covered by paint it is necessary to use a suitable paint remover to clean the paint from the joints. The spot-welds will easily be located by the discoloration of the metal. Reference to the body build-up illustrations will facilitate tracing the various joints.

Gas-welds

A gas-weld may be broken either by cutting with a hacksaw or, alternatively, with a sharp cold chisel. Place a suitable support at the back of the panel to act as an anvil whenever possible.

Lap-welds

Most lap-welds used in the body are hidden from view by solder-filling. Reference should be made to the illustrations showing the build-up of the body in order to obtain the location of the various lap joints. This will enable the operator to direct the flame of the oxy-acetylene blowpipe onto the joint so that the solder-filling can be melted and removed by the use of a duster. A lap-weld is broken by drilling out the spot-welds as previously explained.

Butt-welds

A butt-weld can be broken by the use of a hammer and chisel, the blows being directed against the panel which is to be renewed. If this method does not quickly break the weld heat applied from the oxy-acetylene torch will soften the fused edges, thus assisting the operation. Alternatively, the joint may be cut by a hacksaw.

Remaking welds

The special section of this Manual devoted to welding should be studied carefully before any attempt is made to re-weld a joint on the body by an operator who has not had the necessary experience in this class of work.

When a joint is remade it is necessary, prior to painting, to clean the surface of the weld. During this operation, as previously mentioned, care should be taken to see that the structure is not unnecessarily weakened by excessive grinding or filing. It is preferable to hammer the joint so that it lies slightly lower than the surrounding metal and to flow solder into the depression. No amount of filing on the surface of the solder can reduce the strength of the joint below (see Section O.11).

When placing a new panel in position it should be joined where possible by gas welding through the holes drilled in breaking the original spot-welds. During the welding operations a liberal heap of wet asbestos should be placed over the surrounding panels to prevent buckling and distortion due to heat.

Section O.10

WELDING TECHNIQUE

The following applies to equipment supplied by the British Oxygen Co. Ltd., although they also apply, in the main, to other similar equipment.

Welding equipment

High-pressure oxy-acetylene welding equipment using dissolved acetylene is recommended. This consists of:

(1) Supply of acetylene in cylinders.
(2) Supply of oxygen in cylinders.
(3) Blowpipe with necessary nozzles.
(4) Acetylene pressure regulator.
(5) Oxygen pressure regulator.
(6) Two lengths of rubber-canvas hose.
(7) Set of spanners and spindle key.
(8) Welding goggles and spark lighter.
(9) Welding rods.
(10) Welding fluxes.
(11) Trolley for accommodating complete equipment and cylinders.

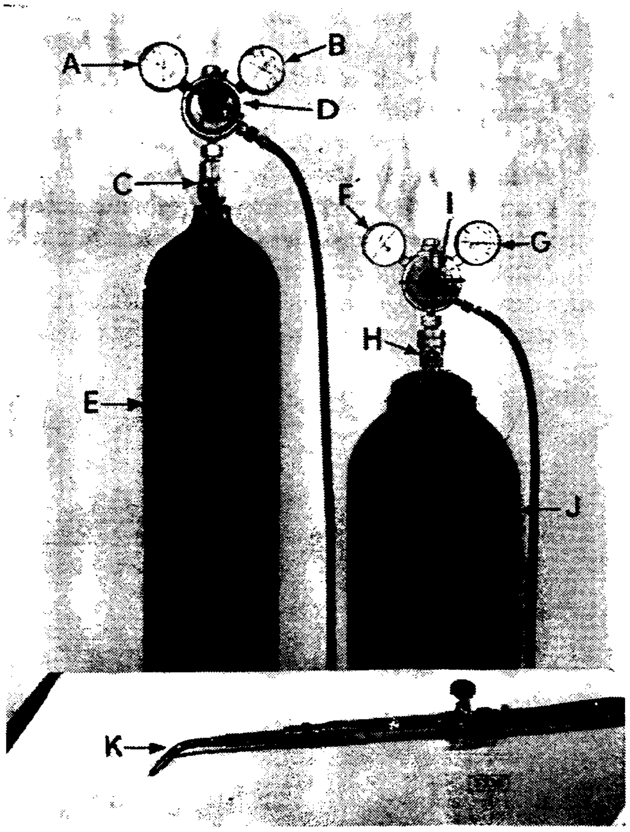


Fig. O.12

High-pressure oxy-acetylene welding outfit

A. Outlet pressure gauge (O).
B. Cylinder contents gauge (O).
C. Valve.
D. Pressure regulating screw.
E. Oxygen cylinder (BLACK).
F. Outlet pressure gauge (A).
G. Cylinder contents gauge (A)
H. Valve.
I. Pressure regulating screw.
J. Acetylene cylinder (MAROON).
K. Blowpipe interchangeable nozzles.

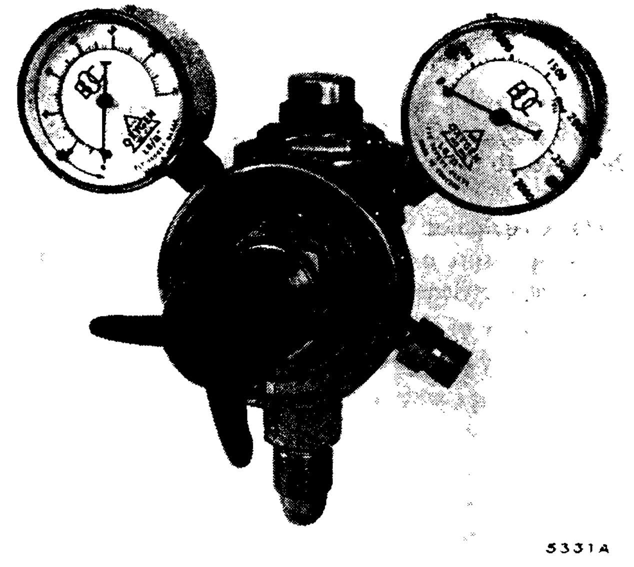


Fig. O.13

Type B.O.R.12A two-stage oxygen regulator

Assembling

(1) Stand both cylinders vertically on the ground or on a trolley. Oxygen cylinders are painted BLACK. Acetylene cylinders are painted MAROON. Never attempt to interfere with the colour of cylinders or to repaint them.

(2) See that jointing surfaces in cylinder valves and regulators are free from oil or grease.

(3) Open the valve on the oxygen cylinder momentarily in order to dislodge dirt or obstruction in the cylinder valve, then close.

(4) Screw the oxygen regulator (painted BLACK) into the oxygen cylinder valve. The oxygen cylinder valve outlet and oxygen regulator connection have **right-hand** screw threads.

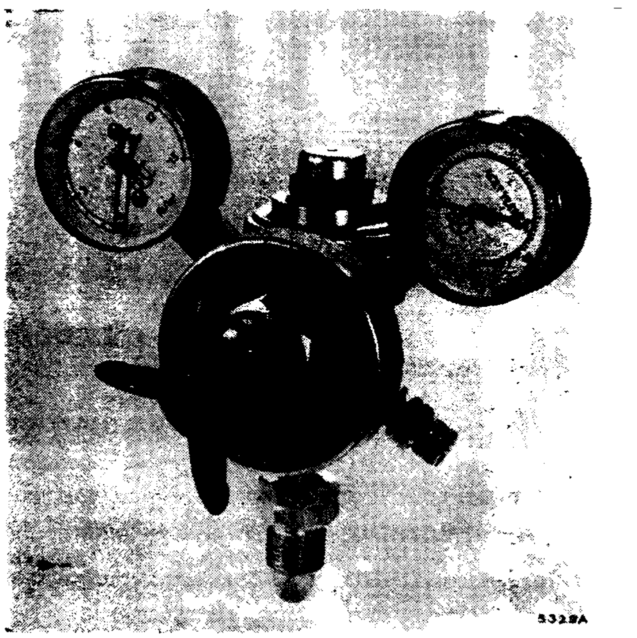


Fig. O.14

Type B.A.R.9 two-stage acetylene regulator

(5) Screw the acetylene regulator (painted MAROON) into the acetylene cylinder valve. The acetylene cylinder valve outlet and acetylene regulator connection have **left-hand** screw threads.

(6) Tighten the regulator in the cylinder valve. Do not use excessive force, but make certain that the joints are gastight.

(7) Connect the hose (acetylene RED, oxygen BLACK) to the screwed outlets of the regulators by means of the screwed connections secured in the ends of the hose. Blow the hose through before attaching to the regulator or blowpipe in order to remove dust or dirt and to remove chalk when the hose is new.

(8) Connect the other end of the hose, that fitted with a hose protector, to the blowpipe—the acetylene hose to the connection marked 'A', the oxygen to the connection marked 'O'. Keep the blowpipe control valves closed. (A high- or low-pressure blowpipe can be used with the dissolved acetylene. If a low-pressure blowpipe is used the acetylene pressure should never exceed 2 lb./sq. in.).

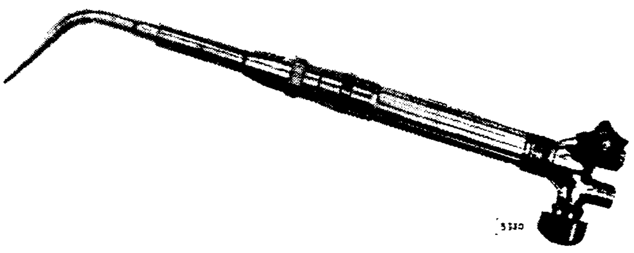


Fig. O.15

The welding blowpipe

(9) Fix the appropriate nozzle to the blowpipe. (See the table on page O.9.)

(10) Open the cylinder valves very slowly by means of the cylinder key. Do not open suddenly, or there may be serious damage to the regulator and the possibility of an accident. Open the cylinder valve spindle one turn only.

(11) Set the regulators at the correct working pressures. (See the table.)

(12) Open the acetylene control valve on the blowpipe, wait a few seconds until air is blown out and pure acetylene is coming from the blowpipe nozzle, then light, preferably by means of a spark lighter, type S.L.1.

(13) Reduce or increase the acetylene supply by the blowpipe valve until the flame just ceases to smoke.

(14) Turn on the oxygen by the blowpipe control valve until the white inner cone in the flame is sharply defined, with the merest trace of an acetylene haze.

The blowpipe is now adjusted for welding steel, and work may be commenced.

The size of nozzle given for a particular thickness of steel is for general guidance only and will vary according to the skill of the welder, mass of metal, etc. The capacity

WELDING

HIGH-PRESSURE BLOWPIPES

Nozzle Sizes, Working Pressures, and Gas Consumptions for Various Metal Thicknesses

M.S. plate thickness		*Nozzle size*	*Regulator pressures, oxygen and acetylene Saffire equipment*		*Approximate consumption of each gas*	
in.	*mm. (approx.)*		*lb./sq. in.*	*kg./cm.²*	*cu. ft./hr.*	*m.³/hr.*
$\frac{1}{32}$	·8	1	2	·14	1	·028
$\frac{3}{64}$	1·2	2	2	·14	2	·056
$\frac{1}{16}$	1·6	3	2	·14	3	·084
$\frac{3}{32}$	2·4	5	2	·14	5	·140
$\frac{1}{8}$	3·2	7	2	·14	7	·196
$\frac{5}{32}$	4·0	10	3	·21	10	·283
$\frac{3}{16}$	4·8	13	3	·21	13	·367
$\frac{1}{4}$	6·4	18	3	·21	18	·504
$\frac{5}{16}$	8·0	25	4	·28	25	·700

of each nozzle overlaps the capacities of those next in size to it. The values given are for downhand butt-welds in mild steel. For other techniques nozzle size and pressure may have to be varied slightly, e.g. for copper select a larger nozzle, for aluminium a smaller nozzle.

On thin-gauge steel up to and including $\frac{1}{16}$ in. (1·6 mm.) thickness tacks should be slightly closer together—say, 1 to 1½ in. (25 to 38 mm.) apart—to keep the edges in alignment and minimize distortion.

For the same reason patches should, wherever possible, be oval or circular. Before welding, these should be slightly 'dished' below the level of the surface to be patched, since welding—even by the correct 'sequence'—will cause them to expand and rise.

Do not light the blowpipe until everything else has been prepared for welding in accordance with the instructions given above. On completion of the job proceed as follows:

(1) Turn off the acetylene first by the blowpipe control valve, and then the oxygen.

(2) Close the cylinder valves.

(3) Open the blowpipe valves one at a time to release the pressure in the hose—open the oxygen valve and shut it, open the acetylene valve and shut it.

(4) Unscrew the pressure regulating screws on the oxygen and acetylene regulators.

(5) In the case of **backfire** turn off the **oxygen** first.

Section O.11

TORCH-SOLDERING

Torch-soldering is the method employed to obtain the desired contour of a panel without weakening the structure and with the minimum amount of straightening, filing, and polishing.

The solder used is an alloy of lead and tin. Lead melts at a temperature of 621° F. (327° C.) and tin at 450° F. (232° C.). Alloys of the two metals change from a solid to a liquid state over this range of temperature within which they are in a plastic condition. The alloys used for torch-soldering are known as tinman's solder (which contains 60 per cent. lead and 40 per cent. tin) and plumber's solder (which contains 70 per cent. lead and 30 per cent. tin). Tinman's solder, as a result of its higher tin content, alloys more readily with the surface of the sheet steel and is applied as a 'base' to which the plumber's solder adheres firmly. Plumber's solder remains plastic over a wide range of temperature (from 358 to 509° F. [181 to 265° C.]), and within this range can be moulded to any desired shape. For this reason it is used to obtain the required contours.

Where it is desired to build up a contour with solder

Fig. O.16
Painting the hollow area with flux

Fig. O.17
Tinning by heating the flux-painted area

the surface of the steel must first of all be cleaned thoroughly. Rust, scale, welding oxide, or any other impurity must be removed by means of a wire brush, file, and emery-cloth. A polishing-wheel, if available, is useful for this operation.

The surface of the metal is heated gently with a blow-lamp or gas-torch and soldering flux applied with a brush (see Fig. O.16).

The flux will melt and act upon the heated surface so that when tinman's solder is applied and rubbed with a wad of hemp the metal will become evenly coated with a thin layer of solder, or 'tinned' (Fig. O.17). The secret of successful torch-soldering lies in the thoroughness with which the tinning operation is carried out as it is the foundation on which the plumber's solder is to be built up.

A second application of flux should be made and gently heated by means of the torch. When wiped by the wad of hemp the entire surface of the metal should have a spotlessly clean and bright appearance.

Plumber's solder is now melted onto the surface (Fig. O.18) and maintained by careful use of the torch in the plastic condition whilst it is moulded to the desired contour with a hardwood paddle coated with palm oil (Fig. O.19). During the moulding operation frequent immersion of the paddle in palm oil assists in the

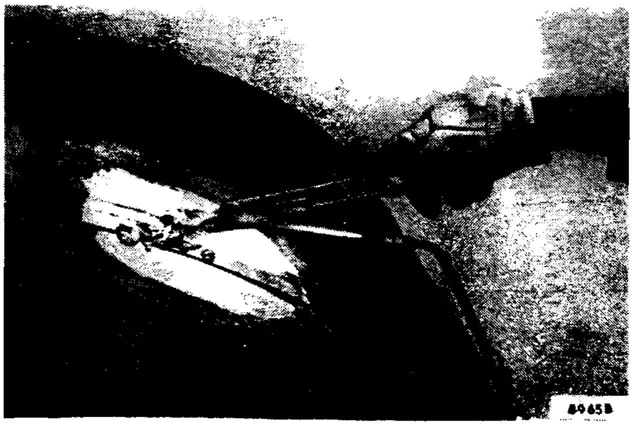


Fig. O.18
Applying the solder

Fig. O.19
Spreading the solder

manipulation of the solder. If palm oil is not available boiled linseed, lard, or machine oil will be found satisfactory.

The final contour is obtained by filing or, if available, by the use of a polishing-wheel. If the work is carefully carried out it should be impossible to trace the presence of the filling.

Section O.12

STATIC SEAT BELTS

WARNING.—When seat belts have been used in a vehicle which has been involved in an accident resulting in a severe impact, the complete belt assemblies must be renewed, including the centre buckles and mounting straps.

Removing

(1) Remove the bolt and detach the lower belt bracket, anti-rattle washer, shouldered distance piece and plain washer.
(2) Extract the cap covering the upper belt bracket bolt.
(3) Remove the bolt, parking device, upper belt bracket, anti-rattle washer and shouldered distance piece.
(4) Remove the bolt with its spring washer and detach the buckle unit and plain distance piece.

Refitting

(5) Reverse the order of the removing procedure, noting the following:
  (*a*) All distance pieces must make full metal-to-metal contact with body fixing points.
  (*b*) The belt brackets and buckle units must be refitted with their component parts in the order shown in Fig. O.20.
  (*c*) The deeper shouldered distance piece must be used at the upper mounting point. The parking device fits over the small diameter of the distance piece.
  (*d*) The bolt securing the buckle unit must be tightened with the buckle placed near the junction between the seat back and the seat cushion.
  (*e*) Tighten the belt bracket bolts to 17 lb. ft. (2·35 kg. m.).

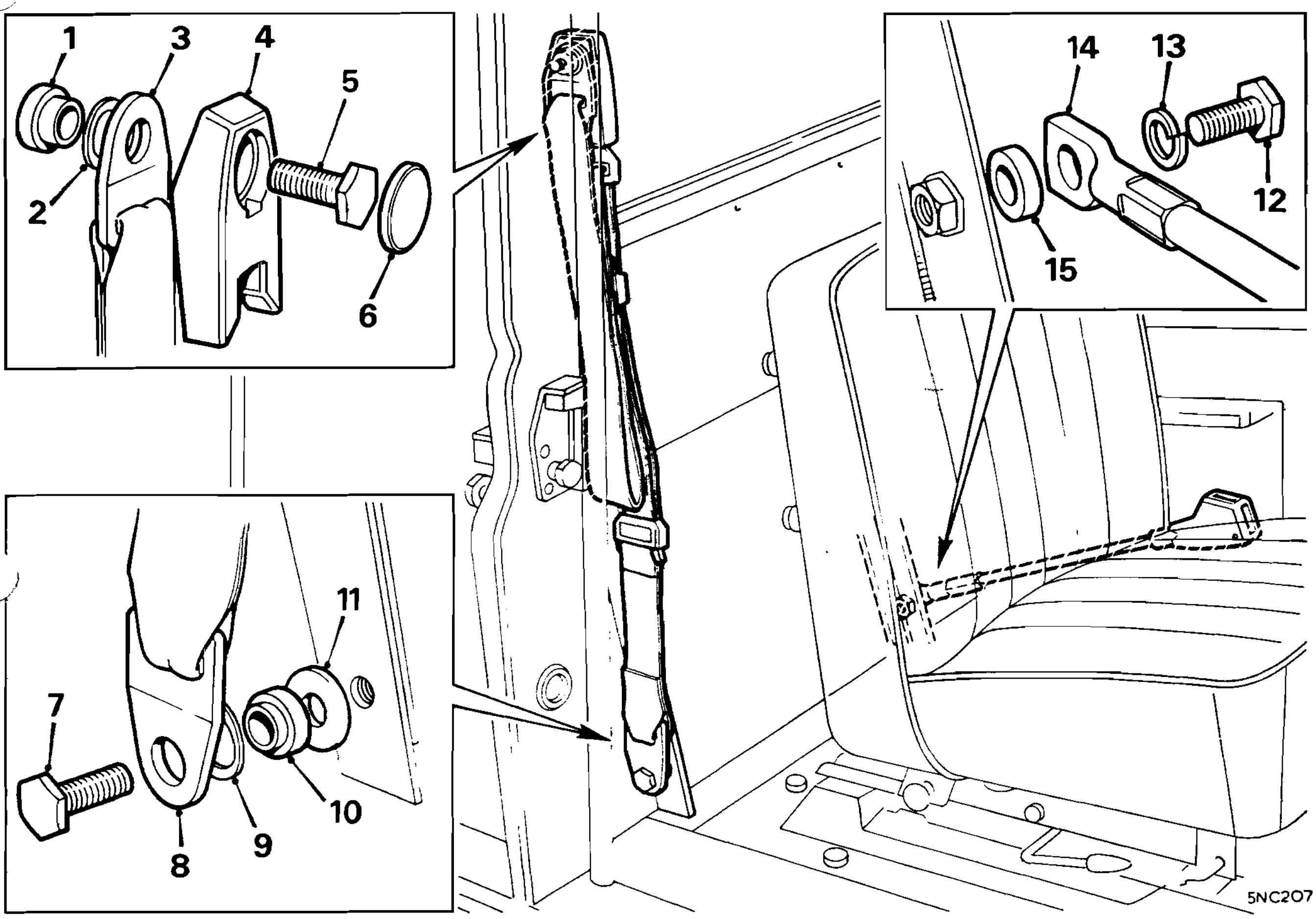


Fig. O.20

Static seat belt fixings

1. Deep shouldered distance piece.
2. Anti-rattle washer.
3. Upper belt bracket.
4. Parking device.
5. Retaining bolt.
6. Cap.
7. Retaining bolt.
8. Lower belt bracket.
9. Anti-rattle washer.
10. Shouldered distance piece.
11. Plain washer.
12. Retaining bolt.
13. Spring washer.
14. Buckle unit.
15. Distance piece.

Section O.13

AUTOMATIC SEAT BELTS
(Earlier Models)

WARNING.—When seat belts have been used in a vehicle which has been involved in an accident resulting in a severe impact, the complete belt assemblies must be renewed, including the centre buckles and mounting straps.

Removing

(1) Attach a clip to the belt just above the reel to prevent the reel retracting during removal. Do not remove the clip until the reel has been refitted.
(2) Pull off the plastic cover beneath the reel.
(3) Remove the nut and bolt, with plain and spring washers, and detach the reel assembly and shouldered distance piece from the mounting bracket.
(4) Remove the two bolts, with spring washers, securing the reel mounting bracket to the floor.
(5) Remove the bolt, with spring washer and detach the lower belt bracket.
(6) Remove the bolt and detach the upper belt bracket, anti-rattle washer, and shouldered distance piece.
(7) Remove the bolt and detach the buckle unit and plain washer.

Refitting

(8) Reverse the order of the removing procedure, noting the following:
  (*a*) All distance pieces must make full metal-to-metal contact with the body fixing points.
  (*b*) The belt brackets, reel assemblies, and buckle units must be refitted with their component parts as shown in Fig. O.21.
  (*c*) The bolt securing the buckle unit must be tightened with the buckle placed near the junction between the seat back and the seat cushion.
  (*d*) Tighten the belt bracket bolts to 17 lb. ft. (2·35 kg. m.).

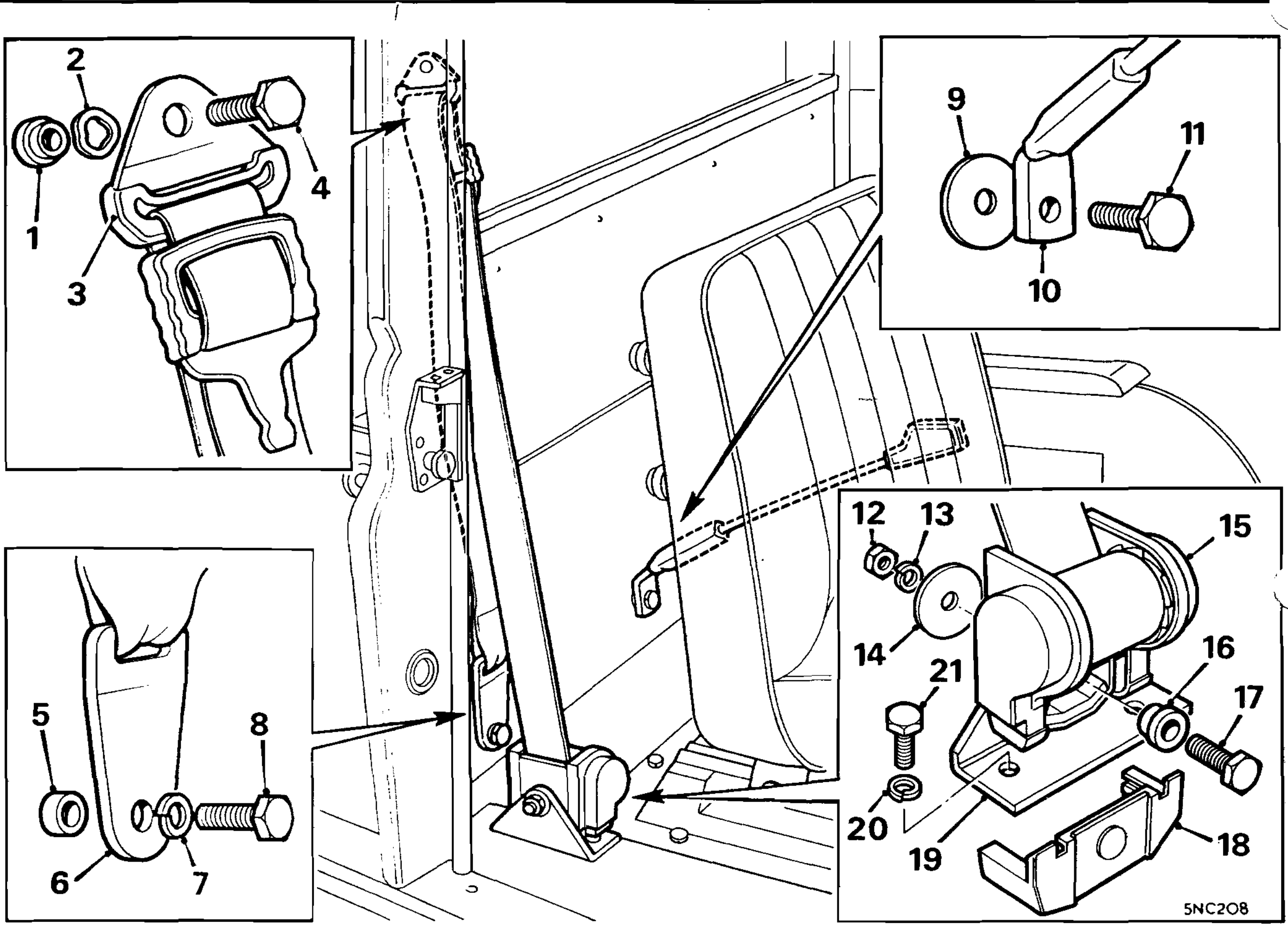


Fig. O.21

Automatic seat belt fixings (earlier models)

1. Shouldered distance piece.
2. Anti-rattle washer.
3. Upper belt bracket.
4. Retaining bolt.
5. Distance piece.
6. Lower belt bracket.
7. Spring washer.
8. Retaining bolt.
9. Plain washer.
10. Buckle unit.
11. Retaining bolt.
12. Nut.
13. Spring washer.
14. Plain washer.
15. Reel assembly.
16. Shouldered distance piece.
17. Retaining bolt.
18. Cover.
19. Mounting bracket.
20. Spring washer.
21. Retaining bolt.

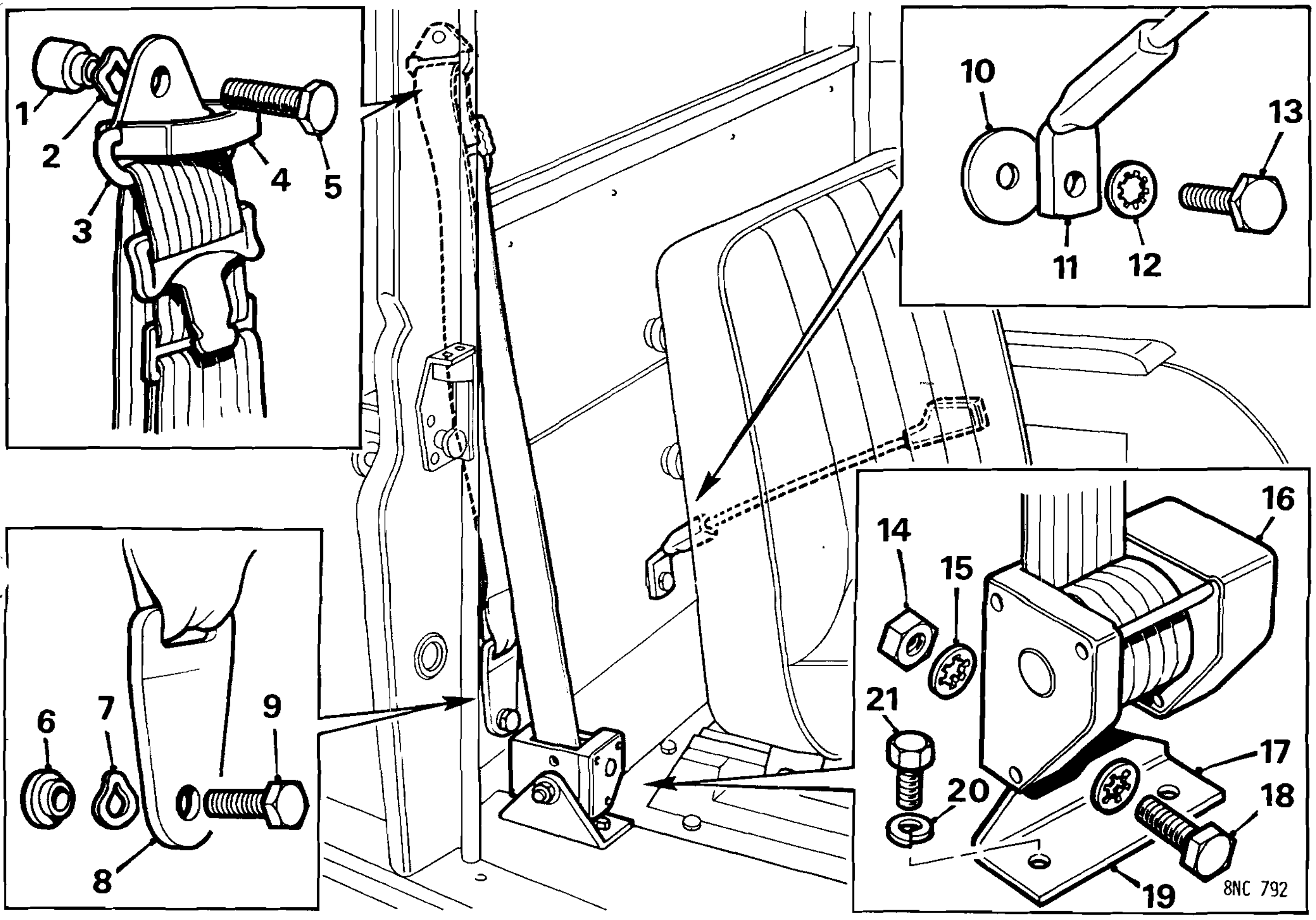


Fig. O.22

Automatic seat belts (later models)

1. Shouldered distance piece.	8. Lower belt bracket.	15. Serrated washer.
2. Anti-rattle washer.	9. Retaining bolt.	16. Reel assembly.
3. Upper belt bracket.	10. Plain washer.	17. Serrated washer.
4. Cover.	11. Buckle unit.	18. Retaining bolt.
5. Retaining bolt.	12. Serrated washer.	19. Mounting bracket.
6. Shouldered distance piece.	13. Retaining bolt.	20. Spring washer.
7. Anti-rattle washer.	14. Nut.	21. Retaining bolt.

Section O.14

AUTOMATIC SEAT BELTS
(Later Models)

WARNING: When seat belts have been used in a vehicle which has been involved in an accident resulting in a severe impact, the complete belt assemblies must be renewed, including the centre buckles and mounting straps.

Removing

(1) Attach a clip to the belt just above the reel to prevent the reel retracting during removal. Do not remove the clip until the reel has been refitted.

(2) Remove the nut and bolt, with serrated washers, and detach the reel assembly from the mounting bracket.

(3) Remove the two bolts, with spring washers, securing the reel mounting bracket to the floor.

(4) Remove the bolt, with anti-rattle washer and shouldered distance piece, and detach the lower belt bracket.

(5) Pull off the cover, remove the bolt and detach the upper belt bracket, anti-rattle washer and shouldered distance piece.

(6) Remove the bolt and detach the buckle unit, with serrated and plain washers.

Refitting

(7) Reverse the order of the removing procedure, noting the following:

(*a*) All distance pieces must make full metal-to-metal contact with the body fixing points.

(*b*) The belt brackets, reel assemblies, and buckle units must be refitted with their component parts as shown in Fig. O.1.

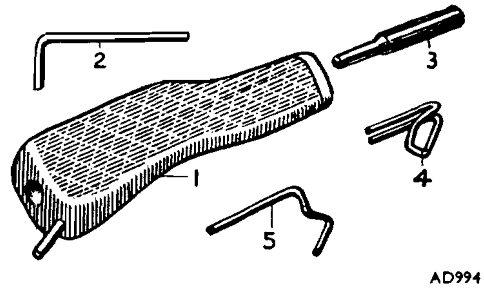
(*c*) The bolt securing the buckle unit must be tightened with the buckle placed near the junction between the seat back and the seat cushion.

(*d*) Tighten the belt bracket bolts to 2·35 kgf m (17 lbf ft).

SERVICE TOOLS

18G468. Rubber Moulding Glazing Tool

A tool for fitting the rubber sealing strip to the windscreen and the rear window rubber mouldings. The tool comprises: (1) Handle, (2) Key, (3) Post, (4) Eye, (5) Hook.



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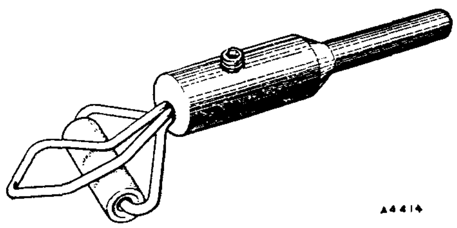
18G468A. Rubber Moulding Glazing Tool Adaptor



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SECTION P

THE CHASSIS FRAME

Section P.1

DESCRIPTION

The frame serves as the structural centre of the vehicle. In addition to supporting the load it provides and maintains a fixed relationship between other units to assure normal freedom of operation. The frame is constructed of pressed-steel channel-section side-members reinforced by cross-bracing. Most of the brackets, members, and gussets are attached to the side-members with rivets.

Section P.2

CHECKING THE ALIGNMENT

Whenever the vehicle has been subjected to any accident which might result in a bent or sprung frame a check should be made for proper frame alignment, correct steering, and alignment of the axles. When a frame is suspected of being out of alignment because of a collision or some other form of accident it is better practice to remove parts and units as required so that diagonal measurements may be taken on the frame itself. A convenient way to check the alignment, particularly when the body, etc., are still in position, is by marking on the floor all points from which measurements are taken by dropping a plumb-bob from these points—say the outer edge of the spring brackets or gussets. Pairs of each diagonal measurements should be within $\frac{3}{32}$ in. (2·4 mm.), and if they are in excess of this amount it means that correction will have to be made between those measured points that are not equal. Cross-checking of this nature between the front gussets and the rear spring brackets, together with a cross-check on the centre portion of the frame, should be sufficient normally to detect any marked degree of misalignment. Longitudinal discrepancies can be checked by using close-fitting bars inserted through the spring brackets, which, within limits, will show up any departure from true alignment.

In cases where bending or twisting is not excessive the frame should be straightened cold. Where, however, a frame member is more severely distorted the damaged area should be heated from 1,380 to 1,560° F. (750 to 850° C.), (cherry red) as quickly as possible before straightening afterwards allowing it to cool slowly in air.

Inspect members and brackets for cracks and fractures and where any are revealed renew the parts. When it becomes necessary to remove or install any of those parts which are riveted the head of the original rivets should be drilled and cut off, the rivet punched out, and the holes reamed to suit high-tensile-steel bolts.

Check for loose rivets and, if necessary, replace by bolts, nuts, and spring washers.

Clean and paint any parts as necessary.

SECTION Q

THE IGNITION SYSTEM

(PETROL MODELS)

Section Q.1

DESCRIPTION

At slow engine speeds the ignition point is retarded. At high speeds the ignition point is advanced by an automatic timing control mechanism operated by centrifugal force.

A vacuum-operated timing control is also fitted, designed to give additional advance under part-throttle conditions. The combined effects of the centrifugal and vacuum-operated timing controls give added efficiency over the full operating range of the engine, with a corresponding economy in fuel consumption. A micrometer adjustment is fitted by which fine alterations to the timing can be made to allow for changes in running conditions as a result of carbonization or change of fuel.

A completely sealed, metallized paper capacitor is fitted to the distributor. This has the property of being self-healing in the event of a breakdown, so that trouble arising from this source should be very infrequent.

The high-tension pick-up brush in the distributor cover is of composite construction, the top portion consisting of a resistive compound and the lower of softer carbon to prevent wear taking place on the rotor electrode.

The resistive portion of the brush is in circuit between the coil and distributor and gives a measure of radio interference suppression. Under no circumstances must a short, non-resistive brush be used as a replacement for one of the longer, resistive type.

Section Q.2

LOCATING THE CAUSE OF UNEVEN FIRING

Start the engine and set it to run at a fairly fast idling speed.

Short-circuit each plug in turn by pulling the insulator sleeve up the cable and placing a hammer head or the blade of a screwdriver with a wooden or insulated handle between the terminal and the cylinder head. No difference in the engine performance will be noted when short-circuiting the plug in the defective cylinder. Shorting the other plugs will make uneven running more pronounced.

Having located the cylinder which is at fault, stop the engine and remove the cable from the terminal of the sparking plug. Restart the engine and hold the end of the cable about $\frac{3}{16}$ in. (5 mm.) from the cylinder head.

If the sparking is strong and regular the fault probably lies in the sparking plug. Remove the plug, clean it, and adjust the gap to the correct setting (see **'GENERAL DATA'**), or alternatively fit a new plug.

If there is no spark or if it is weak and irregular examine the cable from the sparking plug to the distributor. After a long period of service the insulation may be cracked or perished, in which case the cable should be renewed.

Finally, examine the distributor moulded cap, wipe the inside and outside with a clean, dry cloth, see that the carbon brush moves freely in its holder, and examine the moulding closely for signs of breakdown. After long service it may become tracked—that is, a conducting path may have formed between two or more of the electrodes or between one of the electrodes and some part of the distributor in contact with the cap. Evidence of a tracked cap is shown by the presence of a thin black line. A replacement distributor cap must be fitted in place of one that has become tracked.

Section Q.3

TESTING THE LOW-TENSION CIRCUIT

Spring back the securing clips on the distributor and remove the moulded cap and rotor. If the rotor is a tight fit it can be levered off carefully with a screwdriver.

Check that the contacts are clean and free from pits, burns, oil, or grease. Turn the engine and check that the contacts are opening and closing correctly and that the clearance is correct when the contacts are fully opened.

Correct the gap if necessary to between ·014 and ·016 in. (·36 and ·40 mm.).

Disconnect the cable at the contact breaker terminal of the coil and at the low-tension terminal of the distributor, and connect a test lamp between these terminals. If the lamp lights when the contacts close and goes out when the contacts open the low-tension circuit is in order. Should the lamp fail to light, the contacts are dirty or there is a broken or loose connection in the low-tension wiring. The procedure for isolating the fault is detailed in Section Q.4.

Section Q.4

LOCATING A LOW-TENSION CIRCUIT FAULT

Having determined, by testing as described in Section Q.3, that the fault lies in the low-tension circuit, switch on the ignition and turn the engine until the contact breaker points are fully opened.

Refer to the wiring diagram and check the circuit with a voltmeter (0–20 volts) as follows.

NOTE.—**If the circuit is in order the reading on the voltmeter should be approximately 12 volts.**

(1) **Cable—battery to starter solenoid.** Connect the voltmeter between the supply terminal of the starter solenoid and an earthing point. No reading indicates a faulty cable or loose connections.

(2) **Cable (brown)—starter solenoid to ammeter.** Connect the voltmeter between the ammeter terminal and earth. No reading indicates a faulty cable or loose connections.

(3) **Ammeter.** Connect the voltmeter between the ammeter (brown and white cable terminal) and earth. No reading indicates a faulty ammeter.

(4) **Cable (brown with white)—ammeter to control box.** Connect the voltmeter between the control box terminal 'A' and earth. No reading indicates a faulty cable or loose connections.

(5) **Control box.** Connect the voltmeter between the control box terminal 'A1' and earth. No reading indicates a faulty control box.

(6) **Cable (brown with blue)—control box to ignition/master switch.** Connect the voltmeter between the ignition/master switch terminal '1' and earth. No reading indicates a faulty cable or loose connections.

(7) **Ignition/master switch.** Connect the voltmeter between the ignition switch terminal '2' and earth. No reading indicates a faulty switch.

(8) **Cable (white)—ignition/master switch to ignition coil.** Connect the voltmeter between the ignition coil terminal 'SW' and earth. No reading indicates a faulty cable or loose connections.

