SINGER NINE

1946-1949

4A — 4AB

1949-1950 1950-1953

SCIENTIFIC MAGAZINES

Service Manual

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FOR

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SINGER NINE
SERIES 4A AND 4AB

GENERAL DATA, DIMENSIONS AND SPECIFICATIONS

NOTE: All dimensions are in inches unless otherwise specified.

Model	9 Roadster.
Series	4A and 4AB.
Manufacture	Series 4A—September, 1949, to October, 1950. Series 4 AB—October, 1950, to January, 1953.
Turning circle	4A—34′ 0″. 4AB—33′ 0″.
Location of serial number	Brass plate under bonnet.
Track	4A—45.00. 4AB—46.75.
Wheelbase	7′ 7″.
Ground clearance	4A—$5\frac{1}{2}$. 4AB—$6\frac{1}{2}$.
Height	4A—4′ $10\frac{1}{2}$″. 4AB—4′ $10\frac{1}{2}$″.
Width	4A—4′ $7\frac{3}{4}$″. 4AB—4′ 10″.
Length	4A—12′ $7\frac{3}{4}$″. 4AB up to chassis No. 4AB7750U—12′ 6″. From 4AB7751U—12′ $7\frac{1}{2}$″.
Weight	4A—15 cwts. 4AB—$15\frac{1}{2}$ cwts.

Capacities

Crankcase	7 pints.
Gearbox	2 pints.
Rear axle	2 pints.
Fuel tank	7 gallons.
Total cooling system	4A—18 pints. 4AB—13 pints.

SECTION A

ROUTINE MAINTENANCE

Engine Oil.

The engine oil filler will be found on the engine top cover and is stamped with the word "oil". It is air-tight in order to prevent fumes escaping. Full details of the various recommended brands of oil are to be found on the engraved plate fixed to the bulkhead under the right side bonnet.

An oil breather is fitted to the right side of the engine and conveys any fumes emitted below the body level. There is also a by-pass filter, served from the main oil circuit, the filtered oil being returned via the crank chamber to the oil sump. It is fitted on the left side above the starter motor.

The condition of the by-pass filter can be checked by uncoupling the union nut between the filter body and the return pipe to the crankcase and observing the oil flow, if scanty or absent the filter should be replaced, but it is advisable to replace the filter at the end of every year, or after 10,000 miles running.

The oil sump holds seven pints of oil and this quantity should be maintained by checking the oil level daily. A dipper is fitted on the right side of the crankcase and is marked with the correct oil level. To obtain a correct reading of the level of oil in the sump by means of the dipstick, run the engine for a short time until the oil is warm, then with the engine stopped, withdraw the dipstick, wipe it, replace it to its full extent and withdraw again. The level of the oil will then be accurately indicated, and if the oil is below the mark on the dipstick bring it to the correct level by pouring fresh oil through the filler in the engine top cover. A few moments must be allowed when adding oil for it to drain into the sump before finally checking the level, but do not, under any circumstances, fill the sump above the level as this is likely to lead to various minor troubles.

With the filter mentioned above, it should not be necessary to check the oil pressure or flow, but if for some reason this is required, the best way is, with the engine running slowly, to disconnect the union between the oil gauge pipe and the flexible connection from the engine and if oil pressure is present at this point, then either the oil lead to the gauge is choked or the gauge itself is at fault. Make sure that the pipe is clear and if the trouble still persists have the gauge changed.

If no oil pressure is present at the union, then the fault must be in the lubrication system. It is unlikely to be in the pump itself and the cause will most probably be due to (a) a choked sump filter, (b) foreign matter of some description in the pressure release valve. To clean the filter, it will be necessary to lower the sump.

To remove the foreign matter from the pressure release valve, slacken off the nut sufficiently to allow the centre plug to be withdrawn—position of the lock nut will be an indication of how far to screw in the centre plug when reassembling—then withdraw the plug and remove the spring and plunger for cleaning in petrol. When replacing, first insert the plunger, then the spring, then screw in the centre plug up to the locknut and tighten the locknut.

To increase the oil pressure, slacken back the locknut two or three turns, screw in the centre plug, and tighten the locknut. To decrease the oil pressure, release the locknut, screw the centre plug back two or three turns and relock the nut. The correct pressure is 30 to 35 lbs. at 30 m.p.h. in top gear.

Water.

The radiator should be filled with water to a level not higher than one inch below the filler cap. The filler cap is fitted to the right side of the radiator header tank under the bonnet, and it is advisable to use soft water for the cooling system in order to avoid an accumulation of lime deposits, which will eventually impede the water circulation.

If at any time it is considered advisable to flush out the cooling system, drain the water from the radiator by means of the drain tap at the left side bottom corner of the radiator, and the drain plug under the water inlet pipe on the right side of the cylinder block. THIS PLUG MUST BE REMOVED to drain completely the water cooling system. Refill the cooling system with a strong solution of common soda and water. Run the engine until the water becomes hot, drain the solution and afterwards flush out the cooling system with running water from a hose pipe inserted in the radiator filler.

Weekly attention (or every 250 miles).

Important.—It is a good point to make a practice of checking the tyre pressures weekly.

Take care to keep the tyres on one axle at the same pressure. Unsteadiness of the steering is often due to under-inflation or unequal inflation of the front tyres and this also results in a tendency for the steering to pull to either side.

It is also advisable at this period to put two or three spots of oil from a hand oil can on the ball joints of the carburetter controls and the brackets holding the accelerator pedal cross shaft. A little attention given to points of this description is always time well spent.

Monthly Attention (or every 1,000 miles).

1. **Greasers.** Grease the steering swivel pins at four points. In order to facilitate greasing the swivel pins, it is advisable to jack up the front axle assembly and apply the grease gun to the swivel pin greasers, forcing the grease until some exudes from the top and bottom swivel pin bushes. At the same time turn the steering wheel from lock to lock to help distribute the lubricant.

2. Inspect the engine and gearbox oil level dipsticks and top up as necessary.

The dipstick fitted to the gearbox is in a most convenient position and is covered by a rubber grommet in the gearbox cover on the left side.

Oil may be fed into the dipstick aperture by means of a funnel supplied in the tool kit.

3. Top up the battery.

4. Examine the tyres periodically and remove the flints or other road matter which may have become embedded in the thread. Any large cuts should be vulcanised.

Clean off oil or grease which may appear on the tyres with a little petrol, drying the tyres with a duster after the cleaning process.

Every 5,000 Miles.

Drain the engine oil and refill with fresh oil. Draining the sump can be best carried out while the engine is warm, and should the oil appear to be very dirty, swill out the engine case with a thin "flushing" oil. ON NO ACCOUNT SHOULD PETROL OR KEROSENE be used. If a "flushing" oil is used, it will be necessary after draining the sump to replace the drain plug and pour about a quart of "flushing" oil into the engine through the filler, turning the engine over for a number of revolutions by hand to circulate the oil.

Then drain the flushing oil away, replace the drain plug, and refill with the correct grade of oil to the level mark on the dipstick. Cleaning the oil filter becomes necessary at any sign of low pressure, and in any case every 5,000 miles it is advisable. Proceed as follows:—

Drain the oil from the engine sump by removing the drain plug and also remove the dipstick. Remove the sixteen nuts and washers which secure the oil sump to the base of the engine case and take away the oil sump, tray and oil filter. It is wise to prevent them from being damaged. The filter must be withdrawn from the pump and cleaned with petrol, and all traces of carbon, etc., must be removed from the sump.

When refitting the sump, be quite sure that the joint washer is in good condition, and tighten the anchorage nuts evenly.

Drain and refill the gearbox with fresh oil. The only attention the gearbox needs is the periodical replenishing of the oil, and an occasional flushing out before refilling with new oil.

Drain and refill the rear axle with fresh oil. This operation can best be carried out by lifting the rear seat cushion, exposing the cover in the rear seat pan.

The filler plug is located on the top and in the centre of the differential case, and the drain plug at the bottom and in the centre of the axle case. The capacity of the axle (when dry) is two pints, and care must be taken not to over-fill this unit to prevent any possibility of oil finding its way on to the rear brakes. Fill only to the oil level aperture.

Greasers. There are eleven to which the grease gun should be applied every 5,000 miles. They are as follows:—

One at the clutch pedal.

One at the rear end of the propeller shaft.

Two at the forward end of the propeller shaft.

One on the fan bearing.

Four on the steering linkage. To attend to these four properly, jack up the front axle and work the steering from lock to lock while the lubricant is being injected.

One on each rear hub. The rear wheel must be removed to attend to these. Grease the threads of the road wheel studs before replacing the wheels.

The front hubs should also be packed with grease at this time. To do this, jack up both the front wheels, remove the road wheel dust caps, remove the road wheels and prise out the metal hub caps. Remove the split pins and nuts from the stub axles and withdraw the hub assemblies from the stub axles. The hubs may then be packed with grease and refitted to the car.

The road wheel studs should also be regreased before replacing the wheels.

Oil the handbrake lever, pawl and ratchet.

Steering Box. The steering gearbox will not normally use any appreciable amount of oil but it is advisable to put in a small quantity each time the 5,000 mile service is carried out. An oil hole will be observed situated about half way down the steering column.

Valve Clearances. Clearances between the valve stem and the tappet screw is necessary to ensure correct closing of the valves and efficient running of the engine. These clearances should be as follows:—

Inlet valves	.005
Exhaust valves	.007

The manner of checking the tappet adjustment is as follows:—

First run the engine for a few minutes until it becomes warm, then remove the two dome nuts and top valve cover of the cylinder head, care being taken when removing the top valve cover to avoid damaging the cork joint which is fitted. Turn the engine with the starting handle for a half revolution after the closing of the valve which is to be adjusted. Slacken the locknut and adjust the tappet screw until the gauge is a loose sliding fit between the valve stem and the tappet screw. Now tighten the locknut and recheck with the gauge, as tightening the locknut will occasionally alter the clearances. DO NOT SET THE VALVE CLEARANCES TOO SMALL, OR DIFFICULTY WILL BE EXPERIENCED OWING TO THE ENGINE MISFIRING.

Dynamo and Fan Belt Adjustment. This is effected by slackening the three nuts securing the fan bracket to the engine case, and swivelling the bracket in the desired direction. After adjustment be quite certain that all nuts are tight, and it should be possible to depress the fan belt at least ½ inch. This will ensure that the fan belt is not over-tightened and will thus prevent excessive wear.

Camshaft Chain Adjustment. In order to adjust the camshaft chain, it will be necessary to release the locking nut on the knurled screw which passes through the right side of the cylinder head close to the water outlet pipe. Tighten the knurled screw until the tension of the camshaft chain is felt. Then turn the knurled screw back half a turn and lock it in position by means of the locknut. The camshaft chain adjustment will then be correct. Every precaution must be taken against over-tightening as this will cause excessive wear of the camshaft chain.

