AUSTIN

TAXI & HIRE CAR

SERIES FX3. FL1. FX3D. AND FLID.

Service Manual

THE AUSTIN MOTOR COMPANY LIMITED BIRMINGHAM, ENGLAND

AKD 1393A (33324)

Printed in England

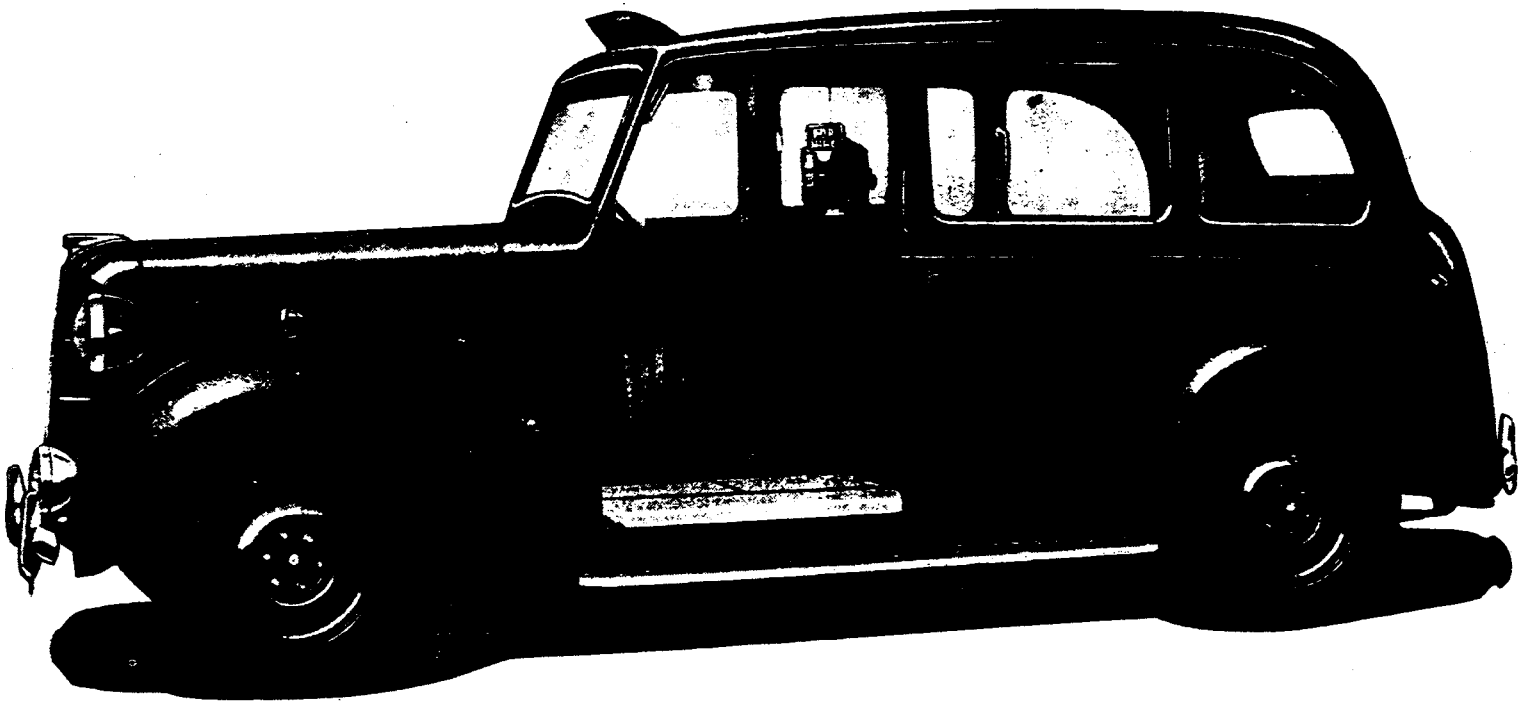
Introduction

This manual has been compiled for the purpose of assisting Austin Distributors and Dealers to efficiently service and maintain the Taxi (FX.3) and Hire Car (FL.1), together with the diesel engined versions (FX.3D and FL.ID). The petrol engine is dealt with in the body of the manual, whilst details of the 2·2 litre diesel engine are contained in a separate manual at the end.

Each assembly of the major components is described in detail. In addition, comprehensive instructions are given for complete dismantling, assembling, adjusting and for inspection of these assemblies. It is emphasised that only genuine Austin parts should be used as replacements for components found unfit for further service.

When ordering spares it is imperative that operators use the 'Spare Parts List' of the appropriate model and **not** refer to the manual.

Any enquiries for advice by individual owners should, in the first instance, be made to the local Distributor or Dealer.



THE METROPOLITAN TAXI CAB

THE AUSTIN HIRE CAR

GENERAL INDEX

Axle, Front	Section	J
Axle, Rear	,,	L
Bodywork	,,	R
Brakes	,,	N
Clutch	,,	G
Cooling System	,,	B
Electrical Equipment	,,	Q
Engine Assembly	,,	E
Engine Lubrication	,,	D
Frame	,,	M
Fuel System	,,	C
Gearbox	,,	F
Ignition Equipment	Section	Q
Instruments and Controls	,,	A
Jacking System	,,	O
Lubrication Chart	,,	V
Part Name Alternatives	,,	T
Propeller Shaft	,,	H
Service Facilities	,,	U
Service Tools	,,	S
Steering	,,	K
Suspension	,,	M
Wheels and Tyres	,,	P

	Page
Introduction	ii
General Specification	viii
Regular Attentions	xi

INSTRUMENTS AND CONTROLS — Section A

Driving	5
Foot Controls	1
Hand Controls	2
Instruments	1

COOLING SYSTEM — Section B

Description	1
Fan Belt Adjustment	2
Frost Precautions	2
Overheating	2
Thermostat	1
Radiator	5
Draining	3
Flushing	3
Removal	5
Water Pump	3
Bearings and Washers	3
Lubrication	4
Re-assembly	4
Refitting	4
Removal and Dismantling	3
Seal Ring	4
Spindle Removal	3

FUEL SYSTEM — Section C

Carburetter—Hire Car	7
Adjustment	10
Cleaning	11
Description	7
Dismantling	10
Emulsion Block	12
Filter	12
Float	11
General	12
Main Carburetter	8
Pump and Economy Device	10
Slow Running	12
Standard Settings	7
Starting	8
Carburetter — Taxi	3
Adjustments	5
Description	5
General Maintenance	6
Standard Settings	3
Starting	3
Fuel Pump	12
Description	12
Dismantling	15
Filter	13
Inspection	15
Operation	12
Reassembly	15
Refitting	17
Removal	14
Testing	16
Testing on Engine	14
Manifolds, Throttle, Air Cleaner	2
Air Cleaner	3
Exhaust Pipe	2
Manifolds	2
Throttle Linkage	3
Petrol Tank	1
Draining	1
Gauge Unit	2
Removal	1

ENGINE LUBRICATION — Section D

Capacity	1
Check for Loss of Pressure	2
Circulation	1
Description	1
Draining Sump	1
Micronic Filter	3
Oil Pump — Dismantle	4
Oil Pump — Removal	4
Oil Pump — Replacement	4
Pressure Gauge	2
Release Valve	5
Refitting	1
Valve Rocker Shaft	5
Strainer and Pick-Up	4
Sump Removal	4
Tecalemit Filter	2

ENGINE ASSEMBLY — Section E

Clearances and Data	2
Diagnosis and Correction of Faults	20
Removing and Refitting the Engine	10
Service Operations—Engine in Position	5
Cylinder Head Removal and Replacement	6
Decarbonising	6
Distributor Removal and Replacement	9
Push Rod Removal	8
Rocker Arm Bushes	5
Sparking Plugs	8
Tappet Adjustment	5
Valves	7
Valve Spring Removal	8
Service Operations — Engine Removed	12
Bearings	17
Bearing Caps	18
Bores	15
Camshaft Bearings	19
Camshaft Withdrawal	18
Flywheel Removal	13
Gudgeon Pin	15
Pistons and Connecting Rods	13
Piston Removal	15
Piston Rings	17
Starting Nut	13
Suspension Plates	13
Tappet Removal	13
Timing Chain Fitting	19
Timing Chain Tensioner	18
Timing Cover	13
Timing Marks	19
Valve Guides	12
Valve Timing Gear	13

GEARBOX — Section F

Data	1
Dismantling the Gearbox	4
Clutch Shaft and Release Bearing	4
Extension Cover	4
First Motion Shaft	5
Front Cover	4
Laygears	5
Rear Oil Seal and Flange	4
Reverse Gears	5
Speed Forks and Rods	4
Taximeter Drive	4
Third Motion Shaft	5
Top Cover and Change Speed Gate	4
Reassembling the Gearbox	5
Change Speed Forks	8
Clutch Shaft	9
Driving Flange	8
Extension Cover	8
First Motion Shaft	8

Page

Fitting Gear Synchroniser Cones 7
Front Cover 8
Layshaft Gears 5
Reverse Gear 6
Synchromesh Sub-Assembly Guide 7
Taximeter Drive 8
Third Motion Shaft 6
Top Cover 8

Removing the Gearbox ... 1

CLUTCH Section G

Cover Assembly 1
Data 1
Description 1
Driven Plate Assembly ... 1
Release Bearing Assembly ... 2
Removal 2
Running Adjustments ... 2

Dismantling, Assembling and Gauging 3
Assembling 4
Dismantling 3
Refacing the Driver plate ... 5
Gauging 4
Method of Tool Operation ... 3

PROPELLER SHAFT Section H

Description 1
Dismantling 2
Examination for Wear ... 2
Lubrication 1
Reassembly 3
Removal of Complete Assembly 1
Replacement 3
Tests for Wear 1

FRONT AXLE Section J

Data 1

Castor, Camber, and Swivel Pin Inclination 2
Camber Angle 2
Castor Angle 3
Description 2
Swivel Pin Inclination 3

Front Hubs 3
Assembly 4
Check for Wear 4
Dismantling 3

STEERING Section K

Data 1

Maintenance 3
Ball Connections 2
Cross Tube Lever 2
Lubrication 2
Side Tube 3
Steering Arm 3
Steering Wheel 4
Swivel Arm 2
Track Adjustment 2

Steering Gear 4
Adjustment 6
Cam Track 6
Central Control 6
Lubrication 4
Mounting the Gear 6
Replacing the Steering Arm ... 6
Rocket Shaft 6

REAR AXLE Section L

Worm type 1
Hypoid type 6

Page

SUSPENSION Section M

Data 1

Shock Absorbers and Anti-Roll Bars 3
Anti-Roll Tension Bars ... 4
Arm Rubber Bushes 4
Description 3
Refitting 4
Testing 3
Fluid Level 4
Topping-up 4

Spring Maintenance 1
Description 1
Dismantling 3
Removal — Front 1
Removal — Rear 2
Replacement 3
Spring Eye Bushes 3

BRAKES Section N

Adjuster Unit 3
Adjustment 4
Backplate 3
Brake Shoes 3
Centralising Shoes 6
Clearances 6
Data 1
Description 1
Expander Unit 2
Handbrake 4
Linings 3
Lubrication 6
New Rods 6
Operation 1
Pedal Pivot 2
Rods and Linkages 2
Servicing 5
Shoe Refitting 6
Shoe Removal 5

JACKING SYSTEM Section O

Conditions 1
Operation 1

Distributor Box 2
Flow of Fluid 2
Lowering the Car 3
Raising the Car 2
Relief Valve Operation ... 2
Valve Operation 2

Faults and Treatment ... 4

Jack 4

Servicing the Distributor Box 3
Cleaning after Refilling ... 3
Clearing the Pump 3
Dirt in Filter 3
Draining 3

WHEELS AND TYRES Section P

Care in Tyre Fitting 3
Changing a Wheel 2
General 1
Pressures 1
Replacing a Wheel 2
Synthetic Tyres 3
Tube Repairs 1
Tyre Refitting 2
Tyre Removal 2
Tyre Care 3

ELECTRICAL EQUIPMENT Section Q

Data 1
Wiring Diagram 2

Page

General Information ... 8

Battery—Initial Filling and Charging ... 8
—Storage 8

Control Box 16
Cleaning Contacts 17
Cut-Out Adjustment ... 17
Description 16
Electrical Setting 16
Mechanical Setting 17
Regulator Adjustment ... 16

Direction Indicator 20
Arm type 21
Flasher type 20

Distributor 14
Bearing Bush Replacement ... 15
Condenser 14
Dismantling 14
Reassembly 15

Dynamo 10
Armature 11
Bearings 12
Brush Gear 11
Commutator 11
Dismantling 10
Field Coils 11
Removing and Replacing ... 10
Reassembly 13
Testing in Position 10

Electric Horn 18
Ajdustment 18

Ignition Coil 18

Lighting 19
Foglamp — Bulb Replacement 21
Foglamp — Focussing... ... 21
Foglamp — Mounting Adjustment 21
Headlamp — Bulb Replacement 19
Headlamp — Focussing ... 20
Headlamp — Mounting Adjustment 20
Number Plate Illumination ... 21
Side lamp — Bulb Replacement 21
Stop and Tail lamp — Bulb Replacement 21

Location and Remedy of Faults 21
Charging Circuit 21
Ignition Circuit 21
Lighting Circuit 22
Starter Motor 22

Starter 13
Armature 13
Bearings 14
Brushes 14
Commutator 13
Dismantling 13
Field Coils 14
Motor 13
Normal Service 13
Reassembly 14
Removal 13
Switch 14

Windscreen Wiper 18
Arm and Blade Assembly ... 18
Blade Replacement 19

Lubrication and General Maintenance 6

	Page
Direction Indicators—Lubrication	7
Distributor	6
Distributor — Cleaning	7
Distributor — Lubrication	7
Dynamo — Lubrication	8

BODYWORK Section R

Care of Bodywork	1
Body Panel Repairs	10
Boot Lid	12
Centre Pillar	11
Drip Mould	12
Rear Panel	11
Rear Quarter Panel	11
Roof Lining	10
Roof Panel	11
Scuttle	11
Dismantling and Assembling Body Parts	1
Arm Rest	8
Badge	3
Body Removal	8
Backlight	8
Bonnet	2
Boot Lid	8
Cowl Fixing Plates	4
Cross Channel	4
Cross Tube	3
Division Panel	7
Division Windows	5
Door Windows	5
Flitch Plates	4
For Hire Sign	4
Front Apron and Bumper	1
Grille Bars	4
Headlamps	3
Mascot	3
Occasional Seats	8
Partition Window	7
Quarter-Light	7
Radiator Cowl	2
Rear Bumper	1
Running Boards	10
Squab — Front	8
Squab — Rear	8
Tool Box — Taxi	10
Windscreen	5
Wiper Motor	4
Wings — Front	2
Wings — Rear	2

SERVICE TOOLS Section S

Engine and Clutch Tools	1
Front Axle and Hub Tools	3
Gearbox Tools	3
Oil Gun	6
Steering and Chassis Tools	5

PART NAME ALTERNATIVES Section T

SERVICE FACILITIES Section U

RECOMMENDED LUBRICANTS Section V

Chassis Lubrication	2
Engine Lubrication	3
Home and Export Market	1

GENERAL SPECIFICATION

ENGINE

Type

Four cylinders cast integral with crankcase. Full length water jackets. Detachable cast iron head carrying overhead valve rocker gear. Forged steel counterbalanced crankshaft supported by three detachable steel backed white metal bearings. Forged steel connecting rods with steel backed detachable white metal big-end bearings.

Dimensions — Taxi

Bore $3\frac{1}{8}$-ins. (79.4 mm.); stroke $4\frac{3}{8}$-ins. (111.1 mm.); cubic capacity 2,199 c.c.; maximum B.H.P. 52 at 3,800 r.p.m.; maximum torque 102 lbs./ft. at 1,600 r.p.m.; compression ratio 6.8 to 1.

Dimensions — Hire Car

Bore $3\frac{1}{8}$-ins. (79.4 mm.); stroke $4\frac{3}{8}$-ins. (111.1 mm); cubic capacity 2,199 c.c.; maximum B.H.P. 68 at 3,800 r.p.m.; maximum torque 116 lbs./ft. at 1,800 r.p.m.; compression ratio 6.8 to 1.

Pistons

Split skirt type in low expansion aluminium alloy with tin-plate finish. Two compression rings and one oil control ring.

Valves

Overhead and operated by tubular push rods and hollow dome-base tappets. Large inlet valves of silicon chrome steel and exhaust valves of special heat and corrosion resisting steel.

Camshaft

Forged steel with cams formed with quietening ramps. Supported by three steel backed white metal liners and driven by Duplex roller chain from crankshaft. The camshaft gear is fitted with a synthetic rubber chain tensioner ring.

Lubrication

Pressure gear pump feeds oil to all main, big-end, camshaft and overhead valve rocker shaft bearings. Drillings in connecting rod big-ends spray oil to cylinder walls, and the camshaft front bearing feeds a controlled supply of oil to the camshaft chain. A full flow filter incorporated in the lubrication circuit and the oil feed to the main and big-end bearings is of a special Austin design which ensures longer journal and crankpin life. Oil capacity $11\frac{3}{4}$ pints (6.62 litres), plus $1\frac{1}{4}$ pints (0.71 litres) for full flow filter.

Mountings

Flexible inclined 'live' rubber mountings front and rear with integral torque reaction stops.

Ignition

Coil with automatic advance and retard assisted by vacuum control.

Dynamo

12-volt fan ventilated unit with compensated voltage control.

Starter

Lucas type operated by a solenoid type of switch.

COOLING

Circulation by centrifugal type pump with thermostat control. Patented radiator to prevent loss of cooling water through expansion. Cooling system capacity 21 pints (11.93 litres).

FUEL SYSTEM

Rear tank of 10 gallons (45 litres) capacity with A.C. mechanical pump feed to a Zenith downdraught carburetter with 'L' type air cleaner. The Taxi fuel tank has a fireproof flooring and a fuel control tap fitted. The Burgess type of exhaust silencer is of large capacity. An aluminium alloy induction manifold incorporates a steel 'hot spot'.

CLUTCH

A Borg and Beck single dry plate with spring cushion drive. Diameter of plate 9-ins. (22.86 cms.). The clutch pedal is isolated from the clutch housing by a special adjustable linkage.

GEARBOX

Central control lever. Four speeds forward and reverse gear with synchromesh on 2nd, 3rd, and top. Rear extension housing giving additional bearings for main shaft. Taximeter drive available. Oil capacity $4\frac{1}{4}$ pints (2.41 litres).

TRANSMISSION

Hardy Spicer propeller shaft employing needle roller bearings for the universal joints with a lubricating nipple at each joint.

REAR AXLE (WORM GEAR)

Three-quarter floating of under-slung worm and wheel final drive. The worm is supported between a double row double purpose ball journal and a ball journal. Oil capacity $3\frac{1}{4}$ pints (1.82 litres).

Overall gear ratios:

Taxi, 4.8, 6.68, 11.86 and 18.2 to 1, with 22.46 reverse.

Hire Car, 4.8, 7.08, 11.86 and 18.2 to 1, with 22.46 reverse.

Road Speeds at 1,000 r.p.m.:

Top 16.45 m.p.h.; Third (taxi) 11.85 m p.h., (Hire Car) 11.15 m.p.h.; Second 6.66 m.p.h.; First 4.34 m.p.h.

REAR AXLE (HYPOID GEAR)

Semi-floating. Oil capacity 3 pints (1.7 litres).

Overall ratios:

4.8, 6.65, 11.86, 18.2 with 22.48 reverse.

Road Speeds at 1,000 r.p.m.:

Top 16.91 m.p.h ; Third 12.2 m.p.h.; Second 6.85 m.p.h.; First 4.61 m.p.h.

STEERING

High efficiency cam gear with a ratio of 20 : 1 for the early models, and 18 : 1 for later types. The steering connections have special ball and socket joints. Steering wheel with spring spokes and cellulose acetate covering. Steering wheel diameter 17-ins. (43.18 cms.). Turning circle (Taxi) 25-ft. between curbs, (Hire Car) 35-ft.

SUSPENSION

Front: Axle beam of 'I' section with long semi-elliptic springs having zinc interleaves and rubber bushed bearings. Control by double-acting hydraulic shock absorbers and anti-roll torsion bar.

Rear: Long semi-elliptic springs with zinc interleaves and controlling as for front suspension.

BRAKES

Girling front and rear with two leading shoe front brakes. The mechanical linkage is cross compensated on each axle and spring mechanism increases braking pressure at the front when either the pedal or handbrake, which operates on all four wheels, is applied.

WHEELS AND TYRES

Taxi: Disc type wheels with six wheel nuts. Dunlop super taxi tyres, 5.75 x 16.

Hire Car: Disc type wheels with six securing nuts and chromium hub plates. Dunlop super taxi tyres, 5.75 x 16.

JACKING

Hand controlled hydraulic jacks for raising both axles simultaneously or individually.

FRAME

Welded pressed steel frame with box section side and cross members giving great torsional stiffness.

ELECTRICAL

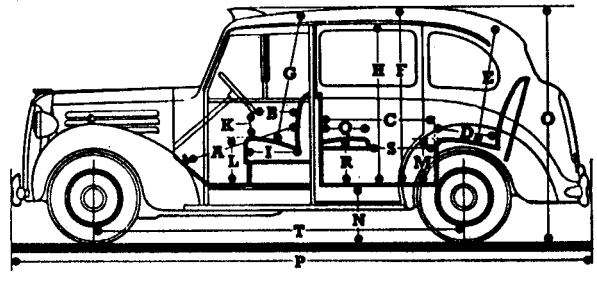
Two 6-volt batteries of 70 amp. hour capacity; separate head and side lamps; head lamps have foot controlled dipping mechanism; rear and stop lamps with rear number plate illumination; twin interior lights; twin blade windscreen wipers ; direction indicators ; provision for interior heating.

INSTRUMENTS

Oil, fuel, and ammeter gauges; speedometer with trip and total readings; electric clock.

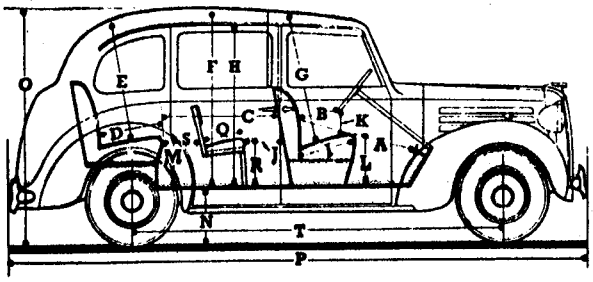
COACHWORK

Taxi: Body and roof of stressed steel construction, combining strength with lightness; doors hung on heavy coach hinges fitted with grease nipples; toughened glass for windscreen and all windows with tinted glass in rear window; windscreen opens to horizontal position; all seats have Dunlopillo moulded interiors and are upholstered in hand-buffed leather; folding seats incorporated in partition; driver's seat adustable for height; full width partition with sliding glass panels; fully enclosed driving cab; rear floor covered with reversible rubber mat; flush fitting ash trays; generous luggage space; accommodation for tools under driving seat; taximeter and fire extinguisher fitted.



TAXI LEADING DIMENSIONS		English	Metric
		ft. ins.	m.
Pedal to Seat Squab	A	3 1	0.94
Steering Wheel to Seat Squab	B	1 3	0.38
Partition to Rear Seat	C	3 0	0.91
Depth of Rear Seat Cushion	D	1 6	0.46
Height—Rear Seat to Roof	E	3 2	0.97
Height—Floor to Roof	F	4 5	1.35
Height—Front Seat to Roof	G	3 3	0.99
Height—Rear Door Opening	H	3 11	1.19
Depth of Front Seat	I	1 6	0.46
Front Seat Cushion to Steering Wheel	K	7½	0.19
Front Seat Cushion to Floor	L	1 2	0.36
Rear Seat Cushion to Floor	M	1 2	0.36
Height—Floor to Ground	N	1 4½	0.42
Overall Height	O	5 10½	1.80
Overall Length	P	14 5½	4.40
Depth of Occasional Seats	Q	1 2½	0.37
Occasional Seat Cushion to Floor	R	1 3½	0.39
Rear Seat to Occasional Seat	S	1 7	0.48
Wheelbase	T	9 2½	2.81
Overall Width		5 7½	1.71
Width of Front Seat		1 4	0.41
Width of Rear Seat between Arm Rests		3 8	1.12
Width of Occasional Seats		1 5	0.43
Track—Front		4 8	1.42
Track—Rear		4 8	1.42
Ground Clearance (Laden)		5½	0.14
Luggage Carrier Load		112-lbs.	51-kg.
Approximate Weight (less spare wheel, tools, and petrol; plus oil and water)		28½-cwt.	1448-kg.

Hire Car: All steel, sound-insulated, six-seater body; doors fitted with heavy coach hinges and locks; spring-loaded door windows of toughened glass; centre division with sliding toughened glass panels; front and rear seats filled with Dunlopillo material, trimmed in hand-buffed hide; flush fitting occasional seats; full width single-piece front seat; flush-fitting ash trays in doors; thick pile carpet; built-in rear spare wheel compartment.



HIRE CAR LEADING DIMENSIONS		English	Metric
		ft. in.	m.
Pedal to Seat Squab	A	2 10½	0.88
Steering Wheel to Seat Squab	B	1 1	0.33
Partition to Rear Seat	C	3 0½	0.92
Depth of Rear Seat Cushion	D	1 6½	0.47
Height—Rear Seat to Roof	E	3 0	0.91
Height—Floor to Roof	F	4 6	1.38
Height—Front Seat to Roof	G	3 2	0.96
Height—Rear Door Opening	H	3 11	1.19
Depth of Front Seat	I	1 6½	0.47
Partition to Occasional Seat	J	1 1½	0.35
Front Seat Cushion to Steering Wheel ...	K	7	0.18
Front Seat Cushion to Floor	L	1 2½	0.37
Rear Seat Cushion to Floor	M	1 4	0.41
Height—Floor to Ground	N	1 4½	0.42
Overall Height	O	5 10½	1.80
Overall Length	P	14 8½	4.40
Depth of Occasional Seats	Q	1 0½	0.32
Occasional Seat Cushion to Floor	R	1 1	0.33
Rear Seat to Occasional Seat	S	9½	0.25
Wheelbase	T	9 2½	2.81
Overall Width		5 7½	1.71
Width of Front Seat		3 8	1.12
Width of Rear Seat between armrests		3 8	1.12
Width of Occasional Seats		1 6	0.46
Track—Front		4 8	1.42
Track—Rear		4 8	1.42
Ground Clearance (Laden)		5½	0.14
Luggage Carrier Load		112-lbs.	51-kgs.
Approx. Weight (less spare wheel, tools and petrol, plus oil and water)		28½-cwt.	1448-kgs.

REGULAR ATTENTIONS

THE following is a convenient list of regular attentions which the car should receive to keep it in good mechanical condition. These instructions should be closely followed, whether the attentions are performed by the owner or the local garage.

The attentions under the Daily and Weekly headings are based on the assumption that the maximum mileage per week does not exceed 500, but see "After Sales Service" as detailed in the handbook for special attention during the first 1,000 miles.

Under more arduous conditions, such as very dusty or very muddy roads, long distances at high speeds or with heavy loads, it will be advisable to attend to chassis lubrication more frequently.

DAILY

Engine

Check the level of oil in the sump, and top up if necessary to the full mark on the dipstick situated on the right-hand side of the engine. When adding oil through the oil filler, at the rear end of the valve rocker cover, pour slowly to avoid the oil overflowing. If the engine has been running, allow a few minutes for the oil to settle before checking the level.

Radiator

Check the level of water in the radiator and top up if necessary. Fill to just below the top of the filler plug thread, when the engine is cold.

Fuel Tank

Check the quantity of fuel in the tank and add upper cylinder lubricant when necessary.

WEEKLY

Swivel Axles

Apply the oil gun on the two nipples on each swivel axle. This is best done with the axle jacked up since the oil is then able to penetrate to the thrust side of the bearing.

Steering Connections

Use the oil gun on the steering cross tube nipples and the steering side rod nipples (4 nipples.)

Wheels and Tyres

Check the tightness of the wheel nuts; also check the tyre pressures, using a tyre gauge, and inflate if necessary. See that all valves are fitted with valve caps and inspect the tyres for injury. Remove any flints or nails from the treads and ensure that there is no oil or grease on the tyre, since these substances prove injurious to rubber.

For recommended pressures, see Section P, page 1.

A tyre that loses more than three to four pounds per square inch in a week should be suspected of a puncture, but first make sure that the valve is not leaking.

500 MILES

Engine

On new and reconditioned engines the sump should be drained and refilled with new oil after the first 500 miles. At the same time as these changes are made, the cylinder head nuts should be tested and tightened if it is found necessary.

With a new engine, during the running in and settling down period (approximately 1,000 miles) a slight falling off of power sometimes develops; it is then advisable to lightly grind-in the valves and re-set tappet clearances. On such occasions there is no need to decarbonise the tops of the pistons.

Gearbox and Rear Axle

After 500 miles on new vehicles, drain and refill the gearbox and rear axle.

Always drain the oil after a run, since it will flow more easily when warm.

EVERY 2,000 MILES OR MONTHLY

Engine

Drain the sump and refill with new oil. Capacity is 12 pints, plus approximately 1¼ pints for the filter.

Gearbox

Check the level and top up if necessary. For access, lift the front carpet and remove the rubber plug on the side of the gear box covering. The filler plug is then accessible. Clean any dirt or grit away from round the plug. Remove the plug and fill up to the bottom of the threads. This gives the correct level.

Front Shock Absorbers

Remove the filler plug, taking care that dirt does not enter the casing and check that the fluid is level with the bottom of the opening. Should the fluid level appear low, examine the shock absorber casing for signs of leakage.

Clutch Pedal

With the oil gun, lubricate the nipple at the right-hand end of the pedal shaft.

Propeller Shaft Splined End

Oil the nipple on the sliding yoke at the gearbox end of the propeller shaft. To get at this yoke, take back the carpet from the front seat of the Hire Car, and remove the rubber gearbox cover. For the Taxi a bung is provided in the gearbox rubber cover for easy access to the propeller shaft nipple.

Brakes

Examine the brakes and adjust if necessary. Apply the oil gun to the balance lever on the front and rear axles, the handbrake pivot and the pedal pivot nipple.

Rear Axle

Check the level and replenish if necessary. The correct oil should be used and injected into the axle casing from beneath the vehicle, using the adaptor on the oil gun.

First remove the plug, which is on the right lower front side of the axle carrier, then place the end of the adaptor into the oil hole and inject the oil.

The plug also serves as an oil level indicator. Therefore, do not replace the plug at once, but give time for the superfluous oil to run out if too much has been injected. This is most important, because, if the rear axle is overfilled the lubricant may leak through to the brakes and render them ineffective. Wipe away the excess oil from the casing.

Steering Column

Lubricate the felt washer at the top of the steering column by adding a few drops of light machine oil through the hole in the steering wheel hub close to the steering column.

Battery

Ascertain the state of charge of the 12-volt battery by taking hydrometer readings. The specific gravity readings should be :

Fully charged	1.280—1.300
Half charged	approx. 1.210
Discharged	below 1.150

These figures are for an assumed electrolyte temperature of 60 deg. F.

Check that the electrolyte in the cells is just level with the tops of the separators. If necessary add a few drops of distilled water. Never use tap water as it contains impurities detrimental to the battery.

Never leave the battery in a discharged condition. If the car is to be out of use for any length of time, have the battery removed and charged about once a fortnight.

EVERY 3,000 MILES

Sparking Plugs

Remove the plugs and clean off all carbon deposit from the electrodes, insulations and plug threads with a stiff brush dipped in paraffin. The plugs may be taken to the local Austin dealer for cleaning in a special machine.

Clean and dress the plug points and reset to the correct gap of .025-in.

Before replacing the plugs check that the copper washers are in a sound condition. Never over-tighten a plug but ensure that a good joint is made between the plug body, the copper washer and the cylinder head.

Use Champion N.8 Modified Long Reach 14 mm. plugs, or Lodge CLN, or K.L.G. FE.50.

Distributor Cam and Drive Shaft Bearings

Lubricate the distributor camshaft bearings by withdrawing the moulded rotating arm from the top of the distributor spindle and carefully adding a few drops of thin machine oil round the screw exposed to view. Take care to refit the arm correctly by pushing it on to the shaft and turning until the key is properly located.

Distributor Cam

Apply a trace of engine oil to the distributor cam. Be careful not to let any oil or dirt reach the contact breaker points.

Distributor Automatic Advance

Remove the distributor cap and add a few drops of engine oil through the hole in the base contact breaker through which the cam passes.

EVERY 5,000 MILES

Air Cleaner

Every 5,000 miles the air cleaner should be removed, cleaned and 'wetted' with fresh oil. To do this slacken the clamping bolt and slacken the hose clip between the cleaner and the carburetter, lift off the air cleaner and then thoroughly rinse the louvred end in a shallow dish of petrol.

After drying, the metal gauze mesh should be re-oiled with clean engine oil, allowing the surplus oil to drain off before refitting the cleaner to the carburetter.

Fuel System

Check the flow of the fuel at the carburetter inlet union and, if necessary, clean the petrol filters in the pump and in the carburetter inlet union, also clean the jets.

Radiator

Flush out the cooling system by opening the drain taps. There is one at the bottom of the radiator and another on the right side at the rear of the crankcase. If a heater is fitted open the heater water cock. Water should then be allowed to run through until it comes out clear.

When refilling, and particularly if cold water is used, a few minutes must be allowed for air to escape past the thermostat valve before final topping up is effected.

In winter, when flushing the radiator, take care to preserve the cooling mixture if anti-freeze has been added.

Speedometer Drive

Disconnect the cable from the speedometer end and pull the inner member out of the casing. Lubricate by dipping it in fairly thick oil.

To reassemble, thread the oily shafting into the casing, giving a twisting movement while threading as this will help to engage it easily at the gearbox end. When the engagement is felt the shafting can be pushed right home so that the top square end stands out from the casing approximately $\frac{3}{8}$-inch.

Gearbox

Drain when the oil is warm, after a run, and refill to the level of the filler plug with new oil. Capacity, $4\frac{1}{4}$ pints.

Rear Axle

It is wise to drain the rear axle after a run, as the oil will flow more freely when warm, then refill to the level of the filler plug with new oil. Capacity $3\frac{1}{4}$ pints (worm), 3 pints (hypoid).

Front Road Wheel Hubs

Unscrew the hub cap and recharge with grease. It is important that the hubs are not given too much grease as it may penetrate to the brake shoes.

Rear Road Wheel Hubs

These are packed with grease upon assembly and do not require greasing attention.

Fan Belt

The fan belt must be sufficiently tight to prevent slip at the dynamo and water pump, yet there should be sufficient slackness to move the centre of the belt sideways about one inch.

To make any necessary adjustment, slacken the bolts and raise or lower the dynamo until the desired tension of the belt is obtained. Then securely lock the dynamo in position again.

Steering Box

The steering box should be topped up with oil, using the special adaptor on the oil gun. Take out the hexagon plug on the top of the steering box to inject the oil. Make certain that grit does not enter the casing during the operation and wipe away any excess oil afterwards.

General Check

Examine and, if necessary, tighten all bolts and nuts of such components as road spring clips, shock absorber retaining bolts, and body mounting bolts.

Examine other parts, such as steering connections, brake rods, etc., neglect of any may be followed by an expensive repair and inability to use the car for a lengthy period.

EVERY 10,000 MILES

Universal Joints

Lubricate the universal joints, front and rear, with the oil gun.

Clutch Operating Shaft

Lubricate the two shaft nipples sparingly, also the release bearing nipple situated at the end of the flexible pipe which is secured to the bell housing flange.

Sparking Plugs

Renew the sparking plugs, Champion N.8 or Lodge CLN, or K.L.G. FE.50.

Dynamo Bearings

Unscrew the wick type lubricator cover and if the wick is dry refill the cup with high melting point grease.

SERVICE ATTENTIONS

The following additional inspections and adjustments should be carried out periodically by an Austin Dealer at the mileages mentioned. These attentions are not usually carried out by normal owner drivers and the tools supplied in the Tool Kit are not sufficient for the work entailed.

EVERY 2,000 MILES

Shock Absorbers

The fluid level for both front and rear shock absorbers is just below the bottom of the filler plug threads. For topping-up details see page M/4

EVERY 5,000 MILES

Decarbonising, Valve Grinding and Tappet Adjustment

This attention may not be needed so frequently on cars used for long journeys. As a general rule, a falling off in engine power with pinking indicates when decarbonising is due.

This operation entails such preliminary dismantling of components as the carburetter, manifolds, cylinder head and push rods. The correct tappet clearance, measured between the rocker arm and the valve stem, is .012-in.

Pressure should be applied to the ball-ended adjusting screw by a screwdriver to disperse the oil cushion which forms between the sliding spring loaded ball cup and tappet rod, at the same time that the feeler gauge is being used. A false reading will be obtained if this procedure is not adopted.

EVERY 10,000 MILES

Contact Breaker Points

Clean the contact breaker points. Cleaning of the contacts is made easier if the contact breaker lever, which carries the moving contact, is removed. To do this, slacken the nuts on the terminal post and lift off the spring, which is slotted to facilitate removal. Before replacing smear the pivot, on which the contact breaker works, with clean oil.

Clean the contact breaker setting, re-set if necessary. The correct gap is .010—.012-ins.

Starter Commutators

Clean, also check the freedom of the brushes within the holders.

Track Adjustment

Check the front wheel alignment: 0—$\frac{1}{16}$-in. toe-in taken along a horizontal line at centre height using the wheel rims as data points.

Steering Box

Check for wear. This may be felt when the front wheels can be moved without creating any movement at the steering wheel.

Clutch Pedal Clearance

Check and adjust if necessary. The pedal should be depressed approximately $\frac{1}{16}$-in. before the clutch springs are felt to be under compression.

Oil Sump

Remove and clean the sump, also the oil pump strainer gauze.

Front and Rear Hub Bearings

Check for any signs of wear. Details for this operation are given in Sections J and L.

Ignition Timing

Check the setting and adjust if necessary.

External Oil Filter

Drain the 'full flow' filter by taking out the drain plug. Take out the old element and replace with a new one.

INSTRUMENTS AND CONTROLS

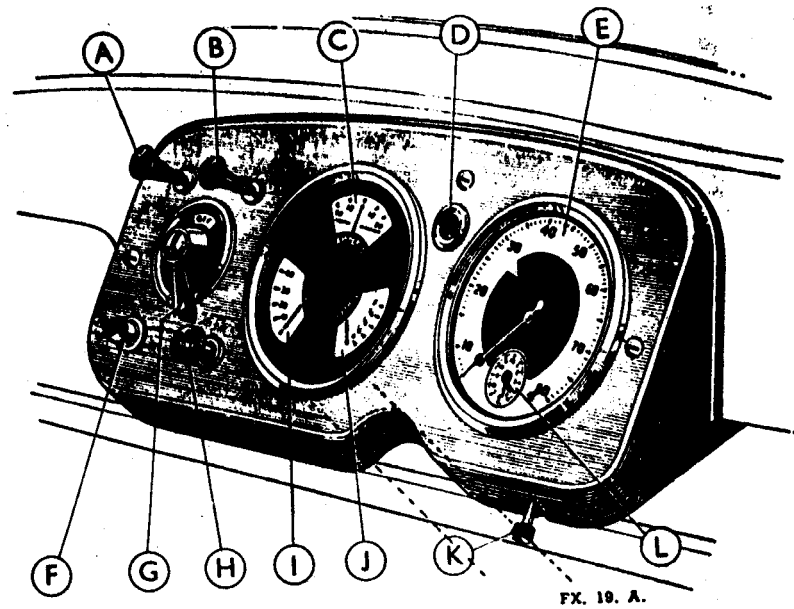


Fig. 1. The fascia panel.

A. Fog light switch.
B. Panel light switch.
C. Ammeter.
D. Ignition warning light.
E. Speedometer
F. Starter button.
G. Ignition and light switch.
H. Choke control.
I. Oil pressure gauge.
J. Petrol gauge.
K. Speedometer trip control.
L. Clock.

INSTRUMENTS

Speedometer

Registers the vehicle speed and total mileage. The trip figures at the top of the speedometer can be set at zero by pushing up the knob at the bottom of the speedometer and turning it to the left.

Oil Pressure Gauge

Indicates the oil pressure in the engine. It does not show the quantity of oil in the sump.

Ammeter

Indicates the flow of current into or out of the battery. With the automatic voltage control system only a trickle charge is shown when the battery is in a well charged condition.

Ignition Warning Lamp

Glows red when the ignition is switched 'on', and fades out when the engine dynamo is charging the battery.

Fuel Gauge

Indicates the contents of the tank when the ignition switch is on. When the tank is being filled, stop the engine. Then switch on again and the needle will record the amount of fuel entering the tank.

Clock

To start the electric clock and set the hands, press in the knob at the bottom of the clock and rotate until engagement is felt. Should the clock not start, press in and release the knob until ticking is heard. The clock regulating screw is at the rear.

FOOT CONTROLS

Accelerator

The right-hand pedal.

Brake

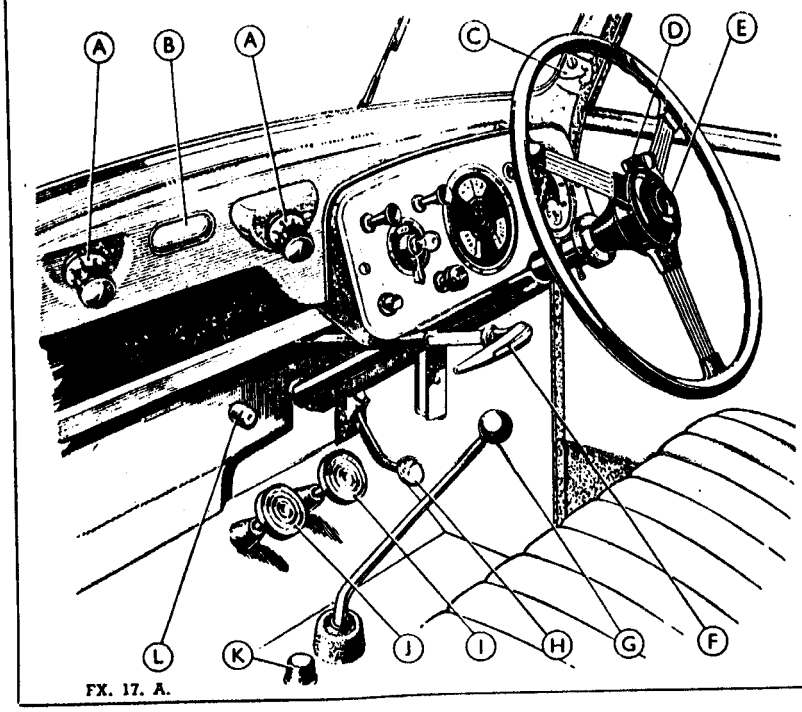
The centre pedal which operates the brakes on all four wheels.

Clutch

The left-hand pedal. Do not rest your foot on this pedal when driving and do not hold the clutch out to 'free wheel'.

Dip Switch

The headlamp dipping switch dips the left-side headlamp beam and at the same time switches off the right headlamp. If the headlamps are on full, a touch of the foot on the switch alters the lights to the 'dipped' position and they remain so until another touch returns them to the 'ahead' position. Certain export models have twin filament bulbs for double dipping.



FX. 17. A.

Fig. 2. Driving controls.

A. Windscreen wiper controls.
B. Ashtray.
C. Windscreen securing catch.
D. Direction indicator control.
E. Horn button.
F. Handbrake (Hire Car).
G. Gear lever.
H. Adjustable accelerator pedal.
I. Brake pedal.
J. Clutch pedal.
K. Gearbox oil dipstick.
L. Headlight dipper switch.

HAND CONTROLS

Accelerator (Taxi only)
Above the accelerator pedal is a small hand adjustment screw to enable the driver to adjust his engine slow running speed to suit prevailing traffic conditions.

Brake (Taxi)
Positioned alongside the driver's seat and operates on all four wheels.

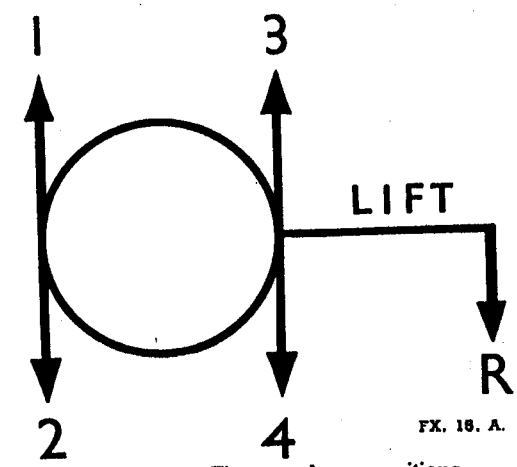
Brake (Hire Car)
Pistol grip, mounted under the fascia panel, and operates on all four wheels.

Gear Lever
Should always be in neutral when starting the engine. Lift the lever before attempting to engage reverse gear.

Choke Control
For use when starting the engine from cold. Pull out to limit until the engine fires, and return it to the half-way position for rapid warming up. The choke must be fully released at the earliest possible moment. To prevent an excessive supply of fuel reaching the cylinders the accelerator movement is automatically restricted when the choke control is operated.

Ignition Switch
To the left of the instruments. Turn clockwise to switch on. Do not leave switch 'on' when the vehicle is stationary, the red warning lamp is a reminder. The ignition key may also be used for locking the driver's door.

Lighting Switch
There are three positions:
1. Off
2. S. Side lamps and tail lamp
3. H. All lamps



FX. 18. A.

Fig. 3. The gear lever positions.

Fog Light
Controlled by a pull and push switch on the left on the instrument panel.

For Hire Light
The 'For Hire' sign above the windscreen is switched on by a switch on the left of the driving seat. When the taximeter arm is lowered the 'For Hire' sign is automatically switched off.

Master Lighting Switch
Alongside the 'For Hire' sign switch.

Rear Compartment Ventilator
This is located on the top left-hand side of the passengers' partition and it can be operated by sliding the shutter.

Ash Trays
The rear door ash trays can be quickly emptied outside the vehicle by opening the door and raising and reversing the ash tray container.

Door Windows
All door windows are spring loaded and can thus be moved easily to any desired position.

Starter Button
Press in to start, and release as soon as the engine fires. If the engine fails to start after a few revolutions, do not operate the starter again until the engine is stationary.

Direction Indicators
The indicators are controlled from the steering wheel. Normally after the vehicle has turned a corner they automatically return, but when only a slight turn has been made it may be necessary to return them by the switch to normal.
Flasher units are installed on later models.

Screen Wipers
The windscreen wiper is started by pushing in the knob on the driver's side and turning it to the left. After this blade is in operation, the second blade may be started by pushing in its knob and turning to the right. The second blade should be stopped first by pushing in its knob and turning to the left; to stop the first blade, push in the knob and turn to the right. The wipers operate only when the ignition switch is 'On'.

Horn Button
Mounted at the centre of the steering wheel. Operates only when the ignition switch is 'On'.

Interior Lights
The two interior lights at the rear are controlled by a common switch mounted above the centre partition between the driver and the rear compartment. It is possible for the driver and passengers to operate the rear lights by this switch.

Screen Opening
The screen can be opened to the horizontal position and held in any of the intermediate openings by clamping screws. Two small clamping arms at the bottom secure the screen in the closed position.

Panel Lights
The concealed illumination for the instruments is controlled by a pull and push switch on the instrument panel.

Driver's Seat (Taxi only)
Adjustable for height by withdrawing the forward locking bar beneath the seat cushion and then lifting or lowering the seat as required according to the adjustment range available. Secure the seat by inserting the locking bar, which should never be oiled as this would damage the rubber bushes holding the bar in position.

Bonnet
To open the centre hinged bonnet sides press and turn the two external spring loaded catches. When closing the bonnet sides press down the catches until engagement is felt.

Hydraulic Jacks
The 'Jackall' hydraulic jacks will lift either the front or the rear axles independently or both axles together. The control is under the bonnet on the left side. A lever is provided in the tool kit for fitting on the operating spindle.

Interior Heating
The engine cylinder head and water pump are designed for the fitting of an interior heating system if required.

Radiator Filler Cap
Screw type, under bonnet.

Crankcase Oil Filler Cap
Positioned on valve rocker cover, bayonet fitting, with anchor cable to prevent loss.

Fuel Filler Cap

On left rear mudwing. Bayonet fitting, with anchor cable to prevent loss.

Fuel Tap

A pull and push knob above the left-hand front wing can be pulled out to shut off the fuel supply from the tank to the pump.

Spare Wheel

Secured vertically in the rear luggage compartment. To open the rear panel use the squared end key provided. A clamping bracket holds the spare wheel in position.

STARTING

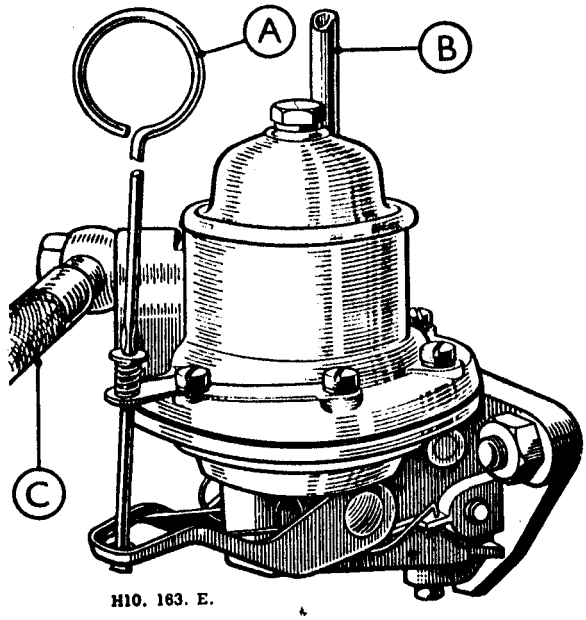
Before starting check the oil level in the sump and the water level in the radiator. The water level should be just below the top of the filler plug thread. Also check that there is fuel in the tank.

See that the gear lever is in neutral. If the engine is cold pull out the choke control. In very cold weather the engine should first be rotated several times with the starting handle.

Switch on the ignition.

Press the starter knob firmly. Release again if the engine fails to start promptly. Allow a short interval between each attempt to start and if the engine does not fire in a reasonably short time look for the cause. Never press the starter knob unless the engine is stationary.

As soon as the engine starts, release the choke to the halfway position for rapid warming-up, and release the choke completely as soon as the engine will run without it.



H10. 163. E.

Fig. 10. The fuel pump.

A. Priming lever: B. Delivery pipe: C. Supply pipe.

When the car has been garaged for some time the fuel in the carburetter may have evaporated. In such circumstances, before attempting to start the engine, refill the carburetter by operating the hand-priming lever on the fuel pump.

The pumping action should be distinctly felt until the carburetter bowl is full. If the pumping action cannot be felt, turn the engine with the starting handle about one full turn, when the priming lever should be free to pump.

Do not race the engine when it is first started, as time must be allowed for the oil to circulate properly. Let the engine idle fairly fast for a few minutes before fully releasing the choke, moving off, or engage top gear as soon as possible. Blanking off the radiator will assist the engine to warm up quickly, but always uncover the grille before moving.

DIFFICULT STARTING

Failure of the engine to start may be due to one, or to a combination of any of the following:—

(1) Ignition switched off.

(2) Lack of fuel in the carburetter due either to an empty tank, or to a fault in the fuel pump. This fault can be localised by disconnecting the inlet pipe union to the carburetter and operating the fuel pump hand priming lever. If the fuel pump is in order, fuel will escape from the loose union.

(3) Ineffective operation of the pump may be due to a choked feed filter gauze, an air leak in the pump or to a mechanical fault in the pump. The servicing of the fuel pump is fully described in Section C.

(4) No spark at the plug points due to:—

(a) Badly fitted, dirty or incorrectly set Contact Breaker points.

(b) Faulty condenser causing the excessive pitting of the points in (a).

(c) A faulty ignition coil.

(d) An open circuit in the low tension ignition circuit, which can be tested by connecting a 12 volt bulb between the low tension terminal on the distributor, and an earth point on the chassis. The bulb should light when the ignition is switched on. Failure of the bulb to light indicates a break in the ignition circuit from the battery to the distributor. This may be due to a poor terminal connection or to a burnt out coil.

By connecting the test lamp bulb between earth and other low tension points in the distributor, the flow of the ignition current can be accurately traced as far as the earthed contact breaker point.

Alternatively, a quick general check, as to whether the low tension ignition circuit is in order, can be obtained by watching the ammeter needle when the ignition is switched on and the engine is turned slowly by hand. If the ignition circuit is in order the ammeter needle will flicker as the contact breaker points open and close.

(e) A poor terminal connection between the high tension cable terminal in the distributor cap and the distributor rotor arm.

(f) Dirty, sooted or oiled up plugs.

DRIVING

To give the engine bearings, pistons and other working parts a chance to bed down, the following recommendations are made. The reader will be aware that the treatment given to a new car in its early life will reflect in its subsequent performance and dependability.

The following speeds should not be exceeded during the first 500 miles.

Second, 16 m.p.h. Third, 28 m.p.h. Top, 40 m.p.h.

When the vehicle is fully laden or facing up an incline always start in first gear, which is engaged by declutching and moving the gear lever forward to the left.

If, when the clutch is let in, the car does not move, it will mean that there has been no proper engagement of the gear. Declutch again, when it will be found that the gear lever may be moved forward to give the correct engagement. Never use force, but always move the gear lever as far as it will go.

When the vehicle is travelling at about 8 m.p.h. engage second gear. Engaging a higher gear is effected by declutching, moving the gear lever steadily through neutral to the next gear, and then letting in the clutch gently. The accelerator must be depressed gently as the clutch is let in to ensure the drive is taken up smoothly.

Engage third gear at approximately 15 m.p.h.

Engage top gear at approximately 25 m.p.h.

When changing down a smoother gear change is made if the accelerator is kept depressed to provide the extra engine speed to suit the lower gear.

Gear changing may be a little stiff with the new vehicle, but the moving parts will ease with use.

Always change down early on a hill since the engine will not pick up speed if the vehicle has almost stopped. Third gear should be engaged before the car speed falls below 25 m.p.h. in top gear.

Keep the foot off the clutch except in heavy traffic.

Engage low gear when descending a steep hill and leave the clutch engaged. The engine will then serve as a brake.

Remember that the braking efficiency of the vehicle decreases as the brakes heat, and for this reason it is inadvisable to coast down long winding hills.

When braking, the clutch should only be disengaged at the last moment prior to stopping.

The handbrake should only be used when parking the vehicle, negotiating traffic or when starting away on a hill.

Always apply the footbrake progressively to ensure the required retardation. Avoid fierce braking, which wastes fuel, wears out the tyres, and in wet or frosty weather may even send the vehicle into a skid.

After the vehicle has been washed or driven through water, ensure that the brakes are dry by gently applying them for some distance. Keep the handbrake hard on while the vehicle is being washed.

COOLING SYSTEM

AN efficient cooling system is of major importance to ensure the satisfactory running of the engine and it is therefore necessary to pay particular attention to its maintenance. Attention is especially drawn to the procedure advised for the winter months, if damage to the unit is to be avoided.

Description

The cooling system is maintained by water pump circulation combined with an efficient fan-cooled radiator and thermostat.

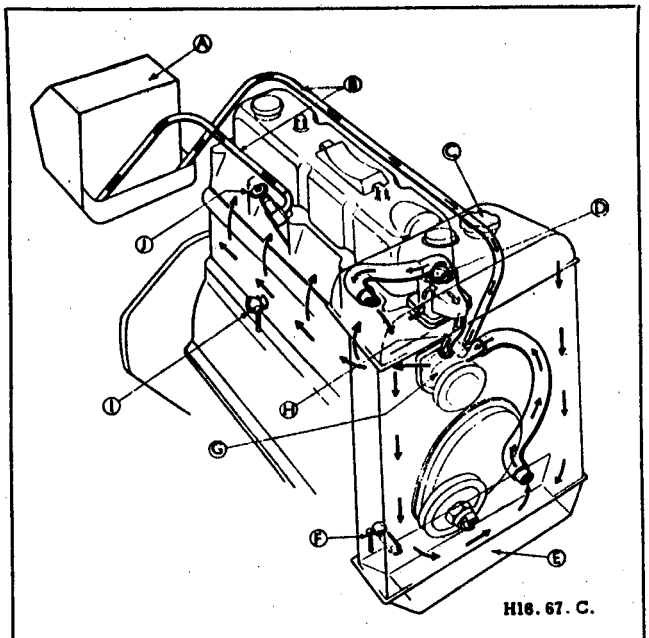


Fig. 1. The cooling system.

A. Heater; B. Heater pipes; C. Filler cap; D, Thermostat; E. Radiator bottom tank; F. Radiator drain tap; G. Water pump; H. By-pass pipe; I. Cylinder block drain tap; J. Heater control valve.

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. Use only rain water, and fill to just below the top of the filler plug thread when the engine is cold. The total capacity of the radiator, cylinder jackets, and interior heater is 24 pints.

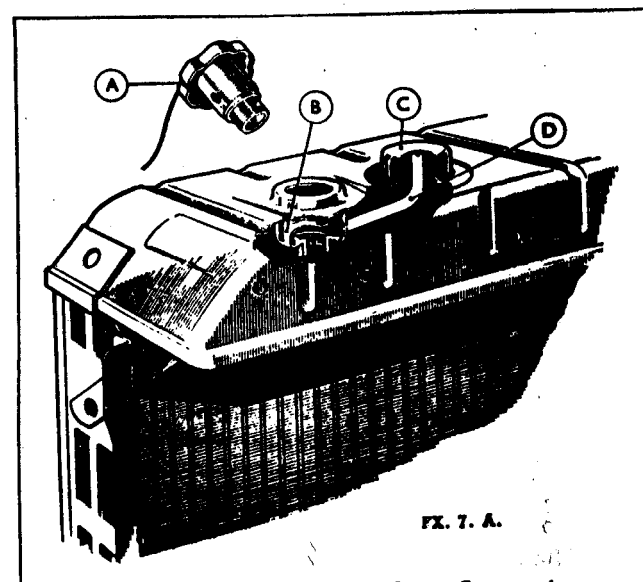


Fig. 2. The radiator filler and overflow system.

A. Filler cap; B. Filler plug well; C. Expansion chamber; D. Overflow pipe.

The Thermostat

In order to ensure maximum engine efficiency, it is essential to keep the engine operating temperatures within certain limits. To assist this, a Smith's bellows thermostat is fitted, being located in the water outlet at the front of the cylinder head. The device consists of metallic bellows, filled with a volatile liquid, which controls a mushroom valve. When the engine is cold this valve is closed, a by-pass being fitted to allow for slight circulation. On starting the engine the flow of water to the radiator will be temporarily restricted. Due to this the temperature of the water in the cylinder jackets will quickly rise, thus ensuring rapid warming up. The heat so generated will gradually expand the bellows so opening the valve, and ultimately permitting full flow to the radiator.

The thermostat itself is detachable ; therefore, should occasion arise, it can be removed from its housing and the hose reconnected to avoid laying up the car. Should the thermostat be tight there are two tapped holes on the top which may be utilised to ease it from the casting.

When the system has been completely emptied, it is essential to wait a minute or two after refilling

to allow air to escape through the thermostat valve and then finally top up.

The thermostat opening is set by the manufacturer and cannot be altered. It opens at a temperature of 65—70 deg. centigrade. During decarbonising it is policy to test this opening by immersing the thermostat in water raised to the requisite temperature. The valve should open under these conditions, but if it fails to open, a new unit should be fitted.

Overheating

Overheating may be caused by a slack fan belt, excessive carbon deposit in the cylinders, running with ignition too far retarded, improper carburetter adjustment, failure of the water to circulate, or loss of water.

Fan Belt Adjustment

The fan is driven by a 'V' belt from the crankshaft, this also driving the dynamo. A new belt can be fitted by first loosening the clamp bolts (A) Fig. 3, which hold the dynamo in position and moving the dynamo towards the engine. Slide the belt over the fan on to the fan pulley, the crankshaft pulley, and finally on to the dynamo pulley. Adjustment is then made by bringing the dynamo away from the engine. The belt should be sufficiently tight to prevent slip, yet it should be possible to move the belt laterally about one inch each way. As the drive is taken on the 'V' of the pulleys it is not necessary to have the fan belt tight ; to do so may cause excessive wear to the dynamo and water pump bearings. After the correct tension has been obtained, securely lock the dynamo in position again.

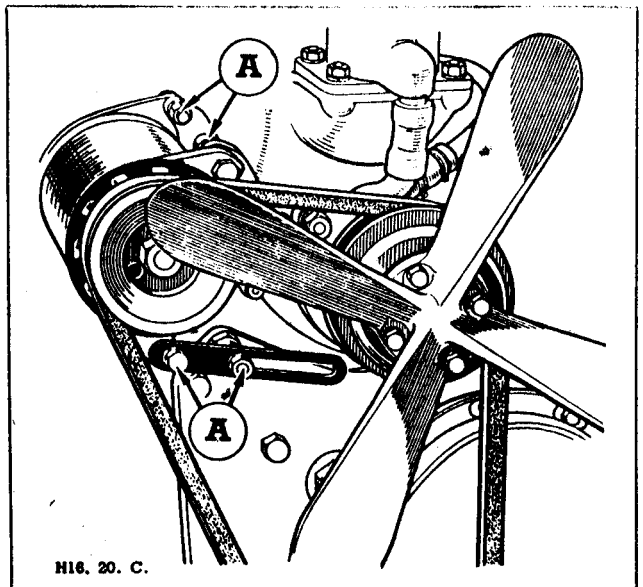


Fig. 3. The bolts indicated at 'A' are for fan belt adjustment.

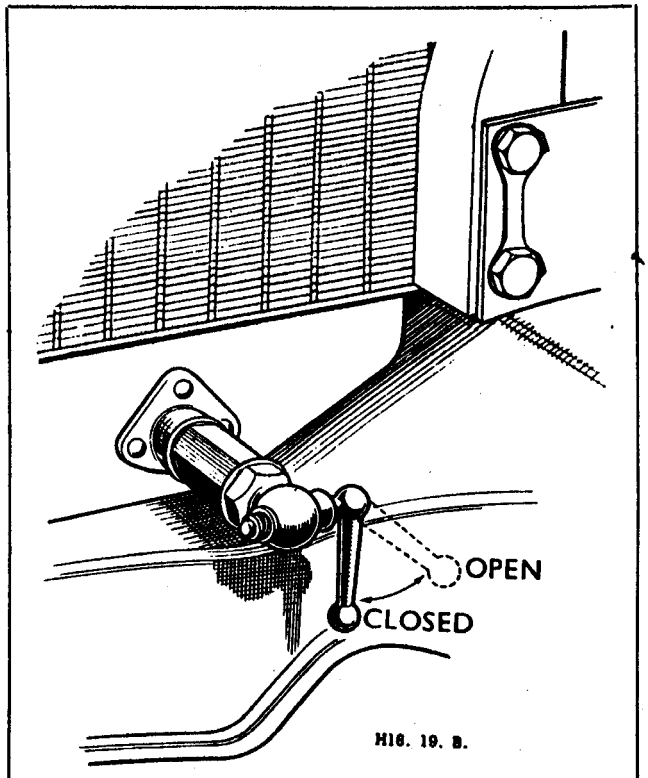


Fig. 4. The radiator drain tap is turned down for the closed position and turned up to open.

Frost Precautions

Care should be taken to see that the water is drained off completely, for in case of freezing, it will do harm by lodging in small places and fracture of the cylinder block may result. There are two drain taps, one of them on the off-side of cylinder block, and the other at the base of the radiator block. Both taps must be opened to drain the system and the vehicle must be on level ground while draining.

Freezing may occur first at the bottom of the radiator or in the lower hose connection. Ice in the hose will stop water circulation and may cause boiling.

A muff can be used to advantage, but care must be taken not to run with the muff fully closed, or boiling will result.

Vehicles with anti-freeze mixture in the cooling system should have an identification mark on the header tank of the radiator, under the bonnet, in the form of disc painted in a specified colour.

The following precautions are necessary on a vehicle so marked :—

1. When frost is expected or when the vehicles are to be used in a very low temperature, make sure that the strength of the solution is, in fact, up to strength ordered by the manufacturers.
2. The strength of the solution must be maintained by topping up with anti-freeze solution as necessary. Excessive topping with water reduces the degree of protection afforded. Solution must be made up in accordance with instructions supplied with the container.
3. Top up when system is cold.
4. If the cooling mixture has to be emptied, run the mixture into a clean container and use again.
5. If for any reason the mixture is lost and the system is filled with water only, remove the painted disc on the header tank.

Protection by Draining

On vehicles where anti-freeze is not used the following precautions must be taken during frosty weather to obviate any damage due to freezing of the cooling system.

When heavy frost is imminent, the cooling system must be completely drained. It is not sufficient merely to cover the radiator and engine with rugs or muffs. The drain taps should be tested at frequent intervals by inserting a piece of wire to ensure that they are clear. This should be done immediately the taps are opened, so that any obstruction freed by the wire may be flushed out by the water. The draining should be carried out when the engine is hot.

When completely drained the engine should be run for a timed minute to ensure that all water has been cleared from the system. A suitable notice should then be affixed to the radiator, indicating that the water has been drained. As an alternative, place the radiator filler cap on the driver's seat or leave the bonnet unlocked as a reminder to fill the cooling system before using the car again.

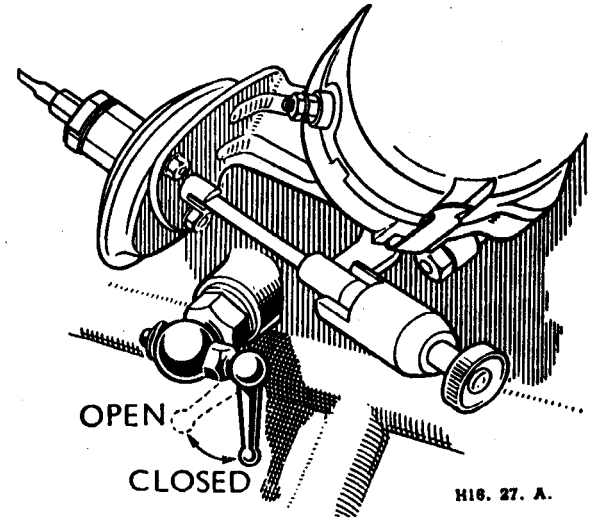


Fig. 5. The cylinder block drain tap showing the opened and closed positions.

To Flush the Radiator

If there is anti-freeze in the cooling system, obtain a receptacle large enough to hold the contents of the radiator and the engine, placing under the drain tap.

Remove the radiator filler cap and open the drain tap. (Turn the tap lever UP to open and DOWN to close.) On completion of the draining remove the receptacle and then proceed to flush the radiator from a hose or other supply of clean water.

WATER PUMP AND FAN

To Remove and Dismantle the Unit

Drain the water from the radiator. Remove the pump unit from the cylinder block by taking the nuts and spring washers from the three studs in front of the block, and disconnecting the lower hose, by-pass hose and the interior heater hose.

Remove the fan blades if necessary by withdrawing the four screws from the pulley.

To Remove the Pump Spindle

Remove the nut from the front end of the spindle, withdraw the fan pulley and take out the key.

While holding the pump body, the spindle can now be tapped out towards the rear, carrying with it the impeller, spring, and washers.

Bearings and Washers

The ball bearings, distance piece, steel and rubber washers have next to be removed from the body. First, prise out the spring retaining ring and remove the grease retaining ring; then, using a soft punch, tap out the first ball bearing, which will be followed by the tubular distance piece. The second ball bearing will require to be centralised in the body before it can be

tapped out in a similar manner to the first bearing. It will be followed by the grease retaining assembly, consisting of a dished steel washer, and a rubber seal.

The Sealing Ring Assembly

Removing the nut on the rear end of the spindle, will enable the impeller and key to be withdrawn, followed by the spring, metal cap washer, rubber washer and carbon sealing ring, the latter registers within the cap washer.

Reassembly

In reassembling, it is essential that the bearings, distance piece, and various washers, together with other parts be positioned correctly. Fig. 6 shows the correct order.

Lubrication

Lubricate sparingly with oil, using oil gun after removal of plug. (See Fig. 7).

To Refit the Unit

When refitting it is most important that the gland spring is holding the carbon seal against the pump body at a correct pressure.

This can be done by making sure that the gland spring is holding the carbon seal up against the shoulder on the spindle before inserting it in the pump body.

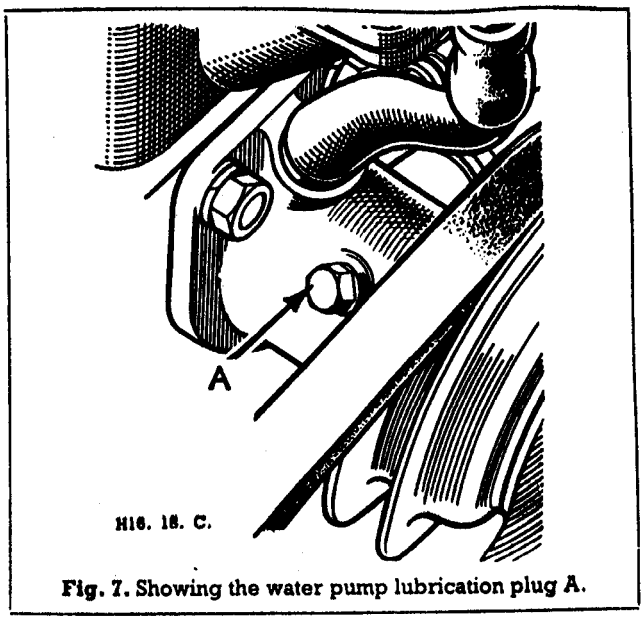


Fig. 7. Showing the water pump lubrication plug A.

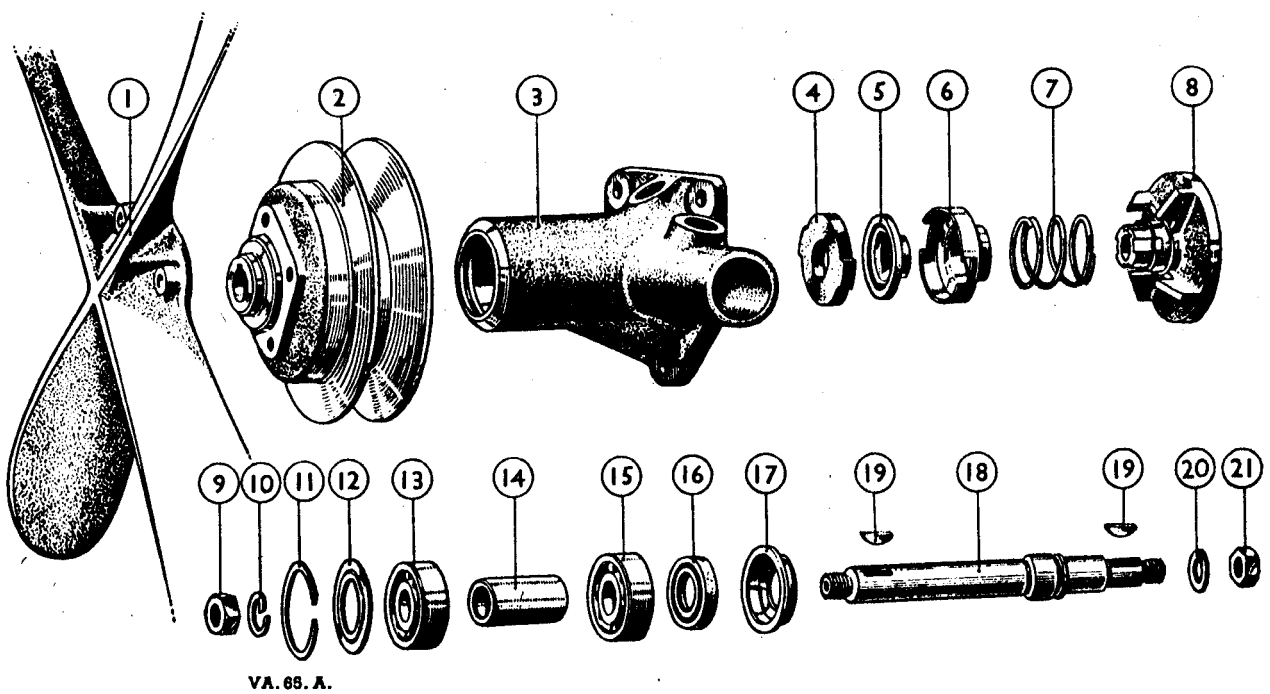


Fig. 6. Water pump assembly.

1. Fan.
2. Belt pulley.
3. Pump body.
4. Carbon ring.
5. Rubber seal.
6. Seal housing.
7. Spring.
8. Water impeller.
9. Spindle nut.
10. Washer.
11. Split ring.
12. Thrust plate.
13. Ball race.
14. Distance piece.
15. Ball race.
16. Rubber seal.
17. Seal cap.
18. Pump spindle.
19. Woodruff key.
20. Washer.
21. Spindle nut.

REMOVING THE RADIATOR

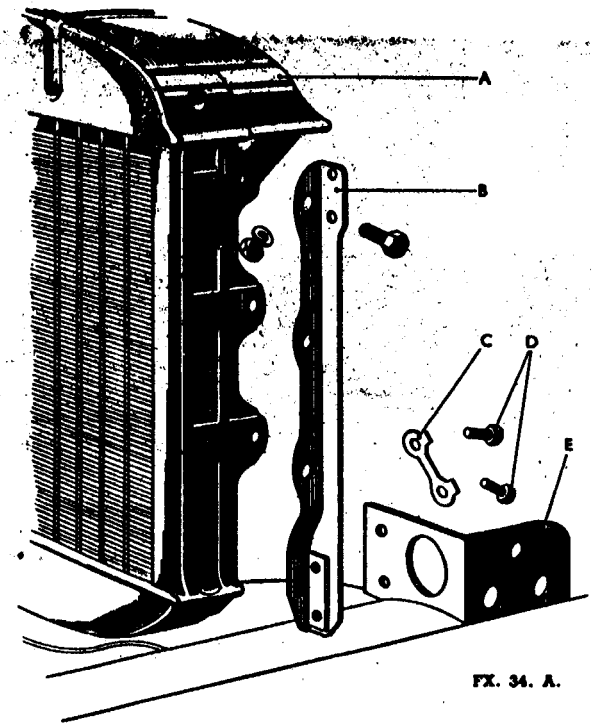


Fig. 8. The radiator and mounting frame.

A. Radiator.
B. Side supporting frame.
C. Lockwasher for frame setpins.
D. Frame setpins.
E. Chassis bracket for radiator frame.

The radiator is mounted to the chassis frame and body work by four setscrews and lockplates and four nuts, bolts and washers. Two of each either side.

For removal first drain the water from the system and then, from beneath the bonnet, release the upper water hose from the radiator header tank and the water pump. To effect this removal, slacken the hose clip screws at either end of the hose with the aid of a screwdriver, and then ease the rubber pipe off both the radiator and pump connections. In a similar manner release the lower water hose from the engine.

Next remove the bonnet by unscrewing the four $\frac{1}{4}$-in. bolts and nuts, two on either end of the centre rod hinges. Release the two bolts and nuts from either side of the radiator, knock back the tabs on the two lockplates and unscrew the four setscrews. The radiator may now be lifted clear of the car.

When replacing the radiator reverse the removal sequence of operations and top up with water or the requisite mixture of water and anti-freeze solution.

FUEL SYSTEM

ALTHOUGH the fuel systems of the Taxi and Hire Car are described here in detail, any measure of intricate servicing is best left to the expert.

The fuel tank capacity is 10 gallons. An A.C. petrol pump, operated by the engine camshaft, draws fuel from the tank via the copper fuel pipe clipped to the left-hand chassis side member and flexible pipe and forces it under pressure to the carburetter. Air to the carburetter is filtered by a large and efficient air cleaner.

A shut-off fuel cock mounted on the left-hand chassis side member and accessible beneath the bonnet is fitted to the taxi to comply with Metropolitan Police regulations.

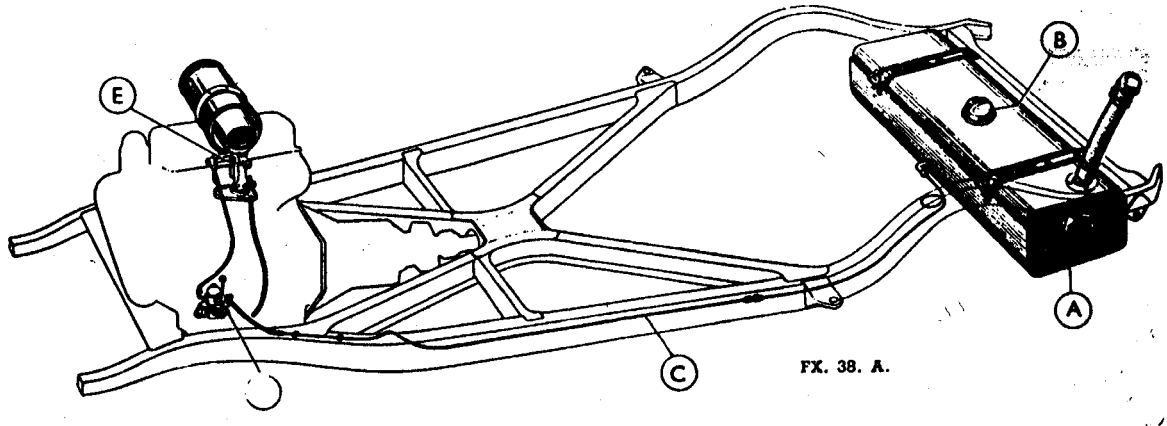


Fig. 1. The general layout of the Taxi fuel system.
A. Tank ; B. Tank gauge unit; C. Pipe line; D. Fuel pump; E. Carburetter.

THE PETROL TANK

Draining the Tank

The drain plug is positioned on the left-hand side in the bottom of the tank and is removed for draining.

Removing the Tank

The tank is carried in a trough between the two chassis side members and close to the rear cross member. It is secured in the trough by two channel arms that pass over the top of the tank to act as straps. These arms are secured back and front by a single nut and stud, the latter being rivetted to the trough.

The trough itself has two strong brackets rivetted to it at each side. Two bolts, the heads of which are brazed to a strip of metal, pass through each chassis side member and the trough brackets, when the whole assembly is held firmly in place by Simmonds self-locking nuts.

To remove the tank, the best policy to adopt is to lower the tank and trough assembly complete

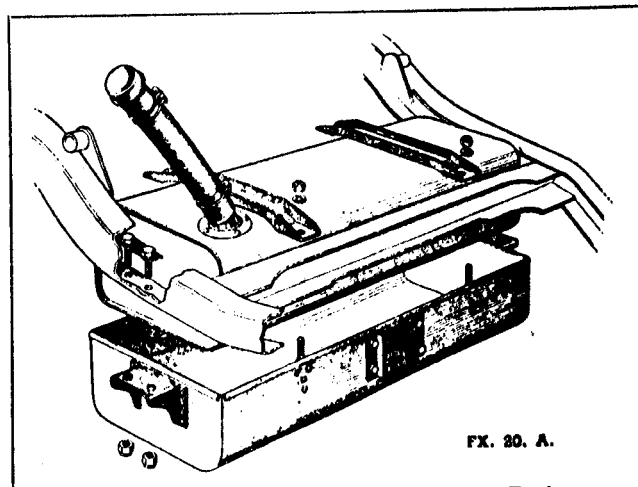


Fig. 2. The fuel tank and tray of the **Taxi**, showing methods of fitting.

from the chassis and withdraw it rearwards. To do this, first drain the tank and then disconnect the electrical lead from the tank gauge unit situated on the top face of the tank. Next, disconnect the fuel delivery pipe at its tank union (front face, left-hand side) and release the self-locking nuts beneath each trough bracket. The whole assembly may then be removed from beneath the vehicle when the tank straps can be freed and the tank lifted out of its trough.

Obviously tank replacement is a reversal of this procedure.

Petrol Tank Gauge Unit

The tank gauge unit is mounted on the top of the tank and can be removed complete by the withdrawal of the six retaining screws, but care must be taken not to bend or strain the float lever otherwise subsequent gauge readings may be seriously affected.

Great care must also be exercised when refitting the gauge unit. Ensure that the joint washer is in place and undamaged as it is essential that a petrol tight joint should be made between the tank and the gauge unit.

MANIFOLDS, THROTTLE LINKAGE AND AIR CLEANER

The Manifolds

To remove the inlet and exhaust manifolds it is necessary to disconnect the air cleaner, carburetter controls, petrol pipe, vacuum timing control pipe and exhaust down pipe.

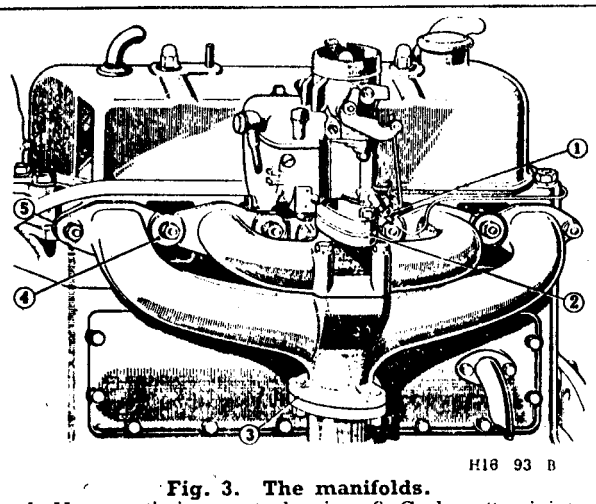


Fig. 3. The manifolds.
1. Vacuum timing control union; 2. Carburetter joint washer; 3. Exhaust pipe washer; 4. Manifold yoke washer; 5. Exhaust manifold washer.

Inlet and exhaust manifolds can be released as one unit after removing the nuts at six points, four of which bear on special clamp washers, the remaining two on the studs which pass through the flange on each end of the exhaust manifold. Detach the manifold washer and if damaged replace on reassembly.

It will be noticed that the induction and the exhaust manifolds are separate castings. At the point where they are joined, immediately below the carburetter flange, a special design of hot-spot is incorporated. The two castings are held in position by four setpins, together with a joint washer. Each manifold should be reassembled to the engine separately and then secured together.

Exhaust Pipe

The exhaust pipe is fitted in two parts; the down pipe being one unit and the silencer and tail pipe the other.

Three studs secure the down pipe to the manifold and a bracket stabilises it at the clutch housing/engine flange. The down pipe is taken rearwards on the left-hand side of the engine and gearbox, until, at the chassis central bracing and the propeller shaft tunnel, it crosses over to the right where it is bracketed to the right-hand diagonal chassis member. This rubber mounted bracket also serves as a clip to secure the down pipe and silencer together.

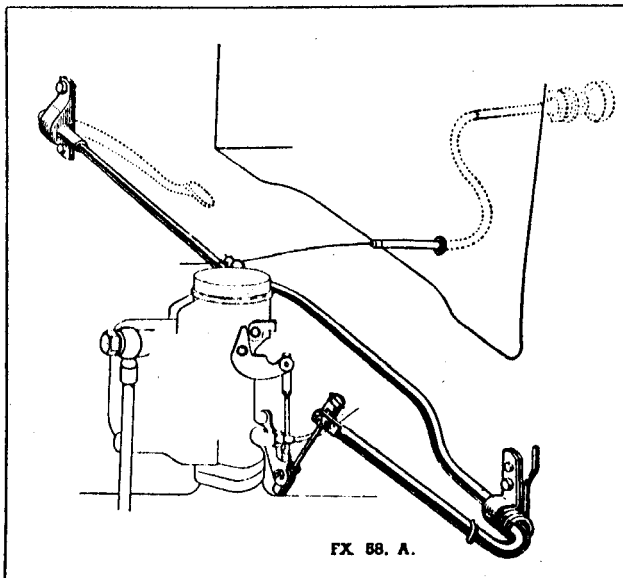


Fig. 4. The throttle layout and choke control of the Hire Car.

After passing beneath the axle the tail pipe is secured by two further brackets, the first of which anchors the pipe to the chassis rear cross member and the last of the brackets holds the tail pipe to the rear bumper arm.

To dismantle the tail pipe, release the rear bracket by withdrawing the bumper arm nut and bolt, then release the two nuts and bolts securing the pipe bracket to the chassis rear cross member.

At the front end of the silencer remove the two nuts and bolts that hold the pipe clip to the rubber mounted bracket and finally pull the tail pipe rearwards an amount sufficient to clear the down pipe. Lower the pipe to the ground.

The down pipe is released from its manifold studs and at the clutch bell housing for removal. If the tail pipe has not already been removed, release the diagonal member clip as previously described when the down pipe will become free of the chassis.

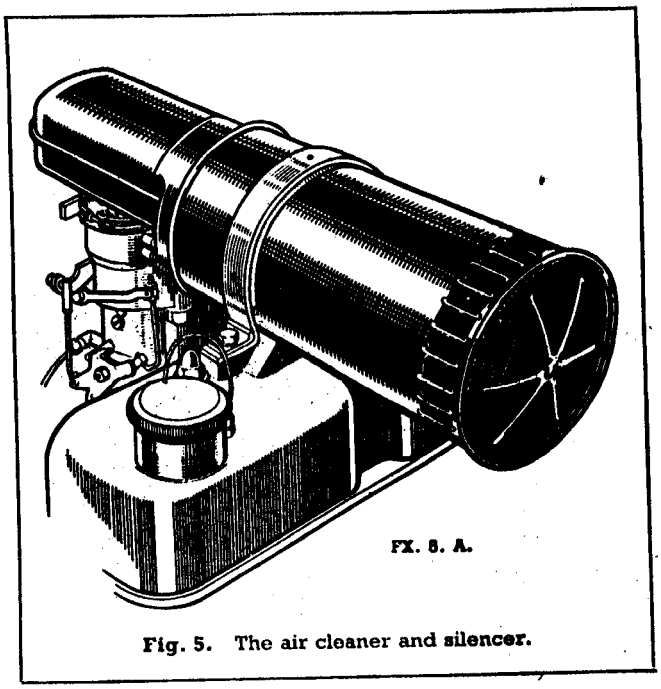


Fig. 5. The air cleaner and silencer.

Throttle Linkage

The accelerator shaft is carried in a bearing and support which are attached to the toe board of the body. The left-hand end of the accelerator shaft is cranked to meet a link rod. This link rod has a ball joint type of connector at each end, one end is attached to the accelerator shaft and the other is connected directly to the carburetter throttle.

The strangler control is a bowden type cable with a friction control knob on the instrument panel.

Air Cleaner

The air cleaner and silencer, as illustrated, is of the normal oil wetted type and apart from regular cleaning as described on page xiii, requires little or no attention.

THE TAXI 30 VM-6 CARBURETTER

Standard Settings

Choke tube	23
Main jet	95
Compensating jet	55
Slow running jet	50
Progression jet	100
Screw over C/well	3.0
Needle and seating	1.5 m/m.

The Zenith carburetter is of the downdraught type, embodying an economy device and also the well-known principles of main and compensating jets.

To comply with police regulations a tray is fitted beneath the carburetter to catch any petrol that may flood from the carburetter bowl. A drain pipe carries the excess fuel safely past the exhaust manifold, clear of the crankcase with its exit alongside the oil sump.

Starting

To start the engine from cold, the strangler control on the fascia panel is extended, which causes the strangler flap (1, fig. 8) to close off the air intake of the carburetter. The same action will cause the throttle to open slightly by means of the inter-connection rod (6).

With the ignition switched on the engine should now be turned over by means of the starter or by hand, but ensure that the accelerator is not touched.

Most of the depression caused by the rotation of the engine is now concentrated upon the slow running outlet (4), progression outlet (3) and

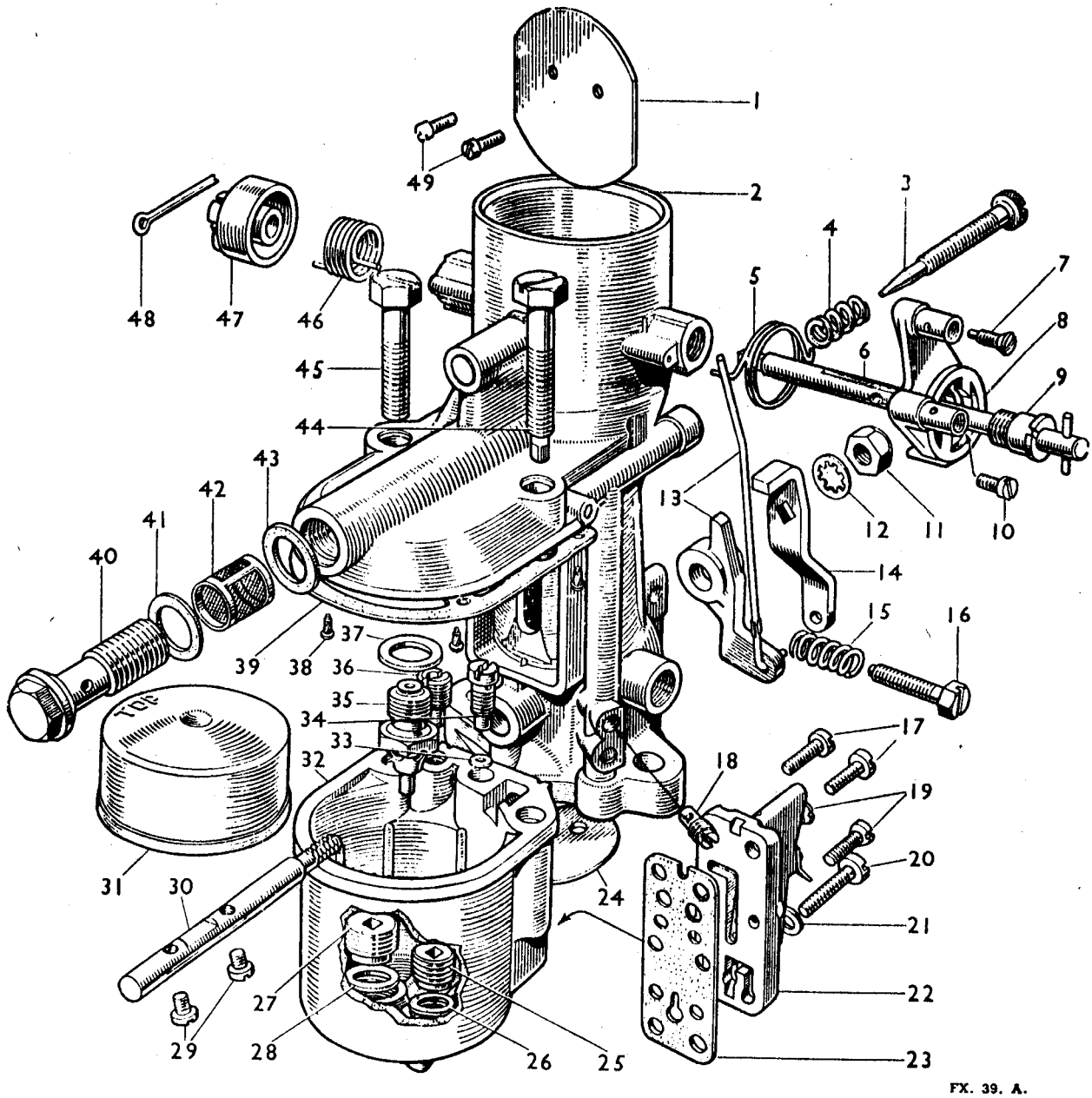
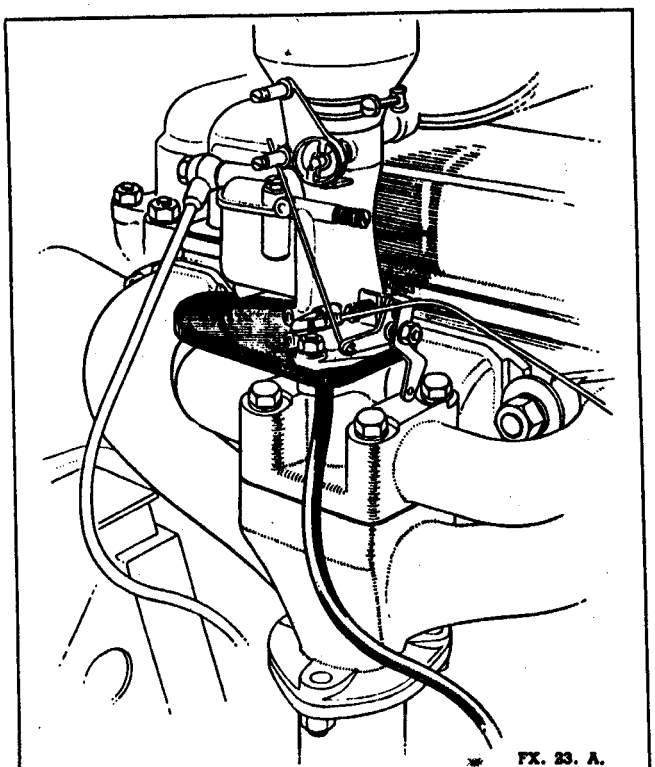


Fig. 6. Exploded view of the 30 VM-6 Carburetter.

1. Strangler flap.
2. Carburetter barrel.
3. Air regulating screw.
4. Air regulating screw spring.
5. Strangler lever spring.
6. Strangler spindle.
7. Screw for strangler lever swivel.
8. Strangler lever.
9. Bearing for strangler lever.
10. Screw for interconnection swivel.
11. Nut for throttle spindle.
12. Shakoproof washer.
13. Floating lever and interconnection rod assembly.
14. Throttle lever.
15. Spring for throttle stop screw.
16. Throttle stop screw.
17. Emulsion block screw.
18. Progression jet.
19. Emulsion block screw.
20. Emulsion block screw.
21. Washer.
22. Emulsion block.
23. Emulsion block joint washer.
24. Throttle.
25. Main jet.
26. Main jet washer.
27. Compensating jet.
28. Compensating jet washer.
29. Throttle fixing screw.
30. Throttle spindle.
31. Float.
32. Carburetter bowl.
33. Slow running jet washer.
34. Slow running jet.
35. Needle and seating.
36. Screw over capacity well.
37. Needle seating washer.
38. Joint washer fixing screw.
39. Joint washer.
40. Petrol pipe plug.
41. Fibre washer.
42. Filter gauze.
43. Fibre washer.
44. Bowl fixing screw (jet key type)
45. Bowl fixing screw (plain type)
46. Automatic spring.
47. Spring carrier.
48. Split pin.
49. Strangler flap screw.



FX. 23. A.

Fig. 7. The drip tray fitted beneath the Taxi carburetter.

upon the outlet (7) of the emulsion block. If the carburetter is not in a worn condition very little air enters at this stage and consequently the rich mixture as required for cold starting purposes is made available for the engine.

Immediately the engine fires a heavier depression will be created on the engine side of the strangler flap, and as this is held closed only by the tension of the automatic spring on the end of the extended spindle, the strangler flap (1) will open and close rapidly against the pulsations of the engine.

This will provide the weaker mixture and greater volume needed to ensure that the engine continues to run at a good speed until the normal working temperature is attained. At this stage the strangler control can be returned to its normal position on the fascia and the strangler flap will be fully open. As the engine warms to its work the strangler may be released gradually.

Working Description

Petrol enters the carburetter at the banjo union and passes through the gauze filter then on to the needle valve. Here it flows into the float chamber bowl, until a pre-arranged level has been attained, when the float rises and the float lever lifts the needle back to its seating and thereby cuts off the fuel supply.

With the engine running and the throttle closed down to the idling position, the mixture will be supplied from the slow running jet (5).

Depression will be concentrated on the outlet (4), and will in turn, be directed on to the slow running jet (5). Here there is a controlled depression fall because of the leak at the slow running air regulating screw (2).

Petrol will be drawn from the well (9) beneath the jet, and measured on passing through, before continuing to the throttle edge.

At the throttle edge there is a further outlet (3) which breaks into the slow running passage. Upon the throttle being opened from the idling position, depression will be concentrated here and a progressive getaway from slow running is assured.

Upon the throttle being opened still further the depression will be concentrated upon the nozzle (7) of the emulsion block which projects into the narrowest part of the choke tube. This will first result in the petrol being drawn from the passages (15, 12, 11 and 18), as there must be a steady reserve of petrol available for instantaneous acceleration.

The source of petrol supply is eventually through the main and compensating jets (14 and 13). It will be observed that the petrol in the well (15) has been consumed, and as the top of the well is open to the atmosphere, petrol issuing from the compensating jet along the passage (11) is now under atmospheric pressure. As a result, petrol drawn from the jet will be broken up by air from the capacity tube. Petrol issuing from the main jet (14), along the passage (12), will meet the emulsified petrol from the compensating jet in the common channel (8). This will also tend to break up the petrol from the main jet. The supply from both sources will then be drawn from the emulsion block nozzle into the choke tube.

It will be realised that as soon as the petrol in the float chamber falls below the predetermined level, the float will fall, permitting the needle (17) to drop, when petrol will pass into the chamber through the seating (18).

Adjustments

Slow running is adjusted by means of the throttle stop screw (10) and the air regulating screw (2). The stop screw determines the speed of the slow running, i.e., it adjusts the throttle position for idling. To increase the slow running

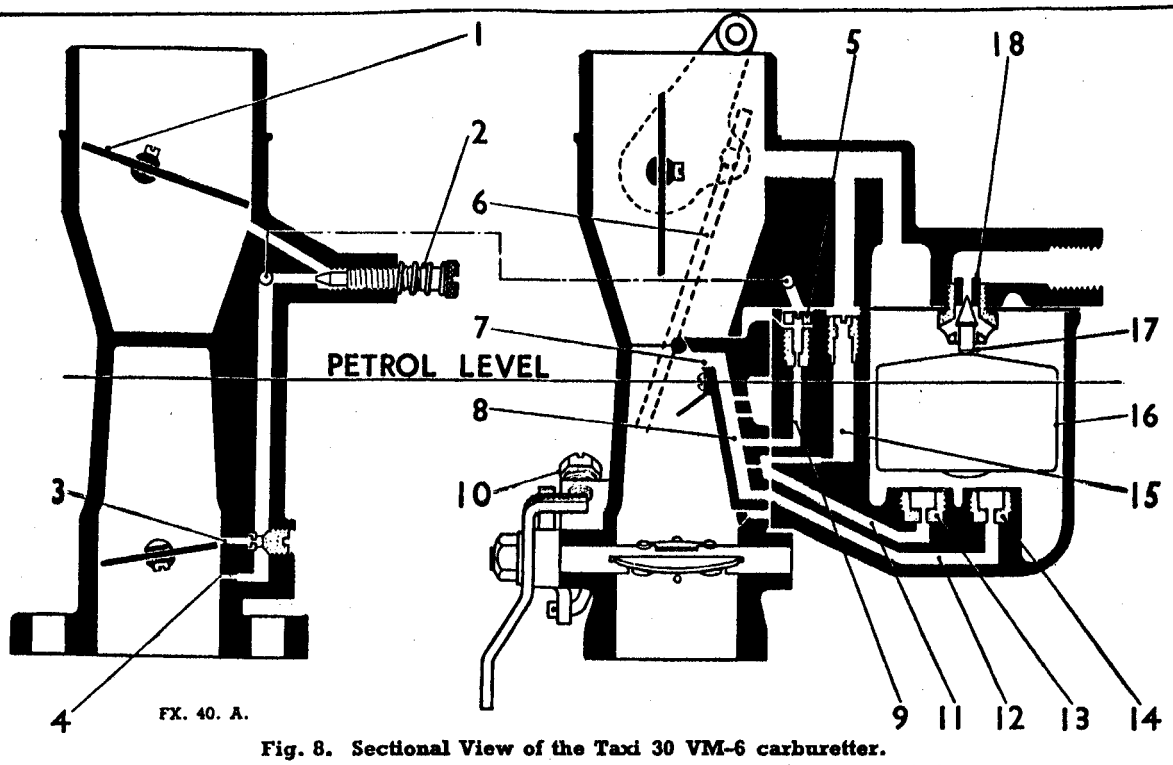


Fig. 8. Sectional View of the Taxi 30 VM-6 carburetter.

1. Strangler flap.
2. Air regulating screw.
3. Progression channel.
4. Slow running channel.
5. Slow running jet.
6. Throttle to strangler interconnection.
7. Emulsion block beak.
8. Emulsion block.
9. Slow running channel.
10. Throttle stop screw.
11. Compensating jet channel.
12. Main jet channel.
13. Compensating jet.
14. Main jet.
15. Capacity well.
16. Float.
17. Needle.
18. Needle seating.

speed the stop screw must be turned in a clockwise direction. If turned with the opposite rotation a slower 'tick-over' will be given. If the engine is inclined to 'hunt' when running slowly, the mixture is too rich and must be weakened by turning the air regulating screw in an anti-clockwise direction. This will cause a reduced depression upon the slow running jet and result in reduced output from this part.

Should weakness at slow running speeds be suspected, then the air adjustment screw must be turned in a clockwise direction. This will reduce the air leak at the screw and give a greater depression upon the slow running jet.

When the carburetter is worn it will be impossible to obtain good slow running, but it must be remembered that there are other factors, quite apart from the carburetter, that have an influence upon slow running; i.e., slow running when the engine is out of gear. These factors include non-airtight joints, worn valve guides, valves not seating, ignition over advanced, incorrect setting of sparking plug points, etc.

General Maintenance

To remove the bowl of the carburetter take out the fixing bolts. It will then be found that the main and compensating jets inside the bowl of the carburetter have squared recesses into which the squared end of one of the fixing bolts can be inserted in order to remove the jets.

Do not pass anything through the drillings of the carburetter or the jets that is likely to damage these parts. The safest way of clearing obstruction is to swill in petrol and clear with air pressure.

Inspect periodically the screws of the emulsion block, the needle seating and the jets, etc., for tightness.

THE HIRE CAR CARBURETTER

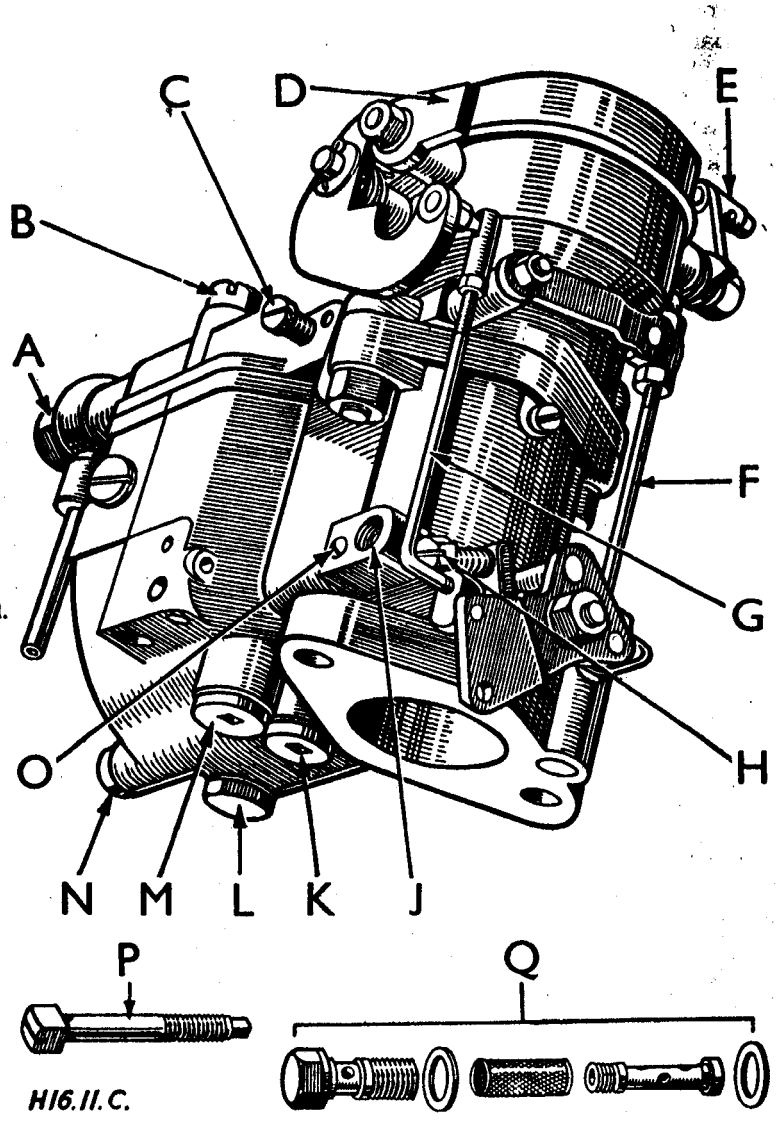


Fig. 9. Zenith downdraught pump type carburetter.

A. Inlet union.
B. Float chamber securing screw.
C. Air regulator screw.
D. Choke control spindle cam.
E. Choke control.
F. Connector rod.
G. Throttle connecting link.
H. Slow running adjuster.
J. Connection for the vacuum timing control.
K. Main jet.
L. Economy device plug.
M. Compensating jet.
N. Economy jet.
O. Progression jet.
P. Float chamber securing screw with squared end for removing jets.
Q. Components of the inlet union.

The carburetter is of Zenith downdraught manufacture, Type 42 VI–8, which embodies an accelerating pump and economy device. A fully automatic strangler flap interconnected with the throttle also incorporated for starting purposes.

This strangler promotes rapid warming up after the initial engine firing has been obtained.

Standard Settings

Main jet		120
Compensating jet		105
Slow running jet		55
Economy jet		145
Choke tube	2nd bar	31
Capacity tube		2.5

Working Description

Petrol enters the carburetter at the union 15, see fig. 10, and, passing through a gauze filter 18 reaches the needle seating 12. Unless the float 16 is already lifted against the needle by petrol in the float chamber 17, the petrol will continue its course past the needle into the float chamber. It continues to flow until the various passages are filled and the petrol reaches a pre-determined level at which the float contacts the needle,

pushing it on to its seating, and thus shutting off the flow of petrol and so preventing the carburetter from flooding.

Petrol will have entered the passage 3 in the base of the bowl by passing through the outlet 1 and the economy jet 2. It will then pass through the main jet 6 into the main channel 11 in the emulsion block 10. Here it will remain at the pre-determined height, which is just below the emulsion block outlet.

The petrol will have also passed through to the compensating jet 4. From the compensating jet the fuel passes along the passage above it and joins the petrol from the main jet in the common channel 11.

From the main channel in the emulsion block petrol will pass into the slow running jet drilling via the passage 8. Similarly the well of the capacity tube 9, which is integrally cast in the float chamber, will be filled to the petrol level by the fuel flowing from the emulsion block.

As long as there is a supply of petrol from the tank or pump, the fuel will occupy the position described, whilst the engine is stationary.

Starting

In starting from cold, the strangler control on the instrument board should be pulled outwards; this will result in the strangler flap 19 closing the air intake of the carburetter. A cam 20 on the end of the strangler spindle will at the same time cause the connecting link 22 to lift and open the throttle slightly, thus ensuring sufficient volume and richness being obtained to give instant starting when the engine is turned over with the ignition switched on. A rich mixture is necessary purely to obtain initial firing. Weaker mixture and greater volume is now necessary. The strangler flap is free to move on the spindle and is only held closed by the spring on the spindle. Immediately the engine fires its speed will increase, thus creating extra depression or suction on the lower side of the strangler flap, sufficient to break down the tension of the spring holding the flap closed. This will cause the flap to open progressively and so admit air, thus giving the necessary weakening effect to the fuel and providing greater volume.

Once the initial firing has been obtained the automatic strangler provides a more normal mixture and causes the engine to run at a speed which prompts rapid warming up and efficient oil fling, thereby minimising cylinder wear.

If necessary the engine can be driven away immediately with the strangler still in action. It is advisable, however, to return the strangler control to the inoperative position as soon as the engine temperature is sufficient to allow the main carburetter only to be used.

The Main Carburetter

When running on the main carburetter with the throttle closed down to the idling position, the mixture will be supplied from the slow running jet 13.

With the strangler out of action and the throttle just slightly open, the depression will be concentrated on the outlet 26, which will in turn be directed on the slow running jet 13. Consequently petrol will be drawn from the well beneath the jet, measured on passing through, which will meet air entering at the base of the adjustment screw 21. The amount of air mixing with the petrol from the slow running jet is controlled by this screw.

At the throttle edge there is a further outlet 25 which breaks into the slow running passage. Upon the throttle being opened from the idling position, this will give an additional mixture to ensure progressive get-away from slow-running; this explains the title 'progression jet' for the jet situated at 24.

Further opening of the throttle will cause the depression to be concentrated on the nozzle of the emulsion block which projects into the narrowest part of the choke tube 27. This results in petrol being drawn from the passages 11, 7, and 8, so that the source of petrol supply is eventually through the main jet and compensating jets. It will be observed that petrol in the well of the capacity tube 9 has been consumed, and as the top of the well is open to the atmosphere, petrol issuing from the main and compensating jet is now under atmospheric pressure. As a result petrol drawn from the jets will be broken up in the main channel 11 by air from the capacity tube. This mixture will then be drawn from the emulsion block nozzle into the choke tube.

It is essential that this mixture should be distributed completely across the choke tube in all directions. To obtain this even distribution, a small circular bar has been integrally cast across the choke tube at right angles to the emulsion block nozzle, with a further short circular bar at right angles to it.

