HUNTER

TECHNICAL
SERVICE MANUAL

Issued by
SINGER MOTORS LTD.
COVENTRY & BIRMINGHAM ENGLAND

TECHNICAL SERVICE MANUAL

for

The Singer **HUNTER** *1½ litre Saloon*

Below is a reproduction of the Name and Number Plate fixed to each Singer Car on the bulkhead under the bonnet on the right-hand side (looking from the front seat).

THE CAR NUMBER WITH PREFIX AND SUFFIX SHOWN ON THE PLATE MUST BE QUOTED IN ALL COMMUNICATIONS.

SINGER MOTORS LTD
BIRMINGHAM WORKS

PATENT Nos.

GEARBOX THRUST COLLAR LOCK
SINGER PATENT 649440

CAR No. _____ MADE IN ENGLAND

RECOMMENDED LUBRICANTS

	VACUUM	B.P.	SHELL	WAKEFIELD	ESSO
ENGINE SUMMER	MOBILOIL A	ENERGOL SAE 30	X-100 30	CASTROL XL	ESSOLUBE 30
ENGINE WINTER	MOBILOIL ARCTIC	ENERGOL SAE 20	X-100 20/20W	CASTROLITE	ESSOLUBE 20
GEARBOX	MOBILOIL B.B	ENERGOL SAE 40	DENTAX 90	CASTROL XXL	ESSOLUBE 40
BACKAXLE	MOBILUBE GX90	ENERGOL EP SAE 90	SPIRAX 90 EP	CASTROL HYPOY	ESSO EXPEE COMPOUND 90

FOR OVERSEAS RECOMMENDATIONS REFER TO CAR-OWNER'S HANDBOOK

DO NOT REMOVE THIS PLATE.

SINGER MOTORS LIMITED, COVENTRY ROAD, SMALL HEATH, BIRMINGHAM, 10.

Telephone : Victoria 4321 (8 lines)

Telegrams : Singacars, Birmingham.

WORKS AT BIRMINGHAM AND COVENTRY.

Issued by

SINGER MOTORS LTD.

PART No. KG. 430.

Singer "Hunter" 1½ Litre Saloon

CONDITIONS OF SALE

ALL new cars and chassis and parts thereof manufactured by SINGER MOTORS LIMITED (hereinafter referred to as "the Company") are sold subject to but with the benefit of the Conditions of Sale hereinafter set forth, and this is so whether the sale is (*a*) by the Company to a Distributor, Dealer or Retail Dealer, or (*b*) by the Company direct to the user, or (*c*) by Distributor or Dealer to a Trader, or (*d*) by a Distributor, Dealer, Retail Dealer or Trader, to the user :—

1. **GUARANTEE.** The Company's Guarantee, a copy of which is enclosed herein, shall be deemed to be incorporated in these Conditions : to the intent, in the case of a sale by a Distributor, Dealer, Retail Dealer or Trader that he shall pass on the benefit of the Guarantee to his purchaser, who shall be subject to its obligations ; but such transfer of the benefit of the Guarantee shall not create any privity of contract between the Company and such purchaser ; and every Distributor, Dealer, Retail Dealer and Trader contracts as a principal and not as an agent, and has no authority to give any warranty or make any representation or otherwise act on behalf of the Company.

2. **PRICE AND PAYMENT.** Prices quoted are for delivery at the Company's Works at Birmingham, net cash on delivery. Freightage therefrom to the depot of a Distributor, Dealer, Retail Dealer or Trader is extra.

3. **DELIVERY.** Neither the Company nor any Distributor, Dealer, Retail Dealer or Trader shall be liable for any delay in delivery on the part of the Company (whatever the cause of such delay), nor for any damage caused thereby.

4. **ALTERATIONS IN PRICE AND CONDITIONS.** The Company's prices and Conditions of Sale may be altered at any time without notice, and all cars and chassis and parts therefore are sold subject to the prices and Conditions of Sale ruling at the time of delivery.

In the event of increase of price, however, a purchaser may in writing cancel his order within seven days of receiving notice of the increase.

5. **ALTERATIONS IN SPECIFICATION.** The Company's specifications may be altered at any time without notice ; and in such event the seller may cancel any order, or goods conforming to the altered specification may be delivered in fulfilment of such order unless, in the case of substantial alterations, the purchaser in writing cancels that order within seven days of receiving notice of the intention to deliver in conformity with the altered specification.

6. **SPARE PARTS.** When ordering spare parts, it is essential that the identification number thereof, as shown in the Company's Spare Parts List, should be given, as well as the chassis and engine number of the car for which they are required.

7. **DISTRIBUTORS AND DEALERS.** (*a*) Every Distributor, Dealer, Retail Dealer and Trader shall incorporate these Conditions in any contract it makes with a purchaser, either by reference or by setting them out in extenso in the order form. Where such incorporation is by reference only, the Distributor, Dealer, Retail Dealer or Trader shall see that a copy of the Conditions is handed to such purchaser prior to the completion of the contract, and that such purchaser's attention is specifically drawn to them. (*b*) If any purchaser from a Distributor, Dealer, Retail Dealer or Trader shall commit a breach of these conditions, the Distributor, Dealer, Retail Dealer or Trader shall, on being required by the Company or his Vendor so to do, take such steps as the Company may think fit, whether by instituting legal proceedings or otherwise, in order to enforce these Conditions.

8. **EXHIBITIONS AND COMPETITIONS.** No car or chassis or part thereof shall be exhibited at any exhibition or show or permitted to take part in any competition unless the same is held or approved by the Society of Motor Manufacturers and Traders Limited. Anyone who commits or allows a breach of these conditions renders himself liable to pay damages not exceeding £250.

9. **GENERAL.** (*a*) The Company may allocate any order placed direct with it to its authorised Distributor or Dealer in the appropriate territory. (*b*) These Conditions and any contract to which these Conditions apply shall be construed according to English Law.

GUARANTEE

Warranty

THE Company warrants that in the manufacture of new vehicles it has taken all precautions which are usual and reasonable to secure excellence of materials and workmanship and undertakes that if any defect is disclosed in any part of a new vehicle within six months of the date of delivery of such vehicle to the retail customer it will (provided such defective part is returned to the Works, Carriage Paid) examine the part alleged to be defective and if on such examination the fault is found to be due to defective materials or workmanship for which it is responsible it will repair or replace the defective part free of charge.

This Warranty is given in respect of a vehicle purchased by the retail customer as a new vehicle, for which the Company's full retail List Price has been paid.

The foregoing Warranty is limited to new vehicles manufactured by the Company and is in lieu of any Warranty (or Condition) whether expressed or implied by Common Law Statute or otherwise as to the description quality or fitness for their purpose of any goods manufactured replaced or repaired by the Company every such Warranty (or Condition) whether expressed or implied being in all cases excluded and the liability of the Company under the terms of this Warranty is strictly limited to the replacement or repair and despatch to the Sender carriage forward of the part replaced or repaired. The Company shall not be responsible for any other liability expenses damages or loss which may occur consequent upon any misdescription, defective material or workmanship of any description.

The Warranty shall not apply to any defects caused by or arising in the following circumstances and in which instances all other Warranties (or Conditions) whether expressed or implied by Common Law Statute or otherwise are also expressly excluded.

This Warranty shall not apply to defects caused or arising under the following conditions :—

(*a*) During or caused by motor racing.
(*b*) Wear and tear accident misuse or neglect.
(*c*) Defects in any vehicle which has been altered in any manner whatsoever or upon which the identification numbers have been altered or removed.
(*d*) Defects in any vehicle which has been or is let out on hire.

This Warranty shall be construed as including and shall be limited in its application to—

(*a*) New vehicles or goods manufactured by the Company and which are bought direct from the Company or from one of its duly authorised Distributors, Dealers or Retail Dealers.
(*b*) Repairs done or replacements supplied by the Company direct.

and all other Warranties (or Conditions) whether expressed or implied by Common Law Statute or otherwise are excluded.

The Company gives no Warranty of any description in respect of any Secondhand Vehicles or goods sold by it or by its authorised Dealers or by any other person nor is any Warranty (or Condition) expressed or implied whether arising by Common Law Statute or otherwise in respect of such vehicles or goods.

All agreements and quotations by the Company to supply goods execute repairs or make replacements shall be deemed to include the above Warranty and the exclusion of all expressed or implied Warranties and/or Conditions.

The Company does not warrant the Specialities of other manufacturers fitted to its vehicles such as tyres, electrical fittings, lamps and horns. It endeavours to secure the best quality in these articles and the Makers whose names usually appear thereon are generally willing to replace any defective part. The Company will be pleased at all times to furnish the Maker's name and address.

Conditions of Warranty

If a defective part be found in any vehicle or goods it must be sent to the Company's Works carriage paid and accompanied by an intimation from the sender in writing that he desires to have it repaired or replaced free of charge under this Warranty. The sender must also furnish at the same time—

(*a*) The number of the car.
(*b*) The name of the dealer if any from whom the car was purchased.
(*c*) The date of the purchase of the car or the date when the repairs were executed or replacements made as the case may be.
(*d*) The Mileage or Kilometres run.

The sender shall accept the Company's decision as final and conclusive on all claims for replacement of or repairs to defective material and/or workmanship and to the exchange of defective parts.

If these conditions are not strictly complied with the goods received by the Company will be at the risk of the Sender and this Warranty shall not be enforceable.

The Company shall not be responsible for the cost of any labour involved in connection with the removal or replacement of any defective parts from or to the vehicle.

Repairs and Replacements

All parts sent for repair or replacement must be forwarded carriage paid and bear the sender's name and address ; the car number and year of manufacture should also be given. The foregoing Warranty is given by the Company in respect of all repairs to vehicles or parts of vehicles executed by it or replacements supplied by it direct but for three months only and subject nevertheless to the reservations limitations and conditions therein contained and all other conditions or warranties whether expressed or implied by Common Law Statute or otherwise are excluded. The Company shall not be responsible for any other liability expenses damages or loss which may occur consequent upon any misdescription defective material or workmanship of any description in connection with any replacements supplied or repairs executed by it.

The Company accepts no responsibility whatsoever for any replacements or parts which are not fitted by it to a vehicle even if such replacements or parts are supplied by it.

Cars which are sent for repairs will only be driven by the Company's employees at the risk and responsibility of the owners and repairs of cars are undertaken only on the assumption that the owners give authority to drive the cars on their behalf.

The Company accepts no responsibility for damage by fire or otherwise to customers' cars or parts thereof whilst on the Company's premises.

SINGER MOTORS LIMITED, COVENTRY.

INTRODUCTION

This Manual is issued in a very comprehensive form for the information of all Distributors, Dealers and Repairers. It will also be found extremely useful and most essential for owners who wish to carry out their own maintenance, and great care has been taken to give all necessary information.

When writing the Factory on any query which may arise, quote the Manufacturer's number of the car concerned together with the prefix and suffix letters. Knowledge of this number helps to identify the car, and avoids delays and disappointments.

A loose leaf form of binding has been chosen, so that the Manual can be kept up to date by the insertion of additional leaves which will be issued when necessary.

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TECHNICAL DATA

(Excluding Electrics Section)

ENGINE.

Description.

Type	4 Cylinder	
Bore, nominal	2.874"	73 mm.
Stroke	3.52"	89.4 mm.
Cubic Capacity	91.36 cu. in.	1497 c.c.

Compression Ratio :—

Single Carburettor	7:1 Up to Engine No. H.2067Y 7.2:1 Commencing Engine No. H.2068Y
Twin Carburettor	7.47 : 1

Cylinder Block.

Diameter of Cylinder Bore :

Standard	2.8735"/2.874"	72.988/73 mm.
First Oversize (+ .005" .127 mm.)	2.8785"/2.879"	73.115/73.127 mm.
Second Oversize (+ .015" .381 mm.)	2.8885"/2.889"	73.369/73.381 mm.
Third Oversize (+ .030" .762 mm.)	2.9035"/2.904"	73.75/73.762 mm.

Pistons.

Type	"HEPLEX" HEPOLITE S.W. Low Expansion Alloy, Tin-plated, Semi-solid, Flexible Skirt.

Diameter of Piston—90° to Gudgeon Pin.

Standard.

Top of Skirt	2.8716"/2.871"	72.94/72.925 mm.
Bottom of Skirt	2.872"/2.8715"	72.95/72.935 mm.

First Oversize.

Top of Skirt	2.8766"/2.876"	73.067/73.052 mm.
Bottom of Skirt	2.877"/2.8765"	73.077/73.062 mm.

Second Oversize.

Top of Skirt	2.8866"/2.886"	73.321/73.306 mm.
Bottom of Skirt	2.887"/2.8865"	73.331/73.316 mm.

Third Oversize.

Top of Skirt 90°	2.9016"/2.901"	73.702/73.687 mm.
Bottom of Skirt	2.902"/2.9015"	73.712/73.697 mm.

Piston Rings.

Compression	2 per piston	
Width of Groove in Piston	.0952" .0962"	2.418 2.4435 mm.
Width of Ring	.0927" .0937"	2.356 2.381 mm.
Radial Thickness	.1175" .1105"	2.986 2.808 mm.
Scraper, 8 slots	1 per piston	
Width of Grooves in Piston	.1577" .1587"	4.006 4.03 mm.
Width of Ring	.1552" .1562" = 5/32	3.944/3.969 mm.
Radial Thickness	.1175" .1105"	2.986/2.808 mm.
Ring Gap		
All Rings when fitted in Bores	.008" .013"	.204 .331 mm.
Side Clearance in Grooves	.0015" .0035"	.038 .089 mm.
Gudgeon Pin Hole	.6249" .6251"	15.872/15.877 mm.

Crankshaft.

Number of Journals	3	
Standard Diameter of Journals	2.000" 1.9995"	50.8/50.788 mm.
First Regrind (—.003" —.076 mm.)	1.997" 1.9965"	50.724/50.711 mm.
Second Regrind (—.010" —.254 mm.)	1.990" 1.9895"	50.546/50.534 mm.
Length of Rear Main Journals	1.595" 1.596"	40.512/40.538 mm.
Standard Diameter of Crank Pins	1.75" 1.7495"	44.45/44.438 mm.
First Regrind (—.003" —.076 mm.)	1.747" 1.7465"	44.374/44.361 mm.
Second Regrind (—.010" —.254 mm.)	1.74" 1.7395"	44.196/44.184 mm.
Length of Crank Pin	1.250" 1.251"	31.75/31.776 mm.
Thrust of Crankshaft	Taken by two thrust washers fitted to rear main bearing.	
End Float of Crankshaft	.001" to .008"	.025 to .203 mm.

Main Bearings.

Type	Detachable steel shells, white metal bearings. The front, centre and rear are identical to one another, and carry the same Service Part Number.	
Diametrical clearance	.001" to .0025"	.025 to .064 mm.
Undersizes available	.003" and .010"	.076 and .25 mm.

Oil Retainer.

Front end, type	Screw thread on hub of crankshaft pulley.	
Diametrical clearance	.006" to .012"	.153 to .305 mm.
Rear end type	Screw thread on crankshaft	
Diametrical clearance	.004"/.008"	.102/.204 mm.

Flywheel.

Diameter of Rim carrying T.C. mark	10.685"	271.4 mm.
Maximum which can be ground off Friction Face	1/16"	1.587 mm.
Starter Ring	Renewable	
Number of Teeth	112	
Constant Mesh Pinion Shaft Bush	"OILITE"	
Outside diameter of Bush	.8145"	20.688 mm.
Inside diameter of Bush	.565"	14.35 mm.

Connecting Rods and Bearings.

Type	Steel forgings with detachable steel shells, white metal big end bearings.	
Distance between Centres	6.249"/6.251"	158.72/158.77 mm.

Big End Bearings.

Type	Steel shells, white metal bearings. All four are identical and carry the same Service Part Number.	
Diametrical clearance	.0005″/.002″	.013/.051 mm.
Side clearance on Crankpin	.006″/.008″	.152/.203 mm.

Small End Bearings.

Type	Fixed bronze bush	
Diameter of Small End	Broached to a tolerance of .0002″	.0051 mm.
Diameter of Gudgeon Pin	.6250″/.6248″	15.875/15.870 mm.
Gudgeon Pin fit in Piston—shrink fit	Thumb push fit at room temperature	
Gudgeon Pin fixing	Retained in piston by two circlips. Seeger type.	

Timing Chains and Wheels.

Chains, type	Endless, Renold Duplex Roller.

Primary Chain.

Number of Links	46	
Pitch	.375″	9.525 mm.

Camshaft Chain.

Number of Links	86	
Pitch	.375″	9.525 mm.

Crankshaft Timing Wheel fixing ... ... Keyed to the crankshaft.

First Intermediate Chain Wheel fixing ... ... Six holes, equally spaced in the flange of the wheel, engage with three pegs in the flange of the second intermediate chain wheel. Both wheels are held to the shaft by a central nut and lock washer.

Second Intermediate Chain Wheel fixing ... Keyed to intermediate shaft.

Camshaft Chain Wheel fixing ... ... Three pegs equally spaced in the flange of the camshaft and six holes in the flange of the wheel. The holes in the wheel are so positioned that by a selection of peg engagement, the relative position of the wheel to the camshaft can be altered to adjust the valve timing.

Intermediate Shaft.

Type of Front Bearing	Steel backed, lead-bronze lined in cast iron sleeve.	
Diameter of Front Bearing	.937″/.9382″	23.800/23.832 mm.
Diameter of Front Journal	.9360″/.9365″	23.774/23.787 mm.
Diametrical clearance	.0005″/.0022″	.0127/.0559 mm.
End float	.004″/.008″	.102/.203 mm.
Type of Rear Bearing	Cast Iron (integral with Crankcase)	
Diameter of Rear Bearing	.6248″/.6255″	15.87/15.887 mm.
Diameter of Rear Journal	.623″/.624″	15.824/15.85 mm.
Diametrical clearance	.0008″/.0025″	.02/.0635 mm.

Lubrication System.

Oil Pump	All gear type.	
Oil Pressure at 30 m.p.h. in top gear—hot	30/35 lbs./sq. in.	2/2.5 Kg./sq. cm.
Clearance between end Faces of Gear and Pump Body.		
Cover (with Gasket fitted)	.0028″/.0048″	.0711/.1219 mm.
Clearance between Periphery of Teeth and Pump Body.	.0006″/.00185″	.0152/.0470 mm.
Speed of Pump	Half engine speed.	
Oil Pump Relief Valve Spring, free length	1.75″	44.45 mm.

Filters.

Sump Filter	Fixed Basket Type
External Filter, type	A.C. By-pass
Element for Filter	A.C. L.14

Cylinder Head.

Type	Detachable, with overhead camshaft.	
Depth of Head :		
Single Carburettor (up to Engine No. H.2067Y)	4.248″/4.243″	107.899/107.772 mm.
Single Carburettor (commencing Engine No. H.2068Y)	4.194″/4.189″	106.528/106.401 mm.
Twin Carburettor	4.194″/4.189″	106.528/106.401 mm.

Valves.

Inlet.

Diameter of Head	1.375″	34.93 mm.
Diameter of Stem	.311″/.310″	7.899/7.874 mm.
Diameter of Guide Bore	.3112″/.3117″	7.905/7.917 mm.
Clearance in Guide	.0002″/.0017″	.005/.043 mm.

Exhaust.

Diameter of Head	1.250″	31.75 mm.
Diameter of Stem	.311″/.310″	7.899/7.874 mm.
Diameter of Guide Bore	.3123″/.3128″	7.933/7.945 mm.
Clearance in Guide	.0013″/.0028″	.033/.071 mm.
Angle of Chamfer on Guide	53° Inclusive (top)	

Valve Seat.

Angle	45°	
Width of Seat on Valve	.075″/.070″	1.905/1.778 mm.
Width of Seat in Cylinder Head	.055″/.045″	1.397/1.143 mm.

Valve Springs.

Free length Outer	2.109″	53.578 mm.
Length at 55 lbs. load Outer (Valve open)	$1\frac{9}{64}$″	28.972 mm.
Free length Inner	1.828″	46.434 mm.
Length at 25 lbs. load Inner (Valve open)	$1\frac{1}{16}$″	26.987 mm.
Valve Lift	.297″	7.54 mm.

Valve Rockers.

Diameter of Bush	.6262″ to .6257″	15.905 to 15.893 mm.
Diameter of Shaft	.6255″ to .6245″	15.887 to 15.862 mm.
Diametrical clearance	.0002″ to .0017″	.0051 to .0432 mm.

Valve Clearances (up to Engine No. H.1500).

Inlet—warm	.004″	.1 mm.
Exhaust—warm	.006″	.15 mm.

Valve Clearances (commencing Engine No. H.1501).		
Inlet and Exhaust—cold	.020"	.508 mm.
	0.180.018" In w/C.12667 on 0.020" Ex	
Valve Timing.		
Exhaust opens 50° B.B.D.C.	$4\frac{11}{16}$"	119 mm. arc on Flywheel
Exhaust closes 10° A.T.D.C.	$\frac{15}{16}$"	23.8 mm. arc on Flywheel
Inlet opens 10° B.T.D.C.	$\frac{15}{16}$"	23.8 mm. arc on Flywheel
Inlet closes 50° A.B.D.C.	$4\frac{11}{16}$"	119 mm. arc on Flywheel
Thickness of Cylinder Head Gasket :		
New } Single Carburettor	.075"	1.905 mm.
Compressed } Single Carburettor	.062"	1.574 mm.
New } Twin Carburettor	.036"	.9144 mm.
Compressed } Twin Carburettor	.031"	.7874 mm.
Firing Order	1, 3, 4, 2	
Camshaft.		
Number of Journals	3	
Diameter of Journals	.9357"/.9352"	23.786/23.754 mm.
Type of Bearing	Cast iron	
Diameter of Bearing	.938"/.9372"	23.825/23.805 mm.
Diametrical clearance	.0015"/0028"	.0381/.0711 mm.
Thrust taken by	Centre Bearing	
End Float	.0015"/.005"	.0381/.127 mm.
Water Pump.		
Type	Centrifugal	
Ball Bearing type	Hoffmann L.S.7, 2 spot	
Gland, type	Carbon ring against ground and lapped face on pump shaft housing.	
Fan Blades	4	
Diameter	$12\frac{3}{4}$"	323.85 mm.
Angle of Blades	30°	
CLUTCH.		
Specification number	BB/8/58	
Clutch type	Borg and Beck.	Single dry plate.
Centre Plate diameter	8"	203 mm. approx.
Damper Springs.		
Number	6	
Colour	Black	
Thrust Springs.		
Free length	2.22"	56.388 mm.
Wire thickness	.176"	4.47 mm.
Number	6	
Colour	Cream	
Thrust Withdrawal Bearing, type	Carbon identification groove on inside of ring.	
Pedal Ratio	9 : 1	
Thrust clearance	$\frac{3}{32}$"	2.3812 mm.

Free movement of Clutch Pedal	¾" to 1"	
Compressed thickness of Driven Plate	.275" to .295"	6.985/7.493 mm.
Release Lever tip height from Flywheel Face ...	1.812" mean	46.04 mm.
Gauge Plate to check the above	Part No. *C.G.10516	

Note. *This gauge plate can be obtained from Messrs. Borg & Beck Company Ltd., Tachbrook Road, Leamington Spa, Warwickshire.

Price on application.

GEARBOX.

Number of Gears	Four forward, one reverse.
Synchromesh on	2nd, 3rd and top.

Gearbox Ratios.

First	3.32 : 1
Second	2.1 : 1
Third	1.354 : 1
Top	Direct
Reverse	3.32 : 1

Overall Ratios.

First	17.02 : 1
Second	10.75 : 1
Third	6.94 : 1
Top	5.125 : 1
Reverse	17.02 : 1

Constant Mesh Pinion Bearing.

Type	Hoffmann L.S.13, two spot, with snap Ring groove.	
Size	1½" × 3¼" × ¾"	
Mainshaft front end Spigot Bearing	Phosphor bronze.	
Outside diameter	.998"/.9975"	25.349/25.336 mm.
Inside diameter	.8125"/.813"	20.637/20.650 mm.

Mainshaft Intermediate Bearing.

Type	Hoffmann M.S.11, two spot, with Snap Ring groove.
Size	1⅛" × 2 13/16" × 13/16"

Mainshaft Rear End Bearing.

Type	Needle Roller. Hoffmann N.R.30

Seals.

Oil seal, end of rear extension.

Type		
Size outside diameter	2.255"/2.251"	57.277/57.175 mm.
Inside diameter	For 1½" shaft	For 38.1 mm. shaft
Width	⅜" to ½"	9.525 to 12.7 mm.
Constant Mesh Pinion Shaft, Oil Retainer	Spiral return groove	
Diametrical clearance between Pinion Shaft and Clutch Housing	.008"/.011"	.203/.279 mm.

Speedometer Gear.

Ratio	2.33 : 1
Driving Gear on Main Shaft	14 teeth (Stamped "M")
Driven Gear to Speedo Drive Cable	6 teeth (Stamped "P")

Layshaft.

Diameter of Layshaft	.8751"/.8748"	22.228/22.22 mm.
Diameter of Bush—Bronze	.8773"/.8768"	22.283/22.271 mm.
Diametrical clearance	.0017"/.0025"	.04318/.0635 mm.

PROPELLER SHAFT.

Type	Hardy Spicer	
Lubricators to Joint	One to each joint	
Lubricator to Sliding Spline	Lubricated by oil from Gearbox	
Length between Trunnion Centres	55 3/8"	1406.5 mm.
Length between Flange Faces	57 7/8"	1470 mm.
Diameter of Flange	3 7/16"	87.31 mm.
Diameter of Register	2.250"/2.248"	57.15/57.1 mm.
Diameter of Tube	3"	76.2 mm.

CHASSIS.

Wheel Base	8' 11½"	2730.5 mm.
Front Wheel Track	4' 2½"	1282.7 mm.
Rear Wheel Track	4' 3"	1295.4 mm.
Overall length	14' 9"	4496 mm.
Overall width	5' 3"	1600 mm.
Overall height (unladen)	5' 4"	1626 mm.
Luggage capacity	13 cu. ft.	.3681 cu. m.
Ground clearance (unladen)	7" (Under exhaust system)	177.8 mm.
Dry weight	22¾ cwt.	1156 kgs.
Wheel size	16 × 3.50"	406 × 89 mm.
Tyre size	16 × 5.50"	406 × 140 mm.
Tyre Pressures	See Page J1	
Turning Circle	33 ft.	10 metres

Front Independent Suspension.

Type of Springing	Coil springs	
Camber	Laden 4 up 1°—38'	
King Pin inclination	Laden 4 up 4°—22'	
Castor	Laden 4 up 2°—45'	
Toe-in-Car unladen, measured at wheel centre height and at centre of tyre tread	3/16"	4.762 mm.
Inner Wheel Max. Lock	38½° } R.H. and L.H. Locks	
Outer Wheel Max. Lock	31° }	

Coil Springs up to Chassis No. H.2358	L.H.	R.H.	L.H.	R.H.
Free Length	15"	15¼"	381 mm.	387.3 mm.
Laden length—4 passengers	8½"	8¾"	216 mm.	222.2 mm.
Load at laden length	955 lbs.	955 lbs.	433 kgs.	433 kgs.

Coil Springs commencing Chassis No. H.2386	L.H.	R.H.	L.H.	R.H.
Free length	15¾"	16"	400 mm.	406.4 mm.
Laden length—4 passengers	9" ± ⅛"	9¼" ± ⅛"	228.6mm.	234.9mm.
Load at laden length	1,000 lbs.	1,000 lbs.	453.6Kgs.	453.6Kgs.

Swivel Pins and Bushes.

Diameter of Swivel Pin	.7493"/.7488"	19.032/19.02 mm.
Diameter of Swivel Pin Bush	.7500"/.7495"	19.05/19.037 mm.
Diametrical clearance	.0002"/.0012"	.005/.03 mm.
Diameter of Bottom Arm Outer Pin	.7493"/.7488"	19.032/19.02 mm.
Diameter of Swivel Pin Bottom Anchorage Bush	.7500"/.7405"	19.05/19.037 mm.
Diametrical clearance	.0002"/.0012"	.005/.03 mm.
Diameter of Top Arm Trunnion Journals	.5623"/.5613"	14.282/14.257 mm.
Diameter of Top Arm Outer Anchorage Bush	.563"/.5625"	14.30/14.287 mm.
Diametrical clearance	.0002"/.0017"	.005/.0432 mm.

Front Hubs.

Bearings

Inner, type	Timken 15112R/15250 R
Size	1.125" × 2.5" 28.575 mm. × 63.5 mm.
Outer, type	Timken 09067/09195
Size	.750" × 1.938" 19.05 mm. × 49.213 mm.

Oil Retainer.

Inner, type	Felt	
Size	$2\frac{1}{2}$" × $1\frac{3}{4}$" × $\frac{9}{32}$"	63.5 mm. × 44.45 mm. × 7.144 mm.
Outer, type	Felt	
Size	$2\frac{1}{4}$" × $1\frac{7}{8}$" × $\frac{1}{4}$"	57.15 mm. × 47.63 mm. × 6.35mm.

Rear Suspension.

Springs.

Type	Semi-elliptic	
Working load	711 lbs.	322.5 kg.
Spring eye centres at working load	49"	1244.6 mm.
Camber working load	$\frac{13}{32}$" neg.	10.32 mm.
Free Camber	$4\frac{3}{4}$"	120.65 mm.

Note. Camber is measured from the centre line of eyes to top plate of the springs.

Number of Leaves	7	
Width of Leaves	$1\frac{3}{4}$"	44.45 mm.
Distance from eye centre pin (front)	25"	635 mm.
Distance from eye centre pin (rear)	24"	609.6 mm.
Shackle Bushes	Moulded rubber	
Rear Spring Front End Bushes	Rubber—Steel inner and outer shells.	
Rear Spring Anchor Bolt diameter	.561" .558"	14.249/14.173 mm.
Shackle Pin diameter	.562"/.559"	14.274/14.198 mm.

Damper—Rear Springs.

Type	Armstrong Double-acting DAS.10
Fluid	Armstrong "Super" thin

Damper—Front Springs. Gabriel Ajustomatic (H.D.) A5015 (#12.84)

Type	Girling Direct Acting.
Fluid	Luvax-Girling piston type damper fluid.

STEERING.

Type	Burman, Recirculating Balls	
Ratio	14 : 1	
Number of turns from lock to lock	3 (approx.)	
Diameter of Steering Wheel	17"	431.8 mm.
Wheel Position	Non-adjustable	

See note (1) PAGE A9

Rear Axle.	*No. 1 Type.* Semi-floating Hypoid unit		*No. 2 Type* Semi-floating Hypoid unit	
Ratio	5.125 : 1		5.125 : 1	
Teeth on Bevel Wheel ...	41		41	
Teeth on Bevel Pinion ...	8		8	
Backlash	.006"/.008"	.1524/.2032mm.	.004" min.	.1016 mm.
Differential Cage Bearing.	SKF.30209		~~Timken 24780 24721~~	
Size	1.771" × 3.346"	45mm × 85mm.	~~1⅝" × 3"~~	~~41.2 × 76.2mm.~~
Pinion Bearings.			Timken #5 Cup 14283/4 & 4AD Salsbury Timken #5 Cone 14138 (A) & type 6HA axle	
Front	Timken 2558/2523		Timken 02872 02820	
Size	1 3/16" × 2¾"	30.1 × 69.8mm.	1⅛" × 2⅞"	28.5 × 73mm.
Rear	Timken 2788/2729		Timken 31593 31520	
Size	1½" × 3"	33.1 × 76.2mm.	1⅜" × 2"	34.9 × 50.8mm.
Adjustment.				
Pinion adjustment by ...	Shims			
Wheel adjustment by ...	Shims			
Rear Axle Shaft Bearing.	Timken 14123T/14276		Cup 1932/1985 Cone Timken 14130 14276	
Size	1¼" × 2 23/32" (with taper bore)	31.7 × 69mm.	~~1 5/16" × 2.717"~~ 1⅛" × 2 5/16"	~~33.3 × 69mm.~~
Oil Seals.				
Bevel Pinion :				
Outside diameter	2¾"	69.8 mm.	3⅛"	79.3 mm.
Inside diameter	For 1⅝" Shaft	41.2 mm.	For 1.552" Shaft	39.4 mm.
Width	½"	12.7 mm.	⅝"	15.8 mm.
Rear Axle Shaft (inner) :			National 40160 or CR-11334	
Outside diameter	2¼"	57.1 mm.	2¼"	57.1 mm.
Inside diameter	For 1¼" Shaft	31.7 mm.	For 1 5/16" Shaft	33.3 mm.
Width	⅜" to ½"	9.5 to 12.7 mm.	½"	12.7 mm.
Rear Axle Shaft (outer) :			CR 14956	
Outside diameter	2¾" ...	69.8 mm.	2¾" 2 1/4"	69.8 mm.
Inside diameter	For 1⅞" Shaft	47.6 mm.	For 1⅞" Shaft	47.6 mm.
Width	⅜"	9.5 mm.	7/16"	11.1 mm.
End Play in Rear Axle Shaft	.003"/.005"	.07/.12 mm.	.006 .008"	.1524 .2032mm.

* For 6HA LS/274112 c.

COOLING SYSTEM.

Type	Water, through copper gill radiator assisted by fan and pump. Radiators fitted with 7 lb. pressure cap.	
Rate of flow of water through radiator under a Head of :—		
2 Feet (.61 metres) ...	9.8 g.p. min.	44.55 L.p. min.
3 Feet (.91 metres) ...	11.9 g.p. min.	54.09 L.p. min.
4 Feet (1.22 metres) ...	13.6 g.p. min.	61.82 L.p. min.
5 Feet (1.52 metres) ...	15.2 g.p. min.	69.09 L.p. min.
6 Feet (1.83 metres) ...	16.45 g.p. min.	74.77 L.p. min.
7 Feet (2.13 metres) ...	17.75 g.p. min.	80.68 L.p. min.
8 Feet (2.44 metres) ...	18.9 g.p. min.	85.9 L.p. min.

Note. When testing the rate of flow of water, the head of water must be kept constant, and unless special facilities to maintain such a head and to measure accurately the flow of water are available, it is advisable to entrust the testing to a firm who specialise in this class of work and for whose benefit the above data is given.

(1) All parts numbers originally printed in this manual are under the #2 (Salsbury) type axle (rear) are relevant only to the Hunter saloon application. This is Salsbury type 3HA axle - pendent It is also a Morgan alternate rear end. The 4AD Roadster is #6HA. are for

FUEL SYSTEM.

Fuel Pump Type	A.C. Delco Mechanical Pump	
Petrol Tank capacity ...	10 gallons	45.46 litres
Tank Unit reference ...	JAEGER TA.121	
Facia Unit reference ...	JAEGER PA.136	

Carburettor.	*Single Carb.*	*Twin Carb.*
Type	Solex 30 FAI Bi-starter down-draught. Up to Engine H.1289. Solex 30 FAIO Progressive Starter down-draught. Commencing Engine H.1290	Solex 30 FAI Bi-starter down-draught
Choke Tube	24	22
Main Jet	125	110
Air Correction Jet ...	230	220
Pilot Jet	45	45
Starter Petrol Jet	115	115
Starter Air Jet	4.5	4.5

BRAKES.

Foot.

Type	Lockheed, two leading shoes on the front and leading and trailing shoes on the rear.	
Size and number of Master Cylinder	$\frac{7}{8}$"	22.225 mm.
Size and number of Front Wheel Cylinder, 2 per Drum	$\frac{7}{8}$"	22.225 mm.
Size and number of Rear Wheel Cylinder, 1 per Drum	$\frac{7}{8}$"	22.225 mm.
Diameter of Brake Drums	9.01" to 9.02"	228.85 to 229.11 mm.
Length of Lining	$8\frac{1}{2}$"	216 mm.
Width of Lining	$1\frac{3}{4}$"	44.45 mm.
Thickness of Lining	$\frac{7}{32}$"	5.56 mm.
Type of Lining	MR.19	
Size of Rivets	$\frac{9}{64}$" × $\frac{9}{32}$"	3.56 × 7.144 mm.
Number of Rivets per lining	12	

Handbrake ... ... Mechanical, lever under dash, operating on Rear Wheels only.

FLUID CAPACITIES OF THE MAIN UNITS.

Engine, dry	7.5 pints + $\frac{1}{2}$ pint for Filter	4.26 litres
Gearbox, dry	$2\frac{1}{4}$ pints	1.3 litres
Rear Axle, dry	3 pints	1:7 litres
Steering Box	$\frac{1}{2}$ pint	.284 litres
Braking System	1 pint	.568 litres
Front Suspension Damper	.21 pints	.1 litres
Rear Suspension Shock Absorber	$\frac{3}{8}$ pint	.213 litres
Battery, per Cell	1 pint	.568 litres
Battery, total	6 pints	3.4 litres
Petrol Tank	10 gallons	45.46 litres
Cooling System, total	15 pints	8.52 litres
Radiator Block only	7 pints	3.98 litres

PERFORMANCE.

Single Carburettor.

Acceleration.	Top Gear	Third Gear
10 to 30 M.P.H. — 16 to 48 K.P.M.	12.8 Secs.	8.0 Secs.
20 to 40 M.P.H. — 32 to 64 K.P.M.	13.0 Secs.	9.1 Secs.
30 to 50 M.P.H. — 48 to 80 K.P.M.	14.0 Secs.	10.4 Secs.
40 to 60 M.P.H. — 64 to 96 K.P.M.	19.5 Secs.	00.0 Secs.

From Rest.	Through the Gears
0 to 30 M.P.H. — 0 to 48 K.P.M.	7.4 Secs.
0 to 40 M.P.H. — 0 to 64 K.P.M.	13.5 Secs.
0 to 50 M.P.H. — 0 to 80 K.P.M.	18.4 Secs.
0 to 60 M.P.H. — 0 to 96 K.P.M.	31.4 Secs.

Time taken from Rest to cover.

¼ Mile — 402 metres ... ... 24.4 Secs.

Fuel Consumption.

31.5 M.P.G. at 30 M.P.H. — 11.15 K.P.L. at 48 K.P.H.
31.5 M.P.G. at 40 M.P.H. — 11.15 K.P.L. at 64 K.P.H.
28.0 M.P.G. at 50 M.P.H. — 9.90 K.P.L. at 80 K.P.H.
23.5 M.P.G. at 60 M.P.H. — 8.3 K.P.L. at 96 K.P.H.

Car Speeds in relation to Engine Speed of 1,000 R.P.M.

Top : 15.25 M.P.H. — 24.6 K.P.H.
3rd : 11.26 M.P.H. — 18.1 K.P.H.
2nd : 7.27 M.P.H. — 11.7 K.P.H.
1st : 4.59 M.P.H. — 7.4 K.P.H.

B.H.P. : 48 at 4200 R.P.M.

Maximum Torque : 72 lbs. ft. at 2200 R.P.M. — 9.95 Kg.m. at 2200 R.P.M.

Maximum Speeds in Gears.

First Gear : 20 M.P.H. — 32 K.P.H.
Second Gear : 33 M.P.H. — 53 K.P.H.
Third Gear : 55 M.P.H. — 88.7 K.P.H.
Top Gear : 71 M.P.H. — 114.0 K.P.H.

Average relation between Speedometer readings and actual Car Speeds in miles per hour.

75 M.P.H. — 79.0 on speedometer.
70 M.P.H. — 74.0 on speedometer.
60 M.P.H. — 64.0 on speedometer.
50 M.P.H. — 54.0 on speedometer.
40 M.P.H. — 41.0 on speedometer.
30 M.P.H. — 30.5 on speedometer.
20 M.P.H. — 20.5 on speedometer.

PERFORMANCE.

Twin Carburettor.

	Top Gear.	*Third Gear.*
Acceleration.		
10 to 30 M.P.H. — 16 to 48 K.P.M.	11.5 Secs.	8.1 Secs.
20 to 40 M.P.H. — 32 to 64 K.P.M.	11.3 Secs.	8.6 Secs.
30 to 50 M.P.H. — 48 to 80 K.P.M.	12.1 Secs.	9.6 Secs.
40 to 60 M.P.H. — 64 to 96 K.P.M.	16.8 Secs.	00.0 Secs.

	Through the Gears.
From Rest.	
0 to 30 M.P.H. — 0 to 48 K.P.M.	7.2 Secs.
0 to 40 M.P.H. — 0 to 64 K.P.M.	11.0 Secs.
0 to 50 M.P.H. — 0 to 80 K.P.M.	17.0 Secs.
0 to 60 M.P.H. — 0 to 96 K.P.M.	26.3 Secs.

Time taken from Rest to cover.

¼ Mile — 402 metres ... ... 22.0 Secs.

Fuel Consumption.

31.5 M.P.G. at 30 M.P.H. — 11.15 K.P.L. at 48 K.P.H.
29.3 M.P.G. at 40 M.P.H. — 10.39 K.P.L. at 64 K.P.H.
26.6 M.P.G. at 50 M.P.H. — 9.41 K.P.L. at 80 K.P.H.
23.9 M.P.G. at 60 M.P.H. — 8.45 K.P.L. at 96 K.P.H.

Car Speeds in relation to Engine Speed of 1,000 R.P.M.

Top : 15.25 M.P.H. — 24.6 K.P.H.
3rd : 11.26 M.P.H. — 18.1 K.P.H.
2nd : 7.27 M.P.H. — 11.7 K.P.H.
1st : 4.59 M.P.H. — 7.4 K.P.H.

B.H.P. : 58 at 460 R.P.M.

Maximum Torque : 77 lbs. ft. at 2,600 R.P.M. — 10.65 Kg.m. at 2,600 R.P.M.

Maximum Speeds in Gears.

First Gear : 21 M.P.H. — 34 K.P.H.
Second Gear : 35 M.P.H. — 56 K.P.H.
Third Gear : 58 M.P.H. — 93 K.P.H.
Top Gear : 75 M.P.H. — 121 K.P.H.

Average relation between Speedometer readings and actual Car Speeds in miles per hour.

80 M.P.H. — 84.0 on speedometer.
75 M.P.H. — 79.0 on speedometer.
70 M.P.H. — 74.0 on speedometer.
60 M.P.H. — 64.0 on speedometer.
50 M.P.H. — 54.0 on speedometer.
40 M.P.H. — 41.0 on speedometer.
30 M.P.H. — 30.5 on speedometer.
20 M.P.H. — 20.5 on speedometer.

TECHNICAL DATA FOR ELECTRICAL EQUIPMENT.

For Detailed Description see Section L Electrical Equipment.

Dynamo.

Model	C39PV-2. Lucas Part No. 22258. Two-brush shunt wound ventilated machine.
Rotation (from Driving End)	Clockwise.
Brush Tension	22-25 ozs.
Field resistance	6.1 ohms.

Test Data.

Cutting-in speed	1,050 to 1,200 r.p.m. at 13.0 dynamo volts.
Maximum output	19 amps. at 1,900 to 2,150 r.p.m. at 13.5 volts.

Control Box.

Model	RB106 1 Lucas Part No. 37138
Later fitment Model	RB106 2 Lucas Part No. 37182.

Houses cut-out, voltage regulator.

Test Data ... ...

(*a*) Cut-out. Cut-in voltage 12.7 to 13.3 volts
Drop-off voltage 8.5 to 11.0 volts

(*b*) Regulator. O.C. setting at :—
10 C. (50 F.) 15.9 to 16.5 volts.
20 C. (68 F.) 15.6 to 16.2 volts
30 C. (86 F.) 15.3 to 15.9 volts.
40 C. (104 F.) 15.0 to 15.6 volts.

Fuse Units.

Model	SF6 Lucas Part No. 033239. Houses two fuses, rated at 35 amperes.

Starting Motor.

Model	M35G. Lucas Part No. 25022. Four-pole design.
Rotation (from Driving End)	Clockwise.
Drive	SB type, inboard.
Brush Tension	15 to 25 ozs.
Test Data	(*a*) Lock torque 9.3 lb. ft. with 370-390 amps. at 7.7-7.3 volts.
	(*b*) Torque at 1,000 r.p.m. 4.9 lb. ft. with 250-270 amps. at 9.3 to 8.9 volts.

Starter Switch.

Model	ST950. Lucas Part No. 76411.

Ignition Coil

	Single Carb.	*Twin Carb.*
Model	Q12. Lucas Part No. 45020.	B.12 Lucas Part No. 45012
Current consumption ...	0.9 amps. (approx.) running.	1.0 amps (approx) running
	2.7 amps. (approx.) stall.	2.9 amps (approx) stall

Distributor (Single Carburettor).

Model	DKY4A. Lucas Part No. 40167.
Rotation (from Driving End)	Clockwise.
Contact breaker gap setting	0.014" — 0.016". .356 mm. — .406 mm.
Contact breaker spring tension	20-24 ozs.

Condenser capacity	0.18 to 0.23 microfarad.
Open period	30° ± 3°.
Closed period	60° ± 3°.
Firing angles	0°, 90°, 180°, 270° ± 1°.
Points just part at 10°—11° B.T.C.D. ...	$\frac{15}{16}$" 23.8 mm.
Test Data	Arc on Flywheel
Centrifugal advance commences at ...	200-400 r.p.m. (distributor) and gives maximum advance of 20° to 23° at 1,850 to 1,900 r.p.m.

Distributor (Twin Carburettor).

Model	DM2P4. Lucas Part No. 40363.
Rotation (from Driving End)	Clockwise.
Contact breaker gap setting	0.014" to 0.016". .356 mm. — .406 mm.
Contact breaker spring tension	18—24 ozs.
Condenser capacity	0.18—0.23 microfarad.
Open period	30° ± 3°.
Closed period	60° ± 3°.
Firing angles	0°, 90°, 180°, 270° ± 1°.
Points just part at 14°—15° B.T.C.D. ...	$1\frac{13}{32}$" 35.8 mm.
Test Data.	Arc on Flywheel
Centrifugal advance commences at ...	625—825 r.p.m. (distributor) and gives maximum advance of 16°—18° at 2,400 r.p.m.
Vacuum advance	*Vacuum in inches of Mercury.* — *Distributor Movement.* 13" — $9\frac{1}{2}$°—11° $9\frac{1}{2}$" — 6° — $8\frac{1}{2}$° $6\frac{1}{2}$" — $1\frac{1}{2}$°— 5° Maximum advance of 10°—12° with vacuum of 20" of Mercury.

Sparking Plugs (Single Carburettor)

Type	Champion N.8B 14 mm.
Gap	.025" .635 mm. (Torque - 25 lbs-ft)

Sparking Plugs (Twin Carburettor)

Type	Champion N.A.8 14 mm.
Gap	.025" .635 mm.

Headlamps.

Model	F700. Lucas Part Nos. 51336 (Home RHD Export) 51337 (LHD Export) 51339 (Export Europe, ex. France) 51590 (Export France) 51343 (Export U.S.A.)
Bulbs	Lucas No. 354 (12 volt 42/36 watt, Prefocus cap) for 51336. Lucas No. 355 (12 volt 42/36 watt, Prefocus cap) for 51337. Lucas No. 370 (12 volt 45/40 watt, Prefocus cap) for 51339. Special bulb fitted in France for 51590. Special bulb fitted in U.S.A. for 51343.

Sidelamps Flasher Lamps.

Model	539. Lucas Part No. 52236
Bulbs	Lucas No. 380 (12 volt 21/6 watt, S.B.C. cap).

Stop Tail and Flasher Lamp.

Model	538. Lucas Part No. 53372.
Bulbs	Lucas No. 380 (12 volt 21/6 watt, S.B.C. cap).

Number Plate Illuminating and Reversing Lamp.

Model	469. Lucas Part No. 53097.
Bulbs	Lucas No. 222 (12 volt, 4 watt, M.C.C. cap) (Illuminating). Lucas No. 382 (12 volt 21 watt, S.C.C. cap) (Reversing).

Foglamps.

Model	SFT576. Lucas Part No. 55160.
Bulbs	Lucas No. 600 (12 volt 48 watt, Prefocus cap).

Inspection Lamp.

Model	100. Lucas Part No. 060121.
Bulb	Lucas No. 5 (12-volt, 36 watt, S.B.C. cap).

Battery.

Model	GTW9A/2. Capacity (at 10 hour rate) : 51 amperes-hours.

Horn(s).

Model	WT614. Lucas Part Nos. 69011 (Low note). 69012 (High note). Wind tone. Normal current consumption 6.5 amps. each horn.

Windscreen Wiper.

Model	CRT14. Lucas Part No. 75145 (Motor only). Current consumption 2—3.25 amps. (total). 1.4 amps. (field only).

Instruments, Switchgear, etc.

Ammeter—Model	CZU34. Lucas Part No. 36169.
Lighting Switch—Model	PPG1. Lucas Part No. 31126.
Ignition Switch—Model	S.55 Lucas Part No. 31216.
Wiper Switch—Model	PS19. Lucas Part No. 31248.
Fog Lamp Switch—Model	PPG1. Lucas Part No. 31126.
Starter Push—Model	SS9. Lucas Part No. 31253.
Panel Light—Model	PS19. Lucas Part No. 31248.
Stop Lamp Switch—Model	HL2. Lucas Part No. 31082.
Steering Column Control—Model ...	CC1. Lucas Part No. 32949.
Dipper Switch—Model	FS22. Lucas Part No. 31284.
Flasher Unit—Model	FL3. Lucas Part No. 35003.
Flasher Relay—Model	DB10. Lucas Part No. 33117.
Reverse Lamp Switch—Model	SS10. Lucas Part No. 31077.

Miscellaneous Bulbs.

Ignition Warning Light	Lucas No. 987 (12 volt, 2.2 watt).
Panel Light	Lucas No. 987 (12 volt, 2.2 watt).
Flasher Warning Light	Lucas No. 987 (12 volt, 2.2 watt).
Main Beam Warning Light	Lucas No. 987 (12 volt, 2.2 watt).

EXPORT CARS.

Cars which are shipped abroad will, on reaching their destinations, need certain running preparations before being driven away.

They are as follows :—

Check that the level of the water in the radiator, and that the levels of the oil in the engine sump, gearbox and rear axle are correct. *See page* M8.

As the Engine and Transmission will not have been run for a considerable time, all parts above normal oil levels will bear only a thin film of oil, and certain parts may even be quite dry. It is, therefore, essential that the lubricants be thoroughly circulated before severe loads are imposed on moving parts.

This can be done by starting the engine and running it at a speed of approximately 1500 r.p.m. for about five minutes before driving off.

During the first 500 miles do not exceed a maximum speed of 40 miles or 64 kilometres per hour in top gear or 30 miles per hour in third speed. After the first 500 miles or 800 kilometres increase gradually the speeds in all gears to normal operation.

TRAVELLING ABROAD.

The Customs Authorities will require the numbers of the main units. These are located at the following points :—

Chassis. On the front end of the chassis right-hand side member under the wing and immediately above the bumper support bracket. This number is the same as the Car number stamped on the Nameplate.

Engine. On the right-hand of the flange of the Cylinder Block Flywheel Housing.

Gearbox. On the top of the face of the flange adjoining Clutch Housing.

Rear Axle. On the top of the casing near the filling plug.

Rear Axle Hypoid Unit. On the top of the casing adjoining the propeller shaft flange.

Steering Gear Box. On the box near the base of the column, or on the top face of the cover plate.

Body Number. On the bulkhead, under the bonnet on the right-hand side.

NOTE. Where the right-hand side is referred to, this is looking from the driver's seat.

TOOLS SUPPLIED WITH THE CAR.

Adjustable Spanner.	Pliers.	Located in Cabinet in Luggage Boot.
Tappet Spanner.	Open-end Spanner.	
Brake Spanner.	Distributor Setting Gauge.	
Brake Bleeding Set.	Tyre Valve Extractor.	
Set of Box Spanners.	Tyre Levers.	
Screwdriver.	Tyre Pump.	
Grease Gun.	Wheel Brace.	

The Tripod Jack and Starting Handle are fitted in the spare wheel compartment under the floor of the luggage boot.

TOOLS AVAILABLE FOR SERVICE USE.

Special tools, which will assist in carrying out certain Services described in this manual, are available, and can be purchased from our Service Depot at Raglan Street, Coventry. Prices will be supplied on application. The following is a list of these tools.

Front Suspension Spring Compressing Clamp	Service Part No. 24081N
Rear Hub Extractor Axle No. 1	Service Part No. 23532A
Rear Hub Extractor Axle No. 2	Service Part No. 26541N
Wedging Tool for Fixing Centre Steering Lever when setting Toe-in of Front Wheels	Service Part No. 24082N
Valve Spring Extractor	Service Part No. 24083N
Broach Burnishing for Wheel Swivel Bushes	Service Part No. 24092N
Pliers for extracting Gudgeon Pin Circlip	Service Part No. 34287N
Pliers for extracting Gearbox Thrust Washer Circlip ...	Service Part No. 34286N
Tools for fixing new Synchromesh Liners	Service Part No. 14692N 14693N 14696N
Axle Shaft Extractor	Service Part No. 24026N
Rear Axle Drain and Filler Plug Spanner (internal Square)	Service Part No. 24061N
Gudgeon Bush Burnishing Broach	Service Part No. 17892N
Bottom Arm and Strut Pivot Bush Broach	Service Part No. 21197N
Box Spanner for Crankshaft and Connecting Rod Bolts ...	Service Part No. 34288N
Box Spanner for Cylinder Head Studs	Service Part No. 34289N
Double End Ring Spanner } For Spring and	Service Part No. 34290N
Double End Ring Spanner } Suspension Arm Bolts ...	Service Part No. 34291N
Spanner for Starting Nut	Service Part No. 23905N
Spanner for Gearbox Mainshaft Rear Nut	Service Part No. 23678N
Assembly Tool for Spring Ring in Gearbox	Service Part No. 22421N

CONTROL OF CAR.

CONTROLS (*See Fig. 1 on Page A18*).

The **Accelerator, Brake** and **Clutch** pedals are of the conventional type.

The **Hand Brake** is the inverted lever under the extreme right of the Facia Board for a R.H. Drive and on the left for a L.H. Drive. It has a forefinger trigger release.

The **Screen Wipers** are put into motion by pulling out the control marked "W". To "Park" the wipers, depress and control when the blades are in the "Parked" position.

The **Bi-Starter** or Choke Control of the Carburettor is brought into action by pulling out the control "CHOKE". **It is not necessary to use the Control when restarting a warm engine,** nor is it advisable to run the engine, for periods longer than necessary, with the control pulled out. As soon as the engine commences to run, push the control to the midway position, and return it to the normal position immediately it is possible to do so.

The **Bonnet** is opened by pulling out the control marked "BONNET". This action releases the catch securing the front edge of the bonnet which can then be raised, by lifting at a point immediately beneath the front motif and at the same time depressing the safety catch with the fingers. To lower the bonnet, press down on the motif until the catch is heard to engage.

The **Side and Tail Lights** are switched "ON" by pulling out the control marked "L", the **Headlights** by turning the control to the right and pulling again. When the side and tail lights are switched "ON" a warning light on the facia board will glow.

Anti-Dazzle Switch. To bring into use the anti-dazzle arrangements (which dip both headlamps) depress this switch with the foot and to restore normal lighting, depress again.

The **Panel** is illuminated by pulling out the control marked "P". This condition will occur only when the Side or Headlights are switched "ON".

The **Speedometer** registers total and trip mileages. The trip mileage is altered by pressing up, to the full extent, the control shown in the illustration and turning as required.

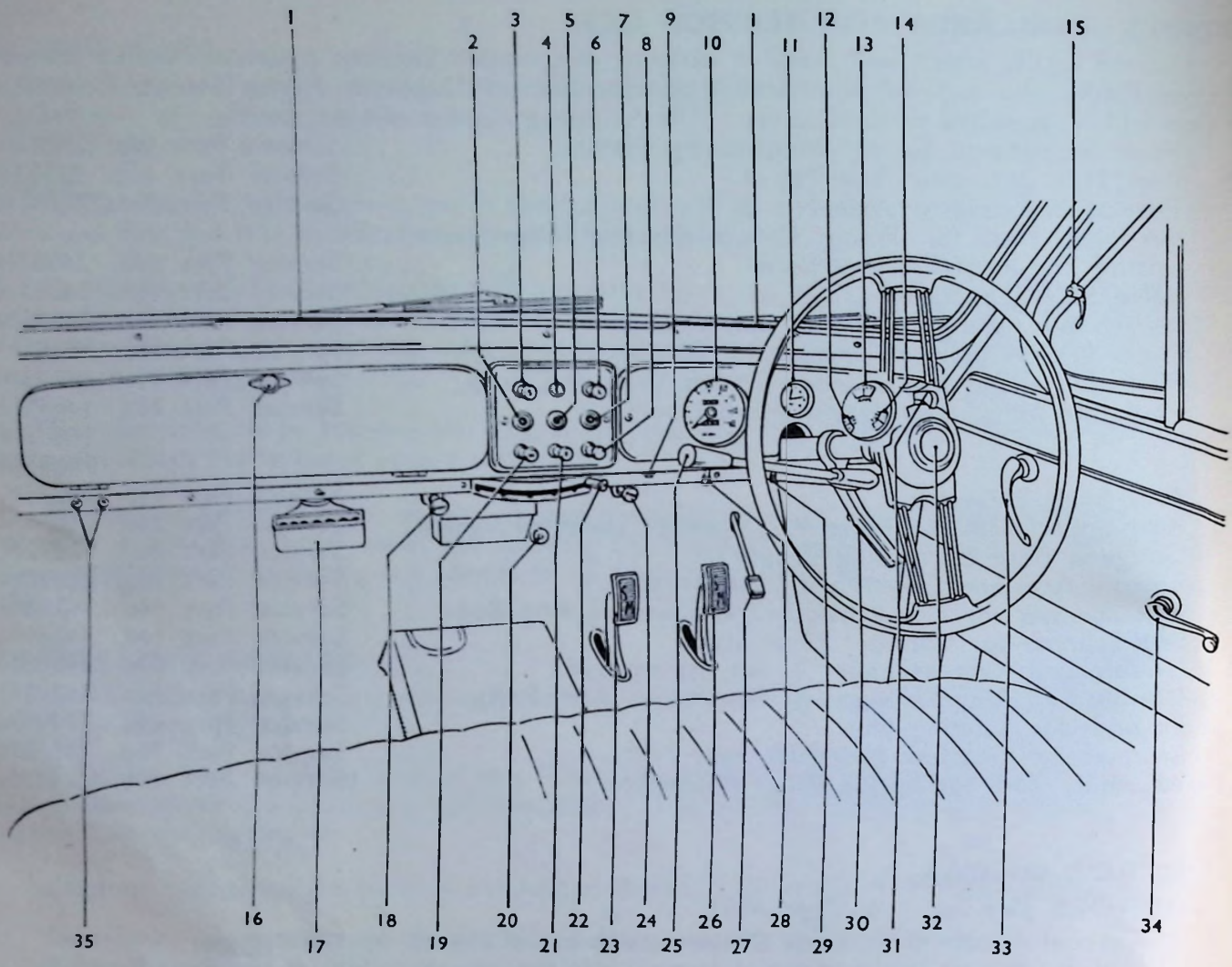

Fig. 1. Controls.

1. Demister Apertures.
2. Ignition Warning Light.
3. Starter Switch.
4. Ignition Switch.
5. Flasher Warning Light.
6. Head, Side and Tail Light Switch.
7. Main Beam Warning Light.
8. Windscreen Wiper Switch.
9. Windscreen Washer Control.
10. Speedometer.
11. Clock.
12. Oil Gauge.
13. Ammeter.
14. Fuel Gauge.
15. Window Vent Catch.
16. Glove Box.
17. Ash Tray.
18. Choke Control.
19. Panel Light Switch.
20. Anti-Dazzle Switch.
21. Fog Lamp Switch.
22. Heater Control Switch.
23. Clutch.
24. Bonnet Catch Control.
25. Gear Lever.
26. Foot Brake.
27. Accelerator.
28. Milometer Trip Control.
29. Clock Control.
30. Handbrake.
31. Flasher Indicator Control.
32. Horn Press.
33. Door Handle.
34. Window Winder.
35. Inspection Lamp Sockets.

The **Clock** is electric and self-starting. The time is set by pushing up the control behind the facia board immediately under the clock.

The **Ammeter** will, during daylight running and with the battery in good condition, seldom register more than a few amperes charge. A discharge reading may be registered when the Headlights are switched "ON", but after a short time the regulator will make the necessary adjustment.

On starting the engine from cold the charging rate may be rather high but after about ten minutes' running it will fall to a charge suitable to the state of the Battery.

At low engine speeds no charge may be registered. This condition is due to the dynamo not rotating fast enough to deliver a charge.

The **Ignition Switch** is operated by means of a removable key. Turn the key in a clockwise direction to switch "ON" and always remove it when leaving the car unattended. Immediately the ignition is switched "ON", the red warning light will glow and will continue to do so as long as the switch is left "ON" without the engine running, or when the engine is running but the dynamo not charging. This condition can only be expected when the engine is running very slowly and the dynamo charging rate insufficient to balance the drain on the battery from the coil ignition.

To operate the **Starter** depress firmly the control marked "S" and release as soon as the engine fires. Do not depress the control a second time, but wait until the engine has stopped revolving after a false start. Do not, under any circumstances, depress the control while the engine is running.

The **Gear Lever** is on the steering column. To obtain the lower gears move the knob of the lever forwards away from the wheel to the full extent, and then upwards towards the dash for First Gear and downwards for Second. Third and Top are obtained similarly, but with the knob of the lever pulled towards the steering wheel. To obtain Reverse, pull out the knob, move the lever forwards away from the wheel to the full extent, and then downwards. *See Fig.* 2.

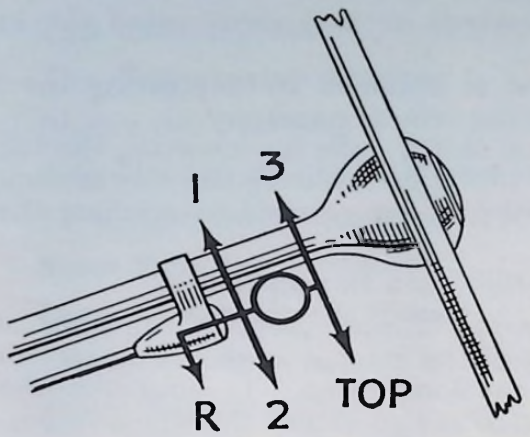

Fig. 2. Gear Lever Positions (Steering Column Change).

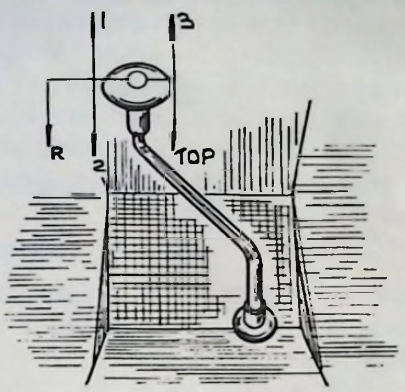

Fig. 3. Gear Lever Position (Central Change).

Central Change Speed Lever. This is available as an optional extra, and the selection of gears is orthodox for this type of change, as indicated in *Fig.* 3.

Luggage Boot Lid. To prop open the luggage boot lid, lift it to the full extent and then allow it to fall against the catches on the stays ; to close, raise the lid to the full extent and then lower. The ignition key fits the lock of the lid.

STARTING THE ENGINE. Check that the gear lever is in "neutral" and that the handbrake lever is in the "ON" position ; switch on the ignition. The red warning light will show while the engine is not running, and when the engine is running but with the dynamo not charging. This condition can only be expected when the engine is running very slowly and the dynamo charging insufficiently to balance the drain on the battery from the coil ignition. Pull out the carburettor choke control to its full extent, depress the starter switch, and release immediately the engine fires. As soon as the engine gathers speed, push in the choke control to the half-way position. It should now be possible to drive off at a moderate speed ; but do not forget to push in fully the choke control as soon as the engine is hot enough to run without hesitating.

On later models with the Progressive Starter Carburettor, the choke control can be pushed home gradually from the halfway position. This eliminates "flat spots" and the tendency to stall.

It is not necessary to use the carburettor choke control when restarting a warm engine, nor is it advisable to run the engine for any length of time with the choke control out. Always remove the switch key when leaving the car standing.

CARE WHEN DRIVING. Do not over-drive. It is bad practice and very harmful to the engine and transmission generally. In addition, it causes wheel spin which in turn gives rise to rapid tyre wear. Change into the top gear as soon as possible for there is no necessity to drive long distances in second before changing to third, and in third before changing into top.

Economy of fuel is achieved by avoiding the habit of changing down and violently accelerating to pass another vehicle, or of changing down from high speeds in order to slow up the car. Bends and corners are either known or are plainly indicated by road signs, traffic in front can always be seen, and it is a simple matter to slow up in time by removing the foot from the accelerator pedal and to use the engine as a brake. To slow the car still further, a touch on the brake pedal is all that should be necessary.

The car must be run carefully for the first 500 miles—800 kilometres. **Do not exceed 30 miles—48 kilometres—per hour in top.** By observing these rules the car will give prolonged service and smooth running. Even after completing the first 500 miles it will pay to increase, with discretion, the maximum speeds in all gears.

Do not use force when operating the gear lever, or keep your foot on the clutch pedal when the clutch is not in use. It is also bad practice to free-wheel by keeping the clutch pedal depressed.

Avoid coasting down hills in neutral, the car is under better control when one of the gears is in engagement and the foot off the accelerator pedal.

Front Seat Adjustment. To move the seat forwards or backwards, wind the handle in the centre of the seat valance as necessary.

On later models forward or backward adjustment is obtained by depressing the lever situated in the centre of Seat Front Border and sliding the seat as necessary.

In addition the Seat is adjustable for height and rake, this is done by removing the locating pins at each side of the seat (front and rear of seat) and lifting or lowering the seat as required. Five positions (fore and aft) are provided. The forward pins are reached by opening the flap in the Seat Side Valance.

IMPORTANT. Do not tighten locating pins until all are in position.

SPARE WHEEL. The spare wheel is carried in the compartment of the floor of the baggage boot. To obtain access to it, turn the handles of the catches at the two rear corners of the floor, and raise the floor. A stay is fitted to keep the floor raised. To close press the stay to the right and lower the floor. Do not forget to recatch and so secure the wheel in position.

HOW TO JACK UP THE CAR. Spread open the legs of the Jack to their full extent. Then engage the spigot with one of the sockets attached to each corner of the car and when doing so, position the base of the Jack slightly towards the centre of the car. This is to help the Jack assume a vertical position as the car is raised. Next rotate the brass nut on the screw of the Jack until the two projections on its upper surface engage with the two slots in the under face of the spigot. Then wind the handle in a clockwise direction until the wheel is clear of the ground. To lower turn the handle in an anti-clockwise direction.

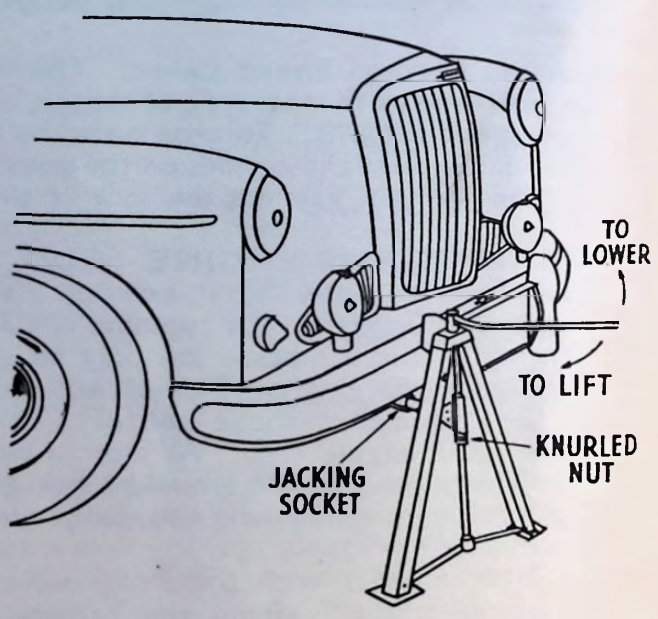

Fig. 4. Jack in position.

HOW TO CHANGE A WHEEL. Jack up the car until the wheel is clear of the ground. Then with the aid of the screwdriver prise off the wheel cap, remove the four nuts exposed, using the brace supplied in the kit, and lift the wheel off the hub.

Before replacing, grease the wheel studs, and, after replacing the wheel, tighten the nuts in diagonal rotation, lower the wheel on to the ground, give the nuts a final tightening and replace the wheel cap by forcing it over its retaining studs.

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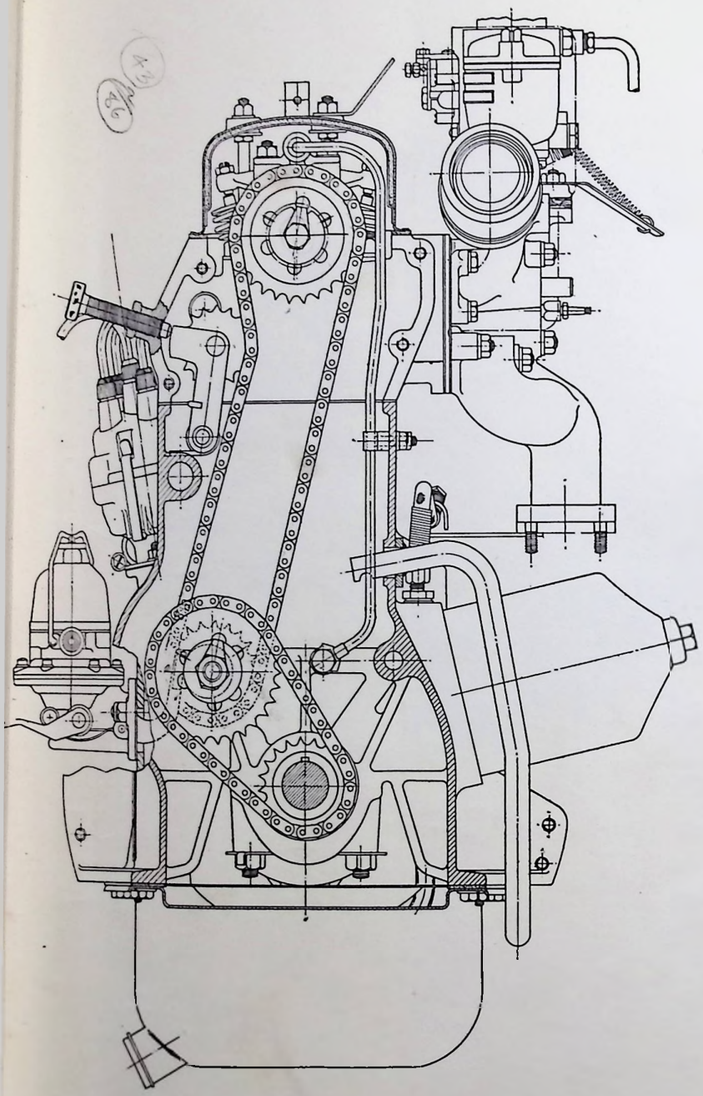
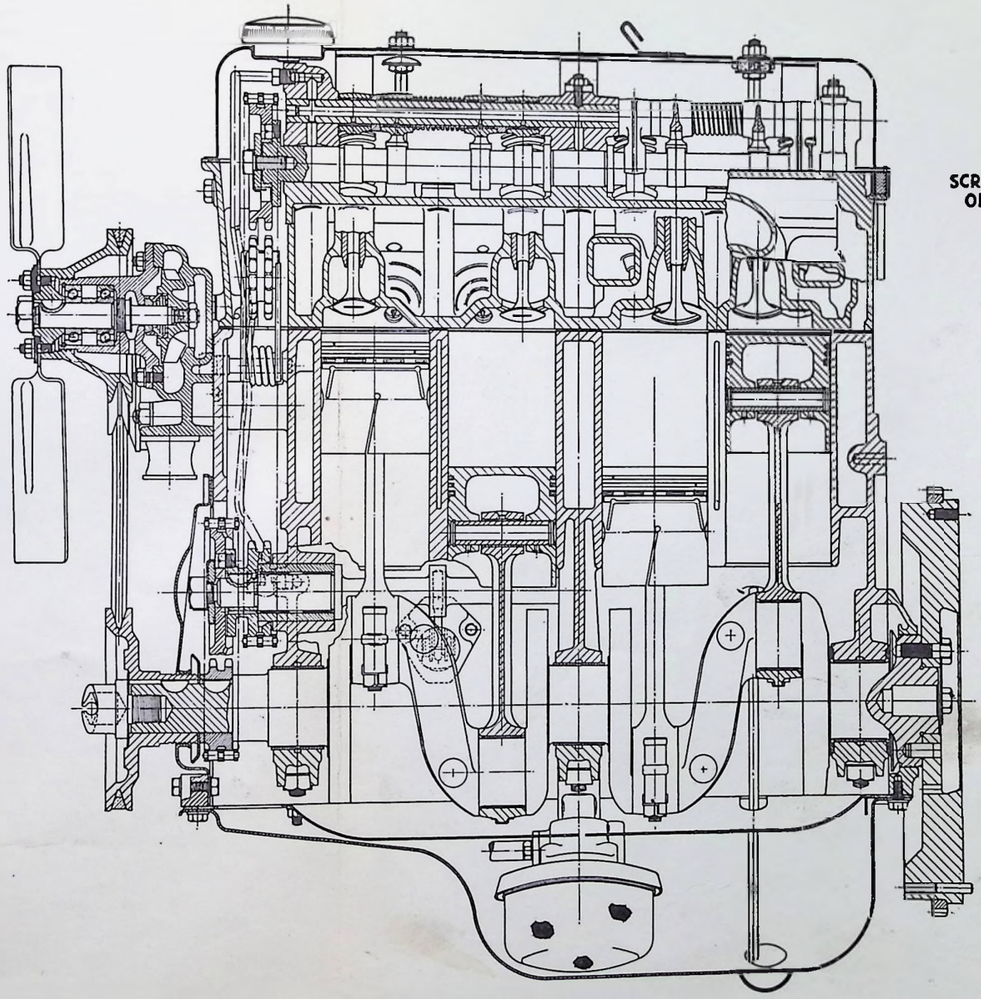
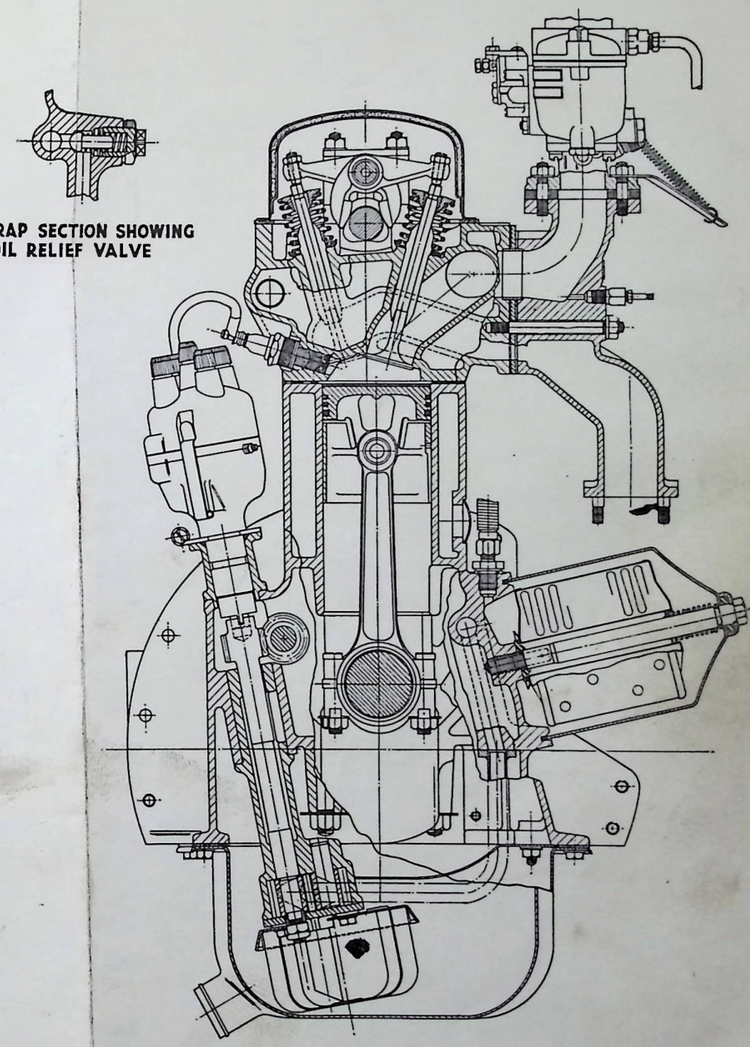


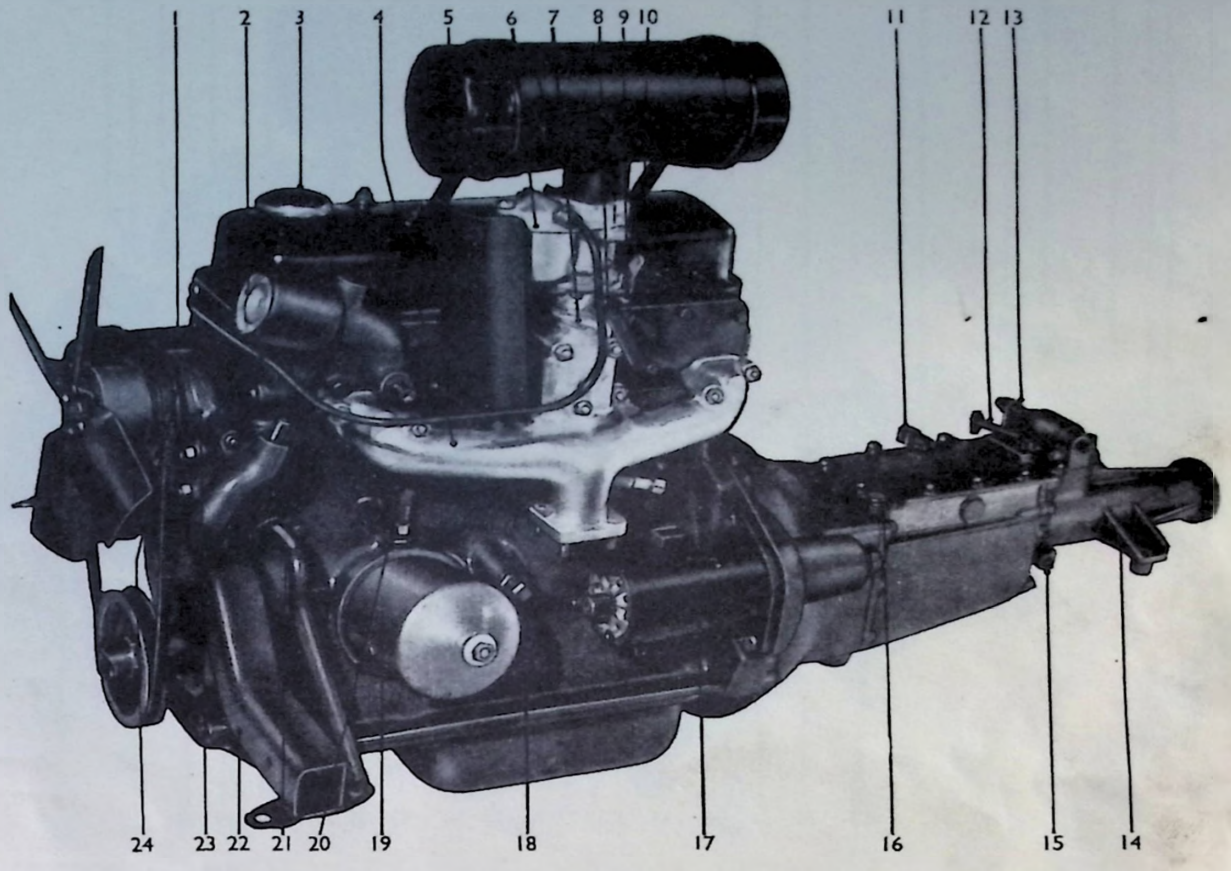


SCRAP SECTION SHOWING
OIL RELIEF VALVE



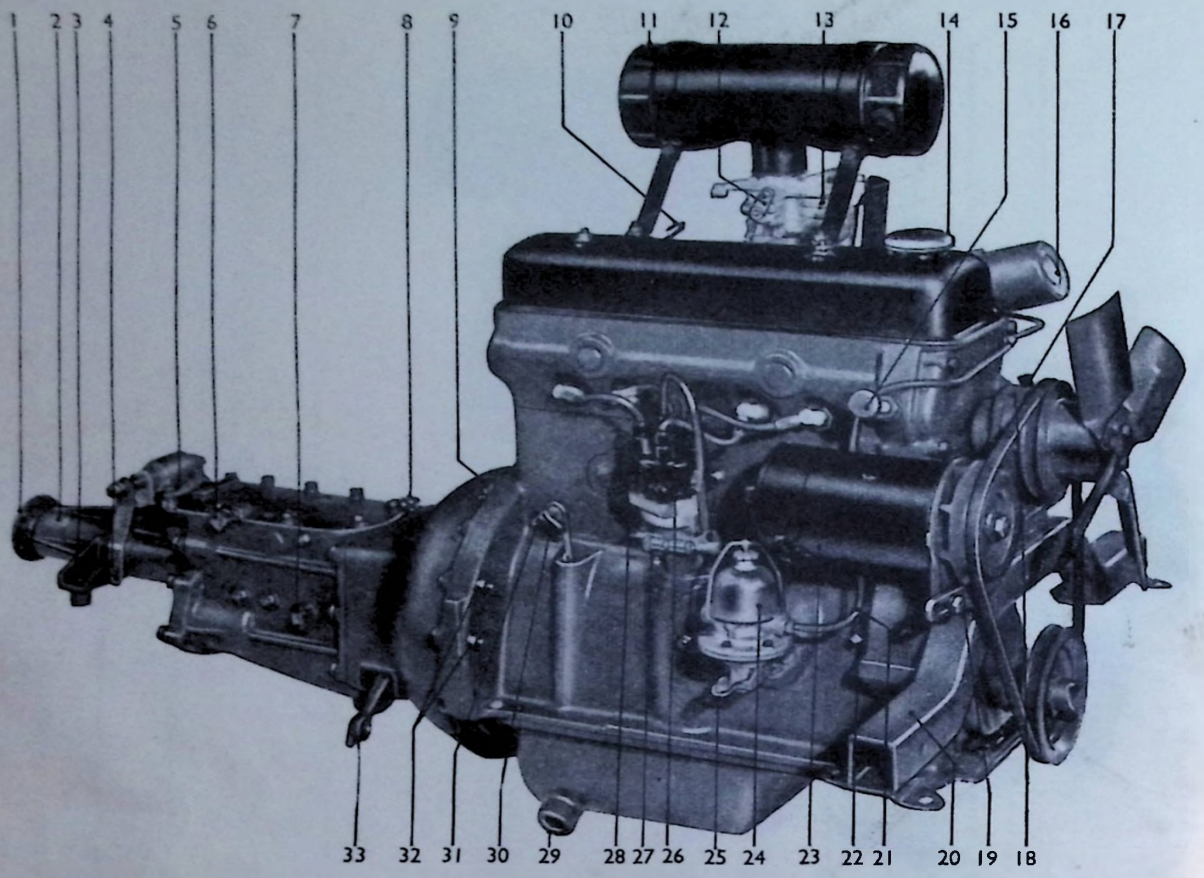
HUNTER SALOON—ENGINE ARRANGEMENT (COMMENCING CHASSIS No. H.1501)

"HUNTER" SINGLE CARBURETTOR ENGINE
L.H. SIDE VIEW



1. Dynamo.
2. Water Outlet and Thermostat Pipe.
3. Oil Filler Cap.
4. Inlet and Exhaust Manifold.
5. Carburettor Baffle.
6. Carburettor.
7. Carburettor Insulator Washer.
8. Slow Running Volume Control Screw.
9. Throttle Lever Adjusting Abutment Screw.
10. Throttle Lever.
11. Change Speed Cable Support.
12. Change Speed Operating Lever.
13. Change Speed Lever.
14. Rear Engine Mounting.
15. Speedo Pinion Guide.
16. Dipstick (Gearbox).
17. Starter Motor.
18. Oil Relief Valve.
19. A.C. Oil Filter.
20. Oil Pressure Gauge Union and Flex.
21. Breather Tube.
22. Front Engine Support Bracket Member.
23. Water Pump.
24. Water Pump Spindle Greaser.

