The SM 1500

TECHNICAL
SERVICE MANUAL

Issued by
SINGER MOTORS LTD.
COVENTRY & BIRMINGHAM ENGLAND

Publication No. 119/10/51

TECHNICAL SERVICE MANUAL

for

The SM *1500*

Below is a reproduction of the Name and Number Plate fixed to each Singer Car on the bulkhead under the bonnet on the offside.

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

SINGER MOTORS LTD.
BIRMINGHAM WORKS.

PATENT Nos
FRONT ANTI-ROLL BAR LICENSED UNDER BRITISH PATENT 449798.
GEARBOX THRUST COLLAR LOCK SINGER PATENT 649440.

CAR No. _____ MADE IN ENGLAND

RECOMMENDED LUBRICANTS.

	VACUUM.	PRICES.	SHELL.	WAKEFIELD	ESSO.
ENGINE SUMMER.	MOBILOIL A.	ENERGOL SAE 30	DOUBLE SHELL.	CASTROL XL.	ESSOLUBE 30
WINTER.	MOBILOIL ARCTIC	ENERGOL SAE 20	SINGLE SHELL.	CASTROLITE.	ESSOLUBE 20
GEARBOX	MOBILOIL BB.	ENERGOL SAE 40	TRIPLE SHELL.	CASTROL XXL.	ESSOLUBE 40
BACK AXLE	MOBILUBE GX90	ENERGOL EP SAE 90	SHELL SPIRAX 90 E.P.	CASTROL HYPOY.	ESSO EXPEE. COMPOUND 90

FOR OVERSEAS RECOMMENDATIONS REFER TO CAR-OWNER'S HANDBOOK.

DO NOT REMOVE THIS PLATE.

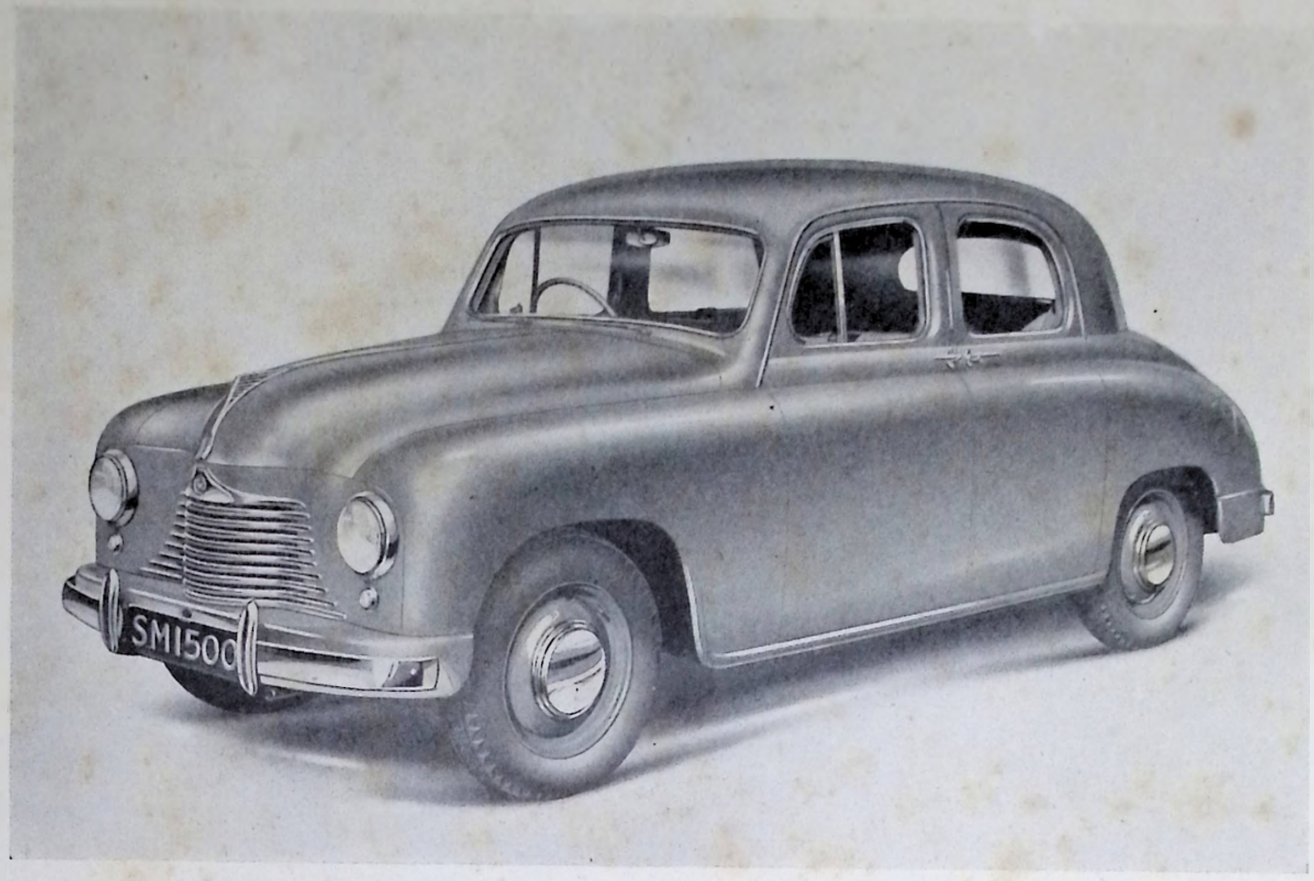
Address for all correspondence—including service matters in the first instance :—

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

Telephone : Victoria 2271 (8 lines).
Telegrams : Singacars, Birmingham.

WORKS AT BIRMINGHAM AND COVENTRY.

PUBLISHED BY SINGER MOTORS LTD. PRICE : 30/-.



The SM 1500 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 reponsibility 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.

Name.....

Address.....

.....

.....

INTRODUCTION

To own an article and to take a pride in it is a natural desire for most human beings, and this is particularly true of most Singer Car Owners.

But in these days when cars are sometimes regarded as little more than a convenient means of transport, it is not always possible for an Owner to pay personal attention to his car, even if he had the knowledge or time.

This situation has created a demand for prompt and efficient Service at reasonable prices, a demand which can only be satisfied by an efficient Workshop Technique.

When setting out to prepare this Workshop Service Manual, it was decided that no effort should be spared to ensure that every phase of Maintenance and Repair should be dealt with. The purpose, therefore, of this Manual is that recommended methods should be known to SINGER DISTRIBUTORS and DEALERS both at Home and Abroad, thus ensuring that Factory Approved Service is within the reach of all S.M. 1500 Owners.

There is a tendency to use a Manual as a book of reference to be consulted only when an urgent problem arises. This Manual is a text book which should be studied, in conjunction with the Spare Parts Catalogue, by those responsible for Servicing SINGER CARS so that the confidence, so necessary if a repair is to be carried out with speed and efficiency, can be acquired.

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.

GROUP INDEX

GROUP A—GENERAL SERVICES

GROUP B—POWER UNIT SERVICES

GROUP C—LUBRICATION SERVICES

GROUP D—FUEL SERVICES

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GROUP A

GENERAL SERVICES

TECHNICAL DATA

ENGINE—General.

Type	Four cylinder, overhead camshaft, detachable head, centrifugal pump and fan cooling.	
Bore, nominal	2.874″	73 mm.
Stroke (up to Chassis No. D81044)	3.543″	90 mm.
Cubic Capacity (up to Chassis No. D81044)	91.87 cu. ins.	1506 c.c.
Stroke (from Chassis No. 81054)	3.52″	89.4 mm.
Cubic Capacity (from Chassis No. D81054)	91.36 cu. in.	14.97 c.c.
Compression Ratio	7 : 1	
Bore to Stroke Ratio	1.23 : 1	
Depth of Cylinder Head	4.243″	107.772 mm.
	4.248″	107.899 mm.
Thickness of Cylinder Head Gasket :		
New	.075″	1.905 mm.
Compressed	.062″	1.574 mm.
Firing Order	1, 3, 4, 2	

CHASSIS—General.

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′ 6″	4420 mm.
Overall width	5′ 3″	1600 mm.
Overall height (unladen)	5′ 4″	1626 mm.
Luggage capacity	13 cu. ft.	.3681 cu. m.
Luggage weight in boot	300 lbs. (2 up)	136 kgs.
	200 lbs. (6 up)	90.5 kgs.
Ground clearance 2 up	7″	178 mm.
,, ,, 4 up	6″	153 mm.
Dry weight	22½ cwt.	1143 Kg.
Wheel size	16 x 3.50″	406 x 89 mm.
Tyre size	16 x 5.50″	406 x 140 mm.
Tyre Pressure	See *Page HX1.*	
Turning Circle	33 ft.	10 metres

FLUID CAPACITIES OF THE MAIN UNITS.

Engine, dry	7.5 pints	4.26 litres
Gearbox, dry	2¼ pints	1.3 litres
Rear Axle, dry	3 pints	1.7 litres
Steering Box	½ pint	.284 litres
Braking System	1 pint	.568 litres
Front Suspension Damper	.21 pints	.1 litres
Rear Suspension Shock Absorber	⅜ pint	.213 litres
Battery, per Cell	1 pint	.568 litres
,, , 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

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 ,,)	11.9 ,,	54.09 ,,
4 Feet (1.22 ,,)	13.6 ,,	61.82 ,,
5 Feet (1.52 ,,)	15.2 ,,	69.09 ,,
6 Feet (1.83 ,,)	16.45 ,,	74.77 ,,
7 Feet (2.13 ,,)	17.75 ,,	80.68 ,,
8 Feet (2.44 ,,)	18.9 ,,	85.9 ,,

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.*

PERFORMANCE. As per *The Motor* Road Test No. 13/49.

Acceleration	Top Gear	Third Gear
10 to 30 M.P.H.—16 to 48 K.P.M.	14.2 secs.	9.5 secs.
20 to 40 ,, —32 to 64 ,, ...	14.4 secs.	10.1 secs.
30 to 50 ,, —48 to 80 ,, ...	16.7 secs.	13.55 secs.
40 to 60 ,, —64 to 96 ,, ...	21.5 secs.	

From Rest	Through the Gears
0 to 30 M.P.H.—0 to 48 K.P.M.	7 secs.
0 to 40 ,, —0 to 64 ,, ...	12.3 secs.
0 to 50 ,, —0 to 80 ,, ...	20.6 secs.
0 to 60 ,, —0 to 96 ,, ...	33.7 secs.

Time taken from Rest to cover.

¼ mile —402 metres	24.5 secs.

Fuel Consumption.

33 M.P.G.	at 20 M.P.H.	—11.7	K.P.L.	at 32	K.P.H.
33.5 ,,	at 30 ,,	—11.9	,,	at 48	,,
32.5 ,,	at 40 ,,	—11.5	,,	at 64	,,
29 ,,	at 50 ,,	—10.3	,,	at 80	,,
26 ,,	at 60 ,,	— 9.2	,,	at 96	,,

Car Speeds in Top Gear in relation to Engine Speeds.

1,000 r.p.m.	15.25 M.P.H.	24.6 K.P.H.
2,000 r.p.m.	30.4 ,,	48.9 ,,
3,000 r.p.m.	45.6 ,,	73.4 ,,
4,000 r.p.m.	60.8 ,,	98 ,,
4,500 r.p.m.	68.5 ,,	110.4 ,,
4,800 r.p.m.	72 ,,	116 ,,

B.H.P. ... ... 50 at 4500 R.P.M.

Maximum Torque. 79 lbs. ft. at 2400 R.P.M.—10.9 Kg/m. at 2400 R.P.M.

Maximum Speeds in Gears.

First Gear	20 M.P.H.	32 K.P.H.
Second Gear	33 ,,	53 ,,
Third Gear	55 ,,	88.7 ,,
Top Gear	72 ,,	116 ,,

Road Speed at 1000 r.p.m.

First Gear	4.24 M.P.H.	6.84 K.P.H.
Second Gear	6.71 ,,	10.8 ,,
Third Gear	10.38 ,,	16.7 ,,
Top Gear	15.25 ,,	24.6 ,,

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

75	M.P.H.	79	on speedometer
70	,,	73.5	,,
60	,,	62.5	,,
50	,,	52	,,
40	,,	40.5	,,
30	,,	30	,,
20	,,	19.5	,,

ENGINE—Details.

Cylinder Block.

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

Piston.

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

Diameter of Piston—90° to Gudgeon.		
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	.0962"/.0952"	2.4435/2.418 mm.
Width of Ring	.0937"/.0927"	2.381/2.356 mm.
Radial thickness	.1175"/.1105"	2.986/2.808 mm.
Scraper, 8 Slots	1 per piston	
Width of Grooves in Piston	.1587"/.1577"	4.03/4.006 mm.
Width of Ring	.1562"/.1552"	3.969/3.944 mm.
Radial thickness	.1175"/.1105"	2.986/2.808 mm.

Ring Gap.		
All Rings when fitted in Bores	.013"/.008"	.331/.204 mm.
Side clearance in Grooves	.0035"/.0015"	.089/.038 mm.
Gudgeon Pin Hole	.6251"/.6249"	15.877/15.872 mm.

Crankshaft.

Number of Journals	3	
Diameter of Journals		
Standard	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	1.596"/1.595"	
Diameter of Crank Pins.		
Standard	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	1.251"/1.25"	31.776/31.75 mm.
Thrust of Crankshaft	Taken by two thrust washers fitted to rear main bearing.	
End Float of Crankshaft	.008"—.001"	.203—.025 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	.0025"—.001"	.064—.025 mm.
Undersizes available	.003" and .010"	.076 and .25 mm.

Oil Retainer.

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

Flywheel.

Diameter of Rim carrying T.C. mark	10.685"	271.4 mm.
Maximum which can be skimmed 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	6.251"/6.249"	158.77/158.72 mm.

Big End Bearings.		
Type	Steel shells, white metal bearings. All four are identical and carry the same Service Part number.	
Diametrical clearance	.002"/.0005"	.051/.013 mm.
Side clearance on Crankpin	.008"/.006"	.203/.152 mm.
Small End.		
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	.00022" clearance	
Gudgeon Pin fixing	Retained in piston by two circlips. Seeger type.	

Timing Chains and Wheels.

Chains, type	Endless. Reynolds 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 shaft 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	.9382"/.937"	23.832/23.8 mm.
Diameter of Front Journal...	.9365"/.936"	23.787/23.774 mm.
Diametrical clearance	.0005"/.0022"	.0127/.0559 mm.
End float	.004"/.008"	.102/.203 mm.
Type of Rear Bearing	Cast Iron.	
Diameter of Rear Bearing	.6255"/.6248"	15.887/15.87 mm.
Diameter of Rear Journal	.624"/.623"	15.85/15.824 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. per sq. inch.	2.109/2.461 Kg. per sq. cm.

Clearance between end Faces of Gear and Pump Body Cover	.0003"/.0023"	.0076/.0584 mm.
Clearance between Periphery of Teeth and Pump Body	.00035"/.0016"	.0089/.0406 mm.
Speed of Pump	Half engine speed.	
Oil Pump Relief Valve Spring, free length	1.75"	44.45 mm.

Filters.

Sump Filter (up to Engine No. D121U)	B.W.P. floating type.
Sump Filter (from Chassis No. D122U)	Fixed Basket type.
External Filter, type	A.C. By-pass.
Element for Filter	A.C. M.11.

Cylinder Head.

Type	Detachable, with overhead camshaft.	
Valves.		
Inlet.		
Diameter of Head	1.375"	34.93 mm.
Diameter of Stem	.311"/.310"	7.899/7.874 mm.
Diameter of Guide Bore	.3117"/.3112"	7.917/7.905 mm.
Clearance in Guide	.0017"/.0002"	.043/.005 mm.
Exhaust.		
Diameter of Head	1.250"	31.75 mm.
Diameter of Stem	.311"/.310"	7.899/7.874 mm.
Diameter of Guide Bore	.3128"/.3123"	7.945/7.933 mm.
Clearance in Guide	.0028"/.0013"	.071/.033 mm.
Angle of Chamfer on Guide	53°	
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	.6257"—.6262"	15.893—15.905 mm.
Diameter of Shaft	.6255"—.6245"	15.887—15.862 mm.
Diametrical clearance	.0002"—.0017"	.0051—.0432 mm.
Valve clearances.		
Inlet—warm	.004"	.1 mm.
Exhaust—warm	.006"	.15 mm.
Valve timing.		
Exhaust opens 50° B.B.D.C.	$4\frac{11}{16}$"	119.06 mm. arc on Flywheel
Exhaust closes 10° A.T.D.C.	$\frac{15}{16}$"	23.812 mm. arc on Flywheel
Inlet opens 10° B.T.D.C.	$\frac{15}{16}$"	23.812 mm. arc on Flywheel
Inlet closes 50° A.B.D.C.	$4\frac{11}{16}$"	119.06 mm. arc on Flywheel

Camshaft.

Number of Journals	3	
Diameter of Journals	.9357"/.9347"	23.768/23.741 mm.
Type of Bearing	Cast iron	
Diameter of Bearing	.9372"/.938"	23.805/23.825 mm.
Diametrical clearance	.0015"/.0033"	0.381/.0838 mm.
Thrust taken by	Centre bearing.	
End Float	.0015"/.005"	.0381/.127 mm.

COOLING SYSTEM.

Type ... Water, through copper gill radiator assisted by fan and pump. Later production fitted with Pressure vacuum caps.

PUMP.

Type	Centrifugal with fan.	
Ball Bearing, type	Hoffman L.S.7, 2 spot.	
Gland, type	Carbon ring against machined face on body of pump.	
Fan Blades	4	
Diameter on early models	12"	304.8 mm.
Diameter on later models	12¾"	323.85 mm.
Angle of Blades	30°	

ENGINE ACCESSORIES.

Dynamo (up to Engine No. D9092U; from Engine No. D9093U; see page AZ13).

Model	C39PV Lucas Service No. 22250F. Two pole ventilated design, compensated voltage control.
Direction of Motion	Clockwise viewed from driving end.
Connections	Connect yellow lead to main terminal, and yellow lead with green tracer to field terminal. Note : Crossed connections will cause serious damage to regulator.

Test Data—Dynamo cold.

Cutting In Speed	1,050—1,200 R.P.M. at 13.0 dynamo volts.
Output	17 amps. at 1850—2100 r.p.m. at 13.5 dynamo volts taken on 0.8 ohm resistance load without regulator. Resistance must be able to carry 20 amps without overheating.
Brush Tension	15—25 ozs.
Field Resistance	6.1—6.3 ohms.

Starter.

Model and type	M.35.G/1.L.3. Lucas Service No. 25022B. Four pole design.
Rotation	Clockwise viewed from driving end.
Drive	In board with 9 tooth pinion.

Test Data.

Lock Torque	9.3 lbs. ft. (approx.) with 300—350 amps and 7.5—8 volts.
Brush Tension	15—25 ozs.

IGNITION.

Distributor.

Model and type	DKY4A. BP86—Lucas Service No. 40167A.	
Direction of Rotation	Clockwise viewed from driving end.	
Contact Breaker Spring Tension	20—24 ozs. measured at contacts.	
Condenser	.2 microfarads.	
Centrifugal Advance	Commences at 200—400 r.p.m.—distributor—and gives maximum advance of 20°—23° at 3000 r.p.m.—engine.	
Timing with Distributor.		
Points set at the standard Gap of	.012"	.305 mm.
Points just part at 4° to 5° B.T.D.C.	$\frac{3}{8}$"—$\frac{15}{32}$" arc on flywheel	9.525 mm.—11.9 mm.
Sparking Plugs.		
Type	Champion N.8.	14 mm.
Gap	.025"	.635 mm.

Coil Ignition.

Type	Q12. Lucas Service No. 45020A.
Current Consumption	1.4 amps.—approx.—running. 2.7 amps.—approx.—stalling.

FUEL SYSTEM.

Fuel Pump Type	S.U. type "L" 12 volt.
Petrol Tank capacity	10 gallons. 45.46 litres.
Tank Unit reference	JAEGER TA.121.
Facia Unit reference	JAEGER PG.126.

Carburetter.

Type	Solex FA.1. Bi-starter 30 mm. down-draught.
Choke Tube	24
Main Jet	125
Air Correction Jet	230
Pilot Jet	45
Starter Petrol Jet	115
Starter Air Jet	4.5

CLUTCH.

Specification number	BB/8/58.
Clutch type	Borg and Beck. Single dry plate. 8.A.6.G.
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 P.D.V-2	
Pedal Ratio	7.7 : 1	
Thrust clearance	$\frac{1}{16}$"—$\frac{3}{32}$"	2.38 mm.
Free movement of Clutch Pedal	$\frac{3}{4}$"	19.05 mm.
Compressed thickness of Driven Plate	.275"—.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 plate can be obtained from :—
Messrs. Borg & Beck Company Ltd.,
Tachbrook Road, Leamington Spa, Warwickshire.
Price on application.

GEAR BOX.

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

Gearbox Ratios.

First	3.59 : 1
Second	2.27 : 1
Third	1.467 : 1
Top	Direct
Reverse	3.59 : 1

Overall Ratios.

First	18.4 : 1
Second	11.63 : 1
Third	7.52 : 1
Top	5.125 : 1
Reverse	18.4 : 1

Constant Mesh Pinion Bearing.

Type	Hoffman L.S.13, two spot, with groove added.	
Size	$1\frac{1}{2}$" x $3\frac{1}{4}$" x $\frac{3}{4}$"	
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	Hoffman M.S.11, two spot, with groove added.
Size	$1\frac{1}{8}$" x $2\frac{13}{16}$" x $\frac{13}{16}$"

Mainshaft Rear End Bearing.

Type	Needle Rollers. Hoffman NR.30

Seals.

Oil seal, end of rear extension Type.		
Size outside diameter	2.255"/2.251"	57.277/57.175 mm.
Inside diameter	For $1\frac{1}{2}$" shaft	For 38.1 mm. shaft
Width	$\frac{3}{8}$" to $\frac{1}{2}$"	9.525 to 12.7 mm.
Constant mesh Pinion Shaft, Oil Retainer	Spiral return groove	
Diametrical clearance between Pinion Shaft and Clutch Housing	.003"/.006"	.076/.15 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	.8768"/.8773"	22.271/22.283 mm.
Diametrical clearance	.0017"/.0025"	.04318/.0635 mm.

PROPELLER.

Type	Hardy Spicer. Ref. No. 470691.	
Lubricators to Joint	One to each joint.	
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
Diameter of Register	2.250"/2.248"	57.15/57.1 mm.
Diameter of Tube	3"	76.2 mm.
Joint size and Maker Ref. No.	1118G.B.134.K.5.L.1.	

CHASSIS.

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. L.H. Lock	38 1/2°	
Outer Wheel Max. L.H. Lock	31°	
Turning Circle	33 ft.	10 metres

Coil Spring.

Free length	15"	381 mm.
Laden length—4 passengers	8 1/2"	216 mm.
Load at laden length	955 lbs.	433 Kgs.
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"/.7495"	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	.5625/.563"	14.287/14.30 mm.
Diametrical clearance	.0002"/.0017"	.005/.0432 mm.

Rear Suspension.

Road Springs.

Type	Semi-elliptic	
Shackle Bushes	Moulded rubber	
Working load	711 lbs.	322.5 Kg.
Spring eye centre 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.

No. 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.

Damper—Rear Springs.

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

Damper—Front Springs.

Type	Girling Direct Acting, Type DA.5
Fluid	Luvax-Girling piston type damper fluid

STEERING.

Type	Burman L3, Worm and Ball.	
Ratio	14 : 1	
Number of turns from lock to lock	$2\frac{3}{4}$ (approx.)	
Diameter of Steering Wheel	17"	431.8 mm.
Wheel Position	Non-adjustable.	

Rear Axle.

Type	Semi-floating Hypoid unit.	
Ratio	5.125 : 1	
Teeth on Bevel Wheel	41	
Teeth on Bevel Pinion	8	
Back lash	.006"/.008"	.1524/.2032 mm.

Differential Cage Bearing.

Type	S.K.F.30209
Size	45 mm. x 85 mm.

Pinion Bearing.

Front type	Timken 2558/2523	
Size	$1\frac{3}{16}$" x $2\frac{3}{4}$"	
Pinion Bearing rear type	Timken 2788/2729	
Size	$1\frac{1}{2}$" x 3"	
Pinion Oil Seal type.		
Outside diameter	2.7555"/2.7525"	
Inside diameter	For $1\frac{5}{8}$" shaft	
Width	$\frac{1}{2}$"	

Adjustment.

Pinion adjustment by	Shims
Wheel adjustment by	Shims

Rear Axle Shaft Bearing.

Type	Timken 14123T/14276	
Size	$1\frac{1}{4}$" x $2\frac{23}{32}$"	

Oil Seals.

Rear Axle, inner, type.	
Outside diameter	2.251"/2.255"
Inside diameter	For $1\frac{1}{4}$" shaft
Width	$\frac{3}{8}$" to $\frac{1}{2}$"
Rear Axle, outer.	
Type.	
Outside diameter	2.755"/2.751"
Inside diameter	For $1\frac{7}{8}$" shaft
Width	$\frac{3}{8}$"
End play in Rear Axle Shaft	.003"/.005"
Differential Gear, type	Offset Bevels

Front Hubs.

Bearings.	
Inner, type	Timken 151128/15250R
Size	1.125" x 2.5"
Outer, type	Timken 09067/09195
Size	.750" x 1.938"
Oil Retainer.	
Inner, type	Felt
Size	$2\frac{1}{2}$" x $1\frac{3}{4}$" x $\frac{9}{32}$"
Outer, type	Felt
Size	$2\frac{1}{4}$" x $1\frac{7}{8}$" x $\frac{1}{4}$"

BRAKES.

Foot.

Type	Lockheed, two leading shoes on the front, and standard on the rear.	
Size and number of Master Cylinder	$\frac{7}{8}$" 21405	22.225 mm.
Size and number of Front Wheel Cylinder, 2 per Drum	$\frac{7}{8}$" 25258 or 30284	22.225 mm.
Size and number of Rear Wheel Cylinder, 1 per Drum	$\frac{7}{8}$" 25259 or 30285	22.225 mm.
Diameter of Brake Drums	9.01"—9.02"	228.85—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	$\frac{9}{64}$" x $\frac{9}{32}$"	3.57x7.144 mm.
Number of Rivets per lining	12	

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

ELECTRICAL—WIRING.

Control Box type

(up to Chassis No. D76U) ... ... RF95 2. L2—Lucas Service No. 37065B, Houses cut-out, dynamo voltage Regulator, Fuses.

(from Chassis No. D101U) ... ... RB106-1. Lucas Service No. 37138A. Houses cut-out and dynamo voltage regulator.

Test Data	
(a) Cut-out	Cut in voltage 12.7—13.3 volts. Drop-off voltage 9.0—10 volts.
(b) Regulator	Setting at 10°C. (50°F.) 16.1—16.7 volts. Setting at 20°C. (68°F.) 15.8—16.4 volts. Setting at 30°C. (86°F.) 15.6—16.2 volts. Setting at 40°C. (104°F.) 15.3—15.9 volts.
(c) Fuses	Two 35 amps. in the circuits of the accessories.
Horn type	WT.614 Lucas Service No. 69011E (low note) and 69012E (high note). Windtone.
Current consumption	6 amps. each horn. Total 12 amps.
Windscreen Wiper type	CR.4—BP86. Lucas Service No. 072639 (or latest models CRT14, Service No. 072805).
Current consumption	2.5 amp.
Field current	.8 amp (approx.)
Battery type	GTW.9A. Capacity 51 ampere hr. at 10 hr. rate.
Voltage	12
Bulb Replacement	*See Service. Page JY1.*
Head Lamps	On Car up to No. D.300S parking lights were fitted inside the body of the headlamps. From Car No. D.301S and onwards separate side lights are fitted.
Dynamo (from Chassis No. D1014)	
Model	C39PV-2. Lucas Service No. 22258A. Two-pole ventilated design, compensated voltage control.
Direction of Motion	Clockwise.
Connections	Connect yellow lead to main terminal and yellow lead with green tracer to field terminal.
Test Data on Dynamo (Cold)	
Cutting in Speed	1,050—1,200 r.p.m. at 13.0 dynamo volts.
Output	19 amps. at 2,100 r.p.m. at 13.5 dynamo volts, or 0.7 ohm resistance load.
Brush Tension	15—25 oz.
Field Resistance	6.1—6.3 ohms.

GROUP A

GENERAL SERVICES

EXPORT SERVICE

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, gear box, and rear axle are correct. *See Page EZ1.*

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—*See Page AX3*—and running it at a speed of approximately 1500 r.p.m. for about five minutes.

When driving away accelerate very gradually and do not during the first five miles—8 kilometres—exceed the following speeds in the various gears.

15 miles or 24 kilometres per hour in 2nd gear.
20 miles or 32 kilometres per hour in 3rd gear.
30 miles or 48 kilometres per hour in Top gear.

During the next 500 miles (805 Kms) gradually work up to a maximum speed of 45 miles or 72 kilometres per hour in top gear, with proportionate increases in the intermediate gears

After the first 500 miles (805 Kms) 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 offside—right—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 offside of the flange of the Cylinder Block Flywheel Housing. On later productions the number is stamped on a lug on the crankcase and at a point immediately beneath the dynamo.

Gear Box. 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 centre of the bulkhead over the battery.

NOTE. The Offside is to the Right when seated, and that the Serial numbers have been placed to conform as near as possible to the International Code.

GROUP A

GENERAL SERVICES

CONTROL OF CAR

CONTROLS (*See Fig. 1 on Page AX2*).

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 thumb trigger release.

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

The **Bi-Starter** or Choke Control of the carburetter 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 **Interior Heater** is switched "ON" by turning the control, marked with an arrow, in a clockwise direction. Maximum point is felt by a slight resistance at about a quarter-turn. Continuing in the same direction reduces the heating effect. To switch off, turn the control back to the original position. On later reproductions a "pull push" type of switch is fitted.

The **Demisters** operate when the Interior Heater is switched on.

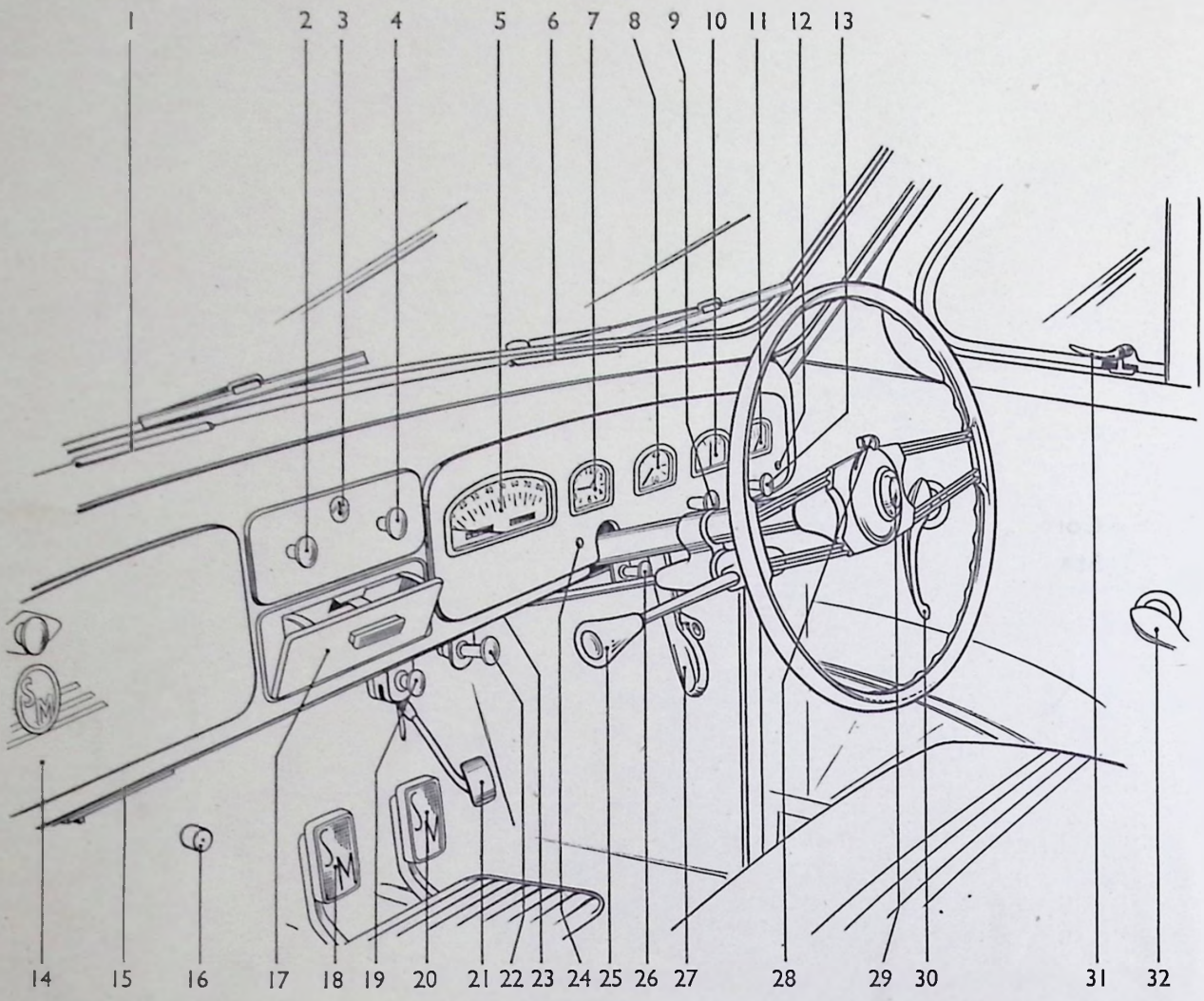
The **Bonnet** is opened by pulling out the control marked "BONNET". This action releases the catch securing the front edge of the bonnet which can then be raised, by lifting at a point immediately beneath the front motif and at the same time depressing the safety catch with the fingers. Prop open the bonnet by means of the stay folded across the front of the car. To close, replace the stay in its clips, lower the bonnet and 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, *Fig.* 12, *Page AX2*, on the facia board will glow.

Anti-Dazzle Switch. To bring into use the anti-dazzle arrangements, 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.



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

Fig. 1.

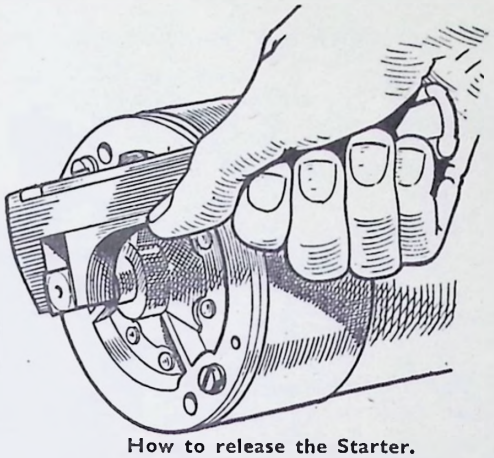
The **Clock** is electric and self-starting. The time is set by pushing up the control behind the facia board immediately under the clock.

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 stage of charge 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.



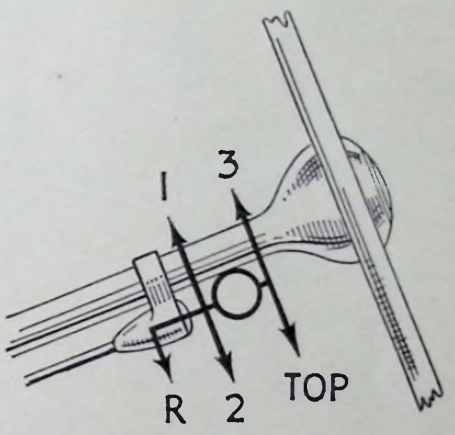
How to release the Starter.

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 also, under any circumstances, depress the control while the engine is running.

By observing the foregoing rules, one will avoid the starter pinion jamming in mesh, but in the event of it doing so, it can usually be released by turning the starter armature by means of a spanner applied to the shaft extension at the commutator end. The extension is exposed by pulling off the small cap.

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

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.



Gear Lever positions.

STARTING THE ENGINE. It is advisable, particularly in cold weather, to revolve the engine with the starting handle. This will help to overcome the normal inertia of the oil and help to conserve the battery and starter.

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 carburetter 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.

It is not necessary to use the carburetter 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.

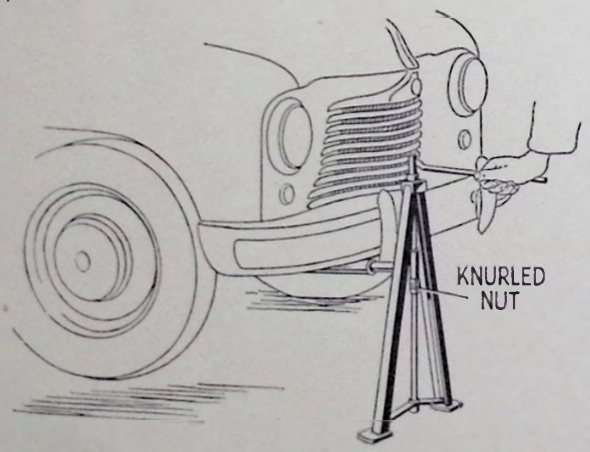
Avoid coasting down hills in neutral, the car is under better control when one of the gears is in engagement and the foot off the accelerator pedal.

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

AIR CONDITIONING. Air is passed into the car through a duct leading from the front grille. Switching "ON" the Heater and by regulating the speed of the fan as described on page AX1 it is possible to maintain a comfortable interior temperature in cold weather. In warm weather cool air can be passed into the car by closing the Heater tap (*see Page EZ3, Fig. 2*), thereby cutting off the hot water to the Heater element.

The volume of heated or cooled air drawn into the car by the Heater can also be regulated by two adjustable doors under the dash. Completely closing these doors allows all the incoming air to flow up through the demisting apertures.

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.

HOW TO CHANGE A ROAD WHEEL. Jack up the car till the wheel is clear of the ground. Then with the aid of the screwdriver prise off the dust cover, remove the four nuts exposed, use 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 dust cover by forcing it over its retaining studs.

GROUP A

GENERAL SERVICES

TOOLS

TOOLS WHICH ARE SUPPLIED WITH THE CAR :—

Adjustable Spanner.
Tappet Spanner.
Brake Spanner.
Brake Bleeding Set.
Set of Box Spanners.
Screwdriver.
Pliers.
Open end Spanner.
Distributor Setting Gauge.
Tyre Valve Extractor.
Tyre Levers.

The starting handle and tyre pump will be found clipped to the offside platform under the bonnet.

The Tripod Jack, Wheel Brace, Grease Gun and Roll of Tools are packed in the spare wheel compartment under the floor of the luggage boot.

TOOLS 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	Service Part No. 23532A
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	Seeger Type S.I.S.
Pliers for extracting Gearbox Thrust Washer Circlip	Seeger Type S.E.B.
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, $\frac{5}{16}$" wide, for Crankshaft and Connecting Rod Bolts.	
Box Spanner, $\frac{3}{8}$" wide, for Cylinder Head Studs.	
Double End Box Spanner for Spring Bolts, $\frac{7}{16}$" wide; $\frac{1}{2}$" wide.	
Double End Box Spanner for Suspension, Arm Bolts, $\frac{1}{2}$" wide; $\frac{9}{16}$" wide.	
Spanner for Starting Nut	Service Part No. 23905N
Spanner for Gear Box Mainshaft Rear Nut	Service Part No. 23678N
Assembly Tool for Spring Ring in Gearbox	Service Part No. 22421N

GROUP B

POWER UNIT SERVICES

ENGINE

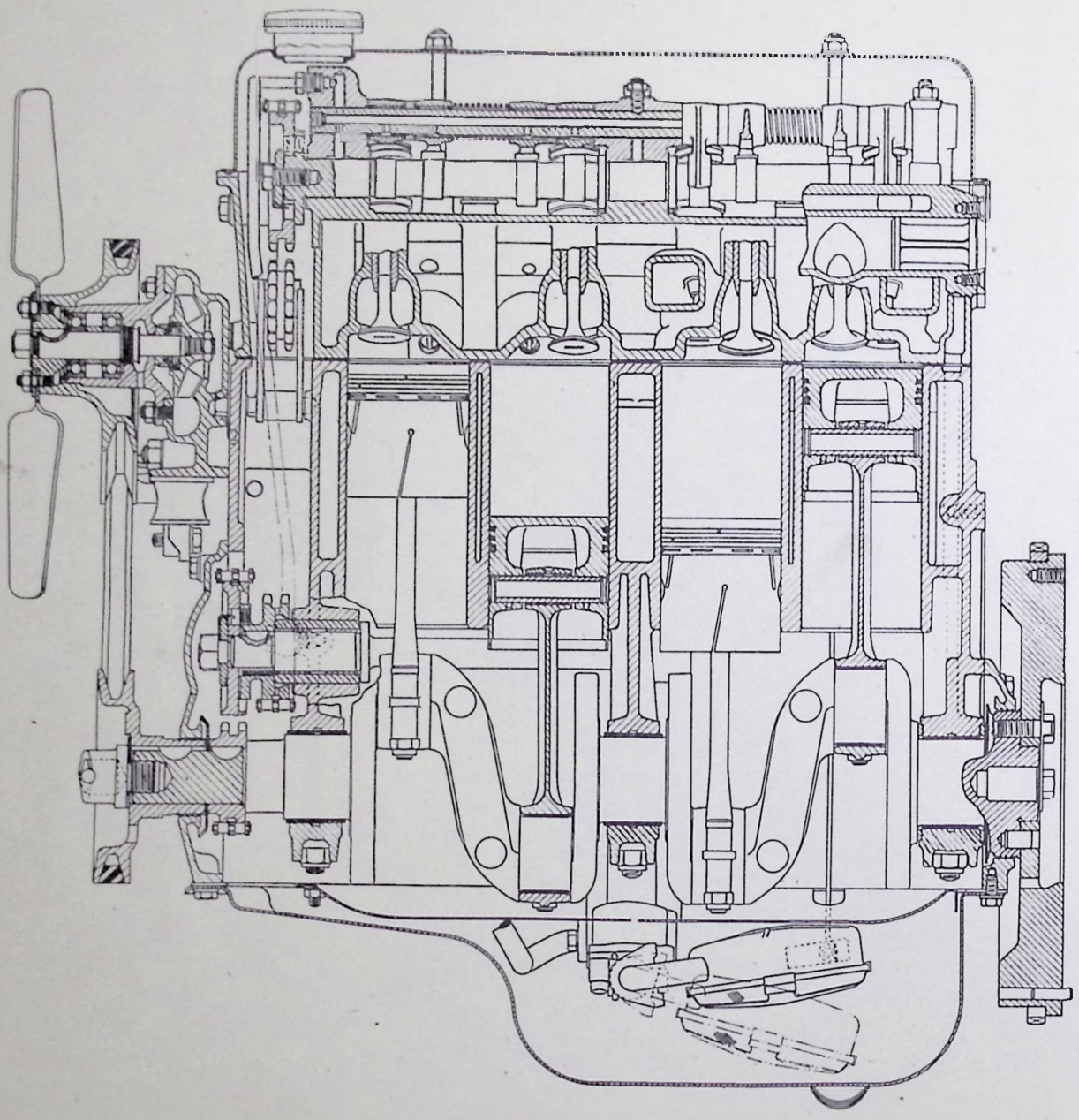


Fig. 1.
Sectional view of SM.1500 Engine with Floating Filter fitted up to Engine No. 122U. For Basket type of Filter used on Engine No. D.123U and onwards see page BZ23, Fig. 20.

DESCRIPTION OF POWER UNIT.

The Engine, Gear Box and Clutch form a single assembly called the Power Unit.

The Engine has four cylinders, a chain driven overhead camshaft and a detachable cylinder head.

The Gear Box, with four forward speeds and a reverse, is fitted with synchromesh mechanism on second, third and top gear. An extended mainshaft with a splined end drives the forward sliding flange—needle bearing mounted in the gear box rear extension—and replaces the usual sliding splined joint on the Propeller shaft.

A Borg & Beck clutch with a single flexible dry plate couples the Engine to the Gear Box.

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

THE FOLLOWING LISTS GIVE THOSE WHICH CAN BE DONE :—

With Bonnet raised and the Car on the Floor.

(1) To remove and replace the Air cleaner and carburetter. *See page BZ6.*

(2) To remove and replace the Valve Rockers. *See page BZ13.*

(3) To remove and replace the Camshaft. *See pages BZ7 to BZ9.*

(4) To remove and replace the Cylinder head. *See page BZ7.*

(5) To remove and replace the Water pump. *See page EZ3.*

(6) To remove and replace the Dynamo. *See page BX3.*

(7) To remove and replace the Distributor. *See page BY6.*

(8) To remove and replace the Coil. *See page BY9.*

(9) To remove and replace the A.C. Oil Filter. *See page BZ27.*

(10) To remove and replace the Heater Unit. *See page FY2.*

(11) To remove and replace the Petrol pump. *See page DZ8.*

(12) To remove and replace the Radiator. *See page EZ3.*

(13) Adjusting the Rockers. *See page BZ13.*

(14) Checking the valve timing. *See page BZ15.*

(15) Checking the ignition timing. *See page BZ16.*

With the Bonnet raised and the Car Elevated.

(1) To remove and replace the Oil Sump. *See page BZ22.*

(2) To remove and replace the Oil Pump. *See page BZ23.*

(3) To remove and replace the Piston and Connecting Rods. *See page BZ25.*

(4) To remove and replace the Main bearing caps for inspection of bearings but not renewal. *See page BZ32.*

(5) To remove and replace the Starter Motor. *See page BW2.*

(6) To remove and replace the Gear box. *See page BU3.*

(7) To remove and replace the Clutch housing. *See page BZ20.*

(8) To remove and replace the Clutch. *See page BZ21.*

(9) To remove and replace the Timing Chains. *See pages BZ17 and BZ18.*

(10) To remove and replace the intermediate shaft. *See page BZ20.*

(11) To remove and replace the Power Unit for general overhaul. *See page BZ29.*

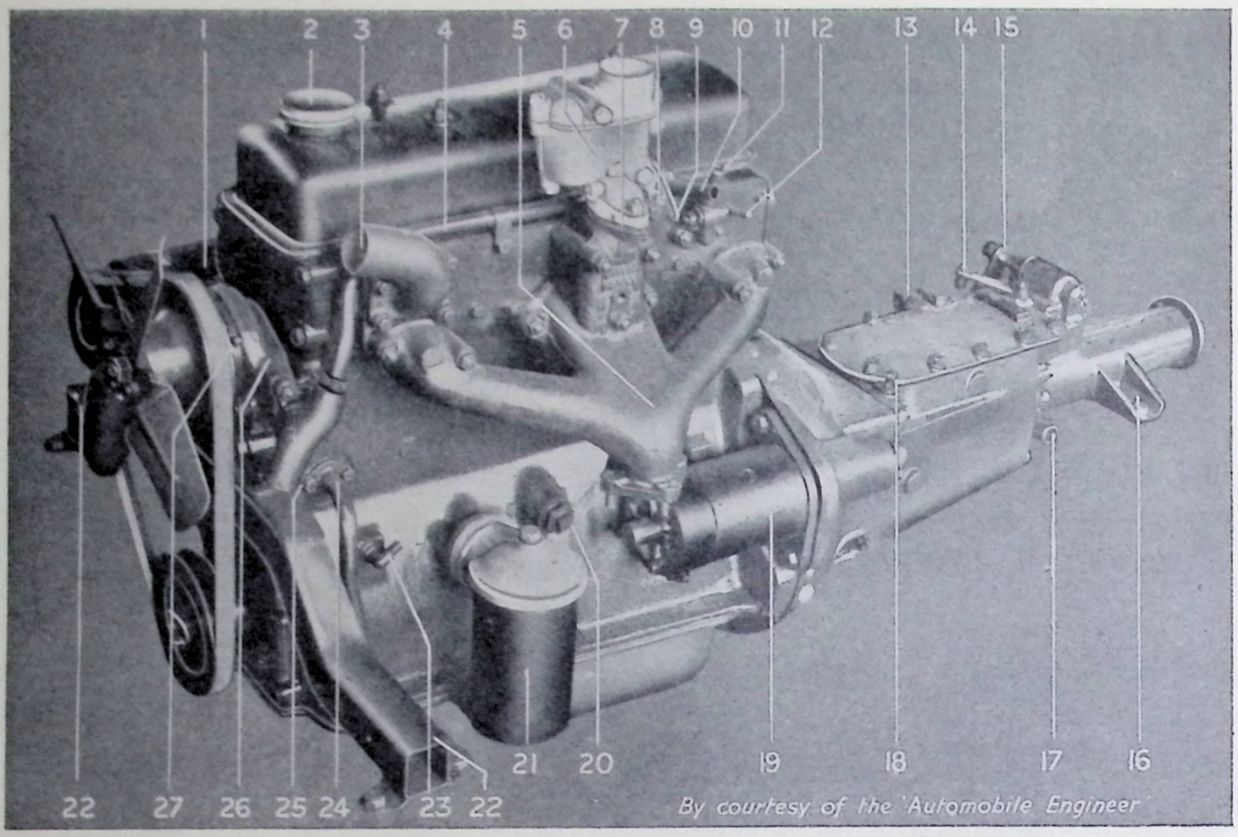


Fig. 2. Engine (Nearside).

1. Dynamo.
2. Oil Filler Cap.
3. Water Outlet Pipe.
4. Car Heater Water Return Pipe.
5. Inlet and Exhaust Manifold.
6. Carburettor.
7. Flange Washer.
8. Throttle Adjustment Screw.
9. Throttle Lever.
10. Car Heater Water Return Pipe.
11. Tap to Car Heater Element.
12. Tap Lever.
13. Change Speed Cable Support.
14. Change Speed Operating Lever.
15. Change Speed Lever.
16. Rear Engine Mounting.
17. Speedo Pinion Guide.
18. Dipstick (Gearbox).
19. Starter Motor.
20. Oil Relief Valve.
21. A.C. Oil Filter.
22. Front Engine Support Bracket.
23. Oil Pressure Gauge Elbow.
24. Breather Tube.
25. Breather Tube.
26. Water Pump.
27. Water Pump Greaser.

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. 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.

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 locknut 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 couples the crank-

shaft to the intermediate shaft from which the oil pump and distributor receive their drive through skew 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 an F.A.I. 30 mm. Bi-Starter, Downdraught Solex Carburetter fitted with a combined air cleaner and silencer. The fuel is fed to the carburetter by an S.U. electric pump, and the ignition is by Lucas high tension coil and distributor with automatic advance.

Oil is carried in the sump from where it is drawn, through a B.W.P. floating filter, by a gear type of pump which receives its drive from the intermediate shaft. From Engine No. D122U the B.W.P. floating filter is replaced by a fixed basket type. Oil to the main bearings, intermediate shaft bearing, and big end bearings is delivered via oil ways formed in the crankcase and webs of the crankshaft.

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.
9. Top Centre Viewing Aperture.
10. Accelerator Cable Clip.
11. Carburetter Starter Lever.
12. Carburetter.
13. Oil Filler Cap.
14. Water Outlet Pipe.
15. Car Heater Water Return Pipe.
16. Water Pump.
17. Front Engine Support Bracket.
18. Dynamo Adjusting Link Bolt.
19. Dynamo.
20. Spark Coil.
21. Distributor Clamp Bolt.
22. Distributor.
23. Distributor Index Adjustment Plate.
24. Oil Level Indicator Rod.
25. Engine Sump Drain Plug.
26. Cylinder Jacket Drain Tap.
27. Torque Arm Assembly Studs.
28. Clutch Withdrawal Lever.

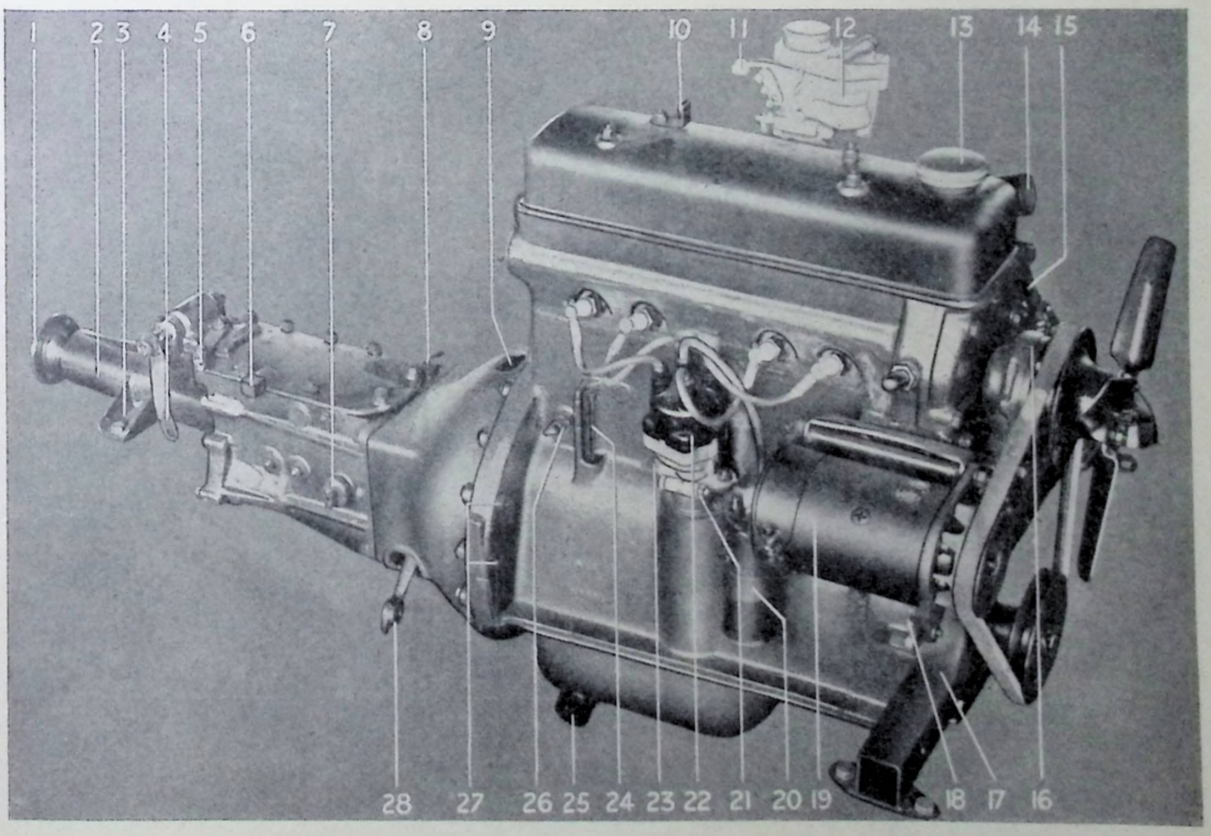


Fig. 3. Engine (Offside).

A portion of the oil overflow from the front intermediate shaft bearings collects in an annular groove formed in the camshaft intermediate driver 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 driver chain wheel into a small recess formed between the joint faces of the two intermediate shaft chain wheels, from here it flows via radial oilways 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 bearing via the hollow rocker shaft. On later productions this pipe is clipped to the cylinder block. *See Page BZ13, Fig. 13.* 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.

THE A.C. COMBINED AIR CLEANER AND CARBURETTER INTAKE SILENCER.

Description. Air entering the carburetter passes through the oil-wetted woven mesh (A), the air tube (B) and the central tube (C). Sound waves ordinarily would pass out of the carburetter into the car in the reverse way. In the A.C. intake silencer, they pass into the main air chamber, the internal diameter and length of which together with the carburetter and air tube characteristics form a tuned silencer, and, in addition, into the resonator chambers (D) each of which contributes towards eliminating or smoothing out the sound waves.

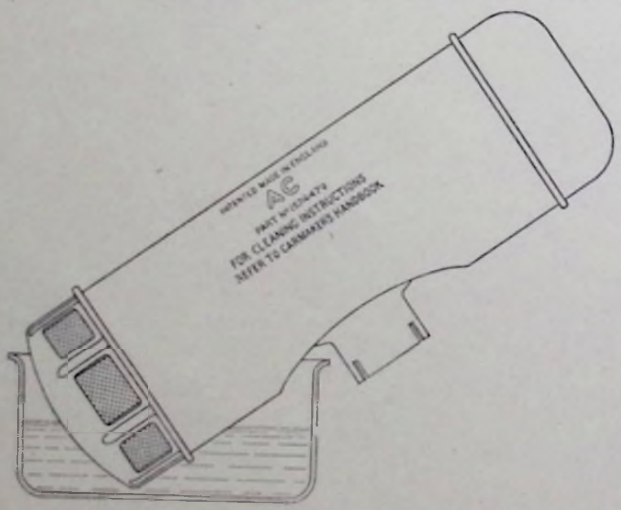


Fig. 4. Method of Cleaning A.C. Air Cleaner.

SERVICE BZ1.
TO REMOVE AND REPLACE THE AIR CLEANER AND CARBURETTER.

(1) Detach the air cleaner after removing the nut holding the forward stay to one of the valve cover studs and then releasing the clip securing the cleaner to the carburetter intake.

(2) Remove the nut securing the clip of the throttle control to the valve cover. Detach the throttle control spring from its anchorage and disconnect the control for the carburetter throttle lever by removing the nut and shakeproof washer securing the joint.

(3) Disconnect the choke control after releasing the set pin securing the control cable and withdrawing the assembly through its abutment anchorage.

(4) Disconnect the petrol pipe.

(5) Remove the two nuts and washers securing the carburetter flange to the induction manifold and lift off the carburetter.
Note the anchorage link for the throttle control spring on the stud furthest away from the engine and also the insulating washer between the carburetter and induction pipe flange.

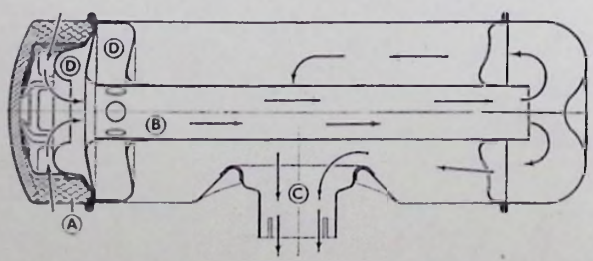


Fig. 5. Direction of Air through Cleaner.

Replacement is the reversal of the foregoing operations. To ensure a gas-tight joint between the induction pipe and carburetter use a new gasket, and tighten the nuts progressively and by equal amounts.