Annually (or every 10,000 miles).

The period of time for which a car will run before requiring an overhaul depends on the way in which it has been driven and the attention it has received. It is advisable, however, to give the car an annual cursory overhaul, and the following points should receive attention:—

1. Electrical equipment — the starter motor, the dynamo, and the distributor must be inspected as explained in the Electrical Section.

2. The engine by-pass oil filter should be replaced if the car has covered over 10,000 miles.

3. The trafficators should be oiled.

4. The hinges of the doors, the bonnet and the boot, also the door catches and striking plates, should receive a few spots of oil to ensure that they are functioning easily.

The striking plates may be adjusted if necessary.

5. The steering joints must be examined. They are not adjustable, so if any excessive play has developed, they must be replaced.

6. Check the toe-in. It should be ⅛ measured at the wheel rims, approximately a foot from the ground.

7. Check the shock absorbers and replenish if necessary. Be sure to use only Armstrong super shock absorber oil.

8. Spray all road springs with penetrating oil (spring leaves only).

Note.—All spring shackles are mounted on rubber bushes which do not require lubrication.

9. The brakes and brake gear should have a thorough overhaul, and it may be necessary to replace the brake linings.

10. In addition all the fork ends of the operating gear and their pins should be removed, cleaned, regreased and replaced.

11. All body bolts should be inspected and tightened as necessary, chassis bolts, springs clips and shackles, the exhaust pipe and silencer clips should also be attended to at this time.

SECTION B

THE ENGINE

Engine

Type	Overhead camshaft.
Bore	2.3622 (60 mm.).
Stroke	3.7401 (95 mm.).
Capacity	65.54 cu. ins. (1,074 c.c.).
Number of cylinders	4.
Firing order	1, 3, 4, 2.
Location of number 1 cylinder	Nearest radiator.
Compression ratio	7 to 1.
Brake H.P.	36 at 5,000 r.p.m.
Maximum torque	47 lbs. ft. at 2,800 r.p.m.
Maximum B.M.E.P.	108 lbs. sq. in. at 2,800 r.p.m.
Cylinder head gasket:	
Type	Copper asbestos.
Nominal thickness	.082 approx.
Compressed thickness	.057 approx.
Ignition timing (initial advance)	5° to 10° B.T.D.C.
Location of engine number	Right side, near flywheel.

Cylinder Block

Bore diameters:	
Standard	2.362.
Bore for oversizes:	
First	2.365.
Second	2.372.
Third	2.382.
Main bearing housing diameter	1.8965 to 1.8953.

Cylinder Head

Combustion space volume	45.6 c.c.
Maximum permissible warp for refitting	Nil.
Maximum permissible reduction of metal (refacing head)	Nil.
Valve seats:	
Angle, inlet	45°
Angle, exhaust	45°
Width	.0650.
Valve throat diameter:	
Inlet	1.156.
Exhaust	1.062.
Hole for valve guide	.5627 to .5623.

Crankshaft

Type	Three bearing.
Overall length	19.00.
Thrust taken at	Centre main.

Crankshaft—(Continued)

Number of journals	3.
Main bearing journal diameter	1.7495 to 1.7500.
Undersize	—.020.
Main bearing journal, length:	
Front	1.622 to 1.627.
Centre	1.500 to 1.501.
Rear	1.620 to 1.630.
Radius of fillet	.070 to .080.
Minimum permissible regrind diameter	—.020.
Method of sealing oil:	
Front end of shaft	Oil return thread.
Rear end of shaft	Oil return thread.
End-float	.003.
Crankpin bearing journals:	
Length	1.125 to 1.126.
Diameter	1.6245 to 1.6250.
Undersize	—.020.
Radius of fillet	.125.

Main Bearings

Type	Shell.
Material	White metal, steel shell.
Number of bearings	3.
Length	1.346 to 1.342.
Diametrical clearance	.002 to .003.
Wall thickness	.072 to .07225.
Diameter, outside	1.8965.
Diameter, inside	1.7525 to 1.752.
Undersizes	—.020.

Connecting Rods

Material	High tensile steel.
Length, centre to centre	7.50.
Small end:	
Type	Bushed.
Bore size	.687 to .688.
Bush, outside diameter	.689 to .690.
Bush, inside diameter	.5632 to .5627.
Big end bearings:	
Type	Shell.
Diameter, outside	1.772 to 1.771.
Diameter, inside	1.626 to 1.6266.
Width	.915 to .919.
Diametrical clearance	.001 to .0021.
End-float on crankpin	.007 to .009.

Gudgeon Pin

Type	Fully floating.
Material	Carbon case hardening steel.
Method of securing	Circlips.
Diameter:	
Inner	$\frac{5}{16}$.
Outer	$\frac{9}{16}$ +.0001 —.0001.
Length	$2\frac{1}{32}$ +.000 —.005.
Fit in connecting rod	.0001 to .0008 clearance.
Fit in piston	.0001 interference to .0008 clearance.
Oversizes available	.003 and .005.

Pistons

Make	Hepworth and Grandage.
Type	Split skirt.
Material	Aluminium alloy.
Removal	Down past crankshaft.
Oversizes	+.003, +.006, +.010, +.020, +.030, +.040.
Skirt clearance	.0002 to .0013.
Gudgeon pin hole diameter	$\frac{9}{16}$ +.0002 —.0000.

Valves

Type	Mushroom.
Material	
Inlet	Silicon chrome.
Exhaust	XB steel.
Operation	Direct from camshaft and rockers.
Timing:	
Inlet opens	20° B.T.D.C.
Inlet closes	55° A.B.D.C.
Exhaust opens	60° B.B.D.C.
Exhaust closes	15° A.T.D.C.
Dimensions:	
Overall length	$4\frac{3}{8}$.
Amount of lift	.224.
Head diameter	1.25 inlet. 1.156 exhaust.
Stem diameter	.280 to .281.
Wear limit	.000 to .0015 inlet. .0015 to .003 exhaust.
Tappet clearance (hot)	.005 inlet, .007 exhaust.
Clearance for setting valve timing	.004 inlet. .006 exhaust.
Angle of face	45°.

Valve Guides

Material	Cast iron.
Overall length	2.25 inlet. 2.50 exhaust.
Outside diameter	.5635 to .5640
Inside diameter	.2815 to .281 inlet. .2825 to .283 exhaust.
Interference fit	.0008 to .0017.

Guides are taper counterbored, from .294 to .293 diameter at the valve head end to the bore diameter for a distance of .250 from the valve head end.

Valve Springs

Free length	$2\frac{7}{16}$.
Solid length not to exceed	$1\frac{3}{64}$.
External diameter	1.050.
Internal diameter	.818.
Pressure when compressed to:	
$1\frac{7}{32}$ (full lift load)	54 lbs.
$1\frac{7}{16}$ (fitted load, no lift)	44 lbs.
Number of active coils	7.
Diameter of wire	.116.

Tappets

Type	Rocker O.H.
Material	Carbon case hardening. steel.
Type of adjustment	Setpin.
Clearance:	
Inlet	.005.
Exhaust	.007.
Set with engine hot.	

Camshaft

Type	Overhead.
Method of taking thrust	Centre bearing.
Maximum end-float	.0035.
Amount of lift	.166.
Number of bearing journals	Three.
Cam heel to toe dimension	1.102.
Length of bearing journals:	
Front	1.500.
Centre	1.4375.
Rear	1.1563.
Diameter of bearing journals	.874 to .873.

Camshaft Bearings

Number	Three.
Material	Alloy cast iron.

Rockers

Outside diameter of bushes	.6895 to .689.
Inside diameter of bushes	.5635 to .564 after fitting.
Running clearance	.0005 to .002.
Diameter of bore for bush	.6882 to .687.
Interference fit of bush	.0008 to .0025.

Camshaft Bearing Housings

Inside diameter	.875 to .876.
Running clearance	.001 to .003.

Camshaft Drive

Type	Chain (two).
Securing of camshaft and intermediate sprockets	Three pegs and spigot. Retained by washer and setpin.
Fit of crankshaft sprocket	Key and starting dog.

Chain Drive

Pitch	.375 Simplex.
Number of pitches	Primary 48. Secondary 84.
Number of wheel teeth:	
Crankshaft	20.
Crankshaft to intermediate	30.
Camshaft	28.
Camshaft to intermediate	21.

Lubrication System

Type	Forced feed.
Type of pump	Submerged gear.
Type of pump drive	Skew gear from intermediate shaft.
Normal pressure	30 to 35 lbs. per sq. in.
Pump driven gear:	
Number of teeth	9.
Length	.624 to .625.
Diameter	1.099 to 1.098.
Idler gear:	
Number of teeth	9.
Bore diameter	.4362 to .4355.
Length	1.099 to 1.098.
Diameter	.624 to .625.
Diametrical clearance between pump body and gears	.0005 to .0025.
Face clearance between gears and cover	.0005 to .003.
Filter:	
Make	A.C.
Type	By-pass ZR.1.
Location	Left side of engine.
Pressure lubrication to	Mains, big ends and overhead valve mechanism.
Splash feed to	Pistons, cylinder walls and gudgeon pins.
Oil pressure relief spring:	
Number of free coils	8.
Rate per inch	11 lbs.
Pressure at fitted length	$5\frac{1}{2}$ lbs.
Fitted length	$1\frac{1}{4}$.
Free length	$1\frac{3}{4}$.
Internal diameter	$\frac{31}{64}$.

Flywheel

Type of ring gear	Shrunk on.
Number of teeth	112.
Type of pilot bearing	Plain bush.
Dimensions of pilot bearing:	
Bore	.563 to .565.
Outside diameter	.8145 to .8155.
Length	$1\frac{3}{16}$.
Method of locating flywheel	Dowels and flange.

To Remove the Cylinder Head.

Remove the bonnet.

Drain the water system by means of the drain tap at the base of the radiator at the left side, and by means of the drain plug underneath the water inlet pipe on the right side of the cylinder block. IT IS ESSENTIAL THAT THIS PLUG IS REMOVED TO DRAIN COMPLETELY THE WATER COOLING SYSTEM.

Disconnect the air silencer and the filter union from the carburetter, exercising care to avoid damaging the filter inside the union. When reconnecting the union be quite certain that the fibre washer is in position.

Disconnect the carburetter throttle and choke controls. It will be noticed that the carburetter throttle control is secured to the top cover by means of one of the dome nuts and care must be taken when refitting the bracket to be quite sure that it is in such a position that the carburetter throttle can be fully closed.

Disconnect the exhaust lead pipe, and remove the drain pipe from the induction manifold. Be careful to avoid damage to the gasket fitted between the lead pipe and the manifold.

Remove the carburetter.

Remove the five nuts securing the inlet and exhaust manifolds, and withdraw the manifolds from the studs. Special gaskets are fitted between the manifolds and cylinder head, and these should be carefully removed and stored for safety.