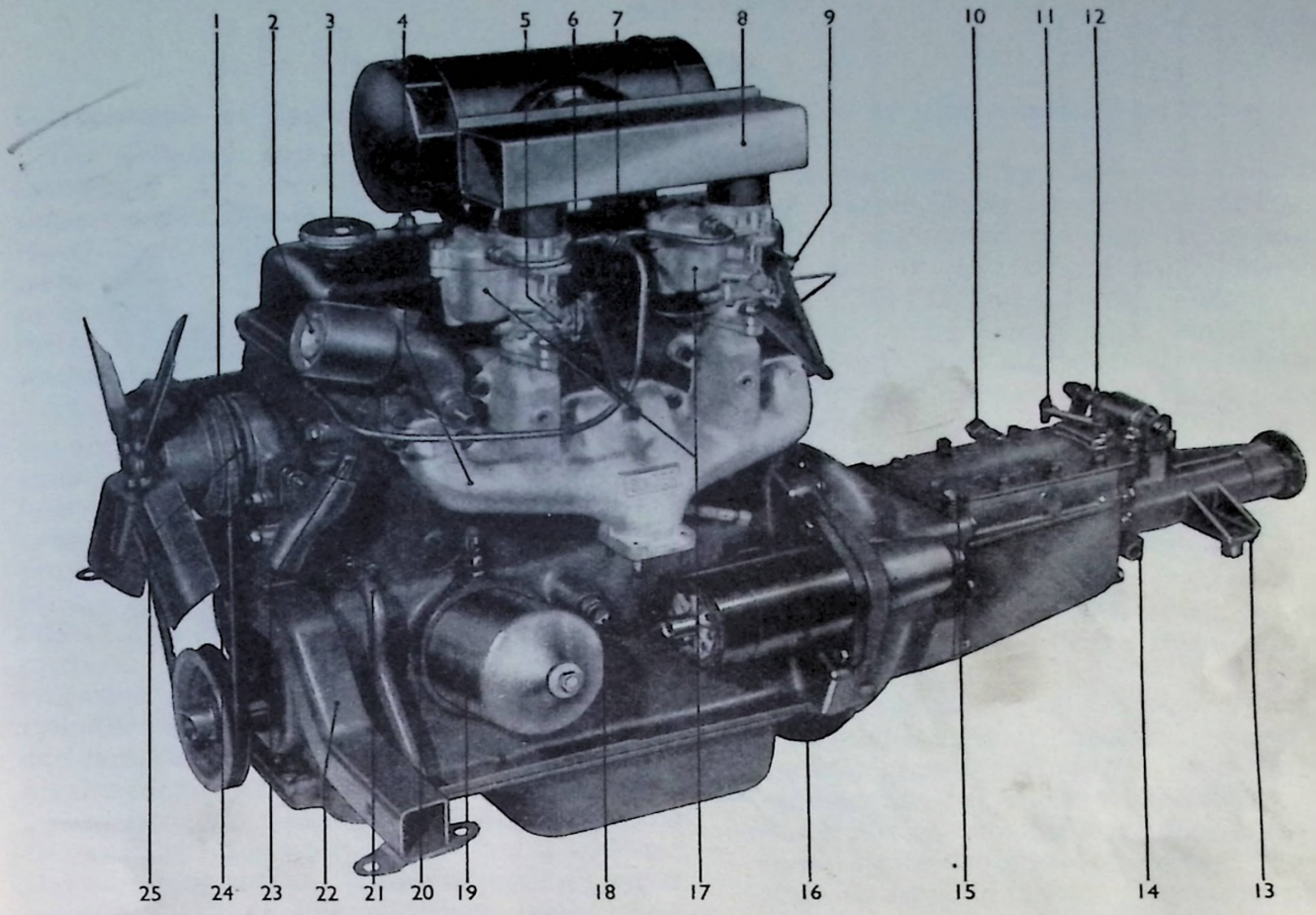
"HUNTER" SINGLE CARBURETTOR ENGINE
R.H. SIDE VIEW



"HUNTER" SINGLE CARBURETTOR ENGINE R.H. SIDE VIEW

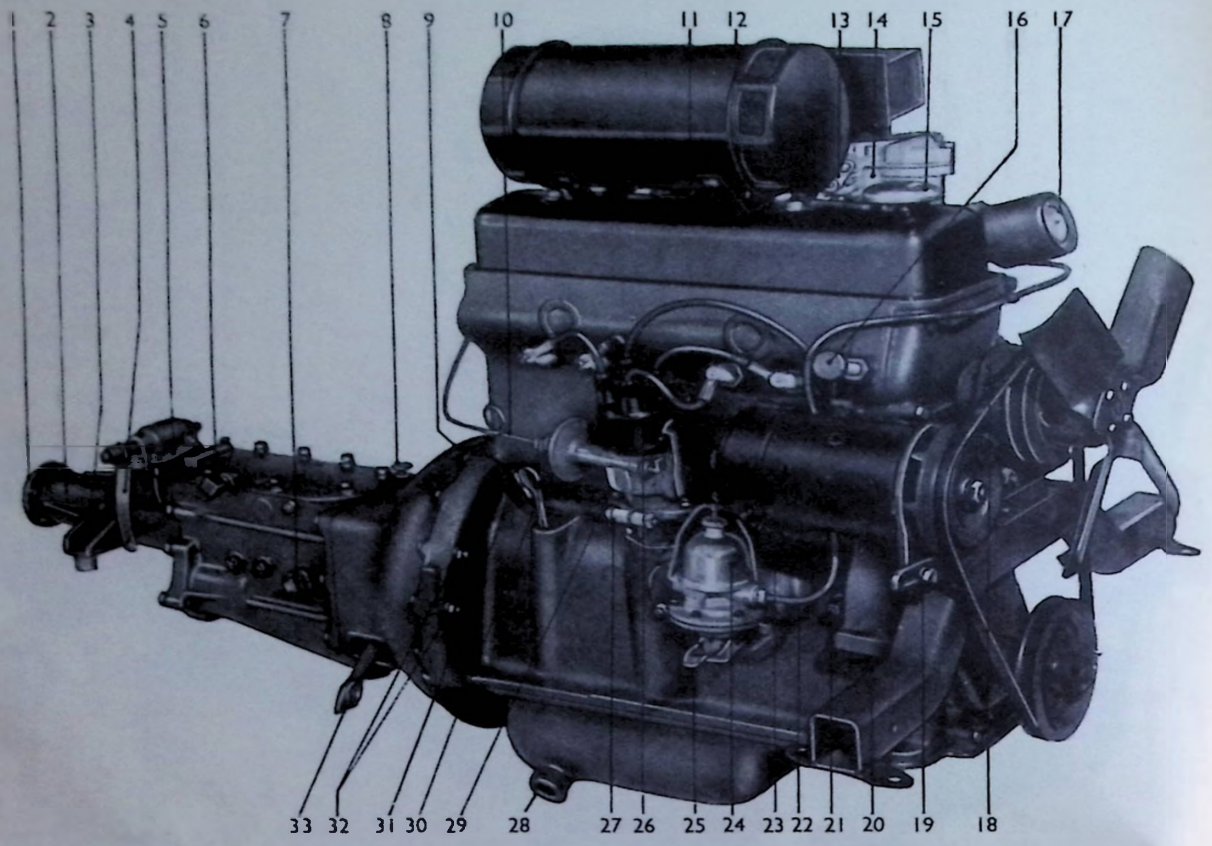
1. Flange, Propeller Shaft.
2. Gearbox End Housing.
3. Rear Engine Mounting.
4. Change Speed Lever.
5. Operating Lever.
6. Cable Support.
7. Reverse Light Switch.
8. Dipstick (Gearbox).
9. Top Centre Viewing Aperture.
10. Accelerator Cable Clip.
11. Air Silencer.
12. Carburettor Starter Lever.
13. Carburettor.
14. Oil Filler Cap.
15. Chain Tensioner.
16. Water Outlet and Thermostat Pipe.
17. Car Heater Water Return Pipe.
18. Water Pump.
19. Dynamo Adjusting Link.
20. Front Engine Support Bracket.
21. Petrol Delivery Pipe.
22. Intermediate Shaft Bush Locking Screw.
23. Dynamo.
24. Petrol Pump.
25. Petrol Pump Priming Lever.
26. Distributor.
27. Distributor Clamp Bolt.
28. Distributor Index Adjustment Plate.
29. Engine Sump Drain Plug.
30. Dipstick (Engine).
31. Cylinder Jacket Drain Tap.
32. Torque Arm Assembly Studs.
33. Clutch Withdrawal Lever.

"HUNTER" TWIN CARBURETTOR ENGINE
L.H. SIDE VIEW



1. Dynamo.
2. Water Outlet and Thermostat Pipe.
3. Oil Filler Cap.
4. Inlet and Exhaust Manifold.
5. Slow Running Volume Control Screw.
6. Throttle Lever Adjusting Abutment Screw.
7. Throttle Lever.
8. Air Intake Adapter.
9. Throttle Synchronising Adjuster.
10. Change Speed Cable Support.
11. Change Speed Operating Lever.
12. Change Speed Lever.
13. Rear Engine Mounting.
14. Speedo Pinion Guide
15. Dipstick (Gearbox).
16. Starter Motor.
17. Carburettor.
18. Oil Relief Valve.
19. A.C. Oil Filter.
20. Oil Pressure Gauge Union and Flex.
21. Breather Tube.
22. Front Engine Support Bracket Member.
23. Car Heater Water Return Pipe.
24. Water Pump.
25. Water Pump Spindle Greaser.

"HUNTER" TWIN CARBURETTOR ENGINE
R.H. SIDE VIEW



"HUNTER" TWIN CARBURETTOR ENGINE R.H. SIDE VIEW

1. Flange, Propeller Shaft.
2. Gearbox End Housing.
3. Rear Engine Mounting.
4. Change Speed Lever.
5. Operating Lever.
6. Cable Support.
7. Reverse Light Switch.
8. Dipstick (Gearbox).
9. Top Centre Viewing Aperture.
10. Vacuum Advance Suction Pipe.
11. Accelerator Cable Clip.
12. Air Silencer.
13. Carburettor Starter Lever.
14. Carburettor.
15. Oil Filler Cap.
16. Chain Tensioner.
17. Water Outlet and Thermostat Pipe.
18. Water Pump.
19. Dynamo Adjusting Link.
20. Front Engine Support Bracket.
21. Intermediate Shaft Bush Locking Screw.
22. Petrol Delivery Pipe.
23. Dynamo.
24. Petrol Pump.
25. Petrol Pump Priming Lever.
26. Distributor.
27. Distributor Clamp Bolt.
28. Engine Sump Drain Plug.
29. Distributor Index Adjustment Plate.
30. Dipstick (Engine).
31. Cylinder Jacket Drain Tap.
32. Torque Arm Assembly Studs.
33. Clutch Withdrawal Lever.

SECTION B

ENGINE

Description of Engine.

The cylinders are cast integral with the crankcase. The crankshaft which runs in three renewable self-locating steel shell white metal lined bearings, has counter weighted webs and is dynamically balanced. The float or end thrust of the shaft is taken at the rear main journal by two renewable thrust washers.

The connecting rods, of high tensile steel, are accurately balanced and fitted with renewable steel shell white metal lined big end bearings and floating gudgeon pins, in wrapped bronze bushes. These pins are held in position by circlips fitting in grooves machined in the gudgeon pin bosses of the Hepolite HEPLEX, low expansion alloy, flexible skirt pistons. Each piston carries two compression rings and one oil control ring. The detachable cylinder head houses the valves, valve rockers and camshaft, the cams of which operate direct on the rocker pads. The rockers oscillate on a shaft lying parallel with and vertically above the camshaft and each rocker has a lock nut and adjusting screw. These adjusting screws, by which the rocker clearance is set, bear directly on the valve stems. The camshaft, valves and rocker mechanism are enclosed by a metal cover.

The camshaft is driven by two Duplex roller chains. The primary chain couples the crankshaft to the intermediate shaft, from which the oil pump and distributor receive their drive through helical gears : the secondary chain couples the intermediate shaft and camshaft. The tension of the secondary chain is maintained by an idler sprocket, spring loaded and adjustable, while the coupling between the camshaft and chain wheel is such that the valve timing can be accurately set.

The cooling water is circulated through the engine and a copper cored radiator by a centrifugal pump bolted to the forward face of the cylinder block and driven, in tandem with the dynamo, by a "V" belt from a pulley on the crankshaft. The cooling is further assisted by a fan mounted on the water pump spindle.

Carburation is by a Solex 30 FAIO Progressive Starter Downdraught Carburettor fitted with a combined air cleaner and silencer. The fuel is fed to the carburettor by an A.C. DELCO mechanical pump, and the ignition is by Lucas high tension coil and distributor with automatic advance on single carburettor engines. Automatic and vacuum advance is provided on twin carburettor engines.

Oil is carried in the sump from where it is drawn, through a basket type filter, by a gear type of pump which receives its drive from the intermediate shaft. Oil to the main bearings, and big end bearings is delivered via oil ways formed in the crankcase and webs of the crankshaft.

A portion of the oil overflow from the front intermediate shaft bearings collects in an annular groove formed in the camshaft intermediate driven chain wheel, from here it is flung out to camshaft or secondary chain via radial holes drilled in the wheel and between the two rows of teeth. The remainder of the overflow passes along holes drilled longitudinally in the boss of the intermediate driven chain wheel into a small recess formed between the joint faces of the two intermediate shaft chain wheels, from here it flows via radial oil ways into an annular groove formed in the rim of the intermediate driven chain wheel, and then on to the primary chain, as in the case of the secondary chain.

An oil pipe carries the oil from the main gallery to the forward bearing cap of the camshaft from where it is delivered to the valve mechanism and camshaft bearings via the hollow rocker shaft. It is returned to the sump down the timing chain case and a channel formed in the rear face of the cylinder head and block.

The pistons and small ends receive their lubrication by splash, while a by-pass A.C. filter having a renewable element is fitted between the main gallery and sump.

SERVICES TO THE ENGINE.

There are certain services which can be carried out to the engine with it in position in the chassis.

The following lists give those which can be done :—

With Bonnet Raised and Car on the Floor.

(1) To remove and replace the air cleaner and carburettor. *See page B3.*

(2) To remove and replace the exhaust and inlet manifold. *See page B9.*

(3) To remove and replace the cylinder head. *See page B9.*

(4) To dismantle and reassemble the cylinder head. *See page B10.*

(5) Decarbonising. *See page B12.*

(6) Adjusting the rockers. *See page B14.*

(7) Adjusting the chain tensioner. *See page B14.*

(8) Checking the valve timing. *See page B16.*

(9) Checking the ignition timing. *See page B17.*

(10) To remove and replace the water pump. *See page B18.*

(11) To remove and replace the dynamo and adjust fan belt. *See page B18.*

(12) To remove and replace the distributor. *See page B19.*

(13) To remove, clean and replace the petrol pump. *See pages B19 and B20.*

With Bonnet Raised and Car Elevated.

(1) To remove and replace the primary chain and chain wheels. *See page B21.*

(2) To remove and replace camshaft chain and chain wheels. *See pages B21 and B22.*

(3) To remove and replace the intermediate shaft. *See pages B22 and B23.*

(4) To remove and replace flywheel. *See page B23.*

(5) To remove and replace oil sump. *See page B24.*

(6) To remove and replace the oil pump. *See page B24.*

(7) To remove and replace the piston and rod assembly. *See page B26.*

(8) To remove and replace the main bearing caps for inspection of bearings but not renewal. *See page B28.*

(9) To remove and replace the A.C. Delco oil filter. *See page B28.*

(10) To remove and replace the starter motor. *See page B29.*

If, in the case of a general overhaul, the entire power unit, *i.e.* (engine, clutch and gearbox) will have to be removed, this is explained on page B30.

THE A.C. COMBINED AIR CLEANER AND SILENCER.

Description : Air entering the carburettor passes through the oil-wetted woven mesh (A), the air tube (B) and the central tube (C) and the resonance chamber (D). *See Fig.* 1.

Particles of dust, etc., in the air being drawn in adhere to the mesh (A), the compartments B, C and D are specially designed to reduce to a minimum the noise of the air at various engine speeds.

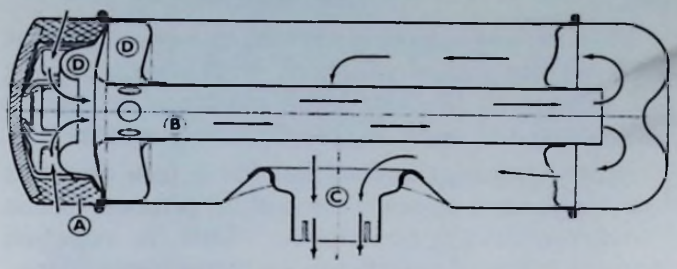


Fig. 1. Direction of Air through Cleaner.

To Remove (Single Carburettor Engines).

Remove two nuts and shakeproof washers, holding strap to rocker cover. The silencer will then lift off complete with retaining stays (note rubber sleeve between carburettor and silencer outlet neck).

To Remove (Twin Carburettor Engines).

Remove four set pins securing silencer to the straps on the valve cover, then release clips holding distributing box to the carburettors, silencer and distributing box can now be lifted off the carburettors.

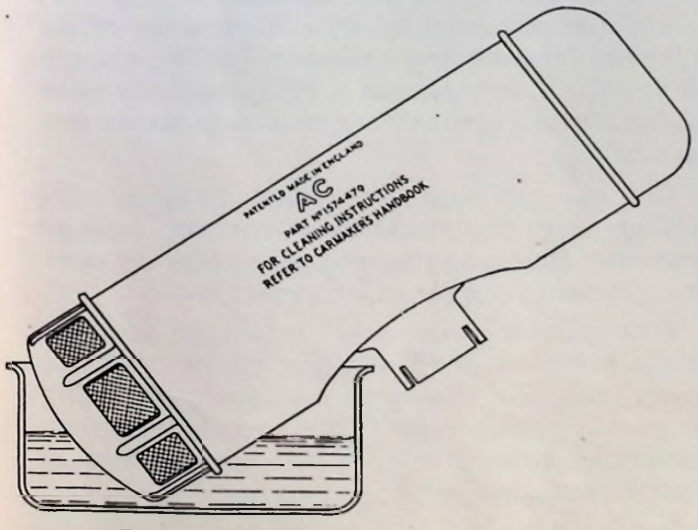


Fig. 2. Method of Cleaning A.C. Air Cleaner.

To Service.

Every 5,000 miles (8,000 kilos) the oil-wetted cleaner portion requires cleaning and re-oiling. This is done by swilling the windowed lid of the cleaner in a pan of paraffin, after drying, the mesh should be lightly re-oiled with new engine oil, allowing any surplus to drain off before refitting to the engine.

To Replace.

This is a reversal of removing, in the case of the single carburettor engine make sure that the rubber sleeve is in position. The windows are always to the front of the engine.

CARBURETTOR.

The Solex 30 F.A.I.O.-2 downdraught carburettor is a development of the 30 F.A.I. model incorporating a progressive starter carburettor in place of the original bi-starter unit.

On some of the earlier models, however, the 30 F.A.I. carburettor may still be fitted, in which case the ensuing data on the progressive starter unit will not apply.

Describing the main carburettor and referring to the diagram on page B5.

(t) is the main jet holder, screwed in the rear of which is the main jet itself (G). This meters petrol from the float chamber into the horizontally disposed channel leading from the jet to the well (A) of the spraying assembly.

Down the middle of this well is the emulsion tube (et) which is located on a conical seating and held by the air correction jet (a) which surmounts the whole and locks the emulsion tube immovably.

Main Jet Operation.

The metered petrol from the main jet (G) passes into the well (A) where it meets air drawn downwards via the calibrated air correction jet (a). This air passes out through the small holes (ch) into the annulus, where an emulsion is formed with the petrol, and the resulting mixture rises to the four large spraying orifices of which two are shown (oo) in the waist of the choke tube. Here the emulsion is caught up in the main air current and passes down to the manifold via the throttle (V).

Pilot Jet Operation.

Idling is effected by petrol drawn from the main jet well via small channel which will be seen emerging immediately above the larger horizontal lead from the main jet. This, it will be noted, turns upwards and eventually passes through the pilot jet (g) into the downwardly-disposed channel where an emulsion is formed with air from the pilot jet air bleed (u). This channel communicates with the mixture orifice (io) controlled by the spring-loaded and knurled taper screw (W).

The orifice (io) is on the engine and therefore on the suction side of the throttle. A branch lead communicates with another orifice (bp) which enters the airway slightly on the atmospheric side of the almost closed throttle.

When the throttle is in the idling position, this branch lead which is termed the "by-pass", acts as an air bleed upon the idling petrol supply and prevents over-richness when idling. Directly the throttle opens, however, the vane passes to the atmospheric side of the orifice, so that both (bp) and (io) function as delivery orifices, thereby proportionately enriching the output at the transfer position between the pilot and main supplies preventing a lean flat spot which might otherwise take place.

Adjustment.

The adjustment of the carburettor consists in the selection of a choke tube (K) of suitable diameter ; a main jet (G) and air correction jet (a) of suitable sizes to correspond with the choke characteristic ; and a pilot jet (g) to handle the idling end of the mixture curve which is in turn assisted in effecting a perfect transfer by the air bleed (u), and eventually by the volume screw (W) which determines the final strength of the idling mixture.

The Progressive Starter.

With the dashboard control pulled out to its full extent the discs (T) and (SV) are rotated to the rich position as shown, and with the engine running petrol drawn from the calibrated jet (Gs) (in the base of the float chamber) is mixed with a small amount of air in the wells above (Gs) and then passes through the channels to duct (D) and through a drilling in (SV), into the mixing chamber of the starter carburettor. Further small amounts of air are now admitted via the small bleed hole at the top of the chamber, and round the edges and through the drillings of the spring-loaded disc (T) which is drawn off its seating and pulled to the right by engine suction once the engine has fired. Prior to this the suction created by the cranked engine does not normally lift the spring loaded disc (T) so that the initial mixture is very rich, only mixing with air from the bleed hole in the starter box. The emulsion passes out of the mixing chamber to the engine via a drilling at the bottom of (SV) and then ducting (C-d) on the engine side of the throttle (V).

This arrangement provides a very rich but well disintegrated mixture which will permit the engine to fire and then continue to run at temperatures well below freezing point.

After the engine has run for a few seconds the dashboard control should be pushed to the "intermediate" position. This is reached when a marked resistance to movement is felt, caused by the engagement of a spring-loaded ball with a depression in lever (sl).

With the starter carburettor in the intermediate position, the discs have been rotated so that now a smaller dished hole at the top of disc (SV) whilst admitting the rich emulsion from the starter wells also puts the mixing chamber in communication with the waist of the choke tube (K) via a drilling through the carburettor body and the choke tube itself. When the throttle is closed, air is drawn through this drilling, by depression acting on (C-d), which mixes with petrol mixture from (D) before passing through the dished hole into the starter mixing chamber.

Also a drilling at the bottom of disc (T) allows unrestricted air to the capacity of jet (Ga) into the mixing chamber. (The starter air jet (Ga), in this case is cast integrally with the cover and is therefore non-detachable nor adjustable).

The car can now be driven away at this setting and the dashboard control pushed gradually home as the engine warms up with the following sequence of events :—

When driving away engine suction at point (d) is relieved progressively as the throttle opens, but for the same reason air passing down the choke tube (K) creates suction on the choke tube drilling which communicates with the starter mixing chamber.

The act of pushing in the dashboard control

gradually allows suction at the above point to become effective, so that mixture from the starter unit drawn through the hole in the choke tube supplements the supply being discharged from (C-d) to ensure clean acceleration, and elimination of unpleasant "flat spots" without "popping-back" and stalling.

At the same time the mixture discharge drilling, in the bottom of valve (SV), is slowly reduced, progressively blanking-off channel (C-d), and reducing the volume of starter mixture being discharged until it is finally closed, when the engine is warm enough to run on the main spraying assembly.

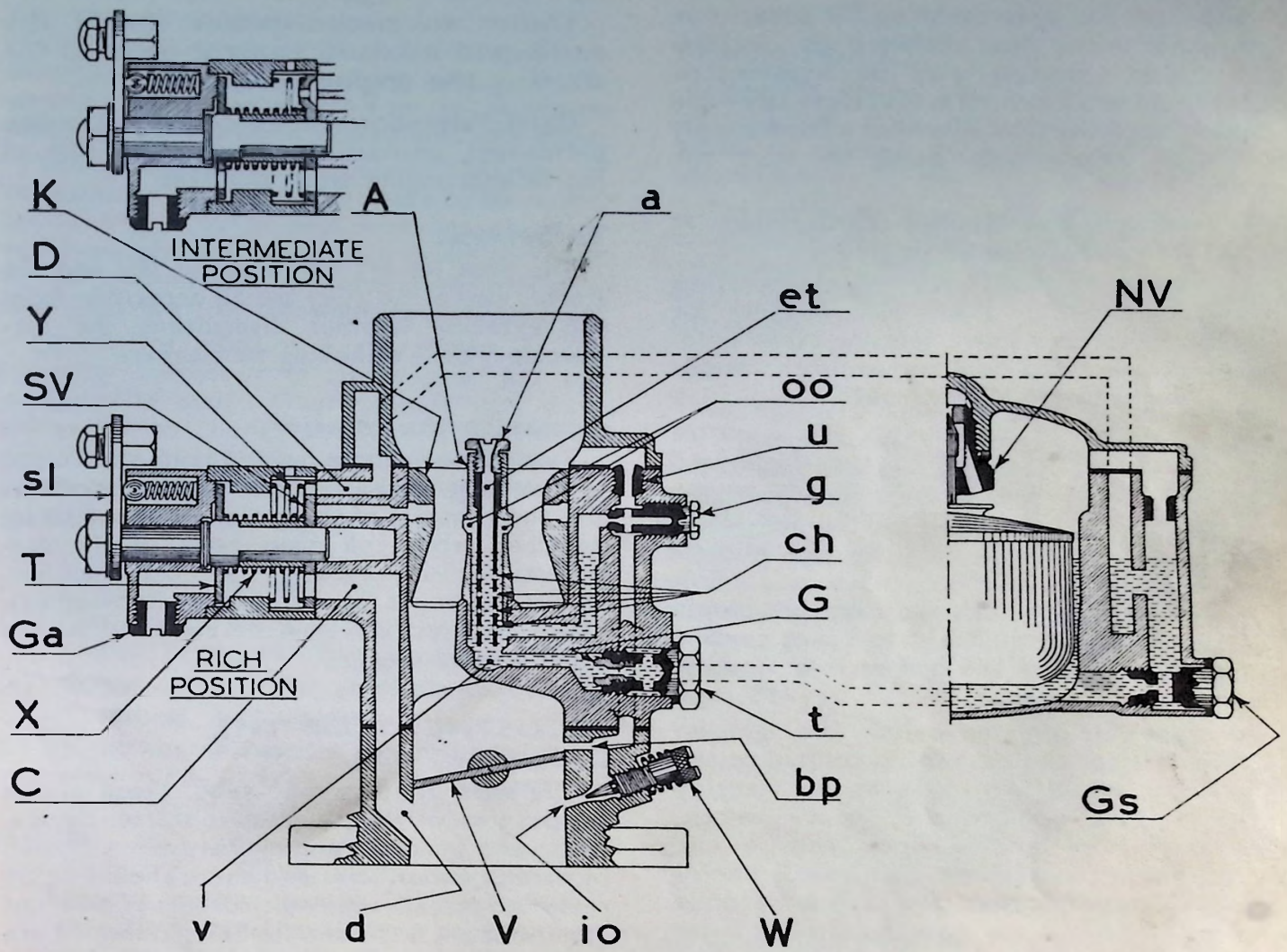


Fig. 3.

KEY TO DIAGRAM.

PROGRESSIVE STARTER

Ga	Starter air jet.
D	Inlet duct.
C-d	Mixture exit duct.
SV	Starter valve.
T	Air inlet disc.
Y	Valve spring.
X	Disc spring.
Gs	Starter petrol jet.
sl	Starter lever.

MAIN CARBURETTOR.

K	Choke tube.
A	Spraying well.
a	Air correction jet.
et	Emulsion tube.
oo	Spraying orifice
u	Pilot jet air bleed
g	Pilot jet.
ch	Emulsion holes.
t	Main jet holder.
bp	By-pass.
W	Volume control screw.
io	Idling mixture orifice.
V	Butterfly.
v	Reserve well.
NV	Needle valve.
G	Main jet.

NOTES ON STARTING.

During cold weather, when the engine has remained at rest for a long period, it is advisable, before switching on the ignition and pulling out the dashboard mixture control of the starter carburettor, to give the engine a few turns by hand to break the normal inertia of the oil.

If the car has been standing for some time the petrol in the float chamber may be stale and difficult starting may be experienced during cold weather. It is therefore advisable to pump into the float chamber a fresh supply of petrol before attempting to start the engine.

The progressive starter carburettor as explained can be selected to give :—

(1) A very rich mixture for very cold weather (fully out), or a less rich mixture for temperatures above freezing point (midway position) and so ensures instantaneous starting from cold.

(2) A means of weakening the mixture rapidly by pushing in the dashboard control half-way as soon as the engine will "take it", thus avoiding the possibility of "piling up" as the engine temperature rises.

(3) A means of gradually reducing the volume of mixture by pushing dashboard control gradually from the half-way to "out of action" position.

To start the engine switch the ignition "ON", pull out the dashboard control to the full extent, when temperatures are freezing or below, and operate the starter switch. Immediately the engine fires, release the starter switch and push the dashboard control to the half-way position after a few seconds running. The car can now be driven away and the mixture control gradually pushed right home as the engine warms up. The starter carburettor can usually be dispensed with after running a mile or so, depending on type of driving, and ambient temperature, etc.

Summarising use of dashboard control is as follows :—

(1) Dashboard mixture control pulled fully out to start in very cold weather, or to the midway position in temperatures above freezing. Engine allowed to run for a few seconds.

(2) Dashboard mixture control pushed halfway as soon as possible. This stage is for driving away, or when starting from the midway position. It will be possible to push control in a little way to a position which gives a fast smooth tick-over a few seconds after starting.

(3) Dashboard mixture control pushed fully "home" gradually from intermediate position as engine warms up.

Under no circumstances should the dashboard mixture control be used for starting the engine when hot.

Careful attention to these details will ensure permanent satisfaction at minimum cost of petrol and engine wear and tear.

To Service.

The pilot jet (g), the main jet (G) and the starter petrol jet (Gs) are all accessible from the exterior without dismantling the carburettor, after removing air cleaner.

Access to the Interior.

Two slotted square headed bolts secure the top casting to the body of the carburettor, and the removal of these allow the top to be detached from the main body of the carburettor, thus exposing the float chamber, air correction jet (a) and pilot jet air bleed (u). These two jets can now be removed with a small screwdriver.

ADJUSTMENT OF THE CARBURETTOR.

The sizes of the choke tube, those of the various jets for the progressive starter device, idling and general running have been chosen by careful experiment and there should be no reason to replace them with others of different dimensions. If the results being obtained are not satisfactory, the sizes stamped on the choke tube and various jets should be checked against the table given below, and replacements fitted as necessary :—

	Single Carb.	*Twin Carb.*
Choke Tube ...	24 mm.	22 mm.
Main Jet	125	110
Air Correction Jet ...	230	220
Emulsion Tube ...	L4	L5
Pilot Jet	45	45
Pilot Jet Air Bleed ...	1.5	1.5
Starter Petrol Jet ...	115	115
Float	26 gms.	26 gms.
Needle Valve ...	1.5 mm.	1.5 mm.

The only adjustment which may at times be needed is that for the slow running and is as follows :—

Slow Running Adjustment (Single Carburettor Engine).

The idling or pilot jet (g) provides the necessary output for idling. The slow running screw mounted on the abutment plate of the throttle lever, limits the closing of the throttle and fixes the idling speed of the engine. By screwing in this screw the engine idling speed will be increased and vice versa.

The mixture adjustment screw (W) permits the richness of the idling mixture to be varied. By turning it in an anti-clockwise direction (out) enrichment takes place up to the limit of the pilot jet output ; conversely by clockwise rotation (in) the mixture is weakened.

Poverty of mixture is recognised by the irregular behaviour of the engine and the tendency to stall. Over-richness will cause the engine to "hunt" and tend to stall when the "hunt" becomes excessive. Normal adjustment is carried out as follows :—

(1) Wait until the engine is hot.

(2) Set the slow running screw until the idling is on the high side.

(3) Slacken the volume screw (W) until the engine begins to "hunt".

(4) Screw it in very gradually until the "hunting" just disappears.

(5) If the engine speed is too high reset the slow running screw to slow it down to idling speed of about 600/700 r.p.m.

(6) This may cause a resumption of slight "hunting". If so, turn the volume control screw gently in a clockwise direction until the idling is perfect.

Slow Running Adjustment (Twin Carburettor Engine).

Screw in the volume control screws on the carburettors until they are both right home, but without forcing them, then release them half a turn each at a time until the engine idles evenly. If necessary further adjust, by equal amounts, the throttle lever adjusting abutment screws.

NOTE. Under local conditions and such as those met with in some countries overseas or at high altitudes, it may be necessary to alter slightly the jet selection already given. Should such need arise, before any readjustment is attempted, the local representative of Messrs. Solex Limited should be consulted.

A list of Solex Agents overseas will be supplied on application to Messrs. Solex Limited, Solex Works, 223/231, Marylebone Road, London, N.W.1.

Tracing Faults.

There is never any question of definite failure with the Solex carburettor. It is simply a matter of finding the incorrect adjustment.

Approach the diagnosis systematically and avoid doing more than one thing at a time, or otherwise it will be impossible to ascertain from the results which was the successful adjustment.

Stoppage in Petrol Supply.

First ensure that there is petrol in the tank, next that the pipework is clear of obstructions and that the filters in the fuel pump and in the drain plug of the petrol tank are clear. A frequent cause of difficult starting is looseness of the pipe unions connecting the fuel pump with the petrol tank. For this and any other causes associated with the fuel pump read carefully the services of the Fuel Pump in pages B19 and B20.

Loose Joints.

It is easy to see whether any of the exterior joints are loose. Check that the various joints and unions of the pipe line are tight.

Grit on the Needle Seating.

This does not as a rule occur since filters are provided in the fuel pump and in the drain plug of the petrol tank, but when it does, remove the needle valve and clean by carefully blowing it out and noting by suction test that it is hermetic. Replace it and be sure that the washer is sound and the tightening adequate.

N.B. Never attempt to "grind in" a needle valve. In cases where damage to seating is small, a new seating can be made by removing the complete needle valve assembly from the carburettor, placing it on a hard surface and lightly tapping the needle "home", rotating it between every two or three taps.

Punctured Float.

Should petrol enter the float its weight is increased, the level is raised and flooding occurs via the jets. In such a case fit a new float as soon as possible.

SLOW RUNNING IRREGULAR.

Before making alterations to the existing setting, check that the jet is clear of obstructions. If clear, reset the slow running volume control screw "W" as directed in *page B7*. If the slow running still cannot be obtained, check the valve and ignition timing, and the condition of the distributor as described on *pages B16 and B17*.

If the slow running still remains difficult suspect an air leak such as would occur with a carburettor and induction manifold flange nut loose or a defective gasket.

When dealing with an engine which has a considerable number of miles to its credit, worn inlet guides may be responsible, in which case replace the guides.

Slow running with air leaks such as those described above is impossible for the engine is inspiring, via various sources, a greater quantity of air than that entering by legitimate means and correct slow running mixture is unobtainable.

LACK OF MAXIMUM SPEED.

Check.

(1) That when the accelerator is depressed fully the butterfly throttle valve opens to the full extent. This can be done by observing the position of the limit screw which should be in contact with the boss cast on the outside of the throttle chamber.

(2) That the jets are clean, that they and the choke are of the correct sizes and that the filters are clean.

(3) That the distributor is working efficiently and that the ignition timing is correct. Read carefully pages on ignition, B17 and B19.

(4) That the rocker adjustment and valve timing are correct. *See pages B14 and B16.*

(5) That the compressions are equal and distinctly evident, particularly when the engine is at normal temperature. If they are not, recommend a Decarbonize. *See page B12.*

(6) That the silencer is not choked.

OVERHEATING.

Check.

(1) That the jets are clean and that they and the choke are of the sizes given in the table on *page B6*.

(2) That the filters in the fuel pump and petrol tank are clean and the pipe line clear.

(3) That the distributor is in accordance with the conditions given in the ignition section, *page B17*, and that the ignition setting is not too late.

(4) That the core of the radiator is not partially choked. It is not sufficient to assume that it is not, merely because water will flow through the core readily. The assurance of a reputable firm of radiator repairers should be obtained that the rate of flow of water is standard.

POOR ACCELERATION.

Check.

(1) That the jets are clear of foreign matter and that they and the choke tube are of the sizes given in the table on *page B6*.

(2) That the pipe lines and filters are clear.

(3) That the slow running adjustment is correct, see *page B7*.

(4) That the valve timing is correct, see *page B16*.

(5) That the distributor automatic advance and retard mechanism is working freely and point gaps and ignition timing are correctly set, see *pages B17, L2 and L7*.

KNOCKING.

Knocking could be due to various causes which as a rule have nothing to do with carburation.

They are : pre-ignition occasioned by defective plugs, excessive carbonisation, excessive ignition advance or to mechanical noises, *i.e.*, loose bearings, worn pistons, etc.

When such knocking is actually caused by carburation it is due to weak mixture. Check that the jets are clean, that they are of the correct size and that the filters are clean.

HEAVY PETROL CONSUMPTION.

When dealing with cases of heavy petrol consumption do not accept, as a reason for making any alterations to existing adjustments, the figures obtained by dividing the number of miles covered by the gallons of fuel purchased

over a period ; but carry out a fuel consumption test over a known mileage with the fuel drawn from a test tank containing say a quart, and with the car driven under average main road conditions and its maximum speed restricted to 30 to 35 miles per hour in top gear.

A test of this description should yield approximately 30-32 (single carb.), 28-30 (twin carb.) miles per gallon. Should it do so, but the figures obtained by dividing the miles covered by the gallons of fuel purchased for normal day to day running compare unfavourably with it, then it could be assumed that the difference would be due to the conditions under which the car is being operated. If the journeys being made are long and the car is being maintained in the higher ranges of speed of which it is capable for long periods, then more fuel will be used than would be under test conditions. Should the journeys be short the same results would occur due to frequent starting and stopping and continued use of the lower gears. In such circumstances, no useful purpose would be served by attempting an alteration to existing adjustments. But should the test fail to give the standard consumption then check the following :—

(1) That the jets are of the correct size as given on *page B6*.

(2) That the distributor is working in accordance with the conditions described in the ignition section, *page B17*.

(3) That the rocker adjustment and valve timings are correct. *See pages B14 and B16*.

(4) That the sparking plugs for the single carburettor engine are Champion No. N.8.B. and for the twin carburettor engine are Champion No. N.A.8. These should be in good condition and in both cases the gap between the electrodes should be .025" (.63 mm.).

(5) That the filters are clean.

(6) That the brakes are not dragging and that the front and rear tyres are inflated to suit the condition under which the car is normally operated, *see pages H8 and J1*.

(7) In very cold weather the use of a muff, the flaps of which should be suitably adjusted for the conditions ruling, will help to keep the engine at normal temperature, approximately 160°F. (71° C.), a most important point where economy of fuel is concerned.

(8) That the mileage covered by the engine is not large since it last received major attention, for it will be appreciated that the general condition of the engine must be reasonably good, if a standard petrol consumption is to be expected.

TO REMOVE THE EXHAUST AND INLET MANIFOLD.

(1) Remove the carburettor(s).

(2) Disconnect the exhaust pipe from the manifold.

Note the four brass nuts and the asbestos joint.

(3) Disconnect screen washer vacuum pipe.

(4) (*a*, Single Carburettor). Remove nine nuts and washers (also carburettor baffle assembly retained by one of these) securing the manifold to the head and draw off over the studs.

(*b*, Twin Carburettors). Remove ten nuts and washers, also one bolt which is positioned centrally. Draw off over studs.

Replacement is the reversal of the above, but before assembling see that the joint faces of manifold and head are clean, and if there is any doubt about the condition of the gaskets, fit new ones.

TO REMOVE AND REPLACE THE CYLINDER HEAD.

(1) Disconnect the battery positive lead.

(2) Lift the bonnet and drain the cooling system. *See page K1*.

(3) Remove the air cleaner and carburettor. *See page B3*.

(4) Disconnect the water outlet pipe hose by removing the clip securing the hose to the head and to the radiator pipe.

(5) Disconnect the hose from water outlet pipe to heater.

(6) Disconnect the exhaust pipe from the manifold flange. Note the four brass nuts and asbestos joint.

(7) Remove the valve rocker cover.

(8) Disconnect the oil feed pipe to the front rocker shaft bearing and when doing so avoid moving it away from its original setting as little as possible. This precaution will help to maintain the necessary clearance between the pipe and the timing chains.

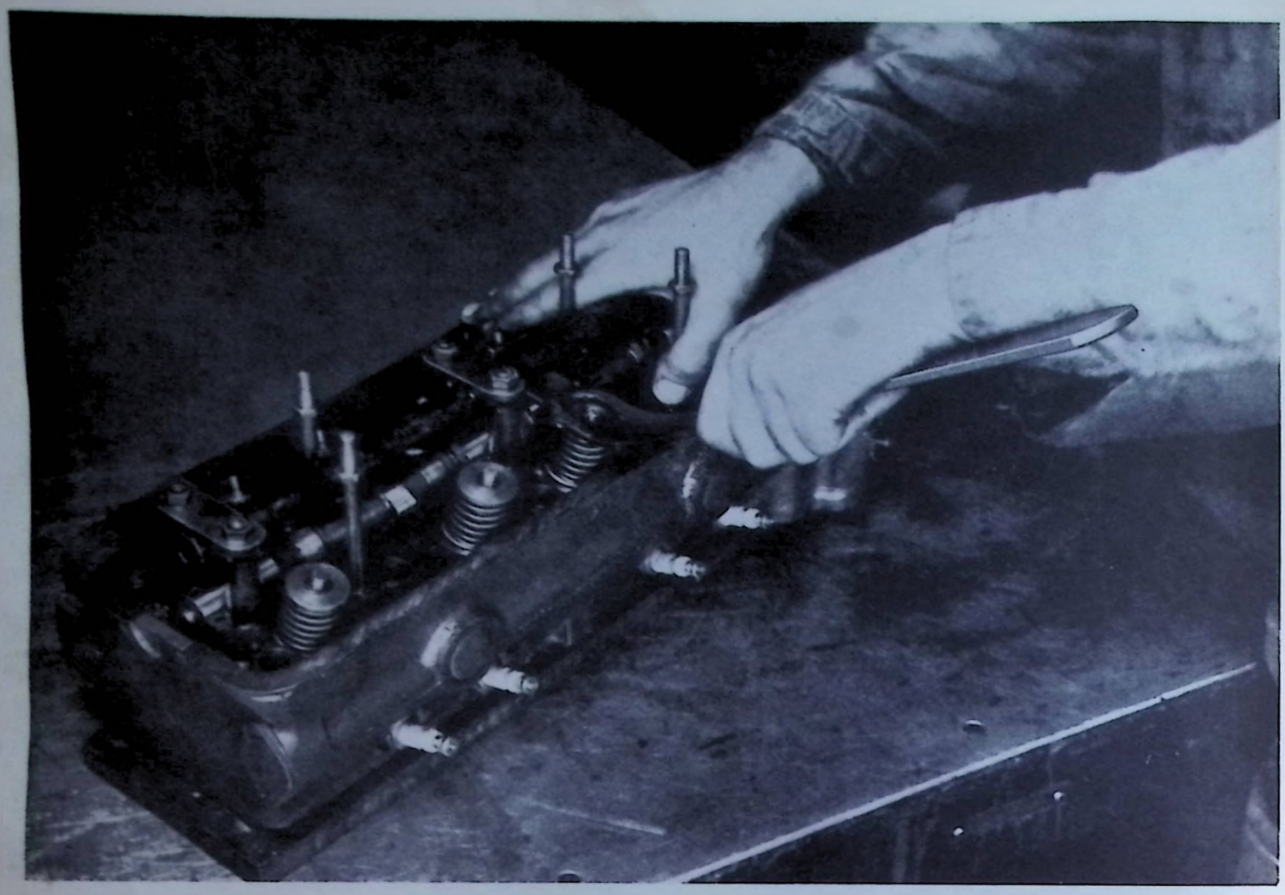


Fig. 6. Valve Extracting Tool in use.

DECARBONISING.

It is not possible to give the mileage at which the engine should be decarbonised since its condition depends on the attention it has received and the manner in which the car has been driven. But it can be accepted, as a general rule, that if there is a noticeable falling away in power with a marked tendency to "pink" under load, decarbonising is necessary.

The operations consist of removing all traces of carbon from the combustion chambers and from off the top of the pistons, the inspection of the valves, and the reseating of them correctly. It is advisable to leave a carbon seal around the outside edge of the piston crown.

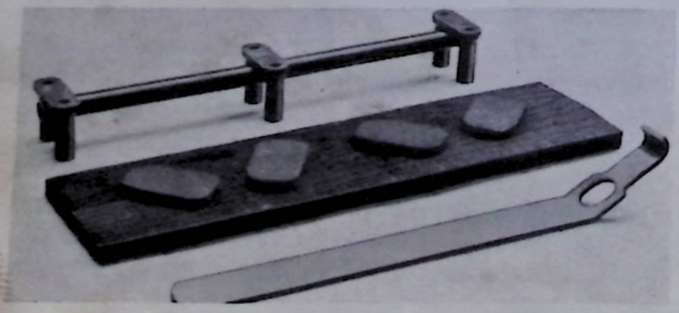


Fig. 7. Valve Extracting Tool and Board.

The services to be carried out as follows :—

(1) Lift the bonnet and drain the cooling system. *See page K1.*

(2) Remove the carburettor. *See page B3.*

(3) Remove the cylinder head. *See page B9.*

(4) Remove the manifold. *See page B9.*

(5) Remove the sparking plugs and clean as described on *page L11.*

(6) If after removing the cylinder head the engine has been turned, Nos. 1 and 4 pistons should be at the top of their strokes. Fill the bores of Nos. 2 and 3 cylinders and the water ports in the cylinder block face with rag and remove the carbon from off the crowns of the pistons with a blunt instrument such as a screwdriver. Do not, under any circumstances, use emery cloth to polish the

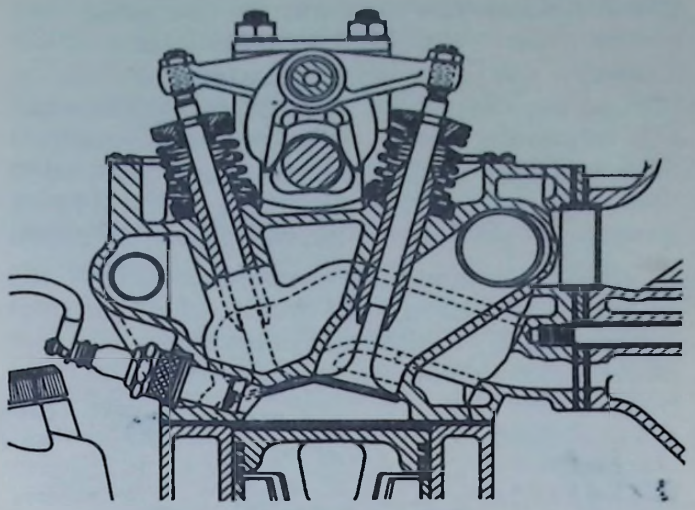


Fig. 8. Section through Valves.

crowns as quantities of abrasive may find its way into the engine and cause serious damage.

(7) To clean Nos. 2 and 3 piston crowns, remove the rag from the bores, support the camshaft chain wheel to maintain the chain in contact with its intermediate sprocket, and turn the engine half a turn in a clockwise direction to bring the pistons on top centre. Stuff Nos. 1 and 4 bores with rag and clean Nos. 2 and 3 piston crowns as before. Remove the rag from the cylinder block face ready for the fitting of the gasket. Remove the rag from the bores.

(8) Support the camshaft chain wheel as before and turn the engine half a turn in a clockwise direction and so restore Nos. 1 and 4 pistons to their original positions.

(9) Dismantle the cylinder head as described on *page B10*.

(10) Remove all traces of carbon from the combustion chambers, the inlet and exhaust ports, in the cylinder head, and from the joint face.
Remove all traces of carbon from the valve stems and heads and should the seats appear pitted or uneven, reface them at an angle of 45° on a valve grinding machine. The maximum depth of the face is .075 in. (1.905 mm.). If the seats in the head are in a similar condition, recut them also with a 45° cutter, but avoid removing metal to an extent greater than necessary.

The maximum depth of a seat is .055 in. and any seat wider should be reduced with the aid of a shallow angle or flat cutter.

To grind in a valve, smear a small quantity of grinding paste or compound over the seat, insert the valve into its guide and with the aid of a "grinding in brace" oscillate it backwards and forwards on its seat, but avoid making complete revolutions. Place a small coil spring between the valve head and the guide to help raise occasionally the valve off its seat. Continue until a true contact ring appears on valve seating. Then clean with petrol all traces of abrasive from both valve and cylinder head seats. A good test of a true valve seating is to chalk strokes across the seatings of the valve and cylinder head in positions similar to those occupied by the figures on a clock face. The valve is then replaced on its seating and a slight turn should break each chalk line if the valve is correctly seated.

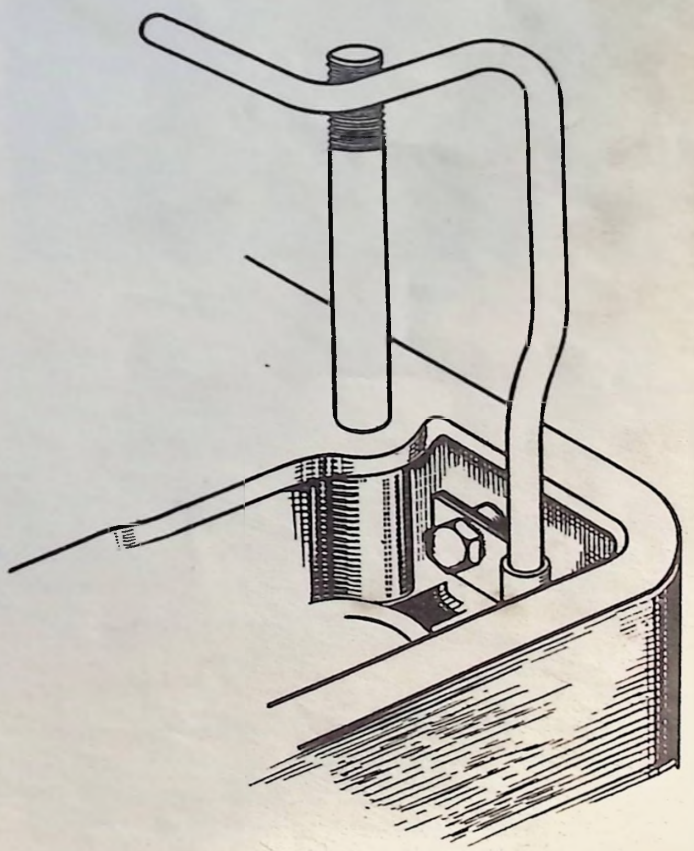


Fig. 9. Clip for Oil Feed Pipe.

Reassembly of the head is carried out in the reverse order to dismantling, ensure that the camshaft feed pipe is clipped to the cylinder block as shown in Fig. 9. When assembling the valves also make sure that they are replaced in their correct positions, and that all parts are clean and liberally coated with oil.

(11) Replace the cylinder head as described on page B10.

TOP DEAD CENTRE LOCATION.

The top dead centre marks 1/4 stamped on the rim of the flywheel can be seen through an aperture cut in the clutch housing and vertically above the centre of the flywheel.

To obtain top centre for Nos. 1 and 4 pistons place the stroke in line with the mark engraved on the clutch housing.

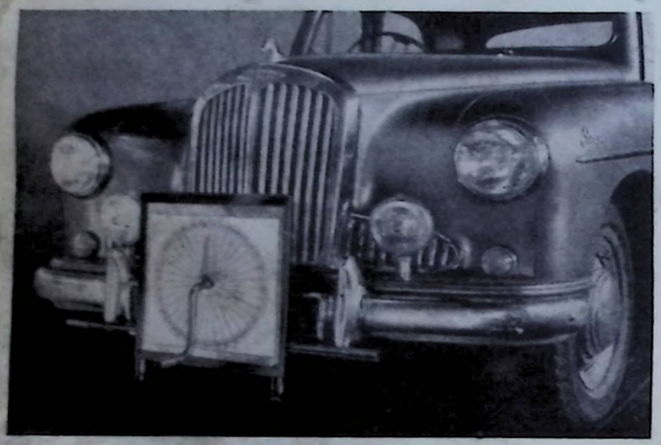


Fig. 10. Timing Degree Indicator.

Fig. 10 illustrates a fixture which can be made quite readily for obtaining in degrees, the exact position of the marks 1/4 relative to top centre.

To use the fixture, set the flywheel at top centre, engage the starting handle and then move the pointer on the handle to read zero on the protractor ; the pointer will give the degrees turned by the flywheel as the engine is turned with the handle.

TO ADJUST THE ROCKERS.

Rotate the engine slowly by means of the starting handle until the cam follower on the rocker, to be adjusted, is in the centre of the neutral portion of the cam. *See Fig. 8, page B13.* Release the lock nut on the valve side of the rocker and with a screwdriver, screw "in" or "out" the adjusting screw until in the case of an inlet valve, the clearance between the adjusting screw and the valve stem is .004 in. (.1 mm.) (warm) and an exhaust valve .006 in. (.15 mm.) (warm). **Use feeler gauges of .004 in. and .006 in. thickness.**

NOTE. Commencing Engine No. H.1501 the clearance is .020 in. (.51 mm.) *(cold) for inlet and exhaust. Camshafts requiring* .020 *in. clearance are identified by a groove in the large flange. See Fig. 11.*

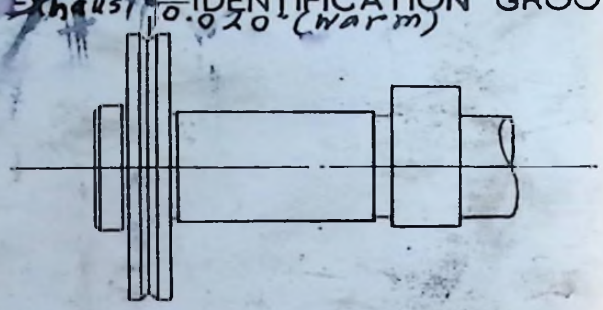


Fig. 11. Identification of Camshaft requiring .020 in. Tappet Clearance.

Tighten the locknut and recheck the clearance.

The use of the following table will help to position the rockers readily, and to complete the adjustment with the minimum amount of engine turning.

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

Numbering of valves as follows :—
Inlet—1, 3, 5, 7 numbering from front.
Exhaust—2, 4, 6, 8 also numbering from front.

TO ADJUST THE CAMSHAFT CHAIN TENSIONER.

Release the locknut, screw in tensioner until it is solid, then screw tensioner back half a turn and tighten locknut. *See section through engine* at front of Section B.

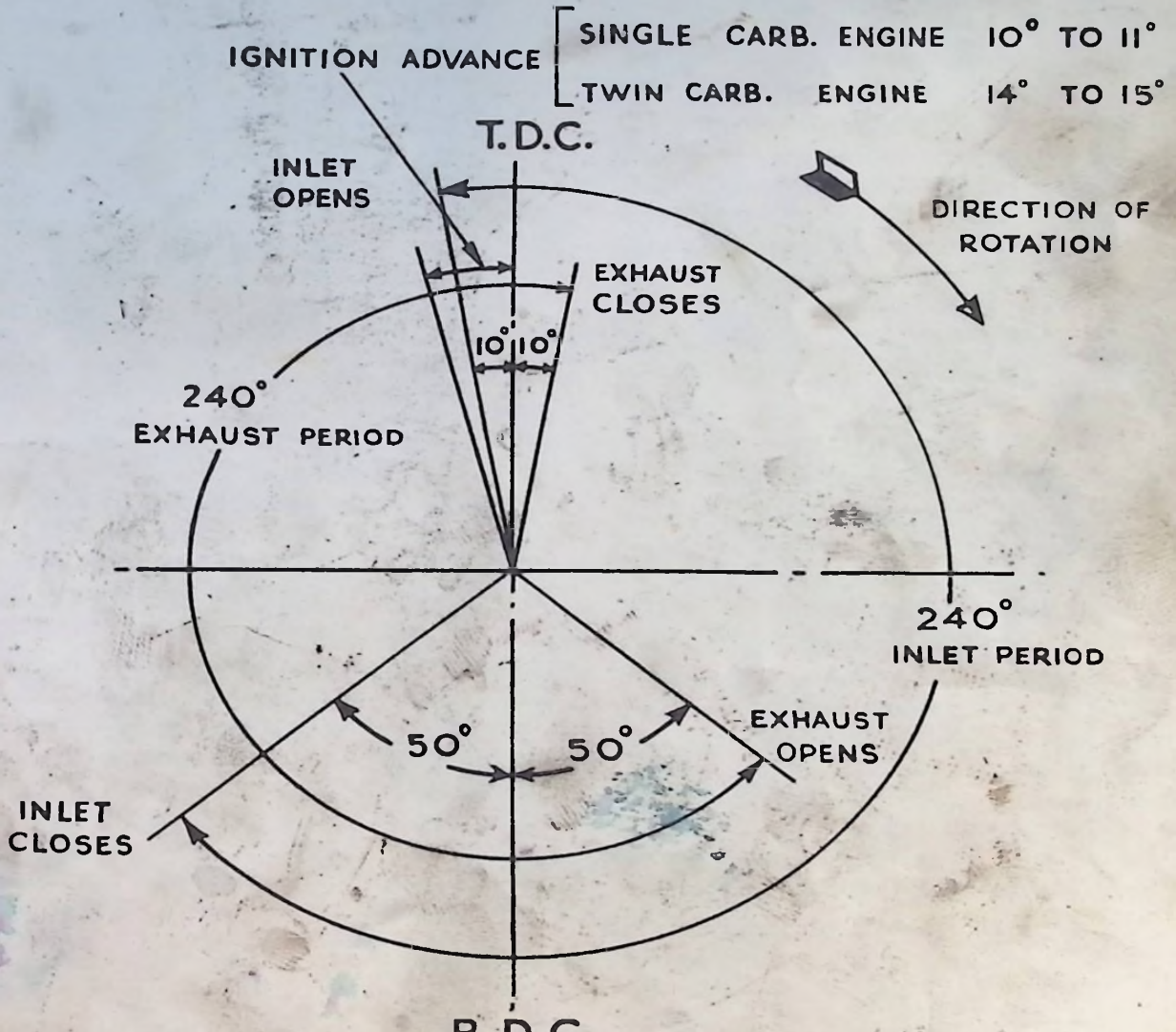
DESCRIPTION OF VALVE OPERATING MECHANISM.

The overhead camshaft receives its drive from the crankshaft by means of two endless duplex roller chains. The primary chain drives the intermediate shaft, and the secondary, the camshaft via the intermediate shaft. The intermediate shaft also drives, through a set of helical gears, the oil pump and distributor, also an eccentric on this shaft actuates the mechanical fuel pump. The secondary chain is provided with a spring loaded adjustable jockey sprocket for tensioning.

The crankshaft chain wheel is keyed to the crankshaft and so also is the driving chain wheel of the intermediate shaft. The flange of the intermediate shaft driving chain wheel is fitted with three pegs, which engage with holes drilled, and equally spaced, in the flange of the intermediate driver chain wheel. Both wheels are held to the shaft by a nut and lock plate.

The camshaft chain wheel is attached to the camshaft flange in a similar way, except that the six holes in the flange of the wheel are not equally spaced but offset in a manner which permits the wheel being engaged with the camshaft flange in six different positions. This arrangement makes it possible to vary the valve setting within the range of the adjustment required.

The opening and closing positions of the



5° = an arc of $\frac{15}{32}$" measured on the rim of the flywheel.
10° = an arc of $\frac{15}{16}$" measured on the rim of the flywheel.
15° = an arc of $1\frac{13}{32}$" measured on the rim of the flywheel.
50° = an arc of $4\frac{11}{16}$" measured on the rim of the flywheel.

Fig. 12. Valve Timing and Ignition Advance Diagram.

valves given on *Fig. 12, page B15*, is the standard valve timing, and normally; it should be possible with the aid of the adjustment provided by the camshaft and chain wheel fixing, to set the inlet valves to open at 10° B.T.D.C. But, in actual practice, it may be observed that a slight variation may occur in the openings of the inlet valves when compared one with the other. In such instances obtain the optimum valve timing by setting the inlet valves to open as near as possible to the standard openings by using the adjustment referred to.

TO CHECK THE VALVE TIMINGS.

Method 1.

(1) Remove valve cover.

(2) Rotate the crankshaft until the 1/4 mark appears exactly in the centre of the aperture in the top of the clutch housing.

(3) The groove cut in the large flange of the camshaft adjacent to the chain wheel should now be in line with the machined pad on the forward camshaft bearing. This position represents inlet valves opening at 10° B.T.D.C. (See Fig. 12).

(groove should be in line w/ top of face (pad))

(4) If this groove is not in line with the pad, adjustment is necessary and should be carried out as follows.

(5) Disconnect the oil feed pipe from the front pedestal of the rocker shaft.

(6) With a $\frac{7}{16}$ in. open ended spanner remove the chain adjuster by working on the nut nearest the cylinder head, to avoid altering the adjustment. For any readjustment necessary *see page B15*.

(7) Bend back the lock tab of the bolt securing the chain wheel to the camshaft and remove the bolt with the plain and tab washers. Prise the chain wheel, complete with chain, off the camshaft. **Do not allow the assembly to drop as this will disengage the chain from the intermediate chain wheel.**

(8) Support the chain and wheel to permit the flywheel being moved backwards then forwards and positioned with the marks 1/4 at $\frac{15}{16}$ in. (23.812 mm.) before top centre. [w/ cam # C.12667: 1/4 on flywheel must be at TDC (in port) when cam aligned]

*(9) Lower chain and wheel sufficiently to permit the chain being worked over the wheel a tooth at a time, and continue this operation until it is possible to engage the holes in the wheel with the pegs on the camshaft driving flange without altering the positions of the crank or camshafts, and with the right hand length of the chain in tension. This last mentioned instruction is most important and must be carried out if the timing is to be set correctly.

(10) Secure the wheel temporarily to the camshaft, re-engage the chain tensioner with a slightly abnormal tension setting —and recheck the valve timing.

If correct, reassemble in the reverse order to dismantling; and do not forget to set the tension of the chain tensioner correctly. *See page B14.* Reassemble.

NOTE. If after adjusting the valve timing by the above method, the engine performance does not seem satisfactory the following method can be used as a check.

Method 2.

(1) Remove the valve cover and if available place in position the degree chart as described on *page B14*. Caution—do not lean on the wings of the car once the pointer has been set to the top centre position.

(2) Check and, if necessary, set the rocker clearances to .004 in. (.1 mm.) for the inlet valves and .006 in. (.15 mm.) for the exhaust valves. *See page B14.*

NOTE. After engine No. H.1500 inlet and exhaust rocker clearances are .020 in. (.51 mm.).

(3) Rotate the engine slowly by means of the starting handle, and while doing so, endeavour to oscillate, with the forefinger and thumb, the collar of the inlet valve for No. 1 cylinder. As long as the valve is on its seat oscillation will be difficult, but immediately the valve commences to leave its seat, oscillation will be comparatively easy. Where this condition occurs is the exact opening position of the valve, and for the timing to be correct, the marks 1/4 on the flywheel should, at that point, be 10° or $\frac{15}{16}$ in. (23.812 mm.), measured on the rim of the flywheel, before top centre. Any correction which may be necessary should be carried out as follows.

* See "The Singer Owner", MAY 1967, V. I #5 ~~Earlier~~ pp. 42 for explanation of peg-hole displacement.

(4) Maintain the camshaft in the position of No. 1 cylinder inlet valve just opening.

(5) Remove the cylinder head front cover.

(6) Disconnect the oil feed pipe from the front pedestal of the rocker shaft.

(7) With a $\frac{7}{16}$ in. open ended spanner remove the chain adjuster by working on the nut nearest the cylinder head, to avoid altering the adjustment. For any readjustment necessary see *page B14*.

(8) Bend back the lock tab of the bolt securing the chain wheel to the camshaft and remove the bolt with the plain and tab washers. Prise the chain wheel, complete with chain, off the camshaft. **Do not allow the assembly to drop as this will disengage the chain from the intermediate chain wheel.**

(9) Support the chain and wheel to permit the flywheel being moved backwards then forwards and positioned with the marks 1/4 at $\frac{15}{16}$ in. (23.812 mm.) before top centre.

(10) Lower chain and wheel sufficiently to permit the chain being worked over the wheel a tooth at a time, and continue this operation until it is possible to engage the holes in the wheel with the pegs on the camshaft driving flange without altering the positions of the crank or camshafts, and with the right hand length of the chain in tension. This last mentioned instruction is most important and must be carried out if the timing is to be set correctly.

(11) Secure the wheel temporarily to the camshaft, re-engage the chain tensioner with a slightly abnormal tension setting —and recheck the valve timing.
If correct, reassemble in the reverse order to dismantling, and do not forget to set the tension of the chain tensioner correctly. Reassemble.

TO CHECK THE IGNITION TIMING.

Remove the rocker cover, and if available place in position the degree chart as described on page *B14*.

Caution. Do not lean on the wings of the car when once the pointer has been set to the top centre position.

To Check the Distributor is Correctly Wired.

(1) Turn the engine until the inlet valve of No. 1 cylinder is just opening. No. 4 cylinder sparking plug is now about to fire.

(2) Remove the distributor cap, and for the wire of No. 4 cylinder sparking plug to be correctly connected it should be attached to the electrode in the cap adjacent to the rotor arm contact. For the other wires to be properly connected they must be in the following sequence, 1, 3, 4, 2, counting in the direction which the rotor revolves. *See Fig. 15, page L12.*

To Check the Ignition Setting.

(1) Set the distributor points to a gap of .014/.016 in. (.4 mm.) when in their maximum open position. *See page L2.*

(2) Turn the crankshaft slowly by means of the starting handle until No. 1 cylinder inlet valve commences to open. Now watch the distributor points and cease turning when they just part. For the setting to be correct, this condition should occur as quoted below :—

Ignition Advance (Single Carb.):

Commercial 5° to 6° B.T.D.C. $\frac{15}{32}$" to $\frac{9}{16}$" on flywheel rim.

Premium 10° to 11° B.T.D.C. $\frac{15}{16}$" to $1\frac{1}{32}$" on flywheel rim.

Ignition Advance (Twin Carb.):

Commercial 9° to 10° B.T.D.C. $\frac{27}{32}$" to $\frac{15}{16}$" on flywheel rim.

Premium 14° to 15° B.T.D.C. $\frac{15}{16}$" to $1\frac{13}{32}$" on flywheel rim.

Should correction be necessary proceed as follows :—

(1) Release the nuts securing the distributor clamp or index plate to the adaptor, set the pointer to zero and tighten the nuts.

(2) Set the flywheel so that the marks 1/4 stamped on the rim of the flywheel are as on chart, *page B15*, before top dead centre—B.T.D.C.

(3) Release the pinch bolt of the distributor clamp or index plate, rotate the body in a clockwise direction until the points are closed ; then in an anti-clockwise direction until the points just part ; tighten the clamp pinch bolt and recheck opening position of points.

TO REMOVE AND REPLACE THE WATER PUMP.

(1) Lift the bonnet and drain the cooling system. (Completely drain system to avoid an air lock when refilling). *See page K1.*

(2) Slack off the dynamo pivot and adjusting nuts. Depress the dynamo body and remove driving belt.

(3) Bend back the lock tab from the central nut securing the fan pulley to the pump spindle and remove the nut. Detach the fan blades by removing the four nuts and spring washers. **Note the central nut lock plate.**

(4) Drive, with the aid of a lead or wooden mallet, the fan pulley sufficiently forward to obtain access to the six nuts and shakeproof washers securing the pump assembly to the pump housing. The pump can now be detached from its housing when these nuts and washers have been removed.

Replacement is the reversal of the foregoing. Make sure that the joint faces of the pump and housing are clean and to use a new gasket. For adjustment of dynamo and fan belt *see page B18.*

TO DISMANTLE AND REASSEMBLE THE WATER PUMP.

(1) Remove the unit from the engine as stated previously.

(2) Secure the boss of the fan pulley in a vice fitted with lead clamps to its jaws. Remove the nut securing the impeller and screw it off the spindle in an anticlockwise direction. Be careful not to damage the gland assembly which is situated in a register machined in the forward face of the vane.

(3) The gland assembly is a push fit in its register and should not be disturbed unnecessarily. If a replacement is necessary, pay particular care not to damage the assembly as it is being inserted. The new gland must be a push fit and the carbon face must run dead true. Before replacing the impeller clean the sealing face on pump body and lap it with grinding paste, if the surface is not smooth.

(4) Secure the vane end of the spindle in the vice fitted with lead clamps and draw off the fan pulley. The tab of the locking washer should have already been bent back and the nut removed when the unit was detached from the engine. Remove the Woodruff key.

(5) Remove the circlip retaining the outer bearing in position and with a lead or wooden mallet drive out the spindle complete with inner and outer bearings and distance piece.

(6) Press off the bearings and distance piece from the spindle. Be careful not to damage the oil thrower and return thread machined on the spindle.

Assembly is the reversal of the foregoing. For maintenance of pump *see Cooling System Section, page K4.*

TO REMOVE AND REPLACE THE DYNAMO AND ADJUST FAN BELT.

(1) Disconnect the two wires attached to the rear face of the dynamo, note that the yellow wire is attached to the large terminal and the yellow with the green tracer to the small one.

(2) Remove bolt securing adjustment link to dynamo lug. Allow the dynamo to drop down to the full extent and remove belt.

(3) Remove nut and shakeproof washer securing forward lug of dynamo to water pump stud, remove two set pins and shakeproof washer securing "L" shaped bracket at rear lug. Note two spacing washers between "L" shaped bracket and engine case.

(4) Draw dynamo forward about 1 in. and it can then be removed from the engine.

Replacement is the reversal of removal. Do not forget to place the two spacing washers between "L" shaped bracket and engine case.

To Adjust the Driving Belt.

Allow the dynamo to remain in its lowest position, tighten the pivot pin nuts, and the bolt securing the adjusting link to the support bracket to an extent where pressure is needed to move the dynamo. Place the adjusting link bolt, nut and washers in position and with the belt engaged, raise the dynamo until it is possible to depress the length of belting between the fan and crankshaft pulley approximately $\frac{1}{2}$ in. (12.7 mm.) then tighten the adjusting link and bolt.

For Description and Maintenance of Dynamo *see Electrical Section, pages L13 and L14.*

TO REMOVE AND REPLACE THE DISTRIBUTOR.

(1) Turn the engine with the starting handle until the inlet valve of No. 1 cylinder is just opening. No. 4 cylinder is now on firing stroke. Continue to turn the engine very gently until the marks 1/4 on the rim of the flywheel are approximately at 10° before top dead centre ($\frac{15}{16}$ in., 23.8 mm.).

(2) Disconnect the distributor high tension leads from the sparking plugs and the spark coil, also the low tension lead from the body of the distributor.

(3) Remove the two nuts securing the adaptor of the distributor to the cylinder block, and withdraw the distributor complete with adaptor. If possible avoid turning the engine until the distributor is replaced, but as the spade drive is offset no difficulty should be experienced when replacing the distributor, always providing the oil pump and/or camshaft and the chain have not been removed from the engine.

NOTE. On twin carburettor engines remove the vacuum advance suction pipe connecting distributor to carburettor before commencing the above.

To Replace the Distributor.

(1) Fit the assembly in the engine, rotate the spindle until the drive engages, and bolt the flange of the adaptor to the cylinder block.

(2) Release the pinch bolt of the distributor clamp and rotate the body in a clockwise direction until the points are closed and the electrode of the rotor is approaching the segment in the cap connected to No. 4 sparking plug. Now rotate the body of the distributor in an anti-clockwise direction until the points are just parting and tighten the clamp pinch bolt securely. To check, rotate the engine backwards for a quarter of a revolution, then forwards gently until the points just part. For the timing to be correct the marks 1/4 on the flywheel should be 10° B.T.D.C. ($\frac{15}{16}$ in., 23.8 mm.) Single Carburettor or 15° B.T.D.C. ($1\frac{13}{32}$ in., 35.6 mm.) Twin Carburettor, measured on the rim of the flywheel. On the completion of any further adjustment recheck.

The distributor revolves in an anti-clockwise direction when viewed from the rotor end, or clockwise when viewed from the drive end, check that the leads are attached to the cap and connected to sparking plugs in their correct sequence, *i.e.*, 1, 3, 4, 2, counting in the direction in which the rotor revolves. *See Fig.* 15, *page L*12. From this point replacement is the reversal of the dismantling.

To check the Ignition Timing *see page B*17.

For description and maintenance of Distributor *see Electrical Section, page L*1.

TO REMOVE AND REPLACE A.C. DELCO FUEL PUMP.

(1) Detach flexible pipe connecting pump to tank pipe.

(2) Detach pipe from pump to carburettor.

(3) Remove two self-locking nuts securing pump to engine case.

(4) Pump can now be drawn off studs.

Replacement is a reversal of removing, make sure that the joint washer between pump and engine case is in good condition, otherwise renew.

Description of Pump.

The A.C. mechanical fuel pump is driven direct from the engine intermediate shaft, and the sectional view shows the general arrangement of this and also internal construction of the pump.

By rotating shaft (G) the eccentric (H) will lift rocker arm (D), which is pivoted at (E) and which pulls the pull rod (F), together with diaphragm (A) downward against spring pressure (C), thus creating a vacuum in pump chamber (M).

Fuel from the rear tank will enter at (J) and through filter gauze (L) and suction valve (N) into pump chamber (M). On the return stroke, spring pressure (C) pushes diaphragm (A) upward forcing fuel from chamber (M) through pressure valve (O) and opening (P) into the carburettor.

When the carburettor bowl is filled the float in the float chamber will shut off the inlet needle valve, thus creating a pressure in pump

chamber (M). This pressure will hold diaphragm (A) downward against the spring pressure (C) and it will remain in this position until the carburettor requires further fuel and the needle valve opens. The rocker arm (D) is in two pieces, the outer operating the inner one by making contact at (R) and the movement of the eccentric (H) is absorbed by this "break" when fuel is not required.

Spring (S) is merely for the purpose of keeping rocker arm (D) in constant contact with eccentric (H) to eliminate noise.

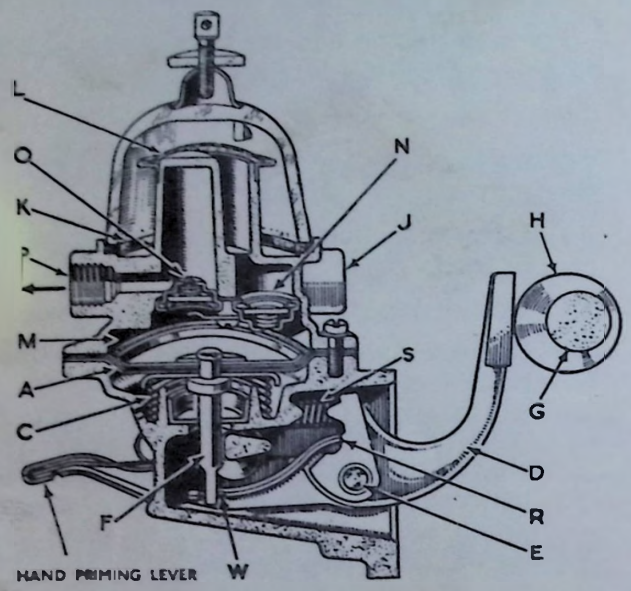


Fig. 13. Description of Pump.

MAINTENANCE OF PUMP.

After 500 miles with a new vehicle and subsequently each 2,500 miles the filter incorporated in the top of the pump needs to be cleaned. This filter is readily accessible—as shown in illustration, *Fig.* 14, and any water or foreign matter should be scraped or blown out of the sediment chamber and the gauze itself washed in petrol or blown clean with compressed air.

Before reassembly make sure that the cover gasket is in sufficiently good condition to make an airtight joint.

Tightness of Pipe Unions and Pump Mounting Studs.

Pipe unions should be periodically checked and also the studs which hold the pump to the engine, the latter especially if there is any tendency for oil leakage.

Testing Pump Delivery.

An easy method to check the delivery volume of the A.C. pump can readily be made by temporarily disconnecting the fuel line where it enters the carburettor bowl.

The engine should then be turned by hand and at each working stroke of the pump, if in good condition, there should be an appreciable flow of petrol—roughly half an egg-cup full. If on this test there is no flow of fuel or perhaps only a trickle, it may denote that the fuel pump requires attention, although it should be borne in mind the possibility of stoppage in the pipe line from the tank ; also unions should be checked over for tightness.

Difficult Starting.

Difficult starting may be due to air leaks at the filter cover of the fuel pump or at some point in the pipe line. Another cause can be leakage from the carburettor bowl allowing it to empty completely overnight ; leakage of this nature is usually due to the joint between the carburettor bowl and the emulsion block not being petrol-tight.

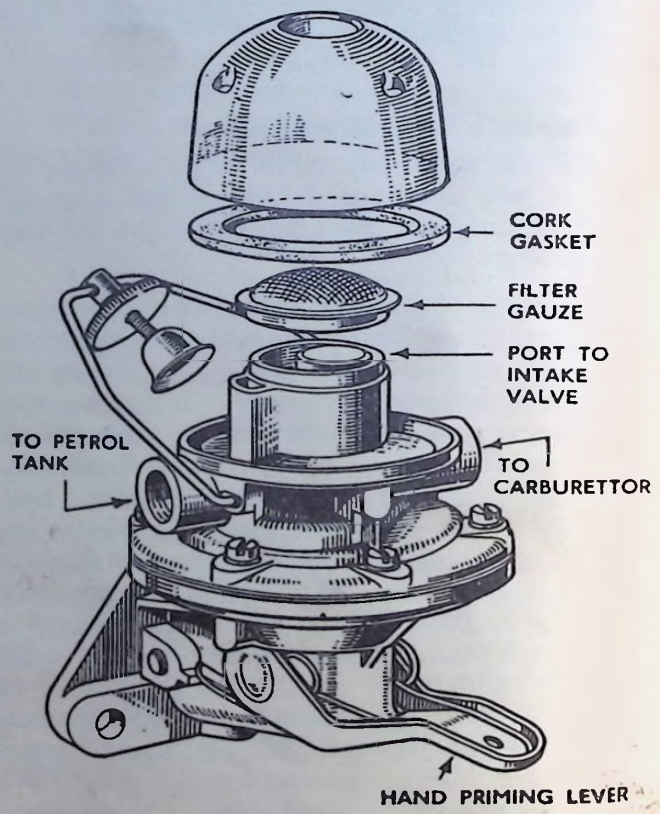


Fig. 14. Maintenance of Pump.

TO REMOVE AND REPLACE THE PRIMARY CHAIN AND ITS TIMING WHEELS, WITH SECONDARY (CAMSHAFT) CHAIN IN POSITION.

(1) Lift the bonnet.

(2) Drain the cooling system. *See page K1.*

(3) Remove the radiator. *See page K2.*

(4) Detach the fan blades.

(5) Remove the fan belt. *See page B18.*

(6) Remove the cylinder head top cover.

(7) Remove the cylinder head front cover.

(8) Turn the engine until the mark engraved on the rim of the camshaft driving flange is level or in line with the machined pad at the butt face of No. 1 camshaft bearing cap. Note, or mark on the clutch housing, the relative positions of the mark 1/4 of the rim of the flywheel and the centre line of the engine.

(9) Detach the engine stabiliser fitted on the offside and adjacent to the flywheel, by removing the two nuts securing the bracket to the crankcase.

(10) Place a jack under the engine sump and, to distribute the load, position a block of wood suitably shaped between the jack pad and the sump.

(11) Remove completely the engine front support bracket, and the two bolts securing the gearbox rear mounting.

(12) Raise the front of the engine sufficiently to allow the starting dog nut to be removed and crankshaft pulley to be withdrawn. Note the shims positioning the starting dog nut at 45° to the vertical with the flywheel at top centre 1/4.

(13) Remove the engine front cover with bottom clamp, first removing the two set bolts which secure the sump to the bottom clamp, also the gasket between it and the cylinder block.

(14) Draw off the oil flinger, which must be refitted with the concave surface facing towards the front of the car.

(15) Bend back the tab locking the nut securing the driven chain wheel to the intermediate shaft and remove the nut, the tab and plain washers.

Notice that the lug of the tab washer is located in one of the holes in the chain wheel.

(16) Prise the driven chain wheel from off its locating studs on the intermediate shaft driver chain wheel, and partially withdraw the crankshaft chain wheel to assist the foregoing. The primary chain and intermediate driven wheel can now be removed.

(17) If the crankshaft chain wheel is to be replaced, draw it from off the shaft completely. **Be careful not to rotate the crankshaft, and observe the same precaution with the camshaft.**

Reassembly is the reverse of the foregoing with the following addition.

Engage the chain with both timing wheels and with a tooth engagement which will permit the wheels being fitted on their shafts, without the shafts being moved from their original settings. From now on proceed in the reverse order to dismantling. Check the valve timing as described on *page B16* and, if necessary, reset as described.

Check and, if necessary, reset the ignition timing. *See page B17.*

Should the crankshaft and or the camshaft have been moved accidentally, re-position the flywheel—and incidentally the crankshaft—so that the marks 1/4 on the rim are at top centre and the camshaft with its flange mark in line with the machined face of the pad at the butt face of the front bearing cap.

Then, as before, proceed in the reverse order to dismantling and check the valve and ignition timing as described on *pages B16 and B17.*

TO REMOVE AND REPLACE THE CAMSHAFT CHAIN AND ITS TIMING WHEELS.