(9) **Ignition coil.** Connect the voltmeter between the ignition coil terminal 'CB' and earth. No reading indicates a faulty ignition coil.

(10) **Cable (black)—ignition coil to distributor.** Connect the voltmeter between the distributor terminal and earth. No reading indicates a faulty cable or loose connections.

(11) **Distributor.** Connect the voltmeter across the distributor contacts. If no reading is given, remove the capacitor and test again. If a reading is given, the capacitor is faulty.

Section Q.5

HIGH-TENSION CABLES

The high-tension cables must be examined carefully and any which have the insulation cracked, perished, or damaged in any way must be renewed.

To fit the cables to the terminal of the ignition coil thread the knurled moulded terminal nut over the cable, bare the end of the cable for about ¼ in. (6 mm.), thread the wire through the brass washer removed from the original cable, and bend back the strands over the washer. Finally, screw the terminal into the coil.

To make the connections to the terminals in the distributor moulded cap first remove the cap and slacken the screw on the inside of the moulding till they are clear of the cables. Cut the new cables off to the required length, push them completely home, and tighten the securing screws.

The cables from the distributor to the sparking plugs must be connected up in the correct firing order, which is 1, 3, 4, 2. Secure them firmly to the connectors.

Section Q.6

CONTACT BREAKER

Check the contact breaker as follows:

(1) Turn the engine until the contact breaker points are fully opened and check the gap with a gauge having a thickness of ·014 to ·016 in. (·36 to ·40 mm.). If the gap is correct the gauge should be a sliding fit. Do not alter the setting unless the gap varies considerably from the gauge thickness.

To adjust the setting keep the engine in the position which gives maximum opening of the contacts and then slacken the fixed contact plate securing screws and adjust the contact gap by moving the plate to give the required gap clearance. Tighten the securing screws.

(2) If the contacts are dirty or pitted they must be cleaned by polishing them with a fine carborundum stone and afterwards wiping them with a cloth moistened with petrol. The moving contact can be removed from its mounting in order to assist cleaning. Check and adjust the contact breaker setting after cleaning the contacts.

(3) Check that the moving arm is free on its pivot. If it is sluggish remove the arm and polish the pivot pin with a strip of fine cloth. Afterwards clean off all traces of emery dust and apply a spot of clean engine oil to the top of the pivot.

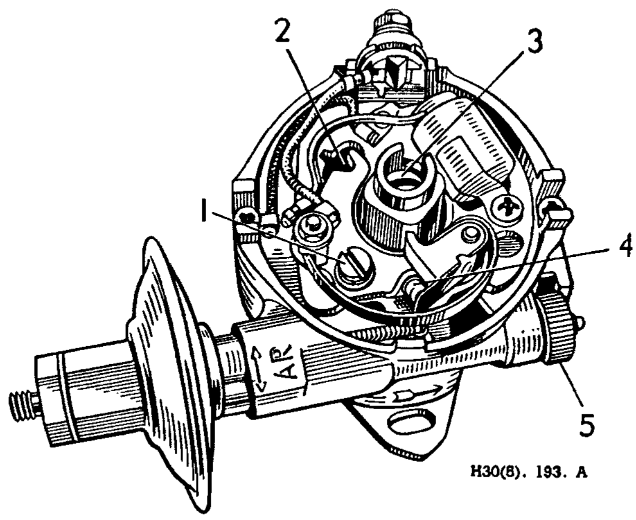


Fig. Q.1
The distributor

1. Clamp screw.
2. Adjusting slot.
3. Oiling point.
4. Contact points.
5. Micrometer adjuster.

Section Q.7

REMOVING AND REPLACING THE DISTRIBUTOR

The distributor can be removed and replaced without interfering with the ignition timing, provided the clamp plate pinch-bolt is not disturbed.

Remove the distributor cover and disconnect the low-tension lead from the terminal on the distributor. Disconnect the suction advance pipe at the union on the distributor.

To facilitate the replacement of the distributor turn the engine over until the rotor arm is in the vertical position to provide a datum for replacement.

Remove the two set bolts attaching the clamp plate to the cylinder block and withdraw the distributor complete with driving spindle and helical gear. The driving spindle is more easily withdrawn if the distributor is turned while being lifted.

To replace the distributor insert it into the cylinder block so that the rotor arm takes up its original position. Turn the distributor body to align the clamping plate holes with those in the housing. The remainder of the assembly is now in the reverse order to that of removal.

NOTE.—Provided that the engine has not been turned, the ignition timing will not require resetting. The high-tension leads can then be replaced on their respective plug terminals in the order of firing, i.e. 1, 3, 4, 2, remembering that the distributor rotation is anti-clockwise when viewed from above.

Section Q.8

DISMANTLING AND REASSEMBLING THE DISTRIBUTOR

When dismantling, carefully note the positions in which the various components are fitted, in order to ensure their correct replacement. The amount of dismantling necessary will depend on the repair required.

Spring back the securing clips and remove the moulded cover. Lift the rotor arm off the spindle, carefully levering with a screwdriver if it is tight.

Remove the terminal nut, washer, insulating piece, and cable connections from the contact breaker spring anchor post; the movable contact assembly can then be removed from its pivot on the contact breaker plate, followed by the fibre washer.

Lift the low-tension terminal complete with mounting and cable from the slot in the side of the distributor body. Remove the fixed contact plate by releasing the single screw.

Remove the capacitor after removing its securing Phillips screw and release the vacuum control link spring from the moving contact breaker plate.

Remove the two screws securing the base plate to the distributor body and withdraw the base plate. Separate the moving contact breaker plate and base plate by turning the base plate.

Remove the peg securing the distributor shaft to the spindle, when the spindle can be withdrawn. The peg is peened over at both ends and the peening must be filed off before the peg can be tapped out.

The distributor shaft, cam, and centrifugal timing control can be pressed upwards through the distributor body. Remove the cam fixing screw from the top of the driving shaft and withdraw the cam and centrifugal timing control.

To release the vacuum control from the distributor remove the spring circlip from the micrometer adjusting screw, remove the knurled adjusting nut with the spring, and withdraw the vacuum unit complete, taking care not to lose the coil springs and ratchet under the micrometer nut.

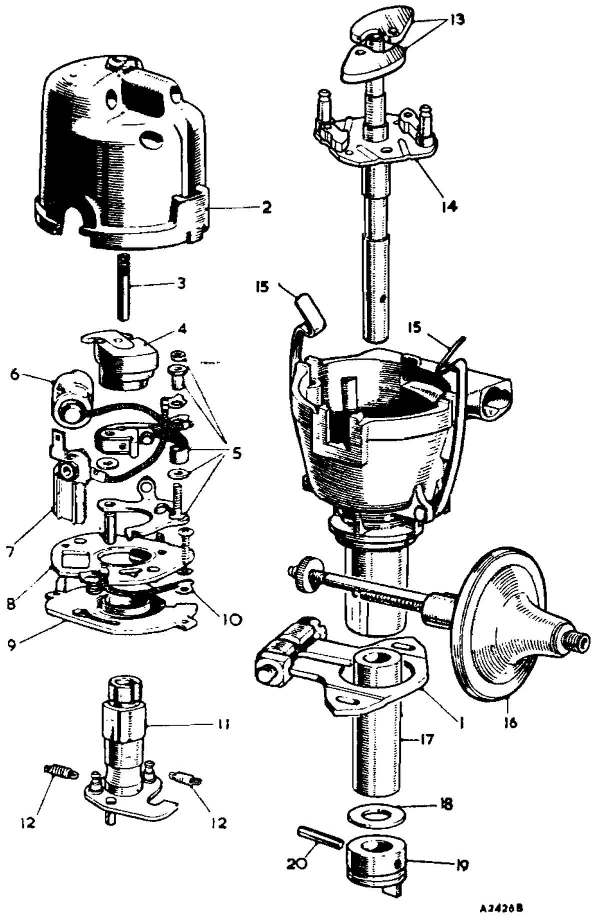


Fig. Q.2

The distributor components

1. Clamping plate.
2. Moulded cap.
3. Brush and spring.
4. Rotor arm.
5. Contacts (set).
6. Capacitor.
7. Low-tension terminal and lead.
8. Moving contact breaker plate.
9. Contact breaker base plate.
10. Earth lead.
11. Cam.
12. Automatic advance springs.
13. Weight assembly.
14. Shaft and action plate.
15. Cap retaining clips.
16. Vacuum unit.
17. Brush.
18. Thrust washer.
19. Driving dog.
20. Pin.

Release the clamp bolt and remove the clamp plate from the distributor.

Clean the distributor cover and examine it for signs of cracks and evidence of 'tracking', i.e. a conducting path may have formed between adjacent segments. This is indicated by a thin black line between the segments; when this has occurred the cover should be renewed.

Ensure that the carbon brush moves freely in the distributor cover. Examine the attachment of the metal electrode to the rotor moulding, and if slack or abnormally burned renew the rotor.

The contact face of the contact breaker points should present a clean, greyish, frosted appearance. If burned or blackened, renew the contact set or polish the contact face of each point with a fine oil-stone, working with a rotary motion. Care should be taken to maintain the faces of the points flat and square, so that, when reassembled, full contact is obtained. Clean the points thoroughly in petrol.

Check that the movable contact arm is free on its pivot without slackness.

Check the contact breaker spring tension, using a small spring scale. The tension measured at the contacts should be within the limits of 20 to 24 oz. (567 to 679 gm.). If necessary, reset the spring by bending.

Check the centrifugal timing control balance weights and pivot pins for wear, and renew the cam assembly or weights if necessary.

The cam assembly should be a free sliding fit on the driving shaft. If the clearance is excessive, or the cam face is worn, renew the cam assembly or shaft as necessary.

Check the fit of the shaft in the body bearing bushes. If slack, renew the bushes and shaft as necessary. Press out the old bushes. The new bushes should be allowed to stand completely immersed in thin engine oil for 24 hours, or alternatively for two hours in oil which has been heated to 100° C. (212° F.), before pressing them into the distributor body.

Reassembly of the distributor is a reversal of the dismantling procedure, noting the following points:

(1) Apply a few drops of engine oil to the centrifugal timing control mechanism and cam bearing.
(2) Lightly smear the cam surface with engine oil.
(3) Apply a drop of engine oil to the top of the pivot on which the moving contact fibre rocker arm works.
(4) Secure the distributor shaft to the driving spindle with a new peg; peen over both ends of the peg.
(5) Be sure to connect the internal cables correctly.
(6) Adjust the contact breaker points.

Section Q.9

TIMING THE IGNITION

If at any time the distributor has been disturbed adjust the ignition timing as follows.

Remove the rocker cover so that the valve action can be observed. Rotate the engine with the starting-handle until the timing marks on the timing plate and the hole or groove in the crankshaft pulley are in alignment and adjacent to each other with No. 1 piston on the compression stroke. Rotate the engine back 6°, using a degree plate on the crankshaft pulley. The ignition should be at this point. Set the micrometer adjustment on the distributor in its central position and remove the distributor cover and rotor. Slacken the distributor clamp bolt and turn the distributor casing in an anti-clockwise direction until the contact breaker points are fully closed, then gradually turn the distributor in a clockwise direction until the contact breaker points just commence to open. Secure the distributor clamp bolt. When installing the rotor and cover it will be noted that the rotor electrode is just approaching one of the metal segments on the cover. The high-tension cable from the terminal of this segment should be connected to No. 1 sparking plug with the other plugs connected in the firing order sequence of 1, 3, 4, 2.

NOTE.—A further method to determine the actual position at which the points break contact is to switch on the ignition, disconnect the centre high-tension cable from the distributor cover, and, holding it to form a small gap with some nearby metal part, turn the distributor in a clockwise direction. There will be a spark across the gap immediately the points open; this is the exact firing position in which the distributor should be locked.

A further method is to connect a test lamp in parallel with the distributor points and bring the timing mark up to 6° B.T.D.C., when the lamp should light up.

Section Q.10

COIL

The coil does not require any attention beyond seeing that the terminal connections and the coil mounting bolts are tight, and that the exterior is kept clean and dry, particularly between the terminals.

Section Q.11

SPARKING PLUGS

When sparking plugs are removed from the engine for inspection and cleaning their gaskets should be removed with them and replaced on the plugs, which should be placed in a suitable holder. It is advisable to identify each plug with the number of the cylinder from which it was removed so that any faults revealed on examination can be traced back to the cylinder concerned.

When examining the plugs place a new plug of the same type beside the others to afford a ready comparison of the relative condition of the used plugs.

Examine for signs of oil fouling. This will be indicated by a wet, shiny, black deposit on the insulator. This is caused by oil pumping due to worn cylinders and pistons or gummed-up or broken rings. Under such conditions oil from the cylinder walls is forced up past the rings on the suction stroke of the piston and is eventually deposited on the plugs.

A permanent remedy for this cannot be effected, the only cure being the fitting of a new piston and rings, or, in extreme cases, a rebore may be necessary.

Next examine the plugs for signs of petrol fouling. This is indicated by a dry, fluffy, black deposit which is usually caused by over-rich carburation, although ignition defects such as a run-down battery, faulty distributor, coil or capacitor defects, or a broken or worn-out cable may be additional causes. If the plugs appear to be suitable for further use proceed to clean and test them.

First remove the plug gaskets and examine them for condition. A large proportion of the heat of the plug is normally dissipated to the cylinder head through the gasket between the plug and the head. Plugs not screwed down tightly can easily become overheated so that they operate out of their proper heat range, thus producing pre-ignition, short plug life, and 'pinking'. On the other hand, it is unnecessary and unwise to tighten up the plugs too much. What is required is a reasonably good seal between the plug and the cylinder head.

If the plugs require cleaning it is preferable to make use of a proper plug cleaner of the type recommended by the plug manufacturers, and the makers' instructions for using the cleaner should be followed carefully.

Occasionally a blistered insulator or a badly burnt electrode may be noticed when examining the plugs.

If the plug is of the type normally recommended for the engine and it was correctly installed (down tightly on the gasket), this condition may have been brought about by a very weak mixture or an overheated engine. There is, however, a possibility that a plug of another type is required, but as a rule the recommended plug should be adhered to.

After cleaning carefully, examine the plugs for cracked insulators and wear of the insulator nose due to excessive previous cleaning. In such cases the plugs have passed their useful life and new plugs should be installed.

Examine the insulator for deposits underneath the side electrode which have possibly accumulated and which act as a 'hot-spot' in service.

After cleaning the plugs in a special cleaner blow all surplus abrasive out of the body recesses, and off the plug threads, by means of an air blast. Next examine the threads for carbon. Any deposits can be removed and the threads cleaned with a wire brush. A wire buffing wheel may also be utilized, but reasonable care must be used in both methods in order not to injure the electrodes or the tip of the insulator. This simple procedure will ensure absence of binding on the threads on replacement and also obviate unnecessary use of the plug spanner.

The thread section of the plug body is often neglected when cleaning the plugs, owing to the fact that it is not generally realized that, like the gaskets, the threads are a means of heat dissipation and that when they are coated with carbon the flow of the heat from the plug is retarded, producing overheating.

When replacing a plug always screw it down finger tight, then use a socket to avoid possible fracture of the insulator.

Examine the electrodes for the correct gap (see **'GENERAL DATA'**). Watch out for an incorrect reading in the case of badly pitted electrodes.

Remember that electrode corrosion and the development of oxides at the gap area vitally affects the sparking efficiency. The special cleaner can remove the oxides and deposits from the insulator, but the cleaner stream does not always reach this area with full effect owing to its location, and cannot necessarily deal with corrosion effectively as this sometimes requires too strong a blast for proper removal.

When the plugs appear worthy of further use it is good practice to dress the gap area on both centre and side electrodes with a small file before resetting them to the correct gap. The intense heat, pressure, explosion shock, and electrical and chemical action to which the plugs are submitted during service are so intense that the molecular structure of the metal points is eventually affected. Plugs then reach a worn-out condition and resetting the points can no longer serve a good purpose. When the points are burnt badly it is indicative that the plug has worn to such an extent that its further use is undesirable and wasteful.

Before replacing the plug in the engine, test it for correct functioning under air pressure in a plug tester, following out the instructions issued by the makers of the plug tester. Generally speaking, a plug may be considered satisfactory for further service if it sparks continuously under a pressure of 100 lb./sq. in. (7 kg./cm.^{2}) with the gap between the points set at ·025 in. (·63 mm.). It is essential that the plug points should be reset to the recommended gap before the plug is refitted to the engine (see **'GENERAL DATA'**).

While the plug is under pressure in the tester it should be inspected for leakage by applying oil round the terminal. Leakage is indicated by the production of air bubbles, the intensity of which will serve to indicate the degree of leakage. The leakage gases have a 'blow-torch' effect when the engine is running which rapidly raises the temperature of the plug to above its designed heat range, thus producing overheating, pre-ignition, and rapid electrode destruction.

The top half of the insulator is frequently responsible for poor plug performance due to the following faults: splashes; accumulation of dirt and dust; cracked insulators, caused by a slipping spanner; overtightness of the terminals.

Examine for a cracked insulator at the shoulder and the terminal post and remove any accumulations of dirt and dust.

25D4 DISTRIBUTOR TEST DATA

Centrifugal advance (vacuum pipe disconnected)

No advance below 180 crankshaft r.p.m.

18 to 36° advance up to 1,800 crankshaft r.p.m.

18 to 36° advance decelerating to 1,400 crankshaft r.p.m.

11 to 15° advance decelerating to 1,000 crankshaft r.p.m.

2 to 6° advance decelerating to 500 crankshaft r.p.m.

0 to 2° advance decelerating to 250 crankshaft r.p.m.

Vacuum advance

Starts at 7 in. Hg (177·8 mm. Hg).

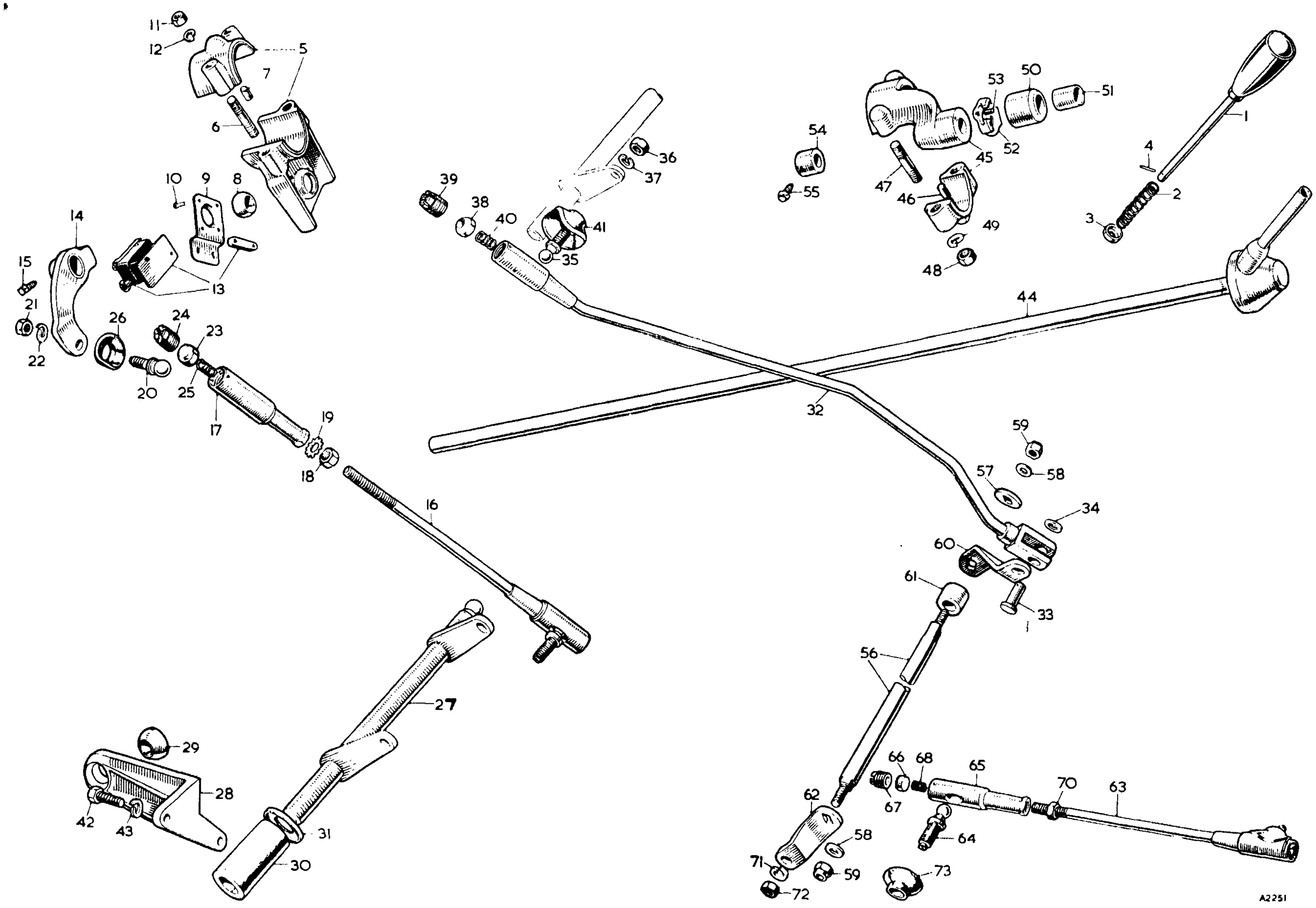
Finishes at 18 in. Hg (457·2 mm. Hg).

SECTION SB

THE AUTOMATIC TRANSMISSION

(MODEL DG)

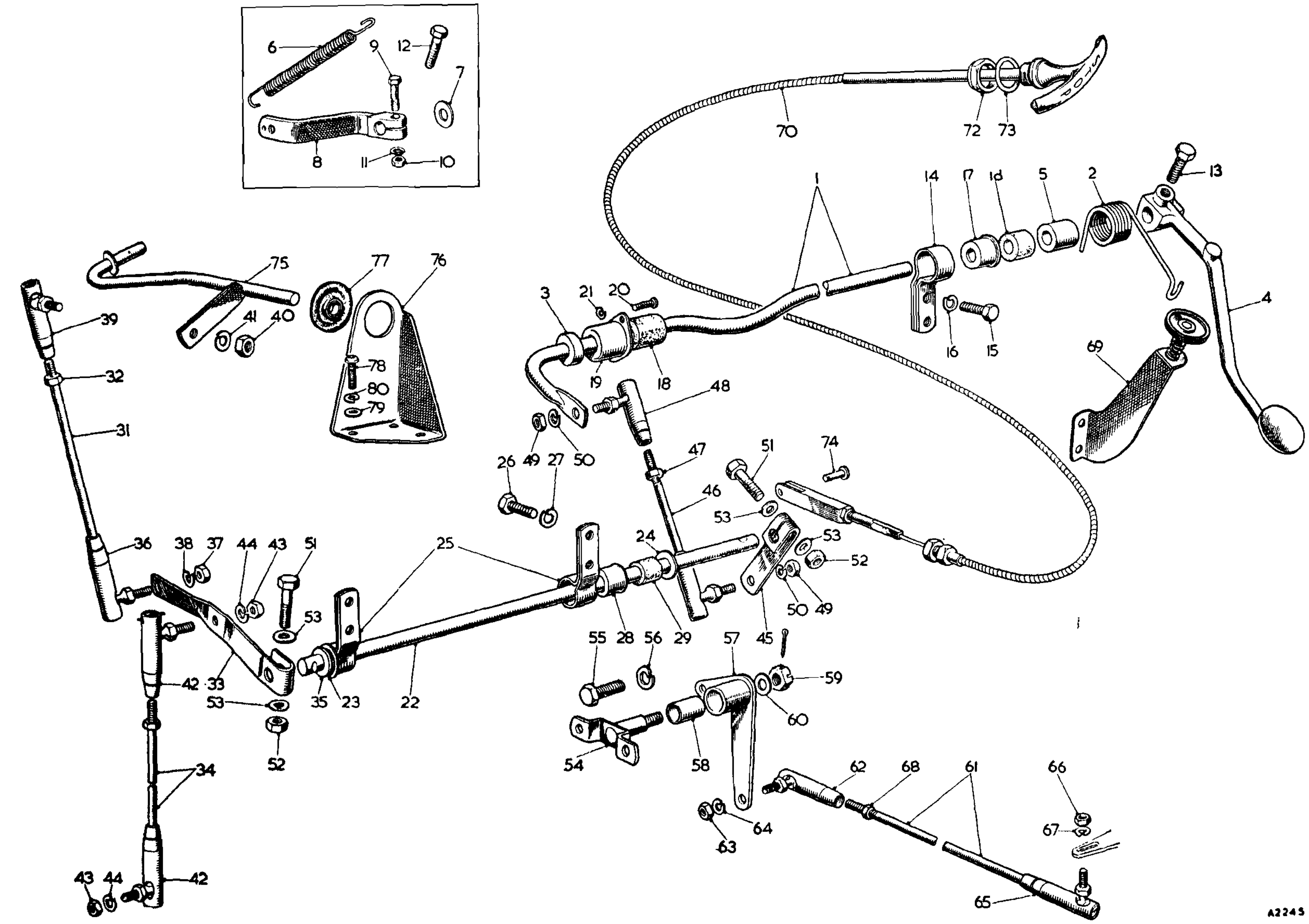
THE GEAR SELECTOR COMPONENTS



KEY TO THE GEAR SELECTOR COMPONENTS

No.	Description	No.	Description	No.	Description
1.	Lever—hand stop rod (with knob).	25.	Spring.	49.	Washer for stud.
2.	Spring—stop rod.	26.	Excluder—dust.	50.	Sleeve for bracket.
3.	Collar—stop rod.	27.	Cross-shaft assembly.	51.	Bearing for bracket.
4.	Peg—locating—for collar.	28.	Bracket—selector cross-shaft.	52.	Plate—selector control stop.
5.	Bracket and cap assembly.	29.	Bush—cross-shaft inner bracket (spherical).	53.	Peg for stop plate.
6.	Stud—bracket and cap.	30.	Sleeve—cross-shaft.	54.	Collar—locating for operating rod.
7.	Locating peg.	31.	Cup—sleeve.	55.	Screw—locating for collar.
8.	Bush (spherical).	32.	Rod—control.	56.	Cross-shaft—change speed selector.
9.	Plate—spherical housing.	33.	Joint pin—control rod fork.	57.	Washer—spacing.
10.	Rivet.	34.	Washer—plain—pin.	58.	Washer.
11.	Nut for stud, bracket, and cap.	35.	Ball pin—ball joint housing control rod.	59.	Stiffnut.
12.	Washer for nut.	36.	Nut for pin.	60.	Lever—cross-shaft.
13.	Switch—safety—for starter button with insulating backplate and tapping plate.	37.	Washer—spring—pin.	61.	Collar—distance.
14.	Lever—gear selector.	38.	Thrust block (fixed).	62.	Lever—selector operating.
15.	Screw—locating (lever to operating rod).	39.	Thrust block (loose).	63.	Rod—selector control.
16.	Rod—adjusting.	40.	Spring.	64.	Ball pin for control rod.
17.	Ball joint housing and adjusting sleeve.	41.	Excluder—dust.	65.	Ball joint housing and adjusting sleeve.
18.	Nut for adjusting sleeve.	42.	Screw—gear selector cross-shaft bracket.	66.	Thrust block for ball joint.
19.	Washer for nut (shakeproof).	43.	Washer—spring—screw.	67.	Anvil for ball joint.
20.	Ball pin for adjusting rod.	44.	Lever—hand (operating rod).	68.	Spring for ball joint
21.	Nut for pin.	45.	Bracket—upper support (with cap).	70.	Nut for control rod.
22.	Washer—spring—pin.	46.	Peg—locating.	71.	Washer for ball pin (spring).
23.	Thrust block (fixed).	47.	Stud for bracket.	72.	Nut for ball pin.
24.	Thrust block (loose).	48.	Nut for stud.	73.	Dust excluder—ball joint housing.

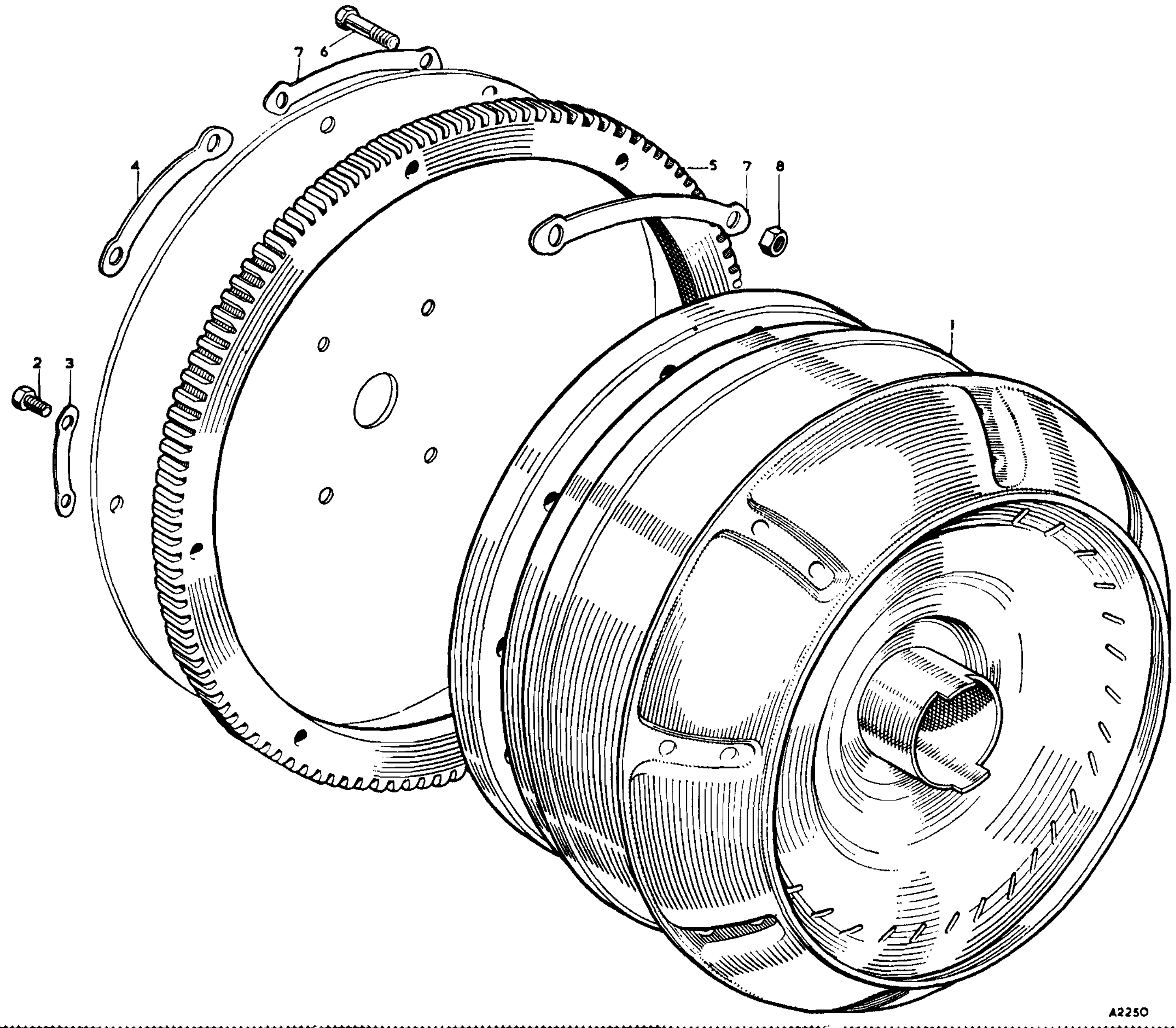
THE ACCELERATOR LINKAGE COMPONENTS



KEY TO THE ACCELERATOR LINKAGE COMPONENTS

No.	Description
1.	Shaft and lever—accelerator.
2.	Return spring—accelerator pedal.
3.	Collar—shaft.
4.	Pedal—accelerator.
5.	Collar—accelerator shaft.
6.	Spring—pedal accelerator.
7.	Washer—accelerator pedal shaft.
8.	Lever—accelerator pedal shaft.
9.	Bolt—lever.
10.	Nut—bolt.
11.	Washer—plain—bolt.
12.	Screw—clamping accelerator pedal.
13.	Screw—clamping accelerator pedal.
14.	Support—accelerator shaft.
15.	Screw—support to dash.
16.	Washer—spring—screw.
17.	Cup—bush.
18.	Bush—shaft (felt).
19.	Bearing cup—shaft.
20.	Screw—bearing cup to dash.
21.	Washer—spring—screw.
22.	Relay shaft—accelerator.
23.	Collar—relay shaft.
24.	Washer—plain—relay shaft.
25.	Support—relay shaft.
26.	Screw—support to dash.
27.	Washer—spring—screw.
28.	Cup—accelerator relay shaft.
29.	Bush—accelerator relay shaft (felt).
30.	Universal coupling assembly.
31.	Rod—control—relay shaft to throttle shaft
32.	Nut—lock—rod.
33.	Lever—relay shaft (bell-crank end).
34.	Rod control—relay shaft to bell-crank lever.
35.	Washer—plain—relay shaft.
36.	Ball joint assembly—rod to throttle shaft (bell-crank lever end).
37.	Nut—ball joint.
38.	Washer—spring—nut.
39.	Ball joint assembly—rod to throttle shaft.
40.	Nut—ball joint.
41.	Washer—spring—nut.
42.	Ball joint assembly—rod to bell-crank lever.
43.	Nut—ball joint.
44.	Washer—spring—nut.
45.	Lever—relay shaft (accelerator end).
46.	Rod—control—accelerator lever to relay shaft.
47.	Nut—lock—rod.
48.	Ball joint assembly—rod to shaft.
49.	Nut—ball joint.
50.	Washer—spring—nut.
51.	Bolt—relay shaft lever.
52.	Nut—bolt.
53.	Washer—plain—bolt.
54.	Bracket pivot assembly—bell-crank lever.
55.	Screw—pivot bracket to cross-brace.
56.	Washer—spring—screw.
57.	Lever—bell-crank assembly.
58.	Bush.
59.	Nut—slotted (lever to pivot bracket).
60.	Washer—plain—nut.
61.	Rod—control—bell-crank lever to gearbox.
62.	Ball joint assembly (front)—rod to gearbox.
63.	Nut—ball joint (front).
64.	Washer—spring—nut.
65.	Ball joint assembly (rear)—rod to gearbox.
66.	Nut—ball joint (rear).
67.	Washer—spring—nut.
68.	Nut—lock—ball joint.
69.	Adjuster—accelerator pedal (hand).
70.	Cable—stop control assembly.
72.	Nut—stop control to instrument panel.
73.	Washer—nut.
74.	Joint pin (stop control fork).
75.	Throttle shaft assembly.
76.	Bracket—throttle shaft.
77.	Bearing—throttle shaft.
78.	Screw—shaft bracket to dash.
79.	Washer—plain—screw.
80.	Washer—spring—screw.

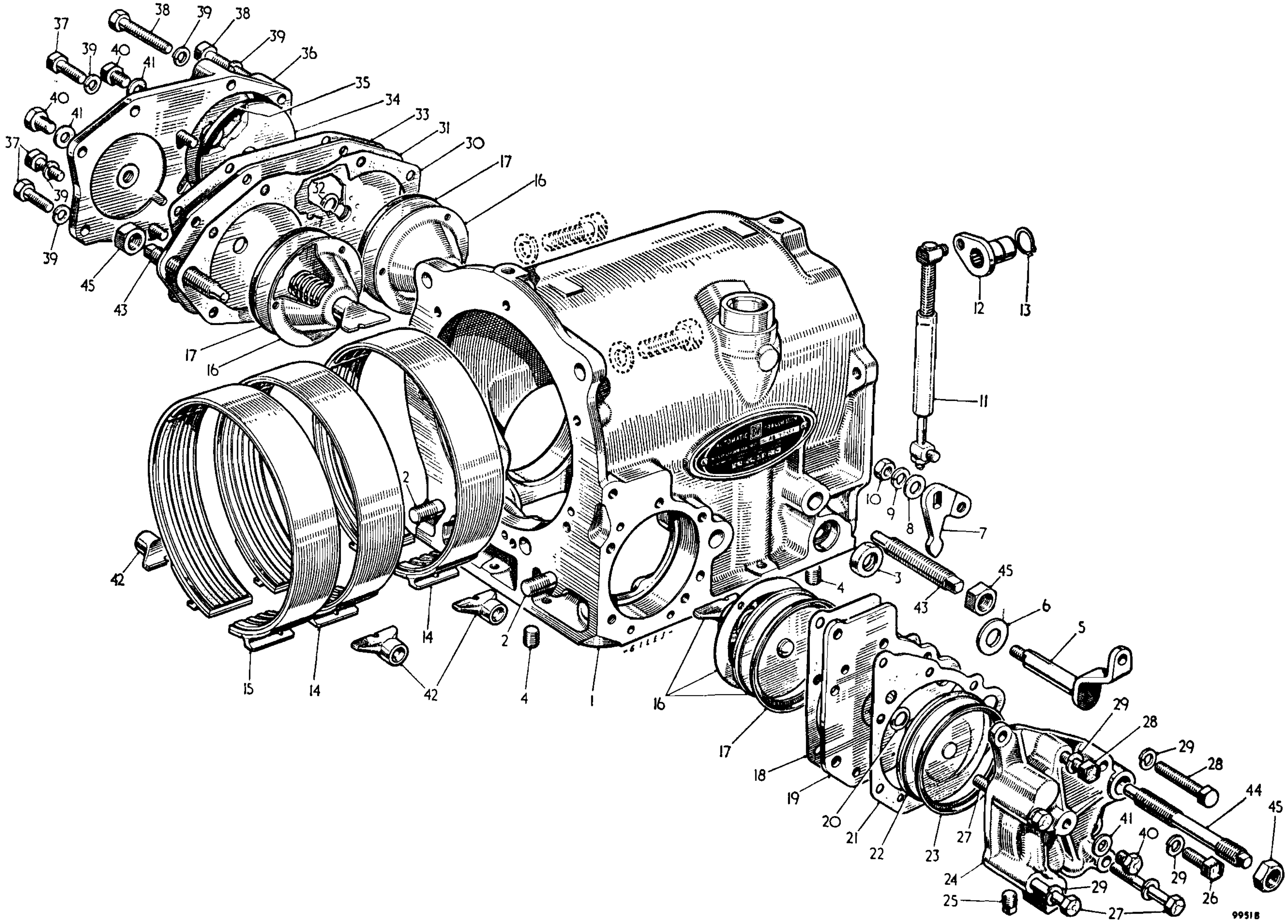
THE DRIVE PLATE AND CONVERTER COMPONENTS



KEY TO THE DRIVE PLATE AND CONVERTER COMPONENTS

No.	*Description*	*No.*	*Description*
1.	Converter assembly.	5.	Ring—starter.
2.	Screw—drive plate to converter.	6.	Bolt—ring—starter.
3.	Washer—drive plate screw—locking.	7.	Washer—locking.
4.	Washer—drive plate screw—locking.	8.	Nut.