The inrush of air from the intake of the carburetter will strike these two bars and so create a vacuum on the sides facing the engine. The petrol air mixture leaving the emulsion block will run along the bars, filling up the vacuum and

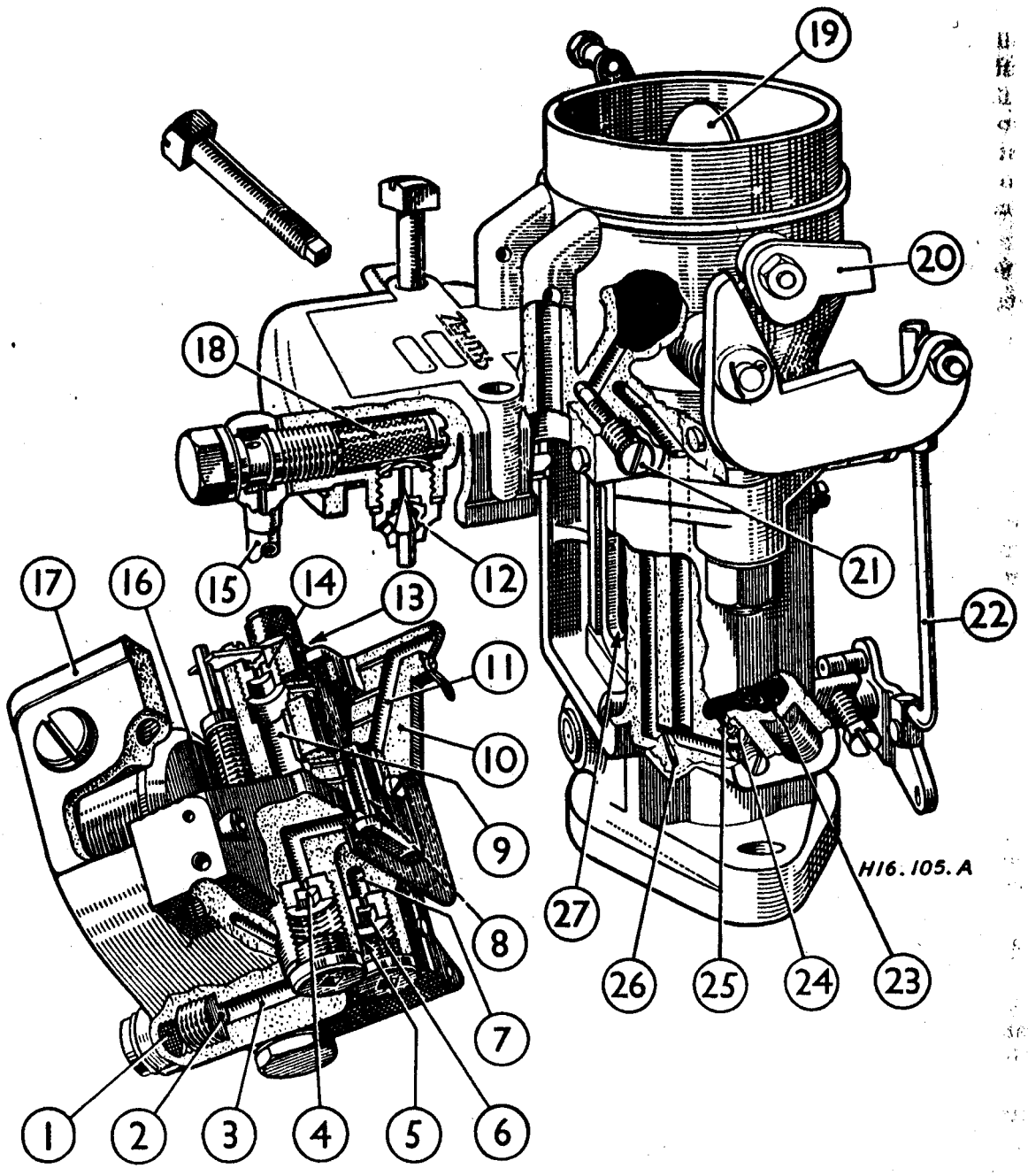


Fig. 10. A sectional view of the Zenith carburetter.

1. Float chamber outlet.
2. Economy jet.
3. Passage to main jet.
4. Compensating jet.
5. Main jet screw.
6. Main jet.
7. Main jet outlet.
8. Passage to slow running jet.
9. Capacity tube.
10. Emulsion block.
11. Main channel.
12. Needle seat.
13. Slow running jet.
14. Securing screw for accelerator piston.
15. Inlet union.
16. Float.
17. Float chamber.
18. Gauze filter.
19. Strangler flap.
20. Strangler cam.
21. Slow running adjuster.
22. Connecting link.
23. Outlet for vacuum timing control.
24. Progression jet.
25. Inlet to slow running chamber.
26. Depression outlet.
27. Choke tube.

then proceed past the throttle valve into the induction pipe.

It will be realised that as soon as the petrol in the float chamber falls below the predetermined level, the float will fall so allowing the needle valve to open, thus a controlled flow of petrol to the float chamber is assured.

The outlet shown at 23 is for the vacuum timing control union.

Pump and Economy Device

To ensure powerful acceleration without detrimental effect to consumption figures, an accelerating pump and economy device is incorporated in the bowl of the carburetter. This device is operated by means of an interconnection between the throttle and the plunger of the pump. As the throttle is operated, so will the pump come into action automatically. The movement of the throttle is transferred by means of an inter-connection mechanism to the top of the pump piston. The arm forces down the piston against the action of the outer spring 21, see Fig. 11. This will depress the inner piston 16, and the plunger will be forced down by the inside spring 15. The petrol, in the chamber 12, will be forced through the outlet 11, along the passage 9, up channel 13, through the pump jet 17, and so from the emulsion block nozzle into the choke tube.

A leak is provided for any excessive petrol from the pump. The outlet for this from the pump chamber is at 6. This excess petrol will pass the ball valve 5, and return to the float chamber of the carburetter through outlet 27.

Upon the throttle being closed, the outer spring 21 will force the piston back to its top or inoperative position. This will cause petrol to be drawn into the top of the fixing stud 30, where a small dome filter is placed, and through the outlet hole 1 at the stud base. At this point petrol passes through another filter, and along the passage 2. The ball valve 3 will be lifted, and the petrol will continue its course round the valve and along the channel, through 9, into the pump chamber 12.

It will be realised that the ball valve 10 will fall back on to its seating by reason of its own weight, and thus prevent petrol returning to the bowl through the inlet passages. Similarly, the ball valve 5 prevents the pump leak becoming an inlet channel. Another ball valve is situated at 18, near the pump jet. When petrol is pumped up the channel 13 it will push this ball valve against the air inlet 19, and prevent petrol escaping through this. The air leak at 19 is to ensure that petrol will not be taken from the pump circuit at any time other than during the accelerating period.

Referring now to the economy device, it will be appreciated that the full effect of the main jet is only required during the last part of the throttle movement. With this in mind the main jet is restricted until the economy device is brought into action. An extension on the top plate 22 of the pump strikes the shoulder 24 of the economy device on the last part of its downward stroke. This causes the valve 29 to be moved off its seating and petrol will enter immediately from the float chamber at 28, flow past the valve 29 through the opening 4, and so into the main jet channel 7. Thus the economy jet is by-passed, and the full effect of the main jet is obtained.

As soon as the throttle commences to close, the top plate 22 will rise and the valve 29 will return to its seating against the action of the spring 25. From then on the supply of petrol to the main jet is once more regulated by passing first through the economy jet.

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, timing of ignition, 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. (Economy note : petrol in the bowl can be emptied back into the tank.)

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.

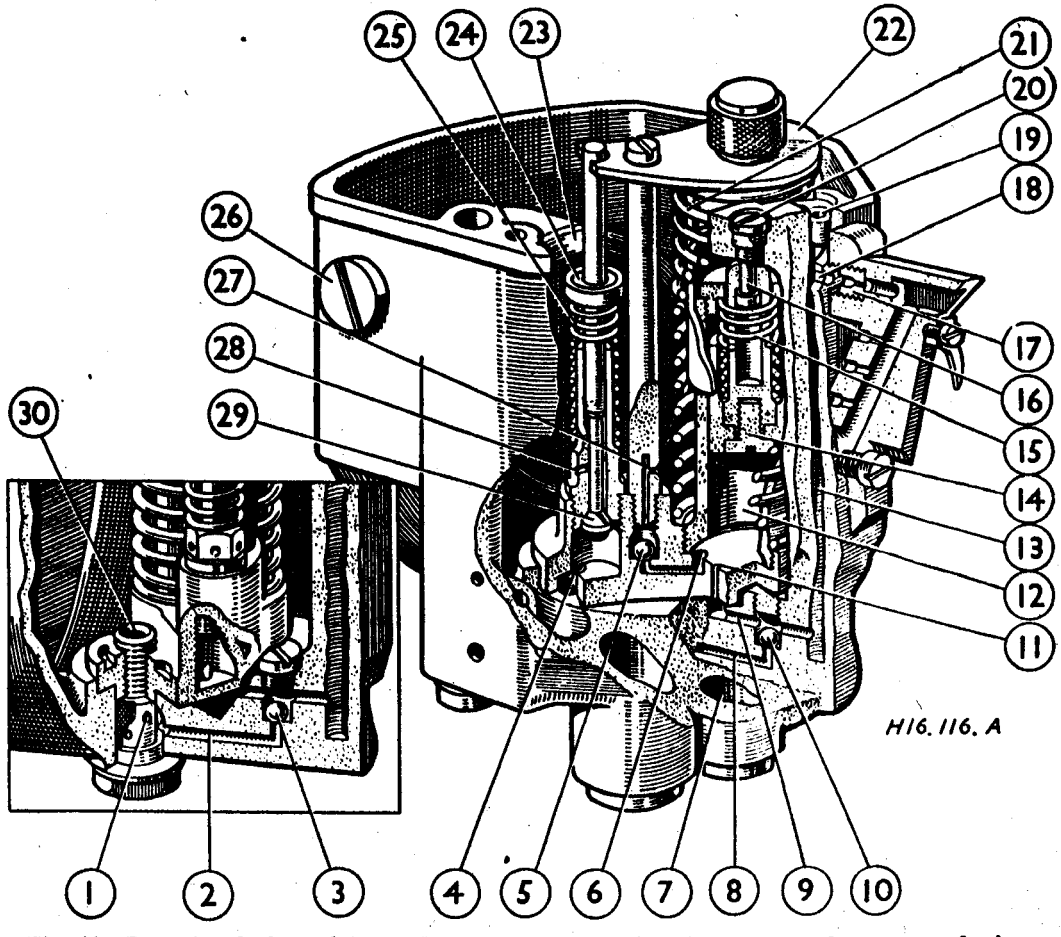


Fig. 11. A sectional view of the carburetter bowl showing the pump and economy device.

1. Outlet hole.
2. Outlet passage.
3. Ball valve.
4. Valve opening.
5. Ball valve.
6. Outlet for excess fuel.
7. Main jet channel.
8. Outlet passage.
9. Pump inlet passage.
10. Ball valve.
11. Pump inlet.
12. Pump chamber.
13. Channel to pump jet.
14. Piston chamber locating screw.
15. Inner piston spring.
16. Inner piston.
17. Pump jet.
18. Ball valve.
19. Air inlet.
20. Slow running jet.
21. Piston spring.
22. Top plate.
23. Float.
24. Economy device.
25. Spring.
26. Float securing screw.
27. Outlet to float chamber.
28. Inlet from float chamber.
29. Economy valve.
30. Fixing stud.

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 screw-driver slot to enable it to be removed. This applies also to the screw in the capacity tube.

The Float

If there have been signs of flooding the float may be suspected. To remove the float release the large-headed screw 26 (Fig. 11). Immerse in boiling water, when rising bubbles will indicate the exact location of the 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.

The Emulsion Block

The emulsion block is held to the side of the bowl by three 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 three 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 20 (Fig. 11) may be choked and should be cleaned. After examination, re-set 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 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 full 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 air-tight joints, worn valve guides, valves not seating, 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.

The Filter

Petrol is filtered on entering the carburetter and the gauze (18, Fig. 10) 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 car 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 to Service Department, or the Zenith Carburetter Co., Ltd., Honeypot Lane, Stanmore, Middlesex.

THE FUEL PUMP

Type and Description

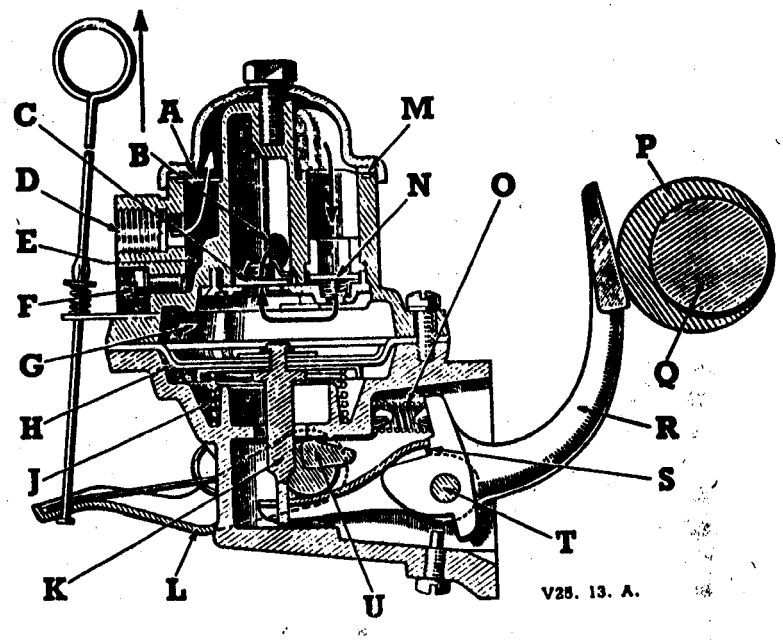
The A.C.-Sphinx Fuel Pump, Type 'T', is operated mechanically from an eccentric othen engine camshaft. The normal working pressure being $1\frac{1}{2}$ to $2\frac{1}{4}$ lbs. per square inch. A clear impression of the working parts is given in Fig. 14.

Method of Operation

As the engine camshaft 'Q' revolves (Fig 12) the eccentric 'P' lifts the pump rocker arm 'R' pivoted at 'T' which pulls the pull rod 'K' together with the diaphragm 'H' downward against spring pressure 'J', thus creating a vacuum in the pump chamber 'G.'

Fig. 12. A sectional view of the fuel pump.

A. Filter gauze.
B. Delivery port.
C. Delivery valve.
D. Inlet union.
E. Sediment chamber.
F. Sediment drain plug.
G. Pump chamber.
H. Diaphragm.
J. Diaphragm spring.
K. Diaphragm pull rod.
L. Priming lever.
M. Cork sealing washer.
N. Suction valve.
O. Anti-rattle spring.
P. Camshaft eccentric.
Q. Camshaft.
R. Rocker arm.
S. Connecting link.
T. Rocker arm pivot.
U. Priming lever.



Petrol is drawn from the tank and enters at 'D' into the sediment chamber 'E' through the filter gauze 'A,' suction valve 'N' into the pump chamber 'G.' On the return stroke the spring pressure 'J' pushes the diaphragm 'H' upwards, forcing petrol from the chamber 'G' through the delivery valve 'C' and opening 'B' to the carburetter.

When the carburetter bowl is full the float will shut the needle valve, thus preventing any flow of petrol from the pump chamber 'G.' This will hold the diaphragm 'H' downward against the spring pressure 'J' and it will remain in this position until the carburetter requires further petrol and the needle valve opens. The rocker arm 'R' operates the connecting link by making contact at 'S' and this construction allows idling movement of the rocker arm when there is no movement of the fuel pump diaphragm.

Spring 'O' keeps the rocker arm 'R' in constant contact with eccentric 'P' to eliminate noise. The hand priming lever is indicated at 'L' and the sediment drain plug at 'F.'

Cleaning the Filter

The filter (see Fig. 13) should be examined every 1,000 miles and cleaned if necessary. Under extreme conditions of dust-laden atmosphere this mileage interval should be reduced as conditions dictate.

Access to the filter is gained by removing the dome cover, after unscrewing the retaining screw, when the filter gauze itself may be lifted

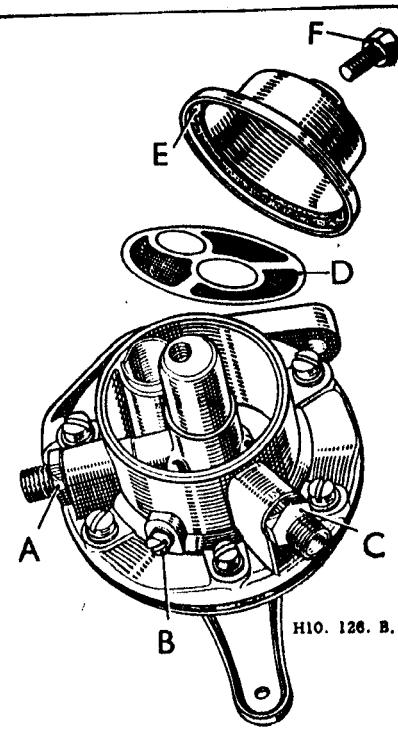


Fig. 13. The pump cap exploded.

A. Outlet union.
B. Drain plug.
C. Inlet union.
D. Filter gauze.
E. Cork seal.
F. Cover screw.

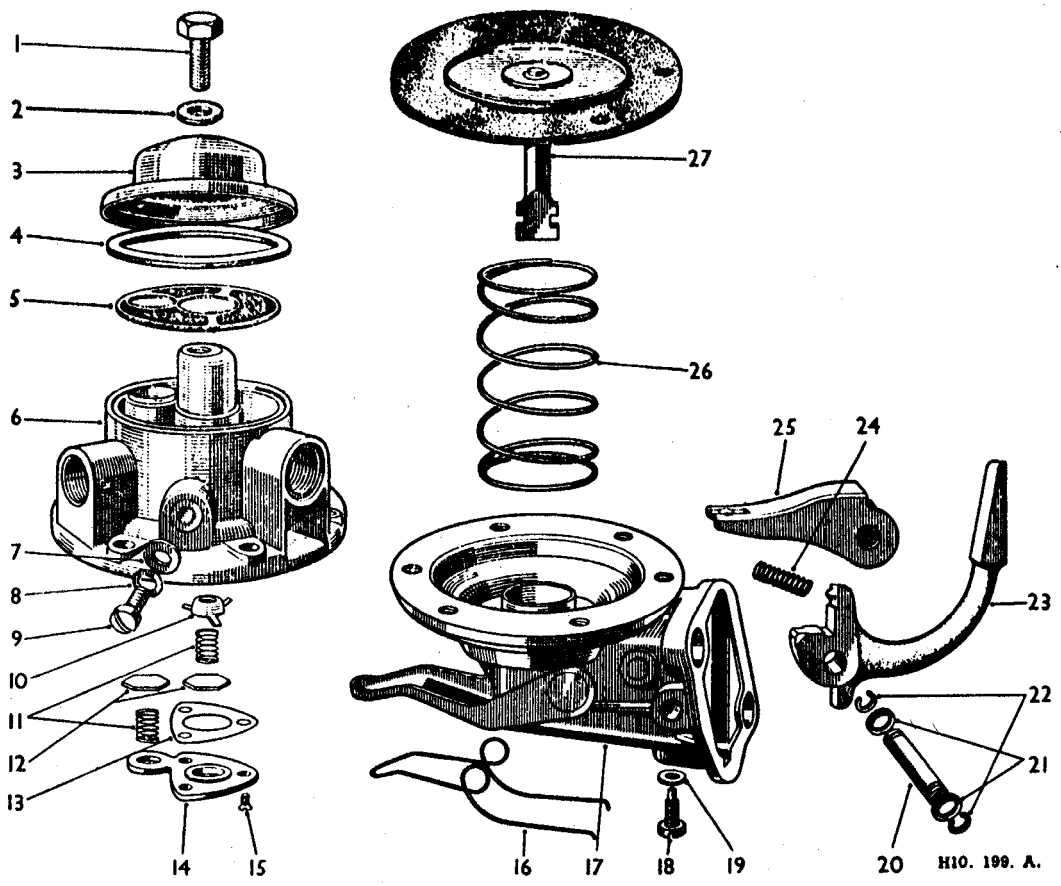


Fig. 14. The fuel pump parts exploded.

1. Top cover screw.
2. Cover screw washer
3. Pump top cover.
4. Cork seal.
5. Filter gauze.
6. Upper chamber.
7. Drain plug joint washer.
8. Drain plug washer.
9. Drain plug.
10. Spring retainer.
11. Valve springs.
12. Valves.
13. Valve plate washer.
14. Valve retainer plate.
15. Valve plate screw.
16. Priming lever spring.
17. Lower casting.
18. Rocker arm stop screw.
19. Stop screw washer.
20. Rocker arm pin.
21. Rocker pin washers.
22. Rocker arm pin clips.
23. Rocker arm.
24. Anti-rattle spring.
25. Rocker link.
26. Diaphragm spring.
27. Diaphragm and pull rod.

off its seating. Remove the drain plug and clean out the sediment chamber. Clean the filter gauze in air jet with petrol.

The cork washer under the filter cover should be renewed if broken or if it has hardened.

When refitting the cover, make certain that the fibre washer is replaced under the head of the screw. Tighten the filter cover retaining screw just sufficiently to make a petrol-tight joint. Over-tightening will either destroy the cork washer, crack the cover, or fracture the main casting.

Check the pump to crankcase mounting bolts for tightness; also check the petrol pipe unions.

Testing while on the Engine

With the engine stopped and switched off, the pipe to the carburetter should be disconnected at the carburetter end, leaving a free outlet from the pump. The engine can then be turned over by hand, when there should be a well defined spurt of petrol at every working stroke of the pump, namely, once every two revolutions of the engine.

Removing from the Engine

Firstly, the pipe unions should be disconnected; the two nuts fixing the fuel pump to the engine crankcase should then be unscrewed, after which the fuel pump will come away readily.

Dismantling the Fuel Pump

Before commencing to dismantle, clean the exterior of the pump and make a file-mark across the two flanges for guidance to facilitate re-assembly in the correct relative positions. After separating the two main castings, dismantling of the remaining components associated with each, is quite straightforward. The diaphragm and pull rod assembly can be withdrawn by first of all turning it through 90° (see Fig. 15). No attempt should be made to separate the four diaphragm layers from their protector washers and pull rod, as this is, at all times, serviced as a complete assembly, being permanently riveted together.

Inspection of Parts

Firstly, all parts (see Fig. 14) must be thoroughly cleaned to ascertain their condition. Wash all parts in the locality of the valves in a clean paraffin bath separate from that employed for the other and dirtier components.

Diaphragm and pull rod assemblies should normally be renewed unless in entirely sound condition, without signs of cracks or hardening.

Upper and lower castings should be examined for cracks or damage, and if the diaphragm or engine mounting flanges are distorted these should be lapped to restore their flatness. Where the hand priming lever, incorporated in the lower casting is broken, the parts should be renewed, the outer end of the spindle being riveted over by hand tools after correctly locating the various components.

All badly worn parts should be renewed, and very little wear should be tolerated on the rocker arm pins (20), the holes and engagement slots in the links (25), holes in the rocker arms (23). On the working surface of the rocker arm which engages with the camshaft eccentric, slight wear is permissible, but not exceeding .010in. depth. The valve seat incorporated in the valve plate (14) should be examined and if at all roughened should be carefully lapped flat on a smooth carborundum stone; similarly, the corresponding outlet valve seat incorporated in the upper-casting (6) should be examined and if worn unevenly to the slightest degree, both the upper casting and valve seat assembly must be renewed. It is not practicable to refit new valve seats into the castings as this calls for special equipment.

Fuel pump valves (12) should be renewed if at all worn, although in an emergency they can be turned over to provide a fresh surface to the valve seat. Valve springs (11) should preferably be renewed, although they can be refitted providing they do not bear undue evidence of rubbing away on the outside diameter. In no circumstances should valve springs be stretched in an endeavour to increase their strength. Diaphragm springs (26) seldom call for replacement but where necessary, ensure that the replacement spring has the same identification colour and consequently the same strength as the original. Rocker arm springs (24) are occasionally found to be broken after service. All joint washers should be renewed.

Re-assembling the Fuel Pump

The following procedure should be adopted dealing with the upper portion of the pump first:

Place the outlet valve spring retainer (10) in the pump upper casting (this retainer is the small three-legged pressing which retains the outlet valve spring), taking care not to distort the legs.

Place the valve plate washer (13) in position.

Valves should be swilled in clean paraffin before re-assembly. Apart from the cleaning effect, this improves the sealing between the valve and seat.

Place the outlet valve (12) on the spring.

Place the inlet valve (12) on the valve seat located in the upper casting.

Place the valve spring (11) on the centre of the inlet valve.

Place the valve plate (14) in position and secure with the three screws (15). (The inlet valve spring must be centred properly in the spring seat formed in the valve plate).

Place the filter gauze (5) in position on top of the casting, making certain that it fits snugly.

Fit the cork washer cover, fibre washer, and retaining screw as previously detailed under 'Cleaning Filter' and detailed on page C/13.

To assemble the lower half of the pump, proceed as follows:—

Assemble link (25), packing washers (21), rocker arm (23), and rocker arm spring (24) in the body (17).

Insert the rocker arm pin (20) through the hole in the body, at the same time engaging the packing washers, link, and the rocker arm; then spring the retaining clips into the grooves on each end of the rocker arm pin.

The rocker arm pin should be a tap fit in the body, and if due to wear it is freer than this, the ends of the holes in the body should be burred over slightly.

Note. The fitting of the rocker arm pin can be simplified by first inserting a piece of .240-in.

diameter rod through the pin hole in one side of the body far enough to engage the rocker arm washers and link, and then pushing the rocker arm pin in from the opposite side, removing the temporary rod as the pin takes up its proper position.

To fit the diaphragm assembly to the pump body:—

Place the diaphragm spring (26) in position in the pump body.

Place the diaphragm assembly (27) over the spring, the pull rod being downwards, and centre the upper end of the spring in the lower protector washer.

Press downwards on the diaphragm at the same time turning the assembly to the left in such a manner that the slots on the pull rod will engage the fork in the link, ultimately turning the assembly a complete quarter turn to the left. This will place the pull rod in the proper working position in the link, and at the same time permit the matching up of the holes in the diaphragm with those on the pump body flanges.

When first inserting the diaphragm assembly into the pump body, the locating 'tab' on the outside of the diaphragm should be at the 11 o'clock position. After turning the diaphragm assembly a quarter turn to the left the 'tab' should be at the 8 o'clock position. These positions are shown in Fig. 15.

The two sub-assemblies of the pump are now ready for fitting together, and this is carried out as follows:—

Push the rocker arm (23) towards the pump until the diaphragm is level with the body flanges.

Place the upper half of the pump into the proper position as shown by the mark made on the flanges before dismantling.

Install the cover screws and lock washers, and tighten only until the heads of the screws just engage the washers.

Release and push the rocker arm away from the pump so as to hold the diaphragm at the top of the stroke, and while so held, tighten the cover screws diagonally and securely. On pumps fitted with rocker arm stop screws (18) and washer (19) these should be removed for the operation and afterwards refitted.

Testing the Pump

The best method is by using an A.C.-Sphinx bench test stand, on which the suction side of the pump is piped to a tin of paraffin at floor level and the outlet side of the pump connected to a stop tap and pressure gauge.

First, flush the pump through to wet the valves and seats, and then completely empty it again by continuing to operate the rocker arm by hand with the suction pipe clear of the paraffin. Again operate the pump. Not more than 20 strokes should be necessary to secure delivery of paraffin from the pump outlet.

With the same apparatus a second test can be made by working the pump with the tap on the delivery side closed, pressure then being recorded on the gauge. After ceasing to work the pump it should take several seconds for this pressure to return to zero, thus denoting that the valves are seating properly. Also, while there is pressure, the outer edge of the diaphragm — visible between the two clamping flanges — should be carefully examined for leakage and the retaining screws tightened if necessary. When working a pump by hand a somewhat longer stroke is obtained and the pressure developed is apt to be higher than when fitted to the engine.

When the above apparatus is not available the

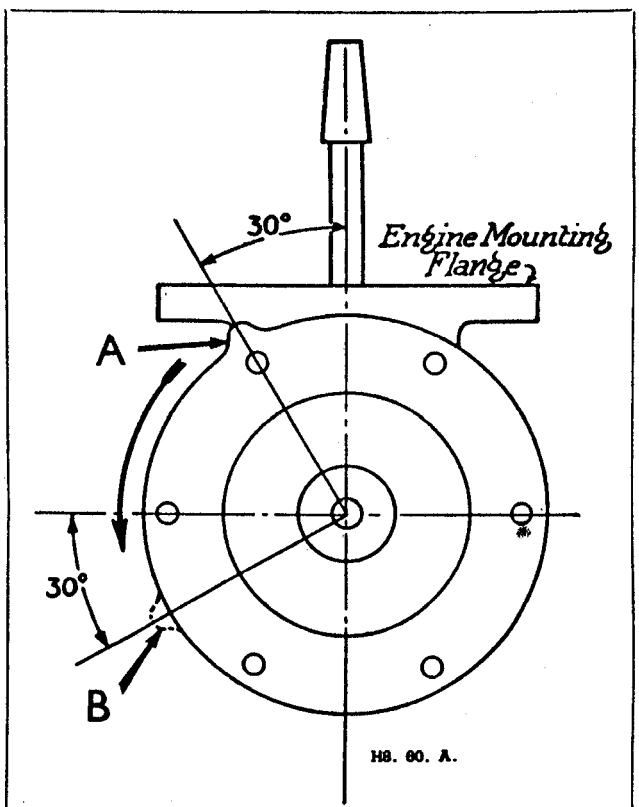


Fig. 15. When first fitting the diaphragm to the pump body the locating tab A on the diaphragm should be in the position shown. After engaging the notches in the bottom of the pull rod, with the slot in the link, turn the diaphragm until the tab is at position B.

pumps should be tested, using a pan of clean paraffin, as follows:—

Firstly, flush the pump by immersing it in the paraffin and working the rocker arm half a dozen times; then empty the pump by continuing to operate it while held above the bath. Then with the pump clear of the paraffin bath place the finger over the inlet union (marked 'in') and work the rocker arm several times. Upon removing the finger a distinct suction noise should be heard, denoting that the pump has developed a reasonable degree of suction. Afterwards the finger should be placed over the outlet union and after pressing the rocker arm inwards the air drawn into the pump chamber should be held under compression for two or three seconds; this should also be done with the pump immersed in paraffin, and the clamping flanges of the diaphragm watched for any signs of air leakages.

Re-fitting to the Engine

Reverse the procedure outlined for removal from the engine. Ensure that the rocker arm is correctly positioned against the eccentric on the camshaft, as there is a possibility of inadvertently getting the rocker arm under the eccentric or to the side, when damage will result after the pump bolts are tightened. The joint washer between the pump and the crankcase should be renewed if unsound.

After re-fitting to the crankcase, the engine should be run for a short time, and the pipe unions and pump examined for any possibility of fuel leakage.

ENGINE LUBRICATION

ENGINE lubrication is vital. Great care has been taken to select oils which will give the best results under all operating conditions. It is therefore imperative that the correct grades of oil be used and that they should be applied in accordance with a definite schedule to ensure the reliability and long life of the moving parts. The chart given in Section V, should be regularly referred to for details of mileage application, grade, and quantity of lubricant required.

Description

There is full pressure lubrication throughout the unit.

The gear type pump draws oil from the sump through a gauze oil filter and delivers it to all bearings and the camshaft chain.

The sump capacity is 11¾ pints, but an external full flow oil filter is fitted, and if the whole system has been drained, 1¼ pints extra will have to be used when refilling in order to charge this filter.

The oil filler is in the valve cover on top of the cylinder head, and the oil level is checked by a dipstick which is on the right-hand side of the engine.

Draining the Sump

The engine and oil filter should be completely drained and fresh oil put in at least every 5,000 miles to provide the best possible running conditions.

There is a drain plug in the base of the sump. On new or reconditioned engines draining should be done after the first 500 miles running and again after the next 2,000 miles. After this period no further attention need be given to the filter, except the renewal of the element as described, when necessary.

Drain when the engine is warm and under no circumstances should petrol or paraffin be poured through the oil filter to clean the engine.

Refilling

When refilling, do not pour the oil in too fast, otherwise it may overflow through the breather at the front end of the valve cover. Check periodically that this breather is not choked up. Failure to keep this clear may result in condensation on the valve gear.

Test the level of the oil with the dipstick, wiping the stick clean before taking the reading. This should only be done when the vehicle is on level ground and not immediately after the engine has been run, or a false reading may be given.

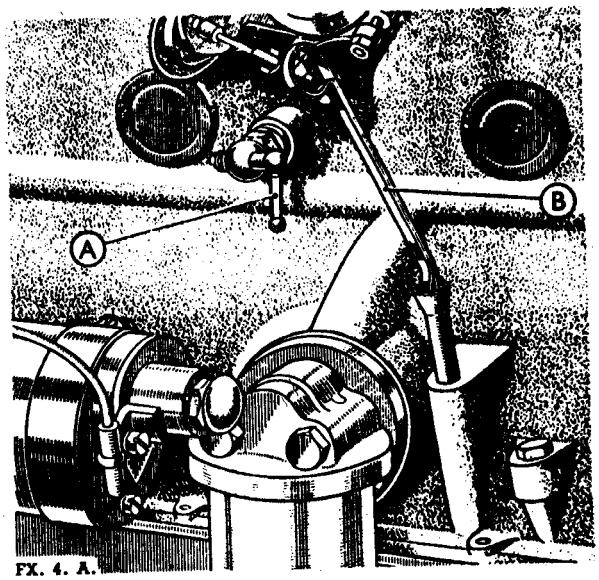


Fig. 1. Location of the dipstick, showing A, the cylinder block drain tap, and B, the dipstick.

Circulation

The oil circulation is clearly shown in the illustration at the rear of the Manual. Starting at the gauze filter and pick up in the sump, oil is drawn into the pump, from which it is fed to the full flow oil filter and thence to the main oil gallery. This runs the length of the engine on the right-hand side, from which the main oil delivery is made. A spring-loaded oil release valve, located between the pump and filter and accessible from the exterior of the crankcase, is provided, the overflow from which is returned to the sump filter. From the main oil gallery, oil is fed to the big ends, main bearings, and the three camshaft bearings.

From one camshaft bearing, oil at reduced pressure is taken through drilled passages in the cylinder block and cylinder head to an oil-feed collar on the valve rocker shaft, and thence to the drilled shaft itself. Therefore the shaft is under

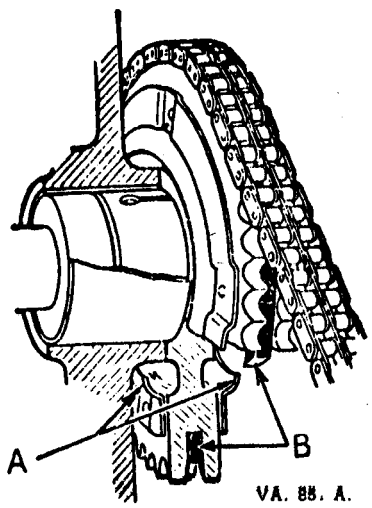


Fig. 2. Oil catchers 'A' feed a flow of oil to the chain on each side the camshaft sprocket, and a synthetic rubber tensioner ring 'B' ensures quiet running and takes up slack in the chain.

pressure, surplus oil after circulation returning from the rocker gear via the push rod holes to the sump.

At the front end of the front camshaft bearing there are two oil bleeds which feed oil to the camshaft gear and thence to the timing chain, see Fig. 2. Separate lubrication for the cylinder bores is effected by a small jet hole in the top half of each connecting rod big end bearing.

The Oil Pressure Gauge

The oil pressure gauge gives an indication whether the oiling system is working properly. The normal oil pressure during ordinary running should be between 50 and 55 lbs. per square inch, with a proportionate lower pressure when idling, and will keep constant as long as the filter element remains clear and is not choked. As the filter gradually becomes choked, the oil pressure progressively becomes less. A drop to between 30-35 lbs. per square inch is an indication that the element is being by-passed and that it should be renewed to restore the oil pressure to normal.

The gauge should be observed when the engine is first started up after refilling the sump to check that the oil is circulating and that the pressure is correct. Periodically the gauge reading should be noted during normal running. Should the gauge fail to register a normal pressure, it may be due to lack of oil in the crankcase. If oil is present and the gauge still fails to register, stop the engine immediately and check for a broken pipe or other cause. To test the gauge clamp another instrument direct to the instrument panel and note the new reading.

Check for Loss of Pressure

First, check the sump oil level by means of the dipstick. If the level is well up, check the oil gauge pipe from crankcase to instrument panel for fracture or leak. If the pipe is in order, remove the sump and examine the gauze filter. This may be choked ; also remove release valve and inspect for foreign matter.

If these tests fail to indicate the cause of the loss of pressure or oil circulation, the crankshaft and other bearings will have to be closely examined and stripped down if necessary.

The Tecalemit Filter

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

The element of the filter is of a star formation in which a special quality felt, selected for its filtering properties, is used.

Oil is passed to the filter from the pump at a

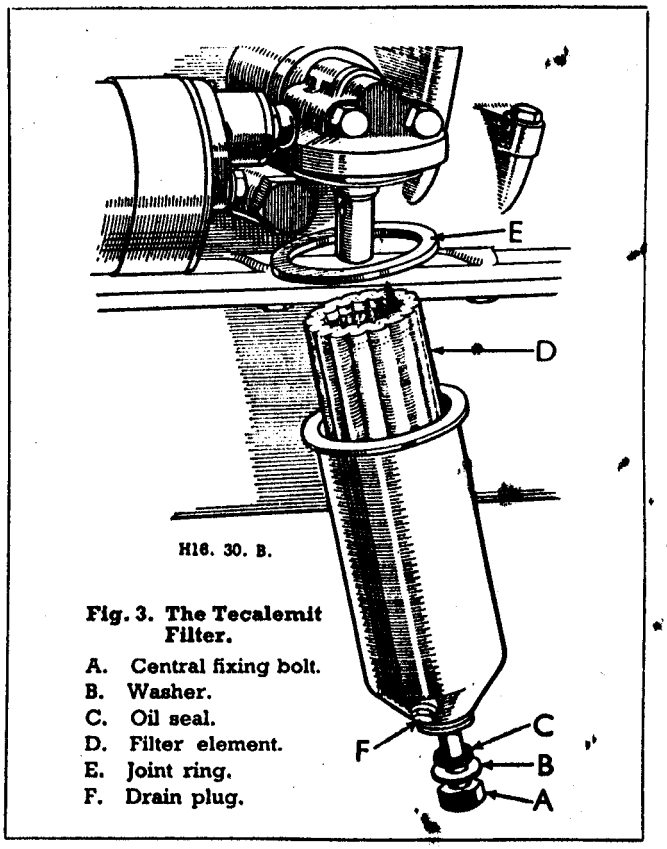


Fig. 3. The Tecalemit Filter.

A. Central fixing bolt.
B. Washer.
C. Oil seal.
D. Filter element.
E. Joint ring.
F. Drain plug.

pressure controlled at 50/55 lbs. per square inch by the engine oil release 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 a pound or two per square inch 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 15/20 lbs. per square inch, 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.

To renew the filter element proceed as follows:

1. Stop the engine and drain the filter by removing the drain plug which is situated in the conical base of the container. Draining can be assisted by slackening the centre fixing bolt slightly and thus allowing air to enter.
2. Unscrew the centre fixing bolt when the container, complete with element, can then be removed.
3. Withdraw the contaminated element and carefully cleanse the container of all foreign matter that has been trapped.
4. After ensuring that no fibres from the cleansing operation have been left in the container, put in a new element. Then replace the centre fixing bolt and washers to seal the end of the container when it may be partially filled with oil as a priming measure. Refit to head casting tightening the centre fixing bolt sufficiently to make an oil-tight joint and then top up the engine.

It is highly recommended that the 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 accumulated dirt on the outside of the filter entering the container and thus being carried into the bearings on restarting the engine.

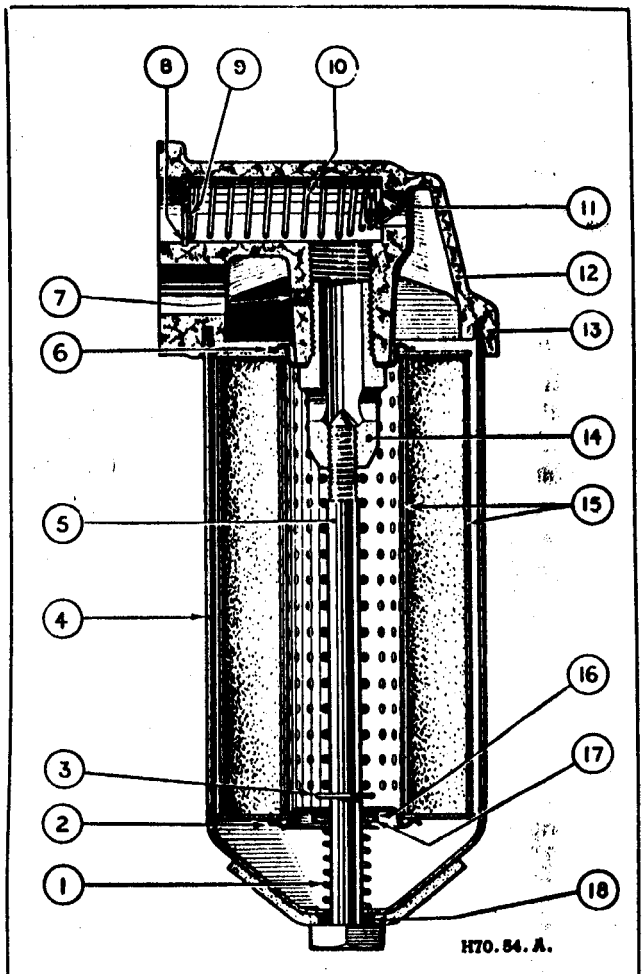


Fig. 4. Sectional view of the Micronic filter.

1. Guide spring; 2 and 6. Upper and lower guides; 3. Circlip; 4. Sump; 5. Centre bolt; 7. Allen screw; 8. Valve spring circlip; 9. Spring washer; 10. Valve spring. 11. Relief valve; 12. Filter head; 13 and 18. Upper and lower seal; 14. Centre tube; 15. Filter element; 16. Joint washer; 17. Washer.

Micronic Filter

The micronic 'Purolator' filter is sometimes fitted as an alternative to the Tecalemit filter, although in function they are identical.

In the same way as the 'Tecalemit' filter, oil is passed from the pump at a pressure controlled by the engine release valve and it also has a balance valve fitted in the filter head.

The element should be handled carefully and changed every 6,000 miles or as soon as the oil begins to discolour; whichever is the sooner.

To remove the element, clean the exterior of the filter assembly and then unscrew the centre bolt (5) of Fig. 4, withdraw the sump (4) and element (15).

Remove the filter element and thoroughly clean the interior of the sump. Ensure that the rubber seal (13) is in good condition and in position within the filter head (12). Place the new element on the lower element guide (2) and offer up the

sump complete with element (or primed with oil) to the filter head so that the former seats squarely on the seal and the latter is located on the upper element guide (6).

Screw the centre bolt back into the centre tube (14) firmly enough to ensure that there will be no leakage past the seals (13 and 18).

Top up with oil and then run the engine for a few minutes and inspect for leakage.

To Remove the Oil Sump

First, drain off the oil by taking out the drain plug; the oil capacity is approximately 11¾ pints, excluding full flow filter.

The sump is secured in position with 22 screws. Support the sump while removing these screws and then carefully lower clear of the oil pump gauze strainer and pick-up.

Remove the joint washer ; if broken, this will have to be replaced by a new one on re-assembly.

The Gauze Strainer and Pick-up

The strainer should be examined for contamination and removed if necessary by releasing three nuts. Wash the gauze with paraffin, using a brush and not a rag.

To Remove the Oil Pump

Disconnect the oil supply pipe from the pump bed to the crankcase.

From the left-hand side of the crankcase remove the oil pump locating screw shown in

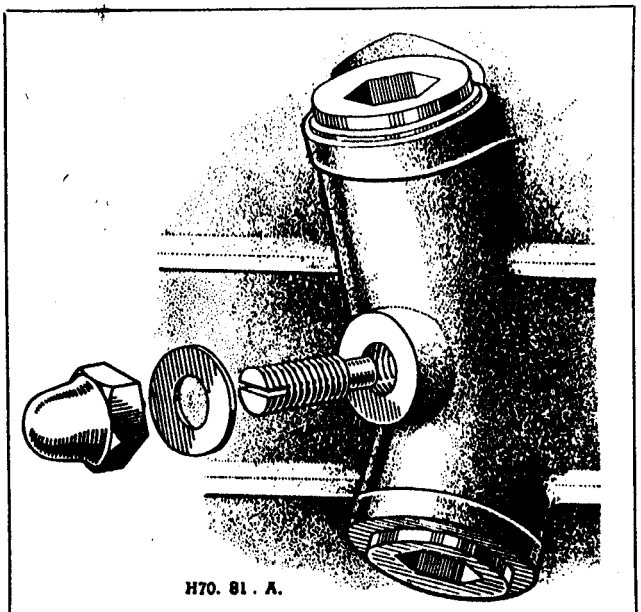


Fig. 5. The oil pump locating screw.

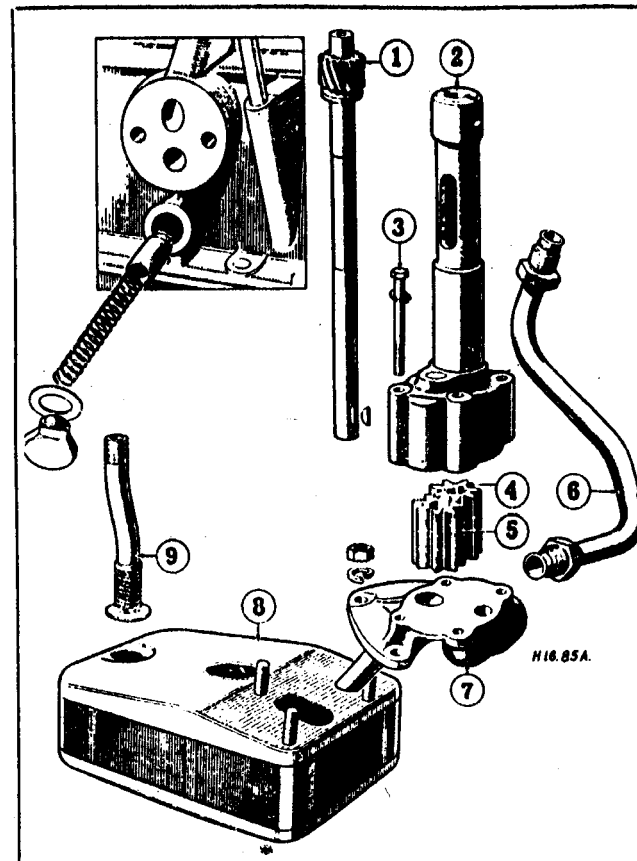


Fig. 6. Details of the oil pump assembly.

1. Driving spindle.
2. Oil pump body.
3. Set screw and washer.
4. Driving gear.
5. Driven gear.
6. Oil delivery pipe.
7. Bottom cover.
8. Oil strainer.
9. Oil return pipe.

Inset shows the release valve assembly.

Fig. 5. When the locking cap is removed a screwdriver can be used on the screw itself. Note that there is a fibre washer under the nut.

The oil pump complete can now be drawn down out of the crankcase.

To Replace the Oil Pump

Insert the pump from below and push the shaft right home, when the driving gear will mesh with the gear on the camshaft.

Insert the locking screw in the left-hand side of the crankcase and tighten. Fit fibre washer and follow with the cap lock nut.

Replace the oil delivery pipe to the pump body and crankcase.

The pump does not need priming.

To Dismantle and Re-assemble the Pump

The pump body (see Fig. 6) is in two pieces ; before dismantling, mark the two flanges to assist in re-assembly.

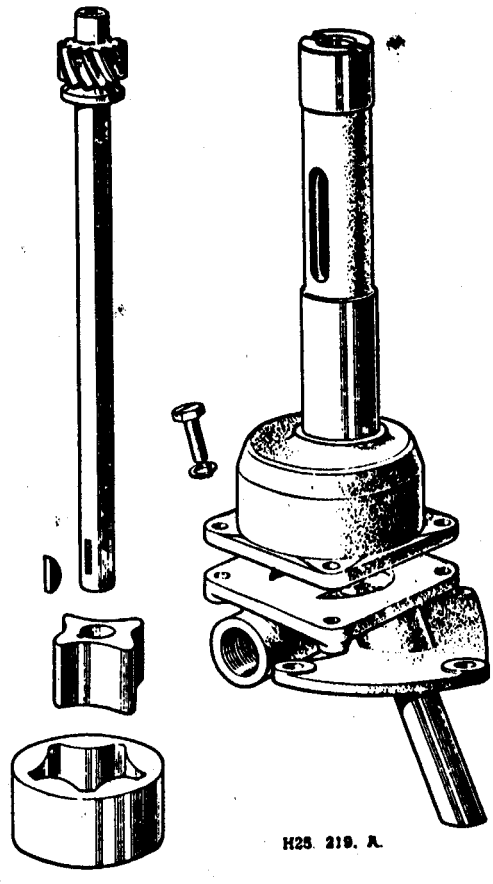


Fig. 7. Components of the Hobourn-Eaton pump.

Remove the four long setscrews from the body, and separate the bottom cover and lift out the driven gear.

The driving gear is keyed to the spindle and will need to be tapped off.

Remove the key. The spindle can then be withdrawn from the pump body.

Check that the driving key is in order in the pump spindle and in the keyway of the driven gear.

On re-assembly with the gears in position and the bottom cover bolted up, the pump must be perfectly free from stiffness, when rotated.

To dismantle the Hobourn-Eaton oil pump which is fitted to some models as an alternative, first mark the flange and the body to assist re-assembly. Then, as for the gear pump separate body from bottom flange when the female star gear can be lifted out of the body and the male eccentric star gear pulled from the shaft. Take care not to lose the key from the driving shaft.

The reassembly of this pump is achieved by reversing the dismantling procedure.

The Release Valve

Release valve pressure is determined by the spring, which is held in position by a plug. This plug is screwed home and no adjustment is possible. (See inset Fig. 6).

The valve is a conical-faced hollow plunger. Check that the plunger and the valve seat are clean and undamaged and that the passages in the crankcase are clear.

When re-assembling, make sure the fibre washer is fitted under the head of the valve plug, and that an oil-tight joint is made.

The Valve 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 of each rocker bearing.

This shaft is plugged at each end, one of these being screwed in and is detachable in order that the shaft may be cleaned internally (see Fig. 8).

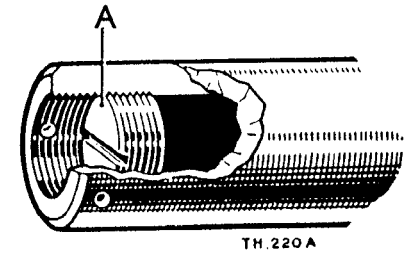


Fig. 8. Showing the screwed plug 'A' to facilitate the internal cleaning of the rocker shaft.

ENGINE ASSEMBLY

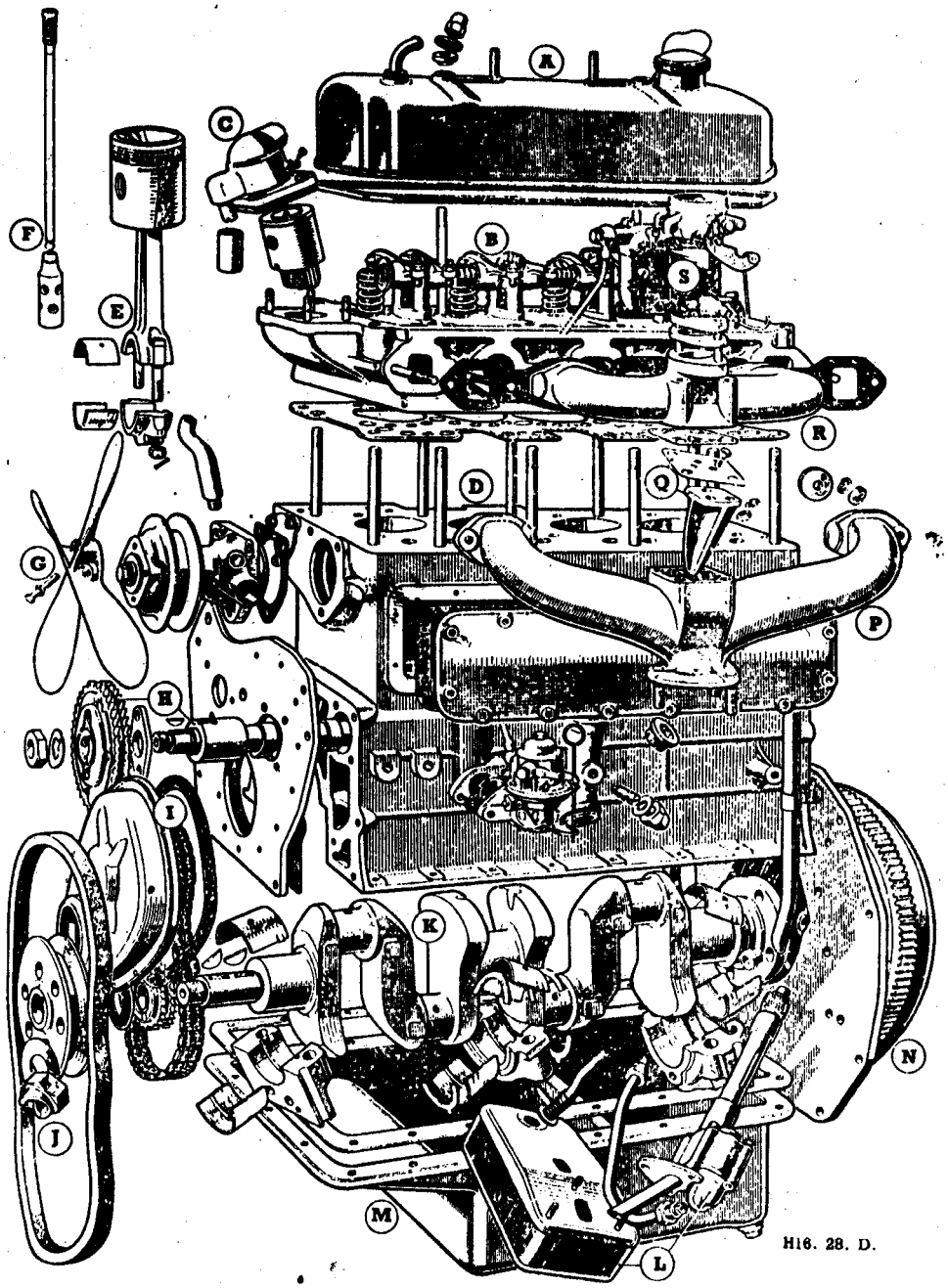


Fig. 1. An exploded view of the engine.

A. Valve cover, breather and oil filler cap.
B. Cylinder head assembly.
C. Thermostat.
D. Crankcase.
E. Connecting rod, piston, bearing cap and bearings.
F. Push rod and tappet.
G. Fan and water pump assembly.
H. Camshaft and cam gear.
I. Timing gear cover and timing chain.
J. Starting nut, pulley, fan and dynamo belt.
K. Crankshaft, bearings, bearing caps and sprocket.
L. Oil pump and strainer assembly.
M. Oil sump.
N. Flywheel.
P. Exhaust manifold.
Q. Hot spot.
R. Induction manifold.
S. Carburetter.

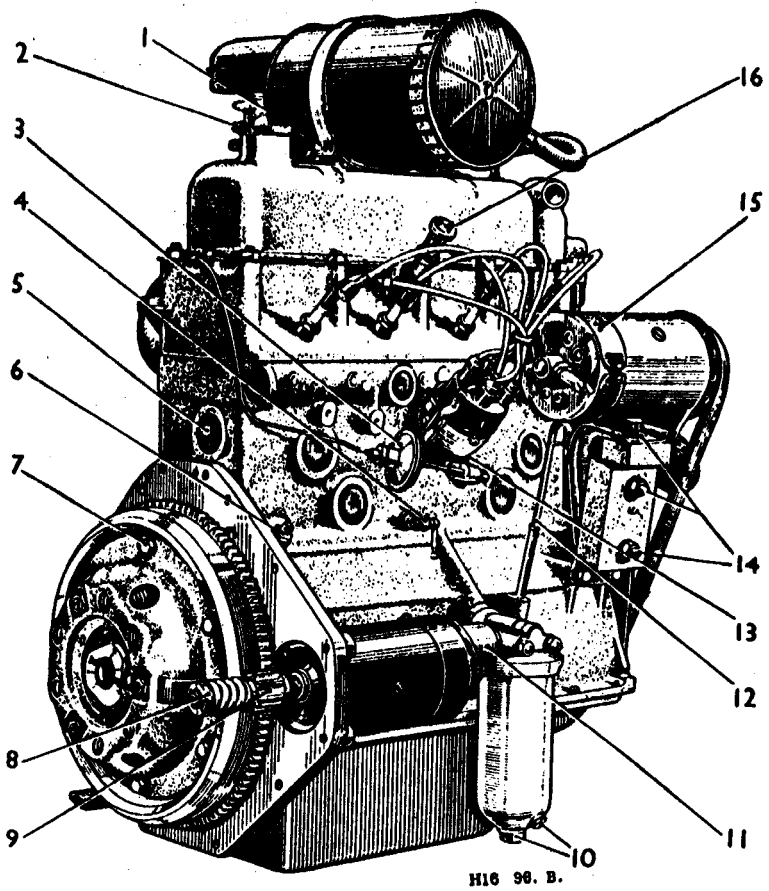


Fig. 2. The right hand side of the power unit.

1. Air cleaner strap bolt.
2. Oil filler cap.
3. Vacuum timing control.
4. Water drain tap.
5. Welch plug.
6. Oil gauge union.
7. Clutch cover screws.
8. Starter motor shaft nut.
9. Starter pinion and sleeve.
10. Full flow filter retaining screw and drain plug.
11. Starter motor switch.
12. Dip stick.
13. Distributor clamp bolt.
14. Engine mounting bolts.
15. Dynamo commutator cover.
16. Interior heater control valve.

RECOMMENDED ENGINE CLEARANCES AND GENERAL DATA

Crankshaft and Bearings	.001 to .00225-in.
Crankpins and Big Ends	.0005 to .00175-in.
Gudgeon Pin to Piston	Thumb fit at 70 F°.
Camshaft and Bearings	.001 to .002-in.
Crankshaft End Clearance or Float	.002 to .003-in.
Thrust	Taken by thrust washers on centre main bearings.
Side Clearance Connecting Rod and Crankshaft	.008 to .012-in.
Crankshaft Diameter of Journals	2.4790 to 2.4795-in.
Diameter of Crankpins	2.0000 to 2.0005-in.
Valve Tappet Clearance	.012-in. with engine cold.
Piston fit	.015-in. at top land ; 0.0012-in. at skirt.

Undersized bearings of .020-in. and .040-in. are listed.

The crankshaft regrinding sizes for undersize bearings are tabulated below.

UNDERSIZE OF BEARING	REGRINDING SIZES			
	CRANKPINS		JOURNALS	
	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
.020-in.	1.9800-in.	1.9805-in.	2.459-in.	2.4595-in.
.040-in.	1.9600-in.	1.9605-in.	2.4390-in.	2.4395-in.

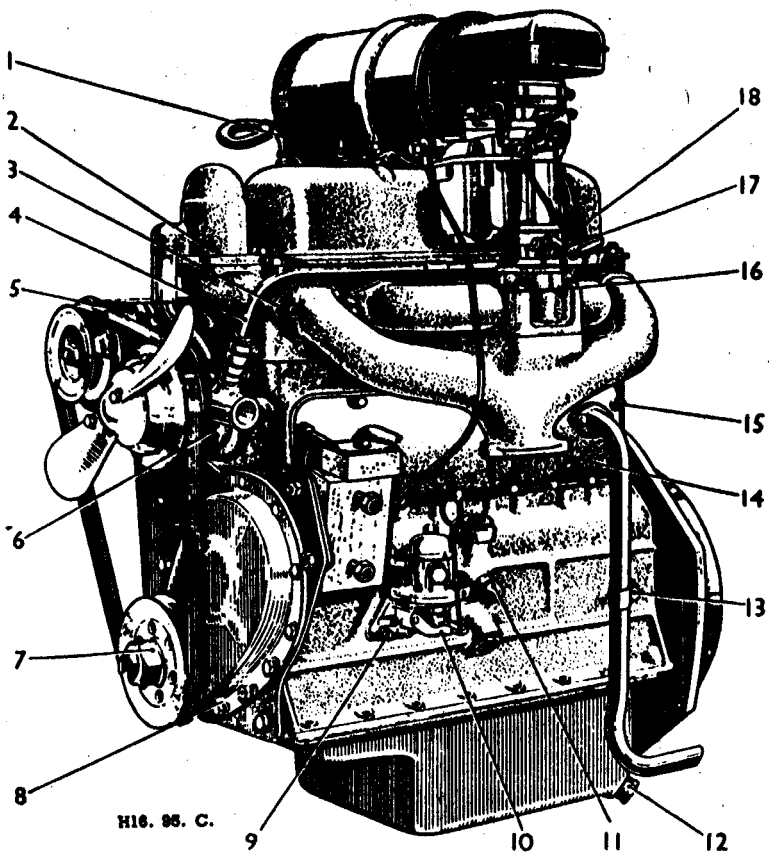


Fig. 3. The left hand side of the power unit.

1. Valve rocker cover cap nut.
2. Water outlet pipe nuts.
3. Exhaust manifold nuts.
4. Heater water outlet pipe.
5. Dynamo bracket locking nut.
6. Water pump.
7. Starting nut.
8. Timing cover screw.
9. Petrol pump flange nut.
10. Petrol pump priming lever.
11. Cap nut for oil pump locating screw.
12. Drain plug for sump.
13. Breather pipe.
14. Exhaust pipe flange studs.
15. Nuts for cylinder side cover.
16. Setscrews.
17. Elbow and union for vacuum pipe.
18. Carburetter flange nuts.

Cylinders and Crankcase

The cylinders are of the cast iron monobloc type with the crankcase being an integral part of the block. The cylinder bore of the Taxi and Hire Car each have a diameter of 3.125-in. (79.4 mm.).

The maximum permissible rebore is the diameter + $\frac{1}{16}$-in.

Cylinder Head

The head is of cast iron construction and is secured to the block by eleven $\frac{7}{16}$-in. G.T. steel studs. Between the cylinder head and cylinder block, is fitted a copper armoured hard clay board washer, which has a compressed thickness of .061-in.

Crankshaft

The counter-balanced crankshaft is of forged steel and has three main bearing journals.

Main Bearings

Each of the three main bearing shells are of steel construction, and are fitted with linings of white metal. The crankcase walls are recessed to locate each end bearing cap, whilst the centre main bearing has a thrust washer at each side to take end thrust.

Connecting Rods

The connecting rods are of 'H' section steel stampings and employ detachable 'Thinwall' bearings, the caps of which are secured by two H.T. steel bolts. The small end is fitted with a clamping bolt to secure the gudgeon pin.

Gudgeon Pin

Of tubular section, the gudgeon pin is grooved to take the connecting rod clamping bolt. At 70 deg. F. the pin should be a push fit into the piston boss.

Pistons

The split skirt type pistons are of tinplate finish on aluminium alloy and the lower ring groove is drilled for oil return.

Piston Rings

The two compression rings and one oil control ring are situated above the gudgeon pin.

Ring gap	Compression	.010—.014-in.
	Oil control	.008—.012-in.

Groove Width:—	
Compression	.127—.128-in.
Oil Control	.1895—.1905-in.
Groove Clearance:—	
Compression	.002—.004-in.
Oil Control	.002—.004-in.

Camshaft

Three, white metal lined, steel shell bearings, support the one-piece forged steel camshaft, on the left-hand side of the engine. Chain driven from the crankshaft, the camshaft incorporates a spiral gear to drive the oil pump and distributor shaft, and an eccentric cam for operating the fuel pump. The end float of .002—.008-in. is controlled by a bronze flange at the rear of the camshaft gear. The camshaft drive employs a patent tensioned gear with Duplex roller chain, .375-in. pitch, 62 pitches.

Overhead Valves

The inlet valve is of Silicon Chrome steel, and the exhaust of XB steel. Each valve has a single coil spring retained by a cup and split cone cotters, the latter being grooved externally to locate a safety clip. Both inlet and exhaust valves have a seat angle of 45 deg. whilst the seat width of the inlet valve is $\frac{1}{16}$-in. (contact face) and the exhaust valve $\frac{1}{8}$-in. valve guides are fitted having a stem clearance of .0035—.0045-in. at the bottom and .001—.002 at the top, for exhaust valves, whilst the inlet valve clearance is .0015—.002-in. all through.

Valve Gear

Tappets and push rods operate bushed rockers on a hollow shaft with an adjusting screw for valve clearance on each push rod end. Side play of the rockers is controlled by four coil springs.

Valve Timing

Both the crankshaft gear and the camshaft gear are spot marked for valve setting; the inlet valve opens 5 deg. before T.D.C.

Flywheel

The flywheel, which has a diameter of 12$\frac{13}{16}$-in., is bolted to the crankshaft flange and the starter ring of V4A steel with 106 teeth, is shrunk on to the flywheel.

Induction and Exhaust Manifolds

The induction and exhaust manifolds are separate castings. They are bolted together at a central flange, at which point a special design of 'hot spot' is incorporated. The combined assembly is attached to the monobloc by clamping washers, studs and nuts.

When assembling the manifolds to the cylinder head, the point is stressed that the manifolds should be pulled up tight to the head before tightening the common central flange bolts, this avoids the possibility of distortion.

Lubrication System

The forced feed lubrication is provided by a spur gear pump or the eccentric drive Hobourn-Eaton pump, situated in the sump, and driven by a vertical shaft from the camshaft. Oil is drawn through a strainer in the sump and forced under pressure to the main, big-end and camshaft bearings, the valve rocker shaft and bearings. Whilst on some models a Tecalemit filter is fitted, others have as an alternative a Purolator 'Micronic' filter. Both types of oil filter employ a removable cleaning element and are of the 'full flow' type.

The crankcase is vented to the atmosphere in the engine side cover.

Expansion Plugs (or Welch Plugs)

Seven expansion plugs are fitted in the cylinder block, two of which will be found on the water gallery. To remove a plug, drill a hole in the centre and lever out the plug with a screwdriver or other suitable tool.

It is usual in fitting a new plug to coat the edge with a jointing compound before inserting; (the 'bulge' must of course be on the outside when a plug is put in position). A carefully aimed blow at the centre with a small hammer direct or with a blunt punch will expand the plug sufficiently to make a water-tight joint. If too heavy a blow is used the plug will be useless and must be replaced by another new one.

SERVICE OPERATIONS WITH ENGINE IN POSITION

Valve Mechanism

On early models the spherical seating, in which the ball end of the tappet adjusting screw engages, is not integral with the tappet-rod, but is formed in a separate sliding piece, which in turn is held up to the ball of the adjusting screw by the engine oil pressure; hence, when under operation there will be no clearance between the end of the valve stem and the other end of the rocker arm. When the clearance is checked it is most important that the oil cushion mentioned be dispersed, this being done by applying pressure to the top of the ball-ended adjusting screw. The latest type of push rod is of one-piece design, i.e. the ball cup and rod are integral. Tappet clearances at the other end of the rocker arm should only be checked when this pressure is applied, otherwise a misreading of the clearance may be obtained.

Adjusting the Tappet Clearance

Lift the valve cover after removing the air cleaner and two acorn cap nuts.

Between the solid type of rocker arm head and the valve stem there must be a clearance of .012-in.

To check this adjustment have the engine turned by the starting handle and note the point at which the push rod stops falling. From that point until it starts to move again there must be this clearance of .012-in. Test with feeler gauge.

If adjustment is necessary, whilst continuously applying sufficient pressure to the adjusting screw with a heavy screwdriver, slacken the lock nut, raise or lower the adjusting screw in the rocker arm.

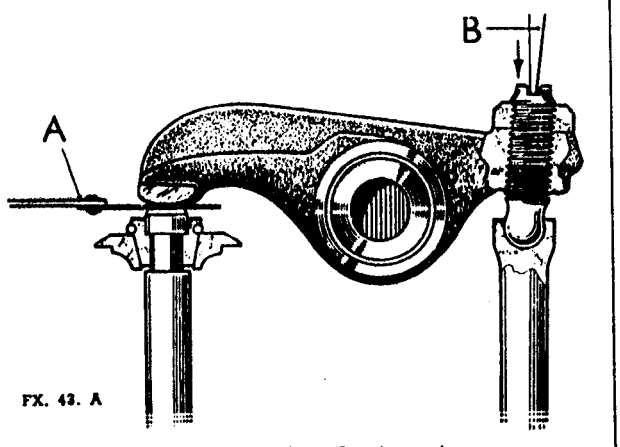


Fig. 4. Adjusting the tappets.
A. Feeler gauge. B. Screwdriver.

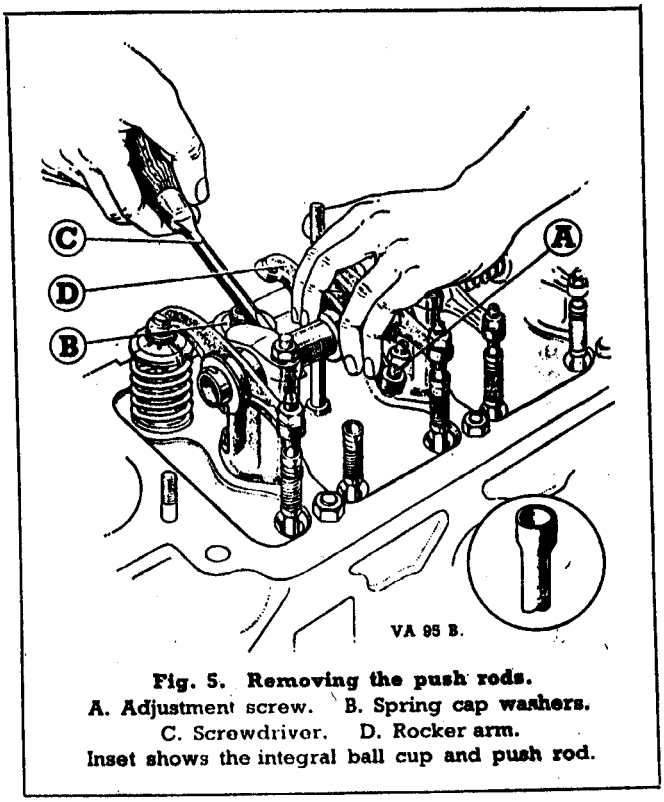


Fig. 5. Removing the push rods.
A. Adjustment screw. B. Spring cap washers.
C. Screwdriver. D. Rocker arm.
Inset shows the integral ball cup and push rod.

Tighten the lock nut when the adjustment is correct, but always check again afterwards in case the adjustment has been disturbed during the locking process. It is most advisable that this recheck of the clearance be made while the engine is at normal working temperature.

In replacing the valve cover take care that the joint washer, using a new one if necessary, is properly in place to ensure an oil-tight joint and then refit the air cleaner.

Removing the Push Rods

To remove the push rods (see Fig. 5) it is not necessary to dismantle the valve gear beyond slackening the tappet adjustment.

Take off the cylinder side cover.

Slacken the tappet adjustment screw to its full extent. With the aid of a screwdriver, supported under the rocker shaft, depress the valve and spring and then slide the rocker sideways free of the push rod. Withdraw the cup insert and then remove the push rod. When removing the push rod ensure that the oil cushion is dispersed.

In respect of the front or rear end rocker, however, it is necessary to take out the split cotter pin from the end of the shaft, when the

rocker can be removed, together with the plain washer (Fig. 5).

Replace in reverse order.

Rocker Arm Bushes

While the rocker gear is detached from the head check for play between the rocker shaft and 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 rams and rocker-shaft brackets may be removed.

The white metal bush is best removed using a drift and an anvil (see Service Tools). The anvil is recessed to retain the rocker in position while the bush is pressed, or gently tapped out with 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 at a finished size, the internal diameter must be reamed to suit the shaft.

Decarbonising

For this operation it will be necessary to remove the carburetter, manifolds, cylinder head, and push rods.

Scrape off all carbon deposit from the cylinder head and ports (see valve grinding for access to ports).

Clean the carbon from piston crowns by scraping with a tool such as a screwdriver. Care being taken not to damage the piston crowns and not to allow dirt or carbon deposit to enter the cylinder barrels or push rod compartment.

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

Removing the Cylinder Head

Drain all water from the radiator (if the water contains anti-freeze mixture it should be run into a clean container and used again).

Detach the top water hose from the cylinder head and disconnect the thermostat by-pass pipe

Disconnect the high tension wires from the sparking plugs; also remove the plugs

Remove the carburetter.

Remove the exhaust and inlet manifolds (see section C, page 2).

Remove the valve rocker cover.

Remove the 11 nuts holding the cylinder head to the cylinder block.

Slacken back the tappet adjusting screws and remove the push rods.

Lift the cylinder head, best accomplished by using a sling under the rocker shaft; a rope is preferable to chains.

With the head on the bench, remove the rocker oil feed pipe (see 13, Fig. 28) and then the rocker brackets (note the position of the bracket which carries the oil feed pipe from the cylinder head). This will assist in replacing. There are two holding down nuts to each bracket.

Lift off the rocker gear complete.

Replacing the Cylinder Head

Refit the cylinder head washer with the side marked 'TOP' uppermost, having smeared both sides with grease to make a good joint and prevent sticking when the head is again lifted.

Replace the rocker gear if this has been removed.

Lower the head over the studs, replace the cylinder head nuts finger tight, and insert the tappet push rods.

Tighten the cylinder head nuts evenly, a quarter of a turn at a time, and in the order shown in Fig. 6.

Reset the tappets to .015-in. and replace the valve cover.

Replace the manifolds and carburetter making sure that good joints are made, connect up the radiator, and by-pass hose, replace the sparking plugs and high tension wires.

Refill the radiator.

Check the valve tappet clearance again after the vehicle has run about 100 miles 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 tappet clearances, although not usually enough to justify resetting.

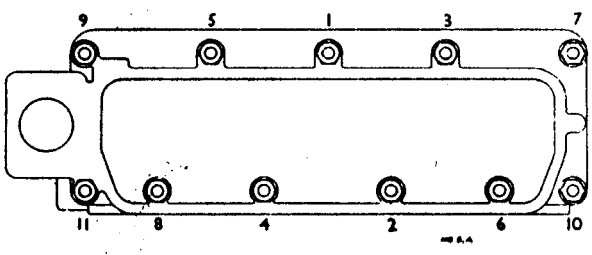


Fig. 6. Tighten the cylinder head nuts, working from the centre outwards in the order illustrated.

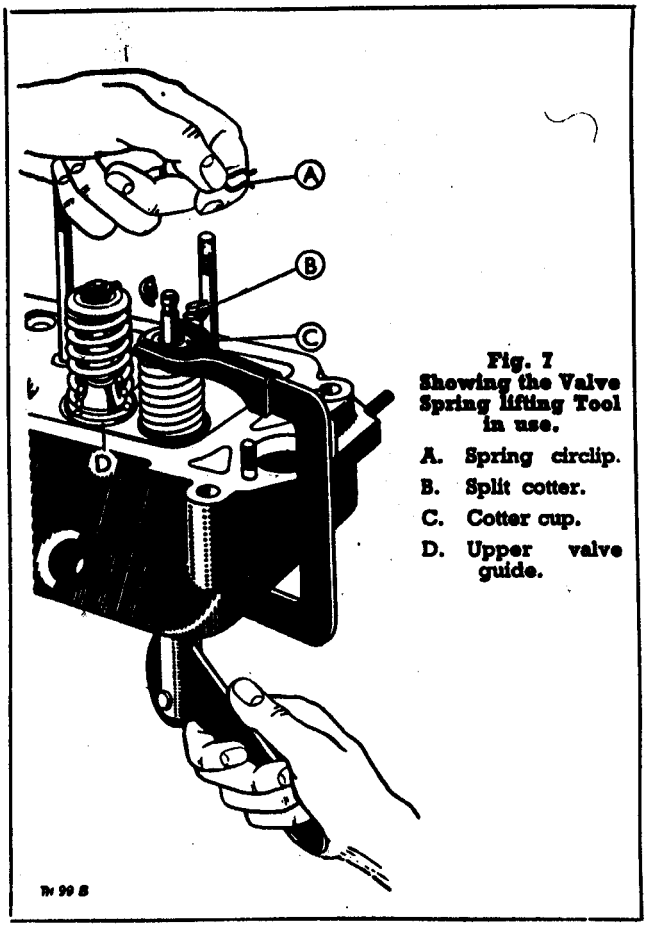


Fig. 7
Showing the Valve Spring lifting Tool in use.

A. Spring circlip.
B. Split cotter.
C. Cotter cup.
D. Upper valve guide.

Valves

Weak compression in any cylinder, in spite of correct tappet clearances, usually suggests that valve grinding is necessary, and the head should be removed for investigation.

Removing and Refitting a Valve

With cylinder head removed, a valve lifting tool as illustrated in Fig. 7, can be used to compress the spring.

Take away the circlip (A) and the split cotters (B), then release the spring and remove the valve.

Reassembly is a reversal of the operations for removal. When fitting the split cotters it is also worth noting that the spring circlip should be replaced as soon as the cotters are in position. This saves holding the cotters in the groove while the spring is released.

Split the two halves of the spring cup between which there is a rubber seal. If this seal shows any signs of damage or perishing, it should be renewed as its object is to prevent excess oil entering the valve guide.

When removing the valves, place them on a valve carrying board to enable them to be identified as to the cylinders from which they have been taken. The valve springs should be tested. The free length being approximately 1 ⅜-in.

Clean the carbon from the top and bottom of the valve heads, as well as any deposit that may have accumulated on the stems. The valve heads should, if necessary, be refaced at an angle of 45°. If the valve seats show signs of excessive pitting it is advisable to reface these also.

The valves now fitted are being made without any indentures or slots in the head, this necessitates the use of a rubber suction headed valve grinding tool. (See Fig. 8.)

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 periodically lifting the valve from its seat. This allows the grinding compound to repenetrate between the two faces again, after being squeezed out.

On completion, all traces of compound must be removed from the valve and seating.

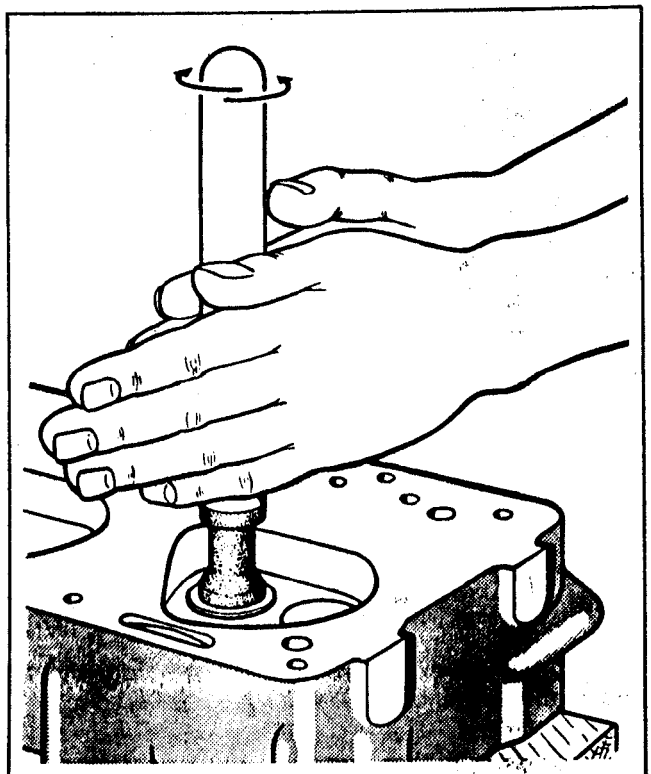


Fig. 8. The suction type valve grinding tool.

It is essential for each valve to be ground-in and refitted on its own seating as indicated by the number on the valve head. The valves are numbered 1 to 8, starting from the front. If a new valve is used it should be identified with its seating by stamping the number on the head, taking care not to distort the valve in the process.

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. Reclean the valve and re-insert in the guide, the valve spring, cup, cotters, and circlip being fitted round it.

Renewing Valve Spring in Position

In an emergency a new valve spring can be fitted without lifting the cylinder head, but it is advisable to first bring the piston to top dead centre, to ensure that the valve cannot fall into the cylinder during the process.

Remove the sparking plug and by means of a screwdriver or similar tool, the valve can be held on its seat whilst the spring is compressed. The valve rocker shaft can be used as a fulcrum point by an operator using two screwdrivers to bear on the valve spring cup each side of the valve stem, while the cotters are dealt with.

Distributor. To Remove and Replace

Remove the vacuum control pipe at the union.

Slacken the pinch-bolt in the clip at the bottom of the distributor, which can now be turned to allow more easy access to the locating screw which anchors the base plate of the vacuum timing unit on early models. Below the distributor is another set screw, upon removal of which the distributor, complete with driving spindle and spur gear, can be withdrawn. The driving shaft is more readily drawn out if the distributor is given a turning movement while being lifted.

Ignition Timing

The spark should occur on cylinders one and four, 6½° before T.D.C. or ¼-in. before the 1/4 mark on the flywheel, as the piston is completing its compression stroke.

In order to reset the ignition timing, first remove the rocker cover, then all plugs except No. 1, until No. 2 valve begins to open. It is essential that the starting handle is maintained in the same tooth of the starting 'dog' throughout the operation.

Now carefully mark the position of the starting handle on a piece of paper stuck to the radiator grille. Continue turning the starting handle until the mark on the paper is reached. The piston is now near T.D.C. on its compression stroke.

Remove the distributor cover, slacken the screw in the clip of the distributor casing and turn the casing until the contact breaker points just begin to open, with the rotor pointing to No. 1 electrode in the distributor cover. The spark is then correctly timed.

To overcome any slackness in the timing chain it is advisable to turn the flywheel back several inches and then to move it forward to the correct position.

As the distributor cover carries the electrodes for the four cylinders it will be realised that it is imperative for the rotating arm to pass the spark to the correct sparking plug lead at each firing stroke.

Finally tighten the adjusting screw, refit the distributor cover and test the car on the road.

If necessary, the timing can be re-adjusted at the distributor by turning the vernier adjustment knob. There is a considerable amount of latitude for adjustment but only extremely small movement should be made at one time.

If the leads from the distributor to the sparking plugs have been disconnected they must be replaced in the firing sequence 1, 3, 4, 2.

Sparking Plugs

The sparking plugs fitted to both the Taxi and Hire Car are of the long reach 14 mm. type; Champion N8 modified, or Lodge CB14.

The gaps of these plugs should be maintained at .025-in. If the gap is allowed to become too wide, misfiring at high speeds is liable to occur; and if too small, bad, slow running and idling will be the result.

Sparking plugs should be regularly inspected, cleaned and tested. This is of vital importance to ensure good engine performance, coupled with fuel economy.

When removing the plugs from the engine, use a box spanner, this will avoid possible damage to the insulator, and always remove the copper washers with them. They should then be placed in a suitable holder which has holes drilled to admit the upper end of the plugs and marked to identify each plug with the cylinder from which it has been removed.

The plugs should now be carefully examined and, for guidance, compared with a new plug.

Oil fouling will be indicated by a wet shiny black deposit on the insulator. This condition is usually caused by worn cylinders, pistons or

gummed rings. Oil vapour is forced from the crankcase during the suction stroke of the piston which fouls the plugs.

Petrol fouling will cause a dry fluffy black deposit to be apparent on the plugs. This is usually caused by faulty carburation or ignition system. In this latter connection the distributor coil or leaking and worn out ignition leads may be contributory causes.

Under the above conditions, if the plugs otherwise appear to be sound, they should be thoroughly cleaned, adjusted and tested.

When preparing for cleaning, the plug washers should be removed and examined. The condition of these washers is important, in that a large proportion of the heat from the plug insulator is dissipated to the cylinder head by them. The washer should therefore be reasonably compressed. A loose plug can be easily overheated, thus upsetting its heat range and causing pre-ignition, with consequent short plug life. On the other hand, do not overtighten. All that is needed is a good seal between the cylinder head and the plug. Tightening too much will cause distortion of the washer, with the possibility of blow-by which will again lead to overheating and resulting dangers. If there is any question of defect, replace with new washers.

The plugs should now be thoroughly cleaned of all carbon deposit, resorting to scraping if necessary, removing as much as possible from the space between the insulator and shell. An oily plug should be washed out with petrol. If a plug cleaning machine is available, 5 to 10 seconds in this will remove all remaining signs of carbon. Remember to thoroughly 'blow out' the plug after treatment under these conditions, in order to remove all traces of abrasive left inside.

After cleaning, thoroughly examine the plug for cracked insulator or worn away insulator nose. Should either of these conditions be apparent a new plug should be installed.

Carbon deposit on the threads of the plug should be carefully removed by using a wire brush or, if available, a wire buffing wheel. Take care not to damage the electrodes or insulator tip. This often neglected cleaning operation will lead to tight threads and resultant loss of heat dissipation due to the carbon deposit, and thereby cause overheating.

The condition of the electrodes should now be noted and any signs of corrosion removed, if it is felt that the plugs are worthy of further use. This can be carried out with the use of a small file, to carefully dress the gap area. The gap should then be reset, using the plug gauge provided in the tool kit. When resetting, bend the side electrodes only, never bend the central one as this may split the insulator tip.

If a plug testing machine is available, the plugs can be accurately tested to ascertain their fitness for further service in the car. The gaps should be set to .025-in. before being subjected to this test. A plug can be considered fit for further use if it gives a continuous spark, when in the testing machine, up to 100 lbs. per square inch.

It is advisable, whilst the plugs are under pressure in the testing machine, to apply a spot of oil to the terminal end, to check for air leakage. Excessive leakage here will tend to cause compression loss, rapid deterioration of the electrode and overheating of the electrode tip. The top half of the insulator should also be carefully examined for any signs of paint splashes or accumulations of grime and dust, which should be removed. Should there be any signs of cracks due to faulty use of the spanner, the plug should be replaced.

It is recommended that plugs should normally be replaced every 10,000 miles. When replacing the plug lead, make sure that it is securely attached.

Make plug inspection, cleaning and testing a routine job and carry this out at least every 3,000 miles. Remember, plugs in good condition will ensure better fuel consumption and good engine performance.

REMOVING AND REFITTING THE ENGINE

Two methods may be employed for removing the engine. In the first, the engine and gearbox are separated before removal; in the second they are removed as one unit. From a servicing standpoint the second method is generally recommended, both for ease of operation and speed.

METHOD 1

First disconnect the battery leads as a safety measure. Drain the water from the cooling system and, if desired, though it is not an essential task, drain the engine and gearbox of oil.

While the draining is in progress, the bonnet can be removed. This is done by removing the hinge bolts at the front and rear end of the bonnet central hinge after the side catches have been released and the right-hand panel raised. The front hinge has two bolts to secure it to the radiator cowl and two nuts and bolts fix the rear hinge to the scuttle. Now lift the bonnet off.

The radiator should be removed by releasing the top hose from the thermostat and the lower hose at the radiator, both hoses being held by jubilee clips. At each side the radiator is secured to the cowl supporting panels by two nuts and bolts which should be removed. At the base of the radiator, on each side, release the two nuts and bolts which hold the radiator frame to the chassis bracket having first knocked back the tab washers that lock the bolt heads. The radiator may now be lifted from position.

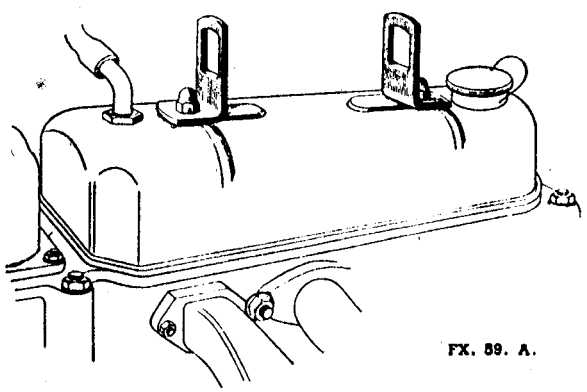


Fig. 9. The lifting brackets fixed to the valve rocker cover

Working at the left of the engine, slacken the clip securing the air cleaner to the carburetter throat, then release the breather hose from its valve cover connection and finally release the two nuts that fix the air cleaner strap to the valve rocker cover. Lift off the air cleaner.

Disconnect the accelerator arm from the throttle link rod, also release the choke cable from its carburetter connection.

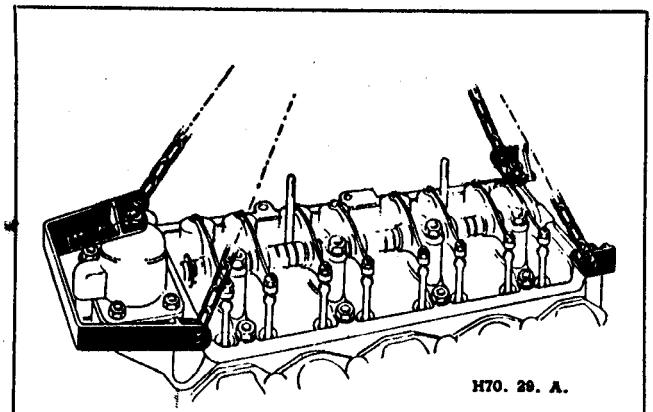


Fig. 10. The engine lifting brackets secured in position.

The exhaust down pipe must be dismantled at the exhaust manifold by removing the three stud nuts on the underside of the flange, then at its first bend release the down pipe supporting clip which is held by an engine/bell housing bolt. Whilst working in the same area free the earth cable from the engine/bell housing flange.

At the petrol pump banjo union release the flexible fuel pipe.

Where lifting brackets are not incorporated in the valve rocker cover, the cover must be removed and a special lifting bracket, as shown in Fig. 10, secured to the engine by the two foremost and the two rearmost cylinder head studs and nuts.

Now release the engine from its front left-hand mounting. Four bolts and nuts secure the engine bracket to the chassis mounting bracket; these must be removed. In addition dismantle the jack pump complete with its bracket from the engine mounting. This pump unit is held by one of the engine mounting bolts, already removed, and by a further nut and bolt to the engine bracket. The pump with its fluid pipes still intact can then be moved gently to one side out of harm's way

Dismantling operations can now commence on the right-hand side of the engine. First disconnect the leads from the sparking plug terminals, also

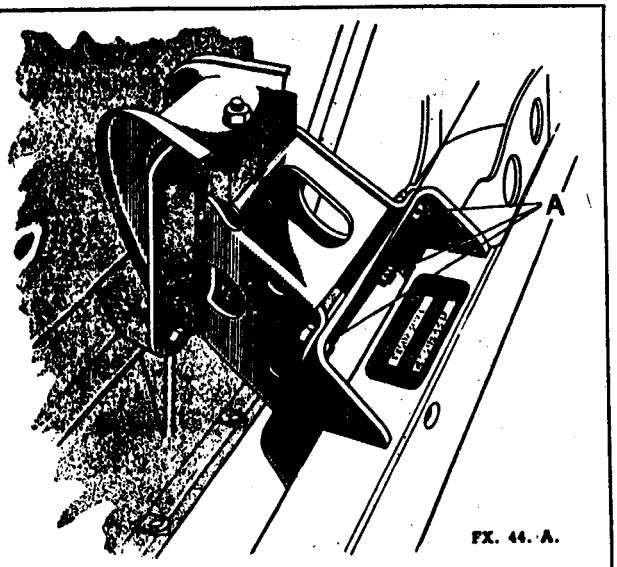


Fig. 11. The engine front mounting brackets. A. The four bracket bolts to be removed.

the coil lead from the distributor cap, to save possible damage to the bakelite.

Those cables that emerge from the right-hand harness should be disconnected at their dynamo terminals, the distributor casing and at the vacuum control switch.

Release the flexible oil pipe from the oil pressure gauge pipe at the scuttle union.

Disconnect the starter cable at the front end of the starter and remove the starter, which is held by three engine/bell housing nuts and bolts, for convenience of engine lifting.

Next remove the four engine mounting bolts from the chassis bracket.

Tension, with an overhead purchase, must be put on the engine lifting bracket slings before the operator commences work beneath the Taxi or Hire Car. The front end of the gearbox must be supported by a screw type jack or suitable packing blocks.

Finally, remove the remainder of the engine bell housing nuts and bolts, and setpins.

With its weight supported by the purchase, the engine should be pulled forward a distance sufficient for the flywheel and clutch plate to become clear of the gearbox first motion shaft and then removed from the chassis with a straight lift.

Refitting of the engine to the chassis can be achieved by simply reversing this procedure.

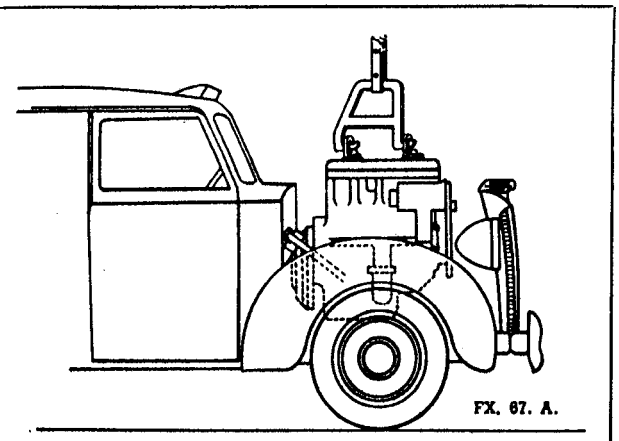


Fig. 12. Lifting the engine without the gearbox.

METHOD 2

For this method the same procedure should be adopted as described under Method 1, with the exception that the engine/bell housing nuts and bolts should be left intact save for those which have to be removed in order to free the starter, exhaust down pipe clip and earthing cable.

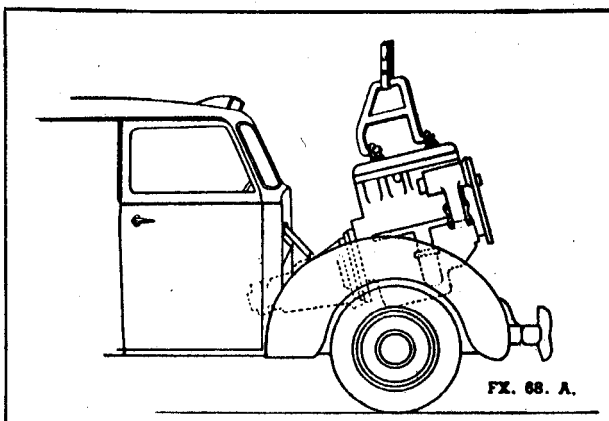


Fig. 13. Lifting the engine and gearbox as one unit.
Note: The radiator cowl and headlamps are removed.

Additional dismantling will include the radiator cowl, a procedure described in the section headed 'Bodywork'.

All attachments to the gearbox such as clutch pedal linkage, speedometer drive (where fitted), and front universal flange joint should be released, each of these operations are described in the 'Gearbox' section.

Release the rear anchorage, an operation which has again been explained fully in the 'Gearbox' section of this manual.

When the gearbox is free and the supporting packing or jack has been withdrawn from under

the bell housing, the complete unit of engine and gearbox will hang from the lifting slings in a sloping position, the gearbox being the lower end. Ease the engine forward and lift slowly, manoeuvring the unit clear of the vehicle and its fittings.

To refit the engine, with gearbox, reverse the removal procedure.

OPERATIONS WITH THE ENGINE REMOVED

The following operations should be carried out with the engine removed, although in some cases it is possible to perform them with the engine in position.

Before removing or replacing any component it is important to ensure that all surrounding surfaces are perfectly clean to prevent the entry of foreign matter into any vital parts. This can best be accomplished by the use of a paraffin bath and a brush, and it is also important to note that fluffy rags should never be used as there is a danger of causing obstruction to small oil ways.

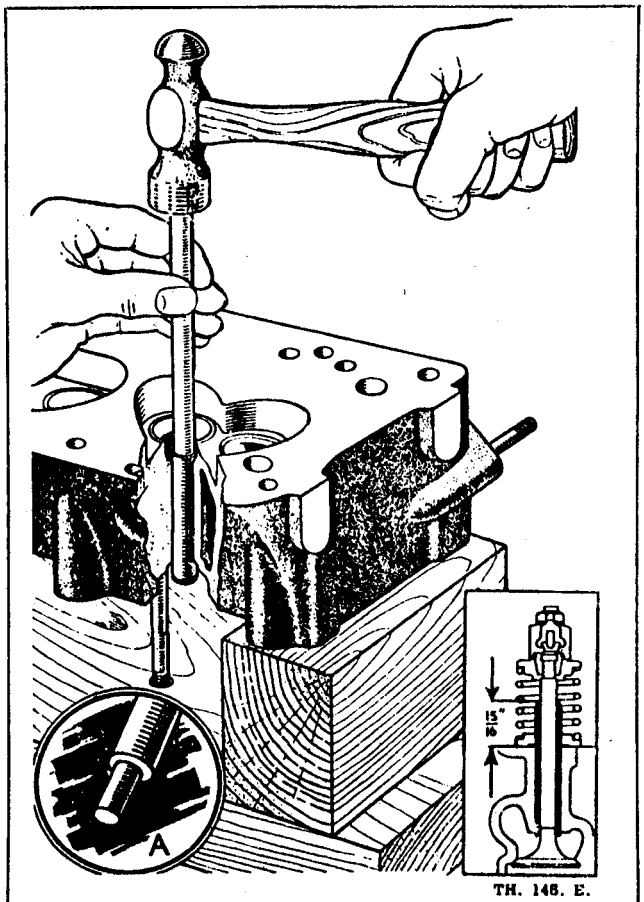


Fig. 14. Renewing a valve guide.
A. Stepped drift. B. The final position of the guide. In the fitted position the one piece guide should stand $\frac{5}{16}$-in. above the cylinder head.

Valve Guides

The valve guides are of a one piece design. They are pressed into the cylinder head with $\frac{5}{16}$-in. of the guide protruding above the head.

Internally each guide is stepped to give three different diameters. The portion of the valve guide above the cylinder head has the closer fit around the valve stem. This is due to the freedom for expansion afforded this part of the guide; the close fit thus restricts the passage of oil and gas along the valve stem

The portion of the guide sunk into the head cannot have so close a fit to the valve, due to the unequal expansion of the gas heated valve stem and the indirect water cooling of the guide.

To position each valve spring at the cylinder head, a stepped collar (see Fig. 14) is fitted over the part of the valve 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 component should be renewed. If a valve is at fault the wear will usually be evident on the stem, but it should be borne in mind that the valve and stem 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 the removal of the valve as shown in Fig. 14.

The drift is shown stepped in order to ensure location and to obviate it slipping off the guide and damaging the port. The guide should be knocked out in the direction shown, working on the plain and not the chamfered end.

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

The final position of the guide is shown in (Fig. 14). It must stand $\frac{15}{16}$-in. above the cylinder head.

Removing the Tappets

Remove the valve cover, slacken back the tappet adjustment and withdraw the push rods.

Remove the cylinder side cover on the left-hand side of the engine; it is held in place by 15 set screws, with fibre washers.

Note that the cover joint is made with a cork washer. Carefully remove this joint washer. Renew, if it is damaged.

Remove the vent pipe attached to the side cover; it is flange mounted with two set screws.

The tappet plungers may be withdrawn from the crankcase by lifting upwards with finger and thumb (Fig. 15).

Replacement is a reversal of this operation, but take care to make an oil-tight joint with the side cover and the vent pipe.

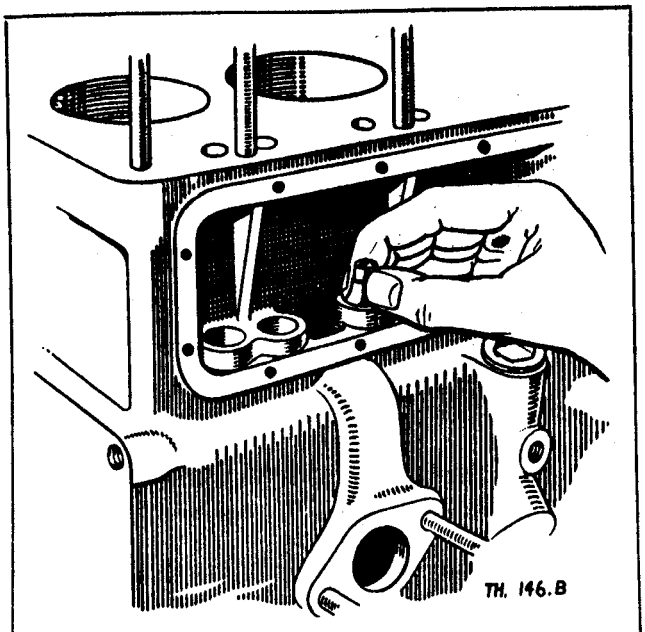


Fig. 15. Removing a tappet.

VALVE TIMING GEAR

For access to the valve timing gears or chain, first drain and remove the radiator complete (see section B, page 3).

Starting Nut and Belt Pulley

Using a suitable heavy box spanner, unscrew the starting nut, Fig. 22, on the crankshaft after knocking back the lock washer. The spanner will probably have to be hammered in order to 'start' this nut, but a few fairly sharp blows in an anti-clockwise direction should be sufficient.

With the nut and its washer removed, the belt pulley can be withdrawn from the shaft. The pulley is keyed but there is no taper fit and withdrawal will present no difficulty, but Tool No. 18G2 can be used to advantage.

Timing Cover

The timing gear cover (Fig. 22) is held to the engine by set screws. These are of two sizes, $\frac{7}{16}$-in. and $\frac{1}{4}$-in.

There are special oval-shaped washers and spring washers under each screw head.

The larger set screws—seven in number—are used in the lower portion of the cover, where the holes are in the crankcase; the smaller set screws—five in number—enter the engine front mounting plate only.

The timing cover and paper washer can now be removed and at the same time the oil thrower should be taken from the front of the crankshaft. Note the correct fitting to prevent oil from creeping to the fan pulley; the concave or hollow side must face front towards the pulley.

When re-assembling, do not damage the felt washer, make the joint carefully, using a new joint washer if necessary, and tighten set screws evenly.

Front Suspension Plate

The engine front suspension plate can be removed by taking out the remaining set screws.

Removal of the Oil Sump (see Section D/4).

Removal of the Flywheel

After taking away the Clutch (see Section G/2), the flywheel can be removed upon releasing the four bolts to crankshaft flange.

In replacing the flywheel, see that the 1/4 timing mark is in line with the first and fourth throws of the crankshaft.

Rear Suspension Plate

The engine rear suspension plate may be removed, after the flywheel, by taking out the remaining set screws into the crankcase.

Pistons and Connecting Rods

There are two oil jets in the top half of the big-end bearing (Fig. 18). Ensure these line up with holes in the shell bearings to give free passage of oil.

For drawing the pistons, the connecting rods

THE COMPONENTS OF THE CYLINDER HEAD

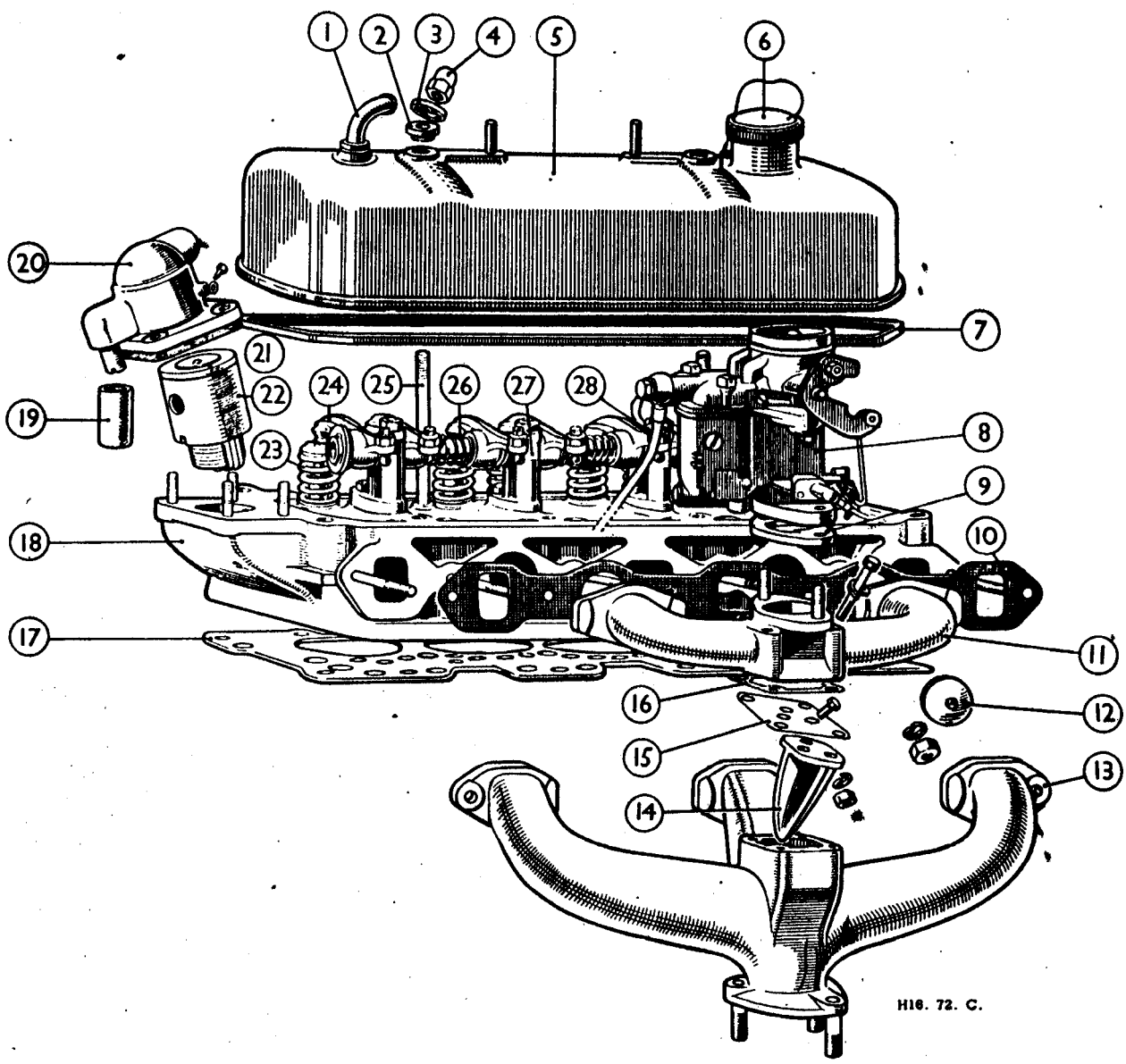


Fig. 16. Valves, cylinder head and manifold.

1. Breather.
2. Rubber bush.
3. Cup washer.
4. Cap nut.
5. Valve rocker cover.
6. Oil filler cap.
7. Joint washer.
8. Carburetter.
9. Joint washer.
10. Manifold washer.
11. Induction manifold.
12. Yoke washer.
13. Exhaust manifold.
14. } Hot spot assembly.
15. }
16. Hot spot washer.
17. Cylinder head washer.
18. Cylinder head.
19. Rubber connection.
20. Thermostat cover.
21. Joint washer.
22. Thermostat.
23. Valve spring.
24. Valve rocker.
25. Valve cover stud.
26. Spacer spring.
27. Rocker shaft bracket.
28. Oil feed pipe and union.

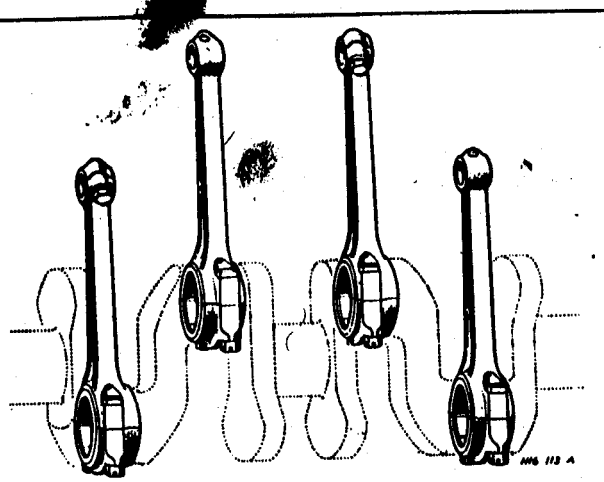


Fig. 17. Order of assembling the connecting rods.

have to be taken upwards through the cylinder bores; sump and cylinder head have therefore to be removed.

Remove the split pins and nuts from the big end bearing cap and withdraw the cap. Before pushing the connecting rod through the bore check that the bearing bolts are still properly in position.

The heads of the bolts are anchored in the top half of the cap by a small peg. If these have been disturbed the big end may not pass through the bore as the head may have turned.

See page E/2 for the bearing sizes and fits. Check the crank for out-of-round and scoring; if either is present the crankshaft will have to be removed for grinding.

Connecting rods are numbered from 1 to 4, starting from the front and this numbering is stamped on both halves of the big end bearing. Note that the numbering is stamped on the side facing the camshaft when assembled.

The shell bearings are removed by hand and new bearings require no scraping or hand fitting, apart from placing in position so that the feathered ends are properly located on top and lower halves (Fig. 18).

When replacing the split pins in the big end and main bearing nuts, after tightening up, the ends should be bent back with pliers; hammering back the cotters is not approved.

Gudgeon Pin Clamping Bolt

The gudgeon pin clamping bolt is set at an angle and a spring washer is used. As will be seen from Fig. 17 the rods should be fitted facing alternately.

Removing a Piston

Slacken the clamping screw in the small end of the connecting rod to release the gudgeon pin and remove the piston. The gudgeon pin is a push fit in the piston.

Care should be taken in withdrawing the connecting rod and piston, or damage may be caused to the piston or the rings

Pistons and Bores

There should be a clearance at the piston skirt, and at the top land, measurement (E/2) being taken at right-angles to the gudgeon pin and in the working part of the cylinder bore. (See Fig. 20). Note that the pistons are of split skirt design. Piston ring gaps (E/3) should be tested in the cylinder bores.