(1) Remove the primary chain and its timing wheels. *See page B21.*

(2) Remove the camshaft chain tensioner by slackening off the lock nut and unscrewing tensioner.

(3) Disconnect the union of the oil feed pipe to the valve mechanism from the camshaft front bearing cap, and when doing so avoid moving it away from its original setting as little as possible. This precaution helps to maintain the necessary clearance between the pipe and the timing chains, and must be observed during the period the pipe is disconnected also when being re-connected.

(4) Bend back the tab locking the bolt securing the camshaft chain wheel and remove the bolt, the tab and plain washers. As a precaution against any part being detached, falling down the chain case, stuff or pack the opening with clean non-fluffy rag.

(5) Prise off the chain wheel from the camshaft when the chain can be disengaged from its wheels and drawn out of position upwards.

(6) Draw off the intermediate driver chain wheel from its shaft.

To Reassemble the Timing Chains and Wheels.

(1) Push the crankshaft timing chain wheel, with the keyway in engagement with the key, on the crankshaft to a little over half the normal distance.

(2) Turn the camshaft until the mark on the driving flange is in line with the machined surface of the pad at the butt joint of the camshaft front bearing cap.

(3) If the distributor is in position on the engine, turn the intermediate shaft until the electrode of the rotor is pointing to the segment in the cap, connected to No. 4 sparking plug. If the distributor is not in position on the engine, set the oil pump spindle so that the driving slot for the distributor is parallel to the centre line of the engine and with the narrower segment adjacent to the cylinder block.

(4) Engage the secondary chain with the intermediate shaft driven chain wheel, and select a tooth engagement between the chain and the camshaft timing wheel, which will allow the holes in the wheel to register with the pegs on the camshaft driving flange without altering the position of the camshaft and intermediate shaft. **When this operation is being carried out keep the length of chain on the right in tension, and when completed engage the chain tensioner.**

(5) Fit the plain and tab washer to the camshaft and secure with the set bolt, do not at this point bend over the locking tab.

(6) Adjust the chain tensioner as described on *page B14*.

(7) Position the flywheel—and incidentally the crankshaft—with the mark 1/4 at top centre.

(8) Engage the primary chain with the crankshaft chain wheel and as before, select a tooth engagement between the chain and intermediate driven chain wheel which will permit the holes in the wheel to register with the pegs on the intermediate driver wheel and without altering the position of the intermediate shaft and crankshaft.

(9) Drive home the crankshaft wheel with the chain and intermediate wheel as an assembly.

(10) Place in position the plain washer, with the machined relief towards the wheel. the tab washer with the lug engaging a hole in the wheel, insert the securing bolt, tighten up and lock with the tab of the washer.

(11) Place into position the oil flinger with its concave surface facing towards the front, and replace the front cover using a new gasket.

(12) Push on the crankshaft pulley and with the shims fitted between the pulley face and the starting dog nut, position the nut so that when it is securely tightened the dogs are at approximately 45° from the vertical, with the flywheel set at top centre. From now on proceed in the reverse order as described on *page B21*. Operations Nos. 1 to 12.

Check the valve timing and if necessary reset as described on *page B16*.

Check the ignition timing and if necessary reset as described on *page B17*.

REMOVE AND REPLACE THE INTERMEDIATE SHAFT.

(1) Remove the primary chain, *see page B21*.
(2) Remove the camshaft chain, *see page B21*.
(3) Remove the fuel pump, *see page B19*.
(4) Release the lock nut on the bearing locating pin situated immediately beneath the dynamo. Remove the pin. The shaft can now be withdrawn complete with bearing bush.

(5) Press off the chain wheel and remove the bearing. There is no detachable bearing for the rear end of the shaft. The rear journal runs in a bore machined in the cylinder block.

Replacement is the reverse of the foregoing, but bear in mind if the oil pump is in position, to select a gear meshing which will permit the slot in the pump spindle to be parallel to the centre line of the engine and with the smaller segment near to the cylinder block. If the distributor is in position then the electrode of the rotor must be opposite the segment in the cap attached to No. 4 sparking plug. When replacing the bush and chain wheel, make sure that the hole in the bush for the locating pin is towards the rear, and the boss of the wheel towards the front of the car.

When inserting the locating pin, do not tighten it excessively as this will distort the bush, but make sure that the tapered end is in firm contact with the bush before tightening the lock nut securely. Before assembling the chain wheel clean the annular and radial grooves in the face of the boss of the wheel, the oil ways drilled through the boss, and those drilled radially between the two rows of teeth. This last mentioned instruction refers equally as well to the driven chain wheel. *Note oil to the chain is fed via these oil ways.*

TO REMOVE AND REPLACE THE FLYWHEEL.

(1) Remove the gearbox, *see page C9.*

(2) Remove the three bolts securing the bottom forward cover of the flywheel and detach the cover, remove the starter motor and the bolts securing the clutch housing to the crankcase and withdraw the housing.

(3) Remove the clutch, *see page C2.*

(4) Bend back the tabs of the locking plates, remove the four securing bolts, and, with the aid of a brass drift and hammer, tap off the flywheel, applying the blows at points close to the rim of the flywheel and diametrically opposite one another. **Replacement** is the reversal of the foregoing.

But ensure that :—

(1) Before fitting the flywheel, to revolve the engine to a position where No. 1 cylinder inlet valve is just opening, and when offering the flywheel into position the timing marks 1/4 stamped on the rim of the flywheel are at top dead centre.

(2) The joint faces of the flywheel and crankshaft flanges are clean.

(3) The lock plates are positioned so that they cover the dowel holes.

(4) The nuts are tightened in diagonal rotation, half a turn at a time.

(5) The bolts are secured by the lock tabs.

RECONDITIONING THE FLYWHEEL.

A detachable starter gear ring is fitted to the flywheel. It fits in an annular groove machined in the rim of the wheel, and is shrunk into position.

To remove the ring saw through it in the manner described in Fig. 15 and then burst the ring apart by driving into the saw-cut a fairly sharp cold chisel.

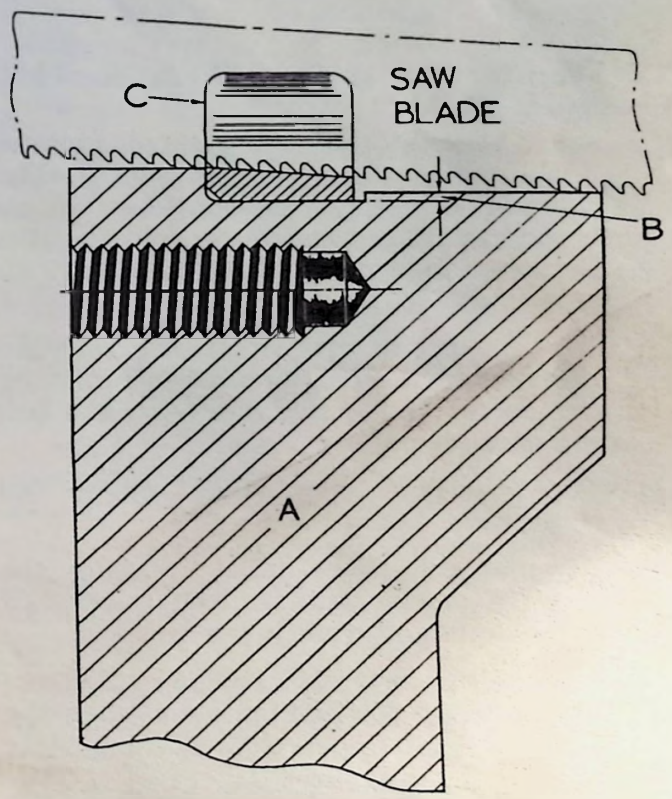


Fig. 15. Method of removing Starter Ring Gear.
A. Flywheel. B. Depth of groove. C. Flywheel tooth.

The replacement ring must be positioned on the flywheel with the chamfered edge of its bore towards and against the abutment shoulder machined on the wheel. To pass the ring over the rim of the wheel heat it uniformly in an oven to 235°C.

It must not under any circumstances be heated by means of a blow lamp or local flame.

The cooling of the ring must not be accelerated by quenching in water or by any other similar means, but it should be allowed to regain normal temperature in a warm atmosphere.

Should the machined surface against which the liner of the clutch plate bears be scored, it may be reground, but on no account must the original thickness of the wheel be reduced by more than 1 32nd of an inch.

The regrinding must be carried out carefully r the surface must be smooth, flat and rallel to the joint faces of the flywheel and ankshaft flange.

If these conditions are not satisfied the surface will run out of true and clutch chatter or judder may be introduced.

TO REMOVE AND REPLACE THE ENGINE SUMP.

(1) Drain the oil by removing the plug on the offside rear of the engine sump. The draining is best carried out when the oil is warm. When refilling use fresh oil as recommended on *page M7* dealing with lubrication.

(2) Disconnect the right side track rod from the central steering arm after removing the cotter and castle nut from the ball pin of the joint.

(3) Turn the left front wheel on to full right lock.

(4) Remove the three bolts securing the forward cover plate for the lower half of flywheel and detach the cover.

(5) Remove the 15 set bolts and 6 nuts securing the sump to the crankcase when the sump can be dropped clear of the engine.

(6) Remove the basket filter by bending back the tabs securing the basket to the cover plate and withdraw.

(7) Remove the four nuts securing the baffle plates—two to each plate—and detach the plates.

Replacement is the reversal of the foregoing.

Before replacing the sump make sure :— That its exterior surface and the joint faces are clean ; that baffle plates and basket filter are in position ; to use a new sump gasket ; that the sump is filled to the correct level with one of the recommended oils.

TO REMOVE AND REPLACE THE OIL PUMP WITH TIMING CHAINS IN POSITION.

(1) Drain and remove the engine sump, *see page B24.*

(2) Detach the delivery oil pipe. Note the gaskets between the flanges.

(3) Remove the nuts securing the oil pump flange to the crankcase and draw out the pump.

Replacement is the reverse of the foregoing operations but since the distributor is driven from the spindle of the oil pump. the drive gear on the intermediate shaft must be engaged correctly with the oil pump gear to ensure that the ignition timing can be set correctly. Turn the engine until No. 1 cylinder inlet valve is just opening. Set the distributor so that the electrode of the central rotor is opposite the segment in the cap attached to the sparking plug of No. 4 cylinder. Now insert the pump and choose the meshing of the two gears which permits the driving dog of the distributor to engage with the slot on the oil pump gear with the least amount of alteration to the position of the distributor spindle. If the distributor is not in position on the engine, choose a tooth meshing which will place the driving slot in the spindle parallel to the centre line of the engine and the narrower segment adjacent to the cylinder block. Set the ignition timing correctly before assembling the engine sump. *See page B17.*

RECONDITIONING THE OIL PUMP.

The pump is of the all gear type, and normally requires no special attention. But should the engine at any time receive an

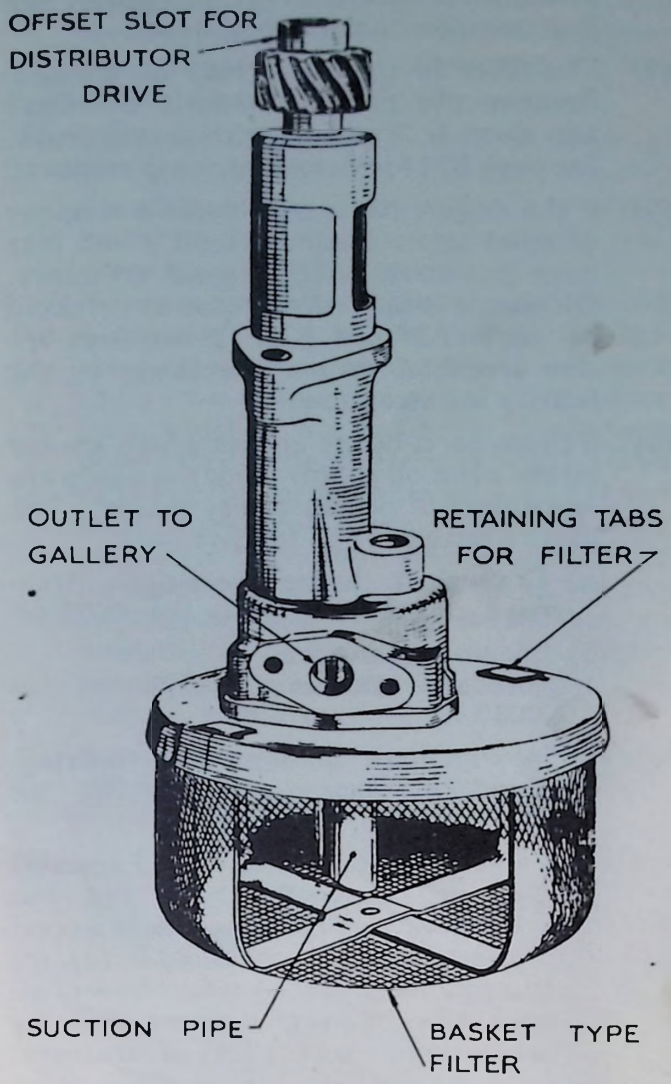


Fig. 16. Oil Pump with Basket type of Filter.

overhaul, it is advisable to recondition the pump at the same time.

The efficiency of the pump depends on two main factors, the extent of the clearances between the end faces of the gear, and the cover ; and between the periphery of the gears and the surfaces of the bores in which they revolve. The extent of the clearance for the former, with gasket fitted, varies from .0028 in. to .0048 in. (.0711 mm. to .1219 mm.) and for the latter from .0006 in. to .00185 in. (.0152 mm. to .0470 mm.).

Excessively worn and/or deeply marked gear tooth faces will also affect the efficiency. Gears showing these conditions should be replaced.

To check the clearances the pump must be stripped as follows :—

First remove the filter by bending back the tabs securing it to the cover plate. Remove the large self-locking nut in the centre of the pump cover, and the four set pins and shake-proof washers securing the cover to the body. Note the distance piece under the large nut. The cover can now be removed. (On later engines the four set pins are wired together and have a plain washer under the head).

Drive out the main spindle from its gear, taking care not to damage the thread on the end. Note when doing so, the driving key on the spindle. Remove the gears from the pump body.

Clean all the parts carefully, particularly the joint faces of the body and cover. Insert the spindle, and check the clearance between it and the bore in which it revolves. If the clearance is excessive, and there are signs on the spindle of wear, replace the spindle. Should excessive wear still be evident, replace the body.

Assemble the spindle and gears to the body, and check the clearances between the periphery of the gears and their bores. If the body is new and the clearance is greater than .00185 in. replace the gears, but if the body is the original, follow the same procedure as previously suggested, for the body and spindle.

When assured that the foregoing conditions are correct, place a straight edge across the face of the gears and the body. The machined face of the body should stand proud of the face of the gears to an extent, where, with a standard gasket and the cover bolted securely to the body, there is a clearance of .0028 in. to .0048 in. (.0711 mm. to .1219 mm.) between the gear faces and cover.

Any excess clearance may be reduced by machining the face of the body the required amount.

The machining operation must be carried out carefully and accurately, for the efficiency of the pump depends on the condition of the joint.

The pump can now be reassembled in the reverse order to dismantling.

LOW OIL PRESSURE.

Should the gauge register pressures considerably lower than 30/35lbs. /sq. in. with the

car travelling at 30/35 miles per hour in top gear, or the needle of the gauge oscillate, one or more of the following causes may be responsible.

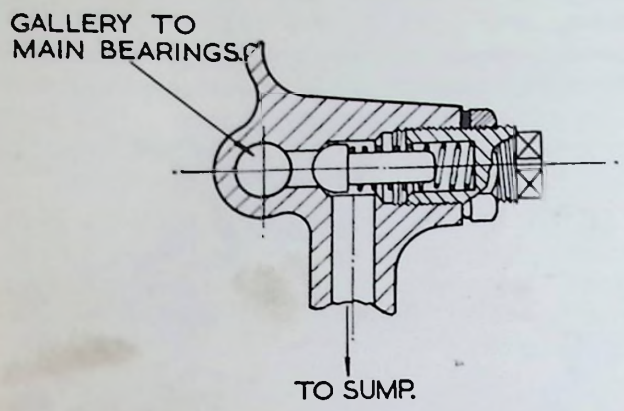


Fig. 17. Section through Oil Pressure Release Valve.

(1) The level of the oil in the sump may not be correct, or the grade of oil not as recommended. A list of recommended lubricants is given on *page M7*. As to the oil level, this can be checked by means of the dipstick. Replenish as necessary.

(2) The oil pressure gauge may not be reading accurately. Check by fitting one known to be correct.

(3) Dirt or foreign matter may be preventing the pressure release valve, situated in the main gallery (see *Fig.* 17) from working correctly. To clean, release the locknut just sufficiently to allow the central plug to be unscrewed. Avoid altering the position on the nut unnecessarily, for the position of the nut on the plug is an indication of how far the plug must be screwed in for the pressure to be approximately correct. Completely detach the plug from the cylinder block, remove the spring and plunger. Clean all parts including the bore in the cylinder block and the seat with petrol, and reassemble, first the plunger, then the spring, and lastly the plug which should be screwed up to the locknut which should now be tightened. If the pressure is low, release the lock nut, and screw the plug "in" until the correct pressure of 30/35 lbs. per square inch at 30/35 miles per hour is registered. To lower the pressure screw "out" the plug appropriately. Do not forget to tighten the lock nut after each adjustment.

(4) The filter in the sump may be choked. Remove the sump, dismantle the filter and clean it in petrol with a stiff brush. *See page B24* for details of sump removal.

(5) If the engine has a considerable number of miles to its credit, the oil pump may have lost some of its original efficiency. Dismantle it and recondition as directed on *pages B24 and B25*. If facilities are not available, return the pump to the factory for attention.

(6) If those parts of the engine which are fed by the main oil supply from the pump are worn, loss of pressure may result. The parts affected are as follows :—

(*a*) Crankshaft journal bearings. Standard clearance .0010 in. to .0025 in.

(*b*) Big end bearings. Standard clearance .0005 in. to .0020 in.

(*c*) Intermediate timing shaft bearing. Standard clearance .0005 in. to .0022 in.

(*d*) Valve rocker bushes. Excessive clearance between these and the rocker bar, and clearances as in excess of the standards mentioned in (*a*), (*b*) and (*c*), may cause a greater flow of oil over the bearing surfaces and its escape will produce loss of pressure.

Attention to external oil pipes and their connections, to ensure that there is no leakage, will help in maintaining correct oil pressure.

TO REMOVE AND REPLACE A PISTON AND ROD ASSEMBLY.

(1) Remove the cylinder head. *See page B9.*

(2) Drain and remove the engine sump. *See page B24.*

(3) Remove the oil suction pipe. Note the gaskets.

(4) Turn the engine until the connecting rod assembly to be treated has its big end in the lowest position.

(5) Remove the nuts and tab washers from the big end bearing bolts and remove the cap complete with the bearing shells.

(6) Push the connecting rod and piston assembly up the bore until the gudgeon pin is exposed to view above the top face of the block.

(7) Turn the assembly through an angle of 90°, extract one of the circlips locating the gudgeon pin in the piston, and with a helper supporting the connecting rod, drive out the gudgeon pin.

Remove the piston upwards and the rod downwards out of the bore. Replace the gudgeon pin into the piston and mark the piston with the number of the bore from which it was removed, naming the bore nearest the radiator as No. 1. The caps and rods are numbered 1, 2, 3, 4 and must be replaced as removed and in their respective bores, but the positions of the halves of each bearing relative to the cap and rod are not marked and should, on dismantling, be marked suitably. These precautions are necessary to assist correct reassembly.

Replacement is the reverse of the above but observe the following :—

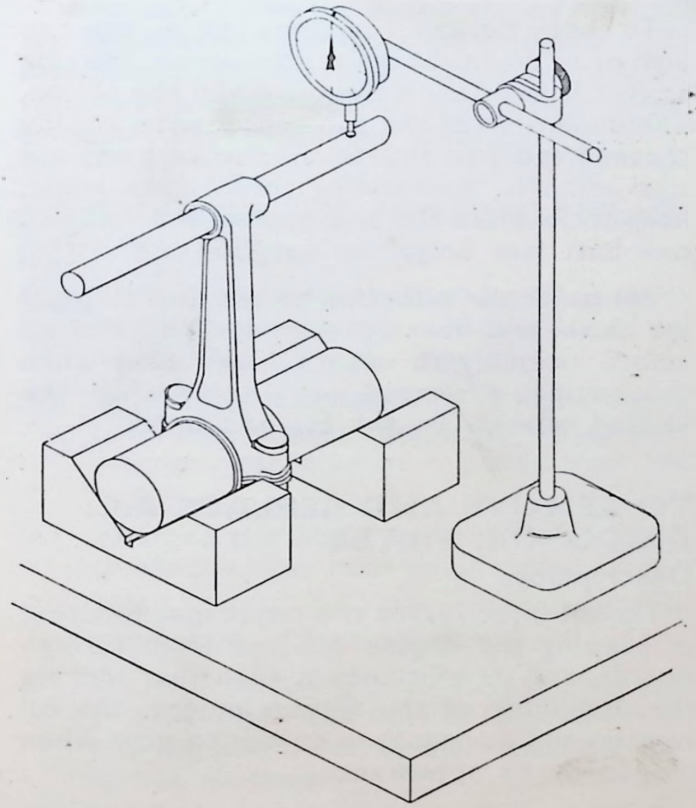


Fig. 18. Aligning Connecting Rod. The height of the small mandrel above the surface plate must be the same on either side of the small end. Adjust by setting shank of rod to the right or left as necessary.

Connecting Rods.

The big end bearings are self-locating shells, white metal lined. They are of the full ringed butted type and non-adjustable, consequently their butt ends and those of the connecting rods and caps must not under any circumstances be filed in an endeavour to reduce excessive diametrical clearance between the bearings and the journals. Any such action will not only scrap the rods by making them unsuitable for the fitting of new shells, but will serve no useful purpose since the filing merely reduces the clearance along a diameter at right angles to the butt faces ; the clearance adjacent to the butt faces remain, for all practical purposes, the same as before.

All replacement connecting rods supplied are aligned accurately before despatch, but if for any reason it is suspected that a particular rod is out of true, it should be checked in an aligning fixture similar to those shown in Figs. 18 and 19 and if necessary reset.

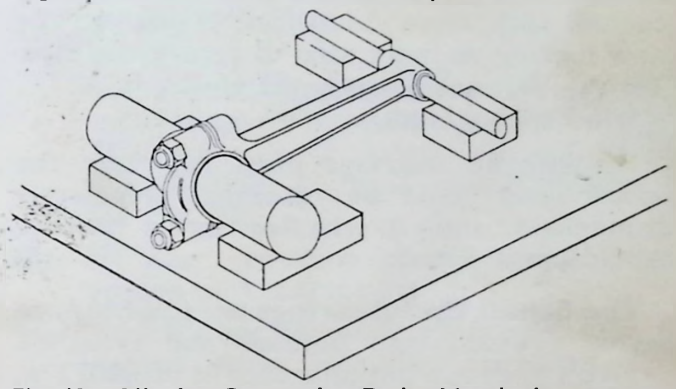


Fig. 19. Aligning Connecting Rod. Mandrels must contact all four blocks at the same time. Adjust by twisting the shank of the rod as necessary.

For the connecting rods to be assembled correctly in the bore the figures 1, 2, 3 or 4, stamped on each rod and cap, must face towards the exhaust manifold side of the engine. On final assembly use new locking washers on the connecting rod bolts. Torque Wrench Setting=33 42 lbs. ft. (Big End Nuts)

Replacement of Big End Bearings.

If, as the result of a shortage of oil, a bearing should fail, a replacement set of shells can be fitted without removing the piston and rod assembly. When this procedure is adopted action must be taken to ensure that before final assembly any bearing metal which may have found its way into the oil way drilled in the webs of the crank is removed, and that the standard clearance of .0005 in. to .0015 in. is present between the bearing and the crank pin.

The cleaning of the oilway can be carried out by removing the cap and bottom shell of the adjacent main bearing, and applying an air line to the main journal end of the oilway which will be visible when the crank pin is placed at top centre. Never attempt to clear the oilway from the crank pin end towards the main journal.

The checking of the clearance can be done by actual measurement—comparative figure for which can be obtained from the Technical Data—or by inserting tissue paper of known thickness between the bearing and crank pin and noting the thickness which just removes freedom of the rod.

MAIN BEARINGS.

In all cases of suspected oil shortage to bearings, the caps of the main bearings should be removed, and the lower shells of the bearings detached for inspection. If found in good condition they must be cleaned, liberally coated with clean oil before replacing, and new locking washers used to secure the caps. Torque Wrench Setting=58/66 lbs. ft. (Main Bearing Nuts)

Should the bearings need replacing the power unit must be removed, completely dismantled and overhauled or a Service replacement fitted.

The Small End Bearings are fixed bronze bushes pressed into position and broached to give a gudgeon pin tolerance fit of .00022 in. (.0057 mm.). A suitable broach—price on application—can be obtained from the Factory. When pressing in the bush make sure that the oil hole in it and the one in the rod register.

The Gudgeon Pins are ground for correct assembly to the small ends. But it may on occasions be necessary to adopt selective assembly to give a condition where it is just possible, by holding the big end in the palm of the hand to oscillate the rod on the pin.

The gudgeon pin is a shrink fit in the piston which should be fitted to the rod so that when in the bore, the word "FRONT" is towards the radiator and the figures 1, 2, 3 or 4, stamped on the big end of the connecting rod towards the exhaust manifold side of the engine. The gudgeon is held in the piston by two circlips. To fit a gudgeon to a piston immerse the piston for a few minutes in very hot water.

The Pistons are Hepolite S.W. Design Units. Each piston is fitted with two compression rings and one oil control or upper scraper ring. The skirt is split circumferentially on the thrust and non-thrust sides. There is also an axial groove extending from the open end, part-way up the non-thrust side of the skirt.

Before inserting a piston and rod assembly in its bore, check that the circlips locating the gudgeon in the piston are correctly positioned in the grooves machined for them, that the gaps of the piston rings are equally spaced, and that the word "FRONT" stamped on the crown is towards the front of the car when the piston is fitted in its bore. Do not disturb the compression rings unnecessarily. If one has to be removed, insert a thin piece of steel approximately .020 in. thick and $\frac{3}{8}$ in. wide between the ring and the piston at a point near the gap. Then work the steel round the piston moving the ring out of the groove and at the same time forcing it upwards over the crown. If a new ring is fitted to an original piston, check that the gap is .008 in. to .013 in. (.203 mm. to .331 mm.) and that the piston groove is clean of all carbon.

To check the gap, support a piston about an inch or so down the bore, then insert the ring so that it lies flat on the crown of the piston. The dimension of the gap can now be readily checked and if an alteration is to be made use a smooth file, maintaining the original angle, keep the surface flat and confine the filing to one butt face only.

Pay particular attention to see that all parts are clean, and liberally coated with clean oil before assembly to ensure lubrication when the engine is started up. Replace all the locking washers on the big end bolts.

TO REMOVE AND REPLACE A.C. DELCO OIL FILTER.

Description.

The oil filter serves the important function of keeping the engine oil free from foreign matter, and its efficiency is such that, during the useful life of the filter element, the oil remains almost equal in colour to new when judged by its appearance.

To maintain these conditions, the element must be changed when its useful life has ended, which is approximately 10,000 miles (16,000

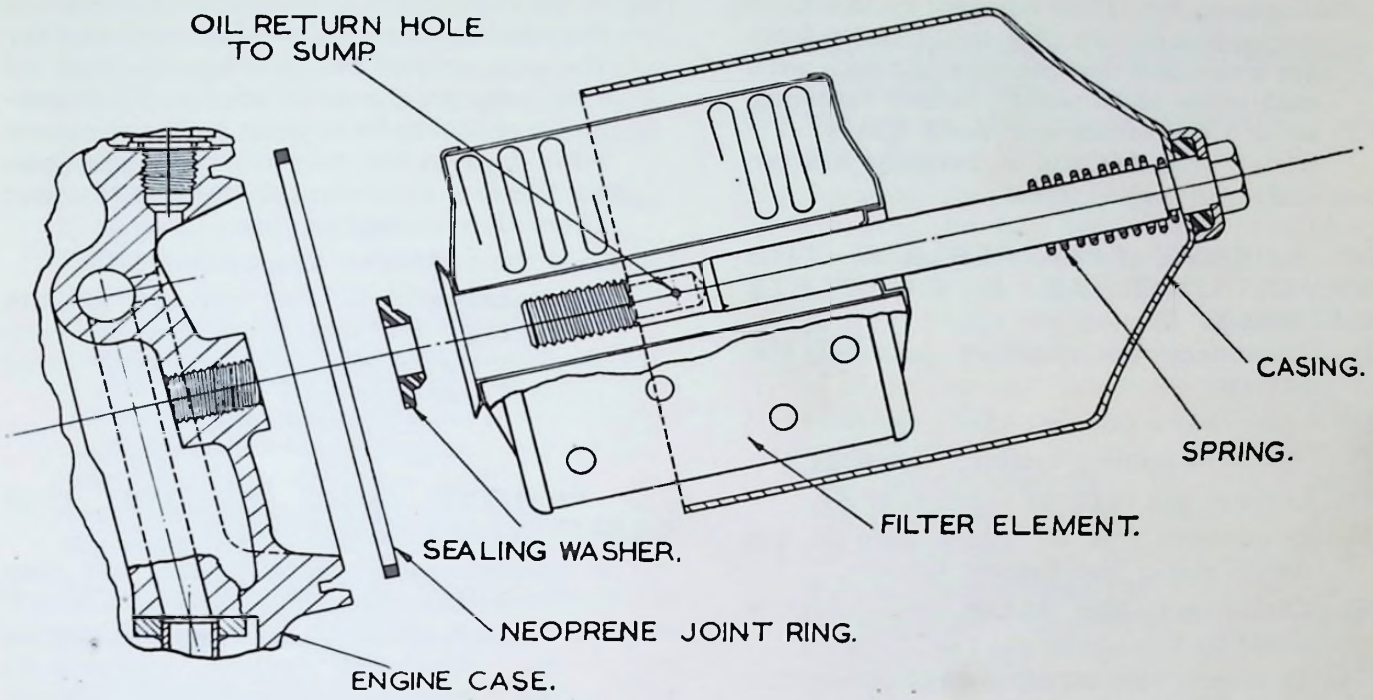


Fig. 20. Section through A.C. Delco Oil Filter

kms.). The engine oil must also be changed at the same time.

The filter is inserted in the engine lubricating system on the by-pass principle, and reference to the oil flow diagram on *page M6* will give a clear idea of the passage of oil through the engine and filter.

TO CHANGE THE FILTER ELEMENT.

(1) Drain oil from sump.

(2) Place a container under the oil filter as when this is removed a quantity of oil will unavoidably be spilt.

(3) Unscrew filter retaining bolt, allowing oil to run into the container. The whole assembly can now be removed from the engine.

(4) Remove the filter element from casing, the former can now be discarded.

(5) Remove the neoprene gasket, located in groove in crank casing.

(6) Clean filter casing of all sludge. See that the counterbored hole in spindle is clear and the small radially drilled escape hole is not blocked.

(7) With every new element there is supplied one neoprene sealing ring and one moulded sealing washer. Insert new element sliding it over bolt with recessed bore fitting over spring. This will leave a flanged disc exposed. On to this fit new sealing washer. See *Fig.* 20.

(8) Fit new neoprene gasket evenly into groove on crank casing.

(9) Attach filter assembly to crankcase and tighten down retaining bolt securely.

(10) Refill sump with new oil.

(11) Run engine for a few minutes and then check for leakage.
NOTE. On earlier models it will be found that the element and its sealing washer are of slightly different design, but the new type is interchangeable.

REMOVAL AND REPLACEMENT OF THE STARTING MOTOR.

(1) Disconnect the positive lead from the battery and Starter Motor.

(2) Detach and lower Front Exhaust Pipe.

(3) Remove the two bolts securing the starting motor flange to the clutch housing and withdraw the motor from its location, remove in a downwards direction and from beneath the car.

Replacement is the reversal of the foregoing, but ensure that the jointing faces are clean, and that they are in touch with each other at all points, before screwing up and tightening the bolts finally. Ensure that felt pad is between starter body and engine case.

TO REMOVE AND REPLACE THE POWER UNIT AS A COMPLETE ASSEMBLY.

(1) Disconnect the positive lead of the battery.

(2) Remove the bonnet. *See page N1.*

(3) Drain the cooling system. *See page K1.*

(4) Remove the radiator. *See page K2.*

(5) Disconnect the oil gauge pipe at the union above the by-pass filter.

(6) Disconnect the choke and throttle controls.

(7) Disconnect the screen washer connection to manifold.
Note throttle control spring attached to anchorage on carburettor flange.

(8) Remove air cleaner and carburettor.

(9) Uncouple the exhaust pipe from the exhaust manifold.
Note the four brass nuts and asbestos joint washer.

(10) Remove the two nuts securing the engine torque reaction bracket to the crankcase on the offside and adjacent to the flywheel housing and detach the bracket.

11. Disconnect the low and high tension wires from the distributor, also the wires from the dynamo and starter.
Note the relative position of each wire and its terminal to facilitate replacement.

(12) Sling the engine by means of a rope passed around the crankshaft just rear of the crankshaft pulley, and also between the flywheel and the sump.

(13) Remove the four nuts and shakeproof washers from the studs securing the engine front support bracket to the chassis frame, and the two nuts and shakeproof washers securing the mounting rubber below the pump housing to the support.

(14) Detach the gearbox from the chassis and propeller shaft by carrying out Operations 1 to 11 on *pages C9 and C10* or operations 1 to 15 on *pages C17 and C18.*

(15) Raise the engine sufficiently to allow the forward support to be removed, and for the rear end of the gearbox to clear its rear support chassis bracket. Now continue to raise the engine, and at the same time depress the rear end of the gearbox to allow it to clear the toe boards, and then lift the engine clear.

16. Place the engine on a suitable trestle.

Replacement is the reversal of the foregoing. For instructions on the connecting up of the change speed lever control, *see page C11.*

TO REMOVE AND REPLACE THE CRANKSHAFT ASSEMBLY.

This operation cannot be carried out with the engine in the chassis. And, since it is a major one, it is advisable to strip the engine completely, clean the various components thoroughly, particularly the cylinder block and crankshaft oilways, and before reassembling recondition individual assemblies where possible.

(1) Remove the power unit, *see page B30.*

(2) Detach the self-starter, *see page B29.*

(3) Detach the gearbox from the engine.

(4) Remove the clutch assembly, *see page C2.*

(5) Remove the flywheel, *see page B23,* and the engine rear cover secured by six bolts to the cylinder block. Pay particular attention not to damage the bore of this cover or the oil return thread on the crankshaft, for the retention of oil at this point depends on the condition of the bore, and the oil return threads.

Before reassembling check that the bore is true, the threads undamaged, and that with the cover in position there is approximately .002 in. to .004 in. (.05 mm. to .1 mm.) at all points between the bore and the periphery of the threads. Note the gasket between the joint faces of cover and block. For reconditioning the flywheel *see page B23.*

(6) Remove the oil pressure relief valve, situated between the starter and the oil filter, by releasing the locknut sufficiently to allow the central threaded plug to be unscrewed and withdrawn. The position of the locknut on the plug determines the setting of the valve and should not be altered unnecessarily.

Extract the spring and plunger, and store carefully to avoid damage. When reassembling, see that the seating in the crankcase and that on the plunger are clean, also that the spring is in good condition.
See Technical Data for dimensions of spring. If necessary fit replacements.
With the plunger and then the spring in position, screw home the plug up to the locknut and, if necessary, adjust the pressure of the oiling system when the engine is warm to read 30/35 lbs. per sq. inch on the gauge, when the car is travelling at 30/35 m.p.h. in top gear. Screw the plug "in" to increase and "out" to decrease the pressure and after each adjustment remember to lock the nut.

(7) Remove the oil filter, *see page B28.*

(8) Remove the oil gauge flex union.

(9) Detach the dynamo and bracket, *see page B18.*

(10) Remove the distributor, *see page B19.*

(11) Remove the cylinder block drain plug.

(12) Detach the water pump, *see page B18,* and also the water pump housing secured to the block by three nuts and two studs. Note the gasket between the joint faces.

(13) Remove the primary and secondary chains. *See page B21.* Observe the same precautions, with the bore of the front cover and oil return thread on the boss of the crankshaft pulley, as those suggested for the rear cover and oil return threads on the crankshaft. The clearance at the front is .006 in. to .012 in.

(14) Withdraw the intermediate shaft, *see page B22.*

(15) Remove the cylinder head, *see page B9.*

(16) Strip and reassemble as described on *page B10.* In addition remove the side cover plate, also the water tube fitted along the right-hand side of the cylinder head above the sparking plugs and clean out all waterways before reassembling.

(17) Remove the sump, *see page B24.*

(18) Remove the oil pump, *see page B24.* Examine and recondition as described on *pages B24 to B26.*

(19) Withdraw the piston assemblies, *see page B26.*

(20) Remove the locking nuts and washers securing the main bearing caps and before detaching the caps mark them suitably to assist correct reassembly. If the main bearing shells are not to be renewed, treat them similarly. Note the two pairs of thrust washers which are fitted one on each side of the rear main bearing. They control the end float of the crankshaft. The correct dimension for this float is .002 in. to .004 in. (.05 mm. to .1 mm.).

(21) Lift off the caps and remove the crankshaft. The main bearings are renewable self-aligning steel shells white metal lined. They are of the full butted type, and under no circumstances must their butt faces or those of their caps be filed to reduce excessive diametrical clearance between the bearings and the crankshaft journals. The correct diametrical clearance between these parts is .001 in. to .0025 in. Should clearance in excess of this be present, the bearing must be replaced, but if the excess is still present the journals should be reground and bearings to suit fitted. For dimensions of standard crankshaft and cylinder bore regrinds *see Technical Data.*

Reassembly is in the reverse order to dismantling, but remember that all parts must be perfectly clean, and liberally coated with clean oil before assembly, for the success of a recondition depends largely on observing these precautions.

Pay particular attention to see that the lugs of the crankshaft thrust washers engage with the slots machined for them in the rear main bearing cap.

In addition, consideration must be given to the reconditioning of such ancillary equipment as Carburettor, Fuel Pump, Dynamo and Starter Motor. Should there be any doubt about the methods which should be adopted the manufacturers concerned should be approached.

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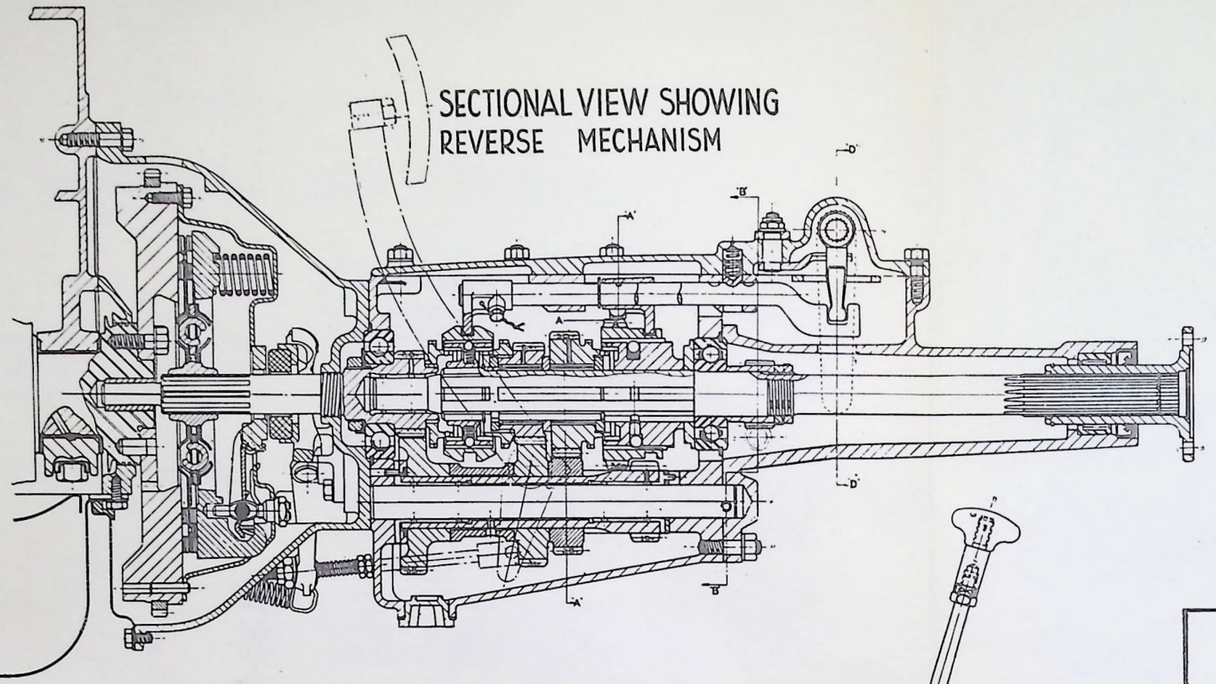
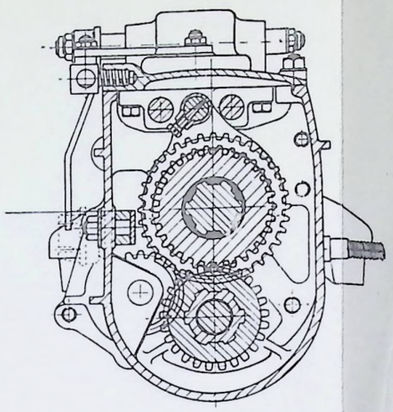


'HUNTER' GEAR BOX ARRANGEMENT (STEERING COLUMN GEAR CHANGE)



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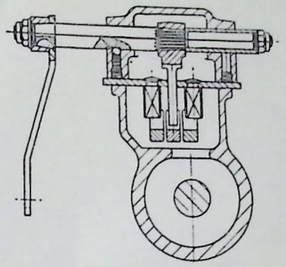

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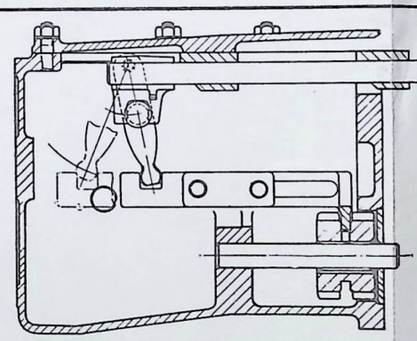

SECTIONAL VIEW SHOWING REVERSE MECHANISM
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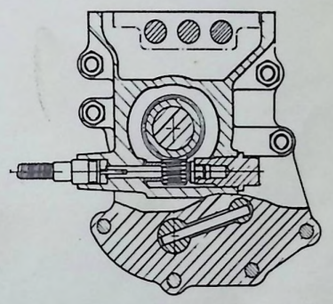

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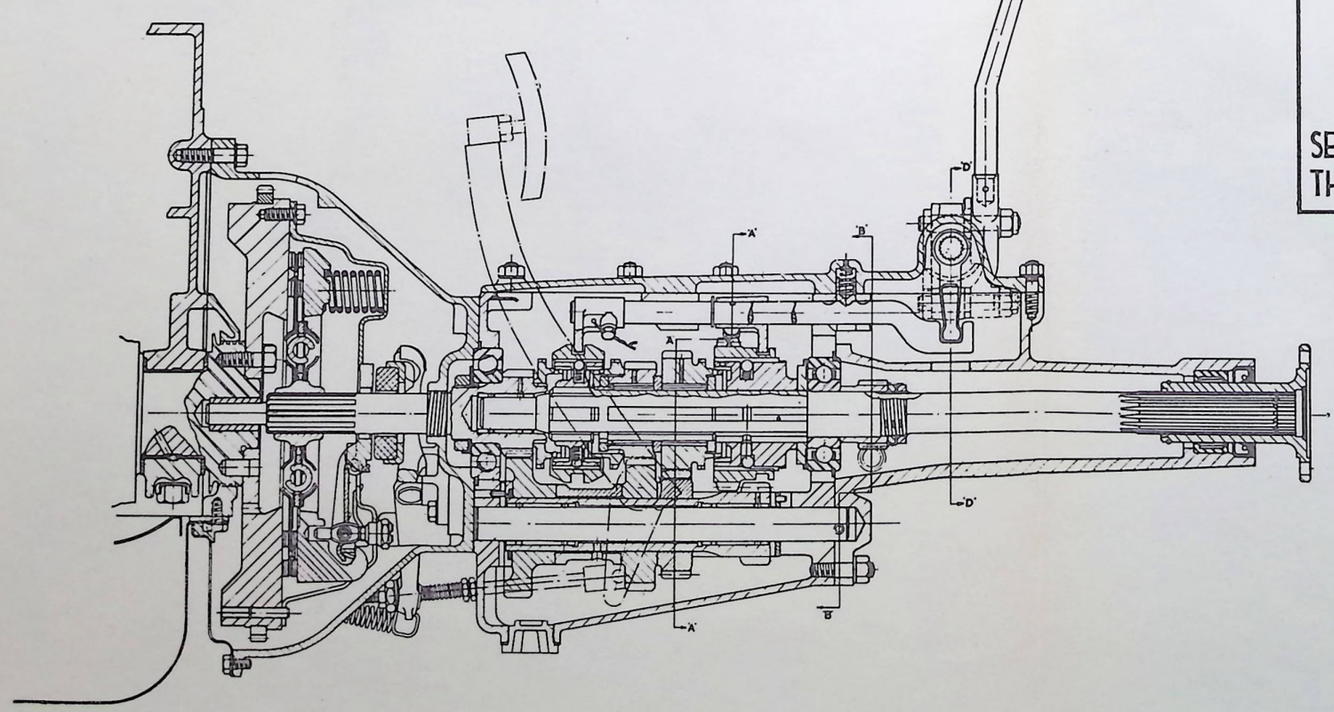
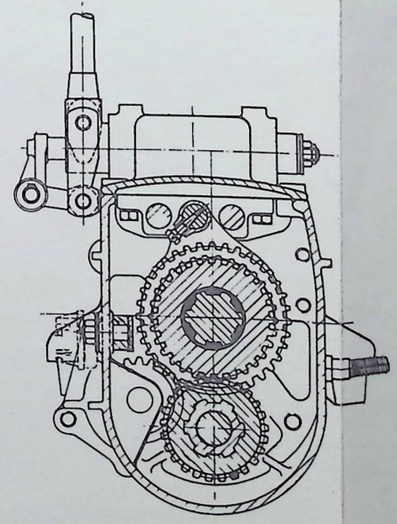
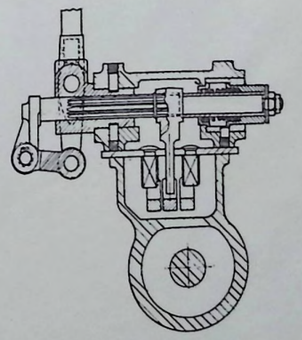


'HUNTER' GEAR BOX ARRANGEMENT (CENTRAL GEAR CHANGE)



SECTION 'A' 'A' 'A' 'A'



SECTION 'D' 'D'

SECTION C

CLUTCH, GEARBOX & CHANGE SPEED MECHANISM

CLUTCH.

Description.

The clutch is the single dry plate type with a driven flexible plate assembly, a cover assembly and a graphite release bearing.

The cover assembly consists of a pressed steel cover (1) and a cast iron pressure plate (2) loaded by six thrust springs (3). Mounted on the pressure plate are release levers (8) which pivot on floating pins (9) retained by eyebolts (10). Adjustment nuts (12) are screwed on to the eyebolts and secured by staking. Struts (13) are interposed between lugs on the pressure plate and the outer end of the release levers. Anti-rattle springs (11) restrain the release levers, and retainer springs (7) connect the release lever plate (4) to the levers.

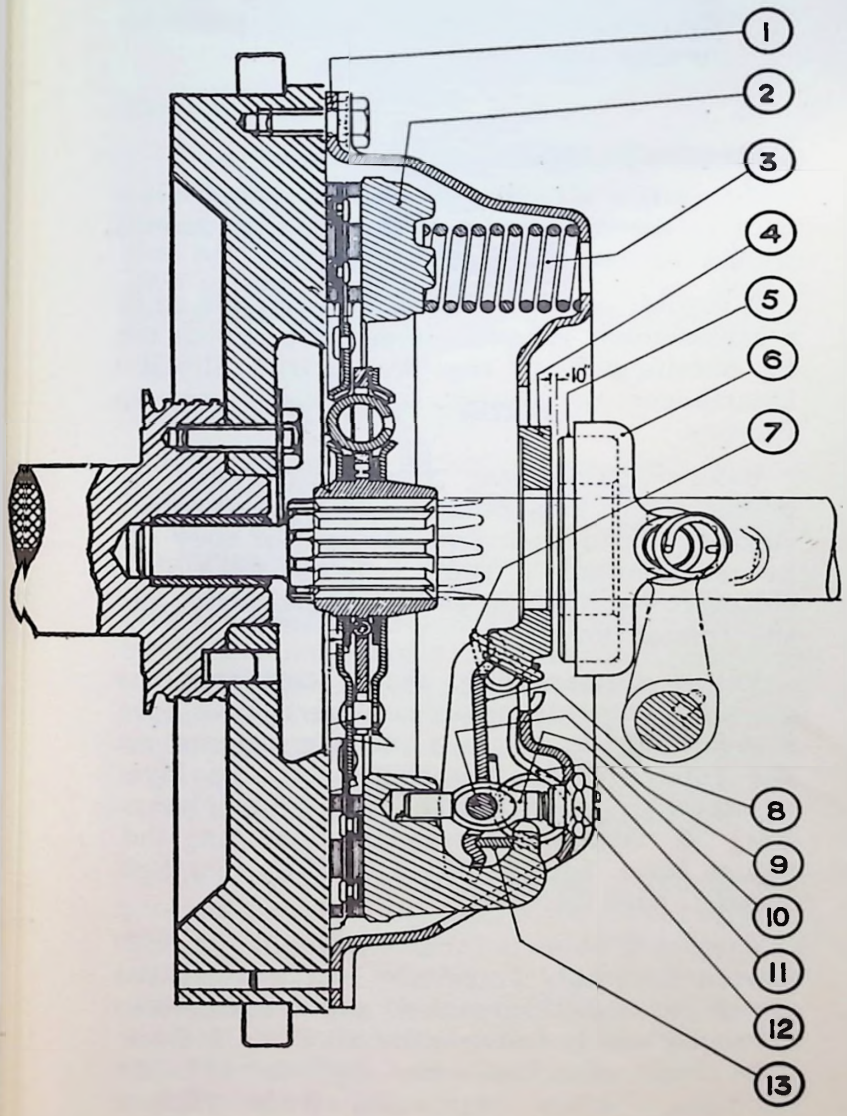


Fig. 1. Section through Clutch.
(See description for key to numbers).

The driven plate carries the friction liners riveted to it, and is of the spring loaded Borglite Belleville Washer Type.

The graphite release bearing (5) is shrunk into a bearing cup (6) which is mounted on the throw-out forks and held by retainer springs.

The function of the clutch pedal is to enable the release bearing to be moved sufficiently to free the clutch. Movement of the pedal beyond the point at which the clutch is freed obviously serves no useful purpose, and may lead to serious damage if carried to excess.

Excessive pedal movement leads to close coiling of the thrust springs after which any pedal pressure exerted by the driver, and this may be considerable, only tends to over-stress the release gear and the internal parts of the clutch. This over-stress causes excessive wear and may introduce failure of one or other of the internal parts.

The required pedal travel is the sum of two movements.

(1) The $\frac{3}{4}$" (19 mm.) of free movement to take up the release bearing clearance which is to ensure that the clutch is fully engaged when the foot is removed from the pedal.

(2) The $3\frac{3}{4}$" (95.2 mm.) effective movement necessary to release the clutch.

The total amount of pedal movement needed to move the release lever plate the required distance to free the clutch plate completely is $4\frac{1}{2}$" (114.3 mm.).

TO REMOVE AND REPLACE THE CLUTCH HOUSING.

(1) Remove the gearbox *See page C9 or C17.*

(2) Remove the three bolts securing the bottom front cover of the clutch housing and detach the cover.

(3) Disconnect the starter motor wire, remove the two bolts securing the motor to the clutch housing and withdraw the motor.

(4) Remove the bolts securing the clutch housing to the cylinder block and lift the housing out of position. Assembly is the reverse of the foregoing, but bear in mind to tighten the bolts securing the housing in diagonal rotation and in equal amounts to avoid distortion and fracture of the housing.

Maintenance.

The only adjustment necessary throughout the life of the driven plate facings is to restore, periodically, the free movement of the pedal before the release bearing comes in contact with the release lever plate and commences to release 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 further towards the gearbox and to increase the free pedal movement.

The standard free movement measured between the pedal pad and the floorboards is $\frac{3}{4}$" (19 mm.) ; when it decreases to $\frac{1}{4}$" (6.35 mm.) it must be restored by pedal adjustment. *See page C6.*

TO REMOVE THE CLUTCH UNIT FROM THE CAR.

(1) Remove the Gearbox, *see page C9 or C17.*

(2) Remove the Clutch Housing, *see page C1.*

(3) Release the six bolts securing the clutch cover to the flywheel, in diagonal rotation and half a turn at a time, until the pressure of the thrust springs is relieved.

(4) Remove the bolts and detach the clutch cover complete with the centre plate from the flywheel. Pay particular attention not to handle the clutch linings with greasy fingers, for once impregnated with grease they are very difficult to clean, if at all.

(5) Remove the constant mesh shaft spigot Oilite bush from the centre of the flywheel and store in a safe place for further use.

DISMANTLING.

To ensure satisfactory results, when overhauling the clutch the following instructions should be carried out.

It would, in all instances, be advisable to fit a replacement reconditioned unit, which can be obtained from any Authorised SINGER Distributor or Dealer or direct from the Factory.

Before dismantling the clutch, and to preserve the balance and adjustments, mark suitably the following parts, so that they can be reassembled in their original positions : clutch cover, lugs on the pressure plate, and the release levers.

When reassembling, make sure that the markings coincide, and if new parts have been fitted which would affect the adjustments, set the release levers by means of the lever adjustment gauge obtainable from Messrs. Borg & Beck, Leamington Spa, England. Gauge Plate, Service No. CG10516. *See Figs. 2 and 3, page C5.*

Also available is the Churchill No. 99 Clutch Assembly Fixture. This enables the clutch to be dismantled and reassembled correctly and is suitable for all Borg & Beck. "A" type clutches from $6\frac{1}{4}$" to 11" dia inclusive. It is obtainable from Messrs. V. L. Churchill & Co., Ltd., 27/34, Walnut Tree Walk, Lambeth North, London, S.E.11.

If a new pressure plate is required a complete cover assembly should be fitted for it is not a practical proposition, when no special equipment is available, to balance an assembly to which a new pressure plate has been fitted.

Before assembly, clean all parts and renew those which show appreciable wear. A very slight smear of grease such as Duckham's H.P.2295 or Keenol should be applied to the release lever pins, contact faces of the struts, eyebolt seats in the clutch cover, drive lug sides on the pressure plate and the plain end of the eyebolts.

Release Bearing.

If the graphite release bearing is badly worn replace it by a complete bearing assembly.

Driven Plate.

When removing old worn facings, the rivets should be drilled not punched out. After removing the facings, thoroughly examine the disc and segments for cracks ; if damaged, a new driven plate assembly should be used, a procedure which is preferable in all instances.

Clutch Frictional Facings.

The possibility of further use of the friction facings of the Borg & Beck clutches is sometimes raised, because of their polished appearance after considerable service. It is natural to assume that a rough surface will give a higher frictional value against slipping, but this is not correct. Since the introduction of non-metallic facings of the moulded asbestos type, in service a polished surface is a common experience, but it must not be confused with a glazed surface which is sometimes encountered due to conditions discussed below.

The ideal smooth or polished condition will provide a normal contact, but a glazed surface, due to an oil film may entirely alter the frictional value of the facings. These two conditions might be simply illustrated by the comparison between polished wood and a varnished surface. In the former the contact is still made by the original material, whereas in the latter a film of dried varnish is interposed between the contacting surfaces.

The following notes are issued with a view to giving useful information on this subject :—

(a) After the clutch has been in use for some little time under perfect conditions, *i.e.*, with the clutch facings working on true and polished or ground surfaces of correct material, without the presence of oil and with only that amount of slip which the clutch provides for under normal conditions, the surface of the facings assume a high polish, through which the grain of the material can be clearly seen. This polished facing is a mid-brown colour and is then in a perfect condition ; the co-efficient of friction and the capacity for transmitting power being up to Borg & Beck standard.

(b) Should oil, in small quantities, gain access to the clutch in such manner as to come in contact with the facings it will burn off, due to the heat generated by slip which occurs under normal starting conditions. The burning off of this small amount of lubricant has the effect of gradually darkening the facings, but, provided the polish on the facings remains such that the grain of the material can be clearly distinguished, it has very little effect on clutch performance.

(c) Should increased quantities of oil or grease obtain access to the facings, one or two conditions, or a combination of the two, depending upon the nature of oil, etc., may arise.

(1) The oil may burn off and leave on the surface facings a carbon deposit which assumes a high glaze and causes slip. This is a very definite, though very thin deposit and, in general, hides the grain of the material.

(2) The oil may partially burn and leave a resinous deposit on the facings, which frequently produces a fierce clutch. It may also cause a "spinning" clutch due to a tendency of the facings to adhere to the flywheel or pressure plate face.

(3) There may be a combination of (1) and (2) conditions, which is likely to produce a judder during clutch engagement.

(d) Still greater quantities of oil produce a black soaked appearance of the facings, and the effect may be slip, fierceness, or judder in engagement, etc., according to the conditions.

If the conditions under (c) or (d) are experienced, the clutch driven plate should be replaced by one fitted with new facings, the cause of the presence of oil removed and the clutch and flywheel face thoroughly cleaned.

Misalignment.

The rim and the frictional face of the flywheel must run true to the machined face on which the clutch housing is bolted to the cylinder block, and also to the bore which carries the bearing for the constant mesh shaft in the clutch housing.

Should the flywheel not run true to these surfaces, then misalignment is present. The most likely cause is dirt or foreign matter between the joint faces of the crankshaft driving flange and flywheel, or clutch housing and cylinder block. It is therefore important that the butting face of the joints are perfectly clean when these components are assembled. The difficulties arising from misalignment are, abnormal wearing of the splines in the hub of the clutch centre plate, and of the constant mesh shaft ; clutch chatter and drag which makes gear changing difficult. This last mentioned condition not only affects the operation and life of the clutch, but is also detrimental to the transmission bearings and gears.

If when assembling the flywheel and clutch housing, the butting faces are free from dirt and foreign matter, misalignment should not occur ; but when endeavouring to trace an undetermined cause for one or other of the difficulties previously mentioned a check as follows should be made.

Mount a clock indicator on the cylinder block, and check the rim and frictional face of the flywheel. Next mount the indicator on the flywheel and check the surface of the cylinder block. The permissible error for the above is .003″ to .005″ (.076 mm. to .127 mm.).

Next fit the clutch housing and with the indicator suitably mounted on the flywheel, check the bore for the constant mesh bearing. The permissible error is .010″ (.254 mm.).

When making the foregoing checks the flywheel should be turned slowly.

Repairs to Driven Plate.

After refacing, mount the driven plate on a mandrel between centres and check for "run out" by means of a clock indicator set as near to the edge as possible. Where the "run out" exceeds .015″ (.38 mm.) true the plate by prizing in the requisite direction the high spots.

When assembling the driven plate in the flywheel, ensure that the splined end of the hub with the large chamfer is towards the gearbox or rear of the car.

Line up the pilot bearing and the driven plate by means of a dummy shaft, a service constant mesh shaft may be used, before tightening the clutch cover securing screws ; do not remove the shaft until the screws are fully tightened.

COMPLETE DISMANTLING OF CLUTCH COVER. *See page C5 for diagram.*

(1) Detach the release lever plate (4) from the retainer springs (7) and place the cover assembly on the bed of a press with the pressure plate (2) resting on blocks, so arranged that the cover is free to move downwards when pressure is applied.

(2) Place a block of wood across the cover, see Fig. 2, resting on the spring bosses, and compress the cover by means of the ram. Remove the nuts (12) which should be released by exerting sufficient turning pressure to shear the peening. Slowly release the pressure to prevent the thrust springs from flying out.

(3) Remove each release lever (8) by holding the lever and the eyebolt (10) between fingers and thumb so that the inner end of the lever and the threaded end of the eyebolt are as close together as possible. Lift the strut (13) over the ridge of the lever and remove the eyebolt from the pressure plate.

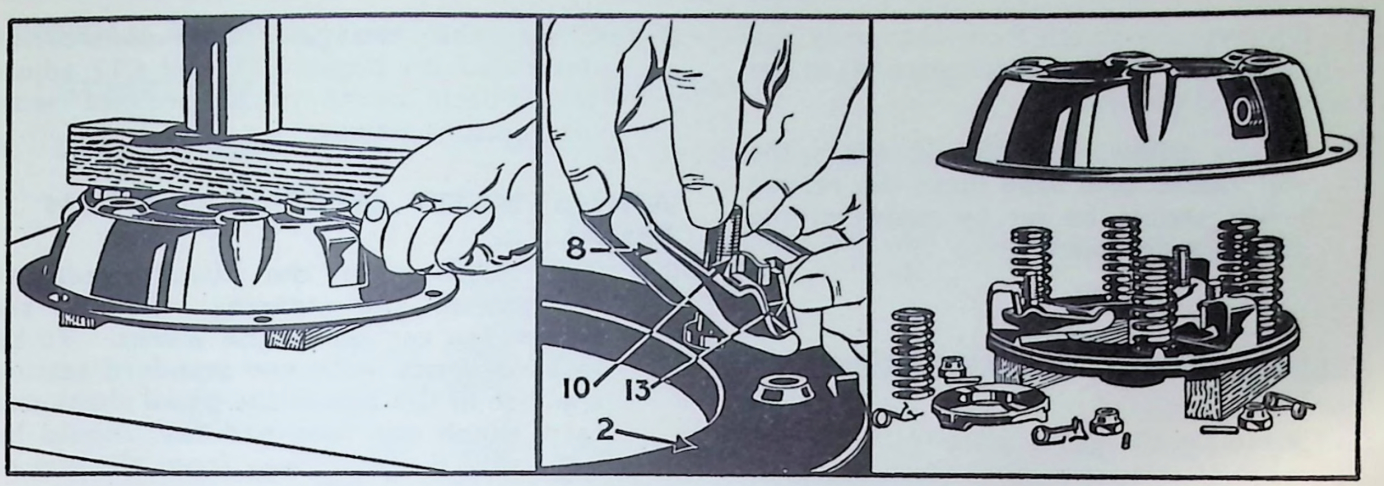


Fig. 2. 8.—Release Lever. 10.—Eye Bolt. 13.—Strut. 2.—Pressure Plate.

ASSEMBLING.

Before assembling note the positions of the marked components.

(1) Assemble one release lever (8), eyebolt (10) and eyebolt pin (9) holding the threaded end of the eyebolt and the inner end of the release lever as close together as possible. With the other hand insert the strut (13) in the slots in the pressure plate sufficiently to allow the plain end of the eyebolt to be inserted in the hole in the pressure plate. Move the strut upwards into the slots in the pressure plate lug, over the ridge on the short end of the lever and drop it into the groove formed in the latter. Fit the remaining release levers in a similar manner. *See Fig.* 2.

(2) Place the pressure plate (2) on blocks on the bed of the press and arrange the thrust springs (3) in a vertical position on the plate, seating them on bosses provided. *See Fig.* 2.

(3) Lay the cover over the assembled parts, ensuring that the anti-rattle springs (11) are in position, that the tops of the thrust springs are directly under the seats in the cover, and that the machined portions of the pressure plate lugs are under the slots through which they have to pass.

(4) Place the block of wood across the cover resting on the spring bosses, and compress the cover by means of the ram, guiding the eyebolts and pressure plate lugs through their respective holes. Screw the adjusting nuts (12) on to the eyebolts (10) and secure by staking. Operate the clutch a few times, by means of the ram to ensure that the working parts have settled in their correct positions.

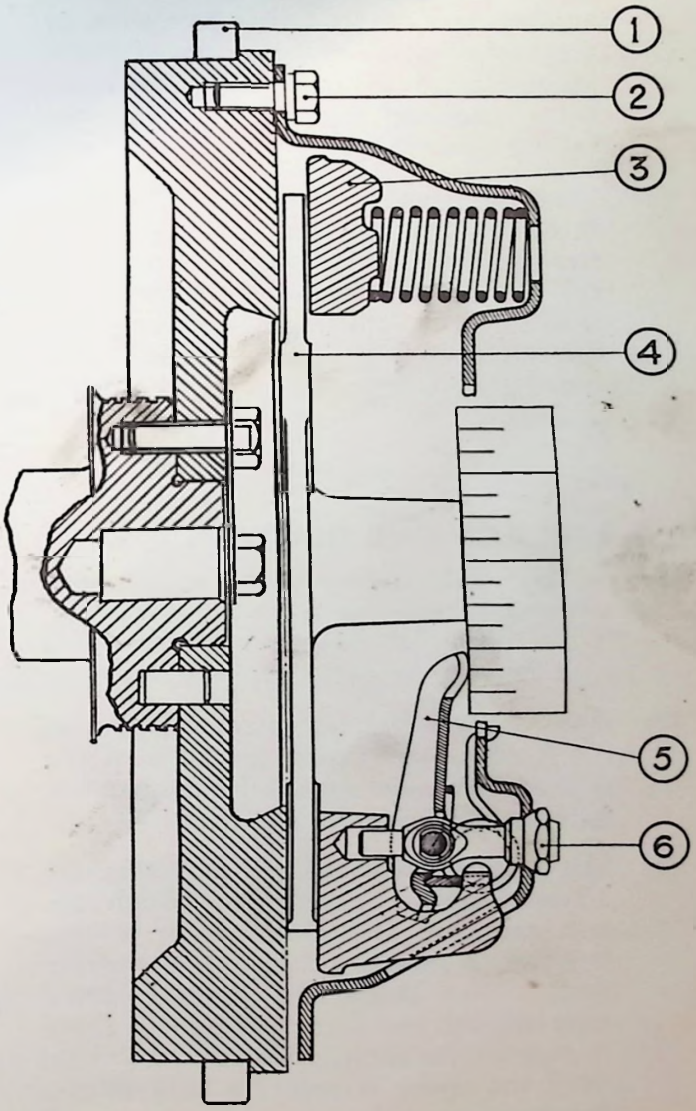


Fig. 3. Release Lever Adjustment.

(5) Remove the clutch from the press and connect the release lever plate (4) to the retainer springs.

(6) If new parts which would affect the adjustment have been fitted the release levers should be set by means of the special gauge plate.

RELEASE LEVER ADJUSTMENT.

Fig. 3.

(1) Assemble the gauge plate (4) in the flywheel (1) in the position normally occupied by the driven plate, and mount the cover assembly on the flywheel tightening the holding screws (2) a turn at a time by diagonal selection and ensuring that the gauge plate is correctly centred with the three machined lugs directly under the release lever (5).

(2) When the cover assembly has been fitted to the flywheel, place a short straight edge across the centre boss and the bearing surface of one release lever, then turn the adjusting nut (6) until the lever is exactly the same height as the gauge plate boss. Repeat for the other levers.

TO REPLACE THE CLUTCH.

(1) Fit the "Oilite" bush in the centre bore of the flywheel—no lubricant is needed. If the bush has been in service for a considerable mileage, replace it.

(2) Place the driven plate assembly against the flywheel face, with the bore of the splined hub carrying the large chamfer, facing away from the flywheel.

(3) Fit the cover assembly, and centralise the driven plate by inserting, through the hub and into the Oilite bush in the flywheel, a service constant mesh drive shaft. Then insert the holding down nuts through the cover and tighten them in diagonal rotation, half a turn at a time, until the cover is securely held to the flywheel.

(4) Remove the service constant mesh shaft, replace the clutch housing and the gearbox as described on *pages C1 and C9.*

(5) Check the change speed control as described on *pages C11 and C12* adjust the clutch pedal in accordance with instructions below.

ADJUSTMENT OF THE CLUTCH PEDAL.

(1) The position of the clutch pedal in relation to the steering wheel is set before the car leaves the works. To be in accordance with the standard setting the face of the eye in the pedal shank and into which the foot pad fits, should be $23\frac{1}{2}$" (596.8 mm.) away from the rim of the steering wheel.

(2) The total travel of the pedal, measured between the face of the foot pad and the floorboards is also set when the car leaves the works, and should require no further attention. The required travel is $4\frac{1}{2}$" (114.3 mm.) and is limited by the adjuster screw in the forward lug formed in the clutch pedal support bracket. Any correction necessary is carried out in the normal way of releasing the locknut, altering the position of the adjuster screw until the correct travel is present, and then retightening the lock nut. *See Fig.* 4, *page C9.*

(3) The free movement, that is the amount the pedal can be depressed before the pressure of the clutch thrust springs is felt, should be $\frac{3}{4}$" (19 mm.) and is measured between the face of the foot pad and the toe board. The adjustment to maintain it is the only one which should be necessary during the life of the clutch liners, for the free movement tends to decrease as wear occurs to the liners. To restore the standard amount proceed as follows :—

Release the locknut on the end of the link connecting the pedal to the clutch operating forked lever, and unscrew the ball joint nut until the required free movement is obtained. Re-tighten the locknut. To reduce excessive free movement, screw up the ball joint nut in the required amount. *See Fig.* 4, *page C9.* Detach pedal pulloff spring whilst adjusting, this will enable the free play to be easily felt.

On completion of the service make sure that all locknuts released are retightened.

IRREGULARITIES AND THEIR REMEDIES.

SYMPTOM	CAUSE	REMEDY
1. Drag or Spin.	(*a*) Oil or grease on the driven plate facings.	Fit new facings.
	(*b*) Incorrect pedal adjustment not allowing full movement to release bearing.	Correct pedal adjustment.
	(*c*) Warped or damaged pressure plate or clutch cover.	Renew defective part.
	(*d*) Driven plate hub binding on splined shaft.	Clean up splines and lubricate with a small quantity of good quality high melting point grease.
	(*e*) Spigot bearing or bushing of clutch shaft binding.	Renew or lubricate spigot bearing.
	(*f*) Distorted driven plate due to the weight of the gearbox being allowed to hang in clutch plate during erection.	Fit new driven plate assembly. Use a jack to take the overhanging weight of the gearbox.
	(*g*) Broken facings of driven plate.	Fit new facings.
	(*h*) Dirt or foreign matter in the clutch.	Dismantle clutch from flywheel and clean the unit, see that all working parts are free. **Caution.** Never use petrol or paraffin for cleaning out clutch.
2. Fierceness or Snatch.	(*a*) Oil or grease on driven plate facings.	Fit new facings and remove source of foreign matter.
	(*b*) Binding of clutch pedal mechanism.	Free and lubricate journals.
	(*c*) Worn out driven plate facings.	New facings required.
3. Slip.	(*a*) Oil or grease on the driven plate facings.	Fit new facings and eliminate cause of foreign presence.
	(*b*) Binding of clutch pedal mechanism.	Free and lubricate journals.
	(*c*) Incorrect pedal adjustment indicated by lack of the requisite $\frac{3}{4}$" free or unloaded foot pedal movement. Incorrectly replaced floorboards preventing complete rearward movement of the pedal.	Correct pedal adjustment and/or clearances.

4. Judder.	(*a*) Oil, grease or foreign matter on the driven plate facings.	Fit new facings and remove source of foreign matter.
	(*b*) Pressure plate out of parallel with flywheel face in excess of the permissible tolerance.	Re-adjust levers in plane and, if necessary, fit new eyebolts.
	(*c*) Contact area of friction facings not evenly distributed. Note that friction facing surface will not show 100% contact until the clutch has been in use for some time, but the contact area actually showing should be evenly distributed round the friction facings.	This may be due to distortion, if so fit new driven plate assembly.
	(*d*) Bent splined shaft or buckled driven plate.	Fit new shaft or driven plate assembly.
	(*f*) Loose or damaged rubber engine mountings.	Replace and ensure elimination of endwise movement of power unit.
5. Rattle.	(*a*) Damaged driven plate, *i.e.*, broken springs, etc. (*b*) Worn parts in release mechanism. (*c*) Excessive backlash in transmission. (*d*) Wear in transmission bearings. (*e*) Bent or worn splined shaft. (*f*) Graphite release bearing loose on throwout fork.	Fit new parts as necessary.
6. Tick or Knock.	(*a*) Hub splines worn.	Check and correct alignment, then fit new driven plate.
	(*b*) Worn spigot bearing.	Spigot bearing should be renewed.
7. Fracture of Driven Plate.	(*a*) Misalignment distorts the plate and causes it to break or tear round the hub or at segment necks in the case of Borg type.	Check and correct alignment and introduce new driven plate.
	(*b*) If the gearbox during assembly is allowed to hang with the shaft in the hub, the driven plate may be distorted, leading to drag, metal fatigue and breakage.	Fit new driven plate assembly and ensure satisfactory reassembly.
8. Abnormal Facing Wear.	Usually produced by overloading and by the excessive slip starting associated with overloading.	In the hands of the operator.

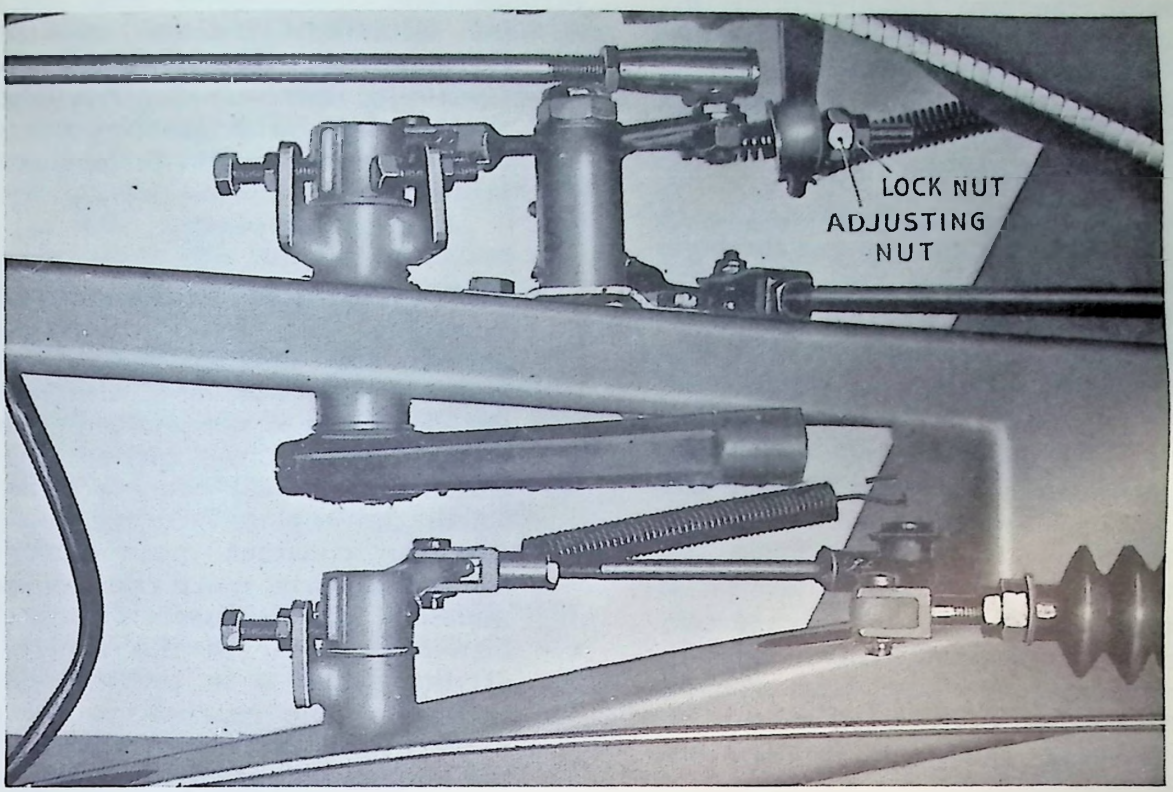


Fig. 4. Adjustment of Clutch Pedal. For description see page C6. The set screws with lock nuts are those which limit the travel of the Pedals.

GEARBOX. DESCRIPTION.

The gearbox has four forward speeds and a reverse, and is fitted with synchromesh mechanism on second, third and top gear. Top, third and second gears have ground teeth for extra quiet running. An extended mainshaft with a splined end carries a sliding flange mounted on a needle roller bearing in the gearbox rear extension. This sliding flange connects with the forward end of the propeller shaft and replaces the sliding joint usually part of the propeller shaft.

TO REMOVE AND REPLACE THE GEARBOX WITH THE ENGINE IN THE CHASSIS.

(1) Remove the carpets which are held by spring fasteners.

(2) Remove the front seat cushion.

(3) Remove the two set bolts which secure the forward ends of the seat runners, raise the forward edge of the seat sufficiently to disengage the trunnion of the adjuster from its support bracket, and push the seat back as far as it will go.

Note.

On later models the cushion is not removable, but sufficient clearance is obtained by pushing the seat back to its furthest position.

(4) Remove the metal cowling over the gearbox and the floorboards. The securing set pins have captive nuts.

(5) Disconnect the operating control cable by releasing the set pin securing it to the lever on the gearbox. Remove the rear nut securing the cable cover to the support bracket, and withdraw the cable control. (*See Fig. 6, page C11*).

(6) Disconnect the change speed control rod from its lever on the side of the gearbox by removing the nut securing the joint.

(7) Detach the clutch pull-off spring from the crankcase and disconnect the clutch control rod by removing the clevis pin from the clutch pedal joint.

(8) Disconnect the speedometer drive at the gearbox end.

(9) Disconnect the earth wire from the gearbox.

(10) Remove the two bolts securing the gearbox rear support bracket to the flexible mounting on the chassis frame.

(11) Disconnect the propeller shaft from the gearbox driving flange. There are four tab washers, bolts and nuts.

(12) Draw out the gearbox rear driving flange to the full extent and remove the bolts from the flange. Push back the flange to its full extent.

(13) Remove the two bottom nuts of the six securing the gearbox to the clutch housing.

(14) Place a jack under the rear end of the engine sump, and to help disperse the load, place between the jack and sump a block of wood shaped to cradle the sump.

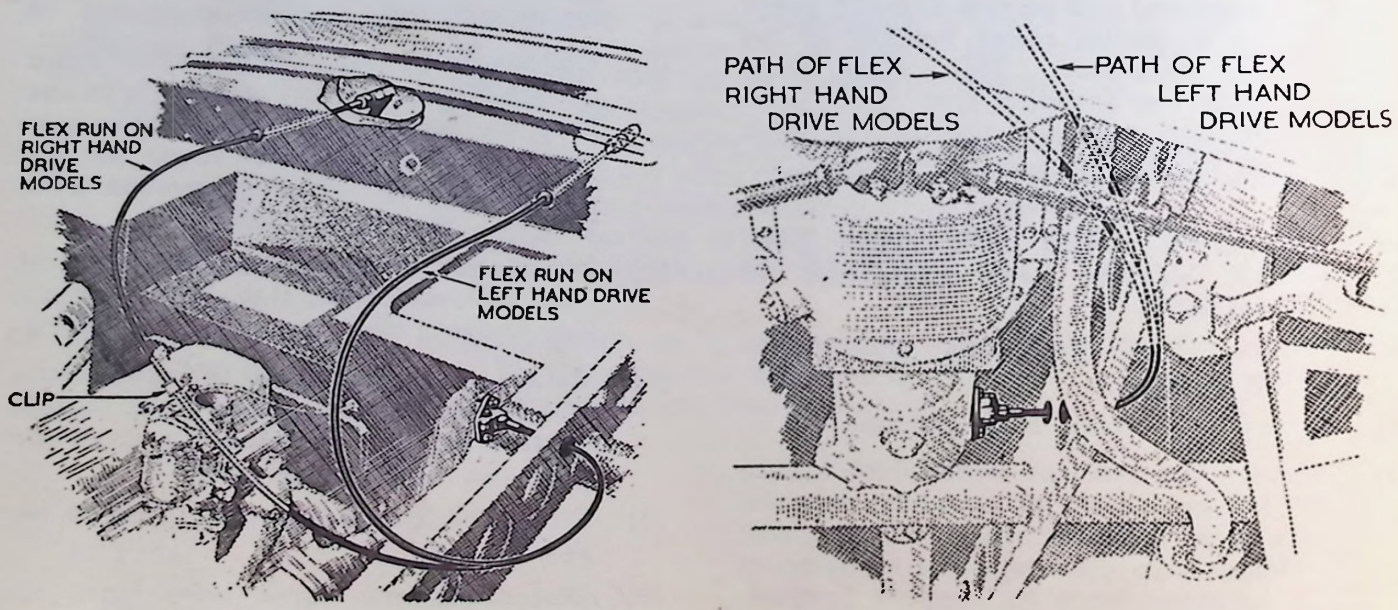
(15) Open the bonnet and remove the two nuts and shakeproof washers securing the engine torque reaction bracket to the crankcase on the offside and adjacent to the flywheel. Disconnect the choke and throttle controls.

(16) Place a piece of thin plywood between the fan blades and the radiator to prevent the blades damaging the radiator as the engine is pushed forward when the gearbox is being removed.

(17) Raise the engine by means of the jack, and at the same time lever the gearbox forward to allow the driving flange to clear the floor of the body. Continue to raise the engine until access can be obtained to the reverse light terminals on the box and the four remaining nuts securing the gearbox to the housing. The gearbox can now be drawn rearwards into the car out of position.

REPLACEMENT is the reversal of the foregoing, but before offering up the gearbox into position see that the joint faces of the box and clutch housing are clean and if necessary fit new joint washer. Check the carbon ring of the clutch withdrawal bearing is facing towards the engine. Engage top gear so that the constant mesh shaft can be rotated to assist mesh the splines of the shaft and clutch plate. Check that the blanking washer in the centre of the driving flange is in position when reassembling the gearbox to the engine. Keep the gearbox in line with the engine and supported until such time as the securing bolts have been tightened. To avoid distortion and fracture, tighten the bolts progressively and half a turn at a time until the joint faces are in contact at all points. To connect the change speed lever mechanism *see page C11.*

For removal and replacement of Gearbox with Central Change *see page C17.*



(a) **Fig. 5. Correct Layout for Speedometer Drive.** (b)

TO REMOVE AND REFIT FLEXIBLE DRIVE TO SPEEDOMETER HEAD.

WARNING. Handle, remove, store and refit the flexible drive carefully. The drive must not be knotted or placed into any temporary position that would cause kinking. Any such action would produce unsteady reading of the speedometer head. These precautions must be observed when the drive is dismantled for any reason whatever.

To Remove the Flex on a Right-hand Drive Car. Release clip securing assembly to the bulkhead. Unscrew the ferrule connection at the speedometer head. Remove the pinch bolt at the gear end and pull out the connection. Note the rubber grommet in the bulkhead.

Removal of the Flex on a Left-hand Drive is similar except that there is no clip on the bulkhead.