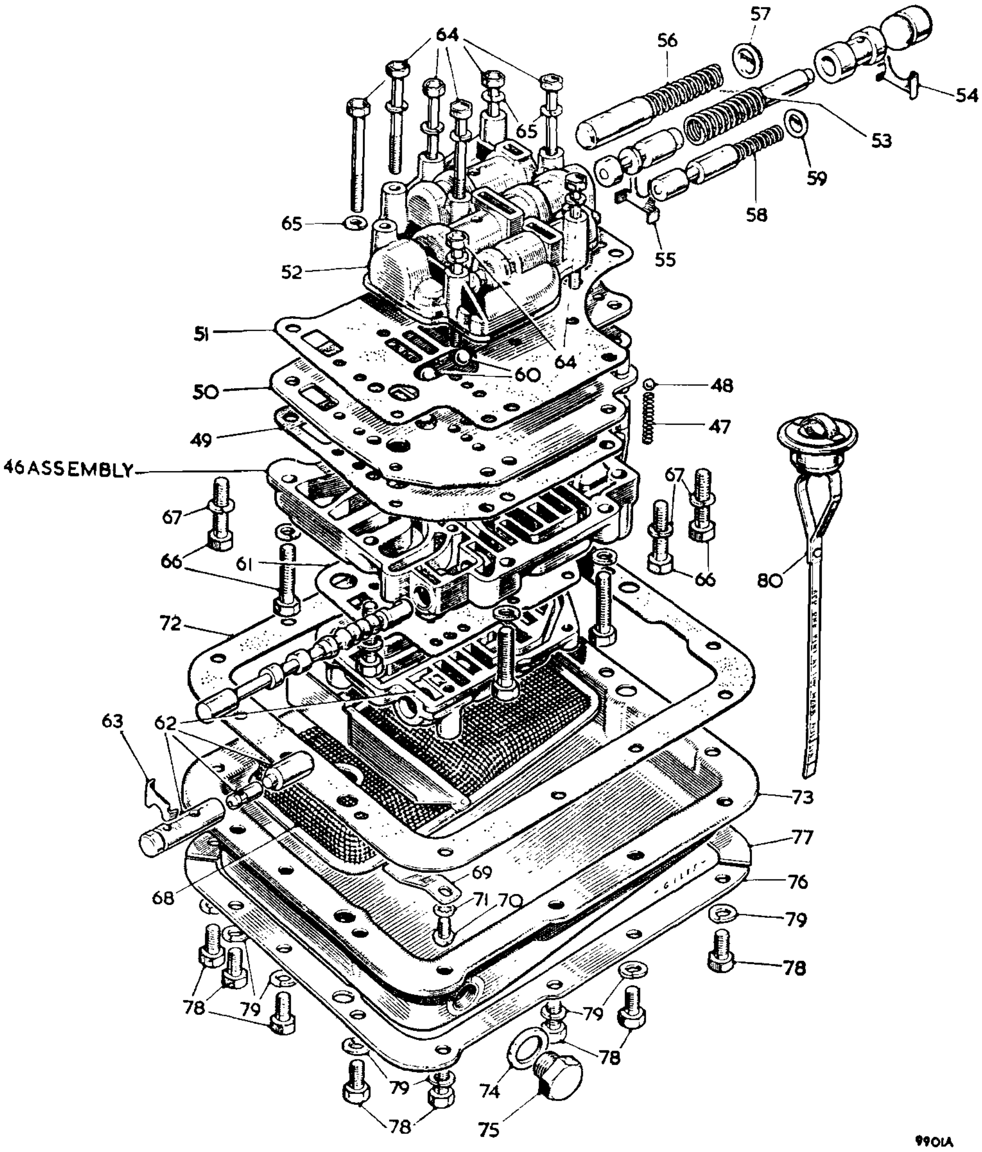
THE MAIN CASING COMPONENTS



KEY TO THE MAIN CASING COMPONENTS

No.	*Description*
1.	Casing assembly—main.
2.	Stud—casing to converter housing.
3.	Oil seal—selector shaft.
4.	Plug—front oil pump and direct clutch pressure test.
5.	Shaft and lever assembly—selector.
6.	Washer—shaft.
7.	Lever—inner selector.
8.	Washer—lever to shaft.
9.	Washer—spring—lever to shaft.
10.	Nut—lever to shaft.
11.	Rod assembly—parking brake actuating.
12.	Lever assembly—toggle arm—parking brake.
13.	Retainer—parking brake toggle arm lever.
14.	Band assembly—brake—forward speed.
15.	Band assembly—brake—reverse.
16.	Piston assembly—inner—brake band.
17.	Seal—piston assembly.
18.	Gasket—reverse cylinder plate to casing.
19.	Plate—reverse brake cylinder.
20.	'O' ring—reverse brake cylinder plate.
21.	Gasket—reverse cylinder to plate.
22.	Piston assembly—outer—reverse brake band.
23.	Seal—reverse brake band outer piston.
24.	Cylinder—reverse brake.
25.	Plug—converter pressure test.
26.	Bolt—1 in. long—reverse brake cylinder to casing.
27.	Bolt—2¾ in. long—reverse brake cylinder to casing.
28.	Bolt—2 in. long—reverse brake cylinder to casing.
29.	Washer—spring—bolt.
30.	Gasket—forward speed brake cylinder plate to casing.
31.	Plate—forward speed brake cylinder.
32.	'O' ring—forward speed brake cylinder plate.
33.	Gasket—forward speed brake cylinder to plate.
34.	Piston assembly—outer—forward speed brake band.
35.	Seal—forward speed brake band outer piston.
36.	Cylinder forward speed brake.
37.	Bolt—1 in. long—forward speed brake cylinder to casing.
38.	Bolt—2 in. long—forward speed brake cylinder to casing.
39.	Washer—spring—bolt.
40.	Bolt—½ in. long—brake cylinder pressure test.
41.	Washer—copper—test bolt.
42.	Strut—brake band adjusting.
43.	Screw—brake band adjusting—forward and reverse.
44.	Screw—brake band adjusting—low speed.
45.	Nut—brake band adjusting screw.

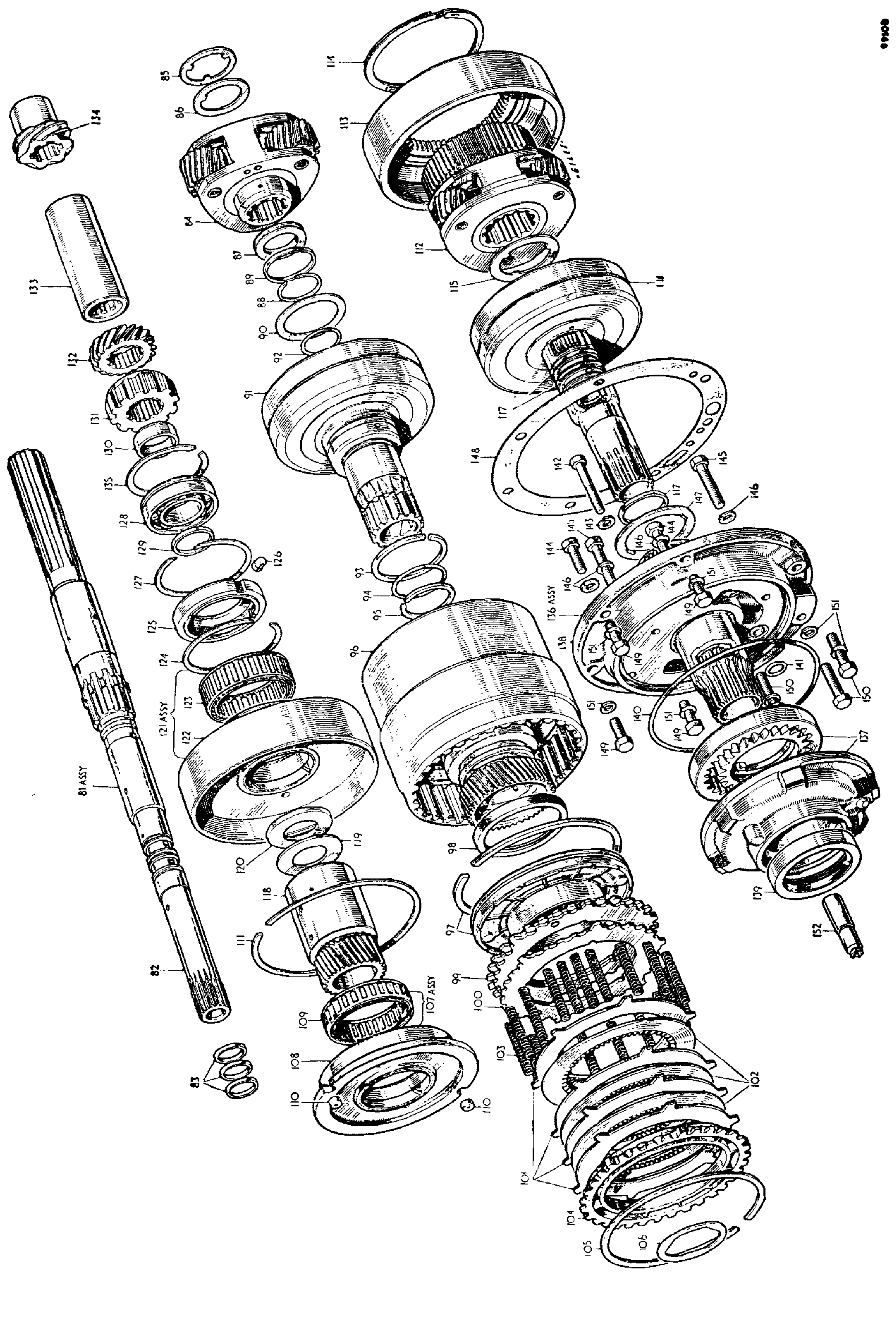
THE VALVE MANIFOLD COMPONENTS



KEY TO THE VALVE MANIFOLD COMPONENTS

No.	*Description*
46.	Manifold assembly—valve.
47.	Spring—selector valve detent.
48.	Ball—selector valve detent.
49.	Gasket—manifold to base plate.
50.	Plate—valve base.
51.	Gasket—base plate to relief valve body.
52.	Body assembly—relief valve.
53.	Spring—main relief valve.
54.	Retainer—anti-bump valve plug.
55.	Stop—main relief valve.
56.	Spring—accumulator.
57.	Retainer—accumulator spring.
58.	Spring—reverse interlock valve.
59.	Retainer—reverse interlock valve spring.
60.	Ball—oil pump valve.
61.	Gasket—manifold to converter valve body.
62.	Body assembly—converter valve.
63.	Retainer—shuttle valve sleeved.
64.	Bolt—relief valve body to converter valve body.
65.	Washer—spring—bolt.
66.	Bolt—valve manifold assembly to main casing.
67.	Washer—spring—bolt.
68.	Filter—oil.
69.	Retainer—oil filter.
70.	Screw—retainer to valve manifold.
71.	Washer—shakeproof—screw.
72.	Gasket—oil reservoir.
73.	Reservoir—oil.
74.	Washer—drain plug.
75.	Plug—drain.
76.	Plate—front—oil reservoir reinforcement.
77.	Plate—rear—oil reservoir reinforcement.
78.	Bolt—oil reservoir to casing.
79.	Washer—spring—reservoir bolt.
80.	Indicator—oil.

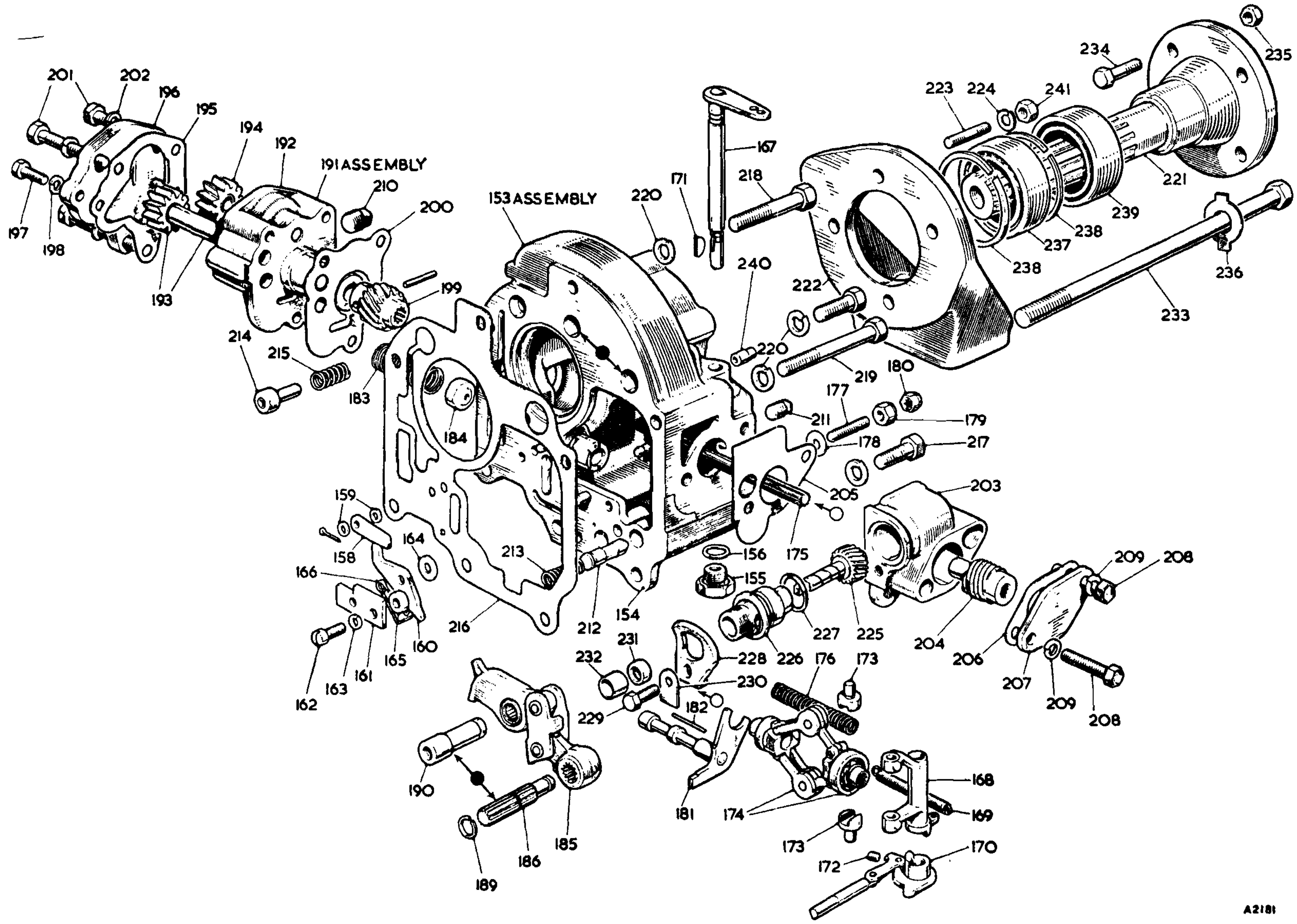
THE MAINSHAFT COMPONENTS



KEY TO THE MAINSHAFT COMPONENTS

No.	*Description*
81.	Mainshaft assembly.
82.	Mainshaft.
83.	Ring—piston—1 in. diameter.
84.	Carrier assembly—rear planet.
85.	Washer—rear sun gear thrust—thick.
86.	Washer—rear planet carrier—thin.
87.	Retainer—piston ring.
88.	Snap ring—piston ring retainer.
89.	Ring—piston—$1\frac{5}{8}$ in. diameter.
90.	Washer—rear planet carrier thrust.
91.	Ring—gear assembly—rear.
92.	'O' ring—$1\frac{1}{8}$ in. I/D.
93.	Ring—piston—rear ring gear.
94.	'O' ring—$1\frac{5}{8}$ in. I/D.
95.	Snap ring—front carrier.
96.	Sun gear and lock-up drum—front.
97.	Piston with ring—first clutch.
98.	Seal—piston—3 in. diameter.
99.	Plate assembly—clutch retractor.
100.	Plate—clutch spacer.
101.	Plate—clutch.
102.	Disc—bronze—clutch friction.
103.	Spring—clutch retractor.
104.	Retainer—spring.
105.	Snap ring—retainer.
106.	Washer—front sun gear.
107.	Clutch (one-way) and lock-up plate.
108.	Plate—lock-up brake-drum.
109.	Clutch assembly—one-way.
110.	Roller—lock-up brake-drum.
111.	Snap ring—lock-up brake-drum.
112.	Carrier assembly—front planet.
113.	Drum—reverse brake.
114.	Snap ring—drum.
115.	Washer—front planet carrier thrust.
116.	Ring gear assembly—front.
117.	Ring—piston—$1\frac{5}{8}$ in. diameter—front ring gear.
118.	Sun gear assembly—rear.
119.	Washer—thin—rear sun gear.
120.	Washer—thick—rear sun gear.
121.	Clutch (one-way) and forward speed brake-drum assembly.
122.	Drum—brake.
123.	Clutch assembly—one-way.
124.	Snap ring—clutch assembly retaining.
125.	Spacer—one-way clutch.
126.	Pin—drive—spacer.
127.	Snap ring—spacer retaining.
128.	Bearing (with snap ring groove)—mainshaft.
129.	Spacer—mainshaft bearing.
130.	Spacer—governor drive gear.
131.	Gear—parking brake.
132.	Gear—governor drive.
133.	Nut—propeller shaft flange.
134.	Spacer—flange to governor drive gear.
135.	Snap ring—mainshaft bearing.
136.	Front pump and collector ring assembly.
137.	Pump assembly—front.
138.	Ring assembly—collector.
139.	Seal—oil.
140.	'O' ring—$5\frac{3}{4}$ in. O/D.
141.	'O' ring—$\frac{11}{16}$ in. O/D.
142.	Bolt—$\frac{1}{4}$ in. $\times$ $1\frac{3}{4}$ in.
143.	Washer—bolt.
144.	Bolt—$\frac{5}{16}$ in. $\times$ $\frac{7}{8}$ in.
145.	Bolt—$\frac{5}{16}$ in. $\times$ $1\frac{1}{2}$ in.
146.	Washer—spring—bolt.
147.	Washer—collector ring to front ring gear thrust.
148.	Joint—collector ring to casing.
149.	Bolt—$\frac{3}{4}$ in. long—collector ring to casing.
150.	Bolt—$1\frac{1}{4}$ in. long—collector ring to casing.
151.	Washer—spring—bolt.
152.	Tube—oil transfer.

THE REAR EXTENSION COMPONENTS



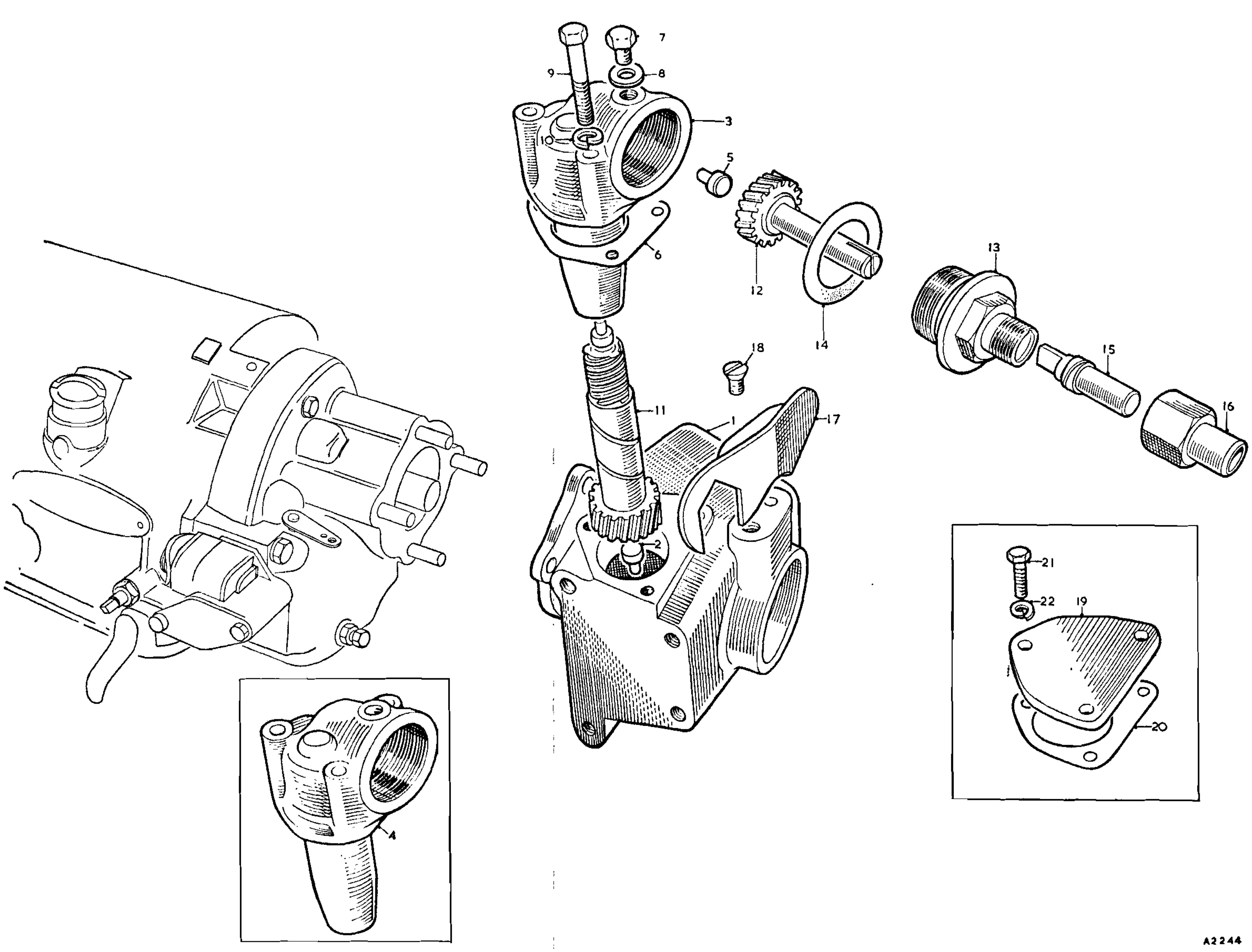
KEY TO THE REAR EXTENSION COMPONENTS

No.	Description
153.	Case assembly—rear extension.
154.	Case.
155.	Bush—governor adjusting shaft.
156.	'O' ring—governor adjusting shaft.
158.	Pawl—second speed drive.
159.	Washer—pawl.
160.	Control—rocker arm.
161.	Plate—governor stop.
162.	Screw—stop plate.
163.	Washer—spring—screw.
164.	Washer—plain—rocker arm control.
165.	Spacer—rocker arm control.
166.	Spring—rocker arm control.
167.	Shaft and lever assembly—governor.
168.	Lever—governor adjusting (forked).
169.	Spring—governor return.
170.	Cam assembly—detent (with control link and plunger).
171.	Key—cam assembly to shaft.
172.	Screw—cam assembly to shaft.
173.	Finger—governor adjusting lever.
174.	Governor assembly.
175.	Shaft—governor.
176.	Spring—governor.
177.	Screw—governor adjusting.
178.	Washer—screw.
179.	Nut—lock—screw.
180.	Nut—cap—screw.
181.	Fork and valve assembly—governor control.
182.	Detent—governor control valve.
183.	Spring—valve booster.

No.	Description
184.	Retainer—spring.
185.	Pawl and toggle assembly—parking brake.
186.	Shaft—toggle.
189.	Ring—shaft retaining.
190.	Pin—pivot—pawl.
191.	Pump assembly—rear oil.
192.	Body.
193.	Shaft and gear assembly—drive.
194.	Gear and bush assembly—idler.
196.	Cover.
195.	Gasket—cover (·002"). Gasket—cover (·003"). Gasket—cover (·005").
197.	Bolt—cover to body.
198.	Washer—spring—bolt.
199.	Gear—driven—governor and pump.
200.	Gasket—pump to rear extension case.
201.	Bolt—pump to rear extension case.
202.	Washer—spring—bolt.
203.	Housing—speedometer drive gear.
204.	Gear—speedometer drive.
205.	Gasket—housing to rear extension case.
206.	Cover—housing.
207.	Gasket—cover.
208.	Bolt—housing and cover to extension case.
209.	Washer—spring—bolt.
210.	Plug for rear oil pump pressure test point.
211.	Plug for multiple-disc pressure test point.
212.	Plunger—accelerator detent.
213.	Spring—plunger.
214.	Piston assembly—parking brake interlock.
215.	Spring—piston.

No.	Description
216.	Gasket—rear extension case to gearbox main case.
217.	Bolt—rear extension case to gearbox main case ($\frac{3}{8}$" × $\frac{1}{4}$").
218.	Bolt—rear extension case to gearbox main case ($\frac{3}{8}$" × $2\frac{1}{4}$").
219.	Bolt—rear extension case to gearbox main case ($\frac{3}{8}$" × 3").
220.	Washer—spring—bolt.
221.	Flange—propeller shaft.
222.	Bracket—gearbox rear support.
223.	Stud—bracket to extension.
224.	Washer—spring—nut.
225.	Pinion—speedometer.
226.	Bush—pinion.
227.	'O' ring.
228.	Clip—bush.
229.	Screw—clip.
230.	Washer—lock—screw.
231.	Oil seal—pinion.
232.	Retainer—oil seal.
233.	Bolt—flange.
234.	Bolt—flange.
235.	Nut—bolt.
236.	Tab washer.
237.	Bearing—flange coupling.
238.	Circlip—bearing.
239.	Oil seal—flange.
240.	Valve—jet—extension case.
241.	Nut—stud.

THE TAXIMETER DRIVE



KEY TO TAXIMETER DRIVE

No.	*Description*
1.	Housing—taximeter drive.
2.	Button—thrust—rear cover.
3.	Housing—taximeter gear.
4.	Housing—taximeter gear.
5.	Button—thrust—housing.
6.	Joint—housing.
7.	Plug—housing.
8.	Joint washer—plug.
9.	Set screw—housing.
10.	Washer—spring—set screw.
11.	Shaft—taximeter driven.
12.	Gear—taximeter driven.
13.	Bush for gear.
14.	Joint—bush.
15.	Tongue—taximeter driving gear.
16.	Union nut—driving gear.
17.	Lock assembly—taximeter drive.
18.	Screw—lock—drive.
19.	Cover-plate—gearbox rear cover.
20.	Joint—cover-plate.
21.	Set screw for cover-plate.
22.	Washer—spring—set screw.

SECTION SB(a)

DRIVING AND MAINTENANCE

Selector lever.

Starting the engine.

Driving.

Maintenance.

SELECTOR LEVER

The selector lever is mounted below the steering-wheel on the left-hand side of the column in a right-hand-drive car and on the right-hand side in a left-hand-drive car.

Five settings of the transmission may be manually selected by movement of the lever, the position selected being indicated by letters on a quadrant below the lever. The letters are 'P', 'N', 'D', 'L', and 'R' and the transmission settings corresponding to the letters are described below. All normal driving is done with the lever at 'D'. The knob in the end of the selector lever must be pulled out before the lever can be moved from 'D' to 'L' or 'N'.

'P' (park)

The transmission is in neutral and the car is mechanically locked against movement by a parking pawl engaging a gear on the transmission mainshaft. The pawl will not engage at road speeds above 3–5 m.p.h. (5–8 km.p.h.) should the lever be moved to 'P' accidentally. The pawl allows the car to be stopped on a hill without fear of running away, though it is advisable to apply the hand brake in such conditions to prevent overloading of the mechanism.

Always move the lever to 'P' when the car is parked. Do not select 'P' when the car is moving backwards.

The engine may be idled or run for tuning.

'N' (neutral)

The transmission is in neutral as in 'P', but the parking pawl has been disengaged so that the car may be coasted, towed, or pushed. The hand brake should be applied when the car is at rest with the lever in this position. The engine may be idled or run for tuning.

Do not move the control lever to 'N' when travelling over 35 m.p.h. (56 km.p.h.).

'D' (drive)

The position for all normal driving, including starting from rest. Three ratios are available—low, intermediate, and high—all of which are selected automatically according to the vehicle speed and torque demand. A free-wheel is operative in low and intermediate (**not** in manually engaged low).

'L' (manual low)

The transmission is in low, the same ratio as that obtained automatically in certain conditions when the lever is at 'D', but when manually selected as at 'L' the transmission will not change out of this ratio until 'D' is again selected. The 'L' position is used for ascending or descending long, steep gradients or in other conditions necessitating lengthy periods of low gear work. There is no free-wheel effect and therefore this ratio may be used for maximum engine braking.

'R' (reverse)

A free-wheel is operative when the transmission is in reverse.

STARTING THE ENGINE

Starter

The starter will only operate if the lever is at 'P' or 'N'. Move the lever to one of these positions and start the engine in the usual way. If 'N' is used make sure that the hand brake is applied to prevent the car creeping.

Emergency starting

Move the selector lever to 'D', switch on the ignition, and push the car at a speed of approximately 18 m.p.h. (29 km.p.h.). Pushing is recommended in preference to towing as it avoids any danger of overrunning the towing vehicle when the engine starts.

DRIVING

Moving away from rest

After starting the engine move the lever to 'D', depress the accelerator pedal, and release the hand brake. As the speed of the car increases, intermediate and then direct top gear will be engaged progressively and automatically and thereafter all ratio changes will be made to suit the car speed and torque demand. Direct top gear will be engaged when the speed is between 15 and 33 m.p.h. (24 and 52 km.p.h.), depending on the accelerator position and car speed.

If a long climb is anticipated or prolonged use of low ratio is necessary, manual low should be used and engaged when the road speed is below 18 m.p.h. (29 km.p.h.).

Engine as brake

Maximum engine braking is available for the descent of steep hills and is obtained by the engagement of the manual low gear ratio ('L'); **no free-wheel is operative in manually engaged low ratio.** Do not engage manual low if the car speed is above 18 m.p.h. (29 km.p.h.) owing to the possibility of damage to the engine by over-revving.

Reversing

A free-wheel is operative when the transmission is in reverse, which considerably simplifies backing the car. It is recommended that the left foot should be used on the brake pedal when manœuvring the car in confined spaces, while the right foot is used on the accelerator in the usual manner.

If the lever is moved to 'R' while the car is travelling forward at more than 3–5 m.p.h. (5–8 km.p.h.) the effect is to change into neutral, and a reverse interlock prevents the engagement of reverse above these speeds.

Stopping

Apply the brakes and leave the control lever at 'D' until the car is stationary and then move the lever to 'N' or 'P' and apply the hand brake. When a temporary stop is made in traffic there is no need to move the control lever from 'D', but it is necessary to hold the foot brake to prevent the car from moving should the accelerator be accidentally depressed.

Soft road surfaces

If the rear wheels fail to grip the road in snow, mud, or sand the car may be rocked backwards and forwards until sufficient grip is obtained to drive away. Hold the accelerator pedal so that the engine speed corresponds to a road speed of between 3 and 5 m.p.h. (5 and 8 km.p.h.) and move the selector lever quickly from 'R' to 'L' and back. It is important to move from 'L' to 'R' while the car is moving forward and vice versa.

Starting from rest on hills

If the car is parked on a hill with the lever at 'P' it may tend to creep downhill against the brakes so that the parking pawl becomes tightly engaged. To free the pawl, apply the foot brake lightly, slightly depress the accelerator, and release the hand brake; engage **reverse** if the car is facing **downhill** or move the selector lever to 'D' or 'L' if facing **uphill.** Depress the accelerator pedal slowly until the pawl is heard to click out of engagement and immediately apply the foot brake fully. The car should not move during this operation; it may then be driven away.

Recovery towing

WARNING.—If there is any reason to suspect that the transmission is faulty or damaged the propeller shaft must be removed before towing.

Check the oil level, and top up as necessary.

Move the selector lever to 'N'. With neutral selected the car may be towed over any distance and at any speed up to the legal limit.

MAINTENANCE

Absolute cleanliness is essential to ensure long, trouble-free transmission life. Make certain that all fluid added to the transmission unit is perfectly clean; thoroughly clean around the filler and drain plugs before checking, filling, or draining the transmission.

Use only a recommended automatic transmission fluid for refilling and for topping up.

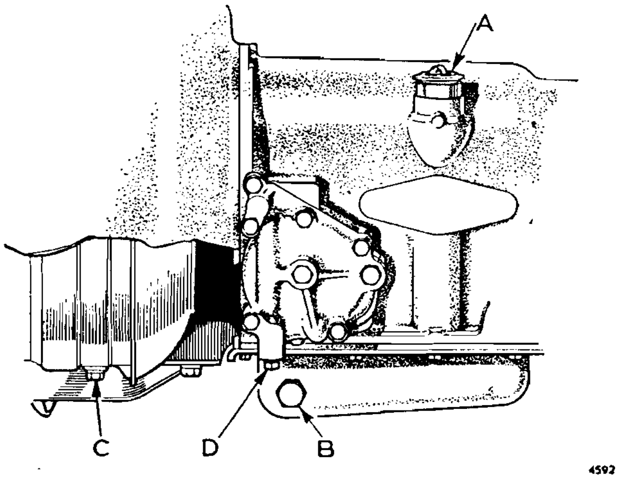


Fig. SB(a).1

The filler and drain plugs

A. Dipstick and filler.
B. Transmission case drain plug.
C. Converter drain plug.
D. Converter pressure take-off.

Check fluid level every 3,000 miles (4800 km.)

(1) Run the car onto a level surface and apply the hand brake.
(2) Place the selector lever at 'L' and allow the engine to idle until it reaches its normal running temperature.
(3) Open the cover in the floor and clean around the dipstick.
(4) With the engine idling take a dipstick reading immediately; delay may lead to a false reading.
(5) Add sufficient fluid to bring the level to the 'FULL' mark on the dipstick. Do not overfill.
(6) **Re-check the level.**

Drain and refill every 24,000 miles (38400 km.)

(1) Run the car onto a level surface, stop the engine, and apply the hand brake. Remove the converter housing cover-plate.
(2) Remove the drain plug in the left-hand side of the transmission oil reservoir and allow the fluid to drain.
(3) Turn the engine until the converter drain plug is at the bottom; remove the plug and drain the converter.
(4) Remove the converter pressure take-off plug from the bottom of the reverse servo cylinder.
(5) Remove the oil pan and pick-up filter. Clean the pan, filter, and drain plugs with a brush—do not use rag. Refit. Tighten the plugs to the recommended torque.

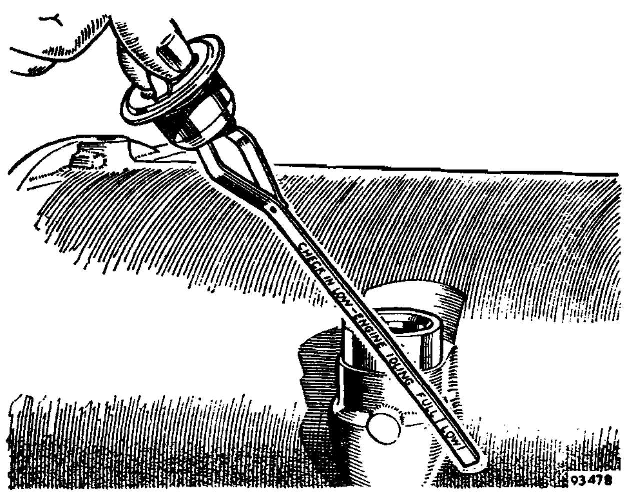


Fig. SB(a).2
The dipstick markings

(6) Remove the dipstick and pour in 10 pints (12 U.S. pints, 5·7 litres) of the recommended fluid.

(7) **Start the engine and allow it to idle for one minute with the selector lever at 'L' to make sure that the converter is filled with fluid from the transmission case.**

(8) **With the engine idling and the lever at 'L', slowly add fluid to bring the level to the 'FULL' mark on the dipstick. Check frequently during this operation.**

The approximate total capacity of the transmission and converter is 15 pints (18 U.S. pints, 8·52 litres). Refill capacity after draining is approximately 14 pints (17 U.S. pints, 8 litres).

SECTION SB(b)

DESCRIPTION

Section SB(b).1

TORQUE CONVERTER

The automatic transmission incorporates a fluid torque converter coupling in place of the conventional clutch, and an hydraulically operated epicyclic gearbox in which all changes of ratio during normal driving are performed automatically in accordance with the speed of the car and the position of the accelerator pedal.

There are nominally three forward speeds—low, intermediate, and high—and reverse, but owing to the torque multiplication available in the converter there is a perfectly smooth progression through the ratios from rest to maximum speed. Torque multiplication is infinitely variable from a minimum equivalent gear ratio of 1 : 1 to a maximum of approximately 2·16 : 1, which, combined with the epicyclic gear ratios, gives a range extending from a maximum reduction of 4·6 : 1 in low to a minimum of 1·435 : 1 in intermediate. For high, a single-plate clutch couples the engine directly to the transmission shaft to give a direct 1 : 1 ratio, by-passing the converter and epicyclic gear train.

Comparison with a simple fluid coupling simplifies understanding of the principle of the three-element torque converter used in the automatic transmission.

In a two-element fluid coupling there are two components, the driving and the driven members. The driving member or impeller is permanently connected to the engine and revolves with the crankshaft and flywheel. The driven member, the turbine, is connected to the transmission. Both members carry radial vanes in their concave faces and are mounted closely with the vaned faces together. The whole assembly is filled with fluid. When the engine is running fluid is carried round by the impeller and thrown outwards and into the vanes of the turbine, its path being partly rotary and partly circular. The energy imparted to the fluid by the impeller is given up in the turbine and the fluid then returns to the impeller. The result is a fluid coupling having a maximum efficiency of 97 per cent. and a ratio of 1 : 1 but giving no torque multiplication.

In the torque converter, torque multiplication is obtained by the addition of a third element, the stator ([A], Fig. SB(b).1), mounted between the impeller and the turbine so that the returning fluid must pass through the vanes of the stator before re-entering the eye of the impeller.

Impeller vanes are flat and approximately radial but those of the turbine and the stator are curved and shaped so that the returning fluid is directed into the impeller **in the direction of engine rotation**; the energy remaining in the fluid assists the impeller, thus giving the required torque multiplication. The fluid is carried round by the impeller and thrown outwards by centrifugal force, passing from the impeller to the turbine at the periphery and returning at the eye. A split guide ring ([B], Fig SB(b).1) is fitted to assist smooth passage of the fluid.

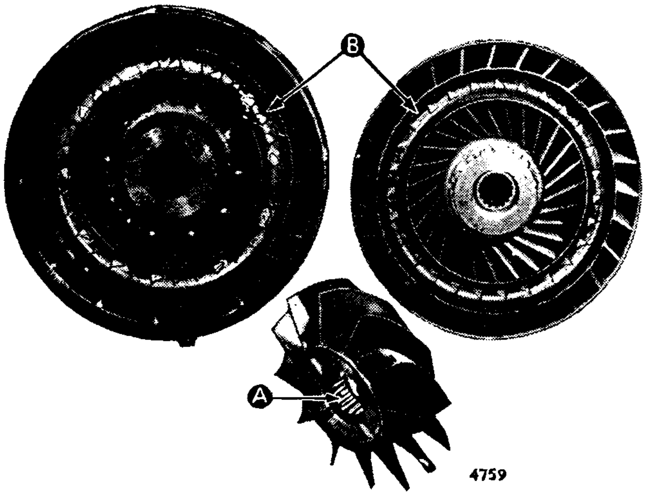


Fig. SB(b).1
Impeller, turbine, and stator

A. Stator and free-wheel.
B. Fluid guide ring.

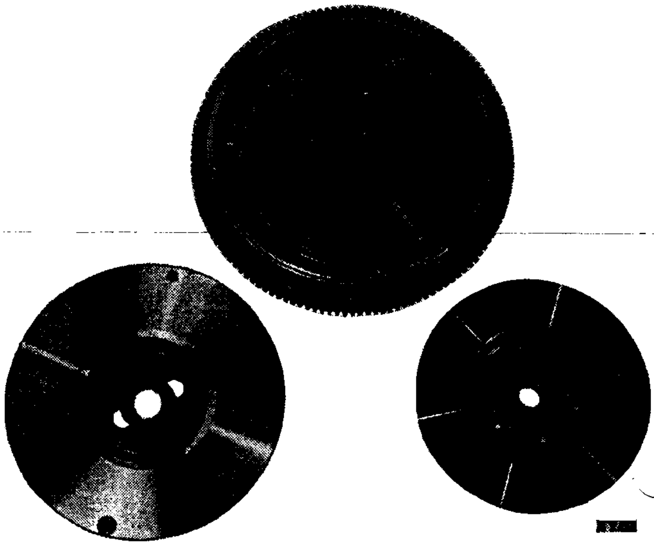


Fig. SB(b).2
(Top) Flywheel and pressure plate.
(Bottom) Clutch backing plate. Clutch driven plate

Maximum multiplication is obtained when the impeller is turning and the turbine is stationary, and becomes progressively less as the relative speed of the two elements decreases until coupling point is reached, when the speed of the turbine is approximately the same as that of the impeller. At this point the converter acts as a fluid coupling and there is no multiplication of torque.

As coupling point is reached the path of the returning fluid becomes more and more axial and would tend to be obstructed by the stator blades if the stato remained static. This interference with smooth fluid flow is reduced to a minimum by mounting the stator on a free-wheel, which allows the stator to rotate in the direction of engine rotation but not in the opposite direction. When there is torque multiplication and the stator blades act as a fulcrum the reaction is taken by the free-wheel and the stator is prevented from rotating anti-clockwise. When the two elements are rotating at approximately the same speed the stator also turns in the direction of engine rotation at speeds controlled by engine speed and fluid flow and offers little obstruction to the fluid.

The efficiency of the converter varies with speed up to a maximum of 90 per cent., and the efficiency at coupling point is approximately 97 per cent. The efficiency of the converter when the transmission is operating in direct top gear is immaterial since the engagement of the direct drive clutch connects the engine with the transmission output shaft and by-passes the converter and the epicyclic gear train.

valving required in the hydraulically controlled changes of ratio.