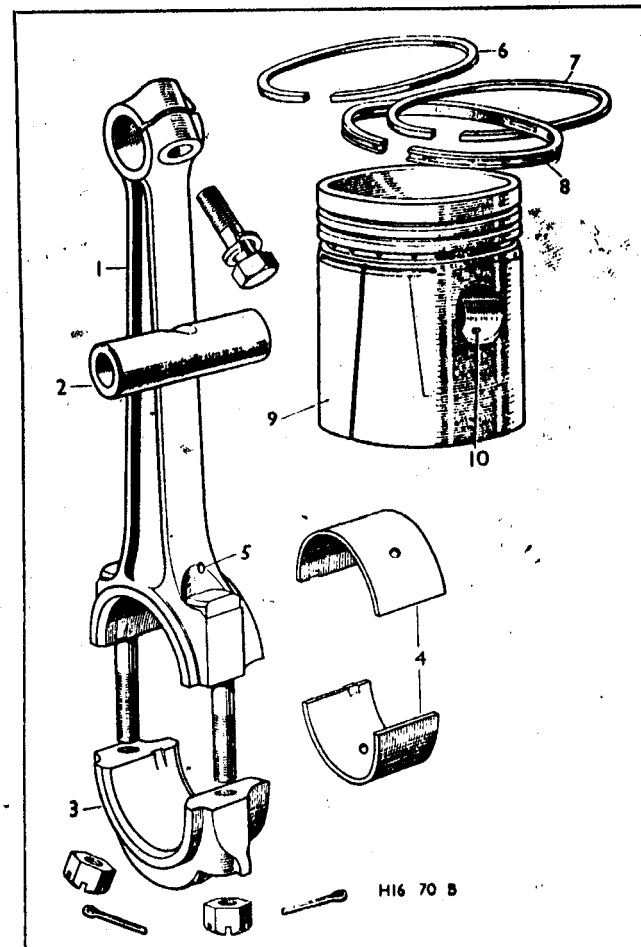


Fig. 18. The piston and connecting rod assembly.

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

COMPONENTS OF THE CRANKCASE

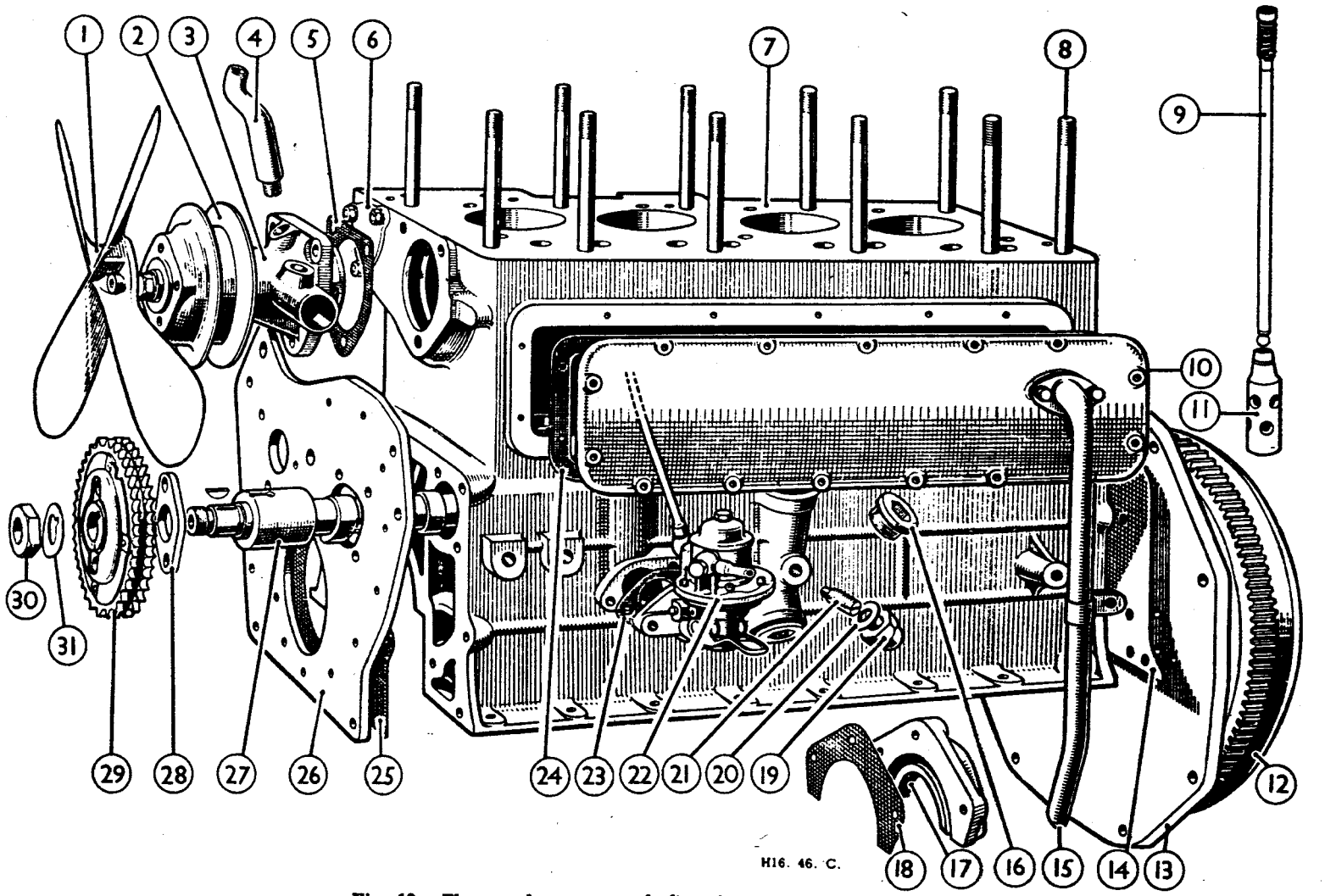


Fig. 19. The crankcase, camshaft and flywheel section.

1. Fan.
2. Fan and pump pulley.
3. Water pump.
4. By-pass pipe.
5. Joint washer.
6. Front cover for water gallery.
7. Cylinder block.
8. Cylinder head stud.
9. Push rod.
10. Engine side cover.
11. Tappet.
12. Flywheel.
13. Engine rear plate.
14. Joint washer.
15. Crankcase vent pipe.
16. Plug.
17. Crankcase rear cover.
18. Jointwasher.
19. Cap nut.
20. Fibre washer.
21. Oil pump locating screw.
22. Petrol pump.
23. Joint washer.
24. Joint washer.
25. Joint washer.
26. Engine front plate.
27. Camshaft.
28. Camshaft locating plate.
29. Camshaft gear.
30. Nut for camshaft.
31. Lockwasher.

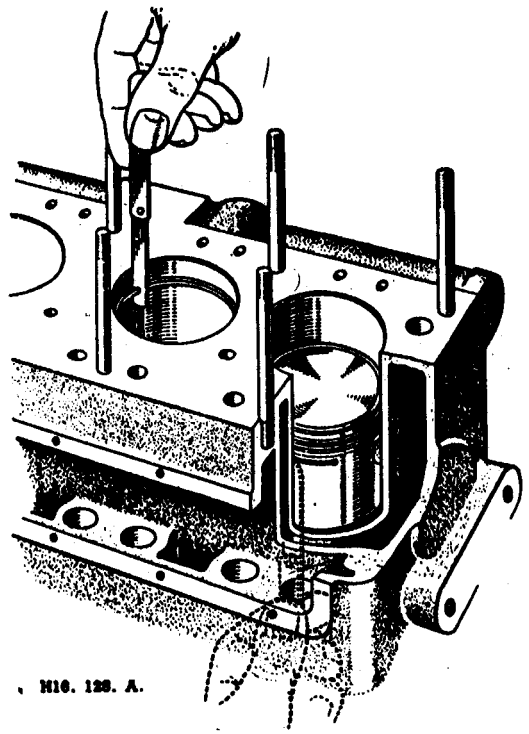


Fig. 20. Checking the piston ring gap and the clearance between the piston and cylinder walls. Pistons and rings are available in oversizes of $+\frac{1}{32}$-in. and $+\frac{1}{16}$-in.

Ensure that the rings are free in their respective grooves in the piston.

A Piston Ring Guide will facilitate the replacement of the piston assembly (see Section S/2).

Oversize Piston Rings

After fitting oversize piston rings there may be a tendency to noisy operation unless attention is paid to any bore 'lip' which may be present in the cylinder. A dial gauge in the cylinder will show the presence of such a 'lip'; it should be eased with the aid of a hand scraper.

Bearings

The bearings can often be dealt with while the engine is in the chassis, but for major overhauls it is preferable to take out the engine unit complete. These bearings are most easily serviced with the engine inverted.

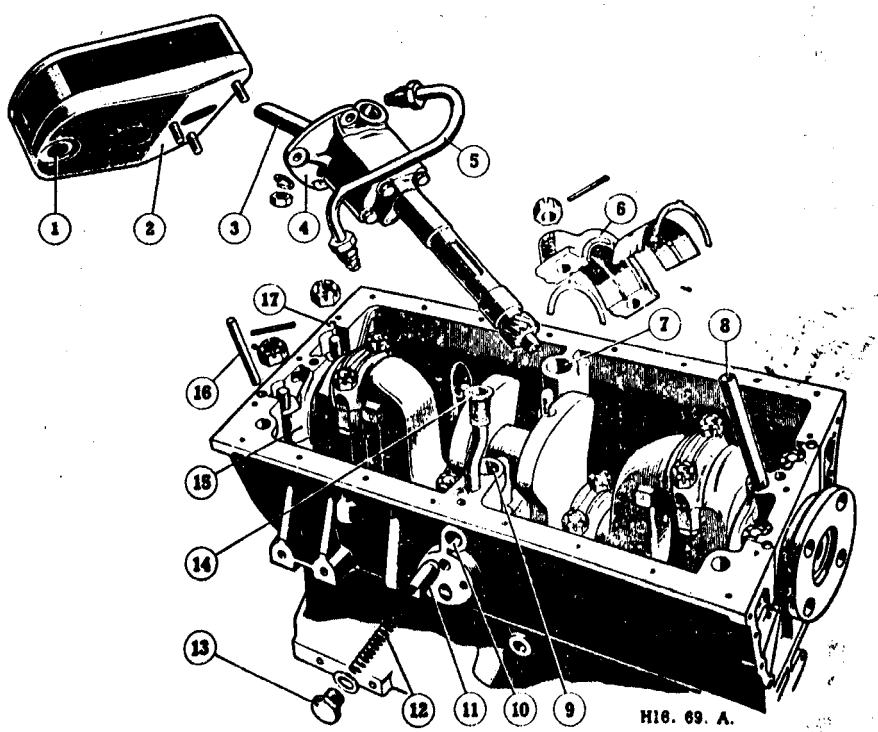
Fig. 21 gives a view of the engine in this position with the sump detached and the centre main bearing cap removed, special attention being drawn to the pair of thrust washers each side.

Centre Bearing

There are thrust washers fitted on each side of the centre bearing. See that the peg formed on each pair fits into the bearing cap (Fig. 21). The end float permissible is from .002 to .003-in.

Fig. 21. An inverted view of the engine.

1. Oil return.
2. Oil strainer.
3. Suction pipe.
4. Bottom cover.
5. Oil delivery pipe.
6. Main centre bearing cap.
7. Oil pump housing.
8. Oil drain pipe.
9. Oil delivery pipe connection.
10. Release valve housing.
11. Oil release valve.
12. Spring.
13. Plug.
14. Oil return pipe.
15. Main rear bearing cap.
16. Cork plug.
17. Drilling for cork plug.



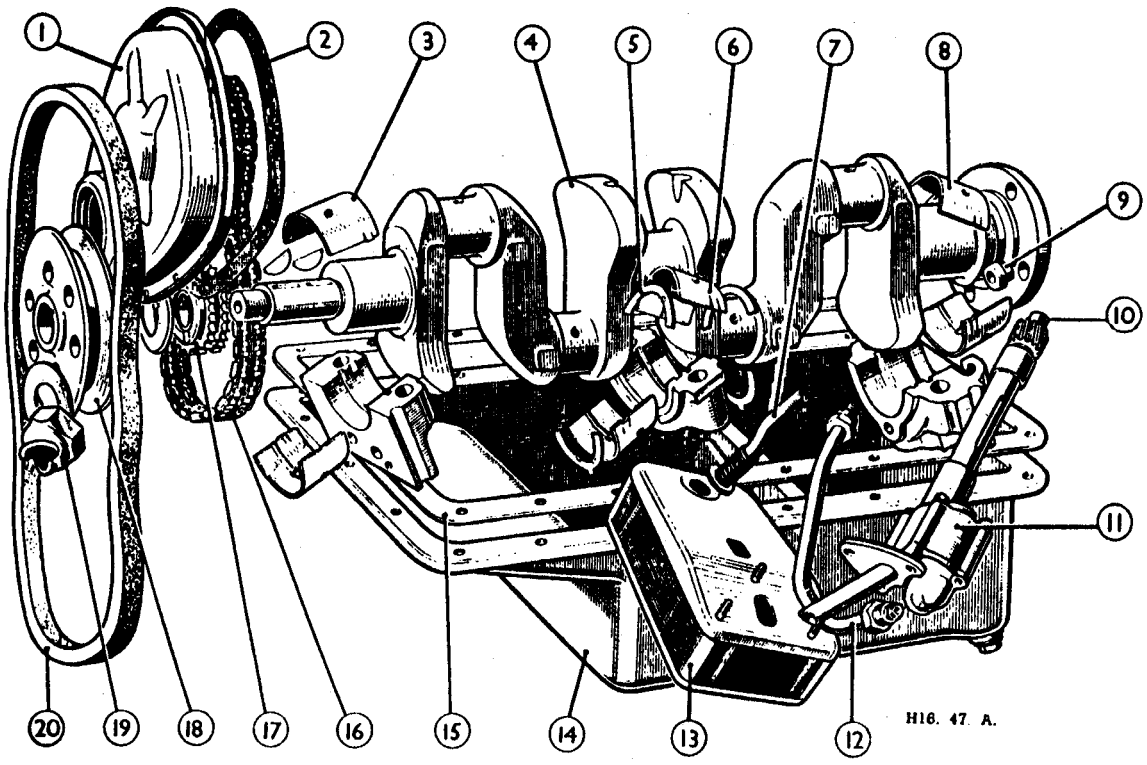


Fig. 22. Crankshaft and sump assembly.

1. Front cover.
2. Joint washer.
3. Main front bearing.
4. Crankshaft.
5. Thrust washer.
6. Main centre bearing.
7. Oil return pipe.
8. Main rear bearing.
9. Flywheel nut.
10. Oil pump spindle.
11. Oil pump body.
12. Oil delivery pipe.
13. Oil strainer.
14. Oil reservoir.
15. Joint washer.
16. Timing chain.
17. Crankshaft gear.
18. Fan pulley.
19. Starting nut.
20. Fan belt.

Bearing Caps

The front and rear main bearing caps have cork oil sealing plugs fitting into a drilling on each side (Fig. 21). In rebuilding see that these plugs are in place and in good condition.

Provided the journals are not unduly worn new shell bearings can be fitted a pair at a time, simply by removing the bearing caps and exchanging the shells.

Handle the new shell bearing halves carefully as they have a very fine finish, and ensure that all dirt and grit is removed from the bearing caps and the journal faces.

When fitting bearings ensure that all bearing caps are replaced the right way round as shown by the stamp markings which face the camshaft. See that connecting rod caps are retained for the same connecting rods, and that they are refitted the same way round as found when dismantling.

The rear main bearing cap horizontal joint surfaces should be thoroughly cleaned and lightly covered with Well-seal compound before the cap is fitted to the cylinder block. This will ensure a perfect oil seal when the cap is bolted down on the block.

Timing Chain Tensioner

The rubber tensioner ring (see Section D, Fig.2) fitted to the camshaft gear sprocket ensures quiet running by constantly taking up the slack in the timing chain.

This ring should be inspected each time the chain cover is removed and if there are signs of wear or damage the ring should be replaced; it is not sufficient to lay the entire blame for rattles on the timing chain.

Withdrawing the Camshaft

First remove the oil sump, the oil strainer and the oil pump as described in Section D, followed by the distributor and driving spindle.

The timing gear cover should then be removed together with the valve rocker cover and engine

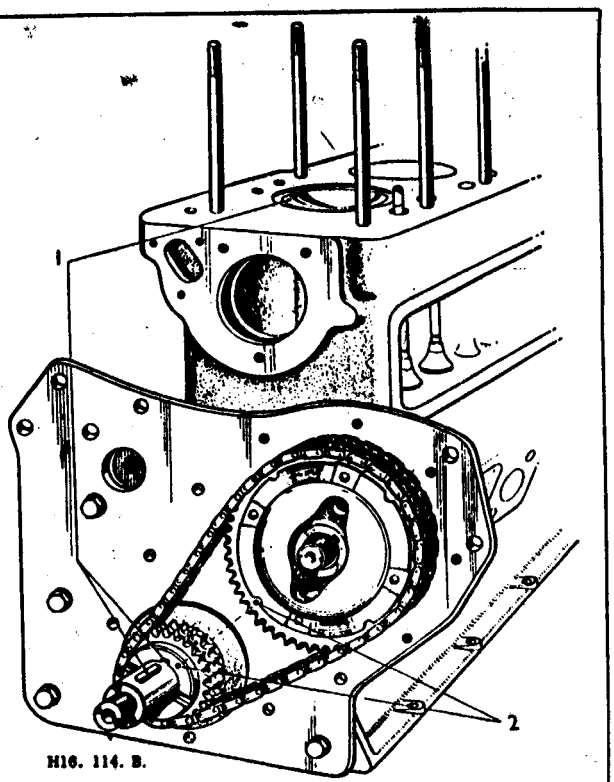


Fig. 23. The timing gear and chain.
1. Pistons 1 and 4 at T.D.C. with the relative positions of the crankshaft and camshaft keys :
2. The correct positions of the 'spots' on both timing gears.

side cover. The push rods, tappets, timing gears and chain can now be taken away.

Unscrew the set screws and spring washers holding the locating plate to the crankcase, and draw the camshaft forward, rotating slowly to assist with withdrawal.

There should be a clearance of .002-in. between the camshaft gear and the camshaft shoulder when assembled to provide a float. Check this with a feeler gauge.

Camshaft Bearings

These can only be renewed with the engine out of the frame, as the engine rear mounting plate must be removed for access to the back bearing (see pages 10, 11, 12 for engine removal).

Old bearing liners can be punched out and new ones tapped into position Oil holes must be carefully lined up.

All bearings must, however, be reamed in line to give .001-in. to .002-in. clearance on each.

Replacing the Camshaft

Replacement of camshaft is a reversal of the above procedure.

Fitting a Timing Chain

The chain must be fitted to the sprockets while both are away from the engine, as no spring link is provided.

If the camshaft sprocket has been separated from the camshaft the smaller sprocket must first be engaged with the crankshaft and passed over the keys (see Fig. 23). The larger sprocket at the same time passing over the camshaft key and being finally secured by means of a nut and spring washer.

Timing Marks

The timing gears are spot-marked and the timing is correct when the spot on the camshaft gear is in line with the spot on the crankshaft gear at their closest position (see Fig. 24). To check the valve timing the inlet valve must be timed to open 5° before top dead centre, the equivalent of which on the flywheel is a point $\frac{9}{16}$-in. before T.D.C. on a diameter of 12 $\frac{13}{16}$-in., tappets being set to .021-in. before timing. These should be re-adjusted to .012-in. afterwards for normal running.

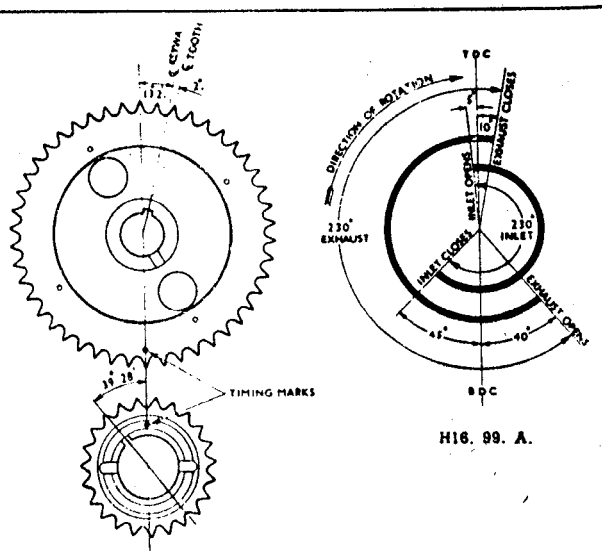


Fig. 24. Showing technical diagram of valve timing and the relative positions of the timing marks on the sprockets.

Refill engine with recommended oil to the correct level.

DIAGNOSIS AND CORRECTION OF FAULTS

Fault and Possible Cause	Rectification
Lack of Power	
Low or poor compression	Decarbonise and regrind valves.
Defective or retarded ignition	Check ignition system.
Incorrect valve clearance	Reset clearance on each valve.
Choked jets	Remove and clear foreign matter.
Overheating	Check cooling system.
Incorrect grade of oil	Drain and refill with correct grade.
Leaking joint washers	Carefully check and replace as necessary.
High Fuel Consumption	
Retarded ignition	Check ignition system.
Air cleaner to carburetter dirty	Clean as described in 'Fuel System'.
Sticking valves	Clean valve guides and polish valve stems.
Faulty sparking plugs	Clean and check gap. Replace if necessary.
Petrol leaks in general	Check all joints and connections.
Carburetter incorrectly set	Reset as specified.
Low Compression	
Leaking valves	Reface and 'grind in'.
Badly fitting piston rings	Refit with correct clearances.
Broken piston rings	Renew the piston rings.
Valve springs weak or broken	Renew springs as necessary.
Piston ring grooves worn	Fit new piston.
Scored or worn cylinder bores	Rebore cylinder and fit new pistons and rings.
Valve stems or guides worn	Replace worn parts.
Valve timing incorrectly set	Reset as specified.
Burned Valves or Seats	
Valve spring weak or broken	Renew springs as necessary.
Sticking valves	Clean valve guides and polish valve stems.
Incorrect valve timing	Reset as specified.
Excessive carbon around valve seat or head	Clean away carbon and reface valves.
Incorrect valve clearance	Reset clearance on each valve.
Sticking tappet	Ease or replace as necessary.
Overheating	Check cooling system.
Rocker arm stuck	Free the rocker arm or replace.
Sticking Valves	
Bent valve	Replace the valve.
Scored valve stem	Polish stem and clean the stem or replace.
Incorrect clearance between valve and guide	Check clearance and refit.
Incorrect valve clearance	Reset clearance on each valve.
Valve spring weak or broken	Renew springs as necessary.
Tappets sticking	Check clearances.

DIAGNOSIS AND CORRECTION OF FAULTS—continued

Fault and Possible Cause	Rectification
Excessive Cylinder wear	
Incorrect grade of oil	Use recommended grades.
Lack of oil	Maintain correct oil level.
Dirty oil	Change oil, using correct grade.
Overheating	Check over Cooling System.
Air cleaner dirty (dust entering combustion chamber)	Clean, and if oil bath type, maintain correct oil level.
Fuel mixture setting too rich	Reset carburetter.
Piston rings stuck in grooves or broken	Replace and refit pistons rings.
Badly fitted pistons	Refit to clearances specified.
Excessive Oil Consumption	
Piston rings badly fitted	Replace and refit piston rings.
Piston rings stuck or broken	Replace and refit piston rings.
Oil return holes in piston choked with carbon	Remove carbon from groove and oil holes.
Excessive cylinder wear	Rebore and fit new pistons and rings.
Cylinder scored	Rebore and fit new pistons and rings.
Oil level too high	Maintain correct oil level.
Oil leaks from washers	Check carefully all joints concerned.
Crankshaft and Connecting Rod Bearing failure	
Crankshaft oil ways restricted	Thoroughly clean all oil ways.
Crankshaft journals worn	Regrind or replace.
Crankshaft bearings loose	Tighten up as necessary.
Lack of oil	Maintain correct oil level.
Incorrect grades of oil	Drain and refill with correct grade.
Low oil pressure	Check filters and oil pump.
Connecting rod bent	Re-align or replace.
Connecting rod bearings loose	Tighten up as necessary.
Overheating	
Cooling system defective	Check Cooling System over carefully.
Thermostat not working	Replace if damaged.
Dirty air cleaner	Clean, and if oil bath type, maintain.
Incorrect valve timing (too early)	Reset as specified.
Fuel mixture setting too weak	Reset carburetter.
Incorrect grade of oil	Drain and refill with correct grade of oil.
Defective or retarded ignition	Check ignition system.
Intermittent running and "Popping back"	
Defective ignition	Carefully check ignition system settings.
Sparking plugs in bad condition	Clean and set gaps. Replace if necessary.
Incorrect carburetter adjustment	Reset carburetter, as specified.
Valve timing set too early	Reset valve timing, as specified.
Weak valve springs	Replace valve springs.
Valves not correctly seated	Regrind valves.
Valve adjustment too closely set	Reset valve clearance.

GEARBOX

GENERAL DATA

Type	Synchromesh on 2nd, 3rd, top
Gear Control	Central lever
Number of Gears	4 Forward, 1 Reverse
Type of Gears	Single Helical
Gear Ratio: 1st Speed	3.79
2nd Speed	2.47
3rd Speed	1.385
4th Speed	Direct
Reverse	4.675

Overall Gear Ratios:

	Early type	Later type
1st Speed	19.7	18.2
2nd Speed	12.85	11.86
3rd Speed	7.2	6.63
4th Speed	5.2	4.8
Reverse	24.34	22.46

Oil Capacity .. .. .. 4 Pints

BEARINGS

3rd Motion Shaft, Front:	
Make	Salter
Type	C105D. Roller Bearing
Size	$\frac{7}{8}$ x $1\frac{1}{4}$ x $1\frac{1}{2}$-ins.
3rd Motion Shaft, Centre:	
Make	R. & M.
Type	MJ $1\frac{1}{4}$ 3 Dot
Size	$1\frac{1}{4}$ x $3\frac{1}{8}$ x $\frac{7}{8}$-ins.
3rd Motion Shaft, Rear:	
Make	R. & M.
Type	MJ $1\frac{1}{4}$ 2 Dot
Size	$1\frac{1}{8}$ x $2\frac{13}{16}$ x $\frac{13}{16}$-ins.
1st Motion Shaft:	
Make	R. & M.
Type	LJ$1\frac{1}{4}$ 3 Dot
Size	$1\frac{1}{4}$ x $3\frac{1}{4}$ x $\frac{7}{8}$-ins.

REMOVING THE GEARBOX

Jack up the vehicle with wood blocks under the axles, front and rear, high enough to allow comfortable working from below. If blocks under wheels are preferred, three only must be used with one end of the rear axle being jacked thus leaving one wheel free in order that the propeller shaft may be turned by hand when removing the four coupling nuts and bolts.

The gearbox may be drained if so desired before commencing work by withdrawing the drain plug in the gearbox base.

Disconnect the battery cables as a safety measure.

Working inside the driving compartment remove the rubber pads from the clutch and brake pedals then turn back the carpet and withdraw the screws fixing the toe plate. Remove the toe plate and the gearbox cover plate.

From beneath the bonnet disconnect the flexible oil gauge pipe—this is a precaution against the pipe being damaged due to handling in the removal operations.

Next, disconnect the starter cables and release the two clutch/engine flange bolts which secure the starter in place. Remove the starter.

Disconnect the exhaust down pipe at the manifold flange and let the pipe hang loose.

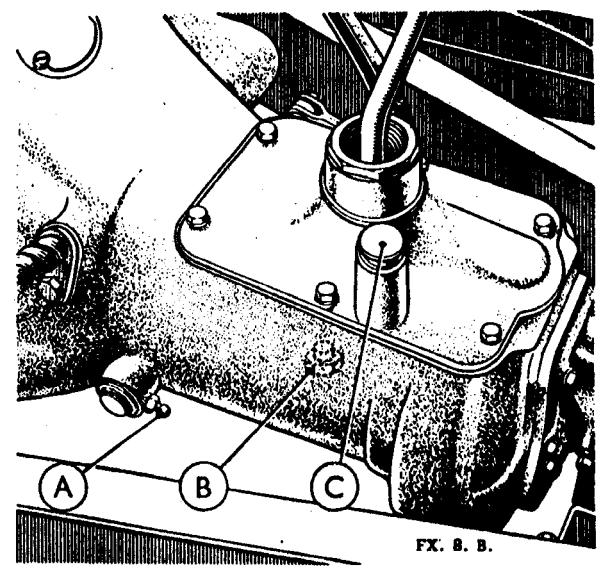


Fig. 1. The gearbox lubrication points.
A. Clutch cross-shaft nipple; B. Drain plug; C. Dipstick.

Dismantle the clutch operating linkage from the clutch main operating shaft by releasing the shaft nut and withdrawing the linkage.

Separate the propeller shaft from the gearbox

A SECTIONAL VIEW OF THE GEARBOX

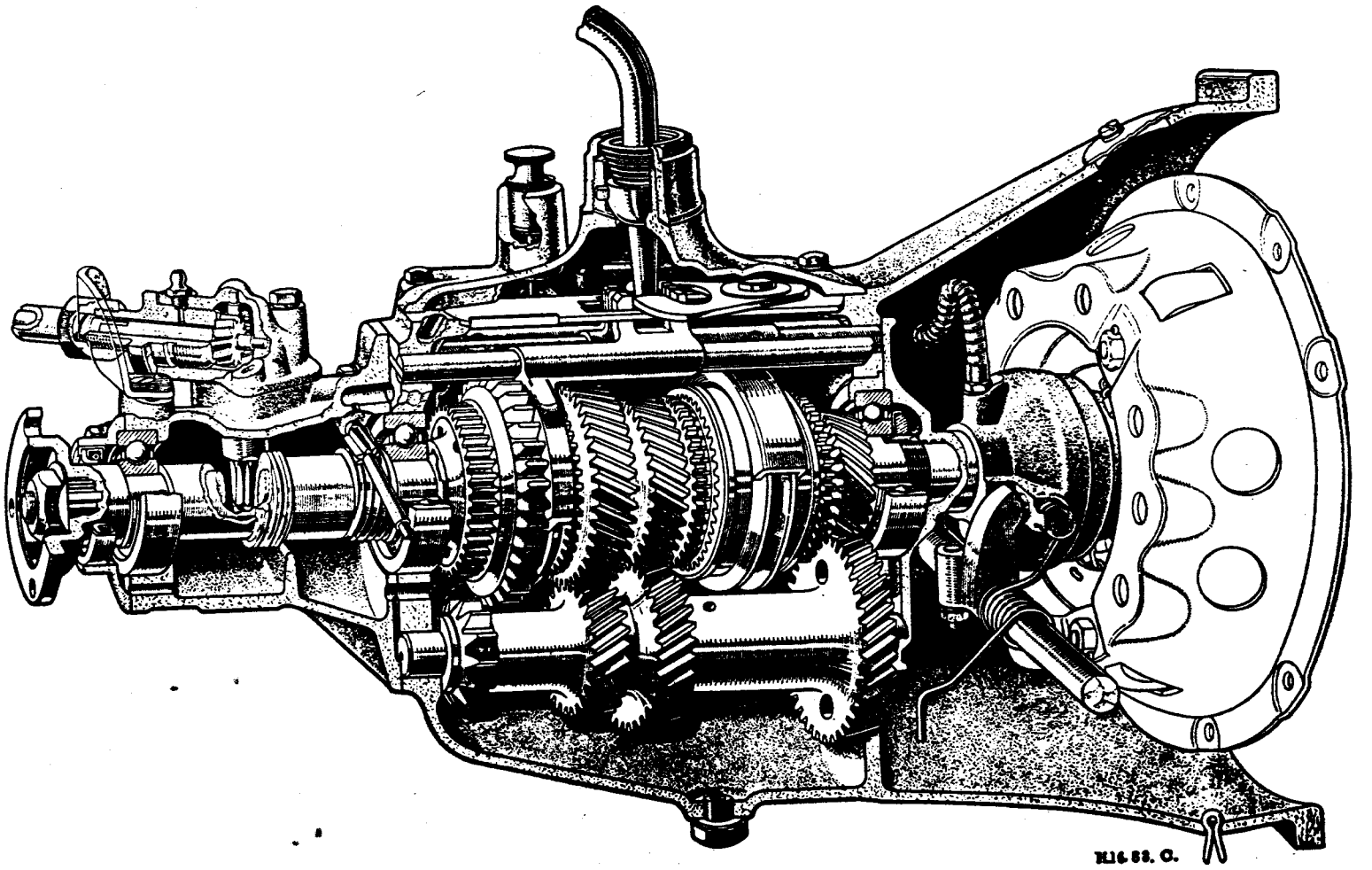


Fig. 2. This sectional view of the gearbox clearly shows the assembly of the various change speed forks and their connections to the coupling sleeves. The extended third motion shaft with its special housing, speedometer drive wheel and taximeter are also indicated.

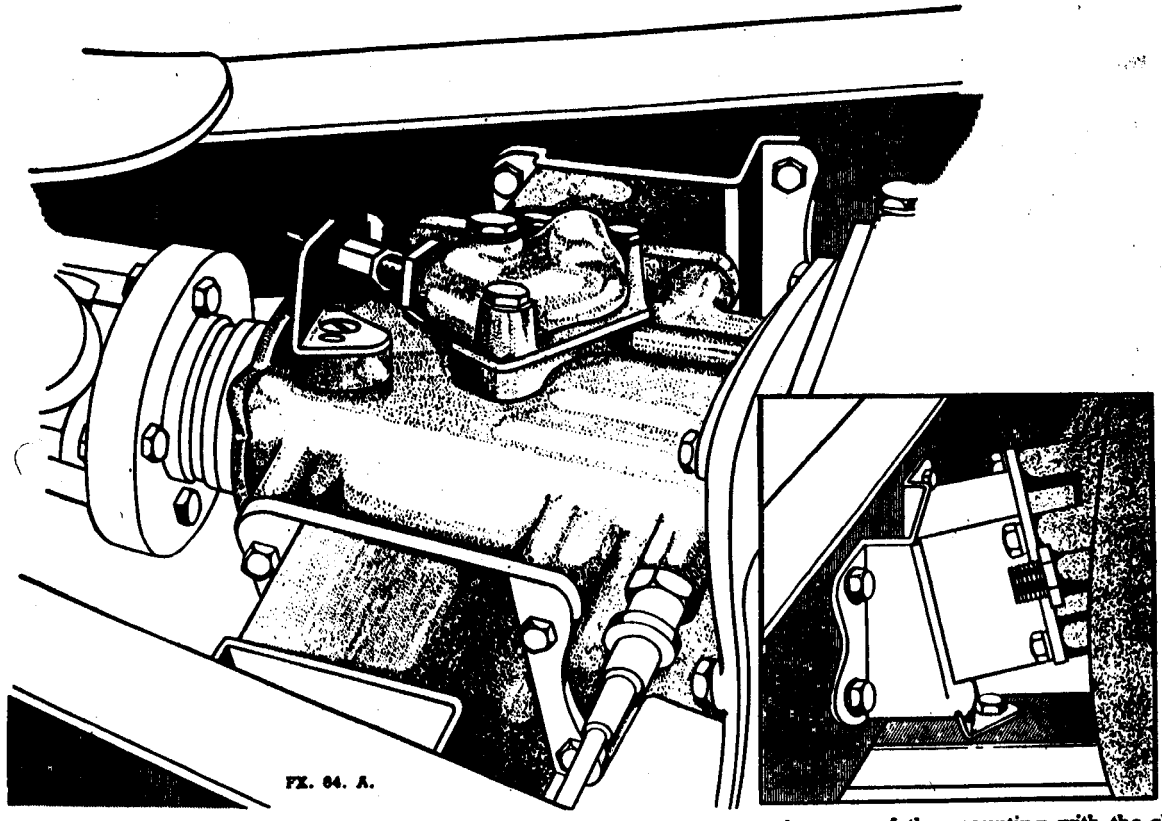


Fig. 3. Showing the gearbox rubber mounting brackets. Inset illustrates a close up of the mounting with the chassis side member bolts and the cross member bolts that must be withdrawn.

driving flange by straightening the lockwasher tabs and removing the flange nuts and bolts. Slide the propeller shaft rearwards.

Withdraw the tachometer drive from the right-hand side of the gearbox casing and if the vehicle is a taxi withdraw the taximeter drive from the left side of the box.

Next, support the engine beneath its oil reservoir by a screw type jack or suitable packing, then commence to release the rear mounting. This is done by removing the short cross member, immediately before the propeller shaft tunnel, secured to the chassis diagonal members by a nut and bolt at each side. The main mounting brackets should be left attached to the gearbox, but should be released from the chassis diagonals. Each bracket is fixed to these members by four nuts and bolts.

Now proceed to take out the bolts from the flywheel housing to the engine rear mounting plate. There are ten points altogether, two of which are studs permanently screwed into the flywheel housing. Two other points are set-screws into the housing whilst the rest are bolts including those which have already been extracted when the starter was removed. During this operation a second operator must be inside the vehicle to take the weight of the gearbox, with a rope sling, and to steady the box by means of the gear lever.

Finally, move the gearbox rearwards an amount sufficient to clear the flywheel and clutch then gently lower the box to the ground.

Refitting the gearbox is a reversal of these operations, but care must be taken when entering the first motion shaft into the clutch and flywheel.

DISMANTLING THE GEARBOX

Taximeter Drive

Where a taximeter is fitted, the drive becomes the first item in the gearbox dismantling procedure. First withdraw the single countersunk head screw which holds the union nut locking bracket in place. The head of this screw is sealed under Metropolitan Police regulations and should not be tampered with unless prior permission has been gained.

With the screw withdrawn the locking bracket may be removed, then the three long setpins which secure the drive housing to the gearbox top casing can be extracted and the drive pinion withdrawn from the gearbox.

Clutch Shaft and Release Bearing

To remove the clutch shaft it is first necessary to remove the nipple from the end of the release bearing lubricating pipe. The flexible pipe may then be pulled clear of the bell housing flange.

Next, extract the single setpin and remove the pipe keep-plate from the side of the bell housing. Pull out the split type oil seal.

Working inside the bell housing pull off the two springs which retain the release bearing assembly in position. These springs are not interchangeable therefore careful note must be taken of their fitting. Lift out the release bearing.

Remove the two nuts and washers from the cotter pins of the clutch shaft fork and tap out the cotters. The clutch shaft can now be withdrawn from the right-hand side of the bell housing threading it clear of the springs and operating fork.

Front Cover

Release the front cover nuts, of which there are six, with their washers, then pull away the front cover, endeavouring not to damage the paper joint washer beneath it or the packing shims within the cover bearing recess, and thread the cover over the first motion shaft.

Top Cover and Change Speed Gate

Undo the six top cover setpins and lift off the top cover complete with lever. Take care not to damage the joint washer.

Lift out the change speed gate.

Rear Oil Seal and Driving Flange

Lock up the gearbox in a forward speed and reverse speed to prevent the driving flange from turning.

Knock back the tab of the lock washer securing the driving flange nut. Pull off the flange.

The oil seal cover is held by four setscrews ; take off the cover together with its joint washer and tap out the oil seal. However, an oil seal should never be taken out unless the intention is that it should be renewed for it is difficult to remove a seal without causing it damage. When fitting a new oil seal ensure that its lip faces the gearbox.

Rear Extension Cover

The main rear cover is secured to the gearbox by six nuts. Once these nuts and their washers have been removed and the speedometer pinion extracted the rear cover complete with rear bearing can be pulled away from the gearbox and the joint washer removed.

With the cover removed, the distance piece, taximeter drive wheel and speedometer wheel can be withdrawn from the third motion shaft.

Change Speed Forks and Rods

Unlock the gears. Remove the fork rod ocationl strip at the rear end of the gearbox then drive out the fork rods from the rear end of the casing retrieving them at the front face. If the box has not to be completely stripped, care must be taken to catch the steel location balls as the rods pass through the forks. On the other hand if the box is to be completely taken down, the balls may be allowed to fall to the bottom of the case from whence they may be retrieved at a later time.

Lift out the forks.

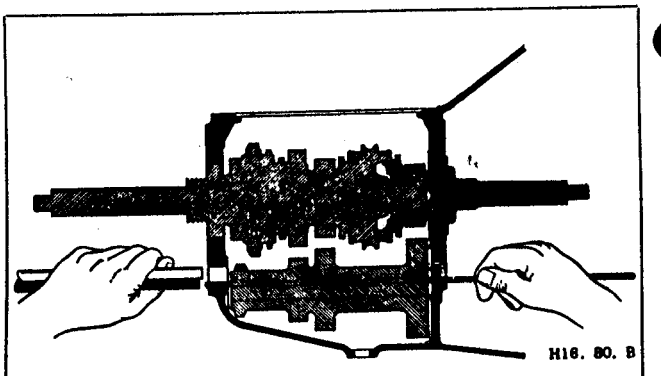


Fig. 4. As an alternative to allowing the laygears to fall to the bottom of the box, a thin pilot rod may be passed through the gears as the shaft is withdrawn.

Laygears

The laygears can only be extracted from the gearbox when the third motion shaft has been removed, but in order to remove the third or first motion shaft the laygears must be lowered out of mesh.

This is simply achieved by driving out the layshaft from the rear of the gearcase and extracting it from the front face. The laygears will thus fall to the base of the casing and so out of mesh, to be taken out at a later stage of the gearbox stripping.

First Motion Shaft

Before attempting to remove the first motion shaft a suitable half collar should be made, large enough in diameter to cover the face of the outer race of the front bearing yet not so large as to foul the case. This half collar is placed over the first motion shaft, directly behind the front bearing, in order that the complete bearing may be extracted when the shaft is driven out.

To drive out the first motion shaft, knock the end of the third motion shaft forward until the front race has left its housing when the first motion shaft, complete with gears, bearing and third motion shaft spigot bush bearing, can be withdrawn through the bell housing opening.

Third Motion Shaft

After extracting the first motion shaft, drive the third motion shaft back into its correct position and pull from the shaft the third and fourth synchroniser and coupling.

Next remove the key from the shaft splines and turn the lock ring until its splines mesh with those of the shaft then extract the ring.

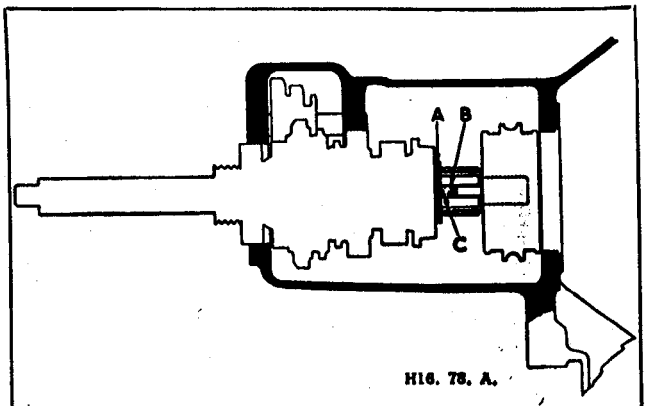


Fig. 5. Location of the third motion shaft locking peg and key. A. Lock ring; B. Key; C. Locking peg.

Knock the third motion shaft through the rear of the case when all the remaining shaft gears, the two sleeves and their coupling washer will be stripped off the shaft and so retrieved from within the box.

With the shaft removed to a bench the spring and plunger may be extracted from the third motion shaft, also remove the rear bearing.

At this opportune moment the laygears may be lifted out of the gearbox.

Reverse Gears

From inside the gearbox, push the reverse gear shaft to the rear and out of the box, then lift out the reverse gears.

Finally, retrieve the bits and pieces now at the bottom of the gearbox—the speed fork locating balls and the laygear thrust washers.

It will be found that the front laygear thrust washer is a snug fit in its recess in the front of the casing.

REASSEMBLING THE GEARBOX

Perfect cleanliness of the gearbox parts is essential before assembly can commence. Although the following complete assembly operation has been sub-divided, it is advisable for the operator to read the whole description before commencing any work as the sub-assemblies of the various parts are so interwoven with one another.

To reassemble the gearbox proceed as follows:—

Layshaft Gears

First position the layshaft front thrust washer in its casing recess. Rest the gears in the bottom of the box and position the rear thrust washer.

Pass a thin pilot bar through from the rear of the casing so that the complete lay-gear assembly is mounted on the pilot bar, see fig. 4.

Later, when the third and first motion shafts are in position, drive in the layshaft from the rear and extract the pilot bar from the front of the casing. The shaft must be turned so that the 'D' shaped portion, at the front end, is uppermost in order to engage with the locking recess of the front cover.

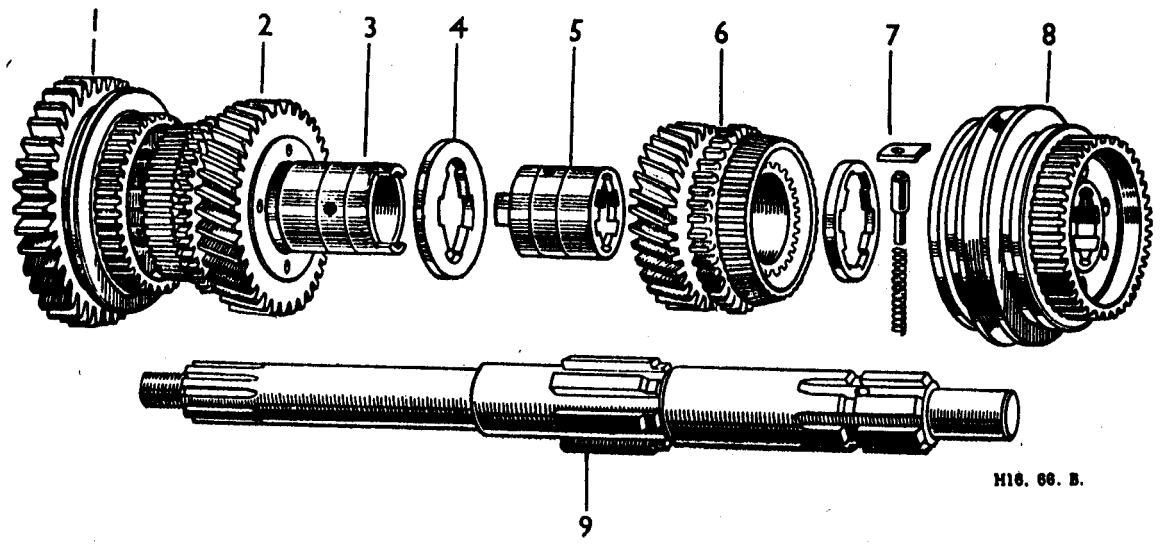


Fig. 6. Assembly order of the third motion shaft and gears.

1. First speed wheel and synchroniser.
2. Second speed gear.
3. First sleeve.
4. Sleeve lock ring.
5. Second sleeve.
6. Third speed gear.
7. Locking peg, key and ring.
8. Third and fourth speed coupling.
9. Third motion shaft.

Reverse Gear

Place the reverse gears in position in the box with the smallest gear facing front, then drive the reverse shaft into place from the rear of the box, taking care that the locking peg in the shaft locates within the socket provided in the gearbox rear face.

Third Motion Shaft

The third motion shaft is replaced in the box complete with all its gears, sleeves, locking plunger and key.

The correct order of assembly on the shaft will be seen in fig. 6, while details of the fitting of the front thrust washer, spring, peg and key is clearly shown in fig. 7.

When fitting the third and fourth speed synchromesh gear it should be noted that one of the internal splines is partly machined away to clear the thrust washer spline key ; the gear can only be fitted in this position.

The centre bush is in three parts—two bushes and a central lock washer. When fitting these bushes the lugs must face one another with the spline of the central ring locking the complete assembly together.

Build up the gears as far as the third speed gear and then fit the splined locked thrust, with its spring, plunger and key. Finally add the third and fourth speed synchroniser and the complete shaft (less rear ball bearing) is ready for fitting in the box.

First, lower the rear end of the shaft through the top cover opening and thread it down through the rear cover and lower the complete assembly

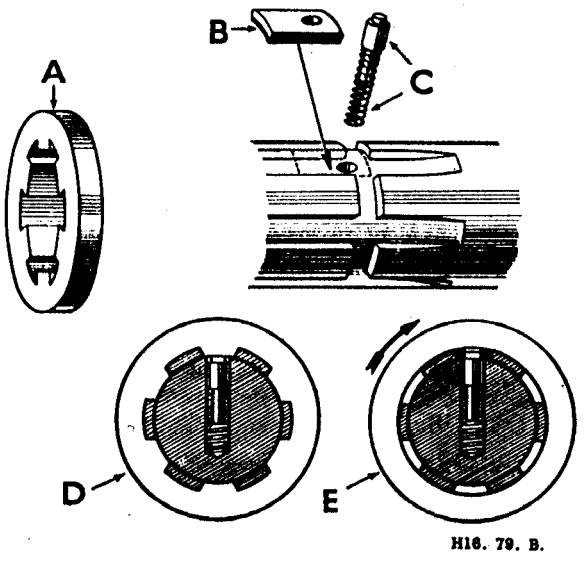


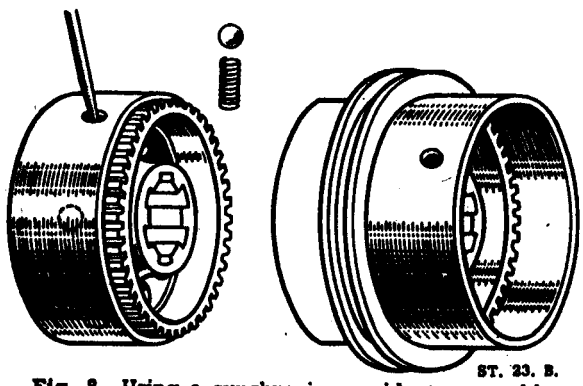
Fig. 7. The third motion shaft locking device.

A. Thrust ring; B. Key; C. Locking peg. Inset D: Thrust washer in position over splines before turning to lock. E. Thrust washer locked after being turned one spline and key inserted.

into position. The first and second speed synchroniser may have to be moved slightly to pass the small boss cast in the box which is a lead for the oil level dipstick.

With the complete shaft in position, the rear ball bearing has to be fitted.

Slide the bearing on the shaft using a drift to finalise it flush in the rear housing. It will be necessary to steady the shaft at the front end to prevent the gears from coming in contact with the front end of the box.



ST. 23. B.

Fig. 8. Using a synchroniser guide to assemble the spring loaded balls to a coupling sleeve and synchroniser.

Synchromesh Sub-Assembly Guide

It should be noted that during manufacture both the first speed wheel and the third and fourth speed coupling sleeve are each paired with their respective synchronisers. Therefore only mated pairs of these parts should be fitted.

Special guides are available to facilitate reassembling the six balls and springs into the speed synchroniser and speed coupling sleeve. The guide is of the same width and diameter as the coupling sleeve.

It will be seen that the machined portion of the guide bore is slipped over the synchroniser and turned until the hole coincides with one of the six sockets in the synchroniser. A spring and ball are then placed in position, the ball depressed and the guide rotated to hold it in position. This procedure is repeated for each spring and ball in turn until they are all held in the depressed position.

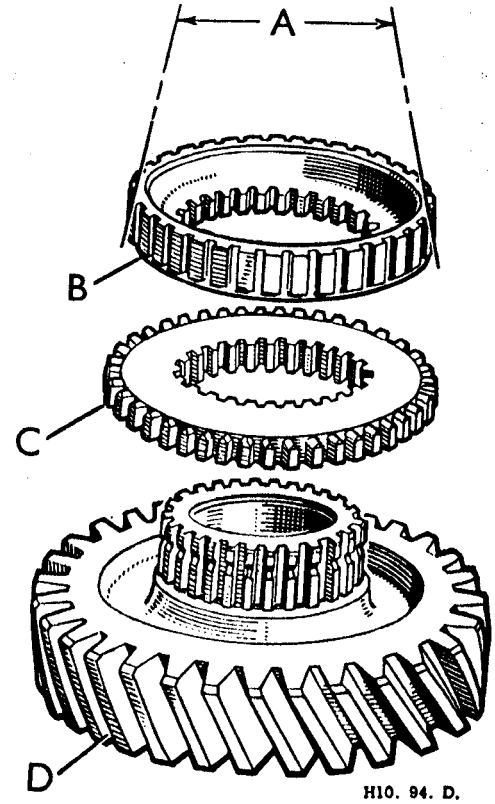
The guide is then pushed further along the synchroniser splines and followed up by the coupling sleeve.

The splined portion of the guide fully depresses the balls against their springs and then, as the coupling sleeve replaces the guide, the balls find their location in the coupling spring groove.

Fitting Gear Synchroniser Cones

The synchroniser cones on the second, third and fourth speed gears are shrunk on to the gear itself, the unit being supplied as a complete assembly for spares purposes. Where facilities exist for shrinking on and final machining however, cones can be supplied separately, but care must be exercised in fitting if the gear is to operate satisfactorily. The internal broaching of the cone is calculated to allow for a shrinkage fit on to the gear serrations, the cone being heat expanded before fitting. When heated to a temperature of approximately 250 degrees Fahrenheit, the expansion will be sufficient to allow the cone to be pressed home on to the gear without damage to the broaching. It will also be close fitting enough to resist displacement in gear changing.

The heating is best done in oil of the required temperature and the cone fitting should be done with the aid of a hand operated press. When the operations are complete the unit should be



H10. 94. D.

Fig. 9. Synchronising cone.
A. Chamfer to be machined after cone is shrunk into position. B. Cone; C. Coupling adaptor; D. Constant mesh gear.

quenched in water to prevent the gear becoming soft.

On each gear the appropriate speed coupling adaptor must be fitted before the cone, but there is no need to pre-heat this adaptor—it can be pressed home cold. The adaptor has a shoulder on one side which must face the gear and not the cone.

When the cone is in position the final machining may be done when the taper of the cone must be true and concentric with the bore to within .001 ins.

First Motion Shaft

Enter the first motion shaft, with its gears and bearing for the third motion shaft spigot, through the orifice in the bell housing and drive home the shaft and bearing using a hide hammer.

Front Cover

Fit the front cover complete with shims and joint washer in place over the studs and tighten the nuts evenly a little at a time. The shims take the thrust of the bearing, their thickness varying according to the race thickness.

Change Speed Forks

Fig. 11 illustrates the special pilot used for loading the ball and spring in each fork ready for entering the fork rod when the fork has been positioned in the box.

First, locate the first and second speed fork in position in the box, then the third and fourth speed fork and finally the reverse fork. Then tap the third and fourth fork rod (centre) through the rear face of the gearbox, the fork and so into position in the front face of the housing, catching the pilot bar in the process as it leaves the fork. Follow the same routine with the first and second fork rod (right-hand orifice) and finally the reverse fork rod.

Level off the slots in the rear ends of the rods and lock them against turning with the location strip.

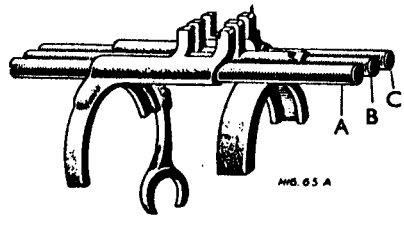


Fig. 10. The correct order of assembly for the change speed forks. A, 1st and 2nd speed fork; C, reverse fork; B, 3rd and 4th speed fork.

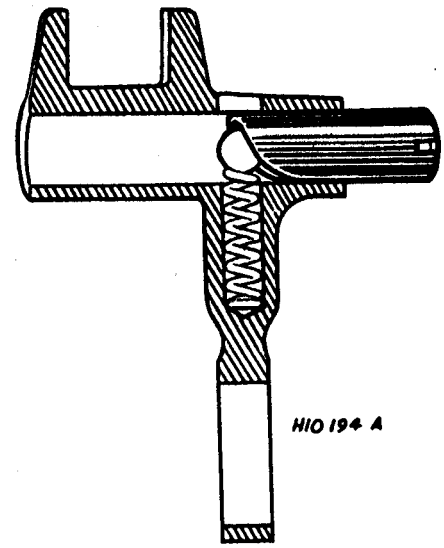


Fig. 11. A section of a selecting fork, showing the pilot drift used for replacing a fork.

Rear Extension Cover

Fit the speedometer ring in place on the third motion shaft, also the taxi drive ring and the distance piece.

Thread the rear extension cover, with the seal cover secured in place and its joint washer, over the third motion shaft, but do not secure it in place until the driving flange has been fitted and its nut securely tightened.

Driving Flange

Fit the driving flange to the third motion shaft, a new lockwasher and then the nut. Tighten the nut fully having first locked the gears, then lock the nut by turning over the tab of the lockwasher.

Now tighten the nuts of the rear extension cover it being finally centralised by tightening the flange nut.

Top Cover

Unlock the gears and position the gate. Now fit the top cover complete with gear lever and joint washer. Tighten the setscrews down evenly and alternately.

Taximeter Drive

Enter the taximeter pinion into the gearbox orifice and guide it into mesh with the drive on the third motion shaft. Secure the housing in position on the top of the box with the three long bolts.

Finally place the locking bracket in position so that the hook encircles the large union nut of the drive and fix the bracket by means of the countersunk head screw.

CLUTCH

GENERAL DATA

Make	Borg and Beck	**Number of Springs**	9
Type ..	Single Dry Plate—Spring Drive	**Total Axial Spring Pressure**	1080—1170 lbs.
Outside Diameter	9ins.	**Distance, Thrust Plate to Thrust Race**	$\frac{1}{16}$in. minimum
Frictional Area	32.9 sq. ins.	**Thrust Plate Travel to Fully Released Position**	.42ins.
Lining Thickness ..	.145—.155ins.	**Pedal Clearance (free movement)**	$\frac{11}{16}$ins.
Thrust Bearing Type	Ball Race		

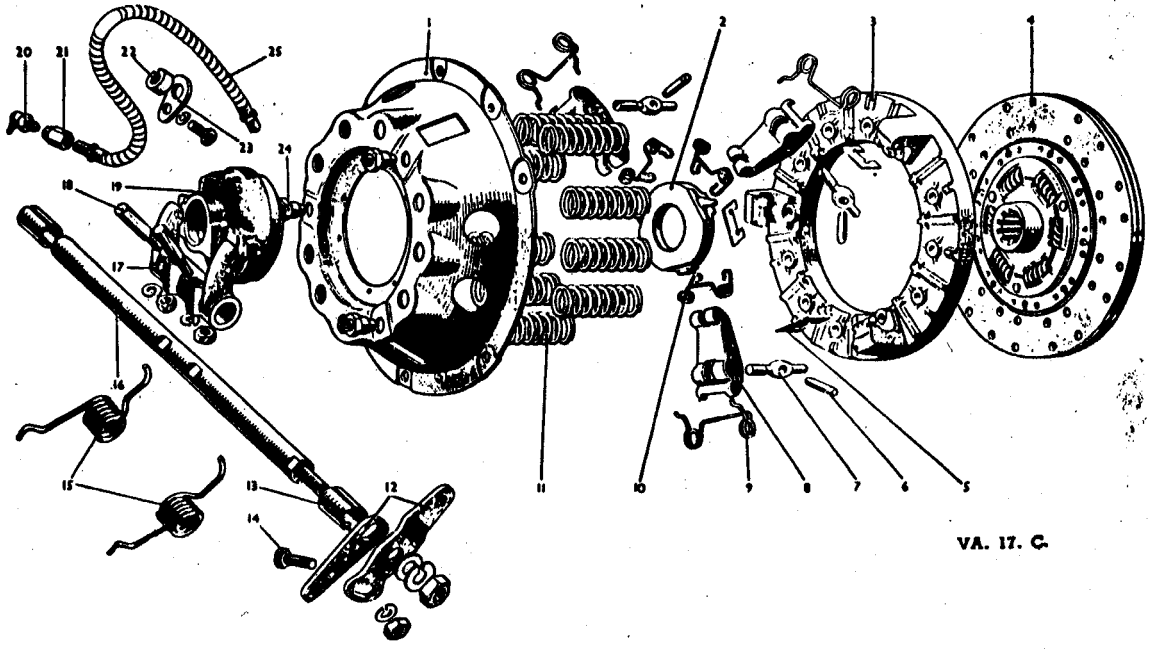


Fig. 1. An exploded view of the clutch.

1. Clutch cover.
2. Release lever plate.
3. Pressure plate assembly.
4. Clutch plate with linings.
5. Strut for release lever.
6. Release lever pin.
7. Eye bolt.
8. Release lever.
9. Anti-rattle spring.
10. Retainer spring.
11. Thrust spring.
12. Shaft lever and adjusting link.
13. Split base bearing.
14. Adjustment bolt.
15. Release bearing springs.
16. Clutch operating shaft.
17. Withdrawal fork.
18. Fork cotter pin.
19. Release bearing and cup.
20. Release bearing oil nipple.
21. Oil nipple union nut.
22. Lubricating pipe seal.
23. Lubricating pipe nut plate.
24. Nut for eye bolt.
25. Flexible lubricating pipe.

General Description

The clutch is of the single dry plate type consisting of a driven plate assembly, a cover assembly and a release bearing assembly.

Driven Plate Assembly

This is of the flexible centre type in which the splined nut 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 rivetted to the disc.

Cover Assembly

The cover assembly consists of a pressed steel cover and a cast iron pressure plate loaded by nine thrust springs. Mounted on the pressure plate are three release levers which pivot on floating pins retained by eyebolts. Adjustment nuts are screwed on to the eyebolts, which pass through the clutch cover, and are secured by staking. Struts are interposed between lugs on the pressure plate and the outer ends of the release levers. Anti-rattle springs are fitted between the release levers and the cover whilst

retainer springs connect the release lever plate to the release levers.

Release Bearing Assembly

The release bearing consists of a thrust ball race fitted into a bearing cup, the cup being located by springs to the operating shaft. An operating fork, cotter pinned to the operating shaft, carries the motion of the shaft to the release bearing assembly.

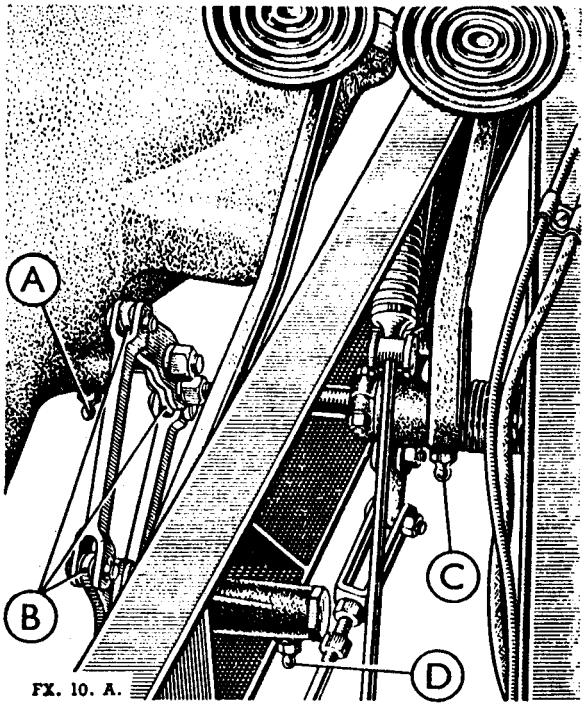


Fig. 2. Pedal and linkage lubricating points.
A. Operating shaft nipple; B. Felt oil pads; C. Brake pedal nipple; D. Clutch pedal cross shaft nipple.

Running Adjustments

The only adjustment necessary throughout the life of the driven plate facings is, periodically, to rsetore the free movement of the clutch pedal, i.e., movement of the pedal before the release bearing comes into contact with the release levers and commences to withdraw the clutch. As the driven plate facings wear, the pressure plate moves closer to the flywheel and the outer ends of the release levers follow. This causes the inner ends of the release levers to travel towards the gearbox and decreases the release bearing clearance or pedal free movement.

The travel of the clutch pedal should be adjusted until the free movement is approximately $\frac{11}{16}$ ins. This is easily accomplished by altering the setting of the adjusting screw—fig. 3, until the pedal moves approximately $\frac{11}{16}$ ins. before

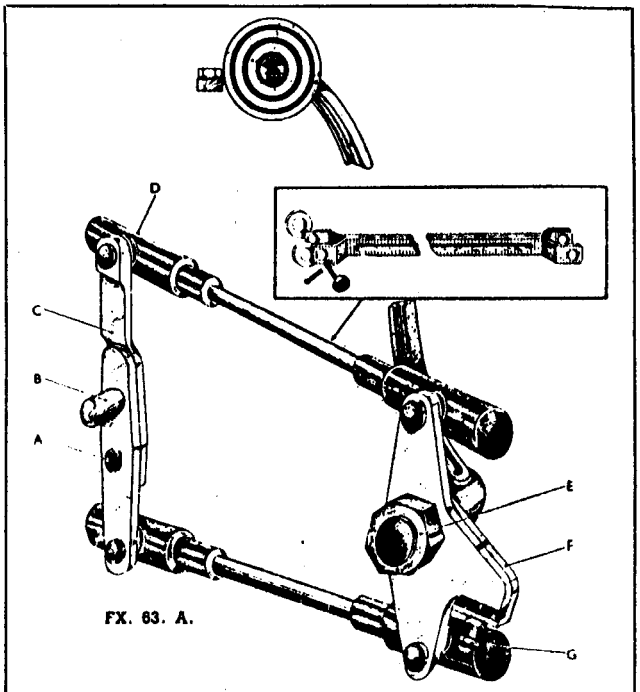


Fig. 3. Clutch pedal linkage.
A. Rocker lever adjusting nut; B. Clutch operating shaft; C. Adjustment lever. D. Ball and socket connection; F. Pedal shaft nut; F. Adjustment plate; G. Pedal adjustment screw.

meeting the resistance of the clutch springs.

To adjust the operating linkage, an operation only necessary when new parts have been fitted to the clutch, slacken the centre securing nut of the front rocker lever also the smaller adjusting nut. Then lightly depress the clutch pedal to take up the clutch bearing clearance. With this movement of the pedal, the adjustable half of the front rocker lever will automatically take up any play and assume the required setting for correct adjustment. Maintain the pressure on the clutch pedal and retighten the two nuts.

Removing the Clutch

The engine and gearbox must be separated, an operation which will be found described on page F/1, after which the screws securing the clutch to the flywheel may be slackened a turn at a time by diagonal selection until the thrust spring is relieved. Remove the screws and lift the complete clutch away from the flywheel. Withdraw the driven plate assembly.

The clutch adjustment nuts are correctly set and locked when the unit is first assembled and they should not be altered unless the clutch has been dismantled and new parts fitted. Interference with this adjustment will throw the pressure plate out of position and cause judder.

DISMANTLING, ASSEMBLING AND GAUGING THE CLUTCH

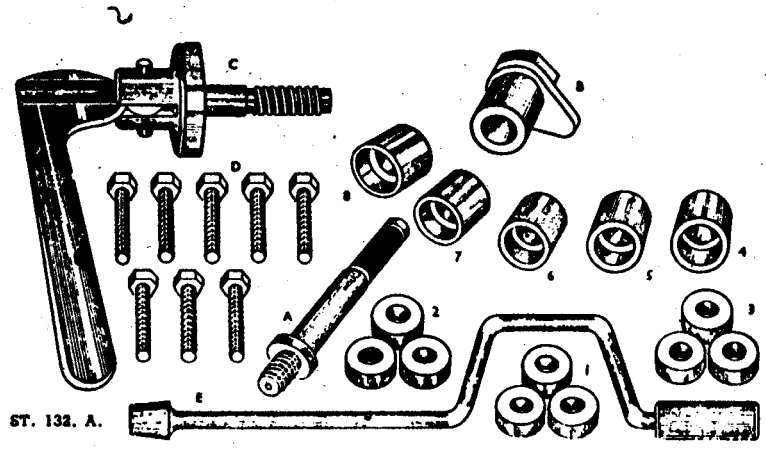


Fig. 4. Parts of the Clutch Assembly Tool.

A. Centre pillar.
B. Height finger.
C. Actuating mechanism.
D. Setpins.
E. Speedbrace.
1. 2. 3. } Spacing washers.
4. 5. 6. 7. 8. } Distance pieces.

By using the new clutch tool, a clutch can be quickly dismantled, reassembled and adjusted to a high degree of accuracy.

The tool comprises the following parts:— a 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 metal box. (See fig. 4).

METHOD OF TOOL OPERATION.

Dismantling

With a 9-in. clutch, select three spacing washers (Code 3) and place them over the code letter (D) on the base plate. (See fig. 5.)

Now place the clutch on to the three spacing 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 eye-bolt nuts or adjusting nuts.

Slowly release the pressure on the springs, unscrewing by diagonal selection, the set screws

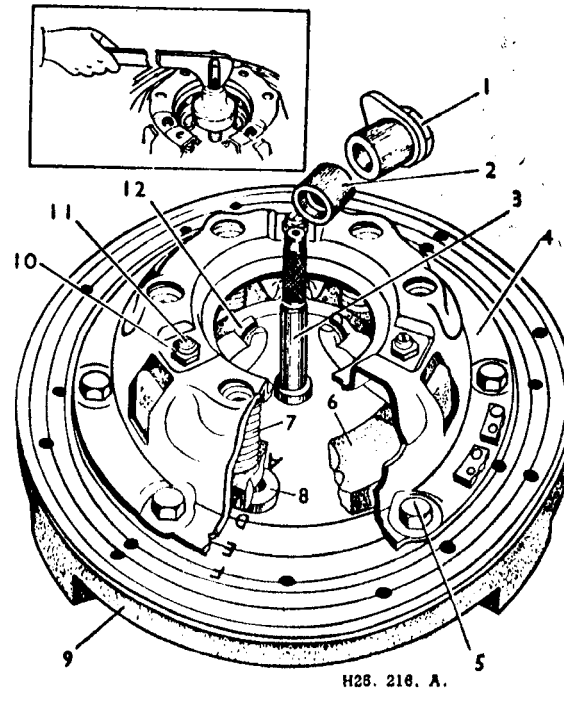


Fig. 5. Clutch assembly tool 18G.99A.

1. Height finger.
2. Distance piece.
3. Centre pillar.
4. Clutch cover.
5. Setscrews.
6. Pressure plate.
7. Thrust springs.
8. Spacing washers.
9. Base plate.
10. Locknuts.
11. Eyebolts.
12. Release levers.

Inset shows the clutch actuating mechanism in use.

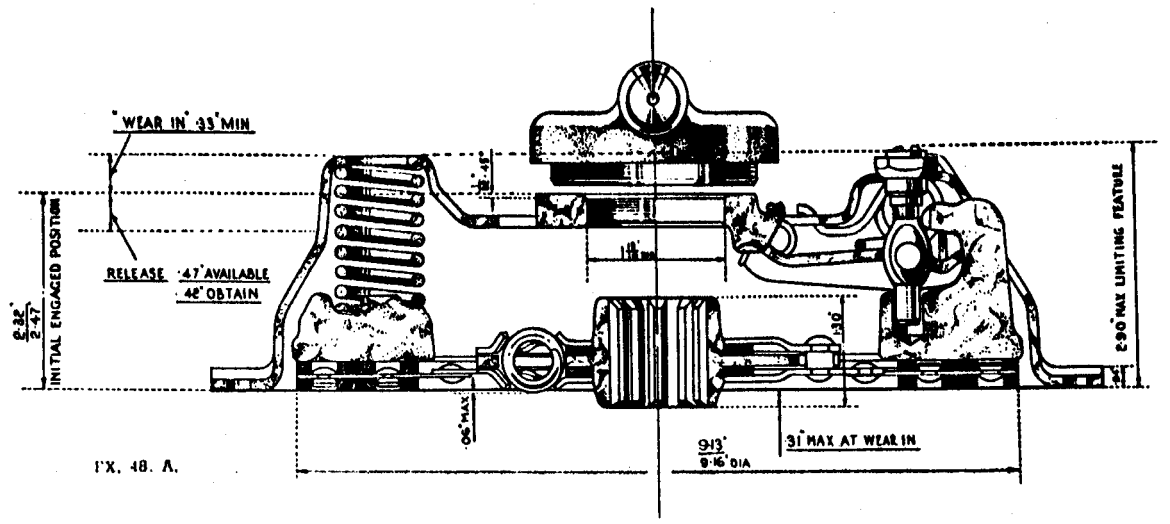


Fig. 6. Dimensional view of the 9-inch clutch.

securing the cover to the base plate. The clutch cover can then be lifted to expose all components for inspection.

The release levers, eye-bolts, struts and springs should be examined for wear and distortion. Renew these parts as 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, eye-bolts, etc., sparingly with grease.

Assembling

Place the pressure plate over the three spacing washers on the base plate (9), with the thrust springs (7) in position on the pressure plate (6). (See fig. 5.)

Assemble the release lever, eye-bolt and pin, holding the threaded end of the eye-bolt 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 eye-bolt 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 (4) over the assembled parts, ensuring that the anti-rattle springs are in position, and that the tops of the thrust springs (7) are directly under the seats in the cover. In addition the machine 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 (4) to the base plate (9) by using the special set screws (5) placed through each hole in the cover. Tighten the screws, a little at a time, by diagonal selection to prevent distortion of the cover. The eye-bolts (11) and pressure plate lugs must be guided through the holes in the cover at the same time.

Gauging

Screw the nuts (10) on to the eye-bolts and proceed to adjust as follows:—

Screw the centre pillar (3) into the base plate and slip the distance piece (2) — (code 7) for 9-in. clutch — over the pillar followed by the cam-shaped height finger (1). Adjust the height of the release levers by screwing or unscrewing the eye-bolt nuts until the height finger, when rotated, just contacts the highest point on the tip of the release levers (12).

Replace the height finger and pillar by the clutch actuating mechanism (see inset fig. 5) 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 eye-bolt nuts (10) and fit the release lever plate on the tips of the release levers (12), then secure by means of the three retaining springs.

Release the set screws (5), a little at a time by diagonal selection, and remove the clutch assembly from the base plate.

Refacing the Driven Plate

When removing old worn facings, the rivets must be drilled and not punched out. Each rivet attaches one facing only. Using a ⅛in. diameter drill, inserted through the hole in the opposite facing, drill out the rivets. After removing the facings, thoroughly examine the segments for cracks. Should cracks be found a new driven plate assembly should be used. Place one facing in position with the countersunk holes coinciding with the ones located on the crown or longer side of each segment.

Insert the rivets with their heads in the countersunk holes of the facing and roll the shanks over securely against the segments. If a rolling tool is not available a blunt end punch will prove satisfactory.

Secure the opposite facing in the same manner, matching the countersunk holes with the remaining holes in the segments. Rivet heads should always face outwards.

Place the assembly on a mandrel between lathe centres and spin for runout. If it should run out of true more than .015ins., prise over as necessary until, the required accuracy is obtained.

Refitting the Clutch

Assemble the driven plate in the flywheel, taking care to place the larger chamfered spline end of the driven plate hub towards the gearbox or rear of the vehicle. Centralise the driven plate by means of a dummy shaft which fits the splined bore of the driven plate hub and the pilot bearing in the flywheel.

Fit the cover assembly to the flywheel by means of the holding screws, tightening them a turn at a time by diagonal selection. Make sure that all screws are securely tightened before removing the dummy shaft.

PROPELLER SHAFT

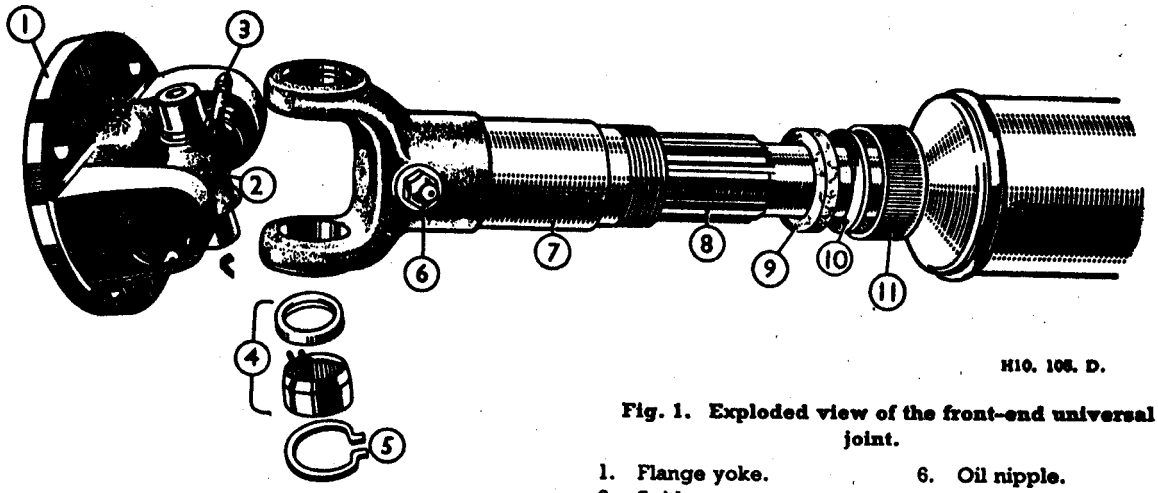


Fig. 1. Exploded view of the front-end universal joint.

1. Flange yoke.
2. Spider.
3. Oil nipple.
4. Needle bearing assembly.
5. Snap ring.
6. Oil nipple.
7. Sleeve yoke.
8. Splines.
9. Cork washer.
10. Steel washer.
11. Dust cap.

Description

The Propeller Shaft and Universal Joints are of Hardy Spicer manufacture (Fig. 1).

The fore and aft movement of the rear axle and other components is accommodated by the provision of a splined joint at the forward end of the shaft. Each joint consists of a centre spider, four needle roller bearings and two yokes. Reference to the Lubrication Chart on page V/3 shows the location of the joints.

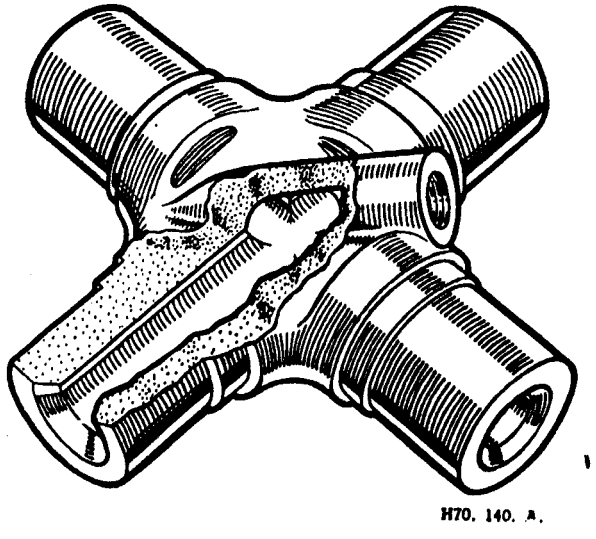


Fig. 2. A cutaway view of the joint spider showing the position of the oil channels.

Lubrication

An oil nipple is fitted to each centre spider for the lubrication of the bearings. Grease must not be used, oil being the correct lubricant. Reference to Fig. 2 shows that the central oil chamber is connected to the four oil reservoirs and to the needle roller bearing assemblies.

The needle roller bearings are filled with oil on assembly. An oil nipple is provided on the sleeve yoke of the sliding spline joint for lubrication of the splines.

If a large amount of oil exudes from the oil seals the joint should be dismantled and new oil seals fitted.

After dismantling, and before reassembly, the inside splines of the sleeve yoke should be liberally smeared with oil.

Tests for Wear

Wear on the thrust faces is located by testing the lift in the joint, either by hand, or by using a length of wood suitably supported.

Any circumferential movement of the shaft relative to the flange yokes, indicates wear in the needle roller bearings, or the sliding spline.

Removal of Complete Assembly

Support the propeller shaft near the sliding joint by wood blocks or a sling from the chassis.

Remove all the nuts and bolts from the companion flange at the sliding spline joint end.

Unscrew by hand, the dust cap at the rear

of the sliding joint. Slide the splined sleeve yoke about half an inch towards the propeller shaft, thus disengaging the pilot flanges.

Next remove all the bolts securing the rear flange yoke from the axle companion flange, and gently lower to a clean space on the ground.

The propeller shaft and the two universal joints can now be removed and dismantled to a further degree.

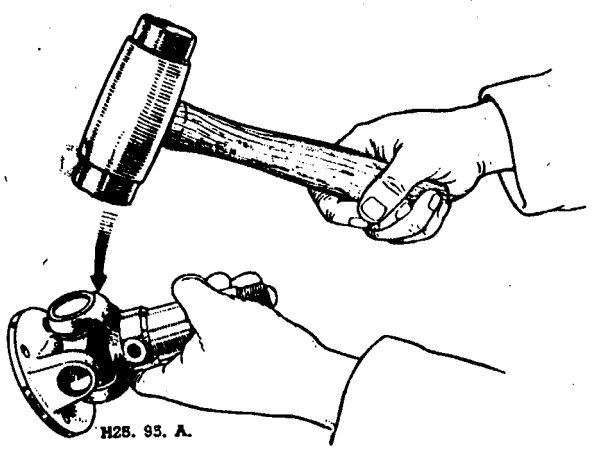


Fig. 3. Tapping the joint to extract a bearing.

Dismantling

The following directions apply to both universal joints, except for the fact that the front joint can be separated from the propeller shaft, whereas the rear joint has one yoke permanently fixed to the tube.

Clean away the enamel from all the snap rings and bearing faces, to ensure easy extraction of the bearings.

Remove the snap rings by pressing together the ends of the rings and extract with a screwdriver. If the ring does not come out easily, tap the bearing face lightly to relieve the pressure against the ring.

Now, holding the joint so that the splined sleeve trunnion is on top, tap the radius of the yoke with a lead or copper hammer (see Fig. 3), and it will be found that the bearing will begin to emerge. If difficulty is experienced, use a small bar to tap the bearing from the inside, taking care not to damage the race itself. Turn the yoke over and extract the bearing with the fingers (see Fig. 4), being careful not to lose any of the needles.

Repeat this operation for the other bearing, and the splined yoke can be removed from the spider (see Fig. 5).

Using a support and directions as before remove the spider from the other yoke.

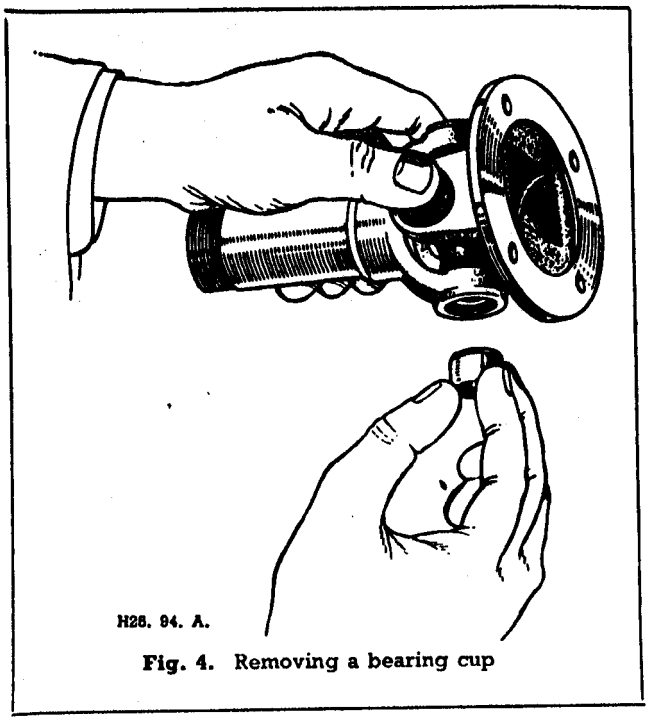


Fig. 4. Removing a bearing cup

Examination and Checking for Wear

After long usage the parts most likely to show signs of wear are the bearing races and the spider journals. Should looseness or stress marks be observed, the assembly should be renewed complete, as no oversize journals or bearings are provided.

It is essential that bearing races are a light drive fit in the yoke trunnions. Should any ovality be apparent in the trunnion bearing holes, new yokes must be fitted.

With reference to wear of the cross holes in a fixed yoke, which is part of the tubular shaft assembly, only in cases of emergency should this be replaced. It should normally be renewed with a complete tubular shaft assembly. The other parts likely to show signs of wear are the splined sleeve yoke, or splined stub shaft. A total of .004-in. circumferential movement,

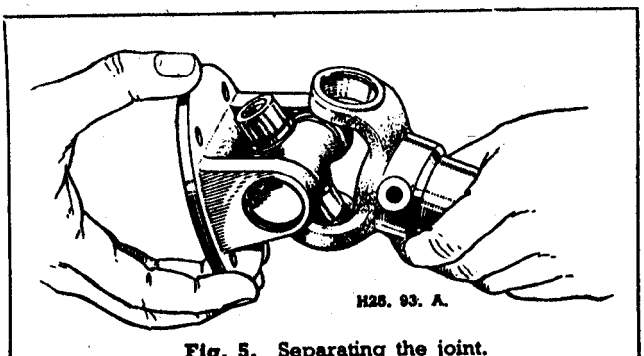


Fig. 5. Separating the joint.

measured on the outside diameter of the spline should not be exceeded. Should the splined stub shaft require renewing, this must be dealt with in the same way as the fixed yoke, i.e., a replacement tubular shaft assembly fitted.

Reassembly

See that all drilled holes in the journals are cleaned out and filled with oil (Fig. 2). Assemble the needle rollers in the bearing races and fill with oil. Should difficulty be experienced in assembly, smear the walls of the races with vaseline to retain the needle rollers in place.

Insert the spider in the flange yoke. Using a soft-nosed drift about $\frac{1}{64}$-in. smaller in diameter than the hole in the yoke, tap the bearing in position. It is essential that bearing races are a light drive fit in the yoke trunnions. Repeat this operation for the other three bearings. The spider journal shoulders should be coated with shellac prior to fitting the retainers to ensure a good seal.

If the joint appears to bind, tap lightly with a wooden mallet, which will relieve any pressure of the bearings on the end of the journals. When replacing the sliding joint on the shaft, be sure that the trunnions in the sliding and fixed yoke are in line. This can be checked by observing that arrows marked on the splined sleeve yoke and the splined stub shaft are in line. It is advisable to renew cork washers and washer retainers on spider journals.

Replacing the Shaft Assembly

Wipe the companion flange and flange yoke faces clean, to ensure that the pilot flange registers properly and the joint faces bed evenly all round. Insert the bolts, and see that the nuts are evenly tightened all round and are securely locked.

The dust cap must be screwed up by hand as far as possible. The sliding joint is always placed towards the front of the vehicle.

FRONT AXLE

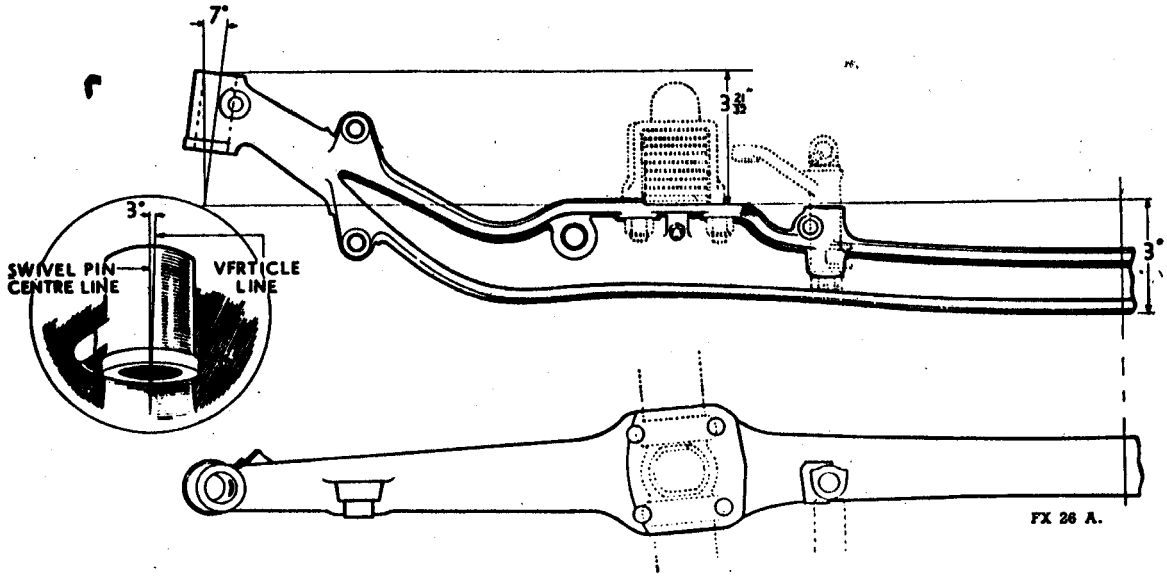


Fig. 1. The axle beam giving essential angles and measurements to check for suspected damage.

GENERAL DATA

Castor angle	3°
Camber angle	1°
Swivel pin inclination	7°
Swivel pin thrust bearing	Clevite
Track-rod location	Rear of axle beam
Inner hub bearing	40×90 23-mm.
Outer hub bearing	1×2½×¾-ins.

SWIVEL AXLE MAINTENANCE

Withdrawing a Swivel Pin

Jack up the vehicle, remove the wheel and clean all the assembly. Take out the setscrew from the top of the swivel housing and remove the cover and felt ring. Slacken the nut of the cotter securing the swivel pin and lightly tap to slacken the cotter grip. It should be noted that the design of the cotter that secures the swivel pin is such that it cannot be driven out until the pin itself is withdrawn.

With an extractor as shown in Fig. 1, withdraw the swivel pin by screwing the internal portion of the extractor into the female thread evacuated by the setscrew.

Remove the thrust washer, cover and shims from between the axle end and swivel pin lower bush.

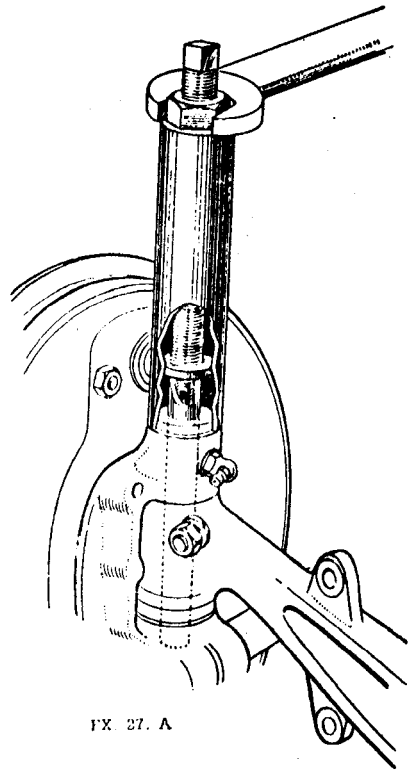


Fig. 2. Using an extractor to withdraw the swivel pin.

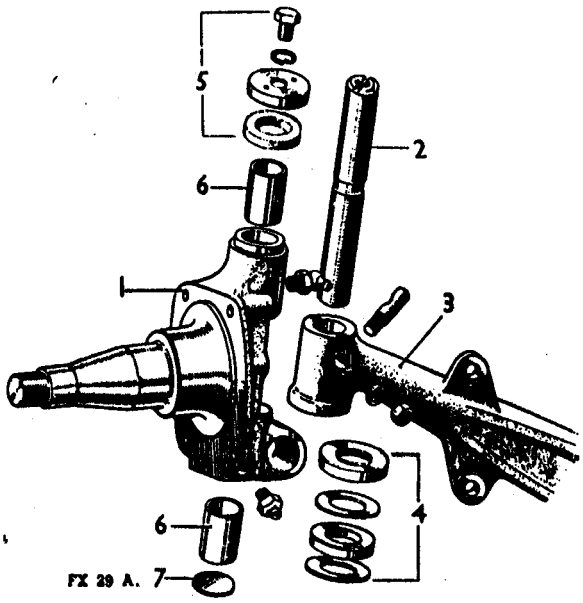


Fig. 3. An exploded view of the swivel axle. 1. Swivel axle; 2. Swivel pin; 3. Front axle; 4. The lower thrust assembly; 5. Setscrew and felt washer assembly; 6. Swivel pin bushes; 7. Welch plug.

Renewing the Bushes

Drive out the expanded welch plug at the base of the lower swivel housing. Both the lower and top bushes may now be tapped out.

Fitting New Bushes

Tap the new bushes gently into place. When they are finally home reamer them in line using a special centring reamer. Insert a new welch plug ensuring that it expands into the groove of the housing.

Re-assembly

Place the cotter in position so that the concave portion is approximately flush with the bush inner face, then dip the leading end of the swivel pin in oil and tap it through the top bush and the axle boss. Insert the thrust washer into the cap and tap into position between the axle end and the lower housing so that the swivel pin can now be gently tapped through and into the lower bush. Tighten the cotter nut to prevent the pin turning in the axle boss.

Finally, replace the felt ring and the retainer cover, and tighten the setscrew.

CASTOR AND CAMBER ANGLES AND SWIVEL PIN INCLINATION

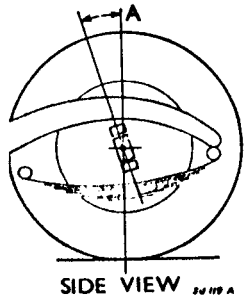
Description

The castor and camber angles and the swivel pin inclination are three design settings of the front axle assembly which have a very important bearing on the steering and general riding of the car. Each of these settings is determined by the machining and assembly of the component parts during manufacture. They are not therefore adjustable.

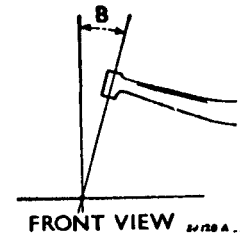
However, should the vehicle suffer damage to its front axle affecting these settings, the various angles must be verified to ensure whether replacements are necessary.

Camber Angle

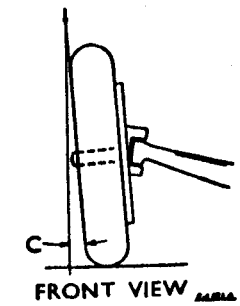
This is the outward tilt of the wheel, see Fig. 4. A rough check can be made by measuring the distance from the outside wall of the tyre, immediately below the stub axle, to a plumb line hanging from the outside wall of the tyre directly above the stub axle. This distance should be the same on both wheels, allowance being made for tyre pressures. The correct method, of course, is with a camber gauge. An incorrect measurement denotes that either the stub axle or the axle beam is bent. Fig. 1 gives the dimensions for checking the axle beam.



SIDE VIEW
Castor angle 3°



FRONT VIEW
Swivel pin inclination 7°



FRONT VIEW
Camber angle 1°

Fig. 4.

Should both the axle beam and the stub axle prove to be in order and yet the camber angle remain incorrect then there can only be the alternative of there being serious wear in the swivel pins.

Castor Angle

The castor angle is the backward tilt of the axle beam ends, set during manufacture, when viewed from the side of the vehicle. Fig. 4 shows clearly the castor angle of 3 degrees.

Swivel Pin Inclination

This is the tilt of the swivel pin when viewed from the front of the car and is best checked when the axle has been removed thus allowing for accurate measurements to be taken, Fig. 1.

FRONT HUBS

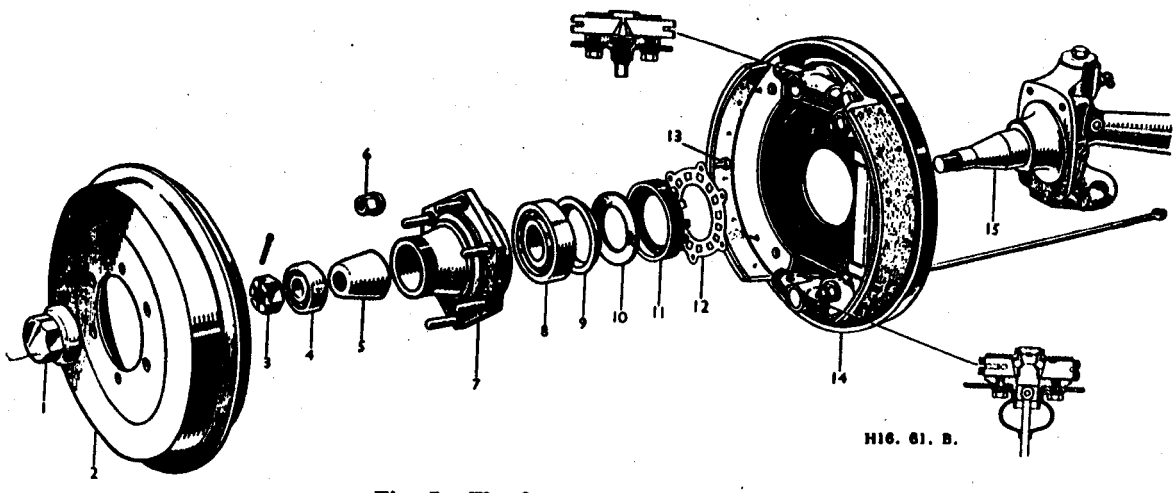


Fig. 5. The front hub in exploded form.

1. Hub cap.
2. Brake drum.
3. Nut and split pin.
4. Outer bearing.
5. Distance piece.
6. Wheel nuts.
7. Hub casing.
8. Inner bearing.
9. Distance ring.
10. Oil retainer.
11. Clamping ring.
12. Lockwasher.
13. Washer retaining pin.
14. Back plate.
15. Swivel axle.

To Check for Wear

The inner and outer bearings of the front hubs are non-adjustable, the amount of thrust being determined by a collapsible distance piece. To check for wear of these bearings, the vehicle should be jacked until the wheel of the front hub to be checked is clear of the ground. Then grasp the tyre with both hands in the horizontal position and rock the wheel sideways. Perceptible movement between the wheel and the back plate denoted wear of the hub bearings and should an appreciable movement be felt then the front hub bearings will need renewing.

Dismantling the Front Hubs

To dismantle either of the front hubs, jack the vehicle until the wheels are clear of the ground. Remove the wheel and with the aid of a screwdriver take out the two screws locating the brake drum when the drum can be tapped off the hub.

Should the brake linings tend to hold the drum even when the handbrake is in the fully 'off' position, the adjuster should be turned back a few notches.

Take off the hub cap and withdraw the split pin from the axle nut. Undo the nut and place a suitable extractor, Fig. 6, in position so that the extractor threads screw over the hub and the centre screw locates at the end of the swivel axle.

On turning the centre screw the extractor will withdraw the hub.

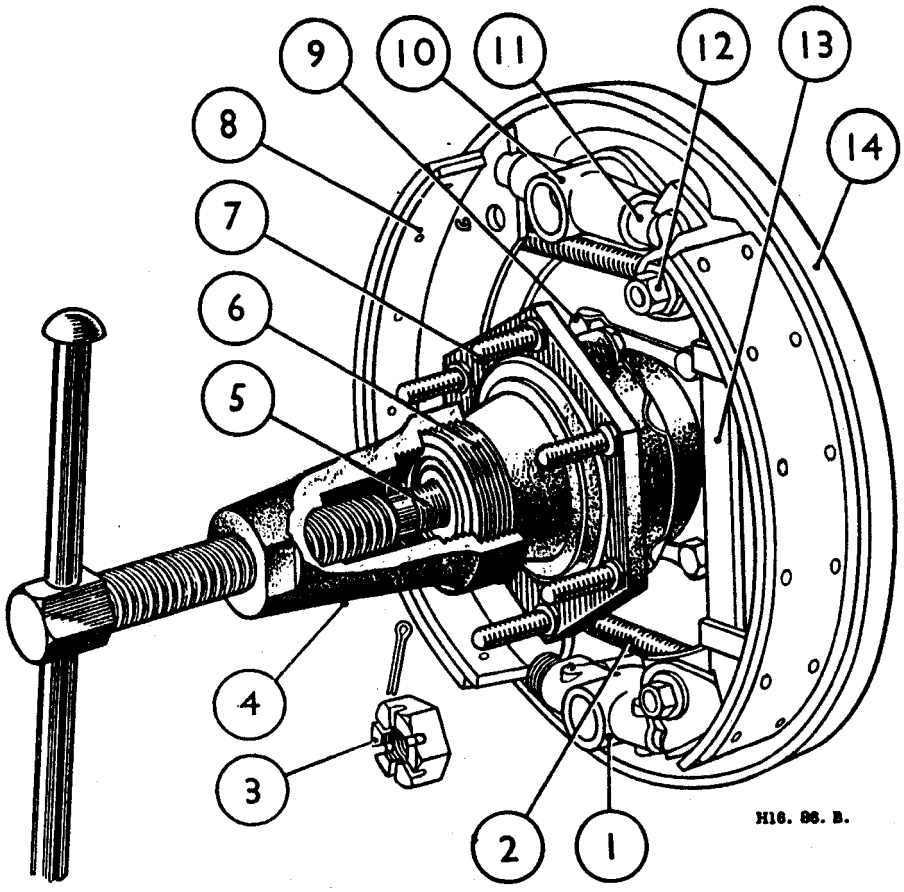


Fig. 6. Using a hub extractor.

1. Expander unit.
2. Shoe return spring.
3. Swivel axle nut.
4. Extractor.
5. Swivel axle.
6. Hub assembly.
7. Wheel studs.
8. Brake shoe.
9. Back plate stud.
10. Adjuster unit.
11. Adjuster plunger.
12. Bell crank nut.
13. Push rod.
14. Back plate.

With the hub removed further dismantling can be carried out on the work bench. Extract the two screws from the inner face of the hub and remove the lockwasher. Unscrew the locking ring when the leather oil retainer and distance ring can be removed. The inner ball race can be extracted and the bearing distance piece picked out. The outer roller race can be pressed out of the hub.

Assembling the Front Hubs

This is a reversal of the dismantling instructions, Fig. 5, giving a clear explanation of the order of reassembly, however, the assembly should be packed with grease during re-building.

It should be borne in mind that the bearings are not adjustable their being held firmly in position by the distance piece between them and the nut on the outside which is split pinned for security.

When the hub has been secured on the swivel axle, replace the brake drum, ensuring that the two holes in the drum coincide with the two tapped holes in the hub for location. Insert the two screws and tighten them. Two of the wheel-nuts screwed on to the wheel studs will help in the tightening of the two locating screws and will ensure that the drum is fully home.

Replace the road wheel then release the jacks and apply the handbrake. Finally tighten the wheelnuts.

STEERING

GENERAL DATA

Type of Gear	.. .. Cam and Lever	**Diameter of Steering Wheel**	.. 17-ins.
Maker's Number	.. .. .. L1	**Turning Circle—Taxi**	.. .. 28-ft.
Steering Gear Ratio	... (early models) 20 to 1	**Hire Car**	.. .. 35-ft.
	(later models) 18 to 1	**Track Toe-In**	.. .. 0—$\frac{1}{16}$-in.
Bearings	... ... Ball bearings	**Steering Connections**	Austin Ball and Socket
Adjustment	... ... Shim		

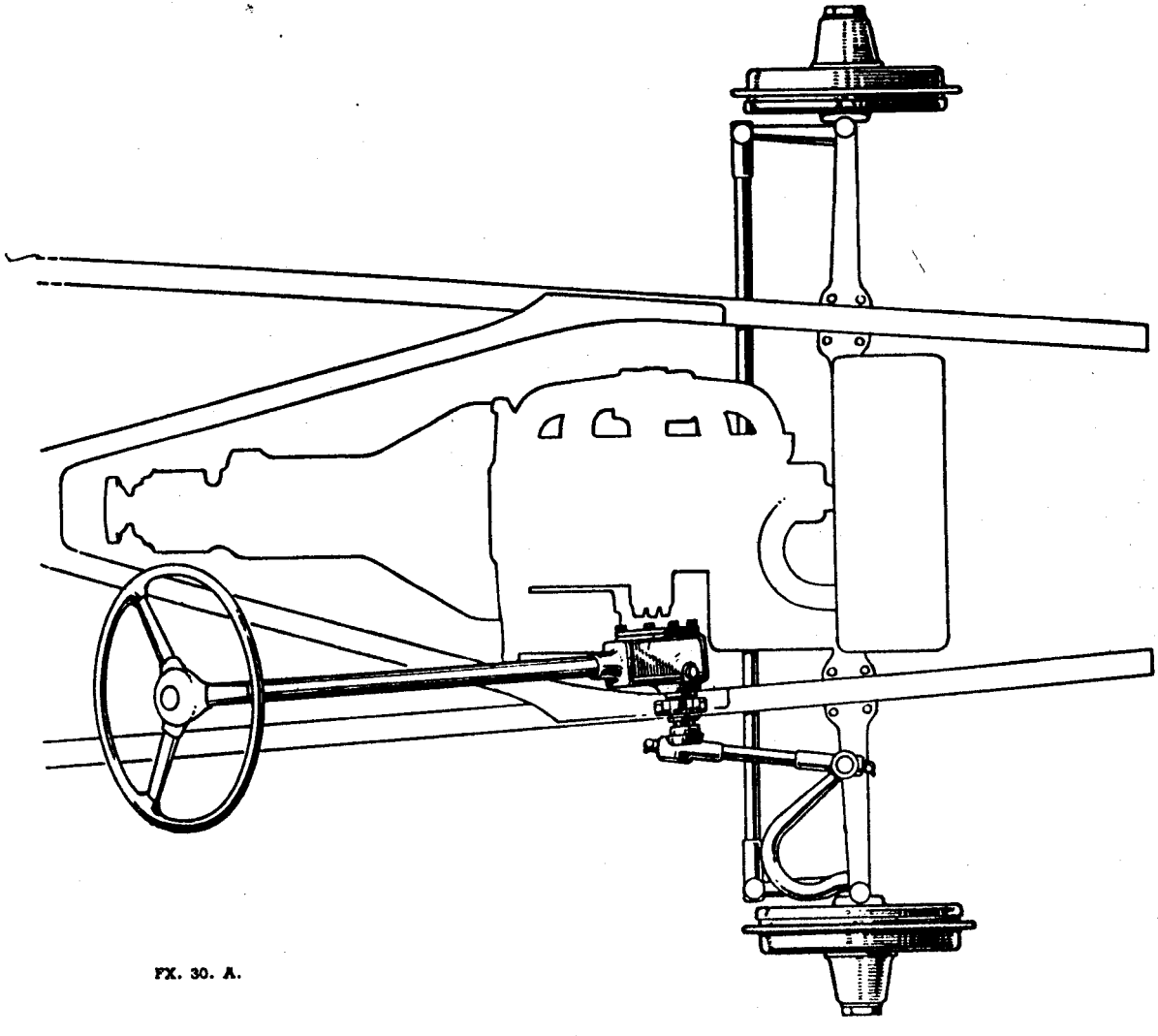


Fig. 1. The layout of the Taxi and Hire Car steering gear.

MAINTENANCE

Lubrication

An oil filler plug is provided at the top of the steering box casing. Oil is the correct lubricant; grease must not be used under any circumstances.

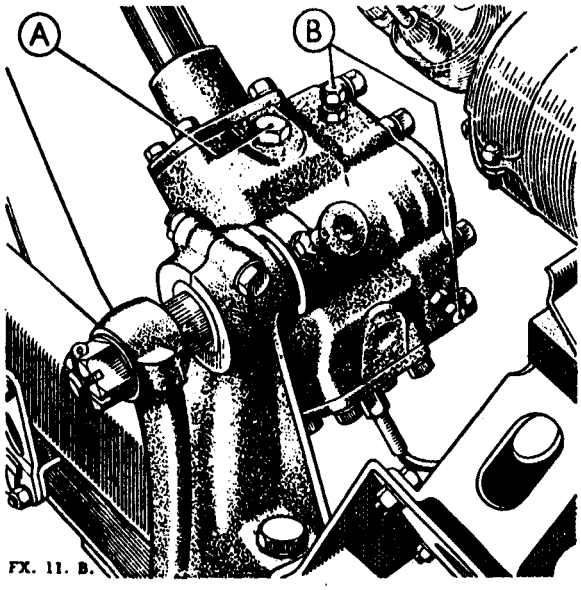


Fig. 2. Showing the steering box mounting with the filler plug at 'A' and the Taxi lockstops at 'B'.

Should a leak appear at the base of the box, check that the brass olive, which clamps the horn and direction indicator lobe in position, is seating correctly and is held firmly by the union nut.

A squeak in the steering column top bush can be remedied by the addition of a small amount of thin oil to the felt bush. For this purpose an oil hole is provided in the hub of the steering wheel.

Lubrication of the various steering connections has been detailed under the heading 'Regular Attentions' early in the Manual.

Periodic Check

Jack up the front axle and test all joints for slackness through wear, also check the steering box for backlash and end play. Ensure that the steering box clamping bolt is tight and its supporting bracket is securely anchored to the chassis side member.

Track Adjustment

With the wheels in the straight ahead position, take measurements at the edge of each wheel rim at the axle height. The rims should be 0-ins.—$\frac{1}{16}$-ins. closer in front than at the rear, see fig. 3. Any deviation from this measurement can be corrected by slackening the pinch bolt at each end of the cross tube and by rotating the tube, the ends of which are threaded right and left-hand for the purpose of adjustment. Tighten the pinch bolts once the adjustments have been made.

However, it must be understood that a track that requires more than slight adjustment may quite possibly have sustained damage to the swivel arms. In this event, re-adjustment is not a cure as the steering geometry will be upset, thus causing heavy tyre wear and inaccurate steering. In addition, ensure that the cross tube itself has not been bent.

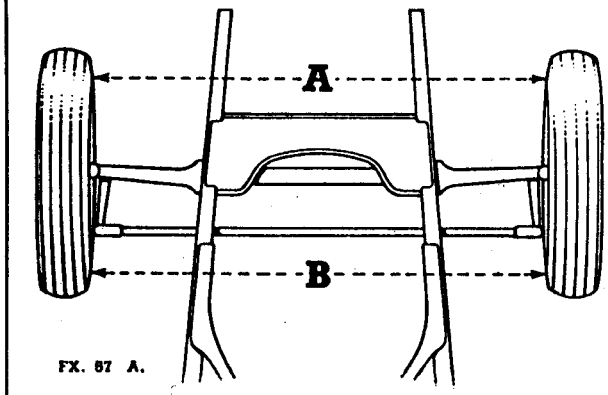


Fig. 3. The toe-in must be adjusted for 'A' to be 0—$\frac{1}{16}$-inch less than 'B'.