To Reassemble. The illustrations, Fig. 5, show the correct layout and run for the flex on the right and left-hand drive models. Note that when correctly connected the drive must be positioned in a natural and unrestricted curve from the head to the gearbox.

Lubrication. Lubricate the inner shaft about every 15,000 miles. To enable this to be done, detach drive from the speedometer head and pull out the inner shaft. Thoroughly clean the shaft and smear grease—not too heavily—over its entire length. Use grease 659 Esso. Thread back into casing, making sure that the squared end engages with the square hole at the driving end. This can best be done by rotating the shafting while threading it until engagement with the square hole at the bottom is felt. The shaft can then be pushed right home, but before the instrument end is re-coupled "feel" that the square on the inner shaft is "in" the square hole of speedometer spindle.

TO CONNECT CHANGE SPEED LEVER CONTROLS.

(1) See that the forward nut (A), Fig. 6, on the gearbox end of the control cable assembly is screwed right down. Pass the cable and the threaded end of the outer casing through the cable support, fit the second nut, and tighten securely.

(2) Thread the inner cable through the swivel pin on the operating lever (B), Fig. 6, push the lever fully forward, place

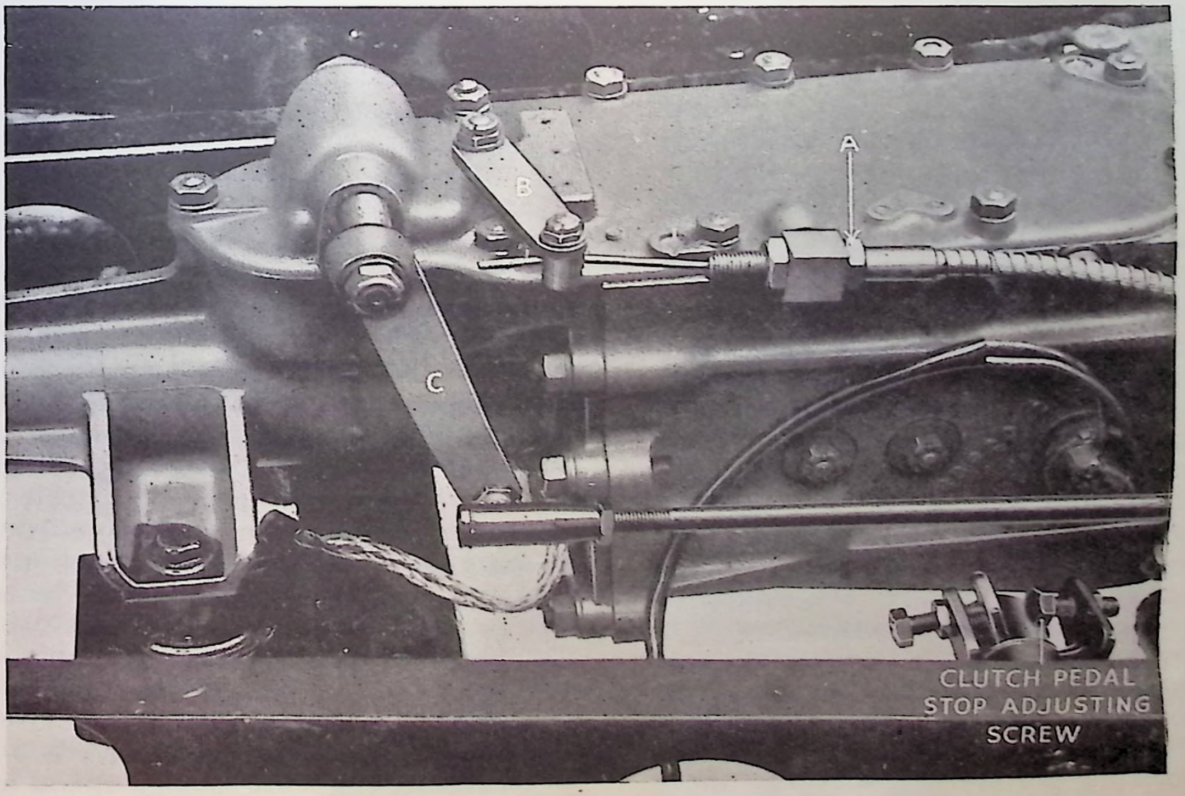


Fig. 6. Arrangement of Gear Change Speed Levers when connecting controls.

the change speed lever on the steering column in reverse gear position, and tighten up the set pin in the operating lever swivel pin.

(3) With operating lever (B) fully forward, push change speed lever (C) (on gearbox) fully forward also, and connect the control rod ball joint to it. If the ball joint does not engage at first in the hole in the lever, the length of the control rod assembly must be adjusted to suit the position of the lever.

(4) Check that it is possible to obtain any gear readily. If difficulty occurs, re-check the foregoing operations to ensure that they have been carried out correctly. If difficulty still persists examine the mechanism as stated in the next section.

(5) The cable assembly should be set so that the assembly has an easy curve between the points of support.

TO CHECK THAT THE CHANGE SPEED LEVER IS CORRECTLY ASSEMBLED.

(1) The control rod of the change speed lever assembly must throughout its length be vertically below the centre line of the steering column.

(2) Select reverse gear and check that there is adequate clearance between the operating lever boss on the control rod and the spherical bush housing mounted on the change speed bracket. This clearance is measured along centre line of control rod and should be approximately $\frac{1}{4}$" (6.35 mm.).

(3) To adjust this clearance, move the change speed bracket up or down the steering column by releasing the U-bolt nuts and the nut for the support strip to the master cylinder, and tighten again securely after adjustment. If the change speed bracket has to be moved, it is necessary to readjust the fitting of the inner operating cable to the operating lever on the gearbox. Procedure as in previous section. With reverse gear engaged, check also that there is clearance between the operating lever on the steering column control rod and the projecting portion of the change speed bracket. If there is not sufficient working clearance, adjustment is effected by lengthening the rod centres between the operating lever and the bell-crank lever on the chassis.

In the neutral position, however, the gear change lever under the steering wheel should be on, or a little above, the horizontal.

(4) Next inspect the relationship between the selector lever on the change speed bracket and the control cable. With the gear change lever in third or top gear position, the screwed end of the inner cable, attached to the selector lever swivel pin, must not foul on the end of the outer casing attached to the change speed bracket. If fouling does occur, it can be eliminated either by moving the inner cable in the selector lever swivel pin or by moving the outer casing in the bracket, but in either case this must be followed by a corresponding adjustment of the inner or outer cable at the gearbox end.

(5) The adjustment at the gearbox end of the cable has already been described in the previous section.

(6) The actuating, or short control rod, should have its joints positioned so that the length of the assembly between ball centres is approximately $11\frac{1}{2}$" (292 mm.). Then, with the vertical lever of the relay assembly on the chassis connected by means of this control rod to the change speed lever on the gearbox and the whole assembly moved rearwards to the full extent, there should be a working clearance between the vertical lever and the clutch stop bracket. If there is not one, lengthen the rod to obtain it.

(7) The ball joint on the relay or long control rod should be screwed on to the rod until pressure of the spring loaded cup is felt. Lock the joint in position and couple the ball pin to the operating lever of the control rod on the column. The length of the rod should now be adjusted by varying the position of the fork on the lower end, until the assembly can be connected to the horizontal arm of the relay lever on the chassis frame, with the change speed lever on the gearbox in reverse, the hand change speed lever on the column also in reverse.

(8) Check that it is possible to obtain all gears.

TO DISMANTLE THE GEARBOX.

(1) Remove the gearbox from the car. *See page C9 or C17.*

(2) Drain the box first drawing out the dipstick and removing the reverse light switch.

(3) Secure the box in a vice. The most convenient way is to screw a threaded ($\frac{7}{8}$" B.S.P.) hexagon bar into the drain hole and grip the bar securely in a vice.

Note. Secure from loss, parts as they are dismantled and keep them as clean as possible throughout the period during which they are handled and so ensure a satisfactory repair.

(4) Remove the nuts and washers securing the top cover and detach the cover. Note the paper joint has a front and rear portion.

(5) Unscrew the plug at the forward end of the gearbox extension housing. (Note it has a left-hand thread). Remove the plug and then speedometer pinion.

(6) Remove the eight nuts and washers securing the rear end extension housing to the box and draw off the housing towards the rear.

Note. The rear extension housing is machined across the top cover joint face when assembled to the gearbox. The housing and the box are then numbered, as a pair, on the flanges by the speedo pinion guide. It is imperative, therefore, that a housing must not be fitted to a gearbox without reference to their numbers which should not be confused with the serial number stamped on the top face of the flange of each gearbox adjoining the clutch housing. If a new housing is to be fitted, the joint surface for the top cover must be faced level with the aid of a surface plate following the removal of the cover studs and locating dowels. The facing operation should be carried out with the box in a stripped condition, but if, for economy reasons, this is not practicable, precautions must be taken to ensure that the swarf does not enter the box when facing.

(7) Remove the self-locking nut and plain washer securing the reverse fork and detach the fork.

(8) Bend back the tabs locking the large nuts securing the speedo drive gear, remove the first nut, the lock washer and the second nut.

Note the method used for securing the nuts with the lock washer.
Draw off the speedo drive gear.

(9) Bend back the tab locking the large nut on the constant mesh pinion shaft, remove the left-hand threaded nut and lock washer. Then, with a brass drift, of suitable dimension, and a hammer, drive out the front ball bearing from the inside of the box and towards the front. Keep the forward end of the pinion shaft well supported in an upwards direction as the bearing is being driven out. Note the spring ring on the bearing.

(10) Keep the constant mesh shaft still well supported at its forward end, and drive the mainshaft rear ball bearing towards the rear with a brass drift and hammer until the bearing is free of the gear case. Draw off the bearing from the shaft, which should now be tilted downwards at its rear end to allow the constant mesh shaft to be lifted over the layshaft gear and drawn out with the floating spigot bush. The mainshaft can now be lifted out through the top opening.

(11) Drive out the reverse and layshaft retaining pin and then the layshaft towards the rear. The layshaft gear assembly can now be lifted upwards out of the box through the top opening. Note the thrust washers ; at the front, a large diameter bronze one located in the case by a peg and a recessed splined steel washer—recess towards the gear—on the layshaft gear assembly ; at the rear end, a small diameter steel washer located by a peg and a floating bronze washer similar in size to the steel washer. Detach these washers.

(12) Remove the split pins and slotted nuts securing the reverse selector fork retainer plate in the case, and detach the plate and fork.

(13) With the aid of a brass drift, of suitable dimensions, and a hammer, tap out towards the rear the reverse gear complete with bush and retainer plate. The reverse shaft can now be drawn out, if necessary, towards the rear.

TO DISMANTLE AND ASSEMBLE THE LAYSHAFT ASSEMBLY.

Disengage the circlip from the shaft of the first gear and press out the shaft through the constant mesh gear, the splined distance piece and the third and second gears.

Assembly is the reverse to dismantling but the following precautions must be observed.

(1) To ensure that the gears run perfectly true see that their butting faces are clean and free from burrs. The latter, when present, may be removed by means of a smooth carborundum stone.

(2) Thread on second and third gears with the narrower of the two bosses on each gear, towards the first gear ; the splined distance piece with the oil holes near the third gear and on a spline which will allow the holes to register with those in the shaft. Lastly, the fourth constant mesh gear with its deep boss against the distance piece. Secure the gears in position by means of the circlip.

TO DISMANTLE THE MAINSHAFT ASSEMBLY.

(1) Draw off the 3rd and 4th speed synchro sleeve assembly, and remove the circlip from its groove in the mainshaft.

(2) Draw out the key fitted in the deepened root of a spline in the mainshaft—a hole is drilled in the key to help do this—insert a $\frac{1}{16}$" (1.5 mm.) diameter rod through one of the oil holes in the 3rd speed gear dog to register with the groove machined in the thrust washer, rotate the gear and washer through the distance of a spline, withdraw the rod and then the washer. Next draw off, progressively, the 3rd gear, the brass splined bush, the second thrust washer, the 2nd speed gear, the second splined bush and the third thrust washer. Apart from the groove in the first thrust washer, all three washers are alike. The splined bronze bushes are similar except that the 3rd speed gear bush is recessed at one end to take the key for the thrust washer.

(3) Draw off the 2nd speed synchro sleeve assembly complete with 1st speed gear and lastly the 1st gear stop.

TO REASSEMBLE THE MAINSHAFT.

This service is carried out by reversing the order of the operations given on *page* C14, but the following point should be observed.

The bronze splined bush on which the 3rd speed mainshaft gear revolves must be fitted with the recess end towards the constant mesh shaft or towards the front of the box. The recess takes the locking key.

The thrust washer with the groove in its face is the last one to be assembled.

TO DISMANTLE AND REASSEMBLE THE REAR END EXTENSION HOUSING.

(1) Immerse rear end cover in a container of boiling water to obtain a degree of expansion which will permit the flange, complete with oil seal, rollers and bearing race, being pressed out readily towards the rear. Use a suitable mandril for this operation and avoid damaging the end of the driving flange shank.

(2) Remove the circlip from the groove on the driving flange shank when the race, rollers and oil seal can be detached.

To Reassemble.

(1) Immerse the rear end of the housing in boiling water for a minute or two and insert the outer race of the bearing into the bore of the housing until it rests against the abutment face.

(2) Smear the bore of the race liberally with heavy grease and embed in the grease 43 needle rollers. Then press into position the oil seal with the sealing tip towards the bearing, using a mandrel of outside diameter 2.248" to 2.247" (57.099 mm. to 57.073 mm.).

(3) Examine and, if necessary, remove any sharp burrs or edges on the shank and the driving flange and insert the shank carefully through the seal and the bore formed by the rollers. Secure the flange in position by inserting the circlip. This clip can be placed in position quite readily by using a tool which can be purchased from our Service Department at Coventry.

TO DISMANTLE AND REASSEMBLE THE TOP COVER.

(1) Hold the cover securely, but not too tightly, in a vice fitted with lead clamps by the boss through which the actuating lever passes.

(2) Turn the reverse, and 3rd and 4th speed selector spindles outwards, *i.e.*, away from the centre of 1st and 2nd speed spindle. Move the change speed lever across either to the right or left, just sufficiently to permit the actuating lever to disengage the slot in the 1st and 2nd speed spindle, and then backwards to the full extent. The locking plate assembly can now be lifted off the actuating lever.

(3) Cut the wire locking the bolt securing the striker fork on the 3rd and 4th speed spindle. Remove the bolt and tap off the fork. Disengage the circlip and draw out the spindle from the housings or guides. Deal similarly with the 1st and 2nd and reverse spindles, and remove the selector plungers and springs from the vertical holes in the housings or guides.

(4) Remove the grub screw, selector spring and ball for the actuating lever shaft, and the self-locking nut on the end of the shaft opposite to that on which the change speed lever is fitted. The shaft can now be tapped out of the actuating lever and its spacing collar.

(5) Remove the self-locking nut and washer from the gear selection fork assembly and detach the assembly from the cover.

(6) The selector spindle housings or guides are reamed after assembly to the cover, and should not be disturbed unnecessarily. If replacements are needed they must, after fitment, be reamed in line to ensure free and correct working of the spindles.

Reassembling is the reverse of dismantling with the following additions.

(1) The gear selection fork assembly must move freely without undue play when the nut is securely tightened.

(2) The actuating lever when fitted to the shaft must be in line with the selector ball slot machined in the shaft. When fitting a shaft to a left-hand drive gearbox the shaft is inserted from the side of the cover opposite to that carrying the cable abutment bracket.

(3) Secure the selector ball grub screw by punching a portion of the cover into the slot.

(4) The set bolts securing the selector forks have tapered ends and consequently do not tighten down to their heads. Make sure they are tightened securely, but avoid using undue force.

TO DISMANTLE AND REASSEMBLE CLUTCH HOUSING.

Remove the two set bolts and shakeproof washers securing the withdrawal lever fulcrum bracket to the housing and detach the bracket complete with the lever. The lever can now be removed from the bracket by detaching the fulcrum pin ; and the carbon thrust by releasing the two spring clips securing it to the forks of the lever.

Assembly is the reverse of dismantling. If for any reason the fulcrum bracket is removed, ensure that it is returned to its correct position, *i.e.*, with the fulcrum pin hole fitted nearest to the centre of the clutch housing.

TO DISMANTLE AND REASSEMBLE THE 3rd AND 4th SYNCHRO SLEEVE ASSEMBLY.

Cover the assembly with a piece of clean rag to secure the balls and springs as the dog leaves the sleeve. Hold the assembly in the left hand and tap out the sleeve with a wooden mallet.

To reassemble choose a set of splines in which the dog slides freely over the sleeve, assemble the springs and balls to the sleeves, compress by means of a slip ring, engage the dog with the selected spline on the sleeve and push the dog over the sleeve until the balls engage the central annular groove machined in the bore of the dog.

TO DISMANTLE AND REASSEMBLE THE 2nd SPEED SYNCHRO SLEEVE ASSEMBLY.

Cover the assembly with a piece of clean rag to secure the balls and springs as the dog leaves the sleeve. Hold the assembly in the left hand and tap out the sleeve with a wooden mallet.

It will be noted on this assembly that there is an additional $\frac{5}{16}$" ball (making 7 in all). With this ball is fitted a spherical ended plunger. The purpose of these two items being to lock the synchro sleeve to a groove in the mainshaft when engaged in bottom gear.

The reassembly of the synchromesh sleeve is slightly different from the method given for the 3rd and 4th sleeve and dog. The following additional point must be observed.

IMPORTANT. Line up the hole in the sleeve for the plunger with the internal tooth on the 1st speed gear that is partially removed. The hole in the sleeve for the plunger is drilled right through and the counterbore for the ball is eccentric.

TO REASSEMBLE THE GEARBOX.

(1) Before reassembling the box examine each part carefully to ensure that it is clean and serviceable. Wash out the gearbox case and make sure that any sediment, which may have collected in the bottom, is removed. Then proceed as follows lubricating each part as it is fitted.

(2) Place the reverse shaft in position with its locking pin hole at about 60 degrees from the vertical, and drive the shaft partially home. Slide on the reverse gear and the reverse gear retaining plate.

(3) Check that the reverse selector fork slides freely on the studs of the retainer plate, and that the shoulders of the studs stand proud of the body of the fork. Fit the fork of the selector into the annular groove in the reverse gear and bolt the retainer plate into position. Tighten the nuts securely, check that the selector slides freely and cotter the nuts. Tap the reverse gear retainer plate into its recess in the case.

(4) Place into position the large pegged front bronze thrust washer for the layshaft, paying attention to ensure that the peg engages with the hole in the case—insert a dummy layshaft to locate the bore of washer with that in the case.

Insert the layshaft from the rear end of the box, thread on first the rear small pegged steel thrust washer with the peg engaging with the slot in the case, and then the bronze thrust washer.

Fit the bronze bearings into the layshaft assembly, one at each end, place the steel thrust washer on the 1st gear shaft at the constant mesh gear end, with the recess towards the gear, insert the assembly into the box and drive home the layshaft. While doing so, line the locking pin hole in the shaft with that in the reverse shaft which should now be driven home. Check that there is a minimum end float of .005" (.127 mm.) in the layshaft assembly. If not present adjust by carefully reducing the thickness of the small bronze thrust washer. Lock the two shafts by inserting the locking pin.

(5) Insert the mainshaft assembly, rear end first, into the box through the top cover and rear main bearing aperture. Place the constant mesh bush into the central bore of the constant mesh pinion, and fit the shaft into position in the bore and on to the mainshaft spigot. Thread the ball bearings complete with spring rings on to the constant mesh and mainshaft, and tap home the bearings making sure that the spring rings locate correctly in their recesses. Secure the front bearings to the constant mesh shaft with its lock washer and left-hand threaded nut. Fit the speedometer drive gear on to the rear end of the mainshaft, together with its locknuts and lockwashers, tighten securely and lock by bending a portion of the lock washer over a flat of each nut.

(6) Fit the reverse lever assembly so that it engages with the slot in the reverse fork, and bolt into position by means of a plain washer and self-locking nut. Check that the lever moves freely without undue play on the spindle and that it moves also the reverse gear easily.

(7) Smear the joint face of the rear extension housing with jointing compound, fit a paper joint and thread the housing into position on the rear end of the mainshaft. Secure in position with eight plain washers and nuts. Check that the driving flange slides freely on the shaft. Insert speedo pinion and retain with left-hand thread plug.

(8) Screw into position the reversing light switch with one copper asbestos washer and two manilla washers between it and the gearbox case. Check that the

reversing light plunger is operated when the reverse lever is moved. The plunger can be observed through the central hole of the switch.

(9) Smear the top joint face of the rear extension housing with jointing compound, place the two portions of the paper joint in position, locate the 3rd and 4th speed sleeve assembly, the 2nd speed sleeve assembly in neutral, and place into position the top cover assembly, making sure the selector forks for all speeds are in correct engagement. Place the washer and the nut on the gear selection lever on the stud before allowing the cover to fit right home. Tighten all remaining nuts evenly and progressively.

(10) Check that all gears can be engaged correctly and reassemble box to the car as stated on *page C9*.

GEARBOX WITH CENTRAL CHANGE SPEED LEVER.

This is supplied as an optional fitment, and is adaptable to the standard gearbox, all the changes are incorporated in the gearbox lid.

Therefore the preceding instructions are applicable except those under the following headings.

To remove and replace the gearbox with the engine in the chassis.

To connect up the change speed lever controls.

To check that the change speed lever is correctly assembled.

To dismantle and reassemble the top cover.

The following instructions replace the above and apply to the central change speed only.

TO REMOVE AND REPLACE THE GEARBOX WITH THE ENGINE IN THE CHASSIS.

(1) Remove the carpets which are held by spring fasteners.

(2) Remove the front seat cushion.

(3) Remove the two set bolts which secure the forward ends of the seat runners, raise the forward edge of the seat sufficiently to disengage the trunnion of the adjuster from its support bracket, and push the seat back as far as it will go.

NOTE. On later models the cushion is not removable, but sufficient clearance is obtained by pushing the seat back to its furthest position.

(4) Remove change speed lever knob, extension and lock nut. Then remove the metal cowling over the gearbox and floorboards. The securing pins have captive nuts.

IMPORTANT. Do not try to remove the rubber grommet from the metal cowling, it has been solutioned in position.

(5) Detach the clutch pull-off spring from the crankcase and disconnect the clutch control rod by removing the clevis pin from the clutch pedal joint.

(6) Disconnect the speedometer drive at the gearbox end.

(7) Disconnect the earth wire from the gearbox.

(8) Remove the two bolts securing the gearbox rear support bracket to the flexible mounting on the chassis frame.

(9) Disconnect the propeller shaft from the gearbox driving flange. There are four tab washers, bolts and nuts.

(10) Draw out the gearbox rear driving flange to the full extent and remove the bolts from the flange. Push back the flange to its full extent.

(11) Remove the two bottom nuts of the six securing the gearbox to the clutch housing.

(12) Place a jack under the rear of the engine sump, and to help disperse the load, place between the jack and sump a block of wood shaped to cradle the sump.

(13) Open the bonnet and remove the two nuts and shakeproof washers securing the engine torque reaction bracket to the crankcase on the offside and adjacent to the flywheel. Disconnect the choke and throttle controls.

(14) Place a piece of thin plywood between the fan blades and the radiator to prevent the blades damaging the radiator as the engine is pushed forward when the gearbox is being removed.

(15) Raise the engine by means of the jack, and at the same time lever the gearbox forward to allow the driving flange to clear the floor of the body. Continue to raise the engine until access can be obtained to the reverse light terminals on the box and the four remaining nuts securing the gearbox to the housing. The gearbox can now be drawn rearwards into the car out of position.

TO DISMANTLE AND REASSEMBLE THE TOP COVER.

(1) Hold the cover securely, but not too tightly, in a vice fitted with lead clamps by the boss through which the actuating lever passes.

(2) Turn the reverse, and 3rd and 4th speed selector spindles outwards, *i.e.*, away from the centre of 1st and 2nd speed spindle. Move the change speed lever across either to the right or left, just sufficiently to permit the actuating lever to disengage the slot in the 1st and 2nd speed spindle, and then backwards to the full extent. The locking plate assembly can now be lifted off the actuating lever.

(3) Cut the wire locking the bolt securing the striker fork on the 3rd and 4th speed spindle. Remove the bolt and tap off the fork. Disengage the circlip and draw out the spindle from the housings or guides. Deal similarly with the 1st and 2nd and reverse spindles, and remove the selector plungers and springs from the vertical holes in the housings or guides.

(4) Remove cover assembly from vice, turn over and hold securely again in vice by the longitudinal sides of the casting, the change speed actuating mechanism can now be removed as follows :—

(5) Remove circlip from pin passing through extension of actuating shaft on right-hand side (right-hand drive) or left-hand side (left-hand drive) of cover, then remove pin.

(6) Remove two self-locking nuts from the change speed lever body, the plate with the two pins welded in can then be removed (note the two rubber anti-rattle bushes).

(7) Remove the self-locking nut and large washer from the end of the actuating shaft (note on left-hand drive a small washer is fitted). Then remove the two grub screws (one underneath) from the top cover adjacent to the change speed lever. The actuating shaft with the bronze trunnion can then be tapped out of the cover leaving the actuating lever and spacing sleeve behind.

(8) To remove the reverse spring remove grub screw from the underside of the cover sleeve, spring and retainers can then be tapped out.

(9) Reassembly is a reversal of the above but it is important that the chamfer on the bore of the actuating lever is next to the spring ring located on the actuating shaft.

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℄ OF CAR

FOR SETTING TOE-IN, REMOVE LOCK STOPS. LOCK STEERING CENTRE LEVER WITH CLAMP 24082N AND ADJUST TRACK RODS TO GIVE ⅛" TOE-IN, EQUAL ON EACH WHEEL.

⅛" MINIMUM CLEARANCE

SECTION SHOWING DETAILS OF TOP ARM PIVOT

INNER PIVOT BEARINGS TO BE TIGHTENED WITH ALL FOUR WHEELS ON THE GROUND AND THE WEIGHT OF THE CAR ON THEM. THIS ENSURES EQUAL TORSIONAL MOVEMENT OF RUBBER BEARINGS.

POINT 'X'

3/32" MIN CLEARANCE HERE TO PREVENT ANY METALLIC CONTACT BETWEEN ARM AND BRACKET.

TIGHTEN THIS NUT UNTIL WASHER AND INNER SHELL OF BEARINGS ARE GRIPPED TIGHTLY UP TO SHOULDER ON SPINDLE.

Note: DO NOT TIGHTEN LEVER PINCH BOLT UNTIL BEARING HAS BEEN GRIPPED.

REBOUND STOP RUBBER FITTED TO EXPORT MODELS ONLY

RETURN SHOCK ABSORBERS WITH AXIS OF BOTTOM PIN PARALLEL TO AXIS OF WISHBONES.

SHIM HERE TO ALLOW FREE MOVEMENT OF TRUNNION BETWEEN TOP ARM BOSSES WITHOUT END PLAY.

VIEW SHOWING BOTTOM ARM TO STABILISER CONNECTIONS

LENGTH OF SPRING - CAR LADEN 9" L.H. SIDE, 9¼" R.H. SIDE (ON EARLIER CARS 8¾" L.H. SIDE, 8¾" R.H. SIDE.)

SECTION SHOWING SHOCK ABSORBER BOTTOM FIXING

WHEN FITTED A MINIMUM OF .001" CLEARANCE BETWEEN HEAD OF PIN & FORK IS NECESSARY TO PREVENT PIN WHEN TIGHTENED FROM LOCKING UP THRUST WASHER.

SECTION 'A' - 'A'

VALANCE

GROUND TO TOP OF FRAME (CAR LIGHT) AT POINT 'X' - 17⅞" ± ¼"

2 1/16"

1° 38' LADEN ± 15'

SHIM HERE (IF NECESSARY) TO LINE UP SPLIT PIN HOLES WITHOUT OVER TIGHTENING

TIGHTEN NUT HARD THEN SLACKEN OFF HALF TURN.

HUNTER SALOON—INDEPENDENT FRONT SUSPENSION ARRANGEMENT

SECTION D

FRONT SUSPENSION

DESCRIPTION.

The front suspension is a fully independent coil and wishbone system, controlled by Girling Telescopic D.A.S. 4.7 Type Dampers and an Anti-Roll Bar. Moulded rubbers are used at all anchorage points to help damp out road noises and to reduce the number of lubrication points. Where lubrication is necessary, *i.e.*, at all swivel pins and trunnion bushes, rubber sealing glands are provided for retaining grease and excluding dirt and moisture.

The lower suspension arms have very wide supporting bases and the junctions of the arms are close up to the wheel swivel to ensure maximum rigidity. The front wheels run on taper roller bearings. Steering is effected by a Burman recirculating ball steering gear. The linkage is by Lockheed Thompson joints moved from a central lever mounted on needle roller bearings and controlled by a 17" two-spoked Steering Wheel.

All Steering connections are in protected positions.

Maintenance.

Apart from normal routine lubrications and an occasional check of the front wheel alignment, the condition of the dampers and that all bolts and nuts are tight, no special attention is necessary.

Lubrication.

This is dealt with fully in the Lubrication Section. *See page M4.*

TO CHECK AND ADJUST THE WHEEL CAMBER.

The Camber Angle is the angle at which the topmost point of each front wheel leans away from the vertical and from the centre line of the car.

The dimension of the angle is $1\frac{1}{2}°$ with four passengers in the car. The angle can be measured by any of the proprietary gauges now available.

Under normal circumstances no adjustment to the Camber Angle should be necessary. If, however, adjustment becomes necessary, the following instructions should be carried out :—

(1) Knock down the tabs locking the three nuts holding the suspension top arm bracket to the frame, also the tabs locking the two adjusting bolt nuts, and slacken all the nuts.

(2) To increase the Camber Angle, remove shims from position "A" (*see Fig. 1, page D2*) and place them in position "B". Note :—five shims equal one degree of adjustment.

(3) Securely tighten the five locknuts and re-check the camber. Note: The tab-washers are reversible and it is advisable to turn them over before finally tightening up.

Swivel Pin Inclination.

This is the angle at which the top of each swivel pin leans towards the centre line of the car and away from the vertical. The dimension is $4\frac{1}{2}°$ and is controlled by the adjustment of the camber.

Castor Angle.

This is the angle at which the top of each swivel pin leans to the rear of the car and away from the vertical. The dimension is $2\frac{3}{4}°$ and is not adjustable.

TO SET THE LEFT AND RIGHT LOCKS.

The locks of the front wheels are limited by the forward arm of the central steering lever abutting against adjustable stops screwed into lugs welded to the chassis front cross member.

To set, for instance, the lock of the right hand wheel, position the stop in the left hand lug so that the distance between the centre of the tread of the tyre and side face

of the chassis frame is 5 inches (127 mm.). Set the lock for the left hand wheel similarly and tighten the locknuts on the stops securely.

IMPORTANT.

Do this operation with both wheels off the ground and make absolutely sure the locks are restricted by the stops provided and not by the rocker shaft stopping against the inside of the steering box.

FRONT WHEEL "TOE-IN".

"Toe-in" is the amount by which the distance between two points on the centre lines of the tread of the front tyres when at wheel centre height and forward of the swivel axles is less than the distance between these same two points when rear of the axles and at wheel centre height.

To obtain the centre lines on the tyre whiten the tread, locate the middle and scribe a line through this point by revolving the wheel through a complete revolution.

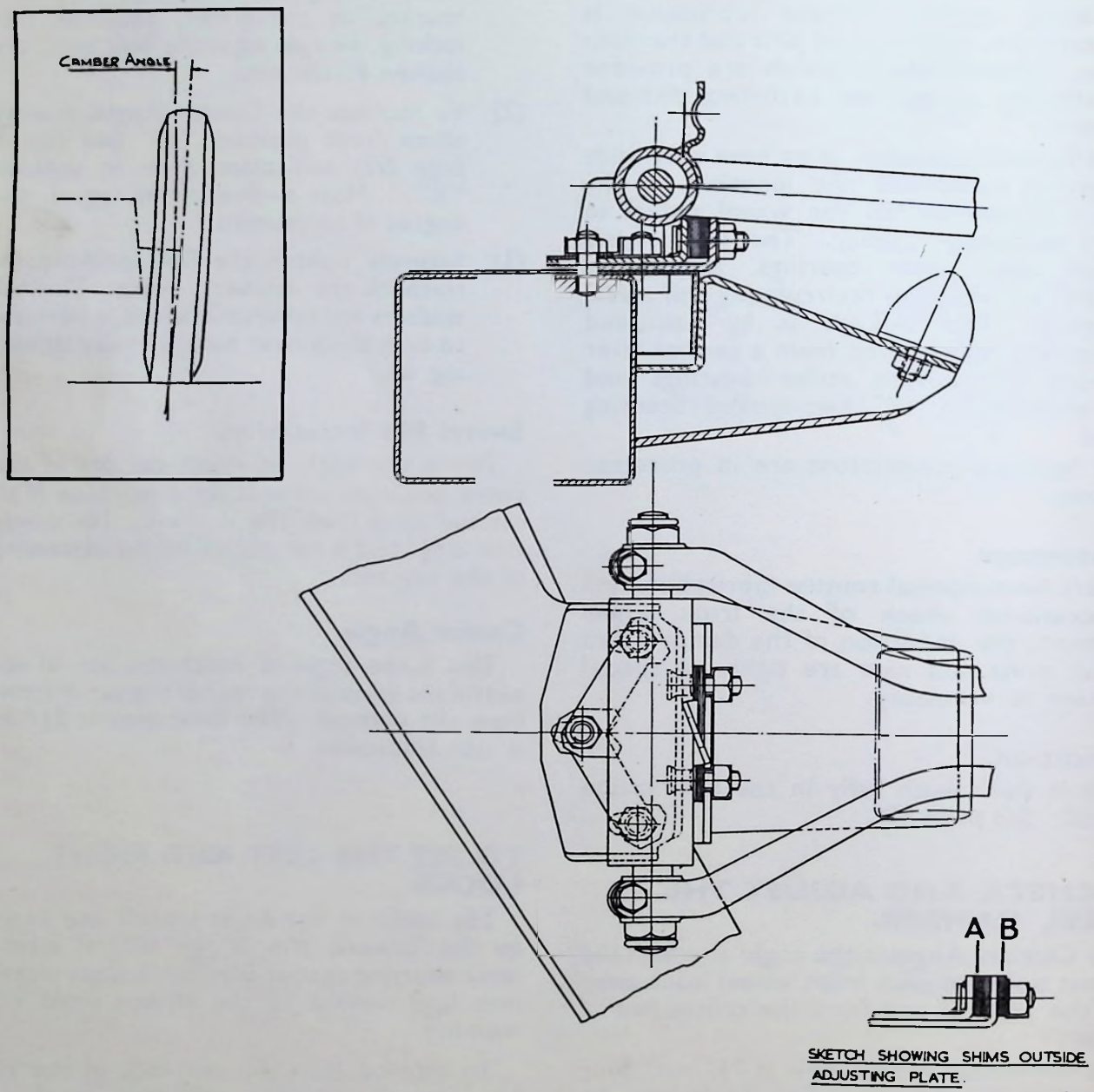


Fig. 1. Camber Adjustment.

TO SET THE FRONT WHEEL ALIGNMENT OR "TOE-IN".

Proceed as follows :—

(1) Check that the front tyres are inflated from 26 to 28 lbs. per square inch and set the front wheels in line with the rear wheels.

(2) Jack both wheels clear of the ground.

(3) Check that the Thompson Joints, or sockets at the ends of the track rods between the steering arms and the central steering lever are in good condition, *i.e.*, without undue free movement.

(4) Remove the lock stops and fit the central steering arm locating jig, Service Part No. 24082N, *see Fig. 2, page D3* Tighten adjuster "B" with bridge "A" over lever shank, this will centralise lever with centre line of car.

(5) Release the locknuts "C", Fig. 2, at each end of centre tube of the track rods. The inner and outer ends of the tie rods are machined with a right and left hand threads, so that by gripping and turning the centre tube either to the right or to the left, the length of the rods can be altered to give the correct setting to the wheels, *i.e.*, a total of $\frac{3}{16}$" (4.76 mm.) for both wheels or $\frac{3}{32}$" (2.38 mm.) for each wheel. **On completion of the adjustment do not neglect to re-tighten securely all locknuts released and before doing so to position the end faces of the track rod joints parallel with each other to avoid cross binding on locks.**
Finally, remove the centralising jig, replace the lock stops and set them as directed for setting the locks.

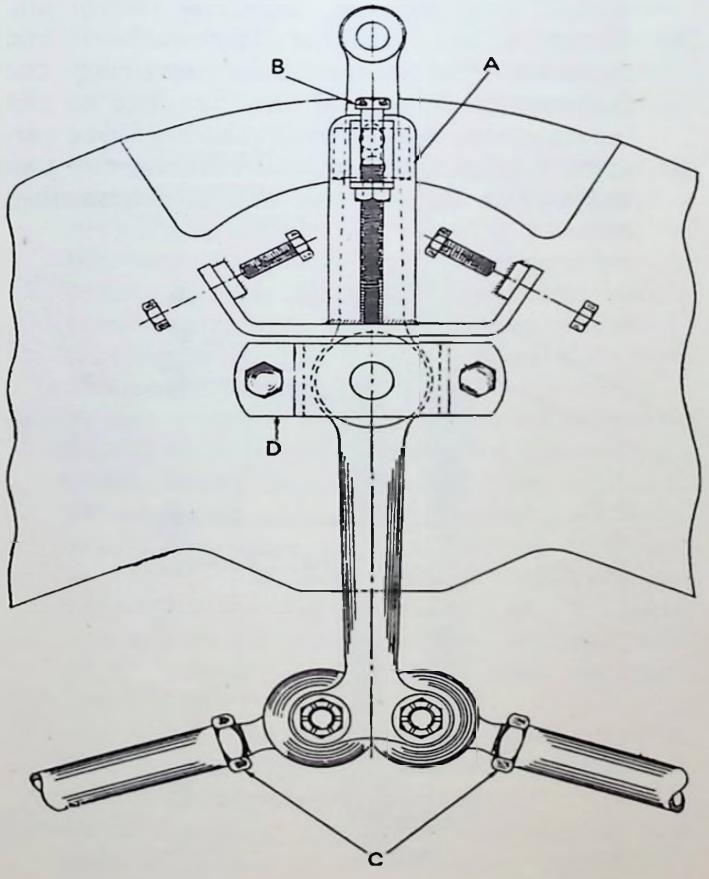


Fig. 2. Method of Using Steering Arm Locating Jig.

(6) It is important that both track rods are adjusted in equal amounts thus keeping them the same length ; also that the amount $\frac{3}{32}$" (2.38 mm.) by which each wheel "toes-in" is measured at wheel centre height and at the centres of the tyre treads.

Camber ... ... Laden 4 up $1\frac{1}{2}°$
King Pin inclination ... Laden 4 up $4\frac{1}{2}°$
Castor ... ... Laden 4 up $2\frac{3}{4}°$
Toe-in Car unladen, measured at wheel centre height and at centre of tyre tread ... $\frac{3}{16}$" (4.762 mm.)

Inner Wheel Max. Lock, L.H. and R.H. : $38\frac{1}{2}°$
Outer Wheel Max. Lock, L.H. and R.H. : 31°
Turning Circle ... ... 33 ft. (10 metres)

TO REMOVE AND REPLACE A FRONT HUB.

(1) Jack up the wheel concerned and remove the wheel.

(2) Remove the two countersunk headed screws securing the brake drum to the hub and prise off the drum by inserting two $\frac{7}{16}$" B.S.F. slave bolts in the threaded holes located between the wheelstuds.

(3) Draw out the split pin and remove the central securing nut, shims (if any) and the felt retainer washer complete with felt. The hub can now be detached complete with front taper roller bearing, rear taper roller bearing, rear felt retainer and felt. The distance washer, against which the felt bears, is keyed to the swivel axle by means of a snug.

(4) Press out the inner race of the rear bearing together with the retainer complete with felt. The outer races of both front and rear bearings can now be pressed out. **When handling and storing the bearings, it is most important that they are kept clean and maintained in this condition during the period of attention.**
Replacement is the reverse of dismantling with the following additions :—
Make sure :—

(1) That the hub is perfectly clean before pressing in the bearings and that the abutment shoulders are not bruised or in a condition which would prevent the outer races making firm and complete contact.

(2) That the hub is packed with the recommended grease—see Lubrication Section.

(3) That the new inner felt retainer is fitting snugly in its retainer plate and that the plate is home against its abutment shoulder in the hub.

(4) That the distance piece is in position and with the keyway engaging the peg in the axle.

(5) That the new outer retainer felt is fitting snugly in the retainer plate and against the hub.

(6) **Lastly, to obtain the correct adjustment for the bearing, tighten the securing nut to the full extent and then release half a turn to a position where the cotter can be inserted. A shim is provided (if necessary) to ensure correct locking of the securing nut.**
(*See Suspension Arrangement*).
If the adjustment has been made correctly the wheel should spin freely without end play. Check that this condition is present.

TO REMOVE AND REPLACE THE TOP SUSPENSION ARMS FOR REPLACEMENT OF BUSHES.

(1) Jack up the car by the forward frame Jack bracket until the shock absorber is extended to its full length and remove wheel.

(2) Detach the brake hose and pipe union junction from the chassis bracket of the suspension arm.

(3) Remove the split pin and nut securing the upper suspension arm trunnion to the swivel pin.

(4) Release the clamp bolts "E" securing the top arms to the main spindle and the nuts "A" (Fig. 3) on the ends of the spindle, then move the trunnion upwards out of engagement with the swivel pin.

(5) Bend down tabs of lockwashers and remove the three nuts securing the horizontal flange of the bracket to the chassis, also bend down tabs on front vertical face of bracket and remove the two nuts then detach the top arm assembly.

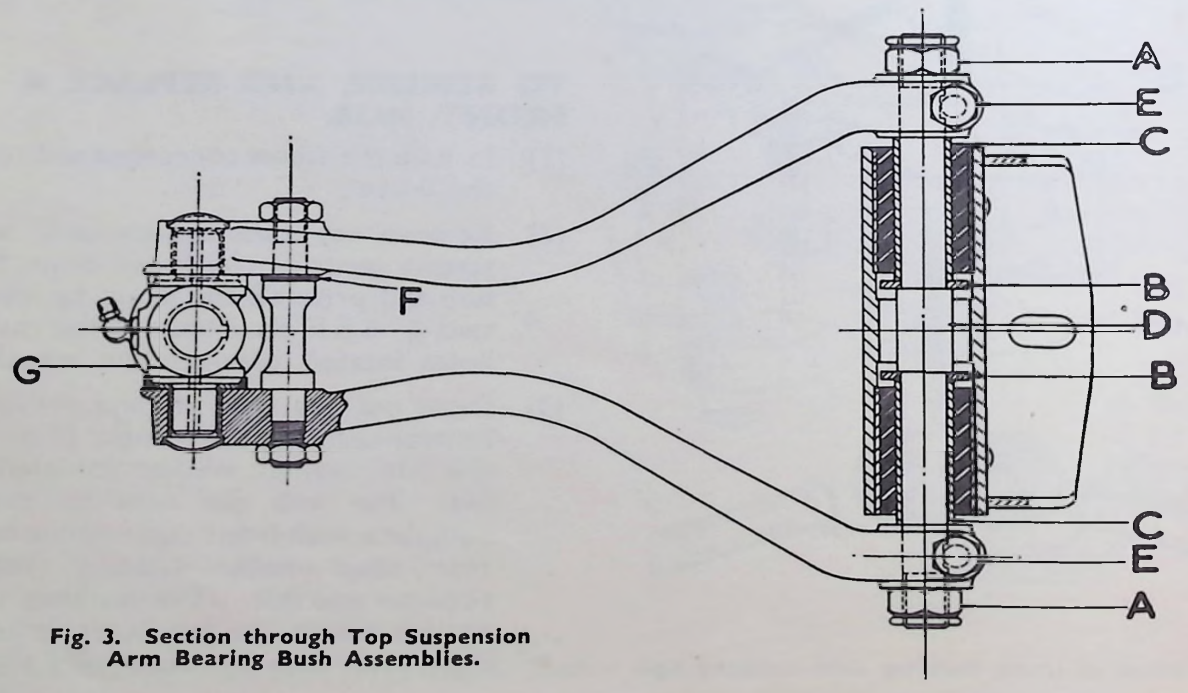


Fig. 3. Section through Top Suspension Arm Bearing Bush Assemblies.

Carefully note the position and number of shims located on the two horizontal studs (these may be half or whole). The purpose of these shims is to position the bracket on the chassis in a manner which will allow the trunnion marked "G" in Fig. 3, to slide freely over the swivel pin and in addition enable the camber to be reset.

(6) Secure the assembly in a vice. Remove the nuts on the main spindle and the two clamp bolts. Note the adjusting shims "F", on the small spindle, remove the nut on the opposite end of the spindle and draw off the arms. Detach the trunnion and preserve the thrust washers for further use.

(7) Press out the main spindle which will come away with one rubber bearing assembly and the two abutment washers. The second bush can now be pressed out in the reverse direction.

Replacement is the reverse of dismantling with the following additions :

(1) Should it be necessary to replace the trunnion bushes it is preferable to broach them in position rather than ream. A suitable broach can be purchased from the Service Department—price on application. Check that the oil holes register before broaching.

(2) When assembling the rubber bearing assemblies to the chassis bracket use a mandrel, which is slightly smaller in diameter than the bore of the bracket, to press in the bearings until the outer steel shells butt up against the shoulders machined in the bores. Use also new abutment washers, "B".

(3) When assembling the arms and trunnion fit the thrust washers so that the radii on their bores are towards the trunnion thrust faces and that the sealing washers, preferably new ones, are fitted as shown in Fig. 3. If new thrust washers are fitted add or subtract shims at "F" until the trunnion moves freely without end play when the nuts are securely tightened.

(4) Assemble the arms to the main spindle, but do not tighten the clamp bolts or end nuts at this juncture.

(5) With the nuts and bolts securing the top arm bracket to the chassis tightened, check that the trunnion will slide freely over the swivel pin. Should it not do so, release the nuts slightly and alter the position of the bracket by adding or subtracting part shims as for camber adjustment until the desired effect is obtained.

(6) Tighten and split pin the nut on the swivel pin in a position where the swivel axle is free to move from lock to lock without noticeable up and down movement.

(7) The nuts on the ends of the main spindle should not be tightened until after the wheels have been fitted, the jacks removed, and the weight of the car is on all four wheels. Lastly tighten the pinch bolts "E".

Do not neglect as a final operation to adjust and bleed all brakes and to re-check the camber.

TO REMOVE AND REPLACE THE BRAKE BACK PLATES AND BRAKE SHOES.

(1) Remove the wheel and front hub complete as previously described.

(2) Detach the hydraulic brake connection from the top arm bracket, and the four bolts securing the plate to the swivel axle and detach the plate.

Replacement is the reverse of dismantling : but do not neglect to tighten the four bolts and nuts securely (300 inch lbs.) or to adjust the brake shoes of all four wheels and bleed the braking system. When reassembling the brake hose make sure that it clears the wheel on full locks (L.H. and R.H.).

TO REMOVE AND REPLACE A SWIVEL AXLE AND PIN.

(1) Jack up the car under the lower front suspension arm and remove the wheel, hub, brake back plate and disconnect the track rod.

(2) Release the nuts on the ends of the main spindle of the upper suspension arm and also the clamp bolts.

(3) Remove the split pin and nut on the top of the swivel pin, raise the trunnion and arm assembly out of position and withdraw the swivel axle. **Note** the thrust washer on the top of the swivel and the sealing washers at the top and bottom.

(4) Remove the self-locking nut of the swivel pin pivot pin, tap out and detach the swivel pin.

Replacement is the reverse of Dismantling but the following precautions must be observed :—

(1) If new bushes are to be fitted it is preferable to broach these rather than ream. A suitable broach can be purchased from the Service Department, price on application.

(2) The correct positions for the various thrust washers and sealing rubbers are indicated on the suspension arrangement.

(3) Tighten the swivel pin nut so that the swivel is free to move sideways without undue up and down motion, then fit split pin.

(4) Do not neglect to adjust and bleed all brakes.

TO REMOVE AND REPLACE A FRONT SUSPENSION DAMPER.

(1) Place the pad of a Jack under the front suspension arm and lift the wheel off the ground. Make sure the Jack is well clear of the self-locking nut which retains the damper.

(2) Remove the wheel.

(3) Remove the securing nuts holding the top end of the damper to the anchor bracket and the top rubber and support washer.

(4) Remove the four $\frac{3}{8}$" nuts and shakeproof washers securing the anchor bracket to the spring bracket.

(5) Remove the self-locking nut securing the damper to the spring bottom plate and draw out the damper from within the spring complete with bottom securing bracket, pivot pin and securing bolt. **Note** the two plain washers beneath the under surface of the suspension arm.

(6) Remove self-locking nut, pivot pin and spacer tube from bottom bracket, brackets and cone rubbers can then be removed from damper.

Replacement is the reverse of Dismantling, but observe the following :—

Tighten the nut of the pivot pin until it is solid against the tube and so obtain the correct fitted length of the conical rubber bearings. Position the damper in the bottom bracket with the nut towards the rear of the car and the pivot pin parallel with the pins on which the suspension oscillates. *See Suspension Arrangement.* With the damper in this position one edge of the lower bracket should register against the strip welded to the top surface of the spring bottom bracket.

TO REMOVE AND REPLACE THE FRONT SUSPENSION SPRING.

(1) Jack up the car under the boss for the rubber buffer fitted to the front suspension arm and remove the wheel.

(2) Place a second jack under the chassis frame at a point some six inches to the rear of the pivot pin bush of the bottom arm strut and just take the weight of the car.

(3) Remove the Damper, top bracket and the two plain washers normally fitted in the space marked "A" in *Figure* 4.

(4) Place the spring compression clamp in position in the manner shown in the *Fig.* 4 and compress the spring to allow a clearance of one inch between the top ring and the chassis bracket.

(5) Remove the nuts securing the link assembly of the stabiliser bar to the bracket on the spring bottom plate for both right and left hand assemblies and turn the bar upwards out of the way of the spring.

(6) Lower the suspension arm by releasing the jack, and at the same time raise the spring assembly sufficiently to allow the head of the rear bolt of the compression clamp to clear the suspension arm, as the assembly is being withdrawn.

(7) When the spring and clamp assembly have been removed release the clamp and the top and bottom ring, when the plate can be detached from the spring.

Replacement is the reverse of Dismantling, but observe the following :—

(1) The spring must be compressed to approximately 7" (178 mm.) measured between the top and bottom coils, before attempting to insert the assembly.

(2) Do not neglect to replace the two plain washers between the under surface of the suspension arm and spring bottom plate bracket.

TO REMOVE AND REPLACE THE STRUT AND FRONT LOWER SUSPENSION ARM ASSEMBLIES AND TO RENEW THE RUBBER BUSH ASSEMBLIES OR PIVOT PIN BUSH.

(1) Jack up the car with the pad of the jack under the boss for the rubber buffer of the front suspension arm and remove the wheel.

(2) Place a second Jack under the chassis frame with the pad approximately six inches away from the strut rear bearing and take the weight of the car.

(3) Remove the front spring as previously described.

(4) Detach the track rod at the swivel axle lever end and remove the swivel pin and suspension arm pivot pin. The chassis should now be jacked up sufficiently to allow the swivel lower pin joint to clear the engaging member on the suspension arm.

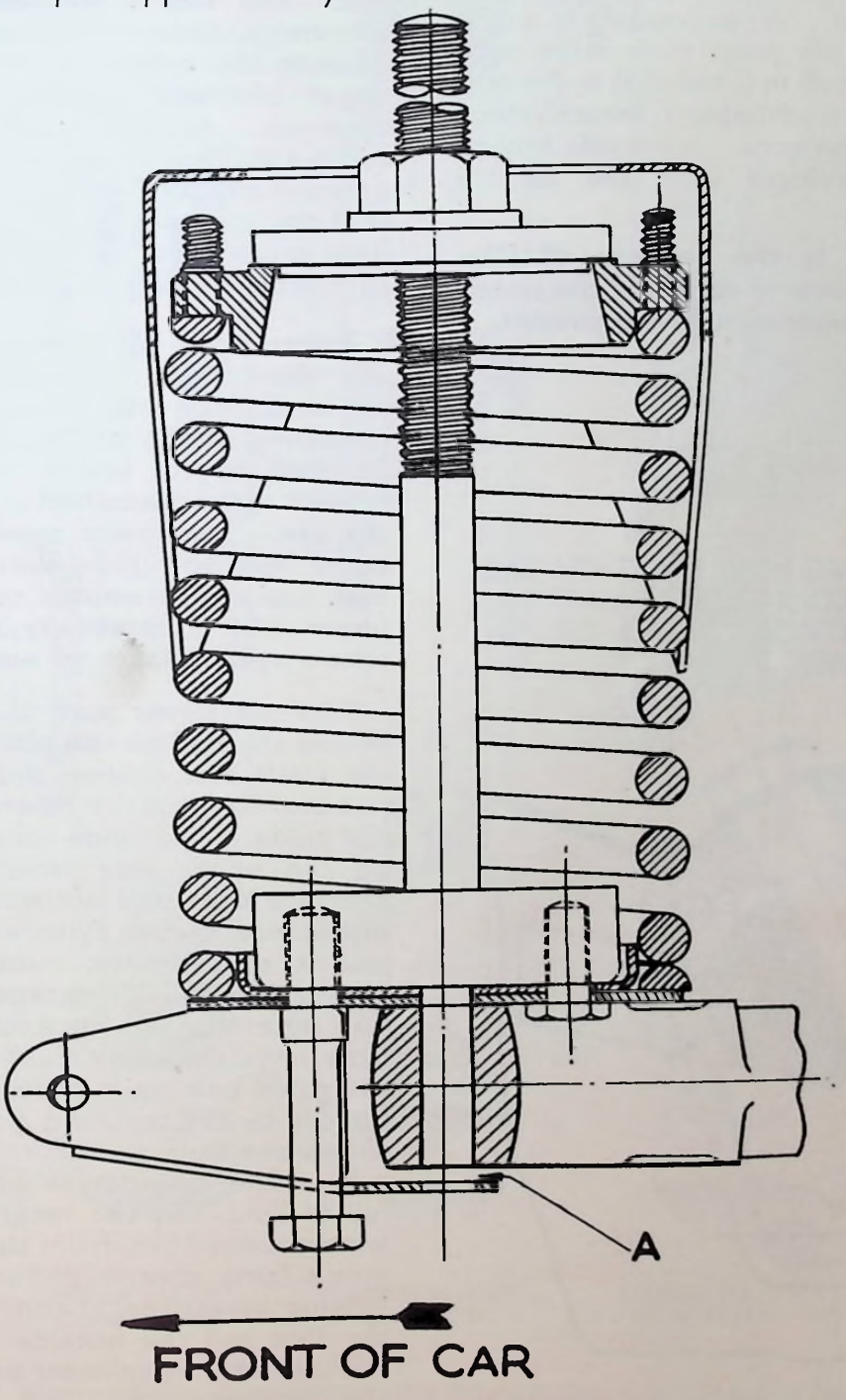
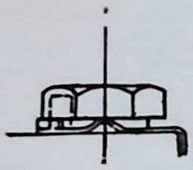


Fig. 4. Spring Compression Clamp.

(5) Bend back the tabs locking the pivot pins of both strut and suspension arm and withdraw the shouldered pin shown in Fig. 5. Detach the strut and arm.

(6) Press out the rubber bearings assemblies and press in the replacements to a position where the outer steel shells lie central in the bosses of the strut and arm. When carrying out the pressing operation use a mandrel slightly smaller in diameter than that of the bores in the strut and arm. When pressing in a new swivel axle pin pivot bush make sure that the oil hole in it and that in the arm register. It is advisable to broach rather than ream the bore. A suitable broach can be purchased from the Service Department.

Replacement is the reverse of Dismantling, but observe carefully the notes iven on the Suspension Arrangement.



VIEW SHOWING HOW PIVOT PIN TAB WASHER ACCOMMODATES VARYING DISTANCE BETWEEN HEAD OF PIN & CROSSMEMBER,

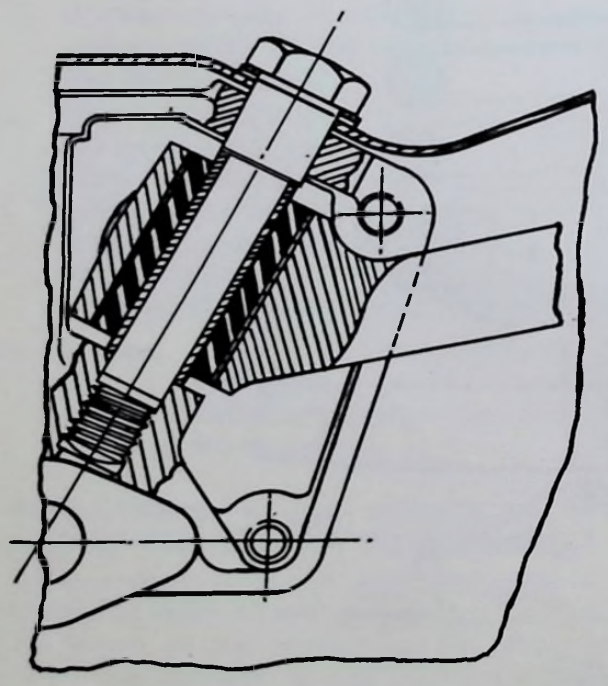


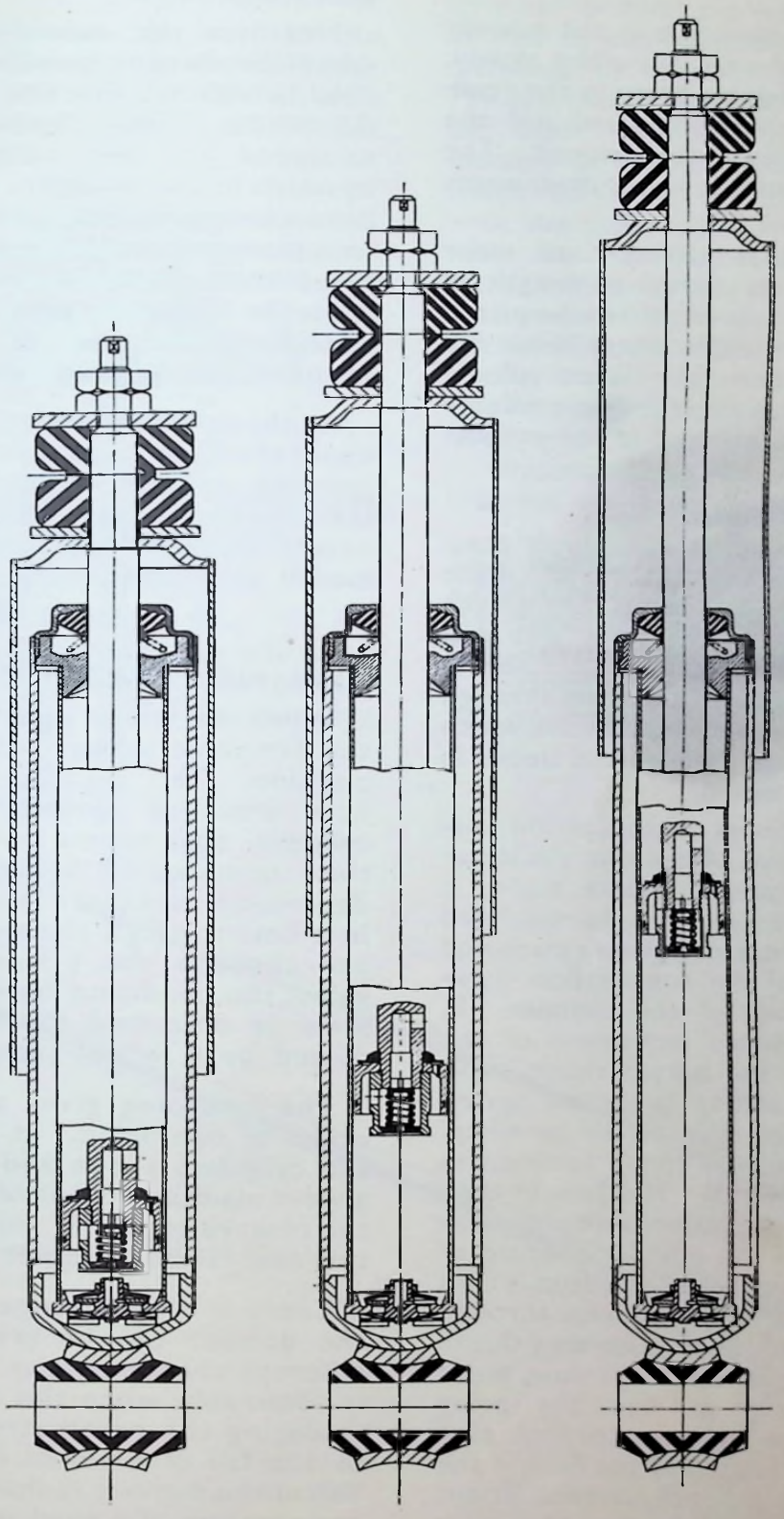
Fig. 5. Section through Lower Suspension Arm Pivot Pin.

DESCRIPTION OF FRONT DAMPER.

The body of the damper is telescopic, and forms a strut between the bottom arm assembly and the frame of the car. The unit consists broadly of a cylinder of small bore and long stroke, attached at its lower and closed end to an eye in which there are rubber bushes for the pin securing it to the axle assembly. Thrusting downwards into this cylinder is a piston carried on a long piston rod. This has a screwed stem at its top extremity, secured to the frame of the car. Outside the cylinder and attached to it is a larger diameter tube which forms a fluid reservoir. Attached to the top of the piston rod is a still larger diameter tube which forms a shroud and dirt excluder. It will be realised that the cylinder and tubes can be of quite light gauge steel, and the total weight of the complete damper kept down to a minimum.

Reference to the illustrations and diagrams will show that the constructional assembly can be divided into two parts, the upper one consisting of the piston rod with the piston attached to its lower end and the outer tubular shroud attached at the top, just below the eye. The lower assembly consists of an outer reservoir tube which terminates in a base cup and is welded to an eye, and at its upper end is internally screw threaded to take a special form of nut.

This nut forms part of an assembly which houses the seal on the piston rod, compresses the static seal rubber and locates the piston rod bearing—usually referred to as the piston rod guide. The guide has a projection formed on the under side which spigots into the pressure tube and accurately centralises the piston rod in the cylinder. The piston rod seal is of synthetic rubber and has multi wiping lips and all except one face inwards. The outer lip acts to exclude dirt, etc., and faces inwards. Any fluid which exudes past the guide bearing is prevented from escaping further by the seal, and a port below the seal allows the fluid to return into the reservoir tube. The cylinder is normally completely full of fluid, and the reservoir tube is full to within about $1\frac{1}{2}$ in. from the top. This should give a fairly concise picture of the two main moving parts, the piston rod with piston at the foot and the outside shroud attached at the top, and the cylinder proper carried inside the reservoir tube.



Diagrammatic Illustration showing the operation of D.A. Dampers on Compression and Extension.

OPERATION OF THE D.A. TYPE DAMPER.

Assume that the damper is in the midway position, and that the car, travelling slowly, passes over a considerable bump in the road. The road springs are compressed and the damper is compressed and shortened. The piston in effect, therefore, moves downwards in the cylinder.

At this point it is necessary to make entirely clear that for any given length of stroke the fluid displacement above the piston is always less than the displacement below the piston, for the reason that swept volume above the piston is less than the swept volume below it, by an amount equal to the volume filled by the piston rod.

Alternative Fluid Paths.

When the piston moves downwards pressure is applied to the fluid beneath it. If the movement is slow the fluid passes through the metering restriction in the valve disc and enters the upper part of the cylinder above. If the movement is fast the fluid passes through the spring controlled compression valve which is quite lightly loaded. The ported sleeve in the piston remains closed.

Downward movement of the piston displaces a greater volume of fluid than the lesser volume above the piston. Hence during a slow movement the excess can find a restricted way out to the reservoir via a groove machined in the valve disc of the compression valve assembly in the base of the cylinder. If, however, the downward movement of the piston is a fast one the slotted sleeve valve controlled by the strong laminated spring washer will be opened. When the car wheel is over the bump the road spring commences to return to zero position. The damper then is in the state where the piston is moving away from the bottom of the cylinder, instead of towards it. The fluid above the piston is thus put into compression. It can squeeze through the restriction provided by a calibrated slot in the bleed shim if the movement is slow, but if the movement is fast it will open the spring controlled disc valve and pass through that way. While this is happening the fluid in the cylinder below the piston will not be sufficient to fill the space. In this event the large diameter disc valve in the base of the cylinder opens against its comparatively light spring and allows fluid to return from the reservoir tube and fill the space.

DEALING WITH A ROAD DEPRESSION.

Next can be considered the operations when the damper is midway position and the road wheel of the car drops into a deep depression. The damper is then rapidly extended and the piston in effect moves upwards in the cylinder. The fluid above the piston is heavily compressed, and, in addition to escaping through the restriction slot in the bleed shim, will have sufficient pressure to open the spring controlled disc valve, against its relatively strong coil spring, and so pass into the base of the cylinder.

At the same the time fluid displaced from above the piston will not be sufficient to fill the growing volume below the piston. Hence the lower part will require more fluid, which enters through the large diameter lightly loaded disc valve in the base.

THE NEXT STAGE.

When the wheel leaves the road depression the damper is forced back towards its midway position. The piston, which may perhaps have travelled almost to the top of the cylinder, now moves inwards again. Fluid is then compressed below the piston and a depression is caused above it. This results in a flow through the slot in the bleed shim, and through the piston upper spring disc valve, the condition becoming practically the same as described for damper compression caused by a wheel passing over the bump.

The foregoing gives an illustration of the cycles of operation. It will be realised that the cylinder, above and below the piston is always maintained full of fluid, provided from the reserve tube. It will also be obvious that this new Girling damper is double acting.

There is a wide range of initial setting and the damper can be arranged to give many different characteristics. Maximum damping is obtainable when the damper is extending, as during the recoil stroke of a road spring, or the fall of a wheel below static position. When the damper is shortening, as during the compression of a road spring, or the rise of a wheel, damping up to a high percentage of the rebound setting is obtainable. Alternatively this compression damping can be very low if required.

Fluid Capacity for D.A.S. 4.7/131 Type Dampers.

Type of fluid which must be used in the Girling Piston Type Damper is the LUVAX-GIRLING PISTON TYPE DAMPER FLUID. THE CAPACITY OF THE UNIT IS .21 PINTS.

Maintenance.

No maintenance attention is required. Should the damping effect of any unit appear other than normal, the attention of Messrs. Girling Limited, Kings Road, Tyseley, Birmingham, or one of their official Agents, should be drawn to it and their observations obtained.

Export Cars.

A slightly higher setting is used for all cars supplied outside the United Kingdom.

STEERING GEAR ASSEMBLY.

This steering gear is of the high efficiency type and comprises a hardened and ground single start worm on the end of the steering column, this worm is supported at each end by a ball bearing, the inner race of which is formed by the column itself and the outer members by specially manufactured races. The top end of the column is supported by a felt bush. The steering worm carries a member in which is cut a helical groove, in which run a series of balls which make contact with the column and are carried through a tube fixed to the sliding member. The member also carries a conical abutment which is surrounded by similar conical faces on the Rockershaft, and a Bearing pin which carries a roller which runs in a slot in the cover plate. The Rockershaft runs in a bush in the steering housing and on its lower end are taper splines to which the Drop Arm is fixed by means of a lock nut and spring washer.

TO REMOVE AND REPLACE THE STEERING GEAR.

(1) Drain the cooling system.
(2) Remove the radiator bottom support channel and radiator side plate adjacent to steering.

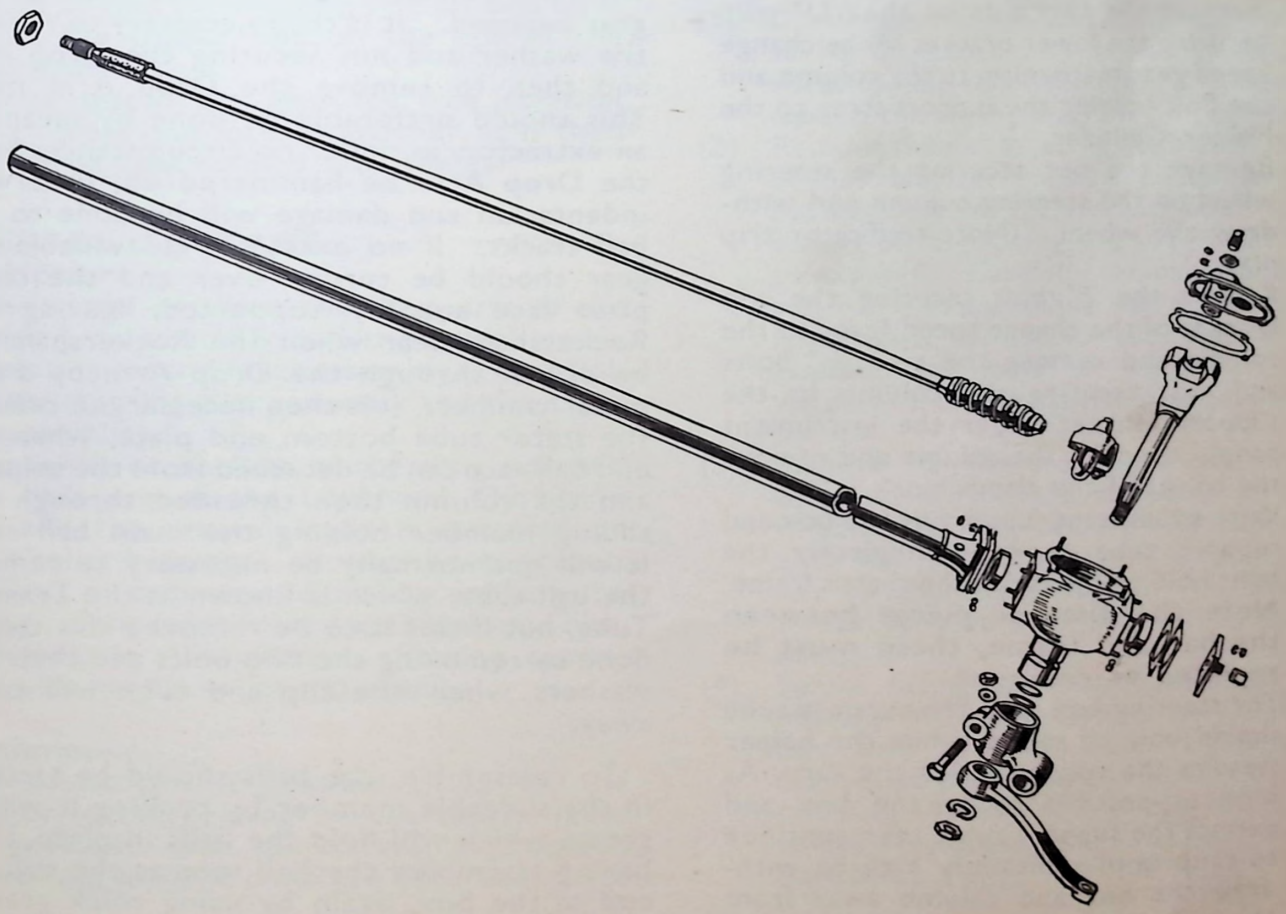


Fig. 7. Exploded View of Steering Gear Assembly.

(3) Disconnect the drag link from the steering box drop arm by removing the split pin and nut securing the ball pin of the joint to the drop arm.

(4) Bend back the tabs locking the heads of the bolts securing the steering box support tube to the chassis frame, one each side of the car ; access to these being obtained from beneath the front wings. (These tab washers have been replaced by spring washers on later models).

(5) Release the nut and bolt securing the trunnion support bracket to the steering box.

(6) Disconnect the horn and trafficator wires at their snap connector joints. Mark the wires to help reassembly. If in doubt about any connection consult the wiring diagram on *page L32*.

(7) Remove the nut securing the trafficator and horn switch stator tube to the bottom cover of the steering box. Carefully remove the brass olive, when reassembling use a new olive if damaged. The stator tube assembly can now be withdrawn into the car.

(8) Remove the two nuts on the "U" clip securing the lower bracket of the change speed gear mechanism to the column and the bolt holding the support strap to the Master Cylinder.

(9) Remove the nut securing the steering wheel to the steering column and withdraw the wheel. (Note trafficator trip plate).

(10) Release the $\frac{3}{8}$" bolt securing the top bracket of the change speed lever to the column and remove the two $\frac{5}{16}$" bolts and nuts securing the column to the support bracket under the instrument panel. Depress the column and remove the halves of the clamp block.

(11) With an assistant supporting the box and support tube remove completely the bolts holding the bar to the chassis frame. **Note the distance pieces between the bar and frame, these must be replaced as removed.**

(12) The steering box with the support tube should now be raised, while the helper steadies the column inside the car. As soon as possible rotate the box and extract the support tube, then continue to raise until sufficiently high to withdraw the box and column away from the car.

(13) Support the change speed lever and bracket conveniently and avoid altering the relative positions of the lever and bracket by preventing the latter from revolving.

Replacement is the reverse of the foregoing, but there are one or two points which must receive attention. Replace the steering wheel so that with the front wheels in a line ahead position the spokes of the steering wheel are horizontal, and that the Trafficator trip plate in the hub of the steering wheel is in correct setting in relation to the mechanism in the central Trafficator switch.

Check the change speed mechanism as directed on *pages C11 and C12*. Do not omit to fill the steering box with lubricant as directed in the lubricating chart, *page M9*.

To dismantle the gear it is necessary first to remove the cover plate by undoing the four nuts which hold it in place, when the cover plate will come away from the gear, together with the adjuster, leaving the inside of the gear exposed. It is then necessary to remove the washer and nut securing the Drop Arm and then to remove the Drop Arm itself. This should preferably be done by means of an extractor, as under no circumstances must the Drop Arm be hammered off, otherwise indentation and damage will be done to the ball tracks. If no extractor is available the gear should be turned over and the cover plate face suitably supported, leaving the Rockershaft clear when the Rockershaft can be driven through the Drop Arm by a soft metal hammer. It is then necessary to remove the stator tube bottom end plate, when the end ball race can be detached from the column, and the column then threaded through the sliding member holding the main ball race. It will not normally be necessary to remove the ball tube, which is known as the Transfer Tube, but if this is to be removed this can be done by removing the two bolts and their tab washers when the clip and tube will come away.

To reassemble, the balls should be secured in the slideable member by packing it with a grease which will hold the balls in place, then having assembled the ball race at the column end of the box, again by using thick grease, the column can be threaded through, the

outer column and its flange bolted into position and the end ball race assembled in position.

The packing shims should be so used that there is no end play on the column, but on the other hand this should not be preloaded otherwise indentation of the ball race will take place. The Rockershaft can then be inserted, making sure that it is a good fit in its Bush and that the oil seal at the drop arm end is in place. The roller can then be assembled and the cover plate refitted. Adjuster should be screwed down until it is just touching the Rockershaft when this is in the straight ahead position. It is important that it should be done in this position as the conical faces on the Rockershaft are so designed as to give slightly more backlash towards full lock as the majority of wear takes place in the straight ahead position. If the Rockershaft is adjusted without end play on full lock it will be tight in the straight ahead position. Having arrived at the correct adjustment in the straight ahead position, with no end float on the Rockershaft, the adjuster can be locked into position. The Drop Arm should be fitted so that the locating line scribed on it matches the similar line on the end of the Rockershaft.

Having tested the gear for free rotation through from one lock to another, it is then ready to be reassembled into the car.

STEERAGE LINKAGE.

Description.

The linkage between the drop arm of the steering gear assembly and the swivel levers, consists of a central lever assembly, a drag link from the steering gear assembly and two track rod assemblies.

The joints or sockets of the drag link and track rods are of the Lockheed Thompson type, and the central lever is mounted on needle roller bearings. Rubber boots protect the joints or sockets and sealing washers the bearings of the lever from water and road dirt, *See Suspension Arrangement*, showing central lever with needle roller mounting.

Maintenance.

No adjustment is possible either to the joints or to the bearings of the central lever and provided the lubrication instructions given on *pages M7, 8 and 9* are observed, there is no reason to believe that wear, other than normal, will occur. In addition to these routine lubrication attentions, the rubber boots of the joints and the sealing washers of the central lever should be examined occasionally and if in a perished condition replaced.

When setting the "toe-in" of the front wheel, particular attention should be paid to the following :—

(1) Both track rods must be maintained at the same length—the central tube is screwed with right and left hand threads to help make this and the "toe-in" adjustment readily.

(2) The end faces of the joints or sockets of each rod must be set parallel to each other before the locknuts are tightened.

(3) The locknuts must be tightened securely. It is advisable to hold the central tube with a pair of "Footprints" or pipe pliers when tightening the nuts.

TO REPLACE THE FELT BUSH AT THE TOP OF THE COLUMN OF THE STEERING ASSEMBLY.

(1) Disconnect the horn and trafficator wires at their snap connector joints. Mark the wires to help reconnecting. If in doubt consult the wiring diagram on *page L32*.

(2) Remove the nut securing the stator tube of the trafficator and horn switch to the bottom cover of the steering box. The sealing olive gripping the tube will now be exposed. Carefully remove the olive and when reassembling use a new olive if damaged. The stator tube and switch assembly can now be withdrawn upwards out of the steering column into the car.

(3) Remove the nut securing the steering wheel to the column and draw off the wheel. The felt bearing will now be observed in the top of the column and can be extracted with an instrument similar to a button hook with a sharp point.

(4) Before fitting the new bush smear it liberally with some form of heavy lubricant such as tallow, and replace the dismantled parts in the reverse order of removal. When fitting the steering wheel, position it, so that its spokes are horizontal.

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SECTION E

REAR AXLE

DESCRIPTION.

The rear axle is of the semi-floating type and receives its motion direct from the gearbox through a single 3″ (76.2 mm.) diameter propeller shaft with Hardy Spicer Universal Joints at each end.

The final drive is through a hypoid spiral bevel pinion and crown wheel. The shaft of the pinion and crown wheel assembly, with offset bevel differential gear, is supported by taper roller bearings. The meshing of the crown wheel and pinion is by shims. The adjustment of the pinion and differential bearing is also by shims.

The hub bearings are Timken tapered rollers and housed in registers machined in the ends of the axle banjo. The adjustment of these bearings is by shims fitted between the brake back plates and the bearing retainer plates. The thrust from one axle shaft to the other is transmitted by a hardened steel button through which passes the differential cross pin.

The hubs are secured to the axle shafts by keyed tapers and castellated nuts with split pins. Each 9″ (228.6 mm.) brake drum is held to the hub by two countersunk headed screws, and each road wheel by four studs and nuts. The nuts for both right and left hubs are threaded right hand, and are enclosed in the wheel centres by press type covers.

Each wheel has two brake shoes operated by the brake pedal and a single hydraulic cylinder.

The hand brake lever operates these same shoes through a mechanical system of cables and levers. Two types of axle are fitted, known as *No. 1 Type* and *No. 2 Type*, illustrations of which are shown on *page E2*.

Maintenance.

Maintenance as far as lubrication is concerned, is dealt with fully in *Section M on Lubrication*, and the care and adjustment of the brakes in *Section H*. The only other attention necessary is a periodical check on the tightness of the nuts securing the differential unit, and the road springs to the axle.

TO REMOVE AND REPLACE THE REAR AXLE.

No. 1 and No. 2 Types.

(1) Disconnect the propeller shaft, at the rear end, from the flange on the pinion shaft. Move it to one side and sling it conveniently to some portion of the chassis. Mark the flanges so that they can be re-assembled in their original position.

(2) Jack up the car under the chassis frame at points just forward of the front end of each rear spring and until the rear wheels are clear of the ground. Place blocks under the chassis in convenient positions, to support it securely when the jacks are removed, and remove the road wheels.

(3) Detach the hand brake rod from the balance lever on axle banjo by removing the clevis pin.

(4) Disconnect the foot brake pipe from its union on the banjo and support the brake pedal to prevent its being depressed inadvertently. Any such action will involve considerable loss of brake fluid.

(5) Uncouple the shock absorber arms from the axle banjo and remove the eight self-locking nuts from the "U" clips securing the axle to the rear springs. On the No. 2 type axle note the wrapper between spring clips and axle tube. Drive out the clips and the axle can then be withdrawn from the chassis as follows :—

(6) Lift up the axle at both ends and pass one end through the aperture formed by the chassis frame and rear road spring. This end should then be moved towards the centre line of the car and towards the front. While this is being done pass the other end of the axle through the aperture between the frame and spring, and when clear draw the unit out endwise towards the rear.

Re-assembly is carried out in the reverse order of the foregoing, but in addition adjust the brake shoes, bleed the hydraulic system and adjust the hand brake as described on *pages H2, H3 and H8* dealing with the brakes.

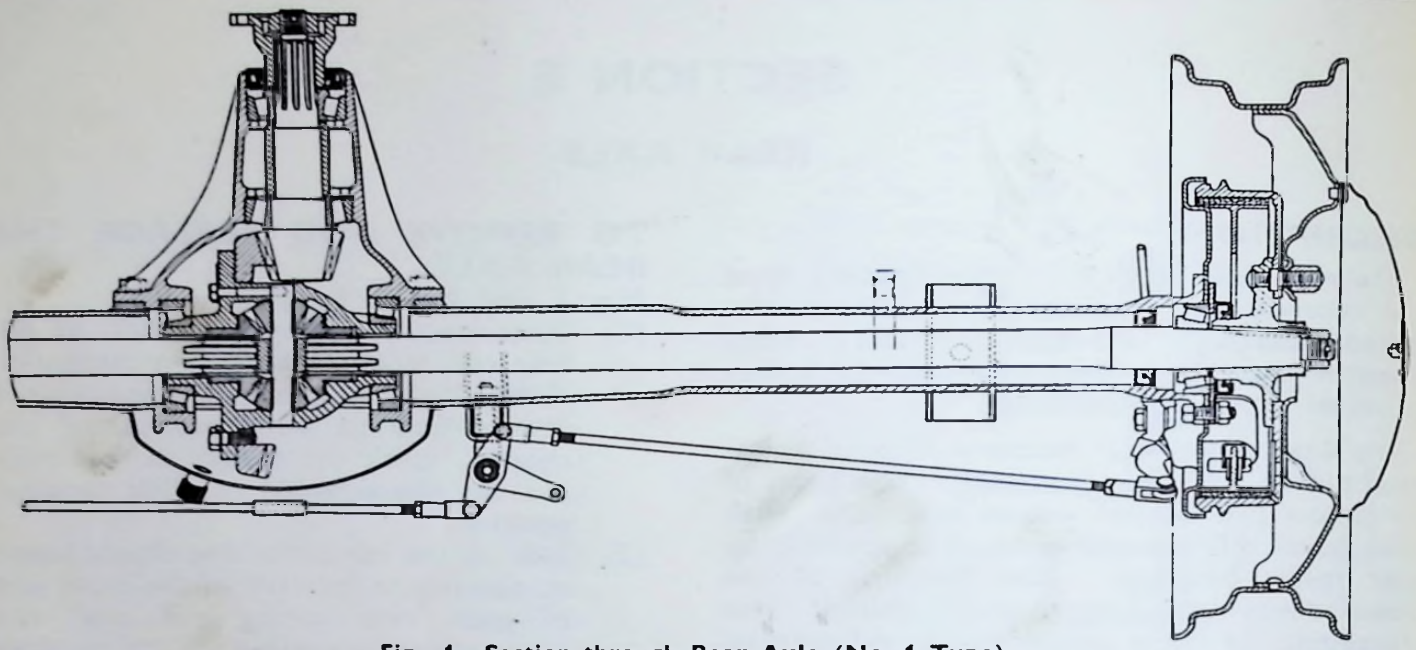


Fig. 1. Section through Rear Axle (No. 1 Type).