Automatic ratio changes are controlled by the governor and governor valve in accordance with engine speed and accelerator position when the control lever is set at 'D' for all normal driving. In this position the selector valve is directing the fluid to the forward band servo for low gear and also to the governor for automatic changes. The selector valve and the valves controlling application of the bands and clutches are housed in the valve block (Fig. SB(b).9) in the lower part of the transmission casing. Fluid for the operation of the hydraulic system is contained in the transmission casing and also acts as lubricant for the gears and bearings.

Section SB(b).3

GEAR TRAIN COMPONENTS—MECHANICAL

Two planetary sets (Fig. SB(b).3), each consisting of a ring gear, a carrier with three planet wheels, and a sun gear, are carried on the mainshaft and arranged one behind the other. Three brake-drums and bands (Fig. SB(b).8), named according to their functions and not to their locations in the case, enable various components of the planetary sets to be locked together for changes of ratio. The front drum (with band applied) is used to engage reverse gear and in consequence is named the reverse drum. In all forward speeds the drum at the rear of the box is held by its brake band and, despite its location, is known as the forward drum. The centre drum is held by its band when the control

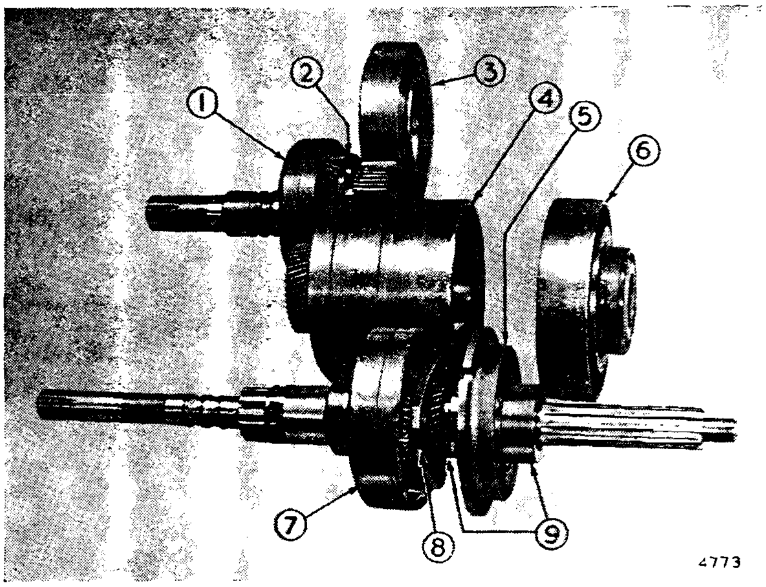


Fig. SB(b).3

1. Front ring gear (input to transmission gearbox).
2. Front planet carrier and pinions.
3. Reverse drum.
4. Low drum and multi-disc clutch assembly, including front sun gear.
5. Low drum plate, including reverse free-wheel.
6. Forward drum and forward free-wheel.
7. Rear ring gear.
8. Rear planet carrier and pinions.
9. Rear sun gear.

Section SB(b).2

GEAR TRAIN

One reverse and two forward ratios are obtained from two planetary gear sets, a multi-disc clutch, and three brake-drums and bands, all hydraulically operated. In forward speeds input is through the ring gears (1) and (7) (Fig. SB(b).3) and output through the carriers (2) and (8) (Fig. SB(b).3), input through the ring gear with a held sun gear giving a reduction of speed and forward rotation. Two free-wheels are incorporated to simplify the lever is at 'L' for manual low ratio and is therefore named the low drum.

The alloy-steel brake bands with bonded linings are actuated by hydraulic servos on the sides of the transmission case and the reaction is taken by adjustable anchors at the opposite sides.

A multi-disc clutch (Fig. SB(b).4) is housed in the low drum and consists of alternate steel- and bronze-faced plates engaged by hydraulic pressure and retracted by a series of springs. Its function is to lock the front sun

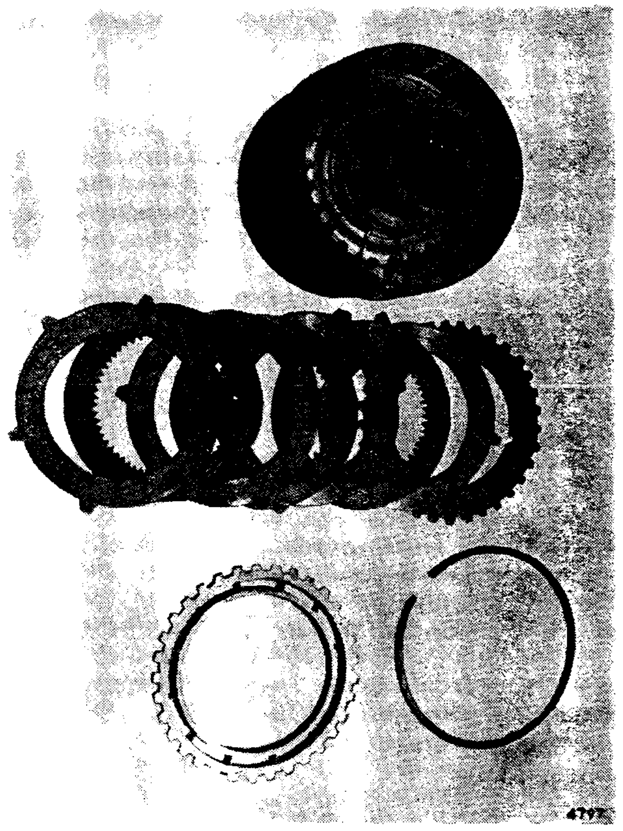


Fig. SB(b).4
Multi-disc clutch components

gear to the front carrier so that the front planetary set revolves as a unit during intermediate ratio (second gear) operation.

Two free-wheels, also named according to their functions, are located on the rear sun gear. The forward free-wheel ([A], Fig. SB(b).6) in the forward drum prevents the sun gear from rotating opposite to the direction of engine rotation, while the reverse free-wheel ([A], Fig. SB(b).5) in the low drum plate turns the sun gear ([B], Figs. SB(b).5 and 6) against engine rotation when reverse is in use and contains the parking pawl.

The extension case, bolted to the rear of the transmission, carries the rear pump, centrifugal governor, speedometer drive gear, and taximeter drive.

The mainshaft, carrying the entire gear train, is supported at the rear by a ball race and at the front by

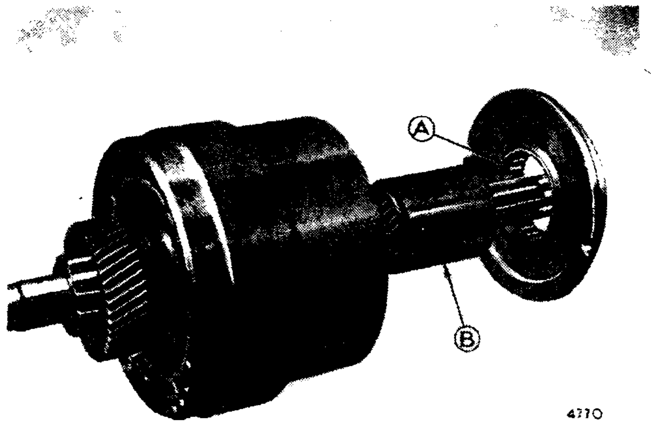


Fig. SB(b).5

A. Low drum plate and free-wheel.
B. Rear sun gear.

two sets of needle rollers located in the collector ring (Fig. SB(b).7). The shaft is splined at the front to carry the direct drive clutch plate and at the rear for the universal joint driving flange. Output from the planetary gear sets is through the rear carrier splined to the mainshaft.

Section SB(b).4

GEAR TRAIN COMPONENTS—HYDRAULIC CONTROL

An internal-external gear-type pump is mounted to the collector ring at the front of the transmission case (Fig. SB(b).7) and is driven by the converter impeller. The front pump supplies the fluid under pressure through the collector ring to the converter and to the hydraulic control valves at low and idling speeds, and in reverse.

A gear-type pump mounted in the rear extension case takes over from the front pump as the car speed rises. It is not operative in reverse.

A valve block (Fig. SB(b).9) bolted to the bottom of the transmission case houses five valves: selector valve, converter shuttle valve, accumulator valve, main relief valve, and reverse interlock valve.

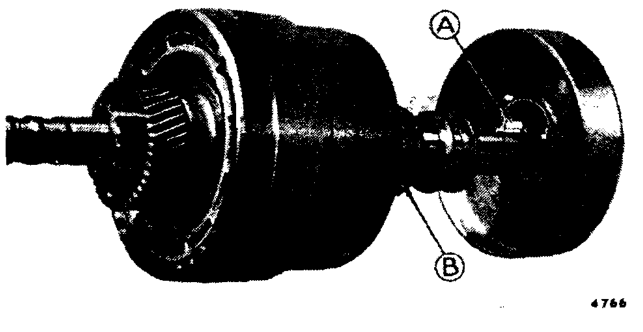


Fig. SB(b).6

A. Forward drum and free-wheel.
B. Rear sun gear.

The selector valve is moved by the control lever on the steering-column and directs the fluid from either or both pumps (depending on road and engine speeds) to the servos and governor in accordance with the position selected (see pages SB(b).6 and 7).

The converter shuttle valve regulates the pressure of the fluid delivered to the converter. The converter is pressurized but the pressure must be controlled below a maximum to avoid distortion of the converter casing. The converter shuttle valve has no spring but is operated solely by fluid pressure (Fig. SB(e).5).

The accumulator valve increases line pressure after the initial application of the bands in the interest of smoothness of application.

The main relief valve regulates the pressure of the front and rear pumps.

The reverse interlock valve prevents application of the reverse band when the car is travelling forward.

In addition to the above-mentioned valves, there are three others: the lubrication valve, the parking pawl

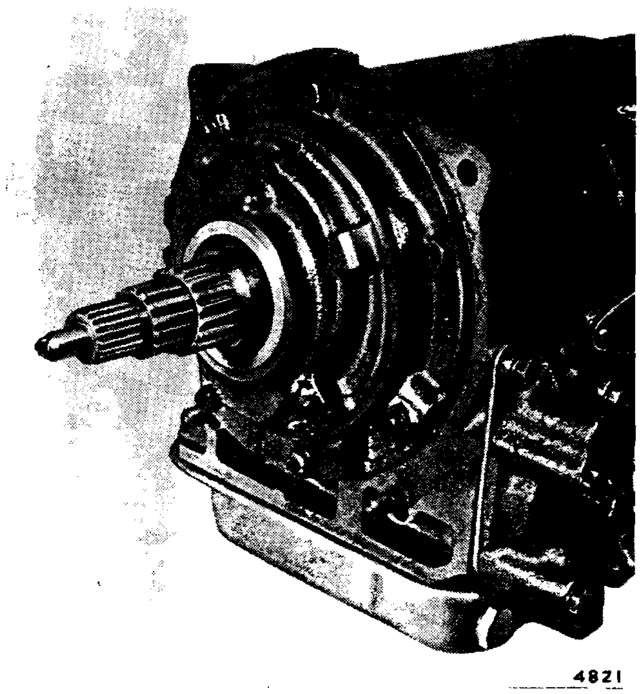


Fig. SB(b).7

The collector ring is bolted to the front of the transmission and houses the front pump

interlock valve, and the governor valve; the operation of the latter is described under '**GOVERNOR**', Section SB(b).6, below.

The lubrication valve is located in the main shaft and maintains the head of fluid in the converter when the engine is not running. As pressure rises, the lubrication valve opens and fluid is returned to the transmission case for bearing and gear train lubrication.

Fig. SB(b).8

A brake band assembly. Note the offset slot and pin (A) at the servo side and the central pin and slot at the anchor side

The parking pawl interlock valve is located in a bore in the extension case joint face. The piston is retracted by spring pressure so that the parking pawl can only be engaged as long as the piston is not pressurized by the rear pump when the car is moving.

Section SB(b).5

SERVOS

A reverse servo ([D], Fig. SB(e).41) on the left-hand side of the case and a low and forward servo on the right-hand side of the case apply the bands as required and directed by the governor valve.

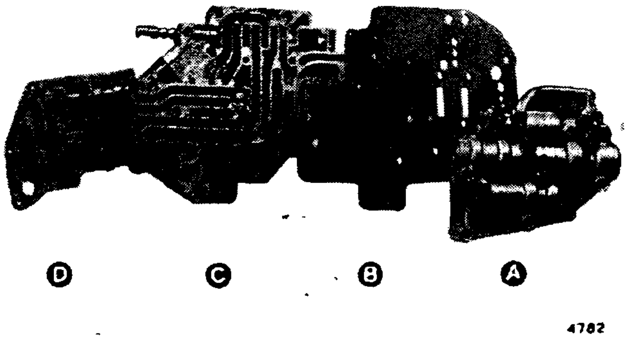


Fig. SB(b).9

The valve block

A. Main relief valve housing.
B. Manifold plate.
C. Manifold.
D. Converter valve housing.

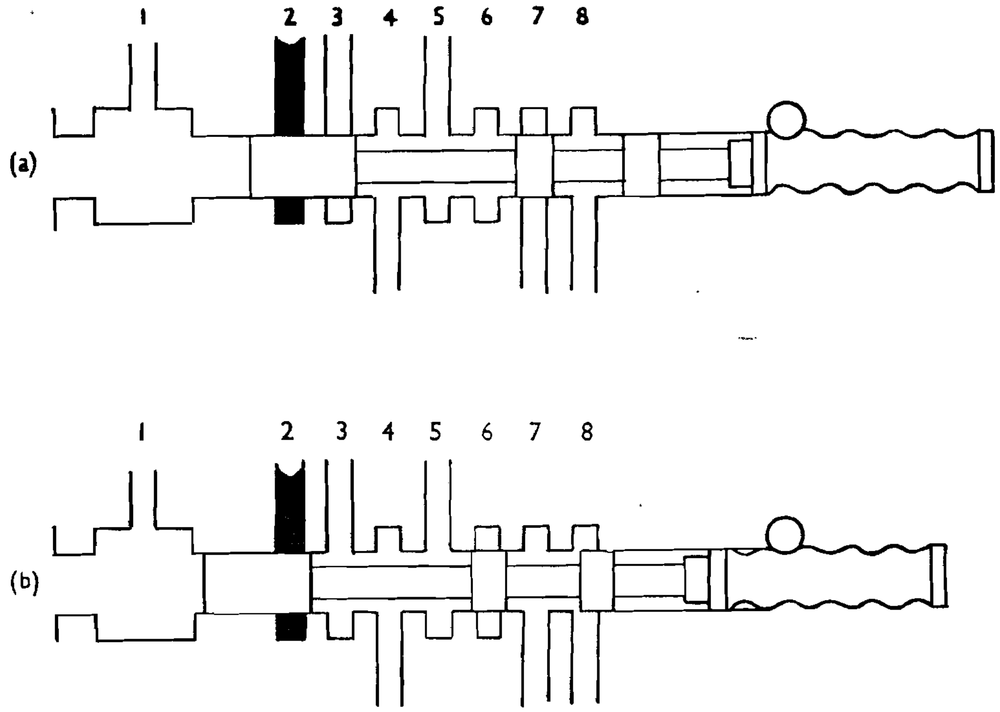


Fig. SB(b).10

The selector valve in the 'PARK' (upper) and 'NEUTRAL' positions. The port (2) is the main feed from the pump

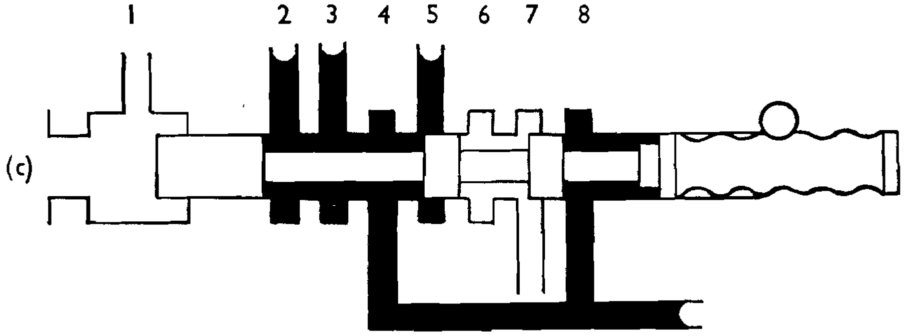


Fig. SB(b).11

The selector valve in the 'DRIVE' position. Port (3), open at all times when port (2) is open, supplies fluid to the accumulator valve. Port (4) allows fluid to pass to the forward servo and to port (8), which is closed, except in 'L'. Port (5) allows fluid to pass to the governor for automatic ratio change

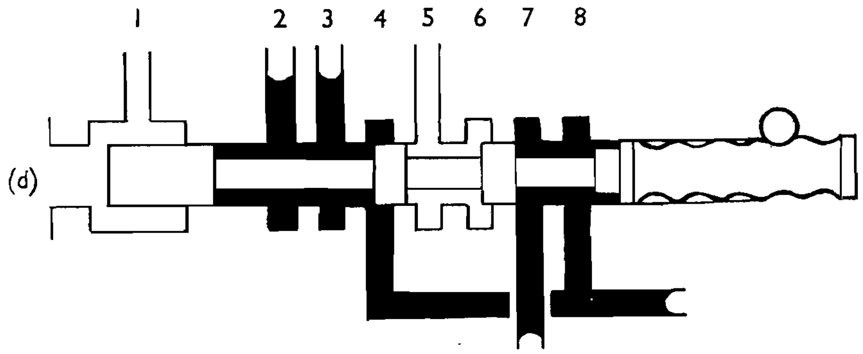


Fig. SB(b).12

The selector valve in the 'L' (MANUAL LOW) position. The governor supply is cut by the closure of port (5) and the forward band is applied from port (7)

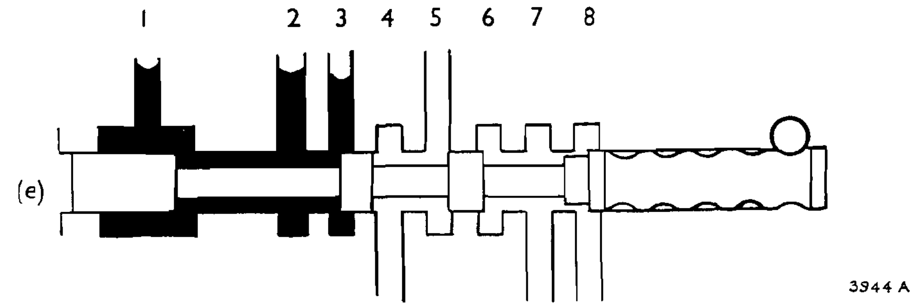


Fig. SB(b).13

The selector valve in 'REVERSE' position. Fluid flows from port (2) to the reverse interlock valve via port (1), and to the accumulator valve via port (3)

Section SB(b).6

GOVERNOR

Movement of the governor under the influence of centrifugal force opens or closes the governor valve ([B], Fig. SB(b).14) ports and directs the fluid to the clutches and servos for ratio changes as required by road speed and accelerator position (Figs. SB(b).15, 16, 17). One side of the governor is linked to the accelerator, thus rendering the governor sensitive to torque demand. A small hydraulic detent ([A], Fig. SB(b).14) works on the governor fork and prevents hunting between top and intermediate ratios.

A second speed pawl drops by gravity as soon as the governor valve is in the intermediate position and prevents the engagement of low ratio when full throttle is employed. Before automatic low can be engaged the pawl must be raised by releasing the accelerator pedal completely when the road speed is below 3 m.p.h. (5 km.p.h.).

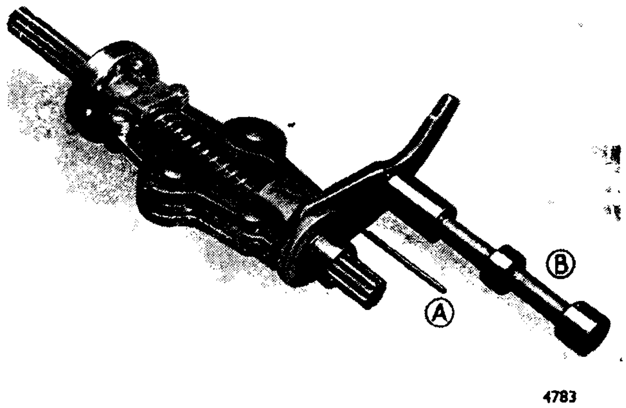


Fig. SB(b).14

A. Hydraulic detent. B. Governor valve.

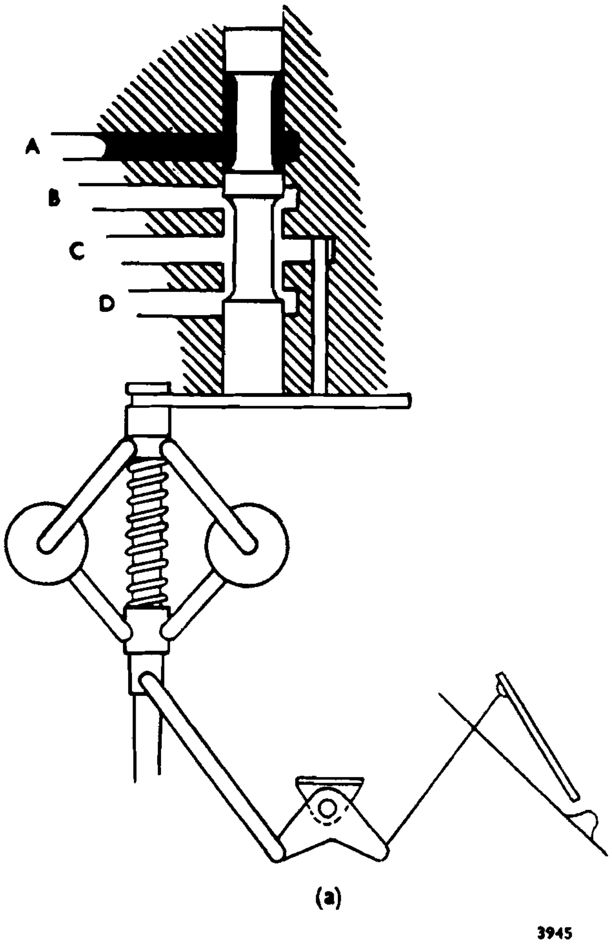


Fig. SB(b).15 (left)

Illustrating the governor valve operation. At low speeds, or at moderate speeds with the accelerator pedal hard down, the governor moves the valve to this position, where fluid from the selector valve is admitted to the valve body but prevented from passing out through any of the remaining ports

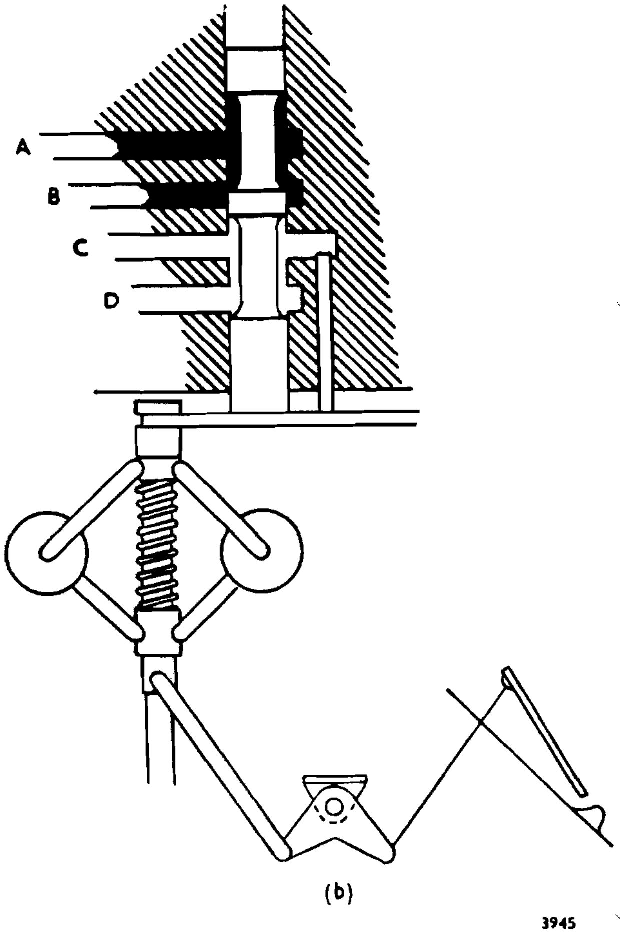


Fig. SB(b).16 (right)

As speed increases or the pedal is released the valve will move down and allow fluid to pass in at port (A) *and out through port* (B) *to the multi-disc clutch for engagement of intermediate ratio*

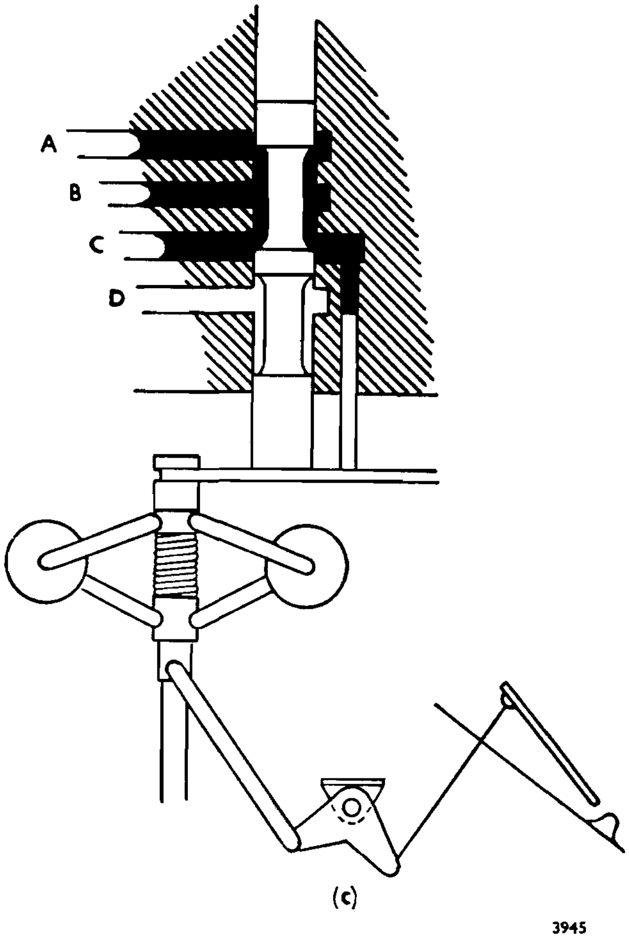


Fig. SB(b).17

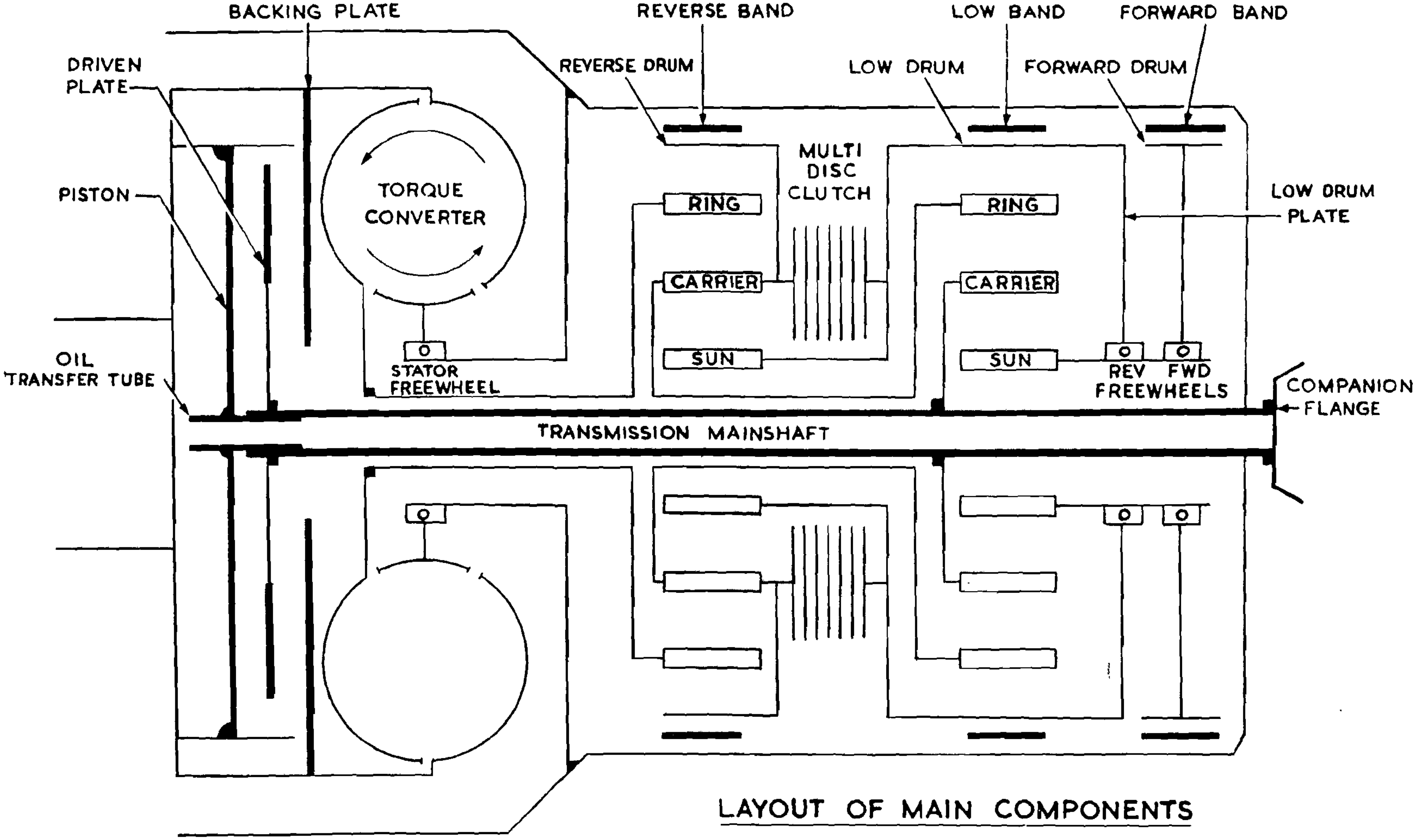
A still further increase of speed will cause the valve to move down, open port (C), *and so engage the direct drive clutch. When the car slows down, the valve closes the ports* (C) *and* (B) *and vents them through port* (D)

SECTION SB(c)

MECHANICAL POWER AND FLUID FLOW

Layout of main components.

Section No. SB(c).1	'L'—Manual low.	Mechanical.
Section No. SB(c).2	'D'—Low ratio (automatic).	
Section No. SB(c).3	'D'—Intermediate.	
Section No. SB(c).4	'D'—Direct drive (top).	
Section No. SB(c).5	'R'—Reverse.	
Section No. SB(c).6	'P'—Park.	Hydraulic.
Section No. SB(c).7	'N'—Neutral.	
Section No. SB(c).8	'D'—Low ratio (automatic).	
Section No. SB(c).9	'D'—Intermediate.	
Section No. SB(c).10	'D'—Direct drive (top).	
Section No. SB(c).11	'L'—Manual low.	
Section No. SB(c).12	'R'—Reverse.	



LAYOUT OF MAIN COMPONENTS

LAYOUT OF MAIN COMPONENTS

Front ring gear
Driven by the converter turbine.

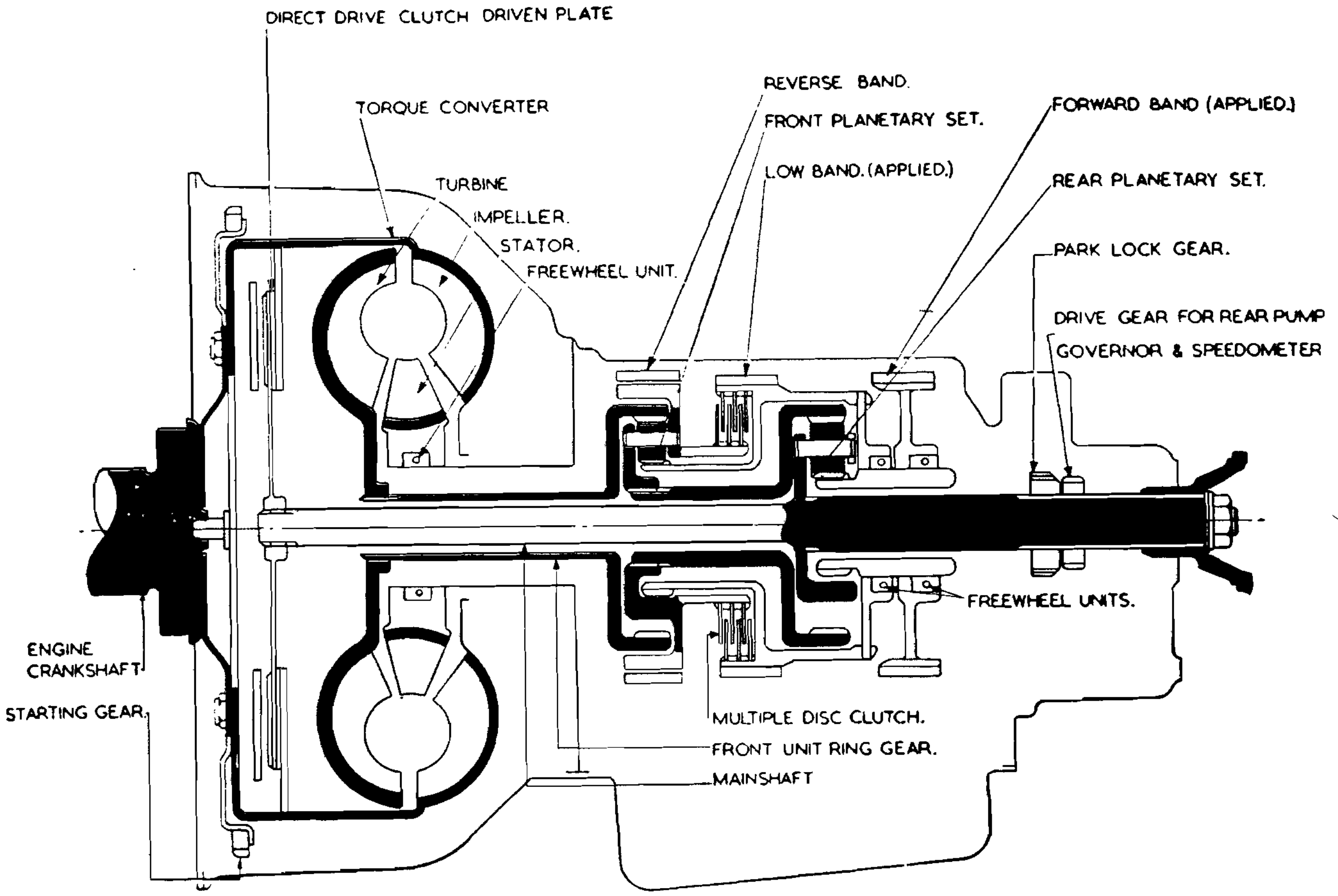
Front carrier
Serrated to the reverse drum and retained by circlip.
Splined to the rear ring gear.
Locked to the front sun gear when the multi-disc clutch is engaged.

Front sun gear
Riveted to the low drum and therefore can drive the rear sun gear in reverse through the low drum plate and reverse free-wheel.

Rear ring gear
Splined to the front carrier.

Rear carrier
The output of the gear train splined to the mainshaft.

Rear sun gear
In manual low ratio held against reverse rotation by the low drum and band and the forward free-wheel.
In automatic low: held by forward band and drum.
In reverse: rotated in reverse by the front sun gear through the low drum and plate and locked reverse free-wheel.



Section SB(c).1

'L' MANUAL LOW

Manual low ratio is the same as that obtained automatically in certain conditions with the control lever at 'D'.

In manual low ratio the low and forward bands are applied (illustration above) and the front sun gear is held independently of the rear sun gear and forward free-wheel; there is therefore no free-wheel effect in the transmission and manual low may be used for maximum engine braking. The engine should not be used for braking at a road speed greater than 18 m.p.h. (29 km.p.h.) owing to the risk of over-revving.

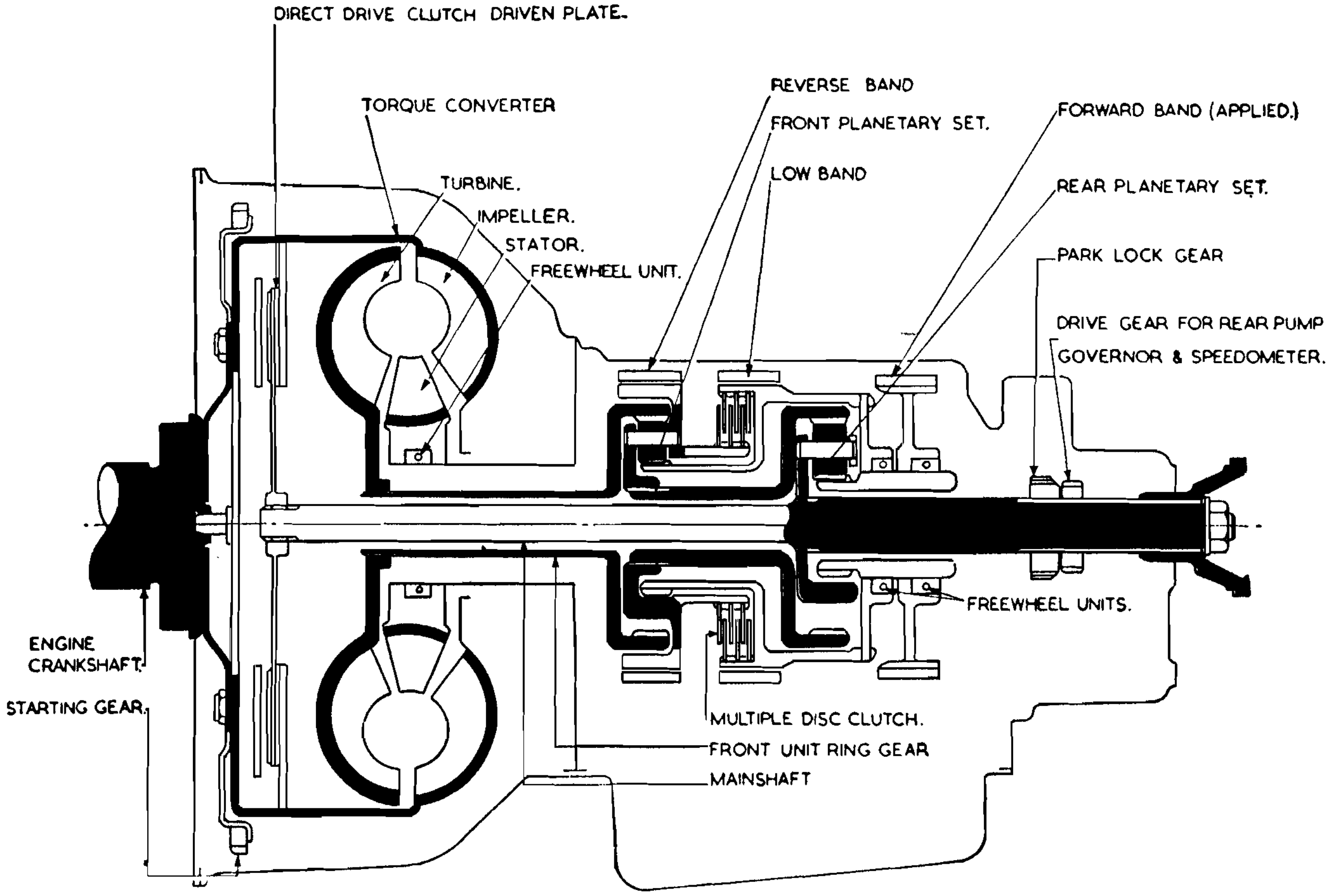
Section SB(c).2

'D' LOW RATIO (AUTOMATIC)

The forward band only is applied (illustration on page SB(c).5).

Low ratio at the output shaft is obtained from the reduction available in each of the two planetary sets. Input in each set is through the ring gear and output through the carrier, both sun gears being held.

Drive is from the converter turbine to the front ring gear, and as the ring gear rotates, the planet wheels of the front set rotate in a clockwise direction and roll round the stationary sun gear; the planet carrier must therefore revolve also in a clockwise or forward direction and at a reduced speed.



The ring gear of the rear planetary set, being splined to the carrier of the front set, must revolve in a clockwise direction, turning the planet wheels clockwise and causing the carrier to rotate at a further reduced speed in the forward direction. As the rear carrier is splined to the transmission main shaft, forward drive in low ratio is obtained at the rear axle.

The two sun gears are held in the following manner.