Swivel Arm or Cross Tube Lever

A swivel arm that is suspected of being damaged must be removed for an accurate dimensional check. To remove a cross tube lever on the steering side, disconnect it at the ball joint connections at both the cross tube and the side tube by removing the ball pin nuts. Then remove the split pin, nut and washer which fix the lever to the boss on the swivel axle.

The swivel arm on the opposite side to the steering must be disconnected at its ball and socket connection at the cross tube and withdrawn from the swivel axle, having first removed the split pinned nut and washer.

If the swivel arms were parallel to one another

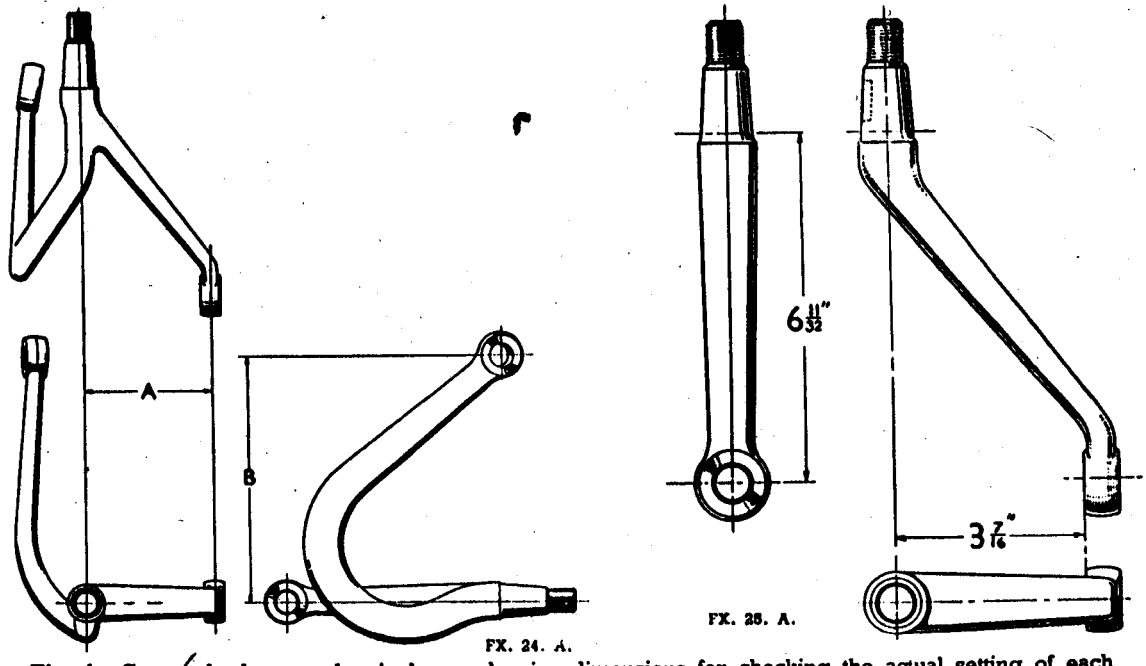


Fig. 4. Cross tube lever and swivel arm, showing dimensions for checking the actual setting of each arm to obtain the correct steering geometry. A=3⅛-in.; B=7 5/16-in.

the toe-in on full lock would be the same as toe-in in the straight-ahead position. This, of course, is incorrect and so the swivel arms are set in order that their projected centre lines shall meet approximately on the centre line of the rear axle, thus giving toe-out at full lock.

Thus it may be seen that if either swivel arm is bent, toe-out at full lock will be out in spite of the fact that toe-in at the straight ahead position is correct.

Accurate measurements for checking the swivel arms for trueness are given in fig. 4.

Steering Arm

To remove a steering arm first disconnect the ball and socket of the side tube from the lower end of the steering arm and then remove the split pin nut and washer securing the arm to the steering box shaft.

The arm should be relieved from the shaft with the aid of a suitable puller, see 'Service Tools', making use of the lugs provided on the steering arm head.

Steering arm measurements may be checked against those given in fig. 5.

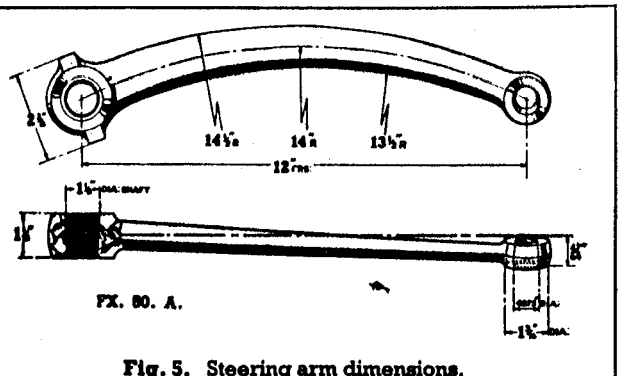


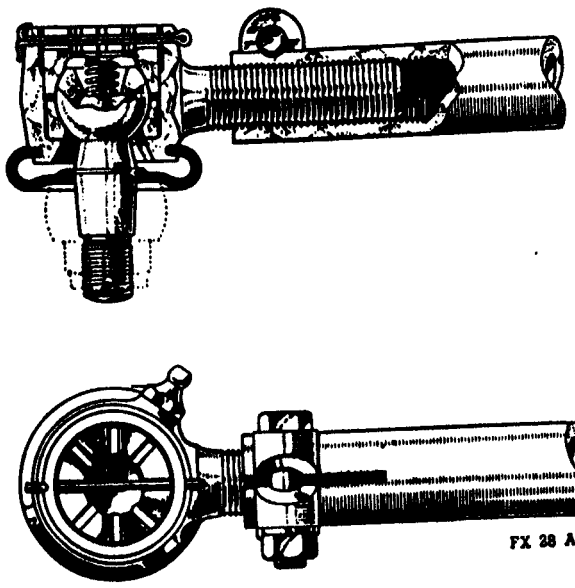
Fig. 5. Steering arm dimensions.

Side Tube

The side tube is connected by ball and socket type joints at one end to the steering arm and at the other to the swivel arm. Its ends are adjustable to meet the requirements of the steering arm and swivel arm, the socket stems being threaded to screw into the tube. When set they are locked by clamp bolts.

Ball and Socket Connections

Two types of Austin patented ball and socket connections are fitted on the Taxi and Hire Car steering linkage. The steering side tube ends are fitted with a self-adjusting type of connection which is spring-loaded as shown in fig. 6. This type needs little attention other than regular lubrication as detailed in 'Regular Attentions'. However, should the ball and socket suffer



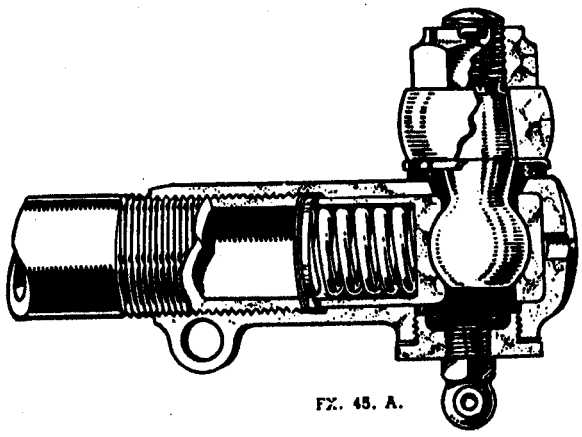


Fig. 6. The two types of ball and socket connection. On the left is shown the non-adjustable type, whilst the right-hand illustration shows the spring loaded adjustable socket.

excessive wear, usually due to lack of lubrication, more tension can be exerted on the spring by slackening the screw clamping bolt of the tube and screwing inwards the socket stem one full turn.

The second type of ball and socket is employed on the cross tube ends. These sockets are not self-adjusting, in other words they do not have springs to maintain a uniform pressure between the ball and its socket. The only spring that is employed is one that is let into the head of the ball as a cure for any rattle that may develop.

The ball of this second type is a running fit in the socket and the resultant working clearance is used to work the lubricant around the whole bearing surface. These connections consist of a threaded and castellated socket screwed into position and locked by a split pin. The body of the tube end has split pin holes, drilled vernier pattern, at a different pitch from the castellations in the socket, thus permitting a very fine manual adjustment.

Adjustments and lubrication should be made and checked regularly, otherwise undue slackness will cause a deformity of the ball pin, thereby making further adjustment impossible.

To make an adjustment, remove the split pin, lightly screw up the socket as far as it will go, and then screw it back to the first alignment of the split pin hole and castellation. The ball should then be able to move freely in the socket.

Always ensure that the rubber boot fits snugly in the groove provided in the socket end.

Steering Wheel

To withdraw a steering wheel from the column first disconnect the horn and direction indicator leads at their snap joint connections near the base of the steering column, then slacken the brass union nut at the base of steering box which secures the indicator tube gland.

Withdraw the stator tube from the steering column by gently prising the steering wheel centre out of the hub and pulling upwards the stator tube. This discloses the steering wheel locking nut which must be removed when the steering wheel can be jerked upwards clear of the column. Should the wheel prove obstinate a suitable extractor, as shown in the section 'Service Tools', should be employed.

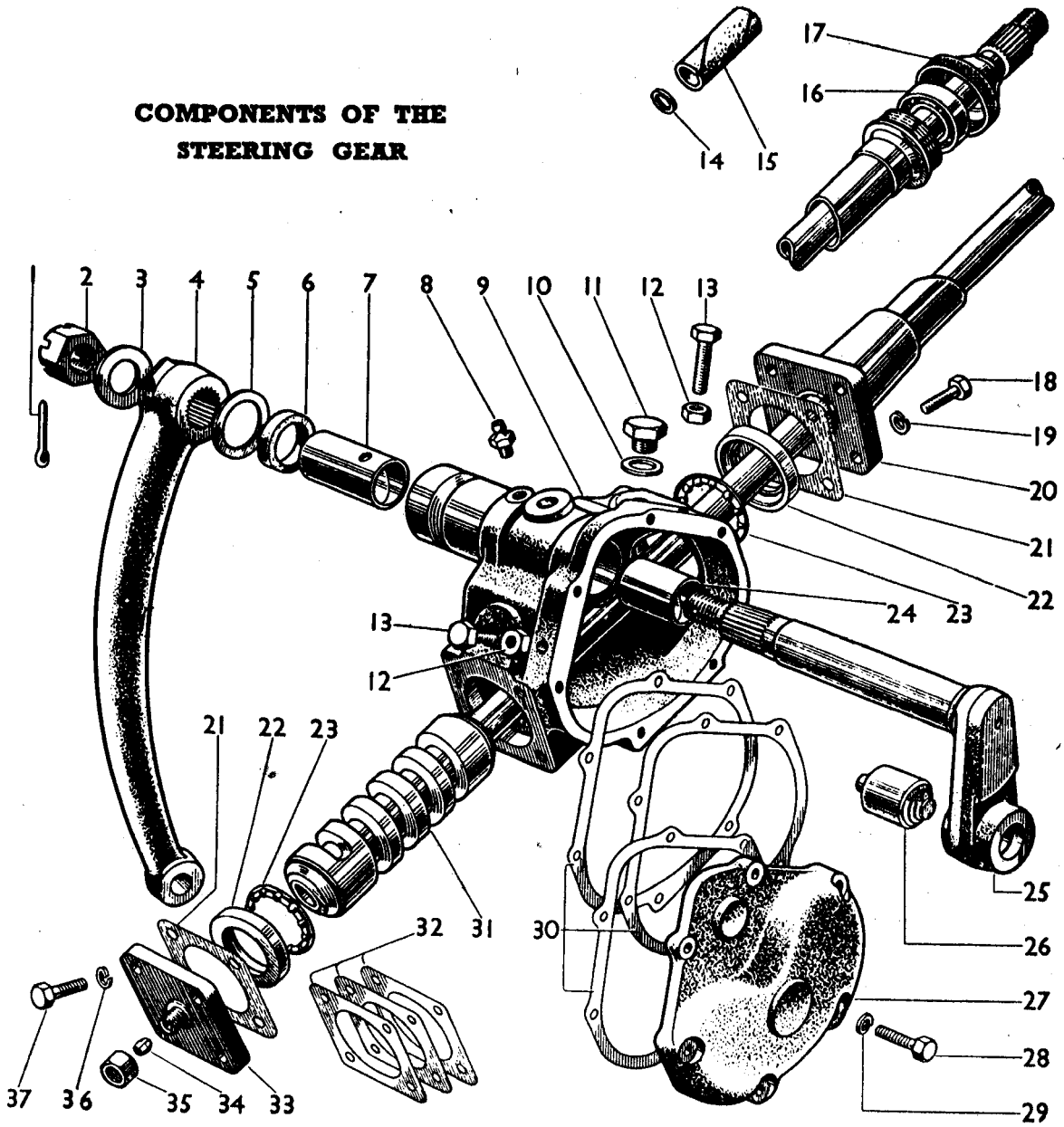
STEERING GEAR

It will be observed that the Bishop Cam Gear is a self-contained unit of extreme simplicity, the whole of the mechanism being contained in an oil-tight casing. Fig. 7 shows the construction of the gear indicating clearly the ball and roller bearings of the conical connection.

Lubrication

'Kamoil' is the lubricant recommended for use in the gear. It is specially compounded for the purpose, but if it is not available a heavy gear oil may be substituted. **On no account must grease be used.**

COMPONENTS OF THE STEERING GEAR



FX. 66. A.

Fig. 7.

1. Split pin.
2. Rocker shaft nut.
3. Plain washer.
4. Steering arm.
5. Thrust ring.
6. Cork retaining disc.
7. Bush bearing.
8. Lubricating nipple.
9. Steering box.
10. Filler plug washer.
11. Filler plug.
12. Locknut.
13. Lockstop screw (Taxi only)
14. Felt bush retaining ring.
15. Felt bush.
16. Outer column ball journal bearing.
17. Bearing cap.
18. Setpin for column flange.
19. Spring washer.
20. Column lower flange.
21. Joint washer.
22. Bearing race.
23. Ball bearing.
24. Bush bearing.
25. Rocker shaft.
26. Cam roller assembly.
27. Side cover.
28. Side cover setpin.
29. Spring washer.
30. Joint washer and shims.
31. Cam.
32. Bottom cover shims.
33. Bottom cover.
34. Olive.
35. Nut
36. Spring washer.
37. Setscrew.

Oil is introduced through the filler plug with the box being kept as full as possible. The internal mechanism of the box is automatically lubricated, but a spot of oil from the oil can should be injected, from time to time, on to the bearing at the top of the column through the oil hole provided in the steering wheel hub.

Adjustment

The Cam: The cam and main shaft are mounted on ball bearings which take the thrust from the rocker shaft, and shims are introduced under each end cover so that the cam is mounted centrally in the box. It should never be necessary to alter this adjustment which is carefully set before the car leaves the works.

The Rocker Shaft

The only adjustment that the operator is ever likely to have to make is the removal of one or more shims from beneath the side cover plate which covers the lever inside the steering box.

The motion of the steering wheel is transmitted to the road wheels through the cam and the cone fitted into the lever, and in time a small amount of wear (as shown by 'lost motion' between the steering wheel and the drop arm) may possibly become apparent, but the whole of this can be removed and the gear restored to its original perfection by the removal of one or more of the shims already mentioned. It must also be remembered that loose steering connections and joints can also cause excessive 'lost motion'.

These shims are made in varying thicknesses in order that a very fine adjustment can be obtained. If, however, too many shims are removed, the gear will become a little stiff in the centre and this must not be permitted. All adjustments to the steering gear should be carried out with the side tube disconnected.

Central Control

Care must be taken to ensure that the fixed tube does not foul the inside of the steering tube.

The only things that can cause the steering to become stiff in use (apart from the front axle and its connections) is lack of lubrication in the box itself or lack of lubrication between the revolving shaft of the steering gear and the stationary tube of the central control.

When properly adjusted the steering will be finger light, free from backlash, no road shock will be felt on the wheel, and the car will 'straighten up' well after cornering.

Cam Track

The cam track is slightly relieved from the centre towards each end, so that whereas in the central position there is practically metal to metal connection and the gear should be adjusted so that there is no 'play' whatever when the road wheels are straight, provision is made to give a little clearance at full lock in both directions. The amount of this clearance, as shown by the motion of the steering arm, should be equal on both locks. If it is greater at one end than the other, the shims must be adjusted by removing one or more from under the end cover, where most motion exists as shown by the lever inside the box, and placing them at the other end until the clearance is equal. On reassembly the main shaft should 'spin' with the fingers, but there should be no end play at all.

Care should be taken to ensure that the flat face of the rocker shaft takes a good bearing against the hardened side cover plate and that the cork gland is in good condition. A new gland can be sprung into position without removing the retaining ring if it is cut radially at one place on the circle.

All adjustments to the gear should be made before the unit is filled with oil or mounted on the chassis.

Mounting the Gear

The clamp, of the gear mounting bracket, that surrounds the trunnion bearing, must not be tightened so tightly as to make the gear stiff.

It is also essential when remounting the gear, after its removal for some purpose or other, that the steering column is in line with its dashboard support and that no strain is imposed upon the column when the mounting bracket and the dashboard bracket are tightened down.

After the gear has been finally bolted down a last test should be made to ensure that the steering is absolutely free before coupling up the side tube.

Replacing the Steering Arm

When replacing the steering arm, care must be taken to refit it to the correct spline to give the proper 'lock'. In the majority of gears a line is cut across the end of the rocker shaft, and a corresponding line is scribed on the boss of the steering arm, then it is only necessary to bring the lines together to put the lever on the correct spline.

The most simple method of finding the correct

position if the parts have not been marked, is to jack up the front axle and connect up the side tube to both the swivel arm and the steering arm, then set the road wheels in the 'straight ahead' position and turn the steering gear until it is exactly in the middle of its travel and mount the steering arm on the spindle in this position, every care being taken to ensure that the slotted nut is tightened right home and the nut securely split pinned. A test should then be carried out to see that there is full lock on both sides and that the stub axles come up against the 'stops'.

✔ Refill steering box with recommended oil to the correct level.

REAR AXLE

GENERAL DATA—WORM TYPE

Type	¾ floating.
Oil Capacity (early models)	3 pints
,, (later models).	4 pints.
Final Drive	Worm and Wheel
Teeth in worm	5
Teeth in wheel (early type)	26
(later type)	24
Ratio (early type)	5.2 to 1.
(later type)	4.8 to 1.

BEARINGS

Worm Shaft (Front)	
Make	R. and M.
Type	MJ 1¼.
Size	1¼ x 3⅛ x ⅞.
Worm Shaft (Rear)	
Make	R. and M.
Type	MJ. D.T. 35.
Size	35 x 80mm. x 1⅜ins.
Worm Shaft (differential)	
Make	R. and M.
Type	LJT. 1¼.
Size	1⅛ x 4 x 1 3/16.
Hub	
Make	R. and M
Type	LLR.J.50 — 3 Dot.
Size	50 x 90mm. x 27.

DISMANTLING AND REASSEMBLING THE AXLE

Dismantling the Axle and Hubs

First, the rear wheels must be removed. Before attempting to withdraw the brake drums, it is advisable to slacken back the brake shoe adjusters at the brake backplate.

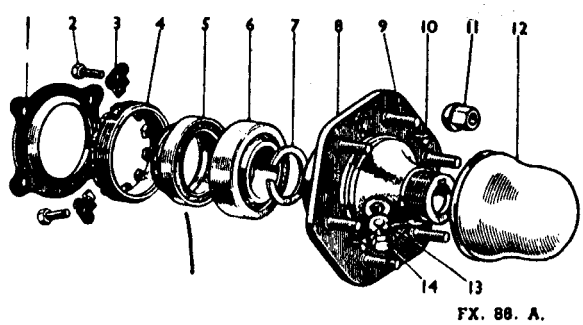


Fig. 1. Rear hub assembly.

1. Backplate lockwasher.
2. Set pin.
3. Lockwasher.
4. Clamping nut.
5. Oil seal.
6. Roller bearing.
7. Spring ring.
8. Rear hub.
9. Wheel studs.
10. Brake drive screw.
11. Wheel nut.
12. Hub cap.

Withdraw the split pins and unscrew the hub retaining nuts. Hub extractor 18G.8 with adaptor 18G.8B can then be used to withdraw the hubs.

In fig. 2 it will be seen that the adaptor 2 must be screwed into the extractor 3 and the adaptor screwed into the hub 1. Hold the tool and then proceed to withdraw the hub by rotating the centre screw 5 with the aid of an open ended spanner or tommy bar 6.

Should the hubs require attention, they can be dismantled by first removing the screw and lockwasher which retain the clamping nut.

Unscrew the clamping nut to expose the oil seal which, if unsatisfactory, can be removed.

The outer race of the hub bearing can now be tapped out. If the bearing is to be replaced, the inner race of the old bearing, which is retained by a spring ring, must be removed from the end of the axle case when a new one may be fitted.

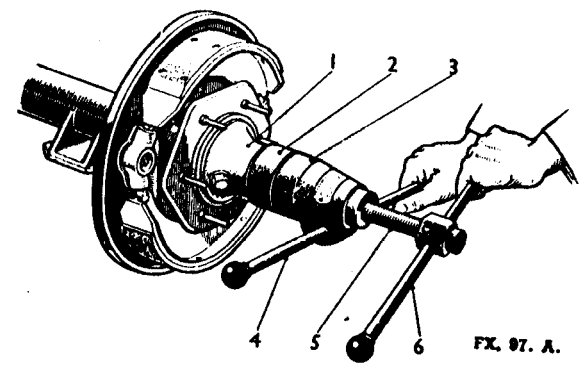


Fig. 2. Withdrawing the hub with the aid of service tool 18G.8.

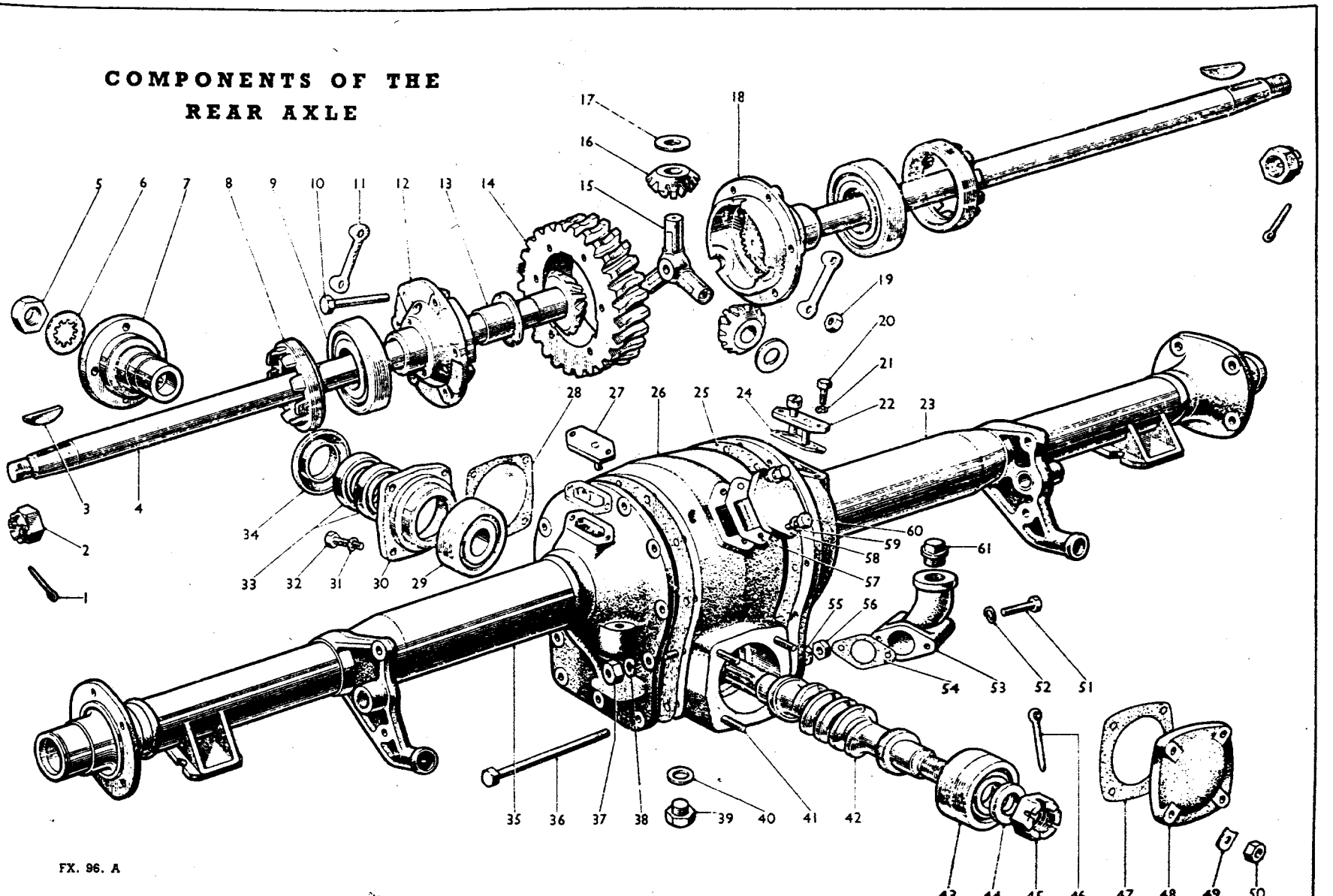


Fig. 3. *See opposite page for caption.*

Fig. 3. Components of worm type rear axle (opposite).

1. Differential shaft split pin.
2. Differential shaft nut.
3. Differential shaft key.
4. Differential shaft.
5. Worm flange nut.
6. Worm flange lockwasher.
7. Worm driving flange.
8. Differential adjusting collar.
9. Differential bearing.
10. Differential case bolt.
11. Differential bolt lockwasher.
12. Differential case, L.H.
13. Differential bush.
14. Differential worm wheel.
15. Differential pinion centre.
16. Differential pinion.
17. Pinion thrust washer.
18. Differential case, R.H.
19. Differential case nut.
20. Adjustment cover setpin.
21. Spring washer.
22. Adjustment cover, R.H.
23. Axle tube, R.H.
24. Adjustment cover joint washer.
25. Side cover joint washer.
26. Rear axle centre case.
27. Adjusting cover, L.H.
28. Joint washer.
29. Worm front bearing.
30. Oil seal housing.
31. Spring washer.
32. Oil seal housing setpin.
33. Oil seals.
34. Dust cover.
35. Axle tube, L.H.
36. Axle case bolt.
37. Side cover, L.H. nuts.
38. Spring washer.
39. Drain plug.
40. Drain plug washer.
41. Rear cover stud.
42. Differential worm.
43. Worm rear bearing.
44. Worm rear washer.
45. Worm rear nut.
46. Rear nut split pin.
47. Rear cover joint.
48. Rear bearing cover.
49. Lockwasher.
50. Rear cover nut.
51. Oil filler case setpin.
52. Spring washer.
53. Oil filler case.
54. Oil filler case joint washer.
55. Spring washer.
56. Side cover, R.H. nut.
57. Inspection cover joint washer.
58. Inspection cover.
59. Spring washer.
60. Inspection cover setscrew.
61. Oil filler plug.

To proceed with the dismantling — the inner left hand brake cross rod 7 fig. 4, must be detached at link 8 to allow the axle tubes 1 to be removed.

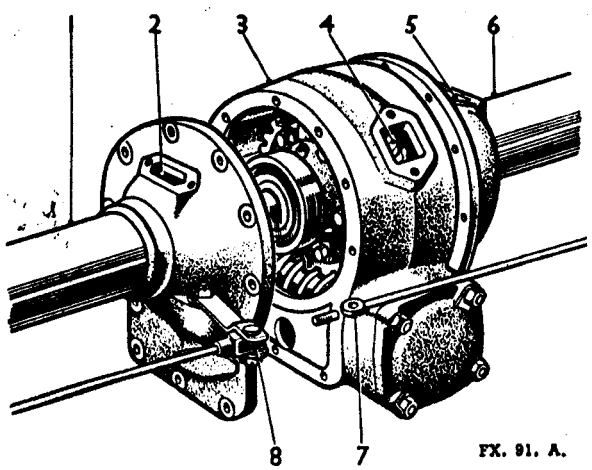


Fig. 4. Removing the axle tubes.

The worm wheel inspection covers at 4 and the adjustment cover at 5 must be removed from the axle centre case 3 and tubes 1 respectively.

Unscrew the nuts and remove the bolts securing the axle tubes to the centre case and withdraw both tubes. The axle case 1 fig. 5, can then be tilted from the top and lifted away.

To withdraw the worm from the case, first remove the rear cover 2 fig. 5, which is secured by four nuts and lockwashers; unscrew the exposed nut, which is locked by a split pin, and take off the plain washer.

After removing the four setscrews securing the front oil seal housing 1, the worm assembly, including driving flange 2, can be tapped out of the case with a hide hammer. (fig. 6).

Next remove the rear bearing from the axle centre case.

Place the worm assembly 1 between lead clamps in a vice (fig. 7) and proceed to unscrew the nut retaining the driving flange 3; wrench (service tool No. 18G.34A) will be required to prevent rotation of the flange. Using tool 4(18G.2), withdraw the flange from the worm and remove the oil seal with its housing 2. The front bearing can then be withdrawn from the worm.

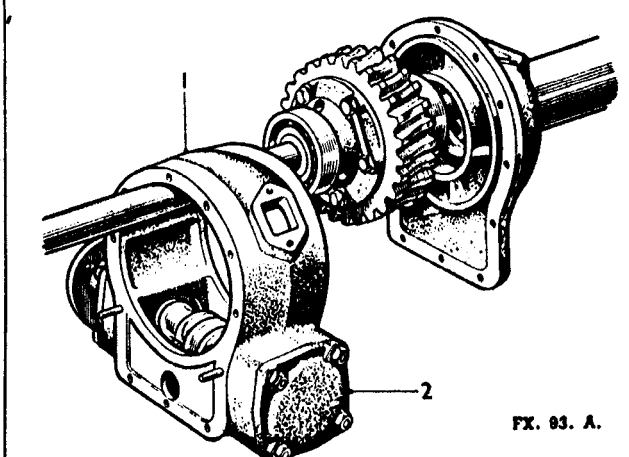


Fig. 5. Removing the centre casing.

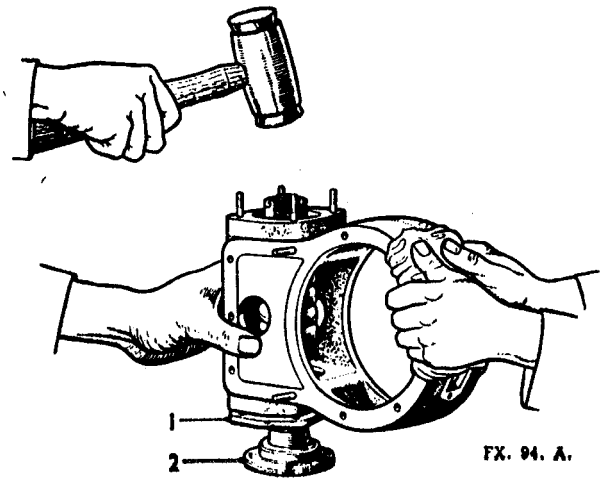


Fig. 6. Tapping out the worm drive.

To remove the worm wheel 3 (fig. 8) unscrew the six nuts and tap out the securing bolts. The two halves of the differential case can then be separated and the wheel lifted away.

The differential pinions 1 with thrust rings and centre 2 can be removed from the differential case for inspection.

Assembling the Axle

Before assembling the differential unit, check the clearance between the differential pinion centre and each differential shaft when in the differential case; this should be .0015 — .002 in. If the clearance is unsatisfactory, new bushes must be fitted to the differential case halves and the inner face of the bushes machined to give the desired clearance.

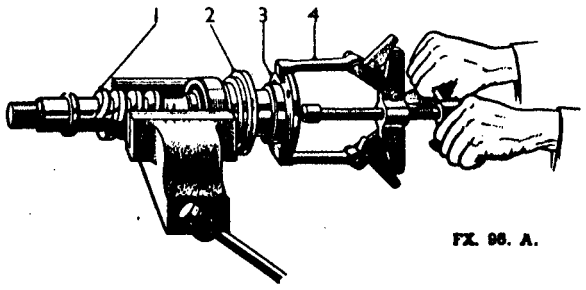


Fig. 7. Withdrawing the worm driving flange.

The blacklash of the differential pinions must also be verified; this should not be more than .004 in. and is controlled by the thrust ring behind each of the three pinions. These rings vary in thickness to enable the desired clearance to be readily obtained. However if desired the rings may be reduced in thickness by rubbing on an emery stone.

Having selected a new worm and wheel, the wheel 3, fig. 8, should be positioned on to a differential case 5 with shaft 4. Insert the pinion centre 2 with pinions 1 and thrust rings into the case, mesh the differential shaft with the pinions and secure the wheel and cases together with the six bolts, nuts and lockwashers.

Then place a "Vee" block beneath each bearing of the assembly and check the wheel for "run-out" by means of a dial indicator. This should not be more than .003 in.

To assemble the worm in the centre axle case, first fit, with the aid of a light press, the rear bearing into the case, then the front bearing to the worm.

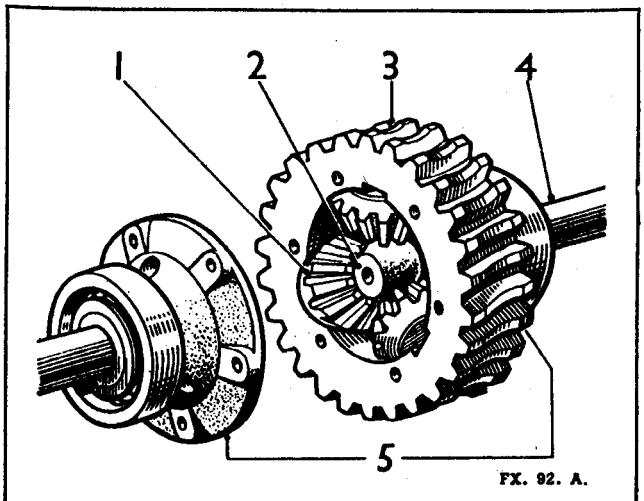


Fig. 8. The differential assembly.

The oil seal and housing, followed by the driving flange, must then be assembled into the worm. Tool 18G.1 will facilitate this work and eliminate the possibility of damage to the components.

Secure the flange by the nut and lockwasher. Tap the worm assembly into position in the case and through the rear bearing. The nut retaining the rear bearing should be light and secured by a split pin.

Place the rear cover in position without the joint washer and measure the gap between the cover and the case. This should be .002 in. less than the thickness of the joint washer to ensure that the cover abuts against the outer race of the rear bearing to prevent the float when the joint washer is fitted.

At this stage marking "blue" should be applied to the whole of the worm.

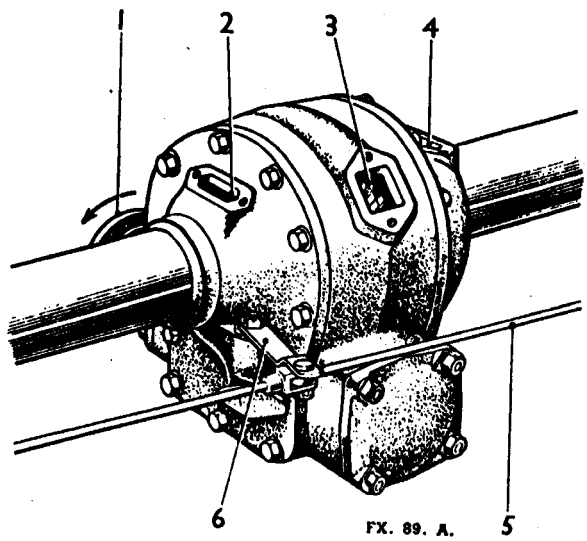


Fig. 9. The axle tubes bolted to the centre case.

To proceed with assembly, tilt the centre case to one side and mesh the worm with the wheel when the top of the case can be passed over the wheel. This should be done so that the lettering stamped on one side of the wheel will face the left-hand side of the unit.

Next, screw back the worm wheel adjusting collars, in the axle tubes, as far as possible. After retaining the axle tube joint washers in position with the aid of a little grease, pass the tubes over the differential shafts.

Having bolted the tubes to the centre case, the worm and wheel can be accurately meshed, (Fig. 9).

To do this, screw the two adjusting collars 2 and 4 inwards by equal amounts to centralise the wheel 3.

Rotate the worm driving flange 1 in a clockwise direction and observe the bearing surface of the worm on the wheel which will be indicated by the marking "blue".

If the worm and wheel are properly meshed the blue marks will be in a similar position to those shown in fig. 10. Should further adjustment be necessary, the wheel must be moved to the right or left accordingly. This is done by slackening off one adjusting collar one notch and screwing inward one notch the opposing collar, which is equivalent to moving the wheel .005 in.

Clean the wheel, rotate the work again and observe the position of the blue marks.

Replace the adjusting collar locking plates and the worm wheel inspection cover.

Refit the inner left-hand brake cross rod 5 to the link 6 (Fig. 9). Hubs and brake drums can then be replaced to complete the assembly.

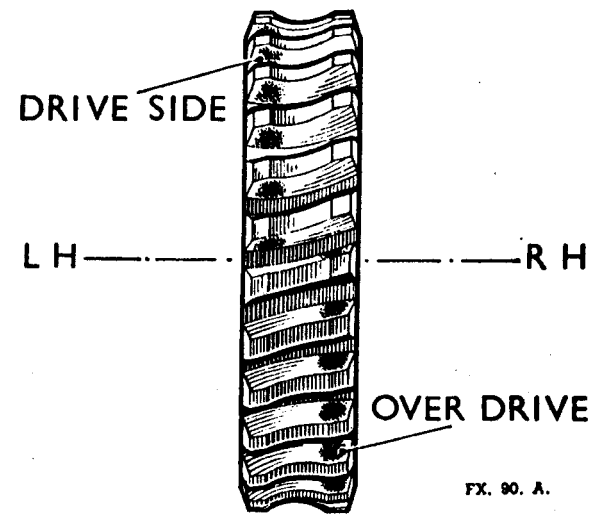


Fig. 10. The wheel "blue" marked to show correct meshing of wheel and worm.

When refitted fill the axle case with the correct amount of approved lubricant.

REAR AXLE—HYPOID TYPE

Type	¾ floating
Oil Capacity	3 pints (1.7 litres)
Final Drive	Gear wheel & pinion
Ratio	4.78—1

GENERAL DESCRIPTION

The rear axle assembly is of the hypoid semi-floating type with shim adjustment for all bearings and for meshing of the driving gear and pinion. Each axle shaft is splined at the inner end and engages the female spline of the differential side gear. At their outer ends the shafts are provided with tapers and keys for attaching the rear wheel hubs.

Each wheel is supported on a taper roller bearing pressed on to the axle shaft. The side thrust from the wheels is transferred from one shaft to the other by a thrust spacer straddling the differential pinion mate shaft.

A cover on the rear of the gear carrier housing permits inspection and flushing of the differential assembly without dismantling the axle. The axle gear ratio is stamped on a plate attached to the assembly by one of the rear cover screws and the axle serial number (which should be referred to in all correspondence) is stamped on the top of the gear carrier casting, on the width of the metal forming the facing for the rear cover.

LUBRICATION

For the lubrication of the hypoid driving gears, use lubricant from approved sources only, as listed on page V.1. Do not, at any time, mix various brands of hypoid lubricants. Should there be any doubt concerning the brand of lubricant previously used, drain and flush the axle with a little of the new hypoid oil before filling with the new lubricant. Do not use paraffin as a flushing medium. The axle should be drained and refilled to the bottom level of the filler plug hole every 6,000 miles.

The filler plug is situated in the axle rear cover plate and the drain plug is positioned beneath the axle casing.

Wheel bearings are each lubricated by a grease nipple located in the axle tube housing adjacent to the brake back plate. On the top side of the housing a vent hole is provided; the greasing operation should be continued until grease appears at this hole indicating that the chamber is full. Do not overfill.

NOTE.—This is the sole lubrication for the hub bearing, which therefore must under no circumstances be neglected.

AXLE SHAFTS AND HUBS

Removal

(1) Before commencing axle shaft removal operations, jack up the car and then remove the road wheel concerned.

(2) The dismantling procedure is started by withdrawing the split pin and then removing the castellated axle shaft nut and washer. Next, withdraw the hub, using a suitable extractor. Before dismantling further, check the axle shaft end play using a dial indicator for accurate measurement. The recommended tolerance ranges from .006 to .008 in. This end play is controlled by shims located between the brake back plate and the axle tube flange. Shims are available in thickness of 003 in., .005 in., .010 in., and .030 in.

(3) Remove the back plate retaining bolts; the nuts and washers pull up to the rear of the axle tube flange.

(4) It is now possible to withdraw the outer oil seal assembly and the brake back plate, taking care of the wheel bearing adjusting shims. The axle shaft with its taper roller bearing may now

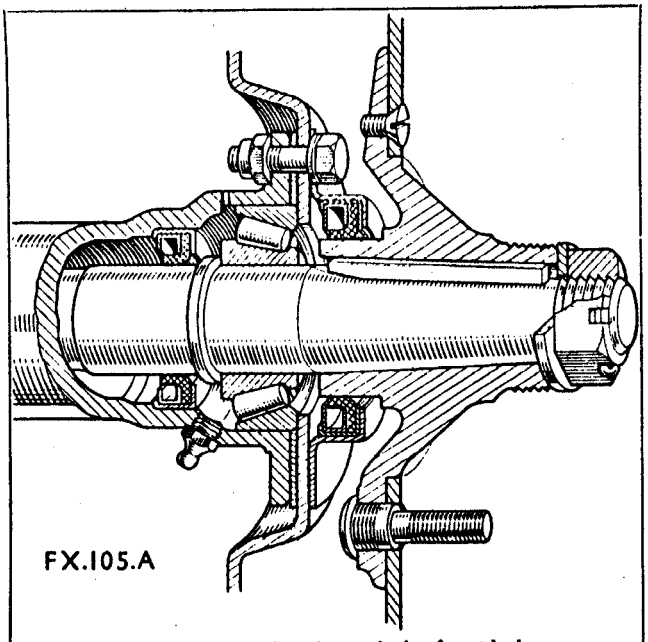


Fig. 11. A section through the front hub.

be withdrawn with an extractor and the axle shaft oil seal, which is pressed inside the axle tube, can be examined. Extract the oil seal and renew if necessary.

Replacing

Add or subtract adjusting shims to obtain the correct axle shaft end play of .006 to .008 in. which will be just perceptible by hand, see fig. 11 (adding shims increases end play, subtracting shims decreases end play). This applies when removing one shaft only. The required shims to give the established end play should be approximately divided between the two sides when replacing both shafts, so as to retain the thrust spacer in a central position. Examine the hub oil seal and replace if necessary. Fit the brake back plate and centralise the hub oil seal. When re-installing, fit new joint washers between the brake back plate and the oil seal assembly to prevent oil leaking into the brake drum.

Finally, it is essential to grease hub bearings as already described.

AXLE REMOVAL AND REPLACEMENT

Removal

For ease of working, if it is at all possible, the car should be standing over a pit when commencing the rear axle removal operations. If there is no pit available, chock the front wheels and then lift the rear of the car by means of a hydraulic garage jack to a convenient working height. Finally pack up the chassis on either side, forward of the axle with suitable wooden blocks.

Remove each of the rear road wheels and then from beneath the car, disconnect the propeller shaft at its rear axle coupling. Four nuts and bolts secure the two flanges together.

Disconnect the exhaust tail pipe at the connection to the chassis and release the silencer from the down pipe. Pull the silencer and tail pipe out of the down pipe and remove them from the car.

Release the shock absorber arms, jacking units, brake balance lever and handbrake rod from the axle anchorage.

Finally dismantle the axle and spring "U" bolts. To do this release the two nuts of each "U" bolt, remove the "U" bolt and lift each buffer plate from the top of the axle tube.

At each spring, the axle is located by a peg protruding from the spring. Lift the axle clear of these two pegs, twist it slightly and lower it to the ground and then clear of the chassis.

Replacing

Replace the axle by reversing the removal procedure. If a new axle is being fitted, remember that the brake piping and the pipes of the jacking system must be transferred to the new axle. This transferring operation also applies to the handbrake transverse rods and balance lever.

DISMANTLING DIFFERENTIAL UNIT

To carry out the disassembly of the differential, first drain the lubricant from the gear carrier housing and remove the gear carrier rear cover. Flush out the unit thoroughly in order that the parts may be carefully inspected.

Remove the axle shafts as previously detailed.

Withdraw the two bolts securing each differential bearing cap and withdraw the caps. To facilitate withdrawal and installation of the assembly, fit the stretching fixture Tool No. 18G.131A. Stretch the case by using a spanner taking care not to exceed the half turn specified or the axle casing will be damaged beyond repair. With the aid of two levers, one on each side of the differential case opening, pry out the differential assembly. During this operation use suitable protective packing between the levers and the gear carrier.

The differential bearing caps and the gear carrier joint facing surface are marked during production and when reassembling the bearing caps, be sure that the position of the numerals correspond, see fig. 12.

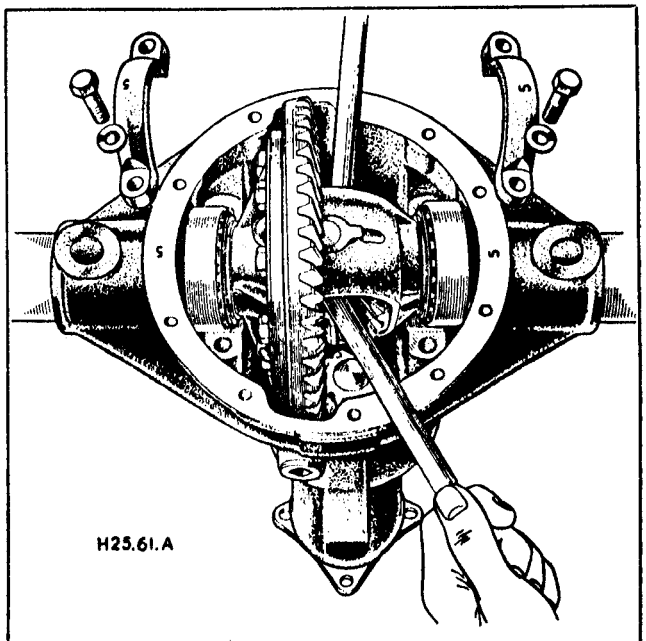


Fig. 12. Using two levers to remove the differential assembly. Note corresponding numbers on casing and bearing caps.

Remove the universal joint companion flange with an extractor and press the pinion out of the outer bearing. The pinion having been freed from its outer bearing can now be removed from the axle housing.

Note.—Keep all shims intact.

Drive out the outer bearing cup and oil seal assembly of the housing and if a damaged inner bearing cup is to be replaced, or if the pinion setting is to be changed, the inner bearing cup must be driven from the housing, care being taken of the shims which are fitted between the bearing cup and the housing abutment face. Remove the ring gear from the differential case by bending down the locking tabs and removing the mounting screws. Drive out the pinion mate shaft locking pin, which is secured in place by peening the case, and remove the pinion mate shaft. Take out the axle shaft spacer and by rotating the gears by hand until the pinions are opposite the openings in the differential case, remove the differential gears and thrust washers which are fitted behind them.

If the ring gear setting is to be altered, it will be necessary to release the differential bearing with an extractor to gain access to the shims located between the bearing and the abutment face on the differential case.

ASSEMBLY OF DIFFERENTIAL UNIT

Reassemble the internal parts of the differential and install the pinion mate shaft with thrust spacer in place and secure by means of the lock pin. Using a punch, peen some of the metal of the differential case over the end of the lock pin to prevent it working loose. The ring gear and differential case contrating surfaces should be cleaned and examined for burrs before the ring is fitted.

When refitting the ring gear on the differential case, align the attaching bolt holes in the ring gear with those in the case. With the ring gear supported on wooden blocks use a hide hammer to tap the case into position. Insert the ring gear set screws with new locking straps and tightening them uniformly. Then bend the locking tabs around the screw heads to prevent their working loose.

Fit the differential bearings without shims on the differential case, making sure that the bearing cones and cups and the housings are perfectly clean. Place the differential assembly with the bearing cups in their housing within the gear carrier. Install a dial indicator in the gear carrier with the button against the ring gear back face

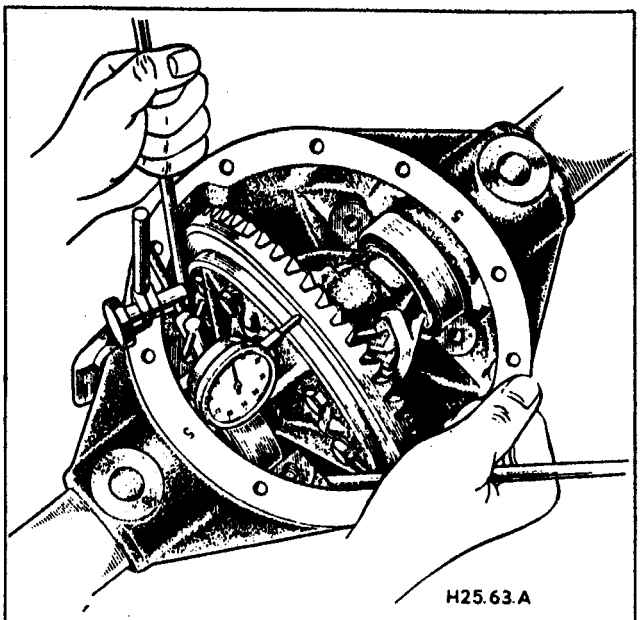


Fig. 13. Using a dial indicator gauge to ascertain correct thickness of shims for adjusting backlash.

and, inserting two screwdrivers between the housing and the bearing cup, move the differential assembly to one side of the case (see fig. 13).

Then after setting the indicator at zero, remove the assembly to the other side and record the indicator reading, which gives the total clearance between the bearings as now assembled and the abutment faces of the axle housing. Add .005 in. more to give preload. This thickness of shims to be used in the installation of the differential bearings, shims to be divided to give the gear position of correct blacklash as detailed later.

Remove the differential assembly from the gear carrier and, if it has been removed, reinstall the pinion outer bearing cup. Also refit the original pinion adjusting shims and the pinion inner bearing cup. Press the inner bearing cone on the pinion, using an arbor press and a length of tube, contacting the inner race only and **not the roller retainer.**

CROWN WHEEL AND PINION ADJUSTMENT

The rear axle pinion should be adjusted properly before further rear axle assembly is attempted. The ground end of the pinion is marked with the correct pinion setting. This marking may be zero (0), a minus (—) or a plus (+). When correctly adjusted a pinion marked zero will be at the zero cone setting distance from the centre line of the gear; a pinion marked plus two (+2) should be adjusted to the nominal cone setting distance, plus .002 in., and a pinion marked minus two (—2) to cone setting distance minus .002 in.

Thus for a pinion marked minus two (—2) the distance from the centre of the ring gear to the face of the pinion should be 2.623 in. and for a pinion marked plus three (+3) the cone setting distance would be 2.628 in. The final tolerance on the above figure should be plus/minus .001 in.

Place the pinion with the inner bearing cone in the gear carrier and adjust the pinion to the correct setting distance by means of shims between the rear bearing cup and the housing. The pinion adjusting shims are available in thicknesses of .003 in., .005 in., and .010 in. Install the original bearing adjusting shims on the pinion shaft behind the outer roller bearing. Then fit the pinion outer bearing cone, companion flange washer and nut. The pinion oil slinger and oil seal should not be assembled until the pinion bearing adjusting procedure has been completed.

Tighten the companion flange nut and test the pinion bearing adjustment. The pinion should have no end play; the pinion bearing preload= 8—12 lbs. Add or remove shims behind the outer bearing to obtain the correct adjustment. On no account disturb the shims already fitted behind the inner bearing, which control the cone setting.

Being sure that the bearing cones, cups and housings are perfectly clean, again place the differential assembly with the bearing cups in the housing. Install a dial indicator on the housing with the button against the ring gear (crown wheel) back face and, inserting two screwdrivers between the housing and the bearing cup, move the differential case and ring gear away from the pinion until the opposite bearing cup is seated against the housing. Then, after setting the indicator at zero, move the differential assembly towards the pinion until the ring gear contacts the pinion deep in mesh.

The indicator reading now obtained (clearance between crown wheel and pinion) minus the backlash allowance as etched on the ring gear (e.g. B/L .007) denotes the thickness of shims to be placed between the differential case and the bearing cone on the ring gear side of the differential. The quantity of shims inserted on the ring gear side of the differential case should then be subtracted from the total figure required, as determined previously.

As an example of a differential and crown wheel adjustment, assume that the total indicator reading is .080 in. This figure plus .005 in. for the recommended preload equals .085 in., which denotes the total thickness of shims to be used. Assuming the clearance between the ring gear and the pinion to be .042 in., subtract .007 in.

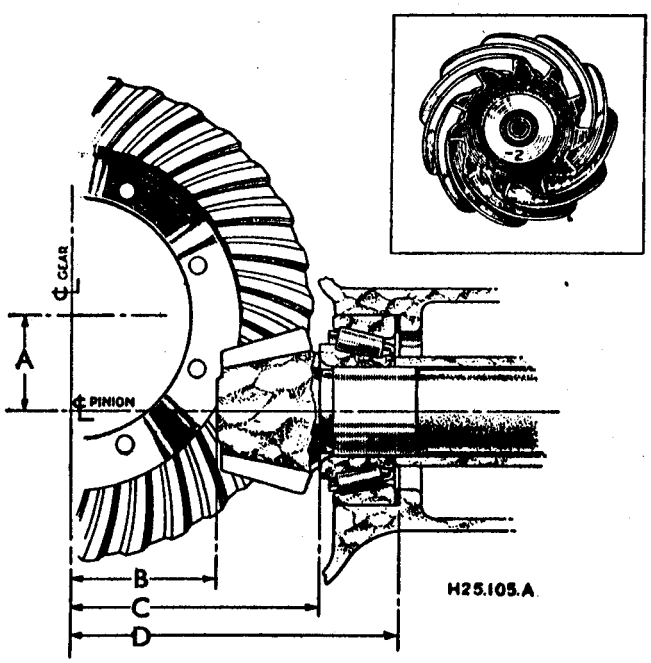


Fig. 14. Correct engagement of pinion to crown wheel.

A=1.800 in. B=2.625 in. C=4.312 in. D=5.505 in.
Inset shows marking on end of pinion.

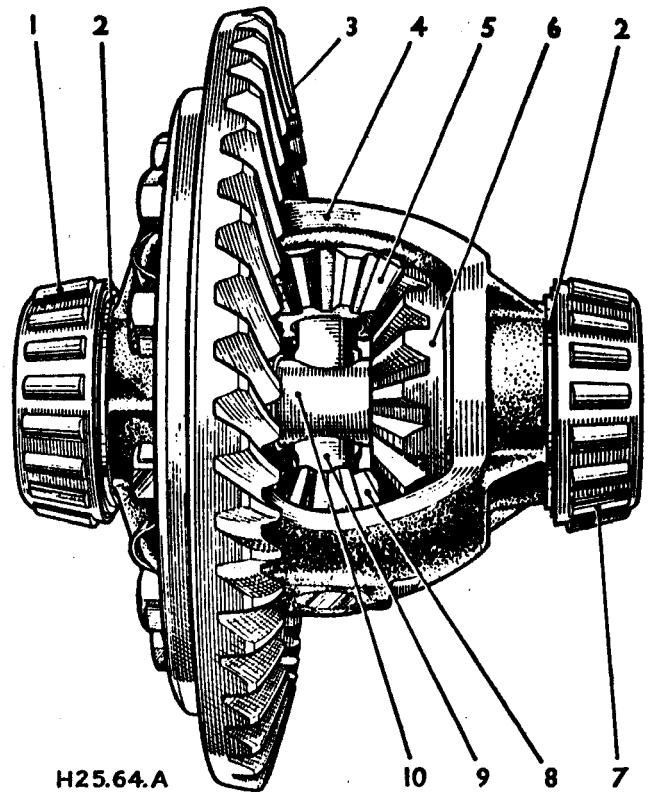


Fig. 15. Crown Wheel Assembly.

1. Taper roller bearing.
2. Adjusting shims.
3. Crown wheel.
4. Differential case.
5. Diff. pinion mate.
6. Diff. side gear.
7. Taper roller bearing.
8. Diff. pinion mate.
9. Pinion mate shaft.
10. Axle shaft spacer.

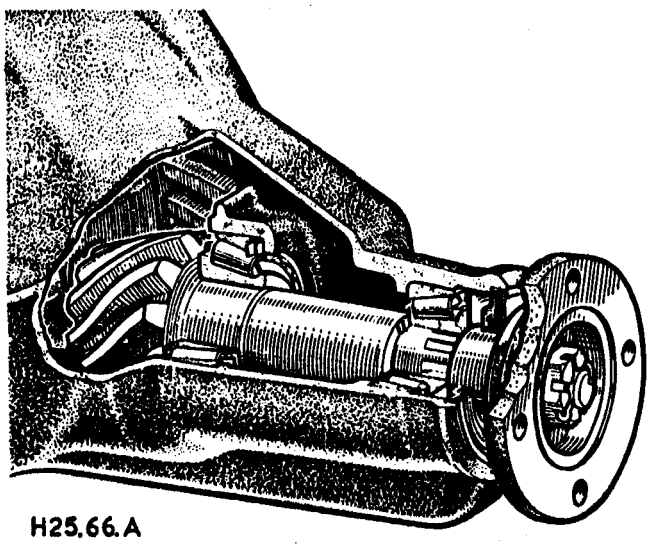


Fig. 16. Showing the bevel pinion in mesh with crown wheel and shim packing between bearing and housing.

(the marked backlash) from this .042 in. clearance. The .035 in. difference denotes the thickness of shims to be placed between the differential case and the bearing cone on the ring gear side of the differential. Then subtract the thickness of shims inserted on the ring gear side of the differential case from .085 in. and the .050 in. difference denotes the thickness of shims to be inserted on the opposite side of the case.

To facilitate installation of the differential assembly, the bearing cups should be tapped lightly into position with a hide or lead hammer. When refitting the bearing caps be sure that the position of the numerals marked on the gear carrier housing face and the caps correspond.

Mount a dial indicator on the gear carrier with the button against one of the ring gear teeth as nearly in line with the tooth travel as possible. Move the ring gear by hand to check the backlash, which should be as etched on the gear (in the foregoing example, .007 in.). If the backlash is not in accordance with specifications, transfer the necessary number of shims from one side of the differential case to the other to obtain the desired setting. Backlash will be changed approximately two thirds of the thickness of shims transferred.

After setting the backlash to the required figure, use a small brush to paint eight or ten of the ring gear teeth sparingly with marking-blue. Move the painted ring gear teeth over the pinion until a good impression of the tooth contact is obtained.

The resulting impressions should be similar to example A of fig. 17.

CROWN WHEEL TOOTH CONTACT

If the tooth is high on the gear teeth, as shown in example B, fig. 17, the pinion should be moved towards the gear by adding shims between the inner bearing cup and the housing, and adding the same thickness of shims between the shoulder of the pinion shaft and the outer bearing cone.

Low tooth contact of the gear, example C, denotes that the pinion should be moved away from the gear by removing shims from between the inner bearing cup and the housing and removing the same thickness of shims from between the shoulder of the pinion and the outer bearing cone.

Where the tooth contact is decidedly towards the toe or small end of the tooth, as in example D, the gear should be moved away from the pinion by removing shims from the ring gear side of the differential case and adding the same thickness of shims to the opposite side.

Should the tooth contact appear on the heel or large end of the teeth, as shown in example E, the gear should be moved towards the pinion by removing shims from the side of the differential case opposite to the ring gear and adding the same thickness of shims on the ring gear side.

Example A of fig. 17 is the type of impression that is desirable when making crown wheel and pinion adjustments.

It must be remembered that in making adjustments to correct a heel or toe contact, that a minimum backlash of .004 in. must be maintained, notwithstanding the theoretical marking on the gear. A reduction of the backlash within the above limits may correct an extreme heel con-

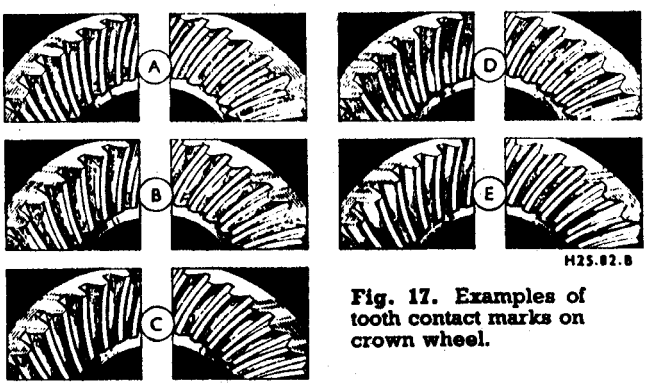


Fig. 17. Examples of tooth contact marks on crown wheel.

A. Ideal ring gear tooth contact under light load.
B. High tooth contact—to correct, move pinion towards gear.
C. Low tooth contact—to correct, move pinion away from gear.
D. Toe contact—to correct, move gear away from pinion.
E. Heel contact—to correct, move gear towards pinion.

tact while an increase of backlash may correct an extreme toe contact. Moving the ring gear .005 in. will change the backlash approximately .0035 in. while moving the pinion .005 in. will change the backlash about .001 in.

Ordinarily, it will not be desirable to move the pinion when making a backlash correction as the movement of the ring gear has a much greater effect upon the backlash.

When finally adjusted, assembled and refitted, fill the axle casing with the correct amount of approved hypoid lubricant.

SUSPENSION

GENERAL DATA

Spring Data	R.H. Drive Taxi R.H. & L.H. Drive Hire Car	L.H. Drive Taxi
Front		
Type	Semi Elliptic	Semi Elliptic
Number of leaves	9	9
Thickness of leaves	9 x $\frac{3}{16}$ ins.	9 x $\frac{3}{16}$ ins.
Width of leaves	$1\frac{3}{4}$ ins.	$1\frac{3}{4}$ ins.
Deflection	$3\frac{9}{16}$ ins. at 6 cwt.	$3\frac{9}{16}$ ins. at 6 cwt.
Free length	$36\frac{3}{8}$ ins.	$36\frac{3}{8}$ ins.
Free camber	$+3\frac{31}{32}$ ins.	$+3\frac{31}{32}$ ins.
Rear		
Type	Semi Elliptic	Semi Elliptic
Number of leaves	9	9
Thickness of leaves	9 x $\frac{7}{32}$ ins.	7 x $\frac{7}{32}$ ins. & 2 x $\frac{3}{16}$ ins.
Width of leaves	2 ins.	2 ins.
Deflection	$6\frac{3}{16} \pm \frac{1}{4}$ at 9 cwt.	$6\frac{3}{16} \pm \frac{1}{4}$ at 8 cwt.
Free length	$46\frac{5}{8}$ ins.	$46\frac{1}{2}$ ins.
Free camber	$+5\frac{3}{16}$ ins.	$+5\frac{3}{16}$ ins.

SPRING MAINTENANCE

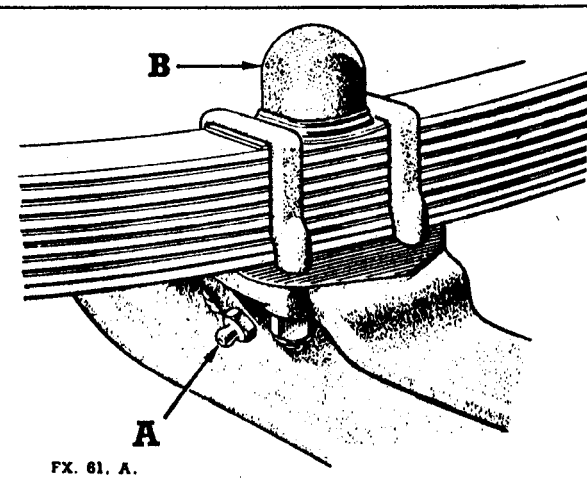
Description

The road springs of the taxi and hire car are of the semi-elliptic type and should be given regular attention to ensure comfort and efficient riding of the body.

Each spring has zinc interleaves and eyelets fitted with silent bloc bushes.

Periodic examination should be carried out to ensure that the spring leaves are in sound condition and the 'U' bolts checked for tightness. The bushes should also be checked for wear and the shackles examined for possible side play. Regularly lubricate the spring leaves via the nipple screwed into the spring centre pin.

Controlling the suspension there are pressure recuperation type shock absorbers, which are accurately set to give the amount of damping most suitable for the vehicle.



FX. 61. A.

Fig. 1. Showing the securing of a front spring to the axle by 'U' bolts with A, the lubricating nipple, and B, the spring buffer.

Removing a Front Spring

Chock all wheels except the one to be serviced. Jack up the vehicle (use a screw type or garage jack but not the hydraulic equipment fitted to the taxi or hire car) until the wheel concerned is clear of the ground then place suitable support blocks under the frame side member. Gently lower the vehicle on to the blocks and

remove the road wheel. A screw type jack placed under the axle is invaluable for relieving the tension of the spring as required.

The 'U' bolt self-locking nuts should be removed with the aid of a box spanner, when the 'U' bolts can be withdrawn upwards from the axle flange and taken clear of the spring. Detach the 'U' bolt spacer plate. This plate serves a dual role ; it keeps the 'U' bolts in their correct position relative to the spring and it also carries the rubber pad which acts as a buffer between the spring and the chassis.

To release the spring from its front shackle mounting, knock back the tab of the lockwasher beneath the lower shackle pin nut and remove the nut. Then tap out the shackle pin. Adopt the same procedure at the spring's rear anchorage.

The spring may now be taken from beneath the vehicle.

Replacement is a reversal of this procedure, but care must be taken to ensure that the flats on the shackle pin heads locate against their respective locking lugs on front and rear anchorages before tightening and locking up the nuts.

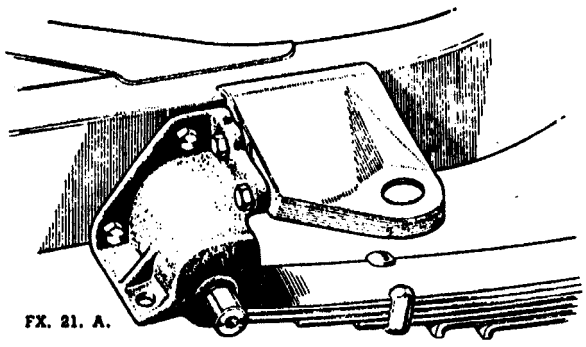


Fig. 2. The rear spring front shackle mounting.

Removing a Rear Spring

Before attempting to remove a rear spring the running board concerned must be detached from the body and chassis, see page R/10.

The procedure outlined for a front spring removal may be adopted for a rear spring, that is as regards jacking, packing up to the frame and the removal of the 'U' bolts.

However, the forward shackle of a rear spring is somewhat different. The shackle pin nut is unlocked and removed on the inside of the chassis side member, then the pin, which has a female thread in its head, is withdrawn with the aid of a suitable extractor if it proves too tight for removal by the usual tapping out method.

The rear end of the spring is released from its shackle in an identical manner to that employed on a front spring.

Dismantling a Spring

First remove the spring as previously detailed.

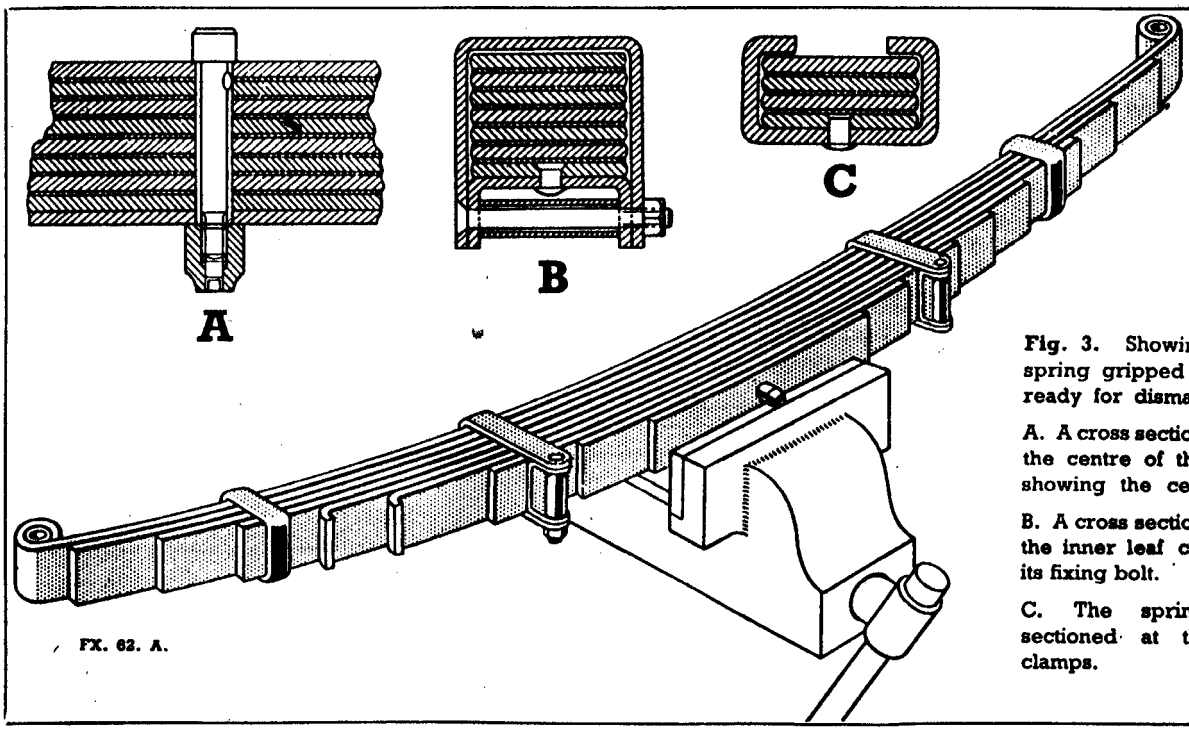


Fig. 3. Showing a rear spring gripped in a vice ready for dismantling.

A. A cross section through the centre of the spring, showing the centre bolt.

B. A cross section to show the inner leaf clamp and its fixing bolt.

C. The spring cross sectioned at the outer clamps.

Grip the spring in a vice with the jaws against the top and bottom leaves, adjacent to the centre bolt. Where a front spring is concerned, free the four leaf clips by opening them out with a punch and hammer. In the case of a rear spring the two outer leaf clips may be opened out in the manner just described, but the inner clips are removed completely by unscrewing the castle nut and screwing out the pin. Finally withdraw the centre bolt.

Carefully open the vice when the spring leaves, together with the zinc interleaves, will separate. These should now be thoroughly examined for cracks or failures. Replace any defective leaves, thoroughly clean and regrease. Also see that the rivets are tight which hold the leaf clips to the bottom spring leaf of those they secure.

Replace the spring in a vice. Utilising a rod of similar diameter to the clamping bolt and having a tapered end, position the leaves so that the clamping bolt can be replaced without the risk of damage to the thread.

Replace the clamping bolt and nut. Follow this by carefully refitting the leaf clips.

Renewal and Replacement of Spring Eye Bushes

These bushes are of the silent bloc type and must therefore be pressed clear of the spring eyes by applying pressure to the outer bush of the assembly. A special tool can be supplied which will greatly simplify this operation. Part of the tool can also be used for replacing the silent bloc bush, which must be so positioned that its outer bush must be perfectly central in the spring eye. Again pressure must only be applied to the outer bush. When the shackle pin is inserted the nut must be pulled up tight otherwise the silent bloc bush will not operate properly.

Replacing a Spring

When the spring is fully assembled it should be fitted at the anchor end and then at the shackle end. Remember that the shackle nuts must be pulled up tight, as already mentioned. Finally fit the spring securing clips and secure the spring to the axle by means of the 'U' bolts using spring washers under the self-locking nuts.

THE SHOCK ABSORBERS AND ANTI-ROLL BARS

Description

The shock absorbers are Armstrong double-acting, hydraulic resistance being offered to the compression and to the recoil of the road springs.

A special anti-roll bar is fitted across the chassis at the front and the rear each being firmly attached to the shock absorber arms.

Shock absorber maintenance in position on the vehicle is confined to the periodical examination of the anchorage to the chassis, the two fixing bolts being tightened as required. Topping up with fluid requires the removal of each unit from the chassis.

No adjustment is provided for and any attempt to dismantle the piston assembly will seriously affect the performance of the shock absorber.

Testing

When there is any doubt that the suspension of the vehicle is not adequately damped, the condition of the road springs and tyre pressures should be borne in mind.

If the shock absorbers appear not to function satisfactorily, an indication of their resistance can be obtained by carrying out the following inspection routine.

Remove the shock absorbers from the chassis. Place them individually in a vice, taking care to grip them by their fixing lugs thus avoiding distortion of the cylinder body.

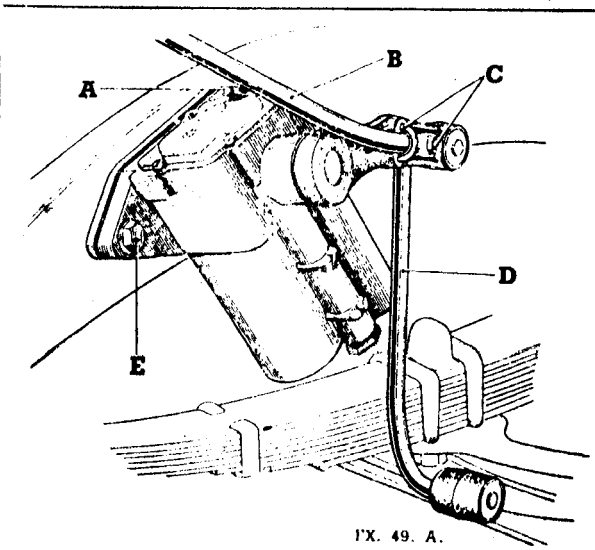


Fig. 4. A front shock absorber in position.
A. Filler plug. C. Anti-roll bar fixing bolt.
B. Anti-roll bar. D. Link arm.
E. Shock absorber securing bolts.

Move the lever arm up and down through its complete stroke. A moderate resistance throughout the full stroke should be felt.

If the resistance is erratic and free movement of the lever arm is noted, it may indicate lack of fluid. If the addition of fluid fails to produce improvement a new unit must be fitted.

Too much resistance, when it is impossible to move the lever arm slowly by hand, may indicate a broken internal part or a seized piston, in which case the unit will have to be replaced.

Topping-up with Fluid

Remove the shock absorber from the chassis. Before removing the filler plug carefully wipe clean the exterior of the shock absorber body. This is most important as it is vital that no dirt or foreign matter enters the interior of the unit.

Ensure that only the recommended Armstrong shock absorber fluid is used for topping-up. While adding fluid the lever arm must be worked throughout its full stroke to expel any air that may be present in the chamber.

Fluid Level

Fluid should be added to the level of the bottom of the filler plug hole.

Refitting the Shock Absorbers

When handling shock absorbers that have been removed from the chassis for any purpose, it is important to keep the assemblies upright as far as possible, otherwise air may enter the working chamber and cause erratic resistance.

Shock Absorber Arm Rubber Bushes

The rubber bushes integral with both ends of the connecting link, which joins the shock absorber to the axle, cannot be renewed. When these bushes are worn the complete link arm must be renewed.

Anti-Roll Torsion Bars

Each anti-roll bar is bolted between its respective shock absorber arms being anchored to the arms by a nut, bolt and washer and also by a 'U' bolt, nuts and spring washers.

THE TAXI AND HIRE CAR CHASSIS FRAME

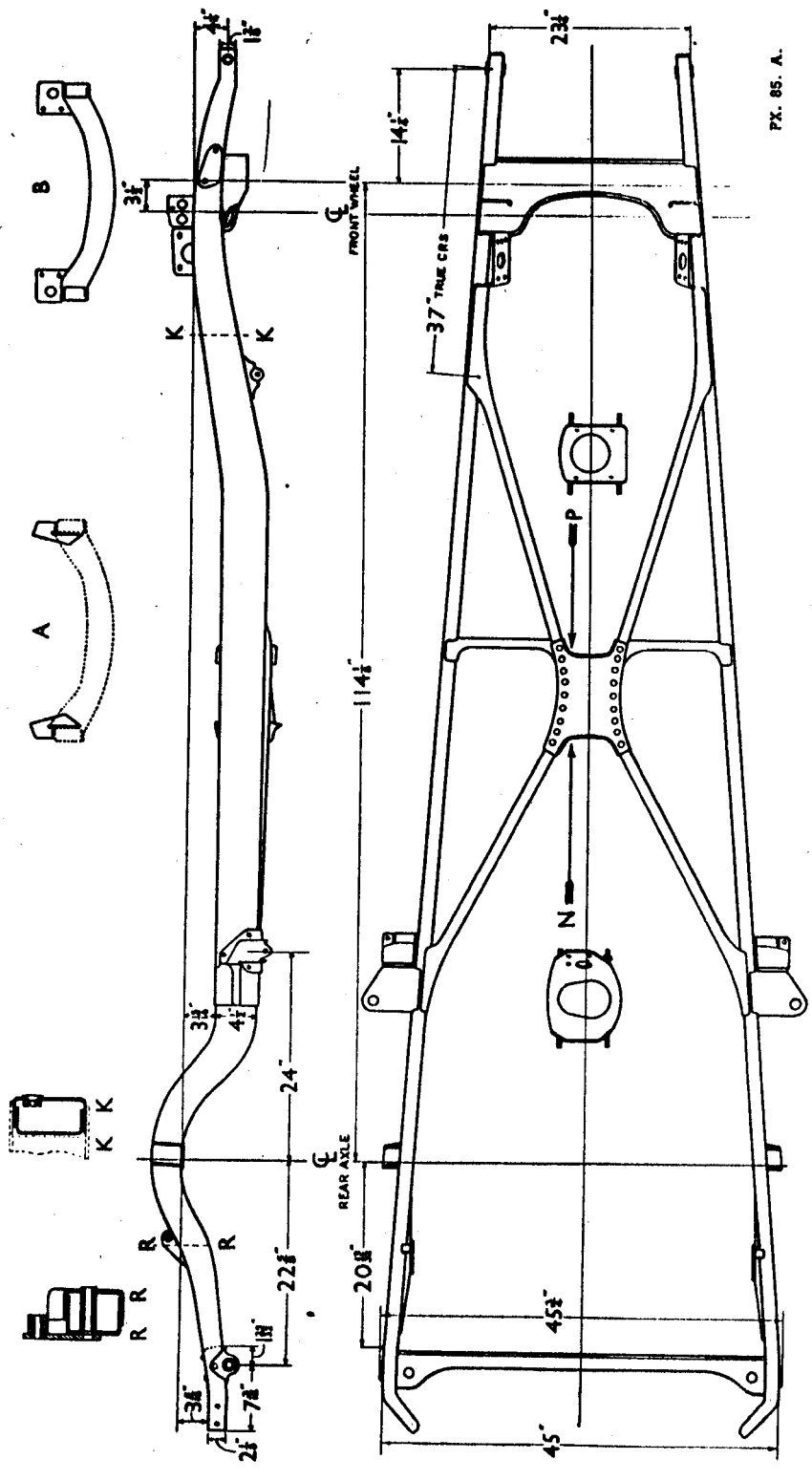


Fig. 5. The principal dimensions of the chassis frame are given in this illustration.

Inset A illustrates the front view of the engine front mounting brackets while inset B shows the front view of the radiator supports and cross-member looking square to front of supports.

BRAKES

GENERAL DATA

Make	Girling
Type	Mechanical, Wedge and Roller (2 leading shoe on front)
Pedal Free Movement	$\frac{1}{4}$-in.
Handbrake	Operates on all four wheels
Taxi	Lever type from floor
Hire Car	Pistol grip type

Total braking area	147 sq. ins.
Inside drum diameter	10.998 — 11.002

Shoe Lining :	Front	Rear
Width	$1\frac{3}{4}$	$1\frac{3}{4}$
Length	$10\frac{1}{4}$	$9\frac{1}{4}$
Thickness	$\frac{3}{16}$	$\frac{3}{16}$

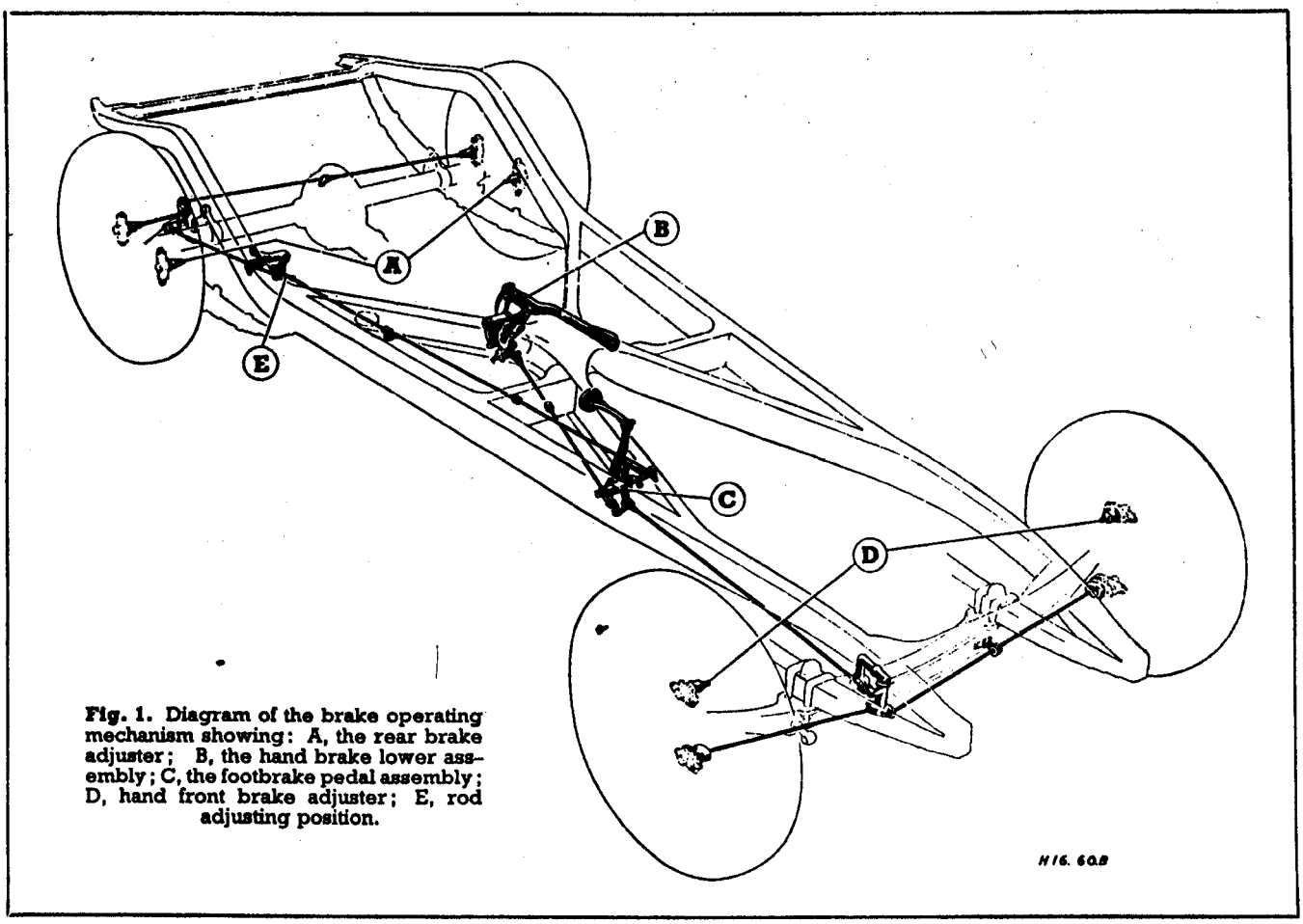


Fig. 1. Diagram of the brake operating mechanism showing: A, the rear brake adjuster; B, the hand brake lower assembly; C, the footbrake pedal assembly; D, hand front brake adjuster; E, rod adjusting position.

Description

The load applied to the footbrake pedal or the handbrake lever is transmitted through a system of rods, to each expander unit. It follows, that the harder either pedal or lever is applied the greater will be the retarding effect of the brakes. Provided that the brake shoes are correctly adjusted and that the rod linkages and the balance levers are properly maintained, even retardation will be effected.

Uneven braking can therefore only be attributed to either (a) lack of adjustment at each wheel, (b) oil reaching the brake linings, (c) inadequate lubrication causing seized joints.

Badly worn or distorted drums may also cause uneven braking, and efficient compensation can only be effected after the renewal of the drums concerned.

Operation

On application of the brakes the following

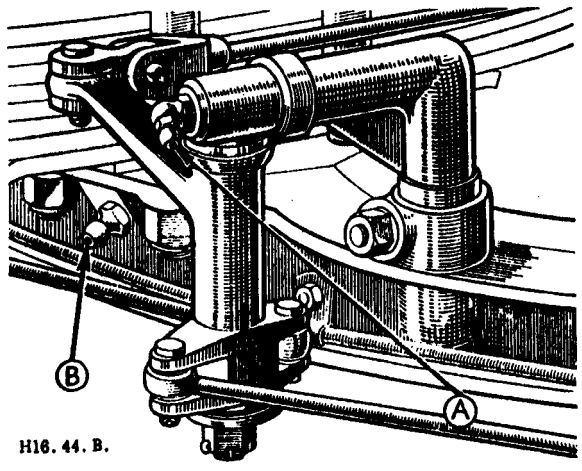


Fig. 2. The front brake balance lever mounted on the front axle with lubrication nipple at 'A'. 'B' is the nipple for oiling the main springs.

sequence of events is put into action.

When foot pressure is applied the pedal pivot converts the force into a direct pull—pull is taken by rods to each axle balance lever—each balance lever causes an equal pull on both wheel expander units—the expander units convert the pull into an outward push which expands between the brake shoe ends—friction is caused between the brake shoe linings and the brake drum and so the vehicle is effectively braked or brought to a standstill.

Pedal Pivot

The pedal is pivoted on a cross shaft and when pressed a lug on the side of the lever engages with the balance lever. This action exerts a pull on the rod to the front axle before pulling on the rod to the rear axle; thus the front brakes are applied slightly before the rear ones. Fig. 3 shows the pedal return spring, the pedal adjusting screw and the rear rod adjusting nut.

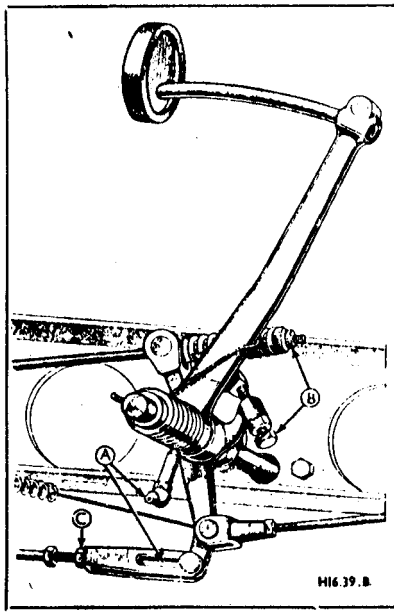


Fig. 3. The brake pedal assembly showing A, the lubrication points. B, the adjusting points and C, locknut. There should be $\frac{1}{32}$-in. clearance at each of these points.

Rods and Linkages

In normal circumstances the rods and linkages should receive no attention as to length, but over a long period rod ends may become elongated. When this has occurred, the rods should be replaced. It is very important that the adjustable fork ends on the rear brake rod, and on the front and rear longitudinal rods, are never screwed off further than the inspection holes. This can be checked with the aid of a thin piece of wire. There is an adjuster on the rod to the rear axle from the pedal pivot.

The fit of the pins in the fork ends must always be free; adequate clearance has been purposely provided. Re-tighten the locknuts after adjustment.

Should it become necessary to replace the cross rods at any time the expander unit concerned will have to be dismantled.

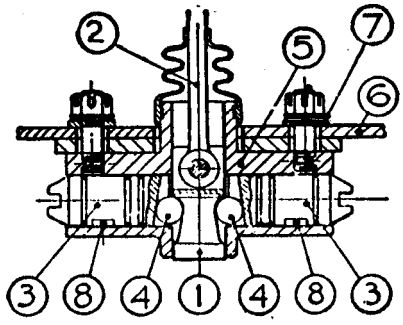


Fig. 4. A sectional view of the expander unit.

Expander Unit

The function of the expander is to convert the pull by the rod into an expanding movement. Reference to Fig. 4 shows that the unit consists of a housing (5) which is bolted (7) to the backplate (6). As the pull on the rod (2) moves the cone (1) inwards, the two rollers (4) are pushed outwards against the plungers (3) forcing them apart. Pins (8) hold the plungers in the housing when the brake shoes are removed.

The plungers in the front brakes are rigidly attached to the backplate, allowing no float, but both rear wheel expanders are lightly held under spring pressure in slots. This float allows the shoes to be self-centring, pivoting on the adjuster unit.

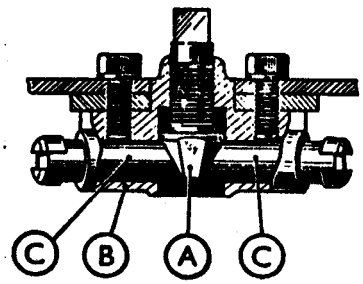


Fig. 5. A sectional view of the adjuster unit showing, A, flats on the expander screw; B, the expander housing, and C, the brake operating plungers.

Adjuster Unit

Fig. 5 gives a section drawing of the adjuster unit which operates as follows:

The brake shoe ends are located in the grooves at the outer end of the plungers (C), the plungers being kept in compression by the brake 'pull-off' springs. As the square end of the adjuster is turned the plungers are forced apart by the conical end (A) of the pin and kept there by the flats engaging with the sloping ends of the plungers. In this way the brake shoes can be adjusted into the closest proximity to the drums without binding. It is also through the adjuster that maximum efficiency is obtained, irrespective of the wear of the shoes.

The adjuster is bolted to the backplate by two setscrews and lock-washers.

Brake Backplate

This consists of a pressed steel plate secured to the axle by four nuts and bolts which are locked by lockwashers. It carries the adjuster and expander units.

Brake Shoes

Front: In the front brakes, to what normally would be the trailing shoe, there is added a strut and bell crank arrangement so that when the expander unit pushes the shoe webs outwards, the bell crank swivels on its fixed pin, pushes the strut, which in turn operates on the bell crank at the other end of the shoe, forcing the end of the shoe away from the adjuster, thus creating an equal outward pressure at each end. This system is known as the two leading shoe arrangement, giving the advantage of two leading shoe efficiency when the vehicle is in forward motion.

Rear: The rear brakes each have one leading shoe. A leading shoe may be defined as being that shoe in which the rotation of the drum is from the expander unit (floating or fixed) towards the anchored end. It will be seen therefore that in the rear brakes the shoes become either leading or trailing with either forward or reverse motion of the drum.

Bonded Brake Linings

The efficiency of both front and rear brakes has been greatly increased by fitting bonded brake linings (later models) in place of the normal riveted type.

This well-tested development means that the lining is now firmly attached to the shoes by means of a plastic cement, the shoes then being heated electrically, eliminating the use of rivets. Afterwards, every lined shoe is tested at a minimum overload of twice the stress which can possibly be appplied to a vehicle's brakes on the road.

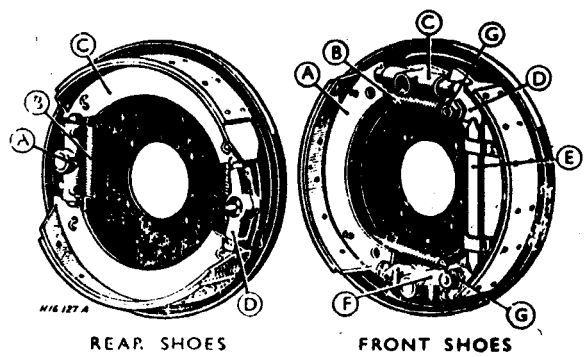


Fig. 6. The brake assemblies showing:
Rear Shoes: A, expander unit; B, return spring; C, brake shoe; D, adjustment.
Front Shoes: A, brake shoe; B, return spring; C, adjusting unit; D, bell crank; E, strut; F, eccentric adjuster; G, expander unit.

Advantages offered by the bonding process may be briefly listed as follows:—

1. **Increased braking efficiency:** Owing to the absence of rivet holes, the area in contact with the brake drum is increased by more than 5 per cent.

Brake fade is reduced as the greater area of lining can absorb more heat, and temperatures are reduced.

Brake drums cannot be scored by dust or other foreign matter that would collect in the countersunk rivet holes of normal brake linings.

A more solid 'feel' is imparted to a vehicle using bonded brakes, due to the fact that the lining is an integral part of the shoe.

2. **Considerable economy:** The effective life of a bonded lining is increased by about 50 per cent as it can be worn throughout its depth.

3. **Brake squeal reduced:** The possibility of brake squeal is considerably reduced due to the integral construction of the shoe and lining.

If it is desired to replace the riveted linings of old models with the new bonded type, a full set of shoes, both front and rear, must be fitted.

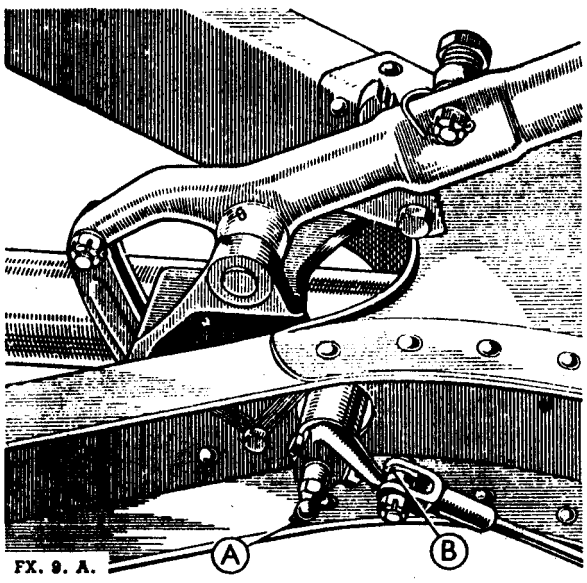


Fig. 8. Showing the Taxi handbrake cross shaft and forked link rod. 'A' is the cross shaft lubricating nipple, and at 'B' there are felt washers which require a periodic oiling.

Handbrake

The Taxi handbrake operates on all four wheels. The connection between the handbrake lever and the balance lever on the foot brake is a rod which is equipped with a slotted end in order that the foot brake can be applied without movement of the handbrake lever. The handbrake should have a little free movement and its adjustment is by means of a screw and locknut on the rod. In tightening the locknut be careful not to twist the slotted link.

The Hire Car handbrake is of the pistol grip type situated beneath the fascia. The pull on the pistol grip handbrake is traversed rearwards to balance lever of the foot brake mechanism by a bell crank lever, shafted to the chassis side member forward of the scuttle, and then by a rod with forked ends to the balance lever itself

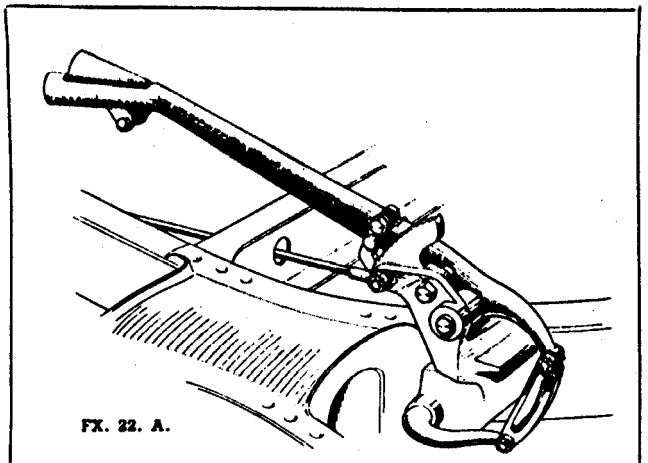


Fig. 7. The Taxi handbrake, showing the linkage and the locking ratchet.

from where the movement is carried to the brakes by the same system of rods and axle balance levers as are operated by the foot pedal. Adjustment for the handbrake can be made at the lower end of the bell crank lever where the rod adjoining it has a screwed fork.

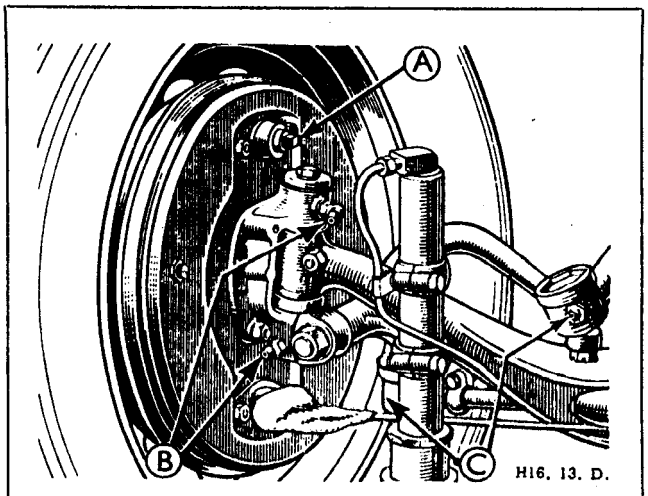


Fig. 9. The front brake adjuster is shown at 'A', whilst 'B' indicates the position of the swivel pin lubricating nipples, and 'C' the steering ball and socket connections.

Brake Adjustment

It is an essential part of the Girling braking system that adjustment for brake lining wear is **always** made at each brake drum and **never** by means of altering the length of the brake rods. The two brakes on each axle are automatically compensated and hand or foot pressure brings all four brakes into operation.

Normal adjustment can be made without

jacking up the vehicle, but the handbrake must be in the off position.

Chock the wheels and release the handbrake. The square ended adjuster screw will be seen at the top of the brake back-plate on the front wheels and at the forward side of the rear back-plates. Turn the screw in a clockwise direction as far as it will go with reasonable pressure. The shoes will then be hard on. At each 45° turn of the screw a click will be heard, the result of the flats on the cone head of the adjuster screw engaging under 'pull-off' spring pressure with the plunger inclined faces. When the screw is fully tight, slacken off the screw one click to give the shoes the necessary clearance from the drums.

Each drum should receive similar treatment. After completion of the four wheels, press the foot brake down hard two or three times to centralise the rear brake shoes in the drums.

Due to the two leading shoe design of the front brakes a further adjustment may be necessary which will require jacking up of the front axle, the removal of the wheels and front brake drums, also the disconnection of the clevis pins anchoring the brake push rods to the balance lever. This operation is to ensure that the expander unit is in the 'off' position.

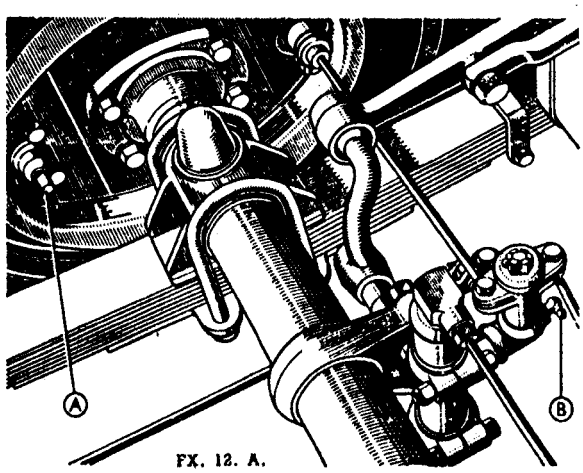


Fig. 10. The rear brake adjuster is shown at 'A' and the balance lever lubricating nipple at 'B'.

An adjustment point as shown in Fig. 10 is provided at each end of each front brake shoe. This consists of an eccentric bush with a hexagon head, which is locked in position after adjustment has been made, by a Simmonds self-locking nut. The bell cranks are positioned by these bushes.

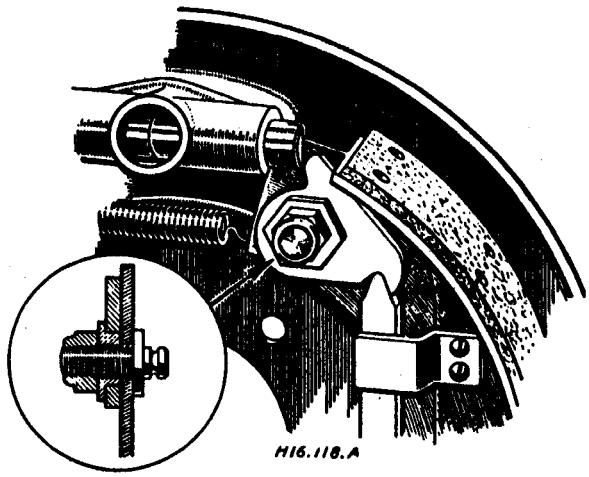


Fig. 11. Showing the bell crank adjusting point, with an inset of the eccentric bush. There should be no clearance between the brake shoe webs and plungers.

Rotation of the bushes will alter the position of the bell cranks and so take up any undue clearance between them and the strut caused by wear. The setting is correct when it is just possible to rock the strut sideways between the finger and thumb. The final clearance should be .002-in.

Under all circumstances care must be taken to ensure that there is no clearance between the webs of the shoes and the expander unit or adjusting plungers.

The brake drum is mounted on the hub and held by two small countersunk screws. Mark the position of the drum on the hub, take out the screws and remove the drum.

Brake Shoe Removal

To remove the shoes place a lever, or a strong screwdriver, under the shoe web in such a manner that the end will act as a pivot. Always lever the end of the shoe nearest to the expander first and as the web clears the expander plunger, so both the shoes become removable. Care must be taken not to stretch the 'pull-off' springs.

Servicing

Clean down the back-plates and see that the expander and adjusting units are working properly. If the 'pull-off' springs are stretched or damaged, they should be replaced.

To equalise brake lining wear, it is a good plan to reverse the brake shoes on each rear hub, i.e., putting the lower shoe on top and vice versa, so that each shoe shares the leading shoe wear.

Brake Shoe Refitting

Hook up the springs between the two shoes and place one shoe in position. Now place the second shoe web into the groove on the adjuster plunger and lever back the other end of the expander.

Free Movement and Clearances

When the brake pedal has from $\frac{1}{4}$-in. to $\frac{1}{2}$-in. free movement there should be $\frac{1}{32}$-in. clearance between the face of the forward adjusting screw and the lever on the pedal shaft. The front and rear rods should be adjusted to suit this position. There should be a $\frac{1}{32}$-in. clearance between the spring and the locking nut on the rod to the rear axle.

New Rods

Should it be necessary to fit new transverse rods on either axle remove the shoes as previously described then remove the expander unit by undoing its two retaining bolts when the rods can be withdrawn through the rubber cover.

Take out the plunger retaining pins. The plungers can now be moved, thus freeing the rollers and allowing the cone and rod to have passage through the housing. Take out the pin attaching the cone to the rod and fit the new rod.

Reassembly is a reversal of these instructions. If any difficulty is encountered when assembling the rollers, a little grease smeared on them, and the slots in which they work, will hold them in place. Replace the plungers in the same position as they were found when dismantling.

Remember when tightening the adjuster to the place-plate that only the front axle units are fixed; the rear units are allowed float for brake shoe self-centring action.

Shoe Centralising (Rear Axle)

With the handbrake off, slaken the adjuster unit retaining nuts about one turn each. Turn the adjuster screw in a clockwise direction so that the shoes become hard on. Press the foot brake pedal hard once or twice to centralise the shoes. Now re-tighten the two retaining nuts, turn back the adjuster screw one click to give brake shoe-drum clearance, and then slacken the retaining nuts half a turn to make the necessary slackness for float.

The unit will now float on the back-plate and be self-centring.

Lubrication

The brake balance levers and the nipple on the pedal and all joints should be oiled regularly.

Inattention to the lubrication of the brake balance levers may cause the brakes to 'stick on'.

JACKING SYSTEM

THE 'Red Jackall' Hydraulic Jacking System fitted, is Type IV. It requires no attention other than a periodical examination of the fluid reservoir; this should be inspected every two or three months and topped up with fluid as necessary.

The use of any other fluid but genuine 'Red Jackall Fluid' cancels the guarantee.

Method of Operation

The indicator dial should be turned until the appropriate lettering, i.e., 'FRONT,' 'ALL' or 'REAR,' is opposite the pointer (see Fig. 1). In selecting 'FRONT' or 'REAR' the dial should be turned as far as it will go without using undue force. Screw down the release valve and then place the handle over the lever at the side of the pump and work to and fro (see Fig. 2). As the pump has a ported inlet, the handle must be moved the full extent in both directions to charge the cylinders of each jack with fluid. This operation should take about 30 seconds. No damage can be caused by continued pumping, because a relief valve has been provided to prevent excessive pressure.

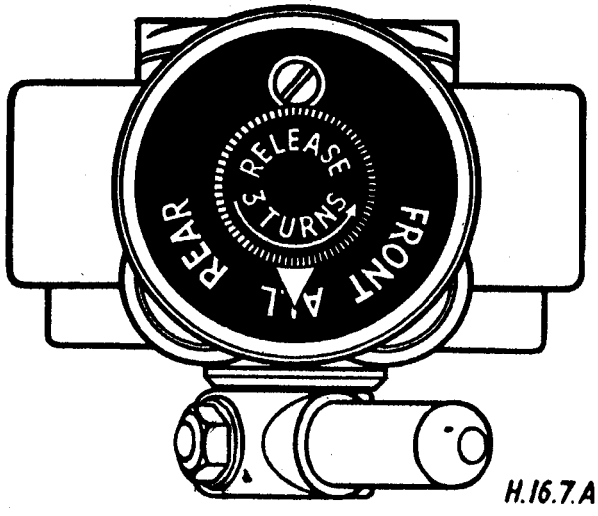


Fig. 1. The indicator dial.

To lower the car, the release valve should first be opened slightly, to control the drop of the car to the ground, after which it should be opened two or three turns and left open until the next jacking operation. **After use, turn the indicator to the 'ALL' position.** This ensures the jacks returning to the inoperative position, thus preventing accidental damage.

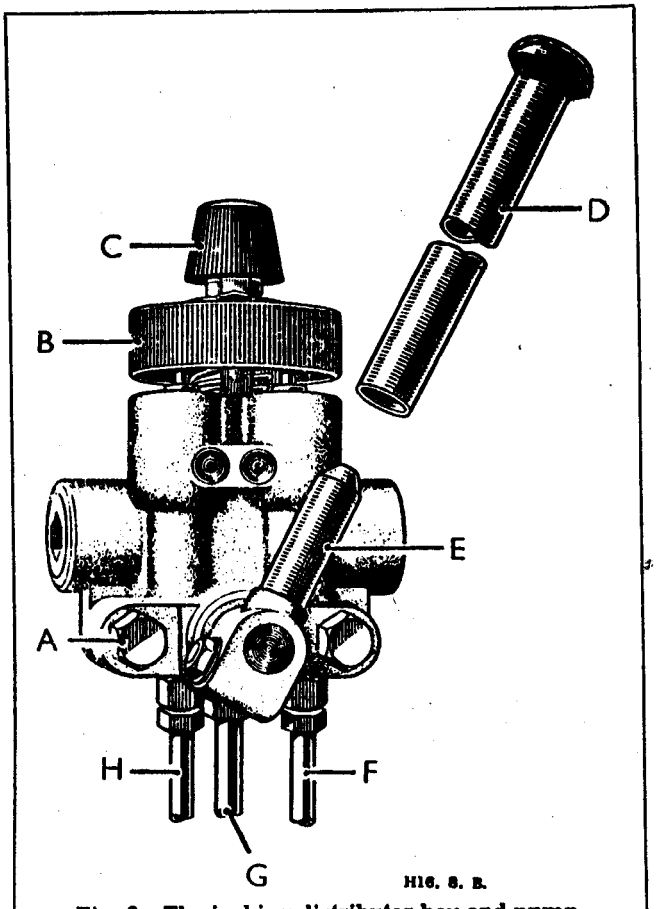


Fig. 2. The jacking distributor box and pump.

A, unit mounting setpin; B, axle selector; C, release knob; D, operating handle; E, operating lever; F and H, pipes to axles; G, feed pipe from supply tank.

Conditions for Jacking

Due to the small diameter of the jack foot it is essential that hard ground such as a tarmac or concrete road should be selected before raising the car. If this should not be possible, the introduction of suitable wooden boards placed under the jack feet, will allow jacking on soft ground to be undertaken. Make sure that the handbrake is firmly applied before raising the car if the front or rear wheel only are concerned. When raising the whole car it is advisable to select level ground before proceeding.