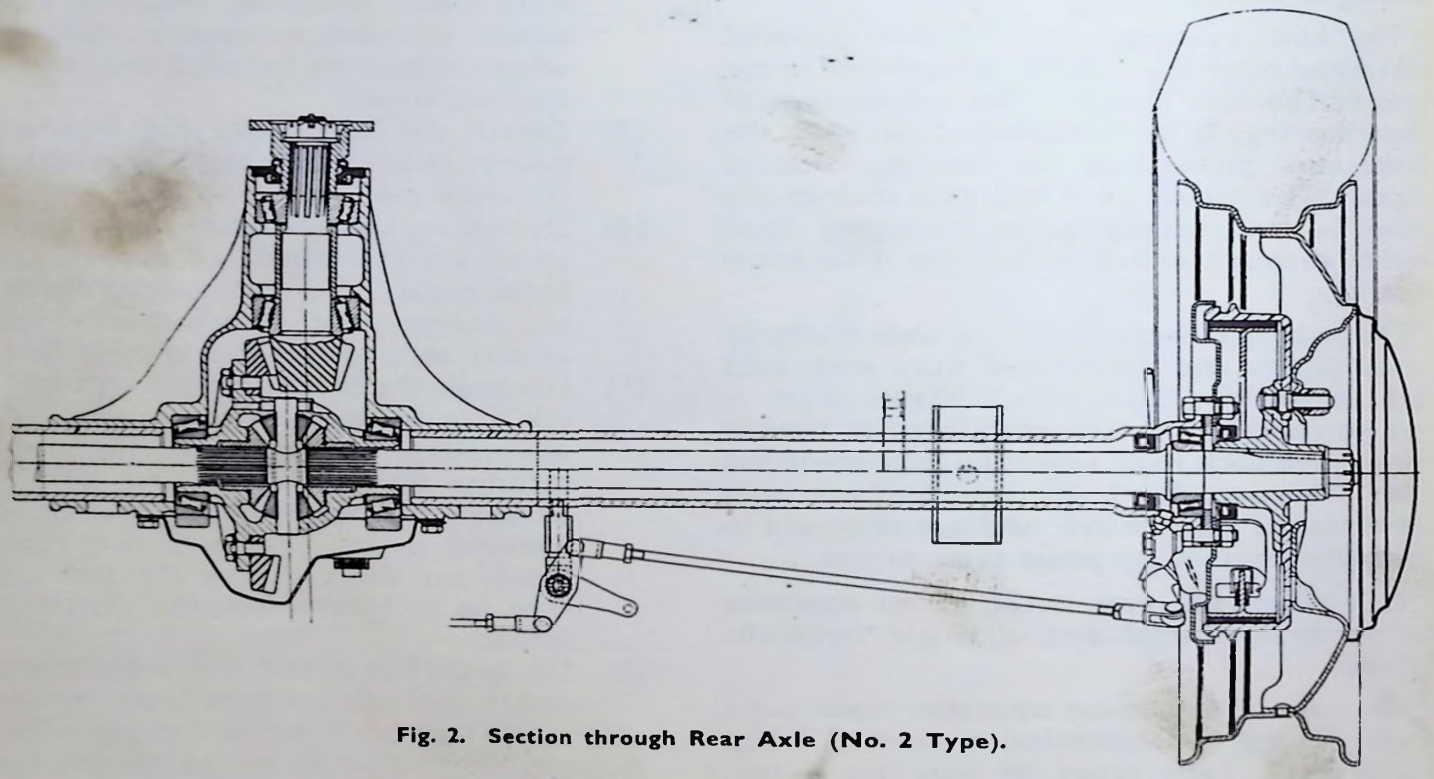


Fig. 2. Section through Rear Axle (No. 2 Type).

TO DISMANTLE THE REAR AXLE.

No. 1 Type Axle.

(1) Support the axle on three suitable trestles, one under each spring pad and the third under the flange of the pinion shaft.

(2) Drain the oil by removing the large drain plug in the centre of the banjo.

(3) Commence to dismantle by dealing with one end of the axle. Remove the two countersunk headed screws securing the brake drum and detach the drum. Threaded holes are provided in the drum into which slave bolts can be screwed as extractors.

(4) Remove the cotter and nut on the end of the axle shaft and draw off the hub, note the key in the shaft. Use extractor tool Service No. 23532A.

(5) Remove the nut securing the hydraulic hose banjo connection to the brake back plate, the brake control rod from the hand brake lever and the balance lever assembly on the axle banjo by extracting the clevis pins. Remove the four nuts securing the oil seal retainer plate, the bearings retainer plate and the brake back plate. Detach these parts.

Note the shims between the bearing retainer plate and brake back plate. These are for the adjustment of the hub bearings, and if the original banjo, brake back plates, shafts and bearings are to be used again the shims must be retained in sets and each set marked so that they can be replaced as removed.

(6) Draw out the axle shaft complete with Timken bearing and, unless the shaft or bearing is to be renewed, there is no need to press off the inner race. Use extractor *Service No.* 24026N. Store the assembly with shims in a clean and safe place.

Note the oil seals in the retainer plate and in the axle banjo.

If these seals are in good condition and it is not proposed to clean the banjo in a Tri-chlorethylene bath they should not be disturbed ; but if removed refer to *page E6* dealing with these seals, before replacing.

(7) Treat the other side of the banjo similarly.

(8) Remove the 11 nuts securing the differential unit and withdraw the unit. For further dismantling and re-assembly of this component see *page E6*.

(9) Remove the clips securing the hydraulic pipe line to the banjo and the nut securing the two-way union to the bracket on the banjo, and detach the pipe line.

(10) Remove the nut securing the balance lever assembly to the banjo and detach the assembly.

(11) Remove the grease nipples from the rear hubs.

(12) To dismantle and re-assemble the brake anchor plates. See *Section H* dealing with brakes.

TO RE-ASSEMBLE THE AXLE.
No. 1 Type Axle.

In the main re-assembly is carried out in the reverse order of dismantling with the following additions.

(1) Before assembling the grease nipples for the rear hubs, check that lubricant will pass through them into the bearing housings.

(2) See that the joint faces of the axle banjo and differential unit are clean, free from burrs and use a new gasket when assembling the unit to the axle banjo.

(3) Check that the splined end of each differential shaft is a sliding fit in the splines of the differential wheel with which it engages. It is important that this condition is present, for should the shafts not slide freely, it will be impossible to adjust the rear hub Timken bearings correctly. Remove any stiffness with the aid of a smooth file.

(4) If the hub oil retaining seals have been removed and are to be replaced, position the new seals in the banjo with the sealing lips of the retaining washers facing towards the differential unit, and when driving the seals home use a drift slightly smaller in diameter than that of the seal casing. Make sure that each seal is right home and making firm contact with the abutment face. The seals in the retainer plates must be fitted similarly and with the sealing lips facing towards the bearings when the plates are in position.

(5) From this point onwards the various parts must be assembled to both ends of the axle progressively. Fit the Timken bearings to the shafts, insert the assemblies into position and equalize approximately the amounts by which the outer races stand proud of the axle flanges.

(6) Assemble the Brake anchor plates and select, for each side, a number of shims the total thickness of which should be the amount that each outer race stands proud of the surface of the brake back plate when this component is bolted securely to the axle flange. Fit the bearing retainer plates, the oil seal retainer plates, insert the bolts and tighten their nuts progressively and in diagonal rotation. When doing so check

that the shafts can be rotated freely. If stiffness is present—and here note the normal resistance offered by the oil seals—dismantle both sides and add shims of equal total thickness to each side until free rotation is present.
Fit a clock gauge in convenient manner to one of the brake plates, and position it

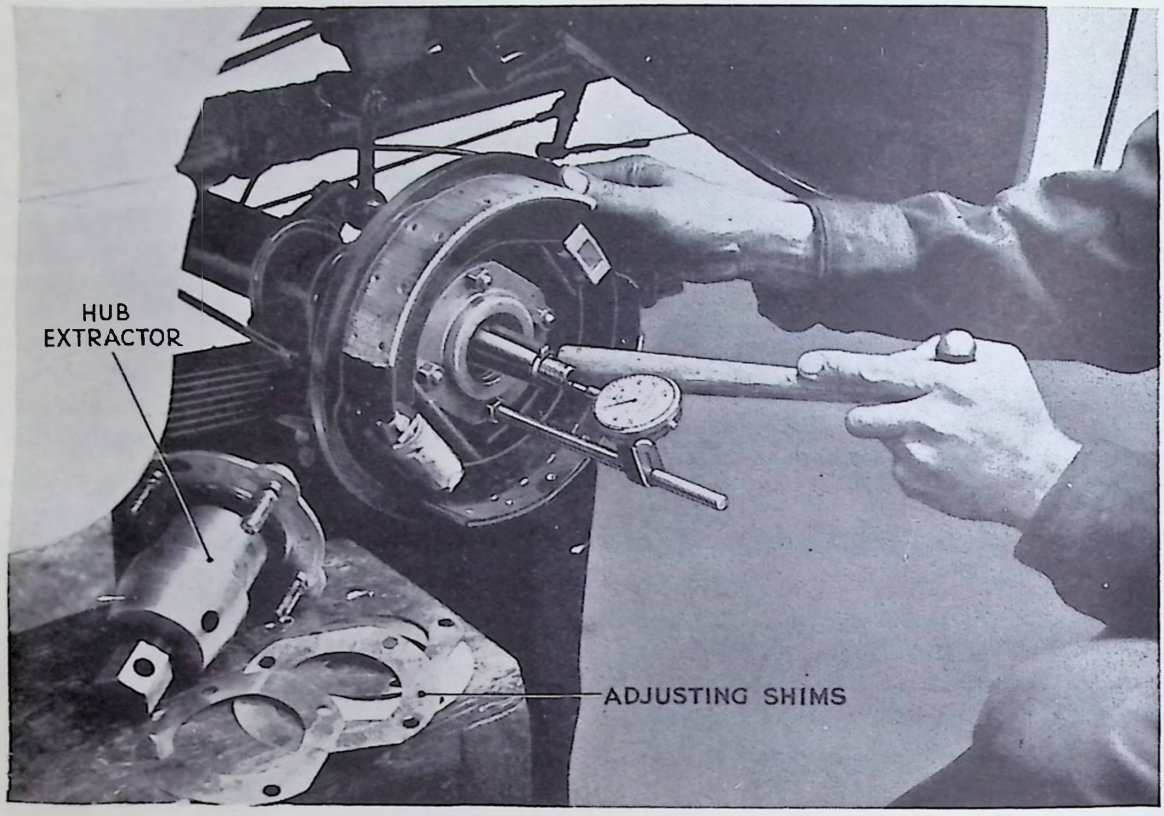


Fig. 3. Method of Setting Clearance in Rear Hub Bearings.

so that the amount of float present in the shafts can be measured. *See Fig.* 3. The correct amount is .004″ (.102 mm.) and if not present, or in excess, add or subtract to or from each side of the axle, shims of equal total thickness, until the desired condition is obtained, *i.e.*, .004″ float.

(7) Make sure after each adjustment that the bolts and nuts are securely tightened with a torque spanner to 300 inch lbs. and that due allowance is made for the normal, resistance of the seals to movement of the shafts when checking the end float.

The keys for the hubs must be a tight fit in the keyways in the shafts, but a push fit in the hubs. When assembling the hubs fit the keys in the shafts with their non-radiused ends standing proud of the tapered ends of the axle shafts by about $\frac{1}{4}$″ (6 mm.). Assemble the hubs to the shafts, drive home the keys flush with the faces of the hubs and secure the hubs in position with plain washers, nuts and cotters.

As previously mentioned, the assembly in other respects is perfectly straightforward. On completion do not neglect to adjust and bleed the brakes as described in *Section H* and to fill the axle with the recommended lubricant to the correct level. *See Section M on Lubrication.*

THE FOLLOWING SERVICES CAN BE CARRIED OUT CONVENIENTLY WITH THE AXLE IN POSITION ON THE CAR.

TO REMOVE AND REPLACE THE REAR HUB.

No. 1 Type Axle.

Jack up the rear axle and remove the wheel. Detach the brake drum by removing the two

countersunk headed screws securing it to the hub and screwing slave extractor bolts into the threaded holes provided in the radial flange of the drum. Extract the cotter and remove the large central nut. Then with the aid of an extractor (Service Part No. 23532A) screwed on to the threaded end of the hub, draw off the hub. A smart tap on the head of the extractor screw with a fairly large hammer while tension is being maintained on the screw will often release a tight hub. *Note the key in the shaft.*

Replacement is the reverse order of dismantling, but when fitting the hub make sure that the key is a tight fit in the keyway in the shaft and a push fit in that of the hub.

Position the key in the shaft with the non-radiused end about $\frac{1}{4}$" (6 mm.) proud of the tapered end of the shaft and when the hub is snugly fitted into the taper drive home the key flush with the face of the hub. Fit the nut, securely tighten and cotter.

TO REMOVE AND REPLACE THE BRAKE BACK PLATE.

No. 1 Type Axle.

(1) Jack up the axle, remove the wheel and brake drum. Draw off the hub with the aid of an extractor (Service Part No. 23532A). Disconnect the hydraulic hose by removing the bolt securing the banjo joint to the brake plate. Detach the hand brake rod from its lever by extracting the clevis pin.

(2) Secure the brake pedal conveniently to prevent its being depressed inadvertently, with consequent loss of fluid.

(3) Remove the four nuts, shakeproof washers and bolts securing the brake plates to the axle banjo flange and detach the oil seal retainer plate, the bearing retainer plate, adjusting shims and brake plate.

Store the shims and brake plate together, for upon their combined thickness plus that of the brake anchor plate depends the adjustment of the hub bearings.

The dismantling and re-assembling of the brake back plates and any attention the components may need is given in *Section H.*

Examine the outer oil seal but do not disturb it unnecessarily, if the sealing lip is in good condition and the spring intact it may be used again.

Replacement is the reversal of removal, but the end float of the axle shaft must be checked and corrected if necessary, before fitting the hub. *See Fig.* 3.

The method is as follows. Secure the brake plate, the shims, the bearing retainer plate and oil seal retainer plate to the flange of the banjo with their bolts, spring washers and nuts. Fit in a convenient manner a clock gauge to the brake plate and position it so that the end float can be measured (*see Fig* 3.) The correct amount of float is .004" (.102 mm.) and if not present, add or subtract shims of suitable total thickness until the desired condition is obtained

Make sure after each adjustment that the bolts and nuts are securely tightened with a torque spanner to 300 inch lbs. and that due allowance is made for the normal resistance of the seals to movement of the shaft.

If the brake plate has been renewed fit securely the plate alone to the banjo flange, check that the outer race of the bearing is right home and measure the amount it stands proud of the face of the brake plate. Select shims whose total thickness is this amount and proceed as described above, thus making sure that .004" (.102 mm.) end float is present.

On completion of the assembly adjust and bleed the brakes as described in *Section H.*

TO REMOVE AND REPLACE AXLE SHAFT AND OR BEARING ALONE.

No. 1 Type Axle.

Jack up the rear axle, remove the wheel, the brake drum and the hub, using an extractor (Service Part No. 23532A) for withdrawing the hub

Detach the oil seal retainer plate, the bearing plate, shims and the brake plate by removing the four bolts, shakeproof washers and nuts securing them to the axle casing. The shaft can now be withdrawn out of position complete with inner, outer races and the roller cage of the bearings, using extractor Service Part No. 24026N. Press the inner race of the bearing off the shaft.

Replacement is the reverse of removal with the following additions. If the axle shaft is to be replaced, check that the splined end is a sliding fit in the splines of the differential wheel, into which it fits. It is most important that this condition exists, for should the shaft not slide freely it will be impossible to adjust

the rear hub bearings correctly. Remove any stiffness by filing with a smooth file the splines of the shaft.

From this point onwards observe the instructions given on *page E3*.

TO REMOVE AND REPLACE REAR AXLE HUB OIL SEALS.

No. 1 Type Axle.

(1) Jack up the rear axle until the wheels are clear of the ground, and remove the wheels.

(2) Remove the hub to be serviced.

(3) Remove the brake anchor plate. The outer seal, which is the larger of the two fitted, can be pressed out quite readily from its retainer plate, but be careful not to damage or to distort the plate when doing so.

(4) Remove the axle shaft and hub. The inner seal is housed in a machined recess in the axle casing and can be extracted with the aid of an "L" shaped tool.

(5) The seals must be fitted with their sealing lips towards the axle centre, and must be pushed home square against the abutment in the axle casing or retainer plate. When the seals have been positioned correctly, assemble the remaining parts in the reverse order of dismantling.

Pay particular attention that the leading edge of the surface of the axle shaft on which the lip of the inner seal bears is free from burrs. The surface itself must also be in a similar condition.

These precautions must also be observed for the hub and its seal.

Before replacing the hub, check in the manner described that the standard end float of .004" (.102 mm.) is present in the axle shafts.

TO REMOVE AND REPLACE THE DIFFERENTIAL UNIT.

No. 1 Type Axle.

Jack up the rear axle until both rear wheels are clear of the ground.

Drain the oil from the axle by removing the drain and filler plugs.

Mark the position of the rear flange on the propeller shaft relative to the flange on the axle pinion and disconnect the propeller shaft. Sling the shaft to some convenient part of the chassis and out of harm's way.

Remove the wheels and brake drums, then withdraw the axle shafts. The differential unit can now be detached from the axle banjo after the eleven nuts and shakeproof washers securing it are removed.

Replacement is a reversal of the foregoing.

TO DISMANTLE AND RE-ASSEMBLE THE DIFFERENTIAL ASSEMBLY.

No. 1 Type Axle.

(1) Mark suitably the pinion housing and the differential case bearing caps to help re-assemble them in their original positions. The differential case complete with crown wheel, bearings and shims can now be removed. The shims are for the purpose of adjustment and must be suitably tallied to their respective sides.

(2) Secure the Hypoid pinion driving flange from turning by means of a 2-peg spanner, remove the split pin, the nut securing the flange and draw off the flange. The pinion can now be pressed out of the housing through the oil seal and front and rear bearings.

Note the distance piece and the shims between the inner races of the pinion bearings and the oil thrower disc immediately behind the oil seal.

The shims are for the purpose of adjusting the position of the pinion in relation to the crown wheel. The oil seal, the oil thrower disc and the inner races of the bearings can now be removed from the housing, the last mentioned by utilising the extractor holes in their abutment shoulders.

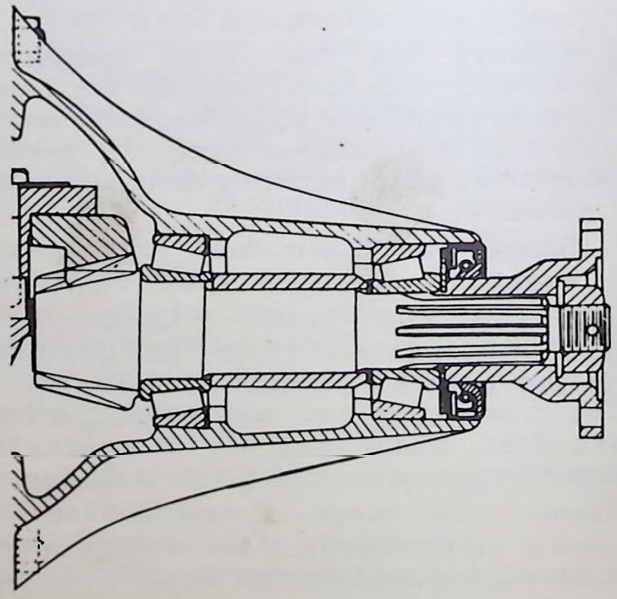


Fig. 4. Section through Pinion Shaft and Bearings.

(3) Bend back the tabs of the lock washers for the hexagon-headed bolts securing the crown wheel to the case and remove the bolts. The small hexagon-headed screw securing the cross pin to the case and the differential wheels together with their thrust washers, can be removed. If re-assembly is to be carried out satisfactorily it is essential that all parts must be scrupulously cleaned and maintained in this condition throughout assembly. It is also important that they are examined carefully and any not in serviceable condition replaced.

Crown wheels and pinions are manufactured and supplied in pairs. They must therefore be fitted in pairs and under no consideration be dealt with otherwise.

TO RE-ASSEMBLE DIFFERENTIAL UNIT.

No. 1 Type Axle.

Assembly in the main is the reversal of dismantling, but bear in mind when undertaking to repair a differential assembly, that the combined operation of obtaining a certain backlash with a tooth marking as shown in the *Figs.* 5 *to* 18, *pages E8 and E9*, is a skilled one and should therefore be carried out only by an experienced engineer. *See page E7* for obtaining correct backlash.

BACKLASH.

No. 1 Type Axle.

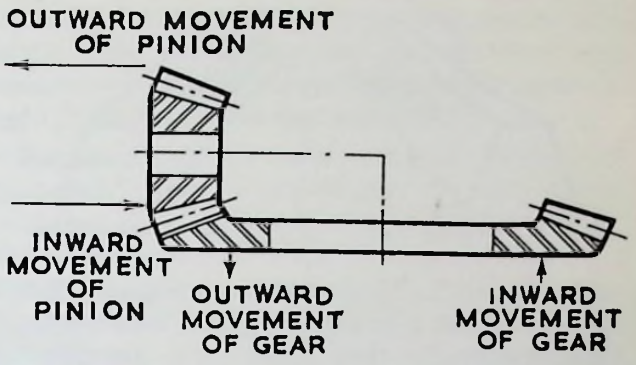
The amount of backlash varies with the pitch of the gears, and the proper backlash should be from .006″ (.152 mm.) to .008″ (.203 mm.).

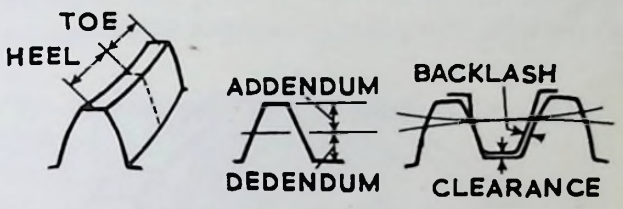
ADJUSTMENT OF BEVEL GEAR AT ASSEMBLY.

The proper adjustment of bevel gears at assembly is a vital factor in obtaining quiet and durable gears.

There are two distinct considerations in obtaining the proper tooth contact ; one is the bearing along the tooth, lengthwise bearing ; the other the bearing up and down the tooth or profile bearing. It is essential that the two be considered separately to obtain the proper results in combination.

In the next column will be found definitions of the terms used in describing the proper procedure to mount a spiral bevel gear.





The gears are cut to run flush at the large end of the teeth, and as a first step they should be so assembled in the mounting for an initial trial. Powdered red lead and any light machine oil should be mixed and spread over the working surfaces of the teeth with a brush to show clearly the tooth contact obtained.

There is no difference in the method of adjusting spiral or straight bevels, and while the following statements are particularly applicable for spiral bevels, they are also true for straight bevels.

After mounting the gears with the large end of the teeth flush with the proper amount of backlash, they should be operated under load in each direction for a minute. To do this, raise the rear axle until the wheels clear the floor, then start the motor and drive the wheels in both directions with the brakes applied to obtain the necessary load.

All figures show the bearing on the gear tooth. The driving side is on the convex side of the tooth, and the concave side of the tooth is used when in reverse.

The tooth bearing, both lengthwise and profile, should appear as shown in *Figs.* 5 *and* 6, but a condition of tooth contact may be obtained as indicated in *Figs.* 7 *to* 18. The lengthwise bearing adjustments will first be considered.

Lengthwise Bearing Adjustments.

Figs. 7 *and* 8 show what is called a cross bearing, and is caused by a misalignment of the mounting. The mounting should be tested,

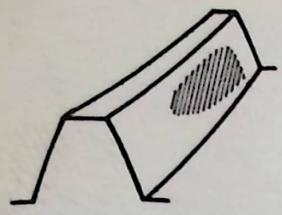


Fig. 5. Driving Side.

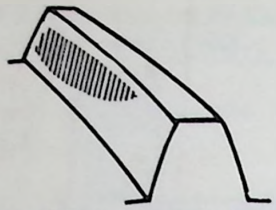


Fig. 6. Reverse Side.

and if found faulty should be replaced. If the drive side has a toe bearing and the reverse a heel bearing, the gears are serviceable provided the bearing is about $\frac{5}{8}$ of the tooth length, but if the heel bearing occurs on the drive side, the gears should not be used.

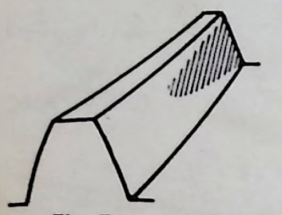


Fig. 7.

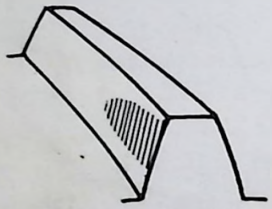


Fig. 8.

Figs. 9 *and* 10 show a toe bearing on each side of the tooth, and the gear must be moved away from the pinion to increase the lengthwise bearing, which will change the profile bearing to some extent, and an adjustment of the pinion may be required as described under "Profile Bearing".

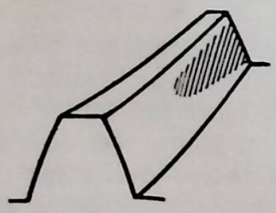


Fig. 9.

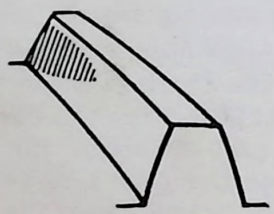


Fig. 10.

Figs. 11 *and* 12 show a heel bearing on both sides, and the gear must be adjusted towards the pinion to increase the lengthwise bearing, which will change the profile bearing to some extent, and an adjustment of the pinion may be required as described under "Profile Bearing".

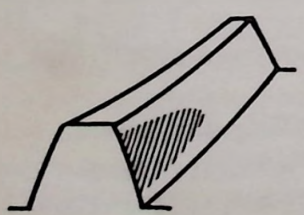


Fig. 11.

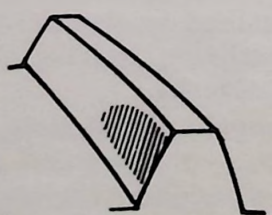


Fig. 12.

Profile Bearing.

Figs. 13 *and* 14 show a low bearing on gear tooth which may appear at any position along the tooth. The pinion should be moved away from the gear, and the gear moved towards the pinion to maintain the proper backlash. This movement of the gear will alter the lengthwise bearing and several adjustments for both lengthwise and profile bearing may be required to obtain the proper tooth bearing.

This condition would cause the ring gear teeth to crumble off at the toe end.

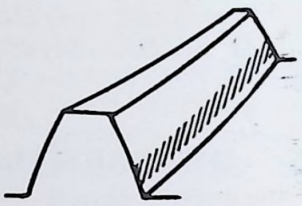


Fig. 13.

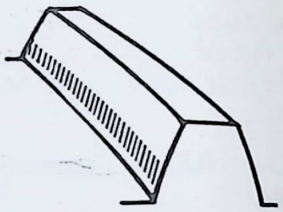


Fig. 14.

Figs. 15 *and* 16 show a high bearing on gear tooth which may appear at any position along the tooth. The pinion should be moved towards the gear and the gear moved away from the pinion to maintain the backlash. This movement of the gear will alter the lengthwise bearing and several adjustments for both lengthwise and profile bearing may be required to obtain the proper tooth bearing.

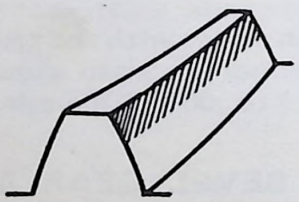


Fig. 15.

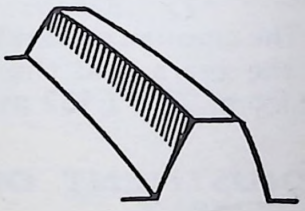


Fig. 16.

This condition would cause the ring gear teeth to crumble off at the heel end.

Figs. 17 *and* 18 show a lame bearing. It is possible to adjust the gears and obtain a fair driving condition as indicated in *Fig.* 5, but a poor coast or reverse.

It must be borne in mind that the adjustments cited should be moderate, and if great amounts of adjustments are needed the mounting must be carefully checked, and the necessary steps taken to correct the trouble.

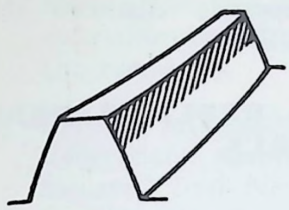


Fig. 17.

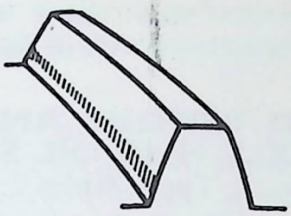


Fig. 18.

General.

Every precaution taken in installation of gears and pinions is time well spent, and may save the cost of doing the job over again.

The installation of gears and pinions is expensive, and the amount of satisfactory service given by the rear axle depends largely on the care exercised by a skilled mechanic.

Never mount the ring gear on to the differential without first running the differential case in a lathe and facing the flange true if it has side wobble.

Most gear failures are caused from worn or improperly adjusted bearings.

The use of worn bearings with new gears is just as wrong as repairing a puncture and letting the nail that caused it remain in the cover.

Bearings that show wear should be replaced with new ones.

If the old bearings are to be used, they should be carefully cleaned and inspected.

The use of red lead to note tooth bearing takes very little time, and while many mechanics neglect this detail, it is quicker than making road adjustments, and more satisfactory than to listen to the gears go to pieces for want of a little care in properly completing installation.

THE FOLLOWING SERVICES CAN BE CARRIED OUT CONVENIENTLY WITH THE AXLE IN POSITION ON THE CAR. TO REMOVE AND REPLACE THE REAR HUB.

No. 2 Type Axle.

Jack up the rear axle and remove the wheel. Detach the brake drum by removing the two countersunk headed screws securing it to the hub and screwing slave extractor bolts into the threaded holes provided in the radial flange of the drum. Extract the cotter and remove the large central nut and washer. Then with the aid of an extractor (*Service Part No.* 26541*N*), draw off the hub. A smart tap on the head of the extractor screw with a fairly large hammer while tension is being maintained on the screw will often release a tight hub. *Note the key in the shaft.*

Replacement is the reverse order of dismantling, but when fitting the hub make sure that the key is a tight fit in the keyway in the shaft and a push fit in that of the hub.

Position the key in the shaft with the non-radiused end about $\frac{1}{4}$" (6 mm.) proud of the tapered end of the shaft and when the hub is snugly fitted into the taper, drive home the key flush with the face of the hub. Fit the nut and washer, securely tighten and cotter.

TO REMOVE AND REPLACE THE BRAKE BACK PLATE.

No. 2 Type Axle.

(1) Jack up the axle, remove the wheel and brake drum. Draw off the hub with the aid of an extractor (*Service Part No.* 26541*N*). Disconnect the hydraulic hose by removing the bolt securing the banjo joint to the brake plate. Detach the hand brake rod from its lever by extracting the clevis pin.

(2) Secure the brake pedal conveniently to prevent its being depressed inadvertently, with consequent loss of fluid.

(3) Remove the four nuts, shakeproof washers and bolts securing the brake plates to the axle banjo flange and detach the oil seal retainer plate, the bearing retaining plate, adjusting shims and brake plate.

Store the shims and brake plate together, for upon their combined thickness plus that of the brake anchor plate depends the adjustment of the hub bearings.

The dismantling and re-assembling of the brake back plates and any attention the components may need is given in *Section H.*

Examine the outer oil seal but do not disturb it unnecessarily, if the sealing lip is in good condition and the spring intact it may be used again.

Replacement is the reversal of removal, but the end float of the axle shaft must be checked and corrected if necessary, before fitting the hub. *See Fig.* 3, *page* E4.

The method is as follows. Secure the brake plate, the shims, the bearing retainer plate

and oil seal retainer plate to the flange of the banjo with their bolts, spring washers and nuts.

Fit in a convenient manner a clock gauge to the brake plate and position it so that the end float can be measured (see *Fig.* 3, *Page* E4). The correct amount of float is .006" to .008" (.152 to .203 mm.) and if not present, add or subtract shims of suitable total thickness until the desired condition is obtained.

Make sure after each adjustment that the bolts and nuts are securely tightened with a torque spanner to 300 inch lbs. and that due allowance is made for the normal resistance of the seals to movement of the shaft.

If the brake plate has been renewed fit securely the plate alone to the banjo flange, check that the outer race of the bearing is right home and measure the amount it stands proud of the face of the brake plate. Select shims whose total thickness is this amount and proceed as described above, thus making sure that .006" to .008" (.152 to .203 mm.) end float is present.

On completion of the assembly adjust the bleed of the brakes as described in *Section H.*

TO REMOVE AND REPLACE AXLE SHAFT AND/OR BEARING ALONE. No. 2 Type Axle.

Jack up the rear axle, remove the wheel, the brake drum and the hub, using an extractor (*Service Part No.* 26541*N*) for withdrawing the hub.

Detach the oil seal retainer plate, the bearing plate, shims and the brake plate by removing the four bolts, shakeproof washers and nuts securing them to the axle casing. The shaft can now be withdrawn out of position complete with inner, outer races and the roller cage of the bearings, using extractor *Service Part No.* 24026*N*. Press the inner race of the bearing off the shaft.

Replacement is the reversal of removal with the following additions. If the axle shaft is to be replaced, check that the splined end is a sliding fit in the splines of the differential wheel, into which it fits. It is most important that this condition exists, for should the shaft not slide freely it will be impossible to adjust the rear hub bearings correctly. Remove any stiffness by filing with a smooth file the splines of the shaft.

From this point onwards observe the instruction given in *page* E4.

TO REMOVE AND REPLACE REAR AXLE HUB OIL SEALS. No. 2 Type Axle.

(1) Jack up the rear axle until the wheels are clear of the ground, and remove the wheels.

(2) Remove the hub to be serviced.

(3) Remove the brake anchor plate. The outer seal which is the larger of the two fitted, can be pressed out quite readily from its retainer plate, but be careful not to damage or to distort the plate when doing so.

(4) Remove the axle shaft and hub. The inner seal is housed in a machined recess in the axle casing and can be extracted with the aid of an "L" shaped tool.

(5) The seals must be fitted with their sealing lips towards the axle centre, and must be pushed home square against the abutment in the axle casing or retainer plate. When the seals have been positioned correctly, assemble the remaining parts in the reverse order of dismantling. Pay particular attention that the leading edge of the surface of the axle shaft on which the lip of the inner seal bears is free from burrs. The surface itself must also be in a similar condition.

These precautions must also be observed for the hub and its seal.

Before replacing the hub, check in the manner described that the standard end float of .006" to .008" (.152 to .203 mm.) is present in the axle shafts.

DIFFERENTIAL AND PINION ASSEMBLIES, TO REMOVE, ADJUST AND REFIT. (AXLE REMOVED FROM CAR). No. 2 Type Axle.

TO DISMANTLE DIFFERENTIAL UNIT WITH SERVICE TOOLS.

First drain the lubricant from the gear carrier housing and then remove the gear carrier rear cover. Flush out the unit thoroughly so that the parts can be carefully inspected. Remove the axle shafts as previously detailed.

To remove the differential, proceed as follows :—

(1) Withdraw the four bolts securing the two differential bearing caps and remove the two caps.

(2) Before attempting to remove the differential assembly, fit the stretching fixture, *Tool No. SE.*104 in the *Service Tool List*, as shown in *Fig.* 19. The fixture should be adjusted to suit the model being serviced, a series of holes being provided in the member opposite the turnbuckles for this purpose. Open the fixture by means of the turnbuckle until it is hand tight, then spread the case by using a spanner. DO NOT OVER-SPREAD, OR THE AXLE CASING WILL BE DAMAGED BEYOND REPAIR. The correct spread does not exceed a half turn on the turnbuckle, and this figure should not be exceeded even if the differential is still stiff to remove.

(3) The differential assembly may now be prised out by means of two levers, one on each side of the differential case opening. During this operation use suitable packing between the levers and the gear carrier.

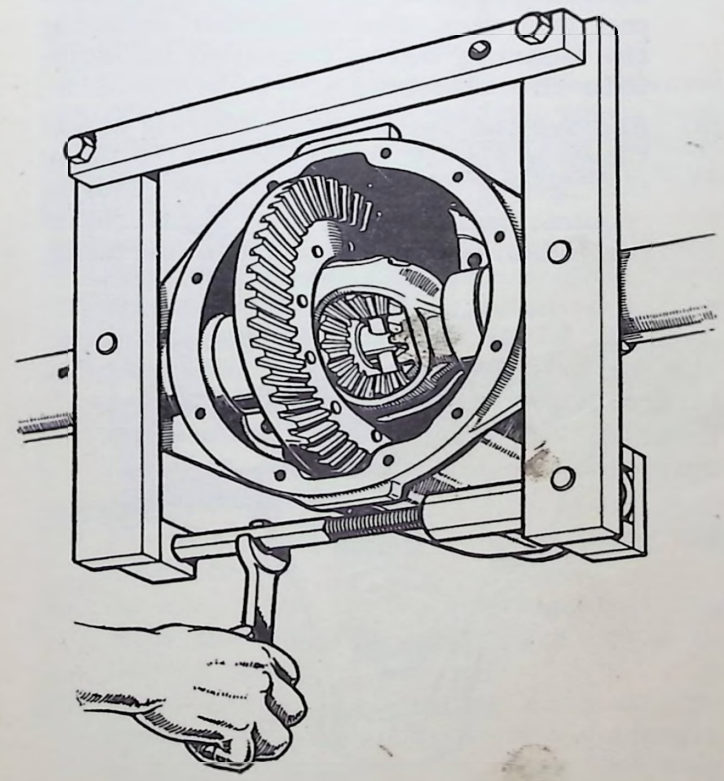


Fig. 19.

To Dismantle Differential Unit Emergency Method.

First drain the lubricant from the gear carrier housing and then remove the gear carrier rear cover. Flush out the unit thoroughly so that the parts can be carefully inspected. Remove the axle shafts as previously detailed.

To remove the differential proceed as follows :—

(1) Withdraw the four bolts securing the two differential bearing caps and remove the two caps.

(2) The differential assembly should now be prised out by means of two levers, one on each side of the differential case opening, taking care not to tilt the assembly and so wedge it more tightly than it is held by the preload. During this operation, use suitable protective packing between the levers and the gear carrier.

STRIPPING DIFFERENTIAL ASSEMBLY.

(1) Bend down the tabs on the drive gear screw locking straps and remove the drive gear screws.

(2) Remove the drive gear from the differential case by tapping with a rawhide mallet.

(3) Using a small punch, drive out the pinion mate shaft locking pin, which is secured in place by peening the case, and remove the pinion mate shaft. *Fig.* 20 indicates direction in which the locking pin is removed ; it is not possible to drift the pin in the opposite direction.

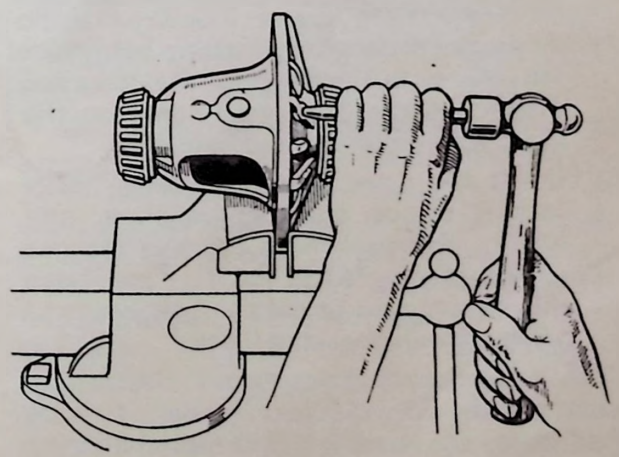


Fig. 20.

(4) Remove the axle shaft spacer.

(5) Rotate the side gears by hand until the pinions are opposite the openings in the differential case, then remove the differential gears, care being taken not to lose the thrust washers fitted behind them.

(6) If the drive gear setting is to be altered, it will be necessary to withdraw the differential bearings, using the extractor *Tool No. SE.*103 in the *Service Tool List*, to gain access to the shims located between the bearing and the abutment face on the differential case.

RE-ASSEMBLY OF DIFFERENTIAL.

(1) Assemble the side gears with the thrust washer in position.

(2) Insert the differential pinions through the openings in the differential case, and mesh them with the side gears.
Hold the pinion thrust washers on the spherical thrust faces of the pinion, whilst rotating the differential gear assembly into its operating position by hand.

(3) Line up the pinions and thrust washers, then install the pinion mate shaft **with the axle shaft spacer in position.**

(4) Line up the cross hole in the shaft with the hole in the differential case, then fit the pinion mate shaft lock pin.

(5) Using a punch, peen some of the metal of the differential case over the end of the lock pin to prevent its working loose and thereby causing extensive damage to the axle assembly.

(6) Clean the drive gear and differential case contacting surfaces and carefully examine same for burrs.

(7) Align the drive gear attaching bolt holes with those in the flange of the case, and gently tap the drive gear home on the case, with a hide or lead hammer.

(8) Insert the drive gear bolts, with NEW locking straps, and tighten them uniformly, preferably with a torque spanner to the reading 40-50 lbs. ft. Then bend the locking tabs round the bolt heads to prevent their working loose.

The procedure for fitting the differential case assembly into the gear carrier is to be found under the heading "Differential Bearing Adjustment".

REMOVING PINION.

(1) Remove the pinion split pin, nut and washer.

(2) Withdraw the universal joint companion flange with a puller.

(3) PRESS the pinion out of the outer bearing. It is important that the pinion should be pressed and not driven out, to prevent damage to the outer bearing. The pinion, having been pressed from its outer bearing, may now be removed from the gear carrier housing.
NOTE :—Keep all shims intact.

(4) Remove the pinion oil seal together with the oil slinger and outer bearing cone.

(5) Examine the outer bearing for wear and, if replacement is required, extract the bearing cup, using *Tool No. SE.*105 in the *Service Tool List*, shown in *Fig.* 21. The extractor plate should be installed behind the cup and then the drawbar may be fitted together with the extractor bar which seats on the nose of the gear carrier. The bearing cup may then be withdrawn by tightening the nut on the drawbar.

(5a) **If the correct service tool is not available, and the old bearing cup is to be scrapped, it is possible to drive out the cup, the shoulder locating the bearing being recessed to facilitate the operation.**

(6) Remove the pinion inner bearing cup as shown in *Fig.* 21, using *Tool No. SE.*105 in the *Service Tool List*, if the bearing requires replacement or adjustment of the pinion setting is to be undertaken.

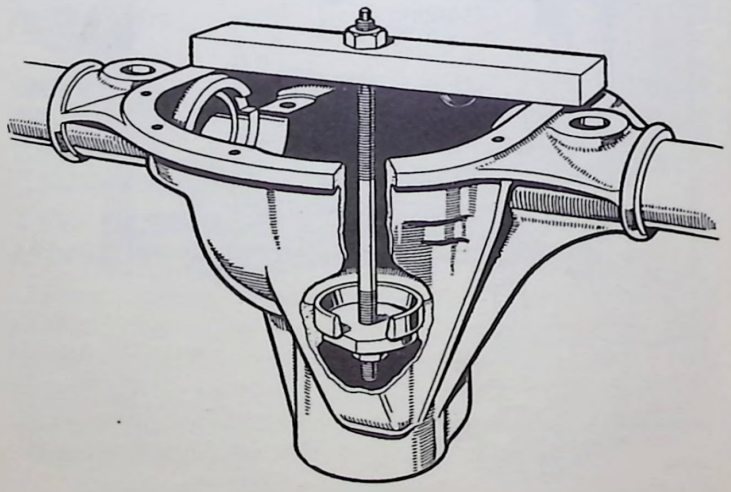


Fig. 21.

Take care of the shims fitted between the bearing cup and the housing abutment face.

(6a) **If the inner bearing is to be replaced it may be driven out, but the correct Service Tool should be used when the bearing is removed in order to carry out pinion setting adjustment.**

DIFFERENTIAL BEARING ADJUSTMENT.

The thickness of shims required in the installation of the differential bearings is determined as follows :—

(1) Fit the differential bearings, without shims, on the differential case, making sure that the bearing cones and cups and the housing are perfectly clean.

(2) Place the differential assembly, with the bearing cups in their housing, within the gear carrier, the pinion not being assembled.

(3) Install the dial indicator set, *Tool No. SE.*101 in the *Service Tool List* on the gear carrier, with the button against the back face of the drive gear.

(4) Inserting two levers between the housing and the bearing cup, move the differential assembly to one side of the carrier, as shown in *Fig.* 22.

(5) Set the indicator to zero.

(6) Move 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 gear carrier housing.
Add .008″ (.203 mm.) more to the clearance reading to give preload ; this thickness of shims to be used in the installation of the differential bearings, the shims being divided to give the gear position with correct backlash as detailed later under "Drive Gear Adjustment".

(7) Remove the differential assembly from the gear carrier.

(8) Re-install the pinion outer bearing cup with *Tool No. SE.*106.

(9) Re-install the pinion bearing inner cup with the original adjusting shims positioning same.

(10) 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.**

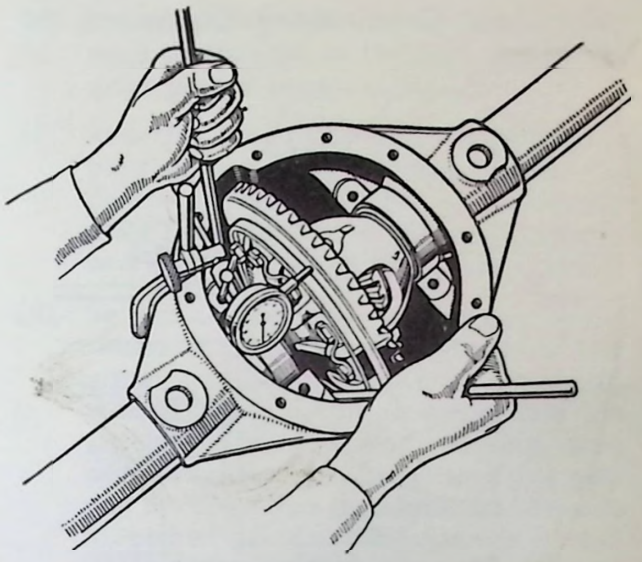


Fig. 22.

PINION ADJUSTMENT.

The hypoid drive pinion should be correctly adjusted before attempting further assembly, the greatest care being taken to ensure accuracy.

The correct pinion setting is marked on the ground end of the pinion as shown in *Fig.* 24. The matched assembly serial number at the top is also marked on the drive gear, and care should be taken to keep similarly marked gears and pinions in their matched sets, as each pair is lapped together before despatch from the factory. The letter on the left is a production code letter and has no significance relative to assembly or servicing of an axle. The letter and figure on the right refer to the tolerance on offset or pinion drop, dimension 1.375″ (34.925 mm.) in *Fig.* 23 which is stamped on the cover facing of the gear carrier housing. When ordering spares, specify the offset required if the best performance is to be obtained. Thus, L1. carrier requires L.1. gears, or H.2. carrier requires H.2. gears.

The number at the bottom gives the cone setting distance of the pinion and may be Zero (0), Plus (+) or Minus (—). When correctly adjusted, a pinion marked Zero will be at the zero cone setting distance, dimension 2.250″ (57.15 mm.) in *Fig.* 23, from the centre line of the gear to the face on the small end of the pinion ; a pinion marked Plus Two (+2) should be adjusted to the nominal (or Zero) cone setting plus .002″ (.051 mm.), and a pinion marked Minus Two (—2) to the cone setting distance minus .002″.

The Zero Cone Setting Distance is as follows :—

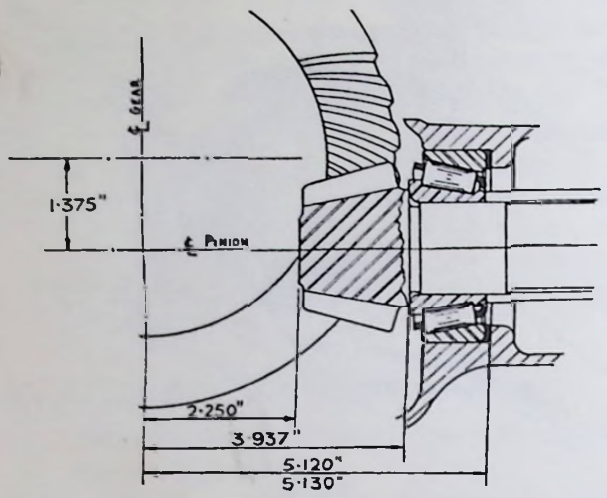


Fig. 23.

Thus, pinion marked Minus Two (—2) the distance from the centre of the drive gear to the face of the pinion should be 2.248″

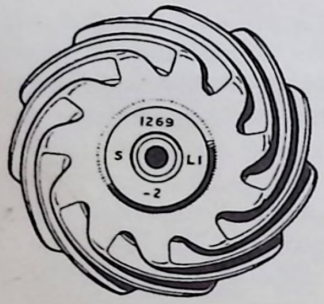


Fig. 24.

(57.09 mm.) (*i.e.* 2.250″—.002″) (57.15 mm.—.051 mm.) and for a pinion marked Plus Three (+3) the cone setting distance should be 2.253″ (57.226 mm.).

When the pinion bearing cups have been installed in the gear carrier, with the original pinion inner bearing adjusting shims, as described in items (7) to (10) in the section entitled "Differential Bearing Adjustment", proceed with pinion adjustment as follows :—

(1) Place the pinion, with the inner bearing cone assembled, in the gear carrier.

(2) Turn the carrier over and support the pinion with a suitable block of wood for convenience before attempting further assembly.

(3) Install the pinion bearing spacer.

(4) Install the original outer bearing shims on the pinion shank so that they seat on the spacer or a shoulder on the shank, according to the construction of the unit.

(5) Fit pinion outer bearing cone, companion flange, washer and nut only, omitting the oil slinger and oil seal assembly, and tighten the nut.

(6) Check the pinion cone setting distance by means of the gauge, *Tool No. SE.*107 in the *Service Tool List*, see *Fig.* 25. The procedure for using the gauge is :—

(a) Adjust the bracket carrying the dial indicator to suit the model being serviced, then set the dial indicator to zero with the setting block.

(b) Place the dial indicator assembly on the fixed spindle of the gauge body.

(c) Fix the fixed spindle of the gauge body into the centre in the pinion head, slide the movable spindle into position, locating in the centre in the pinion shank with the gauge body underneath the gear carrier, and lock the spindle with the screw provided.

(d) Check the pinion cone setting by taking a dial indicator reading on the differential bore with the bracket assembly seated on the ground face on the end of the pinion. The correct reading will be the minimum obtained, *i.e.*, when the indicator spindle is at the bottom of the bore. Slight movement of the assembly will enable the correct reading to be ascertained easily. The dial indicator shows the deviation of the pinion setting from the zero cone setting, and it is important to note the direction of any such deviation as well as the magnitude.

(7) If the pinion setting is incorrect it is necessary to dismantle the pinion assembly and remove the pinion inner bearing cup, using *Tool No. SE.*105 in the *Service Tool List*. Add or remove shims as required from the pack locating the bearing cup and re-install the shim pack and the bearing cup. The adjusting shims are available in thicknesses of .003″ (.076 mm.) .005″ (.127 mm.) and .010″ (.254 mm.). Then carry out the operations (1) to (6) detailed previously.

(8) When the correct pinion setting has been obtained, check the pinion bearing preload, which should afford a slight drag or resistance to turning, there being no end play of the pinion. The correct preload for the pinion bearings gives a torque figure of 8-12 lbs. Less than the correct range will result in excessive deflection of the pinion under load, whilst too much preload will lead to pitting and failure of the bearings.

To rectify the preload, adjust the shim pack between the outer bearing cone and the pinion shank or spacer, but do not touch the shims behind the inner bearing cup, which control the position of the pinion. Remove shims to increase preload and add shims to decrease preload.

Installation of pinion oil seal assembly and oil slinger is usually effected after fitting differential assembly, see operations (1), (2) and (3) under Final Assembly *page E18*.

DRIVE GEAR ADJUSTMENT.

(1) Place the differential assembly with bearing cups, and less shims, in the housing, being sure that the bearing cones, cups and housings are perfectly clean.

(2) Install a dial indicator on the housing with the button on the back face of the drive gear as shown in *Fig.* 22.

(3) Inserting two small levers between the housing and bearing cup, move the differential case and drive gear assembly away from the pinion until the opposite bearing cup is seated against the housing.

(4) Set the dial indicator to zero, then move the differential assembly towards the pinion until the drive gear is in metal to metal contact deeply in mesh with the pinion. The indicator reading now obtained (clearance between drive gear and pinion) minus the backlash allowance as etched on the drive gear (e.g., B/L .007) denotes the thickness of shims to be placed between the differential case and the bearing cone on the drive gear side of the differential.

(5) Install the thickness of shims, determined in operation (4), on the drive gear side of the differential, taking the shims from the pack determined previously, see "Differential Bearing Adjustment".

(6) Install the balance of the total shims required on the opposite side of the differential case.

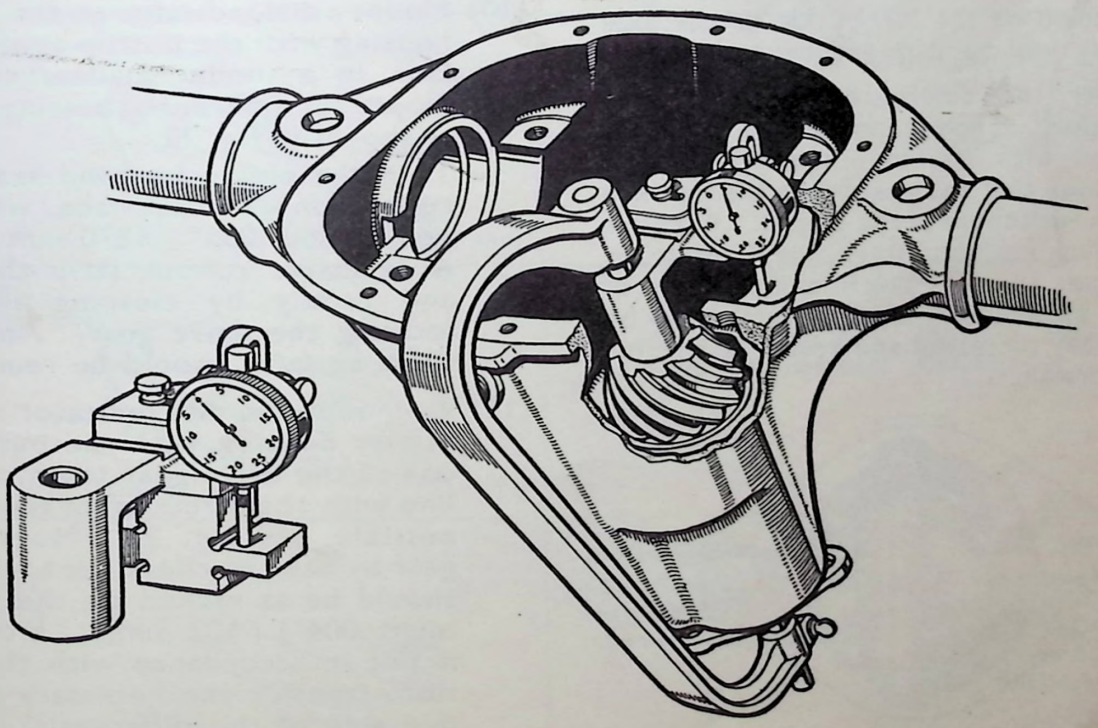


Fig. 25.

As an example of differential and drive gear adjustment, assume that the total indicator reading obtained, as described under "Differential Bearing Adjustment," is .080" (2.032 mm.).

This figure, plus .008" (.203 mm.) for the recommended preload, equals .088" (2.235 mm.), which denotes the total thickness of shims to be used. Also assuming the clearance between the drive gear and pinion to be .042" (1.067 mm.) determined as in operations (1) to (4) above, subtract the backlash as etched on the gear, say .007" (.178 mm.) from the .042" clearance.

The .035" (.889 mm.) difference denotes the thickness of shims to be placed between the differential case and bearing cone on the drive gear side of the differential. Then subtract the thickness of shims (.035") inserted on the drive gear side of the differential case, from .088", and the .053" (1.346 mm.) difference denotes the thickness of shims to be installed on the opposite side of the case.

(7) To facilitate installation of the differential assembly, fit the stretching fixture, *Tool No. SE.*104 in the *Service Tool List*, as shown in *Fig.* 19. Stretch the gear carrier, being sure not to exceed the half turn specified on the turnbuckle or the axle casing will be damaged beyond repair.

(8) Lower the differential assembly into position, lightly tapping the bearings home with a hide hammer, whilst ensuring that the gear teeth are led into mesh with those of the pinion. Careless handling at this stage may result in bruising the gear teeth, and removal of the consequent damage can only be partially successful and result in inferior performance.

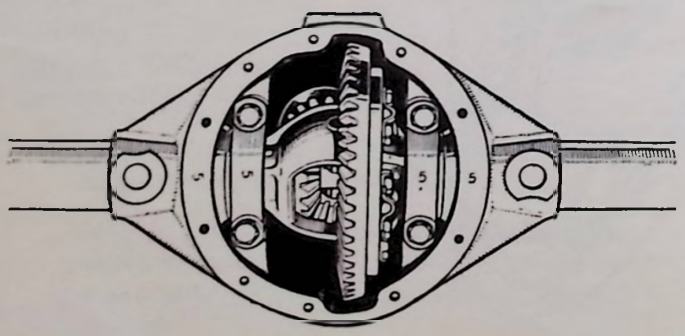


Fig. 26.

(9) When refitting the bearing caps, be sure that the positions of the numerals marked on the gear carrier housing face and the caps correspond, as indicated in *Fig.* 26. Tighten the caps lightly, remove the stretching fixture, then finally tighten the bolts securing the bearing caps. Then continue with operation (10).

Emergency Operation.

(7a) **In an emergency it is possible to install the differential assembly by slightly tilting the bearing cups and tapping same lightly into position with a hide hammer. Naturally, this method increases the difficulty of avoiding damage to gear teeth, and extreme care is necessary to prevent damage to the differential bearings. This procedure is not recommended and should be strictly reserved for emergencies.**

(8a) **Install the differential bearing caps, taking care to ensure that the positions of the numerals marked on the gear carrier housing face and the caps correspond, as indicated in Fig. 26.**

Finally tighten the bolts securing the bearing caps.

(10) Mount a dial indicator on the gear carrier housing with the button against the back face, in a similar manner to that employed for differential bearing adjustment as shown in *Fig.* 22.

Turn the pinion by hand and check the runout on the back face, which should not exceed .005" (.1270 mm.). If there is excessive runout strip the assembly and rectify by cleaning the surfaces locating the drive gear. Any burrs on these surfaces should be removed.

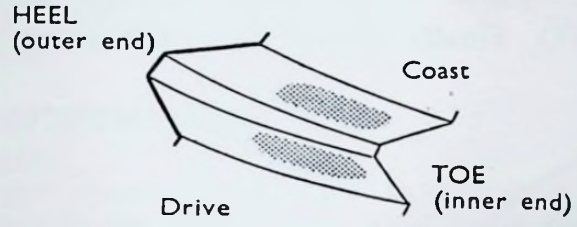
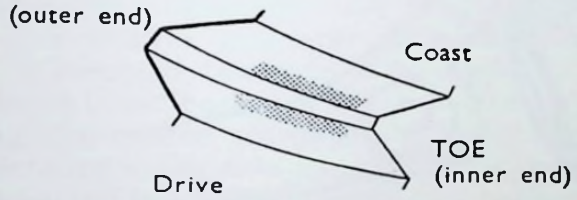
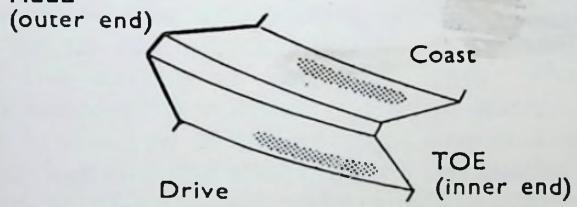
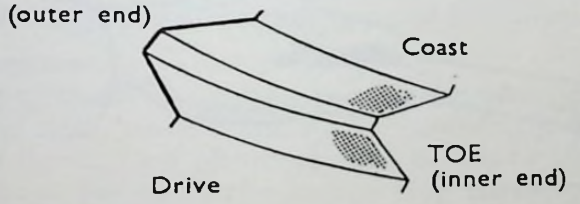
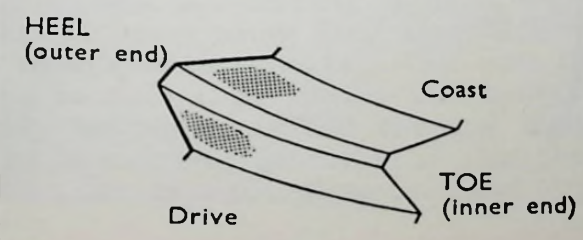
(11) Re-mount the dial indicator on the gear carrier housing with the button against one of the drive gear teeth, as nearly in line with the direction of tooth travel as possible, see *Fig.* 27. Move the drive gear by hand to check the backlash which should be as etched on the gear (minimum .004") (.102 mm.). If the backlash is not in accordance with the specification, transfer the necessary shims from one side of the differential case to the other to obtain the desired setting. To

increase backlash, remove shims from the drive gear side of the differential and install on the opposite side. Backlash is decreased by transferring shims to the drive gear side from the opposite side of the differential case.

(12) After setting the backlash to the required figure, use a small brush to paint eight or ten of the drive gear teeth with a stiff mixture of marking raddle, used sparingly, or engineer's blue may be used if preferred. Move the painted gear teeth in mesh with the pinion until a good impression of the tooth contact is obtained. The resulting impression should be similar to *Fig. A* on Tooth Contact Chart. Refer to the Tooth Contact Chart for instructions on correction of tooth contact if the impression obtained is not satisfactory.

TOOTH CONTACT CHART

Diagrams show contact on drive gear tooth.

	Tooth Contact	Condition	Remedy
A		IDEAL TOOTH CONTACT evenly spread over profile, nearer toe than heel.	o / o
B		HIGH TOOTH CONTACT heavy on the top of the drive gear tooth profile.	Move the Drive PINION DEEPER into MESH, *i.e.* Reduce the pinion cone setting.
C		LOW TOOTH CONTACT heavy in the root of the drive gear tooth profile.	Move the Drive PINION OUT of MESH, *i.e.* Increase the pinion cone setting.
D		TOE CONTACT hard on the small end of the drive gear tooth.	Move the Drive GEAR OUT of MESH, *i.e.* INCREASE BACKLASH.
E		HEEL CONTACT hard on the large end of the drive gear tooth.	Move the Drive GEAR INTO MESH, *i.e.* DECREASE BACKLASH *BUT* MAINTAIN MINIMUM BACKLASH.

FINAL ASSEMBLY.

To complete the rebuilding of the unit :—

(1) Remove the drive pinion nut, washer and companion flange.

(2) Install the oil slinger, and then fit the pinion oil seal assembly, using *Tool No.* SE.108 as shown in *Fig.* 28. Place the oil seal with the dust excluder flange uppermost (not omitting the oil seal gasket used with the metal case type seal on later models), fit the installation collar SE.108 and then tighten down the pinion nut and washer to drive the assembly home. Remove the installation collar.

(3) Fit the companion flange with dust excluder, washer and pinion nut, tighten, and secure with a cotter pin.

(4) Fit the rear cover gasket, renewing it if required, and rear cover, securing same with set bolts and lock washers, not omitting the ratio tag which is attached by one of the set bolts.

(5) Re-install the axle shafts and hub bearings, etc., as previously described.

(6) Check that the drain plug is securely tightened, then fill with the appropriate quantity of one of the hypoid lubricants.

(7) Replace the filler plug and check that the cover set bolts are tight.

(8) Check for oil leaks at the cover, pinion oil seal and where the differential cap bolt holes break through the carrier.

(9) Finally, grease the hub bearings.

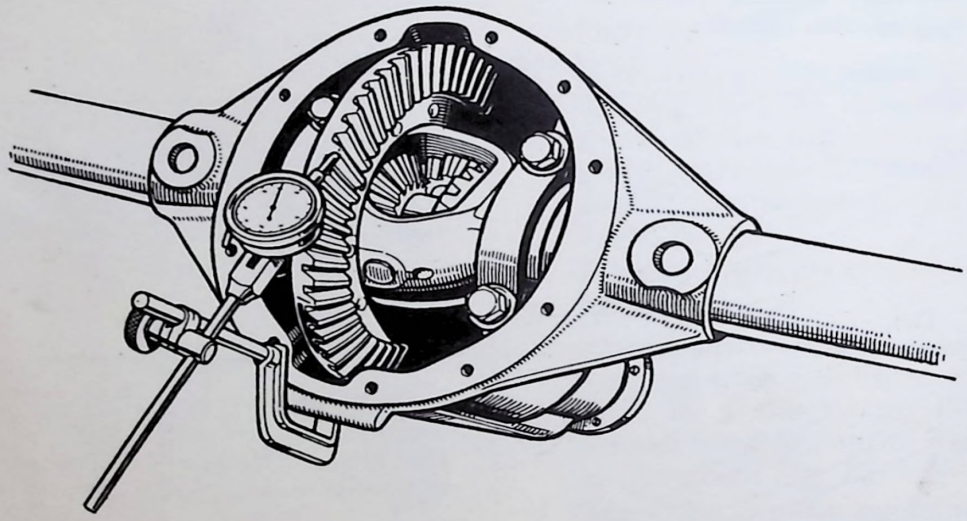


Fig. 27.

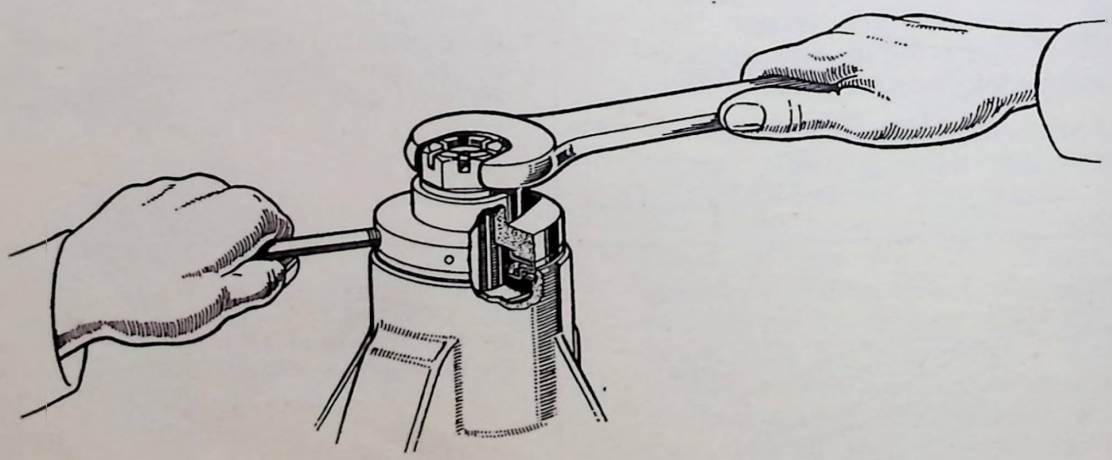


Fig. 28.

SERVICE TOOL LIST. (No. 2 Axle).

Tool No.	*Description.*
SE.101	Universal Dial Test Indicator, Catalogue No. 160 supplied by J. E. Baty & Co., Ltd., 39 Victoria Street, London S.W.1.
SE.102	Axle Shaft Extractor.
SE.103	Pinion and Differential Bearing Cone Puller.
SE.104	Gear Carrier Stretching Fixture.
SE.105	Pinion Bearing Cup Extractor.
SE.106	Bearing Cup Installation Tool.
SE.107	Pinion Cone Setting Gauge.
SE.108	Pinion Oil Seal Installation Collar.

Drawings of these service tools SE.102/108 may be obtained from Salisbury Transmission Co. Ltd., Witton, Birmingham, 6, on application.

REAR SUSPENSION.

Description.

The rear road springs are semi-elliptic. Each spring is secured to the axle banjo by two "U" shaped clips, two bridge pieces and four self-locking nuts. For the No. 2 axle which has a smaller diameter axle tube, a wrapper is inserted between tube and clip. A fibre pad is fitted between the axle pad and the spring, the centre pin of which locates in a hole machined in the axle pad. The forward end is supported in a fixed bracket by a rubber bush with steel inner and outer shells which is a press fit in the eye of the spring, and a push fit on to the shackle bolt. A shackle supports the spring at the rear end. The shackle is fitted with rubber moulded bushes, a push fit in the eye of the spring ; and in the chassis bracket and the shackle pins the bushes are loaded by compressing the shackle plates together. The leaves are held in contact with one another by four turnover type of leaf clips.

Maintenance.

No lubrication is needed by the bushes or their pins and, since a spring is essentially a frictional device, no effort should be made to inject grease between the contacting surfaces of the leaves. To service a spring correctly, keep it clean and periodically spray it with some form of penetrating fluid in sufficient quantity to eliminate squeaks. The nuts of the spring to axle clips should be checked periodically for tightness and the leaf clips maintained in a similar condition so that the leaves will work as a complete unit and not individually.

TO REMOVE AND REPLACE A REAR ROAD SPRING.

(1) Jack up the car under the rear cross member until the wheels are clear of the ground and place blocks or suitable supports under the chassis at points immediately forward of the front spring brackets of both rear springs.

(2) Remove the wheel adjacent to the spring to be dismantled and place a Jack under the centre of the rear axle banjo to support the axle when it is detached from the spring.

(3) Remove the four self-locking nuts on the spring to axle "U" clips, the bridge pieces and drive the clips out of position, also the wrapper in the case of the No. 2 axle. Raise the axle slightly to relieve the spring of all load and remove the fibre packing fitted between the spring and axle.

(4) Bend back the tabs of the lock plates securing the nuts on the pins of the rear shackle, remove the lock plate and the outer side plate of the shackle. Support the spring, and since the shackle pins are formed integral with the inner side plate, drive both pins out at the same time. Remove the forward spring pin, after bending down the tab of the lock washer.

Replacement is in the reverse order of removal, but observe the following :—

The moulded rubber bushes must be a press fit in the eye of the spring. If the original spring is being replaced and the bush is loose in the eye, fit a new bush. If this is also loose replace the main leaf of the spring, but it is preferable to replace the spring complete if it has a considerable number of miles to its credit.

The spring is dismantled quite readily by bending back the ears of the leaf clips and removing the centre bolt. When reassembling see that the nut of the centre bolt is tight and that the leaf clips are firmly riveted in position and embracing all the leaves securely when assembled.

Replace any worn pins and/or bushes.

Assemble the spring with the shackles, bolts, plates, lock plate and nuts to the chassis in their correct sequence, but do not tighten up the nuts. Leave this as a final operation when the weight of the car is on the springs

and wheels. This is to ensure that the moulded rubber bushes will not be in a stressed condition when in their normal working positions. This precaution must also be observed if the shackle nuts are released for any purpose.

Fit the fibre packing between the spring and axle and ensure that all butting surfaces are firmly in contact with one another before inserting the "U" clips or tightening their nuts. Note the "U" clips wrapper on the No. 2 axle.

SHOCK ABSORBERS TO REAR SUSPENSION ARMSTRONG DAS10 TYPE.

Description.

The ARMSTRONG Lever Type Shock Absorber is of the hydraulic double acting type, and works on the principle of pumping oil backwards and forwards between two cylinders through suitable valves set to give the required degree of restriction in each direction. This design has advantages in that, firstly all the working parts are submerged in oil, and, secondly, it is only necessary to recuperate the almost negligible amount of oil which is forced past the pistons by pressure built up as the Shock Absorber operates.

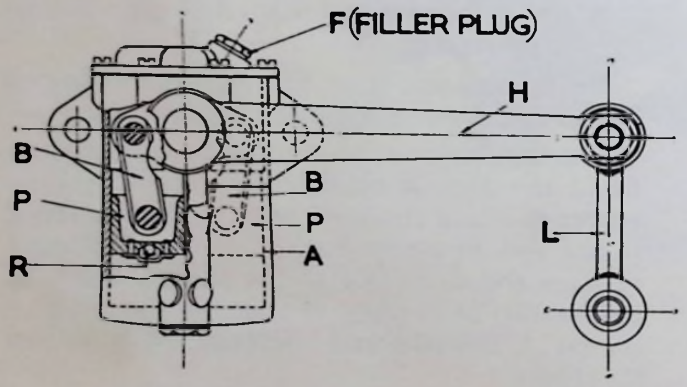


Fig. 29. Sectioned View of Rear Shock Absorber.

Detail Construction of the Armstrong Shock Absorber.

The operation of the Shock Absorber will be understood from the following description and reference to the accompanying drawings.

The Shock Absorber body (A) is bolted to the car chassis and the lower end of link (L) is connected to the axle. When the axle moves relative to the chassis (this movement being allowed by the car spring) arm (H) is moved up or down, and, since it is splined to spindle (S) the latter is rotated. The spindle in turn, is splined to the crank assembly (C) which is connected by means of connecting rods (B) to pistons (P) in which are situated lightly spring-loaded recuperating valves (R). Thus pressure is built up in one cylinder or the other, and since the cylinders are connected by ports in the body to valve chamber this pressure is dependent on the valve settings. The Shock Absorber is filled up to the bottom of the filler plug boss which prevents over filling and maintains the necessary air space essential to correct operation. It is sealed by filler plug (F), thus completely submerging the working mechanism in oil. Oil is prevented from leaking along the spindle by means of oil seal (O).

Valve Operation.

To accomplish general damping of the car springs, a small bleed is built into the valve. This operates both on compression (axle moving up), and on rebound (axle moving down). As bumps become more severe on compression, pressure builds up in the left-hand cylinder of the DAS type, and blows compression valve (VC) off its seat at a pre-determined pressure controlled by spring (SC). As the speed of rebound increases, pressure is built up in the right-hand cylinder, and blows rebound valve (VR) off its seat at a pre-determined pressure controlled by spring (SR). It will be clear that, by suitable selection of springs, any range of blow-off from zero to the maximum rating of the Shock Absorber can be obtained in either direction.

Maintenance.

The maintenance required by the Shock Absorbers consists of a periodical examination of the bolts and nuts which secure the Absorbers to the chassis and the link to the axle, and the topping up of the fluid in the reservoir as directed in the lubricating chart given on *page M9*. Only Armstrong Super (thin) Fluid, No. 624, should be used, and filled as shown in *Fig.* 31 on *page E21*.

Testing a Shock Absorber.

Should it be suspected that the rear suspension is not being adequately controlled, the Shock Absorber should be tested as follows :—

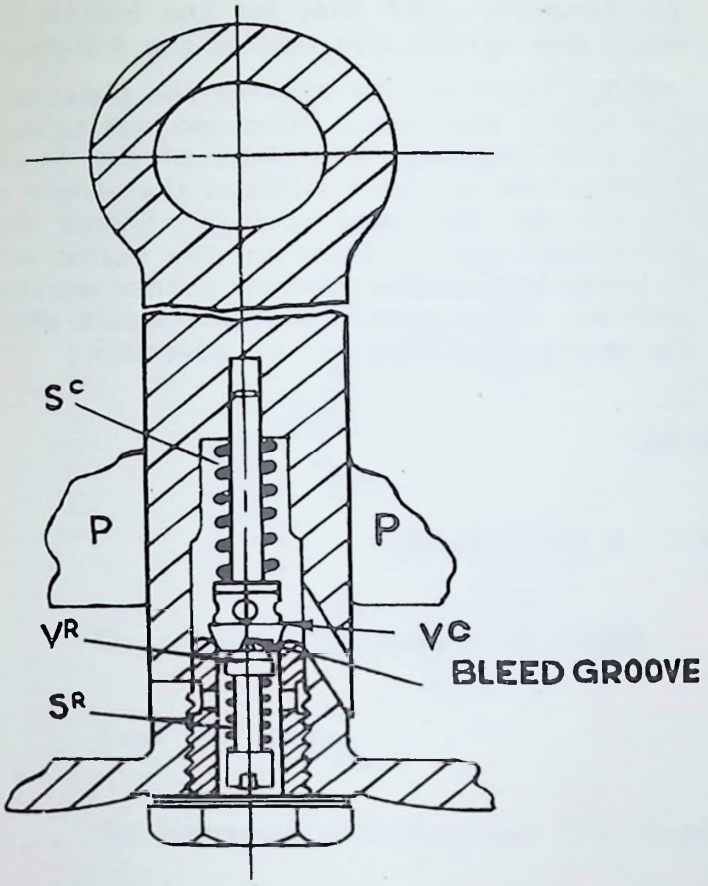


Fig. 30. Section through Valve.

Disconnect the link of each Shock Absorber from its anchorage on the rear axle casing, and move the lever up and down slowly through its complete range of movement. A moderate resistance equal at all points throughout the range of arm movement should be evident. This is the 'bleed' or leak setting.

To check the main valves move the arm sharply up and down. Resistance should immediately be built up, increasing as the arm is moved faster.

Should resistance not be even and free movement felt, this would be an indication that the unit is short of fluid, in which case detach the unit from the car, and deal with it as follows :—

To Remove and Replace the Shock Absorber for Filling or Repairs.

Detach the Shock Absorber from the car by removing the two bolts securing it to the chassis, and the nut securing the Shock Absorber Link to the axle. Place the Shock Absorber in a vice holding it by its fixing lugs to avoid distortion of the cylinder body. Wipe the filler plug and the body of the unit in the vicinity of the plug, remove the plug, and top up with Armstrong Super (thin) Fluid.

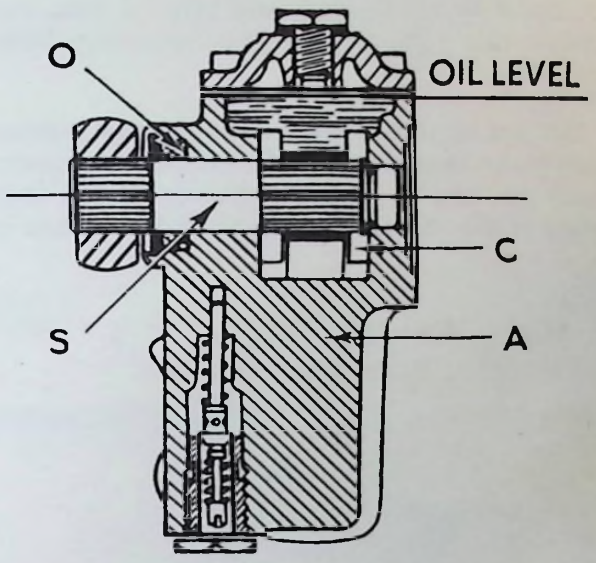


Fig. 31. Section View through Spindle and Valve. Also showing Fluid Level.

When servicing Armstrong Shock Absorbers, it is of primary importance that the correct type of Fluid is used, otherwise the Shock Absorber will not function correctly. The correct type of fluid for use in conjunction with the Armstrong Shock Absorber is Armstrong Shock Absorber Oil, No. 624, but in territories where this cannot be obtained any good quality mineral oil to SAE.20/20W specification may be used for topping up purposes only. It must be clearly understood, however, that these alternatives are not suitable for low temperature operation, and are deficient in various other ways. They should, therefore, only be used as an emergency measure.

During the filling operation work the arm slowly up and down throughout its range of movement to exclude air. Replace the filler cap. Finally, check the tightness of the lid screws and valve cap. In the event of inability to stop a leakage from the lid, a new gasket should be fitted. Should refilling fail to remove the free movement refer the matter to the Armstrong Patents Co. Ltd., Eastgate, Beverley, Yorkshire, and obtain from them their observation.

Failures abroad should be referred to the nearest Distributor for Armstrong Shock Absorbers in the country concerned. Armstrong Patents Co. Ltd., Eastgate, Beverley,

Yorkshire, England, will be pleased to supply a list of their Export Distributors.

To replace the Shock Absorber reverse the dismantling operations, and after a test run check the tightness of the securing bolts and nuts.

Do not neglect to place a shakeproof washer under the head of each bolt, a lock plate under each nut, and to position the leg of the lock plate of the top nut against the top surface of the Absorber, and that for the bottom or lower nut against the side of the Absorber.

If not fitted in this manner the plates will not secure the nuts. Also, do not tighten the nuts securing the links of the Shock Absorber to the axle without the weight of the car on the road springs. Should this precaution not be observed the bushes will be under stress when in their normal working position, a circumstance which would affect the springing of the car very adversely.

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SECTION F
PROPELLER SHAFT

PROPELLER SHAFT.
Description.

A single propeller shaft with a Hardy Spicer type of universal joint at each end connects the gearbox to the rear axle. There are no exposed sliding splines on the shaft, the fore and aft movement, due to the rise and fall of the rear axle, is absorbed by the gearbox rear driving flange sleeve sliding on the splined end of the gearbox mainshaft. The load is taken by a needle roller bearing running on the hardened and ground outer diameter of the sleeve. The outer race for the needle bearing is a drive fit in the gearbox rear extension, and to prevent accidental withdrawal of the sleeve an external circlip is fitted on the inner end of the sleeve. Leakage of oil is prevented by an oil seal fitted in the extension, the lip of which bears on the ground surface of the sleeve. *See Fig.* 4.

TEST FOR WEAR.

Most common cause of wear is incorrect or insufficient lubrication. A needle bearing which has deteriorated can usually be identified by a low rumble and "snatch" at low speeds. Note, however, that propeller shaft is an excellent sounding-board for transmission noises, and noise may be caused by worn axle or gearbox bearings.

With propeller shaft on vehicle test wear on thrust faces by checking "lift" in joints either by hand or with lever. Check wear in needle roller bearings and splines by testing relative circumferential movement between parts. Check all bolts for tightness.

On stripped propeller shaft examine spider journals and needle bearings for signs of wear, such as loose fit, load markings or distortion. Parts must be replaced as complete assemblies, as new spider journal with old needle bearing race or vice versa will cause rapid wear. No oversizes available.

Bearing races should be light driving fit in yoke. If there is too much play, locating holes in yoke will wear oval, and yoke must be replaced. If wear occurs in fixed yoke which is part of shaft, complete tubular shaft assembly should be replaced.

TO REMOVE AND REPLACE THE ASSEMBLY.

Before removing the shaft, mark the relative positions of the flanges of the shaft, gearbox and rear axle to assist re-assembling the shaft in its original position.

Support the front end by a sling from the chassis, bend back the tabs of the lock washers and remove the securing nuts and bolts—four to each joint. The shaft can then be prised out of position ; but in no circumstances damage the joint faces.