Remove the top valve cover which is secured by two dome nuts. A cork washer is fitted between the valve cover and the cylinder head.

Disconnect and remove the sparking plugs.

Disconnect the clips securing the radiator top hose pipe and remove the hose pipe.

Disconnect the camshaft oil feed pipe by unscrewing the union at the timing case end, removing the nut and releasing the clip securing the pipe to the first camshaft bearing and removing the gallery stud, which connects the camshaft feed pipe to the camshaft centre bearing.

Remove the water outlet pipe.

Remove two bolts and washers securing the cover at the front of the cylinder head and open out the small metal clip which secures the oil feed pipe of the overhead camshaft assembly.

Set the engine position by turning the starting handle until the inlet valve on number four cylinder is about to open.

Release the camshaft drive chain tensioner by unscrewing the locknut and turning back the adjusting bolt in the cylinder head.

Remove the camshaft chain sprocket by releasing the tab washer and removing the bolt and plain washer which secure the chain wheel to the camshaft flange. DO NOT UNDER ANY CIRCUMSTANCES REMOVE THE CHAIN FROM THE CHAIN WHEEL.

Remove the two bolts and washers from the timing case to the cylinder head, one of which carries the petrol pipe clip. Remove the eight nuts and plain washers from the cylinder head holding down bolts, and remove the two nuts and washers from the studs, the two which penetrate the cylinder block behind the manifolds on the left side of the engine. These nuts and washers will only be disclosed when the exhaust and inlet manifolds are removed. See Figure 3.

Do not, in any way, interfere with the position of the camshaft. This is in order that the cylinder head can be returned to the cylinder block without interfering with the valve timing.

To Remove the Camshaft Assembly.

Release the six nuts and washers which secure the three camshaft bearings and withdraw the upper halves of the bearings complete with valve rockers and shaft. Release the upper halves of the camshaft bearings from the rocker shaft, withdraw them and mark them to ensure that they are returned to the correct positions. It is advisable at this stage to remove the camshaft bearing bases from the cylinder head studs and pair them with the upper halves. Each valve rocker should be marked to facilitate its return to the correct position.

Place the valve extracting tool in position for compressing the valve spring and removing the split collar. Release the valve extractor and remove the valve spring and collar. The valves may then be withdrawn through their guides from the combustion head. The valves are marked and should be returned to the correct seatings. Counting from the front of the cylinder head, the valves are marked as follows:—

Inlet valves	Nos. 2, 4, 6, 8
Exhaust valves	Nos. 1, 3, 5, 7

To Reassemble the Cylinder Head.

This is merely a reversal of the dismantling operation, BUT DO NOT OVERLOOK RESETTING THE CLIP SECURING THE OIL FEED PIPE TO THE LEFT SIDE OF THE CYLINDER HEAD. Smear the valve stems with oil before refitting them to their guides and be quite sure that the valves are returned to the correct seatings. Check the valve clearances by slackening the locknut of the ball pin in the rocker arm, and turning the adjusting screw until the following clearances are given:—

Inlet valves	.005
Exhaust valves	.007

Tighten the locknut and turn the camshaft in a clockwise direction until the inlet valve of No. 4 cylinder is about to open. Replace the gasket and cylinder head to the engine and tighten the head nuts evenly half a turn at a time, working from the centre outwards. Reassemble the oil feed pipe to the camshaft assembly. Remount the oil feed pipe to the camshaft assembly. Remount the camshaft chain wheel and lock it in position, not overlooking the correct location of the tab washer with the chain wheel and stud.

If the previous instructions have been closely followed, the engine valve timing will be correct, i.e., inlet valve on No. 4 cylinder about to open 20° before the mark 1/4 on the flywheel is in the centre of the inspection aperture. This hole is located on the right side of the clutch casing. The distributor rotor arm must also be opposite the segment for No. 1 cylinder high tension lead. It will be noted that

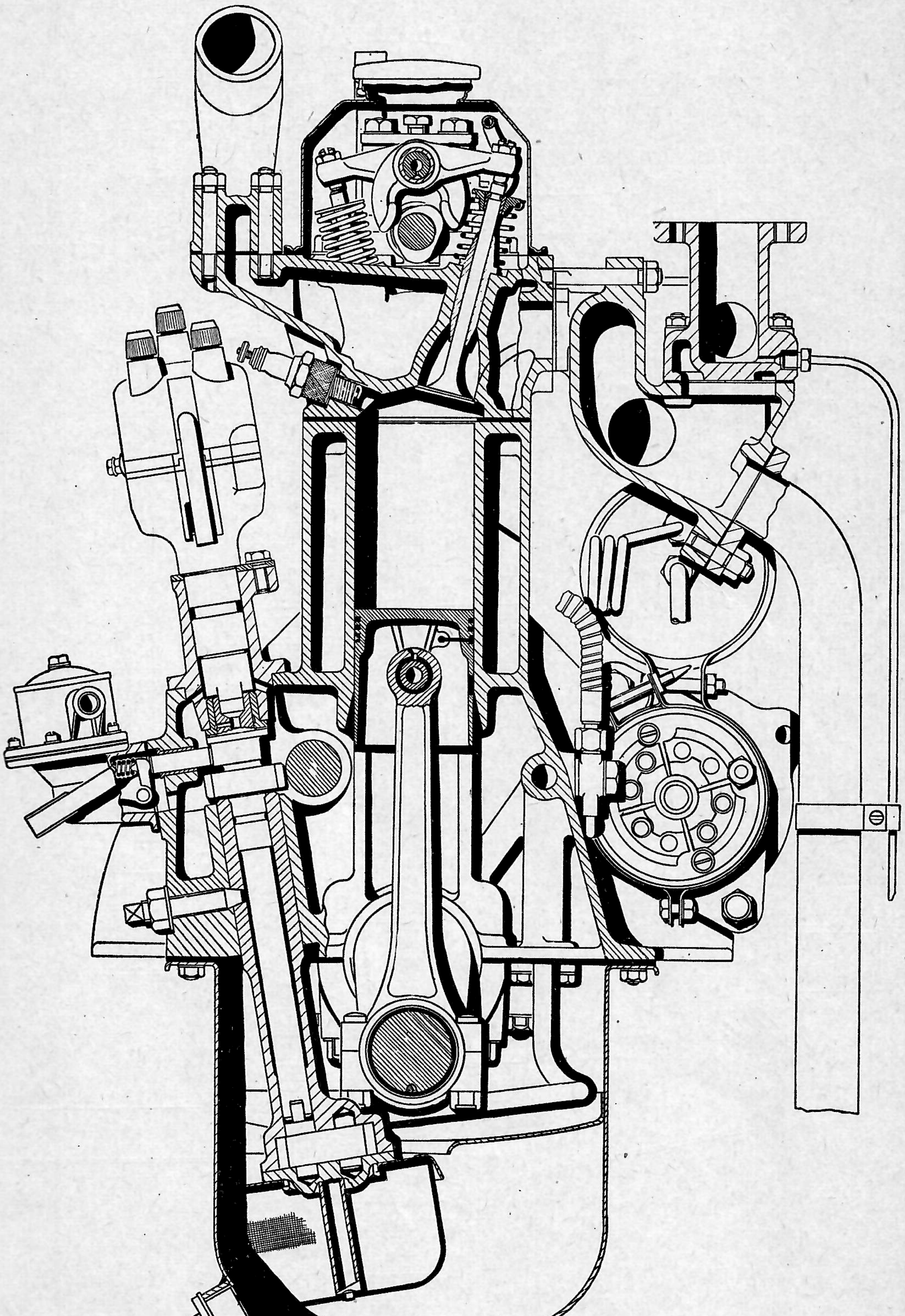


FIG. 1.—Transverse section of the engine.

when pistons 1 and 4 are on top dead centre, the mark 1/4 denoting this is not on the top of the fly-wheel but in a position approximately at two o'clock so that the mark is visible through the inspection hole previously mentioned. The illustration will make this point clearer. (Fig. 4).

Ignition Timing.

After any operation which has necessitated the removal of the distributor unit, it will be necessary to retime the ignition. It will be seen from the timing diagram that the ignition is firing when fully retarded 5° to 10° before top dead centre. Continue

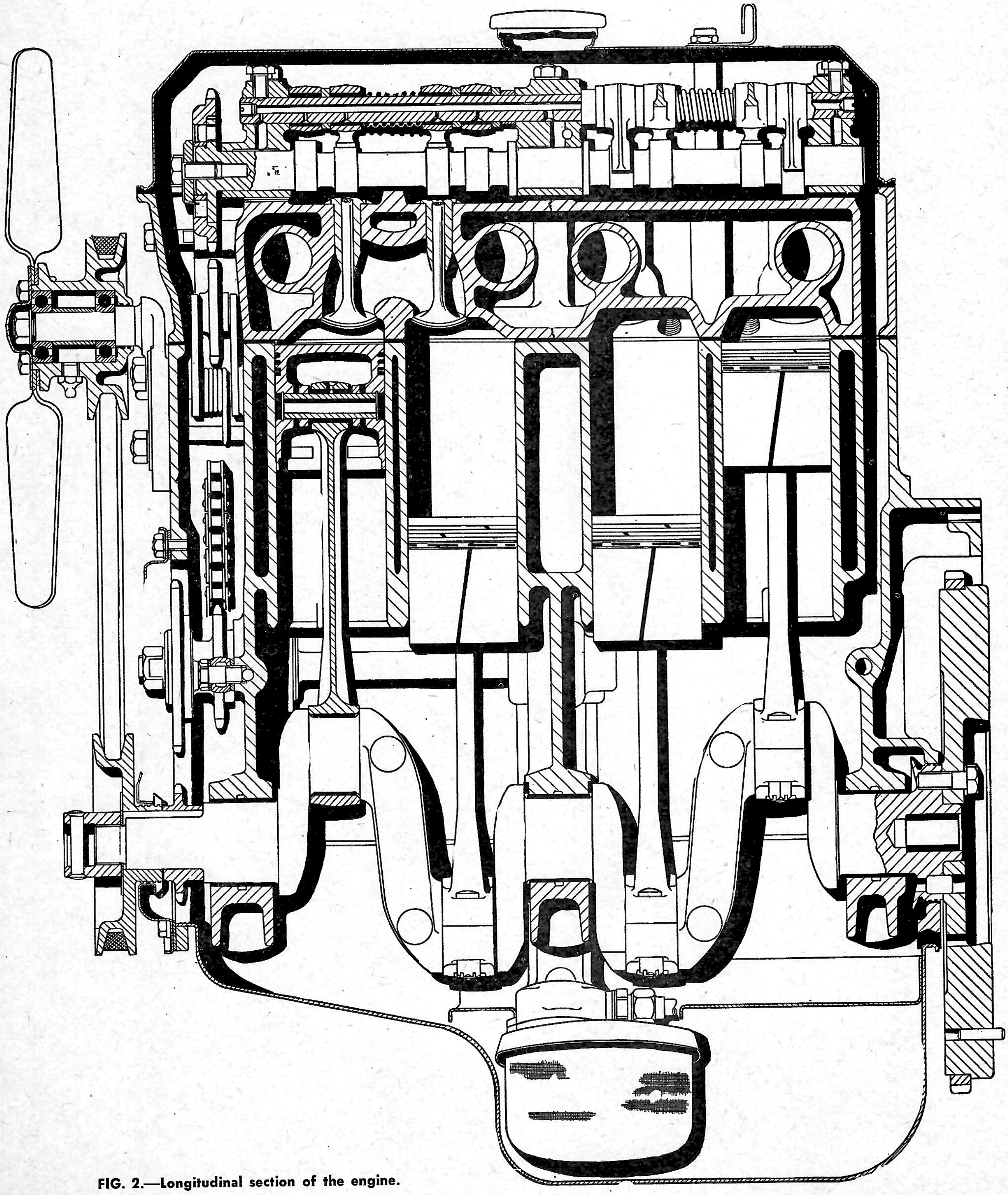


FIG. 2.—Longitudinal section of the engine.

to turn the engine until the 1/4 mark on the flywheel is $\frac{7}{16}$ to $\frac{7}{8}$ before the top dead centre.