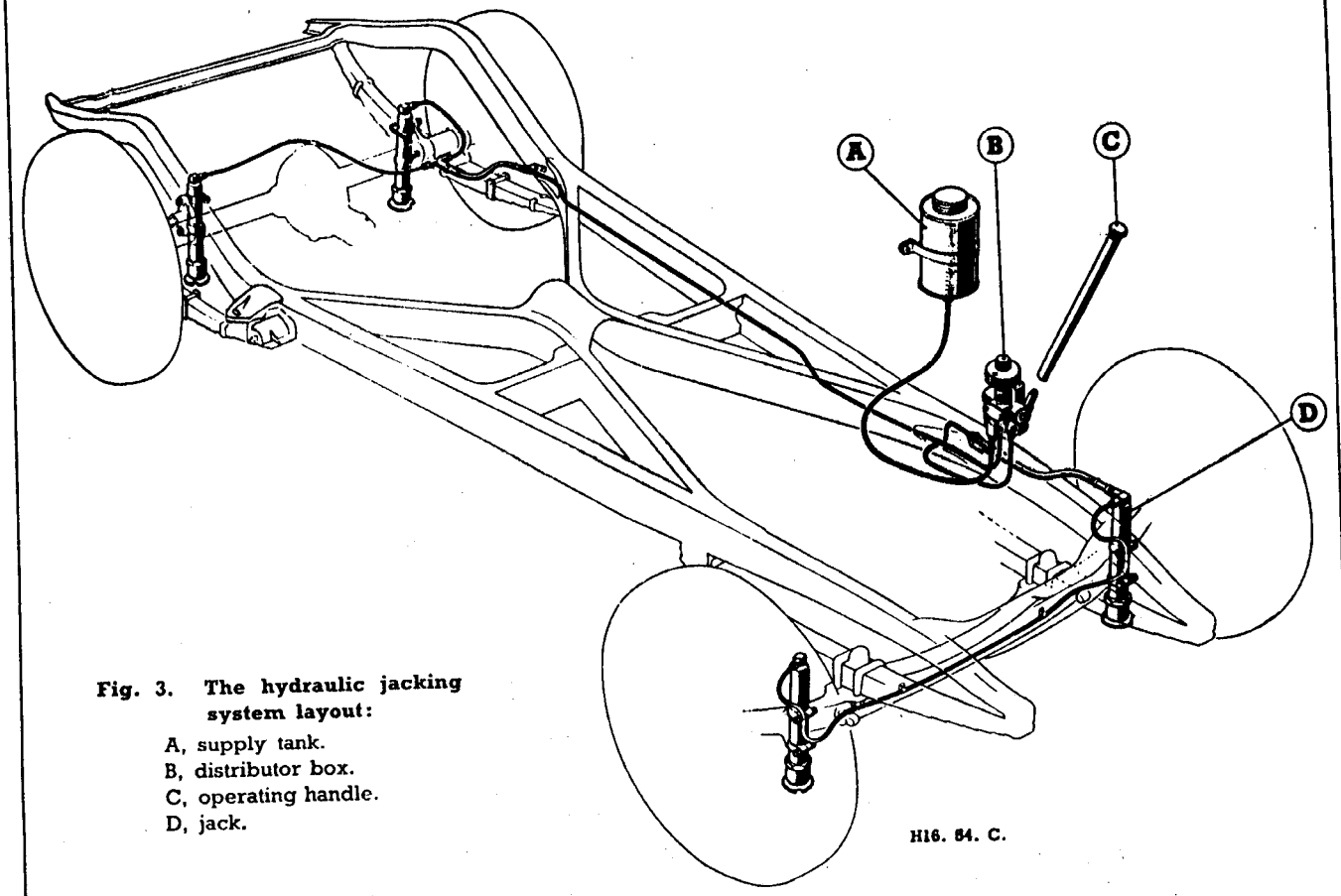


Fig. 3. The hydraulic jacking system layout:

A, supply tank.
B, distributor box.
C, operating handle.
D, jack.

THE DISTRIBUTOR BOX

Flow of Fluid

In operation the fluid passes from the supply tank into the pump body through the filter 'A,' (see Fig. 4) which is mounted in the cover. By reciprocating the lever 'E' its full stroke in both directions, fluid is drawn through the ports 'D' and forced along the passages 'F' into the valve chambers 'G' and 'H' via the duplicated non-return ball valves 'I' and 'K.' These valves have been duplicated to avoid any possibility of dirt rendering the pump inoperative. The top ball in each valve chamber is kept on its seat by a washer 'L' which is lightly spring-loaded by the spring 'M.'

Valve Operation

The valve chambers are interconnected by means of cross holes 'N' into the release chamber 'O.' By this means the fluid delivered into either valve chamber can pass via the cross-holes and release chamber into the opposite valve chamber, when one or other of the selector valves and release valves are closed. Each valve chamber is sealed at its top end by a gland 'P' through which passes the selector valve 'Q.' Each selector valve is depressed on to its seat as the indicator dial is rotated to the 'FRONT' or 'REAR' positions; the fluid then being fed through the other selector valve port to the rear or front jacks.

Raising the Car

The cam surfaces on the underside of the indicator dial depress the appropriate valve through the medium of a rocking plate 'R,' which, by a fulcruming action, uses the fluid load in that side of the system which is being operated, to further depress the selector valve on its seat and thus cut off the inoperative side.

From the valve chambers the fluid thus flows through whichever selector valve is open, through the filter 'U' and into the delivery line to the jacks.

Relief Valve Operation

When the jacks are fully extended, excess pressure developed in the pump, passes through

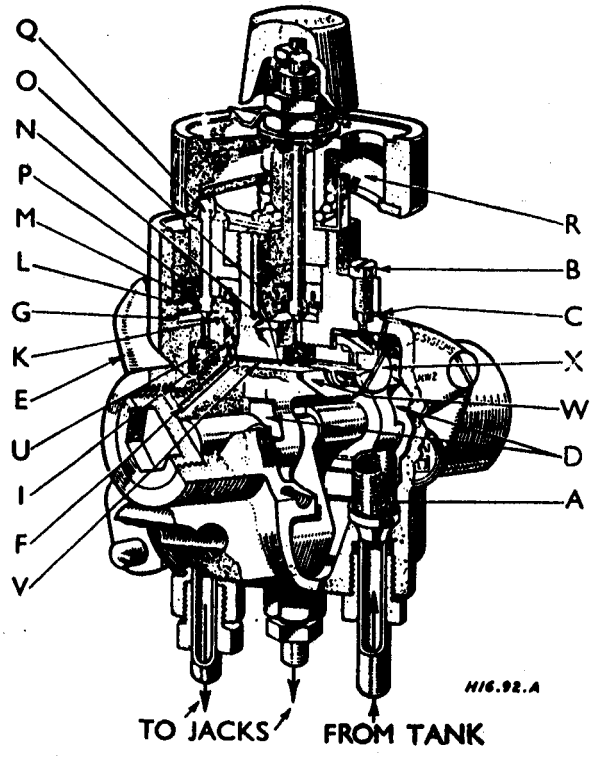


Fig. 4. Section of the distributor box.

NOTE.— In re-setting the indicator dial make sure by adjusting the locknuts, that in selecting 'FRONT' or 'REAR' there is enough angular movement on the dia to bring the centre of the words 'FRONT' or 'ALL' opposite the pointer.

the holes 'V' which are connected with the passages 'F' and escapes into the pump body through the spring-loaded relief valve 'W.' No adjustment is required to these springs as when the return flow valve 'X' is screwed firmly home, the spring resistance obtained gives the correct pressure.

Lowering the Car

When the release valve is opened to lower the car, the fluid from the jacks again passes through the filter 'U' (thus trapping any dirf from the jacks) into the valve chamber and via the release chamber, through the return flow valve 'X' into the pump body and thence back to the tank. The return flow valve 'X' is fitted with a rubber sleeve around its reduced diameter, which covers the outlet hole and thus prevents the head of fluid in the tank resting on the jacks.

SERVICING THE DISTRIBUTOR BOX

To Drain the Fluid

When it is necessary to drain the fluid from the system for the purpose of repairs, close the release valve, set the indicator dial to 'ALL,' disconnect one of the delivery pipes—either at the bottom of the distributor or at one of the jacks —and pump the fluid into a suitable receptacle. The fluid should be carefully filtered when refilling the system.

Clearing after Refilling

After the system has been refilled, the pump should be cleared of air by opening the 'bleed' screw 'B' two turns. When the fluid flows freely from the vent hole 'C,' the screw should be tightened down firmly.

Dirt in Filter

Whilst filters have been incorporated, both on the inlets and outlets of the pump, every care should be taken to prevent dirt getting into the system, either through the tank or dirty connections.

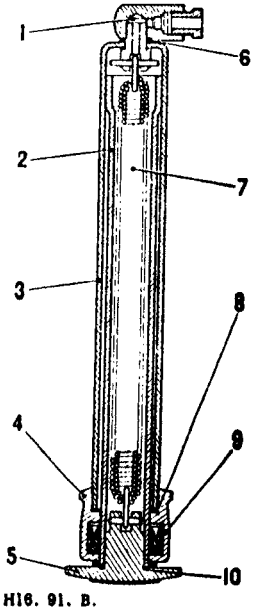
Before dismantling any connections, it is strongly advised therefore to clean these parts thoroughly with petrol or paraffin. This applies particularly to the pipe line connections on the jacks.

Clearing the Pump

During repairs the ends of the pipes should be plugged to keep out dirt. The pump may be cleared out if necessary with thinners and the parts should be smeared with 'Red Jackall' on re-assembly.

Fig. 5. The jack.

1. Elbow.
2. Inner tube.
3. Outer tube.
4. Lower housing.
5. Foot.
6. High pressure copper seal.
7. Coil spring.
8. High pressure copper seal.
9. Gland.
10. High pressure copper seal.



THE JACK

The pressure fluid from the pump is introduced through the elbow fitting 1 and causes an extension of the inner tube 2 from the outer tube 3 ; the fluid being sealed inside the jack by the gland 9 which is carried inside a housing 4. The copper washers 8, 10 and 6 are also high-pressure seals. The inner tube with its foot 5 is retracted by the coil spring 7 when the release valve on the pump is opened.

POSSIBLE FAULTS, SHOWING THE CAUSE AND SUITABLE METHOD OF TREATMENT

THE DISTRIBUTOR BOX

Fault	Diagnosis	Treatment
Pump will not operate	No fluid in the reservoir	
	Vent hole in the reservoir cap choked	
	Loose cotter pin in lever	
	Broken safety valve spring	Replace.
	Release valve not seating	Remove and clean.
	Air lock in the pump	Open the bleed screw 'B' two turns and pump slowly until the fluid flows freely from the vent hole 'C.' Then tighten 'B' firmly.
Will not retain pressure	Faulty valves or seats	Dismantle and examine. The ball valves may be re-seated by lightly tapping while in position on their seat.
	Defective casting	If no defects are apparent on the valve seats and there is no external leak, the casting is faulty and should be replaced.
	Leak at union pipe	Unscrew the threaded sleeve nut and inspect the conical faces of the nipple. Replace this if necessary. When remaking the joint with a new nipple see that the pipe is pushed as far into the receiving hole as possible. This ensures that, when tightened up, the nipple is not peened over at the end of the pipe.
Operates on one cylinder only	The travel of the operating handle restricted on one side	In order to fill the cylinders it is essential that a full stroke be given to the pump in each direction. This is sometimes prevented by an adjustable seat or other obstruction which fouls the handle.
Leakage under pressure	Broken relief spring	Renew.
	Cylinder end plugs loose	Tighten plugs with suitable hexagon bar.
	Faulty valve glands 'P'	Dismantle and replace, taking care that the lips of the gland are not damaged when fitting. Lubricate the glands and the valve with 'Red Jackall' before assembly.
Slight drip leak	Coverplate screw loose or faulty washer	Tighten the screws thoroughly. Do not disturb the cover unless absolutely necessary. If it is removed a new washer must be used and all faces thoroughly cleaned. Soak the washer in 'Red Jackall' fluid before re-assembly.

THE JACKS

Fault	Diagnosis	Treatment
Leakage past the gland	Faulty gland, damaged gland housing, foreign matter lodged between gland and inner tube	Dismantle the faulty jack, and prise out the gland from its housing with a blunt tool. Examine the recess in which the gland sits for dents, distortion or foreign matter. Change the gland and also the gland housing if found in any way faulty, and, when replacing the gland ensure that the lips are not in any way damaged.
Leaks, at the foot, elbow or above the hexagon on the gland housing	Loose front elbow or gland housing, or faulty copper washers	If tightening up will not cure the leak, dismantle and re-make the joints with new copper washers
Inner tube fails to return	Bent or distorted ram	Grip the jack in a vice, using a shaped hard wood or copper-faced clamp. Unscrew the elbow and the gland housing, when the ram can then be withdrawn and checked. Use new copper washers when reassembling.
	Defective valves or glands in the distributor box: choked pipe	Dismantle distributor box and examine valve seats and glands. Check that the valve is not sticking to the gland.
	Broken or distorted return spring	Dismantle jack and check the spring.

WHEELS AND TYRES

A MOST important factor in the road-worthiness of the car is systematic and correct tyre maintenance. The tyres must be able to sustain the weight of a loaded car and be able to withstand satisfactorily the vagaries of road conditions. Tyre pressures should, therefore, be checked at least once a week. According to whether right or left-hand rule of the road prevails, both front and rear tyres on the opposite side of the car to the steering gear, should be inflated with a pressure two or three lbs. sq. inch above the pressure in the tyres on the steering gear side.

The benefit of this differential pressure will be felt in easier handling and less tyre wear, particularly in countries where roads are winding, and are heavily or even moderately cambered.

RECOMMENDED TYRE PRESSURES

Model	Rim Size	Tyre Size	Pressure in lbs. per square inch	
			Front	Rear
Taxi	16 x 4.00	5.75 x 16	28	28
Hire Car	16 x 4.50	6.00 x 16	28	28

NOTE: Super Taxi cord tyres are fitted to the Taxi. Fort tyres are fitted to the Hire Car.

General

Easy clean pressed steel disc wheels with large chromium centre plates for the Hire Car. The six wheel studs are accessible after the chromium-plated wheel disc has been removed by using a screwdriver or thin coin as a lever at the rim. Much harm can be done to a car and its tyres by failure to inspect the tyres regularly for correct inflation.

See that all valves are fitted with valve caps and periodically jack up the car and examine the tyres for cuts, bruises, wall damage and general wear. At the same time remove grit and stones that may be embedded in the tread. It is also important that any tyre which appears to lose an appreciable amount of air between short intervals should be examined at the earliest possible moment for leaks and if found, these should be repaired immediately.

It is essential to keep oil (particularly paraffin) and grease off the garage floor where the car stands, as their presence on the tyres is injurious to the rubber. Removal must be effected immediately by a light application of petrol, which must be thoroughly wiped away.

The treads should be periodically examined for uneven or excessive wear. Flat spots, feathering or unexpected rapid wear on the tyres will indicate incorrect wheel alignment or brake adjustment and a check should be immediately made.

Misalignment plays havoc with the front tyres and a periodical check with an alignment gauge, as detailed in Section K, is highly recommended.

Wheel nuts should be tightened frequently, particularly when the vehicle is new or the wheels have been removed and refitted. Lightly grease the stud threads while the nuts are removed.

Cuts found in the tyres should receive attention—major ones by vulcanisation, and minor by the application of special compound. If this is done promptly an extension of the injury will be prevented. It is important that tyres which have sustained damage should be changed immediately.

Repairing Tubes

Have punctures or injuries vulcanised. Ordinary patches should only be used for emergencies.

Uneven Wear

Because the front wheels are slightly 'cambered' or lean outwards the outer side of

the tyre tread wears more than the inner. To minimise the effect of such wear, change the tyres round periodically so that the worn sides are next to the car. It is also a sound policy to interchange tyres on the left and right-hand side of the car at intervals so that unequal weight distribution and consequent wear caused by road camber are shared. The spare tyre should be used in turn with the others.

Changing a Wheel

Remove the wheel disc and loosen the wheel nuts with the wheel brace. See that the hand-brake is firmly applied and if the car is on an incline, chock one of the wheels not affected. Jack up the car as required, remove the four wheel nuts and remove the wheel.

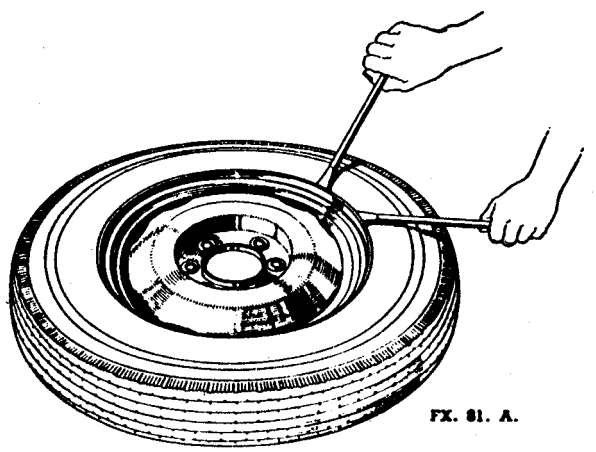


Fig. 1. Press each bead in turn off its rim seat, using the levers as shown, working in small stages round the rim.

Replacing the Wheel

Lightly grease the studs and lift the wheel into position. Replace the wheel nuts and tighten alternately. It is important that particular attention be given to tightening, as loose wheel nuts will cause considerable damage to wheels and studs. Finally replace the wheel disc.

Wheel and Tyre Assembly

Inextendable wires are incorporated in the beads of wired type tyres. Therefore do not attempt to stretch the wire beads of the tyre cover over the rim flange.

Force is unnecessary and may be dangerous as it merely tends to damage the cover beads and serves no useful purpose.

Fitting or removing will be quite easy if the wire beads are carefully adjusted into the rim well. If it is found to be difficult, the operation is not being correctly performed.

Removing a Tyre

1. Remove all valve parts to deflate the tyre and push both tyre beads off the rim seats.
2. Commence to remove the bead on the valve side of the cover. Insert a lever at the valve position and, while pulling on this lever, push the bead into the well of the rim diametrically opposite the valve.
3. Insert a second lever about 2-in. away from the first lever and gradually prise the bead over the rim flange.
4. Continue with one lever while holding the removed portion of the bead with the other lever. The tube can then be removed.
5. Stand the cover upright with the wheel in front.
6. Insert a lever from the front between the bead and the rear flange and pull the cover back over the flange; that is, the tyre comes off over one rim only.
7. If difficult to remove, keep the strain on the bead with the lever and tap off with a rubber mallet.

Refitting a Tyre

1. Place the cover on top of the wheel and push as much as possible of the lower bead by hand into the well of the rim. Insert a lever to prise the remaining portion of the lower bead over the rim flange.
2. Slightly inflate the tube until it begins to round out and insert it in the cover with the valve through the hole in the rim. (Take care that the valve, which is fitted in the side of the tube, is on the correct side of the rim.)
3. Commence to fit the second bead by pushing it into the well of the rim diametrically opposite the valve.
4. Lever the bead over the flange either side of this position, finishing at the valve, when the bead will be completely fitted.
5. Ease the valve in the rim hole and push upwards by hand to enable the beads to seat correctly, and then pull the valve firmly back into position.
6. Inflate the tyre and see that the beads are seated evenly round the rim: check by the line on the cover.

Note: Water on levers considerably eases the fitting and removing of beads.

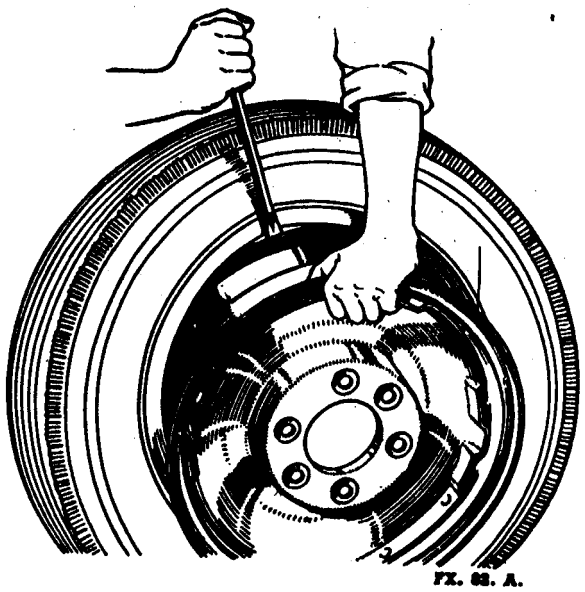


Fig. 2. Stand the wheel upright and insert a lever between the remaining bead and the flange, then pull the cover back over the flange.

Synthetic Tyres

Synthetic tyres can be identified by a red medallion on covers and a red or blue disc on tubes close to the valve. Synthetic rubber is more susceptible to failure from abuse than natural rubber, and tyres therefore require more careful treatment in service and more regular maintenance. Tyre pressures should be checked and corrected at least weekly.

Avoid high speed, which is more detrimental to synthetic than natural rubber tyres. Synthetic tyres generate heat more quickly and have less resistance to cuts and tears than natural rubber tyres, especially when the rubber is hot, and for this reason synthetics require frequent inspection for cuts and tears in order that repairs can be made before serious damage is done to the casing.

Care in Fitting

Special care in fitting synthetic tubes is essential to obtain maximum life and avoid premature failure. Recommendations when fitting on Well Base rims are as follows:—

1. Dust the inside of the cover evenly with French chalk.
2. Inflate the tube until it begins to round out; then insert in cover.
3. Apply a frothy solution of soap and water generously around the entire base of the tube, extending upwards between the tyre beads and the tube itself for at least two inches on both sides. Also apply the mixture to the bottom and outside of the tyre beads. Do not allow the solution to run into the crown of the tyre. Mixture must be strong enough to feel slippery when the fingers are wetted and rubbed together.
4. Mount the tyre on the rim immediately, whilst the soap solution is still wet.
5. Before inflating, be sure the tyre beads are clear of the well of the rim all the way round.
6. Inflate slowly until the beads are fully seated.
7. Remove the valve core to allow the tube to deflate completely. Do not disturb the beads of the cover.
8. Re-inflate to correct working pressure.

This procedure must be followed whenever a tube is refitted.

The object of double inflation is to permit any stretched portions of the tube to re-adjust themselves in the cover and relieve any strains in the tube.

In an emergency, French chalk may be used as a substitute for soap solution, provided it is evenly and generously applied. This practice, however, is not recommended.

MAIN POINTS IN TYRE CARE

Precautions to be taken with all tyres, especially synthetic tyres:—

1. Avoid under-inflation and over-inflation by checking pressure at least weekly and adjust pressure when necessary.
2. Avoid sudden stops and fierce acceleration.
3. Avoid high speed, and drive at a moderate speed round turns.
4. Avoid kerbing and other causes of severe impact.
5. Do not allow flints, etc., to remain embedded in the tread.
6. Have damage repaired immediately.
7. Change tyres round regularly, including the spare.
8. Keep brakes in proper adjustment.
9. Have wheels checked frequently for misalignment and other mechanical irregularities.
10. Remove tyres in time for remoulding.
11. Keep the tyres clear of oil or paraffin.

ELECTRICAL EQUIPMENT

THE electrical equipment will give long periods of service without need for adjustment. The small amount of attention which is required is described under 'Lubrication and General Maintenance.'

Under 'General Information' details are given on the operation of the various items of the equipment and descriptions on the method of setting the lamp beams and fitting replacements, such as bulbs, high tension cables, bearing brushes, etc. which may become necessary from time to time.

GENERAL DATA

Battery
Home: Two Lucas SLTW 15 E; 12 volt, 70 ampere hours at a 10-hour discharge rate.
U.S.A.: Two Lucas SLTZ 15 E; 12 volt, 70 ampere hours at a 10-hour discharge rate.

Dynamo
Early models: Lucas C45PV-4. No. 22435A.
Later models: Lucas C45PV-5. No. 22456

Distributor
Lucas DKY4A. No. 40117F.

Ignition Coil
Lucas Q 12. No. 45020A.

Control Box
Lucas RF 95-2. No. 37076E.
compensated voltage regulator, automatic cut-out switch, two fuses in accessories circuit and spares (35 amp. No. 188218).

Fuse Box
Lucas SF 4. No. 37137A.
four fuses (25 amp. No. 188216) for lamps—headlamps, foglamp, sidelamps and tail lamps excluding stop lights.

Starting Motor
Lucas M 418 G L-3 No. 25521B.

Solenoid Starting Switch
Lucas ST 950. No. 76411B

Starting Pushbutton
Lucas SS 5. No. 31075A.

Electric Horns
Hire Car: Two Lucas WT 614. Nos. 69011, 69012.
Taxi: One Lucas WT 614M. No. 69040A.

Direction Indicators (Trafficators.)
Lucas SF 34N. No. 54040A.

Windscreen Wiper
Hire Car: CR6. No. 072632.
Taxi: Lucas CRT 12. No. 072833.
Windscreen Wiper Switch PS7/1. No. 031324.

Lamps
Headlamps: Hire Car (Home) L.H. MBD 143 EDS No 50707A.
R.H. MBD 143. No. 50708A.
(U.S.A.) L.H. MBD 143 No. 50709A.
R.H. MBD 143 No. 50710A.
Taxi (Home) L.H. MD 143 EDS No. 50711A.
R.H MD 143. No. 50712A.
(U.S.A.) L.H. ML 143. No. 50927A.
R.H. ML 143 No. 50932A.
Foglamp: SFT 575. No. 55029.
Sidelamps: LD109A. No. 52157.
Stop-tail Lamp: (Home) ST 51. No. 53060.
(U.S.A.) 471. No. 53200B.
Number Plate Illumination: (U.S.A.) 467-2. No. 53101E.

Lamp Bulbs:
Headlamps: Home (Taxi and Hire Car) 12 volt, 36 watt, No. 57.
U.S.A. (Taxi) 12 volt, 36/36 watt, No. 301.
U.S.A. (Hire Car) 12 volt, 36/36 watt, No. 171.
Foglamp: 12 volt, 48 watt, No. 323.
Sidelamps: 12 volt, 6 watt, No. 207.
Stop-tail lamp: Home 12 volt, 6 watt, No. 207.
U.S.A. 12 volt, 6/12 watt, No. 353.
Number Plate Lamp: U.S.A. 12 volt, 6 watt, No. 989.
Trafficators: 12 volt, 3 watt, No. 256.
Panel Lights: 12 volt, 2.2 watt, No. 987.
Ignition Warning Light: 2.5 volt, 2 amp, No. 970.
Interior Lights: Wilmot Breedon.
Taxi-meter Light: Carbodies.

AUSTIN TAXI WIRING DIAGRAM

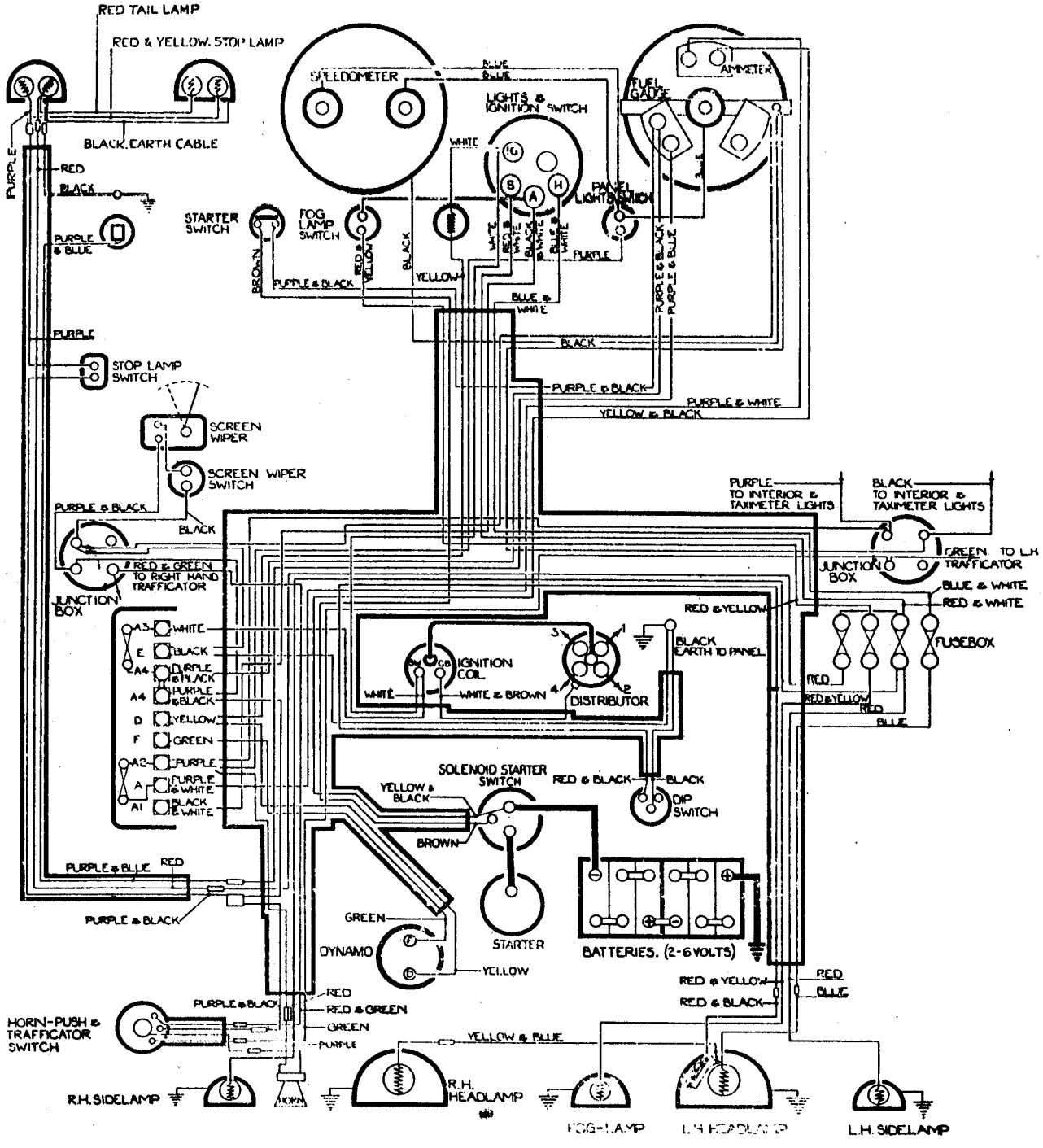


Fig. 1. General arrangement of the electrical circuits and components of the 16 h.p. Taxi.

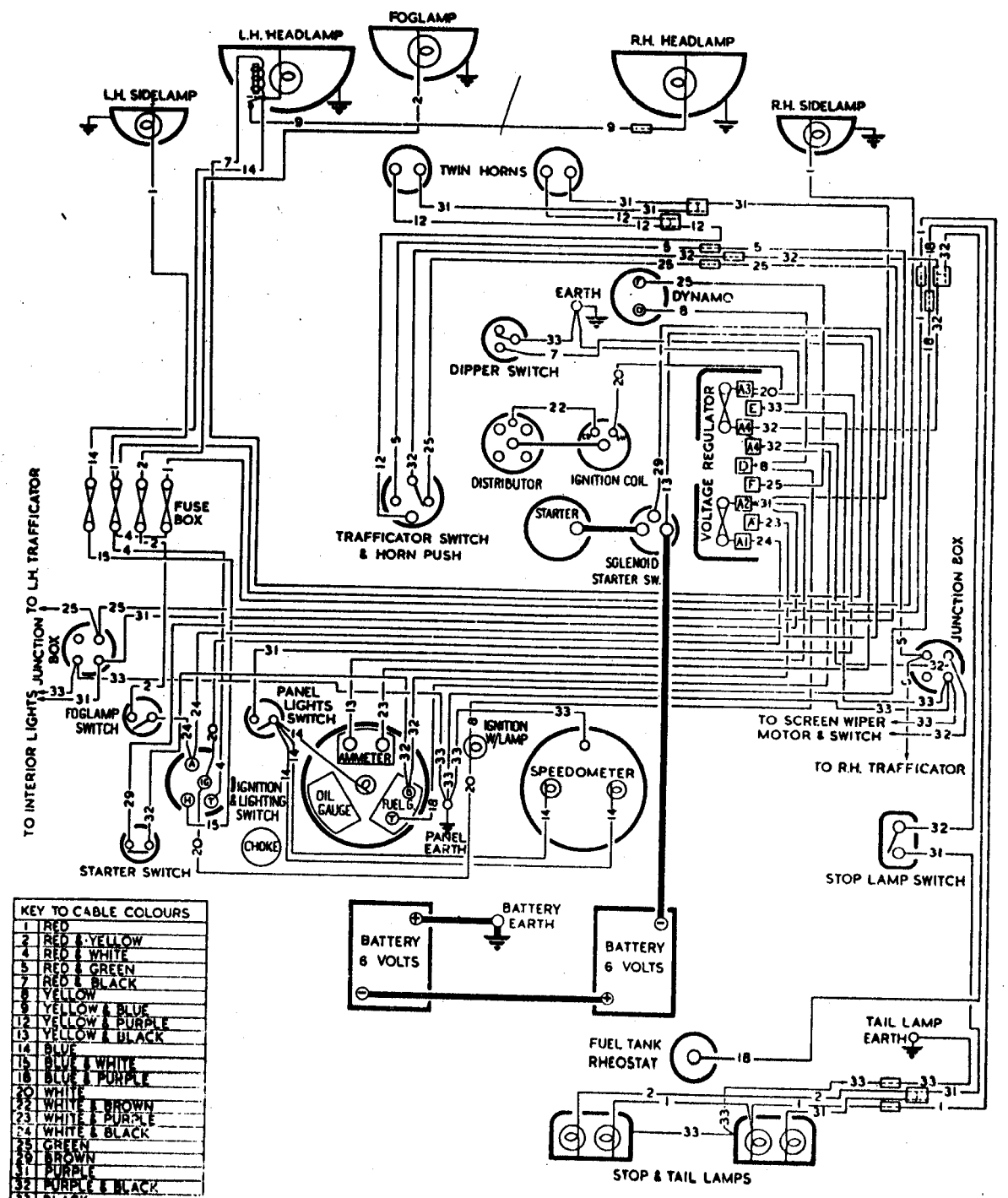
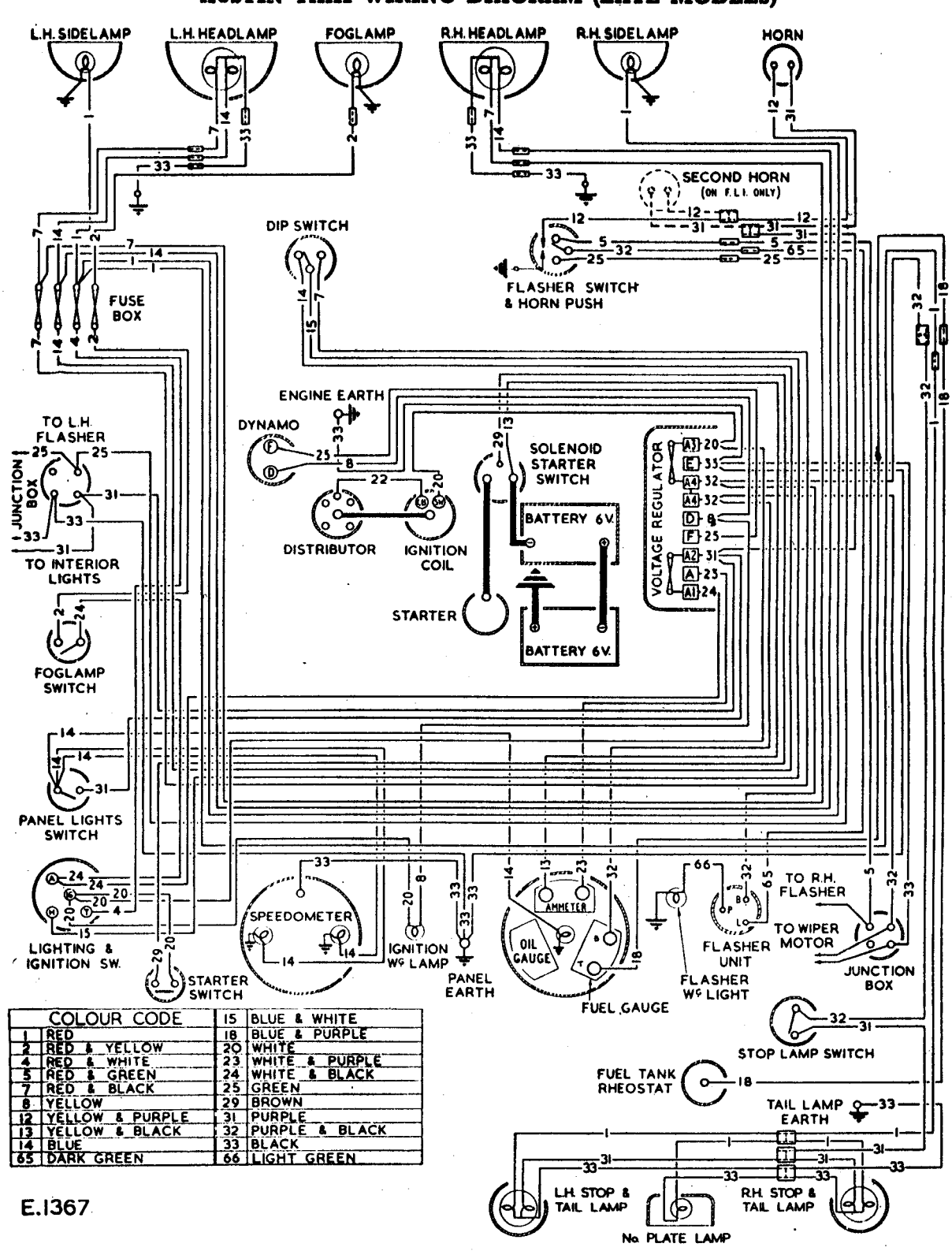


Fig. 2. The general circuit and layout of components of the Hire Car.



COLOUR CODE			
1	RED	15	BLUE & WHITE
2	RED & YELLOW	18	BLUE & PURPLE
4	RED & WHITE	20	WHITE
5	RED & GREEN	23	WHITE & PURPLE
7	RED & BLACK	24	WHITE & BLACK
8	YELLOW	25	GREEN
12	YELLOW & PURPLE	29	BROWN
13	YELLOW & BLACK	31	PURPLE
14	BLUE	32	PURPLE & BLACK
65	DARK GREEN	33	BLACK
		66	LIGHT GREEN

Fig. 3. Wiring diagram for late models, with Flasher Direction Indicator.

COMPONENTS AND HARNESS LAYOUT ON THE DASHBOARD

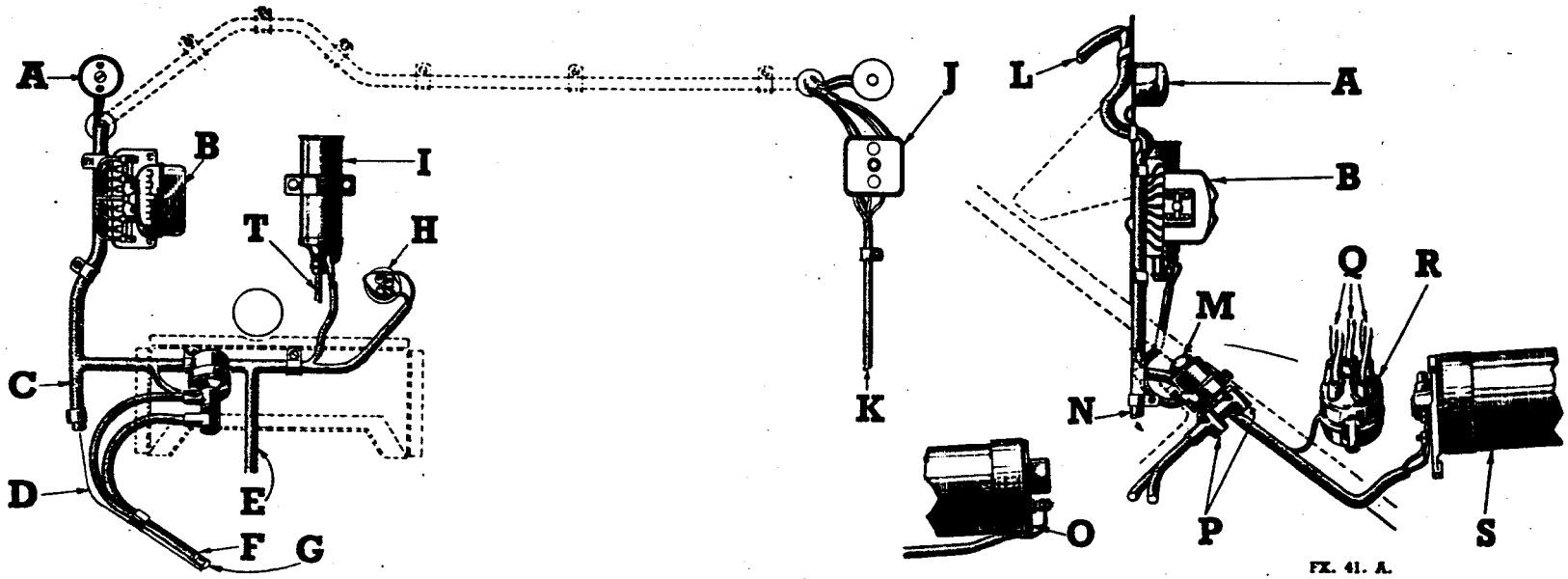


Fig. 4.

A. Junction box.
B. Voltage regulator.
C. Main cable harness.
D. Cable run on flitch plate.
E. Cable to engine.
F. Battery to solenoid switch.
G. Cable for solenoid switch to starter.
H. Dipper switch.
I. Ignition coil.
J. Fuse box.
K. Cable run on flitch plate.
L. Cable to instrument panel.
M. Solenoid starter switch.
N. Cable run on flitch plate.
O. Starter.
P. Terminal insulating caps.
Q. Ignition cables.
R. Distributor.
S. Dynamo.

CABLE HARNESS POSITIONED ON THE CHASSIS

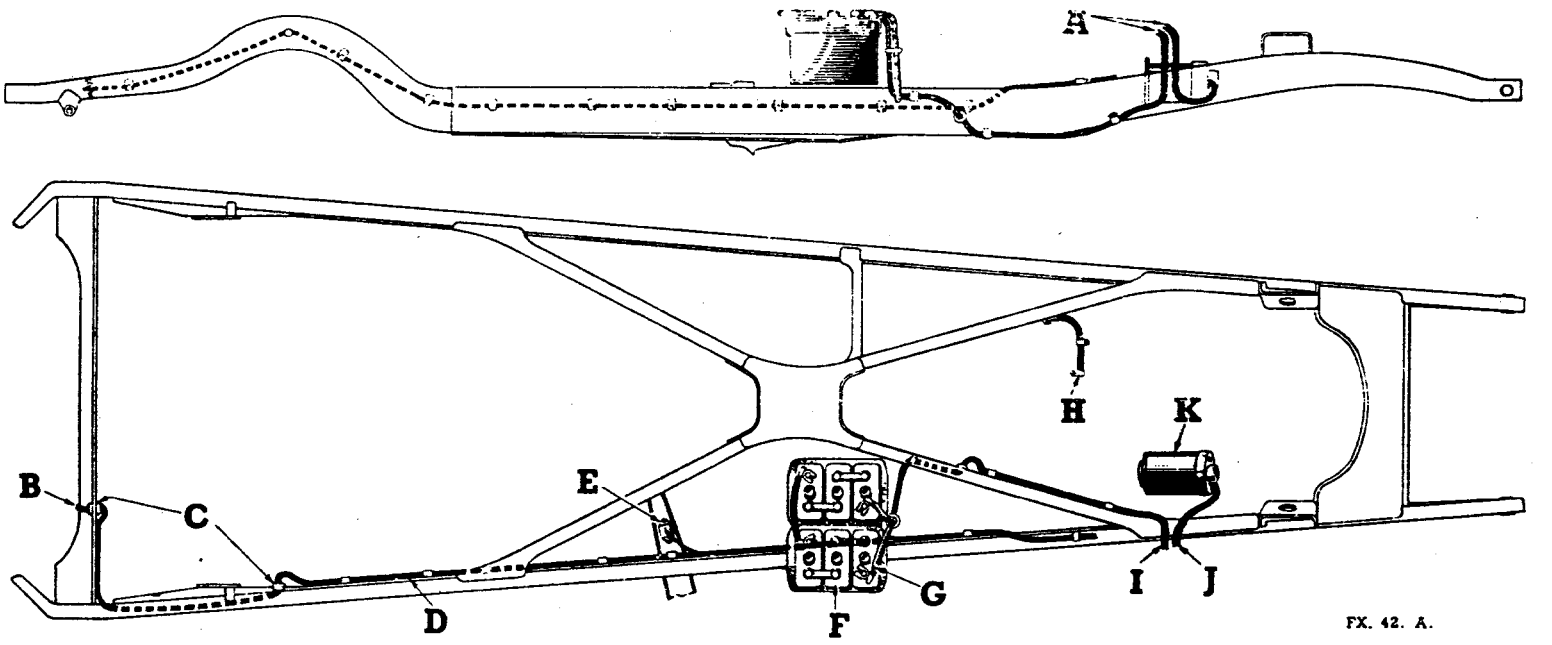


Fig. 5.

A. Cables to solenoid switch.
B. Rear light cable.
C. Rubber grommets.
D. Chassis harness.
E. Stoplight switch.
F. Battery.
G. Battery to earth cable.
H. Engine earth.
I. Negative cable, battery to solenoid switch.
J. Cable solenoid switch to starter.
K. Starter.

LUBRICATION AND GENERAL MAINTENANCE

AFTER THE FIRST 500 MILES RUNNING

Distributor

Remove the moulded distributor cap and turn the engine over by hand, carefully observing that the contacts in the distributor are fully opened. Check the gap with a gauge of thickness 0.010 — 0.012 in. If the setting is correct the gauge should be a sliding fit. If the gap varies appreciably from the gauge, the contact breaker should be adjusted. To carry out the adjustment, keep the engine in the position to give the maximum opening of the contacts and with the screwdriver supplied in the tool kit, slacken the two screws which secure the contact plate to the distributor body. Move the plate until the gap is set to the thickness of the gauge and then fully tighten the locking screws. Recheck the gap.

MONTHLY OR EVERY 1,000 MILES

About every 1,000 miles, or more often in warmer climates, remove the vent plugs from the top of each of the battery cells and examine the level of the electrolyte. If necessary, add distilled water until the top edges of the separators are just covered.

Do not fill above this level, otherwise the excess electrolyte will be spilled from the cell. A hydrometer will be found useful for topping up, as it prevents distilled water being spilled on the top of the battery.

In very cold weather it is essential that the vehicle should be used immediately after topping up the battery, this ensures that the distilled water is thoroughly mixed with the electrolyte. Neglect of this precaution may result in the distilled water freezing and so causing damage to the battery.

When examining the cells, do not hold naked lights near the vent holes as there is a danger of igniting the gas coming from the plates.

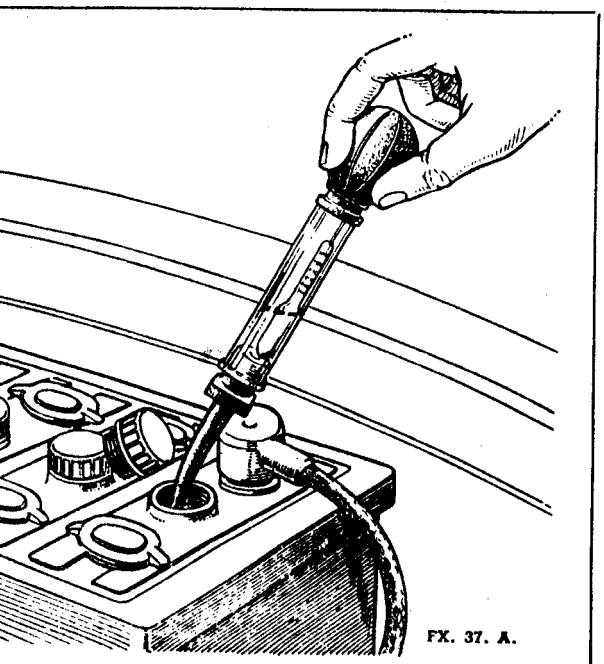


Fig. 6. Using a hydrometer to top up the battery.

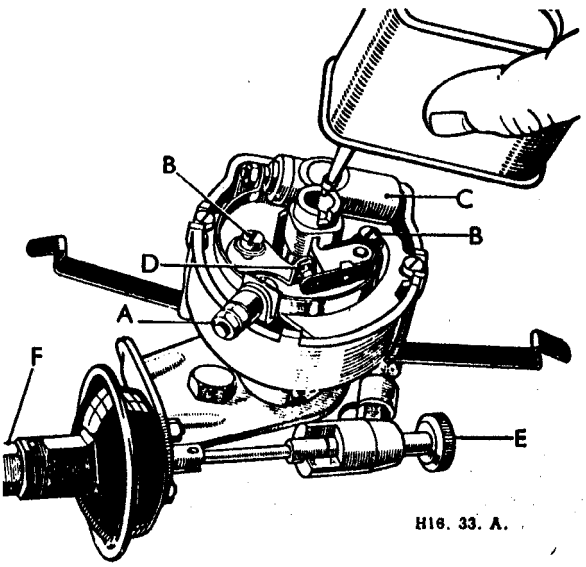


Fig. 7. Oiling the distributor after removing the rotor. A. Connection from coil to contact breaker; B. Points adjustment screws; C. Condenser; D. Contact points; E. Vacuum timing control; F. Vacuum pipe union.

EVERY 3,000 MILES

Carry out the procedure prescribed for 1,000 miles, together with the following.

Distributor Lubrication

Cam

Lightly smear the cam with a very small amount of clean engine oil, or Mobilgrease No. 2.

Apply a spot of clean engine oil to the top of the pivot on which the contact breaker works.

Cam Bearing and Distributor Shaft

Pull the rotor arm from the top of the spindle and add a few drops of thin machine oil to lubricate the cam bearing and distributor shaft.

Do not remove the screw exposed to view, as this screw is drilled to enable the oil to pass through. Take care to fit the rotor arm correctly, pushing it on the shaft as far as it will go.

Automatic Timing Control

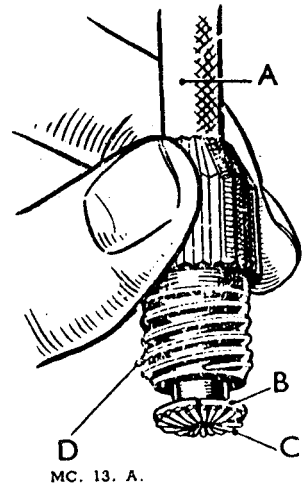
Add a few drops of thin machine oil through the hole in the contact breaker base through which the cam passes. Do not allow any oil to get on or near the contacts.

EVERY 6,000 MILES

Carry out the procedure for every 1,000 and 3,000 miles, together with the following:

Distributor—Cleaning

Wipe the inside and outside of the moulding with a soft dry cloth, paying particular attention to the spaces between the metal electrodes. See that the small carbon brush on the inside of the moulding moves freely in its holder.



MC. 13. A.

Fig. 8. Fitting a high tension cable terminal. A. High tension cable; B. Washer; C. Cable strands; D. Moulded terminal

Examine the contact breaker. The contacts must be free from grease and oil. If they are burned or blackened, clean them with a fine carborundum stone or very fine emery cloth, afterwards wiping away any trace of dirt or metal dust with a petrol-moistened cloth. Cleaning of the contacts is made easier if the contact breaker lever carrying the moving contact is removed. To do this, slacken the nuts on the terminal post and lift off the spring, the latter being slotted to facilitate removal.

After cleaning check the contact breaker setting and if necessary make adjustments as described for the first 500 miles.

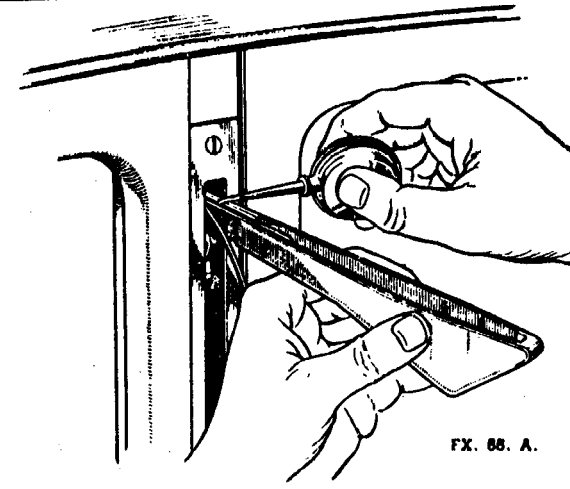


Fig. 9. Oiling the direction indicator felt pad.

High Tension Cables

Examine the high tension cables. Any which have the insulation cracked or perished, or show signs of damage in any other form, must be replaced by 7 m.m. rubber-covered ignition cable. The method of connecting high tension cables to the coil and distributor, is to thread the knurled moulded nut over the cable, bare the end for about $\frac{1}{4}$-in., thread the wire through the washer removed from the original cable, and bend back the wire strands. Screw the nut into its terminal (see fig. 8).

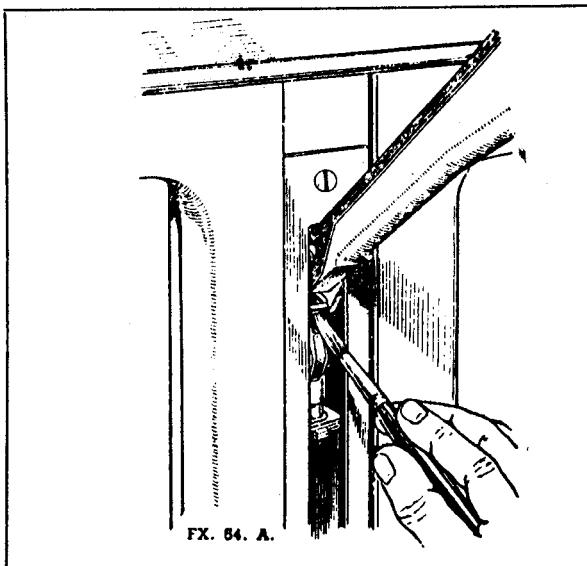


Fig. 10. Application of oil to the catch pin.

Direction Indicators—Lubrication

Apply, by means of a small brush, a drop of thin machine oil to the arm stop pin. Use only

the slightest trace of oil as any excess may adversely affect the operating mechanism (see fig. 10).

Also withdraw the screw on the outer edge of the arm and slide off the arm cover. Place the bulb wire to one side and apply two or three drops of thin machine oil to the lubricating pad at the top of the arm (see fig. 9). To replace the arm cover, slide it in an upward direction so that the side plates engage with the slots on the underside of the spindle bearing and secure with the screw.

On the later type of direction indicator, type SF80, apply one drop of thin machine oil to each side of the arm bearing.

EVERY 10,000 MILES

Dynamo—Lubrication

Repack the dynamo lubricator with H.M.P. grease at every 10,000 miles running. Ensure that the felt pad and spring are replaced before screwing the lubricator in position.

GENERAL INFORMATION

THE BATTERY

Occasionally examine the condition of the battery by taking hydrometer readings. There is no better method of ascertaining the state of charge of the battery. The hydrometer contains a graduated float which indicates the specific gravity of the acid in the cell from which the sample is taken.

The specific gravity readings and their indications are as follows:—

Reading	State of Battery
1.280—1.300	Battery fully charged.
Approx. 1.210	Battery half charged.
Below 1.150	Battery fully discharged.

These figures are given assuming an electrolyte temperature of 60 deg. F. If the electrolyte temperature exceeds this, .002 must be added to hydrometer readings for each 5 deg. F. rise to give the true specific gravity at 60 deg. F. Similarly, .002 must be subtracted from hydrometer readings for every 5 deg. F. below 60 deg. F.

The readings for each of 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 one of the cells, or there may be an internal fault. In the latter case it is advisable to have the battery examined by a battery specialist.

Should the 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 8 amps until the cells are gassing freely.

After examining the battery, check the vent plug, making sure that the air passages are clear, and screw the plugs into position. 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 battery will usually be supplied filled and initially charged, or, for export markets, 'dry-charged'. However, if it should be necessary to prepare for service a new battery, supplied dry and **uncharged**, proceed as follows:

(a) **Preparation of Electrolyte:** The specific gravity of the electrolyte necessary to fill the new battery, and the specific gravity at the end of the charge, are as follows:—

Climate	(Corrected to 60 deg. F.)	
	S.G. of Filling Acid	S.G. at end of Charge
Below 80 deg. F.	1.350	1.280—1.300
Between 80—100 deg.F.	1.320	1,250—1.270
Over 100 deg.F	1.300	1.220—1.240

The electrolyte is prepared by mixing distilled water and concentrated sulphuric acid of

1.835 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 resulting chemical reaction may have dangerous consequences. To produce electrolyte of the correct specific gravity as previously stated, use proportions of acid and distilled water as follows:—

To obtain Specific Gravity (corrected to 60 deg. F.)	Add 1 part by volume of 1.835 S.G. acid to distilled water by volume as below:
1.350	1.8 parts
1.320	2.2 parts
1.300	2.5 parts

Heat is produced by the mixture of acid and water, and it should, therefore, be allowed to cool before pouring it into the battery, otherwise the plates, separators and moulded container may become damaged.

(b) **Filling-In and Soaking:** The temperature of the filling-in acid, battery and charging room should be above 32 deg. F.

Carefully break the seals in the filling holes and half fill each cell in the battery with diluted sulphuric acid solution of the appropriate specific gravity (according to temperature). The quantity of electrolyte to half-fill a two-volt cell is $\frac{3}{4}$ pint.

Allow the battery to stand for at least six hours, in order to dissipate the heat produced by the chemical action of the acid on the plates and separators. Then add sufficient electrolyte to fill each cell to the top of the separators. Allow to stand for further two hours and then proceed with initial charge.

(c) **Duration and Rate of Initial Charge:** Charge at a constant current of 5 amps until 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 forty to eighty hours, but usually not more than sixty.

Throughout the charge, the acid must be kept level with the tops of the separators on each cell by the addition of acid solution of the same specific gravity as the original filling-in acid

If, during charge, the temperature of the acid in any cell of the battery reaches the maximum permissible temperature of 120 deg. F, the charge must be interrupted and the battery temperature allowed to fall at least 10 deg. F. before charging is resumed.

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, some of the electrolyte must be siphoned off, and replaced with either distilled water or acid of the strength used for the original filling-in, according to whether the specific gravity is too high or too low respectively. After such adjustment, the gassing charge should be continued for one or two hours to ensure adequate mixing of the electrolyte. Recheck, if necessary, repeating the procedure until the desired result is obtained.

Finally allow the battery to cool and siphon off any electrolyte above the separators.

Preparing 'Dry Charged' Batteries for Service

These batteries are very similar, as far as their operation and external appearance are concerned, to the normal lead-acid type. The difference lies in the fact that these batteries are 'dry-charged' and sealed before leaving the factory, so that when they are required for service it is only necessary to fill each cell with sulphuric acid of the correct specific gravity. This procedure also ensures that there is no deterioration of the efficiency of the battery during the storage period before the battery is required for use.

(a) Preparation of electrolyte

The electrolyte is prepared by mixing together distilled water and concentrated sulphuric acid, usually of S.G. 1.835. This mixing must be carried out in a lead-lined tank or a glass or earthenware vessel. 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 resulting chemical reaction may cause violent and dangerous spurting of the concentrated acid.

Electrolyte of specific gravity 1.275 can be prepared by adding 1 part (by volume) of 1.835 S.G. sulphuric acid to 2.8 parts of distilled water. 1.215 acid requires 1 part of acid to 4 parts of distilled water.

Heat is produced by the mixture of acid and water, and the electrolyte should be allowed to cool before pouring it into the battery.

(b) Filling the cells

Carefully break the seals in the cell filling holes and fill each cell with electrolyte to the top of the separators, **in one operation.** The temperature of the filling room, battery and electrolyte should be maintained between 60° F. and 100° F. If the battery bas heen stored in a cool place, it should be allowed to warm up to room temperature before filling.

(c) Batteries filled in this way are 90 per cent charged, and may be fitted to the vehicle immediately. When time permits, however, a short freshening charge will ensure that the battery is fully charged. Such a freshening charge should last for no more than 4 hours, at the normal recharge rate of the battery: 8 amperes.

During the charge the electrolyte must be kept level with the top edge of the separators by the addition of distilled water. Check the specific gravity of the acid at the end of the charge; if 1.275 acid was used to fill the battery, the specific gravity should now be between 1.280 and 1.300; if 1.215, between 1.220 and 1.240.

Battery (two units)	Voltage Per Unit	A.H. Capacity		Quantity of electrolyte required Per Unit	Specific gravity of filling electrolyte	
		at 10 hour rate	at 20 hour rate		Climates not normally above 90°F. (32°C.)	Climates frequently above 90°F.
SLTZ 15E	6	70	80	4½ pints	1.275	1.215

THE DYNAMO

The dynamo is of the compensated voltage control type and its output is automatically controlled by a regulator unit, which is housed along with the cut-out in the control box.

Inspect the dynamo driving belt and if necessary adjust by turning the dynamo on its mounting to take up any undue slackness. Care should be taken to avoid over-tightening the belt and to see that the machine is properly aligned, otherwise undue strain will be thrown on the dynamo bearings.

The dynamo requires no other attention during normal service.

Testing in Position

Disconnect the leads from the two terminals, at the rear of the dynamo, and then connect the two terminals with a short length of wire. Connect a voltmeter (0-20 volts) between the dynamo terminals and a good earthing point on the dynamo frame. Increase the engine speed gradually and note the voltmeter reading, which should be 12 volts when at a comparatively low speed. Do not run the engine at a speed above 1,500 r.p.m. If no reading is given, or if it is low or erratic, the dynamo must be removed for examination.

Removing and Replacing the Dynamo

To remove the dynamo, slacken the setpin which secures the adjusting link to the dynamo casing, remove the nut and washer from the adjusting stud, and release the two nuts and bolts holding the dynamo to its mounting bracket.

Replacement is a reversal of the removal procedure, with the adjustment nut being tightened first once the dynamo position has been finalised.

Dismantling the Dynamo

Remove the dynamo from its mounting bracket and transfer it to a clean work bench.

Take off the dynamo pulley by releasing the securing nut and washer. If the pulley is exceptionally tight on the shaft and woodruff key, use a suitable extractor such as tool 18G.2. Remove the cover band, hold back the brush springs and remove the brushes from their holders.

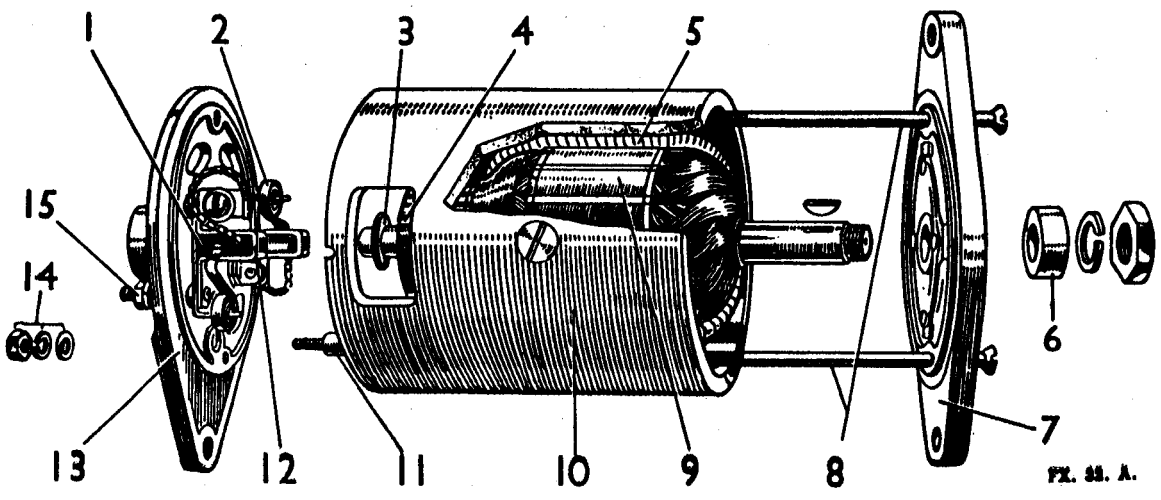


Fig. 11. An exploded view of the dynamo.

1. Brush.
2. Brush spring.
3. Thrust collar.
4. Commutator.
5. Field coil.
6. Distance collar.
7. Driving end bracket.
8. Through bolts.
9. Yoke.
10. Armature.
11. Field terminal.
12. Brush holder.
13. Commutator end bracket.
14. Field terminal nuts and washers.
15. Terminal.

Unscrew the nuts from the two through bolts at the commutator end of the dynamo and withdraw the bolts from the driving end.

Release the nut, spring washer and felt washer from the smaller terminal (i.e., field terminal) from the commutator end bracket and remove the bracket from the dynamo frame.

The driving end bracket together with the armature can now be lifted out of the dynamo yoke.

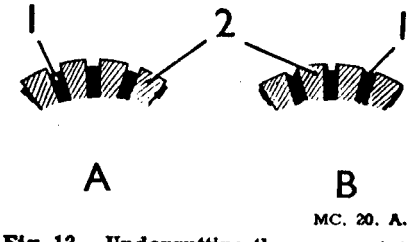


Fig. 12. Undercutting the commutator.
'A' is the correct and 'B' the wrong method.
1. Insulators. 2. Segments.

Commutator

Examine the commutator and if burned or blackened, clean with a petrol-moistened cloth, or in bad cases by carefully polishing with very fine glass paper. If necessary, undercut the insulation to a depth of $\frac{1}{32}$ in. with a hacksaw blade ground down to the thickness of the insulation.

Armature

Check the armature by means of a growler test and volt drop test, and make proof as to the condition of the insulation by connecting a test lamp, at mains voltage, between the commutator segments and the shaft.

Brushgear

Examine the brushes. If they are worn so that they do not make good contact on the commutator or if the brush flexible is exposed on the running face, take out the screw securing the eyelet on the end of the brush flexibles and remove the brushes. Fit new brushers into their holders and secure eyelets on the ends of the brush lead in the original positions. Brushes are pre-formed and in consequence do not require bedding.

Field Coils

Test the resistance of the field coils by means of an ohmmeter. The reading on the ohmmeter should be 6 ohms. If such an instrument is not available, connect a 12-volt D.C. supply with an ammeter in series, between the field terminal and the dynamo frame. The ammeter reading should be approximately 2 amps. If there is no reading, the field coils are open circuited and must be replaced.

To test for earthed field coils, unsolder the end of the field winding from the earth terminal on the dynamo yoke, and with a test lamp connected

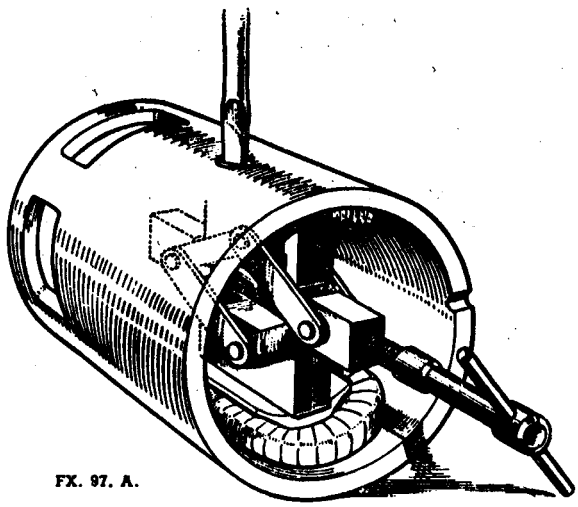


Fig. 13. Using a pole shoe expander to replace the field coils.

from the supply main, check between the field terminal and dynamo yoke. If the lamp lights, the field coils are earthed and must therefore be replaced.

To do this, carry out the following procedure, using a pole shoe expander and a wheel-operated screwdriver.

(i) Remove the insulation piece which is provided to prevent the junction of the field coils from contacting with the yoke.

(ii) Mark the yoke and pole shoes in order that they can be fitted in their original positions.

(iii) Unscrew the two pole shoe retaining screws by means of the wheel-operated screwdriver.

(iv) Draw the pole shoes and coils out of the yoke and lift off the coils.

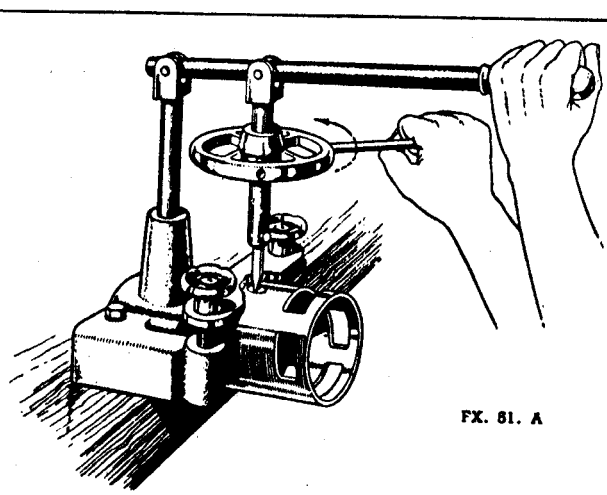


Fig. 14. The wheel-operated screwdriver.

(v) 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.

(vi) Locate the pole shoes and field coils by lightly tightening the fixing screw.

(vii) Insert the pole shoe expander, open it to the fullest extent and tighten the screws.

(viii) Finally tighten the screws by means of the wheel-operated screwdriver and lock them by caulking.

(ix) Replace the insulation piece between the field coil connections and the yoke.

Bearings

Bearings which are worn to such and extent that they will allow excessive side movement of the armature shaft must be replaced.

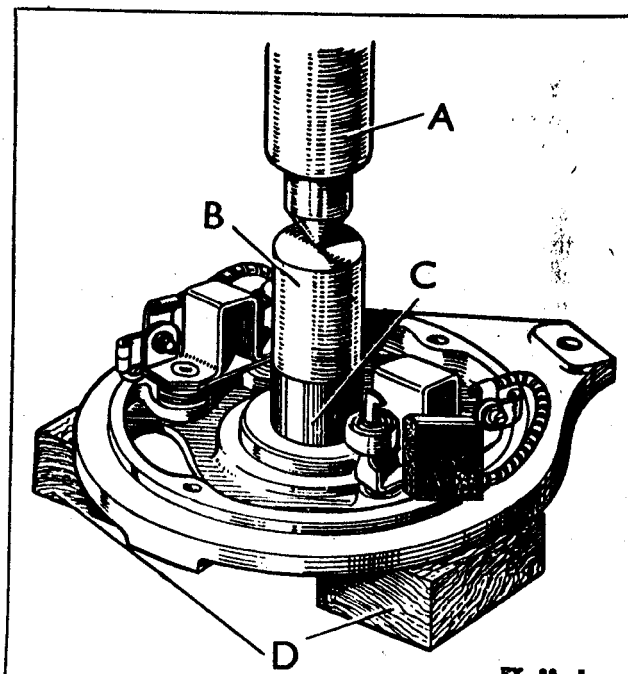


Fig. 15. Fitting a new bearing bush to the dynamo commutator end bracket.

A. Press spindle; B. Distance piece; C. New bush; D. Packing block.

Commutator End

To remove and replace the bearing bush at the commutator end proceed as follows:—

(a) Press the bearing bush out of the bracket by means of a hand press or bench drill.

(b) 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.

Note: Before fitting a new porous bronze bearing bush, it should be immersed for 24 hours in clean thin engine oil.

Driving End

The ball bearing at the driving end is replaced as follows:—

(a) Knock out the rivets which secure the bearing retaining plate to the end bracket and remove the plate.
(b) Press the bearing out of the end bracket and remove the corrugated washer, felt washer and oil retaining washer.
(c) Before fitting the replacement bearing see that it is clean and lightly pack it with high melting point grease.
(d) Place the oil retaining washer, felt washer and corrugated washer in the bearing housing in the end bracket.
(e) Locate the bearing in the housing and press it home by means of a hand press.
(f) Fit the bearing retaining plate. Insert new rivets from the outside of the end bracket and open the rivets by means of a punch to secure the plate rigidly in position.

Reassembling the Dynamo

In the main, reassembling of the dynamo is a reversal of the dismantling procedure. Before refitting the dynamo, however, fill the lubricator with H.M.P. grease as previously described.

STARTER

Normal Service

If difficulty is experienced due to the starter not meshing correctly with the flywheel, it may be that the starter drive requires cleaning. The pinion should move freely on the screwed sleeve, if there is any dirt or foreign matter on the sleeve, it must be washed with paraffin.

In the event of the starter pinion becoming jammed in mesh with the flywheel, it can usually be freed by turning the starter armature by means of a spanner applied to the shaft extension at the commutator end. This is accessible when the cap protecting the armature shaft is removed.

Removing the Starter

Release the main cable from the terminal at the front of the starter, and remove the engine to gearbox nuts and bolts holding the starter body in position.

Dismantling the Starter:

Starter Drive: Remove the cotter pin from the nut at the end of the shaft and then unscrew the square shaft nut. Release the main spring, buffer washer, screwed sleeve and pinion. Finally withdraw the restraining spring, sleeve and collar.

Starter Motor: Take off the cover band at the commutator end, hold back the brush springs and take out the brushes from their holders. Extract the two through-bolts when the armature complete with driving end bracket may be withdrawn. Remove the terminal nuts and washers from the terminal post on the commutator end bracket and withdraw the bracket from the starter yoke.

Commutator

Examine the commutator and if burned or blackened clean with a petrol-moistened cloth, or in bad cases, by carefully polishing with very fine glass paper. **Do not undercut the insulation.**

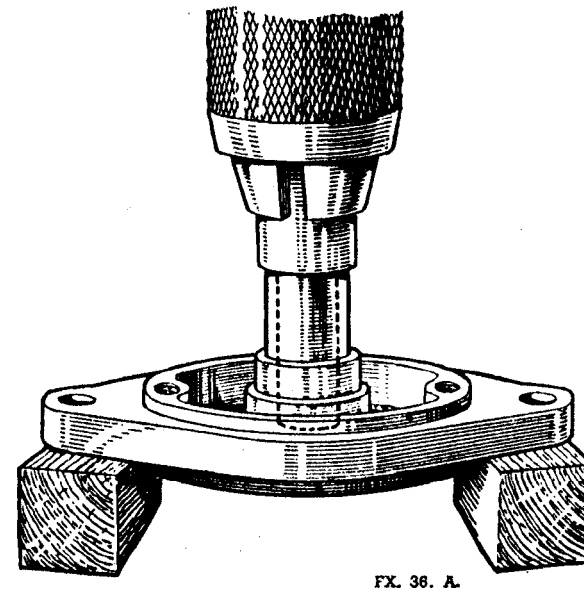


Fig. 16. Fitting a new bronze bush to the starter end bracket.

Armature

Examination of the armature will in most cases reveal the cause of failure. An example of such a failure is when the conductors are lifted from the commutator, due to the starter being engaged while the engine is running and so causing the armature to be rotated at an excessive speed. A damaged armature must in all cases be replaced—no attempts should be made to machine the armature core to true a distorted armature shaft.

Brushes

Examine the brushes. If they are worn so that they do not make good contact on the commutator, or if the brush flexibles are exposed on the running face, they must be replaced. Two of the brushes are connected to terminal eyelets on the brush boxes whilst the others are connected to tappings on the field coils.

The flexible connectors must be removed by unsoldering and the connectors of the new brushes secured in their places by soldering. The brushes are performed so that bedding to the commutator is unnecessary.

Field Coils

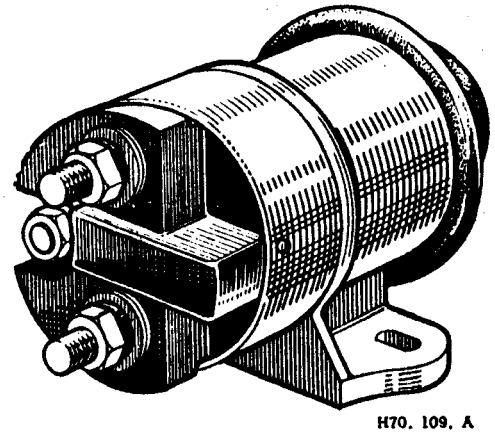
The field coils can be tested for an open circuit by connecting a 12-volt battery and test lamp between the tapping points on the field coils at which the brushes are connected. If the lamp does not light there is an open circuit in the wiring of the field coils.

Lighting of the lamp does not necessarily mean that the field coils are in order, it is quite feasible that one of them may be earthed to a pole shoe or to the starter yoke. This may be checked with a test lamp connected from the supply mains, the test leads being connected to one of the tapping points of the field coils and to a clean part of the starter yoke. Should the lamp light, it indicates that the field coils are earthed and must be replaced.

When replacing field coils the procedure as detailed in the dynamo section should be followed.

Bearings

Bearings which are worn to such an extent that they will allow excessive side play of the armature shaft must be replaced. To replace the bearing brushes adopt the procedure described for the bushes of the dynamo commutator end.



H70. 109. A

Fig. 17. The solenoid type starter switch.

Reassembling the Starter

The reassembly of the starter is a reversal of the dismantling procedure.

STARTER SWITCH

Testing in Position

Press the starter push and listen for the starter switch to operate. If it does not operate connect a 12-volt supply directly across the small terminal on the solenoid switch and the switch body. Should the switch still fail to operate, a replacement unit must be fitted. If the switch operates but does not complete the circuit to the starter (checked by means of a 12-volt test lamp between starter teminal on switch and earth) an indication is given that the contacts are faulty and the switch must be replaced.

DISTRIBUTOR

Dismantling

To dismantle the distributor, spring back the securing clips and remove the moulded cap. Lift the rotor off the top of the spindle, if it is a tight fit, it should be carefully levered off with a screwdriver.

Slacken the nut on the terminal post and lift off the end of the contact breaker spring. The contact breaker lever can now be lifted off its pivot. Take out the two screws, complete with spring washers and flat steel washers, which secure the plate carrying the fixed contact, and remove the plate.

Take out the two screws and spring washers fitted at the edge of the contact breaker base, which can then be removed from the body of the distributor.

Remove the driving member from the shaft.

Lift the cam, automatic timing control and shaft assembly from the distributor. Take out the screw from inside the top of the cam spindle.

Note: Before dismantling, carefully note the positions in which the various conponents are fitted so that they can be replaced correctly. Lift off the cam, when the automatic timing control will be accessible.

Condenser

The best method of testing the condenser is by substitution. Disconnect the original condenser and connect a new one between the low tension terminal of the distributor and earth.

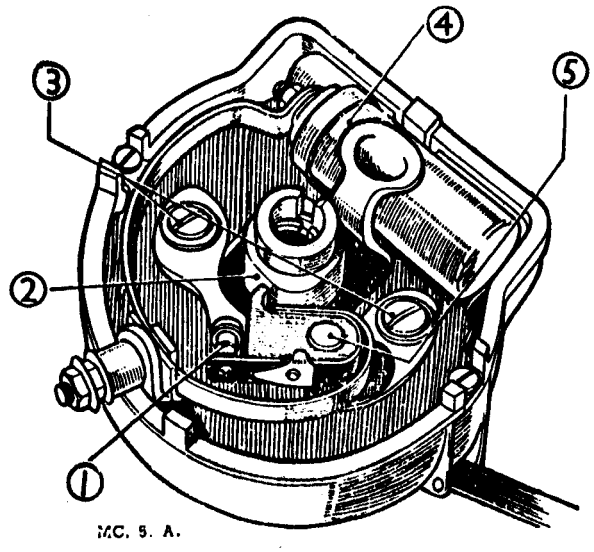


Fig. 18. Distributor head.

1. Contacts; 2. Cam; 3. Contact plate screws; 4. Condenser; 5. Contact breaker pivot.

Should a new condenser be necessary, it is advisable to fit a new complete condenser and contact breaker plate assembly, but should a condenser only be available, care must be taken not to overheat the condenser when soldering in position.

Replacing Bearing Bushes

In order to ensure easy running of the distributor shaft when the shank has been re-bushed, the new porous bronze bushes must be fitted so that they are in correct alignment. The bushes must be fitted by means of a vertical drilling machine or hand press, using a mandrel and a packing block of the type shown in fig. 19.

Fit the mandrel in the drilling machine or hand press and place the distributor body in an inverted position on the table below it. To remove the bushes, a sleeve must be fitted over the mandrel to build it up to the required size. With this sleeve fitted in position, force the old bushes out of the shank by applying a steady pressure.

Before new bushes are fitted they should be allowed to stand for twenty-four hours immersed in thin engine oil.

Take the sleeve off the mandrel. Place one of the longer bushes on the mandrel, then the distributor body in an inverted position, and finally one of the smaller bushes. Locate the end of the mandrel through the packing piece and press the mandrel downwards, taking care that both bushes enter the distributor shank squarely. Continue forcing the bushes into the shank until the mandrel reaches the end of its travel.

After fitting, the bushes must not be opened out as this would tend to impair their porosity and so prevent effective lubrication.

Reassembling the Distributor

The distributor shaft, automatic advance mechanism, and the portion of the shaft on which the cam fits, must be lubricated with thin machine oil before reassembly.

Assemble the automatic timing control, taking care that the parts are fitted in their original positions, and that the control springs are not stretched. Two holes are provided in each toggle: the springs must be fitted to the inner hole in each case. Place the cam on its spindle and secure by tightening the fixing screw.

Fit the shaft assembly in position in the body and replace the driving member.

Place the contact breaker base position on the distributor body and secure by replacing the two fixing screws. A spring washer must be fitted under each of the screw heads, and the screws must be fully tightened.

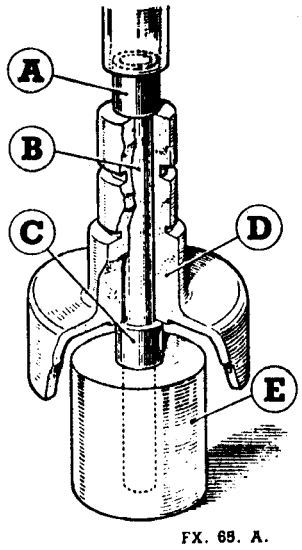


Fig. 19. Fitting new bush bearings to the distributor body.

A and C. New bushes; B. Mandrel; D. Distributor body; E. Packing block.

Position the plate carrying the fixed contact on the contact breaker base and secure it in position by means of the two screws, first placing a spring washer and flat steel washer under the head of each screw.

Place the insulating washer over the contact pivot pin and position the contact breaker lever

on the pin. Locate the slotted end of the contact breaker spring under the head of the terminal screw and tighten the nut to lock the spring in position. Adjust the contact breaker setting to give a gap of 0.010—0.012 in. when fully opened.

If it becomes necessary to renew the contacts, a replacement set comprising fixed and moving contacts must be fitted.

In this case the setting should be 0.014—0.016 in. to allow for the initial 'bedding-in' of the new contact breaker heel. After 15 hours running or 500 miles the gap should be checked and, if necessary, re-set to the normal value of 0.010—0.012 in.

Put the rotor on top of the spindle, locating the register correctly and pushing the rotor fully home.

Finally fit the distributor cover moulding and secure by means of the spring clips.

THE CONTROL BOX

Description

This unit contains the cut-out and voltage regulator. (The RF95-2 unit also houses the two fuses.) The regulator controls the dynamo output in accordance with the load on the battery and its state of charge. When the battery is discharged the dynamo gives a high output, so that the battery receives a quick recharge, which brings it back to its normal state in the minimum possible time.

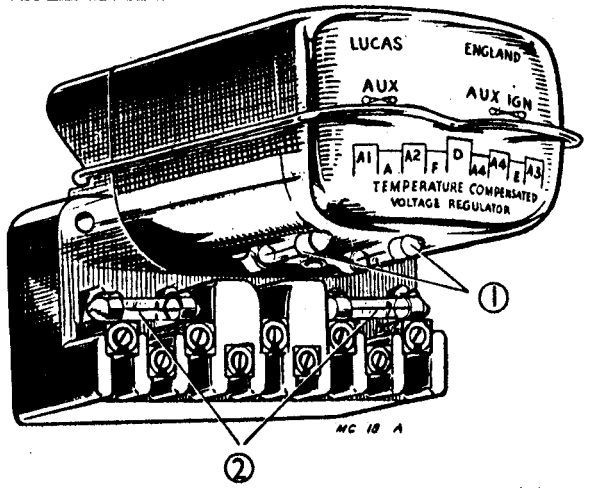


Fig. 20. The control box showing the order of the terminals.
1. Spare fuses; 2. Fuses in circuit.

On the other hand if the battery is fully charged, the dynamo is arranged to give only a trickle charge, which is sufficient to keep it in good condition without any possibility of causing damage to the battery by overcharging.

The cut-out takes the form of an automatic switch for connecting and disconnecting the battery and the dynamo. This is necessary because the battery would otherwise discharge through the dynamo when the engine is stopped or running at a low speed.

Regulator—Adjustment

The regulator is carefully set before leaving the works to suit the normal requirements of the standard equipment, and in general it should not be necessary to alter it. If, however, the battery does not keep in a charged condition, or if the dynamo output does not fall when the battery is fully charged, it may be advisable to check the setting and if necessary to readjust.

It is important, before altering the regulator setting, when the battery is in a low state of charge, to check that its condition is not due to a battery defect or to the dynamo belt slipping.

Checking and Adjusting the Electrical Setting

The regulator setting can be checked without removing the cover of the control box.

Withdraw the cables from the terminals marked 'A' and 'A.1' at the control box and join them together. Connect the negative lead of a moving coil voltmeter (0-20 volts full scale reading) to the 'D' terminal on the dynamo and connect the other lead from the meter to a convenient chassis earth.

Slowly increase the speed of the engine until the voltmeter needle 'flicks' and then steadies; this should occur at a voltmeter reading between the limits given below for the appropriate temperature of the regulator.

Setting Temperature.	Voltmeter Reading
10 deg. C. (50 deg. F.)	16.1—16.7
20 deg. C. (68 deg. F.)	15.8—16.4
30 deg. C. (86 deg. F.)	15.6—16.2
40 deg. C. (104 deg. F.)	15.3—15.9

If the voltage at which the reading becomes steady occurs outside these limits, the regulator must be adjusted.

Shut off the engine, remove the control box cover, release the locknut (A) fig. 21 holding the adjusting screw (B) and turn the screw in a clockwise direction to raise the setting or in an anti-clockwise direction to lower the setting.

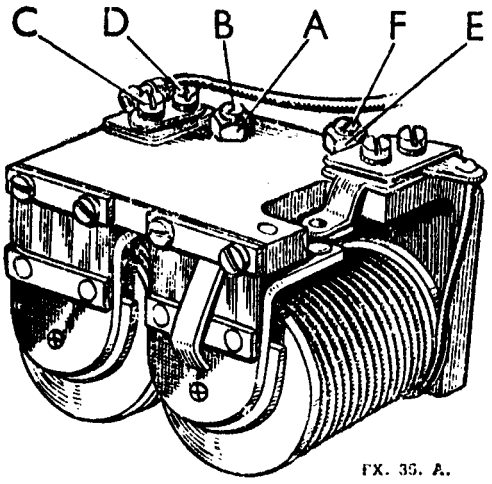


Fig. 21. Voltage regulating at the control box.

A. Locknut; B. Adjusting screw; C and D. Cable and fixed contact securing screws; E. Locknut; F. Cut-out adjusting screw.

Turn the adjustment screw a fraction of a turn and then tighten the locknut.

When adjusting, do not run the engine up to more than half throttle, because while the dynamo is on open circuit, it will build up to a high voltage if run at a high speed and in consequence a false voltmeter reading would be obtained.

Mechanical Setting

The mechanical setting of the regulator is accurately adjusted before leaving the works, and provided the armature carrying the moving contact is not removed, the regulator will not require mechanical adjustment If, however, the armature has been removed from the regulator for any reason, the contacts will have be to reset. To do this proceed as follows:—

(a) Slacken the two armature fixing screws (E) fig. 22. Insert .018-in. feeler gauge between back of the armature 'A' and the regulator frame.

(b) Press back the armature against the regulator frame and down on to the top of the bobbin core with the gauge in position, and lock the armature by tightening the two fixing screws.

(c) Check the gap between the underside of the arm and the top of the bobbin core. This should be .012-.020in. If the gap is outside these limits, correct them by adding or removing shims (F) at the rear of the fixed contact.

(d) Remove the gauge and press the armature down, when the gap between the contacts should be .006-.017in.

Cleaning the Contacts

To render the regulator contacts accessible for cleaning, slacken the screws securing the plate carrying the fixed contact. It will be necessary to slacken the upper screw (C) fig. 21, a little more than the lower screw (D) in order that the contact plate may be swung outwards. Clean the contacts by means of a fine carborundum stone or fine emery cloth. Carefully wipe away all traces of dirt or other foreign matter before finally tightening the securing screws.

Cut-Out Adjustment

If it is suspected that the cutting-in speed of the dynamo is too high, connect a voltmeter between the terminals marked 'D' and 'E' at the control box and slowly raise the engine speed. When the voltmeter reading rises to about 12.7 to 13.3, the cut-out contacts should close.

If the cut-out has become out of adjustment and operates at a voltage outside these limits it must be reset. To make the adjustment, slacken the locknut (E), fig. 21, turn the adjusting screw (F) a fraction of a turn in a clockwise direction to raise the operating voltage or in an anti-clockwise direction to lower the voltage. Tighten the locknut after making the adjustment.

Cleaning the Contacts

To clean the contacts insert a strip of fine glass

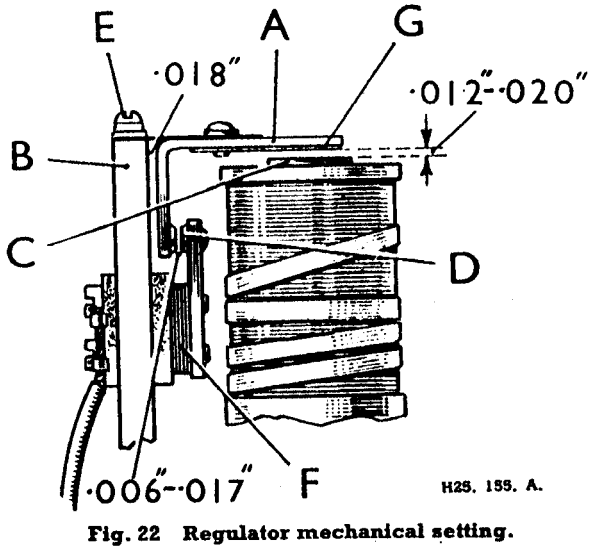


Fig. 22 Regulator mechanical setting.

A. Contact breaker arm; B. Regulator frame; C. Bobbin core; D. Fixed contact; E. Armature fixing screws; F. Packing shims.

paper between the contacts and then, closing the contacts by hand, draw the paper through. This should be done two or three times, the rough side towards each contact.

IGNITION COIL

The ignition coil requires no attention beyond seeing that the terminal connections are tight and that the exterior is kept clean, particularly between the terminals.

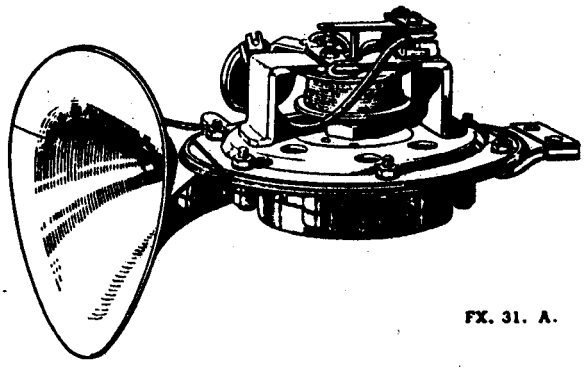


Fig. 23. The electric horn with the cap removed.

ELECTRIC HORN

All horns, before being passed out of the works, are adjusted to give their best performance, and will give a long period of service without any attention : no subsequent adjustment is required.

The Hire Car carries two standard windtone horns, whereas the Taxi Cab carries one muted windtone horn.

In the event of faulty operation check wiring to horn, the state of charge of battery, and—in the event of complete failure—inspect the left hand control box fuse. If this has 'blown' locate the cause and replace fuse.

It is also possible that the performance of a horn may be upset by the fixing bolts working loose, or by some component near the horn being loose. If any carrying out the above examination the trouble is not rectified, the horn may need adjustment, but this should not be necessary until the horns have been in service for a long period.

Adjustment does not alter the pitch of the note, it merely takes up wear of moving parts. When adjusting a horn, short circuit the fuse otherwise it is liable to 'blow'. Again, if the horn does not sound on adjustment, release the push instantly. When making adjustments always disconnect the supply lead of the other horn when two are fitted, taking care that it does not come into contact with any part of the chassis and so cause a short circuit.

Adjusting the Horn

Remove the fixing screw from the top of the horn and take off the cover. Detach the cover securing bracket by springing it out of its location. Using a pair of 4 B.A. open-ended spanners, slacken the locknut below the fixed contact and rotate the adjusting nut until the contacts are just separated. Then turn back the adjusting nut about half-a-turn and measure the current taken by the horn when the horn push is operated. This should by 6—7 amperes. If this value is not measured, continue to re-adjust and test, turning the adjusting nut in a clockwise direction to decrease the current and in an anti-clockwise direction to increase the current.

WINDSCREEN WIPER

To start the electrical windscreen wiper move the switch to the 'On' position. Parking of the arms is effected by switching off at the end of the stroke.

Replacing the Arm and Blade Assembly

The method of securing the arm and blade assembly to the wiper spindle is illustrated in Fig. 24.

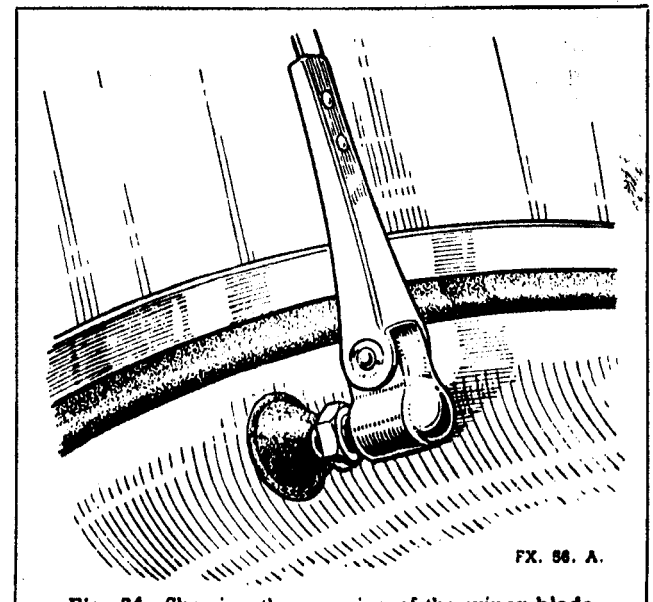


Fig. 24. Showing the securing of the wiper blade assembly to the motor spindle.

To remove the arm and blade assembly, slacken the securing nut and continue to rotate it until the extracting device embodied in the

arm frees the arm from the spindle. When fitting the replacement arm and blade, slacken the securing nut and push the arm on to the spindle as far as it will go. Set the arm in its correct position and tighten the securing nut.

Replacing a Blade

A tongue on the blade passes through a slot in the arm, and is secured by a rubber bush. To free the blade from the arm, remove the bush, pull away the arm from the windscreen and disengage the tongue.

When refitting the blade to the arm first moisten the rubber bush, which can then be fitted more easily.

Note:

The under-bonnet motors of the later models incorporate a thermal device to give overload protection. In the event of overload or abnormally high ambient temperature, the motor current will automatically be switched off.

It is quite in order for this to happen and no counter measures need be taken. The motor will self-start as soon as it has cooled to normal working temperature.

DIRECTION FLASHER INDICATORS

General Description

The flasher unit is housed in a small cylindrical container. Inside, the alternate heating and cooling of an actuating wire causes the operation of a main armature and associated pair of contacts in the flasher lamp supply circuit. At the same time, a secondary armature operates pilot contacts which cause a warning light to flash when the system is functioning correctly. Failure of this warning light to flash will indicate a fault in the system.

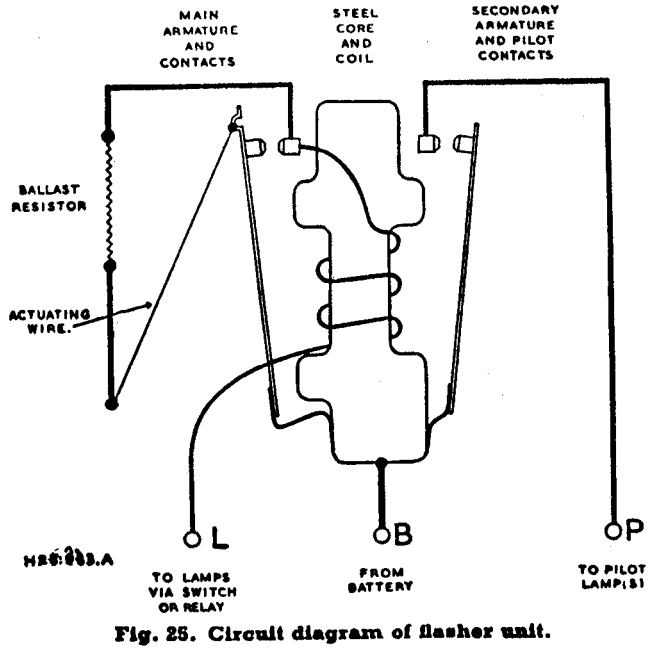


Fig. 25. Circuit diagram of flasher unit.

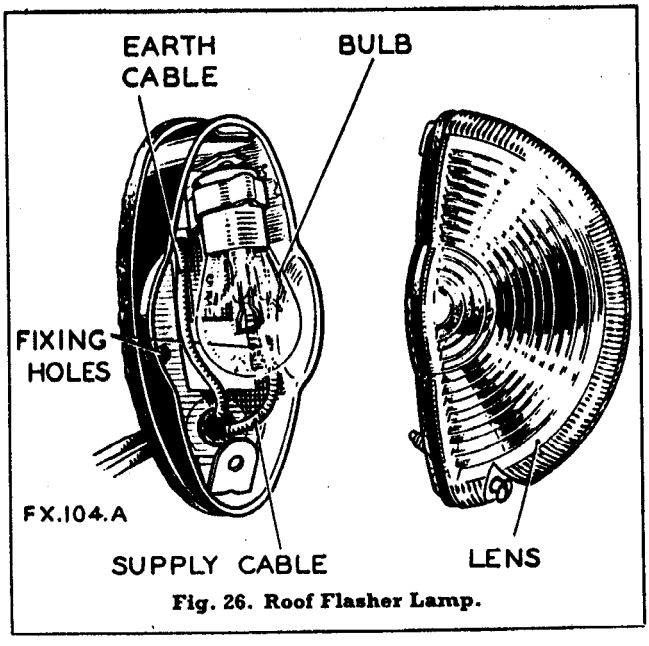


Fig. 26. Roof Flasher Lamp.

Servicing

Flasher units cannot be dismantled for subsequent reassembly. A defective unit must therefore be renewed, care being taken to reconnect as the original.

Checking faulty operation. In the event of trouble occuring with a flashing light direction indicator system, the following procedure should be followed:—

(1) Check the bulbs for broken filaments.
(2) Refer to the vehicle wiring diagram and check all flasher circuit connections.
(3) Switch on the ignition.
(4) Check with a voltmeter that flasher unit terminal "B" (or "X") is at 12 volts with respect to earth.
(5) Connect together flasher unit terminals "B" (or "X") and "L" and operate the direction indicator switch. If the flasher lamps now light, the flasher unit is defective and must be replaced. If the flasher lamps do not light, check the direction indicator switch.

Replacement or installation of Flasher Unit —Precautionary Note. When replacing a flasher unit it is advisable to test the circuits before connections to flasher terminals "L", "B" (or "X") and "P" are made. When testing, join the cables normally connected to these terminals together

and operate the direction indicator switch. In the event of a wrong connection having been made, the ignition auxiliaries fuse will blow but no damage will be done to the flasher unit.

Flasher units must be handled with care. Factory-made setting, though satisfactory for conditions of normal automobile duty, can be thrown off balance by rough handling.

Lamp bulbs:— 12 volt, 21 watt Lucas No. 382.

Warning light bulb:— 12 volt, 2.2 watt Lucas No. 987.

DIRECTION ARM INDICATORS

Description

The Lucas direction indicator or 'Trafficator' is a solenoid-operated unit. When the switch on the steering column is operated to the left or right, the appropriate indicator arm is raised and the bulb, which is incorporated in the arm of the indicator, automatically illuminates the arm.

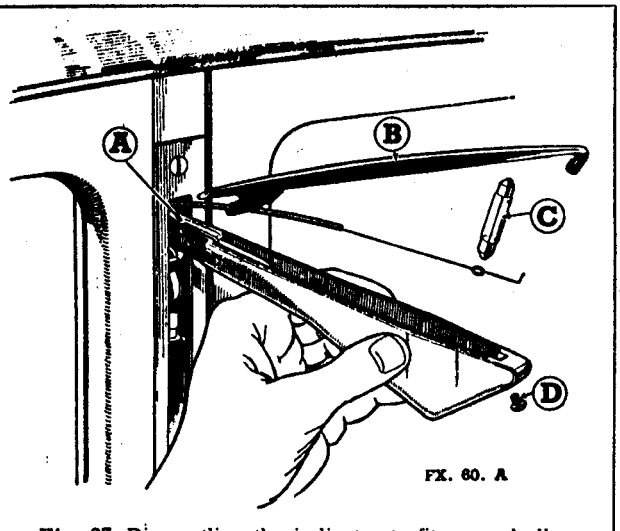


Fig. 27. Dismantling the indicator to fit a new bulb. Remove screw 'D'; lift off cover 'B'; remove bulb 'C'.

D'smantling

To remove a defective direction indicator assembly complete from either door pillar it is not necessary to remove any lining from inside the car. From between the two doors withdraw the two screws, one at the top and one at the base, that secure the indicator escutcheon. These screws pass through the escutcheon, the indicator back plate and so into the door pillar.

The indicator unit can now be lifted out of the pillar casing taking with it sufficient of the single electrical cable for the operator to disconnect the cable at the snap connector.

Replacing an Indicator Arm

Carefully drill out the rivet securing the arm to the bracket, then remove the arm cover, (see fig. 27) and withdraw the cable and the bulb.

Finally open out the clip securing the cable to the arm of the trafficator and remove the arm.

Place the new arm in position so that the arm stop pin locates between the arm lifting plate and locking plate, and secure in position by fitting a new rivet.

Remove the arm cover to replace the cable and the bulb, and then refit the cover. Secure the cable to the arm by means of the clip, taking care to see that the bending over of the clip does not damage the cable or its insulating covering and also ensure that when the trafficator is operated, the cable is free to move in a wide arc.

Finally refit the unit to its position in the car and replace the door pillar casing.

LIGHTING

Headlamps

Bulb Replacement : Hire Car (Home and U.S.A.) and Taxi (Home).

1. Pull the spring-catch at the bottom of the lamp rim forwards and downwards.
2. Grasp the bottom of the rim and pull forwards and upwards. The rim with glass will then come away from the lamp body.
3. Remove defective bulb and fit only the recommended replacement.
4. Replace the front, locating first with the top of the rim and then pressing on at the bottom. Pull spring-catch forwards and upwards.

Bulb Replacement : Taxi (U.S.A.)

The reflector and glass of these lamps form a complete unit known as the Lucas Light Unit. This must be removed for bulb replacement.

1. Pull the spring-catch at the bottom of the lamp rim forwards and downwards. The rim and Light Unit assembly can then be removed.
2. To gain access to bulb remove back shell by twisting to the left and pulling off.
3. Remove defective bulb and fit only the recommended replacement.
4. Engage the projections on the inside of the

back shell with the slots in the bulb holder; press on, and lock by twisting back shell to the right.

5. Replace Light Unit and rim.

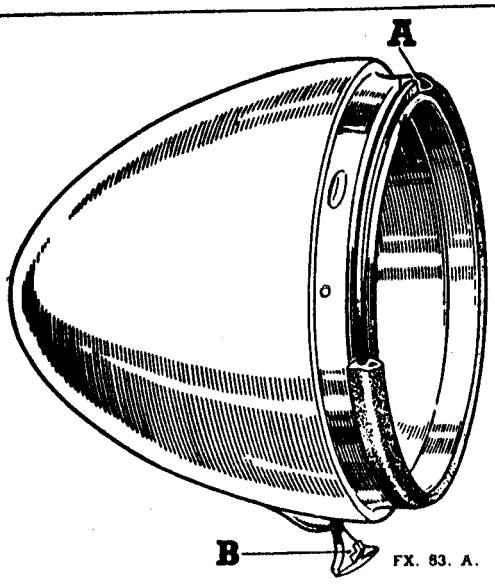


Fig. 28. The headlamp with rim removed to show the rubber seal ring at A, and the rim spring catch at B.

Mounting Adjustment : Hire Car and Taxi (Home and U.S.A.)

Slacken the single fixing nut at the base of the lamp and move the lamp on its adjustable mounting to the required position ; and then tighten fixing nut.

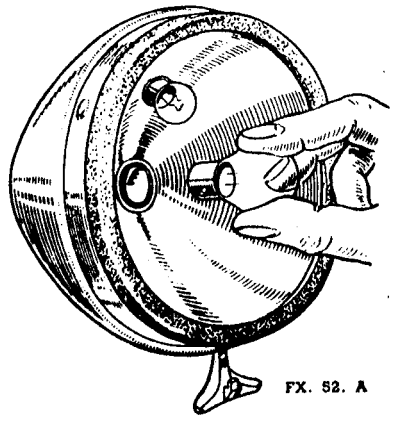


Fig. 29. With the rim removed the bulb may be taken out of its bayonet type socket in the reflector case.

Focusing : Hire Car (Home and U.S.A.) and Taxi (Home)

The lamps are set before leaving the Works to give maximum beam intensity and providing only recommended spares are used no further adjustment should be necessary. If a bulb other than a genuine Lucas spare be fitted, or if the setting of the bulb holder has been altered re-focusing may be found necessary. To check

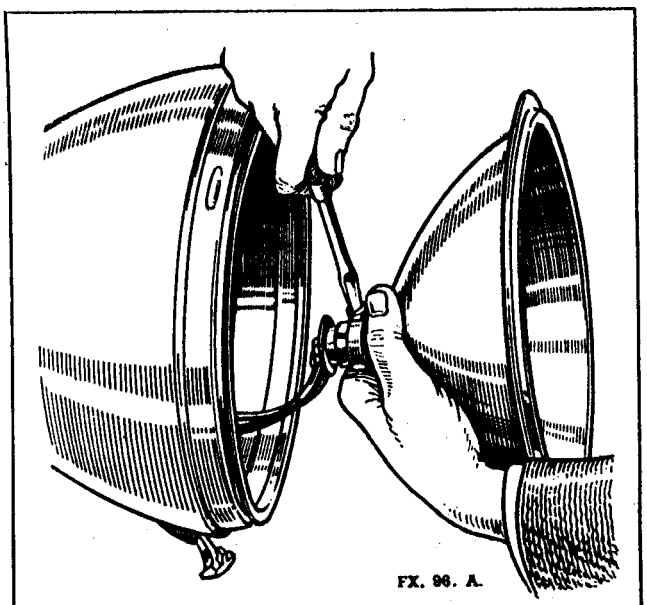


Fig. 30. Slackening the clamping clip at the back of the reflector prior to focusing.

if this is so cover one lamp and switch on. The uncovered lamp should produce a uniform long range beam with no dark centre. If it does not, switch off and proceed as follows:—

1. Remove lamp front and reflector.
2. Slacken clamping clip at back of reflector and slide the bulb holder backwards or forwards until the best result is obtained, remembering that it might be necessary to earth the reflector.
3. Refit reflector and lamp front.

Focusing : Taxi (U.S.A.)

As these lamps incorporate a Lucas Light Unit and prefocus bulb no focusing is necessary.

Foglamp :

Bulb Replacement:

1. Slacken single securing screw at top of lamp rim. The rim and Light Unit assembly

can then be removed.
2. To gain access to bulb remove back shell by twisting to the left and pulling off.
3. Remove defective bulb and fit only the recommended replacement.
4. Engage the projections on the inside of the back shell with the slots in the bulb holder; press on, and lock by twisting back shell to the right.
5. Replace Light Unit and rim.

Mounting Adjustment:
Slacken the single fixing nut at the base of the lamp and move the lamp on its adjustable mounting to the required position, and then tighten fixing nut.

Focusing:
As these lamps incorporate a Lucas Light Unit no focusing is necessary.

Sidelamps
Bulb Replacement: Hire Car and Taxi
1. Slacken screw at top of lamp rim. The front together with reflector and bulb holder may then be withdrawn.
2. Remove bulb holder with a twisting-pulling action.
3. Remove defective bulb and fit only this recommended replacement.
4. Refit bulb holder and see that the retaining springs on the reflector snap home into the bulb holder slots.
5. Refit the front, locating with the bottom of the rim first, and secure with top screw.

Stop-Tail Lamp
Bulb Replacement: Hire Car and Taxi (Home)
Slacken the side retaining screw and the hinged cover will swing open to expose the bulb holders.
(U.S.A.)
To gain access to the bulbs unscrew the two securing screws and lift off the lamp body and glass.

Number Plate Illumination: Hire Car and Taxi (U.S.A.)
To gain access to the bulb unscrew the single securing screw and lift off the lamp body.

LOCATION AND REMEDY OF FAULTS

IGNITION CIRCUIT

1. Engine will not Fire
(a) See that the battery terminals are secure and that the battery is in a charged condition, either by the use of a hydrometer or by checking that the starter will turn the engine and the lamps give good light.
If the battery is discharged, it must be recharged from an independent electrical supply.
(b) Ensure that the controls are correctly set for starting.
(c) Remove the cable from the centre distributor terminal hold it so that the end is about $\frac{1}{4}$-in. away from some metal part of the chassis while the engine is turned over slowly. If sparks jump the gap regularly, the coil and distributor are functioning correctly and the sparking plugs must be examined. If these are clean and the gaps correct, the trouble is due to carburetter, fuel supply, etc.
(d) If the coil does not spark on test (c), check for a fault in the low tension wiring. This will be indicated by (i) no ammeter reading when the engine is slowly turned and the ignition switched on, or (ii) no spark occurring between the distributor contacts when quickly separated by the fingers when the ignition is switched on.
Examine all cables in the ignition circuit and see that all connections are tight.
(e) If the wiring proves to be in order, examine the distributor contacts, if necessary cleaning them and adjusting the gap as described on page Q/7.

2. Engine Misfires
(a) Examine the distributor contacts, if necessary cleaning them and adjusting the gap, as described on page Q/7.
(b) Remove each sparking plug in turn, rest it on the cylinder head and observe whether a spark occurs at the points when the engine is turned. Irregular sparking may be due to dirty plugs, which must be cleaned and adjusted, or defective high tension cables. Any cable on which the insulation shows signs of deterioration or cracking should be renewed (see page Q/8).
(c) If sparking is regular at each plug when

tested, as described in (b) the trouble is probably due to engine defects or the carburetter, petrol supply, etc.