TO DISMANTLE THE SHAFT.

Clean the enamel from off the snap rings and the top of the bearing races. Remove the snap rings by pinching the ears together with a pair of pliers and prising with a screwdriver.

If a ring does not snap out of the groove readily, tap the end of the bearing race lightly to relieve the pressure against the ring. Hold the shaft in position in the left hand with the shaft yoke lug on top, and tap on the radius of the yoke lightly with a copper hammer, see *Fig.* 1. The top bearing should begin to emerge, turn the joint over and remove the bearing race with fingers, *see Fig.* 2. If necessary tap the bearing race from inside with a small diameter bar, taking care not to damage the bearing race. Keep the joint in

Fig. 1. Removing Bearing.

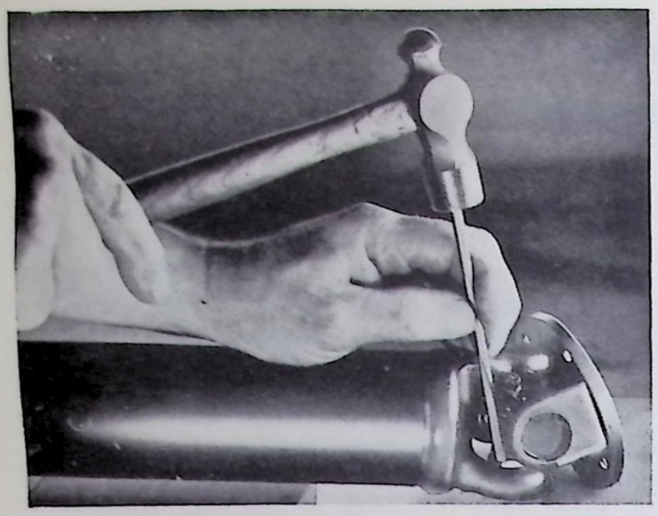

Fig. 2. Removing Bearing.

this position to avoid dropping the needle rollers. Repeat this operation for the opposite bearing. The yoke can now be removed. Rest the exposed trunnion on wood or lead blocks and remove the two remaining bearing races.

Repeat the foregoing operation on the rear joint. Wash all parts for examination.

EXAMINATION OF PARTS.

The parts most likely to show signs of wear after long usage are the bearing races and spider journals. Should load markings, distortion or looseness in the fit of these parts be observed renew them as complete assemblies as no oversize journals or bearing races are available. The bearing races are a light drive fit in the yoke trunnions.

In the event of wear in the cross holes in a yoke, which is part of the tubular shaft assembly, a complete tubular shaft assembly should be fitted.

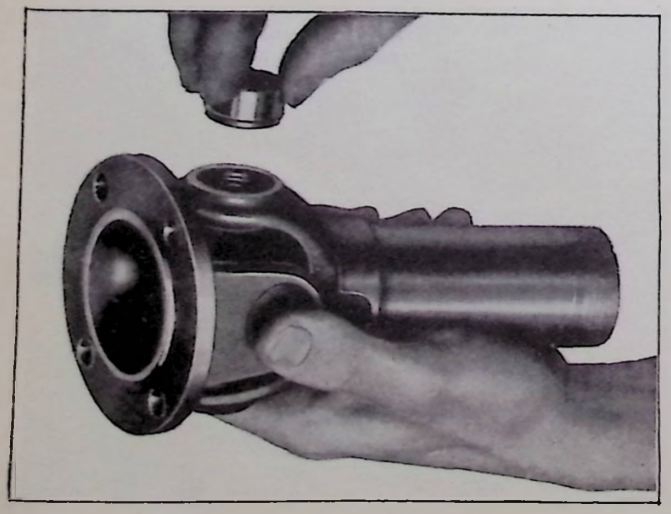

Fig. 3. Replacing Bearing.

TO REASSEMBLE.

See that all drilled holes in the journal are cleaned out and filled with oil, assemble the needle rollers in the bearing races and fill with oil. If difficulty is experienced in assembly, smear the walls of the races with vaseline to retain the needle rollers in place. Insert the journal in the flange yoke hole and tap the bearing into position with a soft flat faced drift about 1/32" (.8 mm.) smaller in diameter than the hole in the yoke. *See Fig.* 3.

Repeat this operation for the other three bearings. Replace the snap rings and be sure that these are clean and firmly located in the groove.

When assembled, if the joint appears to bind, tap the lugs lightly to relieve any pressure of the bearing on the end of the journal.

TO REPLACE SHAFT ASSEMBLY.

Wipe the companion faces of the flange and flange yokes clean to ensure that the pilot flange registers properly and contacts the faces all round. Insert the bolts and see that all nuts are tightened evenly and securely locked by knocking one tab of the washer over flange and the other against the nearest face on the nut.

It is advisable to always use new tab washers.

SLIDING JOINT.

Fig. 4 indicates this and method of dismantling has already been described on *page C.14.* Synthetic rubber oil seals are used for this application and no difficulty should be encountered when servicing the needle roller bearing or the seal. Make sure that the disc is in position in the centre of the sliding flange, this retains oil from the gearbox on the splines.

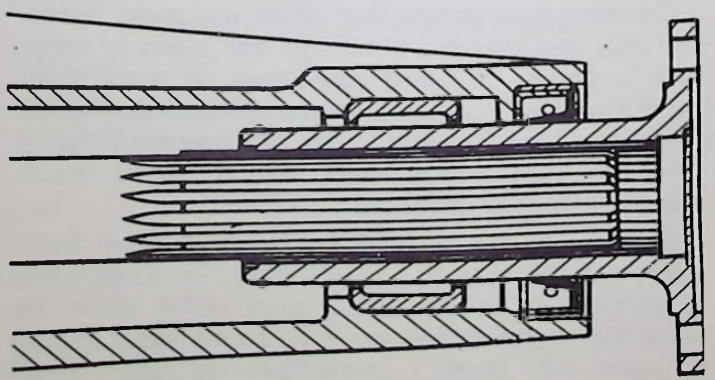

Fig. 4. Correct Method of Fitting Seal.

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SECTION G

CHASSIS FRAME

CHASSIS FRAME.

Description.

The frame is a pressed steel box sectioned unit extending from the front to the rear bumpers, with one cruciform and three tubular cross members.

The steering qualities of the car and such factors as tyre wear and springing, etc., are dependent on the alignment of the chassis being correct.

In view of the design and construction of the frame, misalignment arising under normal usage should not take place ; but there is the possibility that it may occur as the result of an accident, when the extent of the misalignment would depend on the nature of the accident.

Checking.

It is difficult to check the frame with the body in position. In most cases of accident, misalignment is readily apparent, but in any instance where doubt is present the body should be removed so that a satisfactory check can be made. For removal of the body *see page N.11.*

Special tools and considerable experience are needed to set and repair a frame and unless these are available the work should be entrusted to a firm who specialise in it. Fig. 1 indicates the correct relationship of various important holes, these are subject to a tolerance of approximately + or — $\frac{1}{16}$". (1.588 mm).

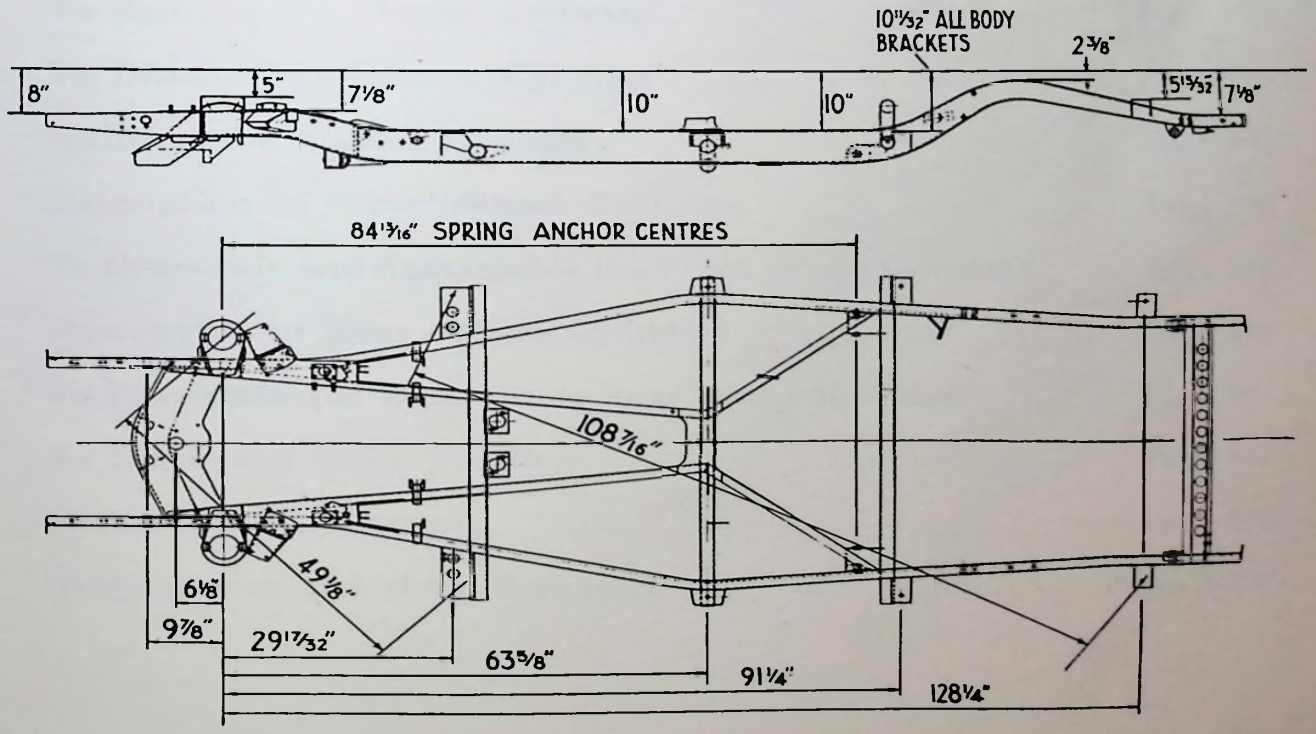

Fig. 1.

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SECTION H
BRAKES

DESCRIPTION OF THE FOOT BRAKE.

The Lockheed brake equipment fitted consists of : a master cylinder in which pressure is generated ; a reservoir formed integral with the Master Cylinder containing a reserve supply of fluid ; single ended internal wheel cylinders which operate the shoes of the front wheel brakes on the two leading shoe principle ; single ended internal wheel cylinders which operate the brake shoes of the rear wheel brakes and which incorporate the hand brake operating levers ; and the "line" consisting of tubing, flexible hoses and unions connecting the master cylinder to the wheel cylinders.

The Principle of Operation.

Pressure exerted on the brake pedal is conveyed to the brake shoes by a column of special Lockheed fluid.

When the brake pedal is operated the master cylinder piston applies a force to the fluid causing the single piston in each front wheel cylinder to apply pressure to the leading tip of its respective brake shoe, while the trailing tip of the shoe finds a floating abutment against the closed end of the cylinder of the other shoe ; at the same time the rear wheel cylinder, which is free to slide in an elongated slot in the rear back plate between the tips of the leading and trailing shoes, operates on the tip of the leading shoe which abuts against a fixed anchor block at the bottom of the back plate, the web of the shoe being free to slide in a slot in the block. The trailing shoe is located in a similar manner between the anchor block and the closed end of the cylinder and is free to slide and therefore self-centering. The trailing shoe is operated by movement of the cylinder assembly as a result of the reaction of the leading shoe against the brake drum. Further effort on the pedal increases the force applied to the brake shoes.

The pressure generated in the master cylinder is transmitted with equal and undiminished force to the piston of each wheel cylinder, therefore the pressures applied to the brake shoes are identical. When the pressure on the brake pedal is released, the brake shoe pull-off springs force each wheel cylinder piston back into its respective cylinder and the fluid passes back to the master cylinder for the next brake application.

Maintenance—Routine Attention.

Check the fluid level in the master cylinder and replenish to a level of half-an-inch (12.7 mm.) below the filler cap. Do not fill completely. Any considerable fall in fluid level would indicate a leak at some point in the system and should be traced and rectified immediately.

To check for leaks, apply firm pressure to the brake pedal and inspect the "line" and connections.

Ensure that the air vent in the filler cap is not choked ; blockage at this point would cause the brakes to drag.

Adjust the brakes when the pedal travels to within an inch of the floor before solid resistance is felt, but adjustment may be carried out before the brake linings have been worn to this extent.

TYPE OF FLUID.

The special fluid used in Lockheed brakes is one of the most important factors in the correct operation of the hydraulic system for no equipment will give satisfaction with incorrect fluid. When topping up or overhauling hydraulic brakes use only GENUINE LOCKHEED BRAKE FLUID (*Labelled SAE SPEC. 70 R2*) for it lengthens the life of all internal parts, acts as an efficient lubricant and operates satisfactorily under all extremes of temperature throughout the world.

TO FLUSH THE SYSTEM.

Should the fluid in the system become thick or "gummy" as it may after years in service, or after a vehicle has been laid up for some time, the system should be drained, flushed

and refilled. It is recommended that this should be carried out once every five years. Pump all fluid out of the hydraulic system through the bleeder screw of each wheel cylinder in turn. Connect one end of a rubber tube to the bleeder screw, allow the other end to fall into a container, unscrew the bleeder screw one complete turn and pump the brake pedal depressing it quickly and allowing it to return without assistance. Repeat, with a pause in between each operation, until no more fluid is expelled. Discard the fluid extracted.

Fill the supply tank with industrial methylated spirit and flush the system by pumping as described above. Keep the supply tank replenished until at least a quart of spirit has been passed through each wheel cylinder.

Where possible, remove the supply tank and pour off the remaining spirit.

Refill with clean Lockheed brake fluid and "bleed" the system.

NOTE. If the system has been contaminated by use of mineral oil, etc., the above process may not prove effective. The various units, including the pipe line, should be dismantled and thoroughly cleaned. All rubber parts, including flexible hoses must be replaced. The contaminated fluid should be destroyed immediately.

BLEEDING THE SYSTEM.

"Bleeding" the system—or expelling air—is not a routine operation and should be necessary only when some portion of the hydraulic equipment has been disconnected or when fluid has been drained off.

(1) Fill the supply tank with Lockheed brake fluid and keep at least a quarter full throughout the operation, otherwise air will be drawn in, necessitating a fresh start.

(2) Attach a rubber tube to the bleeder screw on one of the wheel cylinders and allow the free end to be submerged in a small quantity of fluid in a clean glass jar. Open the bleeder screw one complete turn.

(3) Depress the brake pedal slowly, allow it to return unassisted, repeat this pumping action with a slight pause between each operation. Watch the flow of fluid in the jar and when all air bubbles cease to appear, hold the pedal down firmly and securely tighten the bleeder screw.

(4) Repeat at all wheel cylinders.

NOTE. Clean fluid bled from the system should be allowed to stand for several hours, until it is clear of all air bubbles, before being used again. Dirty or discoloured fluid, if not contaminated, may be filtered and used again.

PEDAL ADJUSTMENT.

Incorrect pedal adjustment, *i.e.*, pedal to master cylinder push-rod, may prevent the master cylinder piston returning to its stop, thereby causing the lip of the main cup to cover the by-pass port. The excess fluid, drawn into the cylinder during the return stroke of the piston, will find no outlet and pressure will build up in the system causing all brakes to "drag" or remain "on".

A minimum clearance is necessary between the pedal push-rod and the master cylinder piston. A free pedal movement of $\frac{3}{4}$" (19 mm.) measured at the pedal pad, will give this minimum clearance. The free movement can be felt by gently depressing the pedal by hand and since the adjustment is set before the car leaves the works, no further attention should normally be needed ; but should an adjustment appear necessary, first check that the return of the pedal to the off position is not being prevented by a displaced mat or floorboard.

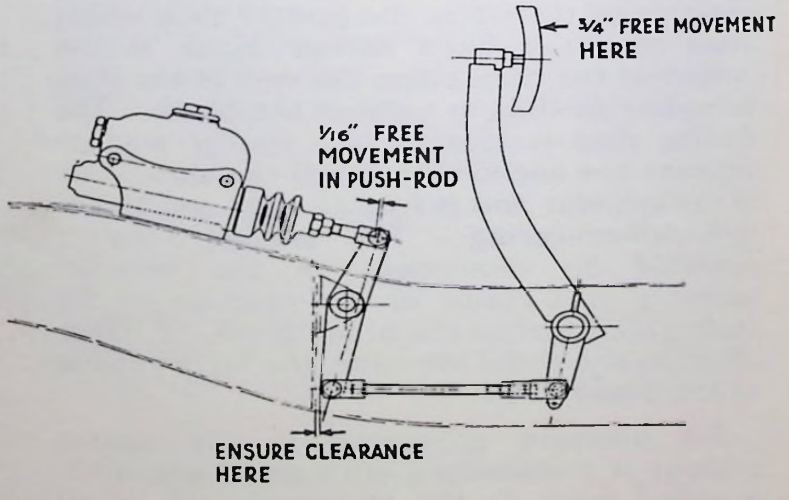


Fig. 1. Measuring Free Movement.

To make an adjustment, slacken the locknut securing the forked joint to the relay lever rod, remove clevis pin and screw "in" or "out" the forked joint, until the pedal can be depressed the correct amount of $\frac{3}{4}$" (19 mm.) free movement before the piston begins to move. Re-tighten the locknut. For details on the setting of the pedal and the relay lever *see page H.7.*

BRAKE SHOE ADJUSTMENT.

Front Wheels "Micram" Adjuster.

Remove the wheel dust cap and jack up the wheel until it is free to revolve. Turn the wheel so that the holes in the wheel hub and brake drum are opposite the slotted head of one "Micram" adjuster. Turn, with the screwdriver, the adjuster in a clockwise direction until the brake shoe is in contact with the brake drum, then turn the adjuster back one notch ; this should provide the correct clearance between the shoe and the drum. If closer adjustment is required, spin the drum and apply the brakes hard ; this will correctly position the shoe, when a further adjustment and check should be carried out. Repeat these operations on the second adjuster. Adjust the brake shoes of the other wheel in a similar manner.

Rear Wheels—"Micram" Adjuster.

Chock the front wheels and release the hand brake. Proceed as for front brake adjustment but note that there is only one adjuster for each rear wheel, *Fig.* 2, and that it may be necessary to back off the adjustment by two notches to provide adequate clearance for the two shoes.

RELINING THE BRAKE SHOES.

When relining the shoes, obtain from an authorised SINGER Distributor or Dealer, genuine SINGER replacement liners complete with rivets.

In no circumstances use linings of different texture on the various brake shoes as this will produce uneven braking despite the equal pressure exerted on all shoes.

TO REMOVE THE FRONT WHEEL CYLINDERS AND BRAKE SHOES.

Jack up the wheel to be treated by placing the jack under the front suspension arm and by the damper attachment. Remove the wheel, back off all the available adjustment and remove the brake drum. Pull one of the brake shoes against the load of the pull-off springs away from the abutment on the closed end of the adjacent cylinder, and slide the "Micram" mask off the piston cover of the operating cylinder ; on releasing the tension of the pull-off springs the opposite brake shoe will fall away. Disconnect the flexible hose at the backplate, unscrew the banjo bolts on both wheel cylinders and remove the banjo adaptors complete with the bridge pipe. Unscrew the nuts and withdraw the wheel cylinders from the back plate.

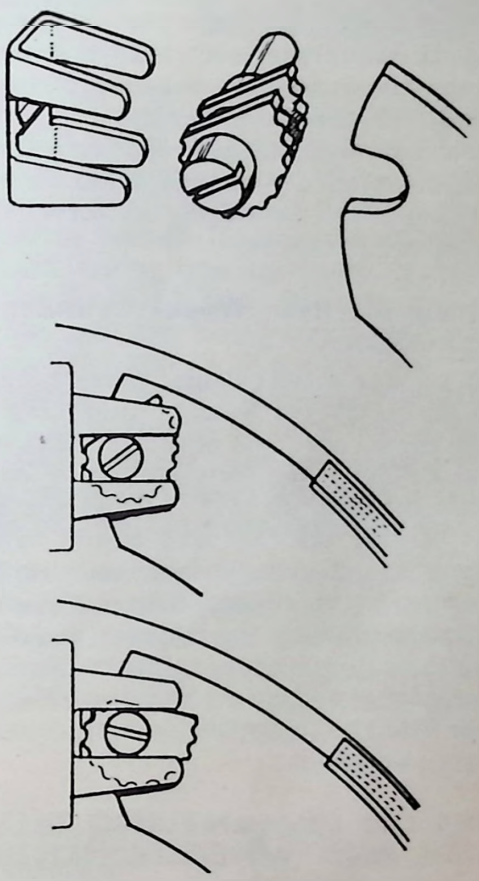


Fig. 2. Micram Adjusters.

Refitting the Front Wheel Cylinders and Brake Shoes.

Mount the wheel cylinders on the back plate and secure by means of the spring washers and nuts. Assemble the bridge pipe and banjo connections on the wheel cylinders, fit the banjo bolts and use new copper gaskets to ensure pressure-tight joints. Screw the flexible hose, complete with a new copper gasket, into the banjo connection and tighten securely. Assemble the brake shoes taking care to locate the "Micram" adjusters in the slots in the leading tip of each shoe, with the masks in position.

TO REMOVE THE REAR WHEEL CYLINDER AND BRAKE SHOES.

Jack up the rear axle and remove the wheel. Back off all the available adjustment, disconnect the rod from the handbrake lever and remove the brake drum. Pull the trailing shoe against the load of the pull-off springs away from its abutment at either end, then on releasing the tension of the pull-off springs the leading shoe will fall away. Collect the "Micram" adjuster and mask. Unscrew the banjo bolt securing the banjo adaptor to the wheel cylinder and remove the rubber boot. Swing the handbrake lever until it is clear of the back plate and slide the cylinder casting forward. Pivot the cylinder about its forward end and withdraw the rear end from the slot in the backplate ; a rearward movement of the cylinder will now bring its forward end clear of the backplate.

Refitting the Rear Wheel Cylinder and Brake Shoes.

Offer up the wheel cylinder to the backplate with the handbrake lever through the slot. Engage the forward end of the cylinder in the slot and slide it well forward, taking care to position the lever so that it clears the backplate. Engage the rear end of the cylinder in the slot and slide it back to hold it in position. Fit the rubber boot. Mount the banjo connection on the cylinder and fit the banjo bolt with new copper gaskets. Assemble the brake shoes and ensure that the "Micram" adjuster is in the slot in the leading shoe with the mask in position.

NOTES ON DISMANTLING THE MASTER AND WHEEL CYLINDERS.

Routine Instructions.

The operation of dismantling the master cylinder or wheel cylinders must be carried out under conditions of scrupulous cleanliness. Clean off the mud and grease before removing the units. Dismantle on a bench covered with a sheet of clean paper. Do not handle the internal parts, particularly rubbers, with dirty hands. Do not swill a unit in paraffin, petrol or trichlorethylene, as this will ruin rubber parts and, on dismantling, will give a misleading impression of their original condition.

Place all metal parts in a tray of clean brake fluid to soak, then dry off with a clean, fluffless cloth and lay out in order on a clean sheet of paper. Rubber parts should be carefully examined by comparison with new parts. Swollen cups or perished rubber indicate that they should be renewed immediately. The main castings may be swilled in any of the normal cleaning fluids but all traces of the cleaner must be dried out before assembly. In the case of the master cylinder make sure that the by-pass port is clear by probing with a piece of fine wire. The brakes will drag if the by-pass port is clogged as pressure will build up in the system and force the shoes into contact with the drums. The port is deliberately drilled first with a $\frac{1}{8}$" (3.17 mm.) drill half-way and then completed with a .028" (.7 mm.) drill which just breaks through into the bore.

All internal parts should be dipped in the Lockheed Brake Fluid and assembled wet.

The Stores Departments should exercise special care in handling brake parts to ensure that no damage is caused which would affect their correct functioning when assembled. Rubbers should be stored in a cold, dark place well removed from any fumes.

MASTER CYLINDER.

The integral barrel type master cylinder, *see Fig. 3, page H5*, incorporates the master cylinder and the fluid reservoir. In the head of the cylinder (E) is an inlet and outlet valve consisting of a metal body (B) containing a rubber cup (C), and a rubber washer (A) on which the metal body is urged by a return spring (D). The function of the valve is to prevent the return, to the master cylinder, of fluid pumped into the "line" during the bleeding operation, thereby ensuring that a charge of fresh fluid will be delivered at each stroke of the brake pedal and a complete purge of air from the system. During normal operation, fluid returning under pressure and assisted by the effort of the brake shoe pull-off springs, lifts the valve off its seat, thereby permitting fluid to return to the master cylinder and the brake shoes to the "off" position.

Directly in front of the main rubber cup (F), when the system is at rest, is a by-pass port which ensures that the system is maintained full of fluid at all times, and allows full compensation for expansion of the fluid due to changes of temperature. It also serves to

release additional fluid drawn into the cylinder from the annular space formed by the reduced skirt of the piston (H), through the small holes in the piston, after each brake application. A dished washer (S) is fitted between the rubber cup and the piston to prevent the adhesion of one to the other. For exact position of washer *see Fig.* 4. If this aforementioned additional fluid is not released to the reservoir through the by-pass port, it is due either to the hole being covered by the main cup as a result of incorrect pedal adjustment, or to the hole being choked by foreign matter and pressure will build up in the system and all brakes will drag.

TO REMOVE THE MASTER CYLINDER.

(1) Disconnect the main pressure pipe line from the master cylinder at the union at the forward end of the master cylinder.

(2) Extract the cotter and clevis pins securing the relay lever to the master cylinder push rod.

(3) Remove the two nuts, bolts and spring washers securing the cylinder to the support bracket on the chassis frame. The cylinder can now be removed.

TO DISMANTLE A MASTER CYLINDER.

Detach the rubber boot (N), *see Fig.* 3 from the cylinder (E) and withdraw the push rod from the boot. Push the piston (H) down the bore of the cylinder to release the pressure on the piston stop (L), remove the circlip (M) and the piston stop. Withdraw the piston, the dished washer (S), rubber cup (F), return spring (D), valve body (B), complete with rubber cup (C) and the rubber washer (A). Then, with the fingers to prevent damage, remove the secondary cup (K) by stretching it over the end flange of the piston.

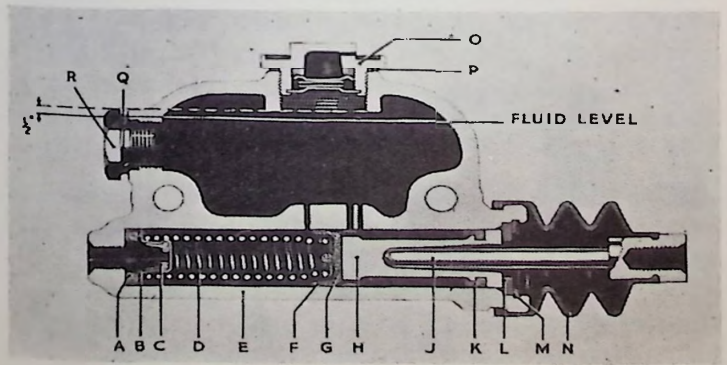


Fig. 3. Fluid Level.

To Assemble a Master Cylinder.

Fit the secondary cup (K) on the piston (H), so that the lip of the cup faces the piston head, and gently work the cup round the groove with the fingers to ensure that it is properly seated. Place the rubber washer (A) in position in the bottom of the cylinder bore. Fit the rubber cup (C) in the metal body (B) and assemble the body on the larger end of the return spring (D). Assemble the retainer (G) on the smaller end of the return spring and insert the assembly into the cylinder so that the valve body is in contact with the rubber washer. Insert the main cup (F) and the dished washer (S) into the cylinder, lip foremost, taking care not to damage or turn back the lip of the cup. Press the piston (H) into the cylinder, taking care not to damage or turn back the lip of the cup (K). Insert the stop (L) and fit the circlip (M), ensuring that it beds evenly in its groove. Fit the boot (N) with the vent hole leading downwards when the master cylinder is in position on the car and insert the push rods (J).

Fill the reservoir with clean Lockheed Brake Fluid and test the master cylinder by pushing the piston inwards and allowing it to return unassisted ; after a few applications, fluid should flow from the outlet connection in the master cylinder head.

REFITTING THE MASTER CYLINDER.

(1) Place the cylinder in its support, the bolts, nuts and shakeproof washers into position and tighten securely.

(2) Attach the eye of the push rod to the relay lever and the main pressure pipe to its union on the cylinder.

(3) Check pedal adjustment as on *page H2.*

(4) Fill the reservoir with fluid, bleed the system and check for leaks by applying firm pressure to the pedal and inspecting the "line" and connections. Do not neglect to bleed the system after a rectification of any leak which may be present.

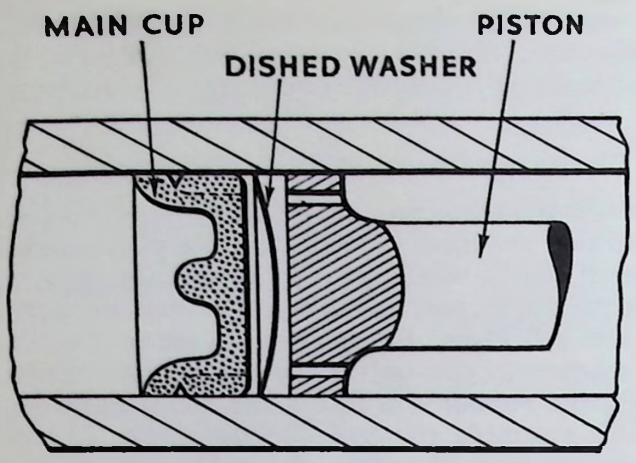


Fig. 4. Section through Master Cylinder showing Position of Dished Washer.

FRONT WHEEL CYLINDERS.

Description.

The front wheel cylinders are rigidly mounted on the backplate inside the brake drum and between the ends of the brake shoes. Each cylinder operates one shoe only. A single piston in each cylinder acts on the leading tip of its respective shoe, while the trailing tip of the shoe finds a floating abutment against the closed end of the actuating cylinder of the outer shoe. Between the piston and the leading tip of each shoe is a "Micram" adjuster located in a slot in the shoe.

This type of wheel cylinder, an exploded view of which is shown in Fig. 5, has a blind bore to accommodate the piston (A), the rubber cup (B), the filler cup (C) and spring (D). The rubber cup mounting the cup filler is loaded upon the piston by a spring which is located in a recess formed in the cup filler.

TO DISMANTLE AND REASSEMBLE THE FRONT WHEEL CYLINDERS.

Withdraw the piston complete with the cover from the cylinder and apply a light air pressure to the fluid connection to expel the rubber cup, the cup filler and the spring. To assemble, fit the smaller end of the coil spring over the projection in the cup filler and insert both parts into the cylinder—spring foremost ; follow up with the rubber cup—lip foremost, and taking care not to turn back or damage the lip, insert the piston complete with piston cover.

REAR WHEEL CYLINDERS.

Description.

The wheel cylinder (A), *see Fig.* 6, contains a single piston split in two, the inner piston (B) being hydraulically operated while the outer piston (C) is manually operated by the handbrake lever (D). A rubber cup (E) mounting a cup filler (F) is loaded upon the inner piston by a spring (J). When operated hydraulically the inner piston butts against the outer piston, leaving the handbrake lever (D) undisturbed, and applies a thrust to the tip of the leading shoe through the dust cover, the "Micram" adjuster and mask. When operated manually an inwards movement of the handbrake lever brings the heel of the lever into contact with the outer piston (C) thrusting it outwards against the leading shoe without disturbing the inner piston. A rubber boot (G) is fitted to prevent the ingress of foreign matter. (Note the sealing ring "K" mounted on a recess on the outer piston "C").

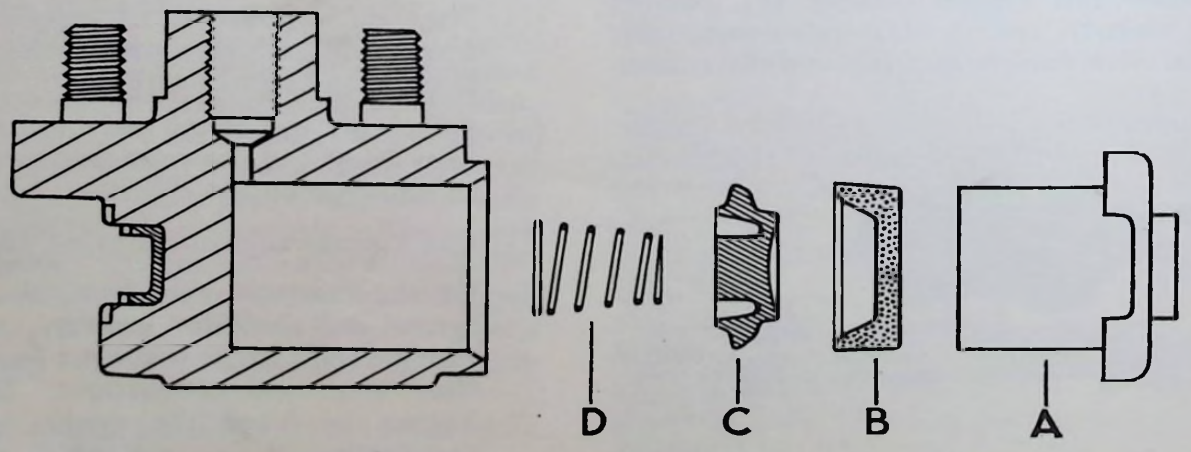


Fig. 5. Exploded View of Front Wheel Cylinder.

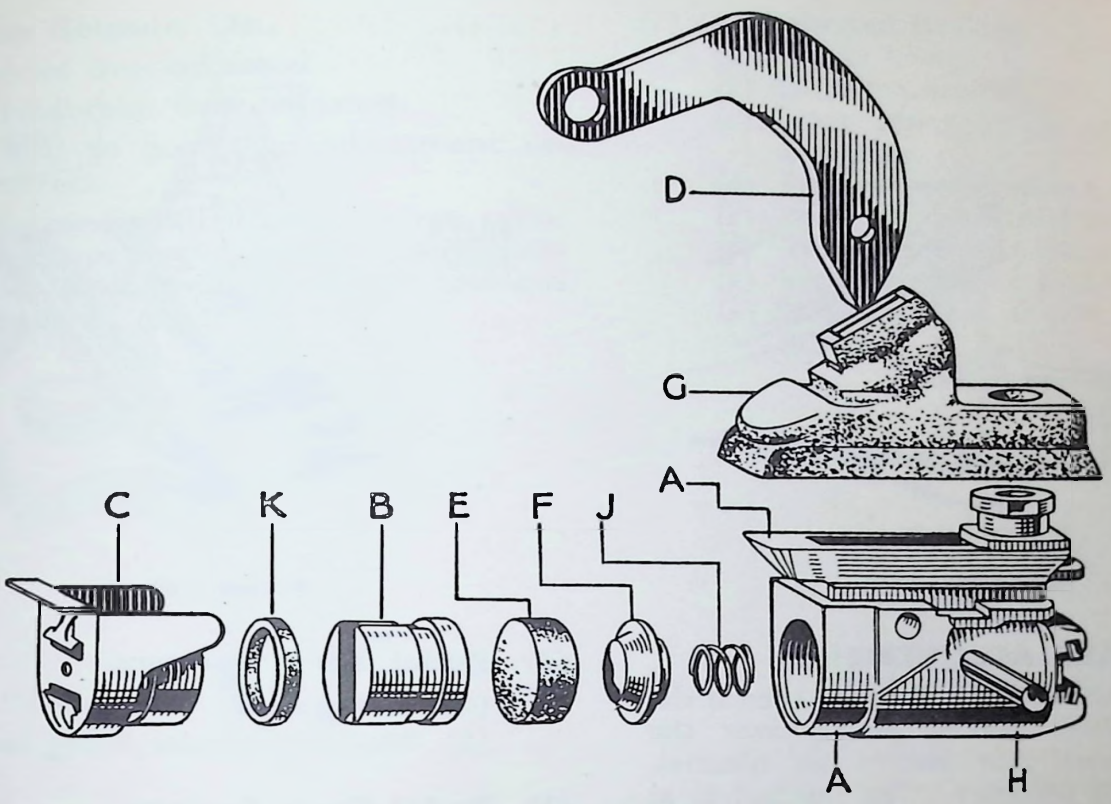


Fig. 6. Rear Wheel Cylinder Exploded.

TO DISMANTLE AND REASSEMBLE.

Withdraw the piston (C), complete with the cover, from the cylinder (A). Withdraw the handbrake lever pivot pin (H) and remove the lever (D). Apply a light air pressure to the fluid connection to expel the inner piston (B), the rubber cup (E), the cup filler (F) and the spring (J).

To Reassemble.

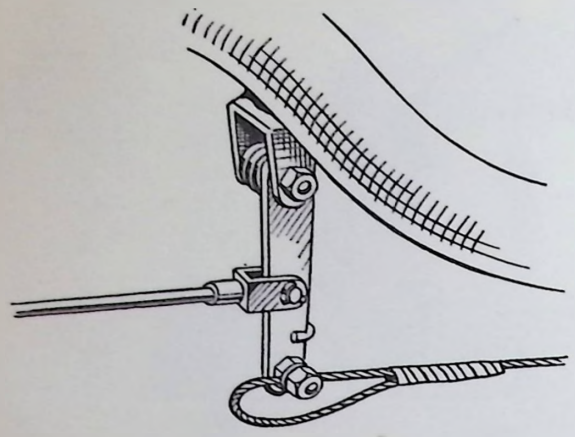
Fit the smaller end of the coil spring (J) over the projection in the cup filler (F) and insert both parts into the cylinder (A), spring foremost ; follow up with the rubber cup (E), lip foremost, taking care not to damage or turn back the lip of the cup. Insert the inner piston (B), ensuring that the slot in the piston coincides with the lever slot in the cylinder casting. Place the handbrake lever (D) in position and fit the pivot pin (H). Insert the outer piston (C) complete with dust cover, ensuring that the lever is engaged in the slot in the piston.

TO SET BRAKE PEDAL POSITION.

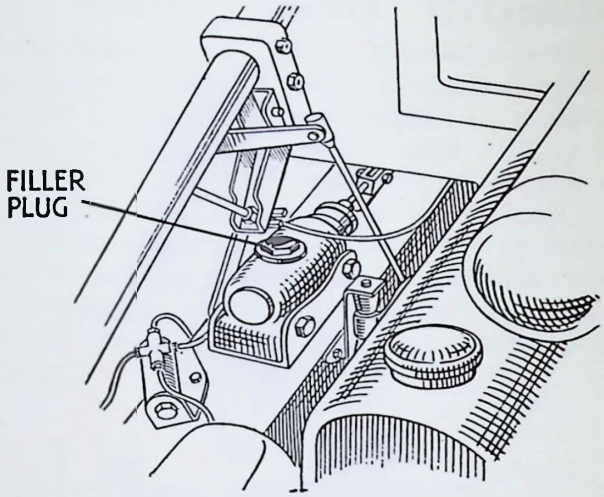
(1) Check and, if necessary, re-position the brake pedal so that the face of the eye in the pedal for the foot pad is 25″ (635 mm.) from the rim of the steering wheel. This adjustment is made by releasing the nut of the stop pin fitted in the lug on the bracket supporting the spindle of the pedal and screwing the pin "in" or "out" until the required dimension is obtained, and then re-tightening the locknut. This should give 4½″ to 5″ (114.3 to 127.0 mm.) pedal movement. If some adjustment of the foot pad from this position is required, release the lock nut on the shank of the pad, screw the pad "in" or "out" as necessary, and tighten the locknut.

(2) Make sure that the return spring for the pedal is maintaining it in the above position, and check that there is a working clearance between the lower end of the relay lever and the chassis frame. If an adjustment is required, lengthen or shorten the rod connecting the pedal to the relay lever by screwing "on" or "off" the forked joint the required amount.

For the pedal adjustment to be correct there should be ¾″ (19 mm.) free movement measured at the foot pedal pad. To obtain this free movement, release the locknut securing the fork joint to the relay lever rod, remove clevis pin and screw "in" or "out" the forked joint to the required amount. Make sure to re-tighten the locknut.



Hand Brake Cable.



Master Cylinder.

HANDBRAKE ADJUSTMENT.

Adjust first the foot brake, and then if the handbrake lever can be pulled over the quadrant more than five to six notches, adjustment is necessary. The method is as follows :—

Place chocks against the front wheels, release the handbrake lever and jack up the rear axle at points below the spring to axle anchorage until the wheels are clear of the ground. Then release the nut of the clip securing the cable to the lever under the chassis and remove the tape binding the end of the cable and the main portion together. Now force the lever under the chassis, forward to its full extent, draw the cable through the clip and tighten the securing bolt and nut. Check that the wheels can be revolved freely and if they are not free release the cable slightly and re-check. When the adjustment is correct bind the ends of the cable in its original position with a piece of new insulation tape, pull handbrake on to its full extent and lower the axle to the ground.

IRREGULARITIES AND THEIR REMEDIES.

(1) **Pedal Travel Excessive.**
(Requires pumping).
(*a*) Brake Shoes require adjusting.
(*b*) Master Cylinder push rod requires adjusting. (**Excessive** push rod clearance).

(2) **Pedal Feels Springy.**
(*a*) Linings not "bedded-in".
(*b*) Master Cylinder fixing loose.

(3) **Pedal Feels Spongy.**
(Does not hold pressure).
(*a*) Master Cylinder main cup worn.
(*b*) Master Cylinder secondary cup worn. (Air bubbles rise in supply tank).
(*c*) Leak at one or more points in system.

(4) **Brakes Inefficient.**
(*a*) Linings not "bedded-in".
(*b*) Linings greasy.
(*c*) Linings incorrect type.

(5) **Brakes Drag.**
(*a*) Shoes over-adjusted.
(*b*) Shoe pull-off springs weak or broken.
(*c*) Pedal spring weak or broken.
(*d*) Pedal to push rod adjustment incorrect.
(e) Handbrake mechanism seized.
(*f*) Wheel cylinder piston seized.
(*g*) Supply tank overfilled.
(*h*) Master Cylinder by-pass port choked.
(*i*) Filler cap air vent choked.

(6) **Brakes Remain On.**

(*a*) Shoes over-adjusted.

(*b*) Handbrake over-adjusted.

(*c*) Pedal to push rod adjustment incorrect.

(*d*) Master Cylinder and/or wheel cylinder cups swollen, due to contamination with mineral oil or spurious fluid.

(7) **Unbalanced Braking.**

(*a*) Greasy linings.

(*b*) Distorted drums.

(*c*) Front spring broken or loose at anchorage.

(*d*) Tyres unevenly inflated.

(*e*) Brake backplate loose on axle.

(*f*) Worn steering connections.

(*g*) Worn suspension shackles.

(*h*) Different types or grades of linings fitted.

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SECTION J
WHEELS & TYRES

WHEELS AND TYRES.
General Note.

It is important that a tyre is properly mounted on the rim of the wheel. An improperly mounted tyre may cause premature failure. On a tyre and tube assembly this is what can happen : the tube can be chafed, pinched, creased or the valve pinched out, or foreign material dropped in the casing can damage the tube and tyre fabric. Improper seating of beads will cause the tube to stretch unevenly and create a series of buckles.

Modern well base rims are designed for ready mounting and tyres can be applied to these rims with the use of short blunt ended tyre tools. The edge of each tyre has a soft rubber tip which protects the tube from chafing. This tip must not be damaged in mounting. Vegetable oil or soft soap solution applied inside and outside the bead will facilitate mounting and protect the rubber tip. **Do not use mineral oil or grease.**

A dented or rusted rim can cause severe damage to the bead area by chafing or cutting. Examine the rim carefully and if these conditions cannot be removed readily, the fitting of a replacement should be suggested.

TYRE PRESSURES.

Check tyre pressures once a week, or more frequently if you drive a lot. Correct tyre inflation at all times will save you the service of one tyre in every four you use.

Inflate the tyres to pressures suitable for the conditions under which the car is to be used. With two passengers in the front seat a pressure of 24 lbs. per square inch in all tyres is sufficient. If in addition two passengers are carried in the rear seat, or luggage (300 lbs.) in the boot in place of two passengers, the pressure in the rear tyres should be increased to 28 lbs. per square inch. When carrying two in the front and two in the rear with luggage (250 lbs.) in the boot, or three in the rear seat, the pressure in the front tyres should be increased to 26 lbs. per square inch and that in the rear tyres to 30 lbs. per square inch. For long trips with luggage or when carrying five or six passengers, the pressure should be increased to 28 lbs. per square inch for both front tyres and 30 lbs. per square inch for both rear tyres.

A tyre which is **under-inflated** generates excessive heat, develops irregular and rapid wear, and is susceptible to injury. The sides bulge, causing excessive flexing and internal heat, and the breakdown of the cords may result.

Over-inflation brings only the centre of the tread in contact with the road. Wear is concentrated here, stealing thousands of normal tyre miles. Wheels ride "hard", and the danger of breaks in the cord and fabric of the tyre is increased.

THE CORRECT WAY TO MOUNT A TYRE AND TUBE.

(1) Inflate the tube to an extent where it is rounded out and place tube in the tyre. This partial inflation of the tube before mounting the tyre on the rim will avoid tube buckles.

(2) Apply the tyre to rim. Guide the valve with your hand through the valve hole in the rim.

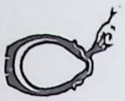
(3) Push the bottom bead at the valve into the well at the bottom of the rim.

(4) Force the remaining portion of the bead over the flange of the rim so that it rests in the well.

(5) At a point opposite the valve, pry the top bead over the rim flange by inserting tool between bead and the rim flange. Hold the tool in position, then with a second tool work around the rim until the entire bead is in place. The part of the top bead which is first applied, namely, opposite the valve, should be

pressed down into the wheel so that the remainder of the bead can be easily levered over the rim flange.

(6) Seat the valve correctly. Pull it out by hand and centre it. This is important.



(7) Hold the valve in this position and inflate until both tyre beads are properly seated.

(8) When a tyre has a centring rib, be sure this shows evenly above the rim all the way round.

CROSS-SWITCH OF TYRES EVERY 2,500 MILES.

The change round from one wheel position to another, or rotation of tyres, is necessary because if tyres are not moved in this way they will wear more rapidly and they may develop irregular wear.

Rotate your tyres every 2,500 miles. This can increase your tyre mileage by as much as 25%.

Front tyres wear faster than rear tyres due chiefly to the effects of independent front suspension layouts. Front wheels are free rolling, but subject to mechanical stresses. Rear wheels transmit the drive ; brake action also causes wear in the opposite direction.

Steeply cambered roads cause wear on nearside tyres. The rate of wear between a car's four tyres is in about this order—No. 1 indicating least wear :—

Offside Rear, 1.	Nearside Rear, 2.
Offside Front, 3.	Nearside Front, 4.

Rotation Method No. 1.

To equalise tread wear on all tyres *including the spare*, rotate your tyres every 2,500 miles. The rotation chart (Method No. 1) shows you how. Change wheels without dismounting tyres.

Additional factors to be considered in the proper rotation of tyres, are uneven tread wear on front tyres through misalignment, unbalanced wheels and mechanical irregularities.

Rotation Method No. 2.

This method is recommended for the car owner *without a dependable spare.* As with Method No. 1, change wheels without dismounting tyres.

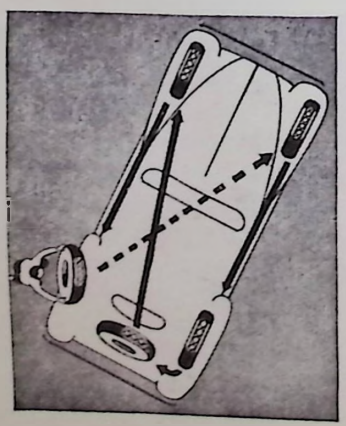
When interchanging tyres or wheels be sure that the front wheel assemblies including tyres, tubes, wheels and hubs, are in balance. Irregular front tyre wear may cause tyre noise. This may be corrected by rotating the front tyres according to any of the methods described above.

To ensure good tyre life, camber and toe-in (*see pages D2 and D3*) should be frequently checked.

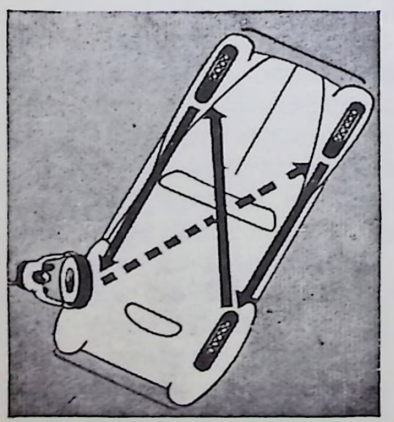
TUBELESS TYRES.

These are now fitted to Hunter cars when required, fitting particulars are given in the Goodyear Tubeless Tyre Service Manual obtainable from :—

The Goodyear Tyre & Rubber Co. (Great Britain) Ltd., Wolverhampton.



Method 1.



Method 2.

Fig. 1.

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SECTION K
COOLING SYSTEM

COOLING SYSTEM
Description

The cooling of the engine is through a copper gilled radiator aided by a water pump and fan.

The water is delivered by the pump to the forward end of the cylinder head and into a tube fitted inside the water jacket, extending along the entire length of the distributor side of the head. Holes in the tube direct the water on to the combustion chamber walls, around the exhaust valve guides and sparking plug bosses. The tube is inserted from the rear of the head and is positioned by a tab registering with a hole drilled in the rear cover which in turn is held by two countersunk screws. The hole is towards the top.

The water then passes through the head via the outlet pipe situated at the forward end of the head on its near side into the radiator header tank, from where it sinks through the gills of the radiator into the bottom tank and from here it is recirculated by the pump. A thermostat is fitted in the outlet pipe, this restricts the flow of water until the temperature in the head reaches 70°C., this is the normal running temperature of the engine, and the thermostat provides quicker warming up and improves the efficiency of the heater system.

Soft or rain water should always be used in the cooling system. A strict observance of this rule is essential, for by doing so the possibility of harmful deposits accumulating in the system is reduced to a minimum ; but it is beneficial to cleanse and flush the system periodically.

There are several reliable brands of flushing compounds on the market and these should be used strictly in accordance with the maker's instructions.

CAUTION. When using flushing compounds pay particular attention not to allow the smallest quantity to splash or contact the paintwork as damage will result.

When draining the compound out of the system do not neglect to do as described in the following paragraph and to make sure there is a free flow of water through all drain cocks. When assured that all traces of the compound have been removed, shut the two drain cocks and fill as previously directed with soft water. For position of cocks *see pages K2 and K3.*

TO FILL AND DRAIN THE COOLING SYSTEM.

The level of the water in the radiator header tank should stand 1½" (38 mm.) below the filler opening. The heater control must be on "HOT" when filling the cooling system.

Fig. 1 on page K1 shows the position of the water level in relation to the filler opening.

Pressure Filler Cap.

All cars are equipped with sealed water cooling system. This equipment not only prevents possible loss of water but also raises the boiling point about 12°F. (7°C.). The filling cap is airtight when fixed and to be fitted correctly it is only necessary to make sure that the cap is turned as indicated on top of the cap and that the seatings are clean and free of dirt or foreign matter and the fibre washer "A" is in good order. The pressure valve "B" is set to blow off at 7 pounds per square inch (.49 ksc.) pressure after which any steam generated will escape through the drain tube "D". If loss of water occurs through slight leakages the vacuum valve "C" opens and so restores the air to atmospheric pressure.

Fig. 1 shows a section through the pressure-vacuum cap, and the water level in radiator.

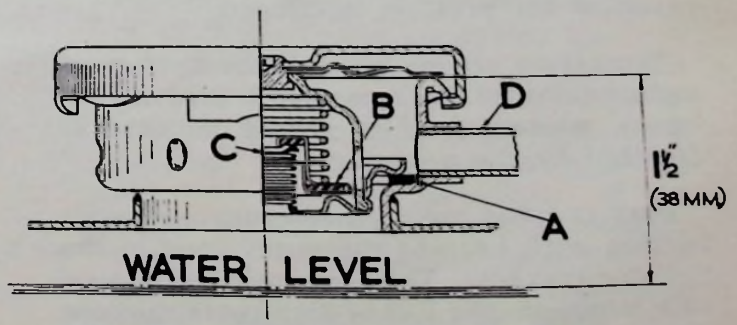

Fig. 1. Section through Pressure-Vacuum Cap.

To Drain Radiator.

To drain the entire system the two taps situated as follows must be opened and the pressure-vacuum cap must first be removed. Always remove the cap slowly and when replacing turn down quite tight (*see Fig. 3, page K.2*).

The first tap is in the bottom nearside corner of the radiator, the second on the off-side of the engine case to the rear of the dip-stick on page K3.

See that the Heater control knob is set to "HOT", so that the Heater element can drain off through the engine.

Should no water issue from any particular tap clean the central hole with a short length of stout wire.

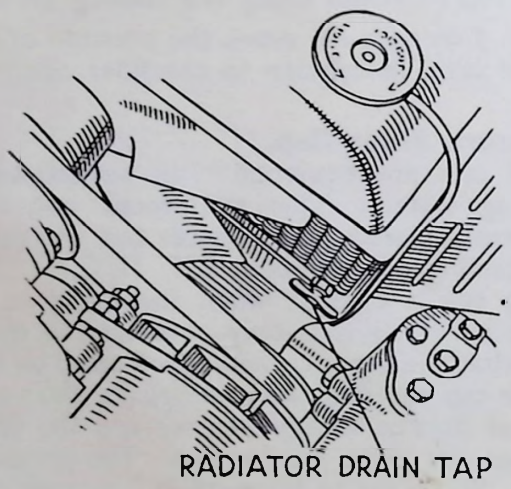

Fig. 2. Radiator Drain Tap.

Frost Precaution.

When frost is expected the entire cooling system should be drained by opening all the taps referred to. Failure to do so may result in the cooling water freezing and damaging the cylinder block and/or radiator as the result of the pressure developed.

Protection can be obtained by the use of one or other of the reputable brands of anti-freeze mixtures, which should be used as directed by the producers.

Bear in mind the recommendation in connection with keeping the water level in the radiator correct. The procedure will reduce to a minimum the loss of anti-freeze mixture down the overflow pipe.

TO REMOVE AND REPLACE THE RADIATOR.

(1) Lift the bonnet and drain the cooling system as described on *page K1*.

(2) Detach the water outlet hose from the outlet pipe on the cylinder head by releasing the clip. Deal similarly with the water inlet hose (connecting the bottom of the radiator to the water pump).

(3) Detach the four nuts, bolts and washers securing the radiator to the horizontal cross bars.

(4) The radiator can now be removed.

Replacement is the reversal of the foregoing. Make sure that the top pipe on the radiator is in line with the outlet pipe on the engine. Misalignment here could cause unnecessary wear on the hose due to engine movement.

Do not store the radiator in an inverted position or lying down, or flush it by passing water through from the pipe in the bottom tank. Any one or all the above circumstances would tend to cause sediment which may have collected in the bottom tank to pass into the gills from where it would be very difficult to dislodge.

Store in an upright position and flush by inserting the nozzle of the hose into the filler aperture.

Fig. 3. Showing Top of Pressure-Vacuum Cap.

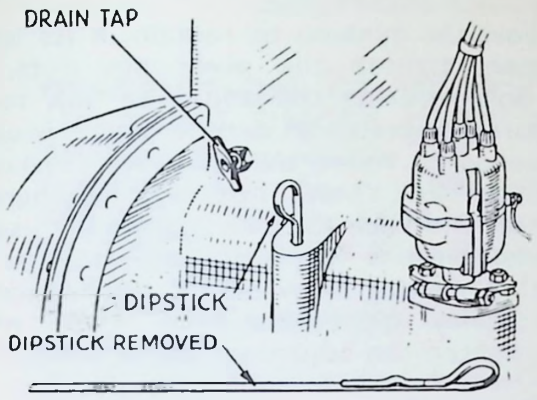

Fig. 4. Drain Tap and Dipstick.

TO DISMANTLE AND REASSEMBLE THE WATER PUMP.

(1) Remove the unit from the engine as stated on *page B.18*.

(2) Secure the boss of the fan pulley in a vice fitted with lead clamps to its jaws. Remove the nut securing the impeller and screw it off the spindle in an anti-clockwise direction. Be careful not to damage the gland assembly which is situated in a register machined in the forward face of the vane.

(3) The gland assembly is a push fit in its register and should not be disturbed unnecessarily. If a replacement is necessary, pay particular care not to damage the assembly as it is being inserted. The new gland must be a push fit and the carbon face must run dead true. Before replacing the impeller clean the sealing face on pump body and lap it with grinding paste, if the surface is not smooth.

(4) Secure the vane end of the spindle in the vice fitted with lead clamps and draw off the fan pulley. The tab of the locking washer should have already been bent back and the nut removed when the unit was detached from the engine. Remove the Woodruff key.

(5) Remove the circlip retaining the outer bearing in position and with a lead or wooden mallet drive out the spindle complete with inner and outer bearings and distance piece.

(6) Press off the bearings and distance piece from the spindle. Be careful not to damage the oil thrower and return thread machined on the spindle.

Assembly is the reversal of the foregoing.

TO RECTIFY A WATER LEAK FROM THE WATER PUMP GLAND.

(1) Remove pump from engine (*see page B18*) and dismantle.

(2) Examine the gland assembly. If it is loose in its location or the carbon ring fractured, or its surface in a pitted condition, or the spring appears weak, remove the gland and fit a replacement. Be careful when pressing it into position not to damage it in any way.

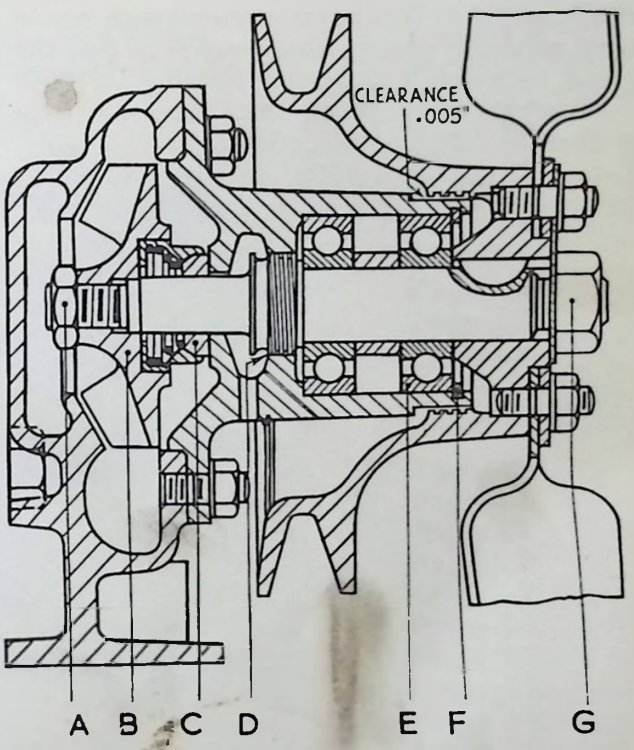

Fig. 5. Section through Pump.

A, Impellor Retaining Nut ; B, Impellor ; C, Gland Assembly ; D, Oil Retainer ; E, Bearing ; F, Bearing Retainer ; G, Fan Retaining Nut.

(3) Examine also the seating machined in the housing for the carbon ring. This seating should be flat, smooth and without evidence of circular grooves. If any one or all the foregoing conditions are present completely dismantle the pump and machine the seating so that its surface is smooth, flat and square to the bearing housing. This operation must be carried out with care, for the success of the repair depends on the degree of accuracy observed. Finally lap the surface of the gland to the seating with fine grinding paste. Wash all traces of paste away before assembling the parts.

Maintenance.

The fan bearings are packed with grease when the unit is assembled, but it is necessary, as directed in the Lubrication Section, *page M4 and M7*, that a small quantity be injected after each 5,000 miles (8,000 kilometres) running. Restrict this amount to one stroke of the gun, for should it be in excess of this the excess will be injected into the space between the bearing and impeller housing and apart from finding its way past the gland into the cooling system it will block the drain hole in the housing. This latter circumstance would tend to allow water, which may seep past the gland, to enter the bearing housing.

After greasing check that the drain hole is clear.

TO ADJUST THE DRIVING BELT.

Allow the dynamo to remain in its lowest position, tighten the pivot pin nuts, and the bolt securing the adjusting link to the support bracket to an extent where pressure is needed to move the dynamo. Place the adjusting link bolt, nut and washers in position and with the belt engaged, raise the dynamo until it is possible to depress the length of belting between the fan and crankshaft pulley approximately $\frac{1}{2}$" (12.7 mm.), then tighten the adjusting link and bolt.

Do not on any account allow the belt to run too tightly.

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SECTION L

ELECTRICAL EQUIPMENT—IGNITION

DISTRIBUTOR, MODEL DKY4A USED ON SINGLE—CARBURETTOR ENGINES.

Description.

The coil ignition equipment comprises a high tension induction coil and a combined distributor, contact breaker and automatic timing control assembly driven at half engine speed via the camshaft. Current flowing through the primary or low tension winding of the coil sets up a strong magnetic field about it. This current is periodically interrupted by a cam-operated contact breaker, driven from the engine, and the subsequent collapse of the magnetic field across the secondary winding of the coil induces a high voltage in it. At the same time, a rotor arm in the distributor connects the secondary winding of the coil with one of a number of metal electrodes, from which cables lead to the sparking plugs in the engine cylinders. Thus, a spark is arranged to occur in the cylinder under compression at the exact moment required to produce combustion of the mixture.

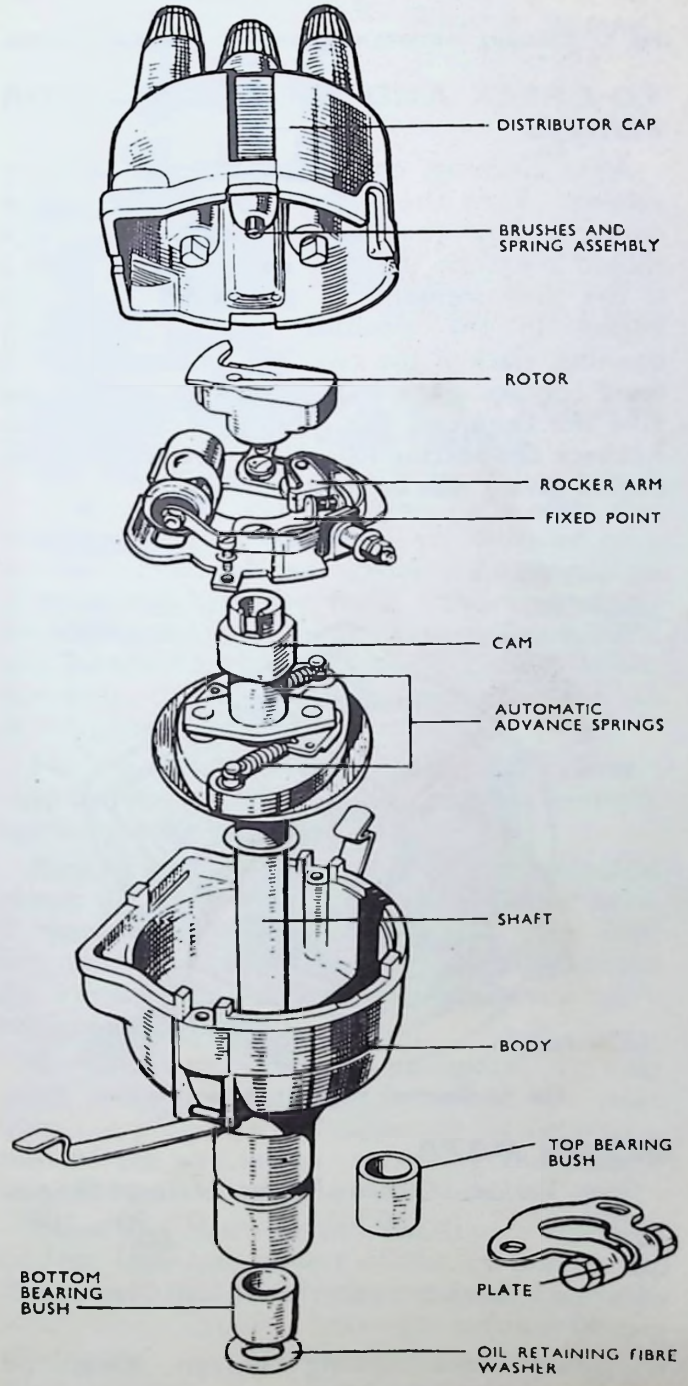


Fig. 1 Exploded View of Distributor.

Mounted on the distributor driving shaft, immediately beneath the contact breaker, is a centrifugal timing control mechanism. It consists of a pair of spring-loaded governor weights, linked by lever action to the contact breaker cam. At low engine speeds, the spring force maintains the cam in a position in which the spark is slightly retarded. Under the centrifugal force imparted by high engine speeds, the governor weights swing out, against the spring pressure, to advance the contact breaker cam and thereby the spark, to suit engine conditions at the greater speed.

ROUTINE MAINTENANCE.

In general, lubrication and cleaning constitute normal maintenance procedure.

LUBRICATION—EVERY 1,000 MILES.

Take care to prevent oil or grease from getting on or near the contacts.

Lightly smear the cam with a small quantity of Mobilgrease No. 2, or, if this is not available, clean engine oil.

Apply a spot of clean engine oil to the top of the pivot on which the contact breaker works.

Lift off the rotor arm by pulling vertically and apply to the spindle a few drops of thin machine oil to lubricate the cam bearing. It

is not necessary to remove the exposed screw, since it is either drilled or affords a clearance to permit passage of oil.

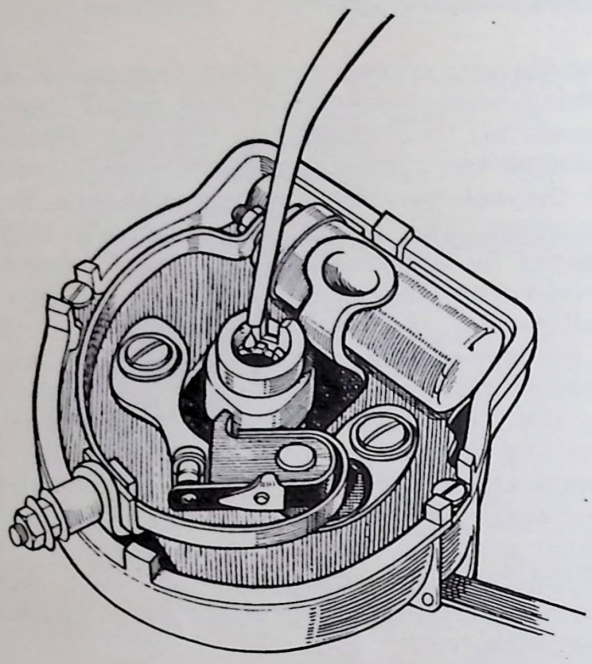


Fig. 2. Lubricating Cam Bearing.

Replace the rotor arm carefully, locating the moulded projection in the keyway in the spindle, and pushing it on as far as it will go, in order to avoid the risk of the moulded cap being burned or tracked.

A few drops of thin machine oil (*SAE.30*) should be applied, through the hole in the contact breaker base through which the cam passes, to lubricate the centrifugal timing control mechanism.

CLEANING—EVERY 6,000 MILES.

Thoroughly clean the moulded distributor cap, inside and out, with a soft dry cloth, paying particular attention to the spaces between the metal electrodes. Ensure that the small carbon brush moves freely in its holder.

Examine the contact breaker. The contacts must be quite free from grease or oil. If they are burned or blackened, clean them with very fine carborundum stone or emery cloth, then wipe with a petrol-moistened cloth. Cleaning is facilitated by removing the contact breaker lever. This can be done by slackening the nuts on the terminal post and lifting off the spring, which is slotted for this purpose.

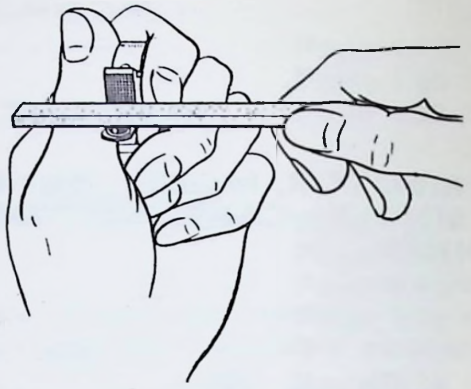


Fig. 3. Cleaning contacts with moving contact removed.

TO CHECK AND SET DISTRIBUTOR POINTS.

After cleaning, check the contact breaker setting. Turn the engine by hand until the contacts show the maximum opening. This should measure 0.014″-0.016″ (.35-.40 mm.) If the measurement is incorrect, keep the engine in the position giving maximum opening, slacken the two screws securing the fixed contact plate and adjust its position to give the required gap. Tighten the screws. Recheck the setting for other positions of the engine giving maximum opening.

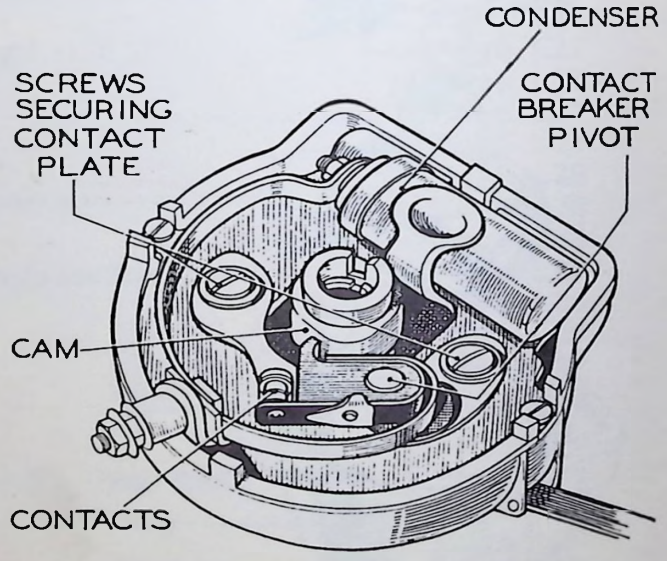


Fig. 4. Contact Breaker Adjustment.

DESIGN DATA.

Open Period	*Closed Period*	*Firing Angles*
30° ± 3°	60° ± 3°	0°, 90°, 180°, 270° ± 1°

Contact braker gap : 0.014″-0.016″ (.35-.40 mm.).

Contact braker spring tension, measured at contacts : 18-24 oz.

Condenser capacity : 0.2 microfarad.
Rotation : Clockwise.

CHECKING CENTRIFUGAL TIMING CONTROL.

Set to spark at zero degrees at less than 100 r.p.m.

Run distributor at 3,000 r.p.m. Advance should lie between 20° and 23°.

Check advance at following decelerating speeds :—

Speed r.p.m.	*Advance (degrees)*
1800	19°—21½°
1125	10°—12°
450	1°—3°
300	0°—1°

SERVICING.

Before starting to test, make sure that the battery is not fully discharged, as this will often produce the same symptoms as a fault in the ignition circuit.

TESTING IN POSITION TO LOCATE CAUSE OF UNEVEN FIRING.

Run the engine at a fairly fast idling speed.

Short circuit each plug in turn with, say, the blade of an insulated screwdriver or a hammer head placed across the terminal to contact the cylinder head. Short circuiting the defective plug will cause no noticeable change in the running note. On the other, however, there will be a pronounced increase in roughness.

Having thus located the defective cylinder, stop the engine and remove the cable from the sparking plug terminal.

Restart the engine and hold the cable end about $\frac{3}{16}$" (4.7 mm.) from the cylinder head. If sparking is strong and regular, the fault lies with the sparking plug, and it should be removed, cleaned and adjusted, or a replacement fitted.

If, however, there is no spark, or only weak irregular sparking, examine the cable from the plug to the distributor for deterioration of the insulation, renewing the cable if the rubber is cracked or perished.

Clean and examine the distributor moulded cap for free movement of the carbon brush. If tracking has occurred, indicated by a thin black line, usually between two or more electrodes, a replacement distributor cap must be fitted.

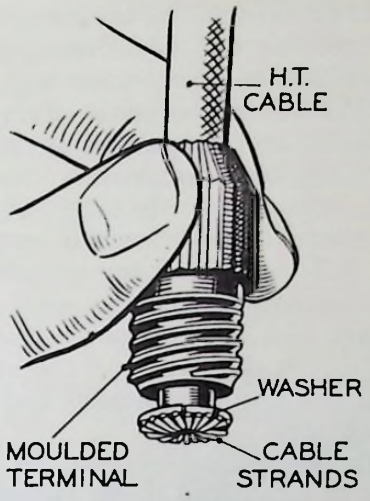


Fig. 5. Connecting H.T. Cable.

TESTING IN POSITION TO LOCATE CAUSE OF IGNITION FAILURE.

Spring back the clips on the distributor head and remove the moulded cap. Lift off the rotor, carefully levering with a screwdriver if necessary.

Check the contacts for cleanliness and correct gap setting as described previously.

Switch on the ignition and turn the engine. Observe the reading on the ammeter which should rise and fall with the closing and opening of the contacts if the low tension wiring is in order. When the reading does not fluctuate, a short circuit, or contacts remaining closed, is indicated. No reading indicates a broken or loose connection in the low tension wiring, or badly adjusted or dirty contacts.

LOW TENSION CIRCUIT—FAULT LOCATION.

No reading in ammeter test.

Refer to wiring diagram (*See page L33*) and check circuit for broken or loose connections, including ignition switch.

Check the ignition coil by substitution.

Steady reading in the ammeter test.

Refer to wiring diagram and check wiring for indications of a short circuit.

Check capacitor (either by substitution or on a suitable tester).

Check ignition coil by substitution.

Examine insulation of contact breaker.

HIGH TENSION CIRCUIT.

If, after carrying out these tests, the fault has not been located, remove the high tension lead from the centre terminal of the distributor. Switch on the ignition and turn the engine until the contacts close.

Flick open the contact breaker lever while the high tension lead from the coil is held about $\frac{3}{16}$" (4.7 mm.) from the cylinder block. If the ignition equipment is in good order, a strong spark will be obtained. If no spark occurs, a fault in the circuit of the secondary winding of the coil is indicated and the coil must be replaced.

The high tension cables must be carefully examined, and replaced if the rubber insulation is cracked or perished, using 7 mm. neoprene covered rubber ignition cable.

To fit new cables to the ignition coil and distributor pass the cable through the knurled, moulded nut, bare about $\frac{1}{4}$" (6.3 mm.) of the end of the cable, thread the wire through the brass washer (removed from the original cable) and bend back the strands. Finally screw the nut into its terminal.

The cables from the distributor to the sparking plugs must, of course, be connected in the correct firing order.

CONTACT BREAKER MECHANISM.

Check and adjust as described previously. Ensure that the moving arm moves freely on its pivot. If sluggish, remove the arm and polish the pivot pin with a strip of fine emery cloth. Replace the arm and lubricate with a spot of clean engine oil.

TO REMOVE DISTRIBUTOR FOR DISMANTLING.

See *page B19* for instructions to remove distributor.

TO DISMANTLE.

(1) Spring back the securing clips and remove the moulded cap.

(2) Lift the rotor arm off the top of the spindle. If tight, carefully lever off with a screwdriver.

(3) Slacken the nut on the terminal post and lift off the contact breaker spring. The contact breaker lever can now be lifted from its pivot. Lift the fibre washer from the pivot. Remove the two screws, together with the spring and plain steel washers, securing the fixed contact plate, and remove the plate.

(4) Undo the two screws with spring washers from the edge of the contact breaker base, which can now be removed from the distributor body.

(5) To remove a faulty condenser, unscrew the condenser terminal nut, lift off the spring washer and remove the connector strip. Soften the solder securing the condenser in its clip by use of a hot iron and remove the condenser by applying pressure at one end.

(6) Remove the dog from the shaft.

(7) Remove the cam, centrifugal timing control and shaft assembly from the distributor. Take out the screw from inside the top of the cam spindle. Lift off the cam and cam-foot.

CONDENSER—REPLACEMENT.

Should the condenser have been found to be faulty when testing, it is advisable to fit a complete new condenser and contact breaker base. If, however, only a condenser is available, great care must be taken not to overheat it, when soldering it in position. *Fig.* 6 shows the extracting tool advised for removing condenser from contact breaker base plate.

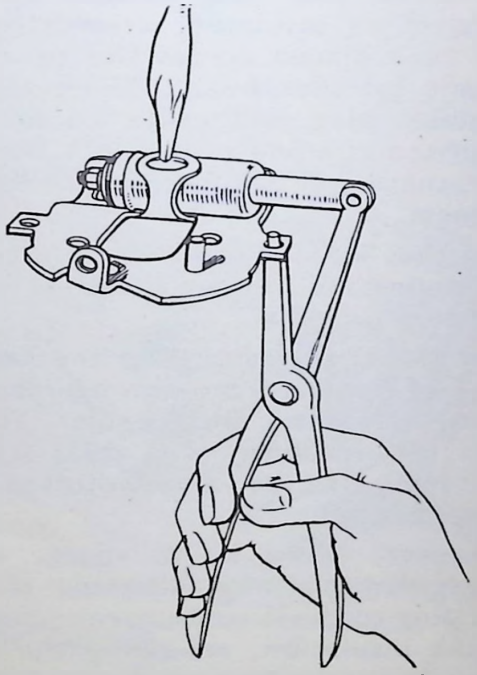


Fig. 6. Tool for Extracting Condenser from Contact Breaker Base Plate.

BEARING BUSHES—REPLACEMENT.

Bushes are removed and fitted using a vertical drilling machine or hand press in which is fitted a highly polished mandrel of the same size as the distributor shaft.

To remove the bushes, locate the distributor body (inverted) beneath the press. A sleeve must be fitted over the mandrel, to enlarge it to the size of the bushes. Apply a steady pressure, to force the bushes from their seats. Remove the sleeve.

New bushes must be completely immersed in thin engine oil for 24 hours before fitting. In cases of emergency, this process may be shortened by heating the oil to 100°C., for 2 hours, **then allowing the oil to cool before removing the bush.**

Place a long bush on the mandrel, then the distributor body (inverted) and finally one of the smaller bushes. Locate the lower end of the mandrel in a suitable packing block (see *Fig.* 7) and apply a steady downward pressure. Ensure that both bushes enter the distributor squarely. When they have been fully inserted, carefully withdraw the mandrel.

Under no circumstances should the bushes be overbored by reamering or any other means, since this will impair the porosity and thereby the effective lubricating quality of the bushes.

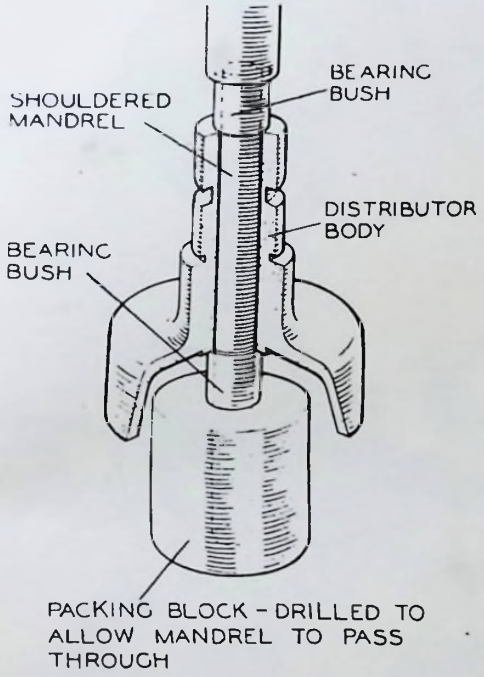


Fig. 7. Replacing Bearing Bush of Distributor.

RE-ASSEMBLY.

(1) Before assembly, the centrifugal advance mechanism, distributor shaft and the portion of the shaft on which the cam fits, must be lubricated with thin engine oil.

(2) Assemble the centrifugal timing control, taking care that the parts are fitted in their original positions and the control springs not stretched. Two holes are provided in each toggle for the control springs, which must in each case be fitted to the inner hole. Place the cam on the spindle and secure with the locking screw.

(3) Fit the shaft in its bearings and replace the driving member.

(4) Place the contact-breaker base in position on the distributor body, securing by replacing the two side screws. Spring washers must be fitted under each screw head and the screws firmly tightened.

(5) Place the end of the connector strip over the condenser terminal post, refit the spring washer and secure by tightening the terminal nut.

(6) Replace the fixed contact plate on the contact-breaker base, fit the two screws, together with their plain and spring washers, and lightly tighten. Place the insulating washer over the contact-breaker pivot pin and fit 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 0.014"-0.016" (.35-.40 mm.) when the contacts are fully opened.

N.B.—*If it is necessary to renew the contacts, a replacement set comprising fixed and moving contacts must be fitted.*

(7) Place the rotor on the spindle, locating the register correctly and pushing the rotor fully home.

(8) Fit the distributor cover moulding and secure by means of the spring clips.

REPLACEMENT CONTACTS.

If the contacts are so badly worn that replacement is necessary, they must be renewed as a pair and not individually. The contact gap must be set to 0.014" to 0.016" (.35 to .40 mm.) After the first 500 miles running with new contacts fitted, the setting should be checked and the gap reset to 0.014" to 0.016". This procedure allows for the initial "bedding-in" of the heel.

DISTRIBUTOR, MODEL DM2P4 USED ON TWIN CARBURETTOR ENGINES.

General.

Mounted on the distributor driving shaft, immediately beneath the contact-breaker, is a centrifugally operated timing control mechanism. It consists of a pair of spring loaded governor weights, linked by lever action to the contact-breaker cam. At slow engine speeds, the spring force maintains the cam in a position in which the spark is slightly retarded. Under the centrifugal force imparted by high engine speeds, the governor weights swing out against the spring pressure to advance the contact-breaker cam, and thereby the spark, to suit engine conditions at the greater speed.

A built-in vacuum-operated timing control is also included, designed to give additional advance under part-throttle conditions. The inlet manifold of the engine is in direct communication with one side of a spring-loaded diaphragm. This diaphragm is linked to the contact-breaker plate and rotates the contact-breaker heel about the cam, thus advancing the spark for part-throttle operating conditions. There is also a micrometer adjustment for making fine alterations in timing to allow for changes in running conditions, e.g., state of carbonisation, change of fuel, etc.

A completely sealed metallised paper capacitor is utilised. This has the property of being self-healing ; should the dielectric break down, the metallic film around the point of rupture is vaporised away by the heat of the spark, so preventing a permanent short circuit.

The HT pick-up brush is of a composite construction, the top portion made of a resistive compound and the lower of softer carbon to prevent wear taking place on the rotor electrode. The resistive portion of this carbon brush which is in circuit between the coil and the distributor gives a measure of radio interference suppression. Under no circumstances must a short non-resistive brush be used as a replacement for one of these longer resistive brushes.

The Pre-tilted Contact Breaker Unit.

During the Spring of 1955 an improved contact breaker was introduced on the DM2P4 distributor. Important features of this pre-tilted contact breaker unit are, improved sensitivity of vacuum control and elimination of any tendency for the moving contact-breaker plate to rock at high cam speeds. Contact adjustment has also been simplified.