The firing order of the engine is 1, 3, 4, 2; No. 1 cylinder being nearest to the radiator. ALWAYS TIME ON No. 1 CYLINDER.

Remove the engine top cover and turn the engine until the inlet valve on No. 1 cylinder closes.

Remove the distributor cover and the contact breaker points at this position should be about to open. Should this not be the case, release the distributor clip nut and turn the distributor body anti-clockwise until the contact breaker points just begin to open, then tighten the clip nut.

Replace the distributor cover after noting which segment makes contact with the rotating arm. The lead for No. 1 sparking plug must be plugged in opposite this segment. Proceeding in a clockwise direction, place the lead of No. 3 sparking plug opposite the next segment, then that for No. 4 plug and finally the lead for No. 2 plug in the last position.

Test the engine after this setting, and any slight variation which may seem necessary can be made by slackening the distributor clip nut and slightly rotating the distributor. Turning it clockwise will retard the ignition and anti-clockwise will advance it.

If the ignition is too early, the engine will be inclined to knock when pulling at low engine speeds. Late ignition causes overheating and lack of power.

Notice when the distributor is removed from the distributor drive shaft that the dog of the distributor shaft is offset. It is very important when refitting the distributor to be quite certain that it is replaced correctly, otherwise it will be impossible to obtain the correct ignition timing, therefore the following procedure must be strictly adhered to.

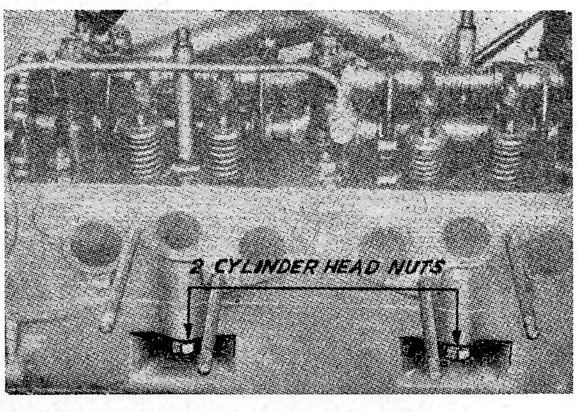


FIG. 3.—The location of the two semi-concealed cylinder head nuts.

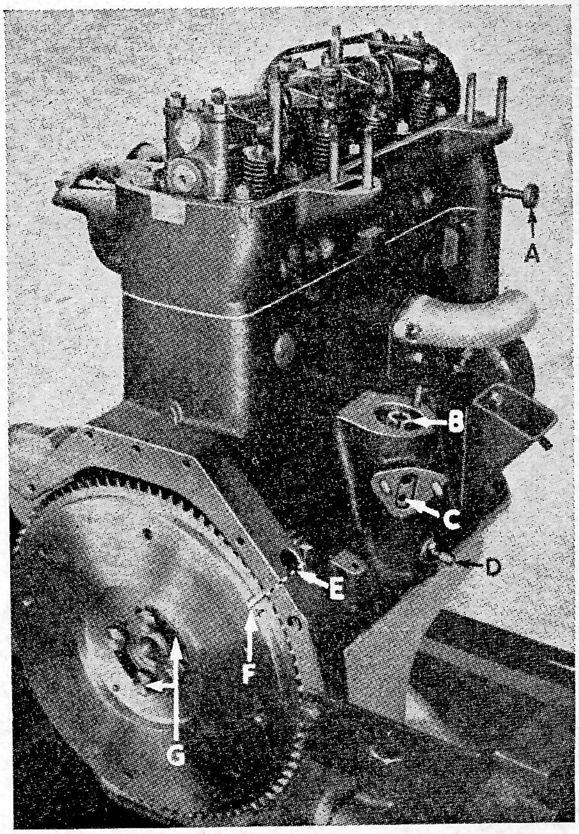


FIG. 4.—Engine view indicating points mentioned in the text.

A—Adjusting screw for camshaft chain.
B—Distributor driving shaft.
C—Fuel pump operating plunger.
D—Drive shaft locating pin.
E—Timing mark inspection hole.
F—Timing mark.
G—Lockwasher.

Turn the engine by hand until the inlet valve on No. 4 cylinder has just closed and the 1/4 mark on the flywheel is in the pisition previously specified. It will then be seen that the distributor drive shaft has the offset or thicker side of the shaft towards the engine case.

The distributor shaft must be fitted so that the dog corresponds with the drive shaft, and if this is observed no difficulty will be experienced. If the distributor drive shaft is removed from the engine case the same rule must be observed.

To Remove the Engine from the Chassis.

Remove the bonnet and drain the water system.

Disconnect the clips securing the radiator top and bottom hose pipes, and remove the hoses.

Remove the four nuts and locknuts from the radiator anchorage studs. The radiator may now be removed from the chassis. It is perhaps as well to point out here that the holes in the chassis front member, through which the radiator anchorage studs pass, are slotted. This is to allow for correctly positioning the radiator so that no difficulty will be experienced when the bonnet is refitted into position.

At the left side of the engine, the following details should be attended to:—

Remove the carburetter air silencer.

Remove the petrol pipe from the carburetter and mechanical petrol pump. The pipe is secured by one clip at the right side of the cylinder head front cover.

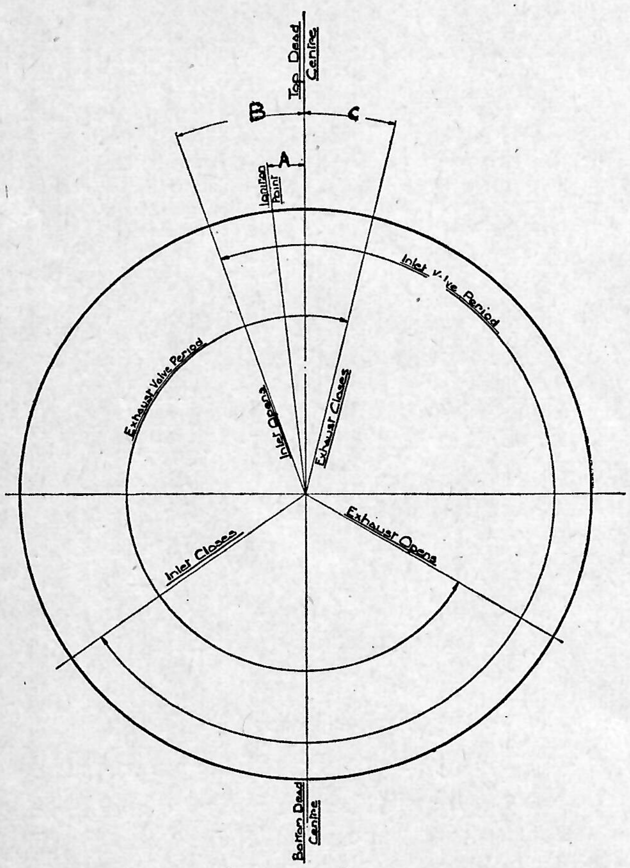
Disconnect the carburetter controls and remove the carburetter.

Disconnect the starter cable from the battery, also disconnect the cables to the starter motor and dynamo and the starter motor switch controls.

Disconnect the oil gauge pipe at the flexible connection.

Remove the three bolts which secure the starter motor and which also carry the earth return cable. The starter motor may then be removed.

Remove the three nuts from the exhaust pipe flange and disconnect the pipe from the manifold.



	A	B	C
FLYWHEEL	$\frac{7}{16}$"—$\frac{7}{8}$" B.T.D.C.	1$\frac{25}{32}$" B.T.D.C.	1$\frac{11}{32}$" A.T.D.C.

FIG. 5.—Timing diagram for the valves.

On the right side of the engine it will be necessary to:—

Disconnect the petrol pipe from the tank to the pump.

Disconnect the lead from the coil to the distributor and the low tension and earth lead from the distributor.

At this stage it will be necessary to fix the pulley block and tackle in position to take the weight of the engine.

To Remove the Gearbox (Engine in Position).

Remove the front seats and carpets, disclosing twelve wood screws securing the gearbox rubber cover.

Remove the propeller shaft guard.

Extract the wood screws securing the metal pedal cover to the right side of the front toe board.

Remove the bolts from the toe board and floor boards and remove the boards.

Remove the floor board supporting straps. These are secured by four nuts and bolts and two screws.

Disconnect the front end of the propeller shaft and the speedometer drive.

Remove the bolts from the unit rear mounting and lift it clear of the cross member.

Remove the six bolts securing the clutch housing to the engine case and withdraw the gearbox from the chassis.

Remove the centre bolts, one each side of the engine front mounting brackets and lift the engine from the chassis, tilting it slightly to the left side in order to clear the steering box.

To Dismantle the Engine.

Slacken off the fan pulley and dynamo adjustment and remove the fan belt.

Remove the three nuts securing the fan assembly to the cylinder block and remove the fan assembly complete.

Remove the two nuts and bolts securing the dynamo to the engine and remove the dynamo. It now becomes necessary to remove the lower pulley and this is secured to the crankshaft by means of the starting handle dog which is screwed on to the crankshaft and machined with a right-hand thread.

The dog assembly is locked in position by two tabs from the locking washer which also register with two bosses cast on the fan pulley. It will be necessary to improvise a tool similar in construction to the starting handle but cut in the opposite direction so that the dog may be unscrewed from the crankshaft.

The fan pulley is keyed on to the crankshaft and when removed will disclose the oil flinger and crankshaft sprocket assembly. The crankshaft sprocket, too, is keyed onto the crankshaft. The oil flinger is fitted with the bevel of the flinger towards the cover. The timing cover is secured to the engine by four bolts at the base and seven nuts around the edge of the cover. A cork washer is fitted.