SERVICE BZ2.
CLEANING AND RE-OILING.

After each 5,000 miles (8047 Kms.) the oil-wetted air cleaner portion needs cleaning and re-oiling.

This is done by swilling the windowed end of the cleaner in a shallow pan of paraffin. After drying, the mesh should be lightly re-oiled with engine oil, allowing any surplus to drain off before refitting to the engine.

SERVICE BZ3.
TO REMOVE AND REPLACE THE EXHAUST AND INLET MANIFOLD.

(1) Remove the carburetter. *See Page BZ6.*

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

(3) Remove the carburetter overflow pipe.

(4) Remove the nine nuts securing the manifold to the head and draw it off over the 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.

SERVICE BZ4.
TO REMOVE AND REPLACE THE CYLINDER HEAD.

(1) Lift the bonnet and drain the cooling system. *See Page EZ1.*

(2) Disconnect the battery positive lead.

(3) Remove the air cleaner and carburetter *See Page BZ6.*

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

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

(6) Remove the clip securing the heater water pipe to the cylinder head. Note the copper and asbestos washers under the set pins. Disconnect the pipe from the water pump housing, and also the heater pipe water hose from the heater tap.

(7) Remove the valve rocker cover.

(8) Disconnect the oil feed pipe to the valve mechanism from the front pedestal for the rocker shaft, 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 timing chains, and must be observed during the whole period the pipe is disconnected, also while being reconnected.
On later productions, the oilpipe is secured to the wall of the timing case by means of a clip held in position by a nut and bolt. For general arrangement see Fig. 13, *Page BZ13.*

(9) With a thin $\frac{7}{16}$" open-ended spanner, remove the chain adjuster as an assembly by turning in an anti-clockwise direction the nut nearest the cylinder head. For any readjustment necessary *see Page BZ14.*

(10) Remove the four bolts and shakeproof washers securing the cylinder head front cover plate.

(11) Revolve the engine by means of the starting handle and set the flywheel with the mark 1/4 on top centre with No. 1 cylinder inlet valve open. No. 4 cylinder sparking plug is now about to fire.

Place sufficient clean rag beneath the chain wheel and around the chain, to prevent anything dropping down the chain case. 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. Now prise the chain wheel complete with chain from off the camshaft and support it by lashing the wheel with the chain in position to the radiator cap with a piece of suitable wire. **From this point onwards, do not revolve the engine, since to do so will upset the valve and ignition timing.** Should it be necessary to

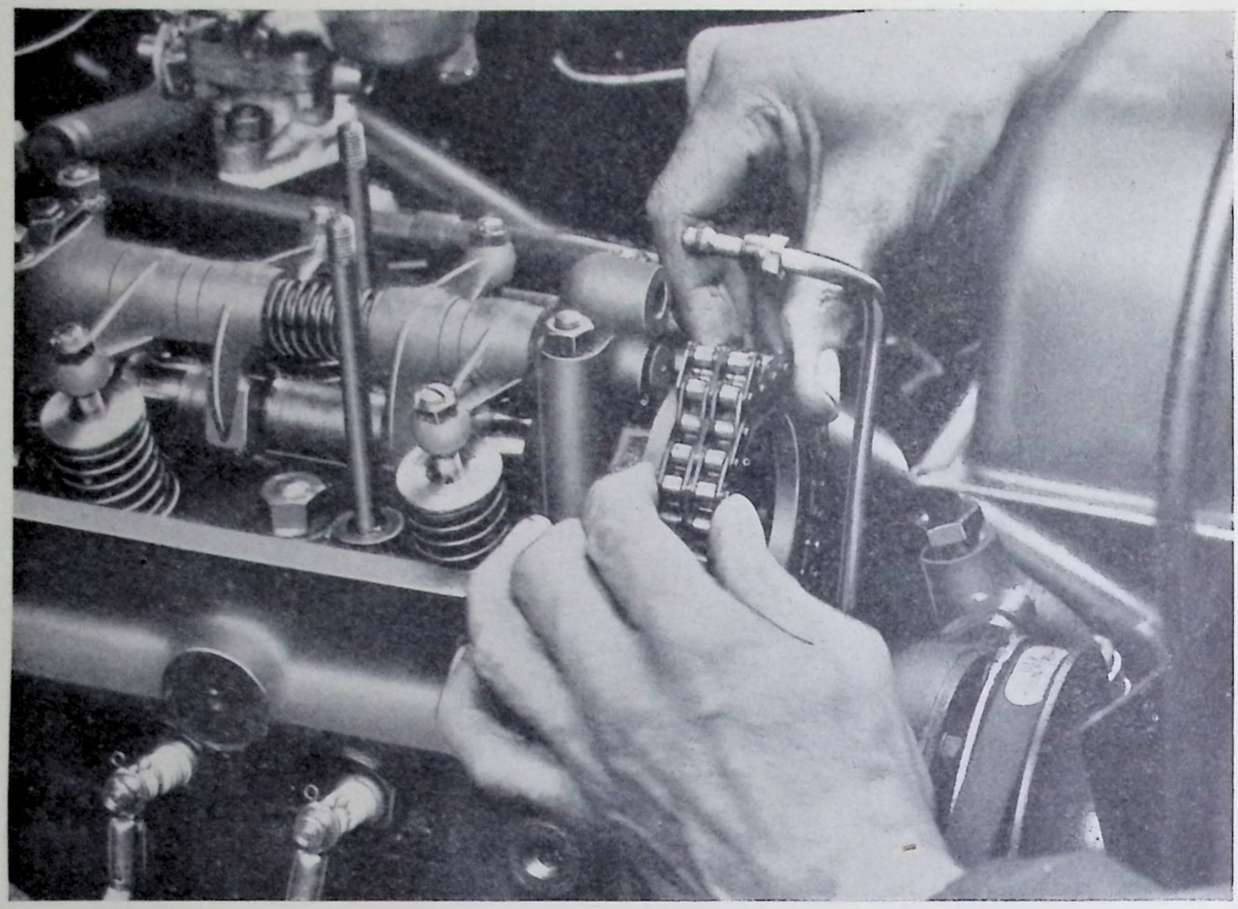


Fig. 6. Observe Method of moving Chain over Wheel one tooth at a time.

revolve the engine for any purpose re-time the valve and ignition timing as described on *Pages BZ15 and BZ16.*

(12) Remove the sparking plugs.

(13) Remove the ten cylinder head holding down nuts and plain washers—take care not to drop any down the front and rear apertures.

(14) Release the head from the cylinder block, and lift it off by a direct pull.

Replacement is by reversing the foregoing.

If the head has been dismantled then proceed as follows for engines numbered D.730S and onwards.

(1) Check that the flywheel is set with the marks 1/4 on Top Centre, and that the electrode of the rotor in the distributor is pointing to the segment, in the cap, connected to No. 4 sparking plug.

(2) Place the head in position on the cylinder block, taking care to see that their joint faces and those of the gasket are clean ; set the camshaft so that the mark on the rim of its driving flange is in line with the machined face of the pad at the butt face of No. 1 bearing cap of the camshaft. Offer the wheel and chain assembly to the camshaft and if the holes in the wheel will not register with the studs on the driving flange, lower the chain wheel sufficiently to work the chain over the wheel a tooth at a time until engagement is effected without altering the positions of the camshaft or crankshaft, and with the right hand length of the chain in tension, and the chain tensioner also in engagement. *See Fig.* 6. Check the valve and ignition timings as described on *Pages BZ15 and BZ16* before proceeding any further with the assembly, which from here is in the reverse order to dismantling.

When reassembling, it is important that the ten cylinder nuts are tightened in the order shown in Figure 8 as otherwise distortion may take place.

For Engines bearing numbers before D.730S proceed as follows :—

(1) Set the rocker clearances of the inlet valves to .004" and of the exhaust valves to .006".

(2) Position the camshaft with the inlet valve of No. 1 Cylinder just opening, *see Page BZ15.*

(3) Position the flywheel with the marks 1/4 at top centre and the electrode of the distributor rotor pointing to the segment in the cap connected to No. 4 sparking plug.

(4) Place the head in position on the cylinder block, taking the usual precautions to see that the joint faces are clean, and endeavour to engage the chain wheel with the camshaft. If it is not possible to register the holes in the wheel with the pegs on the shaft, lower the chain wheel sufficiently to work the chain over the wheel a tooth at a time, until engagement is possible without altering the positions of the camshaft or crankshaft, and with the right hand length of the chain in tension and the chain tensioner in engagement. (*see Fig. 6, Page BZ8*). Check the valve and ignition timing as described on *Pages BZ15 and BZ16* before proceeding any further with assembly, which from here is in the reverse order to dismantling.

SERVICE BZ5.
TO DISMANTLE AND REASSEMBLE THE HEAD.

(1) Remove the six nuts and washers securing the upper halves of the camshaft bearings, and lift off the halves complete with valve rockers and shaft.

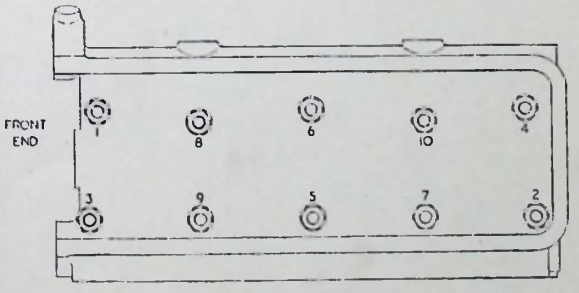


Fig. 8. Order of tightening Cylinder Nuts.

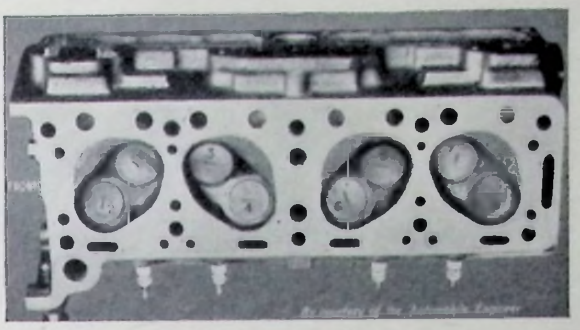


Fig. 9. Valve Markings.

The camshaft can now be lifted out.

(2) Remove the set pin which secures the rocker shaft to the top half of the camshaft intermediate bearing, and slide the various components off the rocker shaft towards the rear. On later production this centre set pin is fitted with a lock washer. *See Fig. 1, Page BZ2.* Note the order and mark the rockers so that they can be reassembled in their original positions. The order of the parts is shown in *Fig. 1, Page BZ2.* Notice that the inlet valves are marked 2, 4, 6, 8, and the exhausts 1, 3, 5, 7, counting from the radiator end. **It is important that the valves are inserted in this order to ensure correct reassembly.** *See Fig. 9.*

(3) Figure 11 shows a type of valve extracting tool which can be purchased from the Factory. The Service No. is 24083N, and the price will be supplied on application.

The board with four wooden pads screwed on it is readily made, and is for the purpose of standing the cylinder head on while the valve springs are being depressed ; the pads bear against the valve heads, thus preventing their being pressed downwards.

Figure 10 shows the tool in use.

With the valve cup and spring depressed, the retaining collars can be removed readily.

The Valve can then be withdrawn from its guide through the combustion chamber. A valve must be refitted into the guide from which it was removed, and if a new valve is to be used it must be stamped with the number carried by the original.

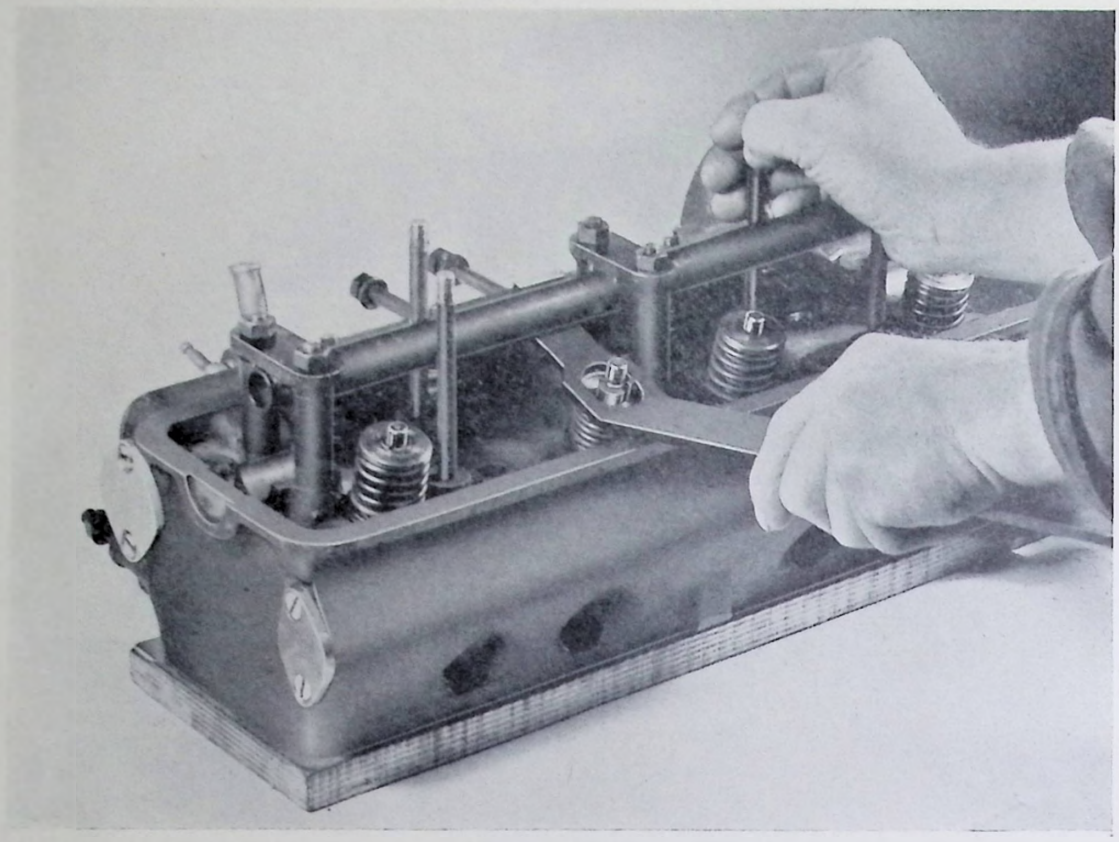


Fig. 10. Valve Extracting Tool in use.

Reassembly is in the reverse order to the foregoing.

When fitting the retaining collars to the valves, make sure that they are properly located in their spring cups and in the annular grooves machined in the valve stems. It is advisable to tap them lightly into position with the aid of a tube and hammer. The bore of the tube should be such that it will just pass over the valve stems.

The rocker bushes and the camshaft bearings receive their supply of oil through the hollow rocker shaft and oil ways drilled radially in the shaft and vertically downwards in the bearing caps. Before assembling these parts make sure that the bore of the shaft, the oil ways in it and in the bearing caps are clean ; also, that when inserting the shaft, the end, with two oil holes diametrically opposite each other, fits into No. 1 Bearing cap, and that the holes register with the oil ways in the cap. To ensure correct assembly the rear end of the shaft is grooved. These precautions are necessary to ensure a supply of oil to the bearings and rockers.

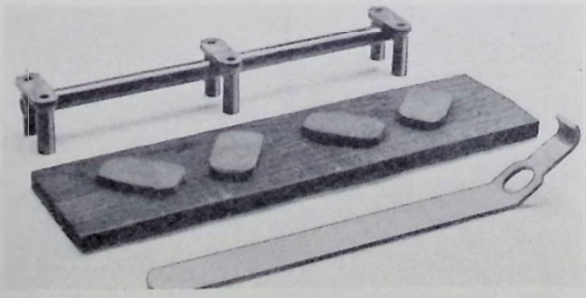


Fig. 11. Valve Extracting Tool and Board.

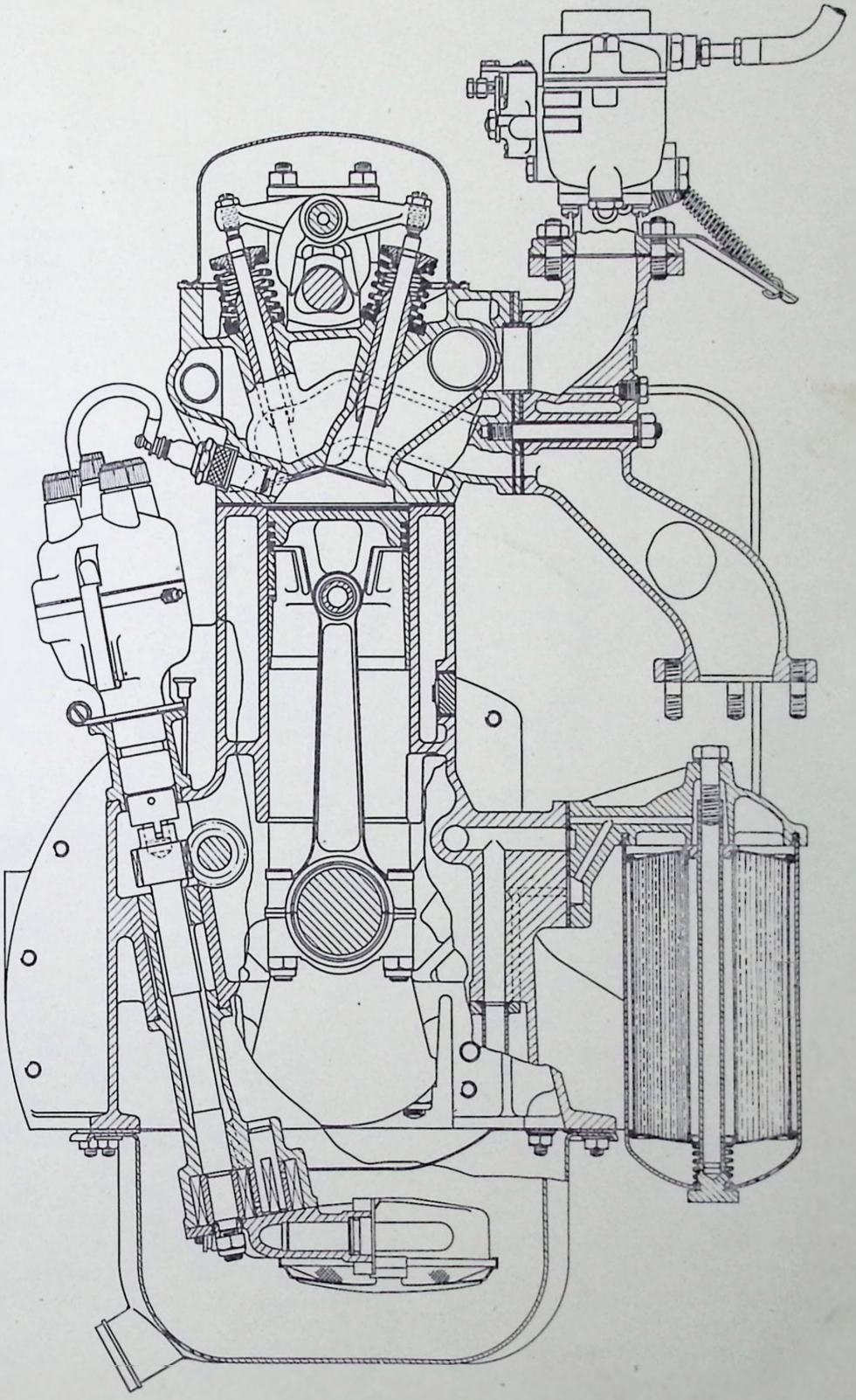


Fig. 7.
Cross Section View of SM.1500 Engine with Floating Filter, fitted up to Engine No. 122U. For Basket type of Filter used on Engine No. D.123U and onwards, see page BZ23, Fig. 20.

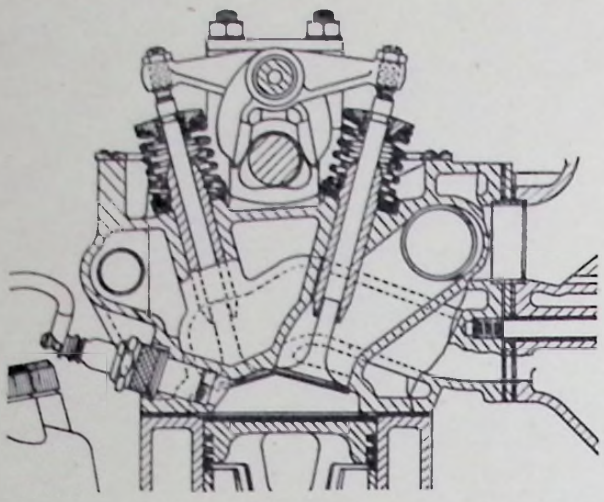


Fig. 12. Section through Valves.

SERVICE BZ6. 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.

The Services to be carried out as follows :

(1) Lift the bonnet and drain the cooling system. *See Page EZ1.*

(2) Remove the carburetter, *see Page BZ6.*

(3) Remove the cylinder head, *see Page BZ7.*

(4) Remove the manifold, *see Page BZ7.*

(5) Remove the sparking plugs and clean as described on *Pages BY5 and BY6.*

(6) If, after removing the cylinder head, the engine has not been turned, No. 1 and 4 pistons should be at the top of their strokes. Fill the bores of No. 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 crowns as quantities of abrasive may find its way into the engine and cause serious damage.

(7) To clean No. 2 and 3 bore, 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 No. 1 and 4 bores with rag and clean No. 2 and 3 pistons as before. Remove the rag from the water ports and clean off 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 an anti-clockwise direction and so restore No. 1 and 4 pistons to their original positions.

(9) Dismantle the cylinder head as described on *Page BZ9.*

(10) Remove all traces of carbon from the combustion chambers, the inlet and exhaust ports, in the cylinder head, and from the joint face.

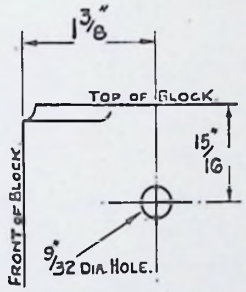
Remove also all traces of carbon from the valve stems and heads and should the seats appear pitted or uneven, reface them at an angle of 45° on a valve grinding machine. The maximum depth of the face is .075"—1.905 mm. If the seats in the head are in a similar condition, recut them also with a 45° cutter,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

The maximum depth of a seat is .055" (1.397 mm.) 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 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. **Reassembly** of the head is carried out in the reverse order to dismantling, *see Page BZ10*. If the Cylinder Head Oil feed pipe is not clipped to the cylinder block arrange for this to be done as shown in Fig. 13. When assembling the valves make sure that they are replaced in their correct positions, and that all parts are clean and liberally coated with oil. The correct order is : Inlet 2, 4, 6, 8, and Exhaust 1, 3, 5, 7. *See Fig. 9, Page BZ9.*

(11) Replace the Cylinder Head as described on *Page BZ7*.



POSITION OF HOLE FOR OIL PIPE CLIP.

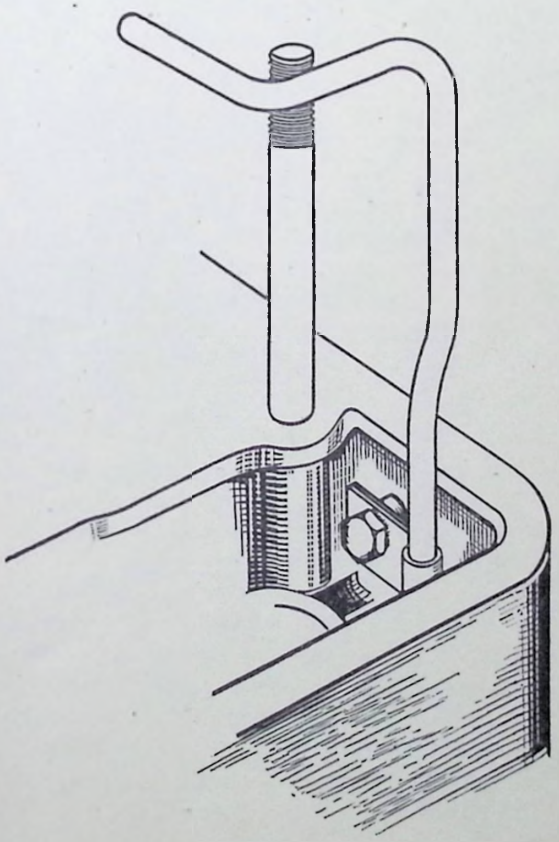


Fig. 13. Clip for Oil Feed Pipe.

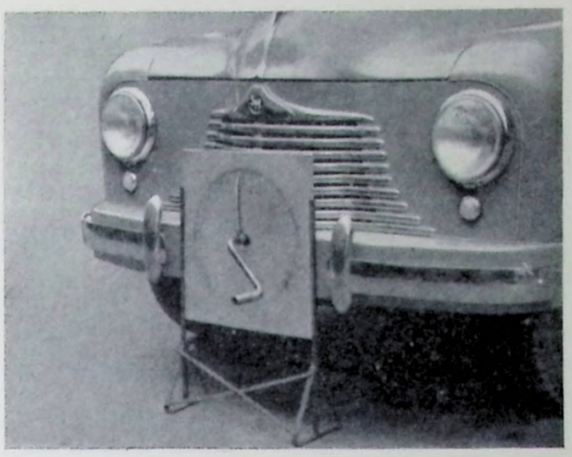


Fig. 14. Timing Degree Indicator.

SERVICE BZ7.
TOP CENTRE LOCATION.

The top 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, *see Fig. 3, Page BZ5.*

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

Figure 14 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.

SERVICE BZ8.
TO ADJUST THE ROCKERS.

Rotate the engine slowly by means of the starting handle and until the cam follower on the rocker to be adjusted is in the centre of the neutral portion of the cam. *See Figure 12, Page BZ12.* Release the lock nut on the valve

end 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 valve stem is .004" (.1 mm.) and an exhaust valve .006" (.15 mm.). **Use feeler gauges of .004" and .006" thickness.**

Tighten the lock nut 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	,,	,,	,,

SERVICE BZ9.
TO ADJUST THE CAMSHAFT CHAIN TENSIONER.

(1) Secure, from turning, with a fairly thin $\frac{7}{16}$" spanner the lock nut of the chain tensioner, and with the aid of a second $\frac{7}{16}$" spanner, remove the cover of the tensioner—the lock nut is the one nearest the cylinder head.

(2) Release the lock nut and, with a $\frac{3}{16}$" spanner, screw "in" or "out" the threaded plug of the tensioner until an "in" and "out" movement of $\frac{1}{32}$" (.7937 mm.) can be felt in the cottered spindle of the tensioner. Tighten the lock nut and replace the cover.

Do not, under any circumstances reduce the "in" and "out" movement of the spindle to less than $\frac{1}{32}$". Any such action will cause the chain to wear abnormally because of excessive tension.

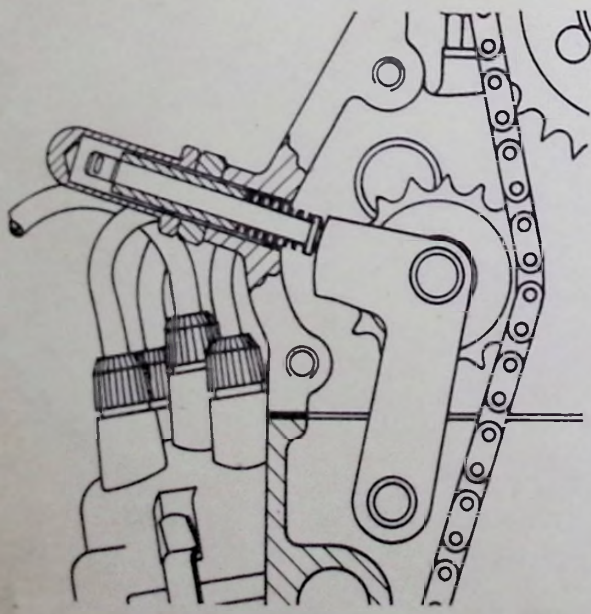


Fig. 15. Camshaft Chain Adjuster.

SERVICE BZ10.
VALVE TIMING—DESCRIPTION.

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 skew gears, the oil pump and distributor. The secondary chain is provided with a spring loaded adjustable idler sprocket type of tensioner—*See Fig.* 15.

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 lockplate.

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.

The opening and closing position of the valves given in the *Figure* 16, *Page BZ15*, 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 opening by using the adjustment referred to.

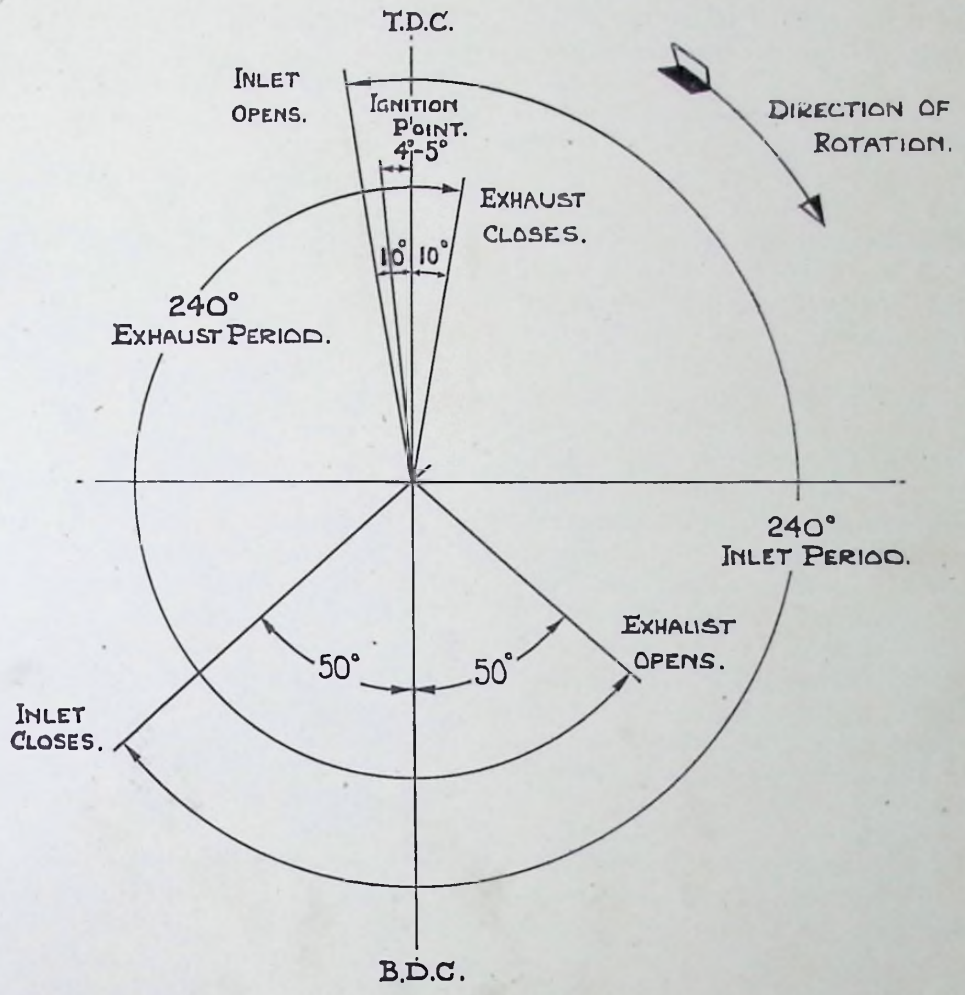


Fig. 16. Valve Timing.

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.
50° — an arc of $4\frac{11}{16}$" measured on the rim of the flywheel.

SERVICE BZ11.
TO CHECK THE VALVE TIMING.

(1) Remove the valve cover and if available place in position the degree chart as described on *Page* BZ13. 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" (.1 mm.) for the inlet valves and .006" (.15 mm.) for the exhaust valves. *See Page* BZ13.

(3) Rotate the engine slowly by means of the starting handle, and while doing so, endeavour to oscillate, with the fore-finger 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 $\frac{15}{16}$" (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.

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

(2) Remove the Cylinder head front cover.

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

(4) With a $\frac{7}{16}$" open ended spanner remove the chain adjuster by working on the nut nearest the cylinder head, to avoid altering the adjustment. For any re-adjustment necessary *see Page BZ14.*

(5) 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.**

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

(7) 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.

(8) 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 BZ14.*
Reassemble.

SERVICE BZ12.
TO CHECK THE IGNITION TIMING.

Remove the rocker cover, and if available place in position the degree chart as described on *Page BZ13.* Caution—Do not lean on the wings of the car when once the pointer has been set to the top centre position.

To check that 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 opposite that on the central rotor. For the other wires to be properly connected they must be in the following sequence, 1, 3, 4, and 2, counting in the direction which the rotor revolves. *See Fig. 9, Page BY7.*

To Check the Ignition Setting.

(1) Set the distributor points to a gap of .012" (.3 mm.) when in their maximum open position. *See Page BY2.*

(2) Turn the engine slowly by means of the starting handle until No. 1 cylinder inlet valve commences to open. Now watch the distributor points and cease turning the engine when they just part. For the setting to be correct, this condition should occur 5° or $\frac{15}{32}$" (10.319 mm.) before Top centre.

Should any 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 5° or $\frac{15}{32}$" (10.319 mm.) before top centre.

(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 re-check opening position of points.

SERVICE BZ13.
TO REMOVE AND REPLACE THE PRIMARY CHAIN AND ITS TIMING WHEELS, WITH CAMSHAFT OR SECONDARY CHAIN IN POSITION.

(1) Lift the bonnet.

(2) Drain the cooling system. *See Page EZ1.*

(3) Remove the radiator. *See Page EZ3.*

(4) Detach the fan blades.

(5) Remove the fan belt. *See Page EZ5.*

(6) Remove the cylinder head top cover.

(7) Remove the cylinder head front cover.

(8) *From Engine No. D.730S and onwards proceed as follows :—*
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 gear box 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, notice the two set bolts which secure the sump to it, 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 BZ15* and if necessary reset as described on *Page BZ16.*
Check, and if necessary, reset the ignition timing. *See Page BZ16.*
Should the crankshaft and/or the camshaft have been moved accidentally, reposition 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 BZ15 and BZ16.*

On engine bearing numbers prior to D.730S proceed as follows :—

(1) Carry out operations 1—7 of this Service.

(2) Turn the engine until the mark 1/4 on the rim of the flywheel is 10°—$\frac{13}{16}$" or 23.8 mm. before Top centre.
The inlet valve of No. 1 cylinder should be just open and the electrode of the

rotor of the Distributor opposite the segment in the cap connected to No. 4 cylinder sparking plug.

(3) Mark a line across the rim of the camshaft driving flange in line with the top machined surface of the cylinder head.

(4) Proceed as in *Operations 9—17 of this Service* and reassembled in the reverse order to dismantling.
Check both valve and ignition timings.
Note. *On the early production of this model, the oil feed pipe to the camshaft bearings was practically straight from the banjo union to about three-quarters of its length. Experience has shown that it is advantageous to set it so that it is nearer to the cylinder side wall than originally, and so avoid the possibility of its fouling the chain. Should a straight pipe be met with, it should be removed and set as shown in the sketch on page BZ19.*
On still later productions, the oilpipe is secured to the wall of the timing case by means of a clip held in position by a nut and bolt. For general arrangement see Fig. 13, Page BZ13.

SERVICE BZ14.
TO REMOVE AND REPLACE THE CAMSHAFT CHAIN AND ITS TIMING WHEELS.

(1) Remove the Primary chain and its timing wheels. *See Page BZ17.*
Note the different procedures suggested for Engines before and after number D.730S.

(2) Remove the camshaft chain tensioner by turning, with a thin $\frac{7}{16}$" spanner and in an anti-clockwise direction, the lock nut adjacent to the cylinder head. By adopting this method there is small possibility of the adjustment being altered. Should an alteration inadvertently occur, readjust as described on *Page BZ14* after reassembly.

(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 timing chains, and must be observed during the period the pipe is disconnected also when being reconnected.

(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.
Reassembly is the reverse to dismantling, and on completion check the valve and ignition timing, as described on *Pages BZ15 and BZ16.*

SERVICE BZ15.
TO REASSEMBLE THE TIMING CHAINS AND WHEELS.

Procedure for Engine No. D.730S and onwards.

(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. On engines bearing numbers before D.730S set the valve clearance for the inlet valve of No. 1 cylinder to .004" and position the camshaft so that the inlet valve is just opening.

(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 alteration to the position of the camshaft and intermediate shaft. **When this operation is being**

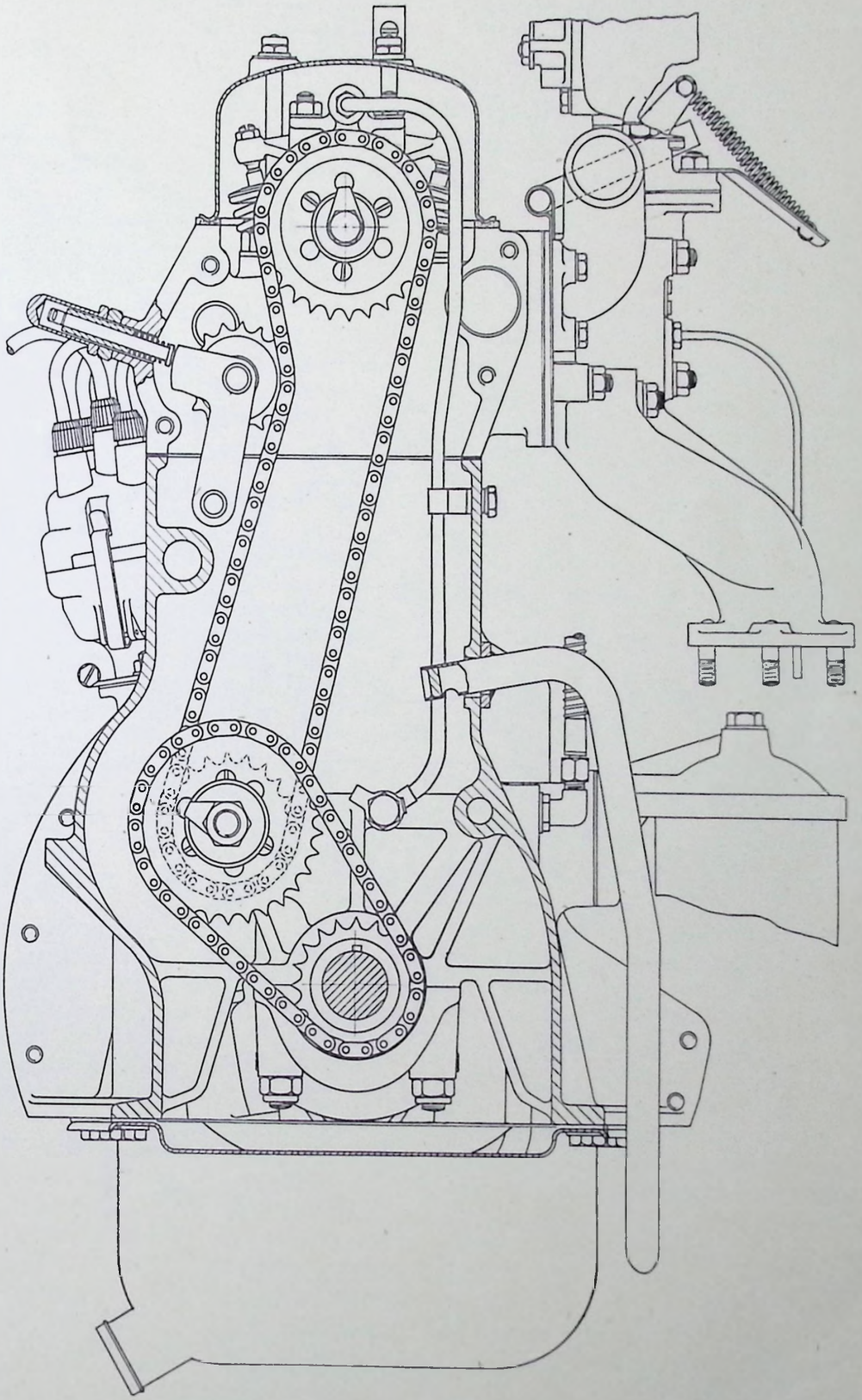


Fig. 17. Layout of Camshaft Drive.

carried out keep the length of chain on the right in tension, and when completed engage the chain tension.

(5) Fit the plain and tab washers 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 in *Page BZ14.*

(7) Position the flywheel—and incidentally the crankshaft—with the mark 1/4 at top centre, for engines after D7305, and 10° or $\frac{15}{16}$" before top centre for engines prior to D7305.

(8) Engage the primary chain with the crankshaft chain wheels 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 recess 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 BZ17, Operations No. 1 to 11.*

Check the valve timing and if necessary reset as described on *Pages BZ15* and *BZ16.*

Check the ignition timing and if necessary reset as described on *Page BZ16.*

SERVICE BZ16.
REMOVE AND REPLACE THE INTERMEDIATE SHAFT.

(1) Remove the Primary Chain. *See Page BZ17.*

(2) Remove Camshaft Chain. *See Page BZ18,*

(3) Release the lock nut on the bearing locating bolt situated between the engine front support member and the coil and immediately beneath the dynamo. Remove the bolt. The shaft can now be withdrawn complete with bearing bush.

(4) 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 skew 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 bolt is towards the rear, and the boss of the wheel towards the front of the car.

When inserting the locating bolt, 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

SERVICE BZ17.
TO REMOVE AND REPLACE THE CLUTCH HOUSING.

(1) Remove the gear box. *See Page BU3.*

(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.

SERVICE BZ18. TO REMOVE AND REPLACE THE CLUTCH WITH THE POWER UNIT IN THE CHASSIS.

(1) Remove the Gear Box. *See Page BU3.*

(2) Remove the clutch housing. *See Page BZ20.*

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

(4) Remove the bolts completely and detach the clutch cover with 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. For further dismantling of the clutch *see Section BV.*

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

Replacement is the reversal of the foregoing.

Pay particular attention to refit the bush in the centre of the flywheel, and since it is an Oilite one, there is no need to smear it with lubricant or grease. If the bush shows signs of wear or if it has been in service for a considerable mileage fit a replacement. Fit the centre plate with the large chamfer of the splined bore towards the gear box. Tighten the bolts securing the cover up to the point where the pressure plate just nips the centre plate to the flywheel, centralise the plate by passing a service constant mesh shaft through the hub of the plate to register with the bush in the flywheel. Do not remove the shaft until the securing bolts are fully tightened. Tighten the bolts in a diagonal direction, half a turn at a time to avoid distorting the clutch cover. With the gear box in position and as a final operation, adjust the clutch pedal as given in *Page BV7* and the change speed lever mechanism as on *Pages BU4 and BU5.*

SERVICE BZ19. TO REMOVE AND REPLACE THE FLYWHEEL.

(1) Remove the gear box. *See Page BU3.*

(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 this page.*

(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.

SERVICE BZ20. 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.

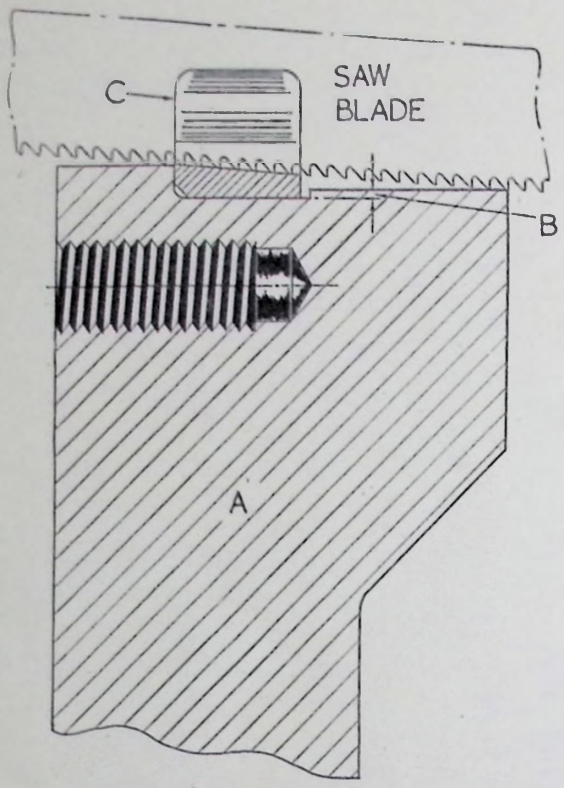


Fig. 18. Method of removing Starter Ring Gear.
A. Flywheel B. Depth of groove.
C. Flywheel tooth.

To remove the ring saw through it in the manner described in figure 18 and then burst the ring apart by driving into the saw cut a fairly sharp cold chisel.

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 circumstance 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.

To avoid the possibility of the rings seizing on the rim of the flywheel, the diameter should be reduced as shown in the Figure 19, if this has not already been done.

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 $\frac{1}{32}$th of an inch.

The machining must be carried out carefully for the surface must be smooth, flat and parallel to the joint faces of the flywheel and crankshaft flange.

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

SERVICE BZ21.
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 in *Group C 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.

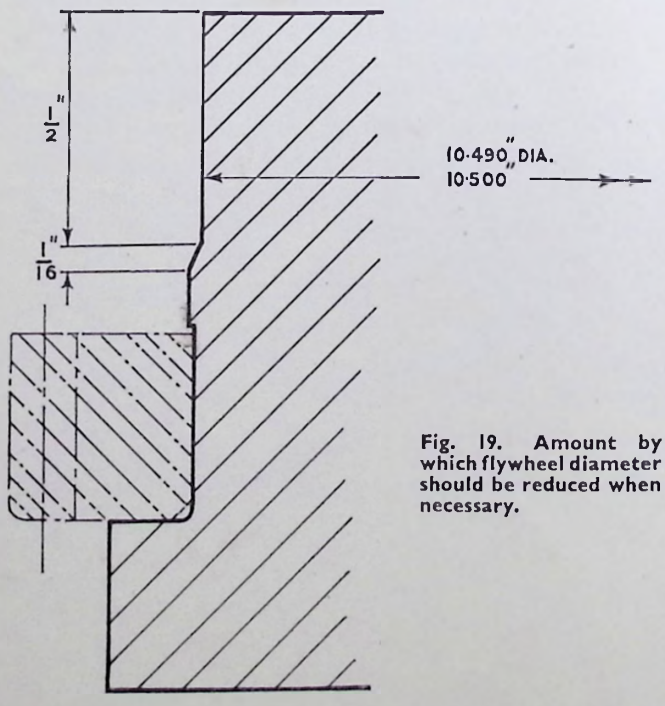


Fig. 19. Amount by which flywheel diameter should be reduced when necessary.

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

(6) Remove the cotter securing the indicator rod to the floating filter, unscrew the button on the top end of the rod and withdraw the rod downwards out of position.

(7) Remove the cotter securing the floating filter to the oil pump and detach the filter from the pump.

(8) 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 with the cotter securing the floating filter in position, the filter is free to move up and down under its own weight ; to use a new sump gasket ; that all bolts and nuts are securely tightened ; that the sump is filled to the correct level with one of the recommended oils.
To remove the basket type of filter, bend back the tabs securing the basket to the cover plate and withdraw.

SERVICE BZ22.
TO REMOVE AND REPLACE THE OIL PUMP WITH TIMING CHAINS IN POSITION.

(1) Drain and remove the engine sump, *see Page BZ22.*

(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 reversal 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 on 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 BZ16.*

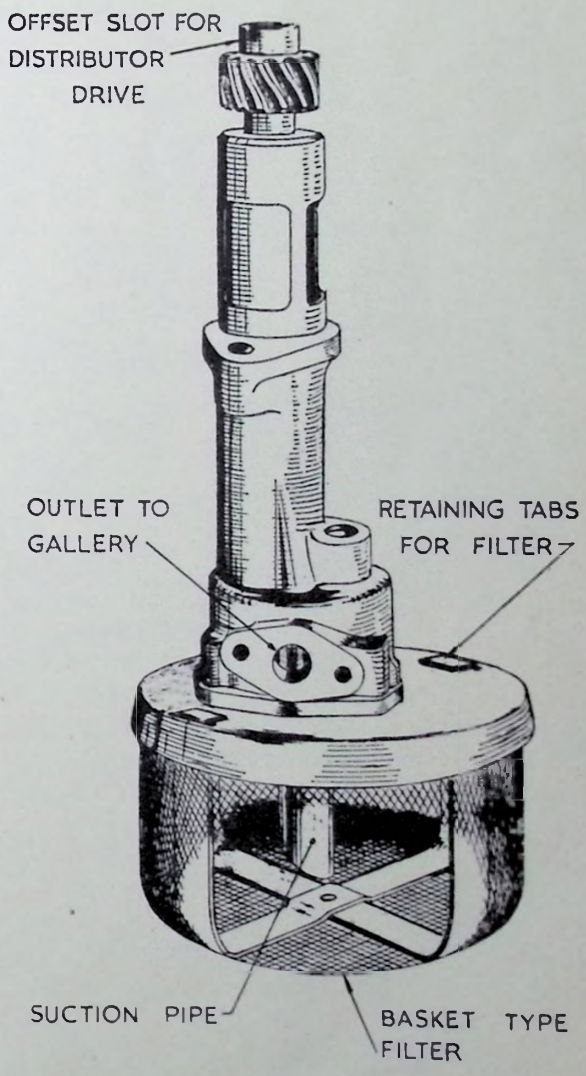


Fig. 20. Oil Pump with Basket type of Filter.

SERVICE BZ23.
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 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 ends 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 varies from .0023" to .0043" (.0584 mm. to .1092 mm.) and for the latter from .00035" to .0016" (.0089 mm. to .0406 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 which is done as follows.

Remove the large self-locking nut in the centre of the pump cover, and the four—also self-locking nuts—securing the cover to the body. Note the distance piece under the large nut. The cover can now be removed.

On pumps fitted with the basket type of filter, first remove the filter by bending back the tabs securing it to the cover plate.

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, *see Technical Data*, and there are signs of wear on the spindle, 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 .0043" 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 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 .0023" to .0043" (.0584 mm. to .1092 mm.)—between the gear faces and cover.

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

But 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.

SERVICE. BZ.24.
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 CZ8*. As to the oil level, this can be checked by means of the visible oil indicator, or 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. 21, Page BZ25) 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.

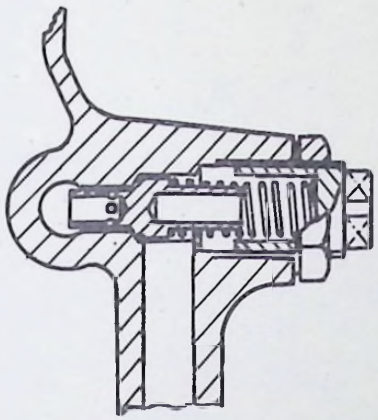


Fig. 21. Sectional View of Oil Pressure Release Valve.

(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 *Pages BZ22* 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 BZ24*. 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.

(7) The clearances between the big end bearings and their journals may be in excess of standard .0005" to .002" and quantities of oil larger than normal are escaping and being flung into the cylinder walls. Under such circumstances no matter how true the bores may be, or the piston rings never so efficient, they would be unable to control the oil which would pass them in quantities above normal and be burnt. If replacing the big end bearings alone does not provide a solution, the engine should receive a general overhaul.

SERVICE BZ25.
TO REMOVE AND REPLACE A PISTON AND ROD ASSEMBLY.

(1) Drain and remove the engine sump. *See Page BZ22.*

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

(3) Open the bonnet and remove the cylinder head. *See Page BZ7.*

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

(5) Remove the self-locking nuts 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 in the piston, and with a helper supporting the connecting rod, drive out the gudgeon. 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, and should, on dismantling, be marked suitably. These precautions are necessary to assist correct assembly.

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

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 purpose, 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 truth, it should be checked in an aligning fixture similar to those shown *in sketches* 22 *and* 23 and if necessary reset.

For the connecting rods to be assembled correctly in the bore the figure 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 self-locking nuts on the connecting rod bolts.

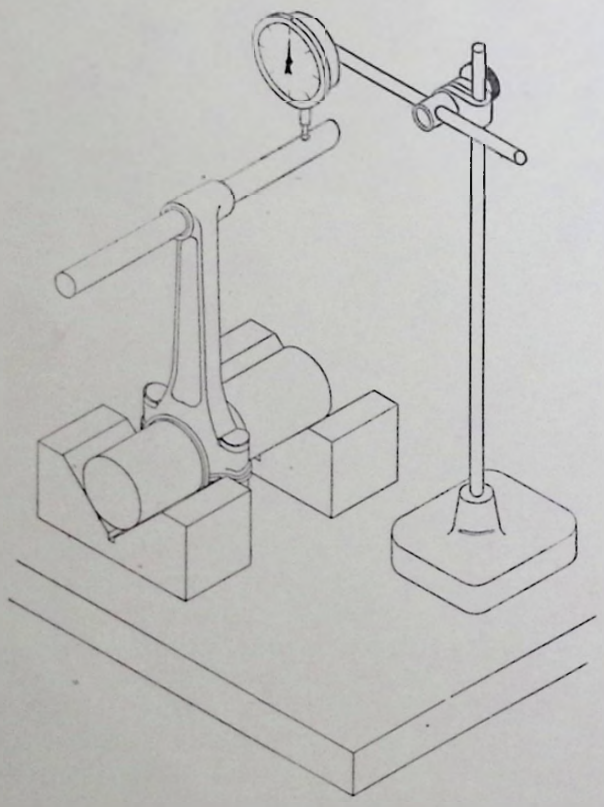


Fig. 22. Aligning Connecting Rod. The height of the small mandril above the surface plate must be the same on either side of the small end. Adjust by setting shank of rod to the right or left as necessary.

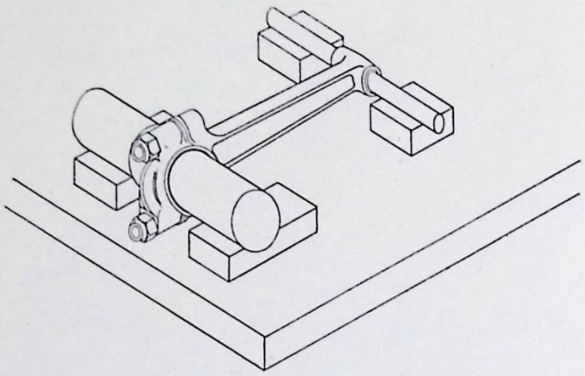


Fig. 23. Aligning Connecting Rod. Mandrils must contact all four blocks at the same time. Adjust by twisting the shank of the rod as necessary.

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″ to .0015″ 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.

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 self-locking nuts used to secure the caps.

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" (.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, 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 warm oil.

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 in the upper scraper ring groove 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" thick and $\frac{3}{8}$" 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" to .013" (.203 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, maintain 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 self-locking nuts on the big end bolts.

SERVICE BZ26.
A.C. 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 (16,093 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* BZ28 will give a clear idea of the passage of oil through the engine and filter.

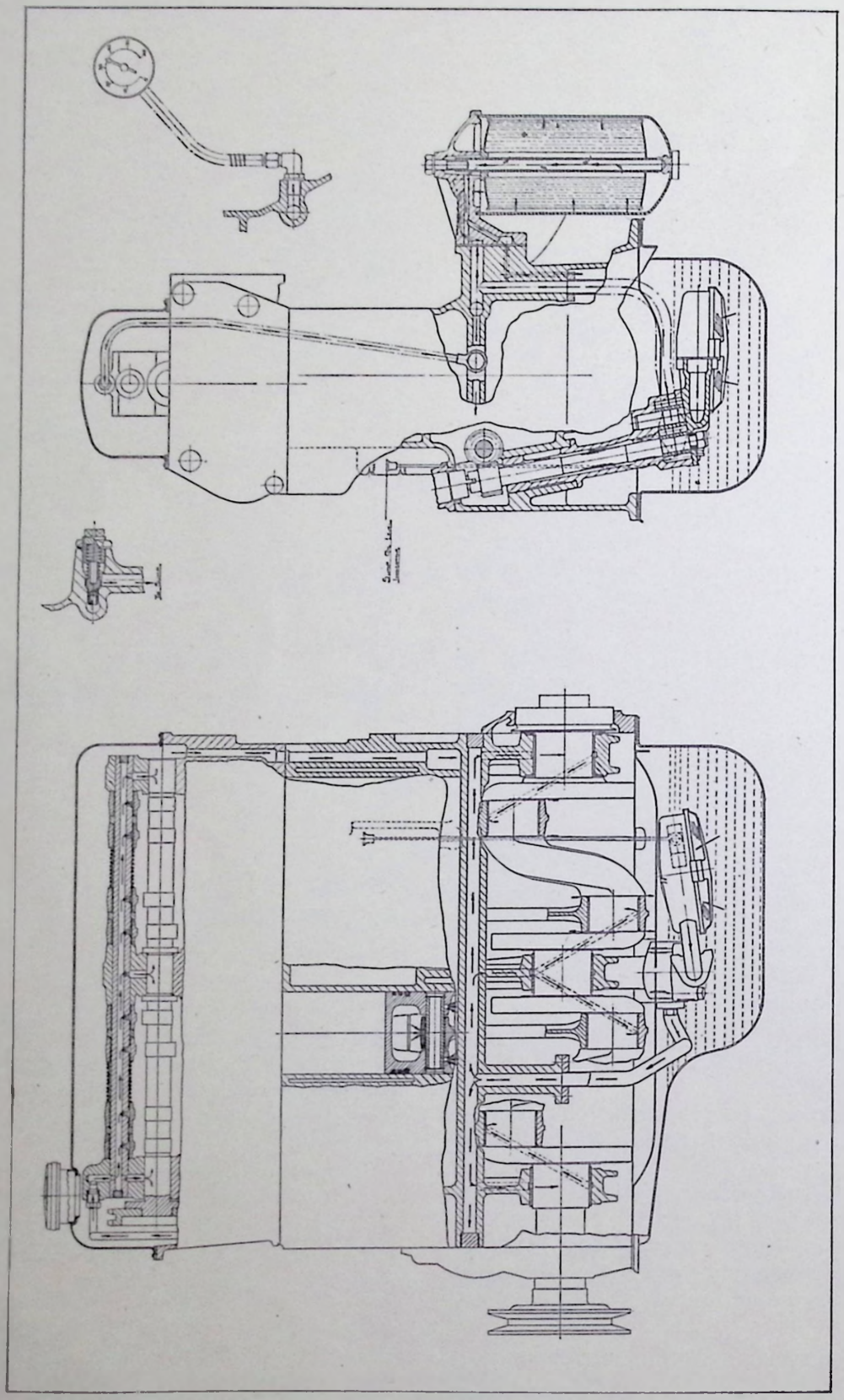


Fig. 24. Engine Oil Circulation Diagram.