Rear sun gear

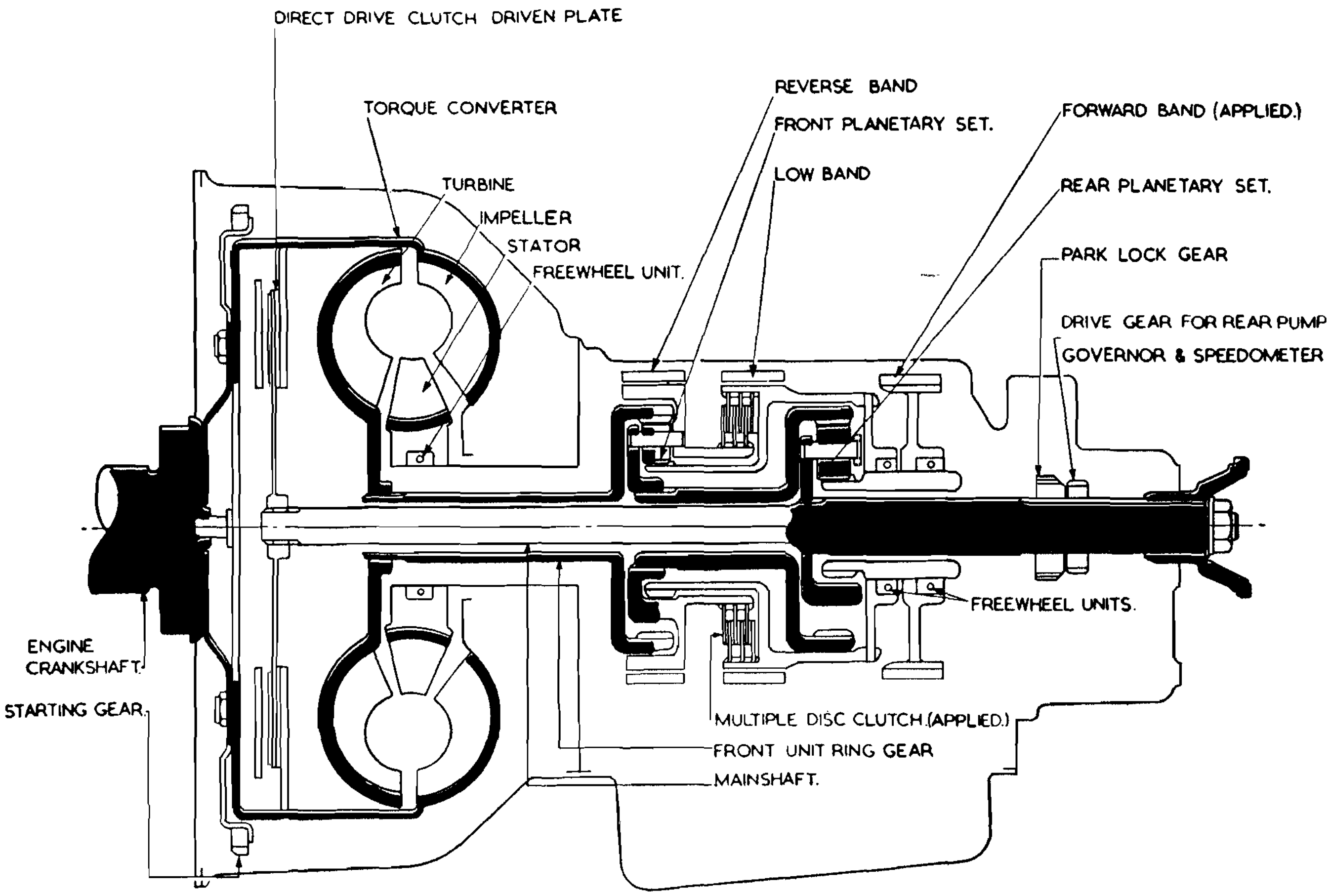
Rotation of the rear ring gear and carrier in the forward direction tends to turn the sun gear in the opposite direction.

An extension of the rear sun gear carries the forward drum and its free-wheel, and when the band is applied as in these conditions, the sun wheel cannot rotate against the direction of engine rotation as the free-wheel allows the sun wheel to turn only in the direction of engine rotation. Reaction in the rear set is therefore taken by the forward band.

Front sun gear

As in the rear planetary set, the reaction of the ring gear, carrier, and planet wheels tends to turn the sun gear against the direction of engine rotation. The front sun gear is integral with the low drum; the low drum and drum plate must also tend to turn anti-clockwise but are prevented by the reverse free-wheel (in the low drum plate) mounted on the rear sun gear (held), which will not allow anti-clockwise rotation of the drum and plate. The front sun gear is therefore held and the reaction of both planetary sets is taken by the forward band.

When the car overruns the transmission the forward free-wheel unlocks and consequently there is a free-wheel effect operative in automatic low ratio and no engine braking is available.



Section SB(c).3

'D' INTERMEDIATE

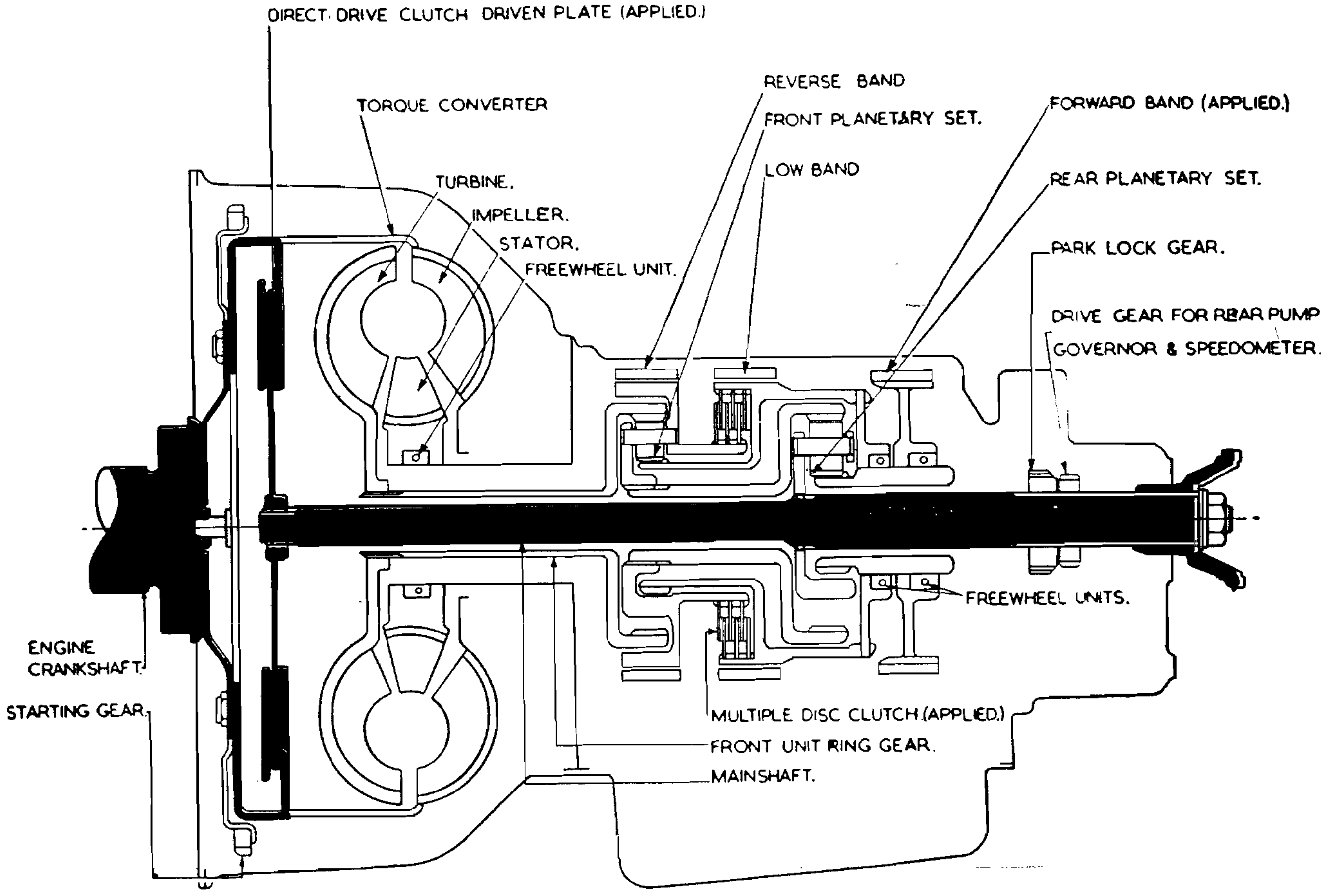
An intermediate ratio is obtained from the reduction available in the rear planetary set while the front set revolves as a unit. The forward band is applied and the multi-disc clutch engaged. Application of the forward band holds the rear sun gear, and the multi-disc clutch locks the front sun gear to the front carrier.

Drive is from the turbine to the front ring gear, and since the sun gear and carrier are held together the planetary set revolves as a unit without any reduction in speed.

The front carrier turns the rear ring gear at the same speed as the turbine.

The rear ring gear revolves and causes the rear carrier to revolve around the stationary rear sun gear (held by the forward band) at a reduced speed, taking with it the output shaft.

When the car overruns, the forward free-wheel unlocks. The reverse free-wheel locks, causing the low drum to rotate and turn the front planetary set as a unit, two elements of the front set being locked together by the multi-disc clutch.



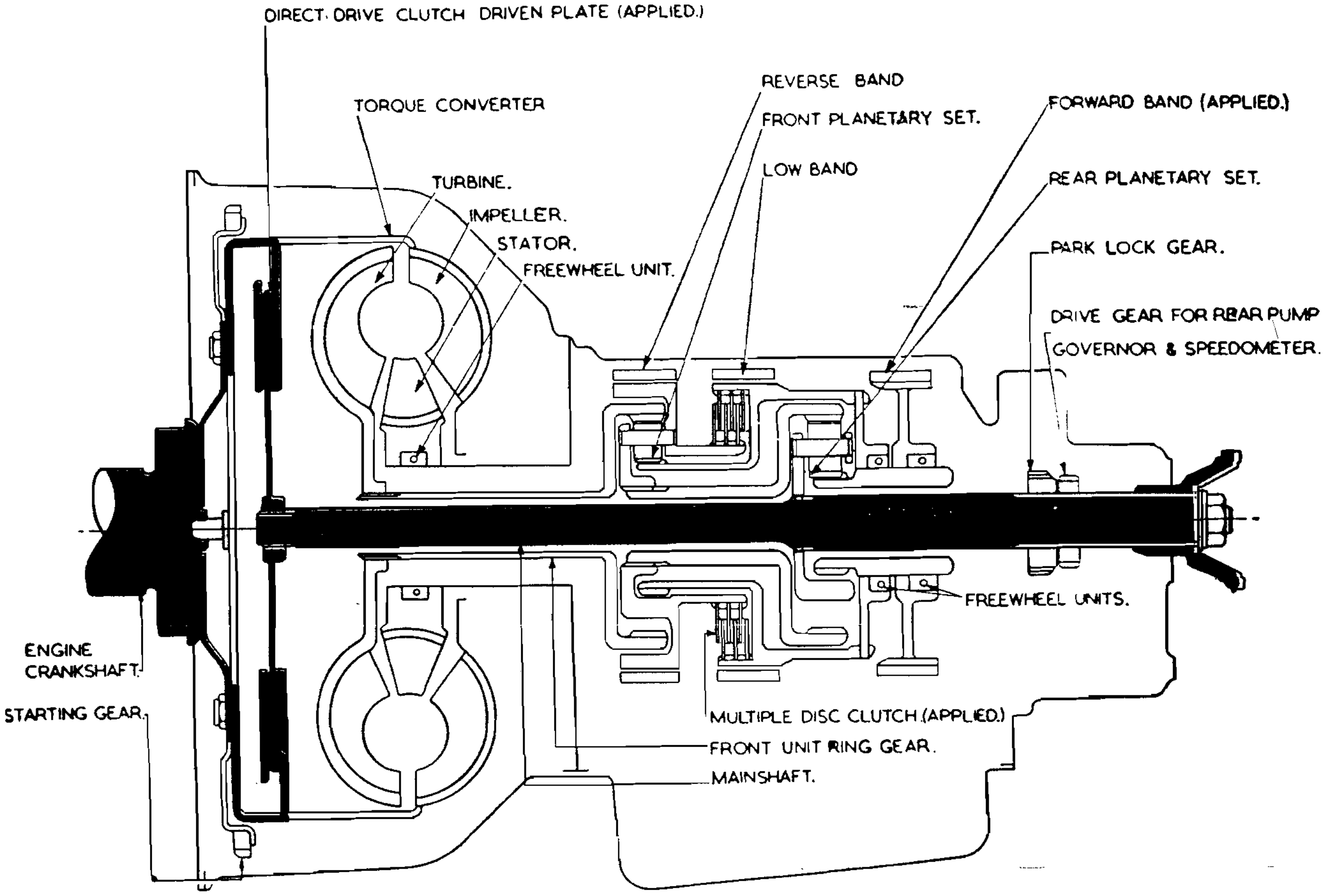
Section SB(c).4

'D' DIRECT DRIVE (TOP)

In direct drive (top gear) a mechanical connection is made between the flywheel and the transmission shaft through the engagement of a clutch plate located in the converter between the flywheel and a backing plate. The torque converter and planetary sets are by-passed (forward free-wheel unlocked) and the ratio is therefore 1 : 1.

A faced, spring-centred driven plate is splined to the main transmission shaft and compressed against the backing plate by hydraulic pressure acting behind a pressure plate located in the flywheel. Fluid is led behind the pressure plate from the main shaft through a small removable oil transfer tube, which must not be omitted when assembling.

The transmission remains conditioned for the intermediate ratio by the continued application of the forward band and engagement of the multi-disc clutch. As soon as the pressure to the direct drive clutch is cut off by the governor the converter and gear train become operative. While in direct drive the forward free-wheel permits the rotation of the output shaft although the forward band is applied, and the gear train components rotate as dictated by friction.



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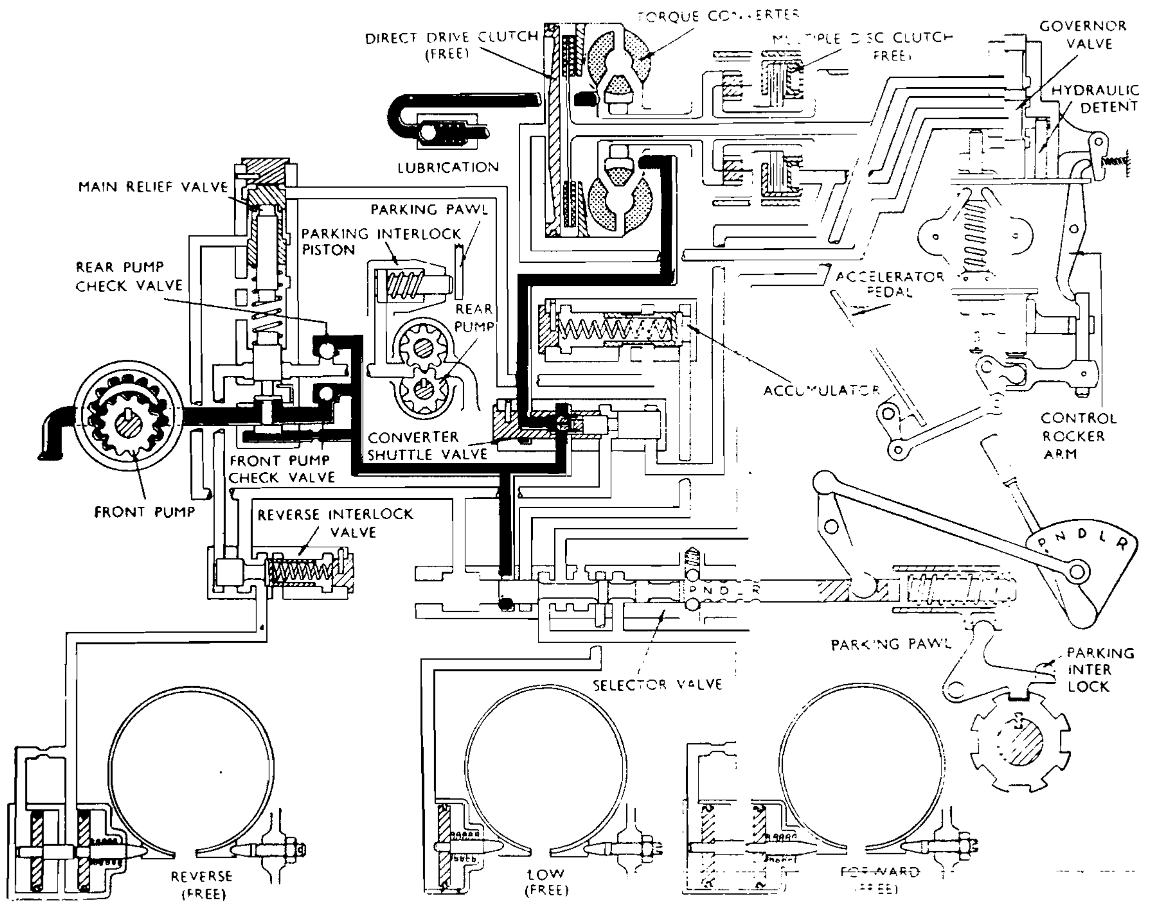


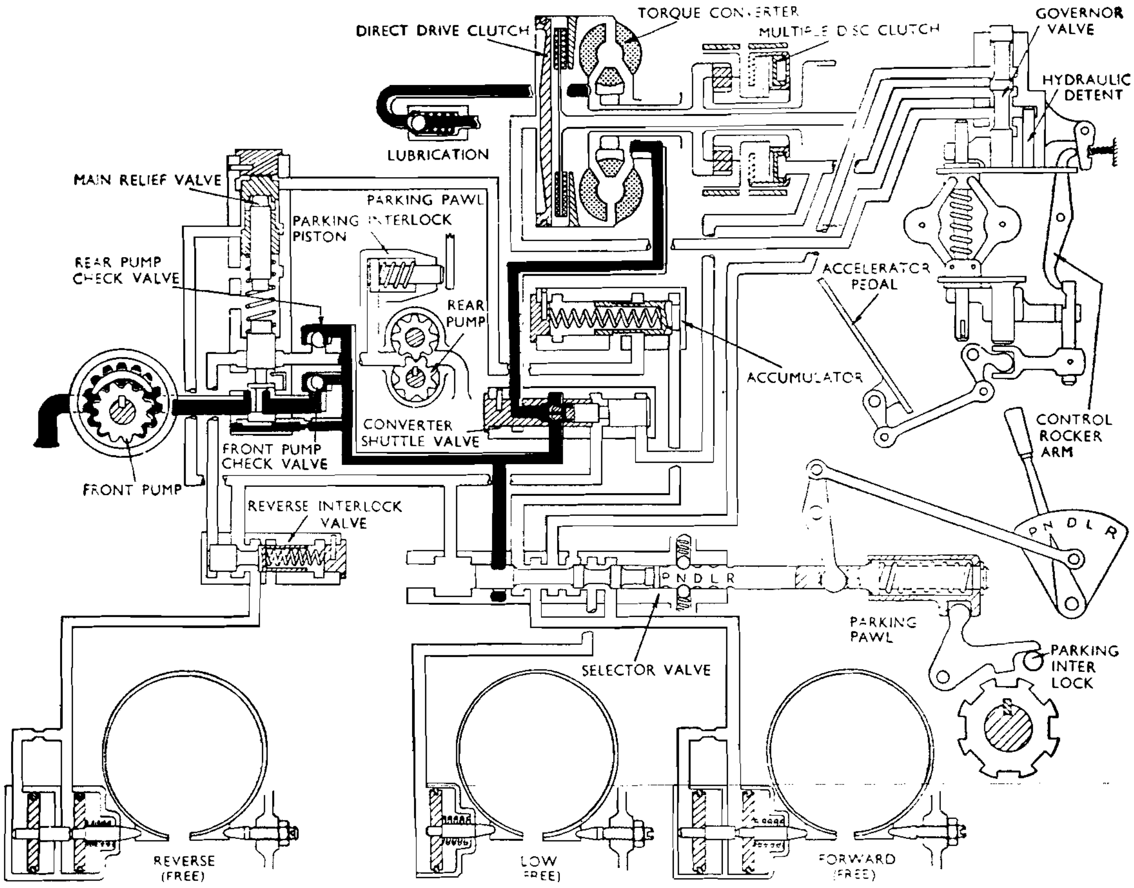
Section SB(c).6

'P' PARK

With the engine running the front pump delivers fluid through the main relief valve and the converter shuttle valve to the converter and to the selector valve. The main relief valve regulates the pressure to 20 lb./sq. in. (1·41 kg./cm.²) and the lubrication valve maintains this fluid head in the converter when the engine is not running, ready for immediate operation. Fluid from the converter returns to the transmission through the lubrication valve.

With the lever at 'P' the selector valve prevents the passage of fluid to the bands, the governor, and the multi-disc and direct drive clutches. As the car is stationary the rear pump is not operative and its check valve ball is retained on its seating by fluid pressure from the front pump.

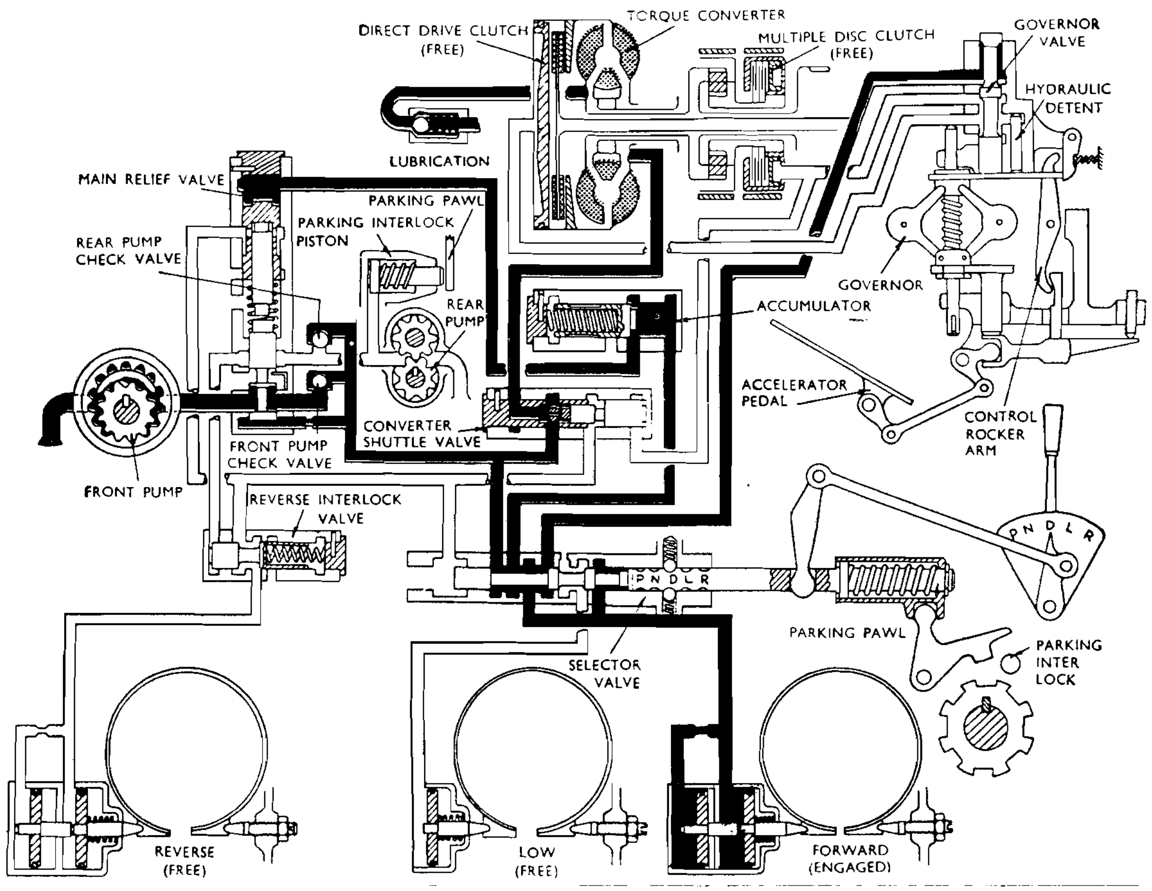
The parking pawl is mechanically engaged.



Section SB(c).7

'N' NEUTRAL

Hydraulically the conditions are as for 'P' Park.
The parking pawl is disengaged mechanically by the movement of the selector lever.



Section SB(c).8

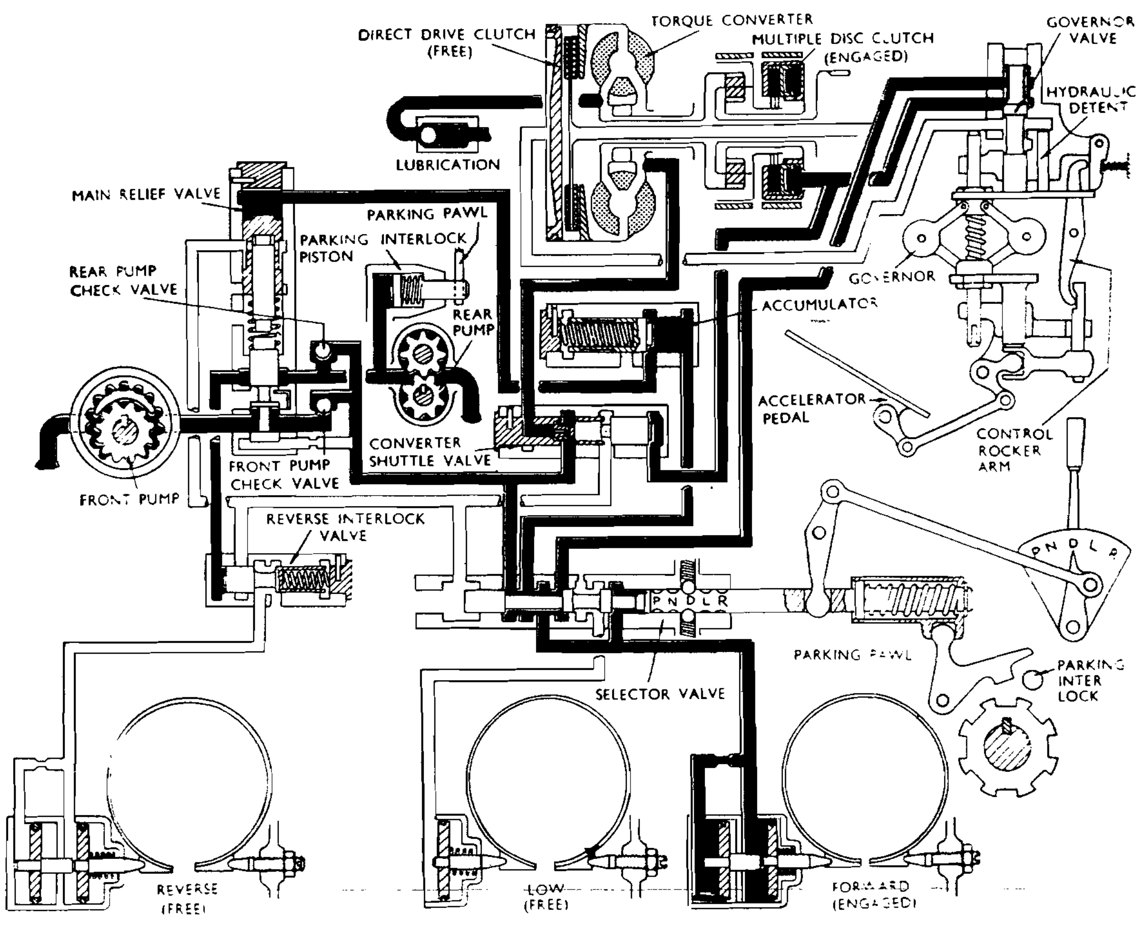
'D' LOW RATIO (AUTOMATIC)

Fluid from the front pump at a regulated pressure (initially) of 20 lb./sq. in. (1·41 kg./cm.^{2}) is delivered to the converter and selector valves as in Park, but the movement of the lever to 'D' has moved the selector valve so that fluid can now pass to the forward band servo, to the accumulator valve and governor valve. The accumulator valve gives sufficient time lag for the band to be applied smoothly at the lower line pressure.

Fluid pressure opens the accumulator valve and a passage to the top of the main relief valve, where the fluid pressure is added to the value of the relief valve spring and the nominal line pressure rises to 85 lb./sq. in. (5·9 kg./cm.^{2}).

Pressure in the converter is reduced by the converter shuttle valve to a value of 15 to 30 lb./sq. in (1·0 to 2·1 kg./cm.^{2}). The higher converter pressure reduces cavitation noise and slip.

Fluid directed to the governor valve is blocked until the engine is speeded up and the governor begins to move the valve piston outwards.



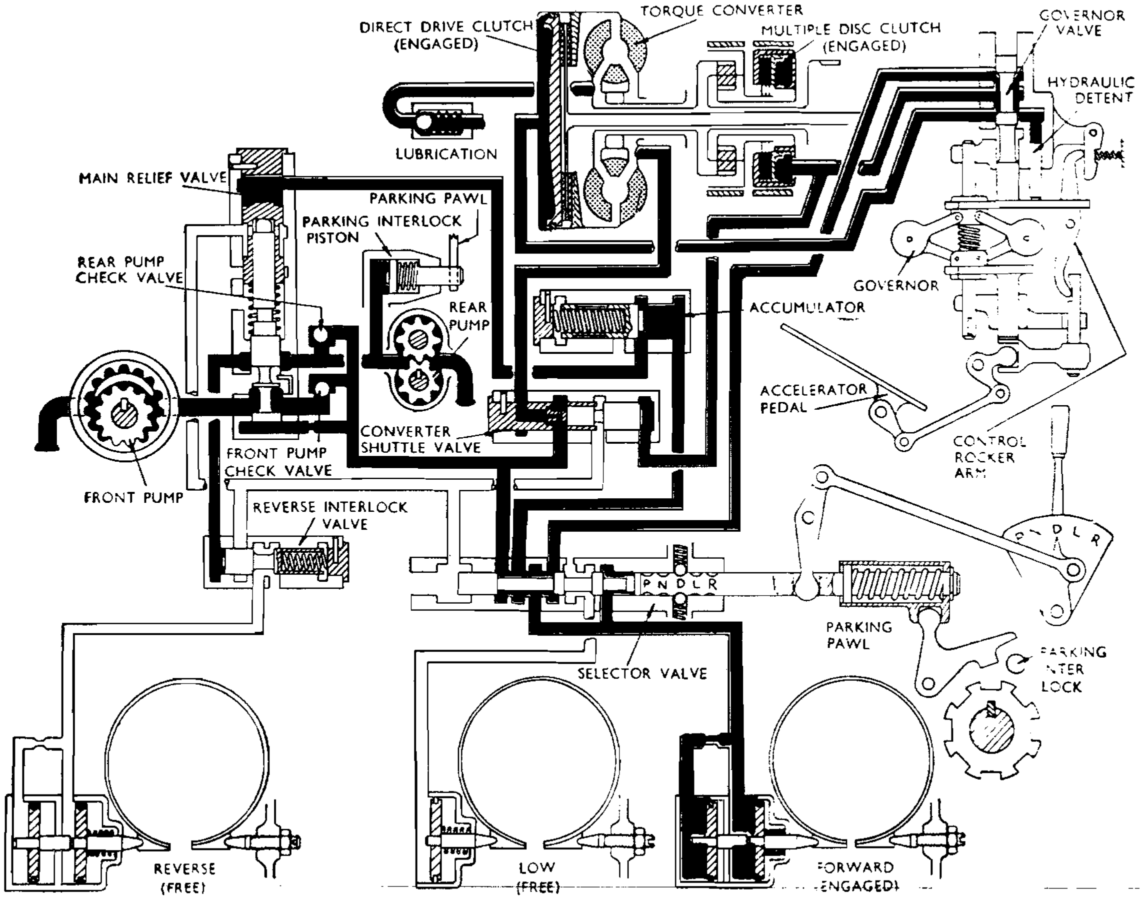
Section SB(c).9

'D' INTERMEDIATE

Fluid is pumped through the main relief valve and via the selector valve and accumulator valve to the top of the main relief valve piston, giving a nominal line pressure of 85 lb./sq. in. (5·9 kg./cm.²). As the speed of the car increases, the rear pump closes the front pump check valve and takes over from the front pump completely.

Fluid pressure from the rear pump is directed to the parking pawl and reverse interlock valves, preventin engagement of either while the car is moving forward a speeds above 3–5 m.p.h. (5–8 km.p.h.).

From the selector valve fluid passes to the forward servo and applies the band, and to the governor valve, from which it is directed to the multi-disc clutch. From the same passage fluid flows through a restricted orifice in the converter shuttle valve and then to the converter. Nominal line pressure of 85 lb./sq. in. (5·9 kg./cm.²) is reduced to 15 to 30 lb./sq. in. (1·0 to 2·1 kg./cm.²).



Section SB(c).10

'D' DIRECT DRIVE (TOP)

Fluid from the front or rear pump passes at a nominal line pressure of 85 lb./sq. in. (5·9 kg./cm.²) to the selector valve and from there is directed to: (*a*) the accumulator valve, (*b*) the governor valve, and (*c*) the forward band.

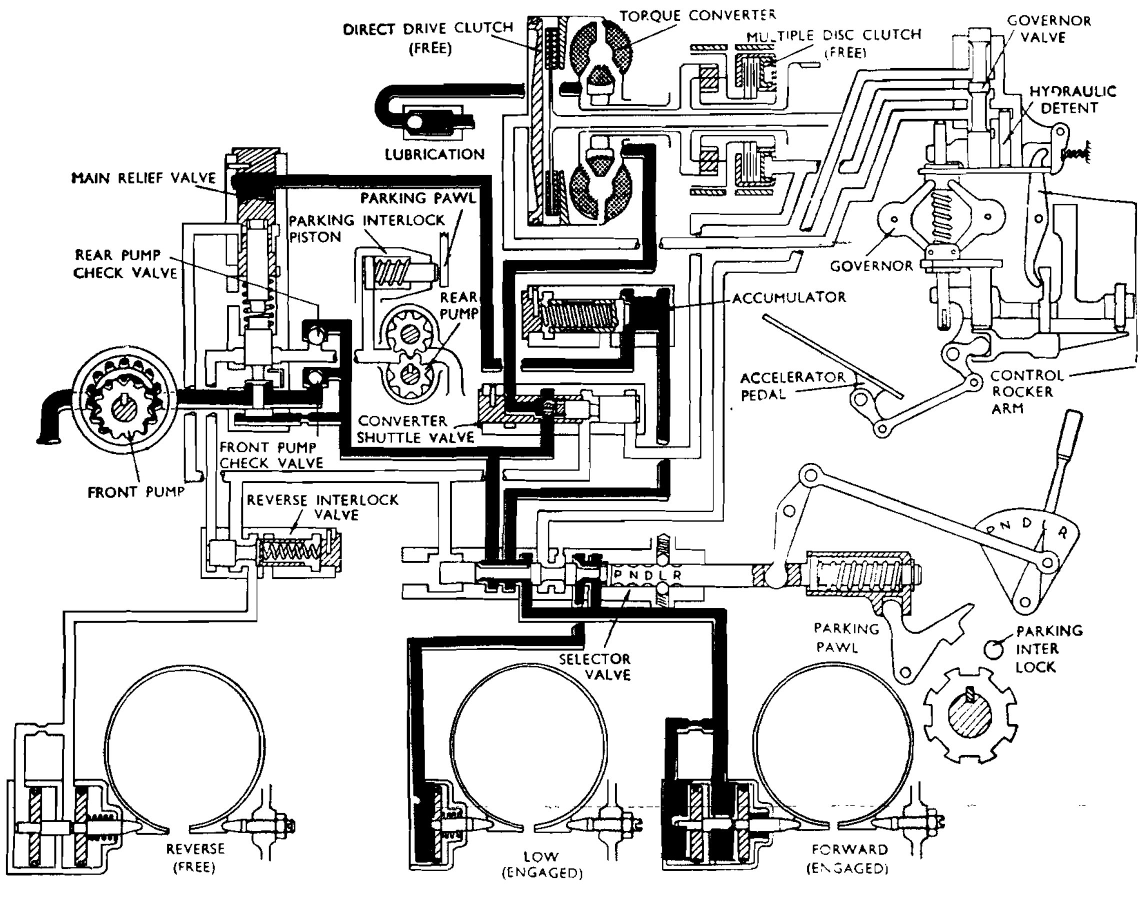
(*a*) From the accumulator valve, when the spring is compressed, fluid is led to the top of the main relief valve piston to maintain the line pressure at 80 lb./sq. in.

(*b*) From the governor, line pressure is directed to the converter shuttle valve, causing the fluid to pass through a restricted orifice; line pressure is reduced to 15 to 30 lb./sq. in. (1·0 to 2·1 kg./cm.²) and delivered to the converter.

From the governor, line pressure is also directed to the direct drive clutch, giving direct drive to the axle and by-passing the planetary sets and the converter.

(*c*) The multi-disc clutch and the forward band are retained in the engaged condition so that the transmission is conditioned for a rapid change down to intermediate ratio.

In the governor, fluid is led to a small piston called the hydraulic detent, which butts against the governor valve arm and prevents any tendency for the transmission to hunt between top and intermediate ratios.

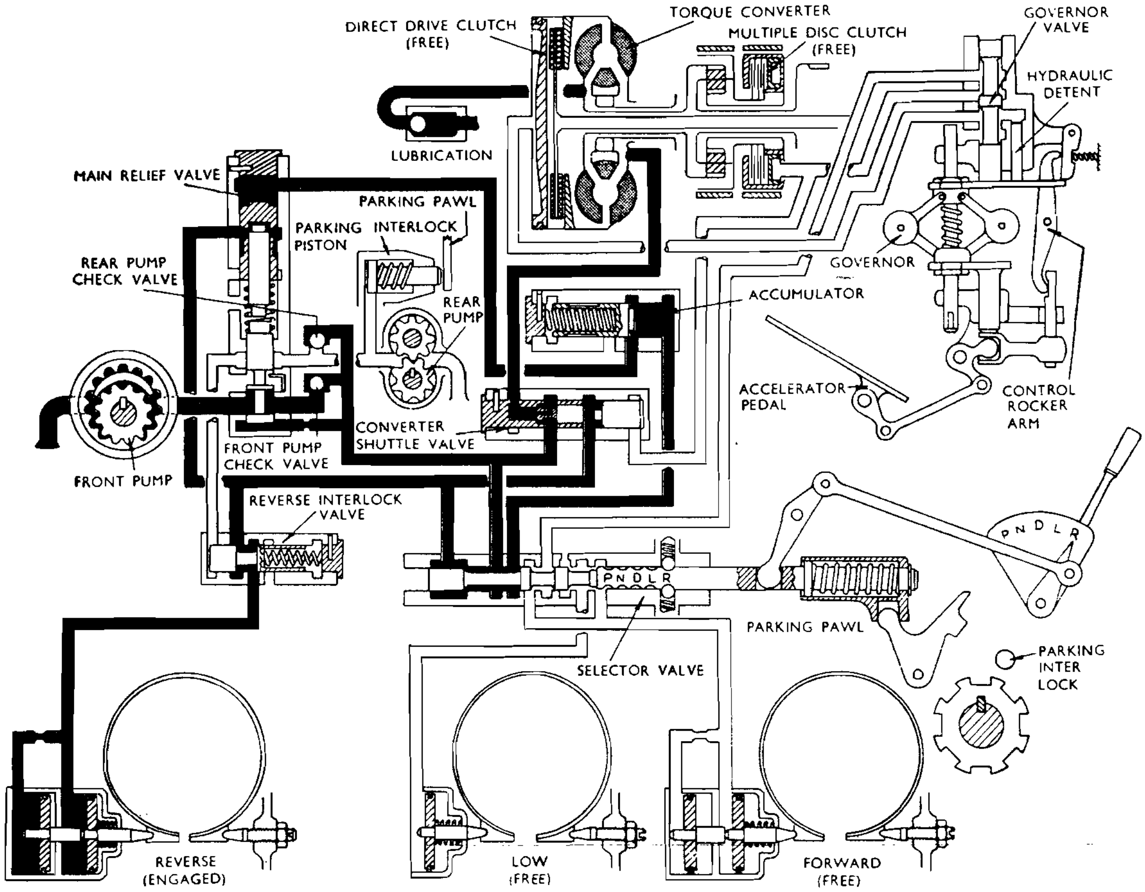


Section SB(c).11

'L' MANUAL LOW

When the car is driven in manual low, conditions of line pressure and forward band application are similar to those described for automatic low, but fluid is now also directed to the low band and cut off from the governor. Both low and forward bands are now applied and, since the governor valve is inoperative, the transmission remains in low until the selector valve is once more moved.