The pre-tilted contact breaker unit is directly interchangeable with earlier DM2 contact breaker units.

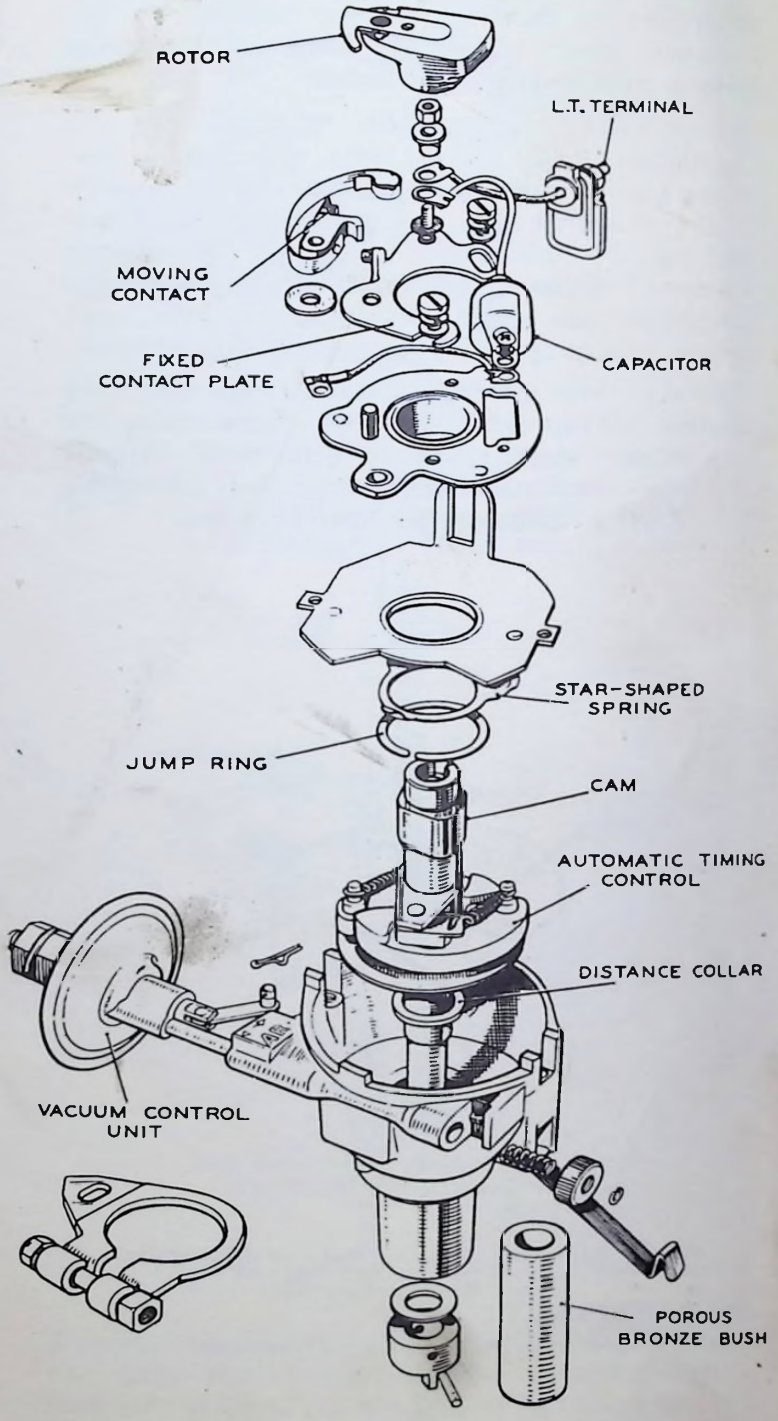


Fig. 8. Earlier Distributor with Cover and Rotor Removed.

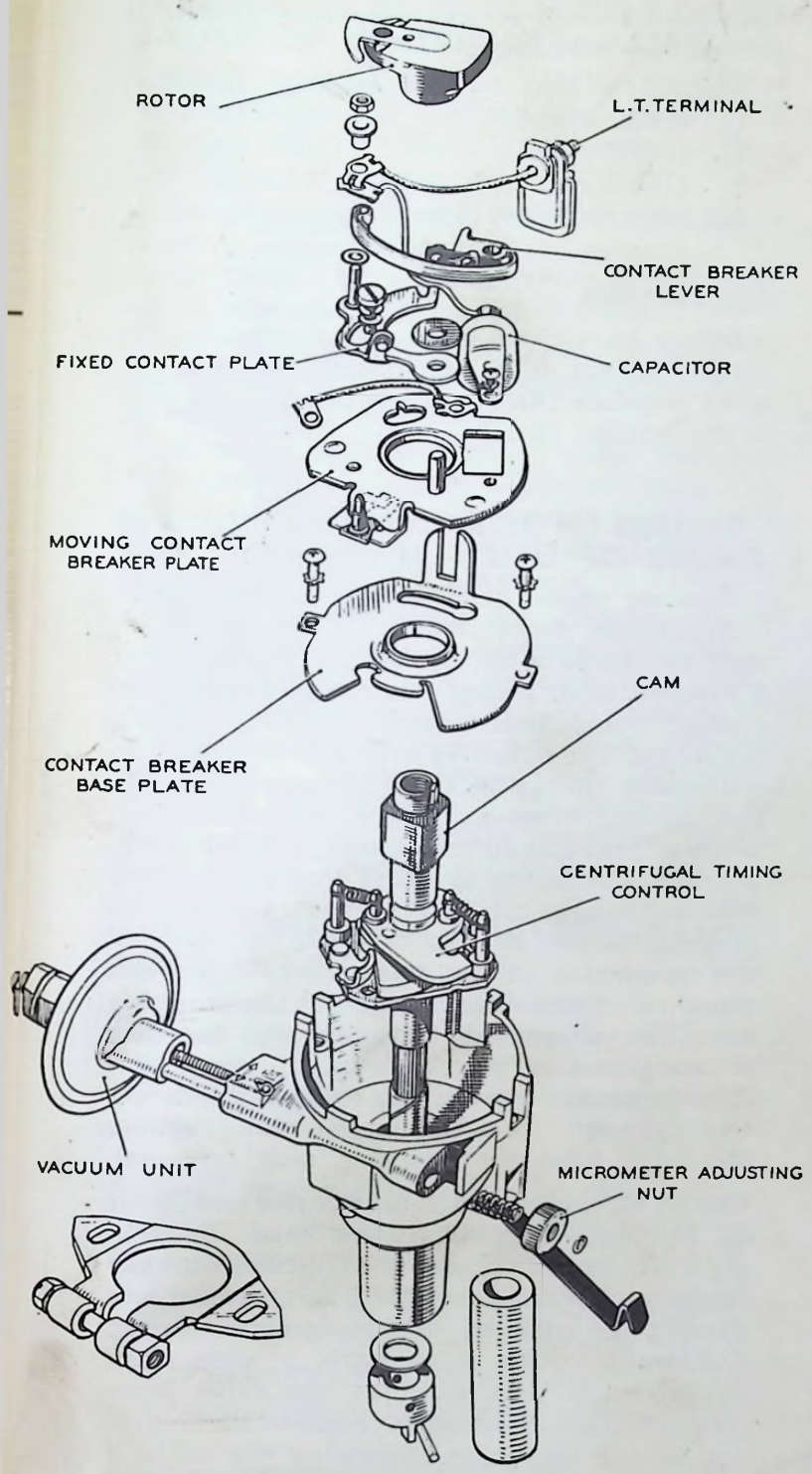


Fig. 9. Later Type Distributor Dismantled.

ROUTINE MAINTENANCE.

In general, lubrication and cleaning constitute normal maintenance procedure.

LUBRICATION—EVERY 3,000 MILES.

Take great care to prevent oil or grease from getting on or near the contacts.

Add a few drops of thin engine oil (SAE.30) through the aperture at the edge of the contact breaker to lubricate the centrifugal timing control. Smear the cam with Mobilgrease No. 2.

Lift off the rotor arm and apply to the spindle a few drops of Ragosine Molybdenised non-creep oil or thin machine oil to lubricate the cam bearing. It is not necessary to remove the exposed screw, since it affords a clearance to permit the passage of oil.

Replace the rotor arm carefully, locating its moulded projection in the keyway in the spindle and pushing it on as far as it will go.

CLEANING—EVERY 6,000 MILES.

Thoroughly clean the moulded distributor cover, inside and out, with a soft dry cloth, paying particular attention to the spaces between the metal electrodes. Ensure that the carbon brush moves freely in its holder. Examine the contact breaker. The contacts must be quite free from grease or oil. If they are burned or blackened, clean them with very fine carborundum stone or emery cloth, then wipe with a petrol-moistened cloth. Cleaning is facilitated by removing the contact breaker lever. To do this, remove the nut, insulating piece and connections from the post to which the end of the contact breaker spring is anchored. The contact breaker lever may now be removed from its pivot. Before refitting the contact breaker, smear the pivot post with Ragosine Molybdenised non-creep oil or Mobilgrease No. 2.

TO CHECK AND SET DISTRIBUTOR POINTS.

After cleaning, check the contact breaker setting. Turn the engine by hand until the contacts show the maximum opening. This should measure 0.014" to 0.016" (.35 to .40 mm.). If the measurement is incorrect, keep the engine in the position giving maximum opening, slacken the screws securing the fixed contact plate and adjust its position to give the required gap. Tighten the screws. Recheck the setting for other positions of the engine giving maximum opening.

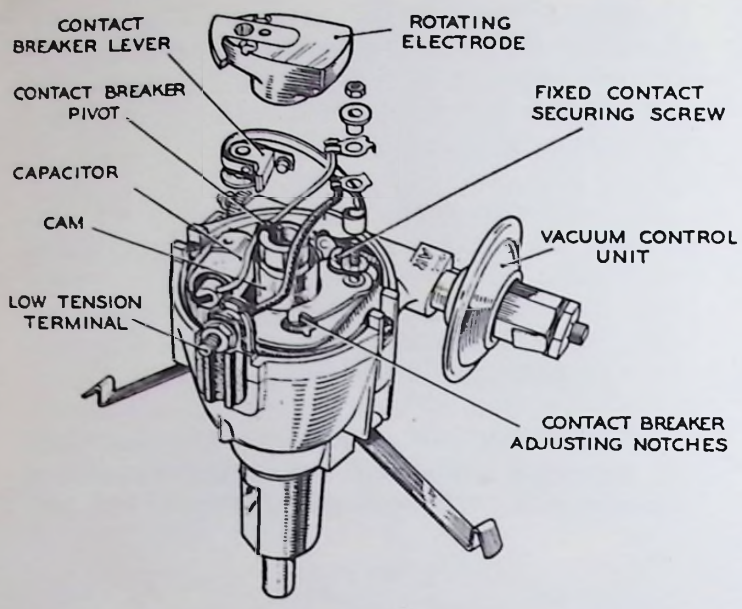


Fig. 10. Pre-Tilted Contact Breaker Dismantled.

DESIGN DATA.

Firing angles : 0°, 90°, 180°, 270°, ± 1°.

Closed period : 60° ± 3°.

Open period : 30° ± 3°.

Contact breaker gap : 0.014″ to 0.016″ (.35 to .40 mm.).

Contact breaker spring tension measured at contacts : 18-24 ozs.

Capacitor : 0.2 microfarad.

Rotation : Clockwise.

CHECKING CENTRIFUGAL AND VACUUM TIMING CONTROLS.

Advance due to centrifugal control.

Set to spark at zero degress at less than 100 r.p.m.

Run distributor at 3,000 r.p.m. Advance should lie between 16° and 18°.

Check advance at following decelerating speeds :—

Speed r.p.m.	*Advance (degrees)*
2,300	15°—17°
1,500	7°—9°
800	0°—2°
650	0°—1°

ADVANCE DUE TO VACUUM CONTROL.

Apply a vacuum of 20″ of mercury.

Advance to lie between 10° and 12°.

Check advance at the following points, as the vacuum is reduced :—

Vacuum (In. Hg.)	*Advance (degrees)*
13″ (330.2 mm.)	9½°—11°
9½″ (241.3 mm.)	6° —8½°
6½″ (165.1 mm.)	1½°—5°

No advance below 4 in. of mercury.

SERVICING.

Before starting to test, make sure that the battery is not fully discharged, as this will often produce the same symptoms as a fault in the ignition circuit.

TESTING IN POSITION TO LOCATE CAUSE OF UNEVEN FIRING.

Run the engine at a fairly fast idling speed. If possible, short circuit each plug in turn with the blade of an insulated screwdriver or a hammer head placed across the terminal to contact the cylinder head. Short circuiting the plug in the defective cylinder will cause no noticeable change in the running note. On the others, however, there will be a pronounced increase in roughness. If this is not possible, due to the sparking plug being fitted with a shrouded cable connector, remove each plug connector in turn. Again, removal of the connection to the defective cylinder will cause no noticeable change in the running note, but there will be a definite increase in roughness when the other plugs are disconnected. Having thus located the defective cylinder, stop the engine and remove the cable from the sparking plug terminal.

Restart the engine and hold the cable end about $\frac{3}{16}$″ (4.7 mm.) from the cylinder head. If sparking is strong and regular, the fault lies with the sparking plug, and it should be removed and cleaned and adjusted, or a replacement fitted. If, however, there is no spark, or only weak irregular sparking, examine the cable from the plug to the distributor cover for deterioration of the insulation, renewing the cable if the rubber is cracked or perished. Clean and examine the distributor moulded cover for free movement of the carbon brush. If a replacement brush is necessary, it is important that the correct type is used. If tracking has occurred, indicated by a thin black line between two or more electrodes or between one of the electrodes and the body, a replacement distributor cover must be fitted.

TESTING IN POSITION TO LOCATE CAUSE OF IGNITION FAILURE.

Spring back the clips of the distributor head and remove the moulded cover. Lift off the rotor, carefully levering with a screwdriver if necessary.

Switch on the ignition and whilst the engine is slowly cranked, observe the reading on the car ammeter, or on an ammeter connected in series with the battery supply cable.

The reading should rise and fall with the closing and opening of the contacts if the low tension wiring is in order.

When a reading is given which does not fluctuate, a short circuit, or contacts remaining closed, is indicated. No reading indicates an open circuit in the low tension circuit, or badly adjusted or dirty contacts.

Check the contacts for cleanliness and correct gap setting as described previously. Ensure that the contact breaker lever moves freely on the pivot. If sluggish, remove the arm and polish the pivot post with a strip of fine emery cloth. Smear the post with Ragosine Molybdenised non-creep oil or Mobilgrease No. 2, replace the lever. If the fault persists, proceed as follows :—

LOW TENSION CIRCUIT — FAULT LOCATION.

No reading in ammeter test.

Refer to wiring diagram see *page L33*, and check circuit for broken or loose connections, including ignition switch. Check the ignition coil by substitution.

Steady reading in ammeter test.

Refer to wiring diagram and check wiring for indications of a short circuit.

Check capacitor (either by substitution or on a suitable tester).

Check ignition coil by substitution.

Examine insulation of contact breaker.

HIGH TENSION CIRCUIT.

If the low tension circuit is in order, remove the high tension lead from the centre terminal of the distributor cover. Switch on the ignition and turn the engine until the contacts close. Flick open the contact breaker lever whilst the high tension lead from the coil is held about $\frac{3}{16}$" (4.7 mm.) from the cylinder block. If the ignition equipment is in good order, a strong spark will be obtained. If no spark occurs, a fault in the circuit of the secondary winding of the coil is indicated and the coil must be replaced.

The high tension cables must be carefully examined, and replaced if the rubber insulation is cracked or perished, using 7 mm. neoprene-covered rubber ignition cable. To fit cables to ignition coils or to distributor covers with vertical outlets, pass the cable through the knurled moulded terminal, bare about $\frac{1}{4}$" (6.3 mm.) of the end of the cable, thread the wire through the brass washer (removed from the original cable) and bend back the strands. Finally screw the moulded terminal into the coil moulding or distributor cover.

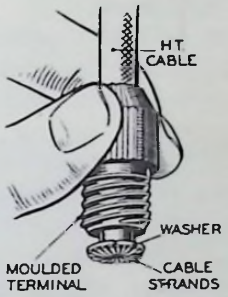


Fig. 11. Fitting H.T. Cable to Distributor Terminal.

To make connections to the terminals in distributor covers having horizontal outlets, remove the cover and slacken the screws on the inside of the moulding. Cut the cables to the length required and push firmly home in the holes in the moulding. Tighten the screws, which will pierce the rubber insulation to make good contact with the cable core. The connection to the centre terminal is made accessible by removing the small carbon brush.

The cables from the distributor to the sparking plugs must be connected in the correct firing order.

TO REMOVE DISTRIBUTOR FOR DISMANTLING.

See *page B19*, for instructions to remove distributor.

TO DISMANTLE.

(1) Spring back the securing clips and remove the moulded cover. Lift the rotor arm off the spindle, carefully levering with a screwdriver if it is tight.

(2) Disconnect the vacuum unit link to the moving contact breaker plate, and remove the two screws at the edge of the contact breaker base. The contact breaker assembly, complete with external terminal, can now be lifted off [see (3) below]. Remove the circlip on the end of the micrometer timing screw, and turn the micrometer nut until the screw and the vacuum unit assembly are freed. Take care not to lose the ratchet and coil type springs located under the micrometer nut.

The complete shaft assembly, with centrifugal timing control and cam foot can now be removed from the distributor body (see (4) below).

(3) **Contact Breaker.**
To dismantle the assembly further, remove the nut, insulating piece and connections from the pillar on which the contact breaker spring is anchored. Slide out the terminal moulding. Lift off the contact breaker lever and the insulating washers beneath it. Remove the screws securing the fixed contact plate, together with the spring and plain steel washers, and take off the plate. Withdraw the single screw securing the capacitor and (on earlier models) contact breaker earthing lead. Dismantle the contact breaker base assembly by turning the base plate clockwise and pulling to release it from the moving contact breaker plate. On earlier models remove the circlip and star washer located under the base plate.

(4) **Shaft and Action Plate.**
To diamantle the assembly further, take out the screw inside the cam and remove the cam and cam foot. The weights, springs and toggles (when fitted) of the centrifugal timing control can now be lifted off the action plate. Note that a distance collar is fitted on the shaft underneath the action plate.

BEARING REPLACEMENT.

The single long bearing bush used in this distributor can be pressed out of the shank by means of a shouldered mandrel.

If the bearing has been removed the distributor must be assembled with a new bush fitted. The bush should be prepared for fitting by allowing it to stand completely immersed in medium viscosity (*SAE.*30-40) engine oil for at least 24 hours. In cases of extreme urgency, this period of soaking may be shortened by heating the oil to 100°C. for 2 hours, then **allowing the oil to cool before removing the bush.** Press the bearing into the shank, using a shouldered, polished mandrel of the same diameter as the shaft.

Under no circumstances should the bush be overbored by reamering or any other means, since this will impair the porosity and thereby the effective lubricating quality of the bush.

RE-ASSEMBLY.

The following instructions assume that **complete** dismantling has been undertaken.

(1) Place the distance collar over the shaft, smear the shaft with Ragosine Molybdenised non-creep oil or clean engine oil, and fit it into its bearing.

(2) Refit the vacuum unit into its housing and replace the springs, milled adjusting nut and securing circlip.

(3) Re-assemble the centrifugal timing control. See that the springs are not stretched or damaged. Place the cam and cam foot assembly over the shaft, engaging the projections on the cam foot with the weights or, on earlier models, the toggles, and fit the securing screw.

(4) Before re-assembling the contact breaker base assembly, lightly smear the base plate with Ragosine Molybdenised non-creep oil or Mobilgrease No. 2. On earlier distributors, the felt pad under the rotating contact breaker plate should be moistened with a few drops of thin machine oil.

Fit the moving contact breaker plate to the contact breaker base plate and secure using a reversal of the dismantling procedure. Refit the contact breaker base plate into the distributor body. Engage the link from the vacuum unit. Insert the two base plate securing screws, one of which also secures one end of the contact breaker earthing cable.

(5) Fit the capacitor into position. On earlier models the eyelet on the other end of the contact breaker earthing lead is held under the capacitor fixing screw. Place the fixed contact plate in position

and secure lightly with the securing screws. One plain and one spring washer must be fitted under the securing screws.

(6) Place the insulating washers, etc., on the contact breaker pivot post and on the pillar on which the end of the contact breaker spring locates. Refit the contact breaker lever and spring.

(7) Slide the terminal block into its slot.

(8) Thread the low tension connector and capacitor eyelets on to the insulating piece, and place these on to the pillar which secures the end of the contact breaker spring. Refit the washer and securing nut.

(9) Set the contact gap to 0.014″ to 0.016″ (.35 to .40 mm.) and tighten the fixed contact securing screws.

(10) Refit the rotor arm, locating the moulded projection in the rotor arm with the keyway in the shaft, and pushing fully home. Refit the moulded cover and secure by means of the spring clips.

REPLACEMENT CONTACTS.

If the contacts are so badly worn that replacement is necessary, they must be renewed as a pair and not individually. The contact gap must be set to 0.014″ to 0.016″ (.35 to .40 mm.); after the first 500 miles running with new contacts fitted, the setting should be checked and the gap reset to 0.014″ to 0.016″. This procedure allows for the initial "bedding-in" of the heel.

SPARKING PLUGS.

The importance of using the correct type, of periodically inspecting, cleaning and testing the sparking plugs and the vital bearing this service has on the engine performance and the petrol consumption, cannot be overstressed. **Types recommended.** Single carburettor Champion N.8.B. Twin carburettor Champion N.A.8.

Normally, the service should be carried out every 5,000 miles (8,000 Kms.), but during the initial "running-in" period of the car, and after any major overhaul to the engine, it is advisable to carry out the service after the first 1,000 miles (1,600 Kms.) of running.

When removing the plugs use a box spanner of the correct size, and arrange for each plug to be identified with the cylinder from which it was removed. This helps in many instances to trace the cause of any misfiring which may be occurring. When replacing, first screw the plug down by hand as far as possible, then use a box spanner for tightening. Do not under any circumstances use a movable wrench.

When cleaning a plug on a cleaning machine, it is advisable to wobble it, and if carboned to any considerable extent to remove by scraping as much of the carbon as possible. When cleaning an oily plug first wash it in petrol and allow it to dry, to avoid the cleaning abrasive adhering.

After cleaning do not neglect to blow out all traces of the abrasive and to set the gap by means of a feeler gauge to .025″ (.63 mm.) before testing. When setting this gap always bend the side wire, never the central electrode as any such action may split the insulator tip. *See Figs.* 12 & 13.

Fig. 12. Oily, dirty, worn-out plug.

Fig. 13. New, clean, efficient plug.

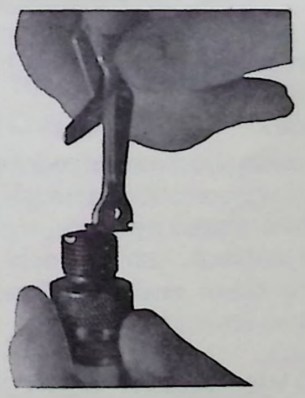


Fig. 14 Setting the Gap between the Sparking Plug Electrode.

The condition of the plug insulator is often responsible for poor plug performance. It should be examined for paint splashes ; accumulation of dirt and grime ; cracks caused

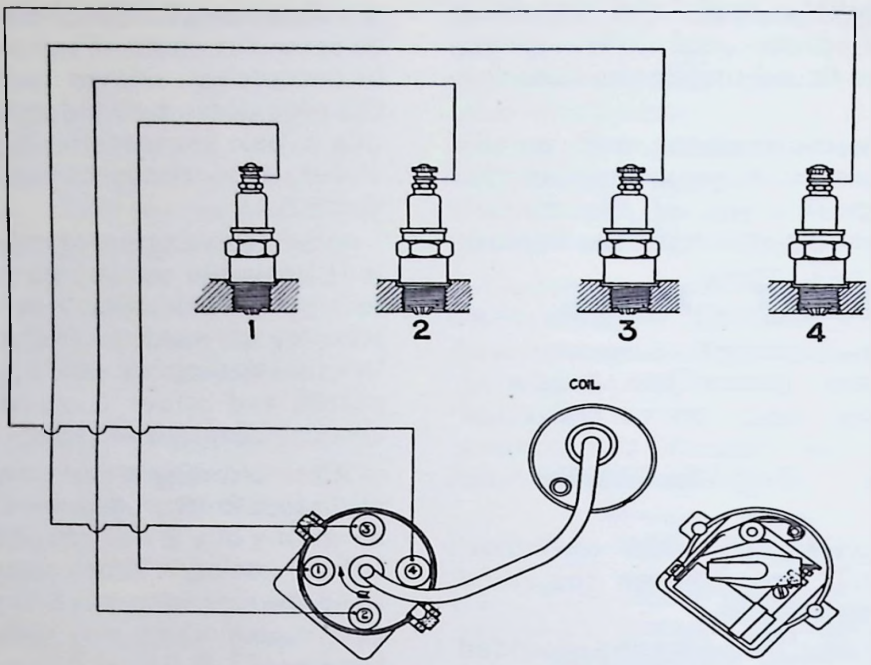


Fig. 15. Diagram showing connections between Distributor and Sparking Plugs.
Arrow on Distributor indicates direction of rotor when viewed from the drive end.

by slipping spanner, or the over-tightening of the terminals. The gaskets should also be examined, and if damaged, or compressed to a considerable extent, replaced.

The firing order is 1, 3, 4, 2 (No. 1 being nearest the radiator. *Fig.* 15 shows how plugs and coil are connected to distributor).

IGNITION COIL.

Description.

The coil is a Lucas Model Q12 for the single carburettor and B.12 for the twin carburettor engine. These identification marks are stamped on the base of the coil, and must be quoted when ordering a replacement.

Maintenance.

The only attention required by the coil is a periodical inspection of the three terminal nuts to ensure that they are tight, and that the exterior surface, particularly around the terminals, are clean and free from accumulation of dirt and foreign matter.

TO REMOVE AND REPLACE THE COIL.

Remove the high and the two low tension terminal nuts securing the wires to the coil. Note the terminals to which the wires are connected. If in doubt consult the wiring diagram.

The coil on the right-hand drive models is mounted to the steering column with a saddle bracket and two nuts and bolts.

On the left-hand drive models the coil is mounted on the right-hand valance with two nuts and bolts.

Replacement is the reverse of the above operations.

IRREGULARITIES AND THEIR REMEDIES.

Starter turns the Engine, but Engine will not Fire.

(1) See that the battery terminals are secure and that the battery is in a charged condition, either by use of a hydrometer or by checking that the starter will turn the engine and the lamps at the same time giving a good light. If the battery is discharged, it must be recharged from an independent electrical supply.

(2) See that the controls are correctly set for starting, ignition switched on, petrol turned on, etc.

(3) Remove the cable from the centre distributor terminal and hold it about $\frac{1}{4}$" (6 mm.) away from some metal part of the chassis while the engine is turned slowly over. 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 carburettor, petrol supply, etc.

(4) If the coil does not spark 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 switch is 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.

Engine Misfires.

(1) Examine the distributor contacts and check that the gaps are .014"/.016" (.35/.40 mm.) on all four cams. Set as necessary.

(2) 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, or defective high tension cables. The plugs should be cleaned and adjusted, and any cable on which the insulation shows signs of deterioration or cracking should be renewed.

(3) If sparking is regular at each plug when tested, the trouble is probably due to engine defects, and the carburettor, petrol supply, etc., must be examined.

Carburation.

The mixture control not being used correctly; defective or incorrectly set ; air filter dirty, the throttle control incorrectly set or valve loose ; the jets partially choked ; the fuel filters in the pump and petrol tank partially choked. *See Engine, Section B, pages B3 to B7.*

Mechanical.

Incorrect rocker adjustment ; the valves tending to stick in their guides ; air leaks in the induction system, probably the result of defective gaskets ; the valve timing incorrectly set ; the compressions unequal ; the cylinder head gasket defective.

The Engine Fails to Deliver its Maximum Power.

The throttle control incorrectly set and not allowing the throttle to open to the full extent ; the mixture control incorrectly set and allowing the starter device to be partially in operation ; insufficient fuel supply due to partially choked jets, filters or pipe line ; the rocker adjustment incorrect ; the valve timing incorrect ; the ignition timing set too late ; the plugs defective or not of the recommended type ; the high tension leads defective ; the coil and condenser defective ; the battery in a low state of charge ; the automatic advance of the distributor not working freely.

The Engine Tends to Knock.

The ignition too far advanced, the automatic advance mechanism seized in the advance position ; the engine running unduly hot due to a weak mixture which in turn may be due to incorrect size of jets ; the jets, silencer, cooling system partially choked, or the fan belt loose ; the engine needing carbonising ; the main and big ends bearings loose, or worn ; the plugs defective or not as recommended ; the rocker adjustment or valve timing incorrect.

The Engine will not Accelerate Readily.

The fuel supplied to the carburettor being insufficient as the result of the jets, pipe line, or filters being partially choked; the fuel pump defective ; the compressions poor ; the valve and ignition timing being incorrect ; the automatic mechanism in distributor seized ; the plugs defective.

DYNAMO MODEL C39PV-2.

DESCRIPTION.

The dynamo is a shunt-wound two-pole two-brush machine, arranged to work in conjunction with a compensated voltage control regulator unit. A fan, integral with the driving pulley, draws cooling air through the dynamo, inlet and outlet holes being provided in the end brackets of the unit.

The output of the dynamo is controlled by the regulator and is dependent on the state of charge of the battery and the loading of the electrical equipment in use. When the battery is in a low state of charge, the dynamo gives a high output, whereas if the battery is fully charged, the dynamo gives only sufficient

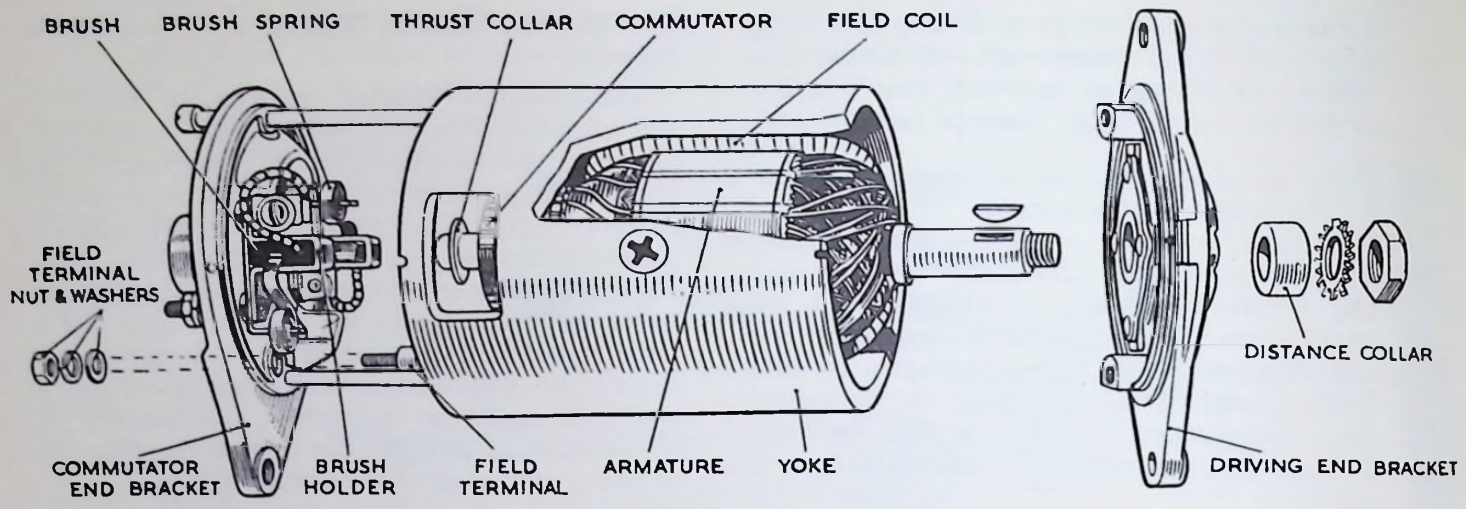


Fig. 16. Dynamo Dismantled View (Yoke cut away to show interior).

output to keep the battery in good condition without any possibility of over-charging. An increase in output is given to balance the current taken by lamps and other accessories when in use. Further, a high boosting charge is given for a few minutes immediately after starting.

ROUTINE MAINTENANCE.

(To remove Dynamo from engine see page B18).

Lubrication.

Every 10,000 miles, inject a few drops of Oiline BBB, or any high quality medium viscosity (SAE.30) engine oil into the hole marked "OIL" in the end of the bearing housing. *See Fig.* 17.

On earlier models, unscrew the cap of the lubricator on the side of the bearing housing, lift out the felt pad and spring and about half-fill the lubricator cap with high melting point grease (H.M.P. Grease). Replace the spring and felt pad and screw the lubricator cap back into position.

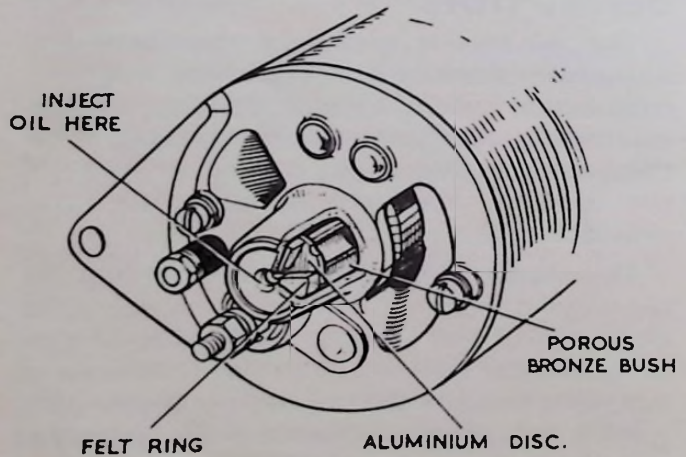


Fig. 17. Commutator End Bearing Lubrlcator.

Inspection of Brushgear and Commutator.

At the same time, remove the metal band cover to inspect the brushgear and commutator. 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 to $\frac{11}{32}$" (8.7 mm.) in length must be renewed. (*See page L*15).

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 fine dry cloth against it while the engine is slowly turned over by hand. If the commutator is very dirty, moisten the cloth with petrol.

Belt Adjustment.

Occasionally inspect the dynamo driving belt. If necessary, adjust to take up any undue slackness by turning the dynamo on its mounting. Care should be taken to avoid overtightening the belt, which should have just sufficient tension to drive without slipping (*see page B*18).

See that the machine is properly aligned, otherwise undue strain will be thrown on the dynamo bearings.

PERFORMANCE DATA.

Cutting-in speed 1,050-1,200 r.p.m. at 13 dynamo volts.

Maximum output : 19 amps. 1,900-2,150 r.p.m. at 13.5 dynamo volts (when connected to a resistance load of 0.7 ohm.).

Field resistance : 6.1 ohms.

SERVICING.

Testing in position to locate fault in charging circuit.

In the event of a fault in the charging circuit, adopt the following procedure to locate the cause of trouble.

(1) Inspect the driving belt and adjust if necessary (*see page B18*).

(2) Check that the dynamo and control box are connected correctly. The larger dynamo terminal must be connected to control box terminal "D" and the smaller dynamo terminal to control box terminal "F". Check the earth connection to control box terminal "E".

(3) Switch off all lights and accessories, disconnect the cables from terminals of dynamo and connect the two terminals with a short length of wire.

(4) Start the engine and set to run at normal idling speed.

(5) Clip the negative lead of a moving coil type voltmeter, calibrated 0-20 volts, to one dynamo terminal and the other lead to a good earthing point on the yoke.

(6) Gradually increase the engine speed, when the voltmeter reading should rise rapidly and without fluctuation. Do not allow the voltmeter reading to reach 20 volts and do not race the engine in an attempt to increase the voltage. It is sufficient to run the dynamo up to a speed of 1,000 r.p.m.

If there is no reading, check the brushgear as described in (7) below. If there is a low reading of approximately $\frac{1}{2}$-1 volt, the field winding may be at fault (*see paragraph on Field Coils page L16*). If there is a reading of approximately half the nominal voltage, the armature winding may be at fault (*see page L16*).

(7) Remove the cover band and examine the brushes and commutator. Hold back each brush spring 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 replace a brush in its original position. If a brush is worn to $\frac{11}{32}$" (8.7 mm.) in length, it must be renewed. Further brush wear will cause the brush flexible to be exposed at the running face with consequent damage to the commutator. Test the brush spring

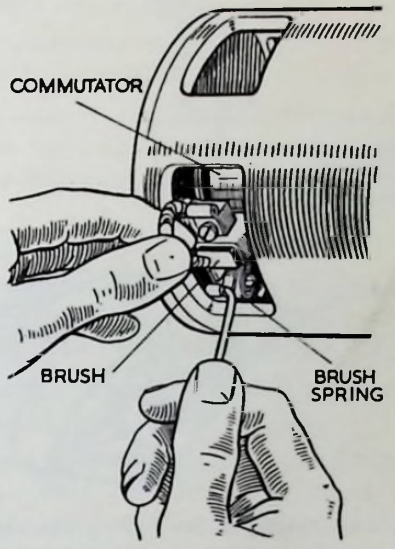


Fig. 18. Checking Brush Gear.

tension with a spring scale. The tension of the springs when new is 22-25 ozs. In service it is permissible for this value to fall to 15 oz. before performance may be affected. Fit new springs if the tension is low. If the commutator is blackened or dirty, clean it by holding a petrol-moistened cloth against it while the engine is turned slowly by hand cranking. Re-test the dynamo, if there is still no reading on the voltmeter, there is an internal fault and the complete unit, if a spare is available, should be replaced. Otherwise the unit must be dismantled for internal examination.

(8) If the dynamo is in good order, remove the link from between the terminals and restore the originals connections, taking care to connect the larger dynamo terminal to control box terminal "D" and the smaller dynamo terminal to control box terminal "F".

To Dismantle.

(1) Take off the driving pulley.

(2) Remove the cover band, hold back the brush springs and remove the brushes from their holders.

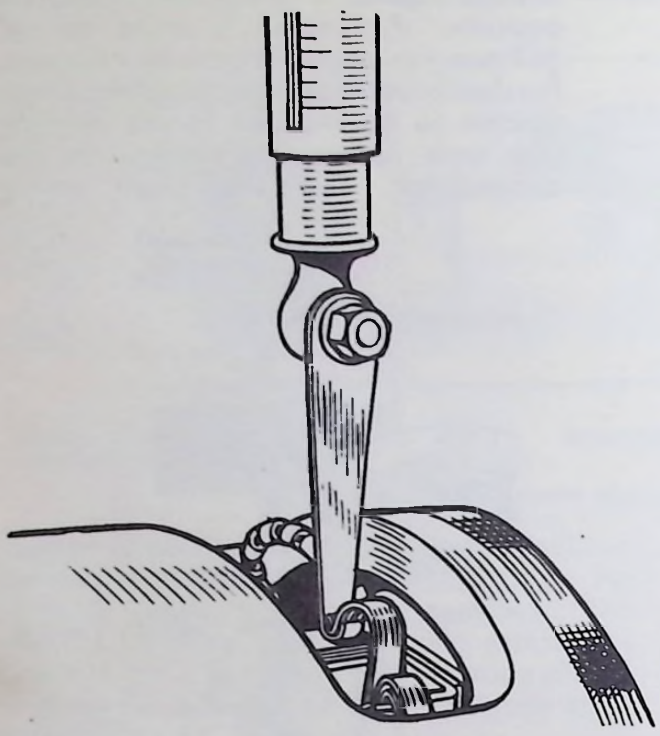


Fig. 19. Testing Brush Spring Tension.

(3) Unscrew and withdraw the two through bolts.

(4) The commutator end bracket can now be withdrawn from the dynamo yoke. Take care not to lose the fibre thrust washer.

(5) The driving end bracket together with the armature can now be lifted out of the yoke.

(6) The driving end bracket, which on removal from the yoke has withdrawn with it the armature and armature shaft ball-bearing, need not be separated from the shaft unless the bearing is suspected and requires examination, or the armature is to be replaced : in this event the armature should be removed from the end bracket by means of a hand press.

Commutator.

A commutator in good condition will be smooth and free from pits or burned spots. Clean the commutator with a petrol-moistened cloth. If this is ineffective, carefully polish with a strip of fine glass paper while rotating the armature. To remedy a badly worn commutator, mount the armature, with or without the drive end bracket, in a lathe, rotate at high speed and take a light cut with a very sharp tool. Do not remove more metal than is necessary. Polish the commutator with very fine glass paper. Undercut the insulators between the segments to a depth of $\frac{1}{32}$" (.79 mm.) with a hack saw blade ground to the thickness of the insulator.

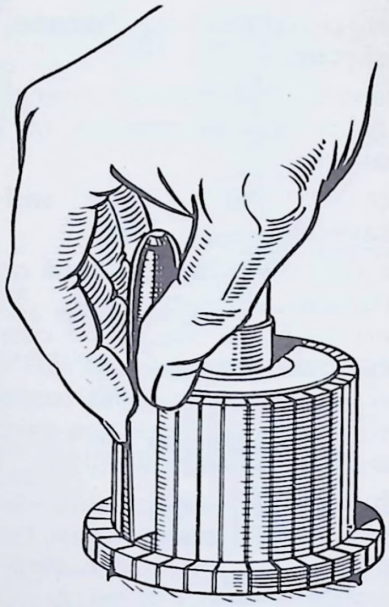


Fig. 20.

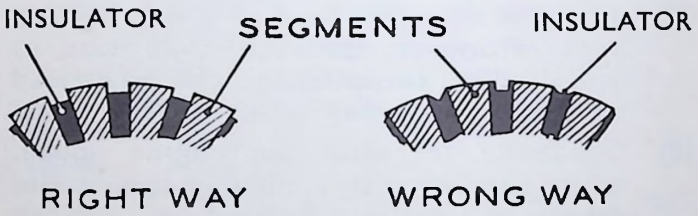


Fig. 21. Method of Undercutting Commutator Insulation

Armature.

The testing of the armature winding requires the use of a volt-drop test and growler. If facilities are not available the armature should be checked by substitution. No attempt should be made to machine the armature core or to true a distorted armature shaft.

To remove the armature shaft from the drive end bracket and bearing, support the bearing retaining plate firmly and press the shaft out of the drive end bracket. When fitting the new armature, support the inner journal of the ball bearing whilst pressing the armature shaft firmly home.

Field Coils.

Measure the resistance of the field coils, without removing them from the dynamo

yoke, by means of an ohm meter connected between the field terminal and yoke. The ohm meter should read 6.2 ohms approximately. If an ohm meter is not available, connect a 12 volt D.C. supply with an ammeter in series between the field terminal and dynamo yoke. The ammeter reading should be approximately 2 amperes.

Zero reading on the ammeter, or an "Infinity" ohm meter reading, indicates an open circuit in the field winding. Current readings of much more than 2 amperes, or ohm meter readings much below 6.2 ohms, are indications that the insulation of one of the field coils has broken down.

In either case, unless a substitute dynamo is available, the field coils must be replaced. To do this, carry out the procedure outlined below.

(1) Drill out the rivet securing the field coil terminal block assembly to the yoke, and unsolder the field coil connections.

(2) Remove the insulation piece which is provided to prevent the junction of the field coils from contacting with the yoke.

(3) Mark the yoke and pole shoes so that the latter can be fitted in their original positions.

(4) Unscrew the two pole shoe retaining screws by means of a wheel-operated screwdriver.

(5) Draw the pole shoes and coils out of the yoke and lift off the coils.

(6) Fit the new field coils over the pole shoes and place them in position inside the yoke. Take care to ensure that the taping of the field coils is not trapped between the pole shoes and the yoke.

(7) Locate the pole shoes and field coils by lightly tightening the fixing screws.

(8) Fully tighten the screws by means of the wheel-operated screwdriver and lock them by caulking. *See Fig.* 22.

(9) Replace the insulation piece between the field coil connections and the yoke.

(10) Re-solder the field coil connections to the field coil terminal tags and re-rivet the block assembly to the yoke.

Bearings.

Bearings which have worn to such an extent that they will allow side movement of the armature shaft must be replaced.

To replace the bearing bush in a commutator end bracket, proceed as follows :—

Remove the old bearing bush from the end bracket. This can be done by screwing a $\frac{5}{8}$" tap into the bush for a few turns and pulling out the bush with the tap. Screw the tap squarely into the bush to avoid damage to the bracket. Insert the felt ring and aluminium disc in the bearing housing, then press the new bearing bush into the end bracket (using a shouldered, highly polished mandrel of the same diameter as the shaft which is to fit in the bearing) until the bearing is flush with the inner face of the bracket. Earlier models, fitted with screw-cap type lubricators, do not have a felt ring or aluminium disc in the bearing housing. *See Fig.* 23.

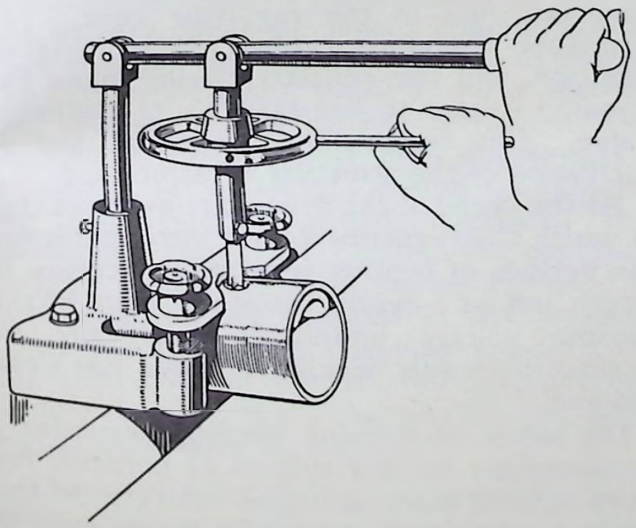


Fig. 22. Tightening Pole Shoe Retaining Screw.

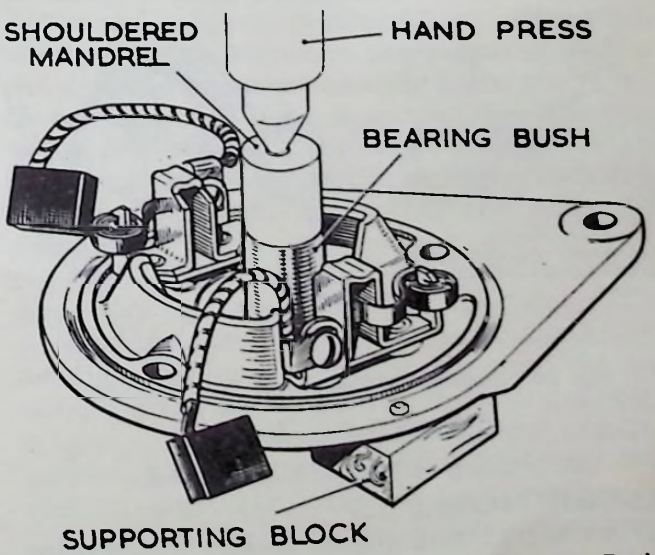


Fig. 23. Method of Fitting Porous Bronze Bearing Bush

NOTE :—Porous bronze bushes must not be opened out after fitting, or the porosity of the bush may be impaired. Before fitting the new bearing bush it should be allowed to stand for 24 hours completely immersed in thin engine oil ; this will allow the pores of the bush to be filled with lubricant.

The ball bearing at the driving end is replaced as follows :—

(1) Drill out the rivets which secure the bearing retaining plate to the end bracket and remove the plate.
(2) Press the bearing out of the end bracket and remove the corrugated washer, felt washer and oil retaining washer.
(3) Before fitting the replacement bearing see that it is clean and pack it with high melting point grease.
(4) Place the oil retaining washer, felt washer and corrugated washer in the bearing housing in the end bracket.
(5) Locate the bearing in the housing and press it home. On earlier models the outer journal should be pressed home by means of a hand press since it is a friction fit in the housing.
(6) Fit the bearing retaining plate. Insert the new rivets from the inside of the end bracket and open the rivets by means of a punch to secure the plate rigidly in position.

Re-assembly.

In the main, the re-assembly of the dynamo is a reversal of the operations described for dismantling. After re-assembly, lubricate the commutator end bearing, referring to *page L14* for the correct procedure.

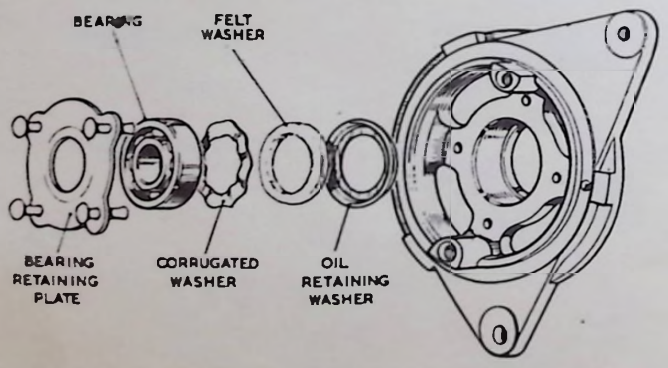


Fig. 24. Details of Bearing in D.E. Bracket.

CONTROL BOX
LUCAS MODEL RB106-1.

DESCRIPTION.

The control box shown in *Fig.* 25 contains two units—a voltage regulator and a cut-out. Although combined structurally, the regulator and cut-out are electrically separate. Both are accurately adjusted during manufacture, and the cover protecting them should not be removed unnecessarily. Cable connections are secured by grub screw terminals.

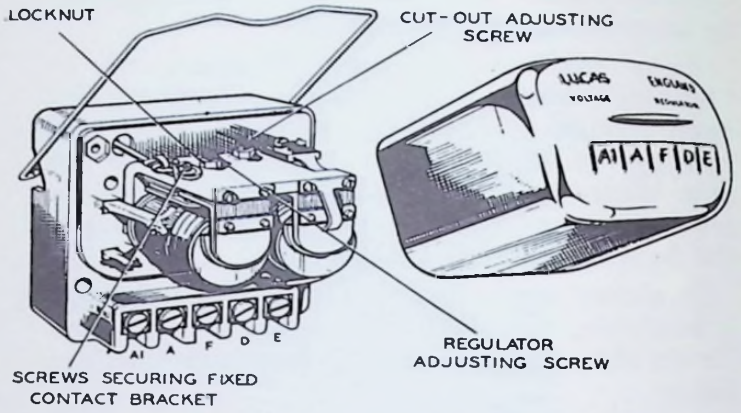


Fig. 25. Control Box with Cover Removed.

The Regulator.

The regulator is set to maintain the dynamo terminal voltage between close limits at all speeds above the regulating point, the field strength being controlled by the automatic insertion and withdrawal of a resistance in the dynamo field circuit. When the dynamo voltage reaches a pre-determined value, the magnetic flux in the regulator core due to the shunt or voltage winding becomes sufficiently strong to attract the armature to the core. This causes the contacts to open, thereby inserting the resistance in the dynamo field circuit.

The consequent reduction in the dynamo field current lowers the dynamo terminal voltage and this, in turn, weakens the magnetic flux in the regulator core. The armature therefore returns to its original position, and the contacts closing allow the dynamo voltage to rise again to its maximum value. This cycle is then repeated, and an oscillation of the armature is maintained.

As the speed of the dynamo rises above that at which the regulator comes into operation, the periods of contact separation increase in length and, as a result, the mean value of the dynamo voltage undergoes practically no increase once this regulating speed has been attained.

The series of current winding provides a compensation on this system of control, for if the control were arranged entirely on the basis of voltage there would be a risk of seriously overloading the dynamo when the

battery was in a low state of charge, particularly if the lamps were simultaneously in use.

Under these conditions of reduced battery voltage, the output to the battery rises and, but for the series winding, would exceed the normal rating of the dynamo. The magnetism due to the series winding assists the shunt winding, so that when the dynamo is delivering a heavy current into a discharged battery the regulator comes into operation at a somewhat reduced voltage, thus limiting the output accordingly. As shown in *Fig.* 26, a split series winding is used, terminal A being connected to the battery and terminal A1 to the lighting and ignition switch.

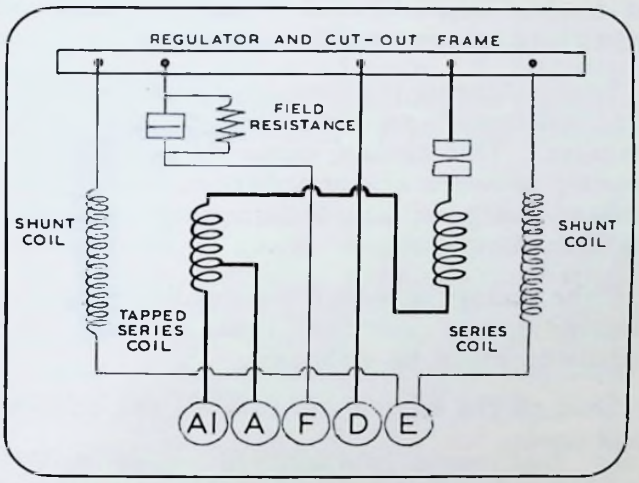


Fig. 26. Internal Connections to Control Box.

By means of a temperature compensation device the voltage characteristic of the dynamo is caused to conform more closely to that of the battery under all climatic conditions. In cold weather the voltage required to charge the battery increases, whilst in warm weather the voltage of the battery is lower. The method of compensation takes the form of a bi-metallic spring located behind the tensioning spring of the regulator armature. This bi-metallic spring, by causing the operating voltage of the regulator to be increased in cold weather and reduced in hot weather, compensates for the changing temperature-characteristics of the battery and prevents undue variation of the charging current which would otherwise occur.

The bi-metallic spring also compensates for effects due to increases in resistance of the copper windings from cold to working values.

The Cut-Out.

The cut-out is an electro-magnetically operated switch connected in the charging circuit between the dynamo and the battery. Its function is automatically to connect the dynamo with the battery when the voltage of the dynamo is sufficient to charge the battery, and to disconnect it when the dynamo is not running, or when its voltage falls below that of the battery, and so prevent the battery from discharging through and possibly damaging the dynamo windings.

The cut-out consists of an electro-magnet fitted with an armature which operates a pair of contacts. The electro-magnet employs two windings, a shunt winding of many turns of fine wire, and a series winding of a few turns of heavier gauge wire. The contacts are normally held open and are closed only when the magnetic pull of the magnet on the armature is sufficient to overcome the tension of the adjusting spring.

The operation of the cut-out is as follows :—

The shunt coil is connected across the dynamo. When the vehicle is starting, the speed of the engine, and thus the voltage of the dynamo, rises until the electro-magnet is sufficiently magnetised to overcome the spring tension and close the cut-out contacts. This completes the circuit between the dynamo and the battery through the series winding of the cut-out and the contacts. The effect of the charging current flowing through the cut-out windings creates a magnetic field in the same direction as that produced by the shunt winding. This increases the magnetic pull on the armature so that the contacts are firmly closed, and cannot be separated by vibration. When the vehicle is topping the speed of the dynamo is decreased until the dynamo voltage is lower than that of the battery. Current then flows from the battery through the cut-out series winding and dynamo in a reverse direction to the charging current. This reverse current through the cut-out will produce a differential action between the two windings and partly de-magnetise the electro-magnet. The spring, which is under constant tension, then pulls the armature away from the magnet and opens the circuit. The contacts opening prevent further discharging of the battery through the dynamo.

Like the regulator, operation of the cut-out is temperature-controlled by means of a bi-metallic tensioning spring.

SETTING DATA.

Regulator.

Open-circuit setting at 20°C. and 1,500 dynamo r.p.m. :— 15.6—16.2 volts.

Note :—For ambient temperatures other than 20°C., the following allowances should be made to the above setting :—

For every 10°C. (18°F.) above 20°C., subtract 0.3 volt.

For every 10°C. below 20°C., add 0.3 volt.

Cut-out.

Cut-in voltage :	12.7 — 13.3
Drop-off voltage :	8.5 — 11.0
Reverse current :	3.5 — 5.0 amp.

SERVICING.

Testing in Position to Locate Fault in Charging Circuit.

If the dynamo and battery are in order, check as follows :—

(1) Ensure that the wiring between battery and regulator is in order. To do this, disconnect the wire from the A terminal of the control box and connect the end of the wire removed to the negative terminal of a voltmeter.

Connect the positive voltmeter terminal to an earthing point on the chassis. If a voltmeter reading is given, the wiring is in order and the regulator must be examined.

(2) If there is no reading, examine the wiring between battery and control box for defective cables or loose connections.

(3) Re-connect the wire to terminal A.

Regulator Adjustment.

The regulator is carefully set during manufacture and, in general, it should not be necessary to make further adjustment. 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, the setting should be checked and, if necessary, corrected.

It is important before altering the regulator setting to check that the low state of charge of the battery is not due to a battery defect or to slipping of the dynamo belt.

Electrical Setting.

It is important that only a good quality MOVING COIL VOLTMETER (0-20 volts) is used when checking the regulator. The electrical setting can be checked without removing the cover from the control box.

Withdraw the cables from terminals A and A1 at the control box and connect these cables together.

Connect the negative lead of the voltmeter to control box terminal D and connect the other lead to terminal E.

Slowly increase the speed of the engine until the voltmeter needle "flicks" and then steadies. This should occur at a voltmeter reading between the appropriate limits given under *Setting Data* according to the ambient temperature.

If the voltage at which the reading becomes steady occurs outside these limits, the regulator must be adjusted.

Shut off the engine and remove the control box cover.

Release locknut A (*see Fig.* 27) of 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. Turn the screw only a fraction of a turn at a time and then tighten the locknut. Repeat as above until the correct setting is obtained.

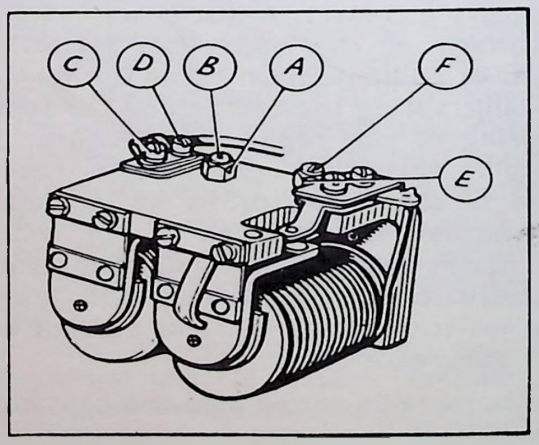


Fig. 27. Cut-out and Regulator Assembly.

Adjustment of regulator open-circuit voltage should be completed within 30 seconds, otherwise heating of the shunt winding will cause false settings to be made.

Remake the original connections.

A dynamo run at high speed on open circuit will build up a high voltage. Therefor, when adjusting the regulator, do not run the engine up to more than half throttle or a false setting will be made.

Mechanical Setting.

The mechanical or air-gap settings of the regulator, shown in *Fig.* 28, are accurately adjusted before leaving the works and, provided that the armature carrying the moving contact is not removed, these settings should not be tampered with. If, however, the armature has been removed, the regulator will have to be reset. To do this proceed as follows :—

Slacken the two armature fixing screws and also adjusting screw B. Insert a 0.020″ (.508 mm) feeler gauge between the back of the armature and the regulator frame. It is permissible for this gap to taper, either upwards or downwards, between the limits of 0.018″ to 0.022″ (.457 to .559 mm.).

With gauge in position, press back the armature against the regulator frame and tighten the two armature fixing screws. Remove the gauge and check the gap between

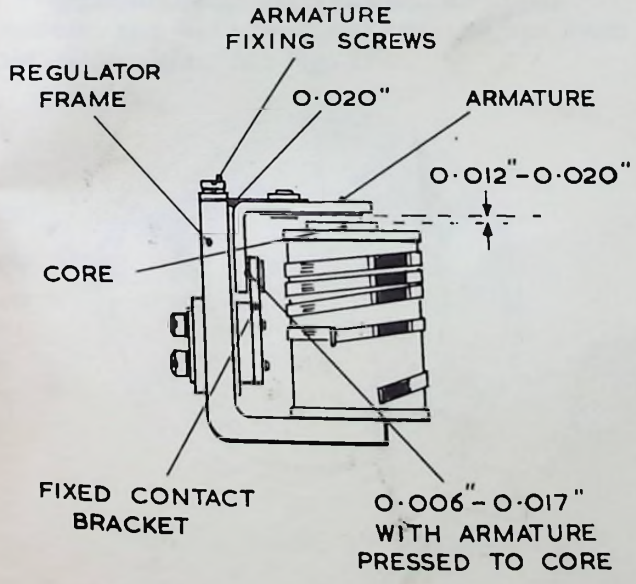


Fig. 28. Mechanical Setting of Regulator.

the **shim** on the underside of the armature and the top of the core. This gap should be 0.012″-0.020″ (.305-.508 mm.). If the gap is outside these limits, correct by carefully bending the fixed contact bracket.

Remove the gauge and press the armature down, when the gap between the contacts should be 0.006″-0.017″ (.152-.432 mm.).

Cleaning Contacts.

After long periods of service it may be found necessary to clean the regulator contacts. The contacts are made accessible by slackening the screws securing the fixed contact bracket. It will be necessary to slacken screw C a little more than screw D (*see Fig.* 27) so that the contact bracket can be swung outwards. Clean the contacts by means of fine carborundum stone or fine emery cloth.

Carefully wipe away all traces of dust or other foreign matter with methylated spirits (de-natured alcohol). Re-position the fixed contact bracket and tighten the securing screws.

Cut-Out Adjustment.

(1) Electrical Setting.

If the regulator is correctly set but the battery is still not being charged, the cut-out may be out of adjustment. To check the voltage at which the cut-out operates, remove the control box cover and connect the voltmeter between terminals D and E. Start the engine and slowly increase its speed until the cut-out contacts are seen to close, noting the voltage at which this occurs. This should be 12.7-13.3 volts. If operation of the cut-out takes place outside these limits, it will be necessary to adjust. To do this, slacken locknut E (*Fig.* 27) and turn screw F in a clockwise direction to raise the voltage setting or in an anti-clockwise direction to reduce the setting. Turn the screw only a fraction of a turn at a time and tighten the locknut. Test after each adjustment by increasing the engine speed and noting the voltmeter readings at the instant of contact closure. Electrical settings of the cut-out, like the regulator, must be made as quickly as possible because of temperature-rise effects. Tighten the locknut after making the adjustment. If the cut-out does not operate, there may be an open circuit

in the wiring of the cut-out and regulator unit, in which case the unit should be removed for examination or replacement.

(2) **Mechanical Setting.**
If for any reason the cut-out armature has to be removed from the frame, care must be taken to obtain the correct air-gap settings on re-assembly (see *Fig.* 29). These can be obtained as follows :—

Slacken the two armature fixing screws, adjusting screw F and the screw securing the fixed contact. Insert a 0.014″ (.356 mm.) gauge between the back of the armature and the cut-out frame. (The air gap between the core face and the armature shim should now measure 0.011″-0.015″ (.279-.381 mm.). If it does not, fit a new armature assembly). Press the armature back against the gauge and tighten the armature fixing screws. With the gauge still in position, set the gap between the armature and the stop plate arm to 0.030″-0.034″ (.762-.864 mm.) by carefully bending the stop plate arm. Remove the gauge and tighten the screw securing the fixed contact.

Insert a 0.025″ (.635 mm.) gauge between the core face and the armature. Press the armature down on to the gauge. The gap between the contacts should now measure 0.002″ to 0.006″ (.051 to .152 mm.) and the drop-off voltage should be between the limits given on *page L20*. If necessary, adjust the gap by carefully bending the fixed contact bracket.

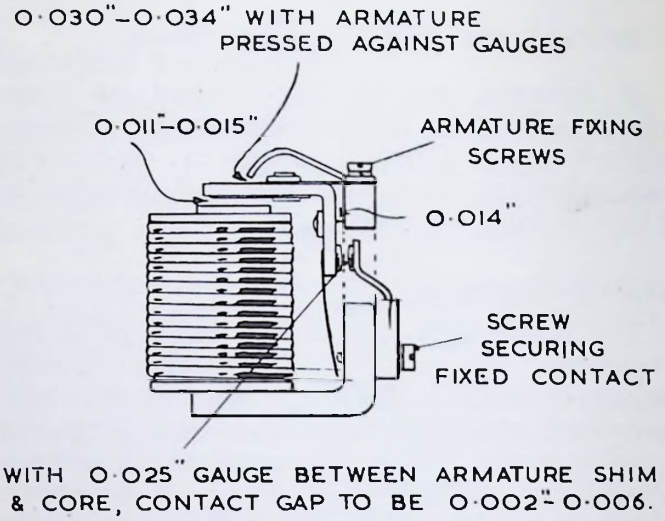


Fig. 29. Mechanical Setting of Cut-out.

(3) **Cleaning Contacts.**
If the cut-out contacts appear rough or burnt, place a strip of fine glass paper between the contacts—then, with the contacts closed by hand, draw the paper through. This should be done two or three times with the rough side towards each contact. Wipe away all dust or other foreign matter, using a clean fluffless cloth moistened with methylated spirits (de-natured alcohol).

Do not use emery cloth or a carborundum stone for cleaning cut-out contacts.

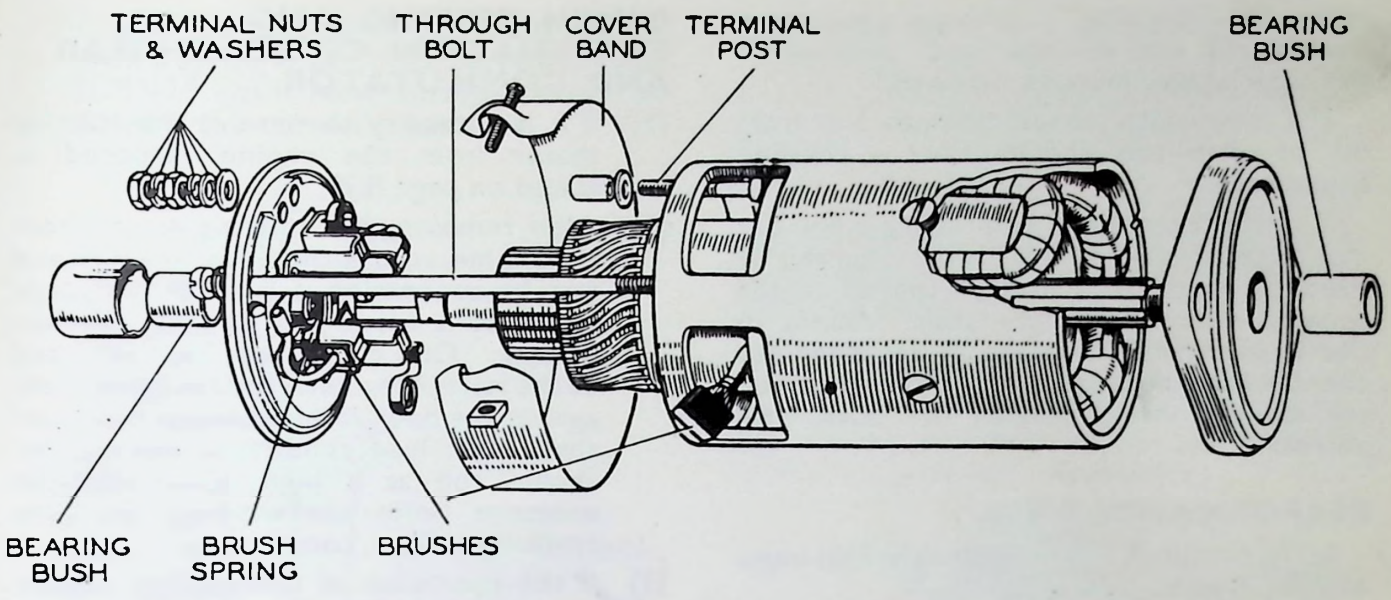


Fig. 30. Starting Motor Dismantled.

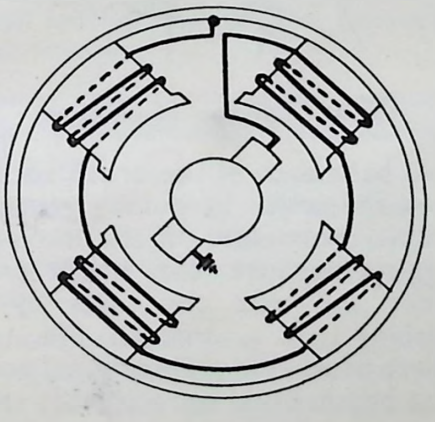
STARTING MOTOR LUCAS MODEL M35G.

DESCRIPTION.

The electric starting motor is a series-wound four-pole four-brush machine having an extended shaft which carries the inboard type engine engagement gear, or starter drive as it is more usually named.

The starting motor is of similar construction to the dynamo except that heavier copper wire is used in the construction of the armature and field coils.

The field coils are connected in series between the field terminal and the insulated pair of brushes. *See Fig.* 31



MODEL M35G (2 BRUSH)

Fig. 31. Internal Connections at the Starting Motor.

STARTER JAMMING.

Should this happen, it can usually be released by turning the armature by means of the square on the forward end of the shaf see *Fig.* 32.

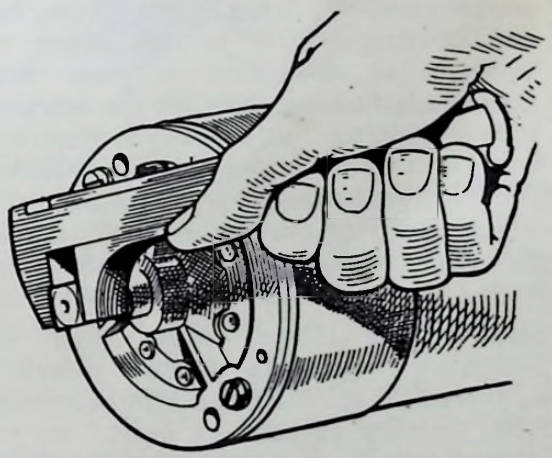


Fig. 32. How to Release the Starter.

ROUTINE MAINTENANCE.

The only maintenance normally required by the starting motor is the occasional checking of brush-gear and commutator. About every 10,000 miles, remove 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 fine dry cloth against it while the starter is turned by hand by means of a spanner applied to the squared extension of the shaft. Access to the squared shaft is gained by removing the thimble-shaped metal cover. If the commutator is very dirty, moisten the cloth with petrol.

PERFORMANCE DATA.

Lock torque 9.3 lb.-ft. with 370-390 amps. at 7.7-7.3 volts.

Torque at 1,000 r.p.m. 4.9 lb.-ft. with 250-270 amps. at 9.3-8.9 volts.

Light running current 45 amperes at 8,500-10,000 r.p.m.

Testing in position.

(1) Switch on the lamps and operate the starter control. If the lights go dim, but the starting motor is not heard to operate, an indication is given that current is flowing through the starting motor windings but that the armature is not rotating for some reason ; possibly the pinion is meshed permanently with the geared ring on the flywheel. In this case, the starting motor must be removed from the engine for examination.

(2) Should the lamps retain their full brilliance when the starter switch is operated, check the circuit for continuity from battery to starting motor via the starter switch, and examine the connections at these units. If the supply voltage is found to be applied to the starting motor when the switch is operated, an internal fault in the motor is indicated and the unit must be removed from the engine for examination.

(3) Sluggish or slow action of the starting motor is usually due to a loose connection causing a high resistance in the motor circuit. Check as described above.

(4) If the motor is heard to operate, but does not crank the engine, indication is given of damage to the drive.

BENCH TESTING AND EXAMINATION OF BRUSHGEAR AND COMMUTATOR.

(1) If it is necessary to remove the starting motor from the engine, proceed as stated on *page* B.29.

(2) After removing the starting motor from the engine, secure the body in a vice and test by connecting it with heavy gauge cables to a battery of the appropriate voltage. One cable must be connected to the starter terminal and the other held against the body or end bracket. Under these light load conditions, the starter should run at a high speed without excessive noise and without excessive sparking at the commutator.

(3) If the operation of the starting motor is unsatisfactory, remove the cover band and examine the brushes and commutator.

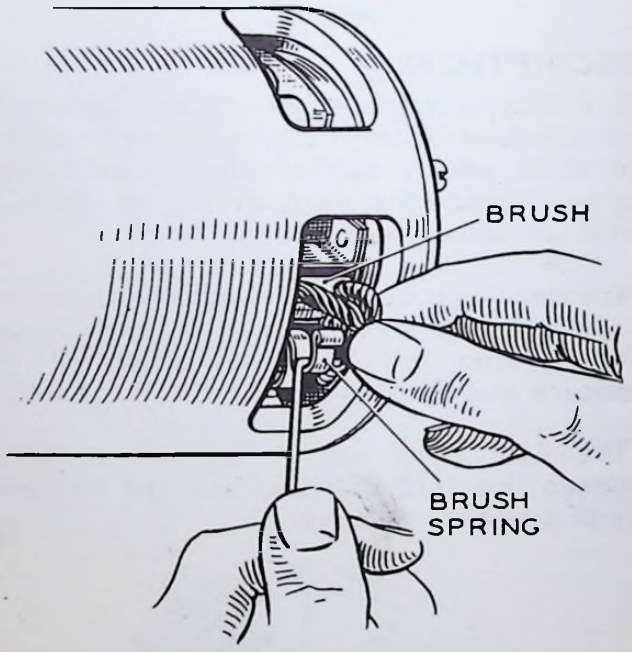


Fig. 33. Checking Brush Gear.

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 replace brushes in their original positions. If the brushes are worn so that they will not bear on the commutator, or if the brush flexible is exposed on the running face, they must be replaced.

Check the tension of the brush springs with a spring scale. The correct tension is 15-25 ozs. New springs should be fitted if the tension is low.

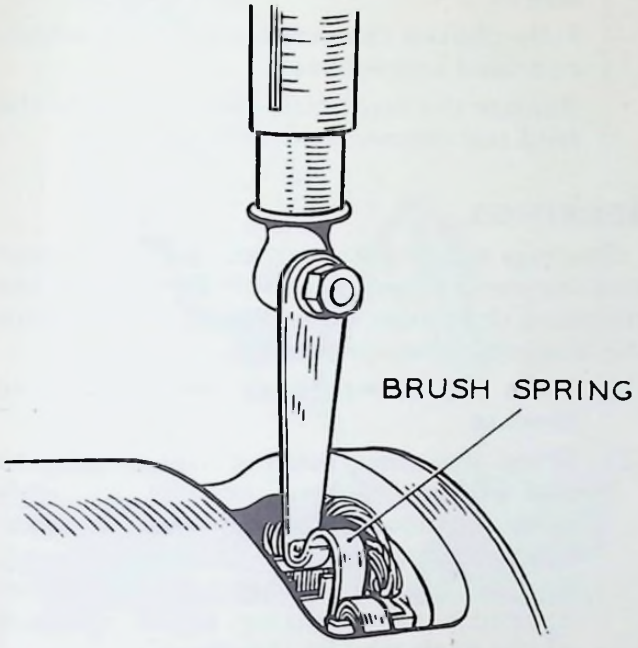


Fig. 34. Testing Brush Spring Tension.

If the commutator is blackened or dirty, clean it by holding a petrol-moistened cloth against it while the armature is rotated.

(4) Re-test the starter as described under (2). If the operation is still unsatisfactory, the unit can be dismantled for detailed inspection and testing as follows :—

TO DISMANTLE

(1) Remove the cover band, hold back the brush springs and lift the brushes from their holders.

(2) Remove the nuts from the terminal post which protrudes from the commutator end bracket.

(3) Unscrew the two through bolts from the commutator end bracket. Remove the commutator end bracket from the yoke.

(4) Remove the driving end bracket and drive from the starting motor yoke. If it is necessary to remove the armature from the driving end bracket, it can be done by means of a hand press after the drive has been dismantled.

REPLACEMENT OF BRUSHES.

If the brushes are worn so that they do not bear on the commutator, or if the flexible connectors are exposed on the running face, they must be replaced.

Two of the brushes are connected to terminal eyelets attached to the brush boxes on the commutator end bracket and two are connected to the field coils.

The flexible connectors must be removed by unsoldering and the connectors of the new brushes secured in their place by soldering. The brushes are pre-formed so that bedding to the commutator is unnecessary.

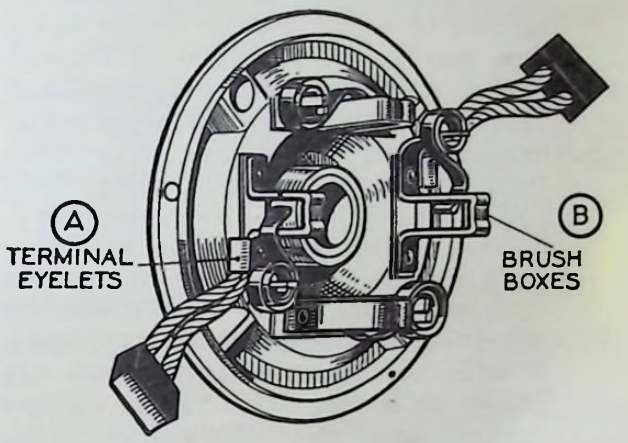


Fig. 35. C.E. Bracket Brush Connections.

COMMUTATOR.

A commutator in good condition will be smooth and free from pits and burned spots. Clean the commutator with a petrol-moistened cloth. If this is ineffective, carefully polish with a strip of fine glass paper, while rotating the armature. To remedy a badly worn commutator, dismantle the starter drive and remove the armature from the end bracket. Now mount the armature in a lathe, rotate at a high speed and take a light cut with a very sharp tool.

Do not remove any 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 cause of failure, e.g., conductors lifted from the commutator due to the starting motor being engaged while the engine is running and causing the armature to be rotated at an

excessive speed. A damaged armature must always be replaced—no attempt should be made to machine the armature core or to true a distorted armature shaft.

FIELD COILS.

(1) Test the field coils for continuity by connecting a 12 volt test lamp between the starting motor terminal and the tapping point at which the brushes are connected.

(2) Lighting of the lamp does not necessarily mean that the field coils are in order, as it is possible that one of them may be earthed to a pole shoe or to the yoke. This may be checked with a 110-volt test lamp, the test leads being connected between the starting motor terminal and a clean part of the yoke. If the lamp lights, defective insulation of the field coils or of the terminal post is indicated. In this event, see that the insulating band is in position and examine the field coils and terminal connections for any obvious point of contact with the yoke. If from the above tests the coils are shown to be open-circuited or earthed and the point of contact cannot readily be located and rectified, either the complete starting motor or the field coils must be replaced.

If the field coils are to be replaced, follow the procedure outlined below, using a pole shoe expander and a wheel-operated screwdriver.

Remove the insulation piece which is provided to prevent the intercoil connectors from contacting with the yoke. Mark the yoke and pole shoes so that the latter can be refitted in their original positions.

Unscrew the four pole shoe retaining screws with the wheel-operated screwdriver.

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.

Take care to 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 fixing screws.

Insert the pole shoe expander, open it to the fullest extent and tighten the screws.

Fully tighten the screws with the wheel-operated screwdriver.

Replace the insulation piece between the field coil connections and the yoke.

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 bushes proceed as follows :—

(1) Press the bearing bush out of the end bracket.

(2) Press the new bearing bush into the end bracket using a shouldered, highly polished mandrel of the same diameter as the shaft which is to fit in the bearing. Porous bronze bushes must not be opened out after fitting, or the porosity of the bush may be impaired.

NOTE :—Before fitting a new porous bronze bearing bush it must be completely immersed for 24 hours in clean thin engine oil. In case 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.

The re-assembly of the starting motor is a reversal of the dismantling procedure.

BATTERY MODEL GTW 9 A/2.

ROUTINE MAINTENANCE.

Every 500 miles, or fortnightly (weekly in hot climates) examine the level of the electrolyte in the cells, and if necessary add **distilled** water to bring the level up to the top of the separators.

N.B.—Never use a naked light when examining a battery, as the mixture of oxygen and hydrogen given off by the battery when on charge, and to a lesser extent when standing idle, can be dangerously explosive.

Examine the terminals and, if necessary, clean them and coat them with petroleum jelly. Wipe away any foreign matter or

moisture from the top of the battery, and ensure that the connections and the fixings are clean and tight.

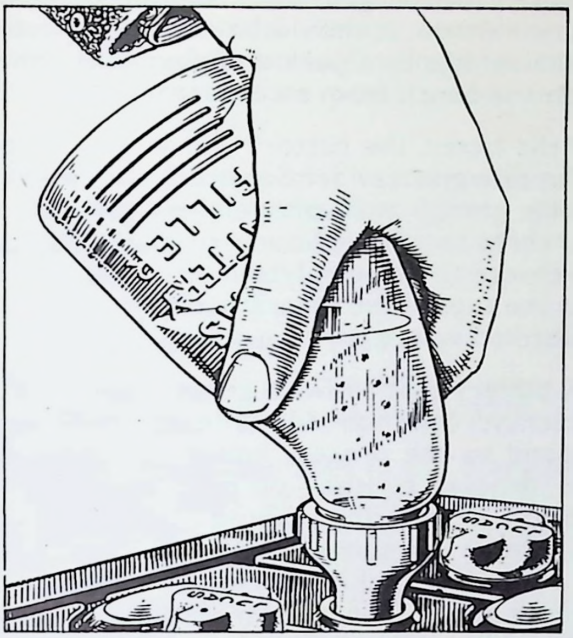


Fig. 36. Topping-up.

SERVICE DATA.

CAPACITY AND CHARGING RATES.

Plates per Cell : 9

Ampere-hour capacity at :—

(a) The 10-hour rate : 51

(b) The 20-hour rate : 58

Volume of Electrolyte required to fill one cell : ½ pint or 284 c.c.

Initial Charging Current : 3.5 amps.

Normal Recharge Current : 5.0 amps.

SPECIFIC GRAVITY OF ELECTROLYTE.

The specific gravity of the electrolyte varies with the temperature, therefore, for convenience in comparing specific gravities, this is always corrected to 60°F., which is adopted as a reference temperature. The method of correction is as follows.

For every 5°F. **below** 60°F., **deduct** .002 from the observed reading to obtain the true specific gravity at 60°F. **For** every 5°F. **above** 60°F., **add** .002 to the observed reading to obtain the true specific gravity at 60°F.

The temperature must be that indicated by a thermometer actually immersed in the electrolyte, and not the air temperature.

Home trade and climates	*Sub-tropical climates*	*Tropical climates*
Normally below 80°F.-27°C.	80°-100°F. (27°-38°C.)	over 100°F. (38°C.)
Filling 1.350	*Fully charged* 1.280-1.300	*Filling* 1.320
Fully charged 1.250-1.270	*Filling* 1.300	*Fully charged* 1.220-1.240

MAXIMUM PERMISSIBLE ELECTROLYTE TEMPERATURE DURING CHARGE.

Climates normally below 80°F. (27°C.)	Climates between 80°-100°F. (27°-38°C.)	Climates frequently above 100°F (38°C.)
100°F. (38°C.)	110°F. (43°C.)	120°F. (49°C.)

SERVICING.

BATTERY PERSISTS IN LOW STATE OF CHARGE.

First consider the conditions under which the battery is used, If the battery is subjected to long periods of discharge without suitable opportunities for re-charging, a low state of charge can be expected. A fault in the dynamo or regulator, or neglect of the battery during a period of low or zero mileage may also be responsible for the trouble.