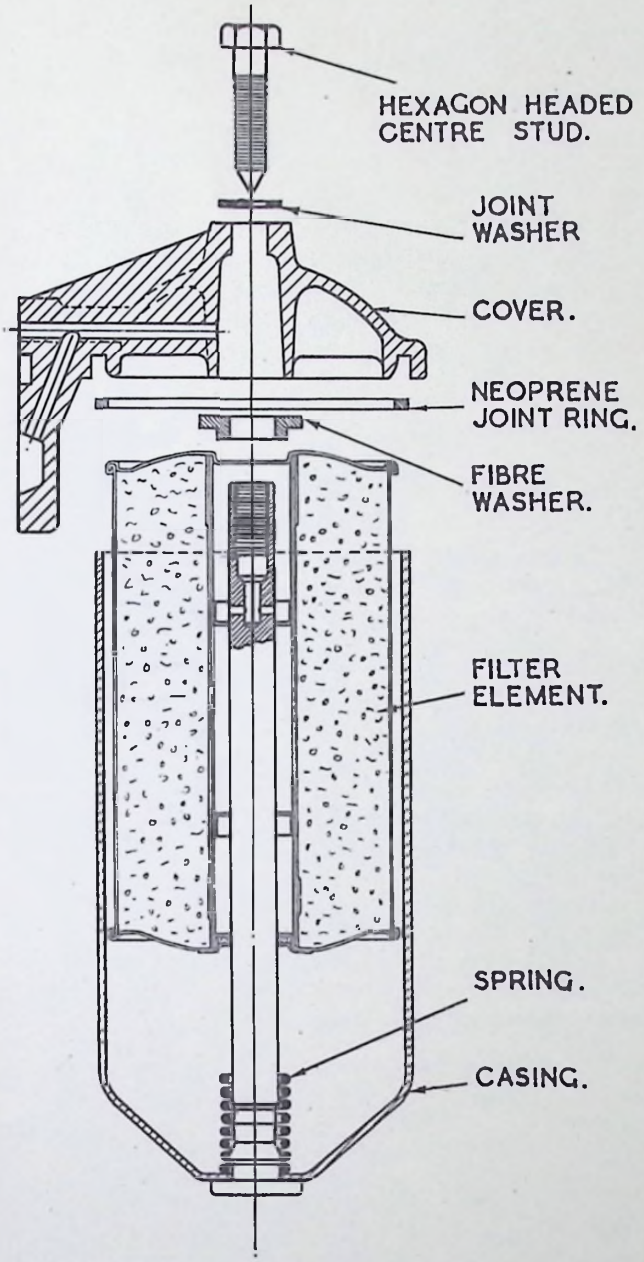


Fig. 25. Section through A.C. Oil Filter.

SERVICE BZ27.
TO CHANGE THE ELEMENT.

Remove completely the hexagon-headed stud in the aluminium support bracket, when the filter casing complete with element will come away.

The element can now be lifted out and should be discarded, the casing cleaned and care taken to ensure that all traces of paraffin or any other solvent used, are removed, the new element inserted and the small fibre washer, supplied with each genuine A.C. replacement element, fitted around the centre tube and on top of the element. The new neoprene joint, supplied with the new element, should replace the old joint in the groove on the under face of the aluminium support bracket. The casing can now be placed in position and the hexagon headed centre stud, with its joint washer replaced and tightened.

As a precautionary measure, the engine should then be run to make sure that there is no oil leakage, and since the filter casing holds an appreciable amount of oil, the level should be checked by the indicator rod or dipstick, and, if necessary, the required quantity of oil added.

The type of filter element is the A.C. M.11.

SERVICE BZ28.
REMOVAL AND REPLACEMENT OF THE OIL FILTER.

Remove the two bolts securing the aluminium support bracket to the crankcase, when the filter will come away as a complete unit. If the casing is removed while the unit is detached from the engine, remember to replace the securing bolts into position, before replacing the bowl.

On later productions the two plain washers under the heads of the securing bolts have been replaced by a lockplate, Service Part No. C10028. If the lockplate is not available, two shakeproof washers should be used in addition to the plain washers.

SERVICE BZ29.
TO REMOVE AND REPLACE THE POWER UNIT AS A COMPLETE ASSEMBLY.

(1) Remove the bonnet. *See Page KZ4.*

(2) Drain the cooling system. *See Page EZ1.*

(3) Disconnect the positive lead of the battery.

(4) Remove the radiator. *See Page EZ3.*

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

(6) Disconnect the choke and throttle controls.

Note throttle control spring attached to anchorage on carburetter flange.

(7) Remove air cleaner and carburetter.

(8) Uncouple the exhaust pipe from the exhaust manifold.
Note the three brass nuts and copper and asbestos joint washer.

(9) Disconnect the carburetter drain pipe.

(10) Remove the two nuts securing the engine steady 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 pump housing to the support.

(14) Detach the gearbox from the chassis and propeller shaft by carrying out *Operations 1—11 on Page BU3.*

(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 controls, *see Page BU4.*

SERVICE BZ30.
TO REMOVE AND REPLACE THE GEARBOX WITH THE POWER UNIT OUT OF THE CHASSIS.

Division between Gearbox and Clutch Housing, Method "A".

(1) Sling the gearbox suitably and independently of the engine.

(2) Remove the nuts securing the box to the clutch housing and withdraw the box backwards taking care to keep it in line with the engine until the front end of the constant mesh gear shaft is clear of the clutch housing.

Replacement is the reversal of the foregoing, but before offering up the box into position, check that the joint faces are clean, and that the carbon ring of the thrust bearing is facing towards the engine.

Engage top gear so that the constant mesh shaft can be rotated to assist the meshing of the splines of the shaft and clutch plate. Keep the gearbox in line with the engine and supported until the securing bolts have been tightened, and to avoid distortion and fracture of the clutch housing, the tightening should be done progressively and half a turn at a time until the joint faces are in contact at all points.

Division between Clutch Housing and Engine, Method "B".

(1) Sling the gearbox suitably and independently of the engine.

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

(3) Remove the self-starter. *See Page BW2, Section BW.*

(4) Remove the bolts securing the clutch housing to the crankcase and withdraw the box backward away from the engine. When doing so keep the gearbox in line with the engine until the constant mesh shaft has cleared the clutch.

Replacement is the reversal of the foregoing, but before offering the gearbox into position, make sure that the joint faces are clean, and to engage top gear so that the constant mesh shaft can be rotated to mesh with the splines of the shaft and clutch plate. Keep the gearbox in line with the engine and supported until the securing bolts have been tightened. To avoid distortion and fracture, the tightening should be done progressively, and half a turn at a time until the joint faces are in contact at all points.

SERVICE BZ31.
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 re-assembling recondition individual assemblies where possible.

(1) Remove the power unit. *See Page BZ29.*

(2) Detach the self starter. *See Page BW2, Section BW.*

(3) Detach the gearbox from the engine. *See Page BZ30, Method "B."*

(4) Remove the clutch assembly. *See Page Page BZ21.*

(5) Remove the flywheel, *see Page BZ21,* 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 re-assembling check that the bore is true, the threads undamaged, and that with the cover in position there is, approximately, a clearance of .002" (.05 mm.) to .004" (.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 BZ2l, Service BZ20.*

(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 re-assembling, 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 square inch on the gauge, when the car is travelling at 30/35 miles per hour 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 BZ29.*

(8) Remove the oil gauge pipe elbow.

(9) Detach the dynamo and bracket. *See Page BX3, Section BX.*

(10) Remove the coil.

(11) Remove the distributor. *See Page BY6.*

(12) Remove the cylinder block drain plug.

(13) Detach the water pump, *see Page EZ3, Group E,* and also the water pump housing secured to the block by five nuts and stud. Note the gasket between the joint faces.

(14) Remove the primary and secondary chains. *See Page BZ21.* 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 retaining threads on the crankshaft. The clearance at the front is .006" to .012".

(15) Withdraw the intermediate shaft. *See Page BZ20.*

(16) Remove the cylinder head. *See Page BZ7.*

(17) Strip and re-assemble as described *on Page BZ29.* 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 re-assembling.

(18) Remove the sump. *See Page BZ22.*

(19) Remove the oil pump. *See Page BZ23.* Examine and recondition as described *on Page BZ24.*

(20) Withdraw the piston assemblies. *See Page BZ25.*

(21) Remove the self-locking nuts securing the main bearing caps and before detaching the caps mark them suitably to assist correct re-assembly. 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" to .004" (.05 mm. to .1 mm.).

(22) 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" to .0025". Should clearance in excess of this be present, the bearings 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 in Group A.*

Re-assembly 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 Carburetter, Fuel Pump, Dynamo and Starter Motor. Should there be any doubt about the methods which should be adopted, the manufacturers concerned should be approached.

GROUP B

POWER UNIT SERVICES

IGNITION

Distributor.

Description. The distributor is a Lucas Model DKY4A, Service No. 40167A or B. These identification marks are stamped on the side of the distributor, and when ordering replacements quote these numbers.

The distributor is fitted with an automatic advance and retard mechanism, the centrifugal weights of which are situated in the base. They are controlled by springs specially designed to give the correct ignition advance for all conditions of engine speed and load, and under no circumstances must the tension of these springs be altered, for to do so would destroy the rate of advance which has been accurately selected. Should the conditions of these springs be suspect, genuine replacements from the Factory or Messrs. J. Lucas should be obtained against the type number of the distributor.

The standard ignition setting is the points of the distributor must just be parting when the marks 1/4 on the rim of the flywheel are 4°—5° before top centre, that is, an arc approximately $\frac{3}{8}$" to $\frac{15}{32}$" (9.525 mm. to 11.9 mm.) long. The check or any subsequent adjustment must not be made without first setting the gaps between the distributor points to .012" (.3 mm.) when in their maximum open positions.

SERVICE BY1.

To Check and Set Distributor Points.

(1) Remove the moulded distributor cap and turn the engine over by hand until the contacts in the distributor head are fully separated.

(2) Check the gap with the gauge on the screwdriver supplied with the tool kit. If the gauge, which is .012" (.3 mm.) thick, is a sliding fit between the contacts, the setting is correct. If the gauge is not a sliding fit set the gap as follows:— Keep the engine in the position for maximum gap opening of the contacts. Slacken the two screws which secure the plate carrying the fixed contact, *see Fig. 1.* Then move the plate until the gap is set to a dimension where the gauge will just slide through. Tighten the screws and re-check.

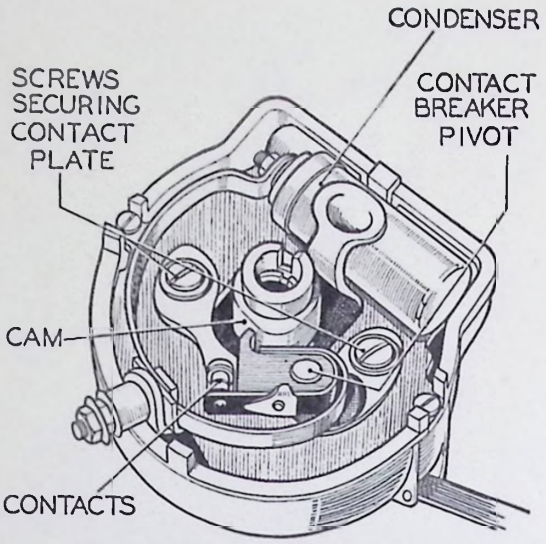


Fig. 1. Contact Breaker Adjustment.

SERVICE BY2.

FIRST 500 MILES (805 Kms.).

During the running in period of a new car most of the "bedding down" of the contact breaker heel occurs and there is a tendency for the size of the gaps to reduce. Check, and if necessary, reset the gaps to .012" (.3 mm.) at the end of the first 500 miles (805 Kms.). *See Service BY1.*

If the use of fuels of different Octane values, or local conditions suggest an alteration from normal standard ignition setting, the initial point of ignition can be varied slightly in the following manner. Release the nuts securing the distributor clamp to the adapter and advance or retard, by turning the distributor as necessary, one division on the scale at a time. Tighten the nuts and check the effect before making any further alterations.

SERVICE BY3.

LUBRICATION.

For mileages and times see Summary of Regular Attentions. See Page CZ9.

(1) **Distributor shaft.**

Some distributors are provided with a lubricator on the distributor shank; add a few drops of thin machine oil.

(2) **Cam.**
Lightly smear the cam with a very small amount of Mobilgrease No. 2 or, if this is not available, clean engine oil may be used.

(3) **Cam Bearing.**
Lift the rotor off the top of the spindle by pulling it vertically upwards and add a few drops of thin machine oil. Replace the rotor correctly and push it on to the shaft as far as it will go, otherwise there is a risk of the moulded cap becoming burned or tracked.

(4) **Automatic Timing Control.**
Add a few drops of thin machine oil through the hole in the contact breaker base through which the cam passes. Do not allow any oil to get on or near the contacts.

(5) **Contact Breaker Pivot.**
Place a small amount of Mobilgrease No. 2 or clean engine oil on the pivot on which the contact breaker lever works, *see Fig.* 1. Do not allow oil or grease to get on or near the contacts.

SERVICE BY4.
CLEANING — every 5,000 miles (8047 Kms.).

Wipe the inside and outside of the moulded distributor cap with a soft dry cloth, paying particular attention to the spaces between the terminals. See that the small carbon brush on the inside of the moulding works freely in its holder.

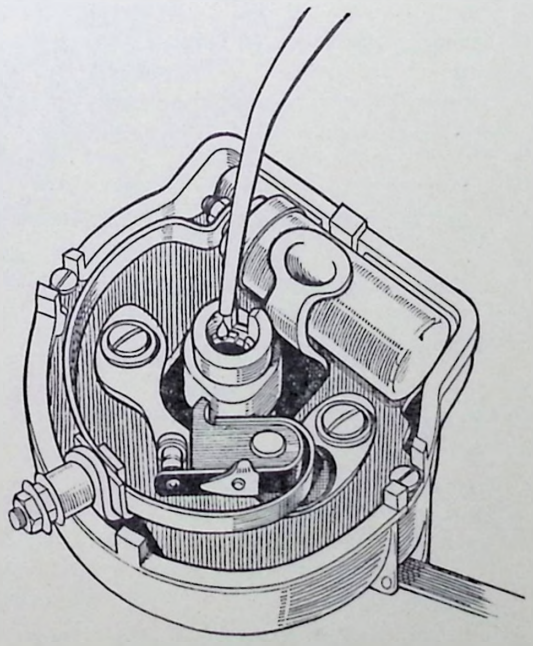


Fig. 2. Lubricating Cam Bearing.

Next examine the contact breaker. The contacts must be free from grease or oil. If they are burned or blackened, clean them with a fine carborundum stone or very fine emery cloth. Afterwards wipe away any trace of dirt or metal dust with a petrol moistened cloth. Cleaning the contact is made easier if the contact breaker lever carrying the moving contact is removed. To do so slacken the nut on the terminal post and lift off the end of the spring which is slotted to facilitate removal. Then lift the contact breaker lever off its pivot pin. Clean as shown *in Fig.* 8, *Page BY6* and after cleaning check the contact breaker setting. *See Service BY1.*

SERVICE BY5.
TESTING IN POSITION TO LOCATE CAUSE OF UNEVEN FIRING.

(1) Start the engine and set it to run at a fairly fast idling speed.

(2) Short circuit each plug in turn by placing a hammer head or blade of a wooden handled screwdriver between the terminal and the cylinder head. No difference in the engine speed will be noted when short circuiting the plug in the defective cylinder. Shorting the other plugs will make uneven running more pronounced.

(3) Having located the cylinder which is at fault, stop the engine and remove the cable from the terminal of the sparking plug. Restart the engine and hold the end of the cable about $\frac{3}{16}$" from the cylinder head.

(4) If the sparking is strong and regular, the fault probably lies in the sparking plug. Remove the plug, clean and adjust the gap to the correct setting or alternatively fit a replacement plug. *See Page BY5.*

(5) If there is no spark or if it is weak and irregular, examine the cable from the sparking plug to the distributor. After a prolonged period of service the rubber insulation may be cracked or perished.

The cable should be renewed. Finally, examine the distributor moulded cap, wipe the inside and outside with a clean dry cloth, see that the carbon brush moves freely in its holder and examine the moulding closely for sign of breakdown. After long service, it may be tracked, that is a conducting path may have formed between two or more of the electrodes or between one of the electrodes and some part of the distributor in contact with the cap. Evidence of a tracked cap is shown by the presence of a thin black line in the places indicated. A replacement distributor cap must be fitted in place of one that has tracked.

SERVICE BY6.
TESTING IN POSITION.
LOW TENSION CIRCUIT.

(1) Spring back the securing clips on the distributor and remove the moulded cap and rotor. If the rotor is a tight fit, it can with care be levered off with a screwdriver.

(2) Check that the contacts are clean and free from pits, burns, oil and grease. Turn the engine and check that the contacts are opening and closing correctly and that the clearance, when the contacts are fully opened, is .012″ (.3 mm). Correct as necessary.

(3) Disconnect the cable at the C.B. terminal of the coil and at the low tension terminal of the distributor and connect a test lamp between these terminals. If the lamp lights when the contacts close and goes out when the contacts open, the low tension circuit is in order.

SERVICE BY7.
LOW TENSION CIRCUIT.
TO LOCATE FAULT.

(1) Should the test show that the fault lies in the low tension circuit, switch on the ignition and turn the engine until the contact breaker points are fully opened.

(2) Refer to the wiring diagram *on Page JY9* and check the circuit with a voltmeter—O—20 volts—as follows :

NOTE : If the circuit is in order, the reading on the voltmeter should be approximately 12 volts.

(3) Battery to Terminal Block (Brown Cable). Connect voltmeter to terminal block and earth. No reading indicates damaged cable or loose connections.

(4) Terminal Block to Ammeter (Brown Cable). Connect voltmeter to Ammeter and earth. No reading indicates faulty cable or loose connections.

(5) Ammeter. Connect Voltmeter to remaining terminal on Ammeter and earth. No reading indicates fault in Ammeter which must be replaced.

(6) Ammeter to Terminal Block (Brown with White). Connect voltmeter to terminal block and earth. No reading indicates faulty cable or loose connections.

(7) Terminal block to Control Box terminal "A". Connect voltmeter to Control Box terminal "A" and earth. No reading indicates faulty cable or loose connections.

(8) Connect voltmeter to control box terminal "A1" and earth. No reading indicates a broken connection in series winding of the control box.

(9) Control box terminal "A1" and lighting switch terminal "A". Brown with Blue lead. Connect voltmeter to lighting switch terminal "A" and earth. No reading indicates damaged cable or loose connections.

(10) Lighting Switch terminal "A" to terminal on Ignition Switch Brown with Blue lead. Connect voltmeter to terminal on Ignition Switch and earth. No reading indicates damaged cable or loose connections.

(11) Ignition Switch. Connect voltmeter to other terminal of Ignition Switch and earth. No reading indicates fault in ignition switch.

(12) Ignition Switch to Control Box terminal "A3" White lead. Connect voltmeter to control box terminals "A3" and earth. No reading indicates damaged cable or loose connections.

(13) Control Box terminal "A3" to Ignition Coil terminal "SW" White lead. Connect voltmeter to ignition coil terminal "SW" and earth. No reading indicates damaged cable or loose connections.

(14) Ignition Coil. Disconnect the cable from the "CB" terminal of the ignition coil and connect the voltmeter to this terminal and earth. No reading indicates fault in primary winding of the coil and a replacement coil must be fitted. If the correct reading is given remake the connections to the coil terminal.

(15) Ignition Coil to Distributor, White with black lead. Disconnect the cable from the low tension terminal on the distributor and connect the voltmeter to the end of this cable and earth. No reading indicates damaged cable or loose connections.

(16) Contact Breaker and Condenser. Connect the voltmeter across the contact breaker points. No reading indicates fault in the condenser.

SERVICE BY8.
HIGH TENSION CABLES.

(1) The high tension cables must be carefully examined and any which have their insulation cracked, perished or damaged in any way, must be replaced by 7 mm. rubber covered ignition cable.

(2) To fit the cables to the Distributor and to the high tension terminal of the ignition coil proceed as follows : Thread the knurled moulded terminal unit over the lead, bare the end of the cable for about $\frac{1}{4}$", thread the wire through the brass washer removed from the original cable and bend back the strands. Finally screw the nut into the distributor cap. *See Fig.* 3. The cables from the distributor to the sparking plugs must be connected up in the correct firing order, which is as follows : 1, 3, 4, 2, No. 1 plug being nearest the radiator and counting on top of the cap in the direction in which the rotor revolves.

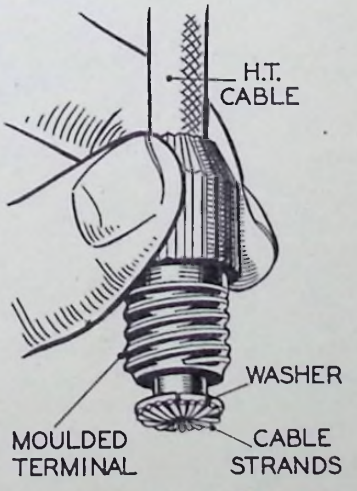


Fig. 3. Connecting H.T. Cable.

Fig. 4. Oily, dirty, worn-out plug.

Fig. 5. New, clean, efficient plug.

SERVICE BY9.
SPARKING PLUGS—Champion N.8.

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.

Normally, the service should be carried out every 5,000 miles (8,047 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 (1,609 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 circumstance 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 Fig.* 7. 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 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.

SERVICE BY10.
CONTACT BREAKER MECHANISM.

(1) Turn the engine until the contact breaker points are fully opened, and check the gap with a gauge having a thickness of .012" (.3 mm.). If the gap is correct, the gauge should be a sliding fit. Do not alter the setting unless the gap varies considerably from the gauge.
To adjust the setting, keep the engine in the position to give maximum opening of the contacts and then slacken the two screws securing the fixed contact plate. *See Fig.* 1, *Page* BY2. Adjust the position of the plate until the gap is set to the thickness of the gauge and then tighten the two locking screws.

Fig. 6. Type N.8.

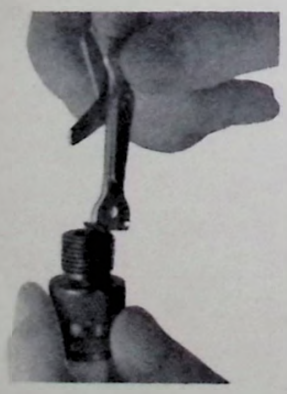


Fig. 7. Setting the Gap between the Sparking Plug Electrode.

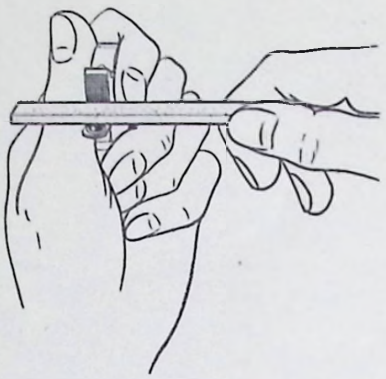


Fig. 8. Cleaning contacts with moving contact removed.

(2) If the contacts are dirty or pitted, they must be cleaned by polishing with a fine carborundum stone, *see Fig.* 8, and then wiped with a petrol moistened cloth. The moving contact can be removed from its mounting in order to assist cleaning.
Check and adjust the contact breaker setting after cleaning the contacts.

(3) Check that the moving arm oscillates freely on its pivot. *See Fig.* 1, *Page* BY2. If it is sluggish, remove the moving arm and polish the pivot pin with a strip of fine emery cloth. Afterwards apply a spot of clean engine oil to the top of the pivot pin.

SERVICE BY11.
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 5° before top dead centre — $\frac{15}{32}$" (11.9 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 out of position. If possible avoid turning the engine until the distributor is replaced, but owing to the spade drive being offset no difficulty should be experienced when replacing the

distributor, always provided the oil pump and/or camshaft and the chain have not been removed from the engine.

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 5° before top centre or approximately $\frac{15}{32}$" (11.9 mm.) 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.* 9. From this point replacement is the reversal of the dismantling.

To Check the Ignition Timing.

See Pages BZ15 and BZ16.

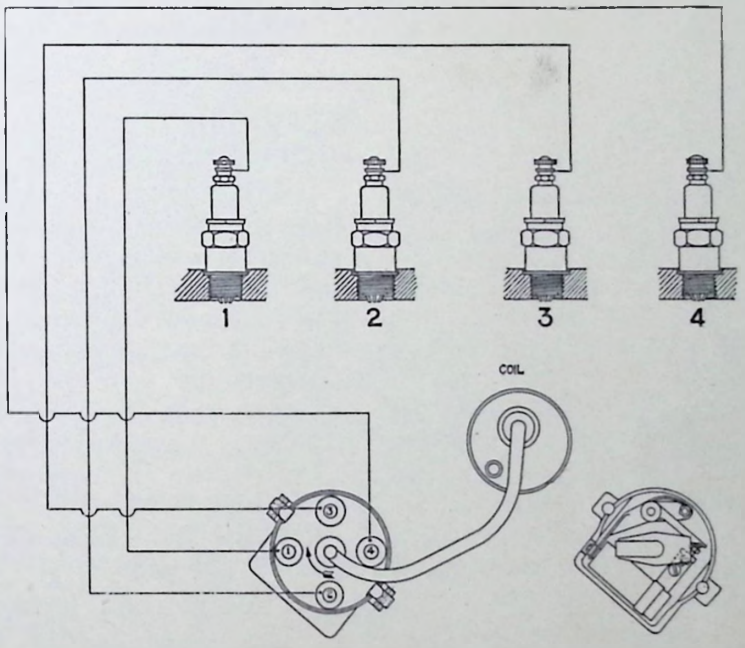


Fig. 9. Diagram showing connections between Distributor and Sparking Plugs. Arrow on Distributor indicates direction of rotor when viewed from the drive end.

SERVICE BY12.
TO DISMANTLE DISTRIBUTOR.

While dismantling note the positions in which the various components are fitted so that they can be replaced correctly.

(1) Spring back the securing clips and remove the moulded cap.

(2) Lift the rotor off the top of the spindle, if it is a tight fit, it should with care be levered off with a screwdriver.

(3) Slacken the nut on the terminal post and lift off the end of the contact breaker spring which is slotted to facilitate removal. Lift the contact breaker lever off its pivot pin.

Note *the fibre washer between the rocker arm and fixed contact point plate.*

Take out the two screws complete with spring washers and the flat steel washers from the plate carrying the fixed contact and remove plate.

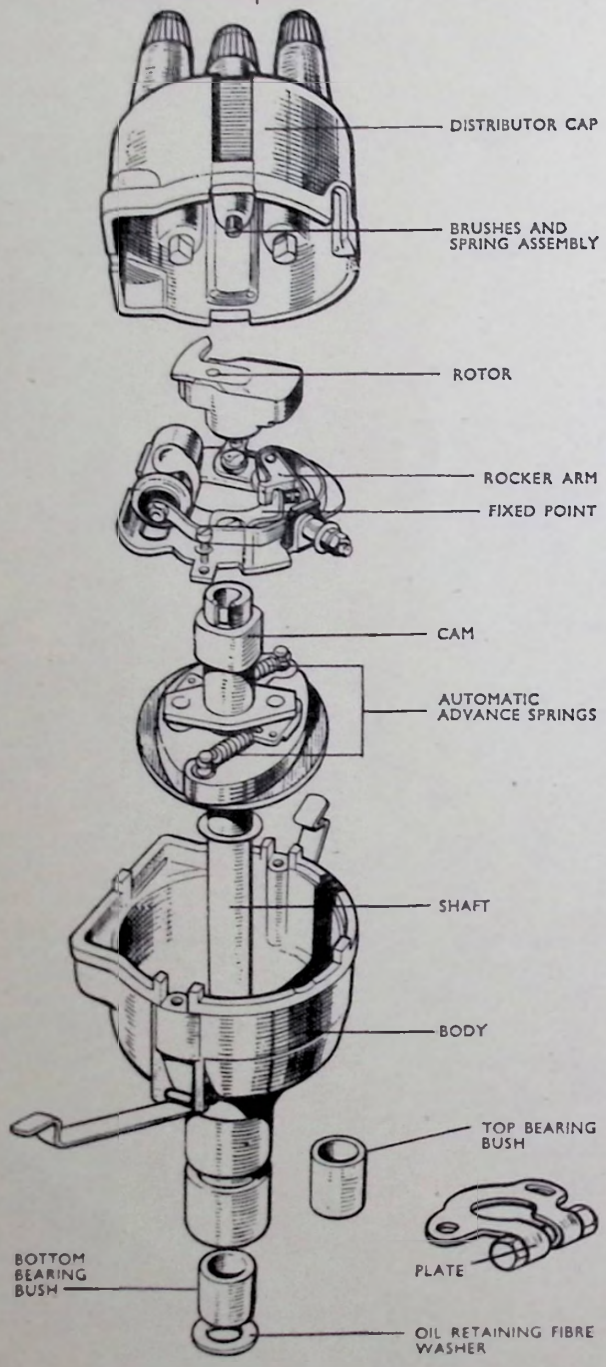


Fig. 10. Exploded View of Distributor.

(4) Undo the two screws fitted at the edge of the contact breaker base and lift them out together with the spring washers. The contact breaker base can then be removed from the body of the distributor.

(5) Unscrew the condenser terminal nut, lift off the spring washer and remove the connector strip. If condenser renewal is contemplated, soften with a hot iron the solder securing the condenser in its clip and remove the condenser by applying pressure at one end. *See Service BY13*

(6) Remove the driving dog from the shaft by driving out the peg and drawing off the dog. Note the fibre washer between the dog and distributor body.

(7) Lift the cam, automatic timing control and shaft assembly from the inside of the top of the cam spindle and lift the cam off. The automatic timing control is then accessible.

SERVICE BY13. CONDENSER.

The best method of testing a condenser is by substitution. Disconnect the original condenser and connect a new one between the LT terminals of the distributor and earth. Should a new condenser be necessary fit a complete condenser and contact breaker assembly, but should a condenser only be available take care not to overheat the condenser when soldering in position.

SERVICE BY14. PROCEDURE FOR THE REPLACEMENT OF BEARING BUSHES.

(1) To ensure easy running of the distributor shaft when the shank has been rebushed, the new bushes must be fitted in correct alignment by means of a vertical drilling machine or hand press.

(2) Fit a mandrel in the drilling machine or hand press and place the distributor body in an inverted position on the table below it.

(3) To remove the bushes, a sleeve must be fitted over the mandrel to build it up to the required size. With this sleeve fitted in position, force the old bushes out of the shank by applying a steady pressure. Before new bushes are fitted allow them to stand for 24 hours immersed in thin engine oil.

(4) Take the sleeve off the mandrel. Place one of the longer bushes on the mandrel, then the distributor body in an inverted position and finally one of the smaller bushes.

(5) Locate the end of the mandrel through the packing piece and press the mandrel downwards taking care that both bushes enter the distributor shank square. Continue forcing the bushes into the shank until the mandrel reaches the end of its travel.

(6) After fitting, the bushes must not be reamed or opened out by any other means as any such action tends to impair the porosity of the bushes, and so prevent effective lubrication.

SERVICE BY15. TO ASSEMBLY DISTRIBUTOR.

Before re-assembling, the automatic advance mechanism, distributor shaft, and the portion of the shaft on which the cam fits, must be lubricated with thin clean engine oil.

(1) Assemble the automatic timing control, taking care that the parts are fitted in their original positions and that the control spring are not stretched. If in doubt about the condition of the spring obtain and fit genuine Lucas replacements Service No. 407267/S. Two holes are provided in each toggle ; the springs must be fitted to the inner hole in each case. Place the cam on its spindle and secure by tightening the locking screw.

(2) Fit the shaft in its bearings, replace the fibre washer, driving dog, and secure with the peg.

(3) Place the contact breaker base in position on the distributor body and secure by replacing the two screws.
A spring washer must be fitted under each of the screw heads, and the screws fully tightened.

(4) Place the end of the connector strip over the condenser terminal post, refit the spring washer and secure by tightening the terminal nut.

(5) Position the plate carrying the fixed contact on the contact breaker base and secure it by replacing and lightly tightening the two screws, but first place a spring washer and flat steel washer under the heads of each of the screws. Place the insulating washer over the contact breaker pivot pin and position the contact breaker lever on the pin. Locate the slotted end of the contact breaker spring under the head of the terminal screw and tighten the nut to lock the spring in position. Adjust the contact breaker setting to give a gap of .012" (.305 mm.) when the contacts are fully opened. *See Service BY1.*
Note. *If it is necessary to renew the contacts, a replacement set comprising fixed and moving contacts must be fitted and should be checked after* 500 *miles. See Service BY2.*

(6) Place the rotor on the top of the spindle, locate the register correctly and push it fully home.

(7) Fit the distributor moulding and secure by means of the spring clips.

Ignition Coil.
Description.

The coil is a Lucas Model Q.12 Service No. 45020A. 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.

SERVICE BY16. 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 can now be detached on the two nuts and shakeproof washers securing it to the crankcase being removed.

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 give 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 carburetter, petrol supply etc. *See Group D on Fuel.*

(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 .012" (.3 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, *see Page BY5* 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 carburetter, petrol supply, etc., must be examined. *See Group D.*

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 Group D.*

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 condensor 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 carburetter 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.

GROUP B

POWER UNIT SERVICES

DYNAMO

DYNAMO.

Description, General.

The dynamo is a shunt-wound two-pole two-brush machine, Model C.39PV, arranged to work in conjunction with a compensated voltage control regulator unit, *see Section JX*. On later productions a Model No. C39PV-2 is used. A fan, integral with the driving pulley, draws cooling air through the generator, 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 output to keep the battery in good condition without any possibility of overcharging. In addition, 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 up, thus quickly restoring to the battery the energy taken from it by the electric starting motor.

Routine Maintenance.

(a) Lubrication.

Every 12,000 miles (19,312 kms.) unscrew the cap of the lubricator fitted on the commutator end bracket, lift out the felt pad and spring and about half-fill the lubricator with high melting point grease (H.M.P. Grease). Replace the spring and felt pad and screw the lubricator cap back into position.

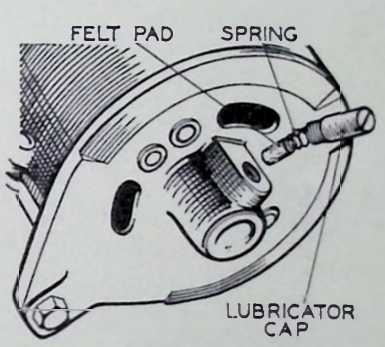


Fig. 1. Dynamo Lubricator.

(b) Inspection of Brushgear and Commutator.

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 so that they will not "bed" properly on the commutator must be renewed.

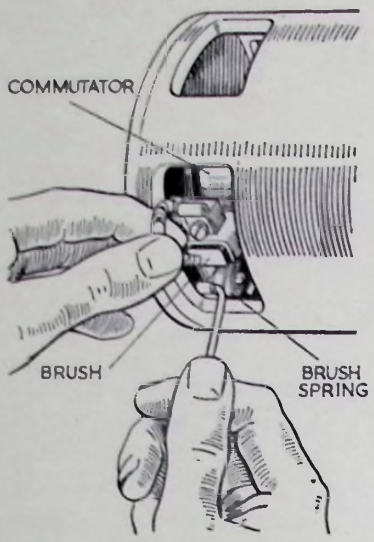


Fig. 2. Checking Brushes.

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.

SERVICE BX1. BELT TENSION.

Occasionally inspect the driving belt and adjust, if necessary. Care should be taken to avoid overtightening the belt which should have sufficient tension to drive without slipping. See that the dynamo is properly aligned, otherwise undue strain will be thrown on the bearings. *For method of adjusting see also Service BX3.*

PERFORMANCE DATA— (cold) Dynamo C39PV.

Cutting-in speed : 1050—1200 r.p.m. at 13.0 dynamo volts.

Output : 17 amps. at 1850—2100 dynamo r.p.m. at 13.5 dynamo volts, taken on 0.8 ohm resistance load without regulator.

Brush tension : 15—25 oz. Field resistance (total) : 6.2 ohms.

Dynamo C39PV-2.

Cutting-in speed: As C39PV above.

Output: 19 amps at 1850-2100 dynamo r.p.m.

Brush tension and Field resistance as for C39PV above.

SERVICE BX2. 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 Service BX3.*

(2) Check that the dynamo and control box are connected correctly, *see Fig. 2, Page JX2.* The dynamo terminal "D" must be connected to control box terminal "D" and dynamo terminal "F" to control box terminal "F".

(3) Switch off all lights and accessories, disconnect the cables from terminals of dynamo marked "D" and "F", 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 1000 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 Page BX5*). If there is a reading of 4—5 volts the armature winding may be at fault.

(7) Remove the cover band and examine the brushes and commutator. Hold back each of the brush springs and move the brush by pulling gently on its flexible connector. If the movement is sluggish, remove the brush from its holder and ease the sides by lightly polishing on a smooth file. Always replace brushes in their original positions. If the brushes are worn so that they do not bear on the commutator, or if the brush flexible is exposed on the running face, new brushes must be fitted.

Test the brush spring tension with a spring scale. The correct tension is 15—25 ozs. New springs must be fitted 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 as in *Section* 6, *Service BX*2 ; 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. *See Pages BX*4 *to* 5 for internal examination.

(8) If the dynamo is in good order, remove the link from between the terminals and restore the original connections, taking care to connect dynamo terminal "D" to control box terminal "D" and dynamo terminal "F" to control box terminal "F". Proceed to test the regulator unit as described on *Page JX*2.

SERVICE BX3.
TO REMOVE AND REPLACE THE DYNAMO, AND ADJUST 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) Bend back the tabs of the lock washers securing the two nuts of the long pivot pin and slide off the nuts.
Remove the nut and bolt securing the dynamo lug to the adjusting link. Allow the dynamo to drop down to the full extent and remove the driving belt.

(3) Remove the distributor cap and the nut nearest to the radiator on the pivot pin. Support the dynamo, drive out the pin and lift the dynamo away. The cradle can be detached from the cylinder block by removing the four set bolts and shakeproof washers securing it.

On later productions, the forward lug of the dynamo bracket pivots on one of the studs securing the water pump body to the crankcase, and the rear lug on a bolt secured to an "L" shaped bracket attached to the crankcase by two set pins and shakeproof washers. The removal of the dynamo is as above except that there is no need to remove the distributor cap.

Replacement of the dynamo on the first type of bracket is the reversal of removal, but on no account must the nuts of the long pivot pin be tightened to their full extent as any such action would tend to fracture the dynamo bracket lugs. Tighten these nuts just sufficiently to secure the dynamo and lock them by bending the tabs of the lock washers over one of their flats.

Replacement of the dynamo on the later type of bracket is also the reversal of removal. In this case the nuts of the pivots should be tightened to their full extent after the belt has been adjusted. If the "L" shaped bracket has been removed the set pins securing it to the crankcase should not be fully tightened until the belt has been adjusted and the pivot nuts securely tightened ; as to the pivot pin nuts, observe the instructions given above.

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 $\frac{1}{2}$" then tighten the adjusting link and bolt.

SERVICE BX4.
TO DISMANTLE AND REASSEMBLE.

(1) Take off the driving pulley.

(2) Remove the cover band, hold back the brush springs and remove the brushes from their holders.

(3) Remove the nut, spring washer and flat washer from the smaller terminal *i.e.*, the FIELD terminal on the commutator end bracket.

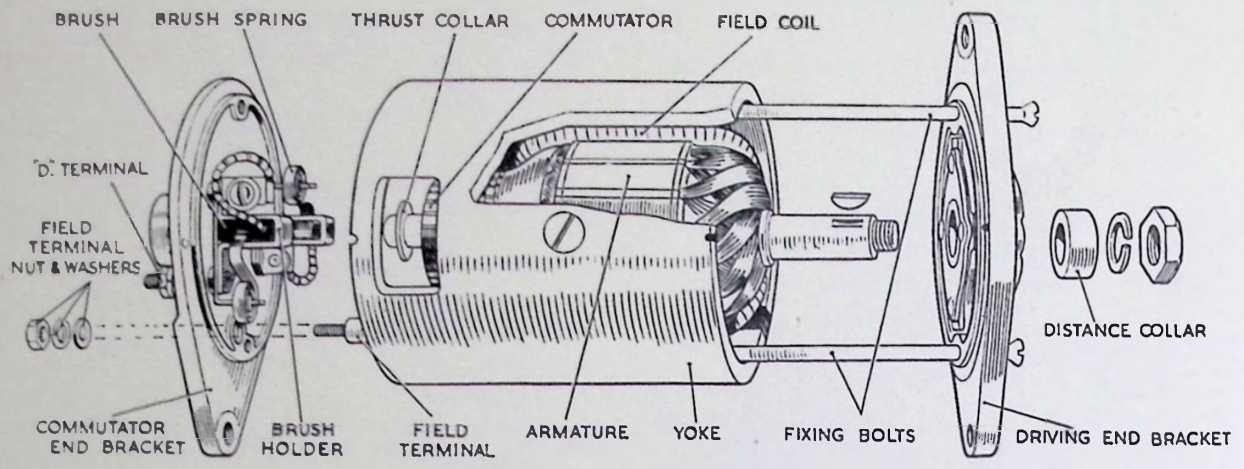


Fig. 3. Exploded View of Dynamo.

(4) On C39PV models, unscrew the locking nuts from the through bolts at the commutator end, and withdraw the two through bolts from the driving end. On C39PV-2 models, unscrew and withdraw the two through bolts from the commutator end.

(5) The commutator end bracket can now be withdrawn from the dynamo yoke.

(6) The driving end bracket together with the armature, shaft and ball bearing can now be lifted out of the yoke.

(7) The driving end bracket need not be separated from the shaft unless the bearing is suspect 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 insulation between the segments to a depth of $\frac{1}{32}$" with a hack saw blade ground down to the thickness of the insulation. *See Fig. 4.*

Armature.

The testing of the armature winding requires the use of a volt drop test and

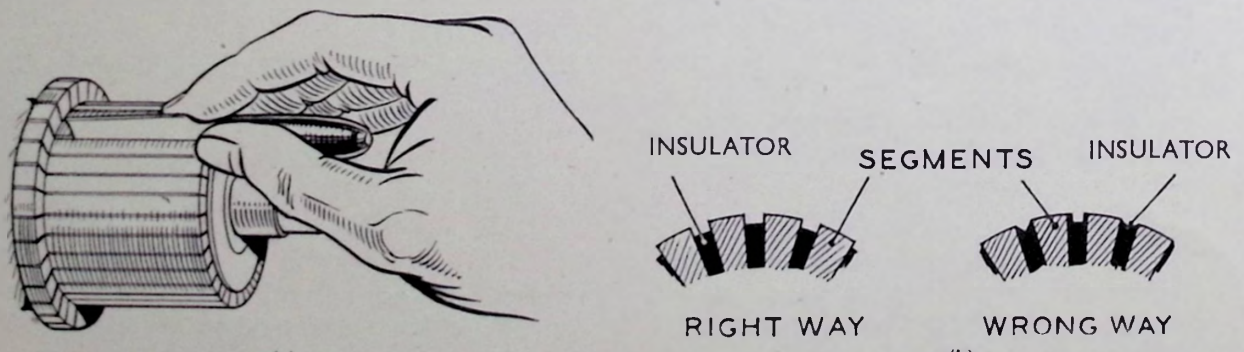


Fig. 4. Method of Undercutting Commutator Insulation.

growler. If these are not available the armature should be checked by substitution. No attempt should be made to machine the armature core or to true a distorted armature shaft.

Field Coils.

Measure the resistance of the field coils, without removing them from the generator yoke, by means of an ohm meter. The value should be 6.2 ohms (approx.)

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. No reading on the ammeter indicates an open circuit in the field winding.

To test for earthed field coils, unsolder and isolate the end of the field winding from the earth terminal on the dynamo yoke and, with a mains test lamp, check between the field terminal and yoke. If the lamp lights, the field coils are earthed. In either case, unless a replacement dynamo is available, the field coils must be replaced. To do this, carry out the procedure outlined below, using a pole shoe expander and a wheel-operated screwdriver.

(1) Remove the insulation piece which is provided to prevent the junction of the field coils from contacting with the yoke.

(2) Mark the yoke and pole shoes in order that they can be fitted in their original positions.

(3) Unscrew the two pole shoe retaining screws by means of the wheel operated screwdriver.

(4) Draw the pole shoes and coils out of the dynamo yoke and lift off the coils.

(5) 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.

(6) Locate the pole shoes and field coils by lightly tightening the fixing screw.

(7) Insert the pole shoe expander, open it to the fullest extent and tighten the screws.

(8) Finally tighten the screws by means of the wheel operated screwdriver and lock them by caulking.

(9) Replace the insulation piece between the field coil connections and the yoke.

Bearings.

The machine is fitted with a ball bearing at the driving end and a porous bronze bearing bush at the commutator end.

Bearings which are worn to such an extent that they will allow side movement of the armature shaft, must be replaced.

To replace the bearing bush at the commutator end proceed as follows :—

(1) On C39PV models press the bearing bush out of the commutator end bracket. With C39PV-2 models, it will be necessary to use a lipped expanding extractor, or if this is not available a $\frac{5}{8}$" tap may be used to remove the bush.

(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 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. In cases of extreme urgency, this period may be shortened by heating the oil to 100°C. when the time of immersion may be reduced to 2 hours.*

The ball bearing at the driving end is replaced as follows :—

(1) Knock 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 the end bracket.

(5) Locate the bearing in the housing and press it home by means of a hand press.

(6) Fit the bearing retaining plate. Insert the new rivets from the inside of the end bracket and open the rivets by means of a punch to secure the plate rigidly in position.

Reassembly.

In the main the reassembly of the dynamo is a reversal of the operations described on *Page BX3.*

Before refitting to the car unscrew the lubricator from the commutator end bracket, lift out the felt wick and spring and refill the cap with H.M.P. grease. Replace spring and wick and screw the lubricator in position in the end bracket.

IRREGULARITIES AND THEIR REMEDIES.
CHARGING CIRCUIT.

(a) Battery in Low State of Charge.

(1) This state is shown by lack of power when starting, poor light from the lamps, the hydrometer readings below 1.200. It may be due to the dynamo either not charging or giving low or intermittent output. Check the ammeter reading when the car is running steadily in top gear with no lights in use. The ignition warning light will not go out if the dynamo fails to charge, or will flicker on and off in the event of intermittent output.

(2) Inspect the dynamo driving belt, adjusting if necessary to take up undue slackness. *See Page BX3.*

(3) Examine the charging and field circuit wiring, tightening any loose connections, or replacing broken cables. Pay particular attention to the battery connections.

If the cause of the trouble is not apparent, have the equipment examined by a Lucas Service Depot or Agent.

(b) Battery Overcharged.

(1) This is indicated by burnt-out bulbs, very frequent need for topping-up battery, and high hydrometer readings. Check the ammeter when the car is running steadily—with a fully charged battery and no lights or accessories in use, the charge reading should be of the order of only 3-4 amperes.

If the ammeter reading is in excess of this value, it is advisable to have the regulator setting tested, and adjusted if necessary by a Lucas Service Depot or Agent.

GROUP B

POWER UNIT SERVICES

STARTER

STARTING MOTOR.

Description.

The electric starting motor is a four pole machine, Model M35G, having an extended shaft which carries the engine engagement gear, or starter pinion 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 armature and field windings, as it must be remembered that the current consumption of the motor is very high. For example, the starter under normal conditions takes 300-350 amps. at 7.5-8.0 volts.

The machine has four brushes and has a series wound field.

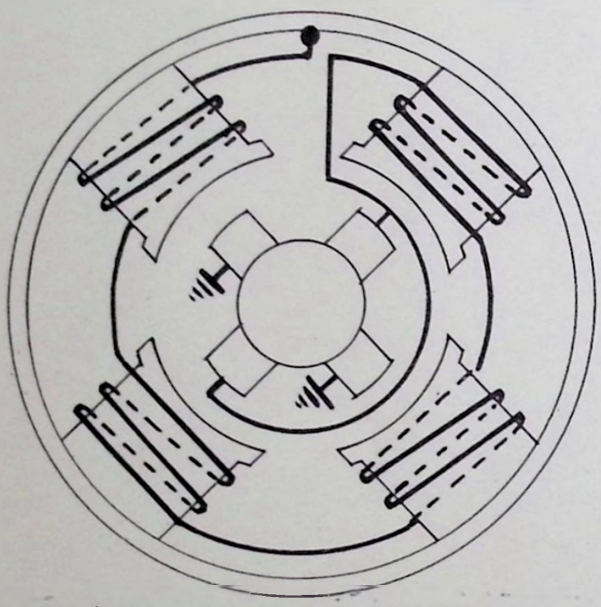


Fig. 1. Internal Connections of Starting Motor. Model M35G (4-brush).

Routine Maintenance.

The only maintenance normally required by the starting motor is the occasional checking of brush-gear and commutator. About every 12,000 miles (19,312 kms.), 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, sometimes secured by two screws. If the commutator is very dirty, moisten the cloth with petrol.

SERVICE BW1.
REMOVAL AND REPLACEMENT OF THE STARTING MOTOR.

(1) Disconnect the positive lead from the battery.

(2) Disconnect the wire from the starting motor.

(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.

Performance Data.

Lock torque 9.3 lbs. ft. (approx.) with 325—345 amps. and 8.1—8.7 volts. Brush tension 15—25 ozs.

SERVICE BW2.
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 switch is found to be faulty, fit a replacement switch. 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 caused by a poor connection in the wiring giving rise to a high resistance in the motor circuit. Check as described above.

(4) If the motor is heard to operate, but does not turn the engine, indication is given of damage to the drive.

SERVICE BW3. BENCH TESTING AND EXAMINATION OF BRUSHGEAR AND COMMUTATOR.

(1) 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 very high speed.

(2) If the operation of the starting motor is unsatisfactory, remove the cover band and examine the brushes and commutator. Hold back each of the brush springs and move the brush by pulling gently on its flexible connector. If the movement is sluggish, remove the brush from its holder and ease the sides by lightly polishing on a smooth file. Always 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 connector is exposed on the running face they must be replaced (*see Service BW4, this Page*). Check the tension of the brush springs with a spring scale. The correct tension is 15—25 ozs. and new brushes should be fitted if the tension is low.
If the commutator is blackened or dirty, clean it by holding a petrol-moistened cloth against it while the armature is rotated.

(3) Re-test the starter as described under (1). If the operation is still unsatisfactory, the unit must be dismantled for detailed inspection and testing.

SERVICE BW4. TO DISMANTLE. (*See Fig. 4, Page BW5.*)

(1) Remove the cover band, hold back the brush springs and lift the brushes from their holders.

(2) Unscrew the terminal nuts from the terminal post on the commutator end bracket.
Unscrew the two through bolts from the commutator end bracket. Remove the commutator end bracket from the yoke.

(3) Remove the driving end bracket complete with armature 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.

Starter Drive.

(1) If the pinion is tight on the screwed sleeve, wash away any dirt with paraffin.

(2) If any parts are worn or damaged they must be replaced.

(3) Remove the cotter pin from the shaft nut at the end of the starter drive. Hold the squared end of the starter shaft at the commutator end by means of a spanner and unscrew the shaft nut.

(4) Lift off the main spring and remove the retaining ring.

(5) The control nut, sleeve and restraining spring will now slide off.

(6) Withdraw the splined washer from armature shaft and remove the pinion and barrel assembly.

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 (Fig. 2) and two are connected to tappings on the field coils (Fig. 3 *Page BW4*).

The flexible connectors must be removed by unsoldering and the connectors of the new

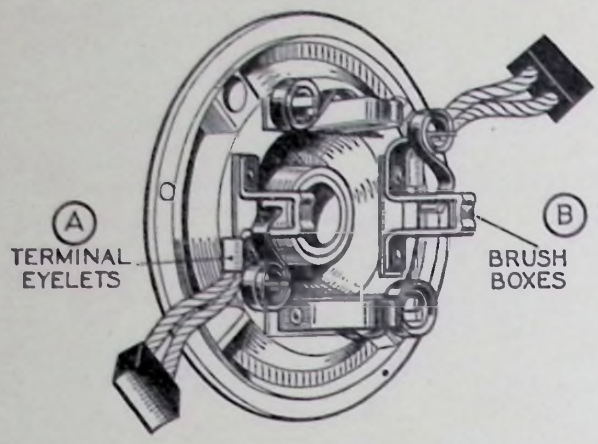


Fig. 2. C.E. Bracket Brush Connections.

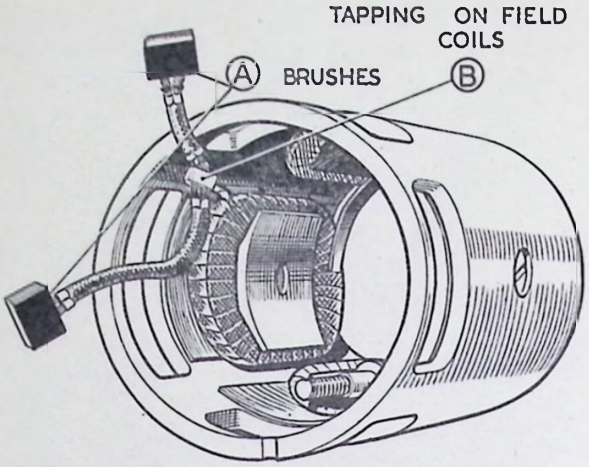


Fig. 3. Brush Connections to Field Coil Tapping.

brushes secured in their place by soldering. The brushes are pre-formed so that bedding to the commutator is unnecessary.

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 as described on *Page BW3* 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 insulation on the commutator **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 in all cases 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 battery with a 12 volt bulb in series between the field coil terminal post and the tapping point at which the brushes are connected. Failure of the lamp to light indicates an open circuit in the wiring of the field coils.

(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 test lamp connected from the supply mains, the test leads being connected to the field coil terminal post and to a clean part of the yoke. Should the lamp light, it indicates that the field coils are earthed to the yoke in which case they must be replaced.

When replacing field coils, the procedure as detailed in the instructions for dynamo should be followed. *See Page BX5.*

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 should be completely immersed for 24 hours in clean thin engine oil. In cases of extreme urgency this period may be shortened by heating the oil to 100°C. when the time of immersion may be reduced to 2 hours.*

Reassembly.

The reassembly of the starting motor is a reversal of the dismantling procedure.

IRREGULARITIES AND THEIR REMEDIES.

Starter Motor Fails to Turn the Engine.

If the engine can be turned by hand check that :—

(1) The battery is not in a discharged condition.

(2) The connection to battery, starter and starter switch are tight and that the cables connecting these units are not damaged.

If the engine cannot be turned by hand check that :—

(1) The starter pinion is not jammed in mesh with the flywheel. This is by no means a common occurrence, but when present disengage the pinion by rotating the square end of the starter shaft by means of a spanner. *See Page BW3.*

Starter Operates, but does not turn the Engine.

This condition may occur if the pinion of the starter drive is not moving along the screwed sleeve into engagement with the flywheel, as the result of dirt having collected on the screwed sleeve. Remove the starter and clean the sleeve and pinion in paraffin.

Starter Pinion will not disengage from Flywheel when Engine is Running.

Stop the engine, and see if the starter pinion is jammed in mesh with the flywheel, releasing it if necessary by rotation of the squared end of the starter shaft. If the pinion persists in sticking in mesh, have the equipment examined at a Lucas Service Depot. Serious damage may result to the starter if it is driven by the flywheel.

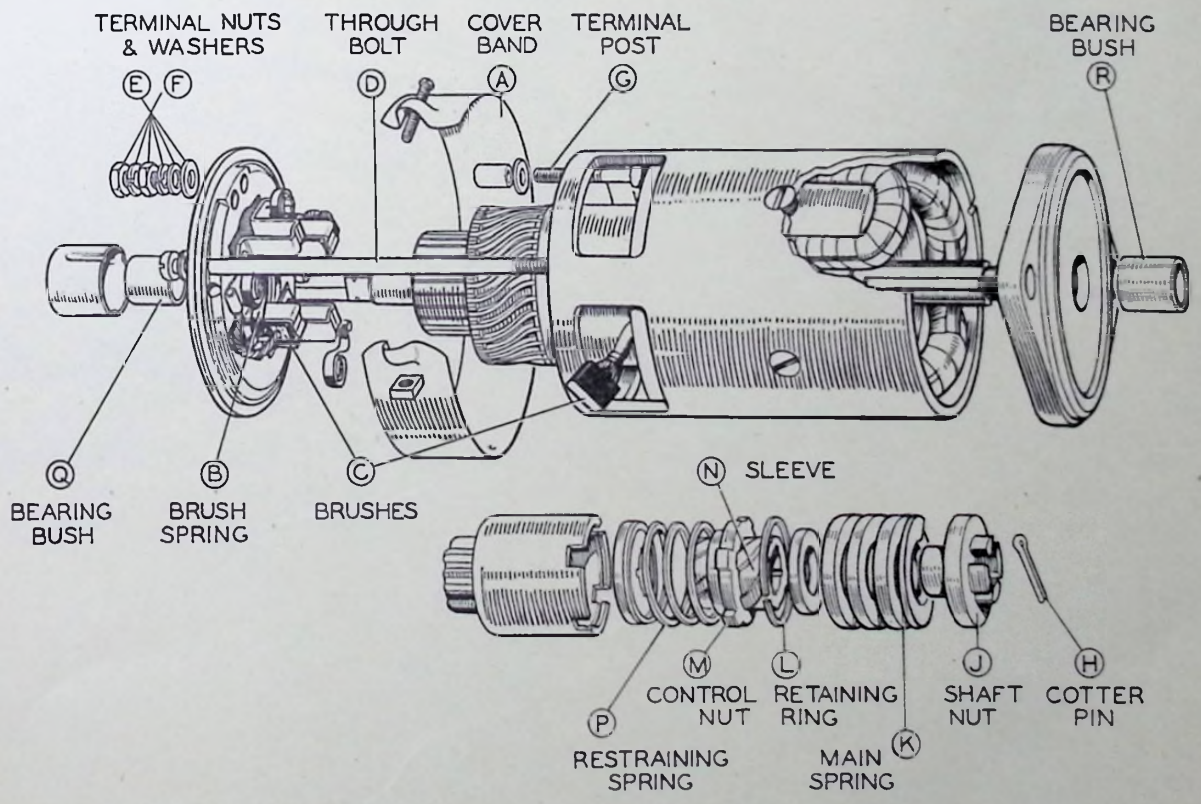


Fig. 4. Exploded view of Starter.