If the selector lever is moved from 'D' to 'L' when the car is travelling, pressure will be at 85 lb./sq. in. (5·9 kg./cm.^{2}) and application of the low band will be at this pressure, giving immediate and positive engine braking. The pressure may be supplied by either the front or rear pump, depending upon the speed of the car.



Section SB(c).12

'R' REVERSE

The rear pump is inoperative in reverse.

Fluid under pressure from the front pump passes to the converter shuttle valve and converter, and to the selector valve. From the selector valve fluid is directed to: (*a*) the accumulator and main relief valves, and (*b*) reverse interlock valve, reverse servos, and the inner piston of the main relief valve.

Fluid pressure opens the accumulator valve and acts on the outer piston of the main relief valve, increasing the nominal line pressure to 85 lb./sq. in. (5·9 kg./cm.^{2}). Pressure is further increased to 250 lb./sq. in. (17·5 kg./cm.^{2}) by leading fluid at line pressure to the inner piston of the main relief valve.

Fluid at 200 lb./sq. in. (14 kg./cm.^{2}) is directed to the large orifice of the converter shuttle valve and passes from the small orifice at a reduced pressure of 40 to 50 lb./sq. in. (2·8 to 3·5 kg./cm.^{2}).

Fluid at 200 lb./sq. in. (14 kg./cm.^{2}) is also directed to the reverse interlock valve, opened by spring pressure, and to the reverse servos to apply the reverse band.

SECTION SB(d)

REMOVING AND REFITTING

MAIN COMPONENTS AND SUB-ASSEMBLIES

Section SB(d).1

REMOVING MAIN COMPONENTS AND SUB-ASSEMBLIES

No particular sequence of operations is laid down for dismantling and reassembling the transmission and that detailed here is one of several possible. Certain special tools are available and some of them are essential for correct reassembly and adjustment of the transmission. These tools will be found listed, with their part numbers, in Section SB(i).

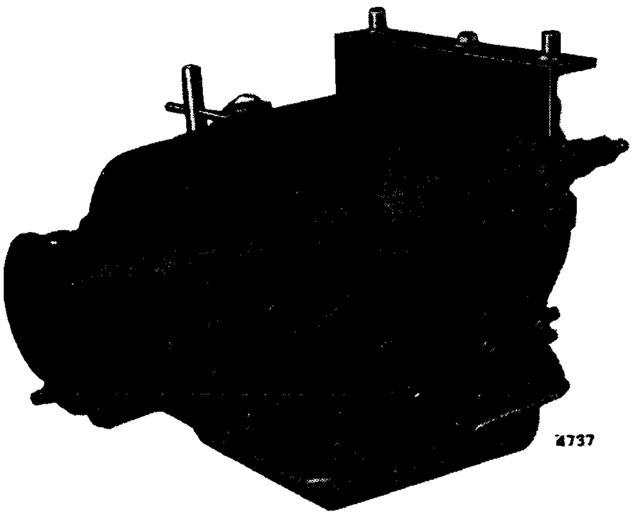


Fig. SB(d).1
Component parts of the bench cradle in position

Absolute cleanliness must be maintained at all times: clean the transmission externally before placing it on the bench where work is to be done, and ensure that the bench is clean. If possible, a dustproof shop is recommended. Do not use fluffy rag. The maximum allowable deposit in the system is ·8 gram.

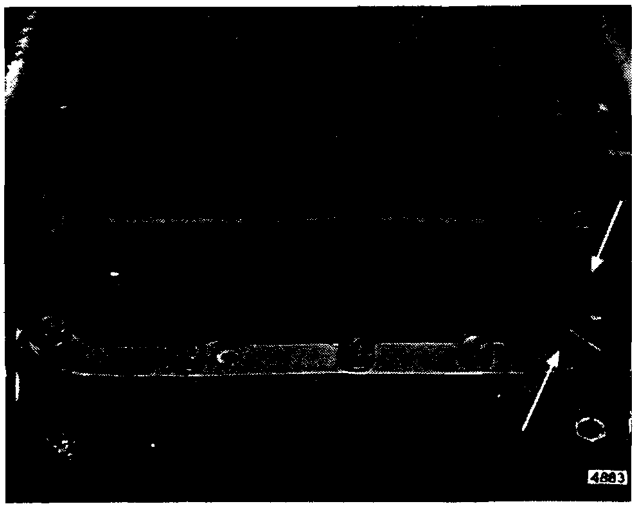


Fig. SB(d).2
Oil pan reinforcing strips

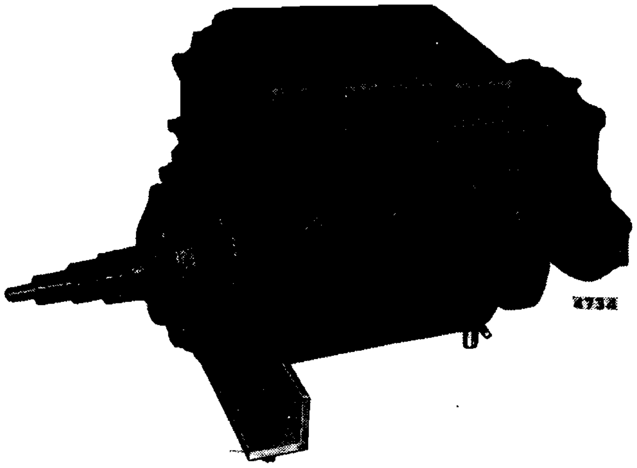


Fig. SB(d).3
The transmission resting on the bench cradle

Drain and remove the transmission, and unscrew the four nuts securing the converter housing; lift off the housing.

(1) Clean the transmission case. Fit the two parts of the bench cradle as shown in Fig. SB(d).1.

(2) Turn the case upside-down to rest on the cradle.

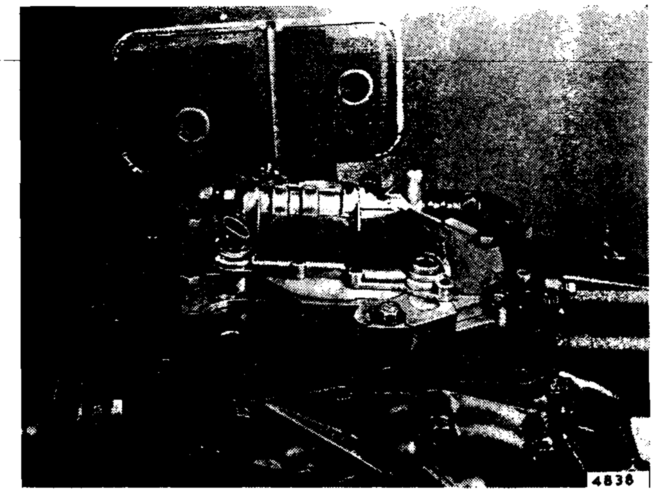


Fig. SB(d).4
Oil pan removed, showing the pick-up filter partly removed

Valve block

(3) Unscrew and withdraw the 14 set bolts securing the oil pan and remove the reinforcing strips and pan from the case.

(4) Slacken the retaining clip screw and remove the pick-up filter, taking care not to damage the gauze.

(5) Unscrew the seven retaining bolts and remove the valve block assembly.

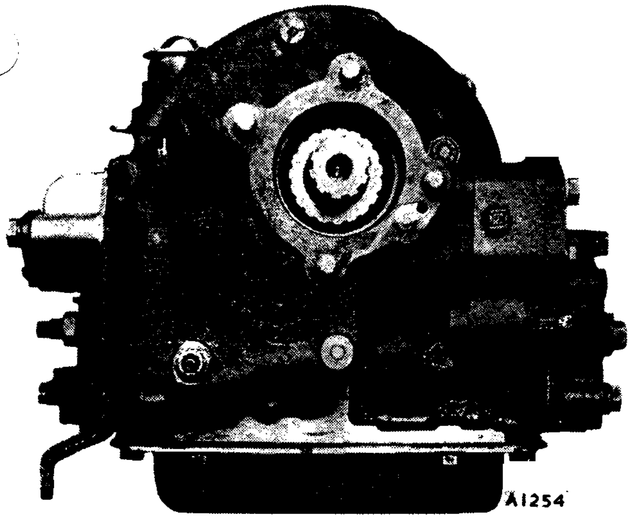


Fig. SB(d).5

The rear extension with taximeter drive removed

Extension case (with taximeter drive)

(6) Move the selector valve to the park position to hold the mainshaft against rotation. Unscrew the self-locking nut securing the driving flange; remove the nut, flat washer, and driving flange.

(7) Remove the six bolts securing the extension case: the upper bolt is a dowel bolt, one bolt is 3 in. (76·2 mm.) long, and the remaining four bolts are 1 in. (25·4 mm.) long.

(8) Withdraw the extension case and taximeter drive. While removing the case do not allow the main-shaft to move to the rear or the front planet carrier thrust washer may be dropped. The washer will have dropped if the front splines on the main-shaft protrude less than $1\frac{3}{16}$ in. (30·16 mm.).

(9) Remove the spacing tube, speedometer drive gear, parking gear, and bearing spacer.

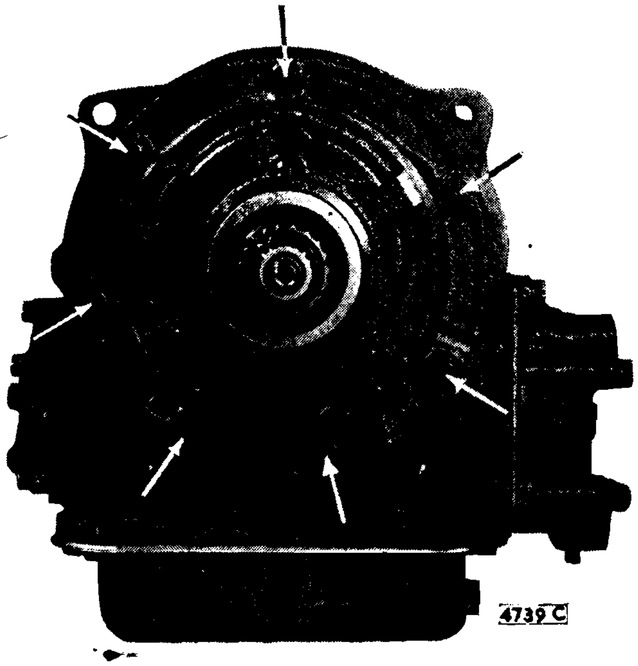


Fig. SB(d).6

Arrows indicate the collector ring securing bolts

Front pump and collector ring

(10) Fit a clip to the front mainshaft spline to prevent the front ring gear from moving forward and allowing the thrust washer to drop (unnecessary if transmission is to be completely dismantled).

(11) Remove the seven bolts, three of which are 1 in. (25·4 mm.) and the remainder $\frac{3}{4}$ in. (19·05 mm.) long. Tap the front pump and collector ring assembly lightly with a soft hammer and remove. Note the selective thrust washer revealed when the pump assembly is removed.

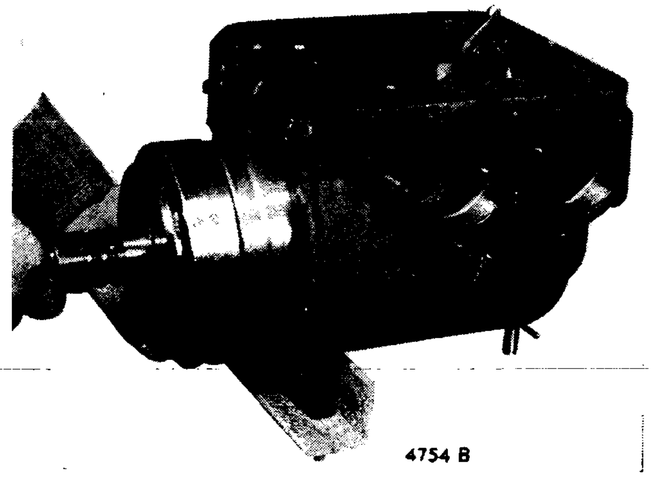


Fig. SB(d).7

Lifting out the gear train

Servos

(12) *Low and forward servos.* Remove the nine retaining bolts, four of which are 1 in. (25·4 mm.) and five are 2 in. (50·8 mm.) long. Unscrew the reverse band adjusting screw locknut and remove the servo cylinders and outer piston, cover, two gaskets, and inner piston. The inner piston can be pushed out from inside the transmission case.

(13) *Reverse servo.* Remove the low band adjustment screw locknut and unscrew the six retaining bolts; one is 1 in. (25·4 mm.), two are 2 in. (50·8 mm.), and three are $2\frac{3}{4}$ in. (69·85 mm.) long. Remove the cover, etc.

Mainshaft assembly

(14) Remove the circlip from the rear bearing, and withdraw the bearing with a suitable tool. Remove the shaft forward complete with drums and epicyclic gear trains (Fig. SB(d).7).

Brake bands

(15) Thread the bands out of the transmission case, taking care not to distort them. The reverse band is heavier than the forward and low bands. Lift out the anchor struts.

Section SB(d).2

REFITTING MAIN COMPONENTS AND SUB-ASSEMBLIES

(1) Replace the brake bands in the transmission casing as detailed in Section SB(e).12.

(2) Insert the mainshaft assembly (with clip on mainshaft to hold the front ring gear) into the case, taking care not to damage the brake bands as the drums pass through. Locate the rear bearing in the bore in the housing.

(3) Push the mainshaft forward so that the bearing lock ring is in contact with the housing.

(4) Assemble and refit the extension case as detailed in Section SB(e).4.

(5) Assemble and refit the front pump and collector ring as detailed in Section SB(e).10.

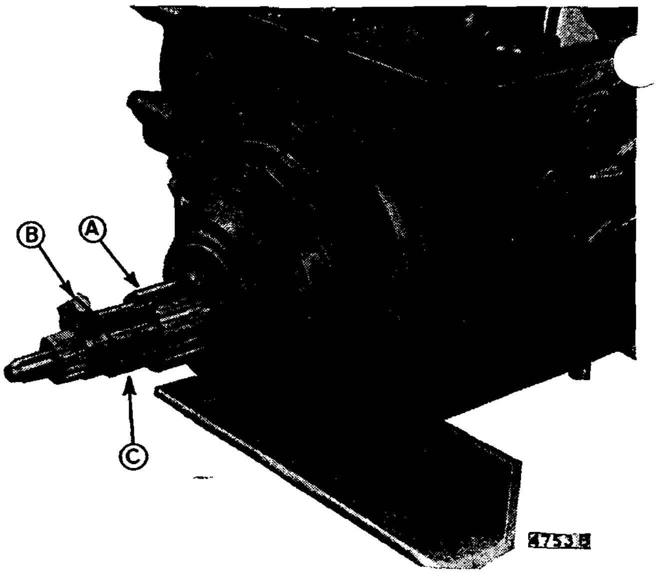


Fig. SB(d).8

(B) *is a small hose clip tightened on the mainshaft*

(6) Refit the servos.

(7) Refit the valve block.

(8) Refit the oil pan.

SECTION SB(e)

DISMANTLING AND REASSEMBLING MAIN COMPONENTS AND SUB-ASSEMBLIES

Section SB(e).1

VALVE BLOCK AND VALVES

Removal (in car or on bench)

Clean the area around the drain plug and oil pan joint.

Drain the oil from the gearbox only (in car).

Unscrew and remove the bolts securing the oil pan to the transmission case and lower the oil pan.

Slacken the screw, turn the clip locating the pick-up gauze, and remove the gauze.

Withdraw the seven set bolts and remove the valve block.

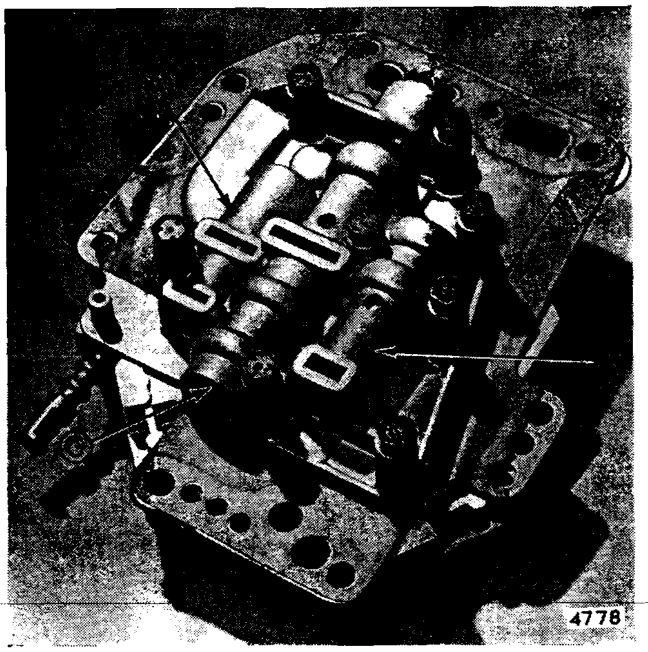


Fig. SB(e).1

The valve block

A. Reverse interlock valve. B. Accumulator valve. C. Main relief valve.

Unscrew the eight set bolts securing the relief valve housing ([A], Fig. SB(e).2), manifold, and converter valve housing. As the bolts are loosened the second selector valve detent spring located at (B), Fig. SB(e).2, will lift the base plate and relief valve housing and may allow the reverse and forward pump check valve balls to drop out of position. Withdraw the bolts and lift off the relief valve housing and base plate. Remove the two balls and the detent ball and spring. Separate the converter valve housing from the manifold.

Converter shuttle valve

Withdraw the retaining clip and shake out the two parts of the converter shuttle valve (see Figs. SB(e).3 and SB(e).5).

Reverse interlock valve

Insert the spring compressor (see Section SB(i)) in the slot in the spring retainer, compress the spring, and slide

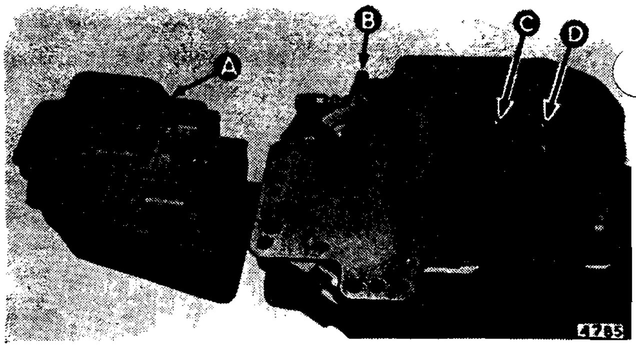


Fig. SB(e).2

A. Relief valve housing. B. Detent spring housing. C and D. Check valve balls.

the retainer tool between the spring and spring retainer with the groove over the spring compressor, as shown in Figs. SB(e).8, 9, 10; withdraw the compressor, and slide

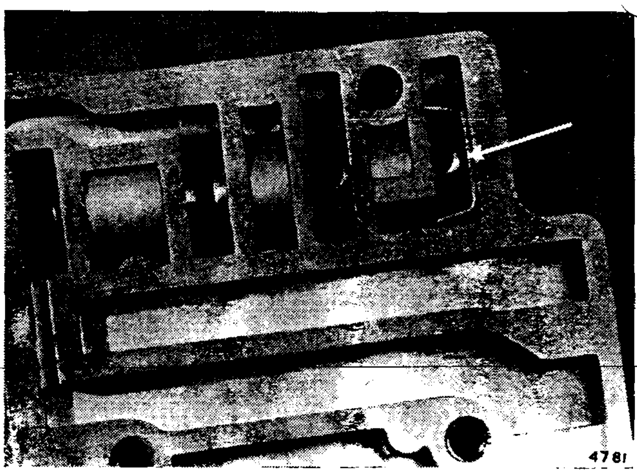


Fig. SB(e).3

The arrow points to the converter shuttle valve retaining clip

the spring retainer from the housing as in Fig. SB(e).10; replace the compressor, withdraw the retainer tool, and release the compressor to remove the valve.

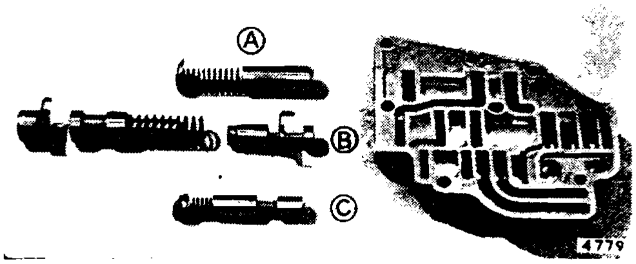


Fig. SB(e).4

A. Accumulator valve. B. Main relief valve. C. Reverse interlock valve.

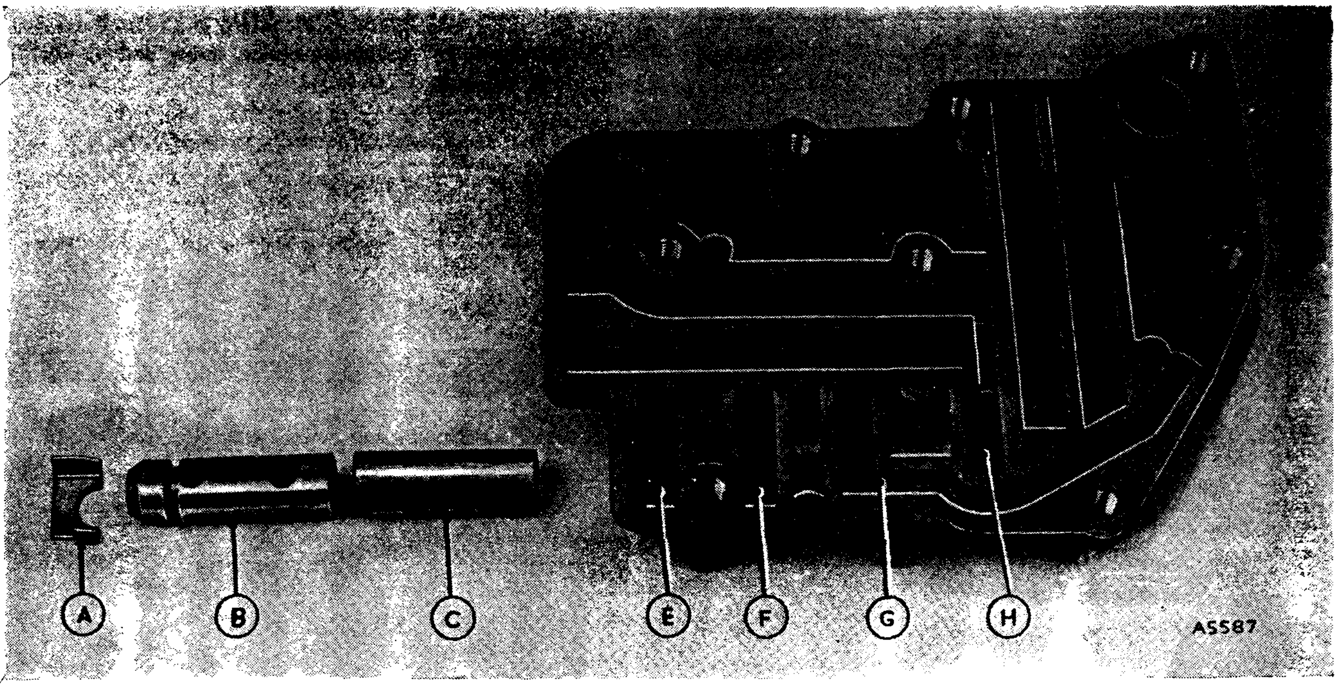


Fig. SB(e).5
The converter shuttle valve

A. Retainer.
B. Converter valve.
C. Spacer—converter valve.
E. Converter pressure.
F. Front and rear pump pressure.
G. Reverse pressure.
H. Multi-disc clutch pressure.

Accumulator valve

Remove the spring retainer and spring as detailed for the reverse interlock valve.

Main relief valve

Compress the spring slightly and withdraw the outer piston plug retainer clip; the spring will push out the plug. Shake out the pistons and spring (Fig. SB(e).7).

Remove the main relief valve retainer and valve.

Selector valve

Turn the selector valve so that the slot for the operating lever is at the top and away from the detent ball and spring. Push the selector valve through the housing from the detent end. Place a finger over the detent hole to prevent the ball and spring from being lost as the valve is removed.

Inspection

Clean all valves and housings thoroughly and inspect the valves and valve bores for scratches and other damage. Badly scored bores or valves require the fitting of a new body assembly. Slightly scratched valves may be polished to give smooth operation.

Make sure that all passages in the housings and manifold are clean and clear of obstruction.

Check the front and rear check valve seats to ensure that they are tight in the base plate. Check the valve housings for distortion.

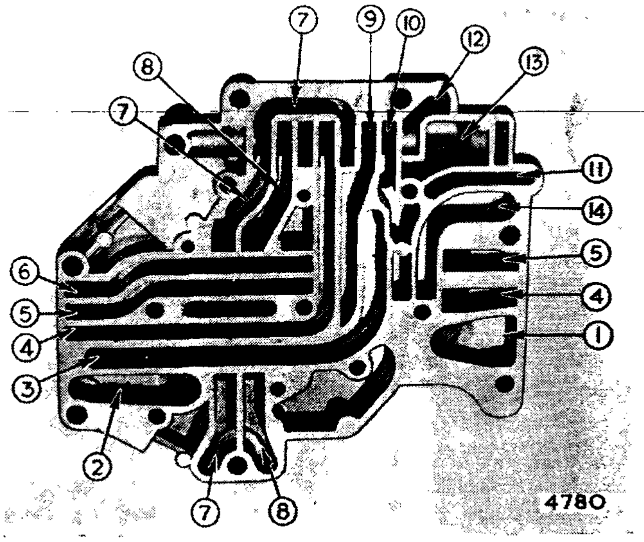


Fig. SB(e).6
Manifold passages

1. Front pump inlet.
2. Rear pump inlet.
3. Rear pump pressure.
4. Governor valve inlet.
5. Governor valve to multi-disc clutch.
6. Governor valve to direct drive clutch.
7. Selector valve to forward servo.
8. Selector valve to low servo.
9. Selector valve to accumulator valve.
10. Front and rear pump pressure.
11. Converter valve to converter.
12. Reverse interlock to reverse servo.
13. Selector valve to reverse interlock.
14. Front pump pressure.

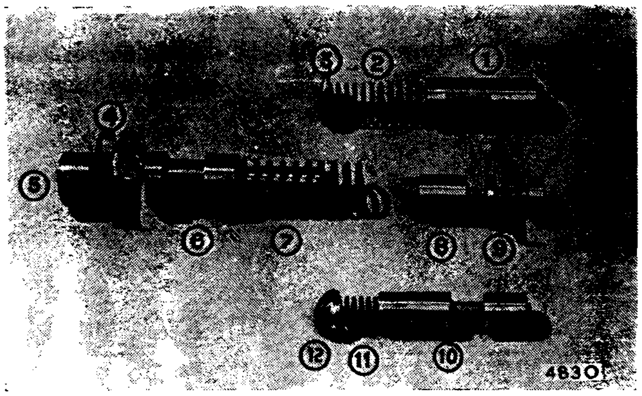


Fig. SB(e).7 (left)

1, 2, and 3. Accumulator valve, spring, and retainer.
4. Retainer.
5. Main relief valve outer piston plug.
6. Main relief valve outer and inner piston.
7. Spring.
8. Main relief valve.
9. Retainer.
10, 11, and 12. Reverse interlock valve, spring, and retainer.

Fig. SB(e).9 (right)
Compressing the valve spring with the thumb and compressor while the removing tool is inserted between spring and retainer

Fig. SB(e).8
The relief valve body showing: at (A) the accumulator valve retainer, and at (B) the reverse interlock valve retainer. Also the special tools (18G507) for removing the retainers

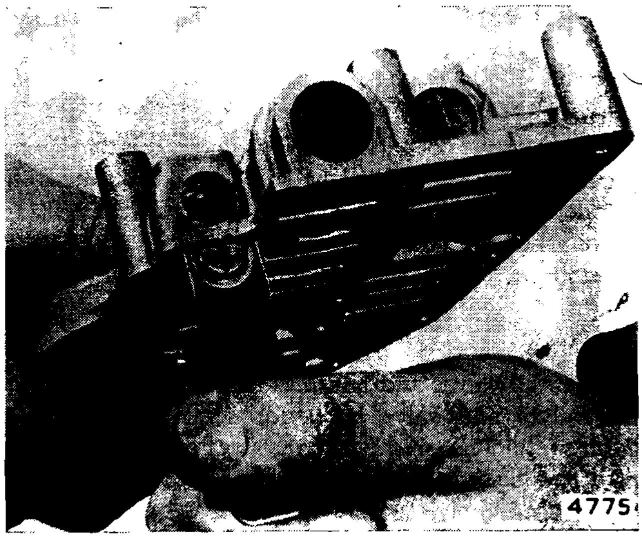


Fig. SB(e).10
Sliding the retainer from the housing. The compressor should be used to hold the spring, but is omitted here to show the slot in the remover

Assembly

Selector valve

Enter the selector valve in its bore with the slotted end leading and uppermost away from the detent. Place the detent spring and ball in position and compress the spring while the valve is pushed through.

Main relief valve

Slide the main relief valve into position in the housing with the lands on the valve towards the closed end of the bore, and, with the valve in the fully closed position, fit the main relief valve retainer. Position the spring.

Manifold, base plate, etc.

Place the converter housing on the bench and fit a new gasket to its face. Locate the manifold on the converter housing, using the large inlet holes as guides.

Place the second selector valve detent ball in the hole in the manifold, and its spring in the base plate. Fit a new gasket to the upper face of the manifold and position the base plate. Fit the two check valve balls to their seats in the base plate and then locate the relief valve housing on the base plate and insert the eight set bolts. Tighten the bolts to the recommended torque.

Fit the pick-up filter and tighten the retainer screw.

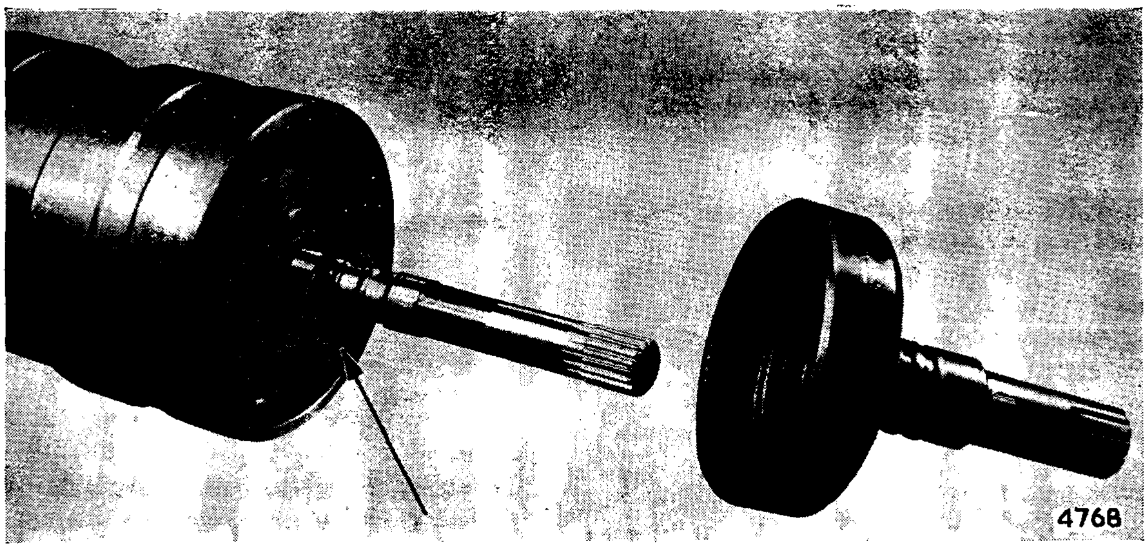


Fig. SB(e).11

The front ring gear removed, showing the thrust washer displaced from its location against the carrier

Fit the inner piston in the bore of the outer piston and the assembly, with the spring, into the bore in the housing. Fit the plug and compress the spring slightly to allow the retainer clip to be fitted.

Accumulator valve

Locate the spring in the bore in the valve and fit the valve and spring assembly into the housing. Compress the spring with the special tool and insert the retainer tool. Slide the spring retainer into position, refit the compressor tool, and remove the retainer tool and compressor.

Make sure the spring retainer is seating correctly.

Reverse interlock valve

Replace in the same manner as that described for the accumulator valve.

Converter shuttle valve

Fit the spacer to the bore in the housing (Fig. SB(e).5). Insert the converter valve in the bore with the open end of the valve towards the spacer. Fit the retainer clip.

Section SB(e).2

MAINSHAFT AND GEAR TRAIN

Dismantling

(1) Support the mainshaft with the front end uppermost.
(2) Lift off the front ring gear. The ring gear and bearings are serviced as an assembly.
(3) Remove the front carrier bi-metal thrust washer. Note that the washer is fitted with the bronze face towards the ring gear.
(4) Slide the front carrier and reverse drum (Fig. SB(e).12) assembly from the shaft.
(5) Remove the front sun gear thrust washer from the hub of the carrier.
(6) To remove the reverse drum from the planet carrier extract the circlip and press the carrier from the drum (Fig. SB(e).12).
(7) Reverse the mainshaft to bring the rear end uppermost.
(8) If the bearing has not been removed from the shaft, withdraw it and the bearing spacer

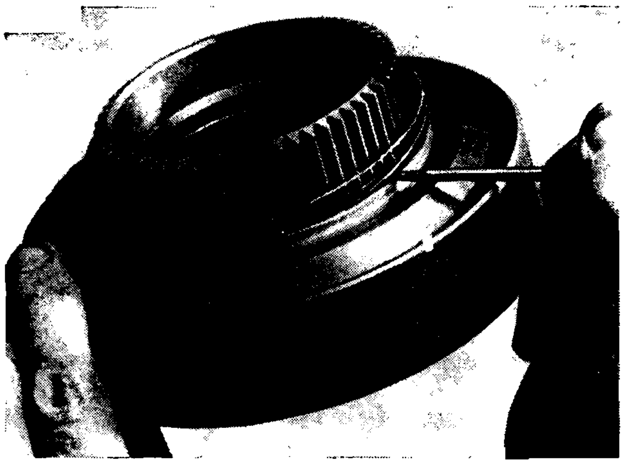


Fig. SB(e).12
Removing the double-coil circlip to release the front carrier, which can then be pressed from the reverse drum

(9) Slide the forward drum with free-wheel and bronze spacer from the shaft (Fig. SB(e).13).
(10) Remove the bronze free-wheel spacer ([A], Fig. SB(e).18) from the forward drum after prising out the circlip. Remove the spacer dowel ([B], Fig. SB(e).18).
(11) Take out the circlip and remove the free-wheel unit.
(12) Remove the rear sun wheel spacer washer and thrust washer from the shaft (Fig. SB(e).13).
(13) Remove the circlip from the low drum and the two driving pins, and withdraw the low drum plate and reverse free-wheel (Fig. SB(e).14).
(14) Withdraw the rear sun wheel.
(15) Push the reverse free-wheel from the low drum plate ([A], Fig. SB(e).15).
(16) Dismantle the multi-disc clutch as detailed in Section SB(e).3.
(17) Remove the rear ring gear thrust washer.
(18) Remove the rear planet carrier oil ring circlip from the rear of the carrier (Fig. SB(e).19) and press the carrier from the shaft towards the rear.

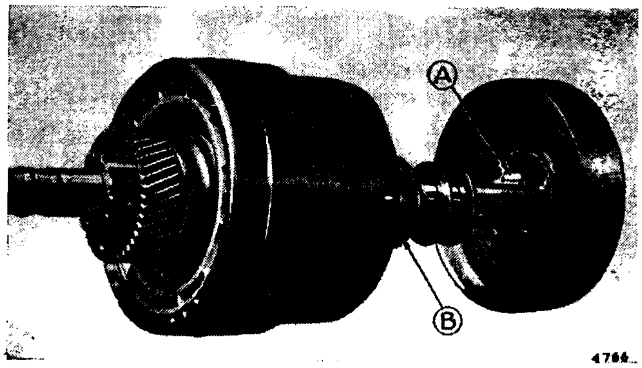


Fig. SB(e).13
The forward drum removed, showing: (A) the forward free-wheel; (B) the rear sun gear; and the thrust and spacer washers

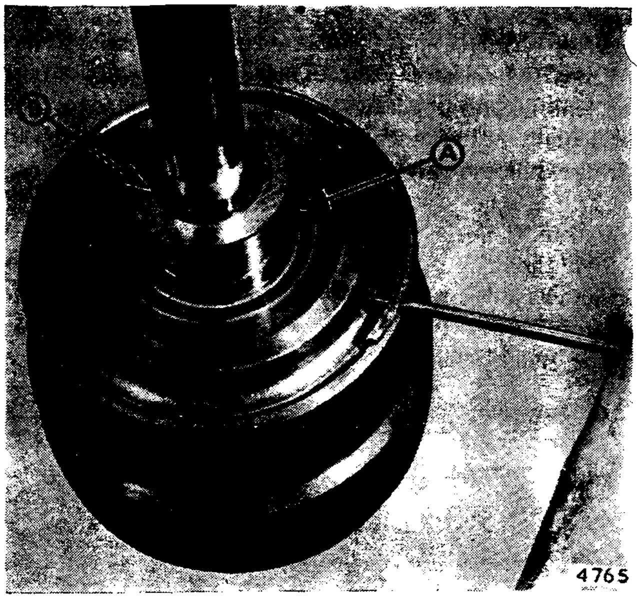


Fig. SB(e).14
Removing the circlip retaining the low drum plate

A. Reverse free-wheel. B. Rear sun gear.

Remove the oil ring and retainer and the carrier spacing and sun wheel front thrust washers from the shaft.

Inspection
(1) Inspect all planet carriers and planet wheels for wear of teeth and slackness in bearings.
(2) Inspect all bushes and machined surfaces for wear and scoring.
(3) Inspect the plates of the disc clutch.
(4) Inspect the free-wheel sprags.
(5) If there is reason to suspect the lubrication valve check its tightness in the mainshaft as shown in Fig. SB(e).17. If slack, replace the mainshaft and valve assembly.
(6) Check the operation of the centrifugal valve in the low drum (Fig. SB(e).16).

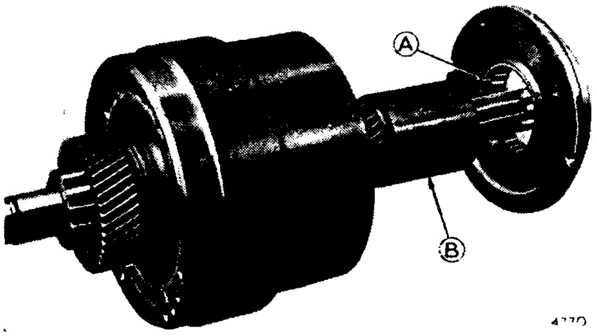


Fig. SB(e).15
Removing the low drum plate with reverse free-wheel (A) and sun gear (B)

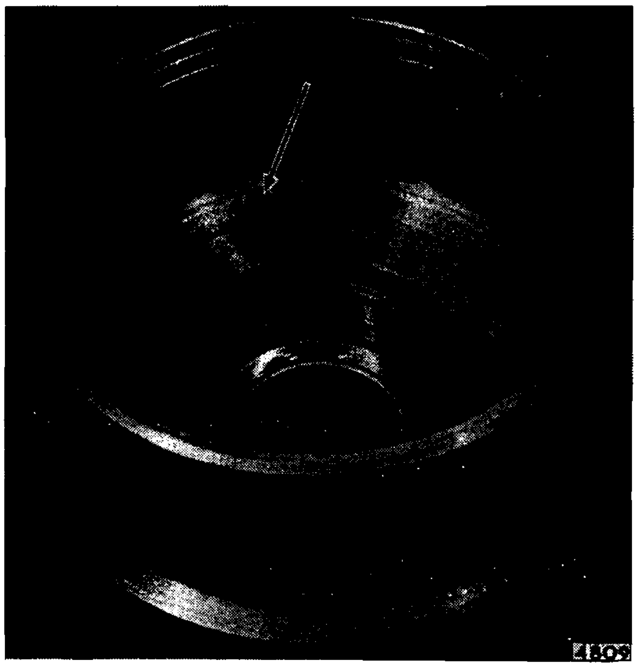


Fig. SB(e).16
The centrifugal valve in the low drum

NOTE.—**The following components are serviced as assemblies: Low drum, sun gear, and bushes. Rear ring gear and bushes. Forward drum and bush. Front ring gear and bearings. Carriers and pinions. Rear sun gear and bushes.**

If the reverse free-wheel requires replacement, replace also the low drum plate and rear sun gear.