CHARGING CIRCUIT

1. Battery in low state of charge

(a) This state will be shown by lack of power when starting, poor light from the lamps and hydrometer readings below 1.200, and may be due to the dynamo either not charging or giving low or intermittent output. The ignition warning light will not go out if the dynamo fails to charge, or it will flicker on and off in the event of intermittent output.

(b) Examine the charging and field circuit wiring, tightening any loose connections or replacing broken cables. Pay particular attention to the battery connections.

(c) Examine the dynamo driving belt: take up any undue slackness by turning the dynamo on its mounting.

(d) If the cause of the defect is not apparent, have the equipment examined by a Lucas Service Depot or Agent.

2. Battery overcharged

This will be indicated by burnt-out bulbs, very frequent need for topping-up of the battery, and high hydrometer readings. Check the ammeter readings when the car is running steadily with a fully charged battery and no lights or accessories in use — the charge reading should be of the order of only 3 - 4 amperes. If the ammeter reading is in excess of this value, it is advisable to have the regulator setting tested and adjusted if necessary by a Service Depot or Agent.

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 of 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 battery, 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 flywheel, although this is by no means a common occurrence. To disengage the pinion, rotate the squared end of the starter shaft by means of a spanner.

2. Starter operates but does not crank engine.

This fault will occur if the pinion of the starter drive is not allowed to move along the screwed sleeve into engagement with the flywheel due to dirt having collected on the screwed sleeve. Clean the sleeve carefully with paraffin.

3. Starter pinion will not disengage from the flywheel when engine is running.

Stop the engine and see if the starter pinion is jammed in mesh with the flywheel, releasing it if necessary by the rotation of the squared end of the starter shaft. If the pinion persists in sticking in mesh, have the equipment examined at a Service Depot. Serious damage may result to the starter if it is driven by the flywheel.

LIGHTING CIRCUITS

1. Lamps give insufficient illumination

(a) Test the state of charge of the battery, recharging it if necessary either by a long period of daytime running or 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 replaced.

2. Lamps light when switched on, but gradually fade out

As para. 1 (a).

3. Brilliance varies with speed of car

(a) As para. 1 (a).

(b) Examine the battery connections, making sure that they are tight, and replace faulty cables.

BODYWORK

THE careful maintenance of the bodywork, both internally and externally, is of primary importance if the vehicle is to retain its appearance and comfort. The paint work, upholstery, carpets, door locks and hinges will each benefit from the periodical attentions briefly indicated in the following paragraphs and these should therefore be undertaken as regularly as possible.

Care of the Bodywork

The cellulose finish of the bodywork should receive regular care and attention if it is to retain its original lustre. If neglected, the finish of the vehicle will have a tendency to become dull, the dullness taking a form of 'bloom' on the surface of the paintwork.

Frequent washing with clean, cold, running water will greatly assist in the retention of the original lustre. Always ensure that the sponge and leather used are free from grit and oil, and are not the same mediums used for the under-carriage.

Should the cellulose become dull, an application — sparingly used — of one of the liquid polishes, of reputable manufacture, will restore the finish to its original shade. An occasional application of a good class wax polish, after the car has been thoroughly washed, will give added protection.

Chromium

Plated parts should be finished with a damp leather. If the chromium is very dirty, it should be washed in warm soapy water, but on no account should metal polish be used.

Door Locks and Hinges

Occasionally apply a few drops of oil on the moving parts of all door locks and hinges. A light touch of grease should be smeared on the lock striker plates or pegs to ensure free movement and to reduce wear of the locks.

In addition, the security of door hinges, locks, dovetails and striker plates or pegs should be checked periodically with a screwdriver.

Upholstery

The leather work has, in general, an impermeable surface which can be kept clean and fresh looking by an occasional wiping down with a damp cloth and saddle soap. Finish off, when completely dry, with a good furniture cream.

Should the cloth of the headlining become stained, the task of cleaning is best undertaken by a firm of specialists.

Carpets

The carpets of the Hire Car should be kept free from dust and grit by vigorous brushing or by the use of a vacuum cleaner. Periodically both the carpets and the felts should be removed and thoroughly beaten, after which the body floor should be inspected.

Any parts of the body flooring which show signs of rust should be cleaned and then painted with a quick drying enamel, before the carpets are replaced.

Windows

Window glasses and mirrors should be cleaned with a damp leather.

DISMANTLING AND ASSEMBLING BODY PARTS

In order to maintain a degree of sequence it is assumed for this purpose that the Taxi, or Hire Car, is in a completed state, and therefore the method relates to the removing of parts. Where a definite operation for re-assembly is at variance with the removal, specific mention is made.

Front Apron and Bumper

Disconnect the wiring from the fog lamp at the snap connector underneath the apron. Extract the two ¼-in. bolts holding the apron to the dumb irons when the apron will come away from the chassis complete with the front bumper. The latter can then be separated from the apron by taking out its four attachment bolts.

Rear Bumper

The rear bumper is secured to each chassis side member by two nuts and bolts. When these

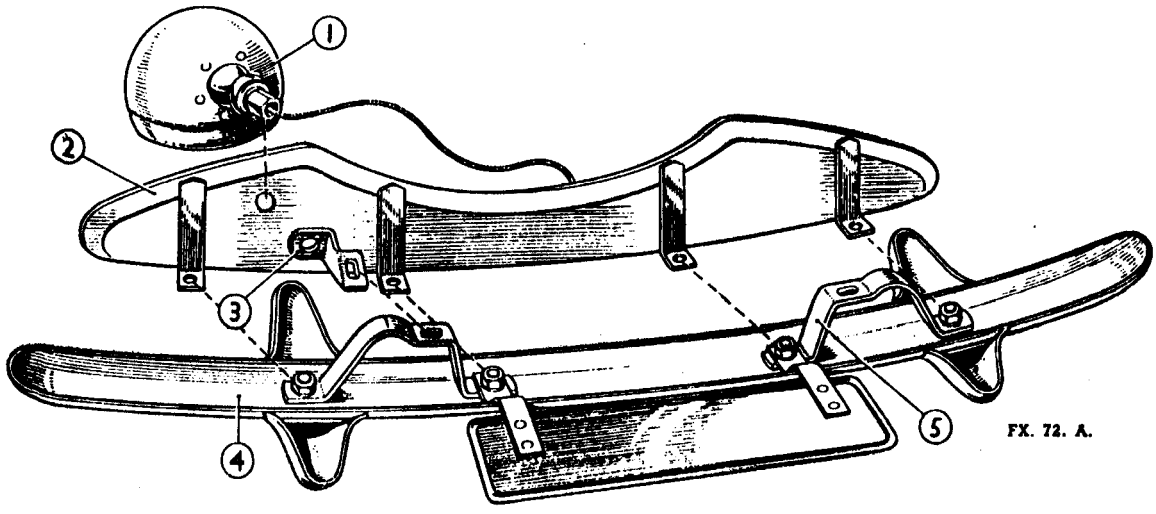


Fig. 1. The front bumper and apron assembly exploded showing: 1, Fog lamp; 2, Apron; 3, Fog lamp bracket; 4, Front bumper; 5, Bumper to chassis bracket.

bolts are withdrawn the bumper complete with side arms can be pulled rearward from the body panelling.

Bonnet

To remove the bonnet, open the left-hand side panel and disconnect the ¼-in. B.S.F. bolts holding the hinge brackets to the top of the cowl and the scuttle, the bonnet can then be lifted off.

To dismantle the bonnet sides, remove the hinge rods by lightly tapping them with a hammer and a drift of slightly smaller diameter than the hinge rods themselves. In the same manner the two halves of the bonnet top may be separated.

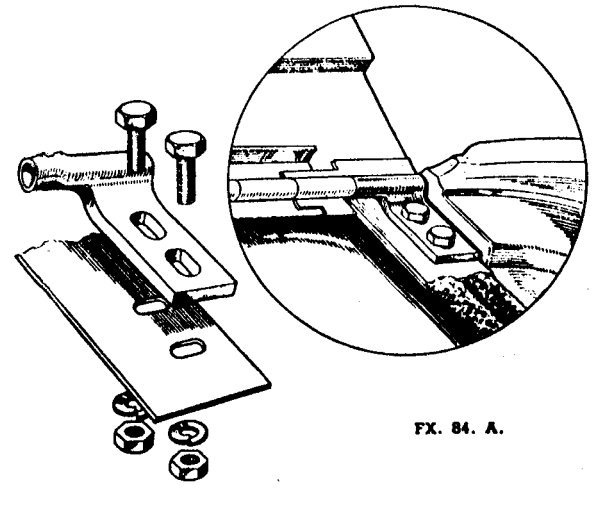


Fig. 2. The bonnet hinge and fixing bolts in exploded form. Inset shows the assembly fixed to the cowl.

When this hinge rod is removed the chrome moulding and brackets will also become detached.

On re-assembling the bonnet it is important to grease the rods before fitting and care must be taken to assemble the chrome moulding and hinge brackets in their correct position.

Front Wings

The front wings can be removed by first disconnecting the electrical cables from the side lamps and then unscrewing five ⅜-in. B.S.F. bolts situated around the flitch plate. In addition, the fixing bolt attaching the wing to the wing stay and the bolt fixing the base of the wing to the step iron must be removed.

Rear Wings

These are secured with eight ⅜-in. B.S.F. set bolts, on each side, which screw into fixed caged nuts in the quarter panel. When the set bolts are withdrawn, the wing is released.

On re-fitting attention should be paid to the alignment of the wing to prevent distortion.

Radiator Cowl

To dismantle the radiator cowl, withdraw the five ¼-in. B.S.F. bolts that hold the cover plate to the cowl fixing plate. Remove two ¼-in. B.S.F. set bolts attaching the guide tube mounting bracket to the front cross-member and extract the set bolts which fix the cowl fixing to the radiator.

Disconnect the head-lamp and horn wires at their snap connectors.

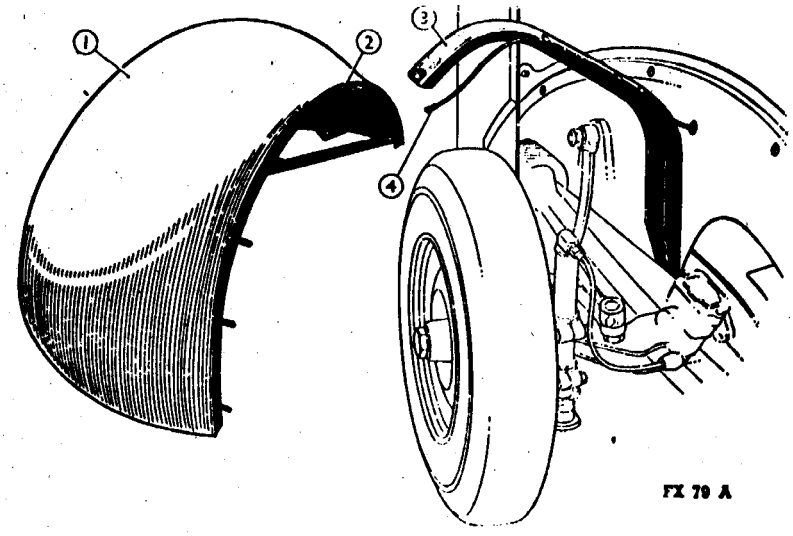


Fig. 3. The Front Wing exploded.

1. Wing with beading riveted in place.
2. Wing bolts.
3. Wing stay.
4. Sidelamp cable.

The two $\frac{1}{4}$-in. B.S.F. bolts securing the side of the cowl to the chassis bracket should be taken out and the two 2 B.A. screws holding the cowl extension panel to the bonnet fastener

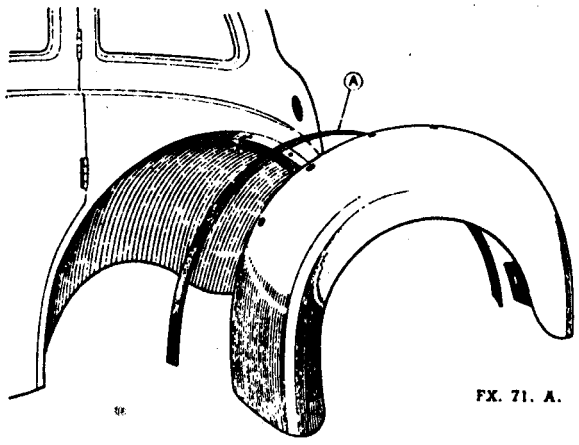


Fig. 4. Rear wing exploded from body, showing at A the beading between wing and body.

bracket must be removed, then the radiator cowl will come away from the chassis.

Mascot

When the two screws holding the mascot and fixing bracket to the cowl have been withdrawn, the mascot will become detached with its protective washer.

Badge

Remove the spring clips by inserting a screwdriver, or similar lever, underneath the badge, but care must be taken not to strain the badge or the enamel will chip.

Headlamps

First disconnect the cables at their snap connectors. Unscrew the nuts fixing the headlamp to the cross tube, slowly turn the lamp and withdraw it from the knurled portion of the tube, the wire will then come through the tube.

Cross Tube

Remove the two locking bolts which fix the cross tube to the cross tube support brackets on the inside of the cowl. The tube can then be driven out using a block and drift of the appropriate size. Care must be taken not to burr the ends on the tube otherwise difficulty will be experienced when re-assembling the headlamps.

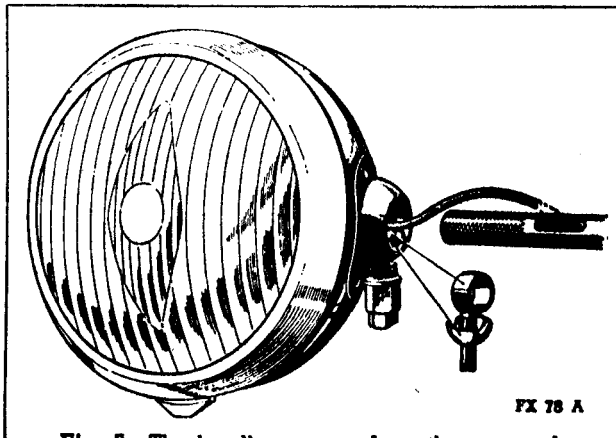
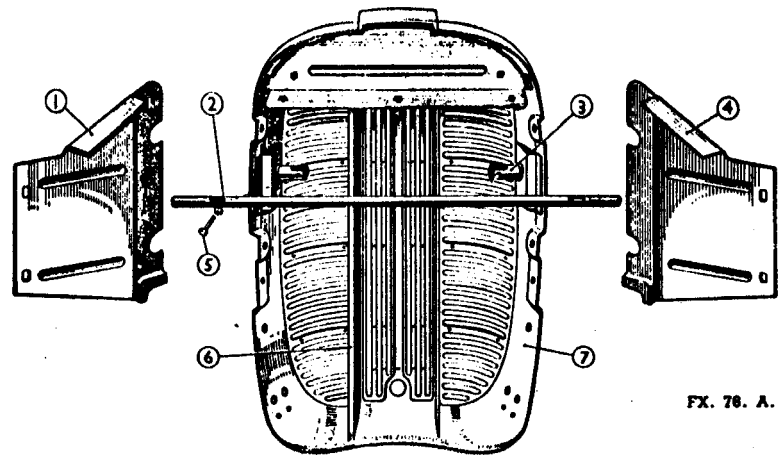


Fig. 5. The headlamp away from the cross tube. The smaller illustration shows more clearly the clamp bolt.



FX. 76. A.

Fig. 6. A rear view of the cowl.

1. Left-hand fixing plate.
2. Cross tube.
3. Cross tube bracket.
4. Right-hand fixing plate.
5. Cross tube bolt.
6. Cowl stiffener.
7. Cowl.

Cross Channel

This is removed by detaching the four nuts and bolts fixing the channel to the cowl side. The horn and starter handle guide tube can then be separately detached. Note: Taxi — one horn only, left-hand side; Hire Car — two horns, high and low tone.

Grille Bars (Taxi)

These are removed by springing the bars away from the cowl using a steady pressure. Fixing clips are removed by sliding separately to the slot cut out on the inside of the grille bar.

Grille (Hire Car)

This is in four separate parts which are detached by removing the nuts around the edge of the grille and cowl. When replacing, care must be taken to see that the grille is a snug fit on the inside face of the cowl.

Cowl Fixing Plates

Remove the four bolts attaching the plates to the cowl side. These bolts are partially concealed by the bonnet webbing.

Flitch Plate

Remove the five $\frac{5}{16}$-in. bolts situated on the chassis side member, also one $\frac{5}{16}$-in. bolt holding the wing stays to the support brackets. Detach the bolts affixing the toeboard brackets and remove the $\frac{1}{4}$-in. B.S.F. bolts holding the wing stays to the flitch plates when the wing stays can be removed. After the harness has been unclipped, the flitch plates can be taken out.

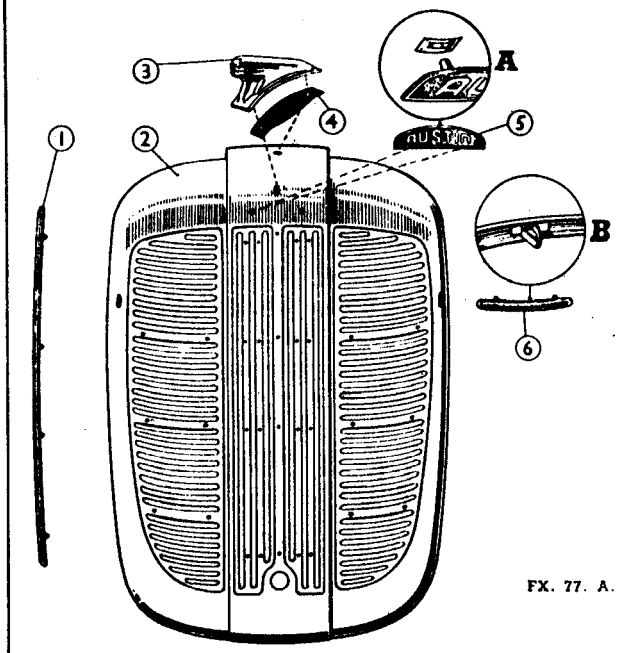
For Hire Sign — Taxi only

To remove the hire sign, first remove the plug from its socket, then extract the three fixing screws on the inside of the roof and remove the sign.

When the two plated nuts of the sign are removed, access is given to the bulbs.

Wiper Motor

To change a wiper motor only, it is necessary to remove the two bolts attaching the motor to



FX. 77. A.

Fig. 7. Taxi cowl assembly.

1. Vertical chrome strip.
2. Cowl.
3. Mascot.
4. Joint washer.
5. Badge. Inset shows fixing.
6. Chrome cross strips. Inset shows securing clip.

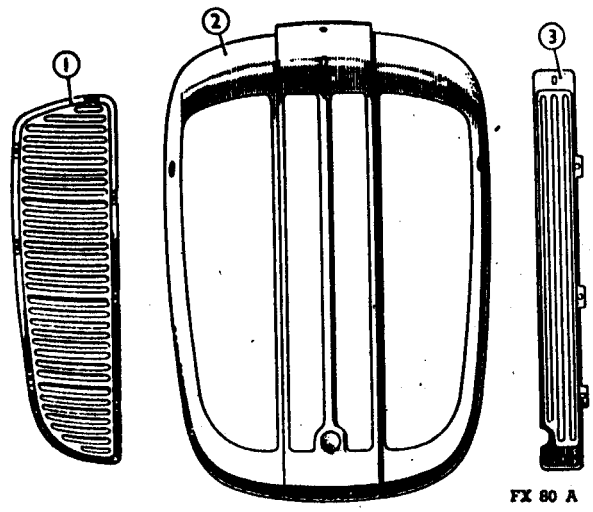


Fig. 8. Hire Car cowl assembly.
1, Side chrome grille; 2, Cowl; 3, Centre chrome grille.

its mounting bracket, this is situated underneath the fascia panel on the near side. The three screws are then removed from the drive casing allowing the drive to be disconnected. The motor is then completely detached.

In order to remove the motor and drive complete, the fascia is detached from the body by extracting the five screws situated under the lower edge of the screen, also one screw at each side of the panel. The motor unit complete with drive can then be easily removed.

Windscreen

Disconnect the quadrant arms by releasing their wing nuts, remove the hinge bolts and withdraw the windscreen forwards.

Front Door Windows

To renew a window, should the necessity arise, the window winding mechanism must be exposed. To do this, the window frame moulding securing screws must be extracted when the moulding can be taken from the door. In addition to this, the door trim casing must be dismantled. This can be done by removing the screws holding the casing and door check strap and then prising the casing from the door interior, evenly, around the edges to release the spring clips.

The front door pillar angle is then detached by removing the two $\frac{5}{16}$-in. B.S.F. countersunk screws which hold it to the door interior top and two $\frac{5}{16}$-in. B.S.F. special headed bolts, situated on each side of the top hinge butt, the angle will then slide upward through the casing.

The interior door handle is removed by applying pressure to the escutcheon which exposes the magnetic key, enabling it to be removed. Release the door grab-handle by withdrawing the two $\frac{1}{4}$-in. B.S.F. screws. The casing can then be detached.

Place the window in its lowered position. Remove the $\frac{1}{4}$-in. B.S.F. screws which hold the window regulator to the door interior panel. Slide the regulator to one side when the glass will be released from the regulator rollers complete with clamplate. Withdraw the window to the inside of the car.

To remove the chrome window pull section from the window glass, use a hammer and a block of wood on the lower edge. This operation will be made easier if the edge is dipped in hot water.

When re-assembling the section, apply a thin coating of gold size.

Rear Door Windows

The same procedure is followed as for the front door — remove window moulding, door trim casing and the ashtray.

To change the rear door window, place the glass in its lowered position, remove the two top screws which hold the glass channel to the door interior, then withdraw the screw holding the bottom of the glass channel to the mounting bracket. The glass may now be removed. Extract two $\frac{1}{4}$-in. B.S.F. screws which hold the window lift to the interior casing, the glass will then come away complete with window lift.

Division Window — Hire Car

In order to remove the division window the following procedure is adopted.

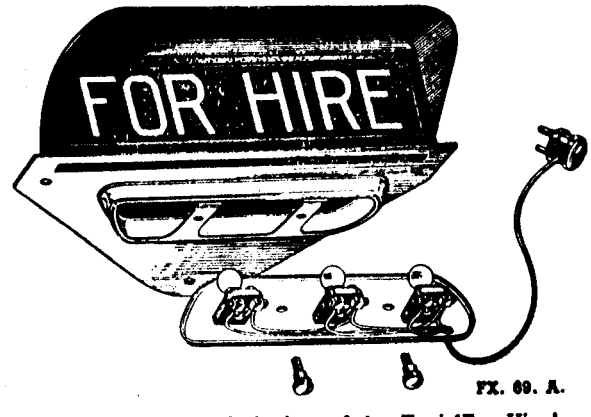


Fig. 9. An exploded view of the Taxi 'For Hire' sign.

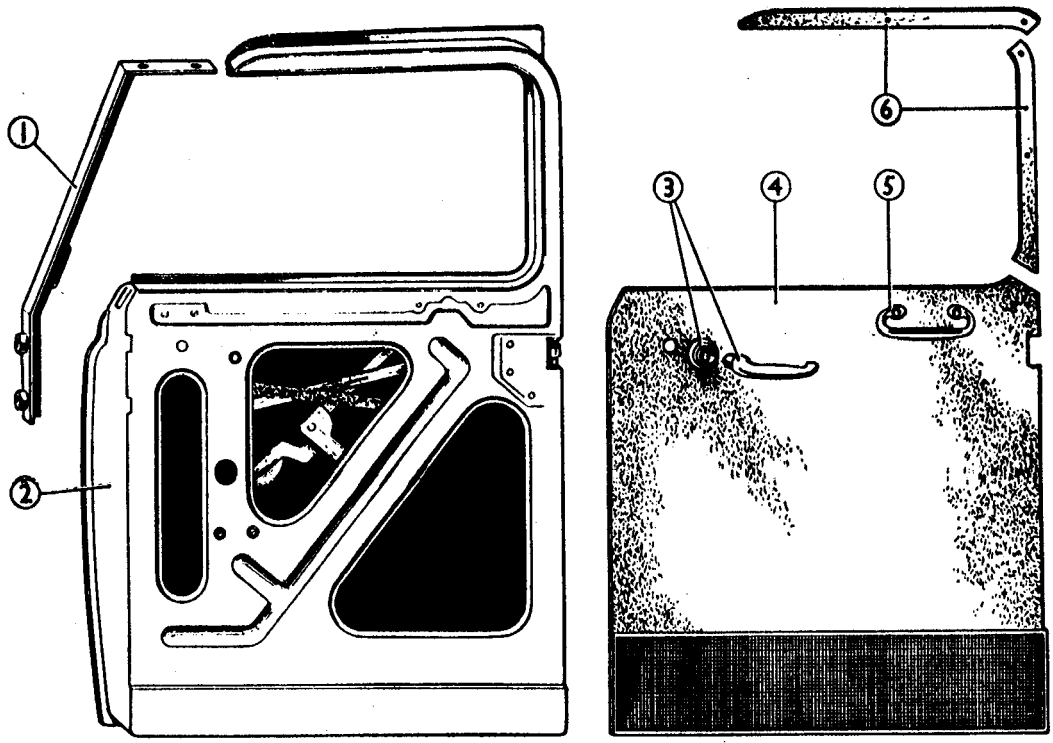


Fig. 10. Front door in exploded form.

1, Front pillar angle; 2, Door shell; 3, Lock handle assembly; 4, Trim casing; 5, Pull handle; 6, Casing fillets.

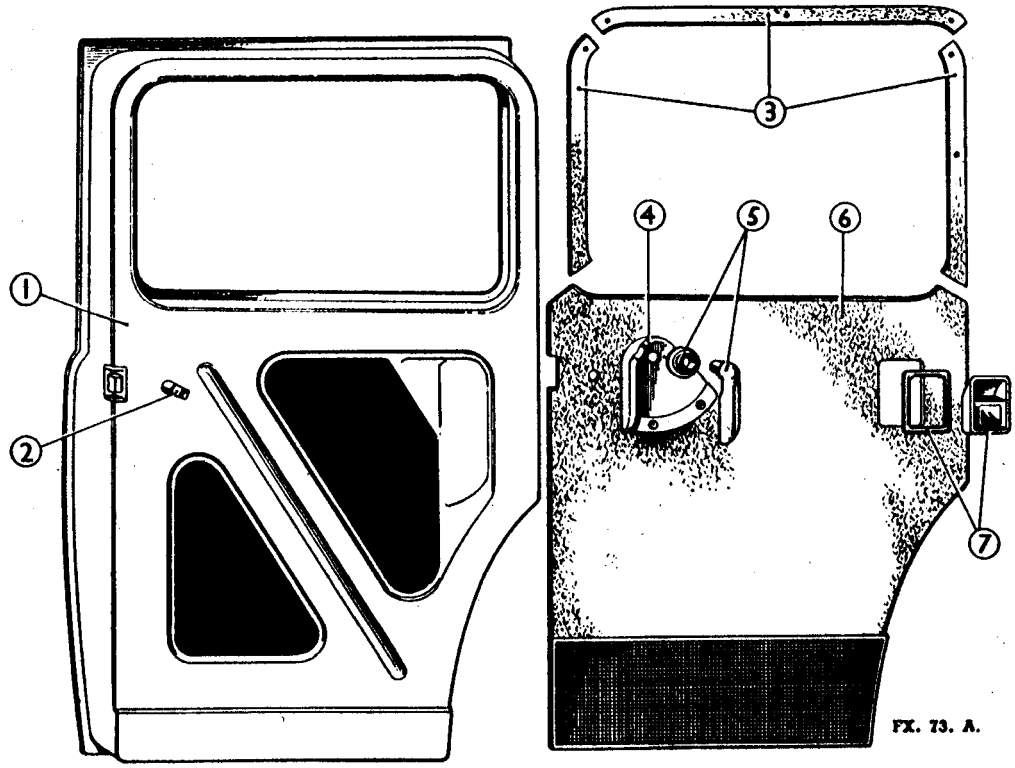


Fig. 11. The rear door in exploded form.

1, Door shell; 2, Lock spindle; 3, Door fillets; 4, Lock handle shield; 5, Lock handle assembly; 6, Trim casing; 7, Ashtray assembly.

Remove frame, slide glass to one side and extract two screws holding glass channel to division rail. Next slide glass to opposite side, remove two screws holding lower glass channel. The glass can then be removed from the passenger compartment complete with glass channel attached.

Division Side Windows — Hire Car

Remove side fillets and trim casing. Release the three wood fillets which are fixed with panel pins to the division, the glass can now be withdrawn to the rear compartment.

Division Windows — Taxi

Release the frame and front fillet. Extract the centre screw of the sliding glass bottom channel. Slide the glass to centre, remove channel screw now exposed and lift the glass channel out.

The fixed glass can now be removed in the following manner:—

Take out the six screws from the top and bottom reverse channel at the front of the cab, slide the glass to the driver's side and remove the screws in the sliding channel, rear side. When the glass is slid to the driver's side it can be withdrawn.

Driver's Partition Window — Taxi

Working from the luggage compartment, remove the screws from the bottom channel, slide the glass as described for the division, and withdraw.

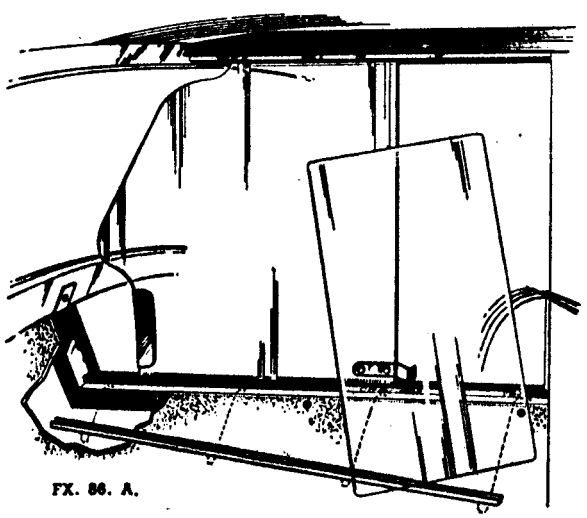


Fig. 12. Taxi driver's division panel. By removing the lower window channels both glass panels may be removed.

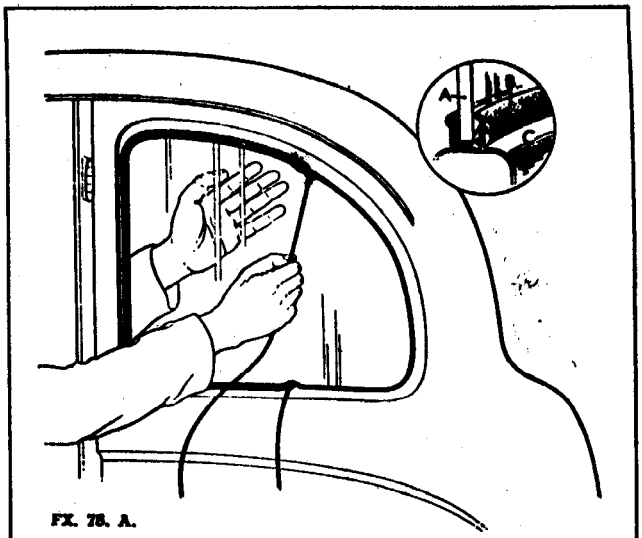


Fig. 13. Fixing a new quarter-light. Inset shows a section of glass A, rubber B, and metal surround C.

Division Panel—Taxi (Driver's Compartment)

Take out the six screws holding the partition angle to the division and screen support. Remove the screws from capping at top of division panel when the panel can be detached by taking out the remainder of the screws situated around the edges.

Division Panel — Taxi (Passengers' Compartment)

This panel is removed complete with the crash panel by extracting the six screws situated around its edges.

Quarter-Light

Remove the frame by extracting the screws at the same time applying pressure to the outside of the glass. The glass is then withdrawn from the interior of the cab.

To fit a new glass, the rubber jointing, too, must be removed from the metal framing.

Fit the square groove of the rubber jointing round the new glass and run a piece of flex or strong cord round the free groove in the rubber. Offer the window into position from the inside of the car and press the free groove in the jointing firmly against the frame.

If, with the window held in position, the cord or flex is now peeled out of the jointing from outside of the vehicle, it will be found that the free groove of the rubber locates properly around the window frame. Bostik solution should now be smeared between the metal frame and

the jointing, on the outside of the vehicle, and gold size solution between the outside of the window glass and the jointing.

Backlight

Follow the same procedure as detailed for the quarter-light.

Rear Squab

On withdrawal of the five screws, beneath the back panel in the boot interior, the squab can be lifted out.

Boot Lid

To remove the boot lid disconnect the quadrant arm by extracting the $\frac{1}{4}$-in. B.S.F. setpins and removing the nuts from the hinges.

On replacement, care must be taken to see that the quadrants do not bind on the boot lid interior panel, also, when tightening the hinge nuts, even pressure must be applied to prevent distortion of the outer panel.

Arm Rest

Take out the three screws from the trim pad and two check strap screws, an additional screw, which will be found beneath the wheelarch, must also be withdrawn. When these have been extracted, the casing complete with arm rest can be withdrawn forward.

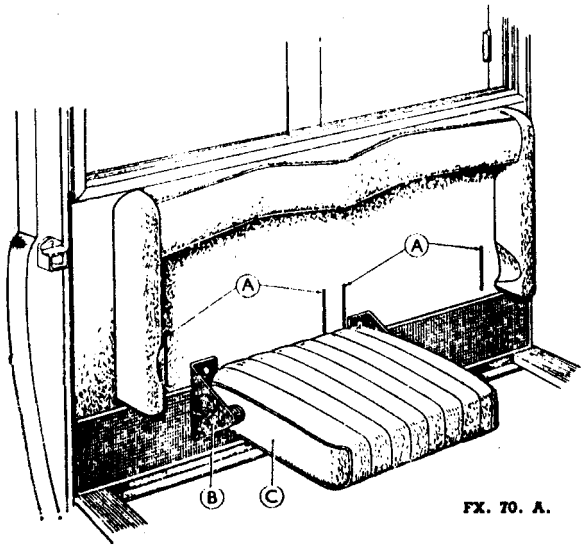


Fig. 14. Taxi occasional seats.

A, Slots in division partition for access to caged nuts; B, Seat bracket; C, Spring loaded seat.

Front Squab — Hire Car

With the division frame removed along with the side casings, take out the screws from the top fillet in the passenger compartment when the screws holding the squab will be exposed, take out these screws and the squab can be readily detached.

Occasional Seats — Taxi

These are removed by extracting the bolts holding the seat brackets to the division panel.

Occasional Seats — Hire Car

The Hire Car occasional seats can be taken out by removing screws from the rubber protecting strip thus exposing the eight $\frac{1}{4}$-in. B.S.F. bolts to be extracted from the seat brackets on the floor.

Body Removal

To remove a Taxi or Hire Car body complete the following dismantling operations should be carried out.

1. Disconnect leads from the battery, the starter motor solenoid on the scuttle, the starter motor and the dynamo. Also disconnect the ignition system, that is, release the plug leads, remove the distributor cap and free the coil lead at its distributor connection.
2. Release earthing cable from dash panel.
3. Isolate the throttle and choke controls at their carburettor connections.
4. Separate oil gauge flexible pipe from copper pipe on dash panel.
5. Unclip the hydraulic fluid container and pipe from the dash panel.
6. Remove clutch and brake pedal stalks.
7. Uncouple toeboard support bracket complete with solenoid after unclipping harness and oil pipe attached.
8. Remove steering wheel, steering plate and seal.
9. Withdraw reserve petrol rod on the left-hand side of the body. This applies to the Taxi only.
10. Detach petrol tank filler extension by releasing the standard hose clip from neck of tank.
11. Separate snap connectors to tail lamps at rear of chassis.
12. Remove rear bumpers from support brackets and support brackets from chassis.
13. Take out mats, floorboards, floorboard support section, toeboard, also trim pad attached to dash panel.

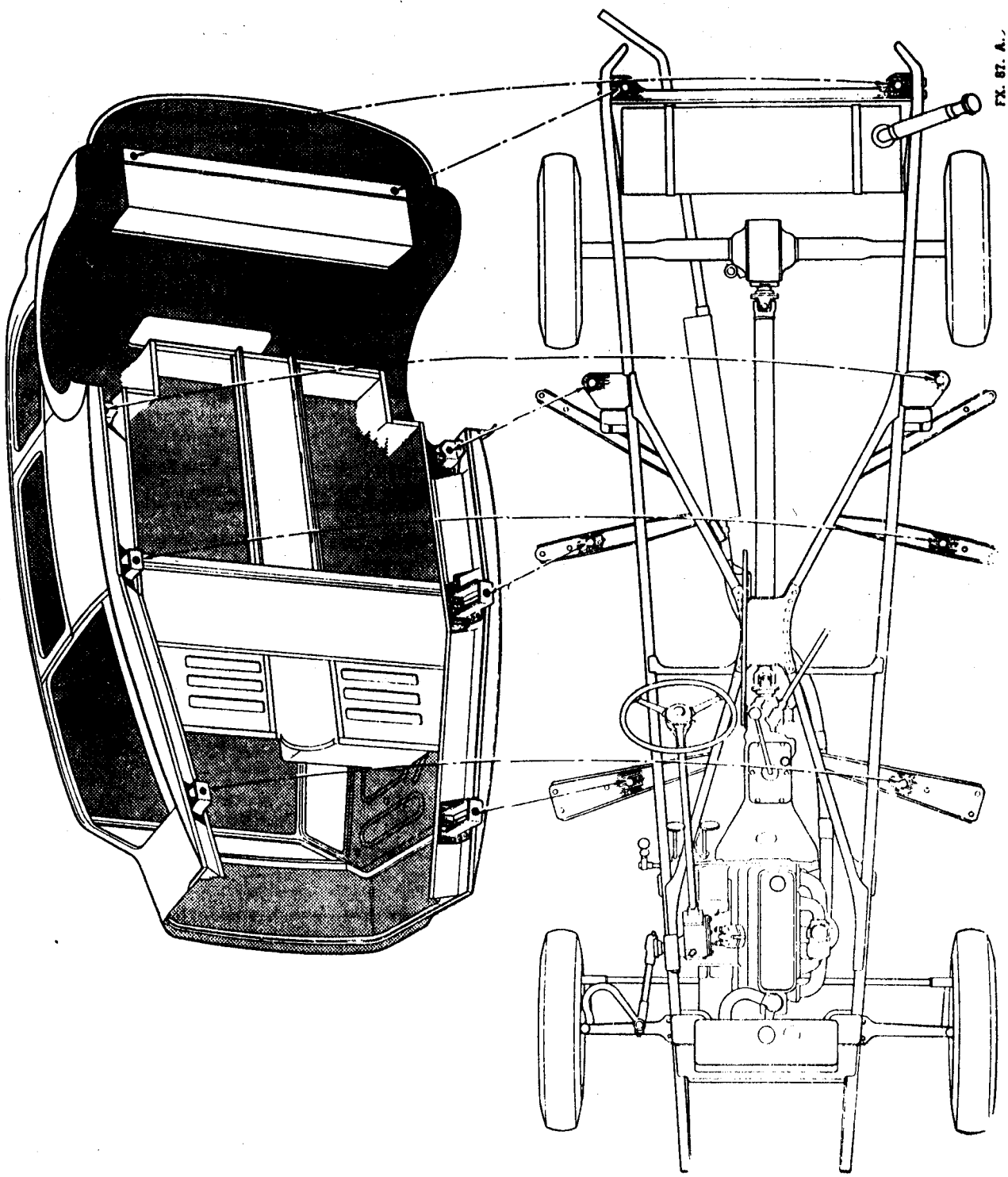


Fig. 15. Showing the body holding down brackets and their relation with the chassis fixing points.

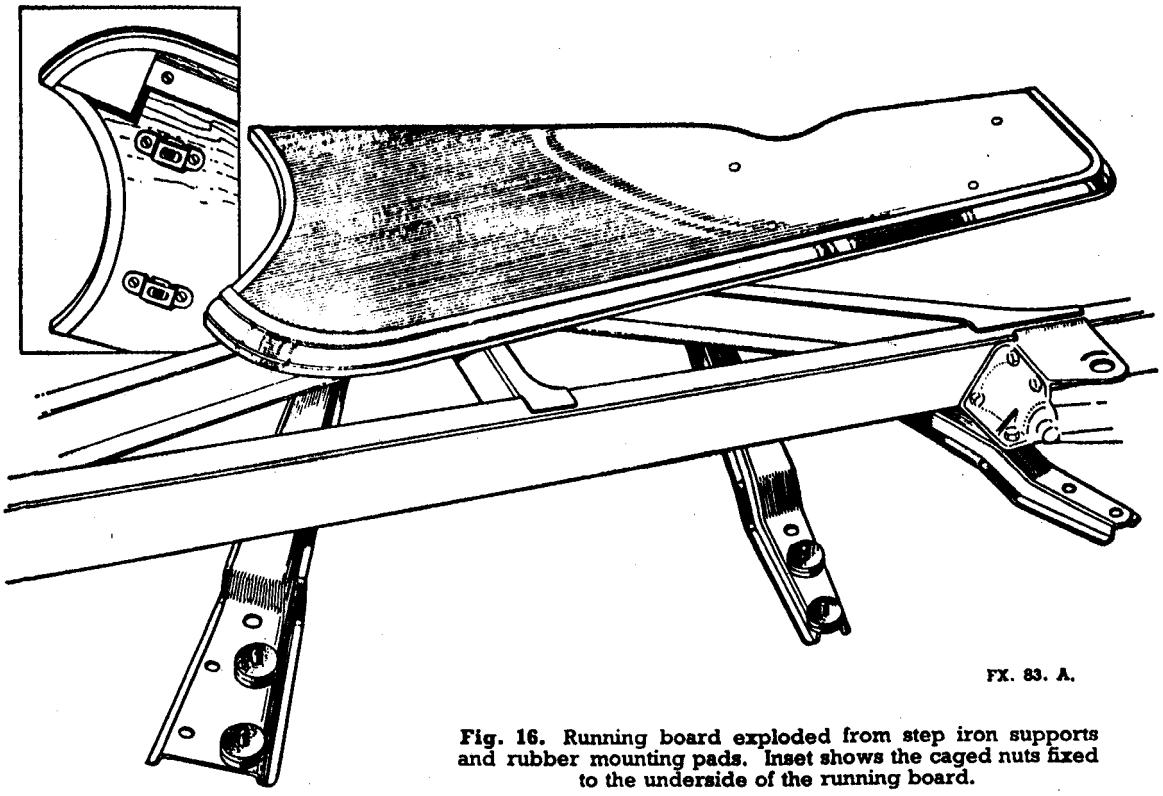


Fig. 16. Running board exploded from step iron supports and rubber mounting pads. Inset shows the caged nuts fixed to the underside of the running board.

14. Remove driver's seat, top and base. This applies to Taxi only.

15. Disconnect handbrake cable from operating arms. This applies to Hire Car only.

16. Disconnect oil gauge, speedometer, and detach cables from instruments on the instrument panel. Also electrical lead to wiper motor.

17. Remove instrument panel by unscrewing the three chromium plated screws and detaching the steering column support clip by removing the two ¼-in. B.S.F. set bolts.

18. Withdraw the eighteen $\frac{5}{16}$-in. B.S.F. bolts and nuts securing dash panel to scuttle mounting ring.

19. Remove eight mounting bolts and pads.

Note : When re-assembling body to chassis, it is important that the mounting pads be replaced in exactly the same position as previously fitted.

20. **Toolbox — Taxi**

The lid is taken from the toolbox by removing the six metal thread screws holding the hinges to the sill. The box itself is detached from the running boards by removing the six countersunk headed screws which pass into the fixed caged nuts on the underside of the running board.

21. **Running Boards**

Running boards may be removed by withdrawing the bolts holding the boards to the step irons.

22. The body may now be removed from the chassis as one complete unit, using a suitable sling which should lift rear of the body first. The dash panel must be carefully manoeuvred from the steering column as the body is carefully pulled rearward to clear the remaining controls.

BODY PANEL REPAIRS

To facilitate body repairs after collision or accidents, the following copy has been written to help the operator in his work.

Roof Lining

To completely dismantle the roof lining of the Taxi the following procedure is necessary:—

Unscrew side fillets at rear of quarterlight; these must be pulled forward to release the casing from the fixing clips. With the rear light frame having previously been removed, as already explained, the rear curtain can then be removed by extracting the screws securing them to the cantrail. The centre division roof filler is

then taken off, but in order to do this, the vent and switch escutcheon must be removed.

The roof lining itself is detached by removing the cover from the roof lights and disconnecting the leads. The listing rods can then be unscrewed from the cantrail and when the tacks are withdrawn the lining becomes completely divorced from the roof.

On the Hire Car, a similar procedure is observed excepting that the lining is carried forward into the front compartment necessitating the removal of additional fillets over the front doors and the top of the windscreen.

Centre Pillar — Hire Car

Should the centre pillar become damaged it can be removed in the following manner:—

Uncouple the trafficators and disconnect wiring. Remove division frame by extracting the screws. Withdraw the screws from the roof bracket holding the centre pillar. Remove harness and withdraw screws from cantrails and sill. Hacksaw through the support strip which is welded into the channel section of the centre pillar. Further screws are concealed beneath the cantrail facing panel from the front and rear doors.

These must be unpinned approximately halfway, thus allowing enough space for a screwdriver to be inserted in order to extract the screws which hold the tabs of the centre pillar to the cantrails.

The centre pillar then comes away as a single unit.

Centre Pillar — Taxi

A similar procedure is observed for the Taxi centre pillar removal as that detailed for the Hire Car, but the division being a steel section is removed as a unit by withdrawing the harness and cutting through top and bottom sections of the division.

The rear floor centre section must also be detached from the bottom channel of the division, thus enabling the division to be withdrawn as a complete unit.

Rear Quarter Panel

If at any time it is necessary to replace the rear quarter panel complete, due to excessive damage to the old one, it is essential to proceed as follows:—

With a blow-pipe remove the lead covering the vertical seam. Additional lead will be found covering the seam situated at the junction of the roof above the quarterlight.

The spotwelds are then drilled out from both the vertical and the roof seam. The welds are broken on the interior which hold the boot floor and rear seat support section to the wheelarches. The rocker is then detached from its fixing point on the sill.

Disconnect the cantrail at its appropriate joint first removing the facing panel. The quarterlight panel can then be detached complete with timber frame.

When separating the cantrail from the quarterlight framing it is necessary to prise open the joint to extract the two screws in the face and one situated at the end of the section. On replacement fresh screw positions can be made and the cantrails secured from the inner face of the quarterlight frame.

Rear Panel

The boot lid having been removed, the rear panel is detached by running the lead from the vertical seams as described previously and also the seam at the top of the rear panel where it joins the roof.

Spot-welds must be drilled out from the seams and also the bottom edge of the flange where it is spot-welded to the rear floor.

Generally, damage to the rear panel is confined to the lower half and often it is more convenient to cut away approximately half of the panel and replace with the bottom half of a new panel.

Scuttle Panel

To change a scuttle panel it is necessary to remove the complete assembly of the scuttle and screen angles, from the body as a unit. This is achieved by releasing the front edge of the roof panel from the header rail, unscrewing cantrail brackets and removing bolts from sill. The assembly can then be removed from the body.

To remove the scuttle itself, the flanges must be unpinned from the 'A' post fixings. It is then possible to manoeuvre the panel from the screen angle unit.

When replacing with a new scuttle panel, a small amount of leading will be necessary to complete the finish required.

Roof Panel

This panel is removed by unpinning, from the cantrails, the spot-welding joints having been released as previously described.

Drip Mould

The drip mould is removed by prising a portion away from the end of the body when the rest can be detached by exerting pressure with the hand.

When replacing a drip mould care must be taken in the pinning to the body so as not to cause dents, especially so when fixing to the quarterlight framing at rear of cantrails.

On closing the moulding to conceal pins, a block of wood approximately 8-in. in length should be used to allow an even application of pressure.

Boot Lid

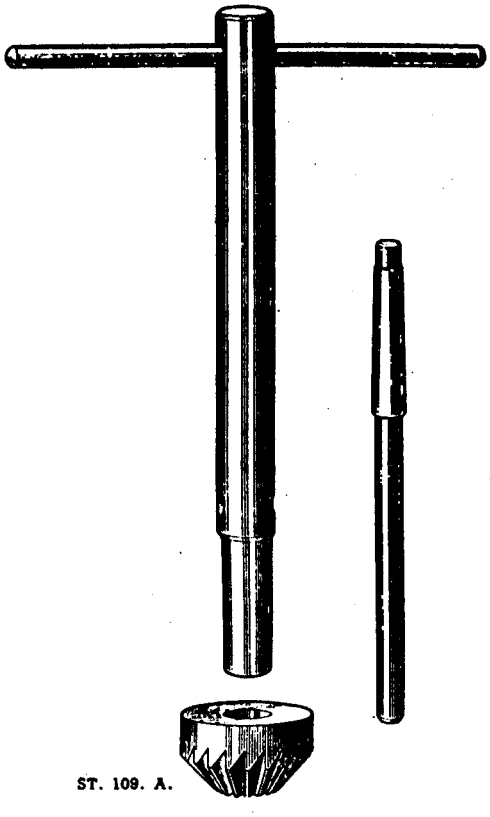
To remove the boot lid, disconnect the quadrant arm by extracting the ¼-in. B.S.F. setpins and removing nuts from hinge bolts.

On replacement, care must be taken to see that the quadrants do not bind on the boot lid interior panel, also when lightening the hinge nuts, even pressure is applied to prevent distortion of the outer panel.

SERVICE TOOLS

THE service tools listed in this section should be used for the various operations described in the text of the Manual. Service efficiency is entirely dependent on the correct use of the right tool for the work in hand.

ENGINE AND CLUTCH TOOLS

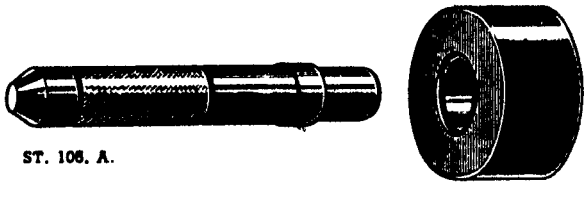


ST. 109. A.

Valve seat cutter: inlet, exhaust — **18G.28**

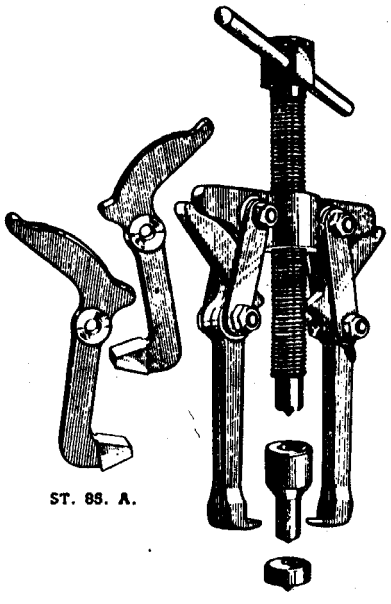
Pilot — **18G.174D**

Handle — **18G.27**



ST. 106. A.

Valve rocker bush drift — **18G.21**

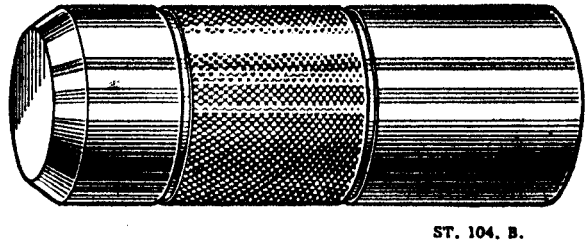


ST. 88. A.

Fan and dynamo pulley and crankshaft gear extractor — **18G.2**

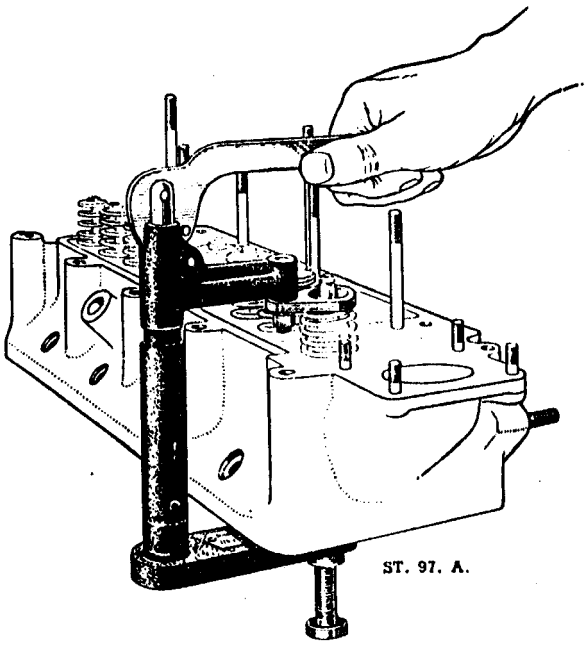
ST. 101. A.

Oil pump release valve grinding-in tool — **18G.69**

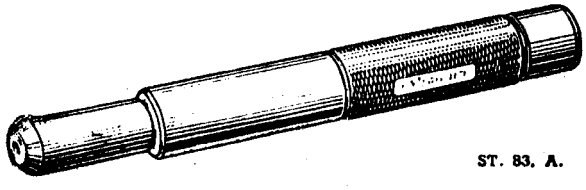


ST. 104. B.

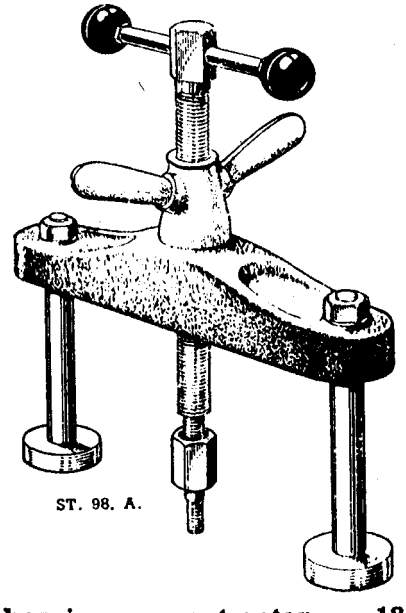
Crankshaft gear drift
Fan and dynamo pulley drift — **18G.16**



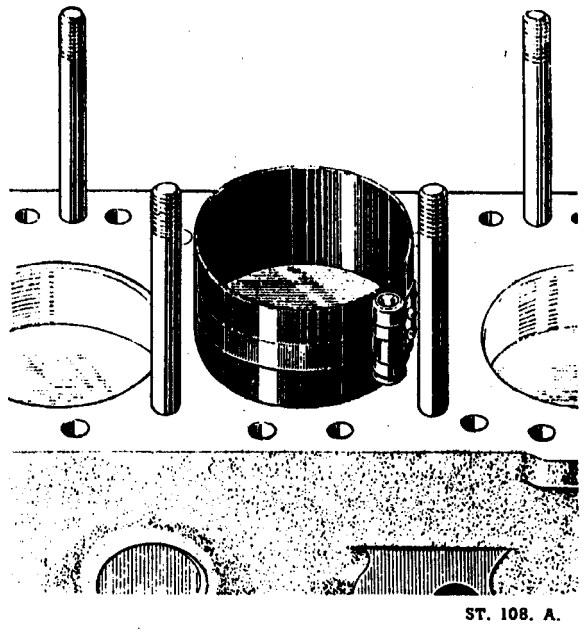
Valve spring compressor **18G.45**



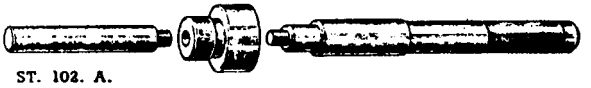
Dummy 1st motion shaft **18G.79**



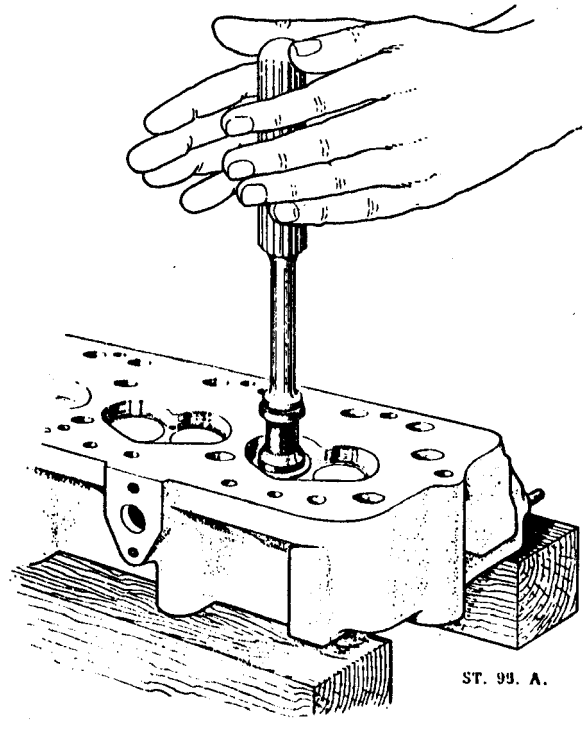
Main bearing cap extractor **18G.42A**
Adaptor **18G.42B**



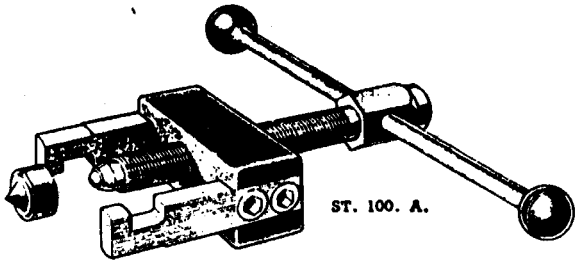
Piston ring clamp **18G.55A**



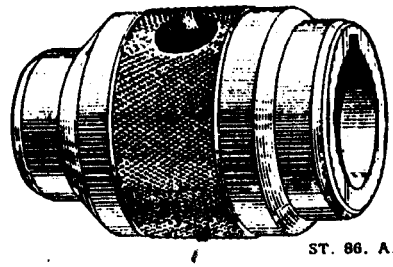
Water pump bearing drift **18G.61**



Valve grinding-in-tool **18G.29**

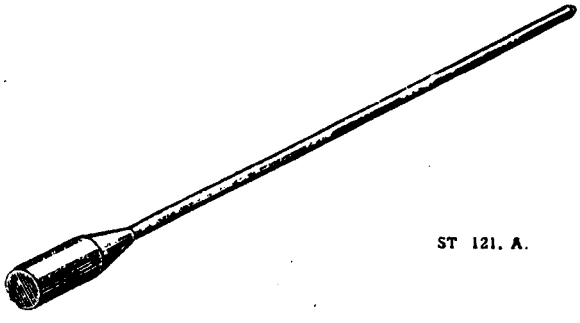


Camshaft gear extractor **18G.58**

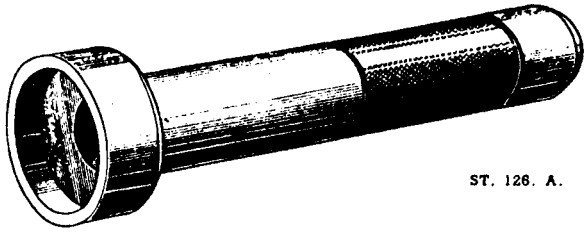


Front cover locating bush **18G.3**

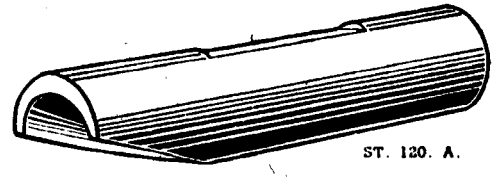
GEAR BOX TOOLS



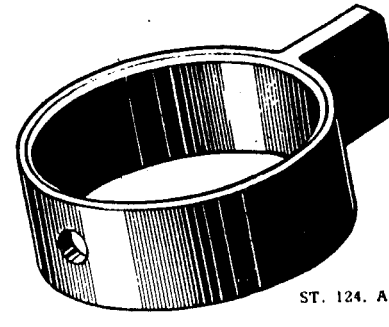
Dummy layshaft **18G.52**



First motion shaft assembly drift **18G.50**

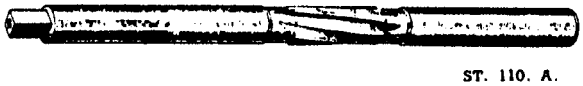


Selector rod guide **18G.53**

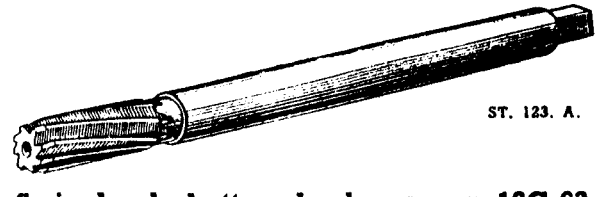


Synchromesh assembly tool **18G.86A**

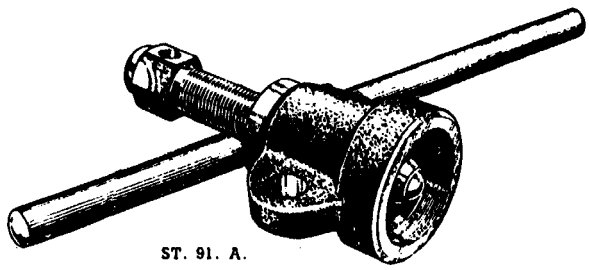
FRONT AXLE AND HUB TOOLS



Swivel axle top bush reamer **18G.62**

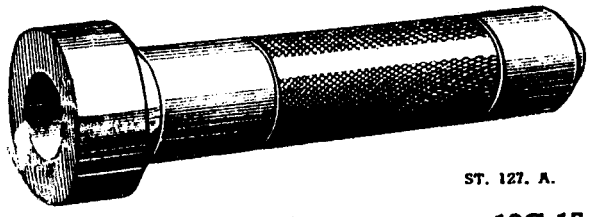


Swivel axle bottom bush reamer **18G.63**



ST. 91. A.

Front hub extractor **18G.8**

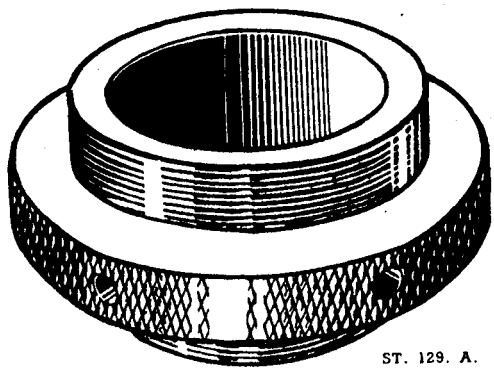


ST. 127. A.

Hub assembly drift **18G.15**

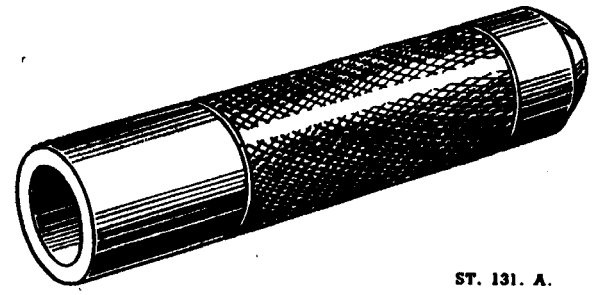
ST. 103. A.

Wrench for swivel axle bush reamer **18G.68**



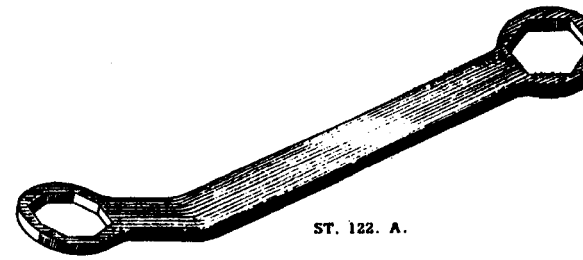
ST. 129. A.

Adaptor for 18G.8 (early models) **18G.8F**



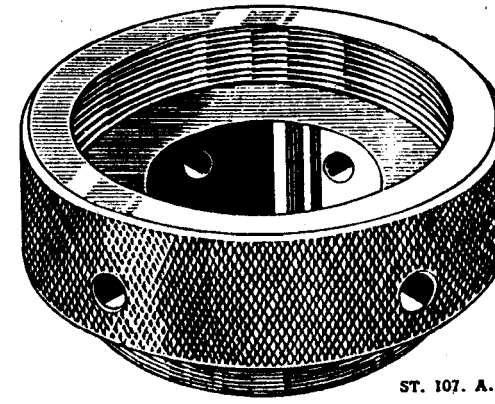
ST. 131. A.

Hub outer bearing drift **18G.7**



ST. 122. A.

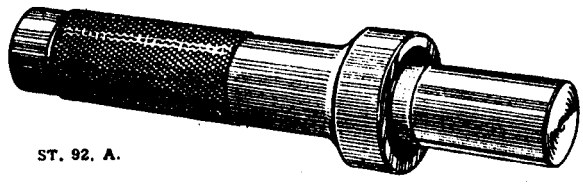
Front hub cap spanner **18G.49**



ST. 107. A.

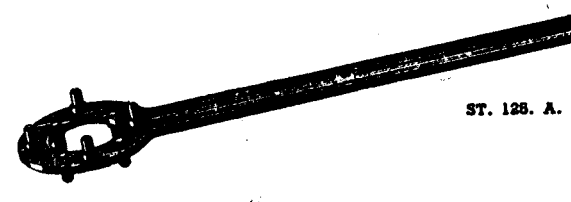
Adaptor for 18G.8 (later models) **18G.8C**

REAR AXLE TOOLS (Worm Axle)



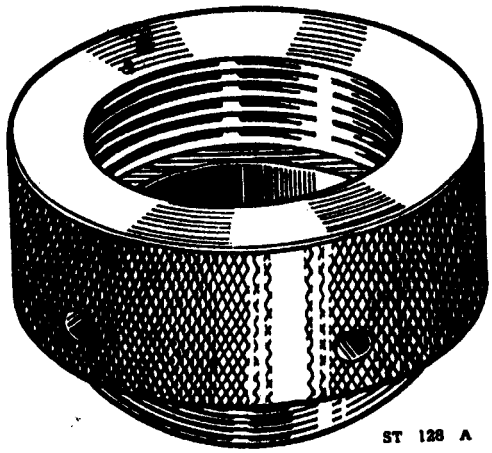
ST. 92. A.

Rear hub assembly and outer bearing drift **18G.13**



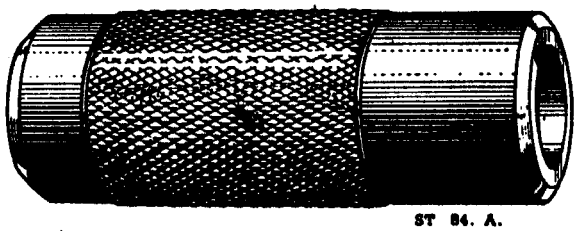
ST. 128. A.

Bevel pinion flange wrench
Propellor shaft flange wrench **18G.34A**



ST 128 A

Adaptor for 18G.8 **18G.8B**

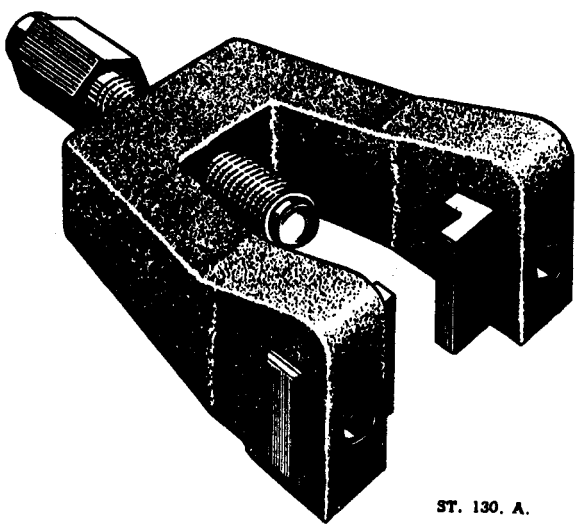


ST 84. A.

Bevel pinion flange drift **18G.1**

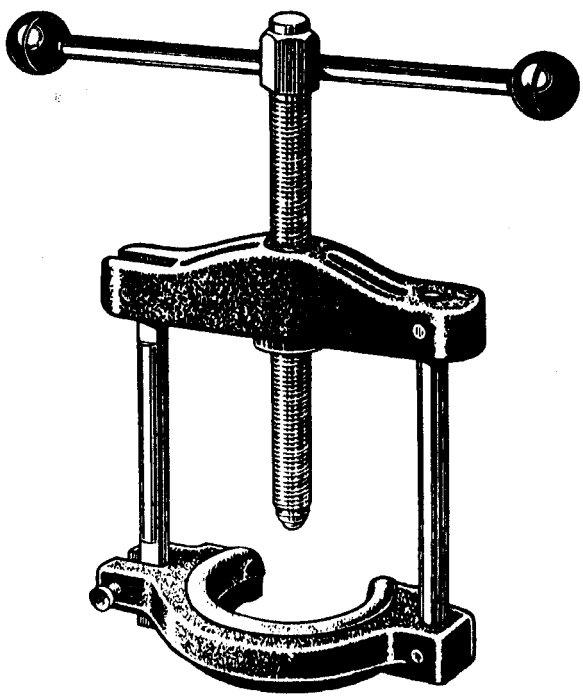
Bevel pinion flange extractor **18G.2**

STEERING AND CHASSIS TOOLS



ST. 130. A.

Steering arm extractor **18G.75**

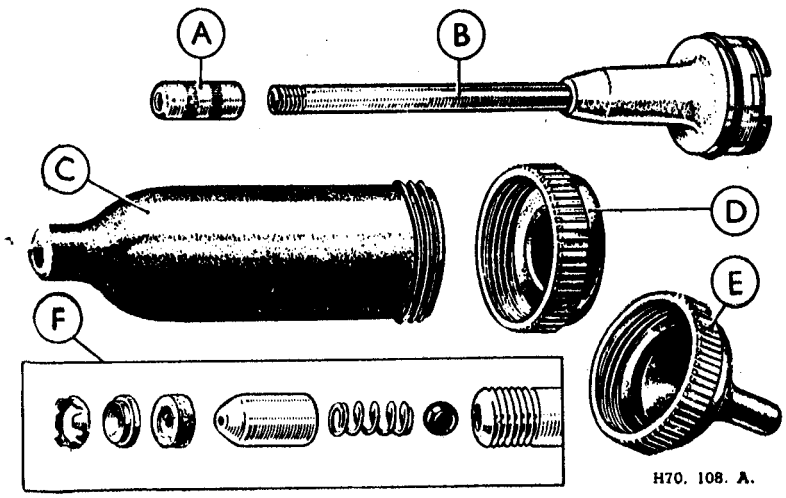


ST. 112. A.

Steering wheel puller **18G.70**

THE OIL GUN

THE gun, as supplied, is used for forcing lubricant through the nipples. Charge the gun by unscrewing the end cap and fill to its capacity.



H70. 108. A.

A. Oil gun nozzle.
B. Piston and telescopic ram.
C. Outer case.
D. End cap.
E. Adaptor.
F. Components of the nozzle.

Oiling Technique

Always make sure that the nipple on the chassis component about to be lubricated is clean before applying the gun. Push the gun body hard and repeat the strokes according to the amount of lubricant required in the component. Wherever possible, watch for old oil exuding from the component concerned, since this is proof that the new is being forced in. A nipple which refuses to pass oil should be removed and cleaned. This is best achieved by leaving the nipple to soak for a short time in paraffin.

Should difficulty be experienced in the operation of the gun it is probably due to air locks. This can be easily overcome by carrying out the following procedure:—Extend the steel cylinder as far as possible, fill the gun with the correct oil and replace the cap, hold the gun firmly in the left hand, unscrew the cap approximately two turns and then force the steel cylinder into the gun. This will force the oil to the top of the barrel and displace any air that may have been included in the filling process; the air can be heard distinctly coming out of the threads of the cap and when oil begins to emerge, the cap should then be tightened. After lubricating a point, it is most essential that the disconnecting process should be made with a sideway breaking movement and not pulled directly away; any attempt to disconnect it by pulling directly away will have a tendency to break the spring clip in the nozzle of the gun and at the same time to extend the cylinder, thereby sucking in air.

PART NAME ALTERNATIVES

	AUSTIN PART NAME	ALTERNATIVES
ENGINE	Gudgeon Pin ..	Piston Pin. Small End Pin. Wrist Pin
	Scraper Ring	Oil Control Ring
	Welch Plug	Expansion Plug. Core Plug. Sealing Disc
	Oil Sump	Oil Pan. Oil Reservoir
CONTROLS ..	Choke	Strangler. Easy Starting Device
GEARBOX ..	Gear Lever	Shift Lever
	Change Speed Fork	Shift Fork. Selector Fork
	First Motion Shaft ..	Clutch Shaft. First Reduction Pinion. Main Drive Pinion
	Layshaft	Counter Shaft
AXLE	Crown Wheel ..	Ring Gear. Spiral Drive Gear
	Bevel Pinion	Small Pinion. Spiral Drive Pinion
	Spring Clips	'U' Bolts
	Axle Shaft	Half Shaft. Hub Driving Shaft. Jack Driving Shaft
STEERING ..	Swivel Pin	Pivot Pin. Steering Pin. King Pin
	Swivel Axle	Stub Axle
	Cross Tube	Tie Rod. Track Rod
	Side Tube	Drag Link. Steering Connecting Rod
	Steering Arm ..	Drop Arm
ELECTRICAL ..	Dynamo	Generator
	Voltage Regulator ..	Control Board. Cut Out. Voltage Controller
EXHAUST	Silencer	Muffler
BODY	Bonnet	Hood
	Mudguard	Fender

SERVICE FACILITIES

THE following are the official addresses of the Austin Motor Company Limited and their Subsidiary Companies overseas, to whom all Service correspondence in those areas should be addressed. In all instances the enquirer is asked, first of all, to contact his nearest appointed Austin Distributor or Dealer before writing to one of the following addresses:

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Birmingham 31

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Telegrams: SPEEDILY, NORTHFIELD
Cables: SPEEDILY, BIRMINGHAM

London

THE AUSTIN MOTOR COMPANY LTD
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London, W.11

Telephone: PARK 8001
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THE AUSTIN MOTOR COMPANY LTD (ENGLAND)
Central Parts Division,
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Telephone: CYpress 8-4500
Telegrams: AUSTINMOTO, NEW YORK

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THE AUSTIN MOTOR COMPANY (CANADA) LTD
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Hamilton, Ontario

Telephone: HAMILTON 4-2816
Telegrams: AUSTINETTE, HAMILTON

Australia

THE AUSTIN MOTOR COMPANY (AUSTRALIA) LTD
109 Dudley Street,
West Melbourne,
Victoria

Telephone: FJ 1131
Telegrams: AUSTINETTE, MELBOURNE

The Austin Motor Co. Ltd., wish to make acknowledgement to:
Messrs. A. C. Sphinx Sparking Plug Co., Ltd.; Armstrong Patents Co., Ltd. ; Borg & Beck Co., Ltd. ; Champion Sparking Plug Co., Ltd. ; Dunlop Rubber Co., Ltd. ; Girling Ltd. ; Hardy Spicer & Co., Ltd. ; Joseph Lucas & Co., Ltd. ; Opperman Ltd. ; Smith's Motor Accessories Ltd. ; Zenith Carburetter Co., Ltd. ; for their assistance in furnishing information and illustrations tor this manual where required.

RECOMMENDED LUBRICANTS—HOME AND OVERSEAS

		Mobil	Shell	Filtrate	Castrol	Esso	BP Energol	Duckham's	Sternol
Engine	Above 32° F. (0° C.)	Mobiloil A	Shell X—100 30	Medium Filtrate 30	Castrol XL	Esso Extra Motor Oil 20W/30	Energol S.A.E. 30	Duckham's NOL Thirty	Sternol W.W. 30
	32° F. Down to 10° F. (0° to—12° C.)	Mobiloil Arctic	Shell X—100 20/20W	Zero Filtrate 20	Castrolite	Esso Extra Motor Oil 20W/30	Energol S.A.E. 20W	Duckham's NOL Twenty	Sternol W.W. 20
	Below 10° F. (—12° C.)	Mobiloil 10W	Shell X—100 10W	Sub-Zero Filtrate 10W	Castrol Z	Esso Motor Oil 10	Energol S.A.E. 10W	Duckham's NOL Ten	Sternol W.W. 10
Gearbox		Moboilil A	Shell X—100 30	Medium Filtrate 30	Castrol XL	Esso Extra Motor Oil 20W/30	Energol S.A.E. 30	Duckham's NOL Thirty	Sternol W.W. 30
Hypoid Axle and Steering Box		Mobilube G.X. 90	Shell Spirax 90 E.P.	Hypoid Filtrate Gear 90	Castrol Hypoy	Esso Expee Compound 90	Energol E.P. S.A.E. 90	Duckham's Hypoid 90	Ambroleum E.P. 90
Worm Axle		Mobilube C	Shell Spirax 140 E.P.		Castrol D	Esso Gear Oil 140 (Heavy)	Energol S.A.E. 140	Duckham's N.2	
Oil Nipples		Mobilube G.X. 140 or Mobilgrease M.P.	Shell Spirax 140 E.P. or Retinax A	Super Lithium Filtrate Grease or E.P. Filtrate Gear 140	Castrol Hi-Press or Castrolease L.M.	Esso Expee Compound 140 or Esso Multi-purpose Grease	Energol E.P. S.A.E. 140 or Energrease L.2	Duckham's NOL E.P. 140 or Duckham's L.B. 10 Grease	Ambroline L.H.T. Grease or Ambroleum E.P. 140
Front Wheel Hubs		Mobilgrease M.P.	Shell Retinax A	Super Lithium Filtrate Grease	Castrolease L.M.	Esso Multipurpose Grease H	Energrease L.2	Duckham's L.B. 10 Grease	Ambroline L.H.T.
Distributor and Oilcan ..		Mobiloil Arctic	Shell X—100 20/20W	Zero Filtrate 20	Castrolite	Extra Motor Oil 20W/30	Energol S.A.E. 20W	Duckham's NOL Twenty	Sternol W.W. 20
Upper Cylinder Lubrication		Mobil Upperlube	Shell Upper Cylinder Lubricant	Filtrate Petroyle	Castrollo	Esso Upper Cylinder Lubricant	Energol U.C.L.	Duckham's Adcoid Liquid	Sternol Magikoyl

Hypoid Axle and Steering Box: For temperatures below 10° F. (—12° C.) use S.A.E. 80 Hypoid Lubricant.

Hydraulic Brakes and Clutch: Use Girling Brake and Clutch Fluid (Crimson) only.

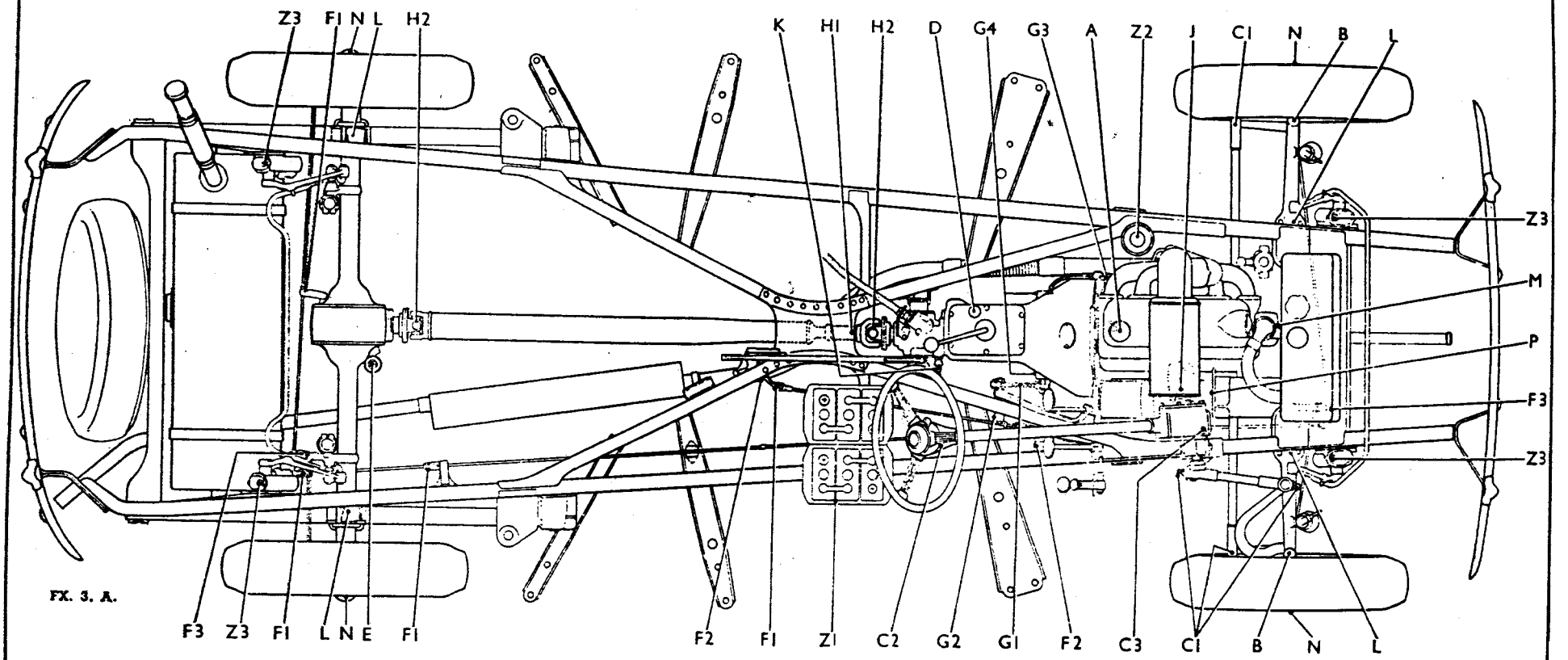
Piston-type Shock Absorbers: Use Armstrong's Super (Thin) Shock Absorber Fluid.

Jacking System: Use Smith's "Red Jackall" Fluid.

MULTIGRADE OILS

In addition to the recommended lubricants listed in the Manual, we approve the use of these new motor oils, as produced by the oil companies shown in our Manuals, for all climatic temperatures unless the engine is old and in poor mechanical condition. Some are more expensive than the recommended motor oils because of their special properties and greater fluidity at low temperatures.

AUSTIN TAXI & HIRE CAR LUBRICATION CHART



FX. 3. A.

WEEKLY OR EVERY 500 MILES

Oil	A	Top-up Engine Crankcase.
Oil Gun	B	Swivel Axles (4).
	C1	Steering Connections (4).

MONTHLY OR EVERY 2,000 MILES

Oil	D	Top-up Gearbox.
	E	Top-up Rear Axle.
Oil Can	C2	Steering Column Bearing.
	F1	Brake Rod Linkages.
	G1	Clutch Pedal Linkages.
Oil Gun	F2	Brake Pedal Shafts (2).
	F3	Brake Balance Levers (2).
	G2	Clutch Pedal Shaft (1).
	H1	Propeller Shaft Sliding Spline (1).
Examine	Z1	Battery Electrolyte.
	Z2	Hydraulic Jack Supply Tank.

OCCASIONALLY

Oil	C3	Top-up Steering Gear (5,000 miles).
Oil Can	J	Distributor Shaft Bearings and Timing (3,000 miles).
Oil Gun	G3	Clutch Thrust Bearing (1).
	K	Speedometer Cable (5,000 miles).
	L	Road Springs (4) (5,000 miles).
	M	Water Pump Bearings (1) (5,000 miles)
Grease	H2	Propeller Shaft Bearings (2) (10,000 miles).
	G4	Clutch Cross Shaft (2) (10,000 miles).
	N	Hubs, Front (5,000 miles), Rear (10,000 miles).
	P	Dynamo Bearings—H.M.P. Grease (10,000 miles).
Examine	Z3	Shock Absorber Fluid Level.

BMC

2.2 LITRE

HIGH SPEED DIESEL ENGINE

Supplement

GENERAL INDEX

COOLING SYSTEM	SECTION	D
ELECTRICAL SYSTEM	,,	J
SERVICE OPERATIONS	,,	H
FAULT DIAGNOSIS	,,	K
FUEL INJECTION SYSTEM	,,	G
GENERAL DESCRIPTION	,,	B
LUBRICATION	,,	E
OPERATION	,,	F
REGULAR ATTENTIONS	,,	C
TECHNICAL DATA	,,	A

TECHNICAL DATA

General

Cubic Capacity	2.2 litres (2178 cc.) (132.7 cu. ins.)
Number of Cylinders	4
Valves	Overhead, Push Rod operated
Valve clearances	.012 in. hot or cold
Bore	3.25 ins. (82.6 mm.)
Stroke	4 ins. (101.6 mm.)
B.H.P. (maximum)	55 at 3,500 r.p.m.
Torque (maximum)	89 ft. lbs. at 2,750 r.p.m.
Compression Ratio	20 to 1
B.M.E.P. (maximum)	101 lbs. per sq. in. (7.1 kg./cm.^{2}) at 2,750 r.p.m.
Type of Combustion Chamber	Ricardo-Comet III.

Pistons

Material	Aluminium
Up to Engine No. 1BD234677	
Piston clearance at bottom of skirt	$\frac{.00403''}{.00463''}$ ($\frac{.1024}{.1176}$ mm.)
Width of ring groove:—	
Compression	$\frac{3}{32}''+\frac{.002''}{.001''}$ ($2.38+\frac{.05}{.025}$ mm.)
Oil Control	$\frac{3}{16}''+\frac{.002''}{.001''}$ ($4.76+\frac{.05}{.025}$ mm.)
Compression rings:—	
1st groove	Plain
2nd and 3rd groove	Internally Stepped
Oil Control:—	
4th and 5th grooves	Slotted Scraper
Ring Width:—	
Compression	.0928″ to .0938″ (2.367 to 2.383 mm.)
Oil Control	.1865″ to .1875″ (4.737 to 4.763 mm.)
Ring Gap	.009″ to .014″ (.23 to .35 mm.)
For engine numbers after 1BD234677	
Piston clearance at bottom of skirt	$\frac{.0040''}{.0046''}$ ($\frac{.1016}{.1168}$ mm.)
Width of ring grooves:—	
1st Compression	$\frac{3}{32}''+\frac{.0035''}{.0045''}$ ($2.38+\frac{.088}{.131}$ mm.)
2nd and 3rd Compression	$\frac{3}{32}''+\frac{.0025''}{.0035''}$ ($2.38+\frac{.063}{.088}$ mm.)
Oil control	$\frac{3}{16}''+\frac{.0015''}{.0025''}$ ($4.76+\frac{.038}{.063}$ mm.)
Compression rings:—	
1st groove	Parallel compression Chrome faced
2nd groove	Parallel compression
3rd groove	Taper faced Compression
Oil Control:—	
4th and 5th grooves	Slotted Scraper
Ring Width:—	
Compression	$\frac{3}{32}''$ (2.38 mm.)
Oil Control	$\frac{3}{16}''$ (4.76 mm.)
Ring Gap	.009″ to .014″ (.228 to .356 mm.

Gudgeon Pin

Type	Floating in Piston
Fit	.0003″ to .0005″ (.0076 mm. to .0127 mm.)
Length	$70.4 \begin{smallmatrix} 0 \text{ mm.} \\ +\ -.25 \text{ mm.} \end{smallmatrix}$
Diameter	$1\frac{1}{8}$″ (28.574 mm.)

Crankshaft

Material	Forged Steel
Diameter of main journals	2.4780″ to 2.4785″ (62.941 mm. to 62.954 mm.)
Diameter of crankpins	2.2480″ to 2.2485″ (57.099 mm. to 57.112 mm.)
Crankshaft end float	.002″ to .003″ (.051 mm. to .076 mm.)
Main journal clearance	.002″ to .0035″ (.051 mm. to .089 mm.)
Main Journal Bearings	(top) Steel Backed, White Metal Lined (bottom) „ „ Lead Indium Lined

Connecting Rods

Material	Forged Steel
Length (centre to centre)	7.999″ to 8.001″ (20.217 cm. to 20.323 cm.)
Big end housing diameter	2.395″ to 2.395$\frac{1}{2}$″ (60.833 mm. to 60.846 mm.)
Side Clearance	.0085″ to .0125″ (.216 mm. to .3175 mm.)
Big-end clearance	.002″ to .0035″ (.0127 mm. to .0444 mm.)

Big End Bearing

Type	(Top) Thin Wall, Steel Backed, Lead Indium (Bottom) Thin Wall, Steel Backed, White Metal
Overall length	.995″ to 1.005″ (25.273 mm. to 25.527 mm.)
Inside Diameter	2.2515″ (57.188 mm.)
Thickness	.072″ to .072$\frac{1}{4}$″ (1.829 mm. to 1.835 mm.)

Camshaft

Material	Forged Steel
Journal Diameters:—	
Front	1.788$\frac{3}{4}$″ to 1.7892″ (45.434 mm. to 45.446 mm.)
Centre	1.748$\frac{3}{4}$″ to 1.749$\frac{1}{4}$″ (44.418 mm. to 44.431 mm.)
Rear	1.622$\frac{3}{4}$″ to 1.623$\frac{1}{4}$″ (41.218 mm. to 41.221 mm.)
Bearing Clearance (all three)	.001″ to .002″ (.025 mm. to .051 mm.)
End Float	.003″ to .006″ (.076 mm. to .152 mm.)
End Thrust taken on	Locating Plate
Drive	Triple Chain

Camshaft Bearings

Type	White Metal
Number	3

Valves

Material—Inlet	E.N 52 Steel
Exhaust	E.N 59 Steel
Head diameter:—	
Inlet	1.605″ to 1.610″ (40.77 mm. to 40.89 mm.)
Exhaust	1.3215″ to 1.3265″ (33.566 mm. to 33.693 mm.)
Seat Angle:	
Inlet and Exhaust	45°
Valve Clearance (Hot)	.012″ (.305 mm.)

Timing

Inlet Opens	5° B.T.D.C.
Inlet Closes	40° A.B.D.C.
Exhaust Opens	60° B.B.D.C.
Exhaust Closes	5° A.T.D.C.
Valve Clearance for Timing	.021″ (.53 mm.)

Valve Guides

Length:	
Inlet	$2\frac{9}{64}$″ (54.37 mm.)
Exhaust	$2\frac{1}{2}$″ (63.499 mm.)
Outside Diameter:	
Inlet and Exhaust	.5635″ to .5640″ (14.313 mm. to 14.326 mm.)
Inside Diameter:	
Inlet	.337″ to .338″ (8.56 mm. to 8.58 mm.)
Exhaust	.3433 to .3438″ (8.72 mm. to 8.73 mm.)
Height above Valve Spring Seat	$\frac{3}{4}''^{+0}_{-\frac{1}{64}''}$ ($19.05^{+0}_{-.4}$ mm.)

Valve Springs (up to Engine No. 1BD223665)

Free length	$2\frac{11}{64}$″ (29.76 mm.)
Fitted length and load	$1\frac{21}{32}$″ at 65 lbs.±2 lbs. (16.67 mm. at 29.5 kg.±.91 kg.)
Number of Working Coils	$4\frac{1}{2}$
Diameter of Wire	.0176 (4.47 mm.)
Core Diameter	1.125″ to 1.140″ (28.57 mm. to 28.95 mm.)

Double Valve Springs (as from Engine No. BD223666)

Outer Spring

Free length	$2\frac{1}{2}$″ (62.5 mm.)
Fitted length and load	$1\frac{45}{64}$″ at 58.5 lbs.±2 lbs. (43.26 mm. at 28.57 kg.±.91 kg.)
Number of Working Coils	$5\frac{1}{2}$
Diameter of Wire	$\frac{5}{32}$″ (3.969 mm.)
Core Diameter	1.125″ to 1.140″ (28.57 mm. to 28.95 mm.)

Inner Spring

Free Length	$2\frac{3}{16}$″ (55.56 mm.)
Fitted Length and Load	$1\frac{1}{2}$″ at 24 lbs.±1 lb. (38.1 mm. at 10.89 kg.±.45 kg.)
Number of Working Coils	$7\frac{1}{2}$
Diameter of Wire	.104″ (2.641 mm.)
Core Diameter	.750″ to .765″ (19.05 mm. to 19.43 mm.)

Flywheel

Material	Cast Iron
Diameter	$12\frac{7}{8}$″ (32.7 cm.)

Lubrication

Oil pump:	
Type	Eccentric rotor
Oil pressure:	
Idling speed (550 r.p.m.)	15 lb. per sq. in. (1.05 kg./cm.²)
Normal speed (30 m.p.h.) (48 k.p.h. or 2,000 r.p.m. in Top Gear)	45 to 50 lb. per sq. in. (3.1 to 3.5 kg./cm.²)
Oil filter:	
Type	Tecalemit—Felt Element
Oil Capacity	$1\frac{1}{4}$ Pints (.60 litres)
Oil Capacity of engine	10 pints (5.68 litres)
Total Oil Capacity	$11\frac{1}{4}$ Pints (6.38 litres)

Cooling System

Circulation	Pump
Capacity (Engine only)	9 Pints (5.112 litres)
Thermostat:	
Opening temperature	158°F. (70°C.)
Fully open temperature	167°F. (75°C.)

Fuel Injection System

Lift Pump	AC Mechanical
Injection Pump	C.A.V.
Type	B.P.E.4A65.S210S6355EL
Injection order	1.3.4.2
Static Injection timing	28° B.T.D.C. at spill cut-off
Injection opening pressure	115 Atmospheres
Venturi control unit	C.A.V.
Type	42 mm.
Injectors	C.A.V.
Type	Ricardo Pintaux B.D.N.12SP6A
Nozzle holders	C.A.V.
Type	B.K.B.35S668
Governor	C.A.V.
Type	B.E.P./M.Z.80A131 (Later Engines B.E.P./A.M.Z.80A131)
Main filter	C.A.V.
Type	F.2/9

Electrical System

Dynamo	Lucas
Type	12 Volt, C.45PV5 (Later Models C.39PV2)
Starter motor	Lucas 12 Volt
(Early Models) Type	M45G
Lock Torque	29 lbs. ft. (4 m/kg.)
Current Amps.	930
Terminal Voltage	5.2
Torque at 1,000 r.p.m.	13.5 lbs. ft. (1.86 m/kg.)
Current Amps.	510
Terminal Voltage	8

Adjusting shims for the Starter Clutch are supplied in thicknesses of .006", .005", and .004" (.152, .127 and .101 mm.)

(Later Models) Type	M45G with Self-Indexing Drive
Lock Torque	32.5 lbs. ft. (4.49 Kg.m.)
Current Amps.	900
Terminal Voltage	6.4
Torque at 1,000 r.p.m.	15.5 lbs. ft. (2.14 Kg.m.)
Current Amps.	570
Terminal Voltage	8.8
Heater Plugs	Lodge, Type DD2/2 (After Engine No. 226988 Lodge DD2/3)

Torque Wrench Settings

Cylinder Head nuts	75 lbs./ft. (10.35 m/kg.)
Main Bearing studs	80 lbs./ft. (11.04 m/kg.)
Big End nuts	50 lbs./ft. (6.9 m/kg.)
Flywheel bolts	50 lbs./ft. (6.9 m/kg.)

GENERAL DESCRIPTION

SERVICE JOURNAL REFERENCE

NUMBER	DATE	SUBJECT	CHANGES

GENERAL DESCRIPTION

General

The B.M.C., 2.2 litre Diesel engines are of the indirect injection type, with four cylinders having a bore of 3.25 ins. (82.6 mm.), and a stroke of 4 ins. (101.6 mm.) with a compression ratio of 20 : 1.

Cylinder Block

The cylinder block and crankcase is a one piece casting in high quality cast iron, ensuring maximum rigidity and strength. It carries flanged cylinder liners of the dry type which are easily renewable. Full length water jackets are provided around the liners so that even cylinder temperatures, and high wear resistance is assured.

Cylinder Head

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.

Camshaft

The forged steel camshaft is mounted in the left-hand side of the cylinder block, and supported by three white metal bearings. The cam profiles are designed to prevent surge and to give quiet operation of the valve gear. A jockey type, oil fed, timing chain tensioner is fitted.

The timing chain is of the triple roller type and drives the fuel injection pump and lift-pump.

Crankshaft

The forged steel, counterbalanced crankshaft is supported by three main bearings.

Main Bearings

The three main bearings are of the "Thinwall" type, and are of generous dimensions to give adequate bearing surfaces in order to withstand the considerable loads experienced in Diesel engines. The top halves of the bearings are steel-backed white metal, and the bottom halves of steel-backed lead indium.

Crankshaft thrust washers, of white metal, are fitted on each side of the centre main bearing. Each main bearing cap is secured in position by large diameter high tensile studs and split-pinned castellated nuts.

Connecting Rods

These are of "H" section, forged steel, employing big-end bearings of the "thinwall" type. The top halves of the bearings are of steel-backed lead indium and the bottom halves, steel-backed white metal.

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.

Pistons

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

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

Valves

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.

Lubrication

The lubrication system is high pressure, forced feed throughout the engine. The eccentric rotor type pump is driven from the camshaft.

Oil is delivered to a gallery in the crankcase and from this point, to the main, big-end, and camshaft bearings at a running pressure of approx. 50 lbs./sq. in. (3.5 kgm./cm^2).

Jet lubrication is provided, via oil holes in the big-ends of the connecting rods, to the cylinder walls. The rocker gear is supplied with oil from the camshaft rear bearing, and the timing chain with its tensioner, from the front main bearing.

A full-flow oil filter is mounted on the side of the crankcase and there are no external oil pipes or connections. The oil filler is located on the valve rocker cover, and a breather is connected to the air cleaner.

The oil reservoir capacity is 10 pints (5.68 litres), plus $1\frac{1}{4}$ pints (.60 litre) for the oil filter. Total capacity $11\frac{1}{4}$ pints (6.38 litres).

Injection Pump and Fuel System

The C.A.V. fuel injection pump is flange mounted, and incorporates a pneumatic governor unit, and an excess fuel device, which is hand operated for cold starting. The pump drive is via the triple roller timing chain.

A cable operated engine stop lever is fitted.

The fuel lift pump is an AC mechanical type, and is driven 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.

Inlet and Exhaust Manifolds

The inlet manifold is of aluminium alloy and carries the venturi unit which contains a spindle for the butterfly throttle control connections. Cast-iron is used for the exhaust manifold and both are mounted on the same side of the cylinder head.

Air Cleaner and Silencer

The air cleaner/silencer is mounted adjacent to the valve rocker cover and is connected to the venturi unit, A breather pipe is taken to the valve rocker cover. An oil bath air cleaner may be fitted to export engines.

Cooling System

Water circulation is by a centrifugal type pump which is belt driven and mounted on the front of the cylinder block. A carbon faced, moulded rubber seal is fitted to the pump.

The cooling water is delivered to a gallery in the cylinder block, and thence through jet holes to the valve seats and cylinders.

A two or four bladed fan may be fitted. The cooling system is controlled by a thermostat in the cylinder head via inbuilt by-pass passages.

Dynamo

A Lucas 12 volt, Type C45/PV5, fan ventilated, belt driven dynamo is fitted.

Starter

Lucas; Type M.45.G. with a lever engaged pinion, operated by a cable from the instrument panel of the vehicle.

Heater Plugs

Lodge: Type DD.2/3 heater plugs are fitted, in series with a resistor.

REGULAR ATTENTIONS

SERVICE JOURNAL REFERENCE

NUMBER	DATE	SUBJECT	CHANGES

REGULAR ATTENTIONS

General

The following regular attentions must be observed in order to keep the engine in good condition so that long and trouble free service may be obtained. Cleanliness is the foundation of all good servicing, and the engine should at all times be kept in a thoroughly clean condition.

The prevention of damage starts with the driver. He should be in a position to clean, inspect, adjust and lubricate the engine, making a report of those defects beyond his capabilities so that they may be corrected by the workshops or an authorised dealer as quickly as possible. The making of a report by the driver when taking the engine in for attention will save time.

Extreme climate or operating conditions may necessitate more frequent attentions than those given, and it must be left to the discretion of the operator to vary these intervals to suit local requirements.

During the early life of an engine the working parts settle down, with the result that various clearances and adjustments have to be corrected. When the engine has covered 500 miles, (800 km.) or 25 hours running, it is recommended that the following operations be carried out, if necessary by an agent.

1. Check and tighten the cylinder head nuts.
2. Check and adjust the valve and rocker clearances.
3. Check and tighten the manifold nuts.
4. Check the vacuum pipe unions.
5. Check and tighten the valve rocker bracket bolts.
6. Check and adjust the accelerator linkage to the venturi for free action and full opening.
7. Check and adjust the fan belt tension.
8. Check all water connections.
9. Drain and refill the engine sump with new oil.
10. Drain and clean the engine oil filter, and fit new element.
11. Lubricate the accelerator linkage.
12. Lubricate the water pump bearings.
13. Check all fuel line connections for tightness.

Note.—Change the engine oil filter again at 2,000 miles after the initial attention above, and thereafter observe the normal period of 3,000 miles.

DAILY

Check the oil level in the sump and top up if necessary.
Check the fuel level in the tank and fill up if necessary.

EVERY 1,000 MILES

(1500 km.) or 50 hours

Lubricate the water pump bearings.
Oil the accelerator linkage.

EVERY 2,000 MILES

(3000 km.), or 100 hours

Clean the fuel lift pump filter.

EVERY 3,000 MILES

(5000 km.), or 150 hours

Drain the engine sump and refill with fresh oil.
Check and adjust the fan belt tension.

EVERY 6,000 MILES

(10000 km.), or 300 hours

*Check and adjust the valve and rocker clearances.

EVERY 7,000 MILES

(12000 km.), or 350 hours

Renew the external oil filter element.

EVERY 10,000 MILES

(16000 km.), or 450 hours

*Drain and clean the engine sump, refill with fresh oil.
*Remove and test the injectors for spray.
†Renew the fuel filter element.

EVERY 12,000 MILES

(20000 km.), or 600 hours

Lubricate the dynamo.

AS REQUIRED

Flush out the cooling system.
Decarbonise, and grind in the valves.
Adjust the idling speed.
Bleed the fuel system.

*These operations should be dealt with by special arrangement and carried out in the workshops.

†This must be done earlier if signs of fuel starvation, indicating a clogged filter, appear.

COOLING SYSTEM

SERVICE JOURNAL REFERENCE

NUMBER	DATE	SUBJECT	CHANGES

COOLING SYSTEM

Description

The water is circulated by a centrifugal impeller-type pump which is mounted on the front of the cylinder block and driven by a Vee belt from the crankshaft.

A thermostat is installed in the outlet pipe, mounted on the front of the cylinder head, to impede the circulation of the water into the radiator until it has reached a predetermined temperature in the cylinder block and so provide a more rapid warming up of the engine.

A drain tap is situated on the right-hand side of the cylinder block.

Air is drawn through the radiator by a fan which is mounted on the pump pulley.

Adjustments in Situ

The purpose of the following adjustments is to maintain the performances of the fan, pump and dynamo at their maximum, and consists of moving the dynamo in relation to the cylinder block to adjust the tension of the belt. Proceed as detailed below. Other specific performance faults should be diagnosed by referring to "FAULT DIAGNOSIS" in Section K.

1. Referring to Fig. D1 slacken the dynamo securing bolts (A). Support the dynamo with one hand and release the set bolt (B) and the nut and bolt (C).
2. Using 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.
3. The belt should be adjusted so that when the securing bolts are finally locked up, the long run of the belt can be pressed in $\frac{1}{2}$" (12.7 mm.) at the centre by normal thumb pressure.

Note: It is important that the fan belt is always run at the correct tension, as any slackness will cause slip and rapid wear, and excessive tightness will induce rapid bearing wear.

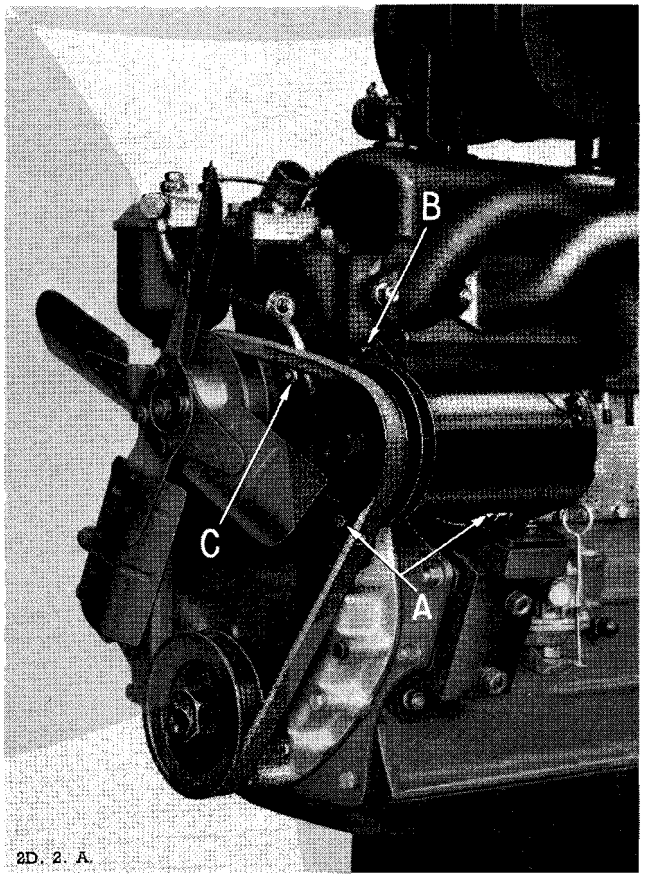


Fig. D1. *Fan belt adjustment*

Thermostat

To remove:

1. Drain the cooling system.
2. Disconnect the air release pipe from the outlet pipe.
3. Disconnect the outlet hose from the outlet pipe.
4. Release the two set bolts and remove the outlet pipe from the thermostat housing.
5. Lift out the thermostat from its housing.

To view and overhaul

1. Test the thermostat by immersing it in water and heat up, checking the temperature. The thermostat should start to open between 170° and 176°F. (77° and 80°C.) and be fully open at 201°F. (94°C.). If the thermostat does not open between the given temperatures it should be renewed. Also if the valve sticks in the fully open position, it should be renewed. No attempt should be made to repair the thermostat.
2. Clean the joint face of the water outlet pipe and thermostat housing.

To install

The installation of the thermostat is a reversal of the procedure "To remove". Fit a new joint gasket between the thermostat housing and the outlet pipe.

Fan and Pump Assembly

To remove:

1. Drain the cooling system.
2. Disconnect the water hose.
3. Remove the radiator.
4. Remove the fan blades if necessary by withdrawing the four screws from the pulley.
5. Remove the set pins from the pump flange and take off the pump.

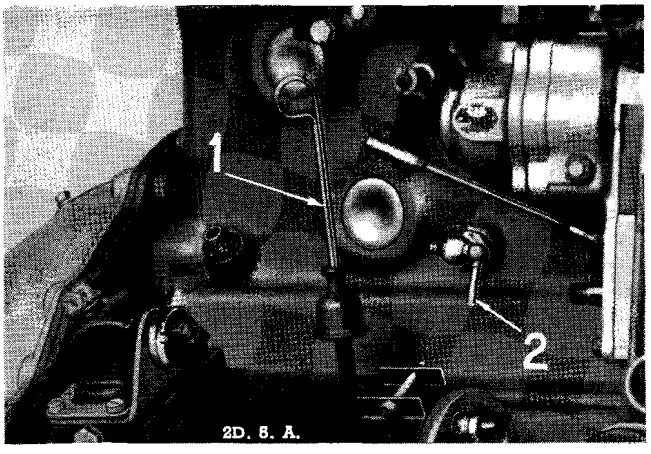


Fig. D2.
The dipstick (1), and cylinder block drain tap (2).

To remove the Pump Spindle

Remove the nut from the front end of the spindle, withdraw the fan pulley and take out the key.

While holding the pump body, the spindle can now be tapped out towards the rear, carrying with it the impeller, spring, and washers.

Bearings and Washers

The ball bearings, distance piece, steel and rubber washers have next to be removed from the body. First, prise out the spring retaining ring and remove the grease retaining ring; then, using a soft punch tap out the first ball bearing, which will be followed by the tubular distance piece. The second ball bearing will require to be centralised in the body before it can be tapped out in a similar manner to the first bearing. It will be followed by the grease retaining assembly, consisting of a dished steel washer, and a carbon faced rubber seal.

The Sealing Ring Assembly

Removing the nut on the rear end of the spindle, will enable the impeller and key to be withdrawn, followed by the spring, metal cap washer, rubber washer and carbon faced rubber sealing ring, the latter registers within the cap washer.

Reassembly

In reassembling, it is essential that the bearings, distance piece, and various washers, together with other parts be positioned correctly.

Lubrication

Lubricate sparingly with oil using oil gun after removal of plug.

To Refit the Unit

When refitting it is most important that the gland spring is holding the carbon seal against the pump body at a correct pressure.

This can be done by making sure that the gland spring is just holding the carbon faced rubber seal up against the shoulder on the spindle before inserting it in the pump body.

Adjust the fan belt as instructed on page D/1.

To drain and flush the system

The instructions covering "draining" and "flushing" the cooling system are given in the manual or instruction book concerned for your particular vehicle. The drain tap for the engine cooling system is located at the rear, on the right-hand side of the engine.

FROST PRECAUTIONS

When frost is expected, or when the engine 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. In these circumstances the water in the cooling system should be mixed with one of the following brands of anti-freeze, or the cooling system drained completely. **NOTE**—If a heater is fitted to the vehicle it will be necessary in most cases to use anti-freeze as usually the heater can not be drained.