GROUP B

POWER UNIT SERVICES

CLUTCH

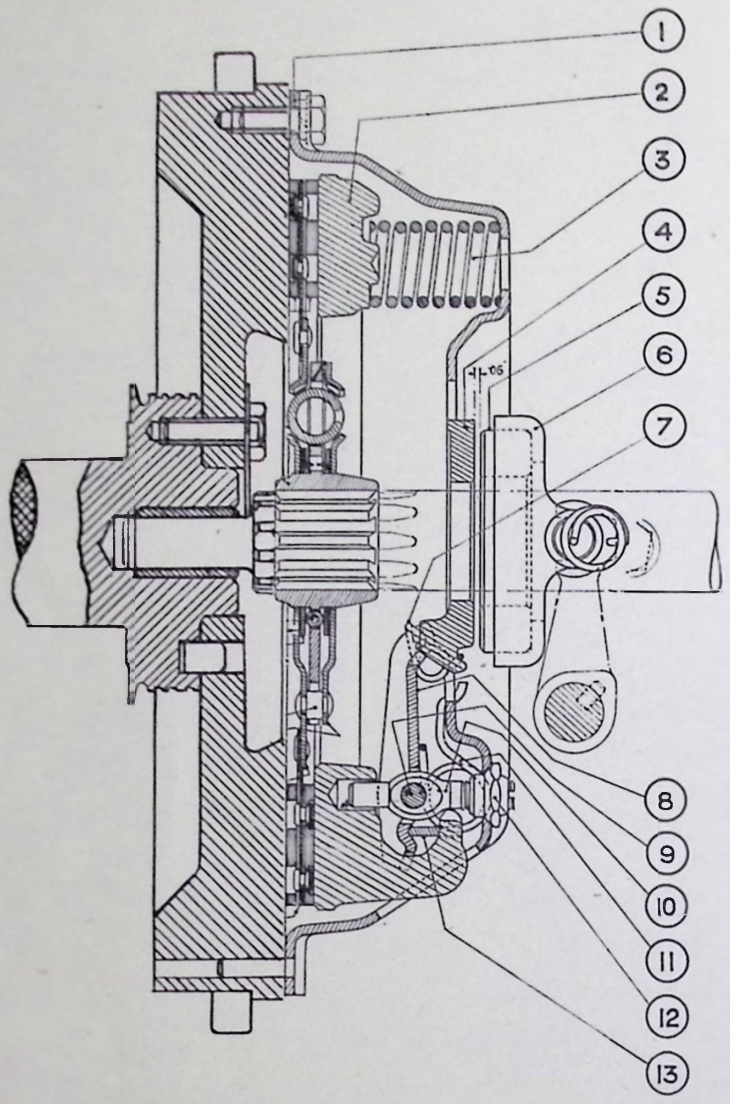


Fig. 1. Section through Clutch.
(See description for key to numbers).

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. In the earlier model of this clutch the adjustment nuts (12) were locked by means of split pins.

The driven plate carries the friction liners riveted to it, and is of the spring loaded Borglite friction controlled 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 overstress the release gear and the internal parts of the clutch. This overstress 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 2.75" (.70 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 3.5" (89 mm.).

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 BV7.*

SERVICE BVI.
TO REMOVE THE CLUTCH UNIT FROM THE CAR.

(1) Remove the Gear Box, *see Page BU3.*

(2) Remove the Clutch Housing, *see Page BZ20.*

(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.

NOTES ON DISMANTLING AND REASSEMBLY.

Clutch Cover Assembly.
General Instruction.

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 Fig. 3, Page BV6.*

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 or 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 which 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 of 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.

NOTE. The appearance of Wound or Woven type facings is slightly different but similar in character.

(*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 above 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.

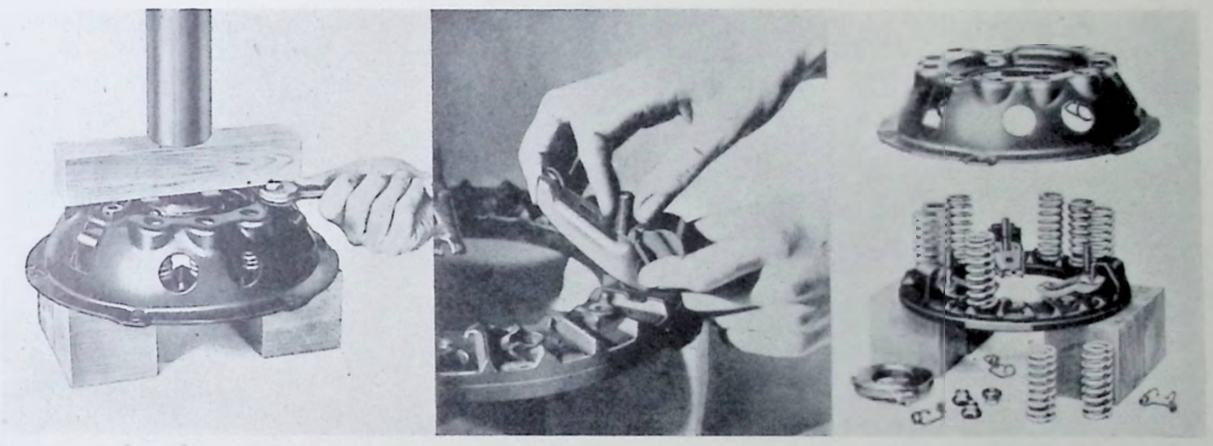


Fig. 2. Clutch Assembly.

SERVICE BV2.

DISMANTLING. *See Page BV2 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 if staked 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.

SERVICE BV3. 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, Page BV5.*

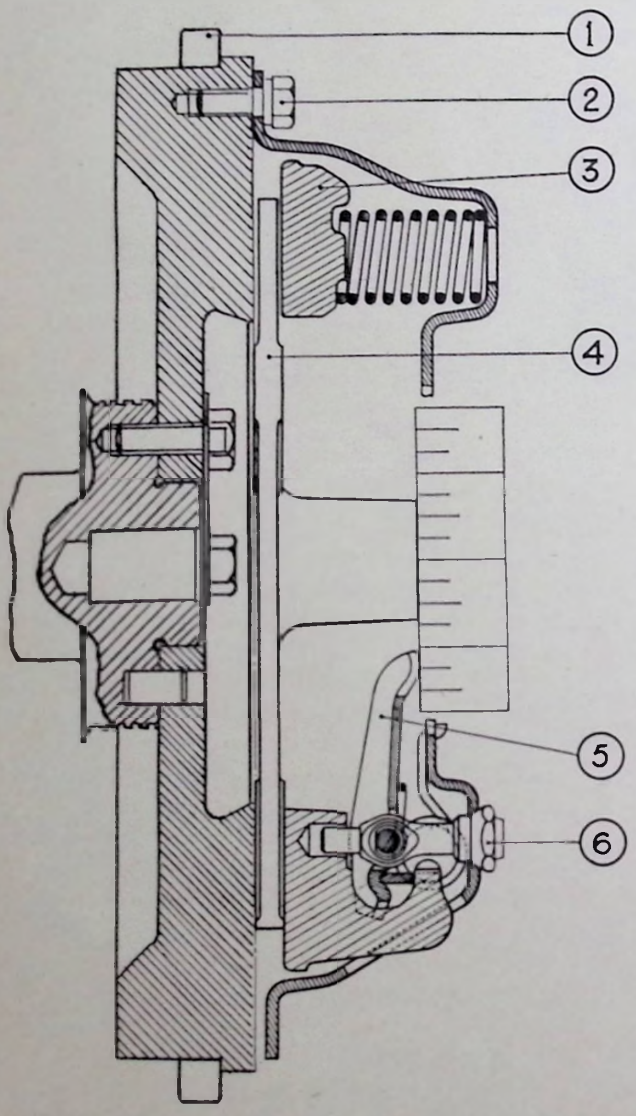


Fig. 3. Release Lever Adjustment.

(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, Page BV5.*

(3) Lay the cover of 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.

(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.

SERVICE BV4. 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.

(3) If the clutch is of the type where the nuts are cottered, drill the nuts and bolts suitably and cotter. If of the type where the nuts are staked, always use new nuts and stake securely.

SERVICE BV5.
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 *Page BZ20 and BU3*.

(5) Check the change speed control as described on *Page BU5* and adjust the clutch pedal in accordance with instructions below.

SERVICE BV6.
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 25" (635 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.

It is in the amount of 3.5" (89 mm.) and is limited by the stop pin in the forward lug formed in the clutch support bracket. Any correction necessary is carried out in the normal way of releasing the locknut, altering the position of the stop pin until the correct travel is present, and then retightening the lock nut. *See Fig. 4, Page BV10.*

(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 BV10.*

On completion of the service make sure that all locknuts released are re-tightened.

IRREGULARITIES AND THEIR REMEDIES.

SYMPTOM	CAUSE	REMEDY
1. Drag or Spin.	(*a*) Oil or grease on the driven plate facings.	Fit new facings.
	(*b*) Improper 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 gear box 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*) Improper 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.

SYMPTOM	CAUSE	REMEDY
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 back lash 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 gear box 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 re-assembly.
8. Abnormal Facing Wear.	Usually produced by overloading and by the excessive slip starting associated with overloading.	In the hands of the operator.

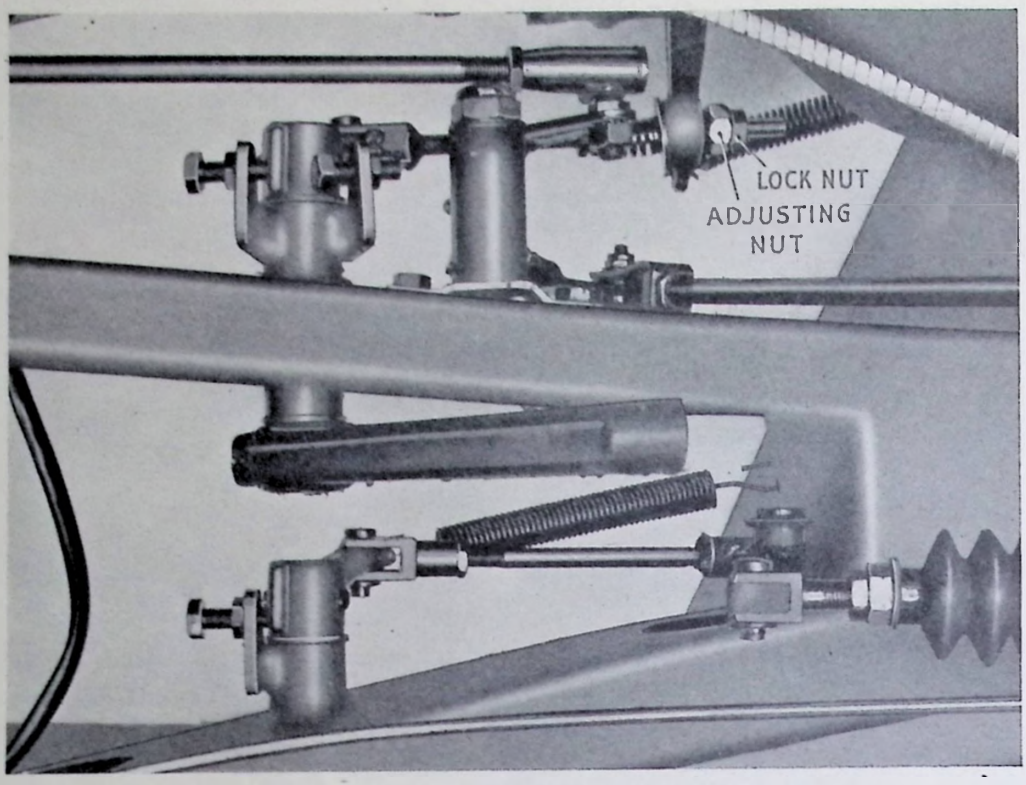


Fig. 4. Adjustment of Clutch Pedal. For description see page BV7. The set screws with lock nuts are those which limit the travel of the Pedals.

GROUP B

POWER UNIT SERVICES

GEARBOX

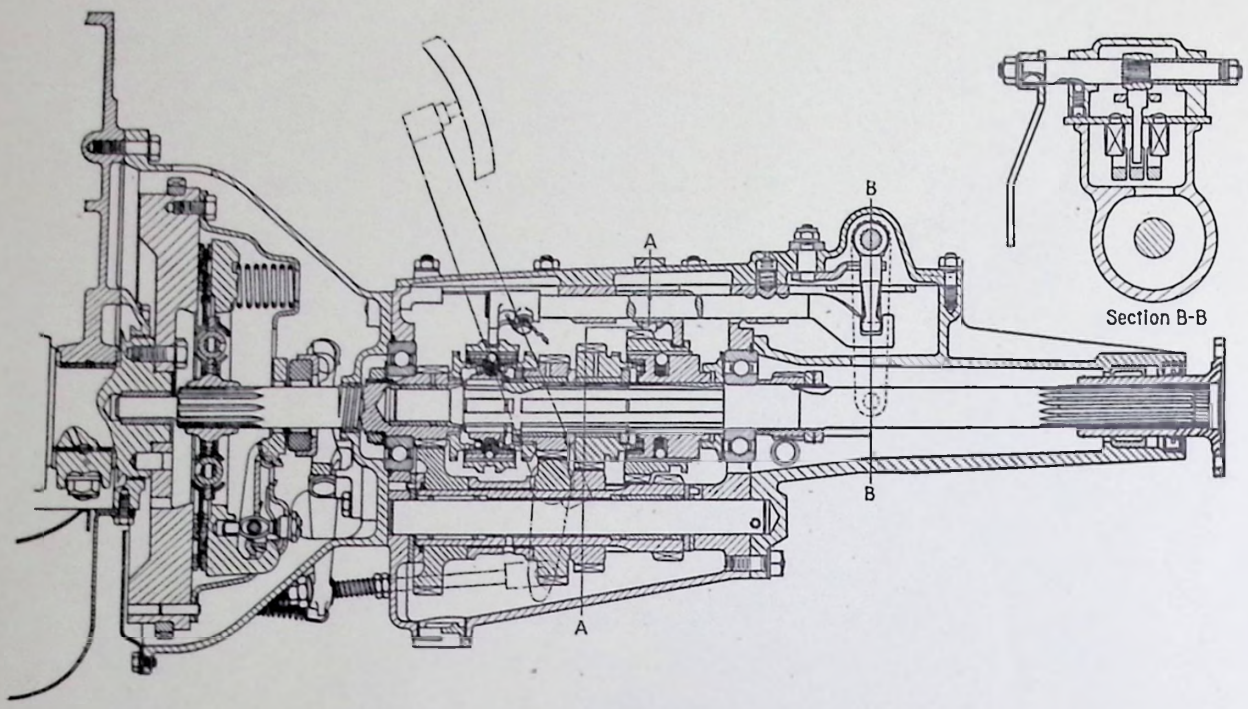


Fig. 1. General arrangement of Clutch and Gearbox.

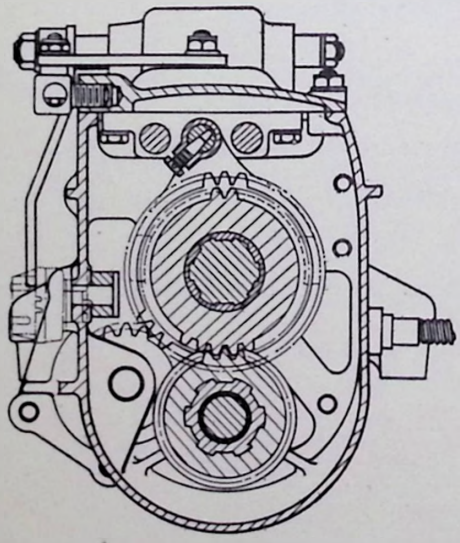


Fig. 2. Gearbox Cross Section.

Description.

The gearbox, with four forward speeds and a reverse, is fitted with synchromesh mechanism on second, third and top gear. An extended mainshaft with a splined end drives the forward sliding flange-needle bearing mounted in the gearbox rear extension and replaces the usual sliding splined joint on the propeller shaft.

SERVICE BU1. TO REMOVE AND REPLACE THE GEARBOX WITH THE ENGINE IN THE CHASSIS.

(1) Remove the carpets which are held by set pins screwed to captive nuts.

(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.

(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. 4, Page BU5*).

(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. *See Service BU2.*

(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 lock plates and four 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. Check that the blanking washer in the centre of the driving flange is in position when stripping and reassembling the gearbox to the engine.

(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 steady 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 wires 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.

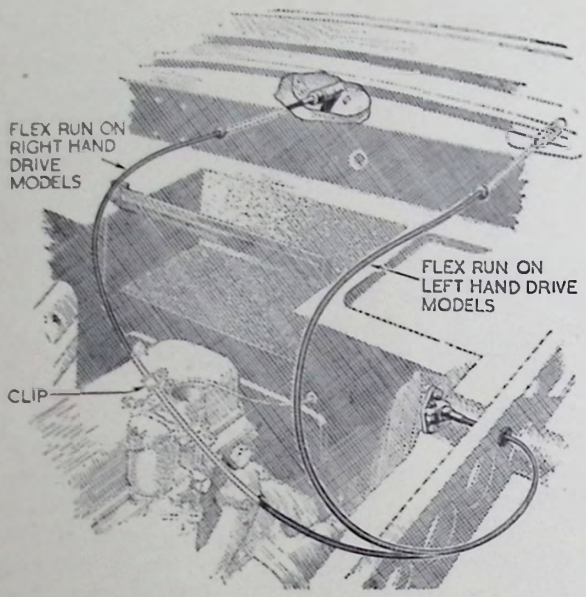
Replacement is the reversal of the foregoing, but before offering up the gearbox into position see that the joint faces of the box and clutch housing are clean and that the carbon ring of the clutch withdrawal bearing is facing towards the engine. Engage top gear so that the constant mesh shaft can be rotated to assist mesh the splines of the shaft and clutch plate.

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 see *Service BU3*.

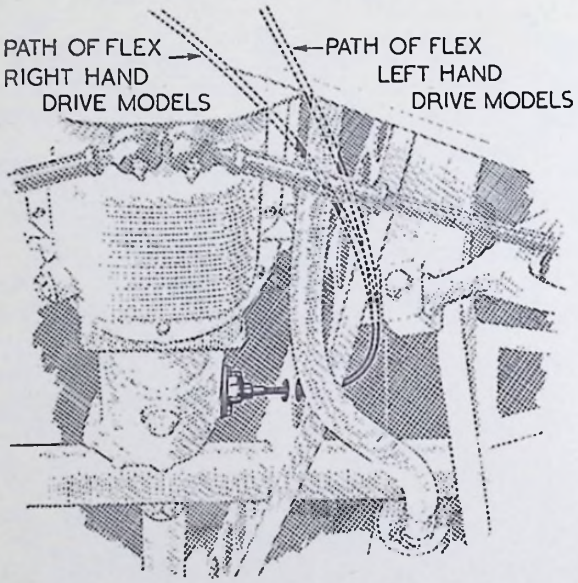
SERVICE BU2.
To Remove and Refit Flexible Drive to Speedometer Head.

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.

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



(a)



(b)

Fig. 3. Correct Layout for Speedometer Drive.

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 ferrule in the bulkhead.

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

To Re-Assemble. The illustrations Fig. 3 show the correct lay-out 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. 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.

SERVICE BU3.
TO CONNECT UP THE CHANGE SPEED LEVER CONTROLS.

(1) See that the forward nut, A, Fig. 4, on the gearbox end of the control cable assembly is screwed right down. Pass the cable and the threaded end of the cover through the cable support, fit the second or rear nut, and tighten securely.

(2) Thread the cable through the swivel pin, of the operating lever, B, Fig. 4, push the lever forward to the full extent of the travel, then place the change speed lever,

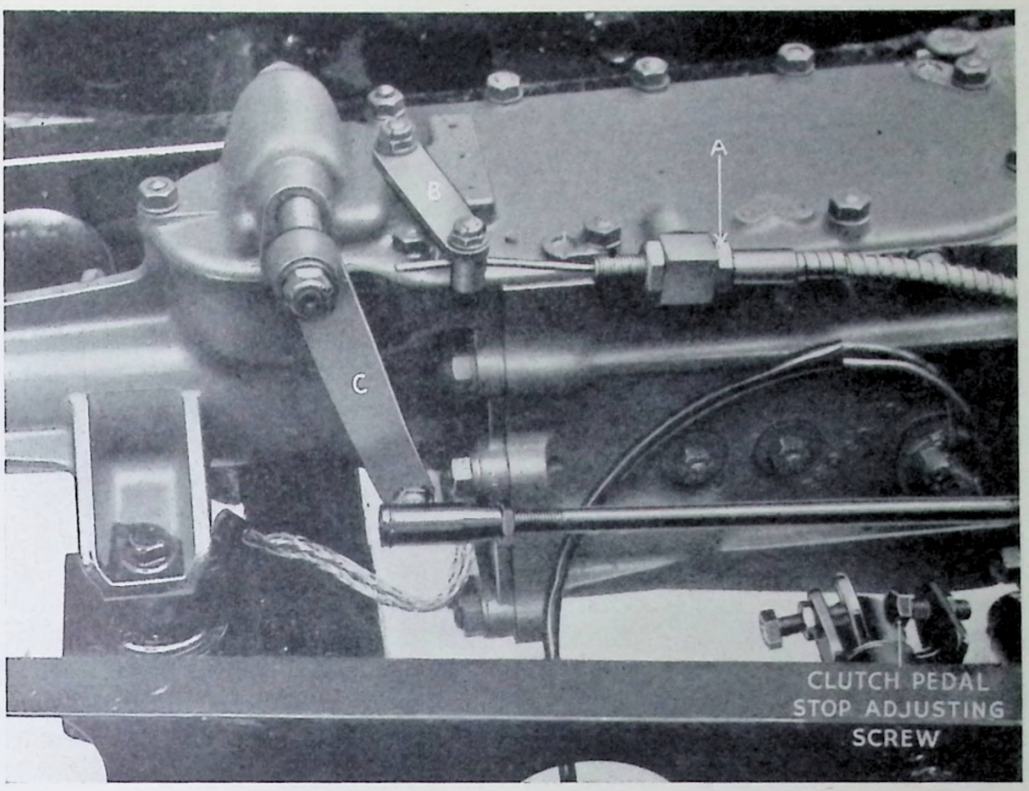


Fig. 4. Arrangement of Gear Change Speed Levers when connecting controls.

on the steering column in reverse and tighten up the set pin of the swivel pin on the operating lever.

(3) Place the change speed lever C on the gearbox in reverse as shown in *Fig.* 4, and connect up the control rod ball joint to it. If this cannot be done without altering the position of the levers, lengthen or shorten the control assembly suitably until this condition can be obtained.

(4) Check that it is possible to obtain any gear readily. If unable to do so, recheck the foregoing operations to ensure they have been carried out correctly. If difficulty still persists examine the mechanism as detailed in *Service BU4.*

(5) The end of the cover of the operating cable attached to the support bracket on the column, should stand proud of the locknut by approximately $\frac{3}{4}$" (19 mm.). The screwed end of the inner cable should be attached to the swivel pin on the selector lever, with the lower lock nut screwed down to the full extent. This lower locknut should not foul the end of the cover, when the change speed lever is in neutral, and raised to the full extent of its travel towards the steering wheel. Any interference should be corrected by lowering the cover.

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

SERVICE BU4.
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) There must be approximately a clearance of $\frac{1}{4}$" (6.35 mm.) between the bobbin of the gear operating lever on the lower end of the control rod and the bottom bracket on the column, when the change speed lever is in reverse gear.

(3) To correct any misalignment, release the clamp bolt on the top bracket of the

control assembly, the nuts on the clips of the lower bracket, the nut for the support strip to the master cylinder, and suitably reposition the brackets, before tightening the nuts and bolts released.

(4) The end of the cover of the operating cable, which is attached to the support bracket on the column, should stand proud of the locknut by approximately ¾" (19 mm.). The screwed end of the inner cable should be attached to the swivel pin on the selector lever with the lower locknut screwed down to the full extent. This lower locknut should not foul the end of the cover, when the change speed lever is in neutral and raised to the full extent of its travel towards the steering wheel. Any interference should be corrected by lowering the cover.

(5) The adjustment at the gearbox end of the cover of the cable assembly has already been set and the inner cable should be secured to the swivel pin on the operating lever with this lever pushed forward to the full extent of its travel and the gear control lever in reverse.

(6) The actuating, or short control rod, should have its joints positioned so that the overall length of the assembly is approximately 12 inches (305 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 and in a position equivalent to that occupied by the large hand of a clock when at approximately 8 to 10 minutes to the hour.

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

SERVICE BU5.
TO DISMANTLE THE GEARBOX.

(1) Remove the gearbox from the car. *See Page BU3.*

(2) Drain the box, draw out the dipstick and remove the reverse light switch.

(3) Secure the box in a vice. The most convenient way is to screw a threaded 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) Remove the bolt and shakeproof washer securing the speedo pinion guide to the gearbox, and draw out the guide and 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 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 radial ball bearing from the inside of the box and towards the front. Keep the forward end of the pinion shaft wall 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 washer —recess towards the gear—on the layshaft 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, drive 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.

SERVICE BU6. 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 3rd and 2nd 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 2nd and 3rd gears with the narrower of the two bosses on each gear, towards the 1st gear ; the splined distance piece with the oil holes near the 3rd gear and on a spline which will allow the holes to register with those in the shaft. Lastly, the 4th constant mesh gear with its deep boss against the distance piece. Secure the gears in position by means of the circlip.

SERVICE BU7. 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 nick 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 nick in the first thrust washer, all three washers are alike. As to the splined bronze bushes, that for the 3rd speed gear is recessed at one end to take the key for the first thrust washer.

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

SERVICE BU8.
TO RE-ASSEMBLE THE MAINSHAFT.

This service is carried out by reversing the order of the operations given *on Page BU7*, but the following points should be observed.

(1) 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.

(2) With the 2nd speed synchro sleeve assembly in position on the shaft and pushed hard up against the 2nd speed mainshaft gear, the rear ends of the mainshaft splines should stand proud of the rear face of the stop by .050"—approx. 1.27 mm. To adjust, withdraw the sleeve till the stop is clear of the splines, then screw "in" or "out" as necessary, push home and re-check.

SERVICE BU9.
TO DISMANTLE AND RE-ASSEMBLE 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 of 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 Re-assemble.

(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 and 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, but before doing so, read carefully the instructions on the seals *in Section BT*.

(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.

SERVICE BU10.
TO DISMANTLE AND RE-ASSEMBLE 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 or 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 driven out of position, and incidentally the actuating lever and its spacing collar off the shaft.

(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.

Re-assembling 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.

SERVICE BU11. TO DISMANTLE AND RE-ASSEMBLE CLUTCH HOUSING.

(1) 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.

SERVICE BU12. TO DISMANTLE AND RE-ASSEMBLE 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 re-assemble 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.

SERVICE BU13. TO DISMANTLE AND RE-ASSEMBLE THE 2nd SPEED SYNCHRO SLEEVE ASSEMBLY.

The dismantling operations are similar to those described *in Service BU12*. But note the 1st speed stop screwed on to the rear end of the sleeve. This stop limits the travel of the assembly to .050" (1.27 mm.) when in position in the box.

When re-assembling, screw the stop on to the sleeve to its maximum extent as a preliminary measure.

As to the assembly of the synchromesh sleeve, this is slightly different from the method given for the 3rd and 4th sleeve and dog. The 3rd speed internal teeth are machined to a depth of .070" (1.78 mm.) by $\frac{9}{32}$" (7.15 mm.) from the front end of the 1st gear main shaft and must therefore be assembled centrally with the block ground diameter of the sleeve.

SERVICE BU14. TO RE-ASSEMBLE THE GEARBOX.

(1) Before attempting to assemble 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 the 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 an end float of .005″ (.127 mm.) to .007″ (.178 mm.) in the layshaft assembly. If not present adjust by fitting a replacement large front thrust washer supplied in three sizes. 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 registers. 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 locknut and 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 by plain washers and new self-locking nuts. Check that the driving flange slides freely on the shaft. Smear jointing compound on the joint face of the speedometer pinion guide, insert the pinion into the guide, place the assembly in position in housing and secure it with a shakeproof washer and set pin.

(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 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 under 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 re-assemble box to the car as shown on *Page BU3*.

GROUP B

POWER UNIT SERVICES

OIL SEALS

OIL SEALS.
General Instructions for the Fitting of Oil Seals.

The type of oil seal fitted to various components on the car consists of a synthetic rubber or leather washer, the lip of which is kept in contact with the shaft by spring pressure. It is important that these seals are fitted correctly to ensure that they work at their maximum efficiency.

If the following instructions are observed, satisfactory results will be obtained.

The Springs Fitted to the Synthetic and Leather Seals.

(1) The spring is very important to the efficient working of a leather or a synthetic rubber seal. The loading of the spring has been determined by considerable development work, and to reduce the length of a spring may temporarily heal a leak, but this expedient will increase the torque on the shaft, raise the temperature, with the result that the sealing element may be burnt. On checking two springs it may be found that the lengths vary. This is due to the fact that the springs are not measured by length but are checked and cut to size by loading : a slight variation as low as 0.0005" in wire diameter will make a marked difference in the radial loading. It does not follow therefore that incorrect springs have been fitted if you find a variation in length.

Examination of Used Synthetic Seals.

(2) As a general rule, the refitting of a used synthetic seal is not recommended. The sealing member will probably have hardened, become highly polished and the interference may have been reduced ; but provided the seal is not disturbed, it will function efficiently, in spite of hardening and loss of interference. If it is necessary to remove it from the housing great care must be taken when refitting to avoid cracking the sealing element. It is advisable to replace a seal which has been disturbed or if there is any doubt about its condition.

Examination of Used Leather Seals.

(3) If the following conditions are present in a leather seal, fit a replacement.

(*a*) The leather cut, charred, hard, or the wiping edge folded back or damaged in any other manner.
(*b*) The leather not securely fixed in the shell but free to rotate.
(*c*) The spring damaged.
(*d*) The shell or metal component damaged or distorted.
(*e*) The shell or metal component loose in its housing.

If the shaft or flanged sleeve is deeply scored or grooved, replace the shaft or sleeve and test the seal on the replacement shaft or sleeve, check that the spring functions. If it does not, fit a new seal.

Fitting the Seal.

(4) Before fitting a leather seal, clean it with cold paraffin ; but under no circumstance should this be done with synthetic rubber seals which must be cleaned with a light lubricating oil ; nor should a seal, leather or synthetic, be passed through a degreasing plant (trichlorethylene). When satisfied that the seal is clean, coat the sealing member with a thin grease. This is imperative for synthetic rubber seals. Check the oil seal on the shaft or on a mandrel of the same diameter, to ensure that the correct seal is being used. Observation of the spring will show whether it is tensioning evenly. To measure the lip diameter of the sealing element may be misleading. The diameter should be approximately $\frac{1}{16}$" smaller than the shaft diameter, but this may vary somewhat through climatic conditions.

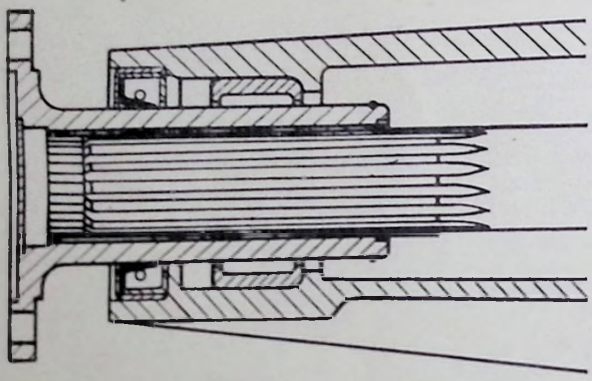


Fig. 1 (a). Correct Method of fitting seal.

Mounting.

(5) It is immaterial whether the seal is threaded on the shaft or the shaft through the seal. In either case the care must be exercised to avoid damage to the sealing member.
From Fig. 1 showing the locations of the seals, it will be noticed that the shafts are provided with radii to help slide the seals into position without damaging their lips. All shafts which carry seals have these radii. But care must be taken to ensure that, before fitting the seals, there are no burrs or sharp edges on the surfaces of the radii or shafts.

The Wiping Edge or Lip of the Sealing Member should be assembled facing towards the Bearing in which the Lubricant is to be retained. (See Figs. 1 and 2).
Failure to observe these instructions will invariably lead to the leather being turned back or the synthetic rubber being cut on the wiping lip. Further trouble may arise if the synthetic rubber is forced back and the spring released from its angular groove, for on the sealing member returning to its normal position the spring will be out of place and the results will be disastrous, since the spring will make contact with the shaft and disintegrate.

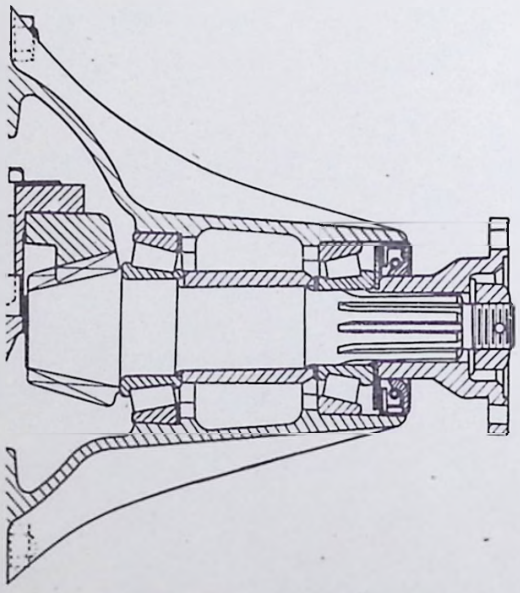


Fig. 1 (b). Correct method of fitting seal.

Fitting into the Housing.

(6) The correct method of fitting an internal type seal is to exert a firm uniform drawing pressure on the seal. This is usually accomplished on an Arbor Press fitted with a tool or ram with a diameter of 0.005" to 0.015" (127 mm. to .38 mm.) less than the outer diameter of the seal but no smaller. Care must be taken to

see that the seal does not enter the recess in the tilted position and under no circumstance must a seal be fitted with a drift and hammer as the irregular impact, exerted by this method, will loosen the rolled edge and release the pressure of the inner member locking and sealing element ; this looseness will cause seepage around the leather or synthetic rubber. If you are unable to use an Arbor Press, make up a fitting tool.

Storage and Soaking Leather Seals.

All leather seals contain a percentage of natural moisture which may dry out if they are kept in stock for any considerable time, or in excessive heat. They should be stored and stacked in a room at a constant moderate temperature and free from dust. Should the leather element harden, it can be softened by soaking in warm oil. In softening, it is most important that the seal should not be allowed to rest on the bottom of a container which is being subjected to direct heat as this may cause serious shrinkage and ruin the seal. Heat the oil to 38°C. (100°F.), shut off heat and then immerse the seal, which should be left in the oil for at least 15 minutes, but may be allowed to remain in the oil until required.

Synthetic rubber seals should also be stored at moderate temperature as variations will alter their hardness, particularly extreme degrees of cold. A sharp rub round the sealing element with the hand is sometimes sufficient to restore it quickly, or it may be left in a warm room overnight.

Stack the seals neatly. Do not allow them to be thrown into a storage bin. Do not allow them to be carried in quantities tied with string or rope in contact with sealing element. This will cause leakage due to lacerated sealing edges.

Dented shells will also give trouble. If seals are thrown into a bin the sealing element is likely to come in contact with the outside diameter of another seal and the synthetic member is liable to take a permanent set in a distorted position.

Cleanliness in storage is a matter not very often considered. Keep all seals free from dust and grit, and treat them as you would ball or roller bearings. They are just as important, because if a seal fails it is not long before the bearing breaks down.

Organise stocks to ensure that the oldest seals are used first.

NOTE. The inner seals of the rear hub bearings must be pushed home and squeezed against the abutments in the axle casings, with the sealing tips in the correct position. See Figure 1, Page GZ2. When cleaning use oil, not paraffin or petrol.

GROUP C

LUBRICATION SERVICES

GENERAL

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 part depends on the degree of lubrication it receives.

The lubrication points on the S.M.1500 have been reduced to a minimum, and are clearly laid out in the "Summary of Regular Attention" *given on Page CZ9.*

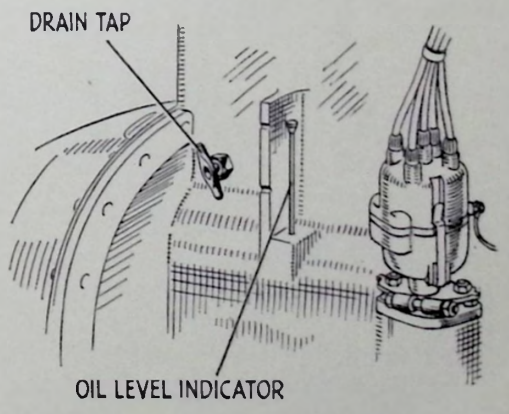
This summary has been compiled on the assumption that the car will cover approximately 10,000 miles (16,093 kms.) a year ; but even though the yearly mileage may not reach this figure, or the car is stored and not used, it is advisable to carry out the suggested routine at the times stated. The lubricating *Chart on Page CZ9* gives the position of the various points of application, and on the name plate of the car will be found the correct titles of five groups of approved lubricants for the main units.

This information is amplified on Page CZ8.

It is bad practice to mix oils, and the use of the selected group should be continued.

SERVICE CZ1.
ENGINE LUBRICATION.

The lubrication of the engine is automatic but the oil in the engine sump must be maintained at the correct level.



The rod of the visible type of indicator, shown in the illustration, is attached to the floating filter in the sump, and automatically registers and readily gives the position of the

oil level in the sump ; but it is advisable to check, by means of the pressure gauge on the instrument panel that the lubricating system is functioning correctly.

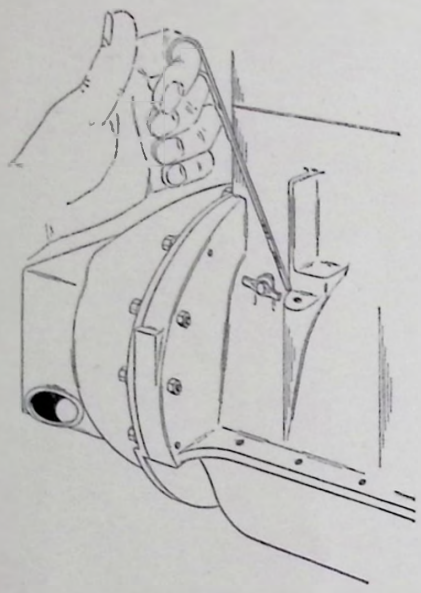


Fig. 1. Dipstick.

The position of the dipstick used on all cars after chassis No. D122U is given on Fig. 1 of this page. 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 skew gears, draws the oil through the B.W.P. Floating Filter and delivers it to the main gallery formed in the crankcase and running along the entire length of the near—left side—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.

From Engine No. D122U and onwards, i.e., on engines with dipsticks, a fixed basket type of filter is fitted. *See Page BZ23.*

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, picks up 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 yield a pressure of 30/35 lbs. when the engine is hot and car running at 30-35 miles per hour in top gear.

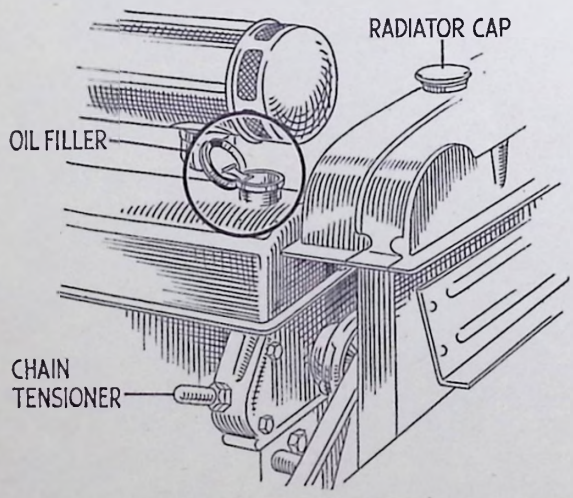


Fig. 2.

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.

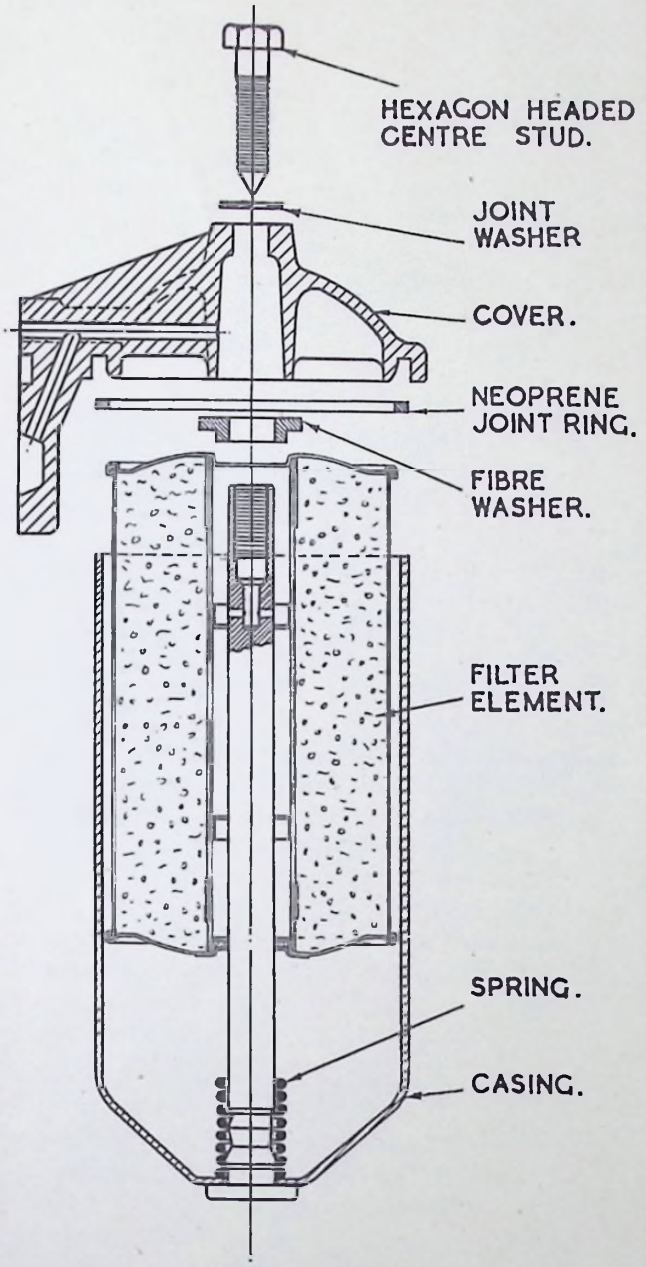


Fig. 1. Section through A.C. Filter.

SERVICE CZ2.
OIL CONSUMPTION.

A normal oil consumption figure is approximately 2,500 miles (4,025 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 visible oil indicator rod, or 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.

Those 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 no matter how true the bores may be, or the piston rings never so efficient, they would be unable to control the oil which would pass them in quantities above normal and be burnt.

If replacing the big end bearings alone does not provide a solution, the engine should receive a general overhaul.

SERVICE CZ3.
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 below.

SERVICE CZ4.
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 CZ8*. As to the oil level, this can be checked by means of the visible oil indicator, or 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, 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 Group B, Page BZ22*, 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 BZ23 and BZ24*. 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 regrinding of the crankshaft and the fitting of the new bearings, giving the standard clearance of .001" to .0025" (.026 mm. to .063 mm.)

For the standard regrinds for the shaft and those for the reboring of the cylinders, see *Service Data Section*.

SERVICE CZ5.
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.

SERVICE CZ6.
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.

Gearbox Dipstick.

SERVICE CZ7.
TO DRAIN THE GEARBOX.

Remove the plug in the underside of the gearbox and towards its front end and also the filler plug. The oil will drain away readily when warm, and the operation should therefore be carried out after a run.

SERVICE CZ8.
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.

SERVICE CZ9.
TO DRAIN THE REAR AXLE. HYPOID BEVEL UNIT.

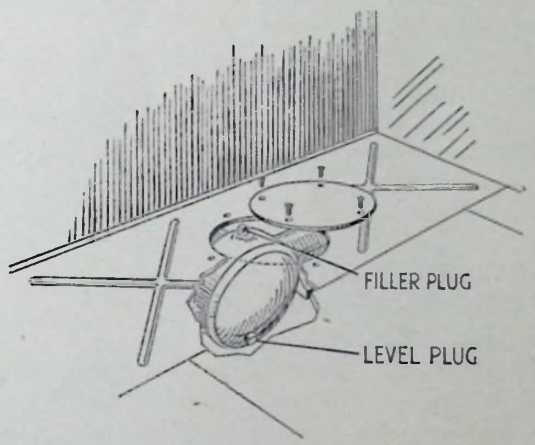
Remove the drain plug on the underside and in the centre of the axle unit and also the filler plug. It is advantageous to drain after a long run when the oil is warm and thin.

SERVICE CZ10.
STEERING BOX LUBRICATION.

The box is the high efficiency Burman "L" 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 in to the level of the filler opening.

SERVICE CZ11.
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.



Rear Axle.

SERVICE CZ12.
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 "CHASSIS 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 is clear.

SERVICE CZ13.
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 GY1 and GY2.*

SERVICE CZ14.
REAR SUSPENSION LUBRICATION.

The Shackle 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.

SERVICE CZ15.
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.

SERVICE CZ16.
REAR HUB BEARING LUBRICATION.

Each wheel bearing is sealed and is indenpendent 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.* 1.

SERVICE CZ17.
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.

SERVICE CZ18.
A.C. OIL FILTER. *See Page BZ27, Service BZ26, Group B.*

SERVICE CZ19.
B.W.P. FLOATING FILTER.
Description.

This filter is situated in the engine sump and, as its name implies, is free to float on the surface of the oil, thus keeping the filter element clear of any sediment which may collect in the sump.

To obtain access to the filter the engine sump must be removed. For details of the operation and the removal of the filter see *Page BZ22, Group B.*

As advised in the "Summary of Regular Attentions", the filter should be removed every 5,000 miles (8,046 kms.) and cleaned in petrol with a stiff bristle brush.

Before re-assembling the sump to the engine make sure that the filter unit, when connected to the suction pipe and indicator rod and secured by a cotter, is free to rise and fall under its own weight.

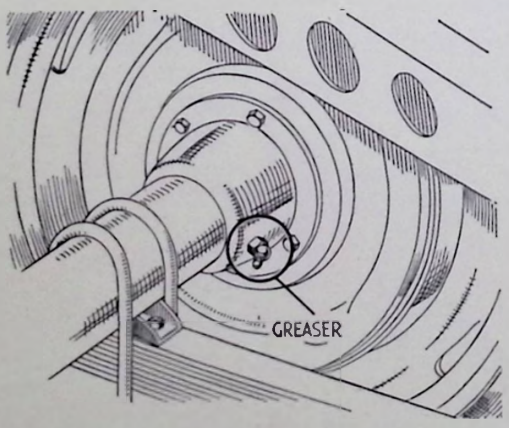
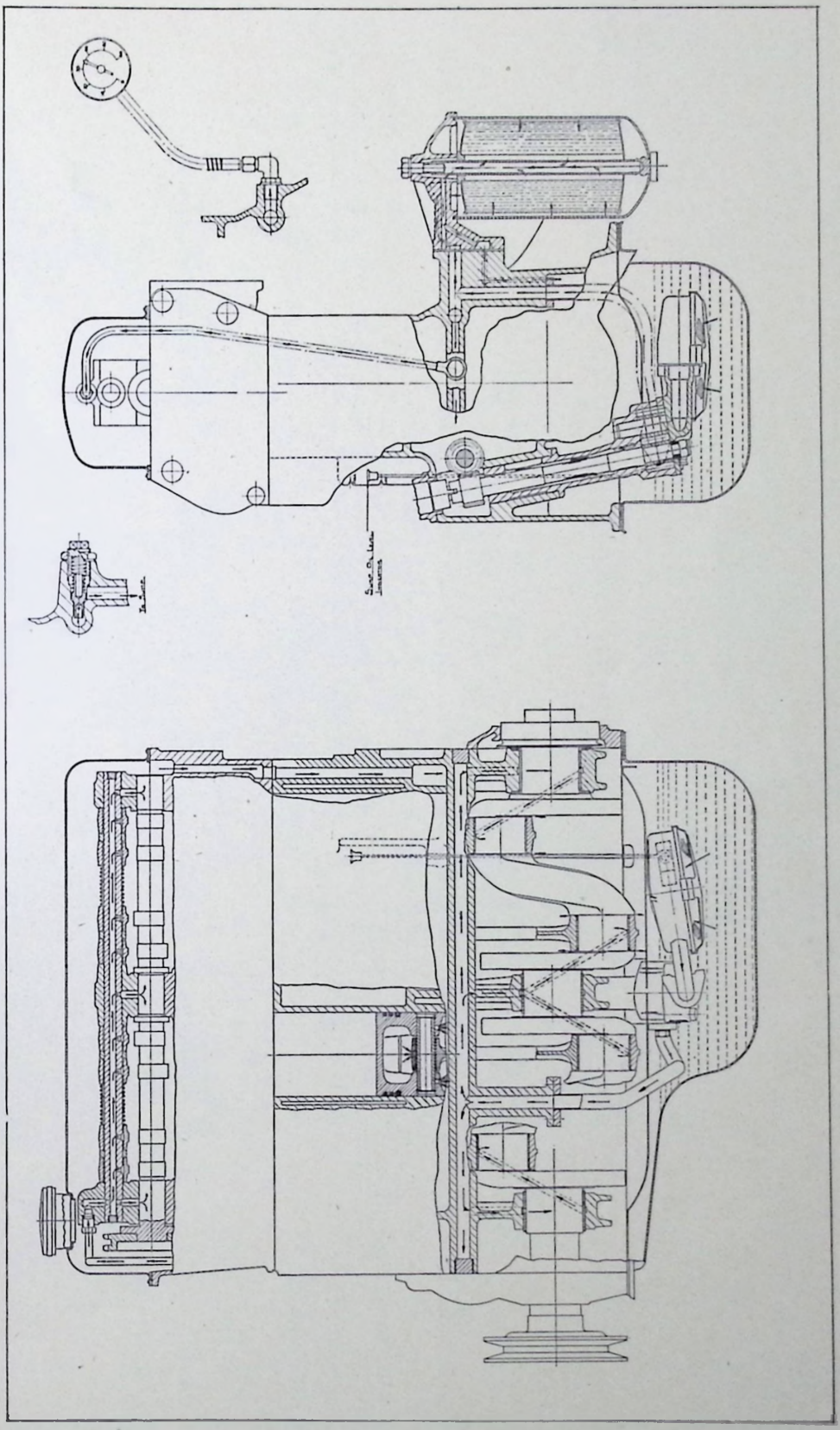


Fig. 1. Rear Hub Grease Nipple.



Engine Oil Circulation Diagram.

RECOMMENDED LUBRICANTS

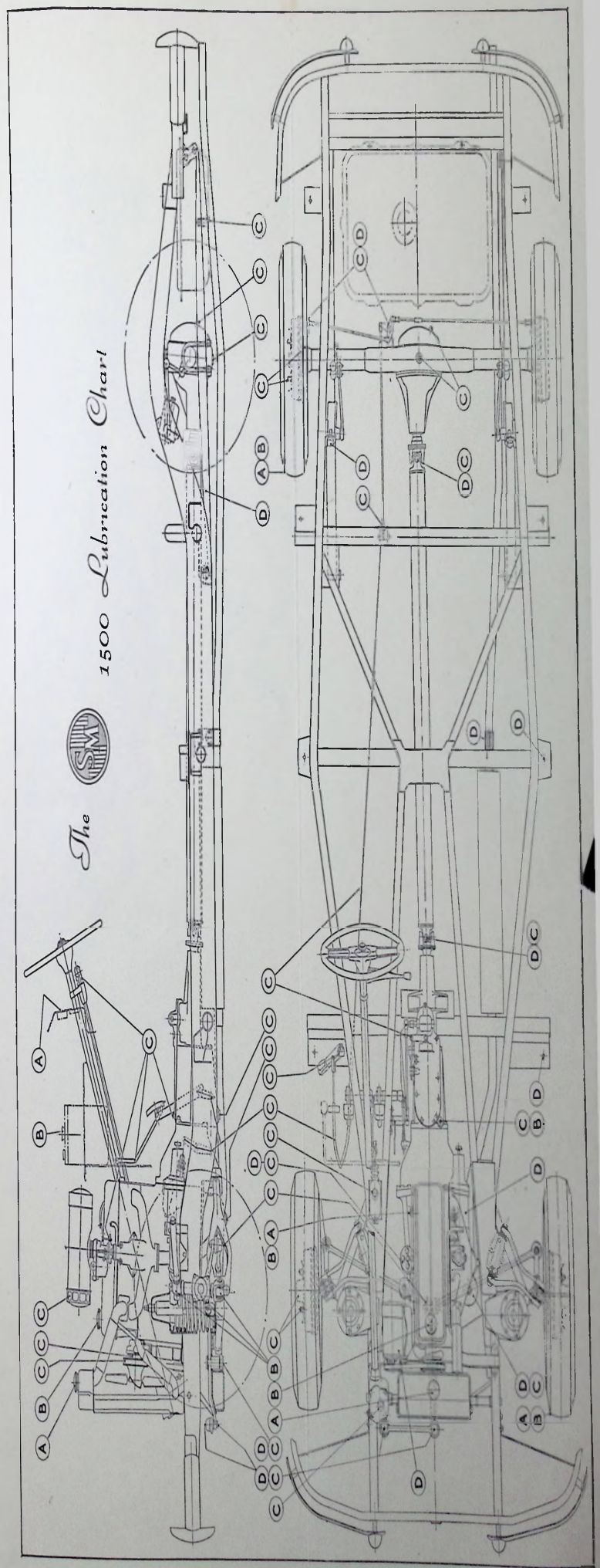
	Vacuum	Price's	Shell	Wakefield	Esso
Engine					
U.K. Summer	Mobiloil A	Energol S.A.E.30	Double Shell	Castrol XL	Essolube 30
U.K. Winter	Mobiloil Arctic	Energol S.A.E.20	Single Shell	Castrolite	Essolube 20
Overseas					
Temps. above 90°F.	Mobiloil AF	Energol Motor Oil S.A.E.40	Shell X.100-S.A.E.40	Castrol XXL	Esso Extra Motor Oil 3
32°F. to 90°F.	Mobiloil A	Energol Motor Oil S.A.E.30	Shell X.100-S.A.E.30	Castrol XL	Esso Extra Motor Oil 3
10°F. to 32°F.	Mobiloil Arctic	Energol Motor Oil S.A.E.20W	Shell X.100-S.A.E.20	Castrolite	Esso Extra Motor Oil 1
—10°F. to 10°F.	Mobiloil Arctic Special	Energol Motor Oil S.A.E.10W	Shell X.100-S.A.E.10	Castrol Z	Esso Extra Motor Oil 1
Below —10°F.	Mobiloil 5W	Energol Motor Oil S.A.E.5W	Shell X.100-5W	Castrol ZZ	Esso Extra Motor Oil Zero
Gearbox					
U.K.	Mobiloil BB	Energol S.A.E.40	Triple Shell	Castrol XXL	Essolube 40
Overseas above 10°F.	Mobiloil BB	Energol Motor Oil S.A.E.40	Shell X.100-S.A.E.40	Castrol XXL	Essolube 40
Overseas below 10°F.	Mobiloil A.	Energol Motor Oil S.A.E.30	Shell X.100-S.A.E.30	Castrol XL	Essolube 30
Back Axle and Steering Box					
U.K.	Mobilube GX.90	Energol E.P. S.A.E.90	Shell Spirax 90 E.P.	Castrol Hypoy	Esso Expee Compound 90
Overseas above 10°F.	Mobilube GX.90	Energol Transmission Oil E.P.—S.A.E.90	Shell Spirax 90 E.P.	Castrol Hypoy	Esso XP Compound 90
Overseas below 10°F.	Mobilube GX.80	Energol Transmission Oil E.P.—S.A.E.80	Shell Spirax 80 E.P.	Castrol Hypoy 80	Esso XP Compound 80
Front and Rear Hubs					
U.K.	Mobil Hub Grease	Belmoline C	Shell Retinax R.B.	Castrolease Heavy	Esso Grease
Overseas	Mobilgrease No. 5	Energrease C.3	Shell Retinax R.B. or A	Castrolease Heavy	Esso Bearing Grease
Chassis Points and Steering Swivels and Links					
U.K.	Mobilgrease No. 4	Belmoline C	Shell Retinax C	Castrolease CL	Esso Pressure Gun Grease
Overseas	Mobilgrease No. 4	Energrease C.3	Shell Retinax C or A	Castrolease CL	Esso Chassis Grease
Brake and Control Linkage					
U.K.	Mobilgrease No. 4	Engine Oil	Shell Retinax C	Castrolease CL	Esso Grease
Overseas	Mobilgrease No. 4	Engine Oil	Shell Retinax C or A	Castrolease CL	Esso Bearing Grease

Front Suspension Dampers ... ... Luvax-Girling Piston Type Damper Fluid

Rear Shock Absorbers ... ... Armstrong Super (Thin) Fluid

SUMMARY OF REGULAR ATTENTIONS

		LUBRICANT	APPLICATION
DAILY INSPECTION. POINTS "A" ON DIAGRAM.	Check fuel supply by switching on the ignition and observing the gauge. Check engine oil level by dipstick or float indicator. 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. See that tyres are properly inflated (check pressures each week).		 See Page EZ1 See Page HX1
POINTS "B" ON DIAGRAM. After each 1,000 miles running. (1,600 kilometres running).	Front Suspension Arms, outer only, 4 points. Front Wheel Swivels, 2 points. Inspect Engine Oil Level Indicator or Dipstick. Inspect Gearbox Oil Level Dipstick. Inspect Battery for fluid level. Inspect Tyres for damage and repair. 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 rubber bushes and need no lubrication of any kind.	See page CZ8 See page CZ8 See Name Plate. " " " Add Distilled " Water. Engine Oil. —	Grease Gun. " " Fill up at Cap. Fill up at Dipstick.
POINTS "C" ON DIAGRAM. After each 5,000 miles running. (8,000 kilometres running).	*In addition to items already mentioned, attend to the following :* Drain and refill the Engine, and clean Sump Filter. Drain and refill Rear Axle Hypoid Bevel Casing. Drain and refill Gear Box. Clean By-pass Filter Element. Clean Air Silencer. 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 Propellor Shaft Joints. Check Front Wheel alignment and tracking. Check Steering Box 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. Check the Level of Brake Master Cylinder Fluid. Remove Road Wheels and change front right to rear left and rear right to front left, grease Wheel Studs.	See page CZ8 See Name Plate. See Name Plate. For Distributor See page CZ8, Chassis Pts. See page CZ8, Chassis Pts See page CZ8. See page CZ8. See page CZ8. See page CZ8. See page CZ8. Top up with Lockheed Fluid.	Cap on Valve Cover. Oil Funnel. " " Grease Gun. Grease Gun. Oil Funnel, add if necessary. Grease Gun. Grease Gun. Grease Brush. Oil Can. See page HY4. Oil Funnel. See HX2. Brush.
NOTE After draining Engine, and prior to refilling with fresh oil, remove the Sump and before re-assembling, clean the Sump and the Floating Filter. Use a new Sump Joint.			
POINTS "D" ON DIAGRAM. After each 10,000 miles or every year. (16,000 kilo-metres).	Fit new Filter Element in Main Oil Filter of Engine. Oil Trafficators, Door Hinges, Latches. Overhaul Dynamo, Starter, Distributor. Check Shock Absorbers. Check Steering Joints, and adjust for toe-in and backlash. 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. Adjust Striking Plates, if necessary. 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 pages CZ8. Engine Oil. Engine Oil.	Refill. Element ACM.11 Oil Can. Top up, if necessary.