If the forward free-wheel requires replacement, replace also the forward drum and the rear sun gear.

Assembly

(1) Fit the carrier washer and rear sun gear thrust washer onto the mainshaft. Slide the rear carrier onto the front end of the mainshaft and press it against the shoulder on the splines. Fit the oil seal ring to the retainer and the retainer to the shaft with the bevel towards the carrier. Press the seal retainer just far enough to allow the fitting of the circlip. Fit the circlip and press the retainer back so that it just contacts the circlip.

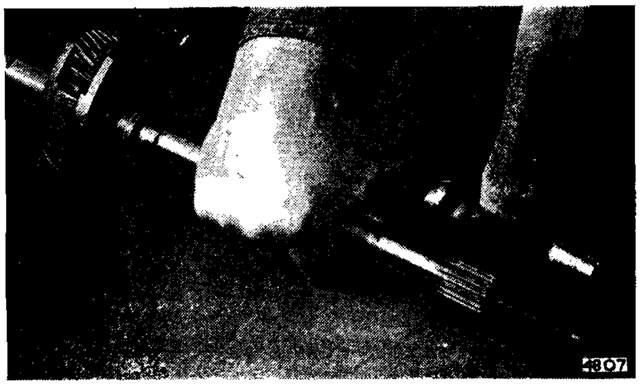


Fig. SB(e).17
Testing the security of the lubrication valve. The special tool (18G510) is screwed into the valve and tapped with a hammer. This should only be done when there is a reason for doubt

(2) Assemble the multi-disc clutch as detailed in Section SB(e).3.

(3) Fit the bi-metal thrust washer to the front of the rear carrier with the steel face towards the carrier. Slide the front end of the mainshaft into the low drum and rear ring gear assembly and support the shaft with the rear end uppermost.

(4) Fit the reverse free-wheel to the low drum plate with the shouldered flange of the free-wheel towards the rear.

(5) Lubricate the inner and outer surfaces of the rear sun wheel and bushes and slide it onto the shaft, meshing the teeth with the rear planet wheels.

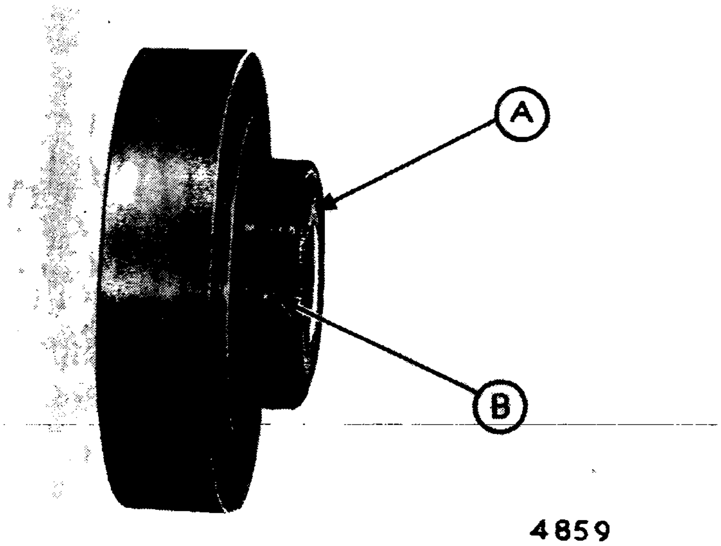


Fig. SB(e).18
The forward drum with bronze spacer (A) and locating dowel (B)

(6) Fit the low drum plate assembly with the flat side towards the drum, carefully slipping the sprags of the free-wheel over the edge of the sun wheel. As soon as all the sprags are started over the edge of the free-wheel rotate the drum anti-clockwise and slide it into position over the sun wheel. The plate and free-wheel assembly should be free to turn in the direction of engine rotation.

(7) Turn the plate to align the slots in the drum with the dowel slots in the plate; insert the dowels and the circlip, making sure that the latter is correctly located in the groove. The ends of the circlip must not be larger than the diameter of the dowels.

(8) Locate the rear sun wheel thrust washer with the bronze face against the sun wheel and follow with the spacer washer.

(9) Replace the forward free-wheel in the forward drum with the shouldered flange uppermost so that it will

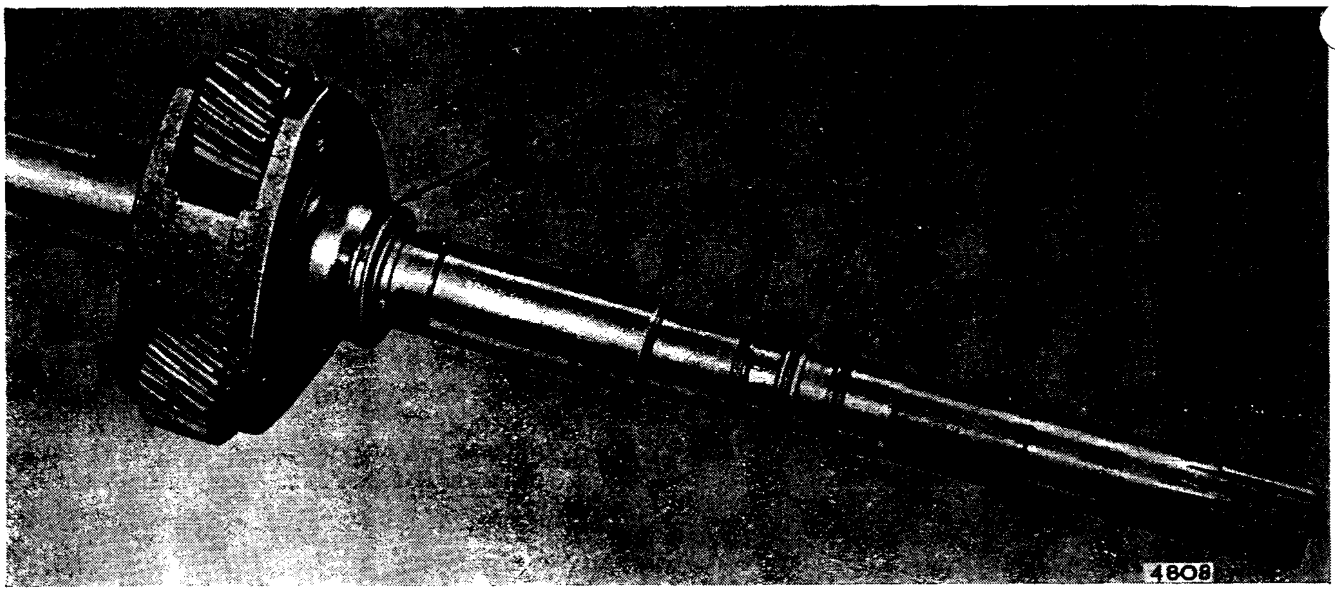


Fig. SB(e).19
Arrows indicate the mainshaft oil rings. Do not remove a ring unless it is faulty, and do not stretch a new ring more than is necessary to pass over the shaft

face rearwards when the drum is assembled on the mainshaft. Fit the retaining circlip.

(10) Fit the free-wheel spacer and dowel into the drum and locate the circlip in its groove.

(11) Fit the drum and free-wheel assembly to the mainshaft, rotating the drum and free-wheel to position the free-wheel sprags on the sun wheel.

(12) Position the rear bearing spacer washer on the shaft and then drift the bearing into position.

(13) Press the front carrier into the reverse drum and fit the circlip.

(14) Reverse the mainshaft and locate the front sun wheel thrust washer in the carrier hub with the steel face against the carrier.

(15) Fit the reverse drum and carrier assembly to the gear train, engaging the splines with the rear ring gear, the planet pinions with the front sun wheel, and the clutch teeth with the clutch plate serrations. Take care not to damage the clutch plates by forcing the assembly into position.

(16) Place the front ring gear thrust washer on the splines with the steel face against the carrier.

(17) If the oil rings have been removed, lubricate new ones with transmission fluid and fit them to the shaft.

(18) Fit the front ring gear.

Section SB(e).3

MULTI-DISC CLUTCH

Dismantling

Place the low drum on a press with the multi-disc clutch ring (18G509) on the retainer ring. Compress the clutch assembly just sufficiently to free the retainer circlip from clutch spring pressure (Fig. SB(e).20). Extract the circlip carefully from the groove in the drum and release the press slowly. Remove the sleeve, retainer, and springs and turn the drum over to remove the alternate steel clutch plates and spring seat (Fig. SB(b).4).

Position six pins as shown in Fig. SB(e).22 to prevent the piston ring from entering the grooves in the low drum as the piston is withdrawn. Lift the piston with two pairs of pliers, one on each of two opposite webs of the piston. Do not damage the piston webs; no great force should be required to pull out the piston, but it must be pulled squarely and care is needed as it passes the teeth of the sun gear. Remove the inner seal from the hub of the sun gear by squeezing it to one side and lifting the edge over the hub.

Inspection

Clean all parts thoroughly with petrol, paraffin, or trichlor-ethylene.

Inspect the low drum bush for wear and scoring; it is not serviced separately and the assembly must be renewed if the bush is worn or damaged.

Inspect the inner seal and renew if faulty.

Inspect the clutch plates for wear and test for distortion. The maximum allowable cone is ·005 in. (·12 mm.) and this is checked with a feeler gauge as shown in Fig. SB(e).23.

Inspect the drum and sun gear teeth, and springs.

Reassembly

Refit the inner seal or a new one if required.

Using the pins to prevent the ring from entering either of the grooves in the drum, refit the piston, again pushing it squarely and slowly into position.

Replace the spring seat. Notice that the seat is in two parts secured together, one plate having six unevenly spaced lugs and the other a series of teeth on which the springs seat. Place the plate in the drum with the lugs

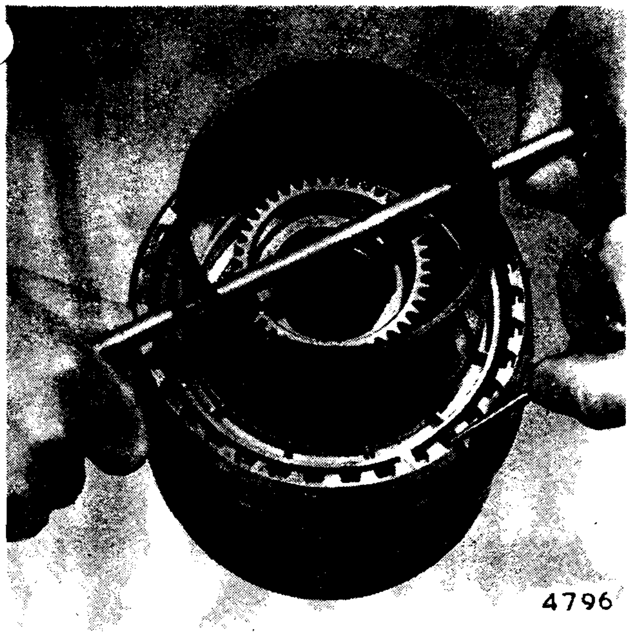


Fig. SB(e).20
The clutch spring compressing ring in position. Use a press where available to allow the circlip to be withdrawn

Fig. SB(e).22
Lifting out the piston

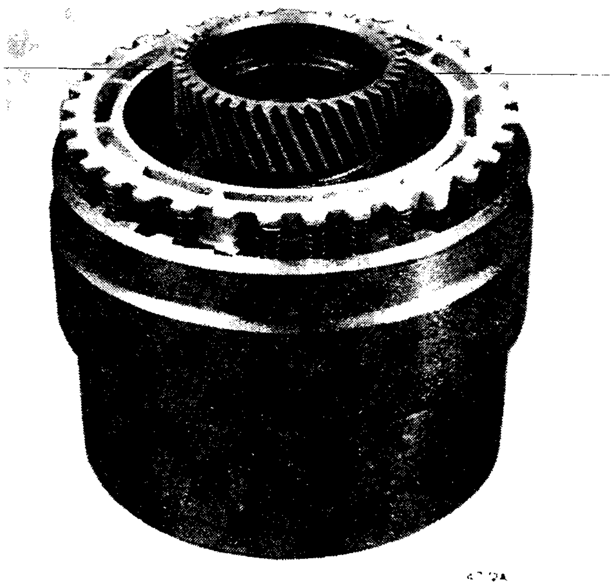


Fig. SB(e).21
Dismantling the multi-disc clutch; the circlip has been withdrawn

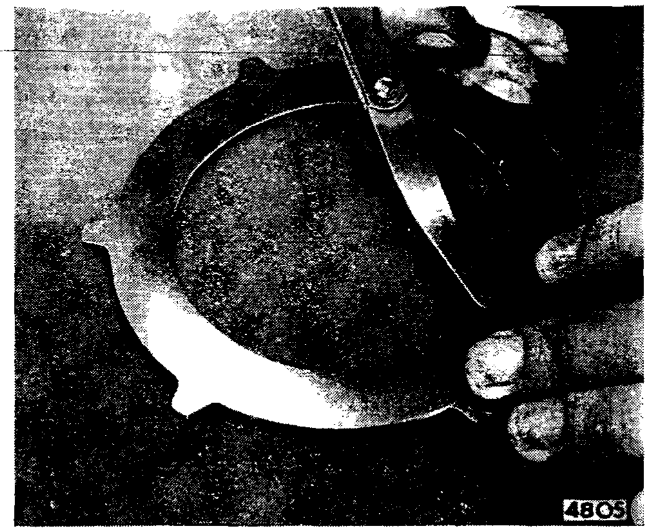


Fig. SB(e).23
Checking the amount of cone on a clutch plate. One of the grooved aligning lugs is seen at the right-hand side

uppermost. Replace the clutch plates, beginning with a steel plate and following with bronze and steel alternately. The lugs of all the plates must be in line and also in line with those on the spring seat. One lug on each plate has a small cut-out and these also must be in line.

Locate the springs as shown in Fig. SB(e).24. There are 27 springs in all.

Place the retainer on the top of the springs, compress the springs with the press and ring, and insert the retainer circlip in the groove.

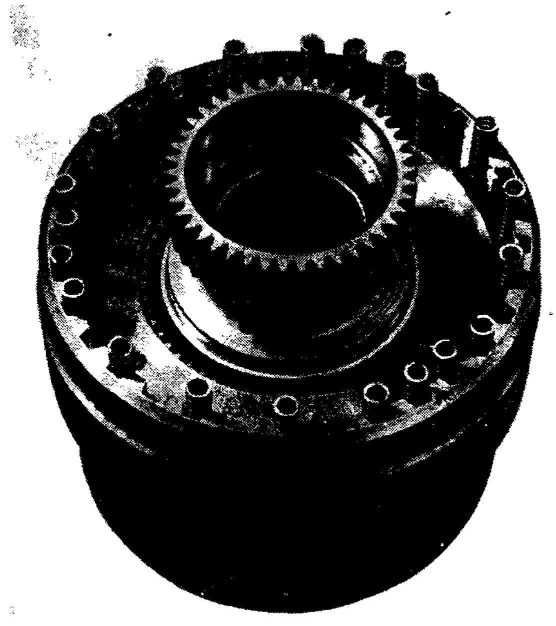


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Fig. SB(e).24
The multi-disc clutch springs assembled

Fig. SB(e).26
Replacing the clutch piston

Section SB(e).4

EXTENSION CASE

Removal

Move the selector lever to engage the parking pawl and prevent the mainshaft from turning as the universal joint flange bolt is unscrewed.

Knock up the locking tab and unscrew the driving flange bolt: remove the bolt and withdraw the flange. Unscrew the four nuts securing the taximeter drive housing to the extension case and withdraw the housing. Pull out the splined driving tube.

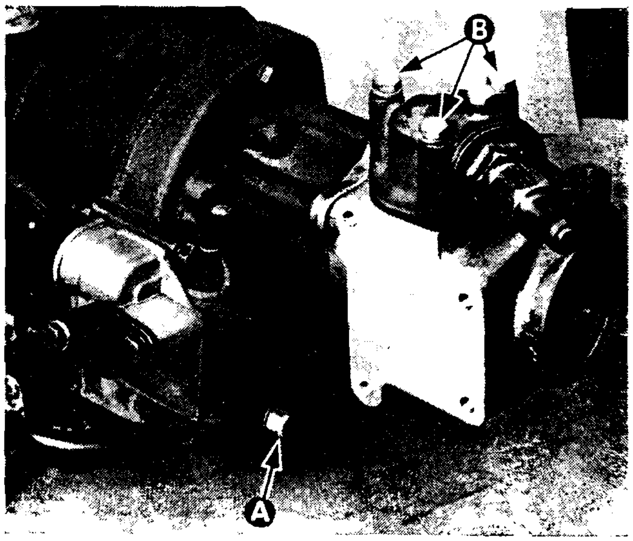

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Fig. SB(e).25
The rear extension and taximeter drive

A. Governor adjusting screw.
B. Taximeter cable housing securing screws.

Unscrew and remove the six bolts securing the extension case to the transmission and withdraw the extension case; take care not to lose the parking pawl interlock piston and the detent spring as the case is withdrawn. If the transmission is not to be completely dismantled, and particularly if it has not been removed from the car, take care that the mainshaft does not move and allow the gear train thrust washers to become displaced. Remove the speedometer housing and gear.

Remove the rear pump.

Inspection

Check the governor and brackets for freedom of operation. If necessary, remove the governor as detailed in Section SB(e).5.

Check the freedom of the governor valve and control plunger assembly. Slight burrs and rough spots may be polished off.

Check the governor clearance as detailed in Section SB(e).5.

Check the operation of the accelerator and parking pawl interlock plungers and springs.

Check the freedom of operation of the second gear latch pawl and rocker arm. The pawl must fall under its own weight.

Assembly

Fit a new washer to the transmission case and stick it in position with petroleum jelly.

If the transmission case is on the bench and resting on the bench cradle it will be inverted and therefore it

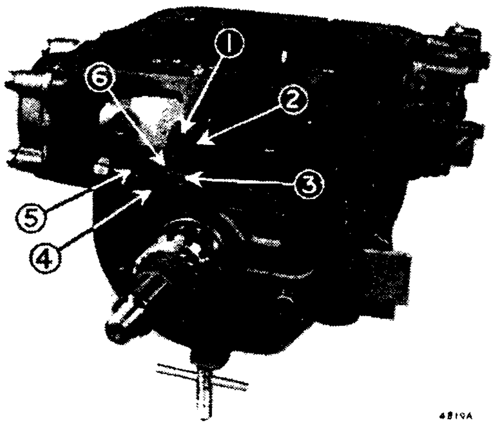

Fig. SB(e).27
Fluid passages

1. Multi-disc clutch.
2. Direct drive clutch.
3. Multi-disc clutch.
4. Rear pump pressure.
5. Rear pump inlet.
6. Valve block to governor.

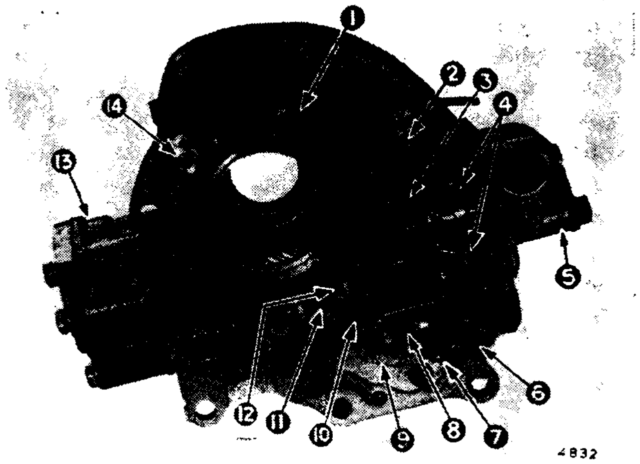

Fig. SB(e).29

1. Parking pawl pivot.
2. Parking pawl operating shaft.
3. Governor.
4. Governor yoke shoes.
5. Speedometer gear housing.
6. Accelerator detent spring.
7. Governor control plunger.
8. Governor valve stop plate.
9. Rocker arm spring.
10. Governor valve fork.
11. Second speed latch.
12. Governor valve.
13. Rear pump.
14. Parking pawl interlock piston.

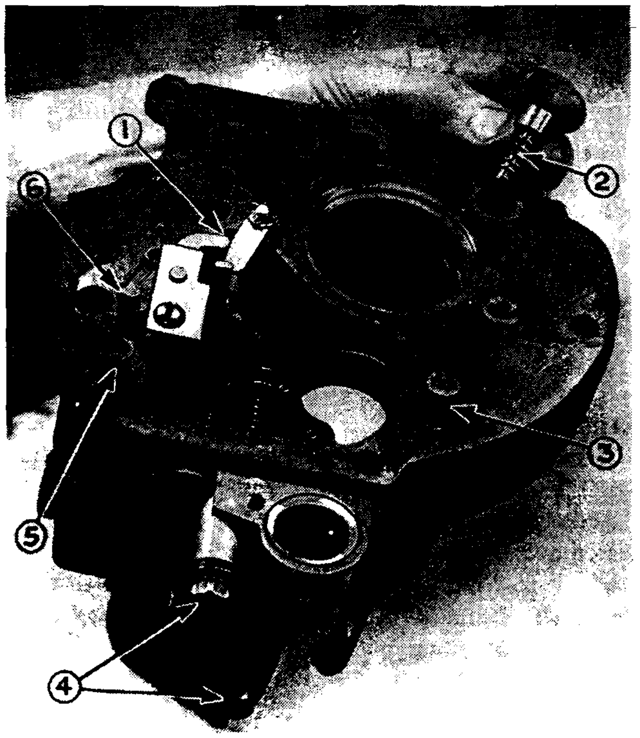

Fig. SB(e).28

1. Second speed latch.
2. Parking pawl interlock piston.
3. Parking pawl pivot.
4. Speedometer gear housing.
5. Accelerator detent spring.
6. Detent plunger.

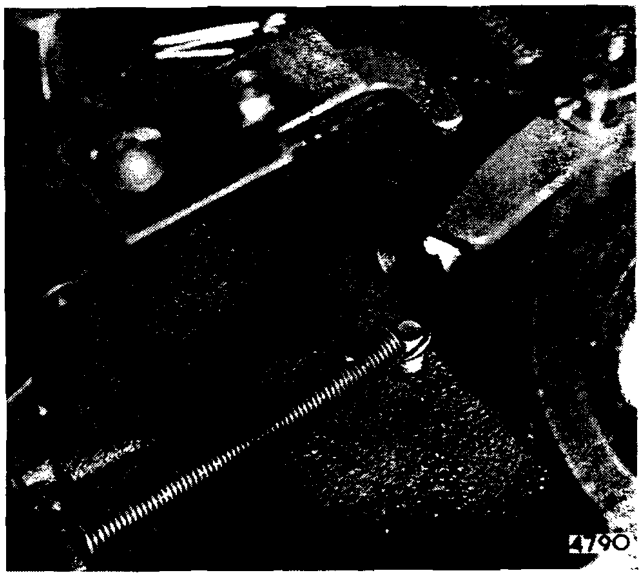

Fig. SB(e).30
The governor return spring. Note the connection to the peg with spring loop down

will be necessary to hold the second gear latch in the operative position to prevent it from fouling the case as the extension case is refitted.

Position the extension case and insert the upper long dowel bolt, then follow with the remainder of the bolts and tighten them all finger-tight.

Fit the universal joint flange to centralize the oil seal and then tighten the securing bolts to the recommended torque.

Refit the speedometer drive gear and housing, and taximeter drive.

Section SB(e).5

GOVERNOR ASSEMBLY

Removal

Remove the extension case as detailed in Section SB(e).4.

Unscrew the two set bolts securing the speedometer drive housing and cover to the extension case; remove the cover and gasket.

Slide the speedometer drive gear from the shaft and remove the housing.

Pull the governor shaft away from the governor assembly.

Disengage the end bracket of the governor from the governor fork and the bearing from the control shaft yoke shoes and remove the governor from the case.

Remove the yoke shoes and the governor spring.

Inspection

Make sure that the governor shaft is free from burrs, which may be caused by the incorrect seating of the governor spring ends. Inspect the splines for damage, and renew the shaft if necessary.

Check the freedom of movement of the governor valve and hydraulic detent.

If there is reason to suspect the governor spring, fit a new one of the correct type.

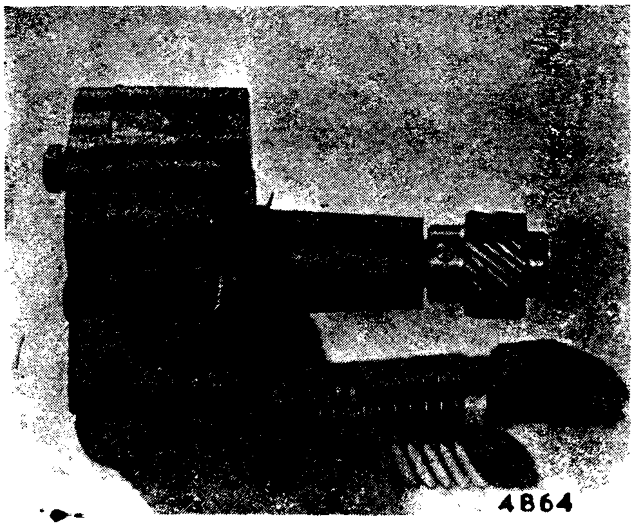

Fig. SB(e).31
The governor valve booster spring and gear pump

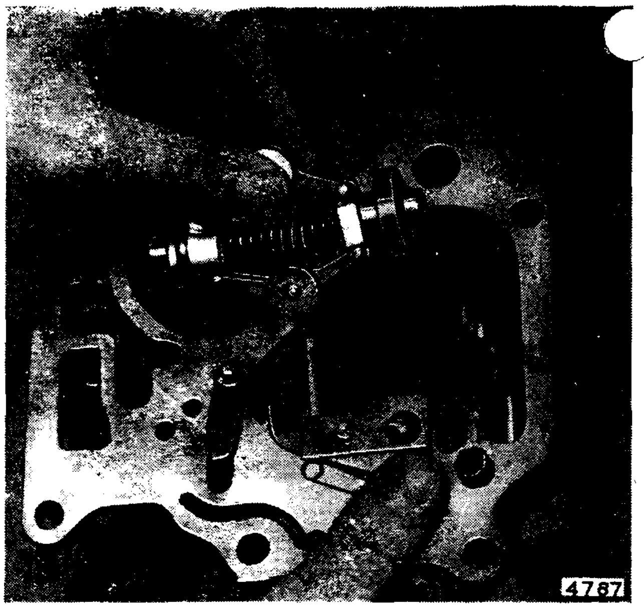

Fig. SB(e).32
Lifting out the governor

Check that there is clearance at the governor inner end bracket and fork.

Assembly

Refit the yoke shoes.

Place one end of the governor spring in the governor, compress the spring, and locate the other end. Make sure that both ends of the spring are correctly located in the governor.

Slide the governor bearing into the yoke shoes, align the governor inner end bracket, and engage it in the governor fork.

Fit the governor shaft and speedometer drive gear and cover. Fit a new cover gasket and make sure that it is correctly positioned. Tighten the screws to the recommended torque.

Section SB(e).6

GOVERNOR VALVE AND HYDRAULIC DETENT PISTON

Removal

Remove the governor assembly as detailed in Section SB(e).5.

Slide the valve out of the sleeve.

Remove the hydraulic detent piston. If the piston is stuck, locate the governor fork to contact the stop on the valve stop plate. Cover the valve body-to-governor and multi-disc clutch passages with the fingers and blow compressed air into the direct drive passage to force out the piston.

Assembly

Lubricate all parts with one of the recommended fluids and replace.

Refit the governor assembly as detailed in Section SB(e).5.

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Fig. SB(e).33
The parking pawl and pivot (centre), with the interlock piston on the left and operating shaft on the right

Section SB(e).7

GOVERNOR VALVE BOOSTER SPRING

Remove the rear oil pump.

Remove the booster spring and retainer and fit a new spring if there is cause to doubt the old one.

When refitting make sure that the retainer is fastened to the end of the spring.

Refit the oil pump.

Section SB(e).8

GOVERNOR CONTROL SHAFT AND LEVER

Remove the governor assembly as detailed in Section SB(e).5.

Unhook the governor return spring from the governor adjusting yoke.

Hold the shaft in position and loosen the Allen-headed set screw, using the key 18G508. Remove the shaft and yoke.

To remove the governor control detent cam and plunger assembly, move the cam and link towards the governor return spring anchor pin, push the plunger into the case, and remove the assembly.

To replace, reverse the above sequence of operations.

Section SB(e).9

PARKING PAWL

Removal

Remove the extension case as detailed in Section SB(e).4.

Screw a suitable bolt ($\frac{5}{16}$"×24 UNF.) into the internal thread in the pivot pin and withdraw the pin with a pair of pliers.

Withdraw the toggle shaft with a pair of pliers but take care not to damage the splines.

Remove the pawl and toggle assembly from the transmission case.

Assembly

Reverse the instructions given for removal.

For adjustment see Section SB(e).13 and Fig. SB(e).35.

Section SB(e).10

FRONT PUMP AND COLLECTOR RING

Removal

Remove the transmission as detailed in Section D.

Fit a clip to the mainshaft to prevent the ring gear from moving and allowing the front ring gear thrust washer to fall.

Remove the seven set bolts securing the collector ring to the transmission case. Tap the assembly lightly and slide it forward from the mainshaft. Remove the thrust washer from the rear face of the collector ring if it is also withdrawn.

Unscrew the five screws on the inside of the collector ring and remove the front pump.

Thoroughly clean the pump and collector ring.

Inspection

Check the gears for wear and damage and the collector ring passages for obstruction. If any part is found damaged it is necessary to renew the pump body and gears.

Inspect the rubber seals and renew if there is any sign of wear. Do not remove the front pump oil seal unless it shows wear or unless fluid has been leaking. If a new seal is fitted, the lettered side must be outside.

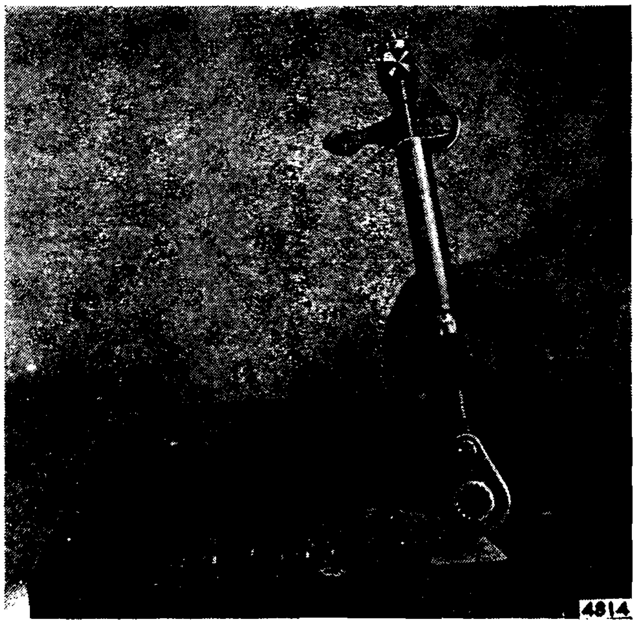

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Fig. SB(e).34
Replacing the parking pawl spring box

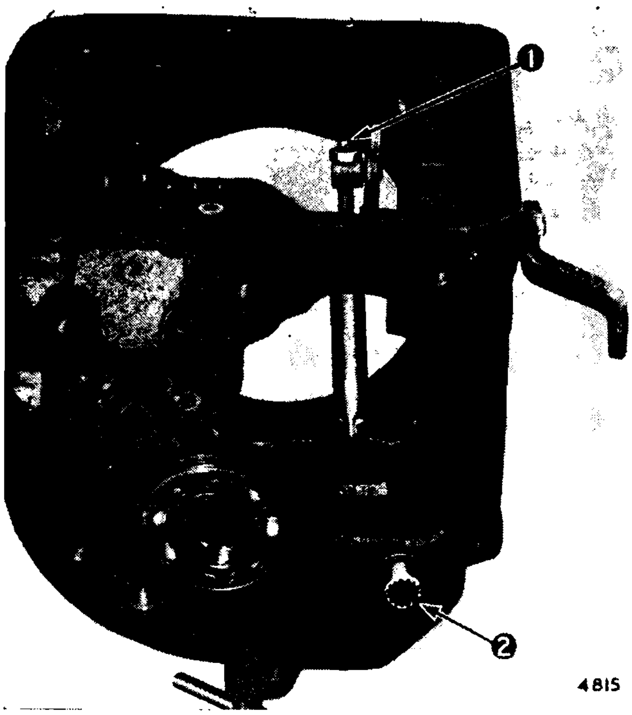


Fig. SB(e).35

1. Parking pawl adjustment.
2. Arrow indicates master spline.

Refit the pump to the collector ring and tighten the bolts to the recommended torque.

Check that the oil sealing rings are in good condition, and renew as necessary.

Assembly

Before refitting the collector ring and pump assembly to the transmission case, check the end-play of the mainshaft to determine the thickness of the thrust washer required. A special gauge is available for the purpose under Part No. 18G511, shown in Fig. SB(e).38.

Check the tightness of the universal joint flange and the bolts securing the extension case.

Fit the gauge over the mainshaft and bolt it into position with two collector ring bolts as shown in Fig. SB(e).38.

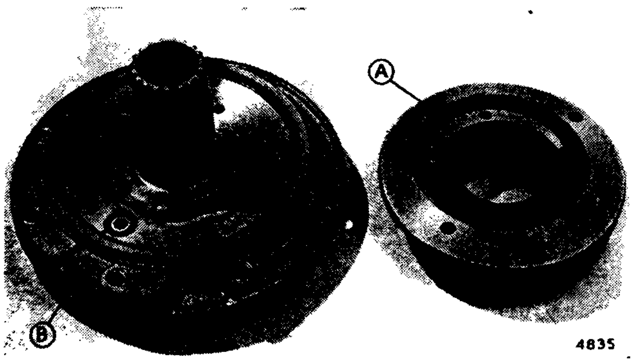


Fig. SB(e).36

A. The front pump spreader.
B. 'O' ring seals (large and small).

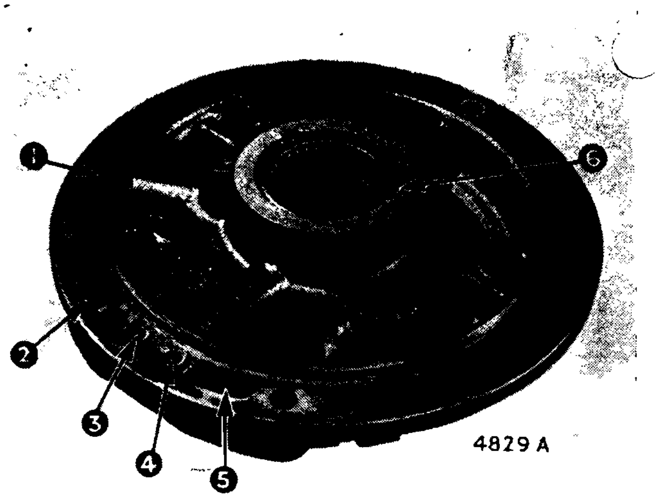


Fig. SB(e).37

Collector ring passages and thrust washer

1. Converter pressure.
2. Front pump pressure.
3. Direct drive clutch.
4. Multi-disc clutch pressure.
5. Front pump inlet.
6. Front ring gear thrust washer.

Turn the hub of the gauge to bring the indicator over the step marked 'START'. Turn the hub of the gauge anti-clockwise while pressing it inwards until it is stopped by one of the steps. The thickness of the required washer is shown against the step on which the indicator rests when stopped by the next higher step.

Select and fit the correct washer (see Section SB(e).14) and stick it in position with petroleum jelly, engaging the tongues of the washer in the slots in the hub of the collector ring. The bronze face of the washer should be towards the ring gear.

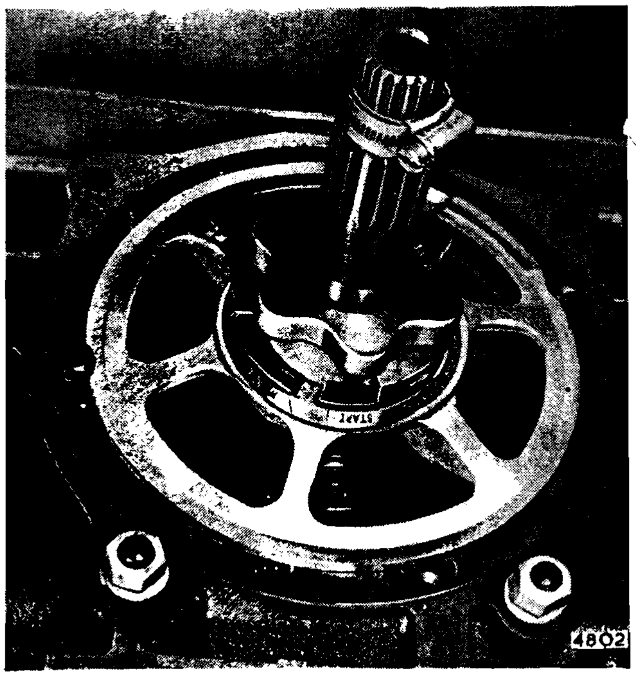


Fig. SB(e).38

Mainshaft end-float gauge

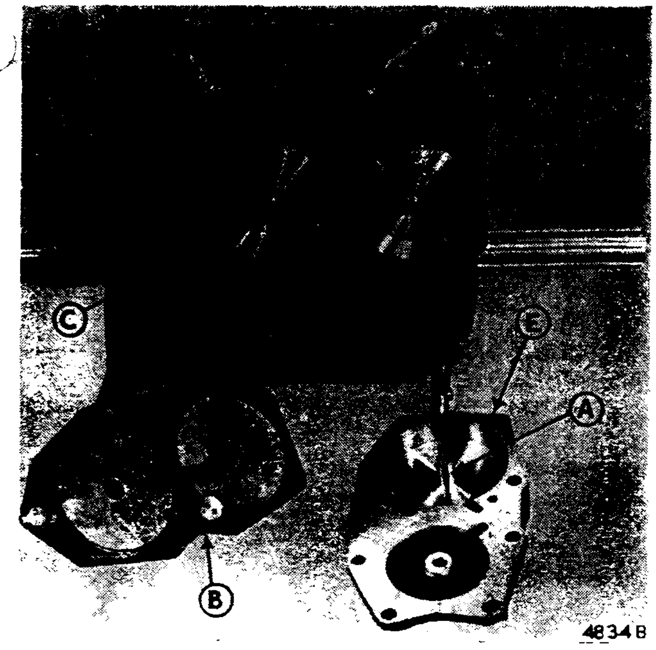


Fig. SB(e).39
Low and forward servos

A. Forward outer piston.
B. Plate.
C. Low piston.
D. Forward inner piston.
E. Outer cylinder.

Fit a new gasket to the collector ring flange and stick it in position with petroleum jelly; make sure that the holes in the gasket line up with those in the flange.

Note the positions of the holes in the collector ring flange and in the transmission case and refit the pump and collector ring assembly with the holes in alignment.

Tighten the bolts to the recommended torque.

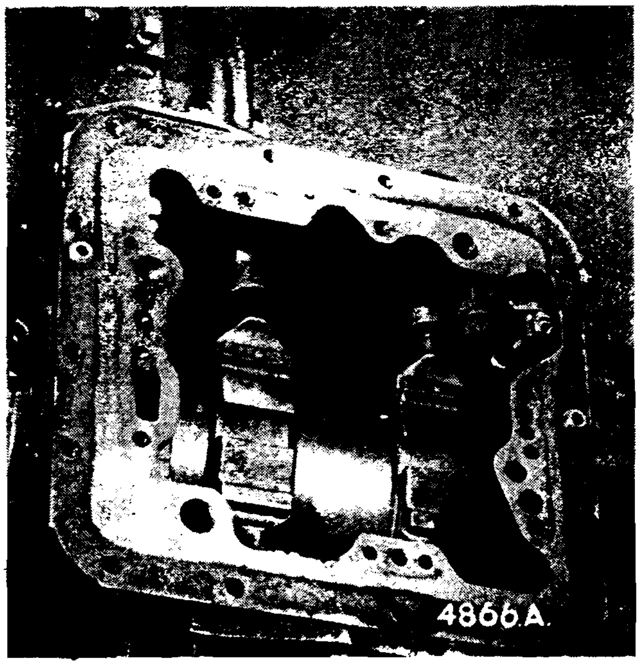


Fig. SB(e).40
Low and forward brake band location

Section SB(e).11

SERVOS

Removal

Clean the transmission case around the servo housing to be removed.

Unscrew the securing bolts and remove the housing as detailed in Section D.