VENT PLUGS.

See that the ventilating holes in each vent plug are clear.

LEVEL OF ELECTROLYTE.

The surface of the electrolyte should be level with the tops of the separators. If necessary, top up with distilled water. Any loss of acid from spilling or spraying (as opposed to the normal loss of **water** by evaporation) should be made good by dilute acid of the same specific gravity as that already in the cell.

CLEANLINESS.

See that the top of the battery is free from dirt or moisture which might provide a

discharge path. Ensure that the battery connections are clean and tight.

HYDROMETER TESTS.

Measure the specific gravity of the acid in each cell in turn, with a hydrometer. The reading given by each cell should be approximately the same ; if one cell differs appreciably from the other, an internal fault in that cell is indicated. This will probably be confirmed by the heavy discharge test described below.

The appearance of the electrolyte drawn into the hydrometer when taking a reading gives a useful indication of the state of the plates : if it is very dirty, or contains small particles in suspension, it is possible that the plates are in a bad condition.

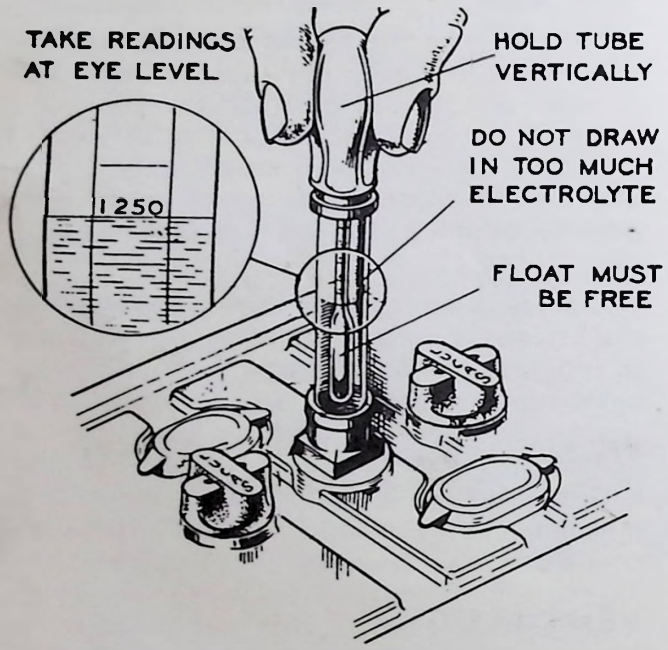


Fig. 37. Taking Hydrometer Reading.

DISCHARGE TEST.

A heavy discharge tester consists of a voltmeter, 2 or 3 volts full scale, across which is connected a shunt resistance capable of carrying a current of several hundred amperes. Pointed prongs are provided for making contact with the inter-cell connectors.

Press the contact prongs against the exposed positive and negative terminals of each cell. A good cell will maintain a reading of 1.2-1.5 volts, depending on the state of charge, for at least 6 seconds. If, however, the reading rapidly falls off, the cell is probably faulty, and a new plate assembly may have to be fitted.

RE-CHARGING FROM AN EXTERNAL SUPPLY.

If the above tests indicate that the battery is merely discharged, and is otherwise in a good condition, it should be recharged, either on the vehicle by a period of daytime running or on the bench from an external supply.

If the latter, the battery should be charged at the rate given under Service Data, until the specific gravity and voltage show no increase over three successive hourly readings. During the charge the electrolyte must be kept level with the tops of the separators by the addition of distilled water.

A battery that shows a general falling-off in efficiency, common to all cells, will often respond to the process known as "cycling". This process consists of fully charging the battery as described above, and then discharging it by connecting to a lamp board, or other load, taking a current equal to its 10-hour rate. The battery should be capable of providing this current for at least 7 hours before it is fully discharged, as indicated by the voltage of each cell falling to 1.8. If the battery discharges in a shorter time, repeat the "cycle" of charge and discharge.

PREPARING NEW UNFILLED, UNCHARGED BATTERIES FOR SERVICE.

PREPARATION OF ELECTROLYTE.

Batteries should not be filled with acid until required for initial charging. Electrolyte of the specific gravity given previously is prepared by mixing distilled water and concentrated sulphuric acid, usually of 1.835 S.G. The mixing must be carried out either in a lead-lined tank or in suitable glass or earthenware vessels. Slowly add the acid to the water, stirring with a glass rod. **Never add the water to the acid,** as the resulting chemical reaction causes violent and dangerous spurting of the concentrated acid. The approximate proportions of acid and water are indicated in the following table :

To obtain Specific Gravity (corrected to 60°F.) of :	*Add 1 vol. of acid of 1.835 S.G. (corrected to 60°F.) to :*
1.350	1.8 volumes of water
1.320	2.3 ,, ,, ,,
1.300	2.5 ,, ,, ,,

Heat is produced by the mixture of acid and water, and the electrolyte should be allowed to cool before taking hydrometer readings—unless a thermometer is used to measure the actual temperature, and a correction applied to the reading as described previously—and before pouring the electrolyte into the battery.

The total volume of electrolyte required can be estimated from the figures quoted previously.

FILLING THE BATTERY.

The temperature of the acid, battery and filling-in room must not be below 32°F.

Carefully break the seals in the filling holes and **half-fill** each cell with electrolyte of the appropriate specific gravity. Allow the battery to stand for at least six hours, in order to dissipate the heat generated by the chemical action of the acid on the plates and separators, and then add sufficient electrolyte to fill each cell to the top of the separators. Allow to stand for a further two hours and then proceed with the initial charge.

INITIAL CHARGE.

The initial charging rate is given in *Service Data*. Charge at this rate until the voltage and specific gravity readings show no increase over five successive hourly readings. This will take from 40 to 80 hours, depending on the length of time the battery has been stored before charging.

Keep the current constant by varying the series resistance of the circuit or the dynamo output. **This charge should not be broken by long rest periods.** If however, the temperature of any cell rises above the permissible maximum quoted earlier, the charge must be interrupted until the temperature has fallen at least 10°F. below that figure. Throughout the charge, the electrolyte must be kept level with the top of the separators by the addition of acid solution of the same specific gravity as the original filling-in acid, until specific gravity and voltage readings have remained constant for five successive hourly readings. If the charge is continued beyond that point, top up with distilled water.

At the end of the charge carefully check the specific gravity in each cell to ensure that, when corrected to 60°F., it lies within the specified limits. If any cell requires adjustment, some of the electrolyte must be siphoned off and replaced either by distilled water or by acid of the strength originally used for filling-in, depending on whether the specific gravity is too high or too low. Continue the charge for an hour or so to ensure adequate mixing of the electrolyte and again check the specific gravity readings. If necessary, repeat the adjustment process until the desired reading is obtained in each cell. Finally, allow the battery to cool, and siphon off any electrolyte above the tops of the separators.

BATTERY CABLE CONNECTORS.

When fitting the diecast cable connectors, smear the inside of the tapered hole with petroleum jelly and push on the connector by hand. Insert the self-tapping screw and tighten with medium pressure only ; fill in the recess around the screw with more petroleum jelly.

If the connectors are fitted dry and driven home on the tapered battery posts too tightly, difficulty may be experienced when it is required to remove them.

HEADLAMPS MODEL F700 MKVI.

GENERAL DESCRIPTION.

The lamps incorporate a combined reflector and front lens assembly known as the Lucas Light Unit. They are fitted with a "prefocus" bulb which ensures that the filament is always positioned correctly with respect to the focal point of the reflector.

LIGHT UNIT.

The construction of the Light Unit ensures that the reflector surface is effectively protected. The outer surface of the "Block-pattern" lens is smooth, to facilitate cleaning, but the inner surface has formed in it a series of small lenses which determine the spread and pattern of the light.

BULBS.

The "prefocus" bulb eliminates the need for any focusing device in the lamp. The bulb cap is carried on a flange accurately positioned

in relation to the filament during manufacture. A slot in the flange engages with a projection on the inside of the bulb holder at the back of the reflector, thus ensuring the correct positioning of the filament. A bayonet-fitting cap with spring-loaded contacts secures the bulb firmly in position, and also carries the supply to the bulb contacts.

BULB REPLACEMENT.

Slacken the captive securing screw at the bottom of the front rim and remove the front rim and dust-excluding rubber.

To remove the Light Unit assembly from the three spring-loaded screws, press the Unit inwards, turning it anti-clockwise to disengage the slotted holes in the seating rim from the setting adjustment screws. Disengage the bayonet-fixed bulb adaptor and withdraw the defective bulb from the Light Unit.

Re-assembly of the Light Unit to the lamp is a reversal of the above procedure.

SETTING.

In overseas markets, lamps must be set to comply with the local lighting regulations.

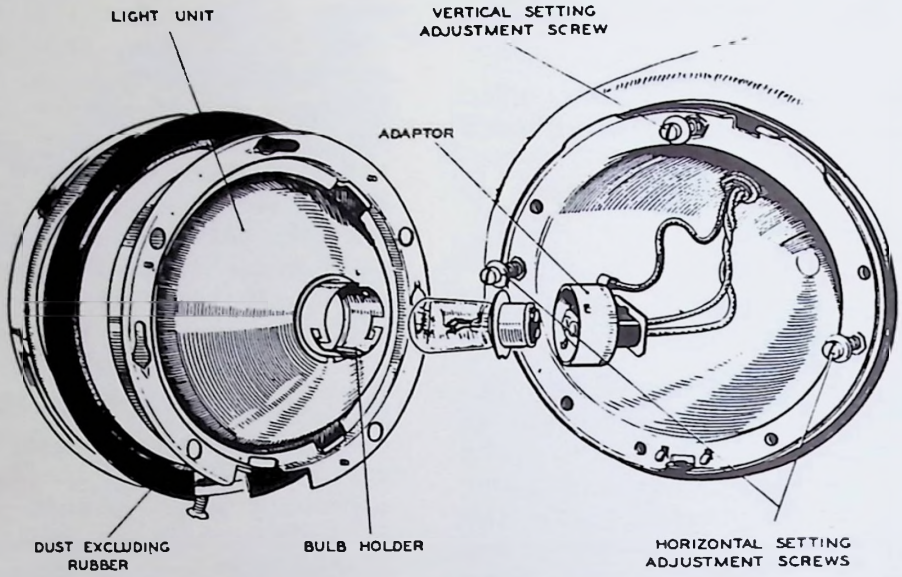
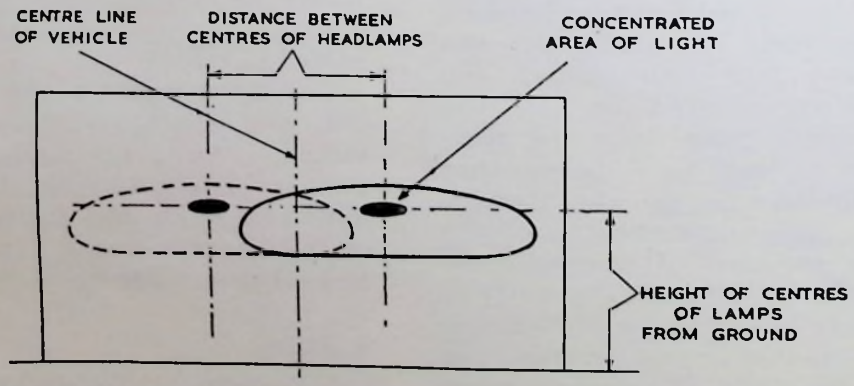


Fig. 38. Headlamp Bulb Replacement.

MINISTRY OF TRANSPORT LIGHTING REGULATIONS (UNITED KINGDOM).

The Lighting Regulations state that a lighting system must be arranged so that it can give a light which is "incapable of dazzling any person standing on the same horizontal plane as the vehicle at a greater distance than twenty-five feet from the lamp, whose eye-level is not less than three feet six inches above that plane". The headlamp must therefore be set so that the main beams of light are parallel with the road and with each other.



(A) FRONT OF VEHICLE TO BE SQUARE WITH SCREEN
(B) VEHICLE TO BE LOADED AND STANDING ON LEVEL GROUND
(C) RECOMMENDED DISTANCE FOR SETTING IS AT LEAST 25FT.
(D) FOR EASE OF SETTING ONE HEADLAMP SHOULD BE COVERED

Fig. 39. Headlamp Beam Setting Diagram.

ADJUSTMENT OF SETTING.

Slacken the captive securing screw at the bottom of the front rim and remove the rim and dust-excluding rubber. The spring-loaded adjustment screws are now accessible.

To adjust the vertical setting, turn the screw at the top of the lamp clockwise to raise the beam and anti-clockwise to lower the beam. Adjustment in the horizontal plane is effected by turning the two spring-loaded screws at the sides of the Light Unit.

RENEWAL OF LIGHT UNIT.

Remove the Light Unit and bulb. Withdraw the three small screws from the unit rim to separate the unit rim and seating rim from the Light Unit.

Position the replacement Light Unit on the seating rim, taking care to see that the locating clips at the edge of the Light Unit fit into the slots in the rim. Ensure that the unit rim is correctly positioned before securing in position by means of the three small screws. Refit the bulb, adapter, etc.

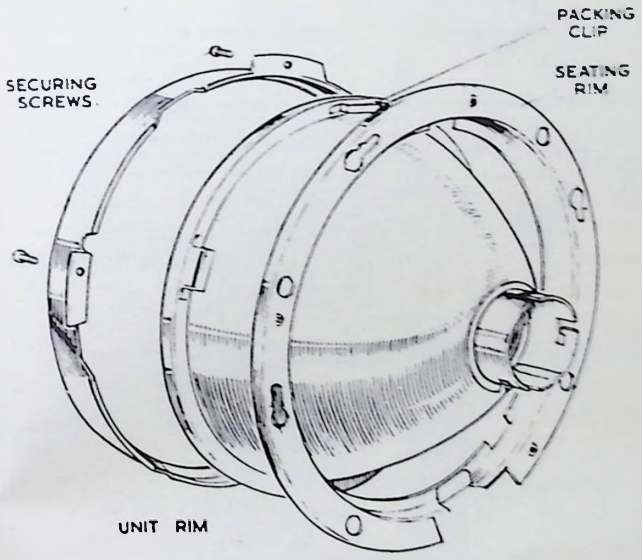


Fig. 40. Light Unit Replacement.

WINDSCREEN WIPER MODEL CRT14.

Normally the windscreen wiper will not require any servicing apart from the occasional renewal of the rubber blades. Should any trouble be experienced, first check any loose connections, worn insulation, discharged battery, etc., before removing the gear box or commutator covers.

To detach the cable rack from the motor and gear box.

Remove the gear box cover. Lift off the connecting link. Disengage the outer casing cable rack and crosshead from the gear box.

Replace the gear box cover to prevent the ingress of dirt.

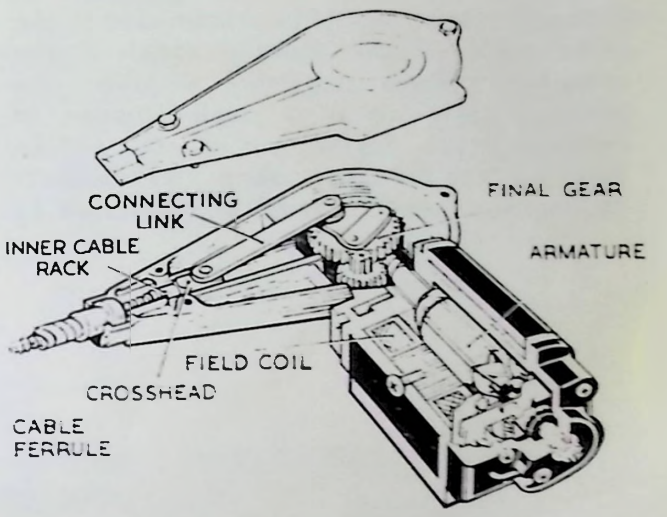


Fig. 41. Sectioned View of Windscreen Wiper.

To detach the cable rack from the wheel boxes.

Remove the wiper arms from the wheelbox spindles by slackening the collet nut, and continue to rotate it until the arm is freed from the spindle. The cable rack can then be withdrawn from the outer casing for inspection. Before refitting the cable rack into the outer casing, see that the wheelbox gears are undamaged and thoroughly lubricate the cable rack with Duckham's H.B.B. or equivalent grease.

Commutator dirty.

Remove the connecting leads to the terminals, withdraw the three screws securing the cover at the commutator end. Lift off the cover. Clean the commutator with a cloth moistened with petrol and carefully remove any carbon dust from between the commutator segments.

Brush lever stiff or brushes not bearing on commutator.

Check that the brushes bear freely on the commutator. If they are loose, and do not make contact, a replacement tension spring is necessary. The brush levers must be free

on their pivots. If they are stiff they should be freed by working them backwards and forwards by hand. If the brushes are considerably worn they must be replaced.

Motor operates but does not transmit motion to spindles.

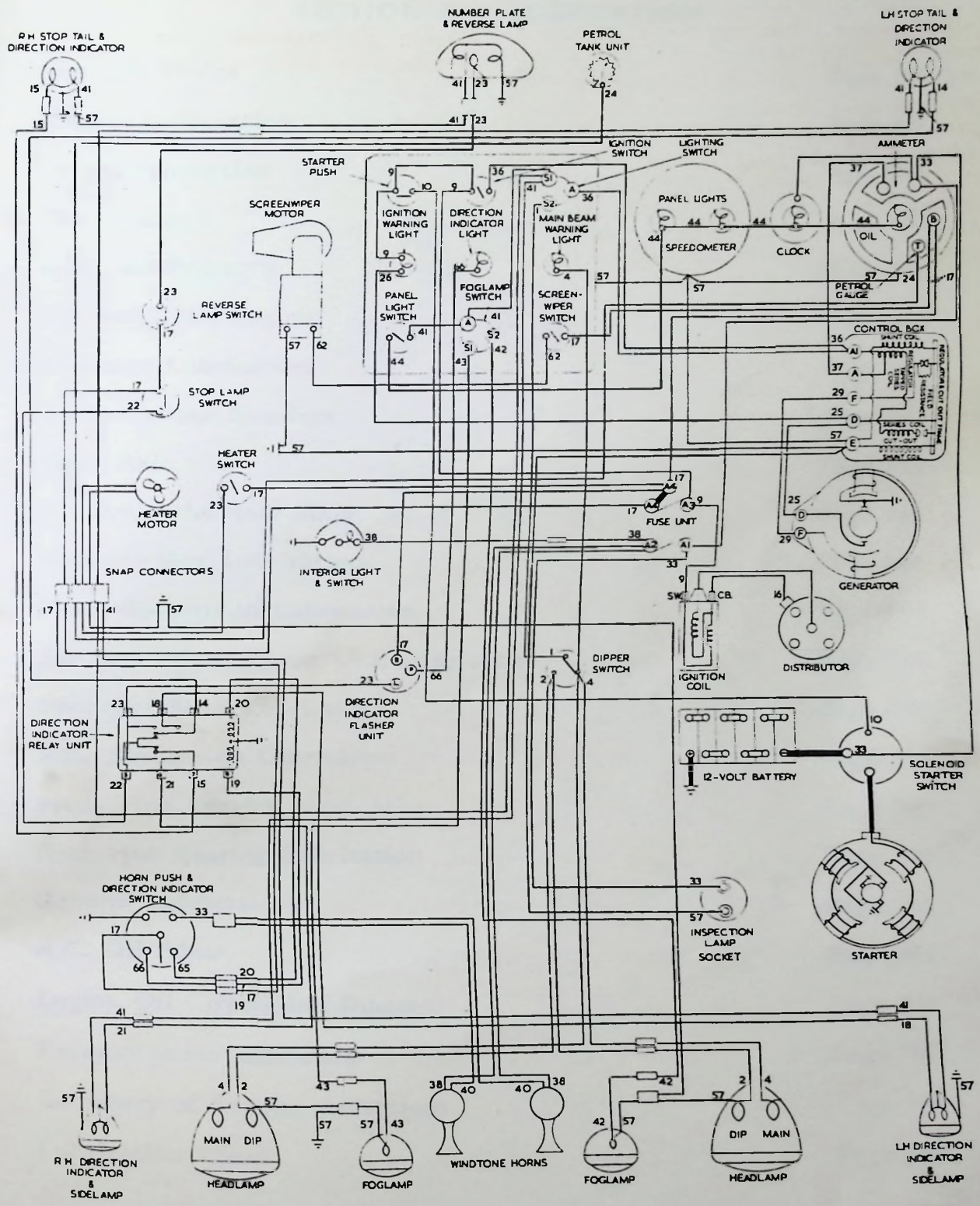
Remove the cover of the gearbox. A Push-pull motion should be transmitted to the inner cable of the flexible rack. If the cross-head moves sluggishly between the guides, lightly smear a small amount of medium grade engine oil in the groove formed in the die-cast housing. When overhauling, the gear box must be lubricated by packing the gearbox with Duckham's Keenol KG25 grease. The rubber grommets or washers round wheelbox spindles should be lubricated with a few drops of glycerine.

The use of Methylated Spirits (de-natured alcohol) on Windscreens.

Methylated spirits should be used to remove oil, tar spots and other stains from windscreens.

It has been found that the use of some silicone and wax-based polishes for this purpose can be detrimental to the rubber wiper blades.

WIRING DIAGRAM FOR 1955 SINGER HUNTER



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SECTION M

LUBRICATION

GENERAL NOTES.

The importance of regular attention being paid to the lubrication of the various parts of the car cannot be stressed too strongly, for the life of a moving part may depend on the degree of lubrication it receives.

The lubrication points on the Hunter have been reduced to a minimum, and are clearly laid out in the "Summary of Regular Attention" given on *page M8*.

This summary has been compiled on the assumption that the car will cover approximately 10,000 miles (16,000 kms.) a year ; but even though the yearly mileage may not reach this figure, or the car is stored and not used, it is advisable to carry out the suggested routine at the times stated. The Lubrication Chart on *page M9* gives the position of the various points of application, and on the serial number plate of the car will be found the correct titles of five groups of approved lubricants for the main units. These lubricants are applicable to the U.K. only.

This information is repeated on *page M7* and in addition are the Overseas recommendations.

It is bad practice to mix oils, and the use of the selected group should be continued.

ENGINE LUBRICATION.

The lubrication of the engine is automatic but the oil in the engine sump must be maintained at the correct level.

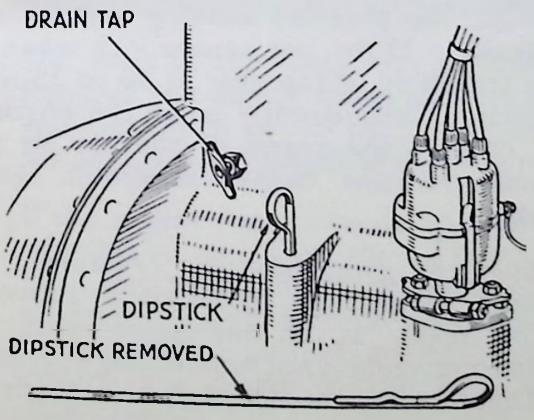


Fig. 1 Drain Tap and Dipstick.

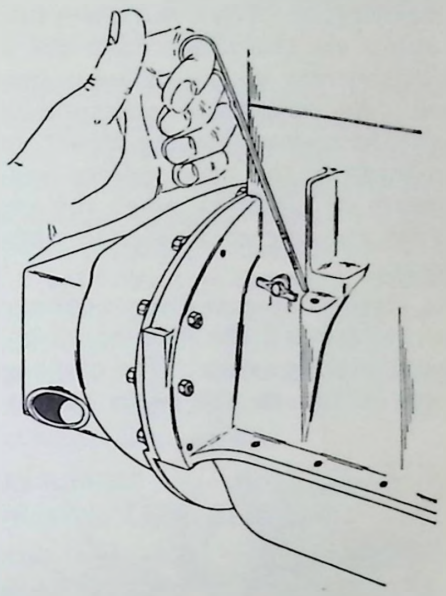


Fig. 2.

The position of the dipstick is shown on *Fig. 1*. To use the dipstick withdraw it, wipe, replace to its full extent and withdraw again. The level of the oil will be shown on the stick and if not at the correct level, fresh oil should be added as necessary. A few moments should elapse before using the dipstick a second time when oil is added or when checking after the engine is switched off. This pause is to allow the oil to drain back into the sump and find its normal level.

The filler opening is situated at the forward end of the top surface of the valve mechanism cover. When filling, therefore, allow a few minutes to elapse before checking the level.

The oil is carried in the removable steel sump. A submerged gear type of oil pump, which receives its motion from the intermediate chain wheel via a shaft and pair of helical gears, draws the oil through the fixed basket type filter and delivers it to the main gallery formed in the crankcase and running along the entire length of the near—leftside—of the engine. From this main gallery oil is fed via passages, also formed in the crankcase, to the three main bearings from where it is picked up by oil ducts formed in the webs of the crankshaft and delivered to the big end bearings.

The piston and gudgeons are lubricated by a splash from the main and big end bearings. An oil feed pipe running up through the chain case carries a supply of oil from the main gallery and delivers it via the hollow rocker shaft to the camshaft bearings, valves and rocker mechanism. The overflow is returned to the sump via the chain case and a duct formed in the rear of the cylinder head and crankcase. An adjustable pressure control valve, with its by-pass leading direct into the sump, is fitted in the main gallery and is set to a pressure of 30/35 lbs. when the engine is hot and car running at 30-35 miles per hour in top gear.

An A.C. type of by-pass filter is connected to the main gallery and the filtered oil is passed back direct into the sump. The oil gauge pipe is also connected to the main gallery pipe.

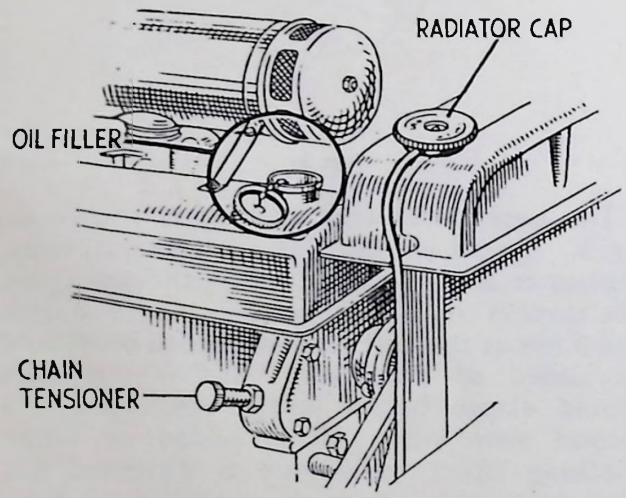


Fig. 3.

OIL CONSUMPTION.

A normal oil consumption figure is approximately 2,500 miles (4,000 kms.) to the gallon. When dealing with a complaint, it is advisable to obtain accurate test figures before deciding on what action to take. To carry out such a test proceed as follows :—

Wash the engine down so as to remove all traces of oil and dirt. Check by means of the dipstick, that the level in the engine sump is correct. Do not make this check immediately the engine is switched "OFF" or fresh oil added. Always allow a few minutes to elapse to permit the oil to find its true level in the sump. Note the mileage on the speedometer and advise the driver to increase it by say 500 miles (805 kms.). Then pour in the amount of oil needed to refill the sump to the correct level. This amount of oil when computed in miles per gallon is the correct consumption, and if not in the neighbourhood of 2,500 to the gallon, check as follows :—

Examine the engine for fresh traces of oil leaks, attend to any as necessary and advise a further test. If no traces of oil are evident, then suspect that oil in quantities above normal are passing down the valve guides and being burnt.

Replace the guides and or valves as necessary. Check also the valve rocker bushes, and shaft for excessive clearance. Replace as necessary. Oil may also work up past the pistons into the combustion chambers. This condition does not mean that the cylinder bores and piston rings are worn, but there may be excessive bearing clearances.

Clearances between the big end bearings and their journals may be in excess of standard and quantities of oil larger than normal are escaping and being flung into the cylinder walls.

Under such circumstances the piston oil control rings would be unable to control the oil and would pass them in quantities above normal into the combustion chamber and be burnt.

If replacing the big end bearings alone does not provide a solution, the engine should receive a general overhaul.

OIL PRESSURE.

When starting the engine cold the pressure reading will be rather high, but as the temperature of the engine increases and the oil thins, the pressure reading will fall to a steady 30 to 35 lbs. per square inch when the car is travelling in top gear at 30 to 35 miles per hour. Consequently when the engine is cold, restrict the speed of the car so that pressure remains below maximum gauge reading.

Should the gauge register pressures considerably lower than those given above, it can be taken as an indication that the lubrication system is not functioning correctly. An examination should then be made as directed in the next paragraph.

LOW OIL PRESSURE.

Should the gauge register pressures considerably lower than 30/35 lbs. per square inch with the car travelling at 30/35 miles per hour in top gear, or the needle of the gauge oscillate, one or more of the following causes may be responsible.

(1) The level of the oil in the sump may not be correct, or the grade of oil not as recommended. A list of recommended lubricants is given on *page M7*. Replenish as necessary.

(2) The oil pressure gauge may not be reading accurately. Check by fitting one known to be correct.

(3) Dirt or foreign matter may be preventing the pressure release valve, situated in the main gallery, from working correctly. To clean, release the locknut just sufficiently to allow the central plug to be unscrewed. Avoid altering the position on the nut unnecessarily, for the position of the nut on the plug is an indication of how far the plug must be screwed in for the pressure to be approximately correct. Completely detach the plug from the cylinder block, remove the spring, and plunger. Clean all parts including the bore in the cylinder block and the seat with petrol, and re-assemble, first the plunger, then the spring, and lastly the plug which should be screwed up to the locknut which should now be tightened.
If the pressure is low, release the lock nut, and screw the plug "in" until the correct pressure of 30/35 lbs. per square inch at 30/35 miles per hour is registered. To lower the pressure screw "out" the plug appropriately. Do not forget to tighten the locknut after each adjustment.

(4) The filter in the sump may be choked. Remove the sump, dismantle the filter and clean it in petrol with a stiff brush. See *page B24* for details of sump removal.

(5) If the engine has a considerable number of miles to its credit, the oil pump may have lost some of its original efficiency. Dismantle it and recondition as directed on *page B24*. If facilities are not available, return the pump to the Factory for attention.

(6) Loss of pressure would also be due to excessive clearance having developed, as the result of normal wear, between the journals and the bearings which are forced fed. The valve rocker mechanism is included amongst these, and some attention to the shaft and rocker bushes may therefore help.

Additional help may also be obtained by replacing the big end bearings. Should these methods fail to produce the desired effect the engine should receive a general overhaul which must include the re-grinding of the crankshaft and the fitting of the new bearings, restoring the standard clearance of .001" to .0025" (.026 mm. to .063 mm.). For the standard re-grinds for the shaft and those for the reboring of the cylinders, see *Technical Data Section.*

TO DRAIN THE ENGINE.

Remove the plug in the right side and towards the rear of the engine sump. The draining is best carried out after a run when the engine is warm and the oil thin. Always use fresh oil when refilling.

GEARBOX LUBRICATION.

So that the various components of the gearbox will receive the lubrication needed, the oil in the box must be maintained at the level indicated on the dipstick. Access to this stick is obtained by lifting the tab on the centre carpet. The dipstick aperture is used for filling.

Fig. 4. Gearbox Dipstick.

TO DRAIN THE GEARBOX.

Remove the plug in the underside of the gearbox and towards its front end and also the dipstick. The oil will drain away readily when warm, and the operation should therefore be carried out after a run.

REAR AXLE—HYPOID BEVEL UNIT.

Attention to this unit is of extreme importance.

All oils for Hypoid lubrication are specially compounded with substances enabling them to withstand high pressures and speeds. The oils recommended have been carefully tested and found to be entirely satisfactory, and brands other than those recommended by us **must on no account be used.**

A trap door, in the floor of the luggage boot and held by four screws, gives access to the oil filling plug on the top of the axle casing. Remove this plug and the level cap screwed to the domed cover on the back of the casing. Pour in oil until it issues from the level hole, and then replace both plugs and trap. (*See Fig.* 5).

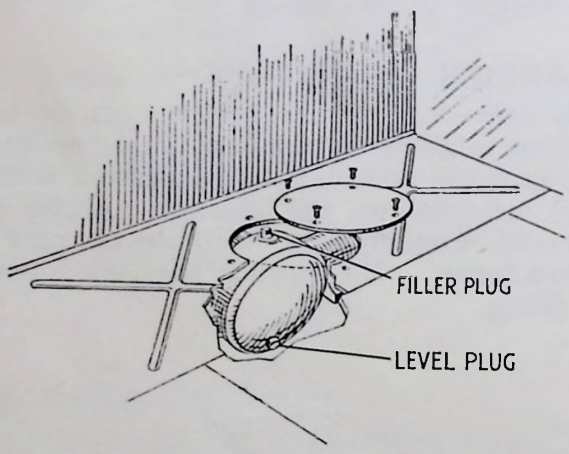


Fig. 5.

TO DRAIN THE REAR AXLE. HYPOID BEVEL UNIT.

Remove the drain plug on the underside and in the centre of the axle unit and also the filler plug. It is advantageous to drain after a long run when the oil is warm and thin.

STEERING BOX LUBRICATION.

The box is the high efficiency Burman "Re-circulated Ball" type moving on ball bearings, and the grade of oil recommended for the rear axle must be used. To fill, remove the plug in the cover and direct the oil into the level of the filler opening.

FRONT SUSPENSION LUBRICATION.

The six inner pivot points of the upper and lower suspension arms are rubber bushed assemblies and require no lubrication. The wheel swivels and the outer trunnion pivots for the arms are sealed with sealing rubbers to retain the lubricant and exclude water and grit. They are fitted with greasing nipples to satisfy the conditions to which these parts are subjected.

FAN AND WATER PUMP UNIT LUBRICATION.

The fan and water pump spindle bearings are lubricated through the same greaser and the lubricant is one of those suggested under the heading "ALL GREASE GUN POINTS". An excessive quantity of lubricant should not be injected since apart from the excess finding its way into the cooling system, portions may block the drain hole in the housing and prevent water, which seeps past the gland, draining away.

After greasing check that the drain hole is clear.

PROPELLER SHAFT LUBRICATION.

There is a grease nipple for each universal joint and if none of the lubricants suggested in the list is available a good quality oil having the consistency of 140-SAE should be used.

Should an excessive amount of grease issue from the seals of the joints, during injection, check the condition of the joint concerned as described on *pages F1 and F2.*

REAR SUSPENSION LUBRICATION.

The Shackles and Anchor Bushes for the Rear Road Springs are rubber bushed assemblies and require no lubrication. The springs should be periodically washed clean of all road dirt and mud and smeared on their tops and side with a small quantity of engine oil to prevent the formation of rust.

Grease should not be forced in between the leaves. The grease will render the

springs unduly flexible and throw an unnecessary load on the Shock Absorbers.

Should a squeak develop spray the springs throughout their length with some form of penetrating oil in sufficient quantities to remove the squeak.

FRONT HUB BEARING LUBRICATION.

Remove each front wheel and the screwed plug in the body of the hub, inject the recommended grease until full and replace all parts removed.

REAR HUB BEARING LUBRICATION.

Each wheel bearing is sealed and is independent of the Differential Bevel Gear Unit. The grease nipples for these bearings will be found on the axle casing near the brake anchor plates, see *Fig.* 6.

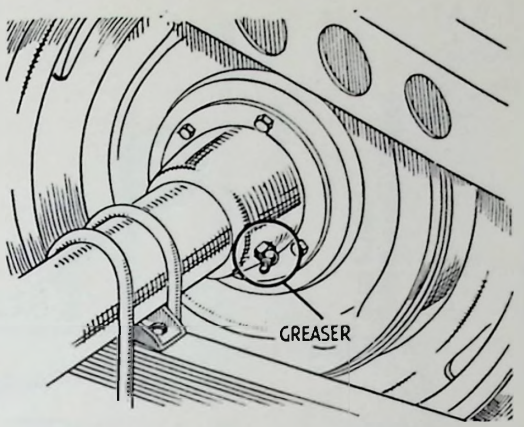


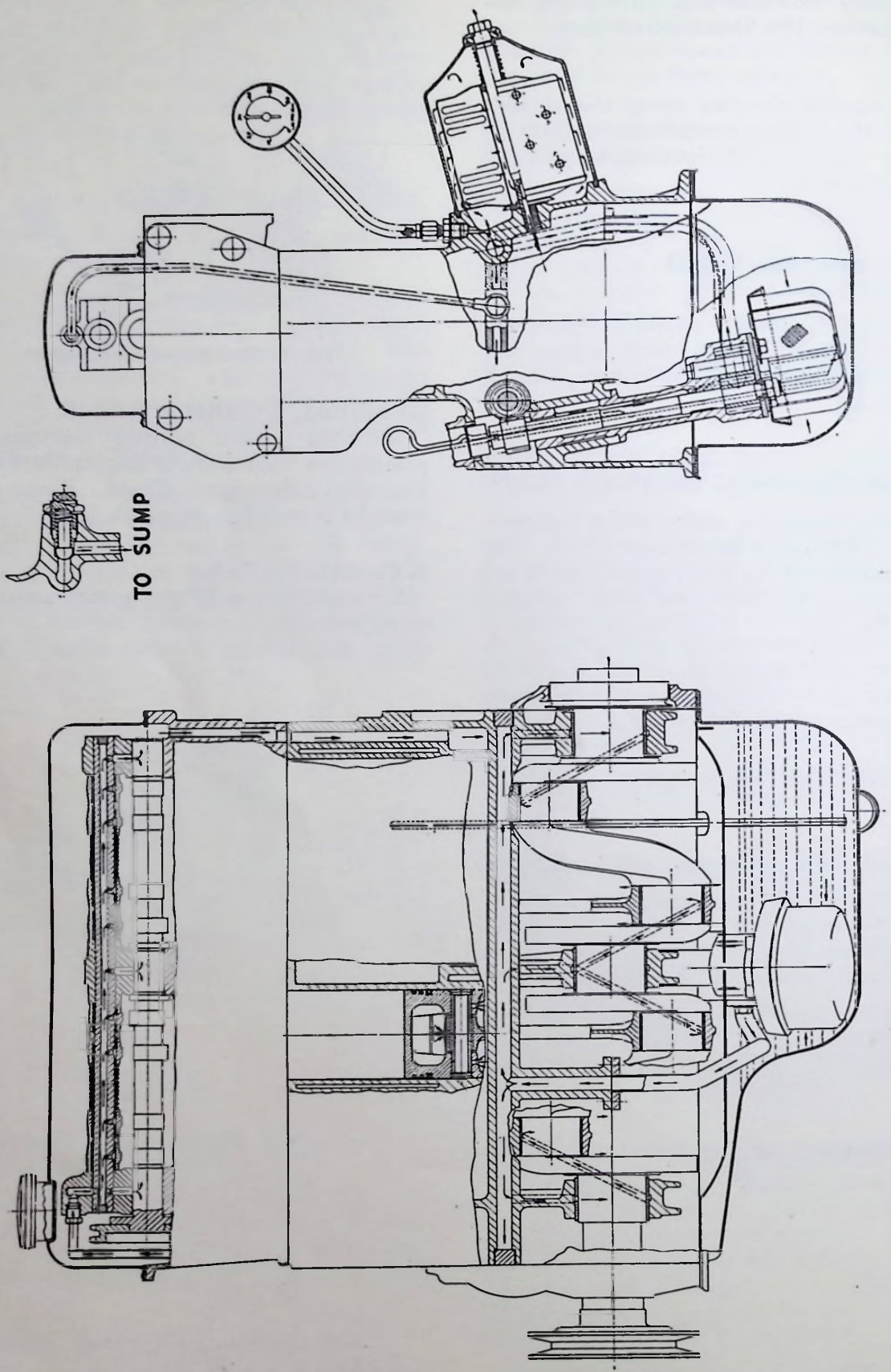
Fig. 6. Rear Hub Grease Nipples.

GENERAL LUBRICATIONS.

All other points needing lubrication are given in the "Summary of Regular Attentions" and the Lubrication Chart. These points must be serviced as directed.

A.C. OIL FILTER.

See page B28 and 29 giving instructions how to service this.



Engine Oil Circulation Diagram.

RECOMMENDED LUBRICANTS

	VACUUM	B.P.	SHELL	WAKEFIELD	ESSO
ENGINE					
U.K. Summer	Mobiloil A	Energol SAE.30	X-100 30	Castrol XL	Essolube 30
U.K. Winter	Mobiloil Arctic	Energol SAE.20W	X-100 20/20W	Castrolite	Essolube 20
OVERSEAS					
Temps. above 90°F.	Mobiloil AF	Energol SAE.40	X-100 40	Castrol XXL	Esso Extra Motor Oil 3
32°F. to 90°F.	Mobiloil A	Energol SAE.30	X-100 30	Castrol XL	Esso Extra Motor Oil 3
10°F. to 32°F.	Mobiloil Arctic	Energol SAE.20W	X-100 20/20W	Castrolite	Esso Extra Motor Oil 1
—10°F. to 10°F.	Mobiloil 10W	Energol SAE.10W	X-100 10W	Castrol Z	Esso Extra Motor Oil 1
Below —10°F.	Mobiloil 5W	Energol SAE.5W	X-100 5W	Castrol ZZ	Uniflo Motor Oil
GEARBOX					
U.K.	Mobiloil BB	Energol SAE.40	Dentax 90	Castrol XXL	Essolube 40
Overseas above 10°F.	Mobiloil BB	Energol SAE.40	Dentax 90	Castrol XXL	Essolube 40
Overseas below 10°F.	Mobiloil A	Energol SAE.30	Dentax 80	Castrol XL	Essolube 30
BACK AXLE AND STEERING BOX					
U.K.	Mobilube GX90	Energol EP.SAE.90	Spirax 90EP	Castrol Hypoy	Esso Expee Compound 90
Overseas above 10°F.	Mobilube GX90	Energol Transmission Oil EP.SAE.90	Spirax 90EP	Castrol Hypoy	Esso Expee Compound 90
Overseas below 10°F.	Mobilube GX80	Energol Transmission Oil EP.SAE80	Spirax 80EP	Castrol Hypoy 80	Esso Expee Compound 80
FRONT AND REAR HUBS					
U.K.	Mobil Hub Grease	Energrease C.3	Retinax A or RB	Castrolease Heavy	Esso Grease
Overseas	Mobilgrease No. 5	Energrease C.3	— do.—	— do.—	Esso Bearing Grease
ALL GREASE GUN POINTS					
U.K.	Mobilgrease No. 4	Energrease C.3	Retinax A or C	Castrolease CL.	Esso Pressure Gun Grease
Overseas	Mobilgrease No. 4	Energrease C.3	— do.—	— do.—	Esso Chassis Grease
BRAKE AND CONTROL LINKAGE					
U.K.	Mobilgrease No. 4	Engine Oil	— do.—	— do.—	Esso Grease
Overseas	Mobilgrease No. 4	Engine Oil	— do.—	— do.—	Esso Bearing Grease

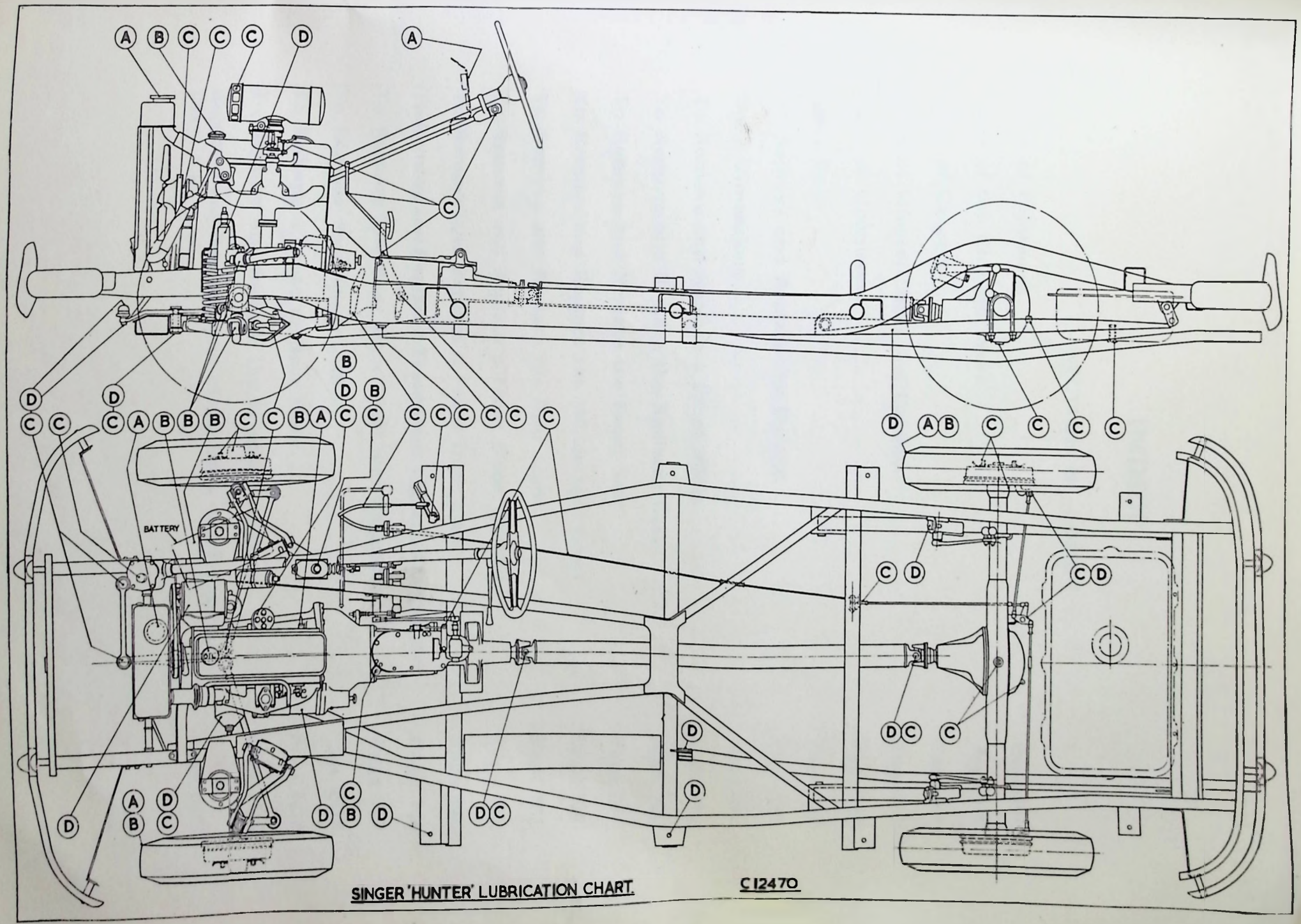
FRONT SUSPENSION DAMPERS
REAR SHOCK ABSORBERS

Wakefield Girling Piston Type Damper Oil (Thin)
Armstrong Shock Absorber Oil No. 624.

The use of an Upper Cylinder Lubricant is recommended particularly during the running in period. Any one of the well known proprietary brands is suitable and should be used as directed by the producer.

SUMMARY OF REGULAR ATTENTIONS

		LUBRICANT	APPLICATION
POINTS "A" ON DIAGRAM. WEEKLY INSPECTION.	Check fuel supply by switching on the ignition and observing the gauge. Check engine oil level by dipstick. It is advisable to keep oil at Top Level by adding the required quantity when necessary. Check Water Level in radiator, use soft (rain) water when possible and keep level within 1.5" or 38 mm. from top of tank (see page K1). See that tyres are properly inflated (check pressures each week).		
POINTS "B" ON DIAGRAM. After each 1,000 miles running. (1,600 kilometres running).	Brake and Clutch Fulcrum Pins. Front Suspension Arms, outer only, 4 points. Front Wheel Swivels, 2 points. Inspect Engine Oil Level. Inspect Gearbox Oil Level. Inspect Battery for fluid level. Inspect Tyres for damage and repair. Check the Level of Brake Master Cylinder Fluid. Distributor. *NOTE.*—Inner fulcrums of the upper and lower front suspension arms, the engine mounting, shock absorber links, anti-roll bar and the back springs are all bonded rubber and need no lubrication of any kind.	See page M7. See page M7. See page M7. See page M7. See page M7. Add Distilled Water. Lockheed Fluid. Engine Oil.	Grease Gun. Grease Gun. Grease Gun. Fill up at Cap. Fill up at Dipstick. See Lucas' Book See Goodyear Booklet. Oil Funnel.
POINTS "C" ON DIAGRAM. After each 5,000 miles running. (8,000 kilometres running). **NOTE•** **After draining Engine, and prior to refilling with fresh oil, remove the Sump and before re-assembling clean the sump and the Filter. Use a new Sump Joint.**	*In addition to items already mentioned, attend to the following :* Drain and refill the Engine and clean Filter.• Drain and refill Rear Axle Hypoid Bevel Casing. Drain and refill Gear Box. Clean By-pass Filter Element and replace. Clean Air Silencer and replace. Clean Filters in Petrol Pump and Main Tank. Check Spark Plugs, Distributor and Tappets. Check Fan Belt and Timing Chain tension. Grease Fan Bearings. Grease Propeller Shaft Joints. Check Front Wheel alignment, camber and R. and L. lock. Check Steering Box adjustment and also oil level. Steering Links and Centre Lever, 7 points. Grease Front and Rear Hub Bearings. Grease Control and Change Speed Linkage. Oil Handbrake, Cable, Joints and Linkage. Adjust Brake Shoes and Linkage. Clutch and Brake Pedals. Remove Road Wheels and change front right to rear left and rear right to front left, grease Wheel Studs.	See page M7. See page M7. See page M7. For Distributor. See page M7. See page M7. See page M7. See page M7. See page M7. See page M7. See page M7. See page H3. See page M7. Grease Heavy.	Cap on Valve Cover. Oil Funnel. Oil Funnel. See Lucas' Book. Grease Gun. Grease Gun. Oil Funnel, add if necessary. Grease Gun. Grease Gun. Grease Brush. Oil Can. Grease Gun. See Tyre Book. Brush.
POINTS "D" ON DIAGRAM. After each 10,000 miles or every year. (16,000 kilo-metres).	Fit new Filter Element in By-pass Oil Filter. Oil Door Hinges, Latches. Overhaul Dynamo, Starter, Distributor. Check Shock Absorbers. Check Steering Joints, and adjust for toe-in and backlash in Steering Column. Inspect and tighten as required, all Spring Clips, Shackles and Chassis and Body Bolts generally. Examine and re-line Brake Shoes, if necessary. Check Exhaust Silencer clips and pipes. Oil Bonnet and Boot Hinges. Remove Door Casings and oil Window Operating Joints and Door Locks. Remove, clean, replace and adjust all Fork Ends, and Linkage of the Brakes. Clean and spray penetrating oil between Rear Spring Leaves.	Engine Oil. Engine Oil. See page M7. Engine Oil. Engine Oil.	Refill. Element AC.L14 Oil Can. See Lucas' Book Top up, if necessary.



SINGER 'HUNTER' LUBRICATION CHART.

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SECTION N

BODY

CARE OF PAINTWORK.

The body and wings of the car are finished in cellulose. Light accumulations of dust can be removed with a soft cloth duster, but mud and road dirt must be removed by washing the body with water freely applied, either by means of a pressure washing plant, or by a large sponge. The surface must then be thoroughly dried with a leather and polished.

Any high grade polish, when used in accordance with the directions printed on the container, will give satisfactory results. On no account must a metal polish be used. Frequent polishing will improve the finish of the cellulose.

When washing the car, take care to avoid water applied under pressure entering the brake drum.

CARE OF THE CHROME WORK.

A metal polish must not be used on the chromium plated fittings. They should be washed with water, thoroughly dried with a leather and polished with a soft duster.

CARE OF CARPETS.

The carpets should be brushed frequently and on convenient occasions removed and cleaned with a vacuum cleaner.

CARE OF HINGES, LOCKS AND CATCHES.

The stays, check straps and hinges of the doors, and those of the bonnet, luggage compartment floor and boot lid should be examined periodically and oiled with thin oil to ensure that they work easily.

The door dovetails and the striker plates of all locks should be lightly smeared with grease occasionally.

The internal mechanism of the locks and window regulator can be greased by removing them as described on *page N8*.

To ensure that the window glasses slide freely in their guides the guides should be lightly smeared with graphite grease.

CARE OF UPHOLSTERY.

The upholstery can be cleaned by wiping over with a cloth damped with warm water and a small quantity of good quality toilet soap. Caustic soaps, spirits or paraffin will damage the upholstery and must not be used.

BODY BOLTS.

The body to chassis bolts, eight in number, should be checked periodically and tightened to avoid body noises developing.

TO REMOVE AND REPLACE THE BONNET.

(1) Lift up and prop open the bonnet.

(2) If the bonnet is to be removed merely to assist the removal of the engine, detach the hinge brackets from the bulkhead by removing the eight securing bolts and shakeproof washers.

The bolt holes in the hinge brackets are elongated and re-assembly is assisted if lines are scribed aroung the hinge brackets on the face of the bulkhead.

(3) If the bonnet is to be removed for repairs, or for the fitting of a Service replacement, detach it by removing the bolts and shakeproof washers securing the hinge brackets to the channel welded to the bonnet. The slots for these bolts are also elongated to make adjustments in a fore or aft direction. Replacement of the original bonnet is quite simple if the precaution suggested in the second paragraph is observed ; but it is advisable to check the following :

(4) An air gap of $\frac{3}{16}$" (4.76 mm.) must be present between the body and the windscreen edge of the bonnet with the bonnet closed. A correction can be made by releasing the eight bolts securing the hinge brackets to the bulkhead and raising or lowering the bonnet in the required amount before re-tightening.

BODY DIMENSIONS (*See Fig. 1, Page N3*).

Key Letter	Description	Body Dimensions	
		Ins.	mm.
A	Wheelbase	107½	2730.5
B	Track—Front	50½	1282.7
C	Track—Rear	51	1295.4
D	Overall Length	176	4470
E	Maximum Width	63¼	1506.5
F	Total Height—Unladen	65	1651.6
G	Height of Front Cushion	13	330
H	Height of Front Squab	20½	520
J	Height from Cushion to Roof—Front	37¼	946
K	Height of Wheel from Floor	18	457.2
L	Distance between Cushion and Wheel	5½	139.8
M	Diameter of Steering Wheel	17	431.8
N	Pedal to Cushion (Adjustable)	16¾–21¼	426–540
O	Pedal to Squab (Adjustable)	36–40½	915–1030
P	Distance Front to Rear Seat (Adjustable)	9–14	228.5–355.5
Q	Height of Rear Cushion	15	381
R	Height from Floor to Roof (Max.)	47	1193.8
S	Height of Rear Squab	21	533
T	Height of Cushion to Roof—Rear	32	812.5
U	Depth of Window (Max.)	14	355.6
V	Max. Interior Width at Waist	51½	1308
W	Width over Front Seat	51	1295
X	Width over Rear Seat	51	1295
Y	Depth of Front Cushion	17	431.8
Z	Distance Wheel to Squab (Adjustable)	12–17	304–432
a	Depth of Rear Cushion	18½	470
b	Width of Luggage Compartment	40	1016
d	Height of Luggage Compartment (Max.)	17½	444.5
e	Length at Bottom	41	1041.4
f	Ground Clearance (laden)	9 3/16	233.3
	Cubic Capacity of Luggage Compartment	13 cu. ft.	.3679 cu. m.

Fig. 1. The key to these diagrams is on Page N2.

(5) There must be approximately $\frac{1}{16}$" (1.58 mm.) clearance between the sides of the bonnet and the wings. Any correction necessary can be usually made by releasing the bolts securing the hinge brackets to the bonnet, centralising the bonnet and then re-tightening the bolts.

(6) The retaining washer for the bonnet catch spring must be centrally positioned between the ramps of the catch plate bolted to the front panel. If it is not, the bonnet will be thrown out of line with the wings. Set the central stud of the catch over to the right or left, as necessary, and adjust the length of the stud by releasing the locknut and screwing it "in" or "out", so that with the bonnet closed and latched it is possible to press the bonnet down slightly against the spring, and for the bonnet latch control on the instrument panel to work freely.

(7) Lastly, make sure that the hook of the safety catch engages readily and securely. Smear the ramps of the bonnet catch plate with grease to help the catch to work freely.

TO REMOVE AND REPLACE A FRONT WING.

(1) Lift the bonnet and prop it open.

(2) Remove the head and side lamps.

(3) Remove one $\frac{1}{4}$" nut and washer connecting side grille air intake baffIle to flitch plate side. Remove eight 2 B.A. nuts and bolts and 16 square washers and 8 shakeproof washers connecting wing to flitch plate top. Remove four 2 B.A. nuts, bolts and eight flat washers and 4 shakeproof washers connecting wing to radiator case side.

Remove five $\frac{1}{4}$" B.S.F. nuts and bolts, ten flat washers and five shakeproof washers connecting wing to front valance.

(4) Open the front door, detach the pivot pin of the check strap, swing the door wide open and remove the rubber moulding secured with Bostic to the hinge pillar flange of the front wing. This will expose the three bolts, flat and shakeproof washers securing the wing to the body. Remove these bolts, the nuts of which are captive, and also the 2 B.A. bolts, nuts, and shakeproof washers securing the bottom edge of the wing to the body. The wing can now be detached by closing the door, lifting the rear end of the wing clear of the body flange and drawing it off towards the rear.

Wing can now be split if necessary by removing eight 2 B.A. bolts and three $\frac{1}{4}$" B.S.F. bolts.

TO REMOVE AND REPLACE THE RADIATOR CASE.

(1) Open bonnet and prop up with stay.

(2) Remove eight 2 B.A. nuts and bolts and 16 flat washers and 8 shakeproof washers connecting sides of radiator case to front wings (4 bolts each side).

(3) Remove five $\frac{1}{4}$" B.S.F. nuts and bolts and five shakeproof washers connecting bottom of case to front valance.

Replacement is the reversal of the foregoing, and when carrying out the work pay particular attention to replace the $\frac{1}{4}$" B.S.F. bolt in centre of valance with the nut uppermost in order to avoid fouling starter handle.

TO REMOVE AND REPLACE THE FRONT SEAT.

The bench type of front seat is mounted on runners. The position, relative to the steering wheel, can therefore be altered by sliding in the required direction, by operating the hand in the centre of the seat valance.

In order that this adjustment may work freely, the runners should be greased periodically.

To remove the seat, slide the seat back to the full extent and remove the bolts and shakeproof washers securing the forward ends of the runners to the floor. Slide seat sufficiently forward to uncover the bolts securing the rear end of the runner. Release these bolts and remove the seat.

Replacement is the reversal of the foregoing operation with the following additions :

Grease the runners and rails before fitting the seat ; tightening the bolts securing the runners. The nuts for the bolts are captive.

TO REMOVE AND REPLACE THE WINDSCREEN GLASS.

(1) If the chrome moulding around the outside of the screen is to be used again do not damage, distort or kink it in any way

when removing it, for on its condition depends, in a large measure, the weather tightness of the screen.

(2) Obtain a piece of 12-gauge brass strip, about 9 inches (230 mm.) long and $1\frac{1}{8}$" (19 mm.) wide, and round off the corners of one end to approx. $\frac{1}{4}$" (6 mm.) radius. Dip the rounded end of the strip in a weak solution of soft soap and water, insert into the groove of the surround in which the tongue of the moulding sits, and run the strip round the groove, thus releasing the moulding from the rubber, and also working in a quantity of soap solution. This operation should be carried out several times to ensure that sufficient soap solution is worked into the groove to help the moulding to slide freely.

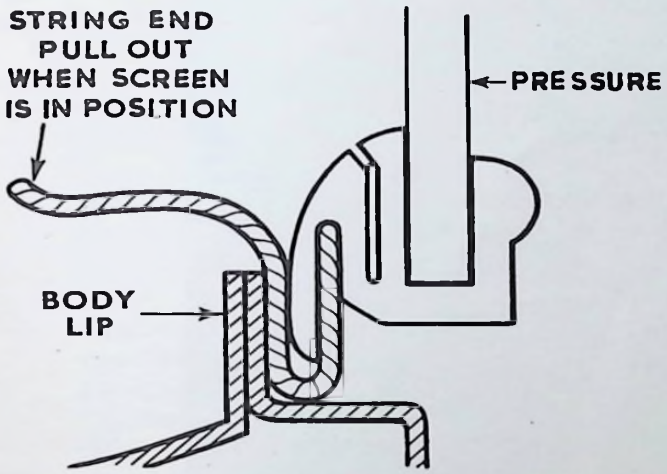

Fig. 2.

(3) With a medium sized screwdriver, lift the lower arm of the left-hand portion of the moulding out of the groove in the rubber at the central joint. Continue this lifting or prising action progressively to the left-hand bottom corner. Then prise the moulding in the centre of the corner when the tongue of the vertical arm should disengage as far as the top left-hand corner. Treat this corner similarly and then draw off the moulding to the left. To avoid it kinking or distorting, maintain a light pressure on the extreme end and keep the moulding parallel to the screen. Treat the right-hand portion of the moulding in a similar way.

(4) Remove the windscreen inside moulding held by seven screws and cupped washers. The screen with the rubber surround can now be detached by easing the lip of the surround over the edge of the body. Detach the surround from the glass.

To replace the Screen Proceed as follows:

(1) Coat the inner groove of the rubber surround liberally with Bostic or some similar adhesive, and fit the surround to the glass.

See that the lips sit snugly all round. Pass a piece of stout twine around the outer groove of the surround, and leave about six to seven inches (150-180 mm.) of the ends hanging on the outer surface of the screen. Position the assembly with the groove for the tongue of the moulding facing outwards, press the assembly well home and then, by pulling out the twine, draw the outer lip of the

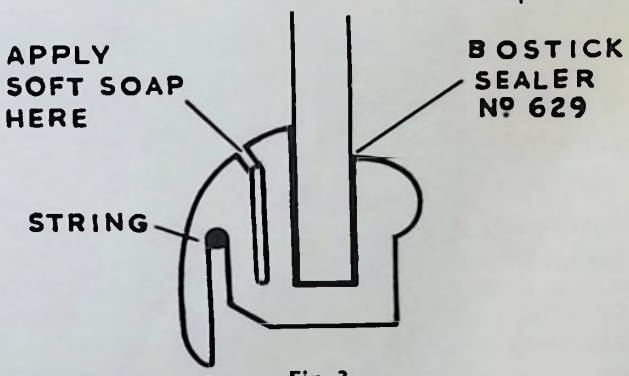

Fig. 3.

surround with it over the edge of the body panel. Check that the lip sits snugly on the outer surface of the body.

(2) With a small brush smear the outer surface of the surround liberally with a solution of soft soap and water, and with the aid of the brass strip, previously mentioned, work in a quantity of the soap solution into the groove in which the chrome moulding fits.

(3) Slide the right-hand portion of the moulding into position over the rubber, until the end is approximately half-way across the screen, *Fig.* 4, *page* N6, and with the tongue in engagement with the groove. Now commence to work the tongue of the corner of the moulding into the groove by forcing the moulding home inch by inch and partially withdrawing it after each movement and so

releasing any folds which may develop in the rubber. Do not attempt to engage the vertical arm of the moulding in a similar manner, but prise the lower right-hand corner into position by a simultaneous upwards movement of the lower arm. It will be found that as the corner engages the vertical arm will engage automatically with the groove. This last operation may give the lower arm of the moulding a slight twist. Rectify this condition at a point close to the corner and to a degree which will make the top and bottom parallel with the screen. The setting must be carried out carefully to avoid kinking the moulding or destroying the rubber surround. The tongue of the arm can now be gradually forced home with the brass strip well wetted with soap solution and preceding the point of pressure by and inch or two.

(6) Lay a thin layer of Bostic in the recess between the rubber surround and the body aperture, also along the edge of the rubber where it meets the glass. When set, trim off the excess Bostic neatly.

(7) Refit the inside moulding or capping. **Should it be necessary to renew the chrome moulding proceed as follows :—**

Deal with the right-hand portion first. Check that the ends of the moulding are square with the arms and make any correction needed.

Set the tongue of the moulding away from the main body by about $\frac{1}{16}$" (1.6 mm.) throughout the length except for about an inch (25 mm.) at the end of the lower arm. File a small radius on each leading edge of the tongue and remove any burrs. These precautions

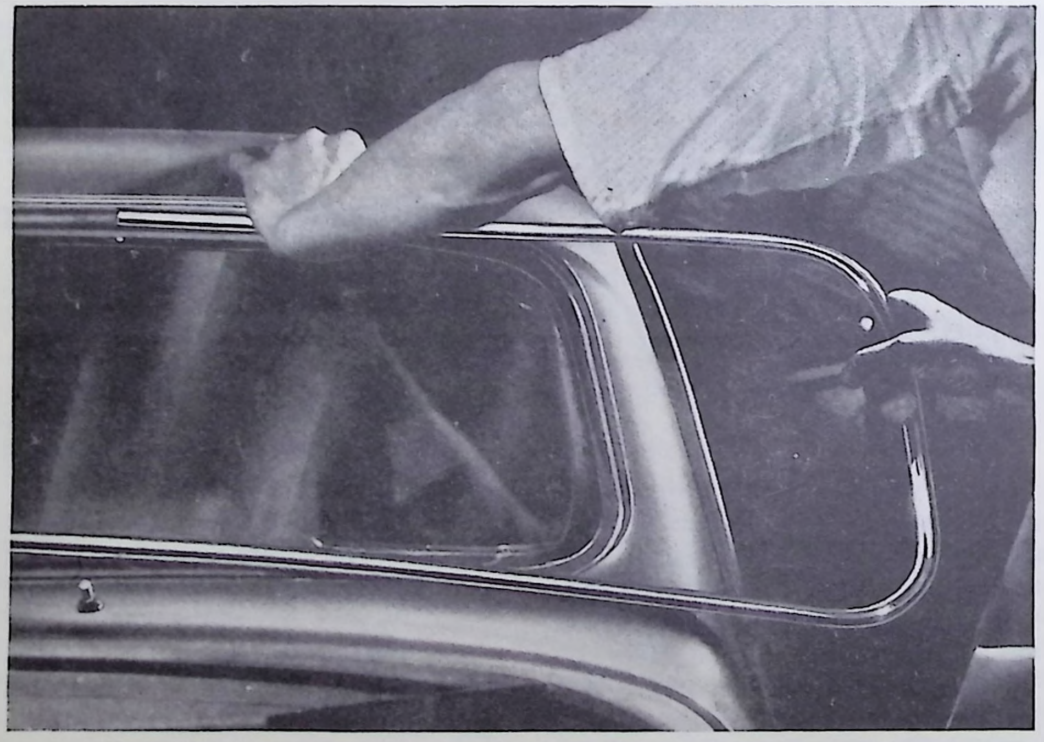

Fig. 4. Fitting Windscreen Beading—Stage 1.

(4) Position the moulding by prising either at the top or bottom corners, so that the vertical arm lies parallel with the edge of the aperture in body.

(5) Fit the left-hand moulding in a similar way and position the moulding centrally in the aperture.

are to ensure that the moulding will slide readily into position. Fit the moulding as described in *pages N6 and N7.*

Now deal with the left-hand portion. Shorten, as necessary, the top arm so that it is approximately $\frac{1}{16}$" (1.6 mm.) longer than the distance between the

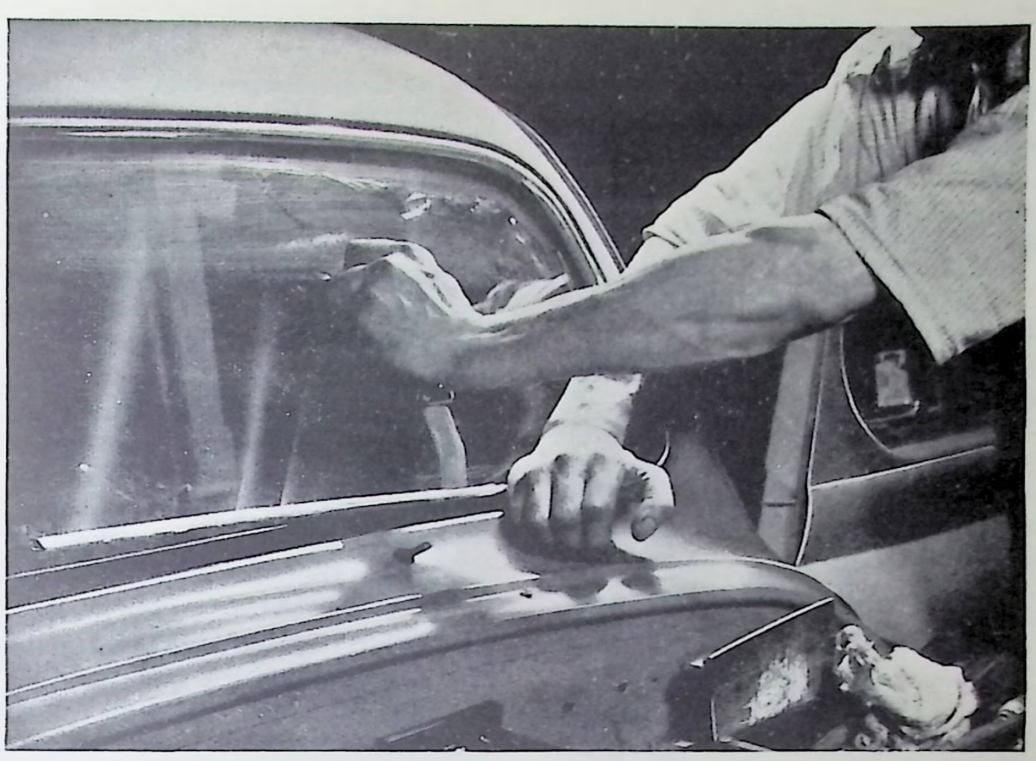

Fig. 5. Fitting Windscreen Beading—Stage 2.

corner edge of the aperture and the end of the right-hand moulding. File the end so that a neat joint will appear where the arms butt, and set the tongue in the manner described above. Fit the moulding and shorten the bottom arm to overlap the right-arm by about $\frac{1}{32}$" (.8 mm.). Force the arm into position and make a neat joint. Square the moulding in the aperture as previously described, Bostic around the edges of the surround, and trim when set.

OPEN FLANGE ON OUTSIDE CHROME MOULDING AT CORNERS AS SHEWN TO ENABLE EASY START

Fig. 6.

TO REMOVE AND REPLACE THE REAR LIGHT.

Remove the screws securing the inside capping and detach the capping. The light complete with rubber surround can now be removed by progressively prising the outer lip of the surround off the surface of the body and pushing the assembly into the car, and into the hands of a helper.

To replace, coat with Bostic the edges of the light and the groove of the surround in which the light fits. Pass a piece of twine around the outer groove of the surround leaving about 5 or 6 inches (130-150 mm.) of the ends hanging on the outer face of the light.

Insert the assembly into the aperture from inside the car, press home and by pulling the twine draw out the outer lip of the surround over the edge of the body, and seal with Bostic the edges of the abutting faces of the surround with the body and light.

TO REMOVE AND REPLACE A FRONT DOOR VENTILATOR.

(1) Remove the inside capping of the window aperture.

(2) Access can now be obtained to the four screws securing the ventilator to the door, the ventilator can be detached outwards.

Replacement is the reversal of the foregoing, but the following points must be observed :—

Position the ventilator so that when locked the chrome surround of the ventilator and the forward edge of the glass fit the rubber surround closely. Also that the lip of the rubber surround fits snugly on the chrome beading around the window aperture. The required corrections can be made by setting the mounting brackets suitably, or by tapping, with the aid of a small block of hard wood and a hammer, the beading into closer engagement with the rubber.

To ensure that the glass will remain snug against the rubber when latched set the striker plate either in or out to give the required tension.

In some instances, releasing the three screws holding the central channels, will help the replacement.

TO REMOVE AND REPLACE A FRONT DOOR LOCK—Left or Right.

(1) Press back the spring-loaded collars between the escutcheons and the bosses of the inner handles of the door lock, and window light winder.
Remove the locking pins exposed and draw off the handles and escutcheons.

(2) Remove the six screws, one in each corner of the door trim panel, and a seventh centrally positioned along the bottom edge. The panel can now be prised away from the door.

(3) Wind the window light up to the full extent.

(4) Remove 3 binding head screws and washers securing the door inner locking handle bracket and spindle.
Press striker claw into the locked position remove 4 binding head screws and washers securing lock to edge of door.
The lock can now be drawn out of position and removed through aperture at bottom of door. Beware of any sharp edges in the metal surrounding the aperture through which the arm is inserted when removing lock.

Replacement is the reversal of the foregoing.

NOTE :—Do not neglect to grease freely the lock mechanism before assembling it into position.

TO REMOVE AND REPLACE A FRONT DOOR LIGHT AND REGULATOR.

(1) Remove the trim panel and door lock as described in *page N8*.

(2) Remove the wooden block seen in the aperture in the door panel for the bottom stop for the light. Wind the light down to the full extent. Remove the two drive screws securing the door shut pillar channel, wind the light up, force the channel down and remove it through the lock aperture.

(3) Wind the light down and tilt the bottom edge away from the centre line of the car, and at the same time wind the Regulator arm up, and disengage the roller from the guide channel.
Lower the light and allow it to rest on the bottom of the door.

(4) Remove the central channel. The screw securing the top end is beneath the Sorbo rubber. Peel the rubber off for about an inch (25 mm.).

(5) Detach the Regulator by removing the four metal thread screws, shakeproof washers and nuts. Note that the heads of the screws are on the inside of the door inner panel. Wind the regulator until the holes in the quadrant uncover the heads of the two top screws.

(6) The light can now be lifted out through the window aperture. It may be necessary in some instances to remove the felt strip on the window ledge.

Replacement is the reversal of the foregoing operation with the following additions :

Grease the guide channel of the light, the roller and gears of the Regulator liberally before placing them into position.

Replace any packings removed from between the shut pillar channel and door, and remove any excessive lateral play in the light by packing out the felt in the central channel. Stick the packing to the channel with Bostic and reduce the width of the felt slightly to compensate for the thickness of the packing.

TO REMOVE THE REAR DOOR LIGHT AND REGULATOR.

(1) Detach the trim panel and lock, remove the screws and cupped washers securing the window aperture capping and detach the capping. It may also be necessary to remove the felt strip on the window ledge.

(2) Wind the light down to the full extent and remove the block of wood seen in the aperture in the door panel forming the bottom stop for the light. The channelling along the shut pillar edge of the door and held by two drive screws should now be removed, and the regulator turned to positions which will give access, through the holes in the quadrant, to the heads of the six metal thread screws securing the regulator. Remove the six screws.

(3) Push the spindle of the regulator through its aperture in the panel and lower the light and regulator.

Fig. 7. Fitting Regulator.

To allow it to travel downwards to the full extent move the arm towards the hinge pillar by turning the regulator spindle. When the assembly is in the lowest position slide the rollers of the regulator off the light rail and move the regulator out of the door. The light can now be removed by drawing it upwards and rotating it slightly towards the hinge pillar.

Replacement is the reversal of the foregoing operations, but the following precautions must be observed :—

Grease the channel of the light rail, the rollers and gears of the regulator liberally before assembling the parts into their respective positions.

When replacing the channelling fit any packing which may have been removed from between it and the door, and also make sure that when inserting the light it engages with the channelling as it is being rotated into position.

To remove any excessive lateral movement of the light, lever the end of the regulator bracket towards the hinge pillar just sufficiently to remove all movement but without introducing tightness.

Fig. 8. Fitting Rear Door Light.

Note the angle at which it is being inserted, and that it must be revolved progressively to the correct position as it is lowered into the door.

See that all screws, bolts and nuts released are securely tightened.

TO REMOVE REAR DOOR LOCK.

The work involved in the service is similar to that described in *page N8* dealing with the removal of the front door lock.

The replacement is also similar.

TO RE-HANG A FRONT OR REAR DOOR.

The front and rear doors swing on large well designed hinges securely mounted on brackets firmly supported in position on the body and doors.

Normally, the position, or hang of a door will not alter while in service. But if as the result of an accident or in some way or other a door is strained it can be re-hung correctly by using the adjustment provided by the enlarged holes in the door support brackets and the elongated holes in the body support brackets for the hinge arms ; always provided the door or the door aperture in the body is not distorted to a considerable extent.

To gain access to the bolts securing the hinge arms to the front and rear doors, detach the trim pads as described in *page N8* and adjust as follows.

If the door has dropped to an extent where the dovetail is not in line with the socket in the central pillar, open the door, place a Jack under the shut pillar bottom corner of the door, release the bolts securing the arm of the top hinge to the door and raise the door slightly above the position it should normally occupy and tighten the bolts securely.

If the door has been kept in service in a dropped condition and the dovetail is worn, fit a new dovetail together with a pair of wedges to the central pillar.

When fitting the dovetail, position it on the door so that as the door is being closed the dovetail passes centrally between the sockets and there is no tendency to raise or depress the door out of the normal position. If necessary drill fresh holes in the door to take the 2 B.A. self-tapping screws.

If the top corner of the door by the central pillar is away from the body it may be the result of the body arm of the bottom hinge having moved inwards on the support bracket. To correct, release the bolts securing the arm to the body and move the arm outwards sufficiently to bring the outer surface of the door flush with that of the wing.

If the working clearance between the edge of the door and the adjacent wing has been reduced so that the door fouls the wing when opened, release the bolts securing the hinge arm to the door, move the door slightly towards the centre pillar and re-tighten the bolts.

The striker plates for the tongues of the lock are adjustable ; by releasing the securing screws the plates can be moved on the central pillar "in" or "out" within the range provided by the slotted holes in the pillar.

Position the plate so that the door fits snugly to the body, without undue force being needed to engage the tongue with the plate ; re-tighten the screws securely.

The clearances in the holes for all securing bolts are usually sufficient to carry out any adjustment needed, but bear the following important points in mind.

(1) The outer surface of the door must be flush with that of the wing.

(2) The waist lines of the door and body must be in line.

(3) The dovetail must pass centrally between the sockets in the centre pillar.

(4) The clearance between the door and the aperture must be approximately equal all round.

(5) The striker plate adjusted so that the rubber surround fits firmly against the body, but force is not required to close the door.

(6) Before replacing the trim pad the hinge bolts must be tightened securely and all moving parts oiled.

Skill and tools usually needed to carry out this class of work are essential if a satisfactory repair is to be made. Should these not be available, it is advisable to entrust the work to a firm who specialise in it, particularly if the door and/or aperture are distorted to a considerable extent.

TO REMOVE AND REPLACE THE HINGES OF A DOOR.

(1) Detach the trim pad. The bolts securing the hinge arms can now be readily removed.

(2) To obtain access to the threaded plates for the bolts securing the body arms of the front door hinges, prise away with a screwdriver the rear vertical edge of the trim pad, tacked to the side of the body and under the facia board, sufficiently to give access to the plates.

(3) In regard to the rear doors, remove the rear seat cushion and the rear squab, which is secured by two wood screws along the bottom edge and two wood screws along the top. The heads of these screws are in the luggage boot. Next detach the side trim pad by removing the three screws securing the forward vertical edge of the pad. The pad can now be prised away sufficiently to give access to the plate for the top hinge. The plate for the bottom hinge is in the wheel arch. To fit a set of new hinges follow the procedure suggested for hanging a door. *See page N10.*

REMOVAL AND REPLACEMENT OF THE BODY OF A RIGHT-HAND DRIVE CAR.

(1) Remove the bonnet. *See page N1.*

(2) Drain the cooling system. *See pages K1 and K2.*

(3) Disconnect the following :—

(a) The positive and negative leads from the battery and remove the battery.

(b) The choke control cable from the lever on the carburettor and the cable cover from the support bracket.

(c) The bonnet catch control cable at the catch lever end, and the cable assembly from the two clips on the right-hand side.

(d) The throttle control cable from the lever on the accelerator shaft assembly, and detach the cable assembly by removing the two bolts, shakeproof washers and nuts securing the guide to the body.

(e) The speedometer cable assembly from the drive on the rear end of the gearbox.

(f) The oil gauge pipe at the point where it is connected to the engine.

(g) The headlamps, the side lamps and the horn looms from the clips on the flitch plates and part the wires at their push pull connection.

(h) The handbrake cable from the lever on the chassis frame and the clip securing the outer cable to the chassis frame. The cable assembly can now be drawn out of the guide on the frame.

(i) The petrol pipe union in the wheel arch of the left front wing and adjacent to the body.

(4) Remove the front seat and the adjuster trunnion bracket attached to the floor by four bolts and shakeproof washers. Note the wooden packing pieces under the feet of the bracket. Remove the rear seat cushion.

(5) Remove the front and rear carpets, the pedal pads from the arms, the pedal grommets, the metal cover over the gearbox, and the left and right-hand detachable front floors. The cover and floors are secured by shakeproof washers and bolts, the nuts of which are captive.

(6) Detach the accelerator shaft assembly by removing the four bolts, shakeproof washers, distance pieces and nuts securing the bearings to the body. The plate securing the steering column rubber draught excluder can now be removed. by withdrawing the four set pins and shakeproof washers. The heads of two of these pins are in the wheel arch. These pins also hold the vertical flange of the right-hand flitch plate to the body.

(7) Remove the bolts, shakeproof washers and nuts securing the steering column to the support bracket on the dash, and the bolt and shakeproof washer securing the change speed bracket assembly support to the Master Cylinder. Release but do not remove, the two bolts securing the front cross shaft steering box support assembly to the chassis. These bolts are situated under the wing.

(8) Remove the front wings. If care is taken when removing and storing the wings, the head and side lamps need not be detached.

(9) Detach the right and left-hand flitch plates from the body by removing the three bolts and washers, holding the horizontal flange and the two bolts and washers and the vertical flange of each flitch plate to the body. On the right-hand flitch plate the two bolts securing

Fig. 9. Mounting the Body. Type of sling which should be used.

the vertical flange were removed when detaching the steering column draught excluder fixing plate. Note the earth wires held by one of the bolts securing the horizontal flange of each plate.

(10) Fit a set of four "G" type clamps to the front suspension springs to keep them compressed to the loaded normal working length, when the body is removed.

Under no circumstances must these clamps be removed while the body is detached from the chassis.

(11) Drain and remove the petrol tank.

(12) Disconnect the number plate lamp wire at the pull-push connection under the rear valance, and remove both tail lamps as described. The rear valance can now be detached by removing the thirteen bolts, plain and shakeproof washers and nuts securing it to the body.

Note the weather beading between the valance and body.

(13) Remove the eight bolts, plain, rubber washers and self-locking nuts securing the body to the chassis. The body can

now be detached from the chassis by slinging in the manner shown in *Fig. 9, page N12*. The packing pieces between the body and each supporting chassis bracket should be marked so that they can be replaced or removed.

Removal of a body on a left-hand drive car is similar in all respects except for the handbrake cable assembly which is held to the chassis by three clips instead of one. The first clip is on the forward left-hand body support bracket, the second and third on the right-hand front and rear cruciform members of the chassis. The cable assembly passes over the silencer and between the body and chassis. As to the cable, this passes direct to the lever on the chassis and not through the guide.

Replacement is the reverse of dismantling but the following precautions should be observed :—

Bostic the mounting pads or packing and if necessary add shims to ensure that the body rests on all the support brackets. The felt strips must be replaced between the butting faces of all flanges and the clamps on the front springs must not be removed until the body is securely bolted to the chassis.

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