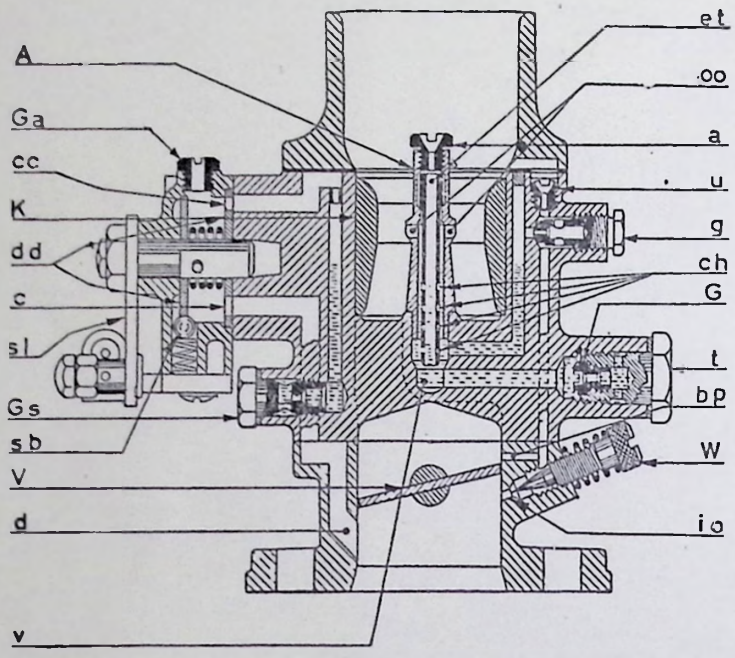
GROUP D

FUEL SERVICES

CARBURETTER

SOLEX CARBURTTER TYPES FAI. and AIC.

DIAGRAMMATIC SECTION



BI-STARTER

Ga	Starter air jet.
cc	Starter valve duct.
dd	Spring loaded disc valves
c	Starter mixture exit duct.
sl	Starter lever.
Gs	Starter petrol jet.
sb	Spring ball (bi-starter position)
d	Starter mixture delivery duct.

MAIN CARBURETTER

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

CARBURETTER.

Description.

The model FAI, Solex carburetter incorporates the Bi-starter principle in which the hand-operated mixture control on the dash for starting from cold has two positions—rich for cold starting, and the intermediate in which the petrol proportion is considerably reduced. In the intermediate position the car can be immediately driven away without the possibility of "overdosing".

It is difficult to show in one diagram all the parts simultaneously, so the float chamber, which is of standard design, has been omitted in the diagram on page DZ2.

Describing the main carburetter and referring to the diagram.

(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 passes out through the small holes 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 a 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 communicating with the mixture orifice (io) controlled by the spring-loaded and knurled-headed 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 and preventing a lean flat spot which might otherwise take place.

Adjustment.

The adjustment of the carburetter consists in the selection of a choke tube (K) of suitable diameter; a main jet (G) of suitable size to correspond with the choke tube 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 idling mixture strength at all points below the actual output value of the jet itself (g).

The Bi-Starter.

The diagram shows the Bi-starter as a disc valve controlled chamber, fed via the starter petrol jet (Gs) and the starter air jet (Ga), and put into operation by the lever (sl) which rotates the spring-loaded discs (dd) until the drillings in the right-hand disc register with the ducts (cc) by which the petrol enters and (c) by which the eventual mixture passes into the airway below the throttle at (d).

It differs from the original Solex starter in that, instead of having two positions, "shut" and "open", there is now an intermediate one, so that it is possible, when the lever is operated along the full length of its travel, to have a very rich mixture which will ensure

easy starting under the coldest conditions. Then, by pushing the lever back a short distance, another very much smaller drilling in the inner disc comes into operation. The effective position of the lever being located by the spring-ball (sb) which makes contact with a corresponding notch in the outermost disc. This cuts down considerably the mixture strength and permits either prolonged "semi-idling" for warming-up purposes, or the car being driven straight away under load without fear of fuel "over-dosing".

When the temperature has reached the point where the assistance of the intermediate starting mixture is no longer necessary, the control on the dash should be pushed fully home so that the holes in the right-hand disc will no longer correspond with the channels (c) and (cc).

As in the case of the main setting, the Bi-starter is adjusted to suit the needs of the engine by a selection of a suitable air jet (Ga) and petrol jet (Gs). This adjustment is done at the works and no alteration under normal circumstances is necessary from the standard selection. *See Page DZ5 for Jet Sizes.*

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 starting device or Bi-starter, 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 fuel chamber may be stale and difficult starting may be experienced during cold weather. It is therefore advisable to pump into the fuel chamber a fresh supply of petrol before attempting to start the engine.

The auxiliary carburetter forming the starting device of Bi-starter, as explained, gives :

(1) A mixture which is enriched proportionately as the temperature falls 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.

To start the engine switch the ignition "ON", pull out the dashboard control to the full extent and operate the starter switch. Immediately the engine fires, release the starter switch and push the dashboard control to the halfway or "Bi-starter" position. The car can now be driven away and the mixture control pushed right home immediately the engine will work without hesitation on the main carburetter. This can usually be done within half a mile (.8 kms.) of starting.

There are three stages in the use of the starting device or Bi-starter :—

(1) Dashboard mixture control pulled fully out to start.

(2) Dashboard mixture control pushed in half-way as soon as possible. This stage is for driving away.

(3) Dashboard mixture control pushed fully "home" after driving a few hundred yards.

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 in petrol and engine wear and tear.

SERVICE DZ1.
DISMANTLING THE CARBURETTER.

When designing the FAI model the principles of Solex simplicity and accessibility have been faithfully followed.

The pilot jet (g), the main jet (G), the starter air jet (Ga) and the starter petrol jet (Gs) are all accessible from the exterior without dismantling the carburetter.

Access to the interior is quite easy, after the air cleaner, if fitted, is removed.

Two slotted square headed bolts secure the top casting to the body of the carburetter, and the removal of these allow the top to be detached from the main body of the carburetter, 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.

SERVICE DZ2.
ADJUSTMENT OF THE CARBURETTER.

The sizes of the choke tube and those of the various jets for the Bi-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 the various jets should be checked against the table given below, and replacements fitted as necessary :—

Choke Tube :	24.
Main Jet :	125.
Air Correction Jet :	230.
Pilot Jet :	45.
Starter Air Jet :	4.
Starter Petrol Jet :	115.

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

Slow Running Adjustment.

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 enrichment takes place up to the limit of the pilot jet output ; conversely, by clockwise rotation the mixture is weakened.

Poverty of mixture is recognized 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 500 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.

All adjustments to the idling and main mixtures must be carried out when the engine is at normal working temperature.

The substantial valve overlap and rubber frame-block mountings of modern engines do not permit the clock-like tickover of earlier days. About 400 to 500 r.p.m. is the normal idling speed for present day engines.

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 a 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).

Messrs. Solex Limited London's address is : "SOLEX WORKS", 223/231 Marylebone Road, London, N.W.1.

SERVICE DZ3.
TRACING FAULTS.

There is never any question of definite failure with the Solex carburetter. 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.

SERVICE DZ4.
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 clean. 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 on the Fuel Pump in section DY.*

SERVICE DZ5.
FLOODING.
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 carburetter, 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.

SERVICE DZ6.
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 *Service DZ2, Page DZ5*. If the slow running cannot still be obtained, check the valve and ignition timing, and the condition of the distributor as described on *Pages BZ15, BZ16 and BX3*.

If the slow running still remains difficult suspect an air leak such as would occur with a carburetter 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.

SERVICE DZ7.
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 Section BY, Group B on Ignition.*

(4) That the rocker adjustment and valve timing are correct. *See Pages BZ13 and BZ 15, Group B.*

(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 Section BZ, Page BZ12.*

(6) That the silencer is not choked.

SERVICE DZ8.
OVERHEATING.
Check.

(1) That the jets are clean and that they and the choke are of the sizes given in the table *on Page DZ5.*

(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 BY, Page BY2* 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.

SERVICE DZ9.
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 *in Service DZ2, Page DZ5.*

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

(3) That the slow running adjustment is correct, *see Service DZ2.*

(4) That the valve timing is correct, *see Group B, Page BZ15.*

(5) That the distributor automatic advance and retard mechanism is working freely and point gaps and ignition timing are correctly set. *See Pages BY2 and BY7.*

SERVICE DZ10.
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.

SERVICE DZ11.
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 33 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 *in Service DZ2.*

(2) That the distributor is working in accordance with the conditions described in the Ignition *Section, see Page BY2.*

(3) That the rocker adjustment and valve timings are correct. *See Pages BZ13 and BZ15, Group B.*

(4) That the sparking plugs are Champion No. N.8, that they are in good condition and with a gap of .025″ (.63 mm.) between their electrodes.

(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 Page HX1.*

(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.

SERVICE DZ12.
FUEL FILTERS.
Cleaning.

There are two filters in the fuel system, the first is in the petrol tank, and forms part of the drain plug, and the second is in the body of the S.U. Fuel Pump.

Access to the one in the petrol tank is obtained by removing the drain plug. The

surge of petrol which occurs in a tank while the car is in motion helps to keep this filter clean ; but it is advisable, on a convenient occasion, such as when the tank is empty or partially so, to remove the filter and clean it.

To remove the one in the fuel pump, proceed as follows :—

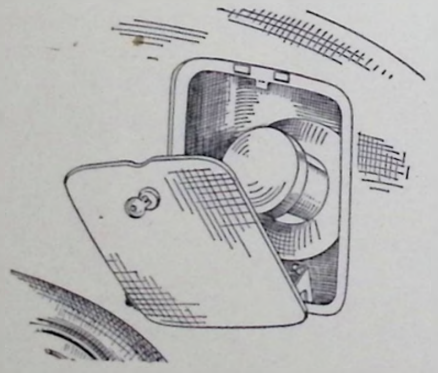
Detach the pump from the car by disconnecting the lead attached to the terminal on the pump, removing the feed and delivery pipes, and the two nuts and washers which secure the unit to the side of the bonnet platform. Hold the pump securely in a vice fitted with lead clamps and remove the filter which forms part of the hexagon nut in the bottom of the pump body.

Clean the elements of both tank and pump filters in petrol with a stiff brush. Do not under any circumstances use rag. Replacement is the reversal of removal.

PETROL TANK.

Description.

The Petrol tank, the capacity of which is 10 gallons (45.4 litres) is situated in the rear of the car and has a concealed filler. The lock of the door of the filler compartment is opened by the ignition key. When the ignition is switched "ON" the gauge on the instrument panel will show the extent of the fuel in the tank.



SERVICE DZ13.

REMOVAL AND REPLACEMENT OF FUEL TANK UNIT.

(1) Drain the tank of all petrol.

(2) Disconnect the main feed pipe union from the tank. This is situated on the vertical face of the tank, and access is obtained to it from beneath the car.

(3) Lift the luggage boot lid and floor. Remove the tools, jack and spare wheel. Disconnect the lead from the tank gauge unit and draw out the lead from the clips.

(4) Release the clips securing the filler pipe hose to the tank, open the door of the filler opening compartment, and draw out the filler pipe. Note the rubber grommets for the pipe, one in the filler opening compartment and the other in the luggage boot.

(5) Remove the five set pins and three bolts and shakeproof washers securing the tank to the body and lift the tank out of position.
Note the rubber joint between the tank and body.

Replacement is the reversal of dismantling with the following additions.

Do not neglect to clean with a stiff brush and petrol the filter gauze which forms part of the drain plug. If the tank gauze unit is removed do not neglect to fit a replacement joint between the unit and the tank when re-assembling. Any jointing compound used must be applied sparingly and only along the outer edge of the joint faces. The reason being that should a quantity of the compound squeeze out into the tank it would be carried in solution by the fuel to the carburetter and may adversely affect the working of the float chamber mechanism.

Lastly, position the rubber joint between the tank and body correctly and the filler pipe so that the cap can be opened readily and downwards, then secure in position by means of the bolts and set pins.

GROUP D

FUEL SERVICES

FUEL PUMP

THE SU. FUEL PUMP.

DESCRIPTION.

The pump is capable of delivering eight gallons of fuel per hour through a suction lift of four feet, with no general maintenance other than an occasional cleaning of the filter. *See Service DZ12, Page DZ7.*

The unit consists of three main assemblies (see Fig. 1, page DY2) : the body, the magnet assembly and the contact breaker.

The body is composed of two aluminium die castings (A) and (B), the larger of which (B) has the filter (X) screwed into the bottom, the inlet union(C) into the side, and the outlet (D) into the top.

The outlet union tightens down on to the delivery valve cage (E) which is clamped between two fibre washers (F) and (G). In the top of the cage is the delivery valve, (H) a thin brass disc, held in position by a spring clip (I), while the suction valve (K) a similar disc, rests on a seating machined in the body. Holes connect the space between the valves to the pumping chamber which is a hollow depression on the forward face of the small body casting. The space is enclosed by a diaphragm (L) clamped between the magnet housing (M) and the smaller of the two bodies (A). A bronze rod (P) is screwed through the centre of the armature to which the diaphragm is attached, and passes through the magnet core to the contact breaker located at the far end. A spring (SL) is interposed between the armature and the end plate of the coil. There is a fabric joint washer (Z) between the large and small body castings.

The magnet consists of a cast iron pot (M) having an iron core wound with a coil of copper wire which energises the magnet.

Between the magnet housing and the armature are fitted eleven spherical edged brass rollers (S) which locate the armature centrally within the magnet and allow absolute freedom of movement in a longitudinal direction.

The contact breaker consists of a small bakelite moulding which carries two rockers (U) and (UI) both hinged at one end to the moulding and connected together at their top ends by two small springs arranged to give a throw-over action. A trunnion is fitted into the centre of the inner rocker and the bronze rod (P) connected to the armature is screwed into this trunnion. The outer rocker (U) is fitted with a tungsten point which makes contact with another tungsten point on the spring blade (V). This blade is connected to one end of the coil, the other end of which is connected to the terminal (W).

To ensure a good earth connection, a short length of flexible wire connects the outer rocker (U) to one of the screws holding the bakelite moulding to the magnet housing.

THE ACTION OF THE PUMP IS AS FOLLOWS :—

When the pump is at rest the outer rocker lies in the outer position and the tungsten points are in contact. The current passes from the terminal, through the coil, back to the blade, through the points and to earth, thus energising the magnet and attracting the armature. This comes forward bringing the diaphragm with it and sucking petrol through the suction valve into the pumping chamber. When the armature has advanced nearly to the end of its stroke the "throw-over" mechanism operates and the outer rocker flies back, separating the points and breaking the circuit. The spring (SL) then pushes the armature back forcing petrol through the delivery valve at a rate determined by the requirements of the engine. As soon as the armature gets near the end of this stroke the "throw-over" mechanism again operates, the points make contact and the cycle operation is repeated.

SERVICE DY1.
FAILURE TO DELIVER FUEL.

Should the pump fail to deliver fuel, disconnect the petrol delivery pipe from the pump. If the pump then works the most likely cause of the trouble is a sticking needle in the float chamber of the carburetter. Should the pump not work disconnect the lead from the terminal and strike it against the body of the pump. If it sparks, current is available in the wire. Then remove the bakelite cover and touch the terminal with the lead. If the pump does not operate and the points are in contact but a spark cannot be struck off the terminal it is probable that the points are dirty. These can be cleaned by inserting a piece of card between them, pinching them together and sliding the card backwards and forwards. If when the wire is connected to the terminal and the tickler of the carburetter is depressed the points fail to break it is possible that there is either an obstruction in the suction pipe, which should be cleaned by blowing down it with a tyre pump, or there is something in the pump itself preventing correct movement. This latter condition may be due to either the diaphragm having stiffened or to foreign matter in the roller assembly which supports

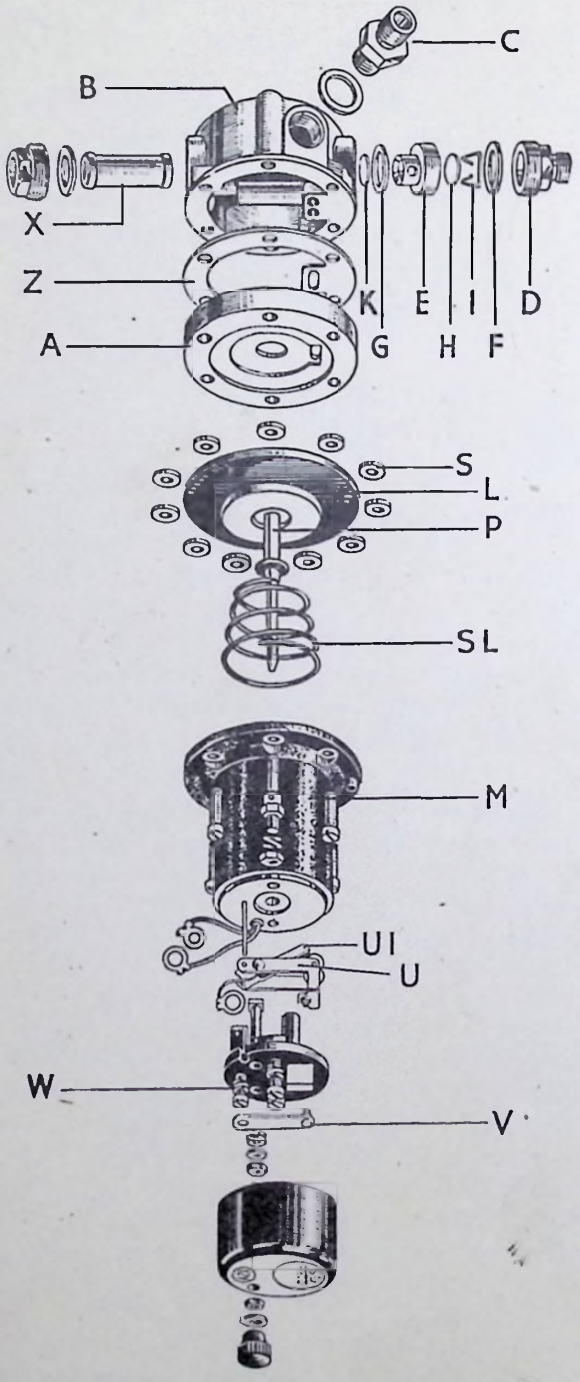


Fig. 1. Exploded View of Fuel Pump.

the diaphragm. The diaphragm should be removed, the whole assembly cleaned and re-assembled in accordance with the instructions given below.

If the pump keeps on beating without delivering any petrol it is possible that a piece of dirt is lodged under one of the valves. These can be removed by unscrewing the top union and lifting the valve cage out. When replacing it see that the thin hard red fibre washer is below the valve cage and the thick coloured one above. A choked filter or an obstruction on the suction side will cause the pump to get very hot and eventually cause failure.

SERVICE DY2.
PUMP NOISY.

If the pump becomes noisy look for an air leak on the suction side. The simplest way to check is to disconnect the petrol pipe from the carburetter and allow the pump to pump petrol into a pint can. If the end of the pipe is then submerged in the petrol and bubbles come through there is an air leak, which must be found and cured. Probable causes, loose union connections or punctured pipes.

SERVICE DY3.
ADJUSTMENTS.
The Contact Breaker.

The contact breaker should be assembled on to the pedestal in such a way that the rockers are a free fit but without side play. Excessive side play on the outer rocker will allow the points to get out of line, while excessive tightness will make the contact breaker sluggish in action. To obtain the required freedom, square up the outer rocker with the aid of a pair of thin nosed pliers. The hinge pin is case-hardened and under no circumstances must pieces of ordinary wire be used. In all instances a standard pin must be fitted.

The spring contact blade must be fitted directly against the bakelite pedestal and under the tag to which the lead is attached. The blade should rest against the ledge on the pedestal when the points are apart and should not be so stiff as to prevent the outer rocker from coming right forward when the points are in contact. The points should just make contact when the rocker is in the midway position.

The simplest way to check this condition is to hold the blade in contact with the pedestal, taking care not to press on the overhanging portion, and see whether a .030" (.8 mm.) feeler gauge will pass between the white rollers and the cast iron body of the magnet. If necessary set the tip of the blade to obtain the correct gap of .030" (.8 mm.).

The spring washer on the 2 BA screw to which the earthing connection is taken must be fitted below the tag, that is next to the pedestal. The reason is that the spring washer cannot be relied on as a conductor, and the brass tag must therefore be next to the head of the screw.

All four connections, that is the ends of the earthing tag and those of the coil, must be soldered. The coil end going to the terminal must be soldered to the tag and not to the nut.

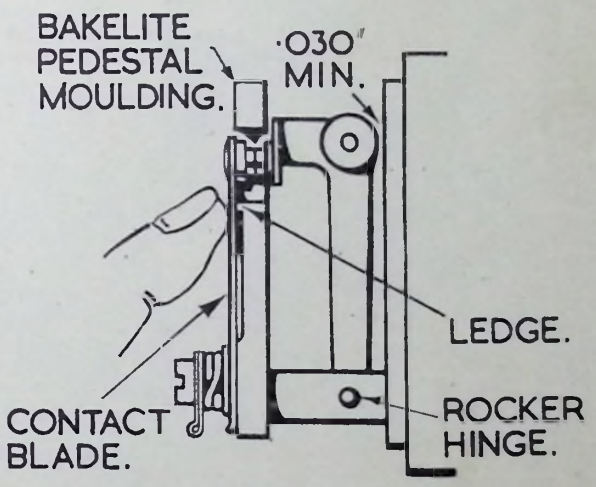


Fig. 1. Rocker Assembly.

The correct order for the assembly on the terminal is the spring washer next to the bakelite pedestal, then the tag, the lead washer and the countersunk nut.

A lead washer is necessary at this point to ensure a good connection. Under no circumstances should this assembly be shortened either by leaving out the spring washers or in any other way, as any such action will cause the pedestal to break when the nut, holding the cover in position, is tightened.

SERVICE DY4.
ADJUSTING THE MAGNET ASSEMBLY.

Under no circumstance should an attempt be made to remove the core of the magnet, since to assemble and locate it correctly special press tools are needed.

The armature spring should be fitted with the large diameter in the mouth of the pot and the small diameter resting against the armature. Do not stretch the armature spring since this will disturb the action of the pump.

steadily. If the contact breaker throws over, the armature should be screwed in until this throw over action does not occur and then unscrewed one-sixth of a turn at a time until a position is found at which the contact breaker just throws over. Take care that the armature is not jerked in but pressed in with a steady pressure. The armature should then be unscrewed two-thirds of a turn, that is four holes, at which position the setting should be correct. Do not forget that this is done with the points out of contact. When a new diaphragm is fitted it is possible that

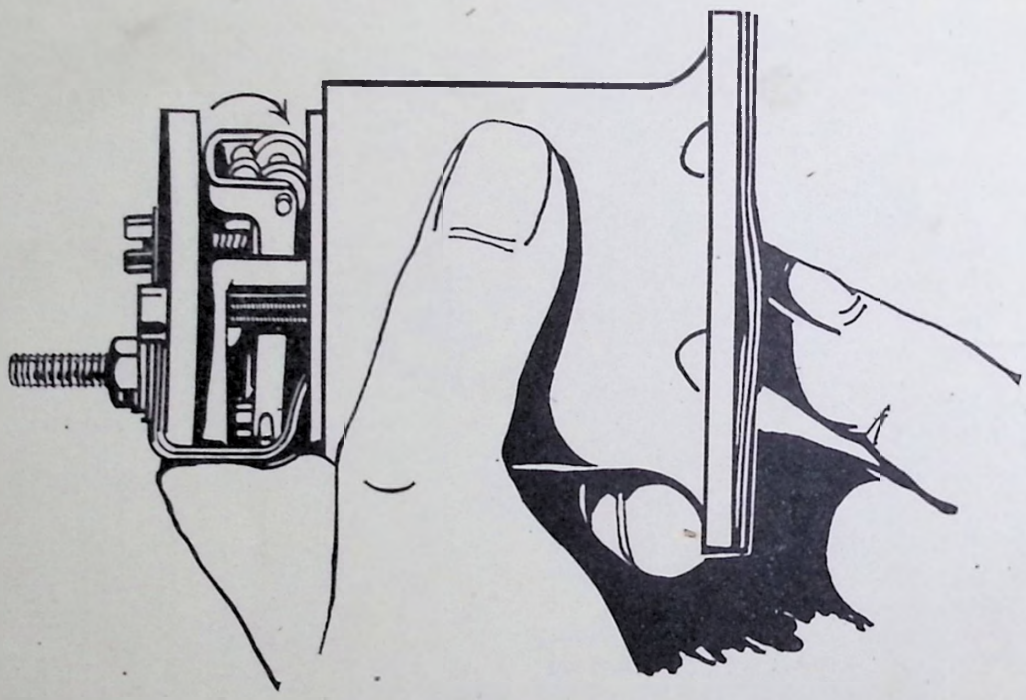


Fig. 1. Adjusting Armature.

Adjust the Armature as Follows.

The contact blade on the pump must be swung to one side while the adjustment is being made. Take care to fit the impact washer into the recess of the armature, which should then be screwed in and the eleven rollers placed into position. Do not dope the diaphragm.

The magnet assembly should be held in the left hand in an approximately horizontal position and the armature pushed in with the thumb of the right hand pressing firmly but considerable pressure will be required to push it right home. If there is doubt about the point at which the contact breaker throws over, come back one-sixth of a turn.

The cast iron body should then be placed into position on the pump body with the drain hole in the former in line with the filter plug on the brass body, that is, at the bottom.

Take care to see that the cast iron body sits down on the pump body before the screws which hold it in place are inserted. If one of the rollers falls out of position it will be

trapped between the two parts and cut a hole in the diaphragm. Five screws and an earthing terminal should then be fitted to hold the two parts together. These should not be screwed right home, for it is necessary that the diaphragm is stretched to its outermost position before tightening the screws down. To stretch the diaphragm a special forked wedge which can be obtained from the S.U. Pump Distributors. *See Fig.* 1.

This fork is inserted between the white roller on the outer rocker and the body of the pump and pressed in under the tips of the inner rocker until it lifts the trunnion in the centre of the inner rocker as far as it will go. If a fork is not available the diaphragm may be stretched by holding the points in contact, inserting a match stick under one of the white fibre rollers and passing a current through the pump. While the diaphragm is held in this position the five screws and the earthing terminal should be tightened down fully.

The pump should then be put on test. The use of a cut away cover while testing prevents the hinge pin from falling out and also makes it possible to observe the action of the contact breaker.

The pump should be mounted suitably three feet above the tank from which the testing fuel, either petrol or paraffin, is to be drawn. When switched on the pump should prime promptly and deliver a continuous stream of fuel from the outlet pipe.

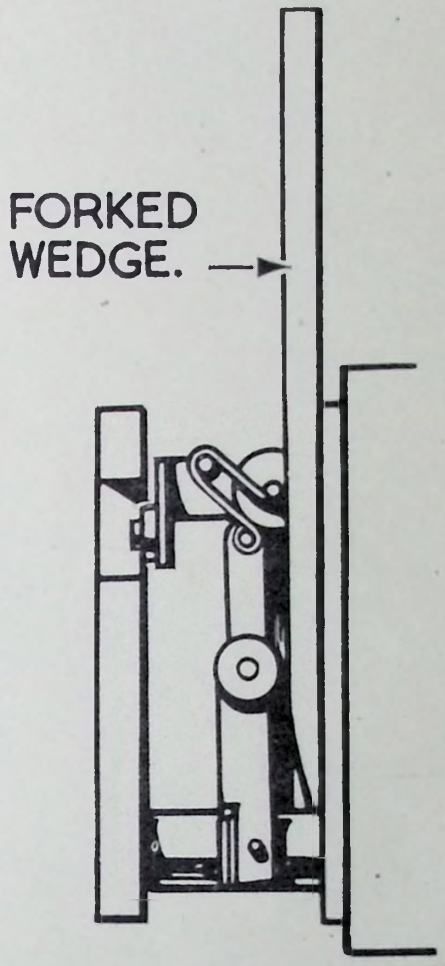


Fig. 1. Fork for Diaphragm Stretching.

NOTE. There are three important instructions which repairers are apt to overlook, and when not observed the working of the pump can be seriously affected, they are :—

(1) To keep the blade out of contact while adjusting the correct diaphragm setting.

(2) To press steadily and firmly on the armature while obtaining the setting. A jerky or bumpy action must be avoided.

(3) Failure to stretch the diaphragm to the limit of its stroke while tightening up the body screws.

GROUP E

COOLING SYSTEM SERVICES

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 brass 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's 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 re-circulated by the pump.

Maintenance.

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 so as described in *Service EZ1* 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 three drain cocks and fill as previously directed with soft water. For position of cocks see Page EZ2, Fig. 2 and 3, also Page EZ3, Fig. 2 and 3.

SERVICE EZ1.

TO FILL AND DRAIN THE COOLING SYSTEM.

The level of the water in the radiator header tank fitted with a non-pressure type of cap should stand 1 inch (25 mm.) below the filler opening. Should the level be higher than this figure the excess will be ejected on the water expanding as the result of temperature rise. On cars fitted with filler caps having a pressure-vacuum valve, the level of the water must be 1.5 inches (37 mm.) below the filler opening. The heater tap must be open when filling the cooling system.

Fig. 1 on Page EZ2 shows the positon of the water level in relation to the filler opening

Filler Cap with Pressure-Vacuum Valves.

Cars approximately after Chassis No. D2850S 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 that the fibre washer A is in good order. The pressure valve B is set to blow off at 4 pounds per square inch (.28 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.

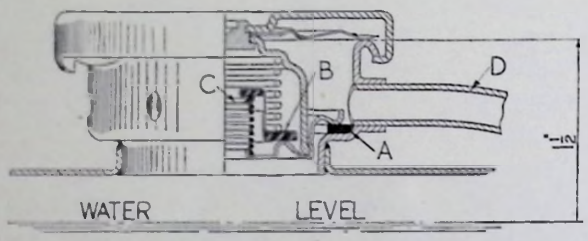


Fig. 1. Section through Pressure-Vacuum Cap.

Fig. 1 shows a section through the pressure-vacuum caps, and the water level in radiators fitted with caps of this type. With radiators fitted with the ordinary type of cap read 1 inch instead of 1.5 inches shown.

To Drain Radiator.

To drain the entire system the three taps situated as follows must be opened, and when draining a system provided with a Pressure-vacuum valve type of cap the cap must first be removed. Always removed the cap slowly and when replacing turn down quite tight. (*See Fig. 1, Page EZ3*).

The first tap is (Fig. 2) in the bottom nearside corner of the radiator, the second (Fig. 3) in the body of the water pump on the offside, the third on the offside of the oil indicator rod or dipstick. (*See Fig. 3 on Page EZ3*).

See that the Heater control tap, (*See Fig. 2 on Page EZ3*), on the rear side of the cylinder head is **open,** so that the Heater element can drain off through the engine ; the tap is open when the lever is in an upright position.

Should no water issue from any particular tap clean the central hole with a short length of stout wire.

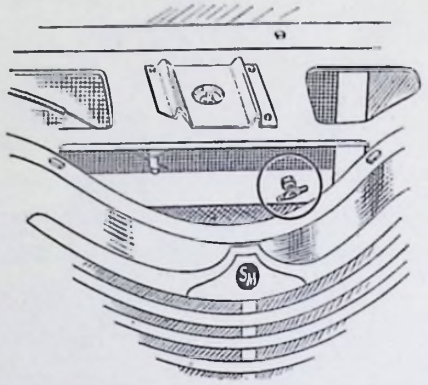


Fig. 2. Radiator Drain Tap.

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.

On cars fitted with a Pressure-vacuum filler cap the level must be 1.5 inch (38 mm.) below the filler opening. *See Figure* 1. The heater cock must be open when filling the cooling system.

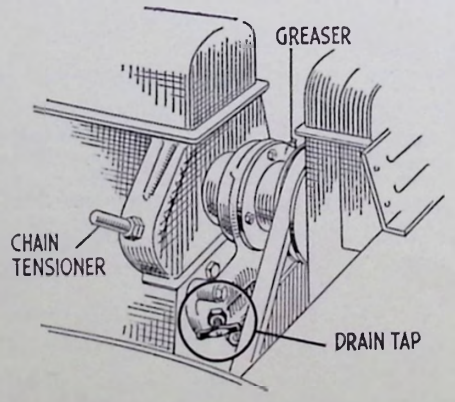


Fig. 3. Pump Drain Tap.

SERVICE EZ2.
TO REMOVE AND REPLACE THE RADIATOR.

(1) Lift the bonnet and drain the cooling system as described in *Service EZ1*.

(2) Detach the plate secured to the radiator by four nuts and spring washers and by four nuts, bolts and spring washers to the front grille.

(3) Remove the four nuts and spring washers securing both side plates to the radiator and prise the plates clear of the securing studs.

(4) Detach the water outlet hose from the outlet pipe on the cylinder head by releasing the clip. Deal similarly with the water inlet hose.

Fig. 1. Showing top of Pressure-vacuum Cap.

(5) Detach the inlet water pipe flange from the water pump housing. Two bolts, nuts and washers.

(6) Remove the two self-locking nuts securing the radiator to the chassis support bracket and lift the radiator out of position. *Note the rubber seating washers.*

Replacement is the reversal of the foregoing. Tighten the bottom securing nuts until they are flush with the tops of the studs.

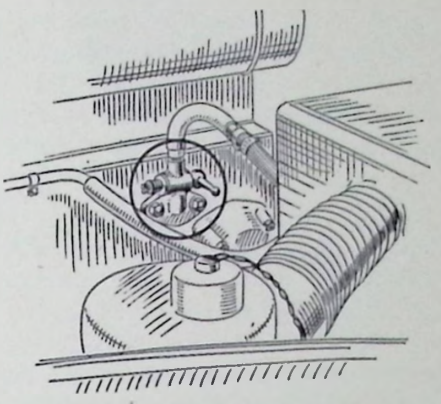


Fig. 2. Heater Drain Tap.

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.

SERVICE EZ4.
TO REMOVE AND REPLACE THE WATER PUMP.

(1) Lift the bonnet and drain the cooling system.

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

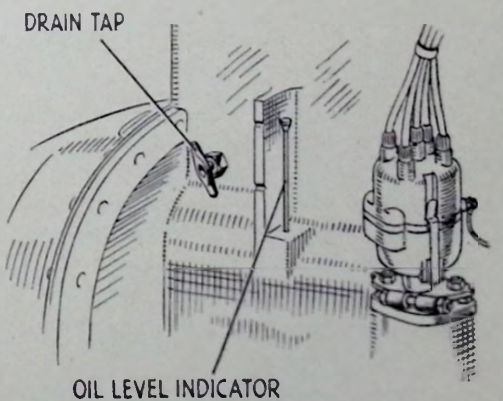


Fig. 3. Cylinder Block Drain Tap.

(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 *Service EZ7, Page EZ5*. Tighten the self-locking nuts only until flush with the ends of the studs.

NOTE. It is important that the entire system be drained as described in Service EZ1 for if the radiator alone is drained, there is the possibility that an air lock may occur in the water pump when the radiator is refilled.

SERVICE EZ5.
TO DISMANTLE AND RE-ASSEMBLE THE WATER PUMP.

(1) Remove the unit from the engine. *See Service EZ4.*

(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.

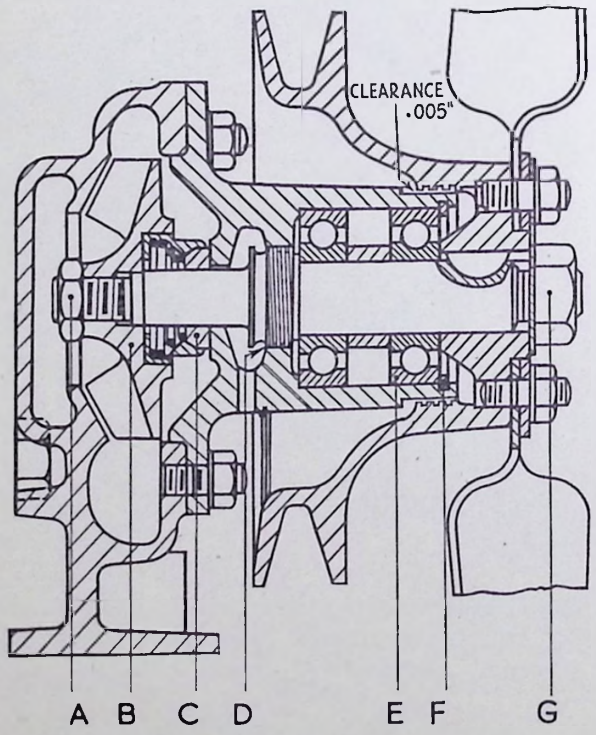


Fig. 1. Section through Pump.

A. Impeller Retaining Nut.
B. Impeller.
C. Gland Assembly.
D. Oil Retainer.
E. Bearing.
F. Bearing Retainer.
G. Fan Retaining Nut.

SERVICE EZ6.
TO RECTIFY A WATER LEAK FROM THE WATER PUMP GLAND.

(1) Remove pump from engine. *See Service EZ4.*

(2) Carry out operations 1 *and* 2 *in Service EZ5.*

(3) 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.

(4) 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 *as given in operations* 4, 5 *and* 6 *of Service EZ5* and machine the seating so that its surface is smooth, flat and right angle to the axle of the 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.

Re-assemble as advised in *Service EZ5.*

On some of the early cars the fan blade retaining nut "G", *Fig.* 1, *Page EZ4*, was .71 inches across the flats. Replace these when possible with one .82 inches across the flats.

Maintenance.

The fan bearings are packed with grease when the unit is assembled, but it is necessary, as directed in the lubricating *Page CZ5* that a small quantity be injected after each 5,000 miles (8000 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. For adjustment of *Fan Belt see Service EZ7.*

SERVICE EZ7.
TO ADJUST THE DYNAMO AND FAN BELT.

Release the nut on the forward end of the dynamo pivot bolt, the bolt and nut holding the adjusting link to the dynamo support and the bolt and nut securing the dynamo to the adjusting link. Raise the body of the dynamo upwards until it is just possible to depress the length of the belting between the fan and crankshaft pulleys by approximately $\frac{1}{2}$", then securely tighten the adjusting bolt and nut, also the nuts of the dynamo and adjusting link pivot pins.

The nuts on the ends of the long pin on which the dynamo pivots must not be tightened dead tight, since any such action may tend to fracture the lugs on the dynamo. These nuts are fitted with tabbed washers to prevent unloosening, and they should be tightened just sufficiently to secure these tabbed washers to the face of the Dynamo Bracket lugs. On later productions the forward lug of the Dynamo is secured to a stud on the water pump casing and the rear lug to an "L" shaped bracket held to the crankcase by two bolts. When adjusting the Dynamo belt on this type of mounting, release the nuts of the two pivot bolts in addition to the nut and bolt securing the adjusting link. Tighten all nuts released after the adjustment is completed. If the "L" shaped bracket is removed tighten the pivot bolt and nut securing it to the Dynamo lug before tightening the bolts securing the "L" bracket to the crankcase thus avoiding fracturing the Dynamo lug.

Do not on any account allow the belt to run too tight.

GROUP F

STEERING AND SUSPENSION SERVICES

FRONT SUSPENSION

Description.

The front suspension is a fully independent coil and special wishbone system, controlled by Girling Telescopic D.A.5 Type Dampers and an Anti-Roll Bar device. 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 "L" Type High Efficiency Worm and Ball Gear. The linkage is by Lockheed Thompson joints moved from a central lever mounted on needle bearings and controlled by a 17" two-spoked Steering Wheel, in the centre of which are fitted the trafficator and horn switches.

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 Group "C" which should at this juncture be read carefully.

Wheel Camber.

This is the angle at which the topmost point of each front wheel leans away from the centre line of the car and from the vertical. The dimension of the angle is $\frac{1}{2}°$—$1\frac{1}{2}°$ and no adjustment is provided, but should an alteration appear necessary the top arm chassis bracket can be moved to a limited extent as described on pages *FZ13 to 16*.

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 $4\frac{1}{2}°$—$5\frac{1}{2}°$ and as in the case of the Wheel Camber no adjustment is provided.

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°—45' and like wheel camber and swivel pin inclination, no adjustment is provided.

SERVICE FZ1. 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 shortest 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.

SERVICE FZ2. 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.

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) 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 slogger.

(3) Remove the lock stops and fit the central steering arm locating jig, Service Part No. 24082N, *see Fig. 1, Page FZ3* as shown in the diagram.

(4) Release the lock nuts A *Fig.* 1, *Page FZ3* at each end of centre tube of the track rod. 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.

As a final operation remove the centralising jig, replace the lock stops and set them as directed in *Service FZ1*.

(5) 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. The total "toe in" for both wheels being $\frac{3}{16}$".

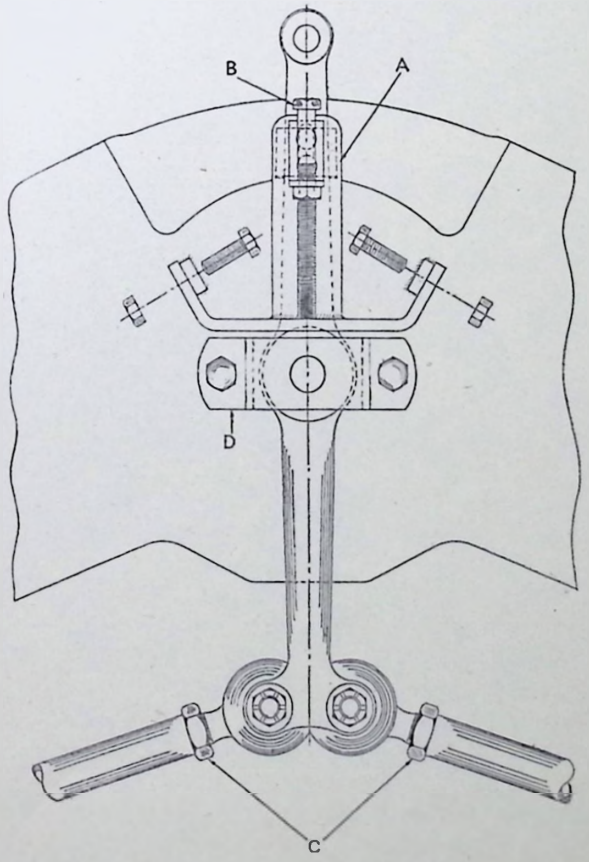


Fig. 1.
Method of using Steering Arm Locating Jig.

SERVICE FZ3.
TO REMOVE AND REPLACE A FRONT HUB.

(1) Jack up the wheel concerned by placing a jack under the boss which carries the rubber buffer on the lower front suspension arm 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 machined in the radial flange.

(3) Draw out the cotter and remove the central securing nut 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 Group C*.

(3) That the new 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 front 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.** (*See Note on Figure* 2, *Page FZ6*).

If the adjustment has been made correctly the wheel should spin freely without end play. Check that this condition is present.

SERVICE FZ4.
TO REMOVE AND REPLACE THE TOP SUSPENSION ARMS AND/ OR RUBBER BEARING BUSH ASSEMBLIES.

(1) Jack up the car under the lower suspension arm and remove the front hub and brake back plate.

(2) Detach the brake hose and pipe union junction from the chassis bracket of the suspension arm.

(3) Remove the cotter and nut securing the upper suspension arm trunnion to the swivel pin.

(4) Release the clamp screws securing the arms to the main spindle and the nuts on the ends of the spindle move the trunnion upwards out of engagement with the swivel pin.

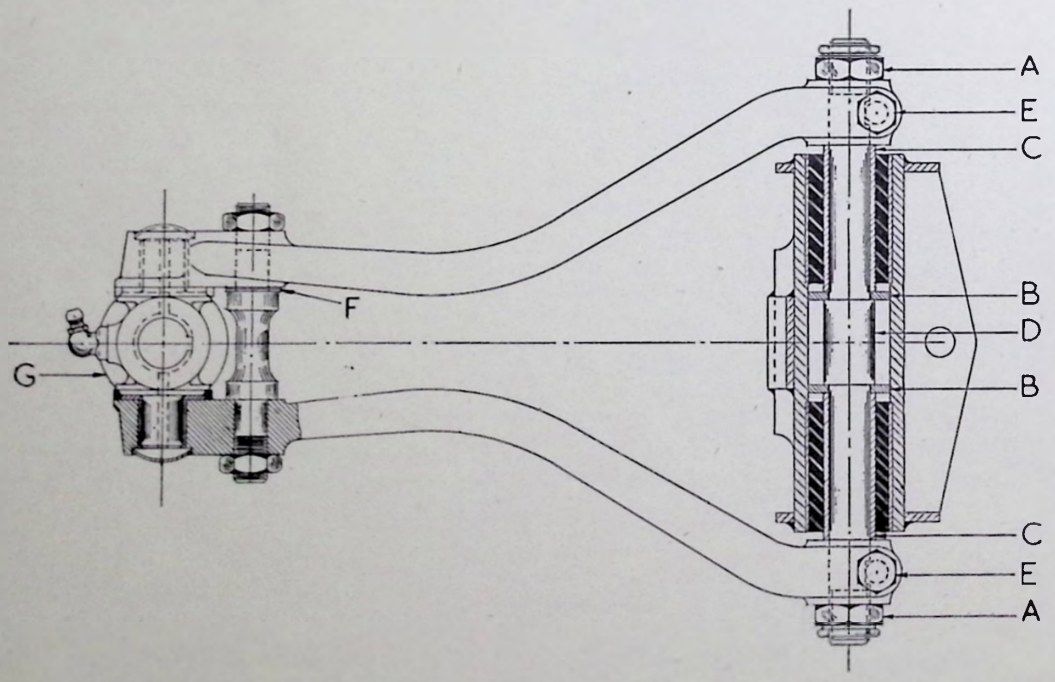


Fig. 1.
Section through Top Suspension Arm Bearing Bush Assemblies.

(5) Remove the three nuts securing the horizontal flange of the bracket to the chassis, the bolt and nut with spring washer securing the vertical flange to the chassis and detach the assembly. When doing so, note the number and position of any shims under the horizontal flange of the bracket and the plain circular washers between the vertical flange and chassis. The purpose of these shims is to position the bracket on the chassis in a manner which will allow the trunnion marked G in sketch 1, (*Page FY4*), to slide freely over the swivel pin. Pay particular attention to preserve these shims and washers and to replace them as removed.

(6) Secure the assembly in a vice. Remove the nuts on the main spindle and the two clamp bolts. Note the adjusting shims "F", Fig. 1, 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. (*See Fig. 1. Page FZ4*).

(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. 1*. If new thrust washers are fitted add or subtract shims at "F" until the trunnion moves freely without 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 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 striking it in the required direction with a lead mallet, or by adding or subtracting shims previously referred to until the desired effect is obtained.

(6) Tighten and cotter the nut on the swivel pin in a position where the swivel axle is free to move without undue "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 clamp bolts "E".

Do not neglect as a final operation to adjust and bleed all brakes and to replace all self-locking nuts removed.

SERVICE FZ5.
TO REMOVE AND REPLACE THE BRAKE BACK PLATES AND BRAKE SHOES.

Read carefully Service FZ3 and FZ4, first and then :—

(1) Remove the wheel and front hub complete.

(2) Remove the hydraulic brake connections 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.

SERVICE FZ6.
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 anchor 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 cotter and nut on the end 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. See Sketch* 2.

(4) Remove the self-locking nut of the swivel pin pivot pin, drive 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 see that the oil holes register and note it is preferable to broach the bushes 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 given in *Fig.* 1, *Page FZ4,* and observe the instructions in connection with the fitting of the pivot pin given in *Fig.* 1.

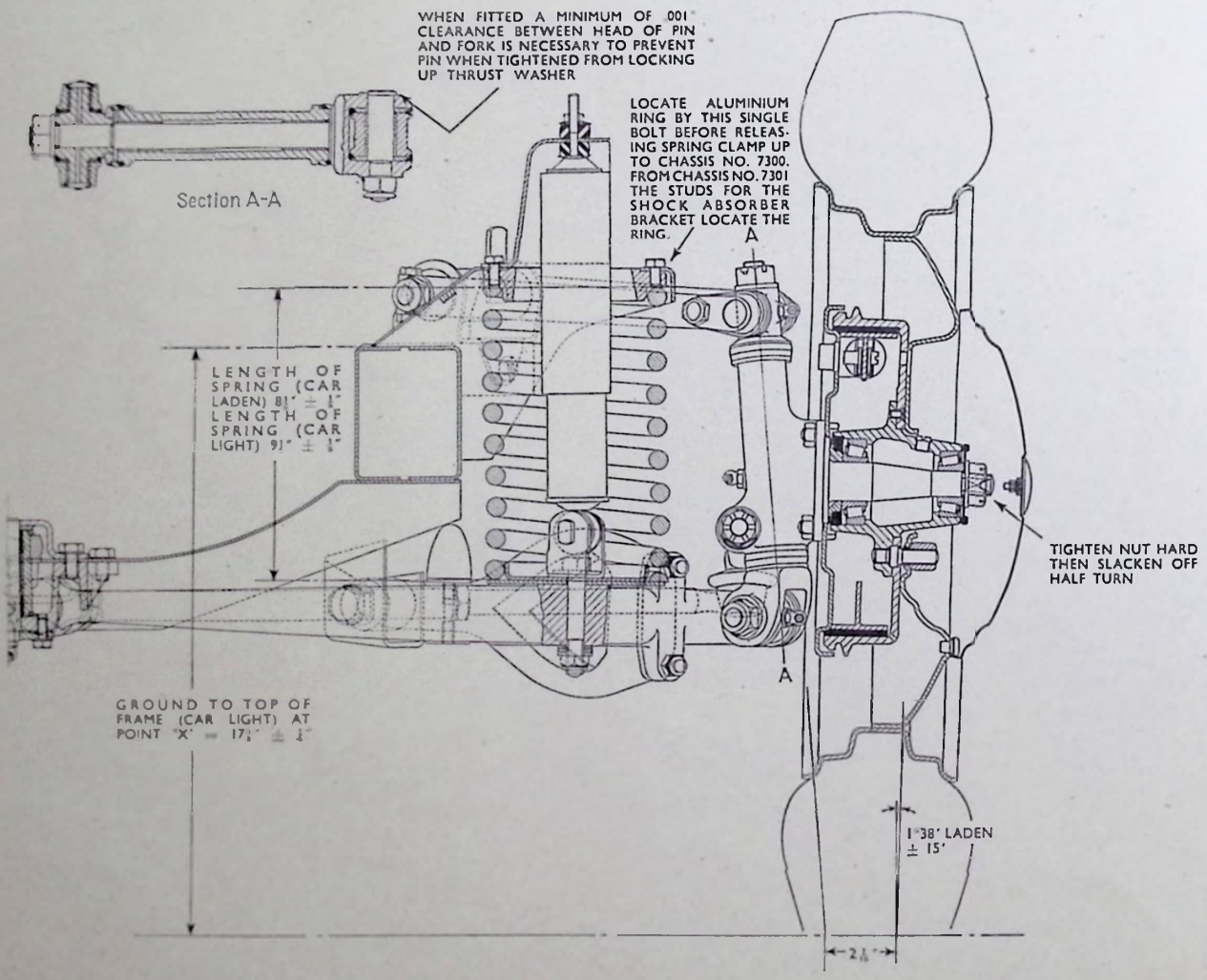


Fig. 2. Front View of Front Suspension.

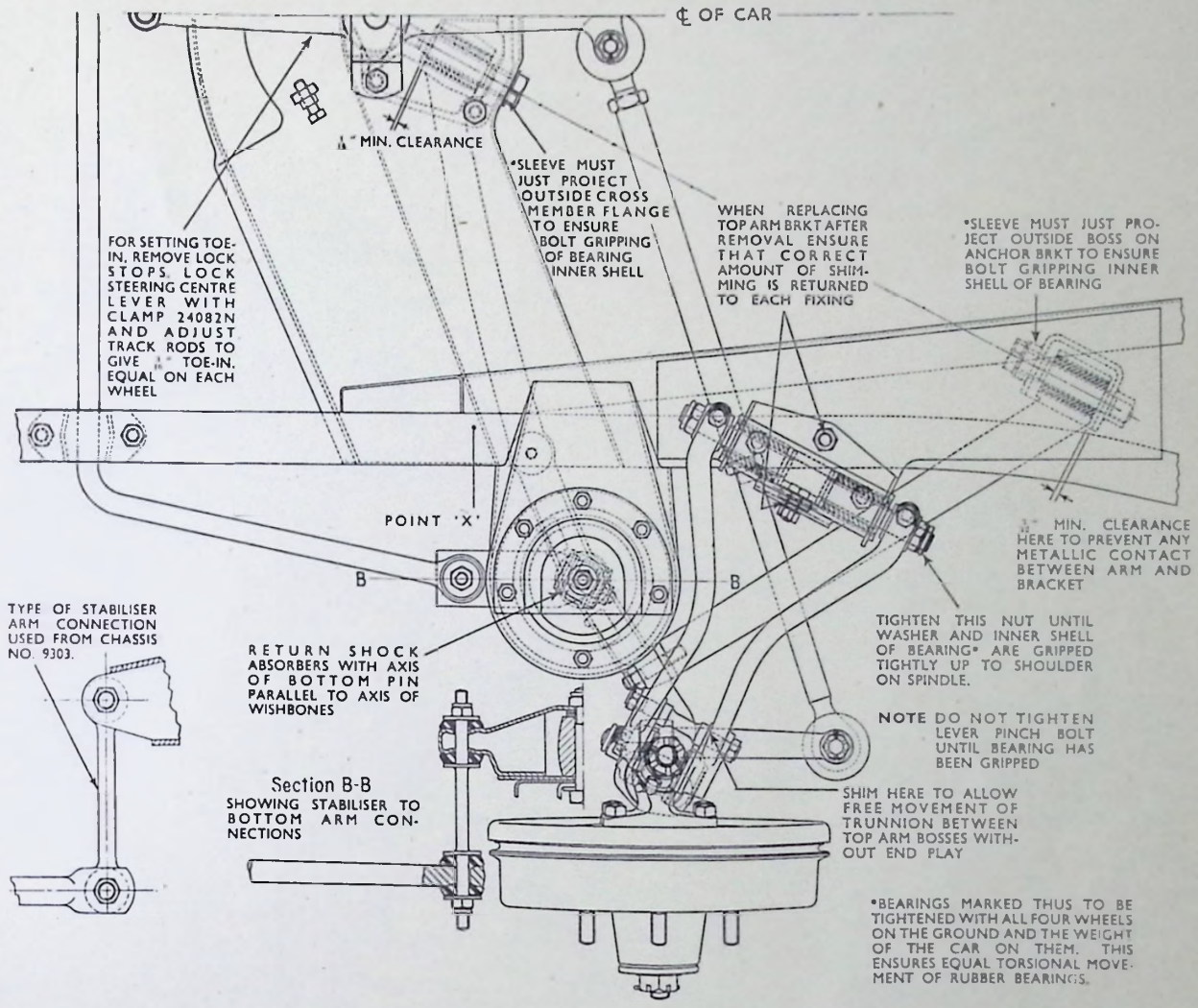


Fig. 3. Plan View of Front Suspension.

(3) Cotter and tighten the swivel pin nut in position where the swivel is free to move without undue up and down motion.

(4) Do not neglect to adjust and bleed all brakes, or to renew any self-locating nut removed.

SERVICE FZ7.
TO REMOVE AND REPLACE A FRONT SUSPENSION DAMPER.

NOTE. Under no circumstances attempt to remove a Damper when the full weight of the car is not being taken by the Front Suspension Springs.

(1) Place the pad of a Jack under the front suspension arm to which the damper to be worked on is attached, and lift the wheel off the ground.

(2) Remove the wheel.

(3) Remove the lock and securing nuts holding the top end of the damper to the top anchor bracket and, if fitted, the bolt securing the steady stay to the wing and move the stay out of the way.

(4) Remove the five $\frac{5}{16}$" set bolts securing the anchor bracket to the spring top cap or strap and detach the bracket.

Note. *After Chassis No. D7301 the strap is held by four $\frac{3}{8}$" studs, shakeproof washers and nuts.*

(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 between the under surface of the suspension arm and bracket.*

(6) Remove the nut and pivot pin and detach the damper.

Replacement is the reverse of Dismantling, but observe the following :—

Tighten the nut of the pivot pin until it is against the shoulder of the pin 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 Figures 2 and 3. With the damper in this position one edge of the lower fixing bracket should register against the strip welded to the top surface of the spring bottom bracket.

SERVICE FZ8.
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 and at a point some six inches to the rear of the pivot pin bush of the strut and just take the weight of the car.