Please note, when refitting the lower pulley, that it will be best to turn the engine on to top dead centre. Be careful when the starting handle dog is locked into position that the peg of the dog is at 90° to top dead centre.

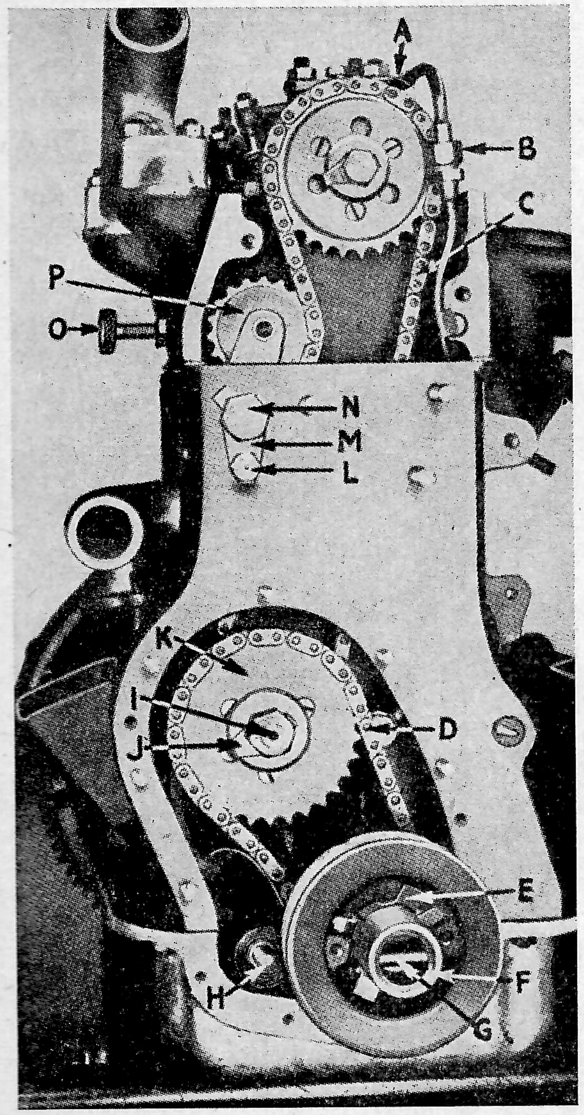


FIG. 6.—View of the camshaft drive.

- A—Camshaft oil feed pipe.
- B—Feed pipe union nut.
- C—Camshaft chain.
- D—Intermediate shaft driving chain.
- E—Fan pulley locking plate.
- F—Starting handle dog.
- G—Dog pin.
- H—Inter chain tensioner.
- I—Inter sprocket locking nut.
- J—Inter shaft nut locking plate.
- K—Inter shaft sprocket.
- L—Camshaft chain tensioner sprocket pin.
- M—Locking plate.
- N—Chain tensioner fulcrum pin.
- O—Chain tensioner adjusting bolt.
- P—Chain tensioner sprocket.

To Remove the Intermediate Shaft.

First remove the intermediate chain tensioner which is secured to the engine by a central bolt. Remove one nut, tab washer and plate from the intermediate shaft, remove the three dividing pins and the intermediate shaft sprocket. The intermediate chain may then be removed. Remove the setpin and nut locating the intermediate shaft to the engine and withdraw the shaft.

To Remove the Chain Tensioner.

This is secured by two bolts from the front of the case. The bolts are locked with tab washers, one bolt acting as a pivot for the jockey sprocket assembly, the other carries the spring which provides tension for the jockey pulley. After removing the bolts, the sprocket assembly may be withdrawn from the engine.

To Dismantle the Distributor Drive.

First remove the two nuts securing the petrol pump to the engine. Remove the petrol pump and extract the plunger. Next remove one bolt securing the distributor and locking plate to the drive housing and remove the distributor.

In order to remove the distributor drive housing take away two nuts securing the housing to the engine. This will disclose the distributor drive shaft which is driven from the intermediate shaft by means of a skew gear. The pump drive is taken from the intermediate shaft by means of a skew gear. The pump drive is taken from the front part of the shaft and the removal of the petrol pump plunger, distributor and drive housing will leave the shaft free to be extracted from the engine.

Particular notice must be taken here that the slot in the distributor drive shaft and dog on the distributor shaft are offset, and if at any time it has been necessary to remove the drive shaft it must be refitted in the following manner.

First, turn the engine until the inlet valve on No. 4 cylinder is just commencing to open. The distributor drive shaft may then be inserted into the engine until it engages with the dog on the oil pump shaft, but the offset or thicker side on the distributor drive shaft must be towards the engine, otherwise it will be impossible to obtain the correct ignition timing.

To Remove the Pistons and Connecting Rods.

Remove the dipstick and drain the engine oil by unscrewing the drain plug on the right side of the sump. Remove the sump nuts and detach the sump, care being taken to avoid damaging the three cork washers which are fitted, one at each side and one to the rear main bearing housing. Care must be taken when refitting the sump to ensure these washers are in the correct positions.

Extract the split pins and release the nuts from the connecting rod bolts. Remove the connecting rod caps, and push the connecting rods and pistons a little way up the cylinder bores, care being taken to avoid the top piston ring passing over the top face of the cylinder block. The crankshaft may then be revolved to clear each cylinder bore and to allow each connecting rod and piston to be withdrawn from beneath.

The connecting rod bearing is detachable, and there is no need to alter the rod in any way. Should it be necessary to pay some attention to a big end bearing, a new one should be fitted. Filing the butt faces of rod and cap will scrap the assembly, and render it useless for the fitting of replacement bearings.

To Dismantle the Main Bearings and Crankshaft.

When the sump, connecting rods and pistons have been removed, proceed as follows:—

Detach the clutch from the flywheel by removing the four nuts and two locking plates securing the flywheel to the crankshaft.

Dismantle the timing case.

Remove the tab washers and nuts from the main bearing caps and withdraw the crankshaft from the engine.

All three main bearings are detachable and though they are covered by the same part number, when once fitted they must not be interchanged one with the other; they must be refitted in pairs and in their original positions. The front and centre main bearings are secured by two nuts and tab washers each, but the rear main bearing cap has four nuts and tab washers. No packing shims are fitted between the main bearing caps and the engine, but detachable thrust washers are provided on the centre bearing.

SECTION C

CLUTCH

Make	Borg and Beck.
Type	Single dry plate.
Model	$7\frac{1}{4}$ A6-G.
Type of hub	Spring.
Clutch pedal free travel	$\frac{3}{4}$.
Type of release bearing	Carbon.
Type of facing	Borglite (moulded).
Outside diameter of clutch facing	$7\frac{1}{8}$.
Inside diameter of clutch facing	$4\frac{7}{8}$.
Thickness of clutch facing	$\frac{1}{8}$.
Number of springs	6.
Colour of springs	Yellow.
Thrust pad clearance	$\frac{1}{16}$.
Maximum variation in finger height	.005.
Gauge plate	CG12916.

GENERAL.

Clutch Cover Assembly.

Before dismantling the clutch, suitably mark the following parts so that they can be reassembled in the same relative positions to each other to preserve the balance and adjustment: clutch cover, lugs on the pressure plate and the release levers.

When reassembling, make sure that the marking coincide and, if new parts have been fitted which would affect the adjustment, carefully set the release levers by means of the lever adjustment gauge.

If a new pressure plate has been fitted, it is essential that the complete cover assembly should be statically balanced. Unless special equipment is available, this is not a practical proposition.

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 lugs on the pressure plate and the plain ends of the eyebolts.

Release Bearing.

If the graphite release bearing ring is badly worn, it should be replaced by a complete bearing assembly.

Driven Plate.

When removing worn facings, the rivets should be drilled out, not punched. After removing the facings, examine the disc or segments for cracks; if damaged, a new driven plate assembly should be used.

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, true the plate by prising it in the requisite direction after finding the high spots. When reassembling the driven plate in the flywheel, ensure that the larger chamfered splined end of the hub is towards the gearbox or rear of the vehicle.

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

Alignment.

Faulty alignment will cause excessive wear of the splines in the hub of the driven plate, and eventually fracture the steel disc around the hub centre as a result of swash action produced by axial movement of the splined shaft. The notes headed "Misalignment" should be carefully followed.

Pedal Adjustment.

This adjustment is most important and the instructions given should be carefully followed. Faulty adjustment falls under two headings:—

(a) Insufficient free (or unloaded) pedal travel may cause a partially slipping clutch which becomes aggravated as additional wear takes place on the facings, and this can result in burning out unless corrected. Over-travel of effective pedal movement imposes undue internal strain and causes excessive bearing wear.

(b) Too much free pedal movement results in inadequate release movement of the bearing and may produce a spinning plate condition, i.e., dragging clutch, rendering clean gear changes impossible.

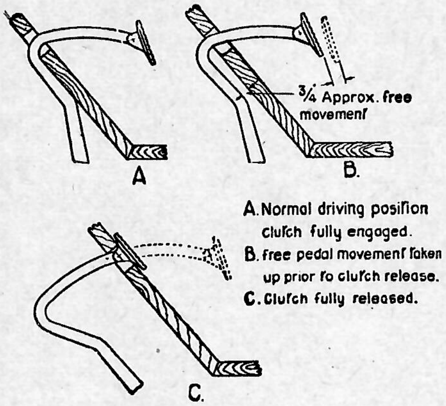


FIG. 1.—Pedal adjustment.

To Remove the Clutch from the Engine.

Loosen each holding screw a turn at a time by diagonal selection until the pressure of the thrust springs is relieved. Then remove the screws and the complete clutch from the flywheel.

Misalignment.

In almost every case of rapid wear on the splines of the clutch driven plate, misalignment is responsible. The consequent looseness of the driven plate on the shaft results in noticeable backlash in the clutch.

Misalignment also puts undue stress on the driven member and may result in the hub breaking loose from the plate with subsequent total failure of the clutch. It is also responsible for worn retractor collars and levers.

Misalignment may also be responsible for a fierce chattering or dragging clutch which makes gear changing difficult. This not only affects the operation and life of the clutch but is also very detrimental to the transmission bearings and gears. Prompt attention may prevent needless expensive replacement of parts.

If considerable backlash is evident or if the clutch drags from an undetermined cause, it is advisable to remove both gearbox and clutch and to check the flywheel and housing with a clock indicator to determine possible misalignment. Run-out on the flywheel face must not exceed .003.

Figure 2 shows the correct method of checking the rear face of the flywheel. Run-out should not exceed .003 as the clutch cover is mounted on this surface.

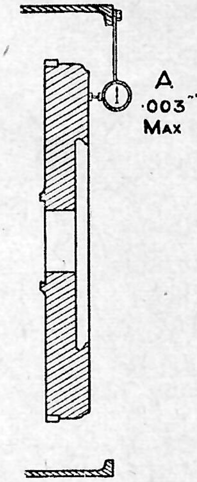


FIG. 2.—Flywheel alignment check.