Recommended Anti-freeze:—

Smith's Bluecol 'D'
Filtrate Nevafreeze 'D'
Mobil-Permazone

LUBRICATION

SERVICE JOURNAL REFERENCE

NUMBER	DATE	SUBJECT	CHANGES

LUBRICATION

Efficient lubrication is of vital importance to ensure the reliability and long life of the moving parts. Great care has been taken to select oils which will give the best results under all operating conditions. It is therefore imperative that the correct grades of oil be used and that they should be applied in accordance with a definite schedule. The chart given in this Section should be regularly referred to for details of application, and grade of lubricant required.

Description

There is full pressure lubrication throughout the unit.

The rotor type pump draws oil from the sump through a gauze oil filter and delivers it to all bearings and the timing chain.

The sump capacity is 10 pints (5.68 litres), but an external full flow oil filter is fitted, and if the whole system has been drained, one pint (.6 litre) extra will have to be used when refilling in order to charge this filter.

The oil filler is in the valve cover on top of the cylinder head, and the oil level is checked by a dipstick which is on the right-hand side of the engine.

Draining the Sump

The engine and oil filter should be completely drained and fresh oil put in at least every 3,000 miles to provide the best possible running conditions.

There is a drain plug in the base of the sump. On new or reconditioned engines draining should be done after the first 500 miles (800 km.) running and again after the next 2,000 (3000 km.) miles, and the filter element changed in each case. After this period no further attention need be given to the filter, except the renewal of the element every 7,000 miles (12000 km.).

Drain when the engine is warm. Under no circumstances should petrol (gasolene), or paraffin (kerosene), be poured through the oil filler to clean the engine.

Refilling

When refilling, do not pour the oil in too fast, otherwise it may overflow through the breather at the front end of the valve cover. Check periodically that this breather is not choked up. Failure to keep this clear may result in condensation on the valve gear.

Test the level of the oil with the dipstick, wiping the stick clean before taking the reading. This should only be done when the vehicle is on level ground and not immediately after the engine has been run, or a false reading may be given.

Circulation

The oil circulation is clearly shown in Fig. E1. Starting at the gauze filter and pick up in the sump, oil is drawn into the pump, from which it is fed to the full flow oil filter and thence to the main oil gallery. This runs the length of the engine on the right-hand side, from which the main oil delivery is made. A spring-loaded oil release valve, located between the pump and filter and accessible from the exterior of the crankcase, is provided, the overflow from which is returned to the sump filter. From the main oil gallery, oil is fed to the big ends, main bearings, and the three camshaft bearings.

From one camshaft bearing, oil at reduced pressure is taken through drilled passages in the cylinder block and cylinder head to an oil-feed collar on the valve rocker shaft, and thence to the drilled shaft itself. Therefore the shaft is under pressure, surplus oil after circulation returning from the rocker gear via the push rod holes to the sump.

At the front end of the front camshaft bearing there are two oil bleed holes which feed oil to the camshaft gear and thence to the timing chain. Separate lubrication for the cylinder bores is effected by a small jet hole in the top half of each connecting rod big end bearing.

The Oil Pressure Gauge

The oil pressure gauge gives an indication whether the oiling system is working properly. The normal oil pressure during ordinary running should be approximately 50 lbs. per square inch (3.5 kg./cm^2), with a proportionate lower pressure when idling, and will keep constant as long as the filter element remains clear and is not choked. As the filter gradually becomes choked, the oil pressure progressively becomes less. A drop of between 10 to 15 lbs. per square inch below normal pressure is an indication that the element is being by-passed and that it should be renewed to restore the oil pressure to normal.

The gauge should be observed when the engine is first started up after refilling the sump to check that the oil is circulating and that the pressure is correct. It should also be kept under observation frequently during normal running. Should the gauge fail to register a normal pressure, it may be due to lack of oil in the crankcase. If oil is present and the gauge still fails to register, stop the engine immediately. Test the gauge by a replacement, clamped direct to the instrument panel.

Check for Loss of Pressure

First, check the sump oil level by means of the dipstick. If the level is well up, check the oil gauge pipe

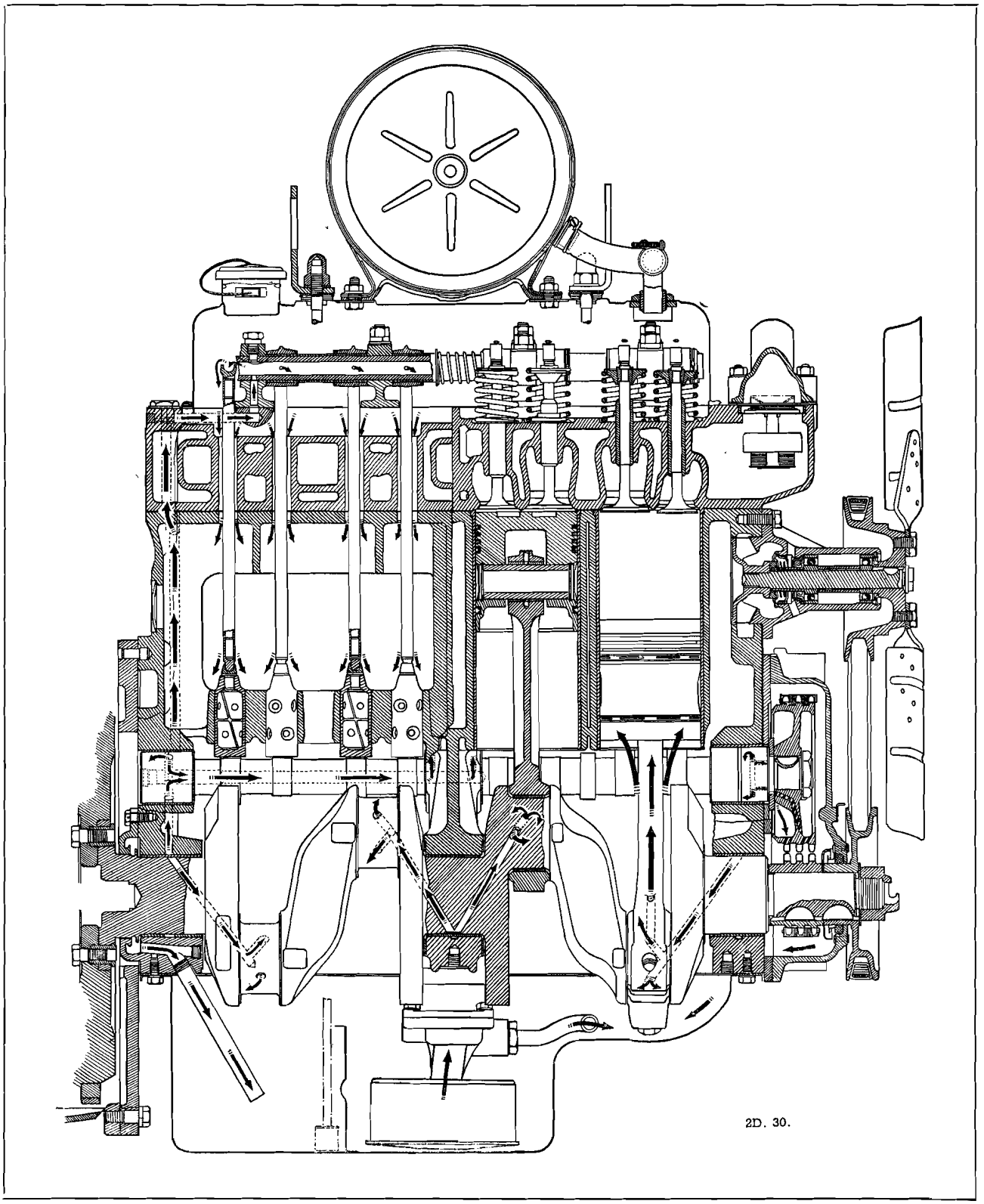


Fig. E1.

This illustration shows the flow of oil from the sump via the oil pump to the main gallery, bearings, and overhead rocker gear.

NOTE. *On later engines the oil filler is positioned at the front end of the rocker cover.*

from crankcase to instrument panel for fracture or leak. If the pipe is in order, remove the sump and examine the gauze filter. This may be choked; also remove release valve and inspect for foreign matter.

If these tests fail to indicate the cause of the loss of pressure or oil circulation, the crankshaft and other bearings will have to be closely examined and stripped down if necessary.

The Filter

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

The element of the filter is of star formation in which a special quality felt, selected for its filtering properties, is used.

Oil is passed through the filter from the pump at a pressure controlled at 50 lbs. per square inch (3.5 kg./cm²) by the engine oil release 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 a pound or two per square inch 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 15/20 lbs. per square inch (1 kg./cm² to 1.4 kg./cm²), 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.

To Renew the Filter Element

1. Place a suitable receptacle under the filter and release the centre fixing bolt from the bottom of the filter body.
2. Withdraw the filter body complete with element.
3. Remove and discard the filter element.
4. Thorougly wash out the filter body in paraffin (kerosene) or petrol (gasoline). Dry it with a clean non-fluffy rag.
5. Install a new filter element and top up the bowl with the appropriate grade of oil. Capacity 1¼ pints (.60 litres).
6. Assemble the filter body to the filter head, ensuring that the joint washer is correctly positioned, clean and undamaged. Install and securely tighten the centre fixing bolt.
7. Start the engine and check the filter for oil leaks.
8. Stop the engine, give the oil time to settle down and check the oil level. Top up, if necessary.

Leakage past a joint will cause serious or total loss of oil, and the engine should not be run until the leaking joint has been made good.

To Remove the Oil Sump

First, drain off the oil by taking out the drain plug.

Support the sump while removing the set screws and then carefully lower clear of the oil pump gauze strainer and pick-up.

Remove the joint washer; if broken, this will have to be replaced by a new one on reassembly.

The Gauze Strainer and Pick-up

The strainer should be examined for contamination and removed if necessary by releasing the two nuts. Wash the gauze with paraffin, using a brush and not a rag.

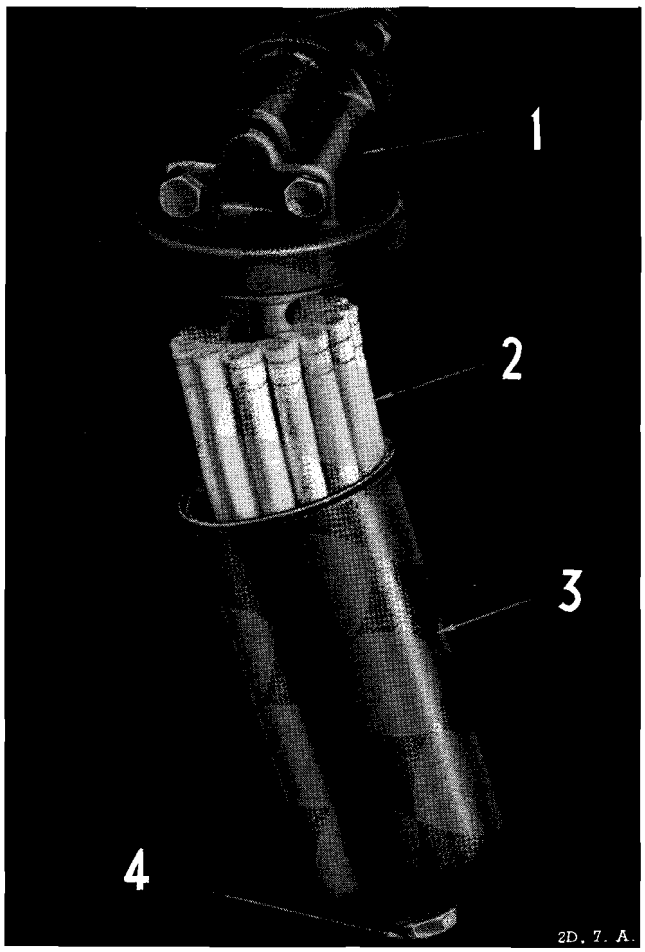


Fig. E3. *The oil filter.*
1. Head casting. *3. Bond.*
2. Element. *4. Centre bolt.*

To Remove the Oil Pump

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

From the left-hand side of the crankcase remove the oil pump locating screw. When the locking cap is removed a screwdriver can be used on the screw itself. Note that there is a fibre washer under the nut.

The oil pump complete can now be drawn down out of the crankcase.

To Replace the Oil Pump

Insert the pump from below and push the shaft right home, when the driving gear will mesh with the gear on the camshaft.

Insert the locking screw in the left-hand side of the crankcase and tighten. Fit the fibre washer and follow with the cap lock nut.

Replace the oil delivery pipe to the pump body and crankcase.

The pump does not need priming.

To Dismantle and Re-assemble the Pump

To dismantle the oil pump, first mark the flange and the body to assist re-assembly. Then, separate the body from the bottom flange when the female star gear can be lifted out of the body and the male eccentric star gear pulled from the shaft. Take care not to lose the key from the shaft.

The re-assembly of this pump is achieved by reversing the dismantling procedure.

The Release Valve

Release valve pressure is determined by the spring, which is held in position by a plug. This plug is screwed home and no adjustment is possible.

The valve is a conical-faced hollow plunger. Check that the plunger and the valve seat are clean and undamaged and that the passages in the crankcase are clear.

When re-assembling, make sure the fibre washer is fitted under the head of the valve plug, and that an oil-tight joint is made.

The Valve Rocker Shaft

The valve rocker shaft on the cylinder head is hollow. It is supplied with oil from the rear camshaft bearing and is drilled for the lubrication of each rocker.

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

RECOMMENDED LUBRICANTS

Cleanliness of the lubrication system is of great importance and involves strict adherence to the recommendations for draining and changing the oil, and cleanliness of oil measures and cans used for refilling and of containers used for storing the lubricants. **The British Motor Corporation cannot hold themselves responsible under the warranty for crankshafts or bearings that are damaged as a result of the use of dirty oil.**

Marketing Company	Engine Sump			Water Pump Bearings
	Climatic Conditions			
	Above 90°F. (32°C.)	Below 90°F. (32°C.)	Arctic: Below 0°F. (–18°C.)	All Conditions
Esso	"Essolube" H.D. 30	"Essolube" H.D. 20	"Essolube" H.D. 10	"Esso" Expee Compound 140
Mobil	Mobiloil A	Mobiloil Arctic	Mobiloil 10W	Mobilube "G.X." 140
Shell	"Shell" Rotella 30	"Shell" Rotella 20/20 W	"Shell" Rotella 10 W	"Shell" Spirax 140 E.P.
B.P.	"Energol" Diesel D S.A.E. 30	"Energol" Diesel D S.A.E. 20 W	"Energol" Diesel D S.A.E. 10 W	"Energol" E.P. S.A.E. 140
Duckham's	Duckham's N.O.L. Diesel "Thirty"	Duckham's N.O.L. Diesel "Twenty"	Duckham's N.O.L. Diesel "Ten"	Duckham's N.O.L. E.P. 140
Wakefield	Castrol C.R. 30	Castrol C.R. 20	Castrol C.R. 10	"Castrol" Hi-Press
Filtrate	"Filtrate" Diesel 30	"Filtrate" Diesel 20	Filtrate Diesel 10 W	E.P. "Filtrate" Gear 140
Sternol	"Auto Deso" H.D. 30	"Auto Deso" H.D. 20	"Auto Deso" H.D. 10	Ambroleum E.P. 140

OPERATION

SERVICE JOURNAL REFERENCE

NUMBER	DATE	SUBJECT	CHANGES

OPERATION

General

Always maintain the engine in as clean a condition as possible, since dirt is ruinous to the very high precision of the fuel injection equipment which is fitted. Keep the fuel clean also, and always use suitable strainers should it be necessary to top up the fuel tank of the vehicle by hand.

In cases where the fuel is stored in drums, these should be set at an angle from the horizontal with a drain tap at the lowest point, and a main tap at the highest. In this way the danger of drawing off sludge, and its ultimate entry into the engine fuel system is greatly reduced.

When a storage tank has been freshly filled, allow the sludge to settle before drawing off any further supplies.

Never interfere with any part of the fuel system unnecessarily. If adjustment should become essential, take the utmost precautions to ensure absolute cleanliness in working. As described later in this section, the only part of the injection equipment which should ever be worked upon at the roadside, is the injectors, and then only to the extent of removing the defective unit, and its replacement with a spare injector, carried on the vehicle for such eventualities.

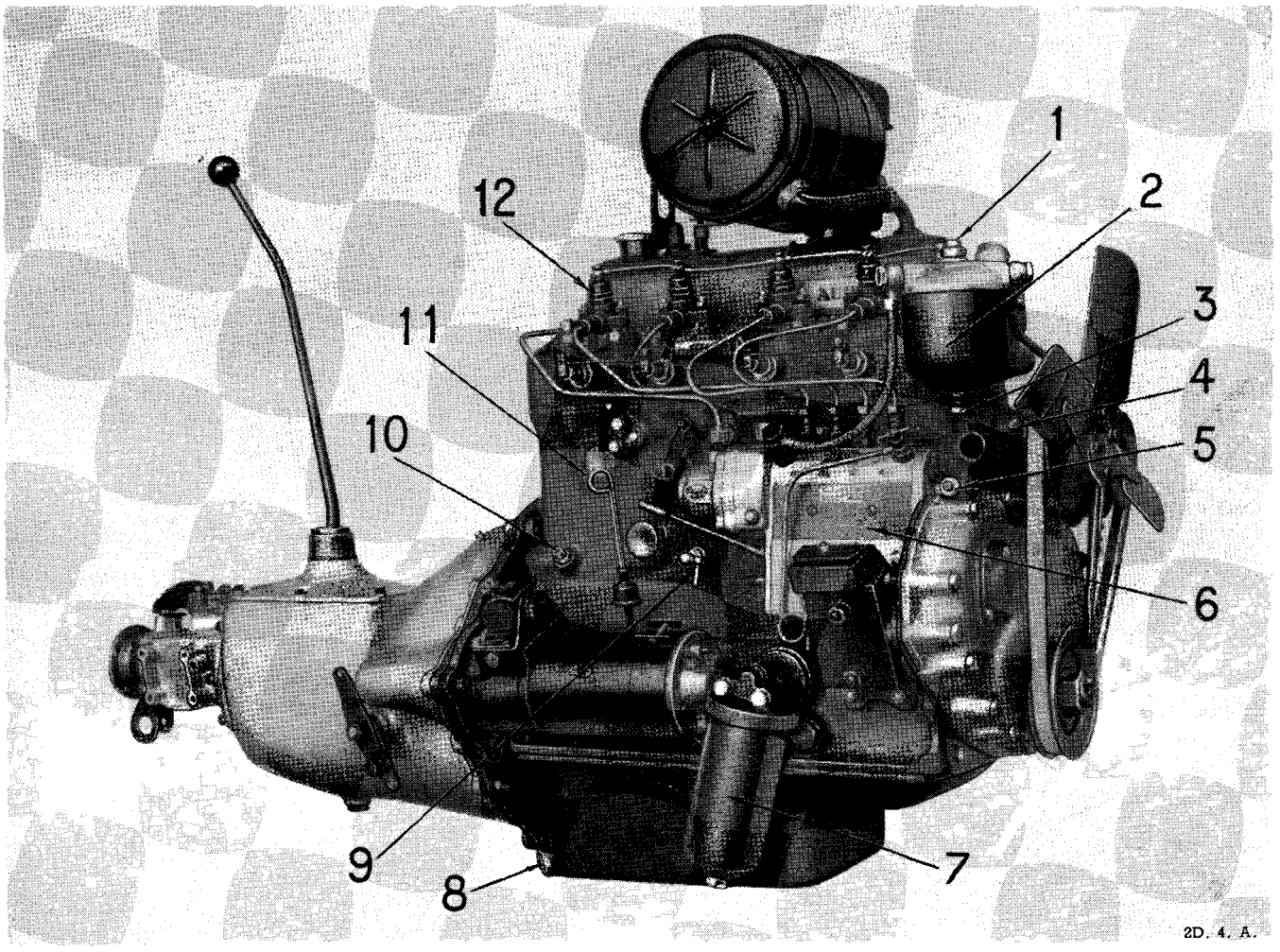


Fig. F1.

1. *Filter bleed plug.*
2. *Filter bowl.*
3. *Filter drain plug.*
4. *Water pump oiling plug.*
5. *Excess fuel button.*
6. *Fuel injection pump.*
7. *Lubricating oil filter.*
8. *Sump drain plug.*
9. *Cylinder block drain tap.*
10. *Oil pressure gauge connection.*
11. *Dipstick.*
12. *Fuel injectors.*

NOTE. *On later engines the oil filler is positioned at the front end of the rocker cover.*

Before Starting the Engine

Check the level of the water in the engine cooling system and top up if necessary. Examine the oil level in the engine sump topping up if required to the mark on the dipstick. Ascertain that the fuel tank contains fuel.

If the unit is a new or reconditioned one, or if air has entered the injection equipment, it will be necessary to bleed the fuel system before attempting to start. This operation removes any air from the fuel filter, fuel injection pump, and connecting pipe lines, ensuring that fuel free from air bubbles is injected into the engine combustion chambers. Although bleeding the system is a simple operation, care should be exercised to obviate the casual handling which is often given. In all cases of fuel filter or fuel line attention, absolute cleanliness is essential. When bleeding is necessary proceed as follows.

First bleed the fuel filter. Slacken the bleed plug on the filter head (Fig. F1), and operate the hand priming lever on the fuel lift pump until the fuel flows from the plug completely free from air bubbles, when the plug must be screwed down.

Note. If the fuel system has been allowed to run dry, the plug on the filter head should be removed, and the filter completely filled with fuel in order to save excessive manual operation of the lift pump. Replace the plug and washer, and carry out the bleeding operation as described.

To bleed the fuel injection pump, slacken the bleed tap (Fig. F2), on the pump, and again operate the hand priming lever on the fuel lift pump until fuel without air bubbles emerges from the bleed tap, which must be closed immediately. The fuel system is now free from air.

Starting in Normal Temperatures

Ensure that the stop control is fully home, and that the master switch is "on". The charging light should show and the fuel gauge register. Operate the starter motor control, and at the same time open the throttle by slightly depressing the accelerator pedal. Release the starter motor control as soon as the engine fires.

If the battery, starter, and fuel injection systems are in good order, the engine should start at once. If it does not, release the starter control and allow a short interval between each attempt to start. This is to ensure that the engine is stationary, and to prevent overheating and possible damage to the starter motor. If the engine refuses to start investigate the cause. Check the oil pressure on the gauge, which should register within 30 seconds of the engine starting. If pressure does not register, **stop the engine and investigate the cause.**

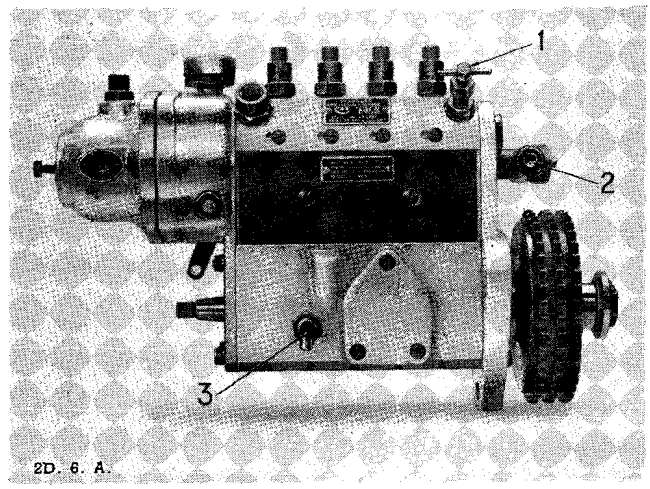


Fig. F2.
1. Bleed tap. 2. Excess fuel button. 3. Level plug.

Starting under Cold Conditions

To ensure easy starting under cold conditions, an excess fuel device is fitted to the fuel injection pump, to allow extra fuel for starting. To operate, ensure that the stop control is fully home, depress the excess fuel button on the pump, and then the heater plug switch on the fascia for 15 to 20 seconds, before operating the starter with the throttle slightly open. **Do not operate the heater plug switch after the engine has started.**

Stopping the Engine

Pull out the stop control fully. This stops the engine by cutting off the fuel supply from the injection pump.

Running-in Period

The treatment given to a new or reconditioned engine during the first 500 to 1,000 miles (800 to 1500 km.) or 25 to 50 hours running, will have an important bearing upon its subsequent performance. During this early period, the speed should be restricted so that racing of the engine does not occur. The engine speed should be increased gradually and progressively until at least 1,000 miles (1500 km.) or 50 hours running have been covered. Labouring by the engine must also be avoided, and a change to a lower gear must be made as soon as the engine speed drops to approximately 750 r.p.m.

Roadside Injection Adjustment.

Never dismantle any part of the injection pump or nozzles at the roadside. It is recommended that a spare injector be carried. Renewing an injector is the only servicing of this nature permissible. If trouble does arise, it is advisable to regard it as a major breakdown and to call upon the asistance of the nearest available service station.

FUEL INJECTION SYSTEM

SERVICE JOURNAL REFERENCE

NUMBER	DATE	SUBJECT	CHANGES

FUEL INJECTION SYSTEM

General

The operation and efficiency of the compression-ignition engine depends largely on the fuel injection system, the main components of which are manufactured to extremely fine limits, therefore cleanliness and accuracy in setting are absolutely essential. It is recommended that, where facilities for servicing are not available at the premises of the vehicle, the parts be taken to a C.A.V. Service Station.

Description

The fuel is drawn from the supply tank by an AC fuel pump which is operated by the engine camshaft. It is imperative that the fuel is absolutely clean and free from foreign matter, and a type F2/9 C.A.V. filter with renewable paper element is used in the system prior to the injection pump. A filter gauze is employed in the fuel lift pump which also embodies a sediment chamber.

The injection pump, meters and forces fuel under high pressure via Pintaux injection nozzles, into the combustion chambers. The Pintaux nozzle has been designed expressly for use with the Ricardo Comet type of combustion chamber, which is employed in this engine. The use of these designs ensures easy starting under arctic conditions, especially when used in conjunction with the heater plugs which are fitted.

The accelerator or control lever is connected to a butterfly valve in the venturi unit which is mounted on the air inlet manifold, and a suction pipe connects the venturi to the pneumatic governor fitted on the fuel injection pump.

The variation in suction created in the venturi, actuates the pneumatic governor, which controls the amount of fuel injected into the combustion chambers by the pump, thus governing the engine speed.

Adjustments in Situ

The purpose of the following adjustments is to maintain performance of the fuel system at its maximum and consists of the cleaning, testing, inspecting and bleeding of the fuel system. The operations as listed below are essential items of maintenance which may have to be accomplished during normal service. Specific performance faults should be diagnosed by referring to "FAULT DIAGNOSIS", Section K.

Removing and Testing Injector Nozzles

It is difficult to give a hard and fast mileage or time limit at which the injectors should be examined, owing to the greatly differing conditions under which engines operate. For general operating conditions, these nozzles should be tested every 10,000 miles (16000 kilometres), or 450 hours. If injector trouble is experienced before this time has elapsed the period should be reduced accordingly.

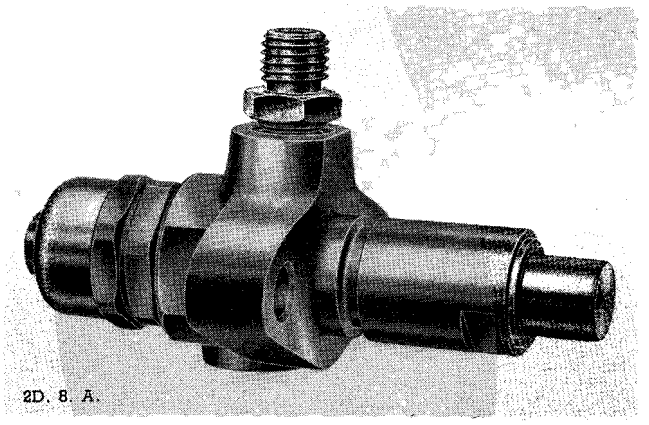


Fig. G1.
A C.A.V. Fuel injector.

It is often possible to locate an injector which is not working correctly by slackening off the injector feed pipe union nut a few turns and allowing the fuel to leak past the union whilst the engine is running slowly. If no change is heard in the performance of the engine or sound of the exhaust, it is reasonable to assume that the injector nozzle is faulty. The same applies if a faulty condition, such as very thick blue smoke on engine acceleration, disappears when one particular injection line is rendered inoperative.

To test an injector, proceed as follows:—

(a) Disconnect the injector feed pipe union nut and all the injector leak-off unions.

(b) Remove the two set bolts securing the injector to the cylinder head and carefully lever the injector nozzle holder out of the sleeve in the cylinder head. Immediately plug the hole to prevent the ingress of foreign matter.

(c) If the injectors are to be stored for any length of time, then the fuel feed and leak-off unions must be blanked off with dust washers or clean cloth.

To completely test the nozzle, the injector should preferably be tested on a nozzle setting outfit.

If a nozzle setting outfit is not available, the injector can be tested on the engine as detailed overleaf:—

(a) Fit the injector to be tested onto its feed pipe, facing away from the engine.
(b) If the engine is then motored at idling speed, the spray can be observed.

Prolonged motoring of the engine is not necessary, as the spray can be observed during the first few engine revolutions. If the spray does not atomize but "hose-pipes", or is weak, or if the nozzle dribbles, then it must be replaced by a clean, tested nozzle. The faulty nozzle should be wrapped in a clean cloth or greaseproof paper and taken for cleaning to a fully equipped workshop or the nearest C.A.V. Service Station.

Note. To carry out the above test it is essential that the throttle unit (venturi) with its suction pipe, connecting it to the governor, is in position. If they are not fitted, the engine will not be governed and will race away if started.

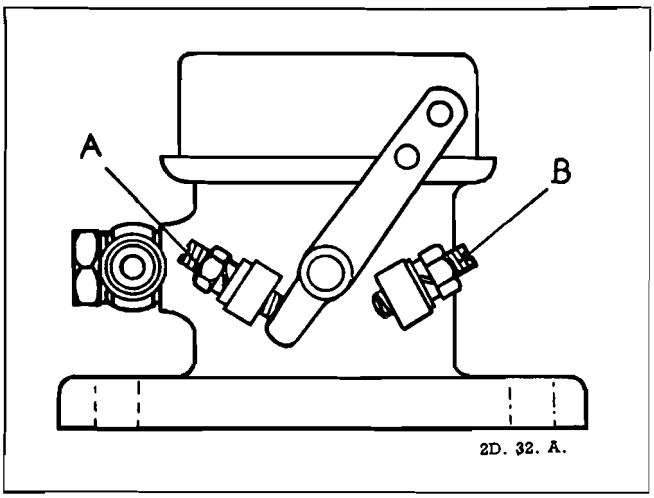


Fig. G2. *The Venturi stop screws.*
(A) Maximum fuel stop. (B) Idling stop.

The test may be carried out with these components removed; if in addition, all the injectors are removed. The engine can then be motored by the starter.

Great care must be taken to prevent the hands from getting into contact with the spray, as the working pressure will cause the oil to penetrate the skin with ease.

To Eliminate Air from the System (bleeding)

One possible cause of failure to start or of erratic acceleration is that air may have entered the fuel system through a leaking joint, the fuel tank being allowed to empty, or through any part of the system having been 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 procedure 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:—

(a) First bleed the fuel filter by slackening the bleed plug on the filter head, and then operate the hand priming lever on the fuel lift pump until fuel, free from air bubbles, flows out of the filter plug. When this occurs, immediately tighten down the plug.

Note. If the fuel system has been allowed to run dry, the plug on the filter head should be removed and the filter completely filled with fuel to save excessive use of the lift pump. Replace the plug and washer, and carry out the bleeding operation as above.

(b) To bleed the fuel injection pump, slacken the bleed tap on the pump, and again operate the hand priming lever on the fuel lift pump to remove air from the fuel, then securely tighten the tap.

To Renew the Fuel Filter Element

The filter element should only need renewing at 10,000 miles (16000 km.) or 450 hours, if clean, filtered fuel has been used and the necessary precautions taken when handling any component of the fuel system. If, however, the engine misfires or runs in an erratic manner through being starved of fuel due to a clogged element, the element must be renewed irrespective of the mileage covered or hours run. Proceed as follows:—

(a) Release the drain plug and allow the dirty fuel to drain into a suitable receptacle.
(b) Release the cap nut and withdraw the body and element complete.
(c) Discard the filter element.
(d) Wash out the filter body thoroughly in petrol (gasoline) and allow it to dry.
(e) Install a new filter element in the body, ensure that the rubber sealing washer is in good condition and in position in the filter head.
(f) Refit the filter body.
(g) Tighten down the cap nut and the drain plug. Ensure that all joints are made thoroughly air tight.
(h) Bleed the filter.

To Clean the Fuel Lift Pump Filter Gauze

The filter gauze should be examined and cleaned every 2,000 miles (3000 km.). Under extremely dusty or dirty conditions this interval should be reduced as the conditions dictate. Access is obtained to the filter gauze by releasing the set bolt in the domed cover and removing the cover from the pump body. Remove the filter gauze and clean it in an air jet or petrol (gasoline). All deposits should also be cleaned from the sediment chamber.

Replace the filter gauze and dome cover, use a new cork gasket between the dome cover and body if the old

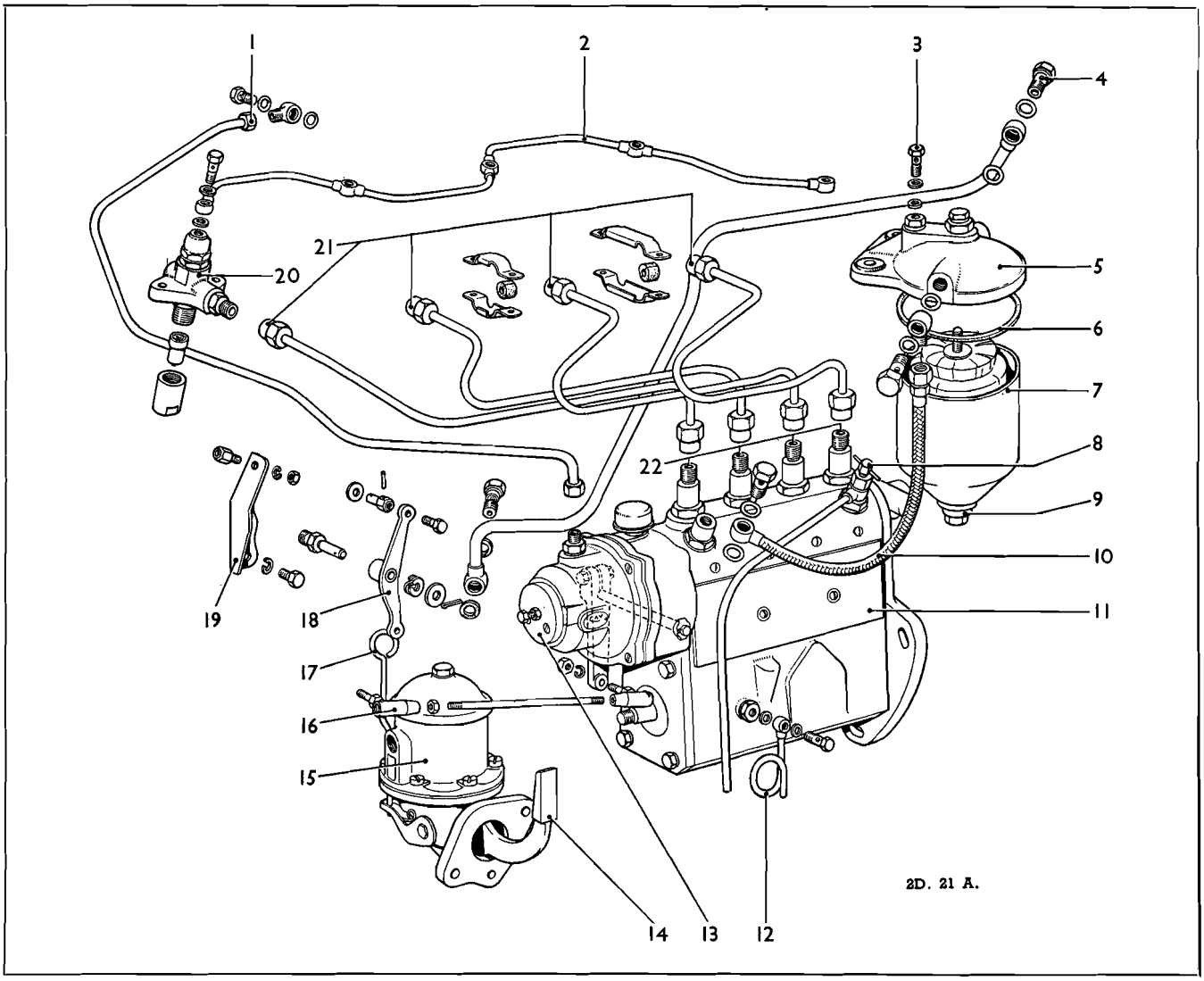


Fig. G3. *The components of the fuel system*

1. *Venturi connection.*
2. *Leak-off pipe.*
3. *Leak-off pipe union.*
4. *Feed pipe union.*
5. *Main filter head.*
6. *Sealing ring.*
7. *Filter bowl.*
8. *Injection pump bleed tap.*
9. *Main filter drain plug.*
10. *Main fuel feed to pump.*
11. *Injection pump.*
12. *Lubricating oil level pipe.*
13. *Governor.*
14. *Lift pump operating lever.*
15. *Lift pump.*
16. *Stop control connection.*
17. *Lift pump priming lever.*
18. *Stop lever bell crank.*
19. *Bracket.*
20. *Fuel injector.*
21. *Injector pipes.*
22. *Injector pipe connections.*

NOTE.—*Later systems embody a coiled copper pipe instead of the flexible one illustrated. A spill return pipe to the fuel tank is also incorporated.*

one is broken or hardened. Tighten the retaining set bolt just sufficiently to make a fuel-tight joint. Over-tightening is liable to damage the cork joint washer.

Finally, bleed the system as described previously.

FUEL LIFT PUMP

Description (Fig. G4)

The 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 main 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 is drawn from the tank and enters into the sediment chamber through the filter gauze, the suction valve, and 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 main fuel filter.

When the main 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 main 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.

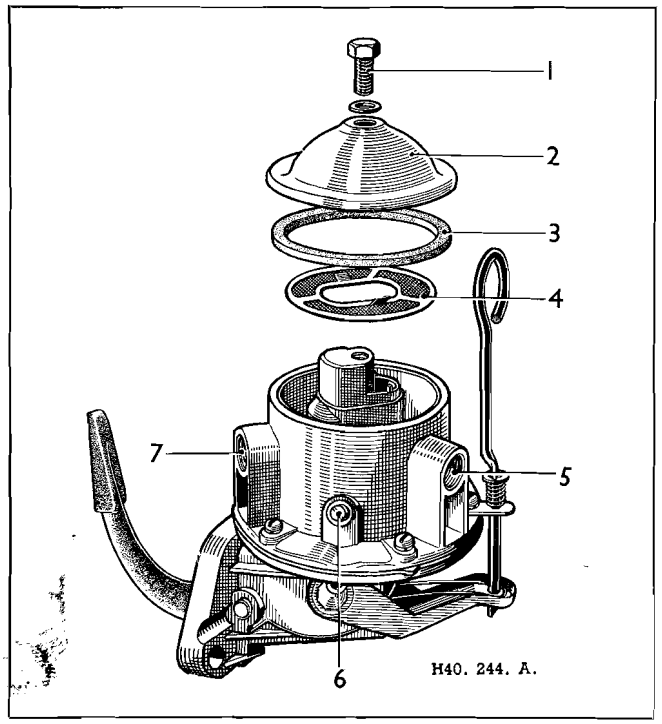


Fig. G4. *The fuel lift pump exploded.*
1. Cover nut. *4. Filter.*
2. Cover. *5. Inlet.*
3. Cork ring. *6. Sediment drain plug.*
7. Outlet.

To Remove

Disconnect the two fuel pipe union nuts from the pump. Unscrew the two set bolts securing the pump to the crankcase and withdraw the pump.

To Dismantle

1. Release the set bolt securing the domed cover and remove the cover with the cork gasket from the top half of the pump body.
2. Lift off the filter gauze.
3. Make a file mark across the flanges of the two halves of the body for guidance on reassembly.
4. Unscrew the six set screws and separate the two halves of the pump body.
5. Unscrew the two set screws, remove the valve plate, the suction and delivery valves and the gasket from the lower half of the pump body.
6. To remove the diaphragm and pull-rod assembly from the lower half of the pump body, turn the diaphragm to the right through 90° and lift it out. This will also release the spring.
7. Remove the two rocker-pin clips, push out the rocker-arm pin, which will release the rocker-pin washers, the rocker-arm, the link and the rocker-arm spring.
8. Remove the spring from the priming lever and body assembly. Further dismantling of the body assembly is not advisable as the priming lever is riveted over at the outer ends of the spindle.

To View and Overhaul

1. Wash all components in petrol (gasoline) and blow them dry with compressed air. Blow out the fuel passages in the top half of the pump body.
2. Examine the valves for proper seating. No attempt should be made to dismantle the valve and seat assemblies. They should be renewed complete if they are not in absolutely perfect condition.
3. Inspect the rocker-arm, linkage and pin for wear. Parts should be renewed where evidence of wear or looseness is found. On the working surface of the rocker-arm which engages the operating eccentric on the cam slight wear is permissible but not exceeding .010 in. (.25 mm.) in depth.
4. Check for weak or broken rocker-arm and diaphragm springs and renew if necessary. When renewing a diaphragm spring, ensure the replacement spring has the same identification colour and consequently the same strength as the original.
5. All gaskets should be renewed as a matter of routine.
6. The diaphragm and pull-rod assembly should normally be renewed unless it is in an entirely sound condition without any signs of cracks or hardening.
7. Examine the engine mounting flange on the lower half of the pump body for signs of distortion; if it is not flat, the flange should be lapped to restore it to its original condition.

To Reassemble

Reassembly of the pump is a reversal of the procedure "To dismantle", noting the following points:—

1. The rocker-arm pin should be a tap fit in the body, and if, due to wear, it is loose, the ends of the holes in the body should be burred over slightly.
2. Before installing the valves, first place a new paper gasket in position. Fit the outlet valve, spring foremost, into its port. The inlet valve cannot be incorrectly fitted owing to a restriction in the port.
3. When installing the diaphragm and pull-rod assembly, the locating "tab" on the periphery of the diaphragm should be at the 11 o'clock position. After pressing the diaphragm downwards and at the same time turning it through 90° to the left (which will allow the pull-rod to engage the fork in the link), the "tab" should be at the 8 o'clock position, with the holes in

the diaphragm matching up with the holes in the body flange.

4. Make certain that the top and bottom halves of the pump body are reassembled in their original positions; the markings scribed on the body flanges when dismantled will ensure this condition. The securing screws should be tightened diagonally and securely while the diaphragm is held at the top of its stroke by pushing the rocker-arm away from the pump.
5. When installing the domed cover, tighten the set bolt just sufficiently to make a fuel-tight joint. Do not over-tighten.

To Install

The installation of the pump is a reversal of the procedure "To Remove", noting the following points:—

1. Lubricate the rocker-arm and rocker-arm pin.
2. The gasket between the pump and the cylinder block should be renewed.
3. Crank the engine if necessary to bring the eccentric on the camshaft into its extreme released position, in order that its small side contacts the rocker-arm, before replacing the attachment screws.

To Test

Test the operation of the pump by disconnecting the outlet fuel pipe union nut from the pump and cranking the engine. There should be a well-defined spurt of fuel from the pump outlet at every working stroke, namely, once every two revolutions of the engine. Connect the fuel pipe and bleed the fuel system.

Finally, run the engine for a short time and check for leaks. The fuel system must be bled again after correction of any leaks.

FUEL FILTER

Construction

The general arrangement of the type "F" filter is shown in Fig. G5. The filter is of the cross-flow type, the inlet and outlet connections being carried on the cover, which also incorporates a bracket for support. The pot or bowl is of pressed steel, and forms an oil-tight container for the paper element. An air vent plug is also carried on the cover, and according to requirements a gravity vent valve or pressure relief may be carried in addition. A drain plug is provided at the bottom of the filter bowl.

The paper element, wound round a tubular core in the form of a spiral, is contained in a thin metal canister. Dirty oil is confined to the underside of the paper coils, and filtered oil to the upper side.

Method of Operation

Reference to Fig. G5 will show how the paper element filter operates. Fuel enters the filter through the inlet connection, passes down outside the element container, then up through the element, and finally emerges via the central outlet at the top of the element and so out through the outlet connection.

Dirty fuel is excluded from the clean side of the element by means of oil seals at top and bottom of the element core, oil tightness of the seals being maintained by the pressure of the spring.

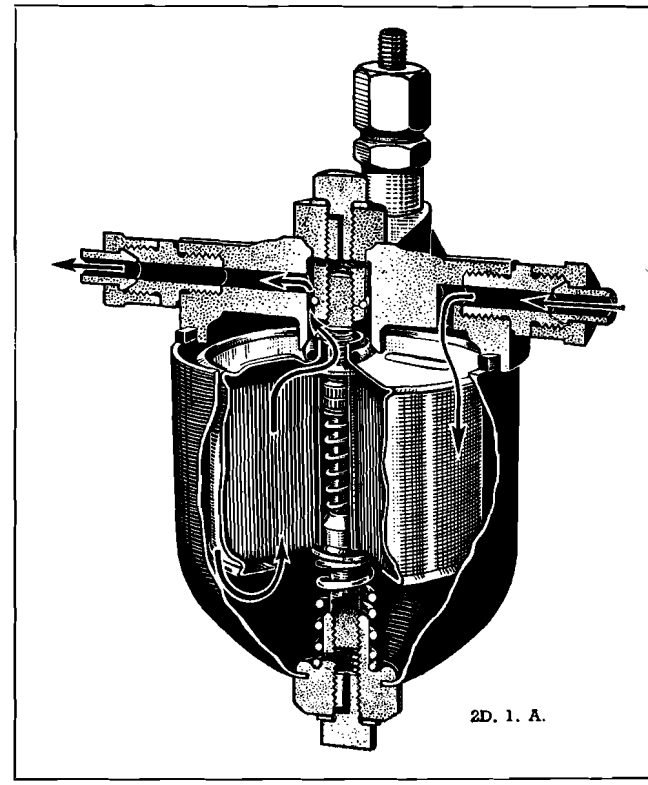


Fig. G5. *The fuel filter cut away, showing its constuction.*

Maintenance

As many complaints of fuel pump element wear can be traced to lack of care in the servicing of filters, the importance of correctly replacing the element, and avoiding getting dirt on the clean side of the filter, cannot be over-emphasized. When choking takes place, this is usually found to be due to a waxy sludge which is deposited from the fuel. If filters are found to choke in an unreasonably short time this will probably point to an unsatisfactory fuel supply, or storage tank installation, and steps should be taken to investigate in order to find out how, and at what point, an undue amount of impurities can enter the system.

Paper elements are not intended to be cleaned and must be discarded when choked.

INJECTION PUMP

Description

The C.A.V. type B.P.E. Fuel Injection Pump is of the camshaft operated, spring-return, plunger type, employ-

ing one pumping unit for each cylinder in the engine, and incorporates its own camshaft and tappet gear.

Barrels and plungers, valves and seatings, are of highly ground steel, being finished to the finest limits and precision, to ensure accurate operation at high speeds and pressures; each pair must, therefore, be regarded as inseparable and not interchangeable.

Great care should be taken to ensure that scrupulous cleanliness is observed in any work done on the pump, as any damage or the slightest particle of dirt will be detrimental to its efficient operation.

Operation

Fuel is delivered by the lift pump into the common suction chamber in the injection pump housing, from which it is drawn into the pumping chambers of the various elements through two small lateral ports. The plunger moves vertically in the barrel with a constant stroke. To enable the pump to vary the quantity of fuel delivered per stroke the plunger is provided with a vertical channel extending from its top edge to an annular groove, the upper edge of which is cut in the form of a helix. A toothed rack is provided whereby the plunger can be rotated in its barrel during operation.

When the plunger is at B.D.C., fuel can enter through the barrel ports ("A" and "D"). In a primed system the barrel and the pipes leading from the pump to the injectors are full of fuel. As the plunger rises a certain amount of fuel is pushed back through the barrel ports, until the plunger reaches its bottom position, where the top land of the plunger has closed both ports. The fuel above the plunger is then trapped, and its only outlet is via the delivery valve which is mounted on top of the pump barrel.

The pressure exerted by the rising plunger upon the fuel causes this to lift the valve and to enter the pipe which connects the pump to the injector. As this is already full, the extra fuel which is being pumped in at the pump end causes a rise in pressure throughout the line and lifts the nozzle needle (or injector valve). This permits fuel to be sprayed into the engine combustion chamber. Thus, fuel is being pumped into the line at the pump end, and an equal amount pushed out at the nozzle end. The lower edge of the control helix ("B") now uncovers the barrel port, thus allowing fuel to be by-passed to the suction chamber (which is under a much lower pressure than the fuel above the plunger), by way of the vertical slot. This causes the delivery valve to shut under the action of its spring, and with the collapse of pressure in the pipe line, the nozzle valve also shuts.

The plunger stroke is always constant but that part of it which is actually pumping is variable. By means of the helical edge which runs round the plunger, which itself can be rotated within the barrel, it is possible to make this point of cut-off occur earlier or later in the stroke. To stop the engine, the plunger is turned so that the vertical slot coincides with the barrel port during the whole of the plunger stroke; thus, no fuel is delivered. The position of the plunger stroke at which the helical edge will uncover the port is adjustable by rotating the plunger axially by means of a toothed quadrant.

The toothed quadrant meshes with a rack provided on the control rod which actuates all the pump elements in the unit, and is connected to the governor or other controls by suitable linkage.

Anti-Dribble Device

When the helical edge of the pump plunger uncovers the port on the pump barrel, near the end of the delivery stroke, the pressure of fuel is immediately reduced so that the delivery valve at once drops onto its seating, thus cutting off communication between the pump and the nozzle until the next delivery stroke takes place. In coming to its seat to act as a non-return valve, the delivery valve is, however, made to perform the other highly important function of pressure pipe release. This double function is obtained by the construction of the delivery valve unit, which is an ordinary mitre faced valve with a guide having a circular groove cut in it, dividing the guide into two parts. The lower part has four longitudinal grooves communicating with the circular groove.

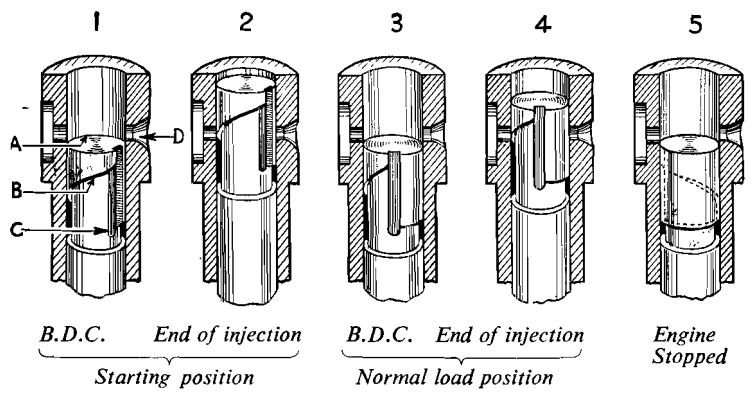


Fig. G6.

Illustrating the injection pump barrel, with the plunger in its various operating positions, reading from left to right.

The upper part of the guide forms a small piston which has a highly ground finish, and forms a plunger fit for the valve seating when the pump is on its delivery stroke, the pressure of the fuel rises and the delivery valve is pushed up until the fuel can escape through the longitudinal grooves over the valve face to the nozzle. Immediately, the pump plunger releases the pressure in its barrel, the delivery valve (under the influence of its spring, and the great difference in pressure between the pump barrel and the delivery pipe), resumes its seat. This causes the small piston parts to the guide to sweep down the valve seating with a plunger action, thus increasing the space in the delivery pipe (by an amount equal to the volume of the small piston part of the valve guide), before the valve actually seats itself. The effect of this increase of volume in the delivery pipe system, is that of suddenly reducing the pressure of the fuel therein, so that the valve in the nozzle can "snap" on to its seat, thus instantaneously terminating the spray of fuel in the cylinder entirely without "dribble".

Lubrication

No lubrication attention during operating service is required by the fuel injection pump; the mechanism is lubricated by the leakage of fuel oil from the pump elements.

If, however, a new or reconditioned pump is fitted to the engine, the inspection cover must be removed and the sump filled with engine oil. An overflow pipe is fitted and the filling process should be continued until oil emerges from the pipe, which governs the correct maximum level.

To Remove the Fuel Injection Pump

To remove the injection pump, first take out the four set-pins securing the drive end cover plate, situated on the timing case, and remove the plate and joint washer. Knock back the lock washer under the head of the barrel nut, Fig. G7, and remove the nut.

Now, disconnect the venturi pipe from the pneumatic governor, and the main fuel feed pipe at the injection pump. Detach the feed pipes to the injection nozzles at the pump end, and the engine stop lever rod at the upper end by removing the securing nut situated at the rear face of the control lever on the engine crankcase.

Three nuts and plain washers securing the injection pump flange to the timing case, must now be removed.

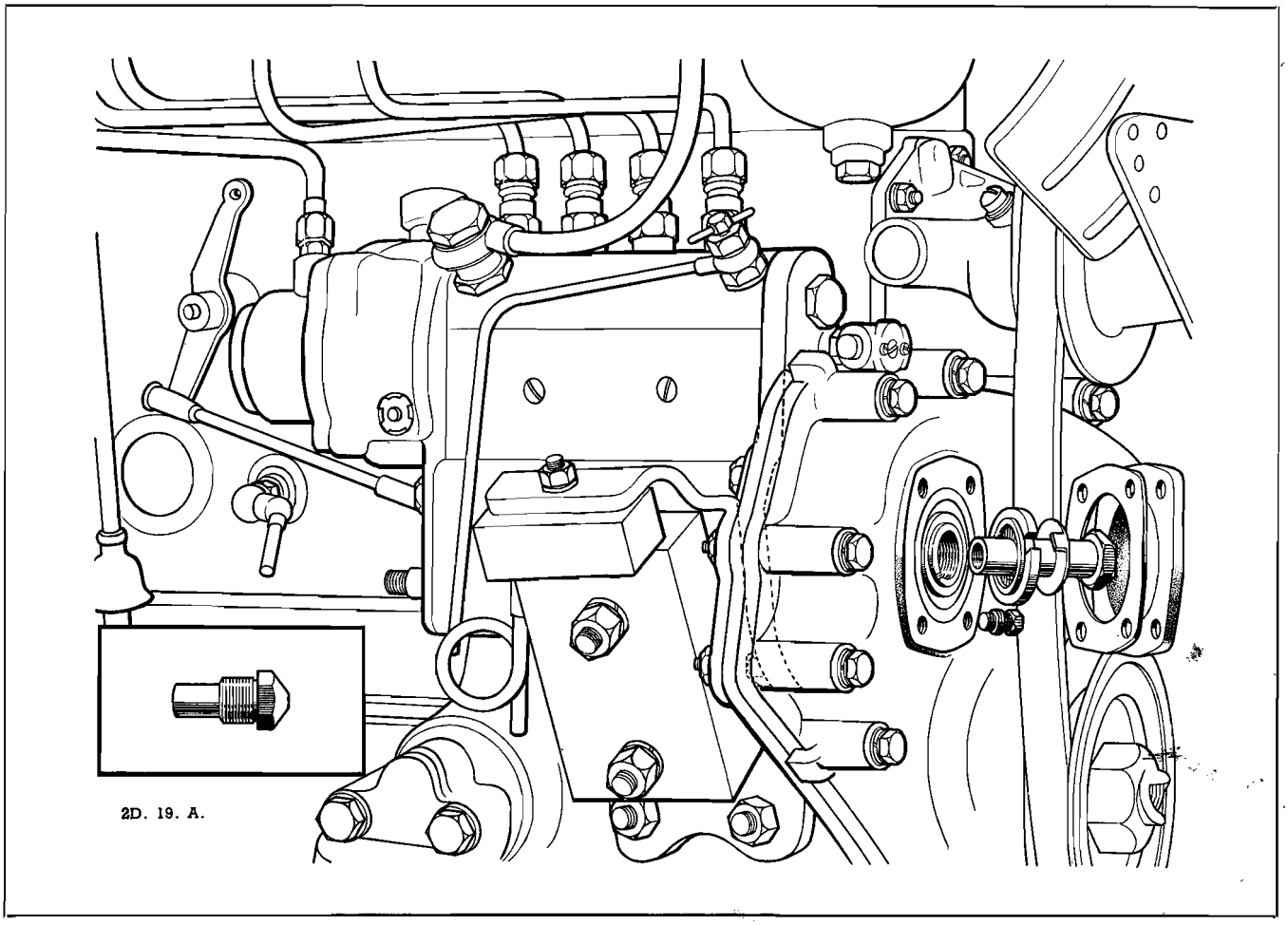


Fig. G7. *Fuel injection pump removal, showing tool No. IF.8337 inset.*

Screw tool number IF.8337, Fig. G7, into the pump drive chain wheel, thereby forcing the pump to the rear and separating the tapered and keyed pump shaft from the drive. The chain wheel will remain in position supported by its ball race. Take care to retrieve the woodruff key from the drive.

Removing the Pneumatic Governor

Before the fuel injection pump can be dismantled the pneumatic governor unit must be taken off. To do this remove the four set screws from the flange of the governor. Keep one hand over the governor, as the diaphragm spring may force the housing away from the pump.

Take out the diaphragm spring, and then actuate the engine stop lever on the pump. This will move the diaphragm away from its seating allowing access to the connecting clevis pin between the diaphragm rod and pump rack. Remove the split pin and washer, and by moving the diaphragm sideways, separate it from the pump.

Reassembling and Refitting the Governor

This is a reversal of the dismantling procedure. The diaphragm being made of specially prepared leather, should give lasting service, but in the event of a leak being suspected, the following procedure should be adopted.

(a) Remove the vacuum pipe.

(b) Move the stop lever to the "stop" position.

(c) Place a finger over the diaphragm housing union in order to seal it.

(d) Release the stop lever.

(e) The control rod should then remain stationary, any movement towards the maximum speed position indicating leakage either at the diaphragm or at the housing union, or between the housing and main cover. If the union, housing, and cover joints are tight, then the leakage is occuring at the diaphragm which should be renewed.

(f) The vacuum pipe can be tested for leaks in exactly the same way as the diaphragm, except that the diaphragm housing end is connected to the governor union, and a finger applied to the venturi end of the pipe.

(g) Ensure that slackness does not occur between the accelerator pedal and venturi unit, or between the stop lever and its control rod.

(h) The engine stop lever must be perfectly free throughout the whole of its permitted movement.

CAUTION. **In no circumstances run the engine without the venturi air or air inlet manifold in position, or with the suction pipe to the governor disconnected. Do not interfere with the idling damper screw on the governor, nor with the maximum fuel stop.**

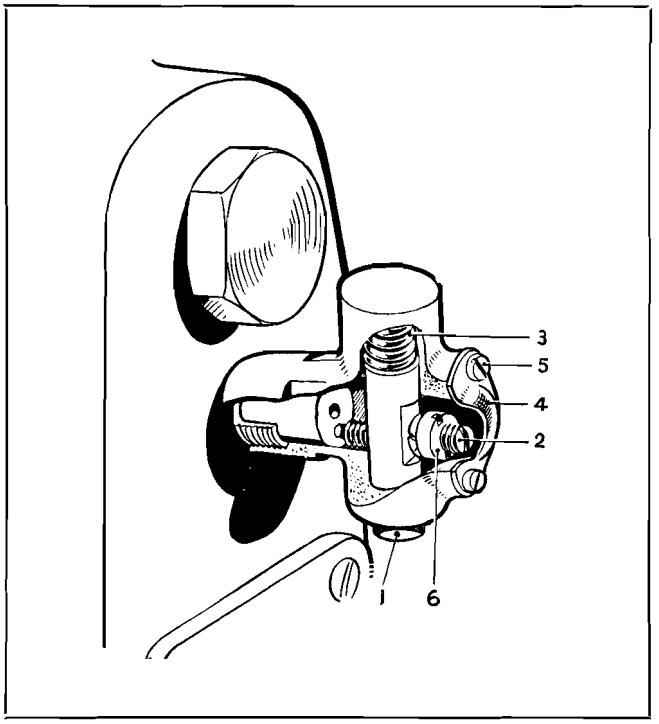


Fig. G8. *The excess fuel button used for cold starting.*
1. Button. *4. Cover.*
2. Stop screw. *5. Fixing screws.*
3. Spring. *6. Locking nut.*

Dismantling the Fuel Injection Pump

This operation should not be lightly undertaken as only mechanics specially trained can be expected to carry it out successfully. Strict cleanliness should be observed when preparing to dismantle fuel injection pumps, care being taken to see that all iron filings, dirt, grit, dust, etc., are removed from the bench on which the work is to be done. The bench should then be covered with a sheet of clean grease-proof paper and a number of small clean containers provided for the various parts removed. It is also advisable to have a thoroughly clean, covered vessel available, containing a supply of fresh clean petrol (gasoline), or fuel oil for washing these parts. If permanent facilities are installed for the servicing of injection equipment, the bench should be covered with zinc sheeting or linoleum or a similar easily cleaned material.

To facilitate dismantling and reassembling fuel injection pumps it is advisable to use special tools, in addition to the ordinary spanners and screwdrivers which are available in every workshop. They can readily be supplied or obtained through any C.A.V. Service Station or Dealer.

Special attention should be paid to the pump plunger and barrel unit, which should carefully be isolated, a specially important point being to ensure that the plungers are never laid down separately or fitted except into the barrels from which they were originally taken.

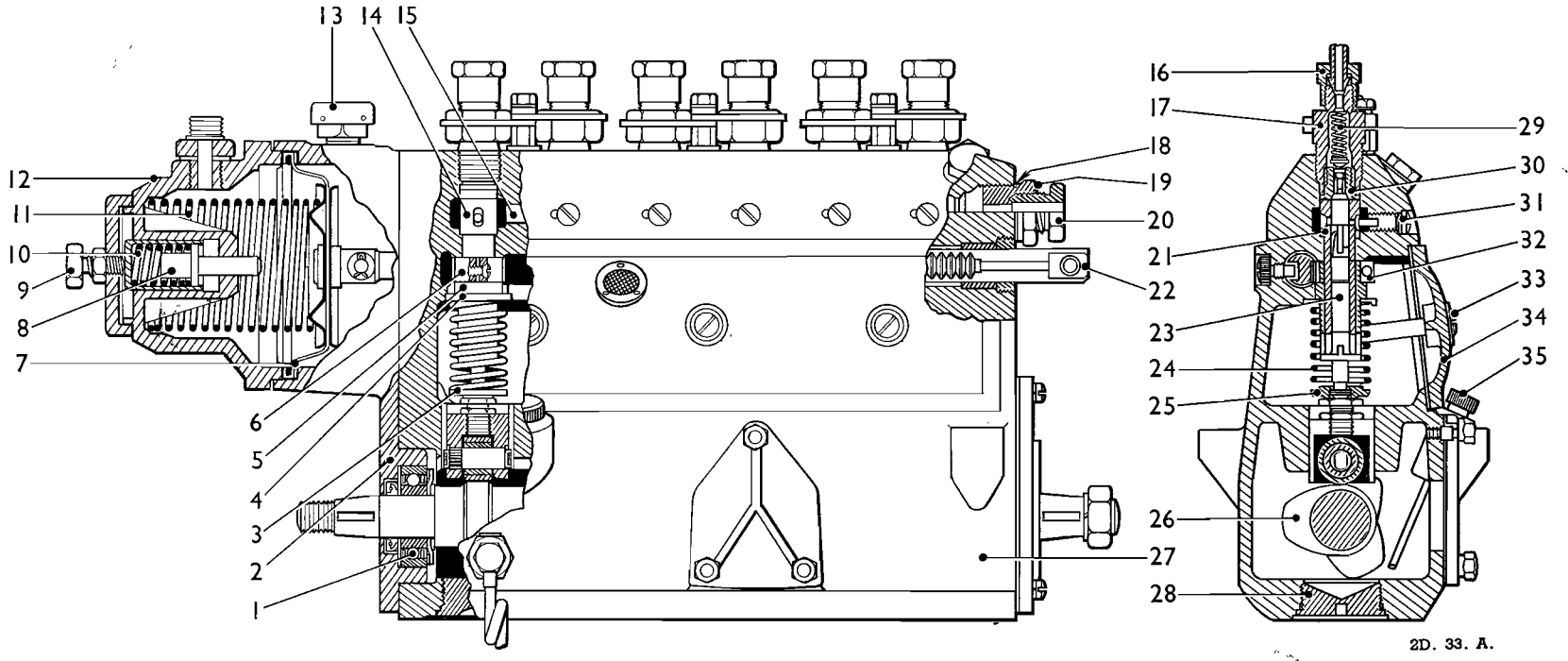


Fig. G9. *The fuel injection pump.*

1. *Ball Bearing.*
2. *Bearing end plate.*
3. *Spring plate lower.*
4. *Spring plate, upper.*
5. *Regulating sleeve.*
6. *Regulating toothed quadrant.*
7. *Diaphragm.*
8. *Auxiliary idling plunger.*
9. *Auxiliary idling set screw.*
10. *Idling spring.*
11. *Main diaphragm spring.*
12. *Housing.*
13. *Governor breather.*
14. *Pump element.*
15. *Suction chamber.*
16. *Delivery nipple nut.*
17. *Delivery valve holder.*
18. *Joint for 19.*
19. *Inlet connection stud.*
20. *Fuel inlet nipple nut.*
21. *Pump element barrel.*
22. *Control rod.*
23. *Pump element plunger.*
24. *Helical spring.*
25. *Tappet assembly.*
26. *Camshaft.*
27. *Housing.*
28. *Closing plug.*
29. *Delivery valve spring.*
30. *Delivery valve and seating.*
31. *Locking screw and joint.*
32. *Clamp screw.*
33. *Cover plate screw.*
34. *Cover plate.*
35. *Dipstick.*

NOTE.—*This illustration differs slightly from the injection pumps now used but the essentials are exactly the same.*

Comment has already been made on the extremely fine limits to which these parts are finished, so that the pump plunger and its barrel should always work together as a pair. The surfaces of these parts should never at any time be touched with a file, scraper, or other hard tool or any abrasive compound. **Should they be damaged, the entire injection pump should be sent to the nearest C.A.V. Service Station** for attention, rather than preliminary efforts be made with any form of grinding paste, powder or stone.

The delivery valve and seating should be treated in the same way, as these are similarly matched, and if trouble is experienced after they have been cleaned and rubbed together, the **pair** should be replaced from service parts stock.

In the case of multi-cylinder injection pumps, unless adequate facilities exist for dismantling the pump elements, control sleeves and control rod, it is important that this work should be referred to the nearest C.A.V. Service Station, in whose workshops will be found the necessary apparatus for ensuring that the controls are again assembled and adjusted to give the uniformity of delivery required. The importance of accuracy in this respect cannot be exaggerated, and a special power-driven machine has been devised to enable the calibration to be performed at high speed.

Examination of Plunger, Spring and Camshaft
(see Fig. G9)

1. Remove inspection cover plate (34).
2. Remove the bearing end plate (2) after rotating camshaft (26) to bring the tappet (25) to its top dead centre position and insert a tappet holder under the head of the tappet adjusting screw.
   (These tools can be obtained from any C.A.V. Station).
   This should be repeated for each element, when the camshaft (26) can be easily withdrawn. NOTE. The camshaft must be marked to ensure that it is replaced the right way round.
3. Unscrew the closing plugs (28) (with tool ET.105) at the base of the housing and push up the tappet until it is possible to withdraw the tappet holder, after which the tappet assembly, the lower plate spring (3), the plunger spring (24) and plunger may be withdrawn through the holes.

To Change Delivery Valve and Seating

Unscrew the delivery valve holder (17), withdraw the spring (29) and the delivery valve. The valve seating and its joint can now be removed by means of an extracting tool which is obtainable from any C.A.V. Service Station.

To Remove the Pump Barrel

Unscrew the locking screw (31) and push the barrel from below be means of a fibre or soft brass drift. This process involves complete readjustment to the delivery of the injection pump, and in the absence of adequate facilities the adjustment should be placed in the hands of an accredited C.A.V. Service Station.

Reassembling (Fig. G9)

In reassembling the pumps great care should be taken that all joints and other parts are entirely clean. They should be (a) rinsed in clean petrol (gasoline) or fuel oil, (b) allowed to drip, (c) smeared with a lubricating oil and finally brought together entirely without the use of cotton waste, rags, or cloth wipers of any kind.

1. Refit the barrel of the element carefully, observing that the slot in it is opposite the hole for the locking screw (31). Tighten down the locking screw after making sure that its joint is in place.
2. Refit valve seating and joint, carefully locating them in position in the pump housing. Replace delivery valve and its spring and finally fit delivery valve holder with its joint in position and screw down tightly.
3. Refit regulating quadrant (6), regulating sleeve (5), and upper spring plate (4).
4. Insert plunger with spring and the lower spring plate into the barrel, taking care that the lug on the lower edge of the plunger fits into the slot in the control sleeve, for which it is marked.
5. Insert tappet assembly (25) and press against the spring until the tappet holder can be located between the tappet adjusting screw and the pump housing. Operations 1 to 5 should be repeated for each element.
6. Refit camshaft (26) in its bearings in the pump housing taking care that it is fitted so that the correct firing order of 1, 3, 4, 2 will be maintained.

Note. The camshaft gives different firing orders according to the position in which it is placed in the pump. A 4-cylinder camshaft firing 1, 3, 4, 2 when reversed in the housing gives a firing order of 1, 2, 4, 3.

7. Refit the bearing end plate (2) and tighten securing screws removing the tappet holders from beneath adjusting screws.
8. Refit inlet connection union nut (20), and inlet closing plugs (28).
9. Smear the mitre joint face of the closing plug with white lead, or other sealing compound, and tighten up hard.
10. Fill the camshaft chamber with lubricating oil to the prescribed level with engine oil of SAE 30 grade.
11. Replace the inspection cover plate.

Refitting the Injection Pump

Fig. G10 illustrates the flywheel timing marks. In view of the 20 : 1 compression ratio of the engine, and the consequent difficulty of rotating the crankshaft, two sets of markings are provided so that the nearest set to the T.D.C. position may be used with greater convenience.

Timing the injection pump, so that the spill cut-off occurs at 28° B.T.D.C. is a simple operation, but great care must be taken to carry out the work accurately, otherwise the engine performance will not be up to standard.

With the timing chain wheels and chain assembled in their correct relationship to each other, as described in Section H, rotate the flywheel until the most convenient injection timing mark is vertical. Notice that these marks are INJ 1/4 and INJ 2/3 respectively, and that the test pipe 18G.223 must be connected, as later described, to the appropriate pump element. Therefore if the mark INJ 1/4 is used, the pump is timed on the elements No. 1 or No. 4, these being numbered from the front of the engine, and similarly on elements No. 2 or No. 3 if the INJ 2/3 mark is used.

Having set the flywheel in position, offer the injection pump to the engine. Ensure 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 its camshaft axis. Connect up the main fuel pipe from the filter to the injection pump.

Insert the barrel nut with its lockwasher and retaining washer in position under the head into the centre of the pump drive chain wheel, and screw onto the camshaft of the pump. In doing so, ensure that the spigot of the retaining washer engages with the recess in the bearing and that the locating tab of the lockwasher is positioned in its recess. **Ensure that the freewheel roller is in the driving position. Also ensure that the camshaft of the pump does not rotate.** This is best achieved by running two nuts onto the other end of the camshaft and locking them against each other. The camshaft can then be held with a spanner. Do not omit to knock over the lockwasher.

Unscrew the applicable element nut on the injection pump, according to the injection timing mark in use, i.e., No. 1 or No. 4 if this mark is set vertical, or No. 2 or 3 if this is more convenient. Take out the spring and valve,

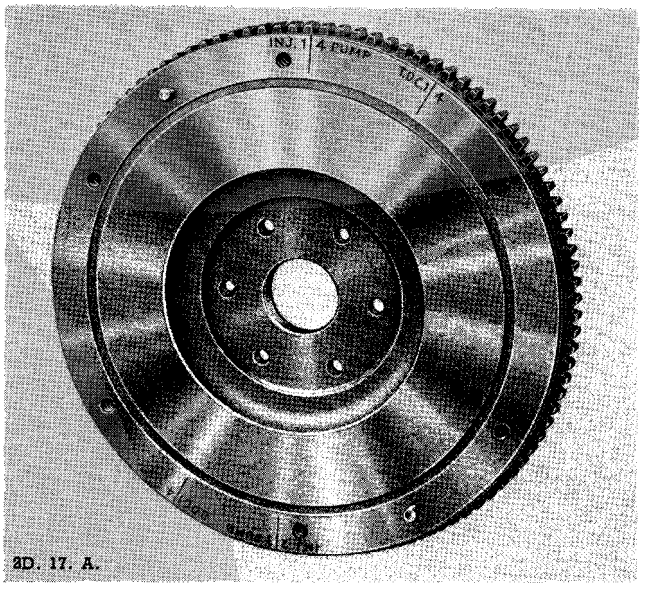


Fig. G10.
Illustrating the flywheel timing marks.

replace the valve holder and connect up the test pipe 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 tightened immediately. Slacken the bleed tap on the fuel injection pump casing and proceed in a similar manner. The system is now free from air up to the pump elements.

Now, rotate the injection pump about the axis of its camshaft, so that the elements move towards the engine. Very slowly rotate it away from the engine, and immediately the flow of fuel ceases from the test pipe, stop the movement. **Great care must be taken during this operation to ensure that the pawl of the freewheel is hard up against its drive. Use a spanner on the lock nuts on the camshaft, as previously described.** This is the pumps correct position, and the spill cut-off is now timed to occur at 28° before the top dead centre position of pistons 1 and 4 or 2 and 3 according to the flywheel timing marks used. Tighten down the pump flange bolts.

Disconnect the test pipe, and connect up the high pressure pipes to the pump elements and the injectors. Before starting the engine ensure that the camshaft chamber of the pump is filled with engine oil. Top up with the level plug removed until the oil flows from the orifice, and replace the plug.

SERVICE OPERATIONS

SERVICE JOURNAL REFERENCE

NUMBER	DATE	SUBJECT	CHANGES

SERVICE OPERATIONS

Adjusting the Tappet Clearance

Between the rocker arm head and the valve stem there must be a clearance of .012-in. (3.05 mm.).

To check this adjustment have the engine turned by the starting handle and note the point at which the push rod stops falling. From that point until it starts to move again there must be a clearance of .012-in. (3.05 mm.). Test with feeler gauge.

Note.—Always operate the engine stop control before turning the engine.

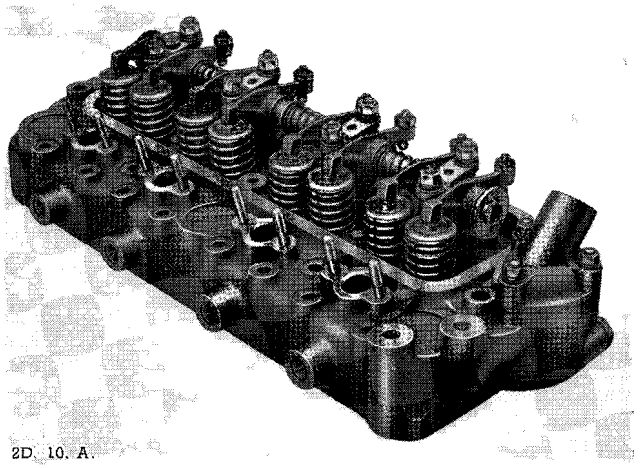


Fig. H1 *Showing the upper face of the cylinder head*

If adjustment is necessary, whilst continuously applying sufficient pressure to the adjusting screw with a heavy screwdriver slacken the lock nut, then raise or lower the adjusting screw in the rocker arm.

Tighten the lock nut when the adjustment is correct, but always check again afterwards in case the adjustment has been disturbed during the locking process. It is most advisable that this re-check of the clearance be made while the engine is at normal working temperature.

In replacing the valve cover take care that the joint washer, using a new one if necessary, is properly in place to ensure an oil-tight joint.

Removing the Push Rods

To remove the push rods it is not necessary to dismantle the valve gear beyond slackening the tappet adjustment.

Slacken the tappet adjustment to its full extent. With the aid of a screwdriver, supported under the rocker shaft, depress the valve and spring and then slide the rocker sideways free of the push rod. Remove the push rod.

In the case of the front or rear end rocker, however, it is necessary to take out the split cotter pin from the end of the shaft, when the rocker can be removed, together with the plain washer, and the push rod lifted out.

Replace in the reverse order.

Rocker Arm Bushes

While the rocker gear is detached from the head check for play between the rocker shaft and 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 arm and rocker shaft brackets may be removed.

The white metal bush is best removed using a drift (Service tool No. 18G21), and an anvil. The anvil should be recessed to retain the rocker in position while the bush is pressed or gently knocked out with the drift.

The flange of the drift must also be recessed to prevent the new split bush from opening when being driven into position. These new bushes are not supplied at a finished size, the internal diameter must be reamed to suit the shaft.

Decarbonising

For this operation it will be necessary to remove the manifolds, cylinder head, and push rods.

Scrape off all carbon deposit from the cylinder head and ports.

Clean the carbon from the piston crowns by scraping them with a piece of wedge-shaped hard wood. Care being taken not to damage the piston crowns and not to

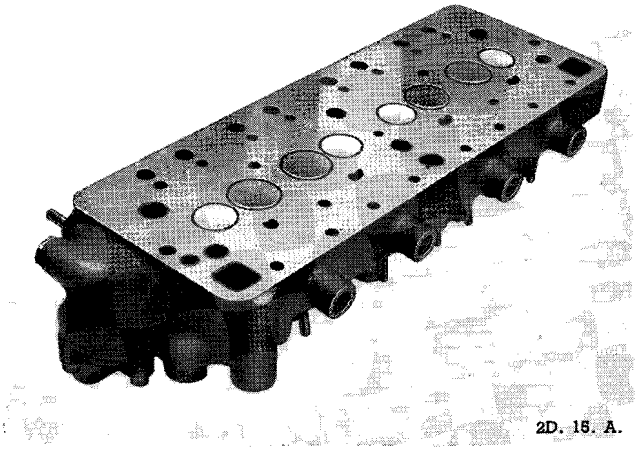


Fig. H2. *Showing the lower face of the cylinder head*

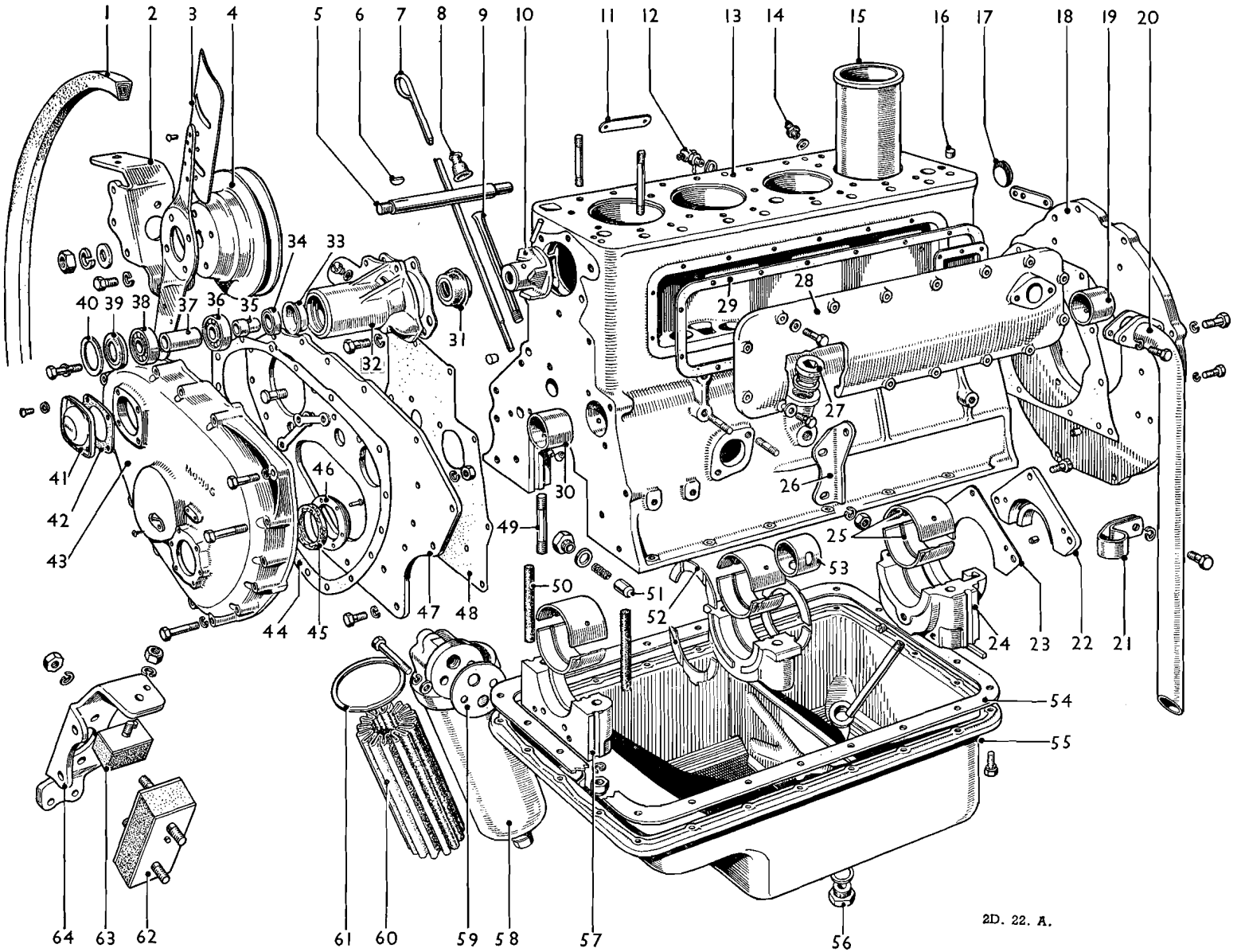


Fig. H3. *Engine Components exploded*

Fig. H3

1. *Fan belt.*
2. *Mounting bracket.*
3. *Fan.*
4. *Fan pulley.*
5. *Water pump spindle.*
6. *Key.*
7. *Dipstick.*
8. *Rubber boot for dipstick.*
9. *Dipstick tube.*
10. *Water pump impeller.*
11. *Serial number plate.*
12. *Cylinder block drain tap.*
13. *Cylinder block.*
14. *Oil pressure connection.*
15. *Cylinder liner.*
16. *Core plug.*
17. *Welsh plug.*
18. *Engine back plate.*
19. *Camshaft rear bearing.*
20. *Breather pipe.*
21. *Clip.*
22. *Crankcase rear cover.*
23. *Joint.*
24. *Rear main bearing cap.*
25. *Rear main bearing shells.*
26. *Dynamo mounting bracket.*
27. *Oil pump Cap Nut.*
28. *Tappet cover.*
29. *Cover joint.*
30. *Camshaft front bearing.*
31. *Water pump seal.*
32. *Water pump casing.*
33. *Cup.*
34. *Felt washer.*
35. *Distance piece.*
36. *Ball race.*
37. *Distance piece.*
38. *Ball race.*
39. *Grease retainer.*
40. *Split ring.*
41. *Injection pump drive cover.*
42. *Joint washer.*
43. *Timing case.*
44. *Joint washer.*
*45. *Oil seal.*
46. *Oil catcher.*
47. *Engine front plate.*
48. *Joint.*
49. *Main bearing cap stud.*
50. *Cork plugs.*
51. *Oil release valve.*
52. *Crankshaft thrust washer.*
53. *Camshaft centre bearing.*
54. *Joint washer, sump.*
55. *Sump.*
56. *Sump drain plug.*
57. *Front main bearing cap.*
58. *Main oil filter.*
59. *Joint washer.*
60. *Oil filter element.*
61. *Sealing ring, oil filter.*
62. *Rubber mounting.*
63. *Rebound stop.*
64. *Front mounting bracket.*

**Early engines up to No.* 229511 *were fitted with a felt oil seal. Later models have an 'O' type ring.*

allow dirt or carbon deposit to enter the cylinder barrels or push rod compartment.

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

Replacing the Cylinder Head

Refit the cylinder head gasket with the side marked "TOP" uppermost, having smeared both sides with grease to make a good joint and prevent sticking when the head is again lifted.

Replace the rocker gear if this has been removed.

Lower the head over the studs, replace the cylinder head nuts finger tight, and insert the tappet push rods.

Tighten the cylinder head nuts evenly, a quarter of a turn at a time, to a final figure of 75 lbs. ft.

Reset the tappets to .012-in. (3.05 mm.) and replace the valve cover.

Check the valve tappet clearance again after the vehicle has run about 100 miles 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 tappet clearances, although not usually enough to justify resetting. They should be rechecked, however.

Valves

Weak compression in any cylinder, in spite of correct tappet clearances, usually suggests that valve grinding is necessary, and the head should be removed for investigation.

Valve Timing

The inlet valve opens at 5° before T.D.C. and closes at 40° after B.D.C., whilst the exhaust opens at 60° before B.D.C. and closes at 5° after T.D.C. Valve clearance for timing .021″ (.53 mm.).

Removing and Refitting a Valve

With the cylinder head removed, a valve spring compressing tool No. 18G45 can be used to compress the spring.

Take away the circlip and the split cotters, then release the spring and remove the valve.

Reassembly is a reversal of the operations for removal. When fitting the split cotters it is also worth noting that the spring circlip should be replaced as soon as the cotters are in position. This saves holding the cotters in the groove while the spring is released.

Split the two halves of the spring cup between which there is an oil seal. If this oil seal shows any signs of damage or perishing, it should be renewed as its object is to prevent excess oil entering the valve guide.

When removing the valves, place them on a valve carrying board to enable them to be identified with the cylinder from which they have been taken.

Clean the carbon from the top and bottom of the valve heads, as well as any deposit that may have accumulated on the stems. The valve heads should, if necessary, be refaced at an angle of 45°. If the valve seats show signs of excessive pitting it is advisable to reface these also, using a pilot, tool No. 18G31, and handle No. 18G27, with cutter No. 18G28. If the seats are glazed, use tool No. 18G189.

The valves are without any indentures or slots in the head, and this necessitates the use of a suction rubber headed valve grinding tool.

Fig. H3

1. *Fan belt.*
2. *Mounting bracket.*
3. *Fan.*
4. *Fan pulley.*
5. *Water pump spindle.*
6. *Key.*
7. *Dipstick.*
8. *Rubber boot for dipstick.*
9. *Dipstick tube.*
10. *Water pump impeller.*
11. *Serial number plate.*
12. *Cylinder block drain tap.*
13. *Cylinder block.*
14. *Oil pressure connection.*
15. *Cylinder liner.*
16. *Core plug.*
17. *Welsh plug.*
18. *Engine back plate.*
19. *Camshaft rear bearing.*
20. *Breather pipe.*
21. *Clip.*
22. *Crankcase rear cover.*
23. *Joint.*
24. *Rear main bearing cap.*
25. *Rear main bearing shells.*
26. *Dynamo mounting bracket.*
27. *Oil pump Cap Nut.*
28. *Tappet cover.*
29. *Cover joint.*
30. *Camshaft front bearing.*
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33. *Cup.*
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39. *Grease retainer.*
40. *Split ring.*
41. *Injection pump drive cover.*
42. *Joint washer.*
43. *Timing case.*
44. *Joint washer.*
*45. *Oil seal.*
46. *Oil catcher.*
47. *Engine front plate.*
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50. *Cork plugs.*
51. *Oil release valve.*
52. *Crankshaft thrust washer.*
53. *Camshaft centre bearing.*
54. *Joint washer, sump.*
55. *Sump.*
56. *Sump drain plug.*
57. *Front main bearing cap.*
58. *Main oil filter.*
59. *Joint washer.*
60. *Oil filter element.*
61. *Sealing ring, oil filter.*
62. *Rubber mounting.*
63. *Rebound stop.*
64. *Front mounting bracket.*

**Early engines up to No.* 229511 *were fitted with a felt oil seal. Later models have an 'O' type ring.*

allow dirt or carbon deposit to enter the cylinder barrels or push rod compartment.

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

Replacing the Cylinder Head

Refit the cylinder head gasket with the side marked "TOP" uppermost, having smeared both sides with grease to make a good joint and prevent sticking when the head is again lifted.

Replace the rocker gear if this has been removed.

Lower the head over the studs, replace the cylinder head nuts finger tight, and insert the tappet push rods.

Tighten the cylinder head nuts evenly, a quarter of a turn at a time, to a final figure of 75 lbs. ft.

Reset the tappets to .012-in. (3.05 mm.) and replace the valve cover.

Check the valve tappet clearance again after the vehicle has run about 100 miles 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 tappet clearances, although not usually enough to justify resetting. They should be rechecked, however.

Valves

Weak compression in any cylinder, in spite of correct tappet clearances, usually suggests that valve grinding is necessary, and the head should be removed for investigation.

Valve Timing

The inlet valve opens at 5° before T.D.C. and closes at 40° after B.D.C., whilst the exhaust opens at 60° before B.D.C. and closes at 5° after T.D.C. Valve clearance for timing .021″ (.53 mm.).

Removing and Refitting a Valve

With the cylinder head removed, a valve spring compressing tool No. 18G45 can be used to compress the spring.

Take away the circlip and the split cotters, then release the spring and remove the valve.

Reassembly is a reversal of the operations for removal. When fitting the split cotters it is also worth noting that the spring circlip should be replaced as soon as the cotters are in position. This saves holding the cotters in the groove while the spring is released.

Split the two halves of the spring cup between which there is an oil seal. If this oil seal shows any signs of damage or perishing, it should be renewed as its object is to prevent excess oil entering the valve guide.

When removing the valves, place them on a valve carrying board to enable them to be identified with the cylinder from which they have been taken.

Clean the carbon from the top and bottom of the valve heads, as well as any deposit that may have accumulated on the stems. The valve heads should, if necessary, be refaced at an angle of 45°. If the valve seats show signs of excessive pitting it is advisable to reface these also, using a pilot, tool No. 18G31, and handle No. 18G27, with cutter No. 18G28. If the seats are glazed, use tool No. 18G189.

The valves are without any indentures or slots in the head, and this necessitates the use of a suction rubber headed valve grinding tool.

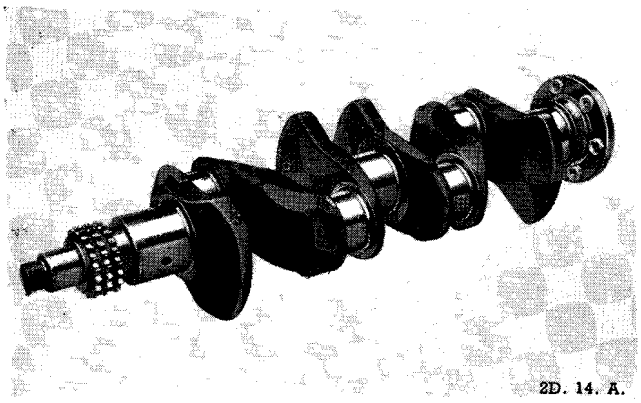

Fig. H4. *The Crankshaft*

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, lifting and advancing it a step at short intervals, until a clean and unpitted seating is obtained. The cutting action is facilitated by the periodical lifting of the valve from its seat. This allows the grinding compound to repenetrate between the two faces again, after being squeezed out.

On completion, all traces of the grinding compound must be removed from the valve and seating.

It is essential for each valve to be ground-in and refitted on its own seating as indicated by the number on the valve head. The valves are numbered 1 to 8, starting from the front. If a new valve is used it should be identified with its seating by stamping the number on the head, taking care not to distort the valve in the process.

It is also desirable to clean the valve guides. This can be done by dipping the valve stem in petrol (gasoline), or paraffin (kerosene) and moving it up and down in the guide until it is free. Reclean the valve and re-insert it in the guide, and replace the valve spring, cap, oil seal cotters, and circlip.

Valve Guides

The valve guides are of a one piece design, pressed into 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 present, the defective component should be renewed. If a valve is at fault the wear will usually be evident on the stem, but it should be borne in mind that the inlet valve and stem 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 the removal of the valve.

The drift used should be stepped in order to ensure location and to obviate it slipping off the guide and damaging the port. The guide should be knocked out, working on the plain and not the chamfered end.

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

Removing the Tappets

Remove the valve cover, slacken back the tappet adjustment and withdraw the push rods as described on page H/1.

Remove the cylinder side cover on the left-hand side of the engine.

Note that the cover joint is made with a cork washer. Carefully remove this washer. Renew, if it is damaged.

Remove the vent pipe attached to the side cover; it is flange mounted with two set screws.

The tappet plungers may be withdrawn from the crankcase by lifting them upwards with finger and thumb.

Replacement is a reversal of this operation, but take care to make an oil-tight joint with the side cover and the vent pipe.

Starting Nut and Belt Pulley

Using tool No. 18G96 or a suitable heavy box spanner, unscrew the starting nut on the crankshaft after knocking back the lock washer. The spanner will probably have to be hammered in order to "start" this nut, but a few fairly sharp blows in an anti-clockwise direction should be sufficient.

With the nut and its washer removed, the belt pulley and crankshaft damper can be withdrawn from the shaft.

Timing Cover

The timing cover is secured to the engine by means of the following:

Three nuts and bolts, $\frac{9}{16}$", A/F.
One stud, $\frac{9}{16}$", A/F.
Three nuts and bolts, $\frac{1}{2}$", A/F.
Ten set pins, $\frac{1}{2}$", A/F.

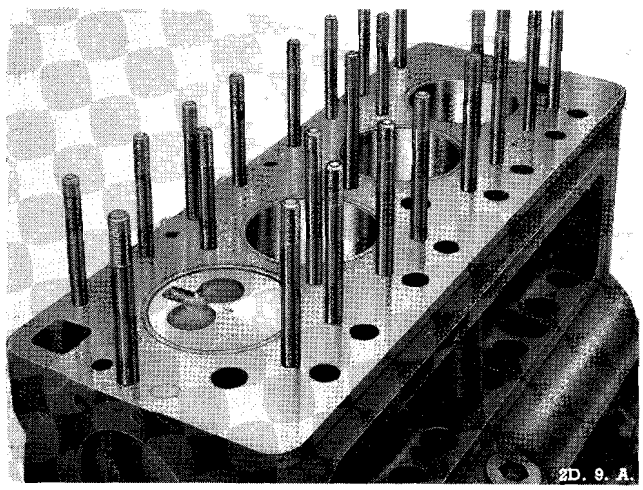

Fig. H5. *Showing the specially shaped piston crown*

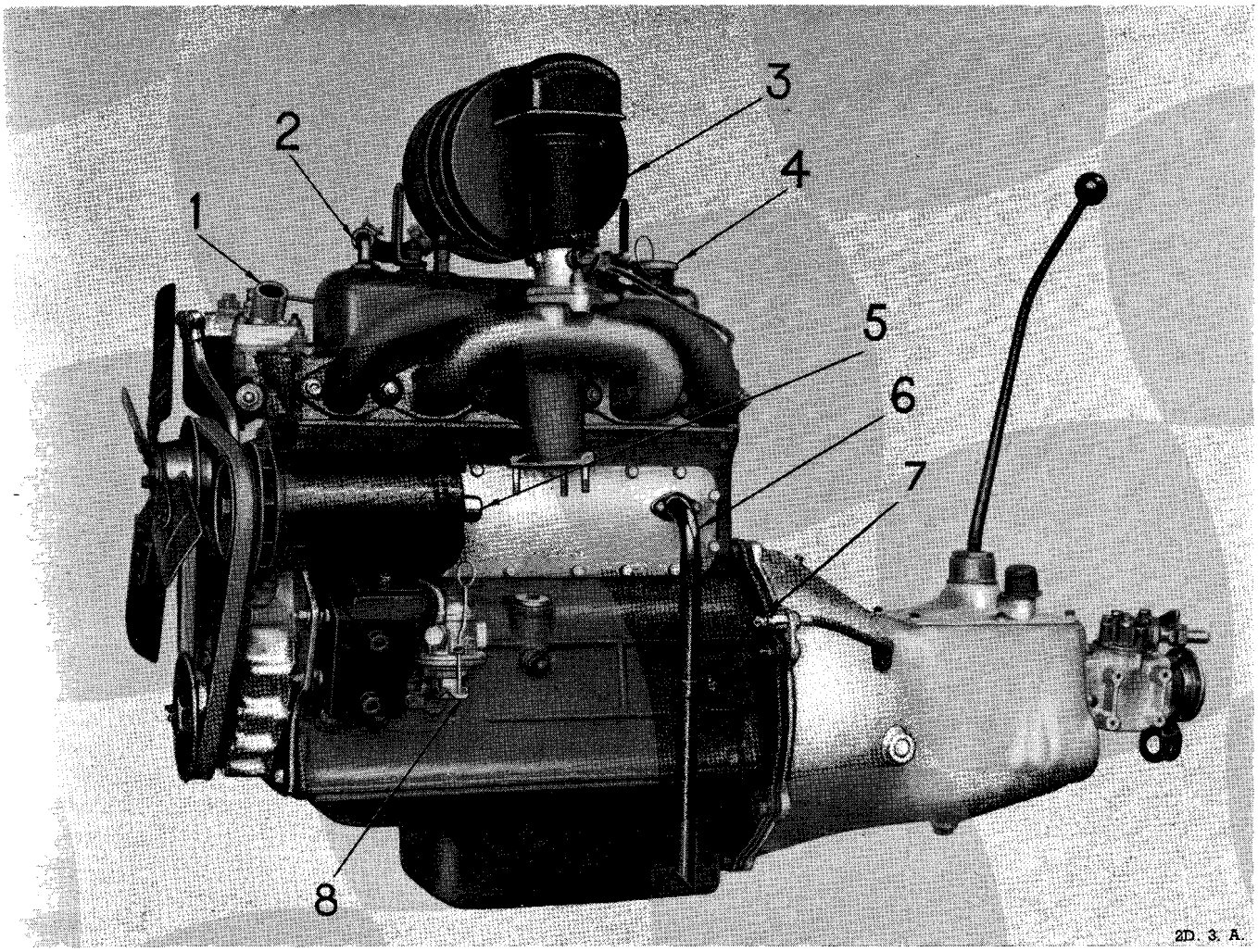

Fig. H6. *General view of engine*

1. *Upper hose connection.*
2. *Vent pipe.*
3. *Air cleaner.*
4. *Oil filler.*
5. *Dynamo.*
6. *Breather pipe.*
7. *Lubrication nipple clutch thrust.*
8. *Lift pump priming lever.*

NOTE. *Later engines have the oil filler at the front end of the rocker cover.*

On later engines a central bolt is also used, positioned through the centre of the timing cover.

Upon removal of these, the timing cover and joint washer can be removed and at the same time the oil thrower should be taken from the front of the crankshaft. Note the correct fitting to prevent oil from creeping to the fan pulley; the concave or hollow side must face forward; towards the pulley.

When re-assembling, do not damage the oil seal; make the joint carefully, using a new joint washer if necessary, and tighten the set screws evenly.

Front Suspension Plate

The engine front suspension plate can be removed by taking out the remaining set screws.

Removal of the Flywheel

Before removing the flywheel, rotate the engine crankshaft so that the notch in the belt pulley is in line with the arrow on the timing case. The engine is now set with No. 1 piston at Top Dead Centre.

After taking away the Clutch, the flywheel can be removed upon releasing the bolts attaching it to the crankshaft flange.

When replacing the flywheel ensure that the 1/4 Top Dead Centre mark is set vertical.

Rear Suspension Plate

The engine rear suspension plate may be removed, after the flywheel, by taking out the remaining set screws into the crankcase.

Pistons and Connecting Rods

There is an oil jet in the top half of the big-end bearing. Ensure that this lines up with the holes in the shell bearings to give free passage of oil.

To draw the pistons, the connecting rods have to be taken upwards through the cylinder bores; the sump and cylinder head have therefore to be removed.

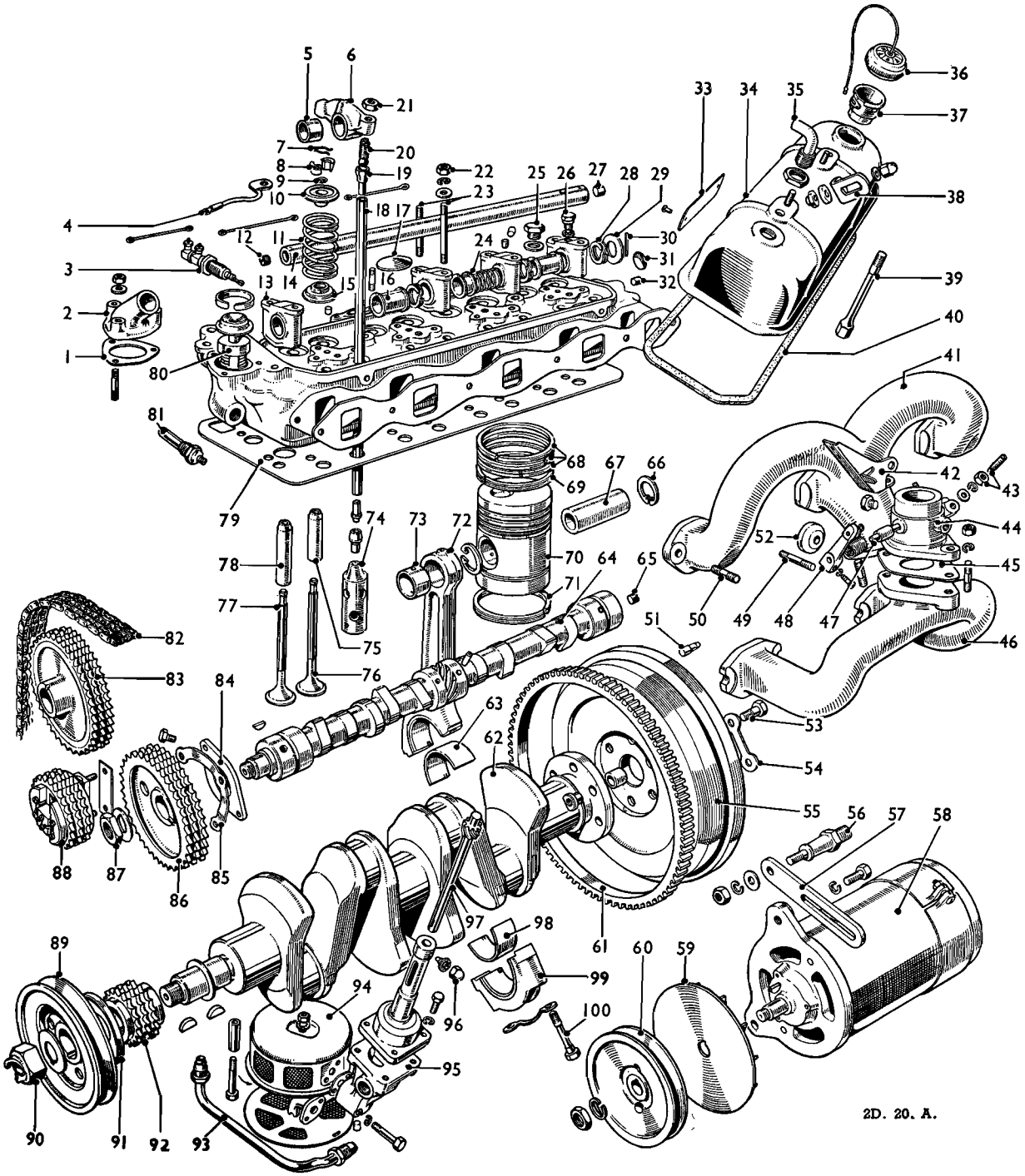

Fig. H7. *Engine Components.*

NOTE.—*The rocker cover is of cast aluminium on later engines.*

As from Engine 226988 heater plugs which differ visually are used. In addition, a chain damper is fitted below the top run of the timing chain.

Fig. H7

1. *Joint washer, thermostat.*
2. *Thermostat cover.*
3. *Heater plug.*
4. *Heater plug lead.*
5. *Rocker bush.*
6. *Rocker.*
7. *Spring clip.*
8. *Valve collets.*
9. *Rubber sealing ring.*
10. *Valve spring cap.*
11. *Valve spring.*
12. *Rocker shaft plug, screwed.*
13. *Rocker shaft standard.*
14. *Rocker shaft.*
15. *Valve spring locator.*
16. *Distance piece.*
17. *Welsh plug.*
18. *Push rod.*
19. *Push rod cup.*
20. *Rocker adjusting screw*
21. *Lock nut.*
22. *Nut.*
23. *Rocker standard studs.*
24. *Distance piece.*
25. *Blanking plug.*
26. *Blanking plug.*
27. *Rocker shaft plug.*
28. *Spring washer.*
29. *Plain washer.*
30. *Split pin.*
31. *Welsh plug.*
32. *Core plug.*
33. *Makers' name plate.*
34. *Rocker cover.*
35. *Breather pipe, rocker cover.*
36. *Oil filler cap.*
37. *Oil filler.*
38. *Lifting bracket.*
39. *Rocker cover stud.*
40. *Rocker cover joint.*
41. *Exhaust manifold.*
42. *Cable bracket.*
43. *Maximum speed stop screw and nut.*
44. *Venturi.*
45. *Joint washer.*
46. *Inlet manifold.*
47. *Butterfly spindle.*
48. *Venturi arm.*
49. *Manifold stud.*
50. *Exhaust manifold stud.*
51. *Flywheel locating dowel.*
52. *Manifold securing washer.*
53. *Flywheel set pin.*
54. *Locking plate.*
55. *Flywheel.*
56. *Dynamo mounting stud.*
57. *Dynamo swinging link.*
58. *Dynamo.*
59. *Dynamo cooling fan.*
60. *Dynamo pulley.*
61. *Starter ring.*
62. *Crankshaft.*
63. *Connecting rod upper bearing.*
64. *Camshaft.*
65. *Camshaft end plug.*
66. *Gudgeon pin circlip.*
67. *Gudgeon pin.*
68. *Compression rings.*
69. *Oil control ring.*
70. *Piston.*
71. *Lower oil control ring.*
72. *Connecting rod.*
73. *Small end bush.*
74. *Tappet.*
75. *Valve guide, inlet.*
76. *Inlet valve.*
77. *Exhaust valve.*
78. *Valve guide, exhaust.*
79. *Cylinder head gasket.*
80. *Thermostat.*
81. *Water temperature gauge connection.*
82. *Timing chain.*
83. *Injection pump chain wheel.*
84. *Camshaft retaining plate.*
85. *Locking plate.*
86. *Camshaft chain wheel.*
87. *Securing nut.*
88. *Chain tensioner.*
89. *Crankshaft pulley.*
90. *Starting handle dog.*
91. *Oil thrower.*
92. *Crankshaft chain wheel.*
93. *Pick-up pipe.*
94. *Oil strainer.*
95. *Oil pump.*
96. *Retaining cap nut, oil pump.*
97. *Oil pump drive shaft.*
98. *Connecting rod lower half bearing.*
99. *Big-end cap.*
100. *Big-end cap stud.*

Remove the split pins and nuts from the big end bearing cap and withdraw the cap. Before pushing the connecting rod through the bore check that the big end bearing bolts are still in position.

Remove the circlips to release the gudgeon pin and remove the piston. The gudgeon pin is a push fit in the piston.

Care should be taken in withdrawing the connecting rod and piston, or damage may be caused to the piston or the rings.

Check the crank pins for out-of-round and scoring; if either is present the crankshaft will have to be removed for grinding.

Connecting rods are numbered from 1 to 4, starting from the front and this numbering is stamped on both halves of the big end bearing. Note that the numbering is stamped on the side facing the camshaft when assembled.

The shell bearings are removed by hand and new bearings require no scraping or hand fitting, apart from placing in position so that the feathered ends are properly located on the top and bottom halves, and ensuring that the lead indium half bearing is placed in the upper position. This half bearing is distinguishable by the fact that it is a darker colour than the white metal lower half.

Replacing a Piston

Use tool No. 18G55 to compress the piston rings when replacing the pistons in the bores.

Oversize Piston Rings

After fitting oversize piston rings there may be a tendency to noisy operation unless attention is paid to any bore "lip" which may be present in the cylinder. A dial gauge in the cylinder will show the presence of such a "lip"; it should be eased with the aid of a hand scraper.

Bearings

These bearings can often be dealt with while the engine is in the chassis, but for major overhauls it is preferable to take out the engine unit complete, as they are most easily serviced with the engine inverted.

Centre Bearing

There are thrust washers fitted on each side of the centre bearing. See that the peg formed on each pair fits into the bearing cap. The maximum end float permissible is .003-in. (.076 mm.).

Bearing Caps

The front and rear main bearing caps have cork oil sealing plugs fitting into a drilling on each side. In rebuilding see that these plugs are in place and in good condition.

Provided the journals are not unduly worn new shell bearings can be fitted a pair at a time, simply by removing the bearing caps and exchanging the shells.

Handle the new shell bearing halves carefully as they have a very fine finish, and ensure that all dirt and grit is removed from the bearing caps and the journal faces.