(3) Remove the Damper, *see Service FZ7*, the two plain washers normally fitted in the space *marked* A in *Figure* 4, and the sixth bolt holding the aluminium ring to the chassis bracket. On later productions where a strap type of top Damper bracket is used, the locating bolt is omitted, the strap is held by four bolts.

(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 nut 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

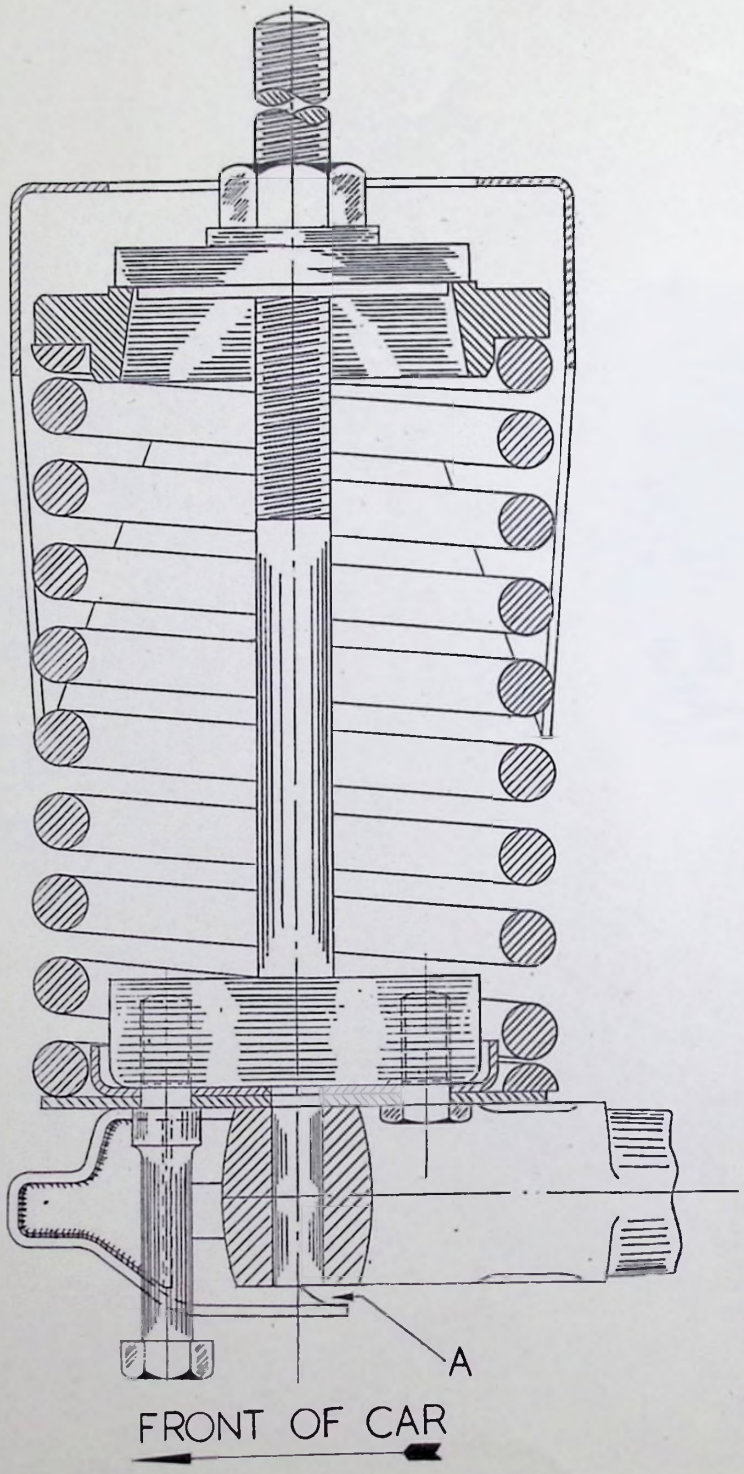


Fig. 4. Spring Compression Clamp.

the spring. Note the relative positions of the cups, rubbers and plain washers of the link assemblies.

(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) With the spring in position locate the aluminium ring with bolt shown in *Fig.* 3, *Page FZ7*. On later productions, where a strap type of top Damper bracket is used, the locating bolt is omitted, the strap bracket is held by four bolts. Do not neglect to replace the two plain washers between the under surface of the suspension arm and spring bottom plate bracket ; and lastly, follow carefully the fitting instructions in *Service FZ7*, when assembling the Damper.

SERVICE FZ9.
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, *see Service FZ8*.

(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.

(5) Bend back the tabs locking the pivot pins of both strut and suspension arm and withdraw the pins and the steel sleeves 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 given in the Figures numbered 2 and 3 on *Pages FZ6 and FZ7*.

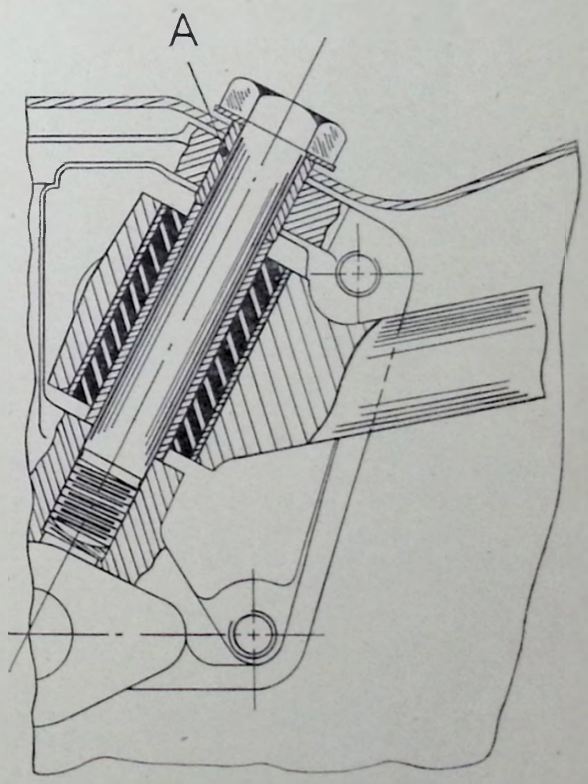
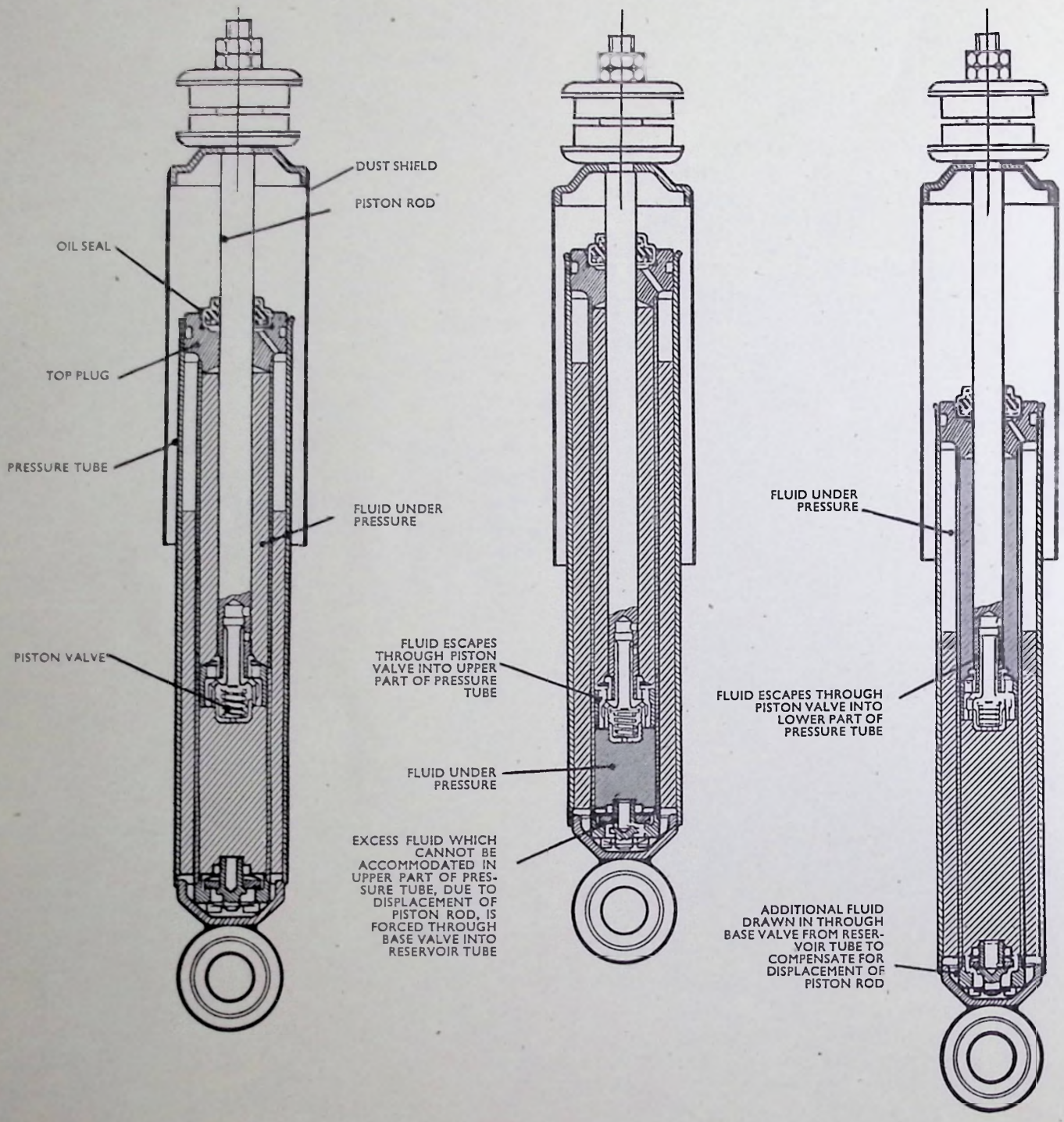


Fig. 5. Section through Lower Suspension Arm Pivot Pin.

FRONT SUSPENSION DAMPER. GIRLING D.A.5 TYPE.



Diagrammatic illustration showing the operation of D.A. Dampers on Compression and Extension.

DESCRIPTION.

The body of the damper is telescopic, and forms a strut between the axle 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 rubber-bushed eye or 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.

Apart from general saving of weight there is another need for this attention to low weight. Radial arm type dampers are carried on the frame of the car, and their weight is "sprung" weight, i.e. it is not added to the weight of the axle. The direct-coupled damper is carried partly by the frame and partly by the axle, and therefore a proportion of its weight is "unsprung". Hence it is theoretically desirable that the damper should be light.

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 plug. A spigot on the lower face of this plug enters the top of the internal cylinder and clamps it down upon a valve assembly which rests upon the base cup of the reservoir tube. Besides locating and clamping the inner cylinder, this special plug has other duties to perform. It provides the guide for the sliding motion of the piston rod, and it also carries an oil seal and dirt excluding gland. The seal consists of a synthetic rubber cup which has its lower lip pressed in contact with the piston rod by the serrated fingers of an annular spring washer. The upper part of the cage of this seal encloses a composition ring. 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.

Operation of the D.A. Type.

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 in 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 time the 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 a 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.5 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.

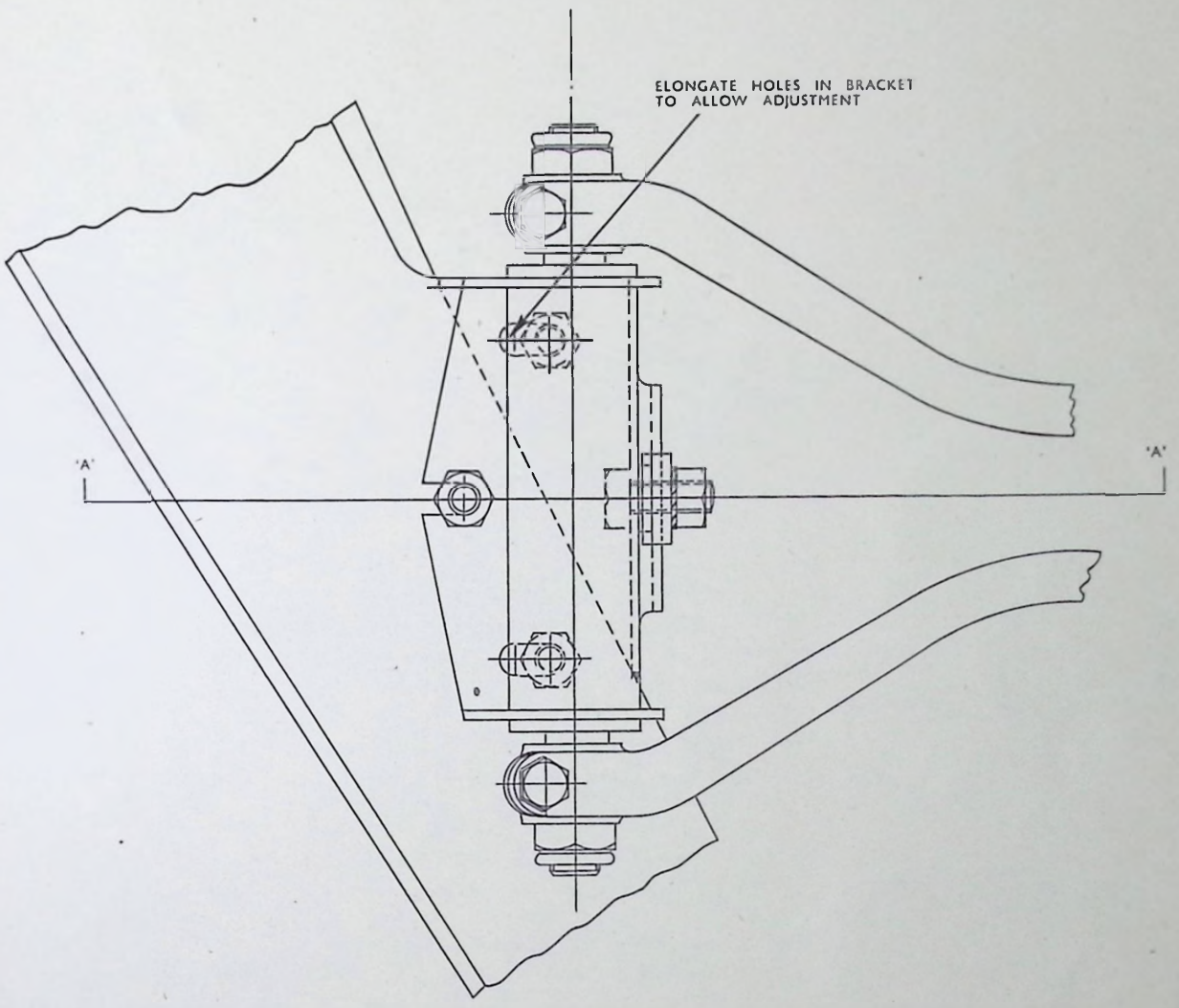


Fig. 1. Plan View of Top Arm Front Suspension Chassis Bracket.

SERVICE FZ.
TO RESET CAMBER ANGLE OF FRONT WHEELS ON CARS NOT FITTED WITH REBOUND STOPS TO TOP SUSPENSION ARMS.

The wheel camber is the angle at which the topmost point of each front wheel leans away from the centre line of the car and from the vertical. Under normal conditions of operation the camber angle should not alter, but if as the result of an accident or some other abnormal circumstance a suspected alteration has occurred, an adjustment can be made in the manner described in the above diagram and that on page FZ14.

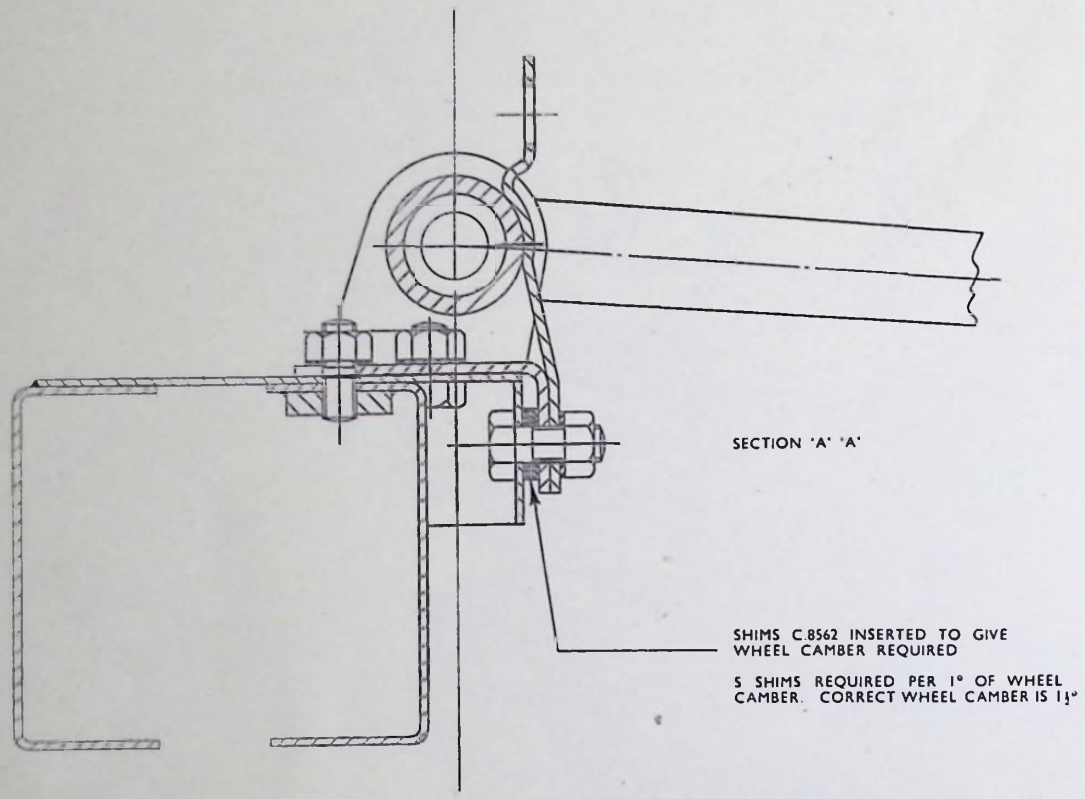


Fig. 2. Section through Line AA shown in Fig. 1, Page FZ13.

Type of springing	Coil Springs
Camber	Laden up 4 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	$\frac{3}{16}$″ (4.762 mm.)
Inner Wheel Max. L.H. Lock	$38\frac{1}{2}$°
Outer Wheel Max. L.H. Lock	31°
Turning Circle	33 ft. (10 metres)

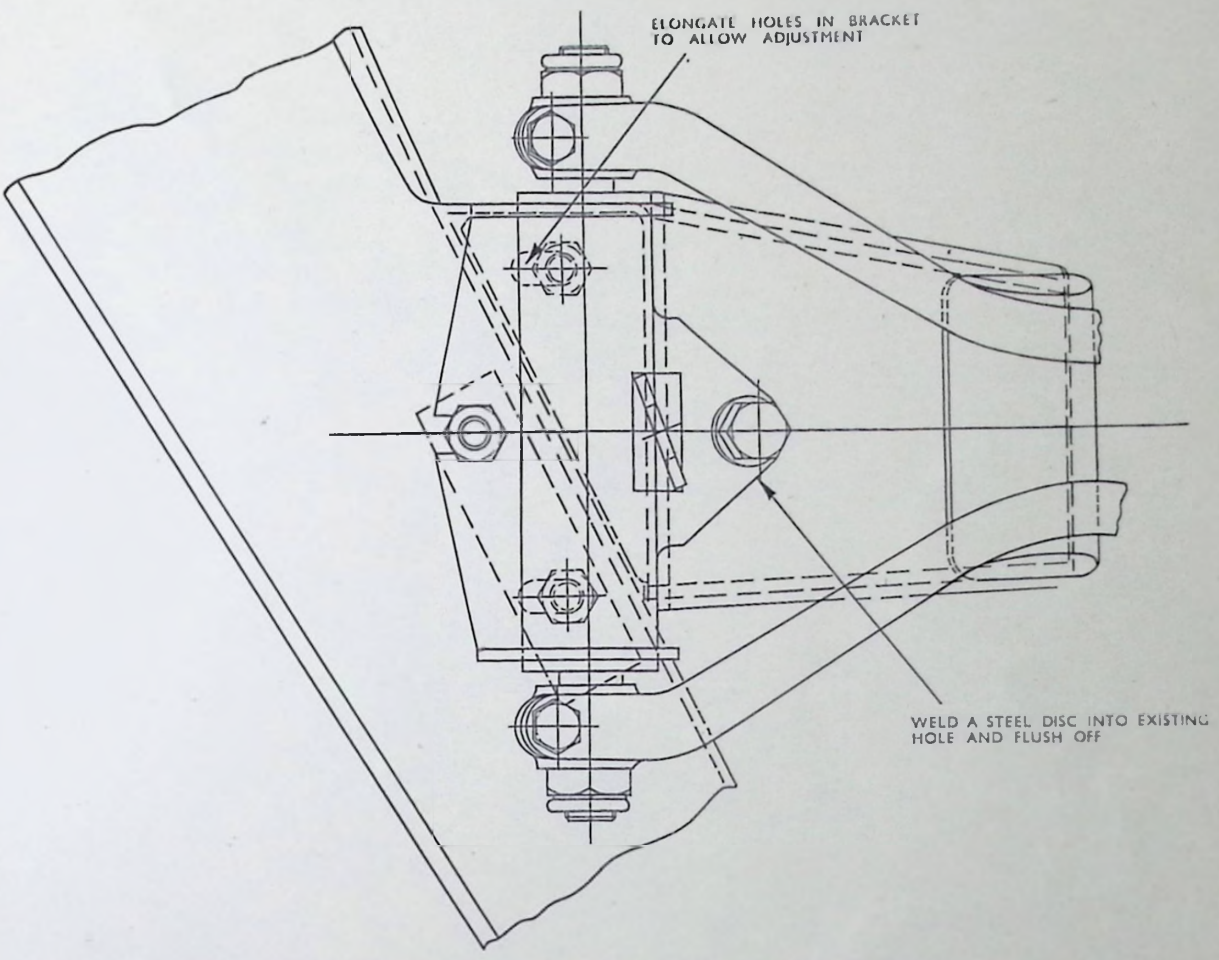


Fig. 3. Plan View of Top Arm Front Suspension Chassis Bracket.

SERVICE FZ.
TO RESET CAMBER ANGLE OF FRONT WHEELS ON CARS FITTED WITH REBOUND STOPS TO TOP SUSPENSION ARMS.

The wheel camber is the angle at which the topmost point of each front wheel leans away from the centre line of the car and from the vertical. Under normal conditions of operation the camber angle should not alter, but if as the result of an accident or some other abnormal circumstance a suspected alteration has occurred, an adjustment can be made in the manner described in the above diagram and that on page FZ16.

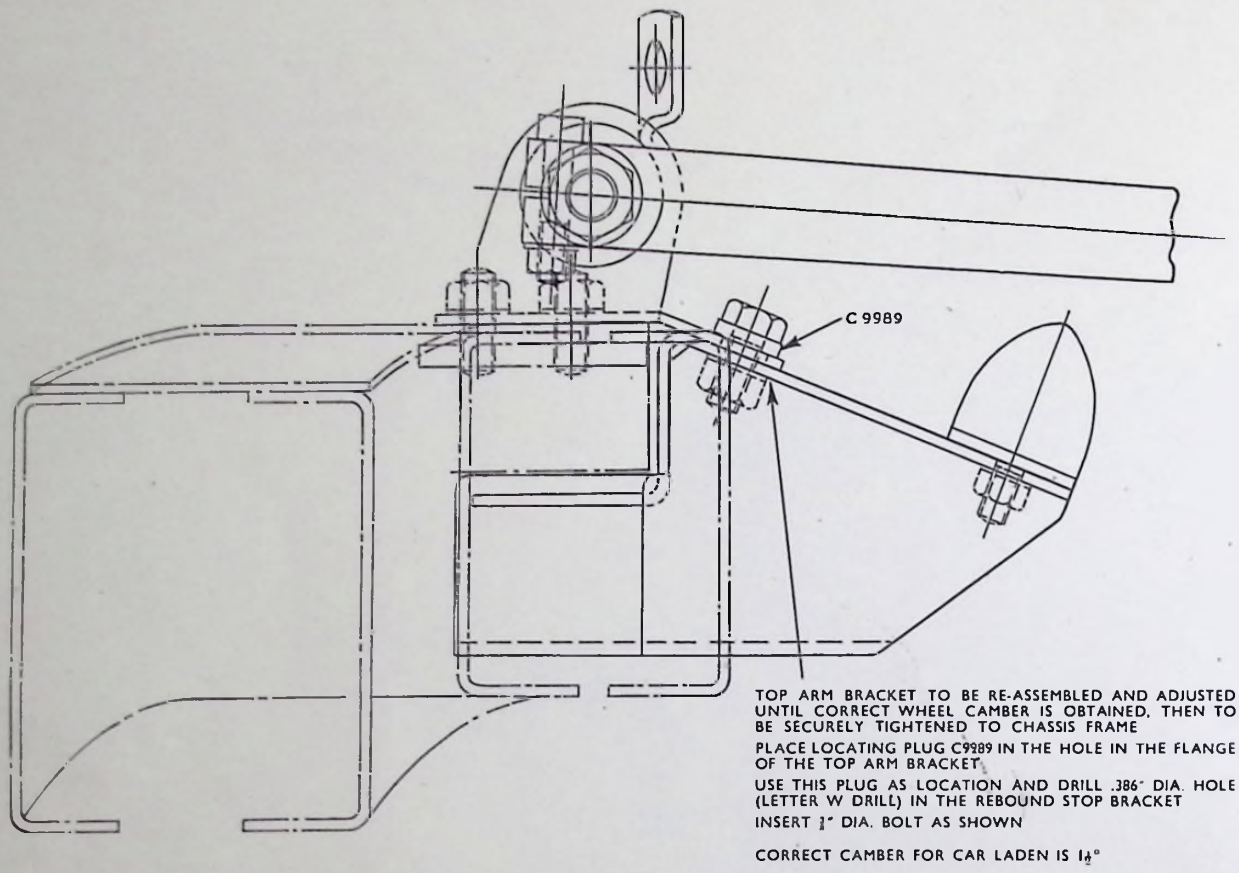


Fig. 4. Section through Fig. 3, Page FZ15.

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	$\frac{3}{16}$″ (4.762 mm.)
Inner Wheel Max. L.H. Lock	38½°
Outer Wheel Max. L.H. Lock	31°
Turning Circle	33 ft. (10 metres)

GROUP F

STEERING AND SUSPENSION SERVICES

STEERING GEAR ASSEMBLY

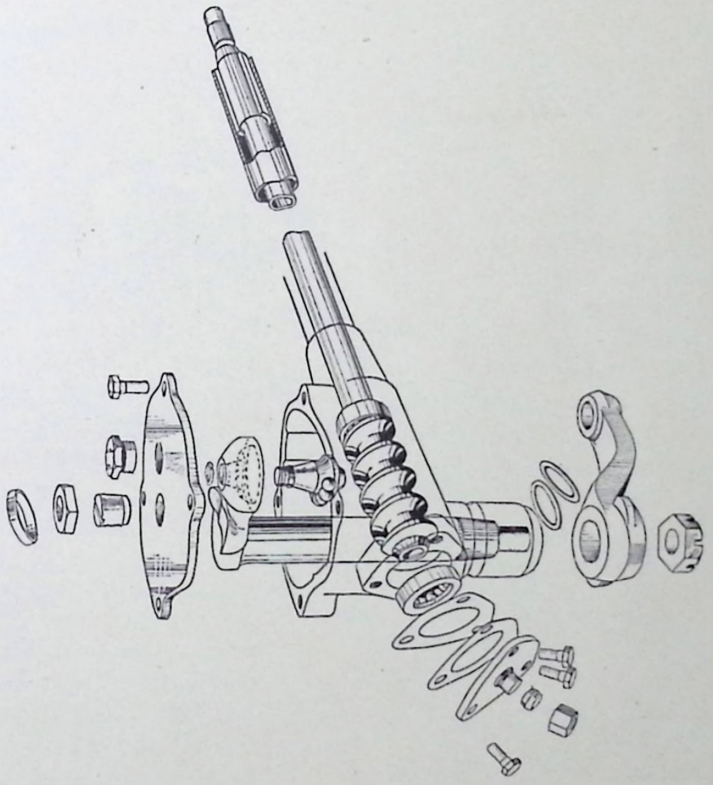


Fig. 1. Exploded View of Steering Gear Assembly.

DESCRIPTION.

The Burman steering gear assembly, type L3, consists of a single start worm fitted to the lower end of the steering column. Two ball races in the housing, fitted immediately above and below the worm, support the column at its lower end and an oil impregnated felt bush at its upper end. On later productions this bush has been replaced by a spring type of bush. This spring type of bush can be fitted in place of the felt one, see *Page FY5*. Engaging the worm is a spherically ended ball peg, also mounted on ball bearings in the rocker shaft. In action, revolving the steering column produces rotation of the ball peg and an accurate movement of the rockershaft. As the ball peg moves out of the plane of the worm the rockershaft is moved in by means of a cam controlled by an adjuster screw in the cover plate, and by this means the ball peg is kept in contact with the worm. Should wear take place in the peg or worm, it can be taken up by adjustment of the adjuster screw. On later productions this adjustment is made

by the addition or subtraction of shims between the cover and box.

Any end play which may develop in the column, also as the result of wear, is eliminated similarly by removing the required number of shims from between the housing and the end plate.

SERVICE FY1.
TO REMOVE AND REPLACE THE STEERING GEAR—LEFT HAND DRIVE.

(1) Lift the bonnet.
(2) Drain the cooling system.
(3) Remove the air cleaner.
(4) Remove the radiator.
(5) Detach the left hand support plate for the radiator and disconnect the hose from the Heater pipe. Three nuts and bolts secure the plate to the grille, the centre one secures the clip for the horn and trafficator wires.
(6) Disconnect the drag link from the steering box drop arm by removing the cotter and $\frac{3}{8}$" nut securing the ball pin of the joint to the drop arm.
(7) Bend back the tabs locking the heads of the bolts securing the steering box support bar to the chassis frame, one each side of the car; access to these being obtained from beneath the front wings.
(8) Release the two nuts and bolts securing the trunnion support bracket to the steering box.
(9) Disconnect the horn and trafficator wires at their pull-push joints. Mark the wires to help re-assembly. If in doubt about any connection consult the wiring diagram on *Page JY9*.
(10) Remove the nut securing the stator tube of the trafficator and horn switch to the bottom cover of the steering box. Drive the sealing olive out of position with a sharp chisel and when re-assembling use a new olive. The stator tube and switch assembly can now be withdrawn into the car.
(11) Release the clips securing the Heater element hoses to the engine and the element and detach the hoses.
(12) Remove the Heater element which is held by three bolts and nuts. *Note the distance pieces on the horizontal bolts and the rubber buffers, one on each side of the support bracket of the vertical bolt.*
(13) Remove the two $\frac{5}{16}$" nuts on the "U" clip securing the lower bracket of the change speed gear mechanism to the column and the $\frac{3}{8}$" bolt holding the support strip to the Master cylinder.
(14) Remove the nut securing the steering wheel to the steering mast and withdraw the wheel.
(15) 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 brackets under the facia board. Depress the column and remove the halves of the clamp block.
(16) Remove the clips holding the head lamp wires to the support bar. Then with an assistant supporting the box and bar, remove completely the bolts holding the bar to the chassis frame. Lock tabs released in operation 7. *Note the distance pieces between the bar and frame, these must be replaced as removed.*
(17) The steering box with support should now be raised, while the helper steadies the column inside the car. As soon as possible rotate the box and extract the support bar, then continue to raise until sufficiently high to withdraw the box and column away from the car.
(18) 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. There must be about $\frac{1}{8}$" (3.2 mm.) clearance between the face of the bracket and the boss of the lever.

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.

Position the hoses of the Heater element so that they do not foul the nuts of the "U" clip securing the change speed lever mechanism

bracket. Check the lever mechanism as directed on *Page BU5*. Do not omit to fill the steering box with lubricant as directed in the lubricating chart, *Page CZ9*.

SERVICE FY2.
TO REMOVE AND REPLACE THE STEERING BOX — RIGHT HAND DRIVE.

The operations are identical to those given in *Service FY1* for a Left Hand Drive Car, except that there is no necessity to remove the Air Cleaner or detach the Heater pipe hoses.

SERVICE FY3.
TO DISMANTLE THE STEERING GEAR ASSEMBLY.

(1) Remove, by means of an extractor, the drop arm held up by a castellated nut and split pin on the tapered splines on the rocker shaft.
Under no circumstances should the drop arm be hammered off as this will damage either the worm or the ball bearing on the follower peg or both.
If no extractor is available remove the cover plate, support the housing on the cover plate face leaving the rocker shaft free and use a soft metal hammer to drive the rocker shaft through the drop arm.

(2) Remove the split ring securing the ball peg to the rockershaft when the peg complete with ball race can be dismantled.

(3) Release the gland nut in the centre of the bottom end plate and draw out the stator tube.

(4) Remove the three set screws holding the end plate to the housing and detach the plate. Note the shims between the plate and box for adjusting purposes. The column, complete with balls and inner and outer races, can now be withdrawn through the bottom of the housing.

Assembly is the reverse of the foregoing but the following precautions should be observed.

(1) Lightly smear the top felt bush with grease before assembling.

(2) To assist assembling the bearings of the column smear their balls with thick grease to hold them in their races.

(3) Adjusting shims should be fitted between the end plate and housing so that while there is no end play in the column stiffness is also not present. Any stiffness would suggest that the bearings are being pre-loaded, a condition which would result in damage to the balls and races.

(4) Hold, with thick grease, the balls in the race of the ball peg, insert the peg in the rocker arm and secure it with the split ring, check that the peg revolves freely.

(5) Drop the rocker shaft complete with ball peg into position and check that the shaft is a good fit in its housing and making good contact with the seal in the lower end of the trunnion. Should there be excessive play between the shaft and housing fit a new rocker shaft ; if still present replace the housing. Any doubt about the condition of the seal should be removed by fitting a replacement.

(6) Remove the steel cap over the adjuster in the cover plate, release the locknut and slack off the adjuster. On later productions a lock plate is fitted to the adjuster lock nut and held in position by one of the nuts securing the cover plate. On completion of the adjustment see that the plate is correctly positioned over the lock nut. On still later productions the adjuster and plate have been deleted and shims fitted between the box and cover plate. For methods of adjustment see *Page FY4*, **Adjustment 2.**

(7) Bolt the cover plate into position and when doing so make sure that an oil-tight joint is formed.

(8) Position the peg in the centre of the worm and screw down the adjuster until there is no free movement between the ball peg and worm.
Normal wear, which takes place in use occurs to a greater degree in the straight ahead position than on locks. The design of the worm makes provision for this by allowing slightly greater free movement towards each lock. It is essential, therefore, that the adjustment of the ball peg be made in the straight ahead position. When the adjustment is complete tighten the lock nut and replace the steel cap.

(9) Fit the drop arm with the locating line on it coinciding with a similar line on the end of the rocker shaft.
(10) Replace the stator tube and fill the steering gear with the **Hypoid** oil recommended on the chart. *See Page CZ9.*
(11) Check that the gear can be moved freely from lock to lock before assembly to the car.

SERVICE FY4.
TO ADJUST THE STEERING GEAR ASSEMBLY.

There are Two Adjustments

(1) The elimination of excessive "up" and "down" movement in the inner column or steering mast.
(2) The removal of excessive backlash between the steering worm and the rocker shaft ball peg. This adjustment sets also the end play, or "in" and "out" movement of the rocker shaft.

Adjustment 1.

Shims are fitted between the end plate of the steering column assembly and the box itself to control the "up" and "down" movement of the inner column.

Should there be too much movement, proceed as follows :—

(*a*) Disconnect the horn and trafficator wires at their push-pull connections, remove the nut in the centre of the end plate, drive out the sealing olive and remove the plate. The required number of shims should now be removed, to obtain a condition where, without stiffness being present, there is no "up" or "down" movement in the column. Any stiffness would suggest that the bearings are being pre-loaded ; a condition which would result in damage to the balls and races. The stiffness must be removed by adding shims of the required thickness to restore freedom without play.

Adjustment 2.

Normal wear which may take place between the peg and worm does so to a greater extent in the straight ahead position than on the locks. The design of the worm makes provision for this by allowing slightly greater degree of backlash towards each lock than at the centre. It is imperative, therefore, that the adjustment of the ball peg must be made with it in the central position.

(*a*) Check that the lines on the drop arm and on the end of the rocker shaft coincide with each other.
(*b*) Place the front wheels in a line ahead position.
(*c*) Remove the steel cap over the adjuster in the cover plate, release the locknut and position the adjuster screw until there is the minimum of backlash between the ball peg and worm with no stiffness present.

NOTE. Do not neglect to retighten the locknut securely. It is advisable to hold the adjusting screw while the nut is being tightened and to check that the adjustment is correct after the nut has been tightened. Replace cap or locking plate where fitted. On later productions the adjuster has been deleted and shims fitted between the cover and the box. To adjust the backlash on this type of box decrease or increase the total thickness of the shims by subtracting or adding shims of the required thickness until the correct degree of adjustment is obtained namely, no stiffness evident to movement with the minimum of backlash between the ball peg and worm.

SERVICE FY5.
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.

Maintenance.

No adjustment is possible either to the joints or to the bearings of the central lever and provided the lubrication instructions given in the "Summary of Regular Attentions", *Page CZ8*, are strictly 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, *see Service FZ2*, 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.

SERVICE FY6.
TO REPLACE THE FELT BUSH AT THE TOP OF THE COLUMN OF THE STEERING ASSEMBLY.

(1) Disconnect the horn and trafficator wires at their pull-push joints. Mark the wires to help reconnecting. If in doubt consult the wiring diagram on *Page JY9*.

(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. Drive out the olive with a sharp chisel and when re-assembling use a new olive. 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 mast 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.

GROUP F

STEERING AND SUSPENSION SERVICES

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. 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 shackle bracket by a moulded rubber bush which is a press fit in the eye of the spring, and a push fit on to the shackle bolt. A swinging shackle supports it 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 leaves are held in contact with one another by three turnover type of leaf clips.

Maintenance.

No lubrication is needed by the shackle 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. Then, to prevent the formation of rust, smear a small quantity of engine oil on the tops and sides. 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.

SERVICE FX1.
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 shackle 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. 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 shackle pin similarly but note that the head of the pin is inside the chassis frame and that there is a short steel bush on the pin immediately by the head of the pin.

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 re-assembling 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 and 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. Renew all self-locking nuts.

SHOCK ABSORBERS TO REAR SUSPENSION—ARMSTRONG DAS.10 TYPE.

Description.

The Armstrong Shock Absorber is of the hydraulic double acting type and works on the principle of pumping oil back and forth between vertical parallel cylinders through suitable valves set to give the required degree of restriction in each direction. This layout has advantages in that all working parts are submerged in oil and it is only necessary to "recuperate" the negligible amount of oil which is forced past the pistons by pressure built up as the shock absorber operates.

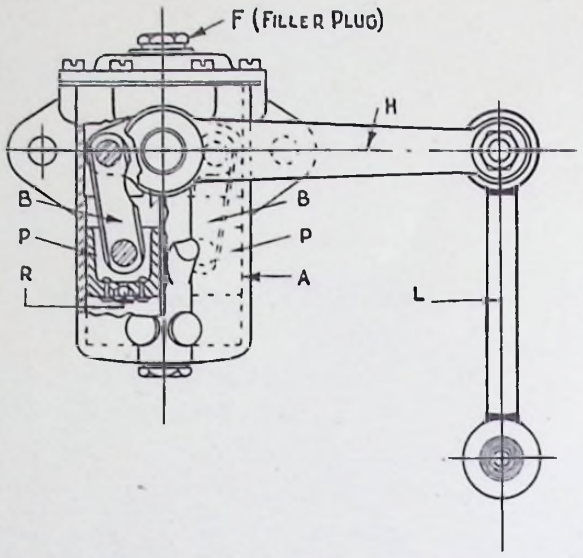


Fig. 1. Sectioned View of Rear Shock Absorber.

Detail Construction of Armstrong Shock Absorber.

The construction can be followed by reference to the drawing. The body A is bolted to the car frame and lower end of the Link L is fixed to the axle. As the axle moves relative to the frame, which movement is allowed by the car springs, arm H is moved up and down and since it is splined to Spindle the Spindle is rotated. The spindle is in turn splined to Crank Assembly S, which is connected to the two pistons P, in which are

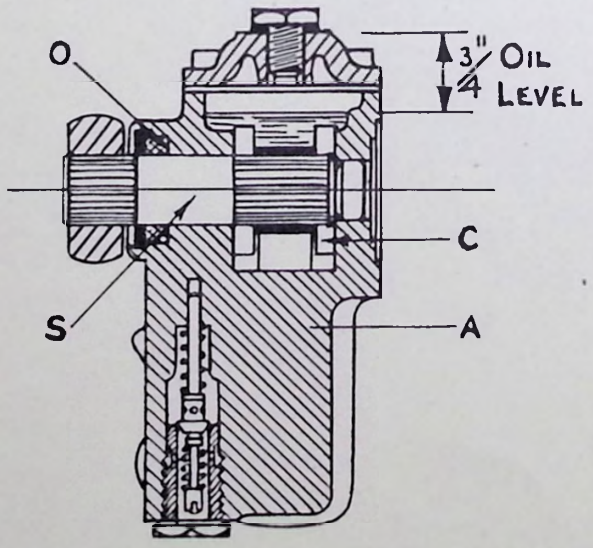


Fig. 2. Section View through Spindle and Valve. Also showing Fluid Level.

mounted Recuperating Valves R by means of connecting Rods B. Thus relative movement between the axle and frame causes pressure to be built up in one cylinder or the other. The cylinders are connected by suitable drillings in the body to the Valve Chambers. The Shock Absorber is filled to within $\frac{3}{4}$-inch (19 mm.) of the top of the filler flange through filler Plug F. Thus the mechanism is submerged in oil which is prevented from leaking along the spindle by means of Oil Seal C.

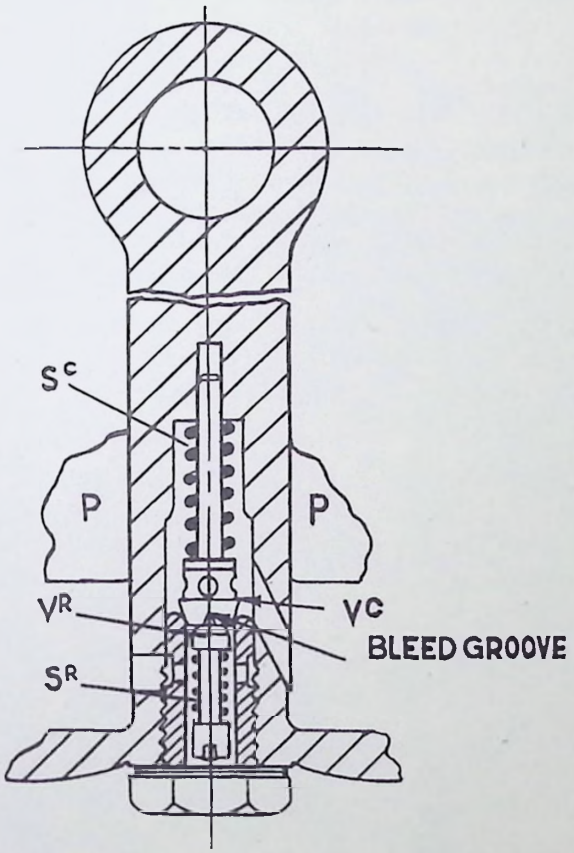


Fig. 3. Section through Valve.

Valve Operation.

To accomplish general dampening of the car spring for small movements of the arm 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 compression pressure built up in the compression cylinder blows the compression valve Vc off its seat at a predetermined pressure controlled by the spring Sc. On rebound, pressure is built up in the rebound cylinder and blows the rebound valve Vr off its seat at a predetermined pressure controlled by the 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 attained independently on compression and rebound.

Maintenance.

The maintenance required by the Shock Absorbers consists of a periodical examination of the bolts and nuts which secure 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 *Group C, Page CZ8.* Only Armstrong's Super (thin) Fluid should be used, and filled as shown in *Fig.* 2, *Page FX2.*

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 :

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 quicker.

Should resistance not be consistent 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 in *Service FX2.*

SERVICE FX2.
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 arm 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's Super (thin) Fluid to within $\frac{3}{4}$" (19 mm.) of the top. For home use, use only Armstrong's Super (thin) Fluid. In countries abroad it may not always be possible to obtain this fluid and the following alternatives may be used.

Esso Hydraulic (medium)
Wakefield Castrolite
Mobiloil Arctic
Shell Donax A.2

or any other good quality mineral lubricating oil to Spec. SAE.20.

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's Patent Co. Ltd., Eastgate, Beverley, and obtain from them their observation.

Failures abroad should be referred to the nearest distributor for Armstrong Shock Absorbers in the country concerned.

Armstrong's Patent Co. Limited, 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 in tension when in their normal working position, a circumstance which would affect the springing of the car very adversely.

GROUP G

TRANSMISSION SERVICES

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 the 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 located by the differential cross pin.

The hubs are secured to the axle shafts by keyed tapers and castellated nuts with split pins. Each 9-inch (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. The banjo casing is a steel pressing.

Maintenance.

Maintenance as far as lubrication is concerned, is dealt with fully in *Group C on Lubrication*, and the care and adjustment of the brakes in *Group H, Section HY*. 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.

SERVICE GZ1.
TO REMOVE AND REPLACE THE REAR AXLE.

(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 inadvertantly. Any such action will involve considerable loss of brake fluid.

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 HY3 and HY4* dealing with the brakes.

SERVICE GZ2.
TO DISMANTLE THE REAR AXLE.

(1) Support the axle on three suitable trestles, one under each spring pad and the third under the flange of the pinion shaft.

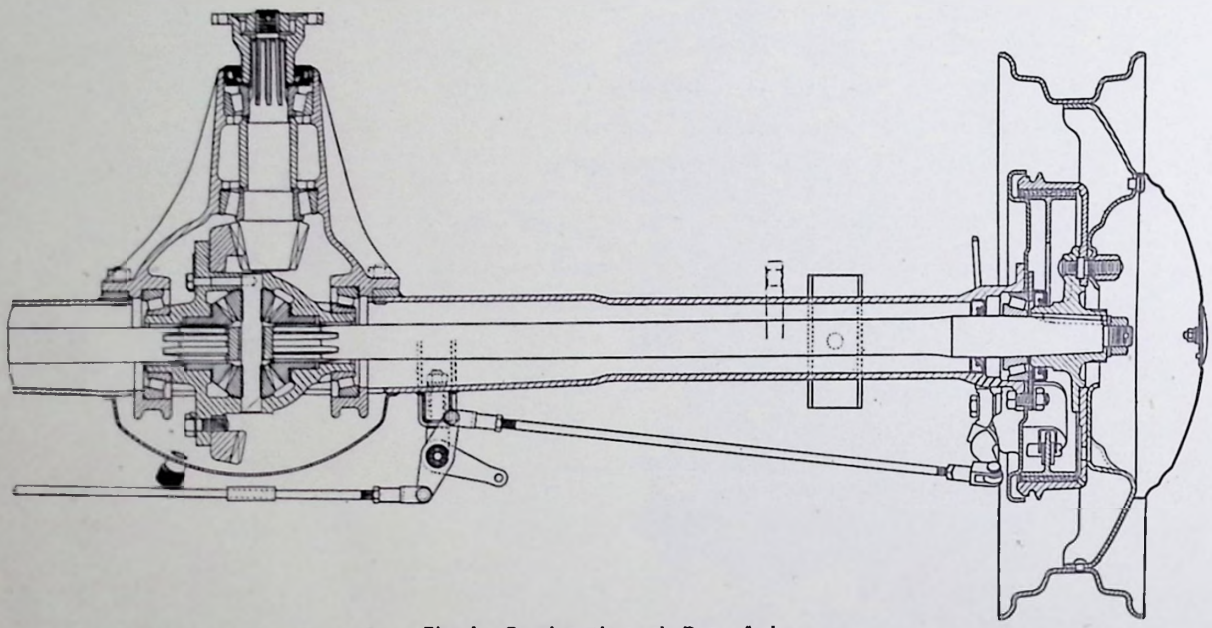


Fig. 1. Section through Rear Axle.

(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. 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

(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.* 24026*N*. 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 *Section BT, Page BT*1, 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 GZ*6.

(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 Group H, Section HY* dealing with brakes.

SERVICE GZ3.
TO RE-ASSEMBLE THE 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 in the amount that each outer race stands proud of the surface of the brake back plate by the same amount 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 so that the amount of float present in the shafts can be measured. *See Fig.* 1. The correct amount is .003″ (.076 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., .003″ 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.

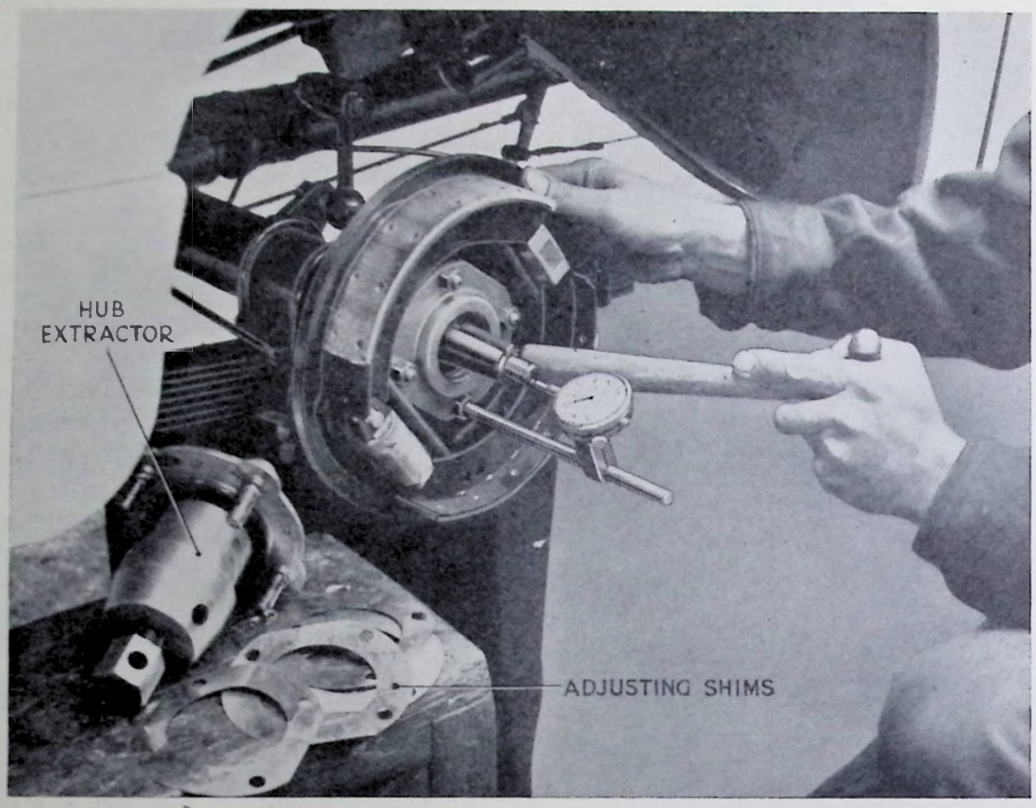


Fig. 1. Method of Setting Clearance in Rear Hub Bearings.

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 HY*, and to fill the axle with the recommended lubricant to the correct level. *See Group C on Lubrication.*

THE FOLLOWING SERVICES CAN BE CARRIED OUT CONVENIENTLY WITH THE AXLE IN POSITION ON THE CAR.

SERVICE GZ4.
TO REMOVE AND REPLACE THE REAR HUB.

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.

SERVICE GZ5.
TO REMOVE AND REPLACE THE BRAKE BACK PLATE.

(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 inadventantly, 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 are given in *Section HY.*

As to the outer oil seal do not disturb it unnecessarily, but examine and deal with it in the light of the information given in *Section BT, Group B.*

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. 1, Page GZ4.*

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. 1). The correct amount of float is .003" (.076 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 in this amount and proceed as described above, thus making sure that .003" (.076 mm.) end float is present.

On completion of the assembly adjust the bleed of the brakes as described in *Group H, Section HY.*

SERVICE GZ6.
TO REMOVE AND REPLACE AXLE SHAFT AND/OR BEARING ALONE.

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 the 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. Examine the condition of the oil seals inside the axle casing and deal with it as described on *Page BT2*.

From this point onwards observe the instructions given in *Service GZ3, Page GZ3*.

SERVICE GZ7.
TO REMOVE AND REPLACE REAR AXLE HUB OIL SEALS.

(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. See *Service GZ5*. 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. See *Service GZ6*. The inner seal that is the smaller, is housed in a register machined in the axle casing and can be extracted with the aid of an "L" shaped tool. Before attempting to replace the seals read the instructions given in *Group B, Section BT*.

(5) The seals must be fitted with their sealing lips towards the axle centre. See *Figure 2, Page BT2*, and must be pushed home square against the abutment in the axle casing and 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 as far as the hub and its seal are concerned.

Before replacing the hub, check in the manner described in *Service GZ3, Page GZ3*, that the standard end float of .003" (.076 mm.) is present in the axle shafts.

SERVICE GZ8.
TO REMOVE AND REPLACE THE DIFFERENTIAL UNIT.

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, brake drums, hubs and withdraw the axle shafts. *See Service GZ2, Page GZ2*, for detailed instructions on these operations. The differential unit can now be detached from the axle banjo on the eleven nuts securing it being removed.

Replacement is the reversal of the foregoing, but before commencing to assemble read carefully *Service GZ3, Page GZ3*, on the reassembly of the axle.

SERVICE GZ9.
TO DISMANTLE AND RE-ASSEMBLE THE DIFFERENTIAL ASSEMBLY.

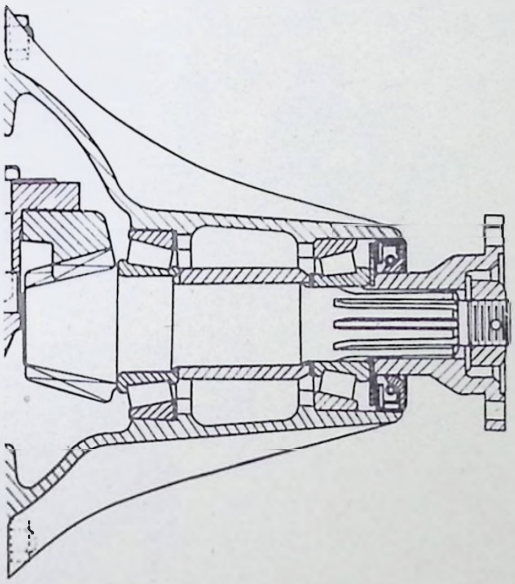
(1) Mark suitably the pinion housing and the differential case bearing caps to help re-assemble them in their original positions. The differential case complete with crown wheel, bearings and shims can now be removed. The shims are for the purpose of adjustment and must be suitably tallied to their respective 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.



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, 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.

When dealing with the oil seal read *Section BT, Group B* dealing with these.

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.

SERVICE GZ10. TO REASSEMBLE DIFFERENTIAL UNIT.

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 back lash of .006" (.15 mm.) to .008" (.2 mm.) with a tooth marking as shown in the Figs. 1 to 14, *Pages GZ8 and GZ9* is a skilled one and should therefore be carried out only by an experienced engineer.

BACKLASH.

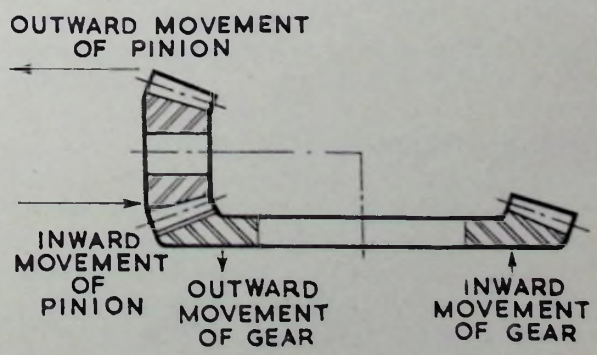
The amount of backlash varies with the pitch of the gears, and the proper backlash should be from .006" to .008", *see illustration on Page GZ8.*

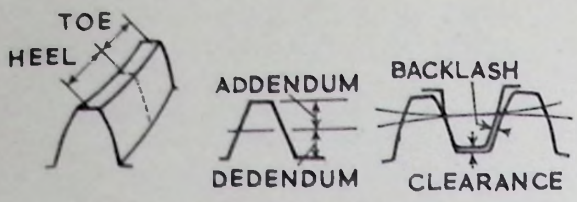
Adjustment of Bevel Gear at Assembly.

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.

Below will be found graphic 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 and 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 Figures 1 and 2, but a condition of tooth contact may be obtained as indicated in Figures 3 to 14. The lengthwise bearing adjustments will first be considered.

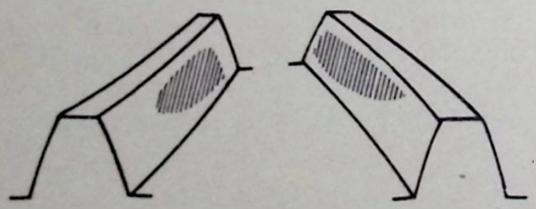


FIG.1. DRIVING SIDE FIG.2. REVERSE SIDE

Lengthwise Bearing Adjustments.

Figures 3 and 4 show what is called a cross bearing, and is caused by a misalignment of the mounting. The mounting should be tested, 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.

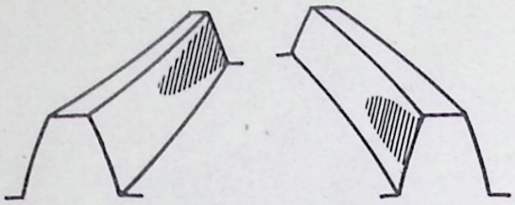


FIG.3. FIG.4.

Figures 5 and 6 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".

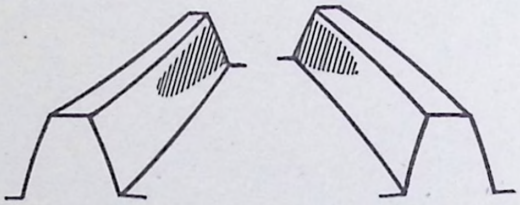


FIG.5. FIG.6.