It is also important that the rear face of the engine housing be parallel with the flywheel face, and this run-out should not exceed .005.

The engine should be turned over slowly by hand to obtain readings.

Condition of Clutch Facings.

The possibility of further use of the friction facings of the Borg and Beck clutch is somethimes raised, because they have a polished appearance after considerable service. It is natural to assume that a rough surface will give a higher friction value against slipping than a smooth one, but this is not correct.

Since the introduction of non-metallic facings of the moulded asbestos type, a polished surface in service 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 may be due to a film or a condition introduced, which entirely alters the friction value of the facings. These two conditions might be simply illustrated by the comparison between a polished wood and a varnished surface. In the former the contact is still made by the original material, whereas in the latter

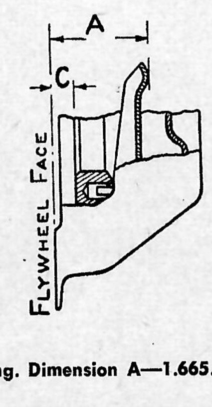


FIG. 3.—Lever setting. Dimension A—1.665. Dimension C—.285.

instance a film of dried varnish is interposed between the contact 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), then the surfaces 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.

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 a 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 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, may arise, depending upon the nature of the oil, etc.

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

(b) Still greater quantities of oil produce a black soaked appearance of the facings, and the effect may be slip, fierceness or judder in engagement, according to 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 the oil removed and the clutch and flywheel face cleaned.

Clutch Pedal Adjustment.

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 lever tips or release lever plate and commences to release the clutch. To ensure this free movement, a clearance of $\frac{3}{4}$ inch is advised. 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 decreases the release bearing clearance or free pedal movement previously referred to.

Adjust the pedal gear by the method described until there is approximately $\frac{3}{4}$ inch free or unloaded movement of the pedal pad. To obtain a clean release, the inner ends of the release levers should be pushed towards the flywheel approximately .37 to .32. When the inner ends of the release levers have travelled this amount and no more, the clutch pedal should be in contact with the pedal stop.

Clutch Pedal Travel.

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 internal parts of the clutch. This overstress causes excessive wear and may cause failure of one or other of the internal parts.

The required pedal travel is the sum of two movements:—

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

(b) The effective movement necessary to release the clutch.

The amount of effective pedal movement to be provided is that necessary to move the release lever plate or release lever sleeve the distance to free the clutch completely.

The pedal travel should be limited by the toe board and back stop, to the correct amount ascertained. This will allow the clutch to be completely freed and at the same time prevent the possibility of damage due to overtravel.

Setting the Release Levers.

Having roughly set the levers to 1.665 from the flywheel face it is necessary to adjust the levers in plane with one another. If the special gauge plate CG12916 is not available, the levers can be adjusted satisfactorily by clamping the cover assembly, with the driven plate in position, to a flat surface, and the adjustment checked by means of a clock gauge recording on the release lever plate. The clutch should be released and the driven plate turned through 90°, during this operation, to counteract for any lack of parallelism in the plate and to ensure that the release levers are in plane with each other.

DESCRIPTION.

This model is of the single dry plate type and consists of a driven plate assembly, a cover assembly and a graphite release bearing. See Figure 4.

The cover assembly consists of a pressed steel cover (1) and a cast iron pressure plate (2) loaded by 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 the 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.

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.

To Dismantle (Figure 4).

Before dismantling mark the components mentioned earlier.

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. Place a block of wood across the cover, resting on the spring bosses, and compress the cover by means of the ram. While under compression, remove the locking from the nuts (12) by shearing away the peening by exerting sufficient turning pressure to the nuts. Slowly release the pressure to prevent the thrust springs from flying out.

Remove each release lever (8) by holding the lever and the eyebolt (10) between the fingers and thumb so that the inner end of the lever and the threaded end of the eyebolt are as close together as possible, keeping the eyebolt pin (9) in position in the lever. Lift the strut (13) over the ridge on the lever and remove the eyebolt from the pressure plate.

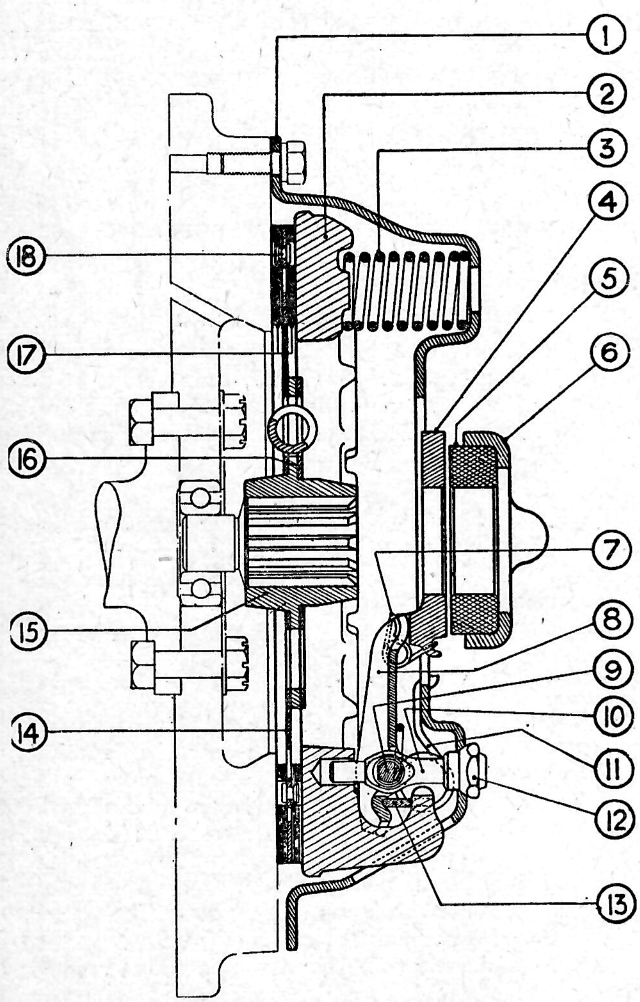


FIG. 4.—The clutch in section.

To Assemble (Figure 4).

Before assembling note the position of the marked components.

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 slot 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.

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 the bosses provided. Lay the cover over the assembled parts, ensuring that the anti-rattle springs are

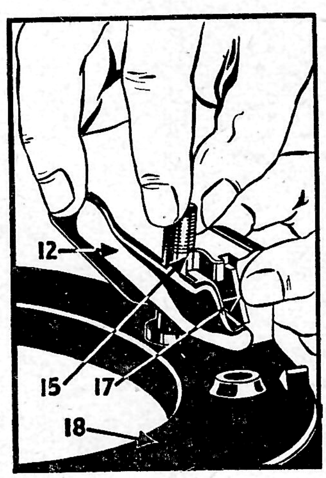


FIG. 5.—Fitting the release levers.

12—Release lever.
15—Eyebolt.
17—Strut.
18—Pressure plate.

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.

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. Remove the clutch from the press and connect the release lever plate (4) to the retainer springs (7).

If new parts have been fitted, which would affect the adjustment, the release levers should be set by means of the special gauge plate CG12916.

Release Lever Adjustment (Figure 6).

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 levers (5). Any position of the gauge plate lugs will give satisfactory results.

After 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.

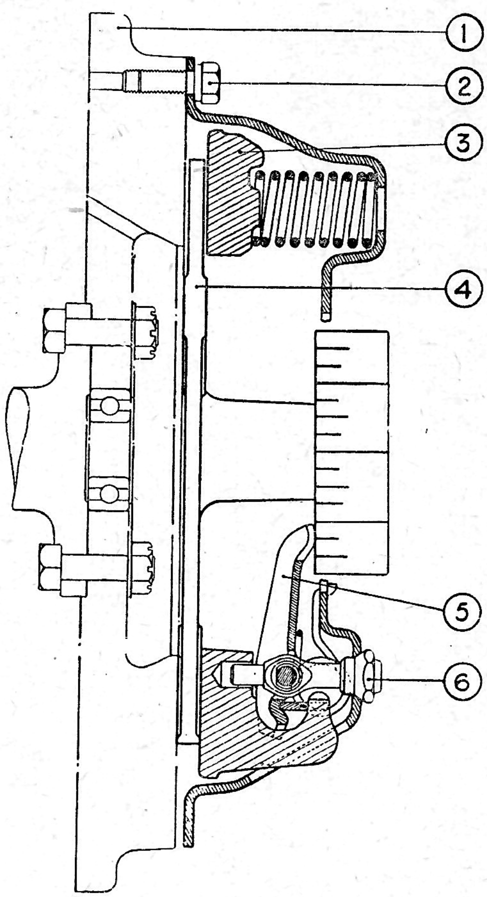


FIG. 6.—Release lever adjustment.

FAULTS AND THEIR REMEDIES

SYMPTOM	CAUSE	REMEDY
1. Drag or Spin.	(a) Oil or grease on the driven plate facings.	Fit new facings.
	(b) Misalignment between the engine and splined clutch shaft.	Check over and correct the alignment.
	(c) Incorrect pedal adjustment not allowing full movement to release bearing.	Correct pedal adjustment.
	(d) Warped or damaged pressure plate or clutch cover.	Renew defective part.
	(e) Driven plate hub binding on splined shaft.	Clean up splines and lubricate with small quantity of high melting point grease, such as Duckham's Keenol.
	(f) Pilot bearing or bushing of clutch shaft binding.	Renew or lubricate pilot bearing.
	(g) Distorted driven plate due to the weight of the gearbox being allowed to hang in clutch plate during erection.	Fit new driven plate assembly, using a jack to take the overhanging weight of the gearbox.
	(h) Broken facings of driven plate.	Fit new facings.
	(j) Dirt or foreign matter in the clutch.	Dismantle the clutch from the flywheel and clean the unit, see that all working parts are free. **Caution.**—Never use petrol or kerosene for cleaning out the clutch.