Fig. H7

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3. *Heater plug.*
4. *Heater plug lead.*
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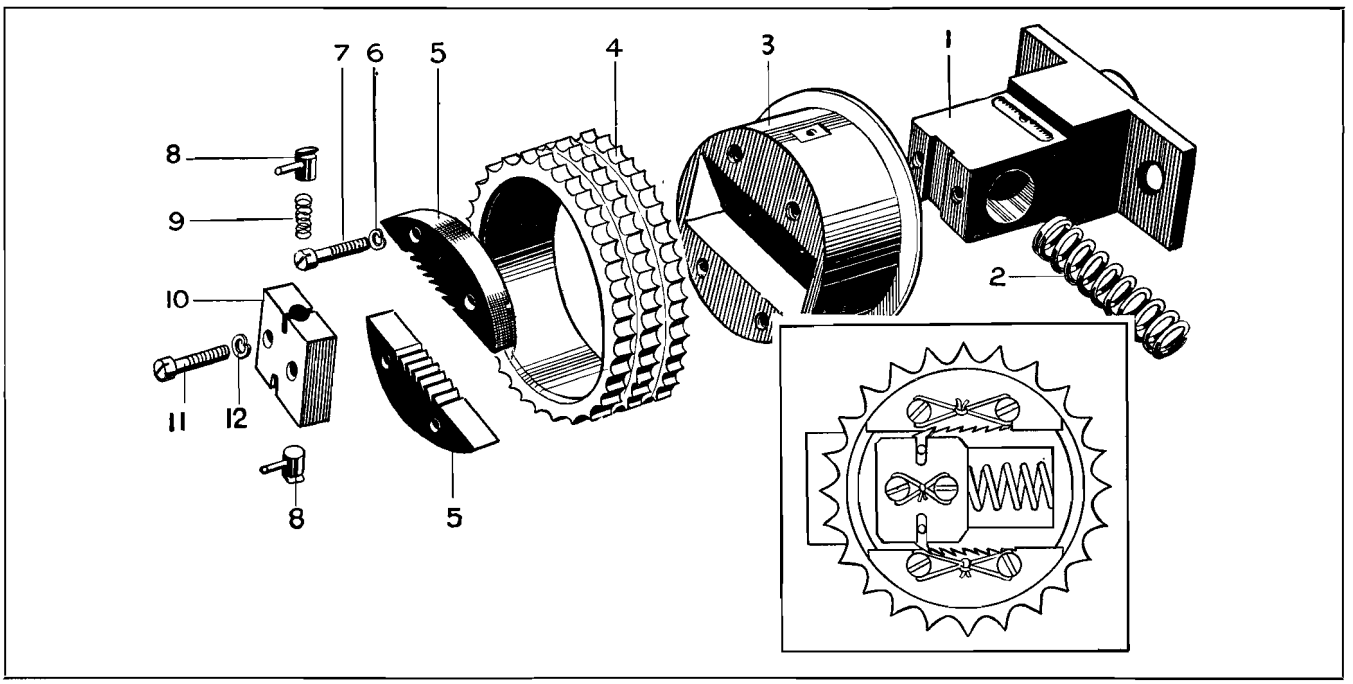

Fig. H8. *Timing chain tensioner exploded.*

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

Take care to place the white metal half bearing in the upper position, and the lead indium bearing at the bottom.

When fitting bearings ensure that all bearing caps are replaced the right way round by the stamp markings which must face the camshaft on re-assembly.

When replacing the split pins in the main bearing nuts, the ends should be bent back with pliers; hammering back should not be resorted to.

Timing Chain Tensioner

The tensioner ensures quiet running by constantly taking up the slack in the timing chain.

If rattles are diagnosed as coming from the timing chain, the chain alone should not be suspected. The tensioner may have deteriorated and if this is found to be so, it must be renewed.

To dismantle the tensioner proceed as follows:—

1. Break the locking wire and remove the set screws (7) securing the retaining plates (5) to the slide block (3) and the end plate assembly (10) to the shank; care must be taken not to lose the spring (9) and two pawls (8) in the end plate assembly.

   It is advisable to mark one of the retaining plates and its mating surface on the slide block to ensure correct reassembly.
2. Withdraw the slide block (3), spring (2) and wheel (4) off the shank.

To view and overhaul

1. Examine the bearing surfaces of the wheel and slide block for wear. If the running clearance is excessive, the wheel or the tensioner assembly, or both, should be renewed.
2. Examine the spring-loaded pawls for correct engagement in the retaining plate serrations. If they do not grip, the tensioner assembly should be renewed.
3. Examine the tension spring for weakness or signs of fracture.
4. Clear the oil feed passages with compressed air.

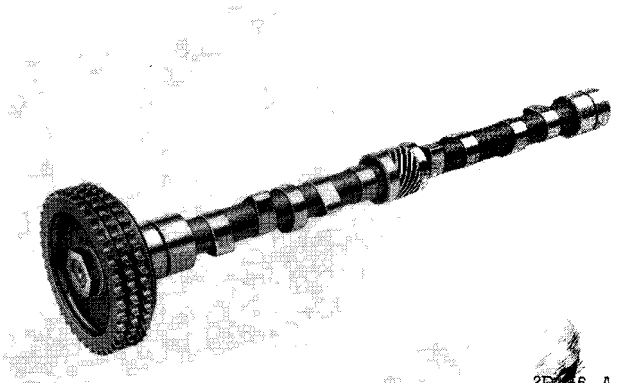

Fig. H9 *Showing the Camshaft*

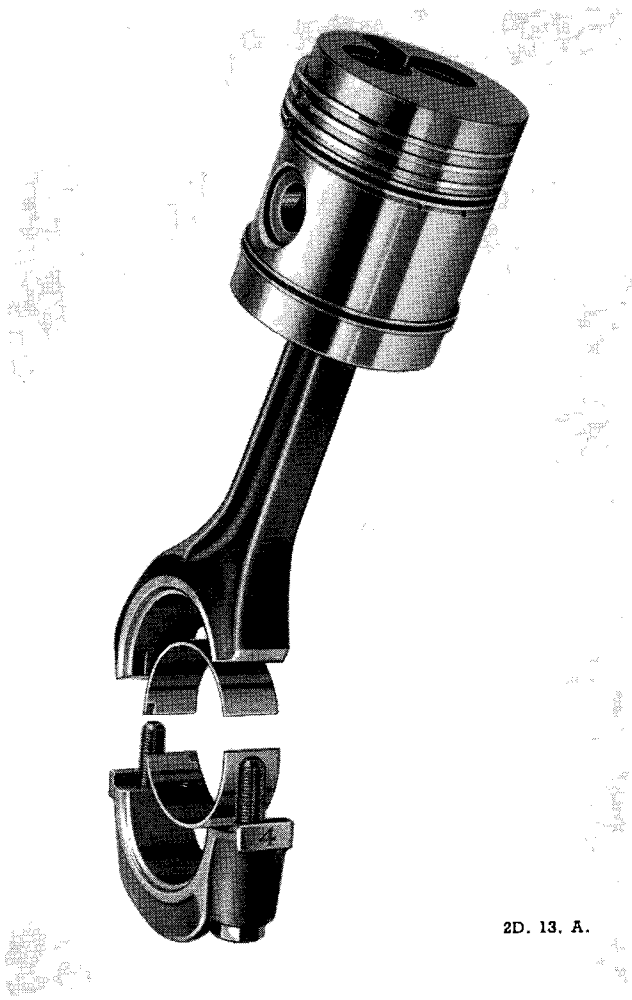

Fig. H10. *Piston and connecting rod assembly.*

5. Examine the teeth of the chain wheel; fit a new wheel if worn.

Note.—The tensioner assembly, excluding the chain wheel, can only be renewed as a complete unit when any component part is worn or damaged.

To reassemble

Reassembly is a reversal of the procedure "**To dismantle.**" Ensure that the pawls are refitted in the correct relative position to the retaining plate. Removal of the tensioner is described under "**Timing marks and chain.**" Lock the screws in pairs with soft locking wire.

Withdrawing the Camshaft

First remove the oil sump, the oil strainer and the oil pump.

The timing gear cover should then be removed together with the valve rocker cover and engine side cover. The push rods, tappets, timing gears and chain can now be taken away.

Unscrew the set screws and spring washers holding the locating plate to the crankcase, and draw the camshaft forward, rotating slowly to assist with withdrawal.

There should be a clearance of .003-in to .006-in. (.076 mm. to .152 mm.) between the camshaft gear and the camshaft shoulder when assembled to provide the necessary end float. Check this with a feeler gauge.

Camshaft Bearings

These can only be renewed with the engine out of the frame, as the engine rear mounting plate must be removed for access to the back bearing.

Old bearing liners can be punched out and new ones tapped into position. Oil holes must be carefully lined up.

All bearings must, however, be reamed in line to give .001-in. to .002-in. (.025 mm. to .051 mm.) clearance on each.

Replacing the Camshaft

Replacement of the camshaft is a reversal of the above procedure.

Timing Marks and Chain

When renewing a timing chain proceed as follows:

1. Remove the heater plugs from the cylinder head. Take off the rocker cover and completely remove the valve rocker shaft assembly. This is necessary so that the crankshaft, camshaft, and injection pump sprockets can be rotated by hand independantly of each other in order to bring the punch marks on them into the correct positions for lining up with the bright links of the timing chain.

   The rocker shaft is removed to obviate damage occuring to the valves and pistons of the engine when the sprockets are independantly moved. With the engine correctly timed, and the chain in position, the bright links and punch marks will only coincide once in every ninety-four revolutions of the crankshaft. It is therefore, of great advantage to be able to rotate

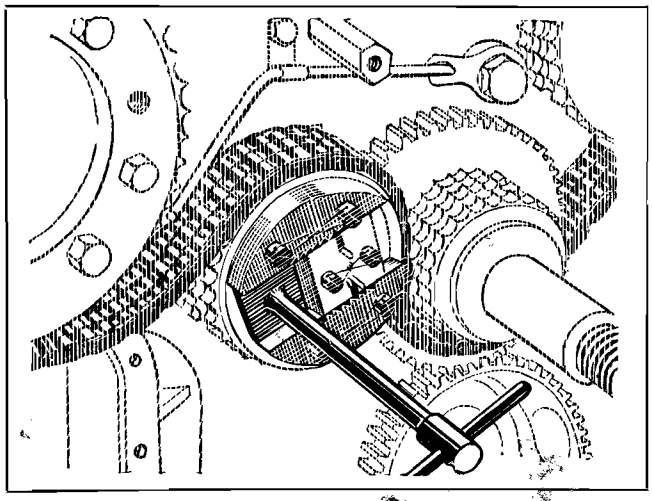

Fig. H11. *Method of using tool No. 18G241*

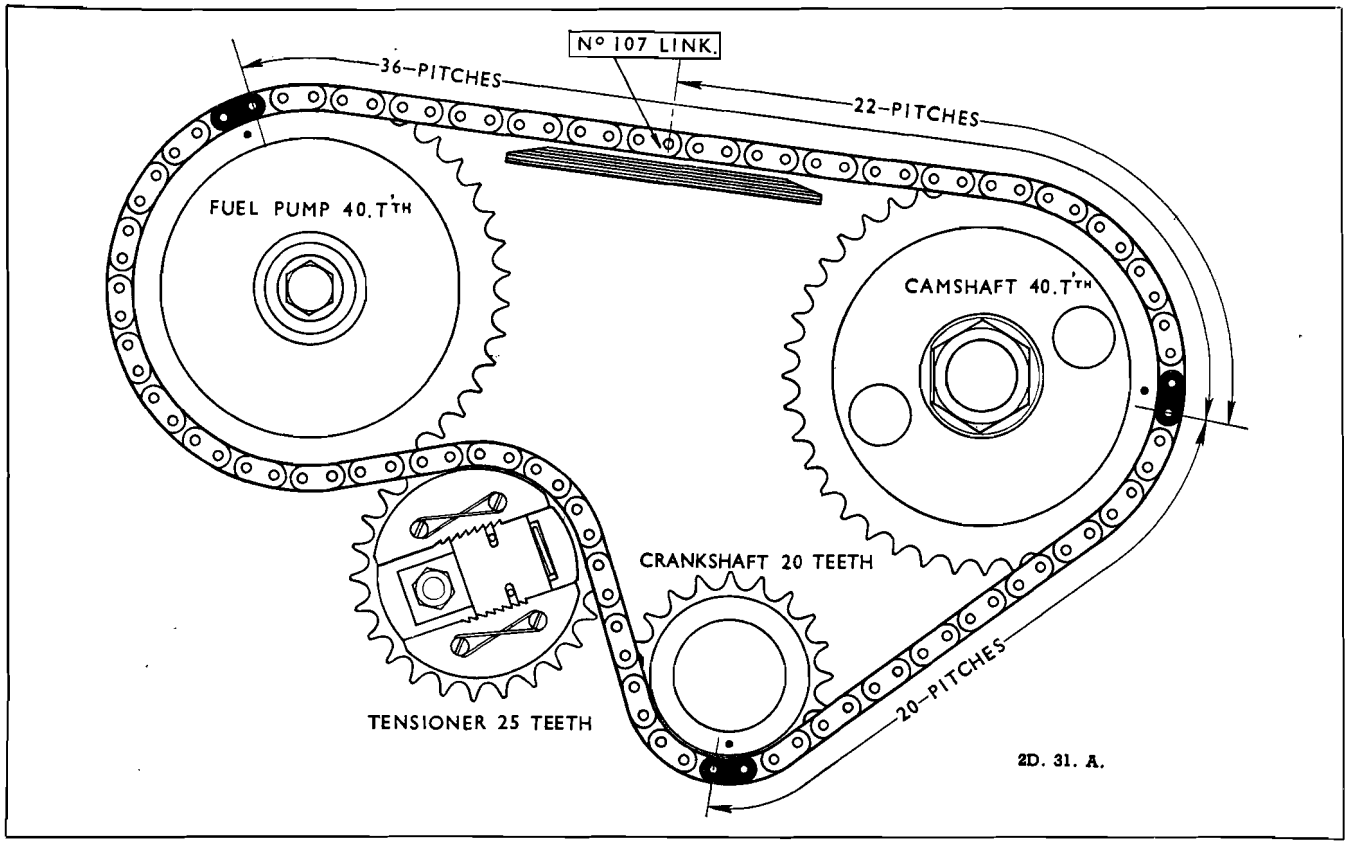

Fig. H12. *Timing chain drive.*
Showing the position of the marked teeth and bright chain links.

the sprockets independantly **but the preceding instructions must be carried out.**

2. To remove the timing chain it is necessary first to take off the automatic chain tensioner. Release the tab washers from the nut and set bolt, and, using a box spanner through the hole in the tensioner, unscrew the set bolt from the bracket. Release the two spring-loaded pawls by squeezing the pins together and push the chain wheel as far over as possible to compress the spring; wedge in position with a small strip of wood or by inserting assembly tool No. 18G241. Unscrew the nut from the other side of the bracket and ease off the tensioner clear of the chain. The chain will be sufficiently slack for removal from the other chain wheels. **Correct reassembly and functioning of the chain tensioner is of great importance, and care must be taken to ensure that it is correctly fitted, or the valves may foul the pistons, thus damaging the engine.**

3. Fit the new timing chain with the bright links and punch marks in register as shown in Fig. H.12 **ensuring that the injection pump chain wheel is hard up against its driving pawl.**

   Correct fitting of the chain is essential to ensure proper timing and to avoid damaging the engine through valve contact with the pistons.

   Note.—In all cases where the timing gears or chain have been renewed or altered, it is advisable to recheck that the injection timing occurs at 28° B.T.D.C.

4. To check the valve timing the valve clearance must be set to .021″ (.53 mm.). Reset to .012″ (.305 mm.) for running.

ELECTRICAL EQUIPMENT

SERVICE JOURNAL REFERENCE

NUMBER	DATE	SUBJECT	CHANGES

ELECTRICAL EQUIPMENT

GENERATORS

C39PV2 and C45PV5

Description

The generator is a two-brush-type machine operating in conjunction with a compensated voltage regulator and is air-cooled by a fan combined with the drive pulley at its forward end.

The generator comprises an armature with commutator field magnet system housed in a yoke, (cylindrical frame), and the brush gear. The brush holders are riveted to the commutator end bracket, which also houses the bearing for the armature shaft, the other end of the armature shaft being supported by a bearing located in the drive end bracket. The two end brackets are clamped to the yoke by two through-bolts.

Rotation of the armature in the magnetic field produced by the field magnets induces alternating voltages in the armature windings which are converted into direct current by the action of the brushes and commutator. The output of the generator depends upon the strength of the magnetic field and the speed at which the armature rotates. Normally, any variation of speed is accompanied by a change of output and, since the generator is driven at varying speeds, means must be provided to control the output. This is done by varying the strength of the magnetic field, the current value being controlled by an automatic voltage regulator.

Adjustments in situ

No external adjustments can be made to the generator. However, the commutator and brushes can be cleaned and the belt drive adjusted to overcome slipping. See also **"To test on the engine."** To adjust the belt drive tension, see Section D.

To test on the engine

If the generator does not charge properly or is inoperative, the fault should be diagnosed by tests, as follows:—

1. Check to see whether the fan belt is slipping.
2. Check that the cables between the generator and control box are connected correctly.
   (*a*) One cable connected between the (D) terminals of each unit.
   (*b*) One cable connected between the (F) terminals of each unit.
3. The following test should be made while the generator is cold:—
   (*a*) Disconnect the two cables from the two generator terminals and bridge the two terminals with copper wire.

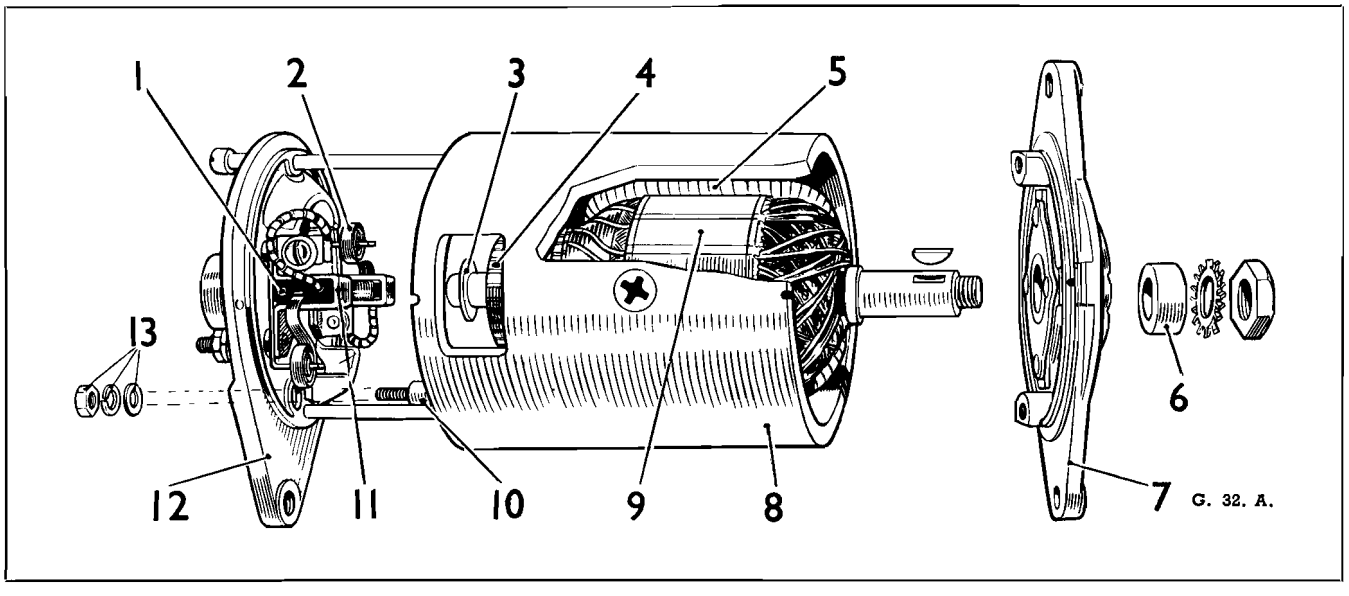

Fig. J1. *The Generator exploded.*

1. *Brush.*
2. *Brush spring.*
3. *Thrust collar.*
4. *Commutator.*
5. *Field coil.*
6. *Distance collar.*
7. *Driving end bracket.*
8. *Yoke.*
9. *Armature.*
10. *Field terminal.*
11. *Brush holder.*
12. *Commutator end bracket.*
13. *Field terminal nut and washers.*

(*b*) Connect the negative cable of a moving coil type voltmeter (range 0 to 20) to the bridging piece and the positive to earth.

(*c*) Start the engine, slowly increase the engine speed and note the reading on the voltmeter. This should gradually rise to 12 volts. Do not race the engine to increase this voltage. If these results are obtained the generator is operating satisfactorily. Do not prolong this test, otherwise serious damage to the generator may result, as under these conditions the generator is operating on open circuit and will quickly overheat.

4. Should the reading indicated on the voltmeter be low, no matter how fast the engine is speeding up, the generator is defective and the commutator and brush gear should be examined as follows:—

(*a*) Remove the generator cover band (later models withdraw end bracket).

(*b*) Check for sticking brushes by holding back the brush spring and moving the brush in its holder. If there is any tendency to stick, remove the brush and clean it with petrol (gasoline) or ease it with a smooth file. Check the brush spring tension by means of a spring balance. Spring tension should be 15 to 25 ozs. (425 to 708 gm.) (C39) and 30 to 44 ozs. (850 to 1247 gm.) (C45).

(*c*) If the commutator is dirty, lift the brushes away from the commutator surface and wedge them in their holders. Moisten a cloth in petrol (gasoline) and clean the commutator surface.

5. Re-test the generator. If the reading on the voltmeter is still unsatisfactory, an internal fault is indicated and the generator should be removed and dismantled for rectification.

6. If the generator is in good order, restore the original connections, remove the generator cable from the (D) terminal on the control box and connect a voltmeter between this cable and a good earthing point on the vehicle. Start the engine and slowly increase the engine speed, when the reading should be the same as that measured directly at the generator. No reading on the voltmeter indicates a break in the cable.

To remove

1. Disconnect the cables from the generator terminals.
2. Remove the set bolt securing the generator to the adjusting link.
3. Support the generator and remove the mounting bolts securing it to its support bracket.
4. Release the drive belt from the pulley and remove the generator.

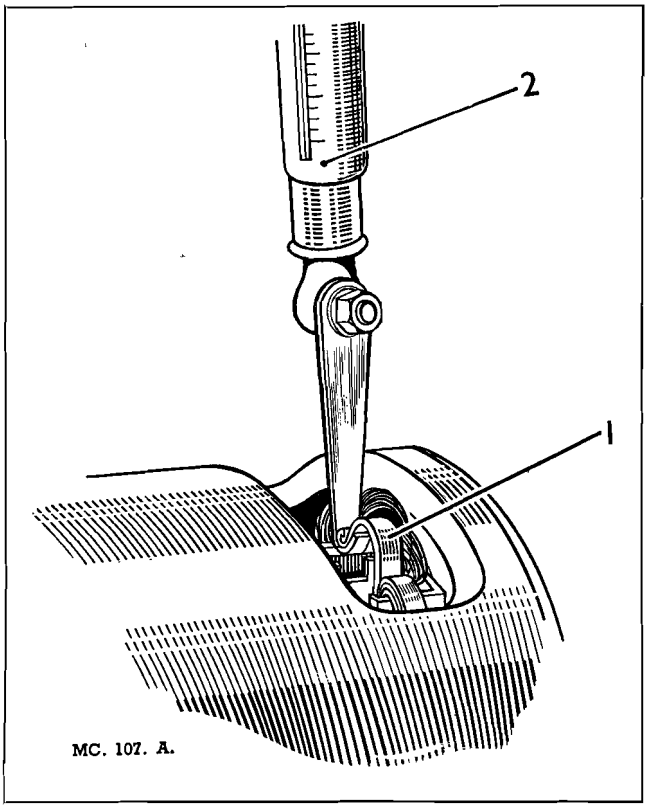

Fig. J2. *Testing brush spring tension.*
1. Spring. 2. Balance.

Dismantling the Generator

Remove the generator from its mounting bracket and transfer it to a clean work bench.

Take off the generator pulley by releasing the securing nut and washer. If the pulley is exceptionally tight on the shaft and woodruff key, use a suitable extractor such as tool 18G2. If fitted, remove the cover band, hold back the brush springs and remove the brushes from their holders.

Unscrew the nuts from the two through bolts at the commutator end of the generator and withdraw the bolts from the driving end.

Release the nut, spring washer and felt washer from the smaller terminal (i.e., field terminal) from the commutator end bracket and remove the bracket from the generator frame.

The driving end bracket together with the armature can now be lifted out of the generator yoke.

Commutator

Examine the commutator and if burned or blackened, clean with a petrol-moistened cloth, or in bad cases by polishing with very fine glass paper. If necessary, undercut the insulation to a depth of $\frac{1}{32}$ in. (.79 mm.) with a hacksaw blade ground down to the thickness of the insulation.

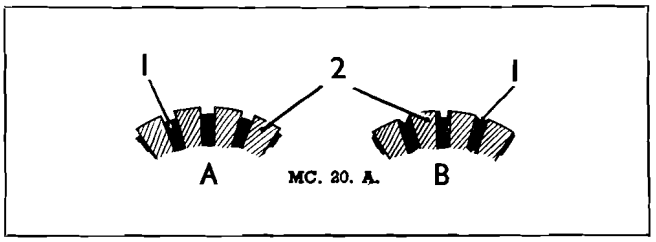

Fig. J3. *Undercutting mica.*
'A' is correct and 'B' incorrect.
1. Insulation. 2. Segments.

Armature

Check the armature by means of a growler test and volt drop test, and prove the condition of the insulation by connecting a test lamp, at mains voltage, between the commutator segments and the shaft.

Brushgear

Examine the brushes. If they are worn so that they do not make good contact on the commutator or if the brush flexible is exposed on the running face, take out the screw securing the eyelet on the end of the brush flexibles and remove the brushes. Fit new brushes into their holders and secure eyelets on the ends of the brush lead in the original positions. Brushes are pre-formed and in consequence do not require bedding.

Field Coils

Test the resistance of the field coils by means of an ohmmeter. The reading on the ohmmeter should be 6 ohms. If such an instrument is not available, connect a 12-volt D.C. supply with an ammeter in series, between the field terminal and the generator frame. The ammeter reading should be approximately 2 amps. If there is no reading, the field coils are open circuited and must be replaced.

To test for earthed field coils, unsolder the end of the field winding from the earth terminal on the generator yoke, and with a test lamp connected from the supply mains, check between the field terminal and generator yoke. If the lamp lights, the field coils are earthed and must therefore be replaced. To remove the field coils, use a wheel operated screwdriver.

When replacing field coils, an expander should be used so as to press the pole shoes into position. A few taps on the outside of the generator frame with a copper-faced mallet will assist the expander to seat the pole shoes. When the pole shoes are finally home, fully tighten up the fixing screws using the wheel operated screwdriver and caulk, to lock them in position.

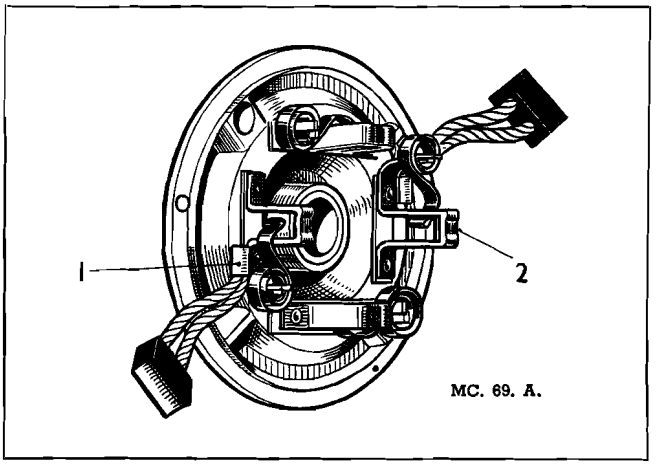

Fig. J4. *Commutator end bracket.*
1. Brush connection. 2. Brush housing.

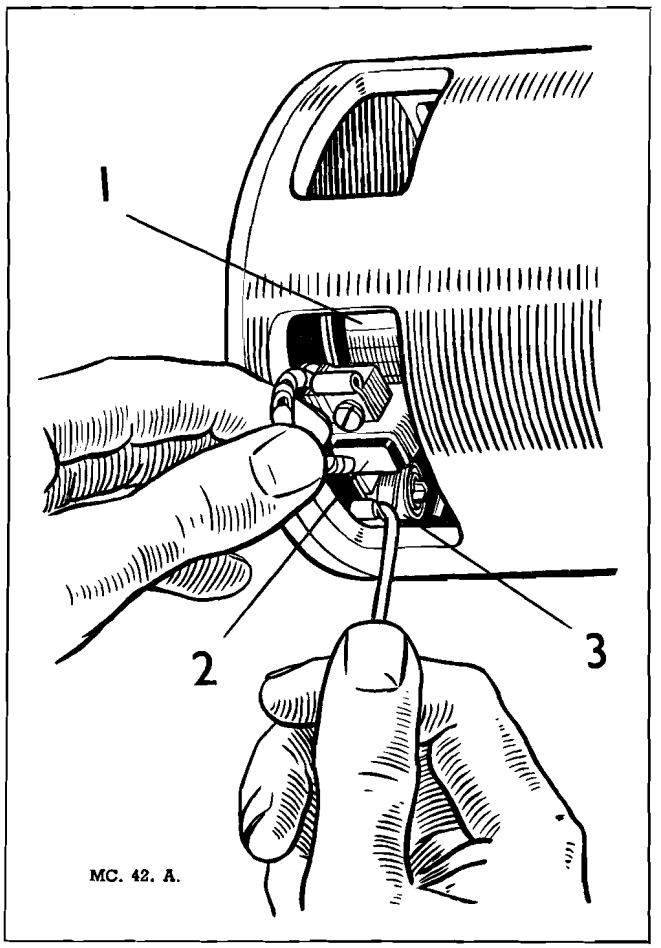

Fig. J5. *Removing a brush.*
1. Commutator. 2. Brush.
3. Spring.

Bearings

Bearings which are worn to such an extent that they will allow excessive side movement of the armature shaft must be renewed.

Commutator End

To remove and replace the bearing bush at the commutator end proceed as follows:—

(*a*) Press the bearing bush out of the bracket by means of a hand press or bench drill.

(*b*) 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.

Note: Before fitting a new porous bronze bearing bush, it should be immersed for 24 hours in clean thin engine oil.

Driving End

The ball bearing at the driving end is replaced as follows:—

(*a*) Knock out the rivets which secure the bearing retaining plate to the end bracket and remove the plate.

(*b*) Press the bearing out of the end bracket and remove the corrugated washer, felt washer and oil retaining washer.

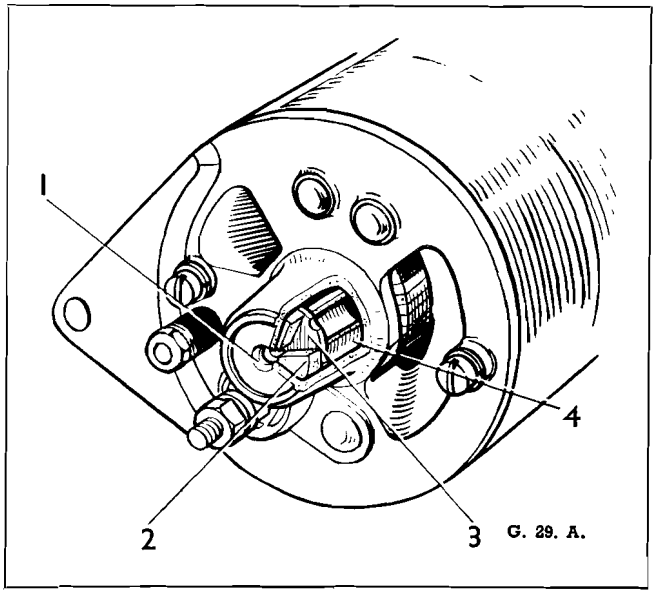

Fig. J6. *Generator Lubrication.*
1. Oil hole. *3. Aluminium disc.*
2. Felt ring. *4. Bronze bush.*

(*c*) Before fitting the replacement bearing see that it is clean and lightly pack it with high melting point grease.

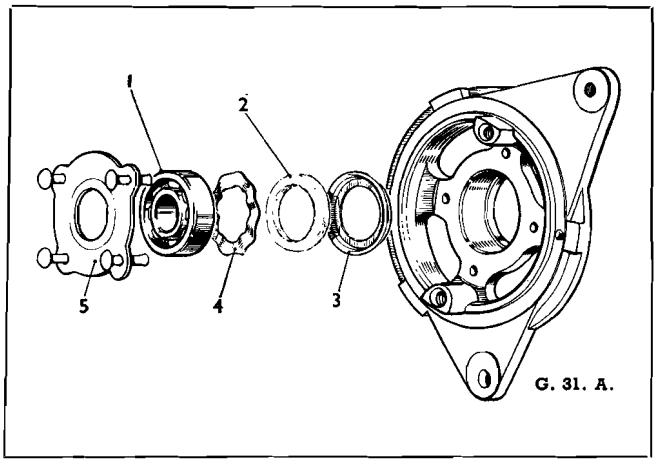

Fig. J7. *Generator drive end bracket.*
1. Bearing. *3. Oil retaining washer.*
2. Felt washer. *4. Corrugated washer.*

(*d*) Place the oil retaining washer, felt washer and corrugated washer in the bearing housing in the end bracket.

(*e*) Locate the bearing in the housing and press it home by means of a hand press.

(*f*) Fit the bearing retaining plate. Insert new rivets from the outside of the end bracket and open the rivets by means of a punch to secure the plate rigidly in position.

Reassembling the Generator

In the main, reassembly of the generator is a reversal of the dismantling procedure.

When reassembling a "windowless" generator the brushes must first be held clear of the commutator in the usual way, i.e., by partially withdrawing the brushes from their holders until each brush is trapped in position by the side pressure of its spring.

The brushes can be released onto the commutator with a small screwdriver or similar tool when the end bracket is assembled to within about half an inch of the yoke.

Before closing the gap between the bracket and yoke, see that the springs are in correct contact with the brushes.

PRE-ENGAGED STARTER MOTOR

TYPE M45G

Description

The use of pre-engaged starting motors to start diesel engines is a matter of engine characteristics rather than of choice. Following the first firing stroke of a low-temperature start, it is common for a compression-ignition engine to make several idle revolutions. Due in part to ignition of the fuel-air mixture, and in part to high compression ratio, the engine will accelerate rapidly following an initial isolated firing stroke. This acceleration can be much greater than that of a petrol engine (despite the heavier flywheel normally fitted to the diesel engine) and could cause an inertia type starter drive to be thrown out of engagement. It is usual therefore to employ a starting motor of the type where the pinion is

held in mesh with the flywheel until the engine develops enough power to run unassisted.

Special protective features associated with the pre-engaged starter include a clutch plate drive guarding against over-running in the event of the drive remaining engaged after the engine has run up to speed, and against over-loading due to backfire or in the event of drive re-engagement at a moment of engine rock-back.

General

The starting motor is a 12 volt, four-brush four-pole machine constructed to provide pre-engagement of the driving pinion before torque is developed by the armature. It has a yoke diameter of $4\frac{1}{2}$ inches. A lever-operated pre-engaged drive assembly is carried on the armature shaft extension. In the event of tooth-to-tooth engagement, this pre-engagement feature is overruled by the action of a compression spring which, on operating the starter lever, allows the pilot switch contacts to close in the normal way, thus energising a solenoid starter switch and causing the armature to rotate and the specially sectioned pinion teeth to slip immediately into mesh with the flywheel.

Also incorporated is a dual-purpose clutch. This protects the motor from overload in the event of a backfire and also prevents the motor from being driven by the diesel engine flywheel. The clutch is shim-set during manufacture to slip against two or three times normal full load starting torque. The clutch also allows torque to be transmitted from the starting motor to the engine but not in the reverse direction which is free-running. In the event of the drive remaining in mesh with the flywheel after the engine has run up to speed, no damage will occur to the starting motor. Details of drive and clutch assembly are given on page J/9.

Operation

When starting the engine, a spring-loaded forked lever slides the clutch and driving pinion assembly outwards along the armature shaft extension. The shaft is straight-splined for part of its length so that torque is transmitted, via the clutch, to the pinion. As the latter meshes with the engine flywheel, the final movement of the forked lever operates a pilot switch connected in the solenoid circuit of the main starter switch. Closure of the starter switch contacts connect the motor to the battery, the armature rotates and cranking commences.

When the engine fires and the forked lever is released, the switch contacts open and the drive assembly is returned to its out of mesh position where it is held under spring pressure against a braking ring mounted on the intermediate bracket. In this way, the starting motor armature is brought rapidly to rest.

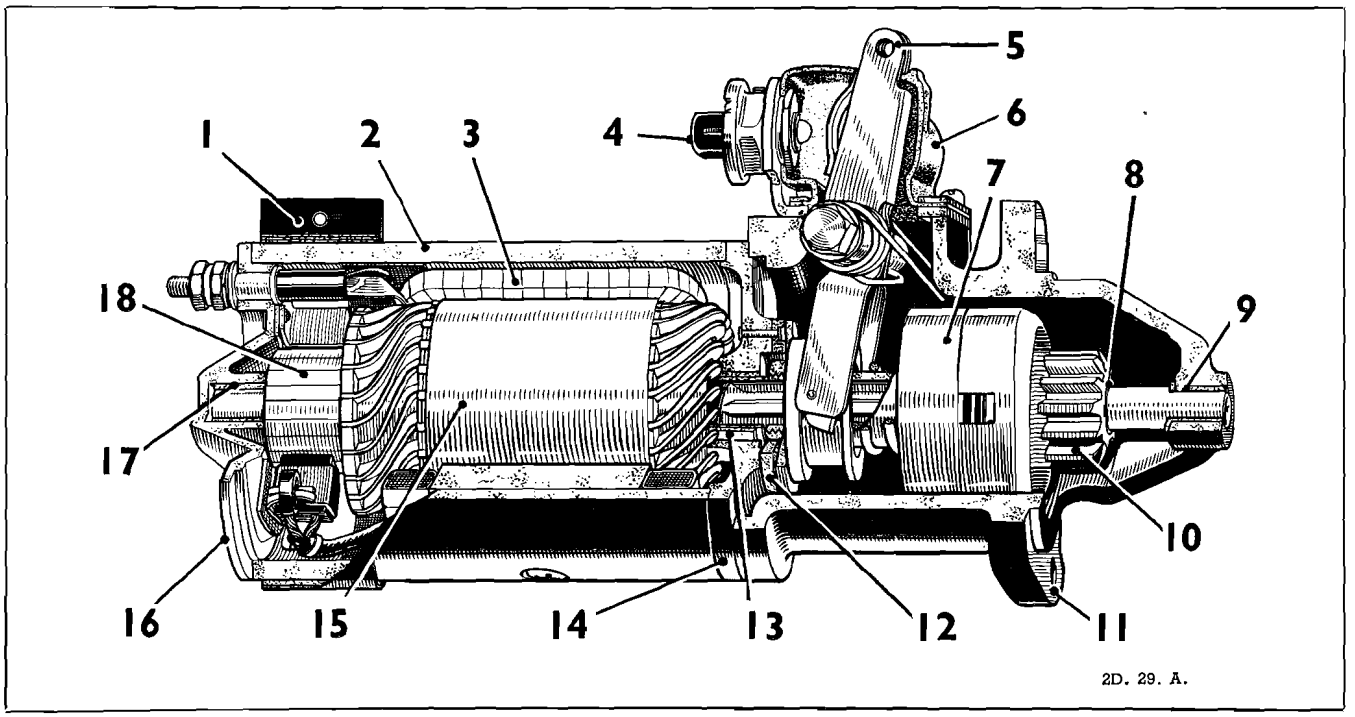

Fig. J8 *A cutaway view of the starter.*

1. *Commutator cover band.*
2. *Yoke.*
3. *Field coils.*
4. *Pilot switch.*
5. *Operating lever.*
6. *Rubber cover.*
7. *Clutch assembly.*
8. *Steel backed bronze bush.*
9. *Porous bronze bush.*
10. *Driving pinion.*
11. *Drive end bracket.*
12. *Brake ring.*
13. *Impregnated brass bush.*
14. *Intermediate bracket.*
15. *Armature.*
16. *Commutator end bracket.*
17. *Porous bronze bush.*
18. *Commutator.*

Routine Maintenance

The only maintenance normally required by the starting motor is an inspection about every six months of the brush-gear and commutator. In some instances, this may be facilitated by first removing the starting motor from the engine.

Clean the outside of the starter before removing the metal band cover. Check that the brushes move freely in their holders by holding back the brush springs and pulling gently on the flexible connectors. If a brush is inclined to stick, remove it from its holder and clean its sides with a petrol-moistened cloth. Be careful to replace brushes in their original positions in order to retain the "bedding". Brushes which have worn so that they will not "Bed" properly on the commutator must be renewed.

The commutator should be clean, free from oil or dirt and should have a polished appearance. If it is dirty, clean it by pressing a dry cloth against it while the starter is turned by hand from the pinion end. If the commutator is very dirty, moisten the cloth with petrol.

SERVICING

Testing in Position

If the motor is heard to operate but does not crank the engine, this indicates damage to the drive. Remove the starting motor for examination.

Connect a 0 to 20 voltmeter across the battery terminals and operate the starter control. If the voltmeter reading drops to about 6 volts, but the starting motor is not heard to operate, this indicates that current is flowing through the starting motor windings but that the armature is not rotating. Remove the starting motor from the engine for examination.

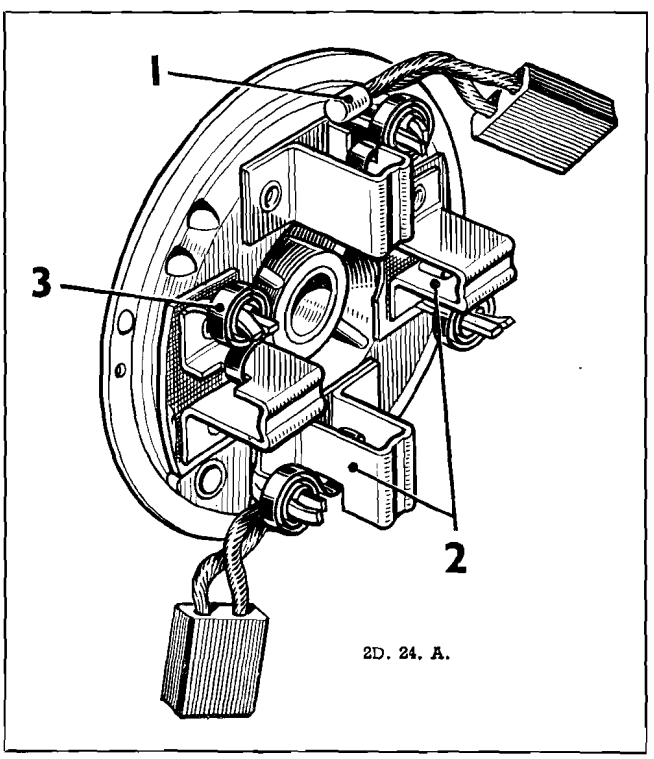

Fig. J9. *Starter end bracket.*
1. Terminal eyelet. 2. Brush boxes. 3. Brush spring.

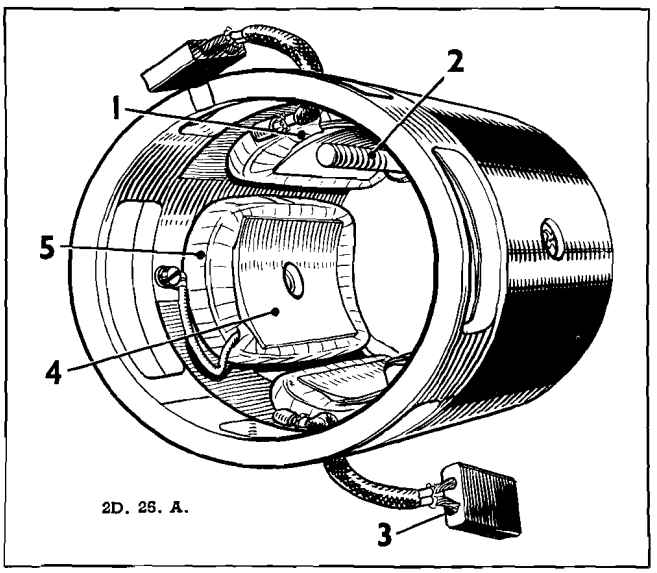

Fig. J10. *The starter yoke.*
1. Field coils. 2. Main terminal. 3. Brushes. 4. Pole shoes. 5. Shunt field coils.

If the voltmeter reading remains steady at about 12 volts when the starting mechanism is operated, check the circuit for continuity from battery to starting motor via the starter switch. Examine the connections at these units.

Sluggish or slow action of the starting motor can usually be traced to a loose terminal connection in the wiring circuit.

To Test the Starter Switch Circuit

Connect the voltmeter between the supply terminal of the pilot switch (mounted on the drive-end casting of the starting motor) and earth. No reading indicates a completely discharged battery, faulty cable or loose connection.

Connect the voltmeter between the second terminal on the pilot switch and earth. Operate the starter. No reading indicates a faulty pilot switch. To remove the switch, disconnect the pilot cables, pull back the rubber cover from the recess in the pilot switch lock nut, undo the lock nut and remove the switch. The switch adjustment must be checked before the motor is used again.

Connect the voltmeter to the small terminal on the main starter switch and to earth. Operate the starter and observe reading on voltmeter. No reading indicates faulty cable or loose connection.

Connect the voltmeter between the large supply terminal on the main starter switch and earth. No reading indicates faulty cable or loose connection.

Connect the voltmeter between the second large terminal on the main starter switch and earth, and operate starter. No reading indicates a faulty switch, which must be replaced.

If the pilot and main switches are in order, check with the voltmeter between the starter motor terminal and earth and operate the starter, when a reading of 6 to 7 volts should be obtained if the starter is operating normally. A lower or zero reading indicates a faulty internal connection, and the starter must be removed from the engine.

Bench Testing and Examination of Brushgear and Commutator

If it is necessary to remove the starting motor from the engine, first proceed as follows:—

Disconnect the cable from the positive battery terminal to prevent possible short circuits.

Disconnect the heavy cable from the starting motor terminal, and the light cables from the pilot switch.

Remove the pin which couples the starting motor operating lever to the operating linkage. Undo the three fixing bolts and withdraw the starting motor.

Hold the starting motor yoke in a vice and test by connecting it with heavy gauge cables to a 12-volt battery. One cable must be connected to the starter terminal and the other held against the body or end bracket. Pull back the operating lever slightly, to disengage the drive from the brake ring. Under these light load conditions the motor should run freely at about 4,500 r.p.m.

If the operation of the starting motor is unsatisfactory, remove the cover band and examine the brushes and commutator. Hold back each of the brush springs and move the brush by pulling gently on its flexible connector. If the movement is sluggish, remove the brush from its holder and ease the sides by lightly polishing on a smooth file. Always refit brushes in their original positions. Renew the brushes when they have worn to $\frac{5}{16}''$ in length. Failure to do this will result in exposure at the running face of the brush flexibles, with consequent damage to the commutator. Check the tension of the brush springs with a spring scale. The correct tension is 30 to 40 oz. (850 to 1134 grms.) and new springs should be fitted if the tension is low. If the commutator is blackened or dirty, clean it by holding a petrol-moistened cloth against it whilst the armature is rotated.

Re-test the starter; if the operation is still unsatisfactory, the unit must be dismantled for detailed inspection and testing.

To Dismantle

Remove the cover band, hold back the brush springs and lift the brushes from their holders.

Remove the four screws which hold the pilot switch bracket and rubber cover. Lift off the complete pilot switch assembly.

To release the pinion return spring, use a notched screwdriver or similar tool and press the spring legs inwards and upwards.

Undo the hexagon nut securing the operating lever pivot bolt. Knock out the bolt using a $2\frac{1}{2}'' \times \frac{3}{8}''$ drift. The assembly of lever, distance collars and return spring may then be lifted out and will form a complete unit ready for re-assembly.

Unscrew the nut on the starting motor terminal and remove the spring washer, plate washer, and insulating washer from the terminal stem. Unscrew and withdraw the two through bolts from the commutator end bracket, and remove bracket from the starter motor yoke.

Remove the driving end bracket; the drive and clutch assembly can then be slid off the armature shaft extension. Remove the intermediate bracket from the starting motor yoke. Draw out the starting motor armature carefully.

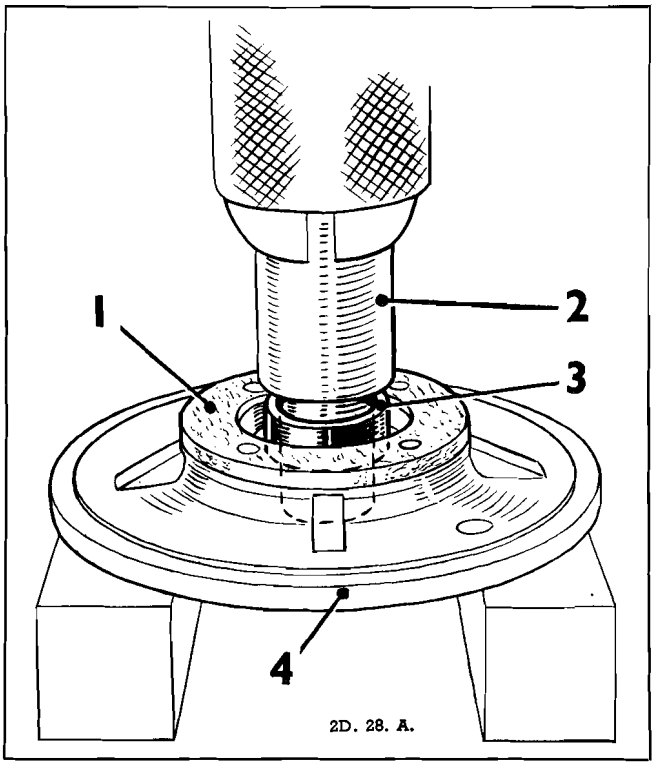

Fig. J11. *Starter intermediate bracket.*

1. Brake ring. *3. Bush.*
2. Mandrel. *4. Intermediate bracket.*

Replacement of Brushes

The flexible connectors are soldered to terminal tags; two are connected to brush boxes, and tow are connected to the free ends of the series field coils. These flexible connectors must be removed by unsoldering, and the flexible connectors of the new brushes secured in their places by soldering. The brushes are pre-formed so that "bedding" to the commutator is unnecessary.

Commutator

A commutator in good condition will be burnished and free from pits or burn spots. Clean the commutator with a petrol-moistened cloth. Should this be ineffective, 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 lather, rotate at high speed and take 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.

Armature

Examination of the armature may reveal the following causes of failure.

Conductors lifted from the end or ends of the armature core; this would indicate overspeeding or overheating. In either case the clutch would be suspect.

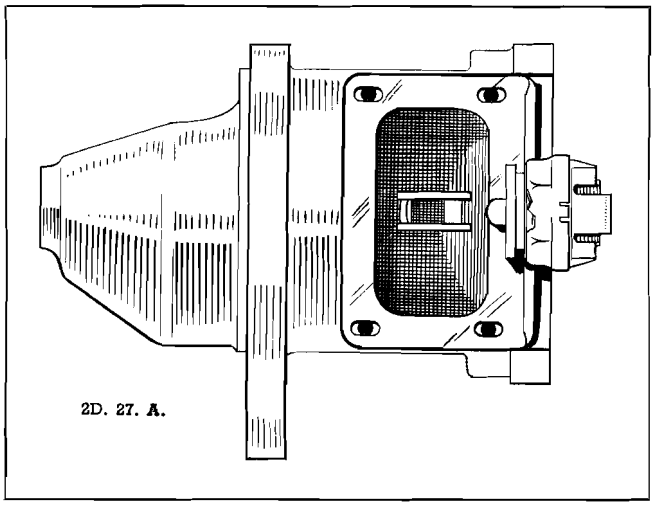

Fig. J12.

Starter operating mechanism with cover removed. Showing elongated holes for adjustment of switch

Fouling of armature core against the pole faces. This indicates worn bearings or a distorted shaft. A damaged armature must in all cases be replced and no attempt should be made to machine the armature core or to true a distorted armature shaft.

Field Coils

Test the field coils for continuity using a 12-volt test lamp and battery between the starter terminal and each brush in turn (with the armature removed from machine). Make sure that both brushes are clear of the yoke.

Using a mains test lamp check between the common field terminal and the yoke. (When using the mains for testing, the voltage should be not more than 110 volts supplied through a suitable transformer.) Should the lamp light, faulty insulation is indicated of one or more coils. Defective coils must be replaced.

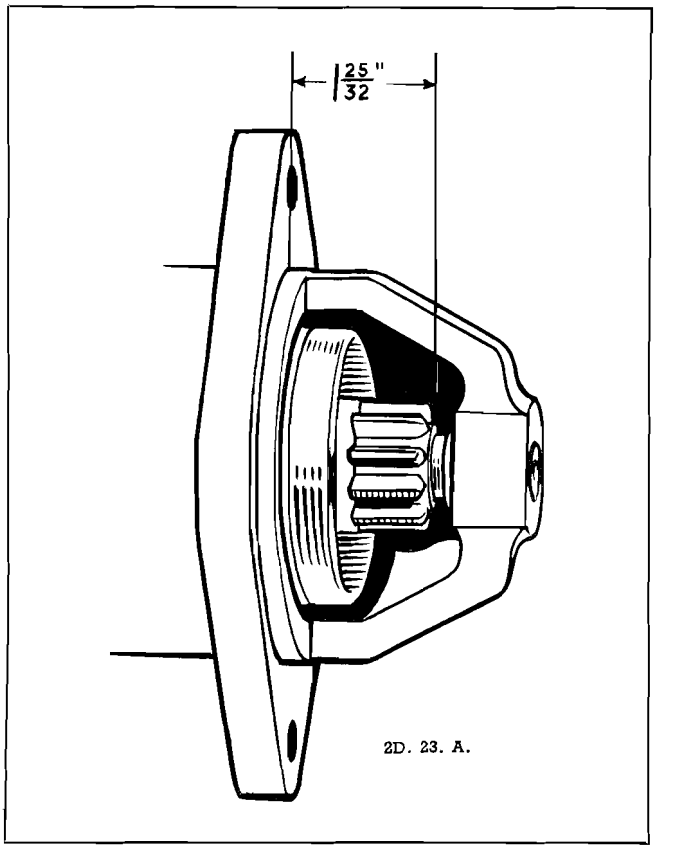

Fig. J13. *Starter drive end bracket. (Pinion in fully engaged position).*

Also test the insulated pair of brush boxes on the commutator end bracket. Clean off all traces of carbon deposit before testing. Check for continuity between boxes and bracket; if the 110-volt lamp lights, this indicates faulty insulation and the end bracket must be replaced.

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 a graphite impregnated brass bush.

Bearings which are worn to such an extent that they will allow excessive side play of the armature shaft must be replaced as follows:—

In the case of the commutator end bracket bearing, a thin toe extractor will be required to remove the old bush. Alternatively, a $\frac{11}{16}$" tap can be screwed in and withdrawn complete with bush. The driving end bush and the intermediate bracket bush may be pressed out.

New bushes may be fitted using a shouldered, highly polished mandrel of the same diameter as the shaft which is to fit in the bearing, see Fig. J11. Porous bronze bushes **must not be reamed after fitting** as the porosity of the bush will be impaired.

NOTE: Before fitting a new porous bronze bearing bush it should be completely immersed for 24 hours in clean engine oil grade S.A.E.30 to 40. In cases of extreme urgency this period may be shortened by heating the oil to 100°C., when the time of immersion may be reduced to 2 hours.

Re-assembly of Starting Motor

The re-assembly of the starting motor is a reversal of the dismantling procedure, but the following special points must be noted:—

In refitting the driving fork assembly see that the flat surfaces of the pivoted operating shoes face towards the driving pinion. When the operating lever closes the pilot switch contacts, the front edge of driving pinion must have travelled $\frac{5}{8}$ in. outwards along the armature shaft extension.

To adjust travel, slacken the four pilot switch bracket screws and slide bracket away from lever to increase travel or towards lever to reduce travel. Retighten screws and check that front of pinion is $1\frac{25}{32}$in. from face of the drive end bracket with operating lever pressed against the pilot switch body. See Fig. J13.

LUCAS PRE-ENGAGED CLUTCH-PLATE STARTER DRIVE

General Operation

This drive assembly is mounted on the armature of the starting motor with the centre core (Fig. J14) splined to the motor shaft. When the vehicle starting lever is moved the operating bush (9) moves the whole of the drive assembly along the motor shaft to engage the pinion with the engine flywheel static ring. When the teeth are correctly engaged a pilot switch on the operating mechanism engergises a solenoid and so applies power to the motor and the engine is cranked.

If the pinion teeth butt directly on to the flywheel teeth the tension spring (8) is compressed and causes a build up of pressure behind the pinion, until the pilot switch contacts close. The armature then rotates and the pinion slides into mesh. The drive torque is transmitted through a multi-plate clutch; this is engaged by pressure from the moving member (15) which rides up the helical splines (6) on the centre core when the motor is switched on. The cushion spring (19) absorbs the initial shock when the drive clutch engages whilst the end thrust from the clutch assembly is taken on the thrust washer (2). If the drive remains in engagement after the engine has

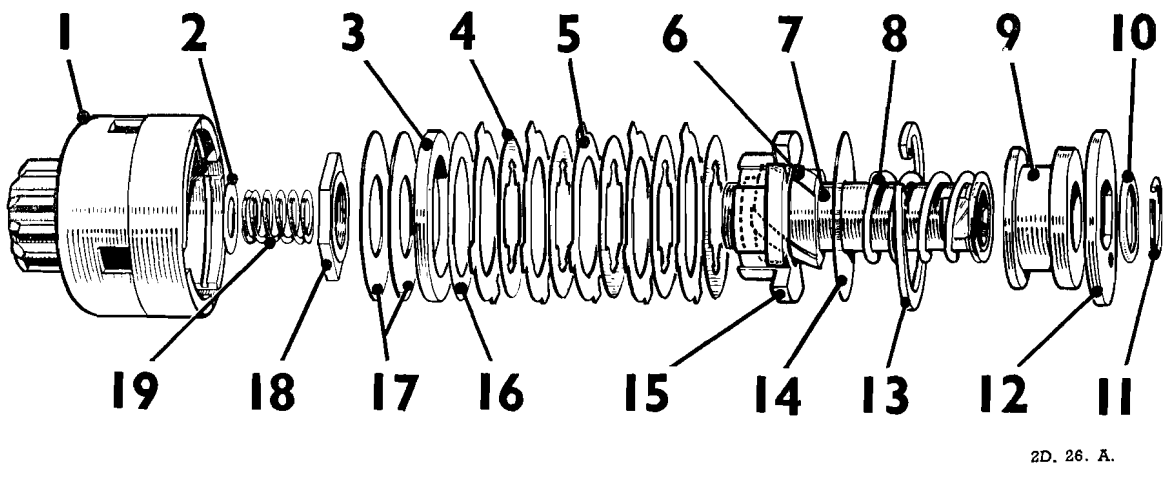

Fig. J14. *Drive Assembly.*

1. *Pinion and barrel nut.*
2. *Thrust washer.*
3. *Backing ring.*
4. *Inner clutch plate.*
5. *Outer clutch plate.*
6. *Helical splines.*
7. *Central core.*
8. *Tension spring.*
9. *Operating bush.*
10. *Lock ring retaining cup.*
11. *Lock ring.*
12. *Brake plate.*
13. *Circlip.*
14. *Retaining washer.*
15. *Moving member.*
16. *Shim.*
17. *Pressure plates.*
18. *Ring nut.*
19. *Cushion spring.*

fired, the clutch automatically disengages and releases the armature shaft—only the pinion and barrel (1) are then driven by the engine. The clutch also serves as an overload protection—it is set by means of shims so that it slips at a torque two or three times greater than the maximum output from the motor. This protects the whole starter from accidental damage if an engine back-fire occurs.

Dismantling

Remove the drive assembly from the armature shaft. Take the lock ring off the centre core—to do this, either place the drive upright with the pinion resting on a soft metal block and compress the tension spring by using a hand press and distance pieces to push down the brake plate (12); or place the drive in a vice with soft metal jaws with two small metal blocks (1″ long×½″×½″) on either side of the centre core so that they press on the brake plate, then tighten the vice until spring pressure is removed from the lock ring and it can be removed.

In either case it will be necessary to prise up the edge of the lock ring retaining cup so that this can be pushed down the centre core to release the lock ring. After the lock ring has been removed, gradually release the pressure on the brake plate, then remove the brake plate, operating bush and tension spring from the centre core.

Next remove the large circlip (13) and withdraw the centre core and clutch unit from the pinion and barrel.

The drive can now be completely dismantled by removing all the parts from the centre core—with the exception of the two pressure plates which are held in position by the ring nut (18). If these have to be removed, hold the centre core by means of a spanner placed across the flats on the rear end (by the lock ring groove) and use a large plate spanner to turn the ring nut, (or a "C" spanner on later models).

This ring nut is held in position by peining the core and should only be removed if it is absolutely necessary. If it is taken off, then the core must be peined over again when the drive is re-assembled.

Re-assembly

The drive is built up in the reverse order i.e.—

Replace the ring nut and pressure plates if these have been stripped down. Place the backing ring, clutch plates, moving member (15) and retaining washer (14) on the core in the correct order. Place the thrust washer (2) and the cushion spring (19) inside the pinion and barrel so that thet are correctly positioned over the bearing bush. Insert the clutch unit and replace the circlip (13).

Check the slipping torque of the clutch as follows: Place the unit, pinion down, in a vice with soft metal jaws and tighten until the pinion is gripped firmly. Apply an anti-clockwise torque to the centre sleeve with a suitable torque wrench fastened on to the flats on the central core (by the lock ring groove).

The clutch should not slip until the load applied exceeds 800 to 950 lbs. ins. (9.2 to 10.9 m/kg.) If the clutch slips at too low a torque figure, dismantle again and **add** shims one at a time until the correct figure is obtained.

If the clutch **does not slip** between the torque limits given, again remove the circlip—dismantle and remove shims one at a time until the torque test gives correct figures. Place the tension spring and brake plate on the core and again compress the tension spring as for dismantling.

Place a new lock ring retaining clip in position on the shaft and replace the lock ring. Release the pressure on the brake plate so that the retaining ring is pushed over the lock ring. Press the edge of the lock ring cup inwards so that it holds firmly **over** the lock ring and finally, replace the drive assembly on the motor.

PRE-ENGAGED STARTING MOTOR WITH SELF-INDEXING DRIVE

TYPE M45G

DESCRIPTION

This starting motor is a four-pole four-brush earth-return machine with series-parallel connected field coils.

A solenoid-operated pre-engaged drive assembly is carried on an extension of the armature shaft. The main features of this type of drive are as follows:

1. Positive pinion engagement, preventing the pinion being thrown out of mesh whilst starting.
2. Dual-purpose plate-clutch incorporated in the drive assembly giving over-speed and over-load protection.
3. Self-indexing pinion to ensure smooth engagement between the pinion and the flywheel teeth before the starting motor begins to rotate.
4. Armature braking system to ensure rapid return to rest when the starter button is released.

On depressing the starter button, a solenoid unit mounted on the starting motor yoke is energised and actuates a forked lever to engage the drive pinion with the engine flywheel.

On occasions of tooth-to-tooth abutment, axial move-

ment of the pinion is arrested whilst a helically splined sleeve on which the pinion is carried, continues to move forward. This causes the pinion to rotate relative to the flywheel. When the teeth become aligned, spring pressure slides the pinion into mesh with the flywheel.

When the pinion is properly engaged with the flywheel teeth, a pair of contacts are closed in the rear of the unit. Closure of the contacts connects the motor to the battery, the armature rotates and the starter pinion commences to crank the engine. Also, as will be seen in Fig. J15, closure at the starter switch contacts shorts out the closing coil and the plunger is retained in the fully home position by the hold-on coil until the starter push is released.

When the engine fires and the starter push is released, the solenoid unit is de-energised and the spring-loaded plunger withdraws the starter pinion to its out-of-mesh position. The armature is brought rapidly to rest by the centrifugal action of a pair of spring-loaded brake shoes bearing against a brake drum inside the intermediate bracket.

Provision is made to ensure that in the case of the pinion jamming in mesh (this may occur with an engine which fails to start), there is sufficient slack in the engagement lever-to-solenoid plunger linkage to permit the solenoid switch contacts to open.

In the event of the drive remaining in mesh with the flywheel after the engine has run up to speed, the starting motor armature is protected from over-speeding by the plate clutch assembly. This clutch allows torque to be transmitted from the starting motor to the engine but not in the reverse direction which is free-running.

The clutch is set to slip at between two and three times normal starting torque, thus providing overload protection for the starting motor. Back firing is a typical example of overloading.

ROUTINE MAINTENANCE

The starting motor requires no routine maintenance beyond the occasional inspection of the electrical connections which which must be clean and tight.

Two Yearly Examination

After the starting motor has been in service for two years, remove the starting motor from the engine and submit it to a thorough bench inspection. This inspection should be carried out by a qualified electrician and the following points checked:

1. Brush wear. Renew brushes worn to, or approaching $\frac{5}{16}$" (8 mm.) in length.
2. Brush spring tension. Correct tension is 30 to 40 oz. (850 gm. to 1.13 Kg.). Renew springs if tension has dropped below 25 oz. (708 gm.).
3. Skim commutator if it is pitted or badly worn.
4. Check bearings for excessive side play of the armature shaft.
5. Check pinion movement.
6. Clean and lubricate the indented bearing inside the pinion sleeve using a bentonite based grease, such as Ragosine 'Bentone', for this purpose. This should be done any time when the drive becomes sluggish in operation.
7. Clean and lubricate the indented bronze bearing in the intermediate bracket. Use Ragosine 'Molypad' Molybdenised non-creep oil for this purpose. Ragosine oils and greases are marketed by the Rocol organisation.

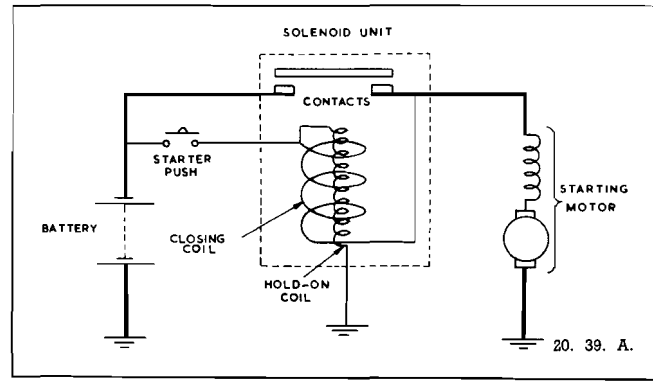

Fig. J15 *Internal Circuit of Solenoid*

PERFORMANCE DATA

Starting Motor

1. Light running current: 90 amp. at 8,000 to 9,000 r.p.m.
2. Lock torque: 32.5 lb. ft. (4.49 Kg.m.) with 900 amp. at 6.4 terminal volts.
3. Torque at 1,000 r.p.m.: 15.5 lb. ft. (2.14 Kg.m.) with 570 amp. at 8.8 terminal volts.

These figures are based on the use of a fully charged 12-volt battery having a capacity of 115 amp. hr. at the 10 hour rate.

Solenoid

1. Closing coil resistance: 0.144 to 0.155 ohm.
2. Hold-on coil resistance: 0.688 to 0.792 ohm.
3. Spring pressure to close switch contacts: 3 to 5 lb. (1.36 to 2.27 Kg.) with plunger return spring removed.
4. Spring pressure to push plunger home: $9\frac{1}{2}$ to $14\frac{1}{2}$ lb. (4.30 to 6.58 Kg.) with plunger return spring removed.
5. Plunger movement to close contacts: 0.116" to 0.189" (2.95 to 4.80 mm.).
6. Total plunger movement: 0.263" to 0.273" (6.68 to 6.93 mm.).

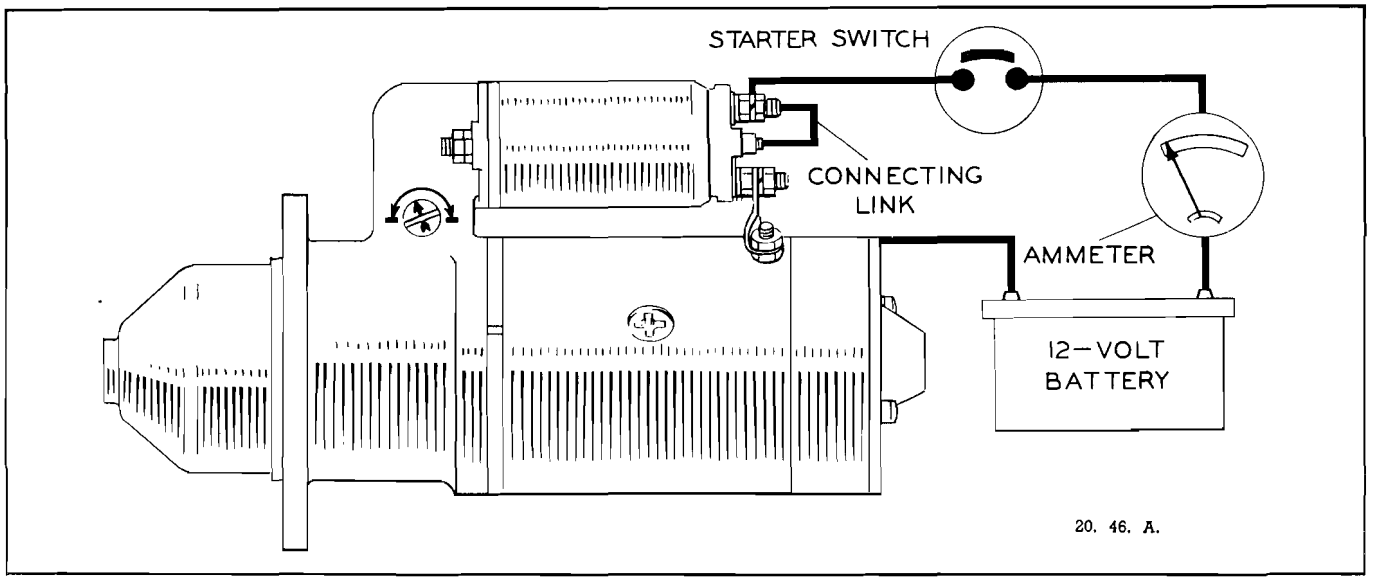

Fig. J16 *Measuring Light Running Current*

SERVICING

Testing in Position

Switch on the headlamps, operate the starter knob or push and watch for the following symptoms:

1. **The lamps dim and the motor does not crank the engine.**
   Check by hand-cranking that the engine is not abnormally stiff.
   Check the battery by substitution.
2. **The lamps do not dim and the motor does not crank the engine.**
   Check the starter circuit for continuity.
   Check the solenoid unit.
   If the armature rotates, check for a defective drive mechanism.

Bench Testing

1. **Measuring the light running current**
   With the starting motor securely clamped in a vice and using a 12-volt battery, check the light running current and compare with the values given under "Performance Data". If there appears to be excessive sparking at the commutator, check that the brushes are clean and free to move in their boxes, and that the spring pressure is correct.

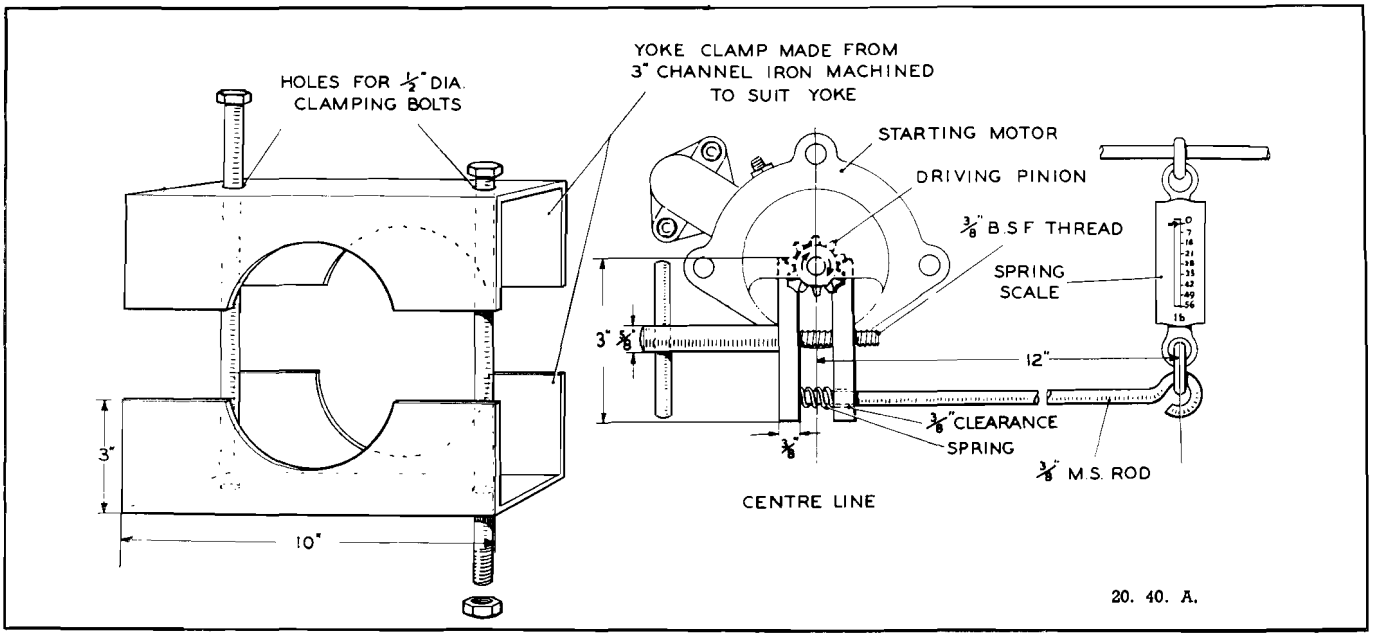

Fig. J17 *Apparatus for measuring Lock Torque*

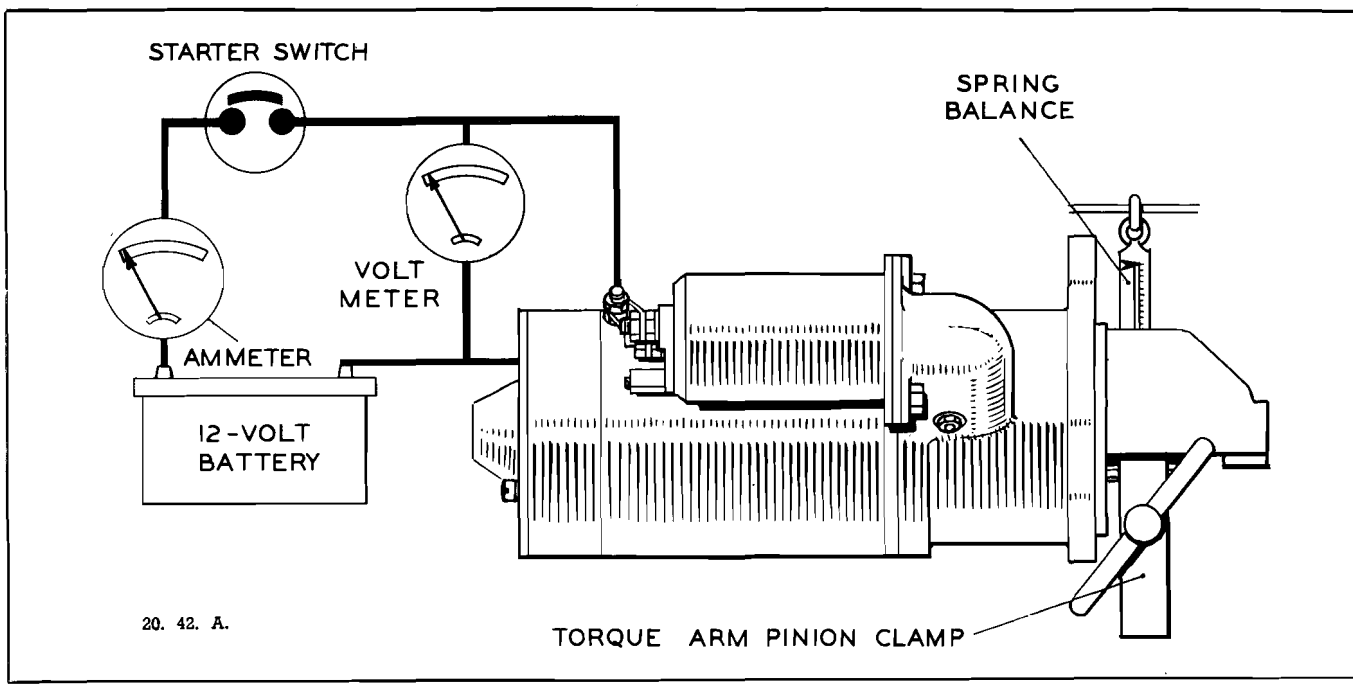

Fig. J18 *Measuring Lock Torque and Lock Current*

See symptoms 7 and 8 under "Bench Test Diagnosis".

2. **Measuring lock torque and lock current**
Carry out a torque test and compare with the values given. If a constant voltage supply is used, it is important to adjust this to be 6.4 volts at the starter terminal when testing.

Bench Test Diagnosis

An indication of the nature of the fault, or faults, may be deduced from the results of the no-load and lock torque tests.

Symptom	Probable Fault
1. Speed, torque and current consumption correct.	Assume motor to be in normal operating condition.
2. Speed, torque and current consumption low.	High resistance in brush gear, e.g. faulty connections, dirty or burned commutator causing poor brush contact.
3. Speed and torque low, current consumption high	Tight or worn bearings, bent shaft, insufficient end play, armature fouling a pole shoe, or cracked spigot on drive end bracket. Short-circuited armature, earthed armature or field coils.
4. Speed and current consumption high, torque low	Short-circuited windings in field coils.
5. Armature does not rotate, no current consumption.	Open-circuited armature, field coils, or solenoid unit. If the commutator is badly burned there may be poor contact between brushes and commutator.
6. Armature does not rotate, high current consumption	Earthed field winding or short-circuited solenoid unit. Armature physically prevented from rotating.
7. Excessive brush movement causing arcing at commutator	Low brush spring tension, worn or out-of-round commutator. 'Thrown' or high segment on commutator.
8. Excessive arcing at the commutator.	Defective armature windings, sticking brushes or dirty commutator.

DISMANTLING

1. Disconnect the copper link between the lower solenoid terminal and the starting motor yoke.
2. Remove the solenoid unit securing nuts. Withdraw the solenoid from the drive end bracket casting, carefully disengaging the solenoid plunger from the starter drive engagement lever.
3. Remove the cover band and lift the brushes from their holders.
4. Unscrew and withdraw the two through bolts from the commutator end bracket. The commutator end bracket and yoke can now be removed from the intermediate and drive end brackets.
5. Extract the rubber seal from the drive end bracket.
6. Remove the nut securing the eccentric pin (Fig. J19) on which the starter drive engagement lever pivots, and withdraw the pin.
7. Separate the drive end bracket from the armature and intermediate bracket assembly.
8. Remove the washer from the end of the armature shaft extension and slide the drive assembly and engagement lever off the shaft.
9. If it is necessary to dismantle the drive assembly proceed as described under "Dismantling Starter Drive".
10. Remove the intermediate bracket retaining ring from the armature shaft extension and slide the bracket and brake assembly off the shaft.

BENCH INSPECTION

After dismantling the motor, examine individual items.

Solenoid—Electrical Testing

The solenoid unit contains two coils; a closing coil which is by-passed when the plunger is drawn fully home, and a hold-on coil to retain the plunger in the fully home position. To check individual coils, remove the existing connections and using a constant voltage 4-volt D.C. supply with cables of adequate size, proceed as follows:

Closing Coil: Connect the supply between the solenoid terminal marked 'STA' and the small centre terminal. This should cause a current of 24 to 28 amperes to pass.

Hold-on Coil: Connect a supply between the solenoid body and the small centre terminal. This should cause a current of 5.1 to 5.8 amperes to pass.

N.B. Do not carry out these tests while the solenoid unit is hot.

If a constant voltage supply is not available check the coil resistances, using an accurate method of measuring low resistance values, such as the Wheatstone Bridge. Connect the measuring instrument as for measuring the

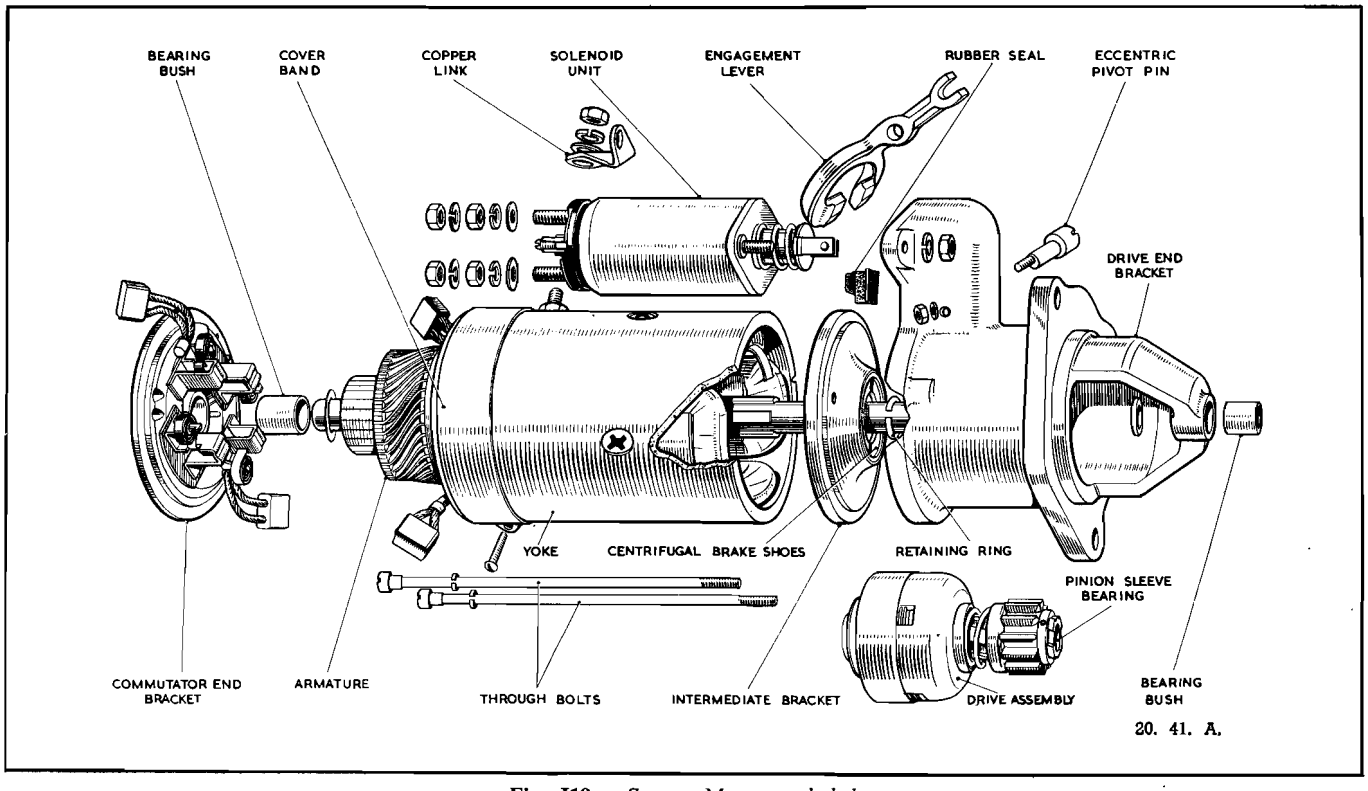

Fig. J19 *Starter Motor exploded*

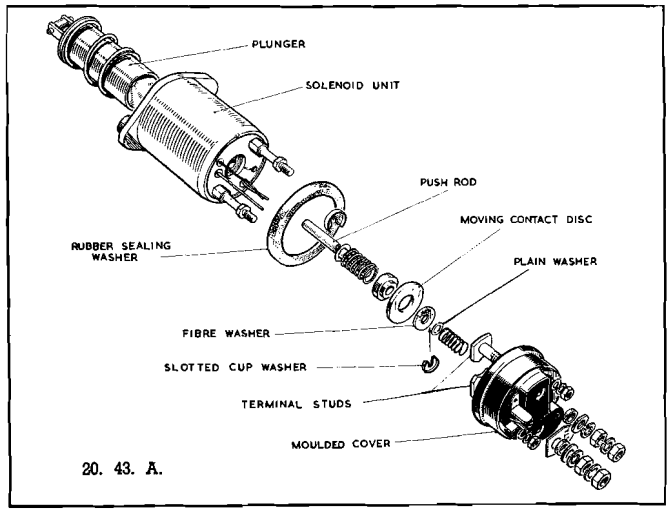

Fig. J20 *Solenoid exploded*

current and compare the resistances with those given.

Solenoid Mechanical Testing

Check the spring pressure and plunger travel.

N.B. Carry out these tests with the solenoid unit cold and with the plunger return spring removed.

If, after testing, the solenoid is found to be faulty, replace it by a serviceable unit. Do not attempt to repair a faulty solenoid.

Solenoid Contact Replacement

Replace the contacts as a complete set. This comprises two fixed contact studs for fitting in the end cover and a moving contact disc for fitting on the push rod.

To remove the fixed contact studs, unscrew the two smaller nuts on the moulded cover and unsolder the wires attached to the terminal strips. Lift off the cover. Unscrew the nuts from the two large terminals studs on the cover and remove the studs. Fit the replacement studs.

To remove the moving contact disc from the push rod, lift the rod from the solenoid unit. Take off the plain washer, the slotted cup washer, the fibre washer and the moving contact disc. Fit the replacement disc.

Finally, reassemble the unit, reversing the procedure used for dismantling.

Replacement of Brushes

The flexible connectors are soldered to terminal tags; two are connected to brush boxes, and two are connected to free ends of the field coils. Unsolder these flexible connectors and solder the connectors of the new brush set in their place.

The brushes are pre-formed so that 'bedding' to the commutator is unnecessary.

Check that the new brushes can move freely in their boxes.

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 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.**

Armature

Lifted conductors: If the armature conductors are found to be lifted from the commutator risers, overspeeding is indicated. In this event, check that the clutch assembly is disengaging correctly when the engine fires.

Fouling of armature core against the pole faces: This indicates worn bearings or a distorted shaft. A damaged armature must in all cases be replaced and no attempt be made to machine the armature core or to true a distorted armature shaft.

Insulation Test: To check armature insulation, use a 110-volt A.C. test lamp. The test lamp must not light when connected between any one commutator segment and the armature shaft.

If a short circuit is suspected check the armature on a 'growler'. Overheating can cause blobs of solder to short circuit the commutator segments.

If the cause of an armature fault cannot be located or remedied, fit a replacement armature.

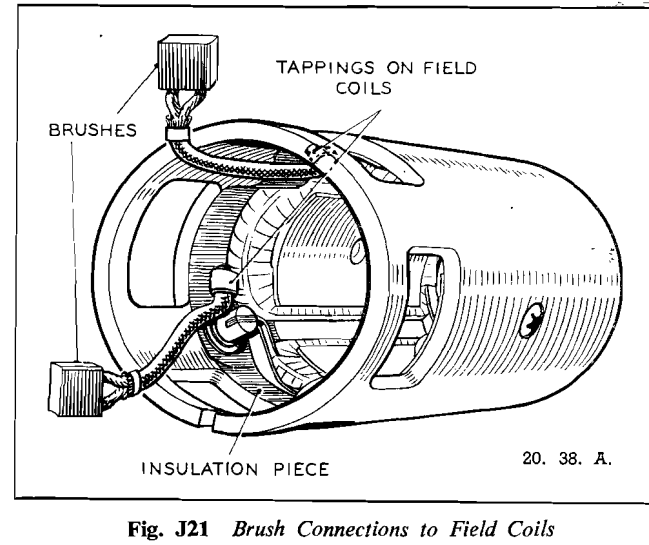

Fig. J21 *Brush Connections to Field Coils*

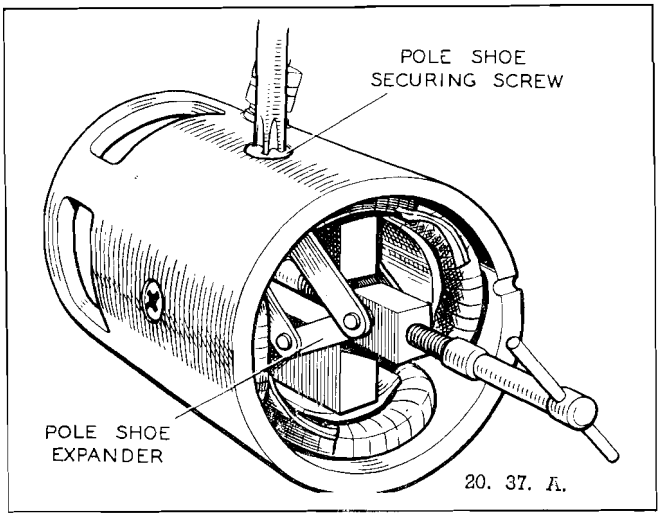

Fig. J22 *Tightening Pole Shoe Screw using Pole Shoe Expander*

Field Coils

Continuity Test: Connect a 12-volt test lamp and battery between the insulated terminal on the yoke and each individual brush (with the armature removed from the yoke). Ensure that both brushes and their flexible connectors are clear of the yoke. If the lamp does not light, an open circuit in the field coils is indicated. Replace the defective coils.

Insulation Test: Connect a 110-volt A.C. test lamp between the terminal post and a clean part of the yoke. The test lamp lighting, indicates that the field coils are earthed to the yoke and must be replaced.

When carrying out this test, check also the insulated pair of brush boxes on the commutator end bracket. Clean off all traces of brush deposit before testing. Connect the 100-volt test lamp between each insulated brush box and the bracket. If the lamp lights this indicates faulty insulation and the end bracket must be replaced.

Replacing the field coils: Unscrew the four pole-shoe retaining screws using a wheel-operated screwdriver.

Remove the insulation piece which is fitted to prevent the inter-coil connectors from contacting with the yoke.

Draw the pole shoes and coils out of the yoke and lift off the coils.

Fit the new field coils over the pole shoes and place them in position inside the yoke. Ensure that the taping of the field coils is not trapped between the pole shoes and the yoke.

Locate the pole shoes and field coils by lightly tightening the retaining screws.

Replace the insulation piece between the field coil connections and the yoke.

Finally, tighten the screws by means of the wheel-operated screwdriver while the pole pieces are held in position by a pole shoe expander (Fig. J22) or a mandrel of suitable size.

Bearings and Bearing Replacement

The commutator and drive end brackets are each fitted with a porous bronze bush and the intermediate bracket is fitted with an indented bronze bearing.

Replace bearings which are worn to such an extent that they will allow excessive side play of the armature shaft.

The bushes in the intermediate and drive end brackets can be pressed out, whilst that in the commutator end bracket is best removed by inserting a $\frac{11}{16}$" (17.5 mm.) tap squarely into the bearing and withdrawing the bush with the tap.

Before fitting a new porous bronze bearing bush, immerse it for 24 hours in clean engine oil (SAE 30/40). In cases of extreme urgency, this period may be shortened by heating the oil to 100°C. for 2 hours and then allowing the oil to cool before removing the bush.

Fit new bushes by using a shouldered, highly polished mandrel approximately 0.0005" (.013 mm.) greater in diameter than the shaft which is to fit in the bearing. **Porous bronze bushes must not be reamered out after fitting,** as the porosity of the bush will be impaired.

After fitting a new intermediate bearing bush, lubricate the bearing surface with Ragosine Molybdenised Non-creep oil.

REASSEMBLY

After cleaning all parts, re-assembly of the starting motor is a reversal of the dismantling procedure, but the following special points should be noted:

1. To facilitate fitting the solenoid unit to the drive end bracket, ease the drive assembly forward along the armature shaft.
2. Set the pinion movement before tightening the eccentric pivot pin securing nut.

SETTING PINION MOVEMENT

After complete assembly of the starting motor connect the small centre terminal on the solenoid unit by way of a switch to a 6-volt supply. Connect the other side of the battery to one of the solenoid fixing studs.

Close the switch (this throws the drive assembly forward into the engaged position) and measure the distance between the pinion and the washer on the armature shaft extension. Make this measurement with the **pinion pressed lightly towards the armature** to take up any slack in the

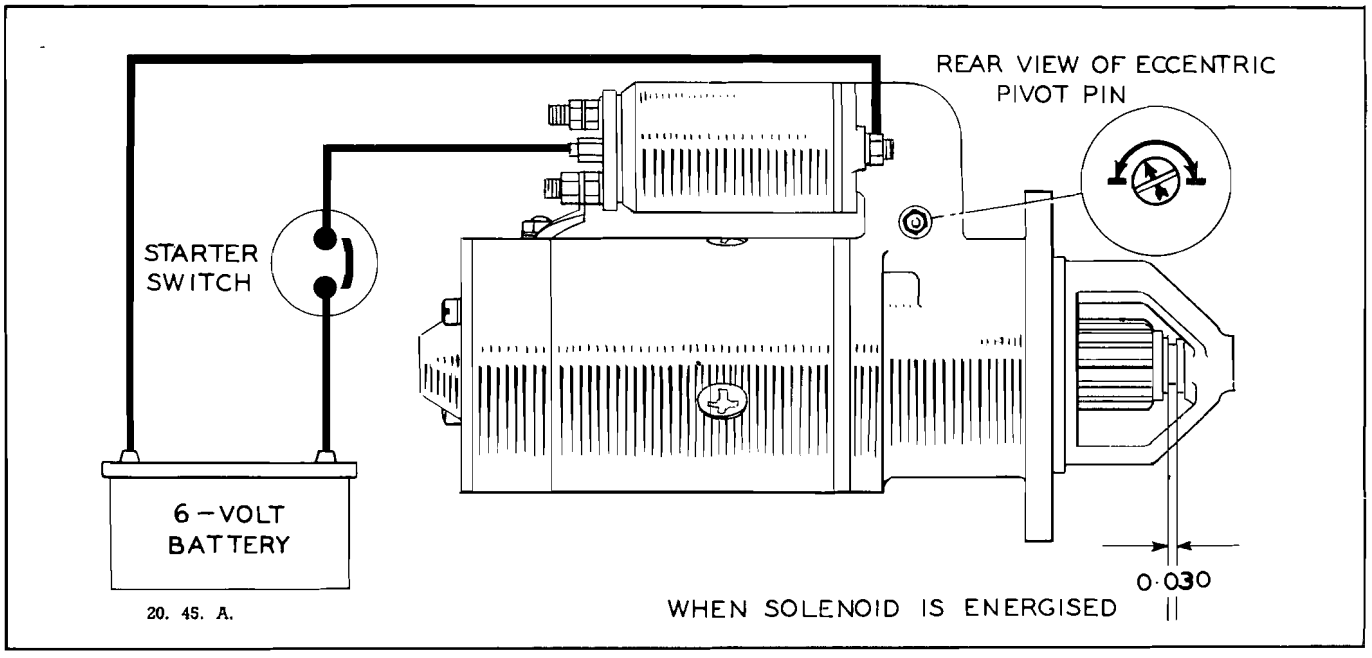

Fig. J23 *Setting pinion movement*

engagement linkage. For correct setting this distance should be 0.020″ to 0.030″ (.508 to .760 mm.).

To adjust the setting, slacken the eccentric pivot pin securing nut and turn the pin until the correct setting is obtained. Note that the arc of the adjustment is 180° and the head of the arrow marked on the pivot pin should be set only between the arrows on the arc described on the drive end bracket casting.

After setting, tighten the securing nut to retain the pin in position.

NOTE. In the event of a replacement motor or drive end bracket being fitted, check the out-of-mesh clearance when assembling the starting motor to the engine. This should be $\frac{1}{8}$″ (3.2 mm.) between the leading edge of the pinion and the engine flywheel with a tolerance each way of $\frac{3}{32}$″ (2.4 mm.).

SELF-INDEXING PLATE CLUTCH DRIVE

Description

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 flywheel.

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 rotates the pinion relative to the flywheel gear ring. When the teeth become aligned for meshing the compressed cushion spring slides the pinion into mesh with the flywheel.

When the armature shaft rotates the drive, torque is transmitted from the shaft through the clutch driving sleeve, plate clutch assembly and barrel unit, to the driving pinion. The clutch is engaged by pressure from the moving member which rides up the helical splines on the driving sleeve when the armature shaft rotates.

This movement clamps the clutch plates together and torque is transmitted to the barrel unit.

If, after the engine fires, the torque reverses direction, the moving member releases its pressure on the clutch plates and the clutch automatically disengages and releases the armature shaft—only the pinion and barrel unit are driven by the engine.

If the clutch is overloaded it slips at a torque two or three times greater than the maximum developed by the motor. This overload protection feature is effected by shim-setting the engagement pressure on the clutch plates. When the moving member exerts pressure on the clutch plates, pressure plates are compressed by backing ring. This compression determines the amount of torque which can be transmitted by the clutch plates, and is pre-set by shims inserted between the backing ring and the clutch plates.

Dismantling

1. Remove the drive assembly from the armature shaft.
2. Remove the lock ring from the driving sleeve.
3. Lift two halves of the engagement bush off the driving sleeve.

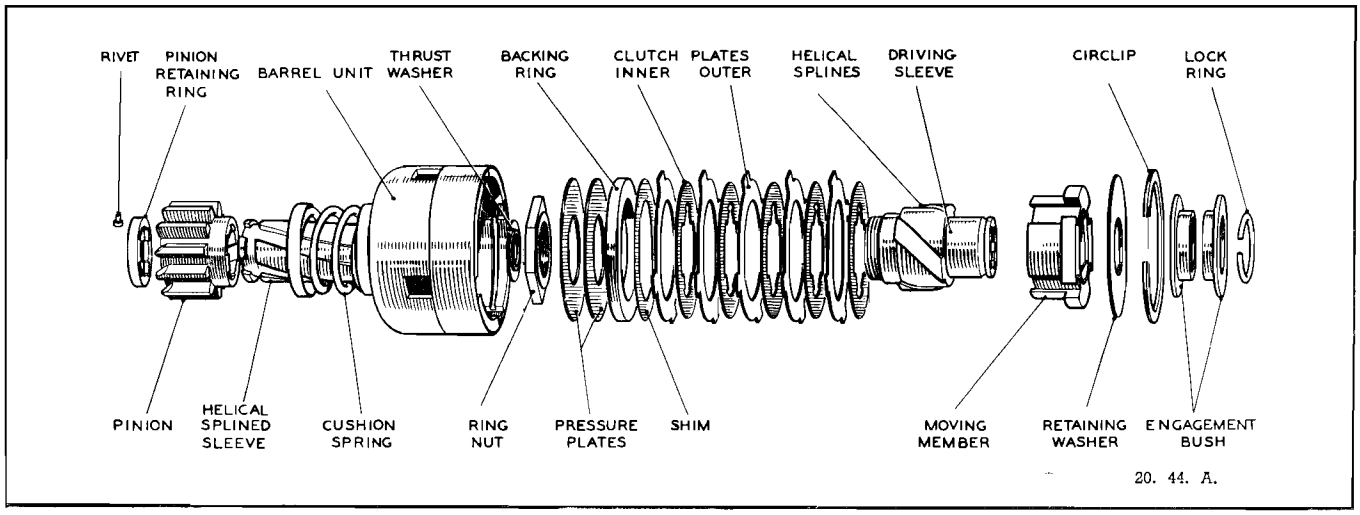

Fig. J24 *Starter Drive exploded*

4. Using a suitable circlip extracting tool, extract the clutch retaining circlip from the barrel unit and withdraw the driving sleeve and clutch unit.
5. The clutch assembly can now be dismantled by removing all the parts from the driving sleeve—with the exception of the two pressure plates which are held in position by the ring nut. To remove the ring nut, slide the driving sleeve on to the splined armature shaft and, using soft metal jaw plates, clamp the armature in a vice. File away the peened rim and use a spanner measuring $1\frac{5}{16}$" (33.3 mm.) across the flats to remove the ring nut.

   When re-assembling, fit a new ring nut and peen the rim over the notch in the driving sleeve to lock the nut in position.
6. To remove the pinion from the helically splined sleeve, knock out the rivet which secures the pinion retaining ring. The retaining ring, pinion, cushion spring with cup washers and the sleeve can now be separated.

Re-assembly

Reverse the dismantling procedure noting the following important points:

1. The correct cushion spring tension is 11 lb. (4.99 Kg.) measured with the spring compressed to $\frac{7}{8}$" (22.2 mm.) in length and 16 lb. (7.26 Kg.) with the spring compressed to $\frac{1}{2}$" (12.7 mm.) in length.
2. Check the slipping torque of the clutch as follows: Fit the drive assembly on the splined armature shaft and clamp the armature between soft metal jaw plates in a vice.

   Apply an anti-clockwise torque to the pinion with a suitable "torque wrench" fastened to the pinion teeth.

   The clutch should slip between 800 to 950 lb. in. (9.21 to 10.95 Kg.m.).

   If the clutch slips at too low a torque figure, dismantle again and add shims one at a time until the correct figure is obtained.

   If the clutch does not slip between the torque limits given, again remove the circlip—dismantle and remove shims one at a time until the torque test gives corect figures.

   The correct adjusting shim thicknesses are: 0.006" (0.152 mm.), 0.005" (0.127 mm.), 0.004" (0.102 mm.).
3. The assembled clutch unit and lever mechanism must be capable of being pushed to the full extent of the set travel. The assembly must move along the armature shaft extension smoothly and freely, but without slackness.
4. Before fitting the drive assembly to the armature shaft lightly smear the shaft and pack the space between the indented bearings inside the pinion sleeve, with a bentonite based grease such as Ragosine 'Bentone'.

FAULT DIAGNOSIS

COOLING SYSTEM	PAGE	**K/1**
ENGINE	,,	**K/2**
ELECTRIC SYSTEM	,,	**K/3**
FUEL INJECTION SYSTEM	,,	**K/1**

FAULT DIAGNOSIS

COOLING SYSTEM

Fault and possible cause	Possible remedy
Overheating—	
1. Insufficient water in the cooling system ...	Top up the system and check for leakage.
2. Thermostat sticking in the closed portion ...	Renew the thermostat.
3. Injection timing incorrect	Adjust the injection timing.
4. Fan belt loose or slipping	Adjust the tension or renew the belt.
5. Water pump inoperative	Overhaul the pump.
6. Radiator core clogged internally	Clean and flush the radiator core and cooling system.
7. Radiator core clogged externally	Clean the core with water or air.
Overcooling—	
1. Thermostat remaining open	Renew the thermostat.
Loss of water—	
1. Hose connection loose	Tighten the hose clips.
2. Hose deteriorated	Renew the hose.
3. Radiator core leakage	Test and repair the radiator core.
4. Leakage at the pump	Overhaul the pump.
5. Cylinder head gasket defective	Renew the cylinder head gasket.
6. Leakage at water covers, screw plugs, or expansion plugs	Renew the joint washers at the covers or plugs responsible. Renew expansion plugs.

FUEL INJECTION SYSTEM

Fault and possible cause	Possible remedy
Loss of Power:—	
1. Pump injects too little fuel. (Internal components of the pump worn or incorrectly adjusted)	Overhaul the injection pump, renewing worn components.
2. Pump injects too early (engine noisy) ...	Adjust the injection timing.
3. Pump injects too late (engine smokes) ...	Adjust the injection timing.
4. Injector nozzles give too much leak-off due to wear	Renew the injectors.
5. Injector nozzles clogged	Fit a new nozzle.
6. Fuel pipes partially blocked	Inspect the pipes for signs of damage, or remove any foreign matter which may be in the pipe bore.
7. Air in fuel system	Bleed the fuel system.

8. Fuel filters clogged	Renew the fuel filter elements.
9. Opening pressures of nozzles too low ...	Test the opening pressure and adjust to the correct setting, or fit a correctly adjusted nozzle.
10. Broken injection pipe	Renew the pipe.

Engine Smokes or Knocks—

1. Pump injects too early	Adjust the injection timing.
2. Pump injects too late	Adjust the injection timing.
3. Opening pressure of nozzles too low ...	Test the opening pressure and adjust to the correct setting, or fit a correctly adjusted nozzle.
4. Compression spring in nozzle holder broken	Fit a new spring.
5. Nozzle valve sticking or seating incorrectly	Dismantle and clean the nozzle, or renew.
6. Broken delivery valve spring or valve sticking	Renew the spring or service the injection pump.

ENGINE

Fault and possible cause	Possible remedy
Lack of power—	
1. Low compression	See **"Low compression,"** below.
2. Fuel and/or injection system faulty ...	See Applicable Section
3. Air cleaner restricted	Service the air cleaner.
4. Excessive exhaust back pressure	Check the silencer for signs of being blocked.
5. Valve springs weak or broken	Test, and renew the faulty springs.
Low compression—	
1. Valves seating improperly	Overhaul the valves and seats.
2. Incorrect valve to rocker clearances ...	Readjust the valve to rocker clearances.
3. Valves or tappets sticking	See **"Valves sticking"**, below.
4. Cylinder head gasket leaking	Renew the gasket.
5. Cylinder bores worn	Renew the cylinder liners and pistons.
6. Incorrect valve timing	Check and adjust.
7. Piston rings broken, worn or stuck ...	Renew broken or worn rings; clean ring grooves and rings if stuck.
8. Pistons or rings improperly fitted ...	Refit correctly.
9. Piston ring grooves worn	Renew the faulty parts.
Crankshaft and connecting rod bearing failures—	
1. Lack of oil	Maintain the oil at the corect level.
2. Low oil pressure	See **"Low oil pressure,"** below.
3. Improper grade of oil	Drain and refill with the correct grade of oil.
4. Oil passage(s) restricted	Clean the passage(s).
5. Bearing loose	Fit to proper clearance.
6. Crankshaft main bearing journals or crankpins tapered, out-of-round or scored ...	Renew or regrind the crankshaft to the recommended undersize and fit new bearings.
Burned valves and seats—	
1. Insufficient valve to rocker clearances. ...	Re-adjust the valve to rocker clearances.
2. Valve springs weak or broken	Test, and renew the faulty springs.
3. Incorrect valve timing	Check and adjust.
4. Valves sticking in the guides	See **"Valves sticking"**, (over).

5. Overheating	See Applicable Section
6. Excessive carbon deposits around the valve seats and head	Decarbonise.
Valves sticking—	
1. Insufficient clearance between valve stem and guide	Fit to proper clearance.
2. Valve springs broken	Renew broken springs.
3. Valve stems carboned or scored	Clean or renew as necessary.
4. Valve tappets sticking	Clean or renew as necessary.
Excessive oil consumption—	
1. Oil level too high	Maintain the oil at the proper level.
2. Oil leaks at gaskets and seals	Renew the gaskets and seals.
3. Excessive oil pressure	Overhaul the relief valves.
4. Improper grade of oil	Drain and refill with the correct grade of oil.
5. Excessive cylinder and piston wear ...	Renew the cylinder liners and pistons.
Low oil pressure	
1. Improper grade of oil	Drain and refill with the correct grade of oil.
2. Main oil pressure relief valve ball not seating	Overhaul the relief valve.
3. Oil pump strainer clogged	Clean the floating strainer.
4. Excessive crankshaft and connecting rod bearing clearances	Fit to the proper clearances or renew the faulty parts.
5. Oil pump components badly worn ...	Renew the faulty components.
Engine knocks continually—	
1. Engine main, big-end or little-end bearings worn	Renew the worn components.
2. Injection equipment faulty	See Applicable Section
3. Excessive carbon deposits	Decarbonise.

ELECTRICAL SYSTEM

Fault and possible cause	Possible remedy
Dynamo not charging properly or inoperative—	
1. Driving belt slipping	Adjust the belt tension.
2. Ammeter registers incorrectly or no charging rate	‡Check, and renew ammeter if required.
3. Ammeter open (low or zero charging rate)	‡Check, and renew ammeter if required.
4. Ammeter earthed	‡Check, and renew ammeter if required.
5. Regulator unit not operating properly ...	‡Check andadjust the regulator unit.
6. Badly worn bearings or pole pieces loose ...	Renew the bearings or repair.
7. Short between commutator bars	Inspect and repair or renew the armature.
8. Armature worn or shaft bent	Renew the armature.
9. Commutator out of round	Turn down the commutator.
10. Insulation high between commutator bars ...	Undercut the insulation.

11. Commutator greasy, glazed or burned ...	Sand or turn down commutator and undercut insulation as required.
12. Brush springs weak or broken	Check the spring tension and renew springs as required.
13. Brushes sticking	Ease brushes or renew.
14. Field coils shorted, on open circuit or burned	Renew field coils or dynamo.

‡ See the vehicle manual concerned for details of the ammeter and voltage regulator.

Starter motor lacks power or fails to turn the engine—

1. Battery in need of attention	See the vehicle or tractor manual concerned.
2. Loose or broken connections in starter circuit	Trace and rectify.
3. Starter clutch slipping	Dismantle and correctly re-shim the clutch.
4. Tension spring weak or broken	Renew the tension spring.
5. Starter main or pilot switch faulty ...	Renew the faulty switch.
6. Brushes worn, sticking or not bedding ...	Ease or renew brushes.
7. Engine abnormally stiff	Examine the engine for mechanical defects.
8. Commutator dirty or worn	Clean or skim the commutator.
9. Starter shaft bent	Renew the armature.

Starter motor operates but does not turn the engine—

10. Starter clutch slipping	Dismantle, re-shim, or renew the clutch plates and then re-shim.
11. Stripped pinion teeth	Renew the pinion assembly.

Noise from the starter pinion when the engine is running—

12. Return spring weak or broken	Renew the return spring.

Starter motor inoperative—

13. Master switch	Check connections and contacts
14. Battery in need of attention	See the vehicle manual concerned.
15. Loose or broken connection in starter circuit switch	Trace and rectify.
16. Armature faulty	Renew parts as necessary.
17. Field coils in open circuit or earthed ...	Renew parts as necessary.

Rough or noisy engagement—

18. Starter motor loose on mounting bolts ...	Tighten the mounting bolts.
19. Damaged pinion and/or flywheel gear teeth	Renew parts as necessary.
20. Cushion spring or compression spring broken	Renew the faulty spring.