Figures 7 and 8 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".

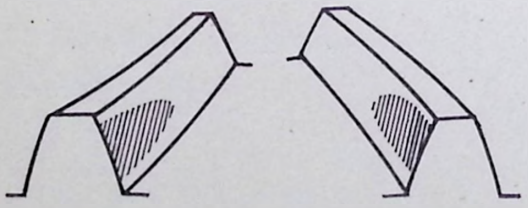


FIG.7. FIG.8.

Profile Bearing.

Figures 9 and 10 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.

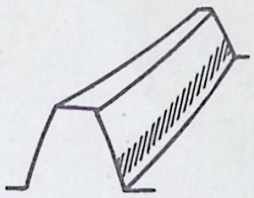


FIG.9.

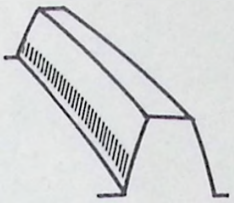


FIG.10.

Figures 11 and 12 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.

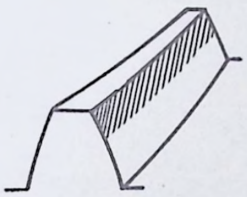


FIG.11.

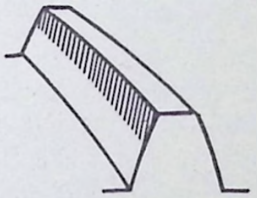


FIG.12.

This condition would cause the ring gear teeth to crumble off at the heel end.

Figures 13 and 14 show a lame bearing. It is possible to adjust the gears and obtain a fair driving condition as indicated in Figure 1, 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.

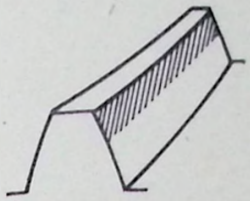


FIG.13.

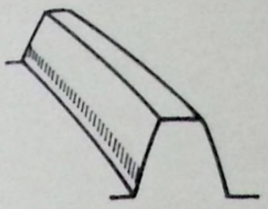


FIG.14.

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 very 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.

GROUP G

TRANSMISSION SERVICES

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 set of needle bearings 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 Figure 1, Page BT2.*

SERVICE GY1.
TEST FOR WEAR.

Wear on the thrust faces is detected by testing the lift in the joint, either by hand or by using a length of wood suitably supported.

Any circumferential movement of the shaft relative to the flange yokes indicates wear in the needle roller bearings.

SERVICE GY2.
TO REMOVE AND REPLACE THE ASSEMBLY.

Before commencing to remove 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.

SERVICE GY3.
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, Page GY2. The top bearing should begin to emerge, turn the joint over and remove the bearing race with fingers, see Fig. 2, Page GY2. 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 this position so as to avoid dropping the needle rollers. Repeat this operation for the opposite bearing. The yoke can now be removed, see Fig. 3, Page GY2. 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 and examine all parts and lubricate well before re-assembling.

SERVICE GY4.
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 replacement yoke may be fitted, but only in cases of emergency should this be done. A complete tubular shaft assembly should be fitted.

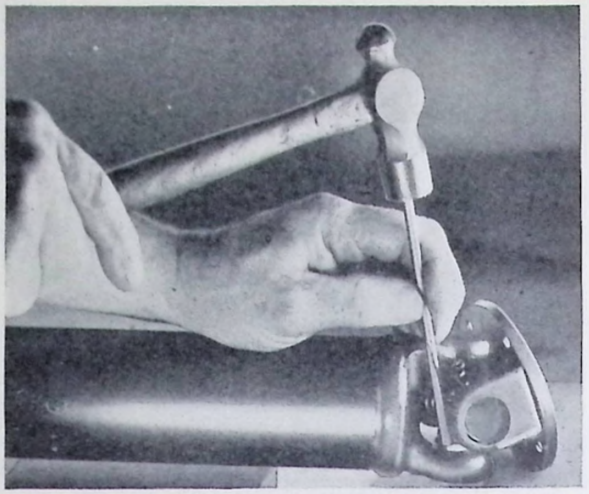


Fig. 2. Removing Bearing.

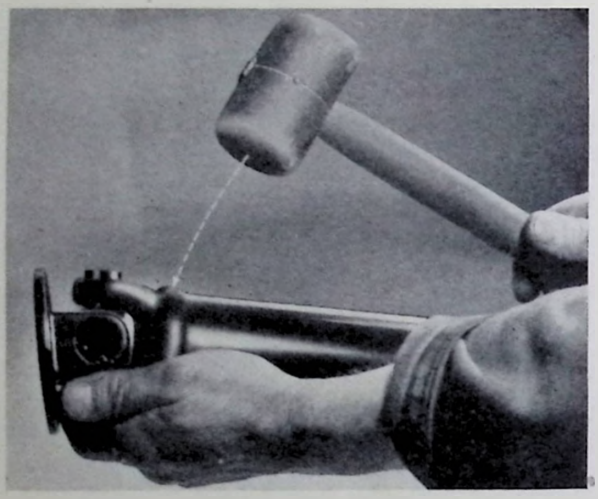


Fig. 1. Removing Bearing.

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.

SERVICE GY6.
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.

SERVICE GY5.
TO RE-ASSEMBLE.

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 $\frac{1}{32}$" (.8 mm.) smaller in diameter than the hole in the yoke.

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.

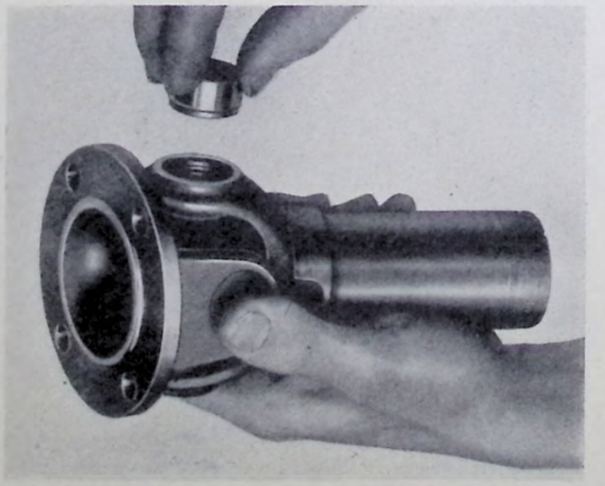


Fig. 3. Replacing Bearing.

GROUP H

CHASSIS SERVICES

FRAME

SERVICE HZ1.
REPAIRS TO FRAME.

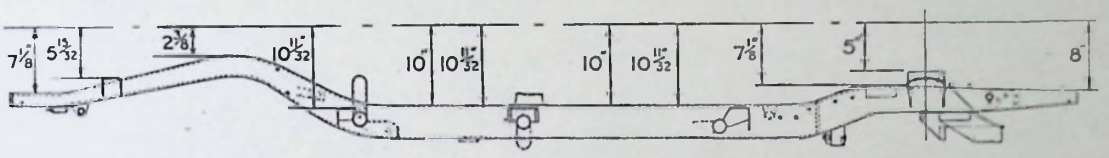


Fig. 1.

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 scarcely 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 KZ12, Service KZ21.*

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. If this cannot be done, write the Factory stating the extent of the damage and the amount by which the dimensions of the damaged frame vary from those given in *Figures 1 and 2.*

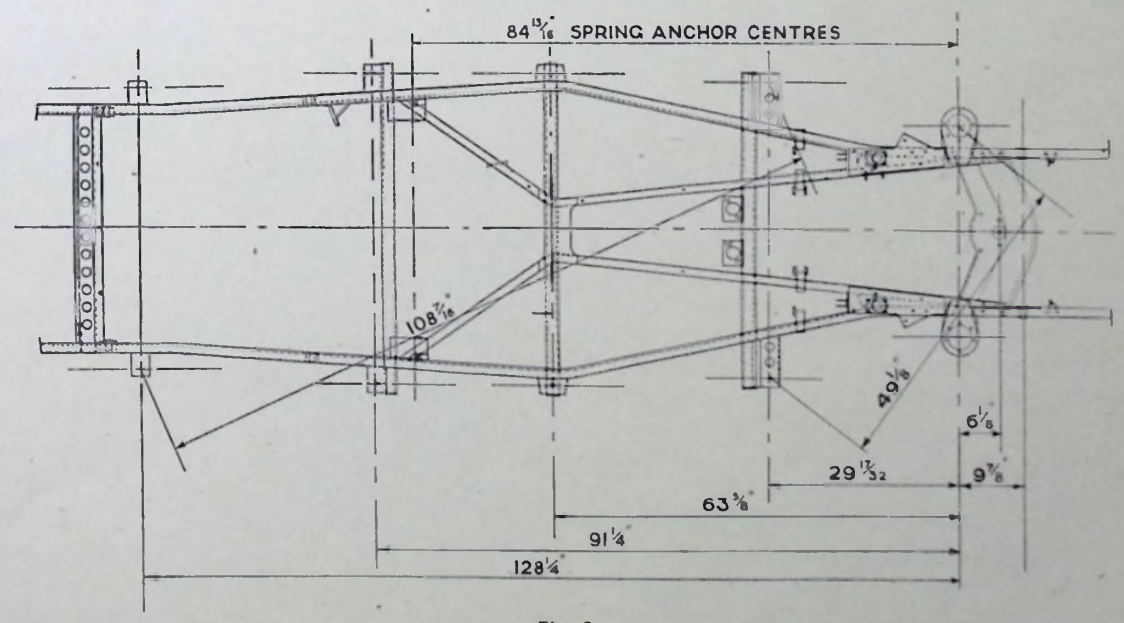


Fig. 2.

GROUP H

CHASSIS SERVICES

BRAKES

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 ; 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** 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.

SERVICE HY1.
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.

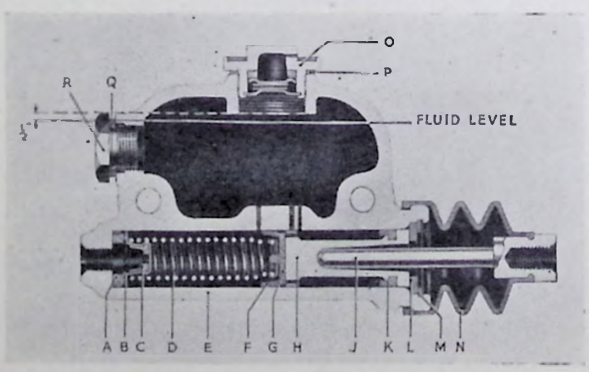


Fig. 1. Fluid Level.

A, Rubber Washer ; B, Valve Metal Body ; C, Rubber Cup ; D, Return Spring ; E, Cylinder ; F, Rubber Cup ; G, Retainer ; H, Piston ; J, Push Rod ; K, Secondary Cup ; L, Piston Stop ; M, Circlip ; N, Boot ; O, Fitter Cap ; P, Washer ; Q, Washer ; R, Plug.

Where possible, remove the supply tank and pour off the remaining spirit.

Refill with clean Lockheed brake fluid and "bleed" the system. *See Service HY2.*

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.

SERVICE HY2.
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.

SERVICE HY3.
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.

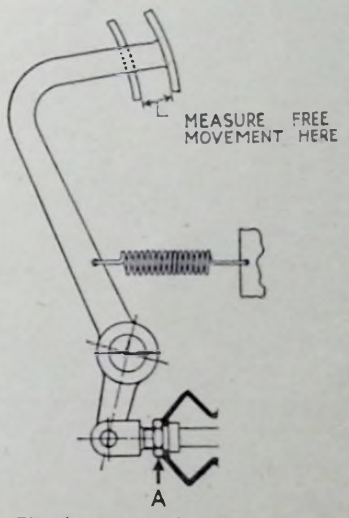


Fig. 1. Measuring Free Movement.

To make an adjustment, slacken the locknut securing the forked joint to the push-rod and screw "in" or "out" the push-rod, 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 *Service HY13, Page HY9.*

SERVICE HY4.
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 shoe of the other wheels in a similar manner.

Rear Wheels—"Micram" Adjuster.

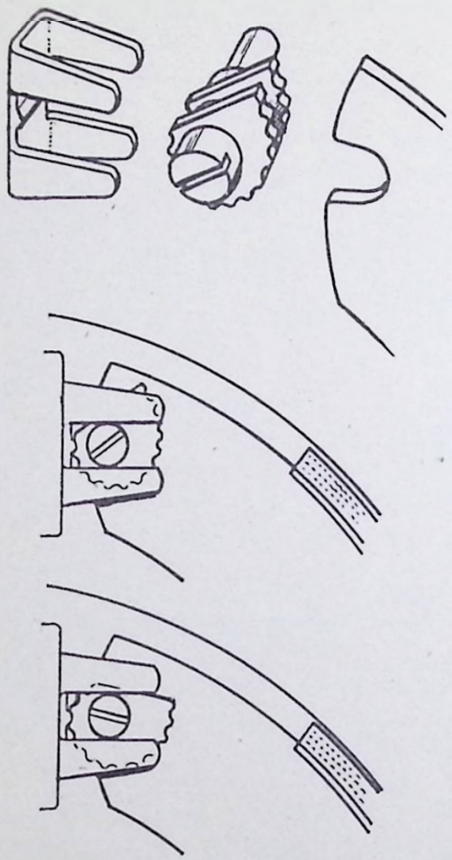
Chock the front wheels and release the hand brake. Proceed as for front brake adjustment but note that there is only one adjuster for each rear wheel, Figure 1, and that it may be necessary to back off the adjustment by two notches to provide adequate clearance for the two shoes.

SERVICE HY5.
RELINING THE BRAKE SHOES.

When relining the shoes, obtain from an Authorized 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.

SERVICE HY6.
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 brake plate end, 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.



Drawings by courtesy of the "Autocar"

Fig. 1. Micram Adjusters.

Re-fitting 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.

SERVICE HY7.
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 the shoulder is clear of the backplate 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.

Re-fitting 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 its shoulder 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 a new copper gasket. 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 OF THE LOCKHEED—TWO LEADING SHOE—HYDRAULIC BRAKES.

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 $\frac{1}{16}$" (1.59 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.* 1, *Page HY2*, 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 main-

tained 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. On later productions a dished washer 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.* 1, *Page HY*10. If this aforementioned additional fluid is not released to the reservoir through the by-pass 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, pressure will build up in the system and all brakes will drag.

SERVICE HY8.
TO REMOVE THE MASTER CYLINDER
Right and Left Hand Drive.

(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.

SERVICE HY9.
TO DISMANTLE A MASTER CYLINDER.

Detach the rubber boot "N", *see Fig* 1, 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 used on later productions, 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.

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 and the dished washer when fitted, *see Fig.* 1, *Page HY*10, (F) 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.

*Note. For assembly of master cylinder with dish washer, see page HY*10.

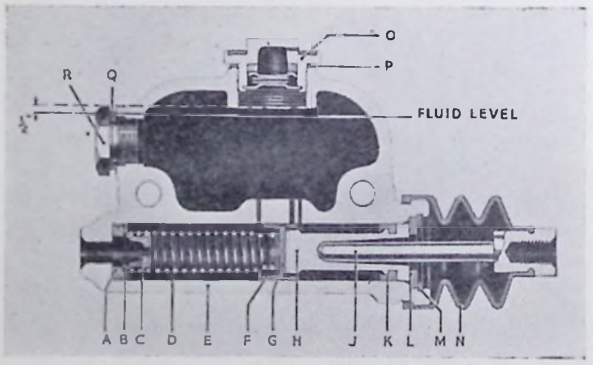


Fig. 1. Section of Master Cylinder.

SERVICE HY10.
RE-FITTING 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 in *Service HY*3, *Page HY*3.
(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.

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.

Each wheel cylinder, see Figs. 1 and 2, consists of a casting (E) containing a piston (B) fitted with a cover (A) and backed by a rubber cup (C). The space in front of the rubber cup is partially occupied by a cup filler (D). For description of the type of wheel cylinder fitted on later productions *see Page HY10.*

For removing the Front Wheel Cylinders from the backplates see Service HY6, Page HY4.

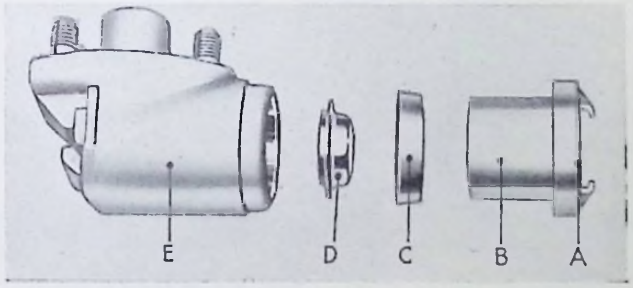


Fig. 1. Front Cylinder Exploded.

SERVICE HY11.
TO DISMANTLE FRONT WHEEL CYLINDERS.

Withdraw the piston (B) complete with the piston cover from the cylinder (E) and apply a gentle air pressure to the fluid connection to blow out the rubber cup (C) and the cup filler (D).

To Assemble Front Wheel Cylinders.

Insert the cup filler (D), recessed face foremost, in the cylinder (E), followed by the rubber cup (C) lip foremost, taking care not to damage or turn back the lip. Insert the piston (B) complete with the piston cover.

For re-fitting the front wheel cylinders to the backplates *see Service HY6, Page HY4.*

Note. For assembly of spring in wheel cylinders see page HY10.

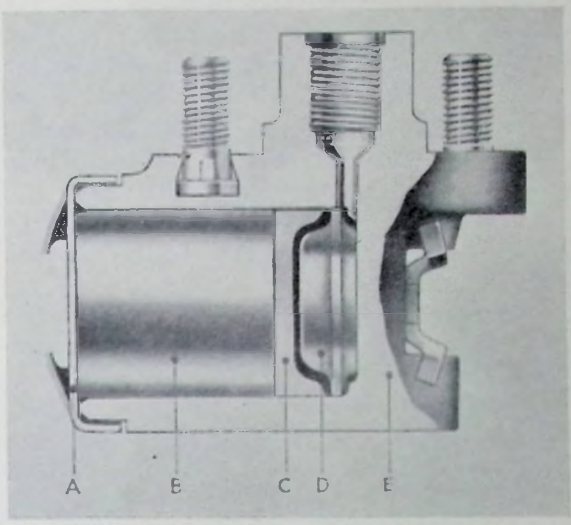


Fig. 2. Section Through Front Wheel Cylinder.

REAR WHEEL CYLINDERS.

Description.

The rear wheel cylinder is fitted in an elongated slot in the rear backplates and is free to slide in the slot between the tips of the brake shoes, which are of the leading and trailing shoe type. The cylinder has a single piston operating on the lip of the leading shoe which buts against a fixed anchor block on the backplate, the web of the shoe being free to slide 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 the movement of the cylinder assembly as a result of the reaction of the leading shoe against the brake drum. A "Micram" adjuster is located in a slot in the tip of the leading shoe. For description of the type of wheel cylinder fitted to later productions *see page HY11.*

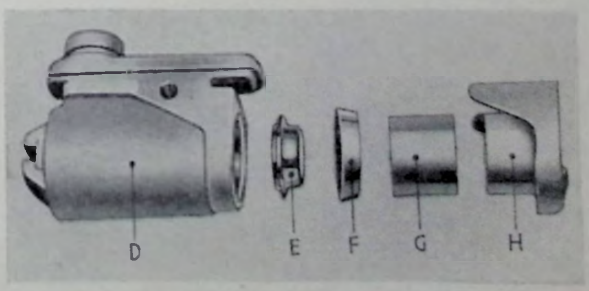


Fig. 3. Rear Cylinder Exploded.

The wheel cylinder (D), *see Fig. 3, Page HY7 and Fig. 2, Page HY8*, contains a single piston split in two, the inner piston (G) being hydraulically operated while the outer piston (H) is manually operated by the handbrake lever (B). The inner piston is backed by a rubber cup (F) and the space in front of the cup is partially occupied by a cup filler (E). When operated hydraulically, the inner piston butts against the outer piston, leaving the handbrake lever (B) undisturbed, and applies a thrust to the tip of the leading shoe through the dust cover, "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 (H) thrusting it outwards against the leading shoe without disturbing the inner piston. A rubber boot (A) is fitted to exclude foreign matter.

For removing the Rear Wheel Cylinder from the backplate see Service HY7, Page HY5.

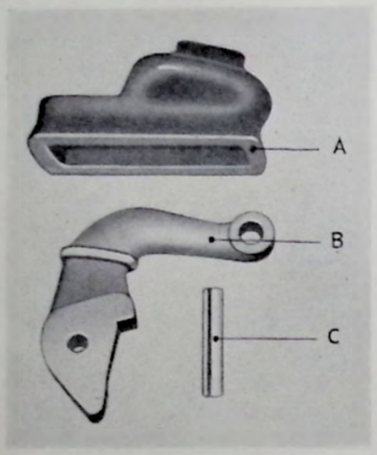


Fig. 1. Exploded View of Hand Brake Lever.

SERVICE HY12.
TO DISMANTLE REAR WHEEL CYLINDER.

Withdraw the piston (H) complete with cover from the cylinder (D). Remove the handbrake clevis pin (C) and the lever (B). Apply a gentle air pressure to the fluid connection and blow out the hydraulic piston (G), rubber cup (F) and the cup filler (E).

To dismantle rear wheel cylinder fitted to later productions *see Page HY11.*

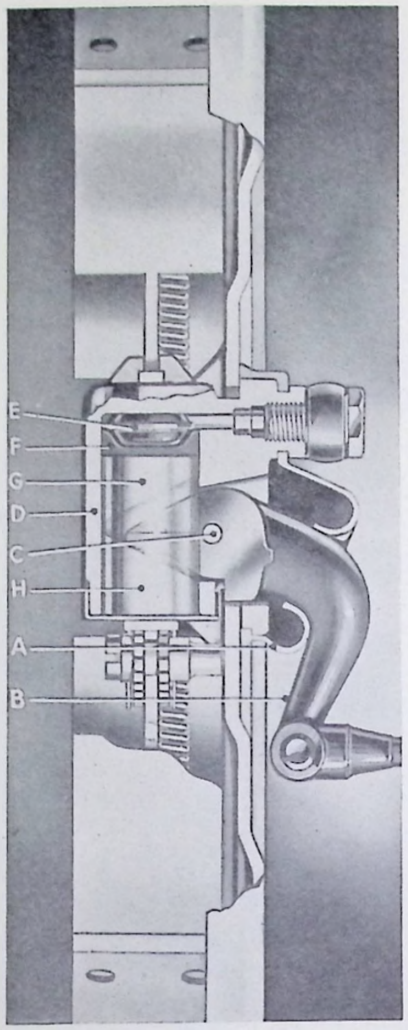


Fig. 2. Section Through Rear Brake Cylinder.

To Assemble Rear Wheel Cylinder.

Insert the cup filler (E), recessed face foremost, in the cylinder (D), followed by the rubber cup (F), lip foremost, taking care not to damage or turn back the lip of the cup. Insert the hydraulic piston (G) ensuring that the slot in the piston coincides with the lever slot in the cylinder casting. Place the handbrake lever (B) in position and fit the clevis pin. Insert the handbrake piston (H) complete with dust cover, ensuring that the lever is engaged in the slot in the piston. For assembly of the rear wheel cylinder fitted to later productions *see Page HY11.*

For re-fitting the Rear Wheel Cylinder to the backplate see Service HY7, Page HY5.

Note. For assembly of cylinder with spring see Page HY11.

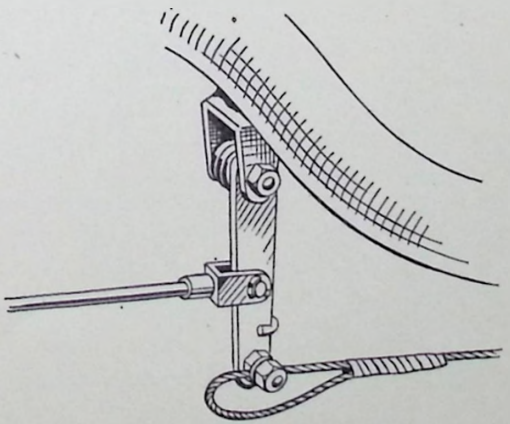
SERVICE HY13.
TO SET BRAKE PEDAL POSITION.

(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.

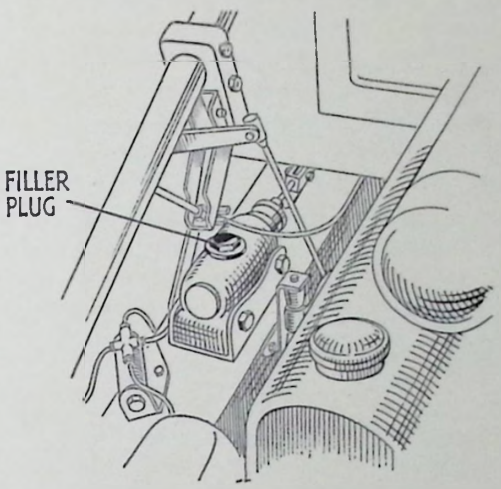
If some adjustment of the foot pad from this position is required, release the lock nut on the shank of the pad, screw the pad "in" or "out", as necessary, and tighten the locknut.

(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 rod. If an adjustment is required, lengthen or shorten the rod connecting the pedal to the relay lever by screwing "on" or "off" one of the eyes the required amount.

For the pedal adjustment to be correct there should be $\frac{3}{4}$″ (19 mm.) free movement measured between the foot pad and floorboards. To obtain this free movement, release the locknut on the shank of the fork joint of the master cylinder and screw "in" or "out" the push rod to the required amount. Make sure to re-tighten all locknuts released and to cotter all clevis pins.



Hand Brake Cable.



Master Cylinder.

SERVICE HY14.
HANDBRAKE ADJUSTMENT.

Adjust first the foot brake, and then if the Handbrake lever can be pulled over the quadrant more than three to four 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.

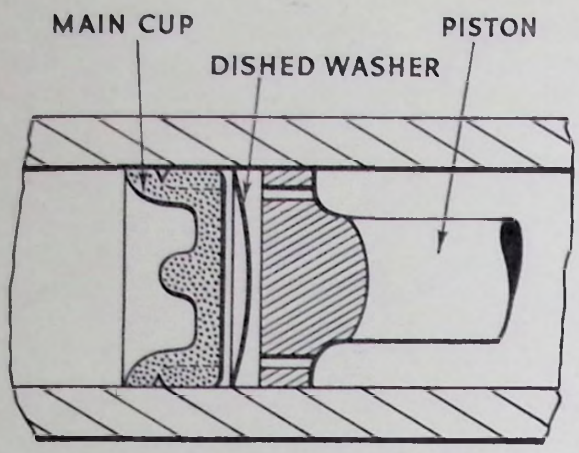


Fig. 1. Section through Master Cylinder showing position of Dished Washer.

MASTER CYLINDER FITTED TO LATER PRODUCTIONS.

Description.

This type of Master Cylinder is similar to that fitted on the early productions, except that a dished washer is interposed between the rubber cup and piston to prevent the adhesion of the rubber cup to the piston.

SERVICE HY15. TO DISMANTLE AND REASSEMBLE THE ABOVE TYPE OF MASTER CYLINDER.

The operations are identical to those given in *Service HY9, Page HY6*, except that the dished washer, referred to above, must be withdrawn after removing the piston, and when reassembling, re-inserted after the main rubber cup has been placed in position, see Fig. 1. When inserting the rubber cup take care not to damage or turn back the lip of the cup.

FRONT WHEEL CYLINDER FITTED TO LATER PRODUCTIONS.

Description.

On this type of wheel cylinder, an exploded view of which is shown in Fig. 2, the cylinder has a blind bore to accommodate the piston, the rubber cup, the filler cup and spring. 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.

SERVICE HY16. TO DISMANTLE AND REASSEMBLE THE ABOVE TYPE OF WHEEL CYLINDER.

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.

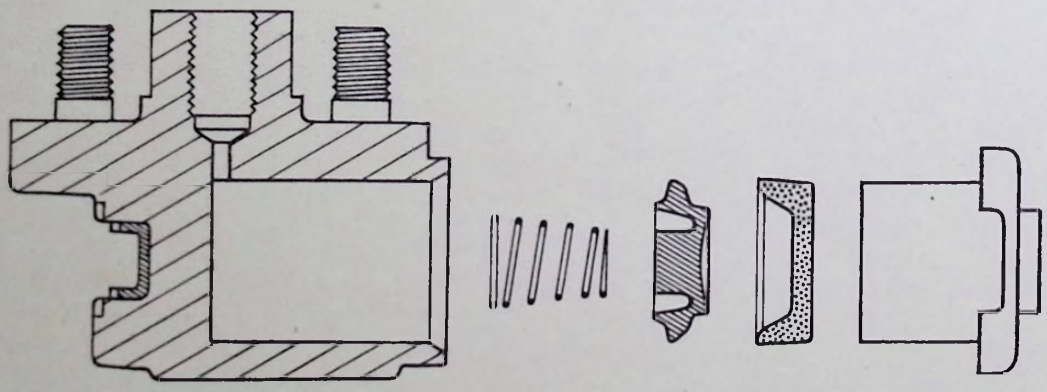


Fig. 2. Exploded view of Front Wheel Cylinder fitted to later Productions.

REAR WHEEL CYLINDER FITTED TO LATER PRODUCTIONS.

Description.

The wheel cylinder (A), see Fig. 1, 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.

SERVICE HY17.
TO DISMANTLE AND REASSEMBLE THIS LATER TYPE OF CYLINDER.

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).

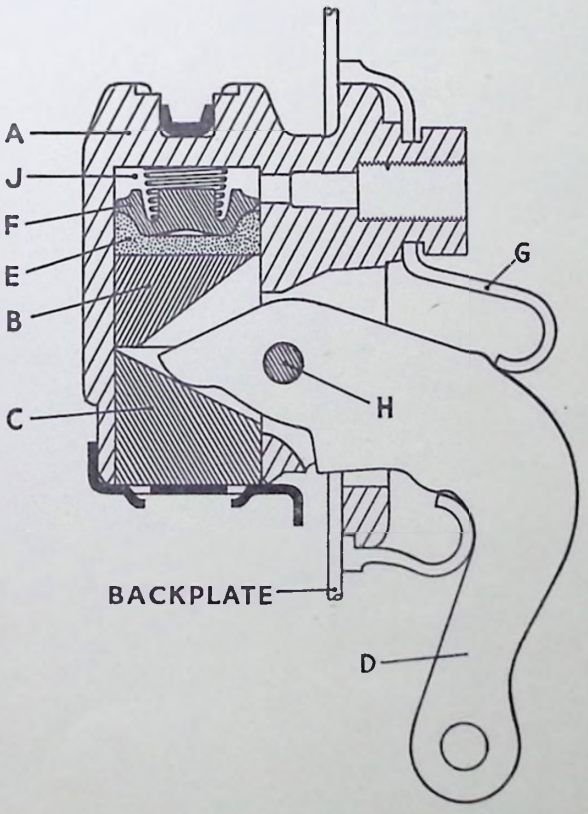


Fig. 1. Exploded view of Rear Wheel Cylinder fitted to later Productions.

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.

SERVICE HY18.
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.

GROUP H

CHASSIS SERVICES

TYRES AND WHEELS

TYRES AND WHEELS.
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. This is what can happen : the tube can be chafed, pinched, creased or the valve pinched out. Mismounted flaps, 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.

SERVICE HX1.
TYRE PRESSURES.

A Tyre loses two to three pounds pressure per week under average driving conditions. This is why the pressures should be checked once a week, or more frequently if the mileage per week is considerable.

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.

SERVICE HX2.
THE CORRECT WAY TO MOUNT A TYRE.

(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.

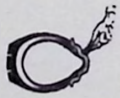
(2) Apply the tyre to rim. Guide the valve with your hand through the valve hole in the rim.

(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 around.

SERVICE HX3.
CROSS-SWITCHING OF TYRES.

Rotating of tyres for change of position and direction of travel will increase tyre mileage as much as 25%.

The tyres on a car do not all receive the same degree of wear. Rear tyres wear faster than the front tyres because power for quick starting is transmitted through the rear wheels. This causes increased road friction. Brake action causes wear in the opposite direction.

Front wheels are free rolling, subject only to the action of brakes.

Tyres on front wheels may wear irregularly due to mechanical and operating conditions.

High crown roads and road shoulders cause more wear on the tyres on the left side.

Rate of wear between a car's four tyres is in about this order (No. 1 indicating least wear).

Right front, 1. Left front, 2.
Right rear, 3. Left rear, 4.

These figures show clearly the need for periodical rotation to even up wear on all tyres and obtain maximum mileage from a car's tyre equipment.

The above instructions refer to right-hand drive cars. On left-hand drive cars the rate of wear is in the opposite order.

Rotation Method.

To equalize tread wear on all tyres, including the spare, rotate the tyres every two or three thousand miles (3,220 to 4,830 kms.) or, at the very latest, not over four thousand miles (6,440 kms.).

The rotation chart, Fig. No. 1, shows how, to change the 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.

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. The first consideration for correction of irregular front tyre wear should be a thorough check and correction of mechanical irregularities which may cause this condition. *See Services in Group F.*

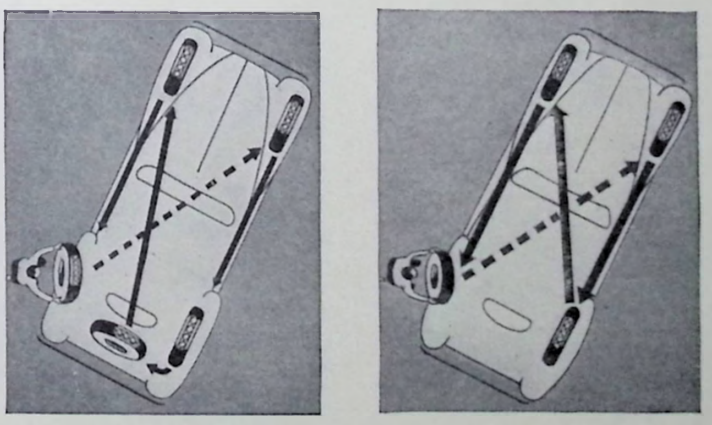


Fig. 1.

GROUP J

ELECTRICAL SERVICES

BATTERY

Description.

The battery, model GTW9A, is a 12 volt, unit of 51 ampere hours capacity at 10 hours discharge rate. It is situated under the bonnet in a recess formed in the bulkhead and is held in position by a strap and two fly nuts. It is accessible and readily detached from the car.

Routine Maintenance.

The positive terminal is earthed. An occasional inspection of this earth connection and of the earth strap fitted between the rear end of the gearbox and chassis frame should be made.

Topping Up.

About once a month, or more often in warmer climates, remove the vent plugs from the top of each of the cells and examine the level of the electrolyte. If necessary, add distilled water until the top edges of the separators are just covered. Do not fill above this level, for the excess electrolyte will be thrown out from the cell. A convenient instrument for adding distilled water to the battery is the Lucas Battery Filler, Fig. 1. It enables the cells of the battery to be filled to the correct level without visual inspection.

To Use the Filler.

(1) Remove the filler plugs from the cells and insert the nozzle of the battery filler into one of the cells until the nozzle touches the tops of the separators.
(2) Keep the filler in this position so that the distilled water can run into the battery cell (indicated by bubbles rising in the battery filler).
(3) When the bubbles cease the electrolyte is at the correct level.
(4) Remove the battery filler and replace the filler plug.
(5) Treat the other cells similarly.

NOTE. In very cold weather it is essential that the car is used immediately after "topping up" the battery to ensure that the distilled water is thoroughly mixed with the electrolyte. Neglect to do so may result in the distilled water freezing and causing damage to the battery.

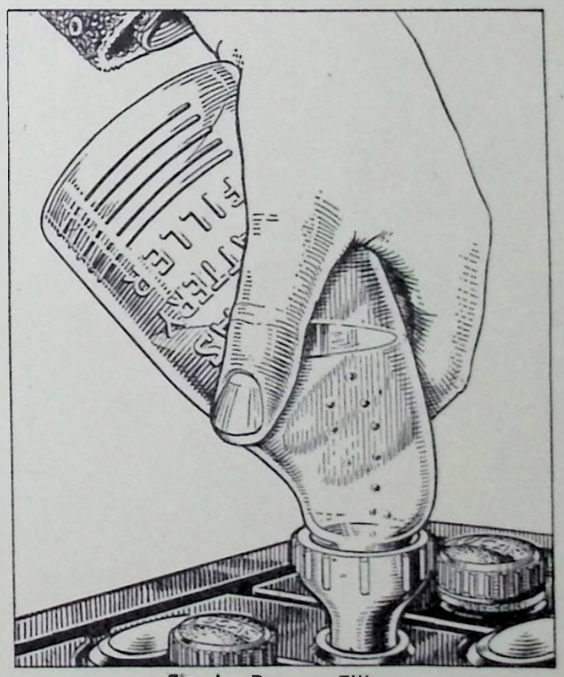


Fig. 1. Battery Filler.

When examining the cells, do not hold a naked light near the vent holes, as there is a danger of igniting the gas coming from the plates.

Storage. If a battery is to be out of use for any length of time it should first be fully charged and then given a freshening charge

about every fortnight during the period of storage. A battery must never be allowed to remain in a discharged condition as this will cause the plates to become sulphated.

SERVICE JZ1
TESTING THE BATTERY.

Occasionally examine the condition of the battery by taking hydrometer readings, since there is no better way of ascertaining the state of charge of the battery. The hydrometer contains a graduated float which indicates the specific gravity of the acid in the cell from which the sample is taken.

The specific gravity readings and their indications are as follows :—

1.280—1.300 ... Battery fully charged.

About 1.210 ... Battery about half-discharged.

Below 1.150 ... Battery fully discharged.

These figures are given assuming an electrolyte temperature of 60°F. (15½°C.). If the electrolyte temperature exceeds this, .002 must be added to hydrometer readings for each 5°F. (3°C.) rise to give the true specific gravity at 60°F. (15½°C.). Similarly .002 must be subtracted from hydrometer readings for every 5°F. (3°C.) below 60°F. (15½°C.).

The readings for all six cells should be approximately the same. If one cell gives a reading very different from the rest it may be that the electrolyte has been spilled or has leaked away or there may be an internal fault. In all cases it is advisable to have the battery examined by a battery specialist. Should the battery be in a low state of charge it should be recharged by taking the car for a long daytime run or by charging from an external source of D.C. supply at a current rate of 5 amperes until the cells are gasing freely.

After examining the battery check to ensure that the air passages of the vent plugs are clear and screw the plugs into position. Wipe the top of the battery to remove all dirt and moisture.

SERVICE JZ2.
PREPARATION OF NEW BATTERIES FOR SERVICE.

For use in the British Isles the battery is normally supplied filled and charged, ready for fitting to the vehicle. Batteries for use overseas are "dry-charged", that is, the battery is supplied sealed, without electrolyte, but with the plates in a charged condition, so that when the battery is required for service it is only necessary to fill the cells with sulphuric acid of the correct specific gravity as described below.

PREPARING DRY-CHARGED BATTERIES FOR SERVICE.

Preparation of Electrolyte.

The electrolyte is prepared by mixing together distilled water and concentrated sulphuric acid, usually of S.G. 1.835. This mixing must be carried out in a lead-lined tank or glass or earthenware vessel. The acid must be added slowly to the water while the mixture is stirred with a glass rod. NEVER ADD THE WATER TO THE ACID, as the resulting chemical reaction may cause violent and dangerous spurting of the concentrated acid.

Specific Gravity of Filling Electrolyte.

Climates not normally above 90°F. (32°C.) : 1.275.

Climates frequently above 90°F. : 1.215.

Electrolyte of specific gravity 1.275 can be prepared by adding 1 part (by volume) of 1.835 S.G. sulphuric acid to 2.8 parts of distilled water. The total quantity of electrolyte required for each battery is approximately 6 pints.

Heat is produced by the mixture of acid and water, and the electrolyte should be allowed to cool before pouring it into the battery.

Filling the Cells.

Carefully break the seals in the cell filling holes and fill each cell with electrolyte to the top of the separators, *in one operation.* The temperature of the filling room, battery and electrolyte should be maintained between 60°F. and 100°F. If the battery has been stored in a cool place, it should be allowed to warm up to room temperature before filling.

Batteries filled in this way are 90 per cent. charged, and may be fitted to the vehicle immediately. When time permits, however, a short freshening charge will ensure that the battery is fully charged. Such a freshening charge should last for no more than 4 hours, at the normal recharge rate of the battery, 5 amps.

During the charge the electrolyte must be kept level with the top edge of the separators by the addition of distilled water. Check the specific gravity of the acid at the end of the charge : if 1.275 acid was used to fill the battery, the specific gravity should now be between 1.280 and 1.300 : if 1.215, between 1.220 and 1.240.

INITIAL FILLING AND CHARGING OF BATTERIES FOR HOME MARKET.

In an emergency an unfilled and uncharged battery may be required for use. The battery is prepared for service as follows :—

The specific gravity of the electrolyte necessary to fill the new battery and the specific gravity at the end of the charge are as follows :—

Climate	S.G. of Electrolyte when Filling (Corrected to 60°F.) (15°C)	S.G. of Electrolyte at End of Charge
Ordinarily below 80°F. (27°C.) ...	1.350	1.280—1.300
Between 80°—100°F. (27°—38°C.) ...	1.320	1.250—1.270
Over 100°F. (38°C.)	1.300	1.220—1.240

The electrolyte is prepared by mixing distilled water and concentrated sulphuric acid 1.835 S.G. The mixing must be carried out in a lead-lined tank or a suitable glass or earthenware vessel. Steel or iron containers must **not** be used. The acid must be added slowly to the water while the mixture is being stirred with a glass rod. **Never add the water to the acid** as the resulting chemical reaction is dangerous. To produce electrolyte of the correct specific gravity as stated above, use proportions of acid and distilled water as follows :—

To obtain specific gravity (Correct to 60°F.) (15½°C)	Add 1 part by volume of 1.835 S.G. acid to distilled water by volume as below.
1.350	1.8 parts
1.320	2.2 ,,
1.300	2.5 ,,

Heat is produced by the mixture of acid and water and the mixture should, therefore, be allowed to cool before being poured into the battery. If poured in warm the plates, separators and moulded container may be damaged.

Filling-in and Soaking. The temperature of the filling-in acid, battery and charging room should be above 32°F. (0°C.).

Carefully break the seals in the filling holes and half fill each cell in the battery with dilute sulphuric acid solution of the appropriate specific gravity (according to temperature) see table above. The quantity of electrolyte to half fill a two volt cell is half-a-pint.

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.

Duration and Rate of Initial Charge. Charge at a constant current of 3.5 amps. until voltage and temperature-corrected specific gravity readings show no increase over five successive hourly readings. This period is dependent upon the length of time the battery has been stored since manufacture, and will be from forty to eighty hours, but usually not more than sixty.

Throughout the charge the acid in each cell must be kept level with the tops of the separators by the addition of acid solution of the same specific gravity as the original filling-in acid.

If, during charge, the temperature of the acid in any cell of the battery reaches the maximum permissible temperature of 120°F. (49°C.), the charge must be interrupted and the battery temperature allowed to fall at least 10°F. (6°C.) before charging is resumed. At the end of the first charge, *i.e.*, when specific gravity and voltage measurements remain substantially constant, carefully check the specific gravity in each cell to ensure that it lies within the limits specified. If any cell requires adjustment some electrolyte must be syphoned off and replaced with either acid of the strength used for the original filling-in, or distilled water, according to whether the specific gravity is too low or too high respectively. After such adjustment the gasing charge should be continued for one or two hours to ensure adequate mixing of the electrolyte. Re-check and, if necessary, repeat the procedure until the desired result is obtained.

Finally, siphon off any electrolyte above the top of the separators.

GROUP J

ELECTRICAL SERVICES

LIGHTS

LIGHTING EQUIPMENT

THE LIGHTING EQUIPMENT IS GROUPED AS FOLLOWS :—

Up to and including Car No. D301S the parking lights are inside the Head Lamp Bodies, from Car No. D1451S a new type of tail light and a more powerful stop light come into use. A tail and a stop light are fitted to each rear wing. The rear number plate embodies a reversing lamp in addition to being illuminated by a MBC Bulb. For method of bulb replacement see pages JY5 to JY7.

Group A, G and N are for Right Hand Drive	Both Lamps dip Left
Group B, H and O are for Left Hand Drive	Both Lamps dip Right
Group C, J and P are for Left Hand Drive	Both Lamps dip Vertical
Group D is for Left Hand Drive	Both Lamps dip Right : American Specification
Group E, I and R are for Left Hand Drive	Both Lamps dip Vertical (Special Bulbs)
Group F and M are for Right Hand Drive	Right Head Lamp out. Left Head Lamp, dip Left

Bulb Replacements up to Car Number D301S.

Group	*Specification*	*Countries.*
A	Headlamps, F.700P. with Bulbs No. 354 Pre-focus, 12V. 42/36W. and Pilot Bulbs No. 989, MBC. 12V. 6W.	For Australia, South Africa, New Zealand, Burma, India, Cyprus, Iceland, Nyasaland, Sudan, Tanganyika, Aden, Bermuda, Jamaica, Malta, Uganda, Hong-Kong, Shanghai, Malay, Straits Settlements.

B	Headlamps, F.700P. with Bulbs No. 301 Pre-focus, 12V. 36/36W. and Pilot Bulbs No. 989, MBC, 12V. 6W.	For Syria, Algeria, Egypt, Iran, Saudi Arabia, Chile, Spain, South America, Eritrea, Ethiopa, Israel, Gibraltar, Canada, Denmark, Greece, Austria, Netherlands, East Indies, Lebanon, Sweden.
C	Headlamps, F700P. Mark II, with Bulbs Hooded Filament, No. 350, C. 12V. 35/35W. and Pilot Bulbs No. 989, MBC. 12V. 6W.	For Finland, Holland, Hungary, Norway, Switzerland, Germany, Belgium, Czechoslovakia, Italy, Portugal.
D	Headlamps, F.700, Mark III, with Bulbs No. 301, Pre-focus, 12V. 36/36W.	For U.S.A., Ecuador.
E	Headlamps, F.700P/EF, Mark III less Bulbs, 3-Pin Bulb purchased on Continent.	For France, French Morocco, Tunisia.
F	Headlamp, L.H., F.700P. with Bulbs No. 354 Pre-focus, 12V. 42/36W and Pilot Bulbs No. 989, MBC. 12V. 6W. Headlamp, R.H., F.700P. with Bulbs No. 325, Pre-focus 12V. 38W. and Pilot Bulbs No. 989, MBC 12V. 6W.	For Great Britain and Eire.

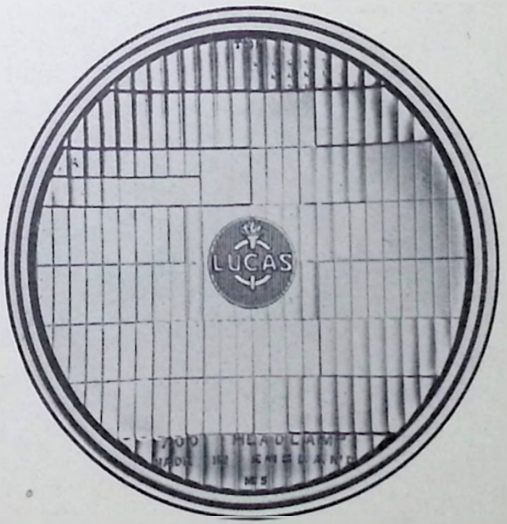
From Car No. D301S and up to Cars fitted with Double Dipping System.

Group.	*Specification.*	*Countries.*
G	Headlamp, F.700 Mark III, with Bulbs No. 354 Pre-focus, 12V. 42/36W.	For Australia, South Africa, New Zealand, Burma, India, Cyprus, Iceland, Nyasaland, Sudan, Tanganyika, Aden, Bermuda, Jamaica, Malta, Uganda, Hong-Kong, Shanghai, Malay, Straits Settlements.
H	Headlamps, F.700 Mark III with Bulbs No. 301 Pre-focus, 12V. 36/36W.	For Syria, Algeria, Egypt, Iran, Saudi Arabia, Chile, Spain, South America, Eritrea, Ethiopa, Israel, Gibraltar, Canada, Denmark, Greece, Austria, Netherlands, East Indies, Lebanon, Sweden.
J	Bulbs, Headlamps F.700 Mark III, with Hooded Filament No. 350, 12V. 35/35W.	For Finland, Holland, Hungary, Norway, Switzerland, Germany, Belgium, Czechoslovakia, Italy, Portugal.
D	Headlamps, F.700 Mark III with Bulb No. 301, Pre-focus 12V. 36/36W.	For U.S.A., Ecuador.
L	Headlamps, F.700/EF. Mark III less Bulbs. 3-Pin Bulb purchased on the Continent.	For France, French Morocco, Tunisia.
M	Headlamp, L.H., F.700, Mark III with Bulb No. 354, Pre-focus, 12V. 42/36W. Headlamp R.H., F.700, Mark III with Bulb No. 325, Pre-focus, 12V. 38W.	For Great Britain and Eire.

Sidelamps, used with Headlamps D, G, H, J, L, M	Type 489, Bulb No. 989, MBC. 12V. 6 Watt
Tail Lamps, up to Car No. D1450S	Type 482, Bulb No. 189, 12V. 6/24 Watt
Tail Lamps, on Car No. D1451S onwards	Type 488, Bulb No. 189, 12V. 6/24 Watt
Number Plate and Reversing Lamp.	Type 469.
Number Plate Bulb	Bulb No. 989, 12V. 6 Watt
Reversing Lamp Bulb	Bulb, No. 221 MBC. 12V. 18 Watt
Trafficator Bulbs	Bulb No. 256, 12V. 3 Watt (Festoon)
Warning Lights on Instrument Board...	Bulb No. 987, 12V. 2.2 Watt
Instrument Panel Lighting	Bulb No. 987, 12V. 2.2 Watt
Roof Lamps	Bulb No. 254, 12V. 6 Watt (Festoon)

DOUBLE DIPPING SYSTEM.

Headlamps using a "block pattern" lens make it possible to revise completely the existing methods of headlighting for vehicles and enables the use of a double-dipping system which, whilst giving double the amount of light for driving in the dipped position, restricts the amount of dazzling light to the level of present dip-and-switch systems. Effective utilisation of all available light from the bulb and reflector has also resulted in a marked increase of usable light for illuminating the road when driving in the non-dipped or normal headlight position.



"Block Pattern" Lens.

In the new double-dipping system, the "block-pattern" lens is used in conjunction with the well-known Lucas Light Unit, a method of headlamp construction which employs a reflector and front lens permanently fixed to each other and a specially designed bulb fitted into the reflector from the rear. Several important advantages accrue from this method of construction, the chief of them being that the bulb, by virtue of its design, can be fitted in one position only in the reflector ; once this position has been determined by the Designer to give correct focusing, it cannot be subsequently altered. With the double-filament bulb used to provide dipping facilities, this advantage applies with equal force to both main and dip filaments—both are permanently located in their correct positions with respect to the focal point of the reflector.

Cars fitted with Double Dip System using Block Pattern Lens.

Group.	*Specification*	*Countries*
N	Headlamp F.700 Mark III "Block Pattern" Lens with Bulbs. Lucas No. 354 Pre-focus 42/36 Watt.	For Australia, South Africa, New Zealand, Burma, India, Cyprus, Iceland, Nyasaland, Sudan, Tanganyika, Aden, Bermuda, Jamaica, Malta, Uganda, Hong-Kong, Shanghai, Malay, Straits Settlements.
O	Headlamp F.700 Mark III "Block Pattern" Lens with Bulbs, Lucas No. 301, 12 volt 36/36 Watt	For Syria, Algeria, Egypt, Iran, Saudi Arabia, Chile, Spain, South America, Eritrea, Ethiopia, Israel, Gibraltar, Canada, Denmark, Greece, Austria, Netherlands, East Indies, Lebanon, Sweden.
P	Headlamp F.700 Mark III "Block Pattern" Lens with Bulbs, Lucas No. 360 12 volt 45/35 Watt. Duplo hooded filament.	For Finland, Holland, Hungary, Norway, Switzerland, Germany, Belgium, Czechoslovakia, Italy, Portugal.
D	Headlamp F.700 Mark III "Block Pattern" Lens with Bulbs, Lucas No. 301, 12 volt 36/36 Wtt.	For U.S.A., Ecuador.
R	Headlamp F.700/EF Mark III "Block Pattern" Lens, less Bulbs 3 Pin Bulb purchased on the Continent.	For France, French Morocco, Tunisia.
S	Headlamp F.700 Mark III "Block Pattern" Lens with Bulbs, Lucas No. 354, 12 Volt 42/36 Watt.	For Great Britain and Eire.

Sidelamps, used with above Headlamps	Type 489, Bulbs No. 989, MBC. 12V. 6 Watt
Stop Tail Lamp, up to Car No. D1540S	Type 482, Bulbs No. 189, 12V. 6/24 Watt.
Stop Tail Lamps, on Car No. D1541S	Type 488, Bulb 361, 12V. 6/18 Watt. Index Cap Type.
Number Plate and Reversing Lamp.	
Number Plate Bulb.	Type 469 Bulb, No. 989 12V. 6 Watt.
Reversing Lamp Bulb.	Type 469 Bulb, No. 221 MBC. 12V. 18 Watt.
Trafficator Bulbs.	Bulb No. 256, 12V. 3 Watt (Festoon).
Warning Lights on Instrument Board.	Bulb No. 987, 12V. 2.2 Watt.
Instrument Panel Lighting.	Bulb No. 987, 12V. 2.2 Watt.
Roof Lamps.	Bulb No. 254, 12V. 6 Watt (Festoon).

SERVICE JY1.
HEADLAMPS BULB REPLACEMENT.

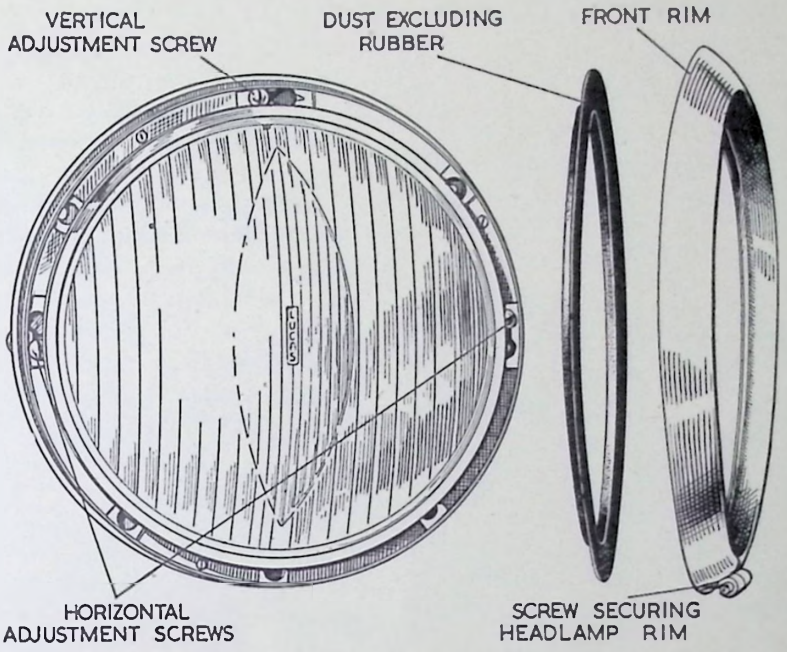


Fig. 1.

To remove the Light Unit for bulb replacement, unscrew the screw securing the front rim and lift off the rim, Fig. 1. Next remove the dust-excluding rubber and expose the three spring-loaded adjustment screws. Press the Light Unit in against the tension of the adjustment screw springs and turn it in an anti-clockwise direction until the heads of the screws can be disengaged through the slotted holes in the Light Unit rim. Do not disturb the screws as this will alter the lamp setting.

Twist the back shell in an anti-clockwise direction and pull it off. The bulb can then be removed, Fig. 2, Page JY6.

Place the replacement bulb in the holder taking care to locate it correctly. Engage the projection on the inside of the back shell with the slots in the holder, press on and secure by twisting in a clockwise direction.

Position the Light Unit so that the heads of the adjusting screws protrude through the slotted holes in the flange, press the Unit in and turn in a clockwise direction. Replace the dust excluding rubber and refit the front rim.

SERVICE JY2.
REPLACEMENT OF LIGHT UNIT.

In the event of damage to either the front lens or reflector, a replacement Light Unit should be fitted as follows :—

(1) Remove the Light Unit assembly as already described.

(2) Withdraw the three screws from the unit rim and remove the seating rim and unit rim from Light Unit.

(3) Position the replacement Light Unit between the unit rim and seating rim, taking care to see that the die cast projection at the edge of the Light Unit fits into the slot in the seating rim and also that the seating ring is correctly positioned. Finally secure in position by means of the fixing screws.

SERVICE JY3.
TO REMOVE AND REPLACE A HEAD LAMP.

(1) Remove the screw securing the front rim and lift off the rim. Next remove the dust excluding rubber and expose the three spring loaded adjustment screws. Press the Light Unit in against the tension of the adjustment screw springs and turn it in an anti-clockwise direction until the heads of the screws can be disengaged through the slotted holes in the Light Unit rim. Do not disturb the screw as this will alter the lamp setting.

(2) Open the bonnet and disconnect the head lamp wires at the snap connections just rear of the rubber sheath of the head and side lamp wires on the bonnet platform. Attach a piece of strong string to the wires and pull the wires through the sheath. The string will help to rethread the wires. Mark the wires to assist reconnecting them. If in doubt, consult the wiring diagram given on *Page JY9*.

(3) Remove the three brass bolts and nuts securing the head lamp to the wing and detach the lamp. Note the rubber joint between the lamp and wing.
Replace by reversing the foregoing operations.

SERVICE JY4.
PILOT LAMP BULB REPLACEMENT—UP TO CAR D.300S.

Remove the rim and light unit as for headlamp bulb replacement when the pilot bulb, which is of the bayonet type fitting, can be replaced readily.

SERVICE JY5.
SIDELAMPS BULB REPLACEMENT FROM CAR No. D.301S.

Move aside the rubber ring and lever the rim and glass assembly from the bottom of the lamp. When refitting the assembly, move aside the rubber ring, locate the rim at the top of the lamp, press, and finally position the rubber ring so that it fits around the rim.