FAULTS AND THEIR REMEDIES

SYMPTOM	CAUSE	REMEDY
2. Fierceness or Snatch.	(a) Oil or grease on driven plate facings.	Fit new facings and ensure isolation of clutch from possible ingress of oil or grease.
	(b) Misalignment.	Check over and correct the alignment.
	(c) Binding of clutch pedal mechanism.	Free and lubricate journals.
	(d) Worn out driven plate facings.	New facings required.
		Fit new facings and eliminaate cause of oil.
3. Slip.	(a) Oil or grease on driven plate facings.	Free and lubricate journals.
	(b) Binding of clutch pedal mechanism.	Correct pedal adjustment and/or clearances.
	(c) Incorrect pedal adjustment indicated by lack of the requisite free or unloaded foot pedal movement.	
	(d) Incorrectly replaced floorboards preventing complete rearward movement of the pedal.	
4. Judder.	(a) Oil, grease or foreign matter on the driven plate facings.	Fit new facings and eliminate cause of oil.
	(b) Misalignment.	Check over and correct alignment.
	(c) Pressure plate out of parallel with flywheel face in excess of the permissible tolerance.	Re-adjust levers in plate and, if necessary, fit new eyebolts.
	(d) Contact area of friction facings not evenly distributed. **Note.**—The 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.
	(e) Bent splined shaft or buckled driven plate.	Fit new shaft or driven plate assembly.
	(f) Unstable or ineffective engine rubber mounting.	Replace and ensure elimination of endwise movement of power unit.
	(g) Chassis to engine tie bar out of adjustment.	Correct to ensure that power unit is held against endwise travel.
5. Rattle.	(a) Damaged driven plate, i.e., broken springs, etc.	Fit new parts as necessary.
	(b) Worn parts in release mechanism.	
	(c) Excessive backlash in transmission.	
	(d) Wear in transmission bearings.	
	(e) Bent or worn splined shaft.	
	(f) Graphite release bearing loose on throwout fork.	
6. Tick or Knock.	(a) Hub splines badly worn due to misalignment.	Check and correct alignment, then fit new driven plate.
	(b) Worn pilot bearing.	Pilot 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 Borglite type.	Check and correct alignment, and fit a new driven plate.
	(b) If the gearbox during assembly be allowed to hang with the shaft in the hub, the driven plate may be distorted, leading to drag, metal fatigue and breakage.	Fit new driven plate assembly and ensure satisfactory reassembly.
8. Abnormal Facing Wear.	Usually produced by overloading and by excessive slip starting associated with overloading.	In the hands of the driver.

SECTION D

GEARBOX

Type	Four-speed.
Ratios:	
Top	5.43 : 1.
Third	7.96 : 1.
Second	12.32 : 1.
First	19.5 : 1.
Reverse	19.5 : 1.
Bearings:	
Clutch shaft	Plain bronze bush.
Inside diameter	.8125 to .813.
Outside diameter	.998 to .9975.
Length	$1\frac{7}{16}$.
Mainshaft, front	Ball.
Bore	$1\frac{1}{2}$.
Outside diameter	$3\frac{1}{4}$.
Length	$\frac{3}{4}$.
Mainshaft, rear	Ball.
Bore	$1\frac{1}{8}$.
Outside diameter	$2\frac{13}{16}$.
Width	$\frac{13}{16}$.
Layshaft	Bronze bush.
Bore	.8773 to .8768.
Outside diameter	1.060 to 1.0595.
Length	$1\frac{3}{4}$.
End float:	
Mainshaft	Nil.
Cluster gear	.004 to .015.

THREE-SPEED GEARBOX.

To Remove.

Remove the front seats and carpets, thereby disclosing twelve wood screws securing the gearbox rubber cover.

Remove the propeller shaft guard.

Extract the wood screws securing the pedal metal cover to the right side of the front toe board.

Remove the bolts from the toe board and floor-boards and remove the boards.

Remove the floorboards supporting straps. These are secured by four nuts and bolts and two screws.

Disconnect the front end of the propeller shaft and the speedometer drive.

Remove the bolts from the unit rear mounting and lift it clear of the cross member.

Remove the six bolts securing the clutch housing to the engine case and withdraw the gearbox from the chassis.

Remove the centre bolts, one each side of the engine front mounting brackets, and lift the engine from the chassis, tilting it slightly to the left side in order to clear the steering box.

To Dismantle.

After having drained the oil from the gearbox, hold the unit in a vice by means of the drain plug. Then proceed as follows:—

Remove the six bolts securing the gearbox lid and control tower to the box.

Select two gears to hold the mainshaft assembly stationary, and remove the nut and split pin from the rear end of the mainshaft in order to allow the front universal joint flange to be withdrawn.

Take out one bolt and withdraw the speedometer drive bracket complete.

Remove the six nuts securing the gearbox rear end cover and take away the cover.

Slide the speedometer drive gear from the mainshaft.

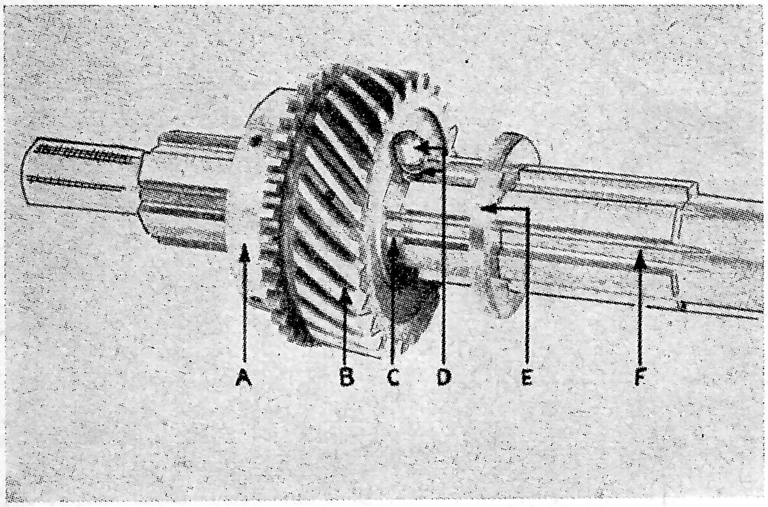


FIG. 1.—Mainshaft (9 h.p. Roadster).

A—Synchronising cone; B—Gear; C—Groove; D—Locking ring plunger and spring; E—Locking ring; F—Mainshaft.

Remove the four bolts securing the gearbox clutch housing and withdraw the housing.

Again select two gears to hold the mainshaft assembly stationary and unscrew the constant pinion nut which is machined with a left-hand thread. Withdraw the tab washer, oil scroll, and chip shield from the front of the constant pinion bearing.

Tap out the constant pinion bearing from the inside of the box and remove the inner clip shield.

By holding the constant pinion with the left hand and tilting the pinion shaft downwards the mainshaft spigot can be withdrawn from the bush of the constant pinion. The mainshaft assembly may then be removed through the top of the gearbox.

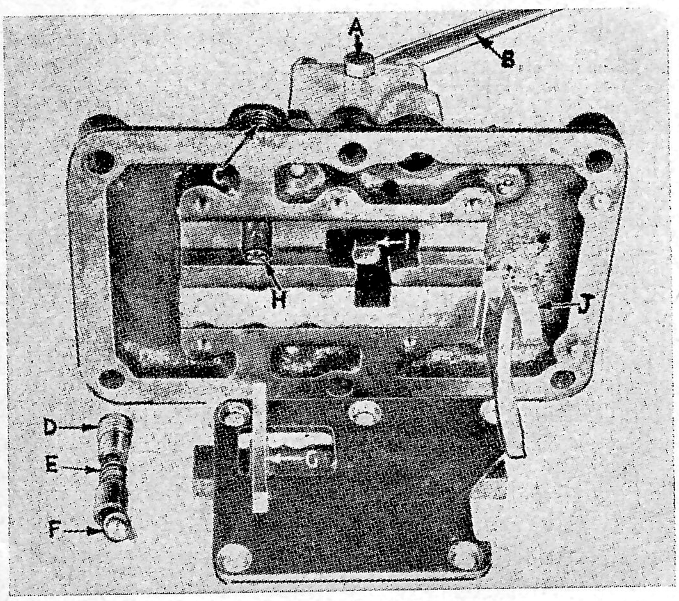


FIG. 2.—Gear selectors (9 h.p. Roadster).

A—Locating pin; B—Gear lever; C—Hole for plunger; D—Selector plunger adjusting cap; E—Selector plunger spring; F—Ball; G.—Striker fork; H—Selector safety locking ball; I—Striker lever; J—Selector fork.

Remove the setpin and shakeproof washer which secure the lock plate for the reverse shaft and layshaft.

Tap out the layshaft from the front through the rear of the gearbox.

Remove the layshaft gear cluster from the top of the box, taking special care of the one bronze thrust washer at the front end of the assembly. The slotted steel washer registers in the reverse gear.

Tap out the reverse shaft and remove the reverse gear.

To Dismantle the Mainshaft.

Slide the first speed gear from the mainshaft.

Remove the synchro assembly complete from the mainshaft.

To remove the second mainshaft gear, depress one small spring-loaded plunger which secures the splined locking washer at the rear of the second gear. Turn the washer in order to clear the splines and slide this off the shaft. It is then possible to withdraw the second speed gear, leaving the bush on the mainshaft, but great care must be taken to avoid losing the plunger and spring.

It will be noted that there is a similar spring-loaded plunger and washer at the front end of the second speed gear bush.

The synchro assembly comprises the third and second sliding dog, inside which slides the synchro sleeve carrying two serrated synchro cones of brass. There are also six balls and springs which lock the top and second sliding dog in the selected position. To dismantle the synchro assembly, slide the assembly back on to the mainshaft until it abuts against the second speed gear bush. Then depress the third and second sliding dog to its limit, great care being taken to avoid losing the six synchro balls and springs. Then withdraw the synchro sleeve from the mainshaft. No further dismantling is necessary.

To Dismantle the Gearbox Lid and Selector Mechanism.

Hold the gearbox lid and control tower in a vice and remove the four bolts which secure the change speed lever tower to the gearbox lid. The tower complete with lever may then be withdrawn from the lid. Withdraw the two plugs, followed by the springs, plunger and balls from the offside of the lid and one of each from the nearside of the lid. This will release the tension from the selector shafts and forks, which are in one piece. Remove the five setscrews which secure the selector fork clamping plate, the latter can then be removed and will bring away with it the 2nd and top selector shaft and fork. Care should be taken not to lose the safety locking ball concealed in the guide boss which separates the two selector shafts.

FOUR-SPEED GEARBOX.

To Remove.

Remove the front seats and carpets, thereby disclosing the twelve wood screws securing the gearbox rubber cover.

Remove the propeller shaft guard.

Extract the wood screws securing the pedal metal cover to the right side of the front toe board.

Remove the bolts from the toe board and floorboards and remove the boards.

Remove the floorboards and supporting straps. These are secured by four nuts and bolts and two screws.

Disconnect the front end of the propeller shaft and the speedometer drive.

Remove the bolts from the unit rear mounting and lift it clear of the cross member.

Remove the six bolts securing the clutch housing to the engine and withdraw the gearbox from the chassis.

Remove the centre bolts, one each side of the engine front mounting brackets, and lift the engine from the chassis, tilting it slightly to the left side in order to clear the steering box.

To Dismantle.

If the gearbox requires inspection for wear of the synchro cones, bushes or bearings, it is possible to do so without removing the gearbox from the chassis. The change gear mechanism is integral with the gearbox cover and remote control and the removal of this leaves the gears and synchromesh sleeves open for examination.