If the inner pistons are to be withdrawn the oil pan and valve box must also be removed from the transmission to ensure the correct replacement of the anchor struts on reassembly. For the same reason, unless the inner pistons are to be removed, do not allow them to move from their positions when servicing the outer pistons only.

Separate the outer housing from the cover-plate and remove the two gaskets.

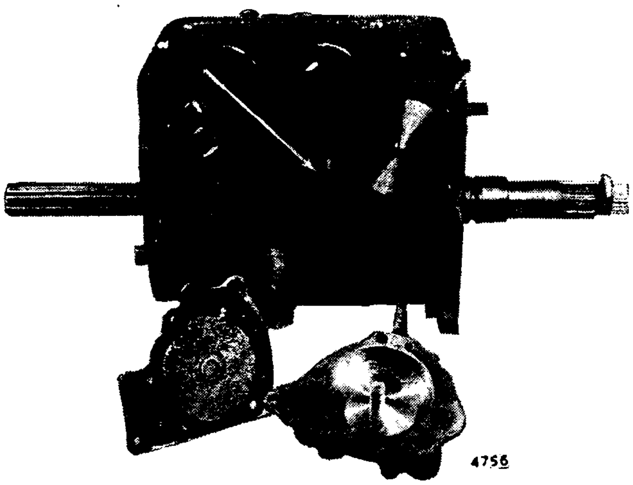


Fig. SB(e).41
Components of the reverse servo. The arrow indicates the low band adjusting screw

Withdraw the outer pistons from their cylinders.

If the inner pistons are to be removed the pistons can be pushed out of the cylinders in the transmission case with a thumb on the piston spring retainer inside the case.

Inspection

Note the condition of the piston rings and, if there is any sign of deterioration, remove them from their grooves and fit new ones with the lip towards the outer face of the piston.

Renew the 'O' ring seals in the plates if there are any signs of wear.

Fit new piston rings and 'O' ring seals where necessary and lubricate all parts with one of the recommended transmission fluids.

Assembly

Refit the inner piston and spring retainer of each assembly to the transmission case, taking care not to damage the piston rings. Make sure that the anchor struts are correctly fitted.

Smear a film of petroleum jelly on the outer cylinder face and stick a new gasket in position on the face of the transmission case.

Place the plate over the outer piston rod of each assembly and fit the housing, plate, and piston to the transmission case. Tighten the bolts to the recommended torque figures.

If the inner pistons have been serviced, replace the valve block and oil pan.

Refill the transmission to the correct level with the recommended fluid (after installation).

Section SB(e).12

BRAKE BANDS

Removal

Remove the bands from the transmission as detailed under **'REMOVING AND REFITTING MAIN COMPONENTS AND SUB-ASSEMBLIES'**, Section SB(d).

Inspection

Inspect the linings for wear, the bands for damage and distortion, and the band shoes and strut location pins for tightness.

Assembly

Replace the bands in the case, taking care not to distort them by straining. Remember that the reverse band is heavier than the low and forward bands and must not be interchanged with either. Locate the bands in the slots in the transmission case. Fit the anchor struts at the servo side of the bands, noting that the locating pins at this side are offset. Close the bands and insert the reaction anchor struts; the pins are central (see Figs. SB(b).8 and SB(e).40).

Tighten the adjusters sufficiently to hold the bands in position without preventing the entry of the mainshaft.

Replace the mainshaft as detailed in Section SB(d).

Adjust the brake bands as detailed in Section SB(e).13.

Section SB(e).13

ADJUSTMENTS

Accelerator control linkage

The accelerator and governor linkage must be adjusted correctly.

Disconnect the rod from the governor lever, and hold the governor lever fully back. Hold the venturi in the fully closed position and adjust the linkage so that the

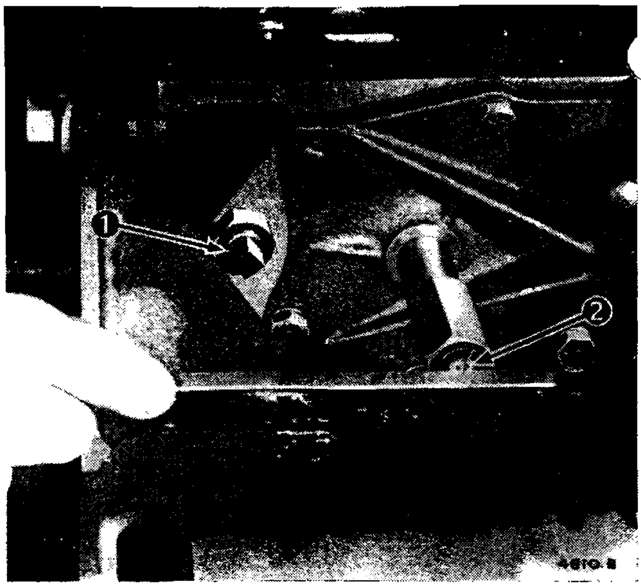


Fig. SB(e).42
Adjusting the low band
1. Forward band adjusting screw.
2. The inner plunger of the adjusting tool.

rod to the governor lever can be connected to the governor lever.

Parking pawl

(1) Remove the oil pan and valve block.

(2) Rotate the mainshaft with the control in the neutral 'N' position and then move the lever slowly to 'P'. The pawl should be heard clicking over the gear lightly as soon as the lever has moved out of 'N'. If adjustment is required, slacken the locknut ([1], Fig. SB(e).35) and adjust the length of the rod until the pawl adjustment is correct. Lock up, and refit the valve block and oil pan.

Brake bands

(1) Screw out the pressure take-off plug from the centre of the servo for the band requiring adjustment.

(2) Screw the band adjustment checking tool, No. 18G503, into the pressure take-off hole.

(3) If the band adjustment is correct, the plunger in the checking gauge will be flush with the OUTER end; if below or above, slacken the adjustment locknut at the other side of the housing and turn the adjusting screw in the required direction to bring the end of the plunger flush with the end of the gauge.

(4) Tighten the adjusting screw locknut without altering the adjustment, remove the gauge from the servo, and replace the plug with a **new copper washer.**

Selector lever and valve

(1) Disconnect the selector lever connecting rod at the ball joint.

(2) Check that the control lever moves without obstruction through its complete travel, and place it in 'D'.

(3) Check the rods and linkages for slack and stiffness.

(4) Move the selector valve to the central position and adjust the length of the gear shift rod until the ball joint can be connected without movement of the linkage.

(5) Check that the selector valve moves into the correct positions corresponding to the movement of the control lever.

Section SB(e).14

NUT AND BOLT TIGHTENING TORQUE FIGURES

Component	*Number off*	*Thread size*	*Torque required lb. ft.*	*Torque required kg. m.*
Shuttle valve body to manifold screw	8	$\frac{1}{4}$–20	6–8	0·83–1·11
Valve block assembly to case screw	7	$\frac{5}{16}$–18	10–13	1·38–1·8
Front pump to collector ring screw	1	$\frac{1}{4}$–20	10–12	1·38–1·66
Front pump to collector ring screw	4	$\frac{5}{16}$–18	15–18	2·07–2·49
Front pump and collector ring to case screw	7	$\frac{5}{16}$–18	15–18	2·07–2·49
Extension case to transmission case screw	6	$\frac{3}{8}$–16	28–33	3·87–4·56
Detent cam to shaft set screw (Allen screw)	1	No. 10–32		
Governor stop to extension case screw (Allen screw)	1	$\frac{1}{4}$–20	Tighten	fully
Extension case—detent cam adjustment—set screw locknut	1	$\frac{1}{4}$–20	14–17	1·94–2·35
Extension case—detent cam adjustment—cap nut	1	$\frac{1}{4}$–20	3–4	0·41–0·55
Governor adjusting shaft bushing	1	$\frac{9}{16}$–18	25–30	3·46–4·15
Rear pump body to extension case	3	$\frac{5}{16}$–18	15–18	2·07–2·49
Pump cover to rear pump body screw	2	$\frac{1}{4}$–20	6–8	0·83–1·11
Speedometer housing and cover to extension case screw	2	$\frac{5}{16}$–18	10–13	1·38–1·8
Reverse servo to case screw	2	$\frac{5}{16}$–18	15–18	2·07–2·49
Low and forward servo to case screw	9	$\frac{5}{16}$–18	15–18	2·07–2·49
Oil pan to transmission case screw	14	$\frac{5}{16}$–18	10–13	1·38–1·8
Transmission oil pan drain plug	1	$\frac{5}{8}$–18	35–45	4·84–6·22
Universal joint flange nut	1	$\frac{3}{4}$–16	60–80	8·3–11·06
Band adjusting screw nut	3	$\frac{1}{2}$–20	20–30	2·77–4·15
Lever to selector control shaft nut	1	$\frac{5}{16}$–24	6–8	0·83–1·11
Parking pawl actuating rod nut	1	$\frac{1}{4}$–28	3–4	0·41–0·55
Servo pressure take-off screw	3	$\frac{3}{8}$–16	28–33	3·87–4·56
Converter drain plug	1	$\frac{3}{8}$–24	15–20	2·07–2·77
Rear pump pressure test plug	1	$\frac{1}{4}$–pipe	8–10	1·11–1·38
Converter pressure test plug	1	$\frac{1}{8}$–pipe	8–10	1·11–1·38
Front pump and direct drive clutch pressure test plugs (Allen)	2	$\frac{1}{8}$–pipe	8–10	1·11–1·38
Multi-disc clutch pressure test plug	1	$\frac{1}{8}$–pipe	8–10	1·11–1·38
Converter housing cover screw	6	$\frac{1}{4}$–20	6–8	0·83–1·11
Converter drive plate to crankshaft screw	6	$\frac{7}{16}$–20	66	9·13
Transmission to converter housing stud nut	2	$\frac{7}{16}$–20	23–28	3·18–3·87
Torque converter to drive plate	6		25–30	3·46–4·15

MAINSHAFT THRUST WASHERS

17H3061	·052 to ·054 in. (1·32 to 1·37 mm.).
17H3062	·061 to ·063 in. (1·54 to 1·60 mm.).
17H3063	·072 to ·074 in. (1·83 to 1·88 mm.).
17H3064	·082 to ·084 in. (2·08 to 2·13 mm.).

Section SB(e).15

TAXIMETER DRIVE

Removing and dismantling

Knock up the locking tab and unscrew the bolt securing the driving flange; withdraw the flange.

Unscrew the four nuts securing the housing to the rear extension; remove the nuts and spring washers.

Lift the taximeter housing from the rear extension.

Withdraw the driving sleeve and gear and the inner ring of the roller race.

Unscrew and remove the three set screws securing the gear housing and remove the housing.

Remove the countersunk screw to release the dowelled lock assembly.

Unscrew the brass bush and remove the driven gear.

If the oil seal shows signs of deterioration, remove it and fit a new one.

Inspect all parts for wear, and replace as necessary. Note the location and conditions of the two thrust buttons.

Reassembling and refitting

Locate the taximeter gear housing with the taximeter driven shaft in the drive housing. Insert the three set screws.

Position the driven gear with its brass bush and gasket in the gear housing and tighten the bush. Fit the lock assembly.

If a new oil seal is required, fit this into the drive housing. Also fit the inner ring of the roller bearing. Push the driving flange through the oil seal and bearing and fit the mainshaft driving gear; push the driving sleeve onto the driving flange splines.

Place a new gasket in position on the rear face of the extension case, taking care to ensure that the oil valve is not obstructed. Place the taximeter drive housing in position and tighten the nuts.

SECTION SB(f)

TESTING

Section SB(f).1

TRANSMISSION

Before carrying out the tests detailed below check the general condition of the engine, adjust the idling speed to its normal r.p.m., and check the fluid level in the transmission as detailed in Section SB(a).

Starter switch

Test the operation of the starter switch with the control lever in each of the five positions; it should operate only when the lever is at 'P' or 'N'. Adjust the position of the switch as detailed in Section SB(e).13.

Selector lever

Check the selector lever and selector valve positions and adjust as detailed in Section SB(e).13.

Stall speed

The stall speed is the maximum speed at which the impeller can be driven while the turbine is held stationary and it should be noted that this will vary to some extent with the condition of the engine; an engine in poor condition will give a lower stall speed. Engine condition must therefore be considered in interpreting the cause of a low stall speed.

Run the engine until the fluid temperature is normal.

Connect a tachometer to the engine.

Apply the hand brake and move the control lever to 'L'. Allow the engine to run for a time to warm the engine and transmission to the normal operating temperature and then press the accelerator to the full throttle position and note the tachometer reading. THE ENGINE MUST NOT BE RUN AT FULL SPEED FOR MORE THAN 10 SECONDS WITH THE CONTROL LEVER AT ANY OF THE DRIVING POSITIONS.

Engine r.p.m.	*Condition*
1,150–1,340	Normal
600–700	Fault in the converter
Below 100	Engine in poor condition
Over 1,340	Converter fault. Transmission slip

Section SB(f).2

ROAD-TESTING

Free running

Check the freedom of the transmission with the control lever at 'N'. There should be no tendency for the engine to drive the car, nor should there be any engine braking effect.

Engine braking

Drive the car with the lever at 'D' at a speed of 18 m.p.h. (29 km.p.h.) and move the lever to 'L'; the car should decelerate immediately and noticeably.

Ratio changes

Check the speeds at which the various ratio changes are effective.

1. *Light throttle change up*
   Accelerate the car gradually from rest and note the speeds at which the transmission changes from low to intermediate and from intermediate to direct drive.
2. *Closed throttle change down*
   Release the accelerator pedal when the car is travelling in direct drive and allow it to decelerate gradually, noting the speeds at which the change from direct to intermediate and that from intermediate to low take place.
3. *Full throttle change up*
   Press the accelerator pedal down to the fully open position. Note the speeds at which the ratio changes are effective.

Multi-disc clutch

With the car travelling at about 1 to 4 m.p.h. (2 to 6 km.p.h.) in 'L' and the accelerator pedal in the full throttle position, move the control lever to 'D': there should be an immediate change up to intermediate.

Direct drive clutch

Stop the car quickly when driving at 18 m.p.h. (29 km.p.h.) with the control lever at 'D'. The transmission should change smoothly to low without any judder or tendency to stall the engine, or to snatch the final drive.

Rear pump and reverse interlock

Move the control lever from 'D' to 'R' and back again when the car is travelling forward at about 20 m.p.h. (32 km.p.h.). While the lever is at 'R' the car should roll freely and the transmission should appear to be in neutral.

Parking pawl interlock

Move the control lever from 'D' to 'P' and back again when the car is travelling at about 20 m.p.h. (32 km.p.h.). While the lever is at 'P' the transmission should appear to be in neutral.

Section SB(f).3

PRESSURE CHECKS

Pressure check points are located as follows: (*a*) Centre of reverse servo. (*b*) Centre of low servo. (*c*) Centre of forward servo. (Use a new copper washer every time the plug in the centre of each servo is removed and replaced.)

Ratio changes and road speeds

	Change	*M.P.H.*	*Km.P.H.*
Light throttle change up	1–2 2–3	1–4 14–16	1·6–6·5 22·5–25·7
Full throttle change up	1–2 2–3	15–18 33–37	24–29 53–59·5
Closed throttle change down (overrun down)	3–2 2–1	12·5–13 3–4	20–21 5–6·5
Change down (maximum)	3–2	32–35	51·5–56

(*d*) Front pump: in oil pan front flange. (*e*) Converter: in bottom of reverse servo. (*f*) Rear pump: in rear pump housing. (*g*) Multi-disc clutch: in under side of extension case flange. (*h*) Direct-drive clutch: in oil pan rear flange.

Checks should be carried out with a pressure gauge or, if several gauges are available, different checks may be carried out simultaneously. A rev. counter is essential.

Reverse servo

(1) With engine running, apply hand and foot brakes firmly.

(2) Move the selector lever to 'R'.

(3) Gradually speed up the engine to the normal stall speed.

(4) Check for a minimum reading of 150 lb./sq. in. (10·5 kg./cm.^{2}).

Low servo

(1) With the engine running, apply hand and foot brakes firmly.

(2) Place the selector lever at 'L'.

(3) Increase the engine speed to the normal stall.

(4) Check for a minimum reading of 75 to 95 lb./sq. in. (5·2 to 6·6 kg./cm.^{2}).

Forward servo

(1) With the engine running, apply hand and foot brakes firmly.

(2) Move the selector lever to 'D'.

(3) Increase the engine speed to normal stall speed.

(4) Check for a minimum reading of 75 to 95 lb./sq. in. (5·2 to 6·6 kg./cm.^{2}).

NOTE.—To avoid overheating of the transmission the engine should not be run at speeds higher than idling for more than 30 seconds when the selector lever is at 'D', 'L', or 'R' and the rear wheels are stationary.

Front pump

(1) With the selector lever at 'N', run the engine at normal stall speed. Check for a reading of 15 to 25 lb./sq. in. (1·0 to 1·7 kg./cm.^{2}).

(2) With the selector lever at 'D' or 'L', engine running at normal stall speed, and the rear wheels locked, check for a reading of 80 to 95 lb./sq. in. (5·6 to 6·6 kg./cm.^{2}).

(3) With the selector lever at 'R', the engine running at normal stall speed, and the rear wheels locked, check for a reading of 200 to 270 lb./sq. in. (14 to 19 kg./cm.^{2}).

Converter

(1) With the selector lever at 'N' and the engine running at the normal stall speed, check for a reading of 15 to 25 lb./sq. in. (1·0 to 1·7 kg./cm.^{2}).

(2) With the selector lever at 'D' and the engine running at normal stall speed, check for a reading of 15 to 30 lb./sq. in. (1·0 to 2·1 kg./cm.^{2}).

(3) With the selector lever at 'L' and the engine running at normal stall speed, check for a reading of 15 to 30 lb./sq. in. (1·0 to 2·1 kg./cm.^{2}).

(4) With the selector lever at 'R' and the engine running at normal stall speed, check for a reading at the converter pressure take-off point of 40 to 50 lb./sq. in. (2·8 to 3·5 kg./cm.^{2}).

See NOTE in previous column concerning overheating the transmission.

Rear pump

(1) With the engine idling and the rear wheels raised off the floor, move the selector lever to 'D'.

(2) At approximately 14 m.p.h. (6·5 km.p.h.) speedometer reading the rear pump pressure should be 70 to 90 lb./sq. in. (5·0 to 6·3 kg./cm.^{2}).

Multi-disc clutch

(1) Jack up the rear wheels and, with the selector lever

at 'D', bring the rear wheel speed up to approximately 10 m.p.h. (16 km.p.h.).

(2) Check for a minimum pressure of 75 to 95 lb./sq. in. (5·3 to 6·6 kg./cm.²).

Direct drive clutch

(1) With the rear wheels of the car raised off the floor and the engine idling, move the lever to 'D' and check for zero reading.

(2) Slowly increase the road speed to 16 m.p.h. (22 km.p.h.): the transmission should then change into direct drive, indicated by a rapid rise in temperature. While in direct drive check for a minimum reading of 75 to 95 lb./sq. in. (5·3 to 6·6 kg./cm.²).

(3) Check the direct drive clutch pressure during acceleration. At approximately 10 m.p.h. (16 km.p.h.) the pressure reading should fall to zero.

Section SB(f).4

PRESSURE CHECKS—MODIFIED TRANSMISSION

Transmissions with the numbers listed below incorporate a converter valve from which the shuttle direct valve and shuttle sleeve have been omitted. The lubrication valve ball and spring have also been deleted from the same units, and this affects the converter pressure in certain conditions. When checking converter pressures in the new transmissions paragraph (3) under '**Converter**', page SB(f).3, should read as follows:

(3) With the selector lever at 'L' and the engine running at normal stall speed, check for a reading of 15 to 30 lb./sq. in. (1·0 to 2·1 kg./cm.²).

The transmissions affected are numbered from DTB3640, with the addition of 20 units with numbers prior to DTB3640; these are:

DTB2470	DTB3584	DTB3610
2521	3585	3615
3400	3587	3616
3548	3588	3633
3549	3595	3634
3573	3597	3637
3574	3605	

SECTION SB(g)

DIAGNOSIS AND FAULT RECTIFICATION

Section SB(g).1

DIAGNOSIS

Before any attempt is made at diagnosis the fluid in the transmission must be of the correct specification and its level must be up to the 'FULL' mark on the dipstick.

Selector and governor linkages must be correctly adjusted.

Fault	*Action*
Slip or ineffective drive	
Inoperative in 'D', 'L', and 'R'	1, 2, 3, 4, 5, 6, 7
Excessive slip on take-off in 'D', 'L', and 'R'	2, 3, 4, 5
Excessive slip on take-off in 'D' only	2, 3, 4, 5, 12 8, 11,
Excessive slip on take-off in 'R' only	2, 3, 4, 5, 12 10, 11,
Excessive slip on change from low to intermediate	2, 3, 13, 14, 15, 16 12, 17, 18
Excessive slip on change from intermediate to direct drive	2, 3, 19, 14, 15, 16, 22, 21 12, 20, 4, 17 21
Drag or engine labouring	
Drag on down change from intermediate to low (H.T. models only)	13, 14, 18
Drag in 'R'	7, 8, 9, 11
Drag in 'D' and 'L'	7, 10, 11
Drag in 'D', 'L', and 'R'	7
Engine stalls when selecting 'D' or when coming to rest in 'D'	19, 14, 22, 21
Judder on engagement of direct drive	21
Drag on change from low to intermediate	4
Poor hill-climbing, lack of acceleration in indirect ranges	7, 23
Judder while cruising in direct drive	7, 6
Incorrect operation	
Will not change up in 'D'	13, 19, 20, 14, 32
'Hunts' between direct and intermediate	24, 14
Starts in intermediate	24, 14, 13, 18
Will only move off in 'L'	1, 6
Will only move off in 'R'	1, 6
Selects reverse at speeds above 3–5 m.p.h. (5–8 km.p.h.)	25, 4
Parking pawl attempts to engage at speeds above 3–5 m.p.h. (5–8 km.p.h.)	25, 26, 31
Car cannot be push-started	1, 2, 25
Parking pawl will not engage	1, 26, 31
Ineffective engine braking on overrun in 'L'	1, 9, 11
Excessive jerk when selecting 'D', 'L', or 'R' (accumulator valve sticking)	7, 2, 8, 10, 4
Delay in taking up drive in 'D', 'L', or 'R'	2, 4, 7, 6
Poor acceleration and low maximum speed in direct drive, normal in indirect ranges (stall speed normal)	7, 21
Car creeps or drives in 'N'	1, 8, 10, 21
Noisy operation	
Rattling noise, more noticeable at idling speeds	1, 7, 24
Whine in direct drive at 30–40 m.p.h. (48–64 km.p.h.) (do not confuse with axle or tyre noise)	28, 32
Whine at fast idling speed in all selector positions	29
Gear noise at low speed in indirect ranges	30
Knocking, scraping, or grating noise in all selector positions	7, 27, 29, 6
Excessive swishing noise on take-off from rest	2, 24, 20, 23
Barking noise when selecting 'D', 'L', or 'R'	2, 4

Section SB(g).2

ACTION KEY

Where the action line in Section SB(g).1 is divided the following procedure should be used.
If the preceding pressure reading is incorrect follow the upper line.
If the pressure reading is correct follow the lower line.

1. Check selector linkage.
2. Check fluid level.
3. Check front pump pressure.
4. Clean or overhaul valve block and clean filter.
5. Check front pump and drive tangs on converter hub.
6. Check free-wheels and/or races.
7. Check external features (e.g. engine performance, idling speed, brakes, anti-creep, and half-shafts).
8. Check forward band adjustment and/or condition of band and adjuster.
9. Check low band adjustment and/or condition of band and adjuster.
10. Check reverse band adjustment and/or condition of band and adjuster.
11. Check relevant servo pressure and/or correct functioning of servo piston.
12. Check for blocked fluid passage and/or damaged casting.
13. Check multi-disc clutch pressure.
14. Check action of governor, governor valve, hydraulic detent, and booster spring.
15. Check oil rings, 'O' rings, and oil seals.
16. Check gaskets on extension case, valve block, and collector ring.
17. Check for tightness and correct position of lubrication valve and tube in mainshaft.
18. Check mechanical condition of multi-disc clutch pack, piston, and retractor springs.
19. Check direct drive clutch pressure.
20. Check converter pressure.
21. Change torque converter and direct drive clutch assembly.
22. Check that transfer tube is correctly fitted, and has grooved front end.
23. Check stall speed. If low, change torque converter assembly.
24. Check governor linkage.
25. Check rear pump pressure. If incorrect, see 4 and 32.
26. Check action of parking pawl, interlock piston, and spring.
27. Check for converter fouling bell housing, gearbox, or adjacent parts.
28. Change rear pump assembly.
29. Inspect and, if necessary, replace front pump.
30. Inspect and, if necessary, replace gear train components.
31. Check adjustments of pawl actuating rod.
32. Check rear pump drive.

SECTION SB(h)

REMOVING AND REFITTING TRANSMISSION AND CONVERTER

Section SB(h).1

REMOVING THE TRANSMISSION AND CONVERTER

See Section D

Section SB(h).2

REFITTING THE CONVERTER AND TRANSMISSION

Correct alignment is vitally important if damage to the front pump and oil seal is to be avoided; incorrect alignment will be shown by leakage of fluid between the transmission and the converter.

It is also important that the transmission mainshaft should be correctly aligned with the engine crankshaft and this depends on the accuracy of the converter housing. The bore of the converter housing must be concentric to the crankshaft to within ·003 in. (·076 mm.) and the rear face of the housing square to the crankshaft to within ·004 in. (·102 mm.). The converter housing is dowelled to the crankcase and matched; a replacement engine should be fitted complete with converter housing.

(1) Refit the converter driving plate to the crankshaft flange and bolt up.
(2) Bolt the converter to the driving plate
(3) Clean the faces of the converter housing and crankcase and bolt the housing into position.
(4) Fit the converter aligning tool (Part No. 18G505) over the hub of the converter and bolt it into position on the rear face of the housing. Slacken off the bolts holding the converter assembly to the drive plate. revolve the crankshaft several revolutions to centralize the converter, and re-tighten the bolts to the recommended torque reading. Remove the aligning plate.
(5) Remove the oil transfer tube and align the splines and front pump driving dogs with tool 18G506 (see Fig. SB(h).1). Fit the spline aligner onto the mainshaft and push it as far as it will go. Slacken the positioning arm locking screw (A) and move the arm so that the positioning pin (B) lines up with one of the two lower studs. Make sure that the dogs on the aligner are meshing correctly with the front pump driving gear and align the positioning pin with one of the lower studs. Tighten the locking screw (A) and remove the aligner from the shaft, taking care not to move the splines or pump gear out of alignment.
(6) Replace the oil transfer tube with the tapered end outwards.
(7) Align the splines in the converter assembly and the front pump driving dogs, using tool 18G506 reversed as shown in Fig. SB(h).2. Push the tool into the converter assembly, working it to line up the splines and the pump driving dog (A). Rotate the converter slightly until the positioning pin (B) enters easily into the stud hole corresponding to the stud on the transmission to which the aligner was set. Remove the aligner carefully.
(8) Screw the two pilot studs (part of 18G505) into the two upper holes in the rear of the converter housing.
(9) Offer up the transmission and align the two studs with the holes in the transmission housing. Slide the transmission carefully onto the studs and enter the front pump driving lugs into the pump. Do not force the transmission into position by tightening the nuts as this will damage the converter or pump. If the transmission fails to meet the converter housing by ¼ in. (6 mm.) or less, turn the

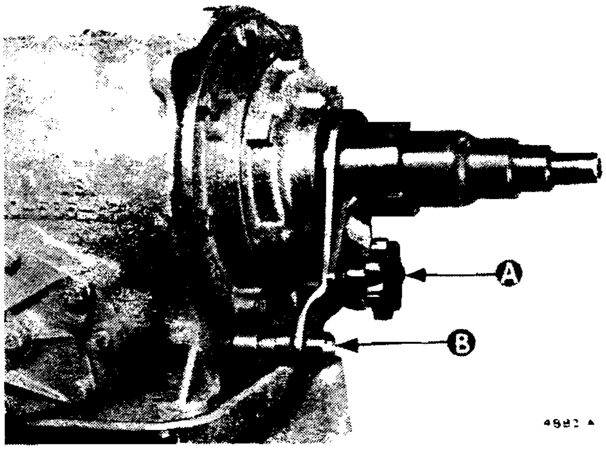


Fig. SB(h).1
Mainshaft spline alignment with 18G506
A. Positioning arm locking screw. B. Positioning pin.

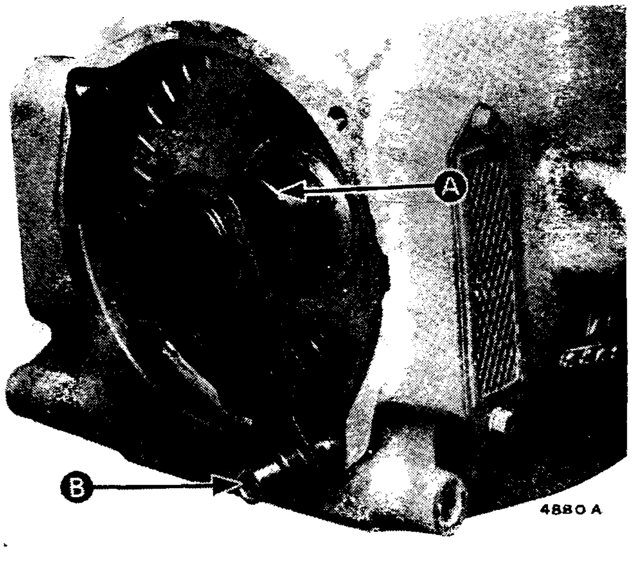


Fig. SB(h).2
Using 18G506 to align converter splines, front pump drive (A), and direct drive clutch spine. (B) is the positioning pin

universal joint coupling or the converter slightly in each direction and apply pressure to the rear of the transmission.

(10) Remove the pilot studs with a screwdriver and fit the bolts, washers, and nuts. Tighten to the recommended torque.

(11) Refit the engine sump and the converter housing cover-plate.

Checking converter alignment

Alignment of the crankshaft to the gearbox is controlled by the converter housing and must be held to very close limits.

In certain cases it is essential to align the engine and converter housing. The cases are:

(1) Replacement engine and existing transmission.

(2) Replacement converter housing and existing engine.

(3) Suspected transmission misalignment.

Alignment procedure is detailed in the following paragraphs:

(1) Fit the converter housing to the engine without using the dowel bolts.

(2) Mount a dial gauge by means of a suitable bracket and pillar on the rear face of the crankshaft flange. Turn the crankshaft and take the dial reading off the machined face of the housing—the reading to be held true to within a total limit of ·004 in. (·102 mm.).

NOTE.—**If the reading exceeds this tolerance check the joints between the housing, backplate, and the cylinder block to ensure that foreign matter is not causing misalignment. The backplate should also be checked for distortion.**

(3) To check that the rear bore is concentric with the crankshaft flange move the dial gauge and revolve the crankshaft to take the reading off the inside bore diameter at the rear of the housing. This reading must be held true to within a total limit of ·003 in. (·076 mm.); should the reading exceed this figure, slacken the housing bolts slightly and tap the housing into position until the best reading below this figure is obtained. Fully tighten the bolts, ream out the dowel bolt holes to size, and fit the dowel bolts. Re-check the dial reading and remove the gauge and the mounting. Should it be necessary to open up dowel holes above the standard size, $\frac{1}{32}$ in. (·800 mm.) oversize bolts (Part No. AEC3338) are available.

(4) Remove the housing, and fit the drive plate to the crankshaft flange and the converter assembly to the drive plate. Refit the housing and fully tighten the housing bolts.

(5) Fit the converter aligning tool (Part No. 18G505) over the hub of the converter and bolt it into position on the rear face of the housing. Slacken off the bolts holding the converter assembly to the drive plate, revolve the crankshaft several revolutions to centralize the converter, and re-tighten the bolts to the recommended torque reading. Remove the aligning plate.

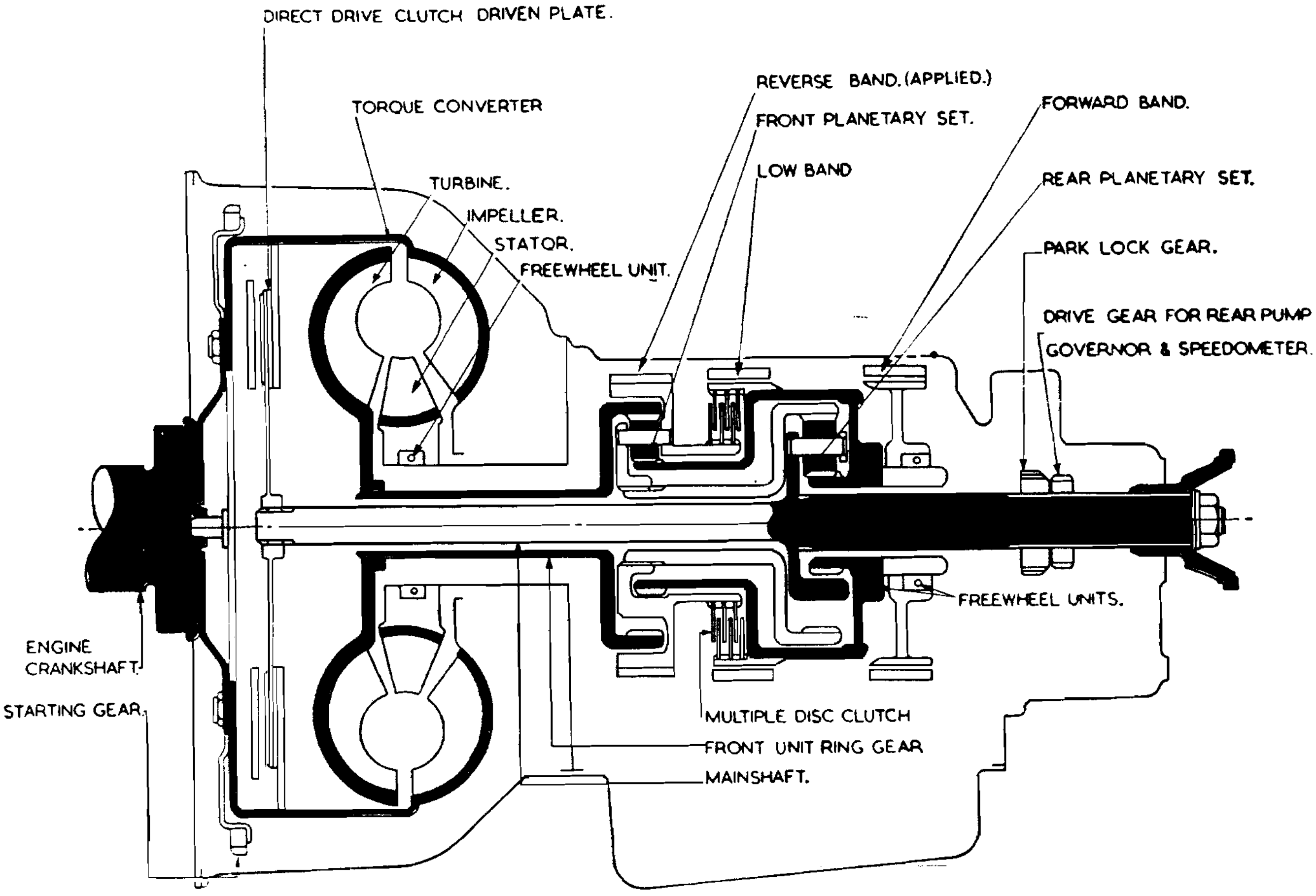
(6) Fit the gearbox to the housing in the manner detailed in Section SB(h).2, taking care to avoid damaging the oil seal on the front pump driving dogs. It will be of assistance to the operator if, during the operation, a short length of chain is fitted with set screws between the two tapped holes in the top of the gearbox casing, and the gearbox slung on pulley blocks, thus leaving the hands free to guide the gearbox into position.

SERVICE LUBRICANTS (Petrol Models)

Component	Engine and Carburetter	Manual Gearbox, Rear Axle, Steering Box and Idler	Grease Points	Upper Cylinder Lubrication	Automatic Gearbox
Minimum performance level	British Leyland Specification B.L.S. OL.02	MIL-L-2105B	Multipurpose Lithium Grease N.L.G.I. Consistency No. 2	Upper Cylinder Lubricant	Automatic Transmission Fluid Type G
UNIPART	Unipart Super Multigrade Motor Oil 15W/50				
SHELL	Shell Super Motor Oil 20W/50	Shell Spirax Heavy Duty 90	Shell Retinax A	Shell Upper Cylinder Lubricant	Shell Donax T 7
DUCKHAMS	Duckhams Q Motor Oil	Duckhams Hypoid 90S	Duckhams LB 10 Grease	Duckhams Adcoid Liquid	Duckhams Q-Matic
CASTROL	Castrol GTX2 or Castrolite 10W/40	Castrol Hypoy B E.P. 90	Castrol LM Grease	Castrollo	Castrol TQF
TEXACO	Eurotex 15W/50 20W/50 or 10W/30	Multigear Lubricant E.P. 90	Marfak All Purpose	Special Upper Cylinder Lubricant	Texamatic Type G
PETROFINA	Fina Supergrade Motor Oil 20W/50 or 10W/50	Fina Pontonic XP 90-140	Fina Marson HTL 2	Fina Cyltonic	
MOBIL	Mobil Super 15W/50	Mobilube HD 90	Mobilgrease MP or Super	Mobil Upperlube	Mobil ATF 210
ESSO	Esso Superlube 10W/40	Esso Gear Oil GX 85W/140	Esso Multipurpose Grease H	Esso Upper Cylinder Lubricant	Esso Glide Type G
BP	BP Super Visco-Static 20W/50 or 10W/40	BP Hypogear 90 E.P.	BP Energrease L2	BP Upper Cylinder Lubricant	BP Autran G

SERVICE LUBRICANTS (Diesel Models)

Component	Engine and Oil-can Points		Manual Gearbox, Rear Axle, Steering Box and Idler	Grease Points	Automatic Gearbox
Minimum performance level	MIL-L-46152		MIL-L-2105B	Multipurpose Lithium Grease N.L.G.I. Consistency No. 2	Automatic Transmission Fluid Type G
UNIPART	Unipart Super Multigrade Motor Oil 15W/50				
SHELL	Shell Super Motor Oil 20W/50	Rotella SX 20W/40	Shell Spirax Heavy Duty 90	Shell Retinax A	Shell Donax T 7
DUCKHAMS	Q Motor Oil 20W/50	Fleetol Multi-V 20W/50 Fleetmaster	Duckhams Hypoid 90S	Duckhams LB 10 Grease	Duckhams Q-Matic
CASTROL	Castrol GTX	Deusol RX Super 15W/40	Castrol Hypoy B E.P. 90	Castrol LM Grease	Castrol TQF
TEXACO	Ursa Oil LA 15W/40	Eurotex Motor Oil HD 20W/50	Multigear Lubricant E.P. 90	Marfak All Purpose	Texamatic Type G
PETROFINA	Fina Supergrade Motor Oil 20W/50	Fina Delta Multigrade 20W/50	Fina Pontonic XP 90-140	Fina Marson HTL 2	
MOBIL	Mobil Super 15W/50	Mobil Delvac Super 15W/40 Mobil Delvac Special 20W/50	Mobilube HD 90	Mobilgrease MP or Super	Mobil ATF 210
ESSO	Esso Superlube 10W/40	Essolube HDX Plus 20W/50	Esso Gear Oil GX 85W/140	Esso Multipurpose Grease H	Esso Glide Type G
BP	BP Super Viscostatic 20W/50	BP Vanellus Multigrade 20W/50 BP Vanellus C3 Multigrade	BP Hypogear 90 E.P.	BP Energrease L2	BP Autran G



Section SB(c).5

'R' REVERSE

Reverse is obtained from the two planetary sets by holding the carrier in the front set and, consequently, the ring gear in the rear set. The reverse band only is applied.

Drive is from the turbine to the front ring gear, which causes the planet wheels on the carrier to rotate in a clockwise direction. As the carrier is held by the reverse band, rotation of the planet wheels causes the sun gear to rotate in an anti-clockwise direction. The front carrier is held stationary by the reverse band, and as the front carrier is splined to the rear ring gear the rear ring gear is also held. The front sun gear and low drum rotate anti-clockwise and, through the reverse free-wheel, the rear sun gear also. Rotation of the rear sun gear in an anti-clockwise direction drives the rear carrier around the stationary ring gear and gives reverse rotation of the output shaft.

Notice that holding the front carrier results in an increase in speed in the front planetary set, while holding the rear ring gear and driving with the sun gear gives the required reduction in the rear planetary set.

A free-wheel is operative in reverse as the reverse free-wheel is unlocked when the rear sun gear, rotated by the carrier, overruns the low drum plate.

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