SERVICE JY6.
STOP AND TAIL LAMP BULB REPLACEMENT UP TO CAR No. D.1450S.

Slacken the single securing screw and remove the front glass. To gain access to the bulb move aside the glass fixing stirrup. When replacing the bulb, move it slowly until the locating catch is felt, for if not correctly located the stop lights will not operate properly.

From Car No. D.1451S adopt a method similar to that described for the side lamp bulb replacement. Note, however, that in this lamp the rim and glass are separately located by rubber flanges, and that the bulb, of the "indexed" type, can only be fitted in one position in its holder.

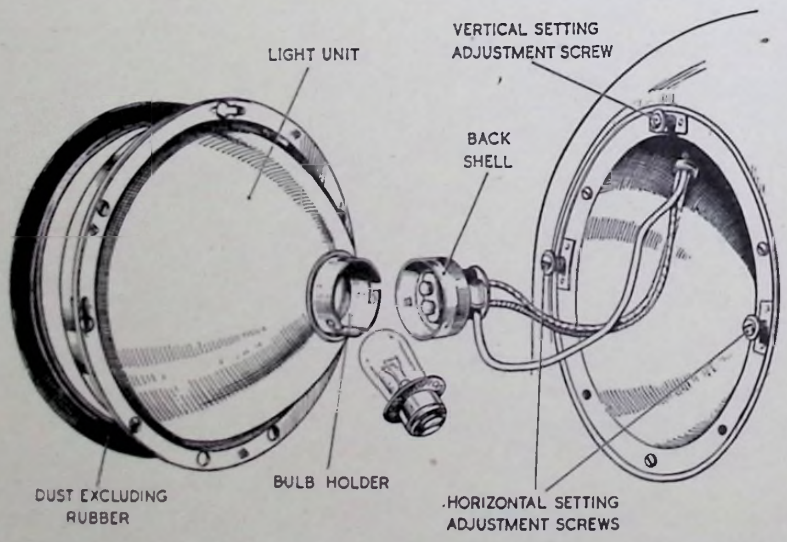


Fig. 2.

SERVICE JY7.
TO REMOVE AND REPLACE A SIDE LAMP FROM CAR No. D.3015 AND ONWARDS.

(1) Open the bonnet and disconnect the head lamp wires at the snap connections just rear of the rubber sheath of the head and side lamp wires on the bonnet platform. Attach a piece of strong string to the wires and pull the wires through the sheath. The string will help to rethread the wires. Mark the wires to assist reconnecting them. If in doubt, consult the wiring diagram given on *Page JY9*.

(2) Remove the rim and glass assembly as detailed in *Service JY1*. Detach the lamp from the wing by removing the three brass screws securing it.
Replacement is the reversal of the foregoing.

SERVICE JY8.
TO REMOVE AND REPLACE A STOP AND TAIL LAMP FROM CAR No. D.1451S ONWARDS.

(1) Move aside the rubber lip and lever off the front rim ; next move aside the inner rubber lip and remove the glass.

(2) Remove the three 2 B.A. bolts, shake-proof washers and nuts, when the body of the lamp complete with the rubber surround can be withdrawn out of the wing. Separate the body from the surround and detach the earth connection, the red and green tail and the stop light connections. *Note the positions of the red and green wires relative to the lamp body, to help replacement.*

Replacement is the reverse of removal, but before fitting the glass and rim, check that when the brake pedal is depressed the 24 watt stop light is switched on. If the 6 watt light is switched on remove the bulb, revolve it through an angle of 180° and reinsert it. Check again before completing the assembly.

On lamps using the index cap type of bulb No. 361 this precaution is not necessary.

SERVICE JY9.
TO REMOVE AND REPLACE THE ILLUMINATED NUMBER PLATE AND REVERSE LAMPS.

The lamp assembly is bolted to the car by two bolts, nuts and washers.

On these being removed and the wire connectors disconnected, the assembly can be detached.

Replacement is the reversal of removal.

SERVICE JY10.
TO SET THE HEADLAMP.

Ministry of Transport Lighting Regulations.

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 headlamps must be set so that the main beams of light are parallel with the road and with each other.

To comply with the regulations the lamps must be set as shown. Check the setting by placing the car in front of a blank wall at the greatest possible distance, taking care, of course, that the surface on which the car is standing is not sloping relative to the wall. (*See Fig. 2, Page JY8*).

Methods of Adjustment.

When adjusting headlamps it will be found an advantage to cover one lamp while testing the other.

Remove the front rim by unscrewing the rim securing screw and lifting off the rim, which is split to facilitate removal. Next remove the rubber dust excluder, when three spring-loaded adjustment screws will be visible, by means of which the setting can be adjusted as required.

Vertical adjustment is made by turning the screw at the top of the lamp. Horizontal adjustment can be altered by means of the adjustment screws on each side of the Light Unit.

IRREGULARITIES AND THEIR REMEDIES.

LIGHTING CIRCUITS.

Lamps Give Insufficient Illumination.

(1) Test the state of charge of the battery, recharging it if necessary either by a long period of daytime running or from an independent electrical supply.

(2) Check the setting of the lamp.

(3) If the bulbs are discoloured as a result of long service, they should be replaced.

Lamps Light When Switched On, but Gradually Fade Out.

As (1).

Lights Flicker.

Examine the circuits of the lamps for loose connections.

Brilliance Varies with Speed of Car.

(4) As (1).

(5) Examine the battery connections, making sure that they are tight, and replacing faulty cables.

Failure of Lights.

(6) As (1).

(7) Examine the wiring for a loose or broken connection, and remedy.

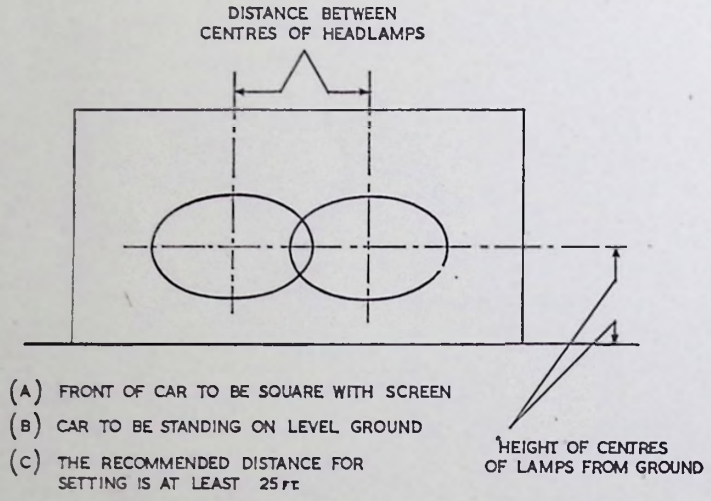
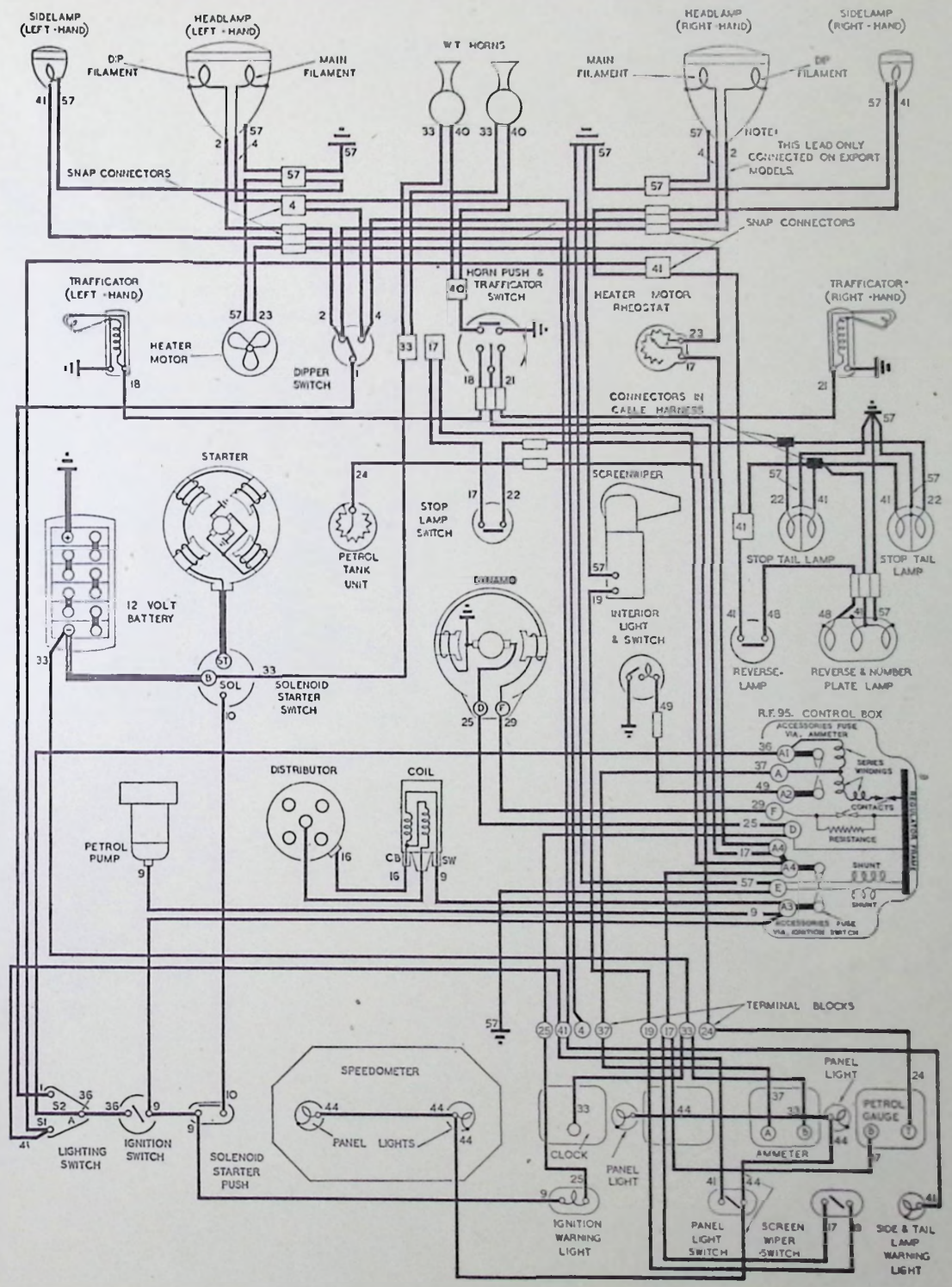


Fig. 2. Headlamp Setting Chart.

WIRING DIAGRAM S.M.1500 FOR CARS No. D 301 S AND UPWARDS



KEY TO CABLE COLOURS

1 BLUE
2 BLUE with RED
3 BLUE with YELLOW
4 BLUE with WHITE
5 BLUE with GREEN
6 BLUE with PURPLE
7 BLUE with BROWN
8 BLUE with BLACK
9 WHITE
10 WHITE with RED
11 WHITE with YELLOW
12 WHITE with BLUE
13 WHITE with GREEN
14 WHITE with PURPLE
15 WHITE with BROWN
16 WHITE with BLACK
17 GREEN
18 GREEN with RED
19 GREEN with YELLOW
20 GREEN with BLUE
21 GREEN with WHITE
22 GREEN with PURPLE
23 GREEN with BROWN
24 GREEN with BLACK
25 YELLOW
26 YELLOW with RED
27 YELLOW with BLUE
28 YELLOW with WHITE
29 YELLOW with GREEN
30 YELLOW with PURPLE
31 YELLOW with BROWN
32 YELLOW with BLACK
33 BROWN
34 BROWN with RED
35 BROWN with YELLOW
36 BROWN with BLUE
37 BROWN with WHITE
38 BROWN with GREEN
39 BROWN with PURPLE
40 BROWN with BLACK
41 RED
42 RED with YELLOW
43 RED with BLUE
44 RED with WHITE
45 RED with GREEN
46 RED with PURPLE
47 RED with BROWN
48 RED with BLACK
49 PURPLE
50 PURPLE with RED
51 PURPLE with YELLOW
52 PURPLE with BLUE
53 PURPLE with WHITE
54 PURPLE with GREEN
55 PURPLE with BROWN
56 PURPLE with BLACK
57 BLACK
58 BLACK with RED
59 BLACK with YELLOW
60 BLACK with BLUE
61 BLACK with WHITE
62 BLACK with GREEN
63 BLACK with PURPLE
64 BLACK with BROWN

GROUP J

ELECTRICAL SERVICES

CONTROL BOX

General Description.

The control box houses the dynamo voltage regulator unit and the cut-out ; also two fuses connected in the circuits of the accessories.

Although combined structurally, the regulator and cut-out are electrically separate. Both are accurately adjusted during manufacture, after which the cover protecting them is sealed and should not be removed unnecessarily.

The Regulator.

The regulator unit is arranged to work in conjunction with the shunt-wound dynamo described on *Group B, Page BX1*. The regulator is set to maintain a predetermined dynamo voltage at all speeds above the regulating point, the field strength being controlled by the automatic insertion of a resistance in the dynamo field circuit. When the dynamo voltage reaches a predetermined value the magnetic field due to the shunt or voltage winding becomes sufficiently strong to attract the armature. This causes the contacts to open, thereby inserting the resistance in the field circuit.

The consequent reduction in field current lowers the dynamo voltage and this, in turn, weakens the magnetic field due to the voltage coil. The armature is allowed to return to its original position, thus closing the contacts, so that the voltage returns to the predetermined maximum. The cycle is then repeated, and the armature is set into vibration.

As the speed of the dynamo rises above that at which the regulator comes into operation, the amplitude of vibration increases and the periods of interruption increase in length, with the result that the mean value of the dynamo output undergoes practically no increase once the operating speed has been attained.

The series or current windings provide 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 very

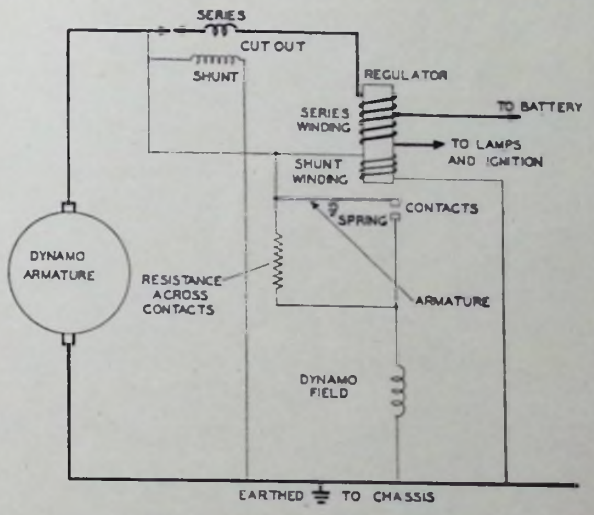


Fig. 1. Diagram of C.V.C. Charging Circuit.

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 the dynamo would be forced to give an output to bring the voltage of the system up to the same value as if the battery were in its normal fully charged condition, and this, with a battery of low internal resistance would necessitate an extremely heavy current far beyond the

normal capacity of the machine. The series winding assists the voltage coil, 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.

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 bimetallic spring suspension for the armature of the regulator which causes the operating voltage of the regulator to be increased in cold weather and reduced in hot weather, and thereby compensate for the variation in charging current which would otherwise occur due to the changed characteristics of the battery.

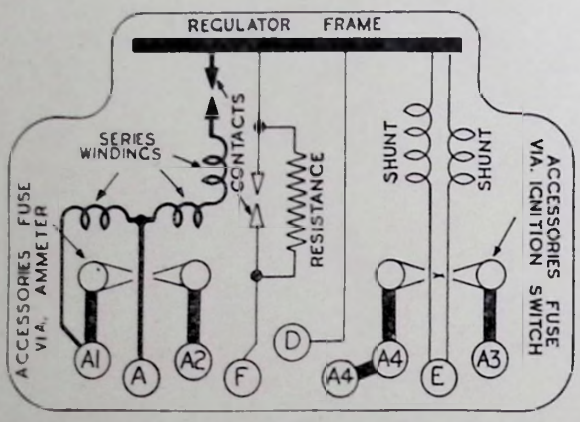


Fig. 2. Internal Connections of Control Box. RF95-2.

The Cut-out.

The cut-out is an automatic switch connected between dynamo and battery. It consists of a pair of contacts held open by a spring and closed magnetically when the engine is running fast enough to cause the dynamo voltage to exceed that of the battery. The battery will then be charged by the dynamo. On the other hand, when the speed is low or the engine is stationary, the contacts open, thus disconnecting the dynamo from the battery and preventing current flowing from the battery through the windings.

SETTING DATA.

(a) **Cut-out.**

Cut-in voltage	...	12.7—13.3 volts
Drop-off voltage	...	9—10 volts
Reverse current	...	3—4.5 amps.

(b) **Regulator—Setting on open circuit.**

10°C. (50°F.)		
Cold climate	... ...	16.1—16.7 v.
20°C. (68°F.)		
Normal temperature	...	15.8—16.4 v.
30°C. (86°F.)		
Hot climate	... ...	15.6—16.2 v.
40°C. (104°F.)		
Very hot	... ...	15.3—15.9 v.

SERVICE JX1.
TESTING REGULATOR IN POSITION TO LOCATE FAULT IN CHARGING CIRCUIT.

If the procedure given in *Group B, Section BX*, the dynamo section shows the dynamo to be in order, proceed to check further as follows :—

(1) First 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 broken wires or loose connections.

(3) Reconnect the wire to terminal A.

SERVICE JX2.
REGULATOR ADJUSTMENT.

The regulator is carefully set during manufacture to suit the normal requirements of the standard equipment and in general it should not be necessary to make further adjustments. However, if the battery does not keep in a charged condition, or if the dynamo output does not fall when the battery is fully charged it may be advisable to check the setting and readjust if necessary.

It is important before altering the regulator setting when the battery is in a low state of charge, to check that its condition is not due to a battery defect or to the dynamo belt slipping.

(1) **Electrical Setting.** It is important that a good quality **Moving Coil Voltmeter** (0—20 volts) be available before attempting to adjust the regulator.
The electrical setting can be checked without removing the cover from the control box.

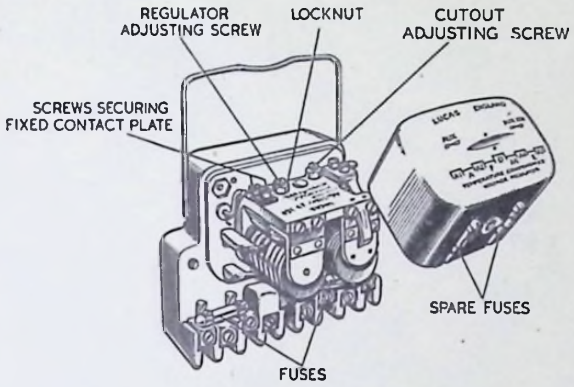


Fig. 3. Control Box with Cover Removed.

Withdraw the cables from the terminals marked A and A1 at the control box and join the wires together.

Connect the negative lead of the moving coil voltmeter to the D terminal of the dynamo, and connect the other lead from the meter to a convenient chassis earth. Slowly increase the speed of the engine until the voltmeter needle "flicks" and then steadies ; this should occur at a voltmeter reading between the limits given in Setting Data (b) on Page JX2 for the regular appropriate temperature of the regulator.

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 the locknut (A) holding the adjusting screw (B) and turn the screw in a clockwise direction to raise the setting or in an anti-clockwise direction to lower the setting. Turn the screw a fraction of a turn only at a time and then tighten the locknut. Repeat as above until the correct setting is obtained.
Remake the original connections.

When the dynamo is run at a high speed on open circuit, it builds up a high voltage. Therefore, when adjusting the regulator, do not run the engine up to more than half-throttle or a false voltmeter reading will be obtained.

(2) **Mechanical Setting.** The mechanical setting of the regulator is accurately adjusted before leaving the works and provided that the armature carrying the moving contact is not removed, the regulator will not require mechanical adjustment. If, however, the armature has been removed from the regulator for any reason, the contacts will have to be reset. To do this proceed as follows :— Slacken the two armature fixing screws (see Fig. 5, Page JX4). Insert a .018″ (.457 mm.) feeler gauge between the back of the armature and the regulator frame.

Press back the armature against the regulator frame and down on to the top of the bobbin core with gauge in position and lock the armature by tightening the two fixing screws.

Check the gap between the underside of the arm and the top of the bobbin core. The gap should be .012″—.020″ (.305—.508 mm.). If the gap is outside these limits correct by adding or removing shims at the back of the fixed contact.
Remove the gauge and press the armature down, when the gap between the fixed contacts should be .006″—.017″ (.152—.432 mm.).

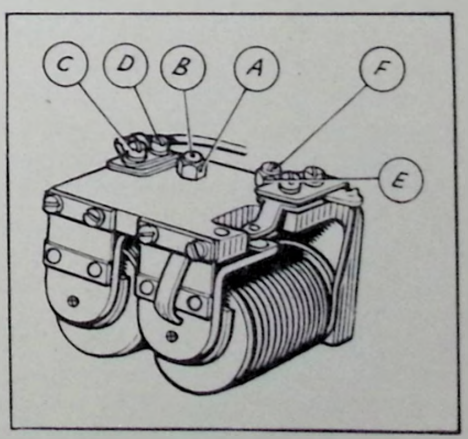


Fig. 4. Cut out and Regulator Assembly.

(3) **Cleaning Contacts.** After long periods of service it may be found necessary to clean the vibrating contacts of the regulator. These are made accessible by slackening the screws securing the plate carrying the fixed contact. It will be necessary to slacken the upper screw (C), Fig. 4, Page JX3, a little more than the lower (D) so that the contact plate can be swung outwards. Clean the contacts by means of fine carborundum stone or fine emery cloth. Carefully wipe away all traces of dirt or other foreign matter. Finally tighten the securing screws.

SERVICE JX3.
CUT-OUT ADJUSTMENT.

(1) **Setting.** If the regulator setting is within the correct limits, but the battery is still not receiving current from the dynamo, the cut-out may be out of adjustment, or there may be an open circuit in the wiring of the cut-out and regulator unit.

Remove the cable from the terminal marked A on the control box (ensuring that the bared end does not come into contact with the chassis). Remove the voltmeter lead from the D terminal of the unit and connect it to terminal A. Run the engine as before : at a fairly low engine speed, the cut-out should operate, when a voltmeter reading should be given of the same value as that when the voltmeter was connected to terminal D.

If there is no reading, the setting of the cut-out may be badly out of adjustment and the contacts not closing. To check the voltage at which the cut-out operates remove the control box cover, and connect the voltmeter between the D terminal and earth. 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 the locknut on the cut-out adjustment screw and turn the screw in a clockwise direction to raise the voltage setting or in an anti-clockwise direction to reduce the setting, testing after each adjustment by increasing the engine speed until the cut-out is seen to operate, and noting the corresponding voltmeter reading.

Tighten the locknut after making the adjustment.

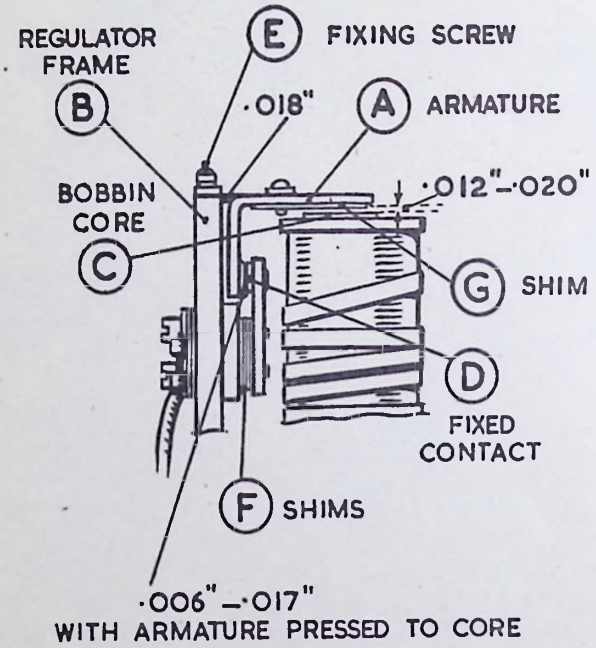


Fig. 5. Mechanical Adjustment of Regulator.

(2) **Cleaning Contacts.** If the cut-out contacts appears burnt or dirty, 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.

GROUP J

ELECTRICAL SERVICES

ACCESSORIES

SCREEN WIPER.

The windscreen wiper fitted to the latest cars incorporates a protective device in the form of a thermostat which under conditions of excessive heating cuts off the current supply to the motor until normal conditions are restored.

If the blades are prevented from moving, as for instance by ice or packed snow on the windscreen, the thermostat will operate as soon as the motor temperature rises to an excessive extent. Normal working will be resumed, if the obstruction has been removed, as soon as the motor has cooled. The time taken to reach the "restart" temperature will vary according to the general conditions, and may be up to ten minutes.

The thermostat may also operate in normal use should the motor temperature for any reason rise to an excessive value. Here again the motor will recommence running as soon as cooling has taken place.

Maintenance.

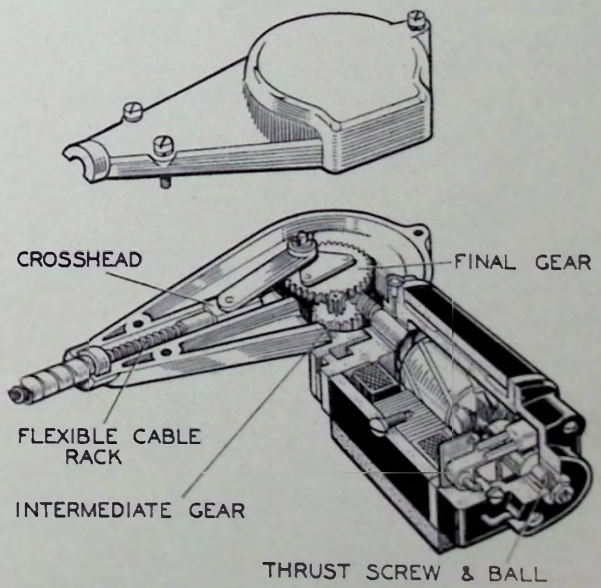
Normally the windscreen wiper does not require any servicing apart from the occasional renewal of the rubber blades. Should trouble be experienced first check for loose connections, worn insulation, etc., before dismantling the motor.

SERVICE JW1.
TO REMOVE AND REPLACE BOTH SCREEN WIPER DRIVING MECHANISMS.

(1) Remove the inside driving mirror held by two wood screws and detach the windscreen inside capping by removing the securing screws.

(2) Remove the ash tray and the two metal thread screws securing the facia plate to the panel and central support bracket. Also the two round headed 2 B.A. screws securing the panel to the underside of the central support bracket and the six bolts, nuts and plain washers securing the bottom edge, with facia strip, to the body. The two bolts and nuts on either side of the steering column need not be removed, they merely hold the facia strip to the instrument panel.

(3) Detach the oil gauge pipe and the speedometer cable from the gauge and meter respectively. The instrument panel, complete with instruments and controls, can now be drawn into the car suffi-



Section through Screen Wiper.

ciently to give access to the wiper driving mechanisms.

(4) Remove the wiper arms and blades by slackening the nut behind the boss of each wiper arm and pulling the arm off the spindle. Remove the grommets.

(5) Detach the clip securing the cover of the cable to the body of the drive mechanism nearest to the motor and draw out the drive cable. The mechanisms can now be detached by removing the two bolts securing each to the demister casing.

Replacement is by reversing the foregoing operations with the following additions :—

When replacing the cable casing make sure that the slots of the clips engage the pegs in the bodies of the mechanisms and that when the mechanisms are secured in position the spindles are central with the apertures in the scuttle. To centralize, tap the bodies in the required direction with the securing bolts partially tightened. Do not forget to tighten the bolts finally.

To engage the drive with the mechanism furthest away from the motor, release by about half-an-inch the three screws, holding the cover, and drive the spindle and the cover into the car. The drive will now engage. Re-tighten the screws released.

Before replacing the instrument panel assembly, fit the screen wiper arms on the spindle so that the blades wipe the screen in equal areas. Normally this condition can be obtained by positioning the blades on the spindles suitable, when the spindles are at the ends of their clock or anti-clockwise oscillations. Position the cable so that there are no sharp curves and check that the motor drives the blades readily. When assured on these points fit the panel.

SERVICE JW2. REPAIRS TO SCREENWIPER.

To detach the cable rack from the motor and gearbox, remove gearbox cover, the split pin and washer from crank pin on the final gear wheel, and lift off the connecting link. The latest wipers have a peg on the connecting link instead of a crank pin on the gear, and there is thus no split pin to be removed.

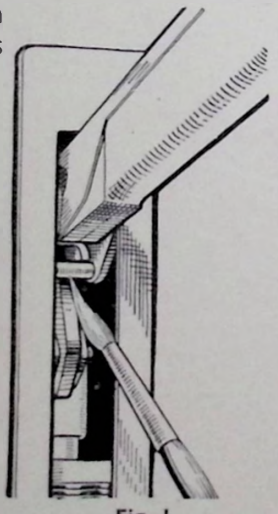


Fig. 1.

Commutator Dirty.

To clean the commutator, remove the connecting leads to the terminals, withdraw the three screws securing the cover at the commutator end, and lift off the cover. Clean the commutator with a cloth moistened with petrol and carefully remove any carbon dust from between the commutator segments.

Check that the brushes bear freely on the commutator. If they are loose and not making contact a replacement tension spring is necessary. The brush levers must be free on their pivots. If they are stiff, free them by working them backwards and forwards by hand.

If the brushes are considerably worn they must be replaced.

The 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.

When overhauling, the gear must be lubricated by lightly packing the gearbox with a grease of the zinc oxide type.

TRAFFICATORS.

Maintenance.

Oil the Trafficators as in Figs. 1 and 2, every 10,000 miles (16,000 kilometers).

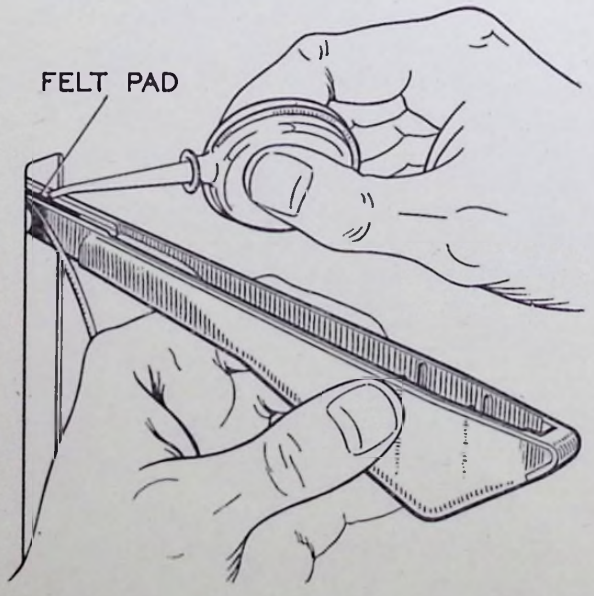


Fig. 2.

SERVICE JW3.
TO REMOVE AND REPLACE A TRAFFICATOR.

(1) Ensure that the Trafficator switch is in the **off** position and that it remains in this position while the Trafficator is being removed and replaced.

(2) Remove the three plated screws securing the trim casing to the pillar. Move the front seat backwards or forwards and then to obtain access to the two lower screws. Lift the casing upwards towards the roof of the car and when doing so avoid removing it from under the trimming at its top edge.

(3) Detach the weather rolls in the neighbourhood of the Trafficator and the asbestos sheet over the aperture in the pillar, by removing the securing tacks. The Trafficator unit can now be withdrawn from its position by removing the two securing screws and disconnecting the feed wire at its pull-push connection.

Replacement is by reversing the foregoing, but before finally tightening the securing bolts, make sure that the arm is central in the aperture in the outer face of the pillar, and that with the bolts securely tightened the arm will work when switched on.

SERVICE JW4.
TO REPLACE TRAFFICATOR ARM.

(1) Drill out rivet securing arm to bracket. Remove Trafficator arm cover and withdraw cable and bulb. Open out clip securing cable to arm of Trafficator and remove arm.

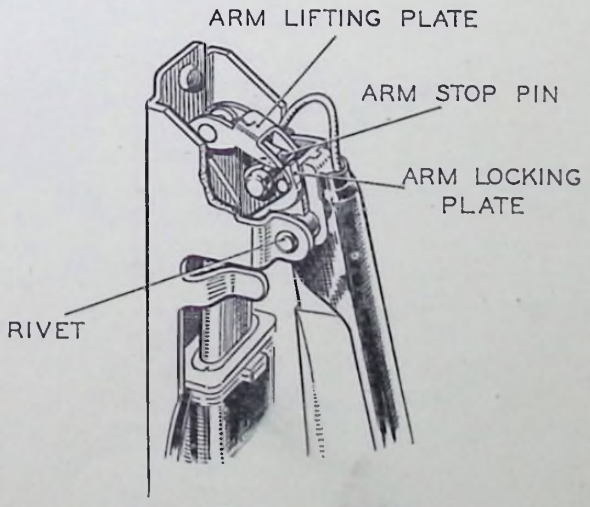


Fig. 1. Trafficator Mechanism.

(2) Replacement of Arm.
Place the new arm in position so that the arm stop pin locates between the arm lifting plate and locking plate. Secure in this position by fitting new rivet. Remove arm cover, replace cable and bulb and refit cover. Finally secure cable to arm by means of the clip, taking care to see that the bending over of the clip does not damage the cable or its insulating covering. Also see that when the Trafficator is operated the cable can move in a wide arc.

SERVICE JW5.
ELECTRIC HORNS—Model WT.614.

NOTE. The above type of horn was fitted from Car No. D101S. From Car No. D1537T the shape of the flares or trumpets was altered but the adjustment is the same.

Figure 2 shows the first type and the alteration which should be made to the position of the wire "lead in" hole, because of the possibility of water entering, with the hole in the original position. The domed cover should be completely detached, the mechanism cleaned and all traces of water removed. It is advisable to clean the horn of any car which has been in a heavy rainstorm.

The letter "X" in Figure 2 marks the original position of the "lead in" hole. To set the "lead in" as shown by "Z", release the central screw securing the dome and turn the dome round until the hole is between the two bolts securing the support bracket.

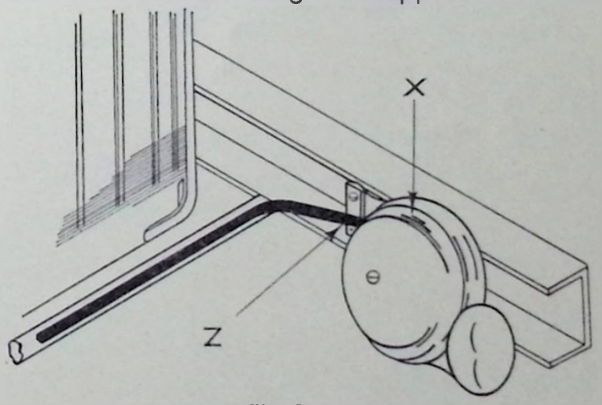


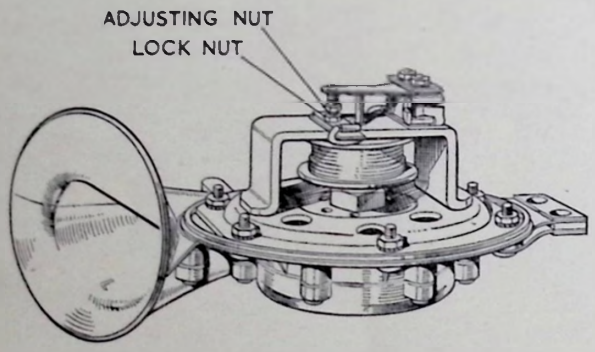
Fig. 2.

All horns before being passed out of the works are adjusted to give their best performance and will give a long period of service without any attention ; no subsequent adjustment is normally required. If one of the horns fails or becomes uncertain in its action, it does not follow that the horn has broken down. First ascertain that the trouble

is not due to a loose or broken connection in the wiring of the horn. If both horns fail or become uncertain in action, the trouble is probably due to a discharged battery.

The horns do not normally require adjustment. Should the performance be upset it may be due to a loose fixing bolt or some other nearby component being in a similar condition. Examine for some such condition before attempting any adjustment which may be necessary after a long period of service.

Adjustment does not alter the pitch of the note, it merely takes up wear of moving parts. If the horns do not sound on adjustment, release the push instantly. When making adjustments to one of the horns always disconnect the supply lead of the other, taking care to ensure that the lead does not come into contact with any part of the chassis and so cause a short circuit.



WIND TONE HORN, MODEL WT614, WITH COVER REMOVED

Fig. 1. Position of Adjusting Nut.

Adjustment.

Remove the fixing screw from the top of the horn and take off the cover. Detach the cover securing bracket by springing it out of its location.

Slacken the locknut on the fixed contact and rotate the adjusting nut until the contacts are just separated—indicated by the horn failing to sound. Turn the adjusting nut half a turn in the opposite direction and secure it in this position by tightening the locknut.

Position of Horns on later models. See Fig. 2.

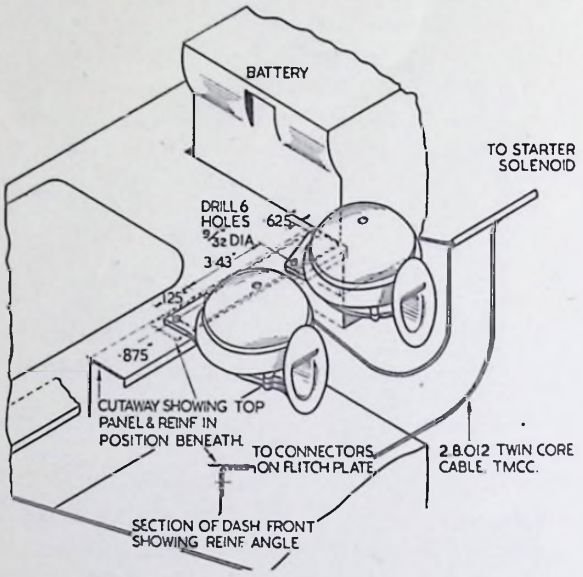


Fig. 2.

The position to which the horns have been moved is clearly shown in Fig. 2.

The method of fixing and rewiring are also clearly described by the wording on the illustration. The additional supporting bracket needed is quite simple to make. The dimensions are given in Fig. 3 below.

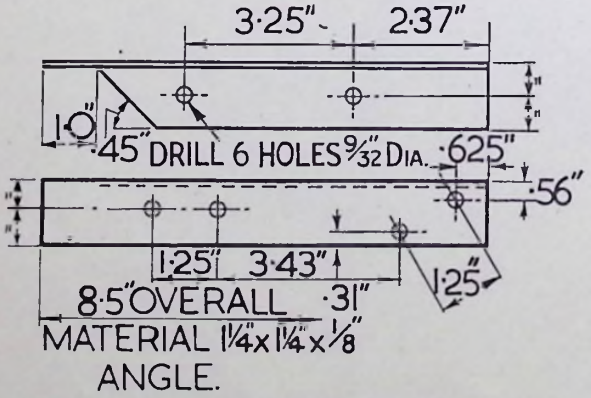


Fig. 3. Horn Support Bracket.

GROUP K

BODY SERVICES

DIMENSIONS, MAINTENANCE AND ADJUSTMENTS

SERVICE KZ1.
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, it is advisable to remove the wheel, and so avoid water when applied under pressure entering the brake drum.

SERVICE KZ2.
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.

SERVICE KZ3.
CARE OF CARPETS.

The carpets should be brushed frequently and on convenient occasions removed and cleaned with a vacuum cleaner.

SERVICE KZ4.
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 *Pages KZ8 to KZ10.*

To ensure that the window glasses slide freely in their guides the guides should be lightly smeared with graphite grease.

SERVICE KZ5.
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.

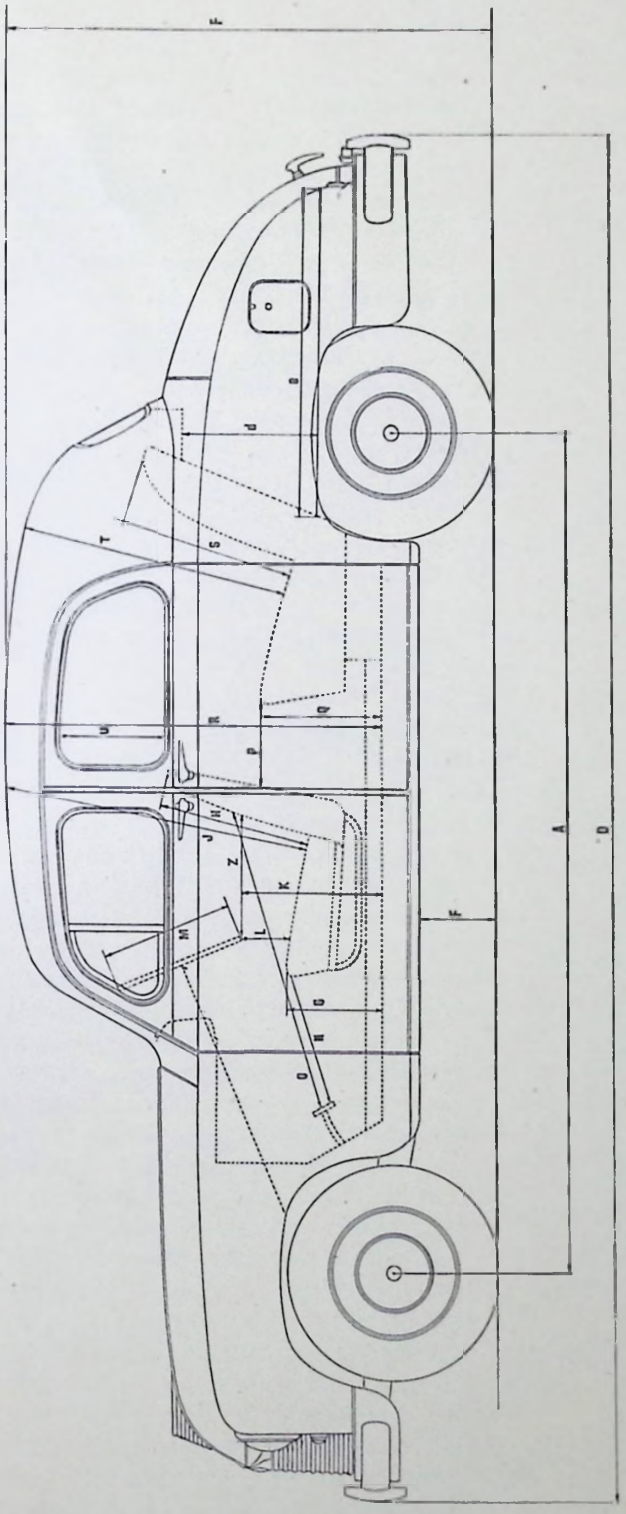
SERVICE KZ6.
BODY BOLTS.

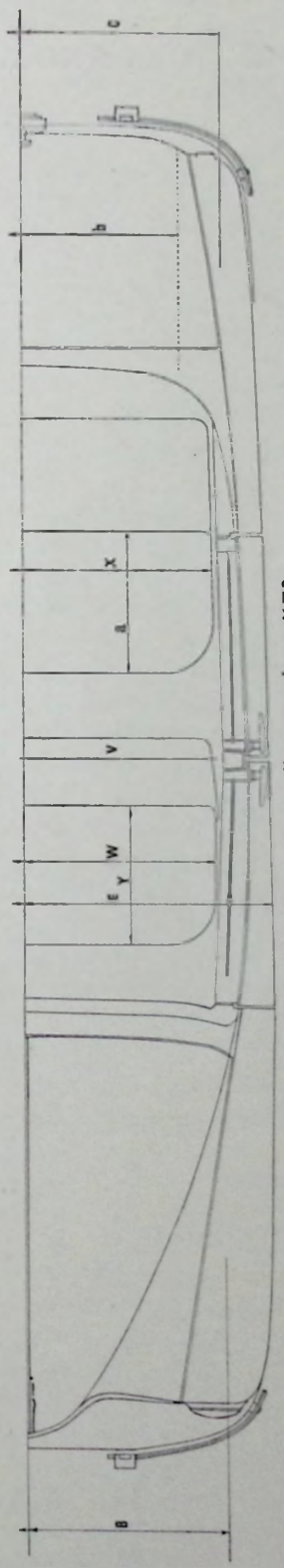
The body to chassis bolts, eight in number,

BODY DIMENSIONS

(*See Fig. 1, Page KZ3*)

Key Letter	Description	Body dimensions ins.	Body dimensions m/m.
A	Wheelbase	107½	2730.5
B	Track, front	50½	1282.7
C	Track, rear	51	1295.4
D	Overall length	174	4419.6
E	Maximum width	63	1600.2
F	Total height, unladen	64	1625.6
G	Height of front cushion	11½	292.1
H	Height of front squab	20	508.0
J	Height from cushion to roof, front	38	965.2
K	Height of wheel from floor	18	457.2
L	Distance between cushion and wheel	6½	165.1
M	Diameter of steering wheel	17	431.8
N	Pedal to cushion (adjustable)	14½ 20½	358.3 520.7
O	Pedal to squab (adjustable)	34 40	863.6 1016.0
P	Distance front to rear seat (adjustable)	12½	317.5
Q	Height of rear cushion	15	381.0
R	Height from floor to roof (max.)	47	1193.8
S	Height of rear squab	24	609.6
T	Height of cushion to roof, rear	36	914.4
U	Depth of window (max.)	14	355.6
V	Maximum interior width at waist	50½	1282.7
W	Width over front seat	50	1270
X	Width over rear seat	53	1346.2
Y	Depth of front cushion	19	482.6
Z	Distance, wheel to squab (adjustable)	13 to 18	330.2 457.2
a	Depth of rear cushion	19½	495.3
b	Width of luggage compartment	40	1016.0
d	Height of luggage compartment (max.)	17½	444.5
e	Length at bottom	41	1041.4
f	Ground clearance (laden)	7″	178
	Cubic capacity of luggage compartment	13 cu. ft.	3679 cu. m.
—	Turning circle	33′ 0″	10 m.
—	Overall length	14′ 6″	4420
—	Overall width	5′ 3″	1600
—	Overall height	5′ 4″	1626
—	Wheelbase	8′ 11½″	2730
—	Weight	22 cwts. 56 lbs.	1143 ks.





The key to these diagrams is on KZ2.

should be checked periodically and tightened to avoid body noises developing.

SERVICE KZ7. 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 around 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 retightening.

(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 retightening the bolts.

(6) The front edge of the bonnet must stand slightly proud of the face of the front grille panel. Usually this condition can be obtained by hinge bracket adjustment, but if this is not possible, release the two bolts securing the front panel to the flitch plates, the four bolts securing the radiator baffle to the front panel and force the panel either in or out, as necessary, before retightening the bolts.

(7) 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.

(8) Lastly, make sure that the hook of the safety catch engages readily and securely beneath the lip of the top surface of the front panel. The bracket of the catch can be set backwards or forwards to obtain the correct position. Smear the ramps of the bonnet catch plate with grease to help the catch to work freely.

SERVICE KZ8. TO REMOVE AND REPLACE A FRONT WING.

(1) Lift the bonnet and prop it open.

(2) Remove the head and side lamps as described in *Pages JY6 and JY7*.

(3) Remove the nine 2 B.A. bolts, nuts and eighteen flat washers—a washer under each bolt head and nut—also the five $\frac{1}{4}$" B.S.F. bolts, nuts and shakeproof washers securing the front end of the wing to the grille panel and 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. bolt, nut and shakeproof washer 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.

Replacement is the reversal of the foregoing with the following additions :—

Do not neglect to replace the felt strip

between the top flange of the wing and the flange of the flitch plate. Also the plastic beading about four inches long between the wing and the scuttle. This beading should be liberally smeared with Bostic or other similar compound before being inserted. The corner formed by the scuttle and the water channel in the wing should be plugged with Bostic, and any aperture which may be present between the end of the flange and scuttle, plugged with Sorbo rubber and secured in position with Bostic. On later productions a drain has been provided at this point to allow water, forced up the channel by wind pressure, to drain away. The Sorbo rubber rests in the channel should also be secured similarly.

SERVICE KZ9.
TO REMOVE AND REPLACE THE FRONT GRILLE PANEL.

It is advantageous to remove the panel complete with the front valance attached.

(1) Prop open the bonnet by placing a block of wood between the scuttle and one of the hinge brackets. Remove the four bolts, nuts and shakeproof washers securing the radiator baffle plate to the front grille panel, also the two bolts, nuts and shakeproof washers securing the panel to the flitch plates.

(2) Disconnect the control cable from the bonnet catch and remove the clip securing the cable to the panel.

(3) Detach the bumpers which are held to the chassis frame and front wing forward support brackets by four nuts and shakeproof washers. Note the rubber spacer bushes.

(4) Remove the head and side lamps as described in *Services JY3 and JY7* and detach the grille panel from the wings by removing the two bolts, nuts and shakeproof washers securing them together. Note the beading between the panel and each wing, also any packing which may be present. This packing is for obtaining a $\frac{1}{16}$" (1.58 mm.) clearance between the wings and the bonnet. The packing when necessary is fitted in the curve formed in the wing to accommodate the head lamp.

(5) The panel and valance can now be removed and separated by removing the nine bolts securing them together. The motif and slats are held to the panel by 2 B.A. nuts and washers.

Replacement is the reversal of the foregoing, and when carrying out the work pay particular attention to replace or renew any beadings removed.

SERVICE KZ10.
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 winding in the required direction, the handle in the centre of the seat valance.

In order that this adjustment may work freely, the runners and the worm of the winder should be greased periodically. To gain access to the runners and worm, lift the seat cushion.

To remove the seat, lift the cushion out of position, wind the seat back to the full extent and remove the bolts and shakeproof washers securing the forward ends of the runners to the floor. Wind the seat sufficiently forward to uncover the bolts securing the rear end of the runner. Release these bolts.

Raise the front end of the seat and disengage the arms of the adjuster nut from the bracket and slide the seat off the runners in a forward direction.

Replacement is the reversal of the foregoing operation with the following additions :

Grease the runners and rails before fitting the seat ; position the adjuster nut at the forward end of the adjusting screw, and make sure that the arms of the adjuster nut are in engagement with the slots in the bracket before tightening the bolts securing the runners. The nuts for the bolts are captive.

SERVICE KZ11.
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 it 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.

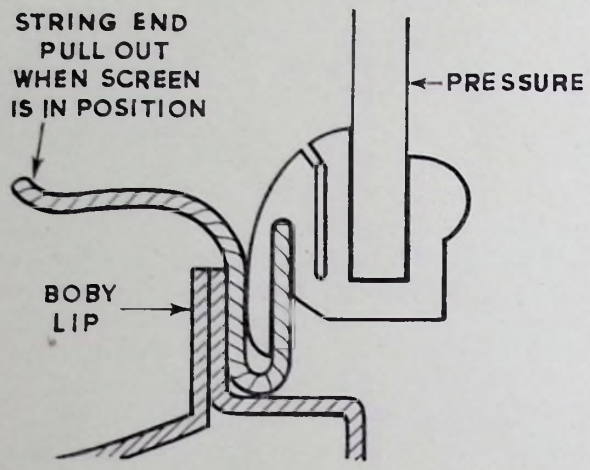


Fig. 1.

(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

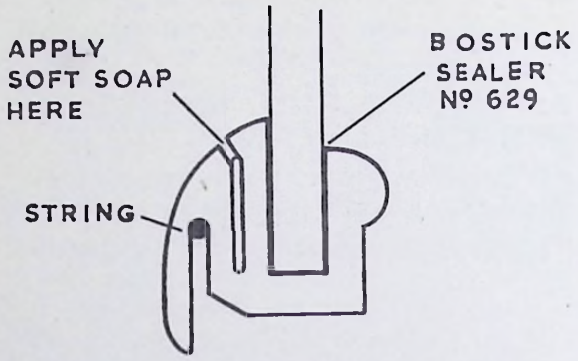


Fig. 2.

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 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. 3, Page KZ7, 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

Fig. 3. Fitting Windscreen Beading—Stage 1.

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 an inch or two.

(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.

(6) Lay a thin layer of Bostic in the recess between the rubber surround and the body aperture, also along the edge of the rub-

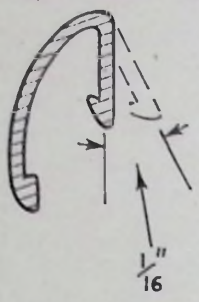
Fig. 4. Fitting Windscreen Beading—Stage 2.

ber 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



OPEN FLANGE ON OUTSIDE CHROME MOULDING AT CORNERS AS SHEWN TO ENABLE EASY START

corrections 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 are to ensure that the moulding will slide readily into position.

Fit the moulding as *described in Service KZ11*.

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 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.

SERVICE KZ12.
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.

SERVICE KZ13.
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.

SERVICE KZ14.
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 four screws, one in each

corner of the door trim panel, and a fifth centrally positioned along the bottom edge. The panel can now be prised away from the door against the resistance of the spring clips.

(3) Remove the two screws securing the escutcheon of the door outer handle and drive out the handle complete with shaft.

(4) Wind the window light up to the full extent.

(5) Remove the screws and cupped washers securing the window aperture capping and detach the capping. Lift up a portion of the draught rubber immediately above the lock and wedge, with a suitable piece of wood, the inner panel away from the light. This should provide sufficient room to insert the fingers and to hold the nut of the top screw of the two screws securing the lock to the panel of the door. Remove also the three bolts securing the door inner locking handle bracket and spindle. The lock can now be drawn out of position after the three screws securing the face flange to the edge of the door have been removed. Beware of any sharp edges in the metal surrounding the aperture through which the arm is inserted to hold the bolts.

Replacement is the reversal of the foregoing.

NOTE. Do not neglect to grease freely the lock mechanism before assembling it into position.

SERVICE KZ15.
TO REMOVE AND REPLACE A FRONT DOOR LIGHT AND REGULATOR.

(1) Remove the trim panel and door lock as described in *Service KZ14*.

(2) Remove the wooden block seen in the aperture in the door panel for the lock, and also 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 operations 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.

SERVICE KZ16.
TO REMOVE THE REAR DOOR LIGHT AND REGULATOR.

(1) Detach the trim panel, the lock and window aperture capping as described in *Service KZ14*.

(2) Wind the light down to the full extent and remove the block of wood seen in the aperture in the door panel for the lock. Also the block 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

Fig. 1. Fitting Regulator.

its aperture in the panel and lower the light and 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 channeling 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.

See that all screws, bolts and nuts released are securely tightened.

SERVICE KZ17.
TO REMOVE REAR DOOR LOCK.

The work involved in the service is similar to that described *in Service KZ14* dealing with the removal of the front door lock except that in this instance there is no remote control spindle bracket to be removed.

The replacement is also similar.

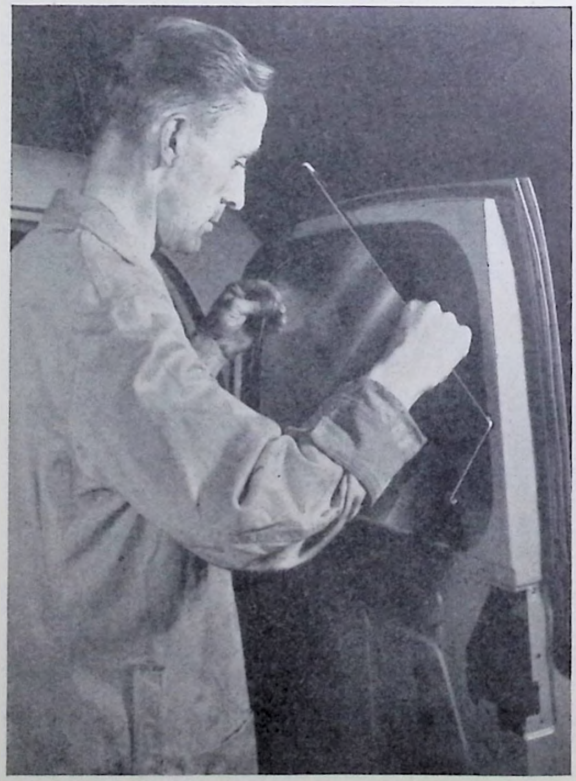


Fig. 2. Fitting Rear Door Light. Note the angle at which it is being inserted, and that it must be revolved progressively to the correct position as it is lowered into the door.

SERVICE KZ18.
TO REHANG A FRONT OR REAR DOOR FROM CAR No. D.701S AND ONWARDS.

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 rehung 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 *Service KZ14* 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 retighten 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 ; retighten 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.

SERVICE KZ19.
TO HANG A FRONT OR REAR DOOR FROM CAR No. D.101S TO D.700S.

In general, the doors fitted to these cars are similar in construction to those used on Cars after D.700S. The main differences being they have wooden frames and the bolt holes in the door hinge arms are enlarged not elongated. To secure each arm in position when once the door is set, two dowel bolts are fitted to each door hinge arm in addition to the four securing bolts.

The bolt holes in the support brackets for the body hinge arms are not, as in the case for Car No. D.701S and onwards, elongated ; the securing bolts are a fit in the holes, consequently these arms cannot be moved as suggested in *Service KZ18*.

Should a door drop for any reason the enlarged holes in the door hinge arms will permit the method suggested in *Service KZ18* for the adjustment of this condition being used after the dowel bolts have been removed. When the door has been positioned correctly a fresh dowel hole should be drilled in the hinge arm and between two of the main support bolt holes, or the existing holes enlarged to take bolts a size larger than the originals.

No attempt should be made to set a door. Any correction necessary should be made by inserting suitable packings between the hinge arms and their support brackets. But as previously suggested, work of this nature should be entrusted to a firm skilled in this class of work and in possession of the necessary tools.

SERVICE KZ20.
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 Parker Kalon screws along the bottom edge and two wood screws along the top. The heads of these last mentioned 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 Service KZ18*.

SERVICE KZ21.
REMOVAL AND REPLACEMENT OF THE BODY OF A RIGHT HAND DRIVE CAR.

(1) Remove the bonnet. *See Service KZ7, Page KZ4*.

(2) Drain the cooling system. *See Page EZ1*.

(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 carburetter 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 flitch plate.

(*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 draught rubber 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.

Fig. 1. Mounting the Body. Type of sling which should be used.

(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 the vertical flange were removed when detaching the steering column draught excluder fixing plate. Note the earth wires held by the 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. 1, Page KZ13. 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 chasiss.