The procedure for dismantling is consequently simplified as follows:—

Detach the top cover complete with striking gear and control by removing the six nuts and washers. Be sure that the change speed lever is in neutral before lifting.

To check wear of synchro cones, move the sleeves towards the engaging teeth of each gear until the cones make contact. If the sleeve is then close to, or touching, the toothed ring the cones will need renewal. Normally there should be $\frac{1}{8}$ space between the ends of the sleeves and the teeth when the cones are in contact.

To renew these parts detach the gearbox from the engine as follows:—

Remove the carpets and floorboards, then uncouple the propeller shaft flange. Next detach the rear mounting cradle, speedometer cable and clutch pedal connection, leaving the gearbox ready to be withdrawn from the engine by removing the sheet metal cover under the clutch housing and the seven bolts and washers from the clutch housing.

As the engine unit is flexibly mounted in the chassis, it will be necessary to lift the engine slightly by means of a jack or block under the oil sump. Lift it just enough to raise the gearbox free of the frame member, when it can be drawn away and removed.

To Remove the Constant Mesh Pinion and the Mainshaft.

Remove the clutch housing and nut securing the ball bearing. Withdraw the propeller shaft flange and the speedometer driving pinion and bearing. Then take off the rear cover of the gearbox.

Carefully tap each ball bearing outwards, from the inside of the gearbox, until they are free, when the complete shaft can be raised. The mainshaft assembly and the constant mesh pinion can then be withdrawn apart, enabling the mainshaft to be tilted upwards and removed from the box.

Both synchro sleeves can be pulled off the mainshaft. If there is excessive end play or wear in the bushes of the 2nd and 3rd gears these can be easily detached by removing the circlip and withdrawing the key that secures the front thrust ring. After this the thrust ring can be turned and pulled off the splines, thus releasing the gears and bushes.

This now leaves the layshaft and reverse gear, which are both easy to remove after withdrawing the locking pin that prevents the layshaft and reverse pinion shaft from revolving.

The layshaft should be pushed out from the front or clutch end and the reverse pinion can be withdrawn from the cover end, after removing the circular plate and the reverse fork locating bracket.

As the gears on the layshaft have ground teeth the assembly has to be built up with separate gears, which are kept in place by a spring ring fitted in a groove at the large wheel end, under the thrust washer.

If at any time these gears are replaced, great care must be used to see that the splines and all end faces are perfectly free from dust or grit, and that the surfaces are not in any way bruised or burred, for it is vitally important that when reassembled, all the gears should run dead true.

Before reassembling, be sure to thoroughly clean the interior of the gearbox.

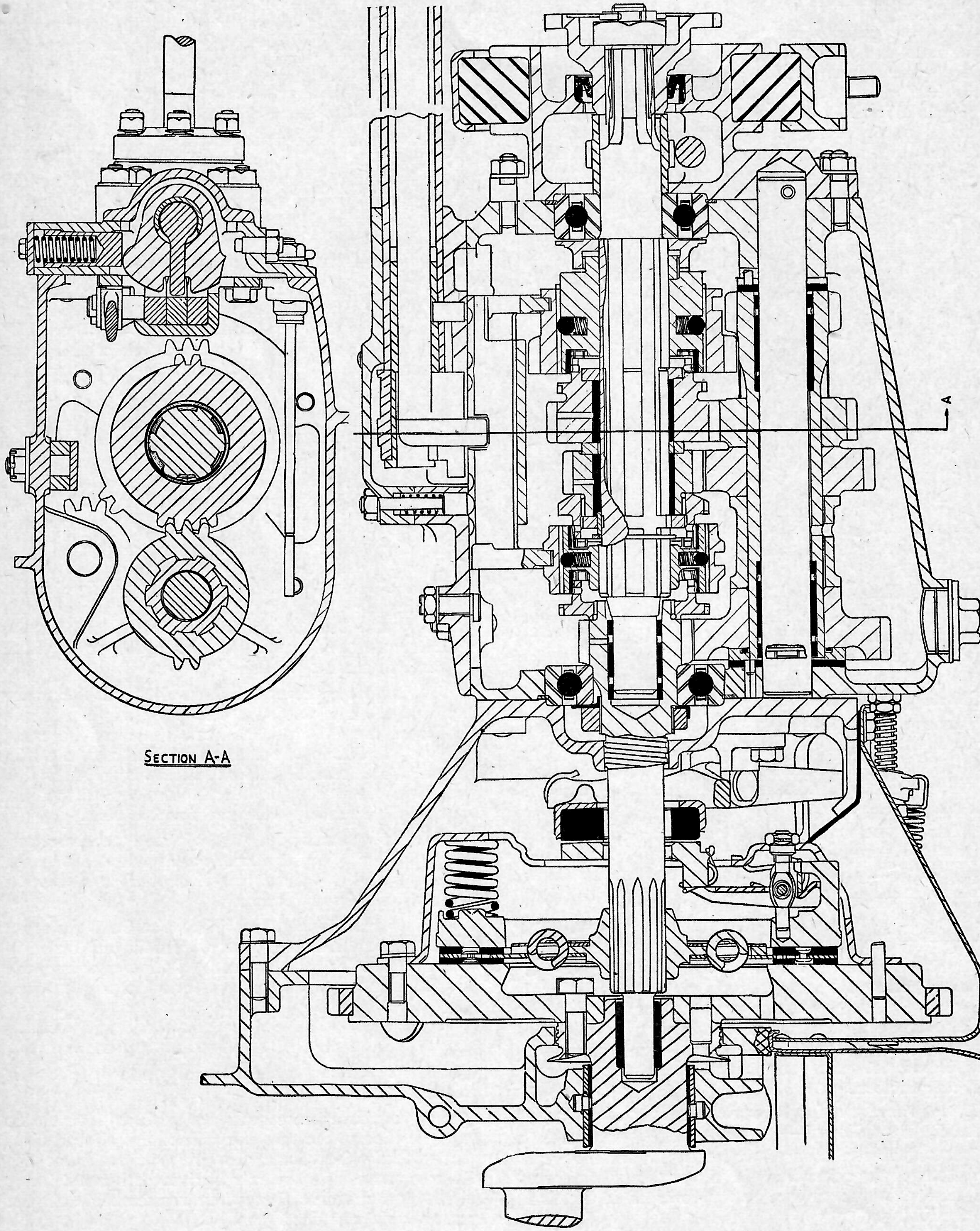


FIG. 3.—Longitudinal and transverse sections of the four-speed gearbox (Series 4A and 4AB).

SECTION E

REAR AXLE

Rear Axle

Type	Spiral bevel.
Axle shaft type	Upset, $\frac{3}{4}$ floating.
Hub bearing type	Ball.
Pinion bearings:	
Front	Taper roller.
Rear	Taper roller.
Method of adjustment	Shims (crownwheel and pinion).
Normal backlash	.006 to .008.
Crownwheel bearing	Taper roller.
Number of pinion teeth	7.
Number of crownwheel teeth	38.
End play at axle shaft	Nil.

Rear Suspension

	4A	4AB
Type	Semi-elliptic	Semi-elliptic
Number of leaves	6	4
Width of leaves	$1\frac{1}{2}$	$1\frac{1}{2}$
Thickness of leaves	$\frac{1}{4}$	Top $\frac{9}{32}$ Others $\frac{1}{4}$
Distance between eyes: Laden	43.0	43.0
Average load rate	155 lbs. per. in.	110 lbs. per in.
Working load	440 lbs.	387 lbs.
Free camber	$3\frac{5}{8}$	$4\frac{5}{8}$
Laden camber	$1\frac{3}{16}$ at load of 440 lbs.	$1\frac{1}{8}$ at load of 387 lbs.

9 H.P. ROADSTER.

To Remove.

To remove the propeller shaft, remove the nuts, bolts and washers securing the rear and front universal joint flanges. The propeller shaft may then be removed entirely.

Lifting jacks or blocks should be placed under the chassis frame at a position level with the front ends of the rear road springs. The chassis should then be jacked up until the rear road wheels are clear of the ground, and blocks placed in position to support the chassis weight when the jacks are removed.

Remove the road wheels, release and remove the lifting jacks.

Disconnect the brake rod.

Remove the four nuts and bolts securing the buffer carriers to the chassis frame and remove the buffer carrier complete.

Disconnect the top ends of the shock absorber links.

Disconnect the petrol pipe line from the tank.

Withdraw the rear axle from the chassis frame by lifting the axle unit towards one side of the chassis, passing one brake drum assembly through the aperture of the wheel arch and the chassis frame. The rear axle unit may then be withdrawn end-ways from beneath the chassis.

To Dismantle.

Remove the rear axle drain plug and drain out the oil.

Release the two countersunk screws securing the brake drums to the rear hubs and remove the brake drums (two extractor holes are provided).

Remove the brake shoes.

Remove the four nuts and shakeproof washers securing the rear hub assembly to the axle case and withdraw the rear hub, bearing housing and bearing, together with the axle shaft.

Release the tab washer and locknut securing the bearing housing and bearing to the rear hub and withdraw the bearing housing and bearing together. Remove the bearing and washer from the bearing housing. The rubber moulded oil seals can remain in position, but care must be taken when withdrawing and replacing the axle shafts not to distort the rubber sealing surfaces.

Remove the axle case bolts and nuts, and release the four nuts and spring washers securing the rear axle bearing case to the axle casing. Withdraw the bearing case and differential assembly.

FIG. 3.—Longitudinal and transverse sections of the four-speed gearbox (Series 4A and 4AB).

Extract the bevel pinion and universal joint coupling by releasing the four setpins and spring washers which secure the bevel pinion bearing sleeve to the axle bearing case. Withdraw the sleeve, bevel pinion and universal joint coupling. Remove the split pin and locknut securing the universal joint coupling to the bevel pinion; remove the coupling and withdraw the bevel pinion. Extract the distance piece and bearings from the bevel pinion sleeve.

Remove the differential case and bevel wheel from the axle bearing case by releasing the two setscrews in the bearing case which secure the differential bearing adjusting ring. Release the two tab washers and remove the four nuts securing the bearing case caps, remove the caps and mark them, to be quite sure when reassembling that they are returned to their correct positions. The two adjusting rings and the differential and bevel wheel assembly can now be removed from the axle bearing case.

To extract the differential bearings, lever the outer rings of the bearings upwards and extract the inner cage and bearings very carefully, to ensure that the balls are not lost in the process. Remove the six split pins, bolts and nuts securing the bevel wheel and two halves of the differential case, and remove the bevel wheel. Tap out the six differential pins, thus releasing the two halves of the differential case, together with the differential pinions and the two axle shaft pinions. This operation is most easily carried out by supporting the differential case on the splined end of an axle shaft which has been secured in the vice because the shoulders of the differential pins prevent their being driven out by supporting the differential case on the vice.

SERIES 4A AND 4AB.

To Remove.

Remove the nuts, bolts and washers securing the universal joint flanges. The propeller shaft may then be removed entirely.

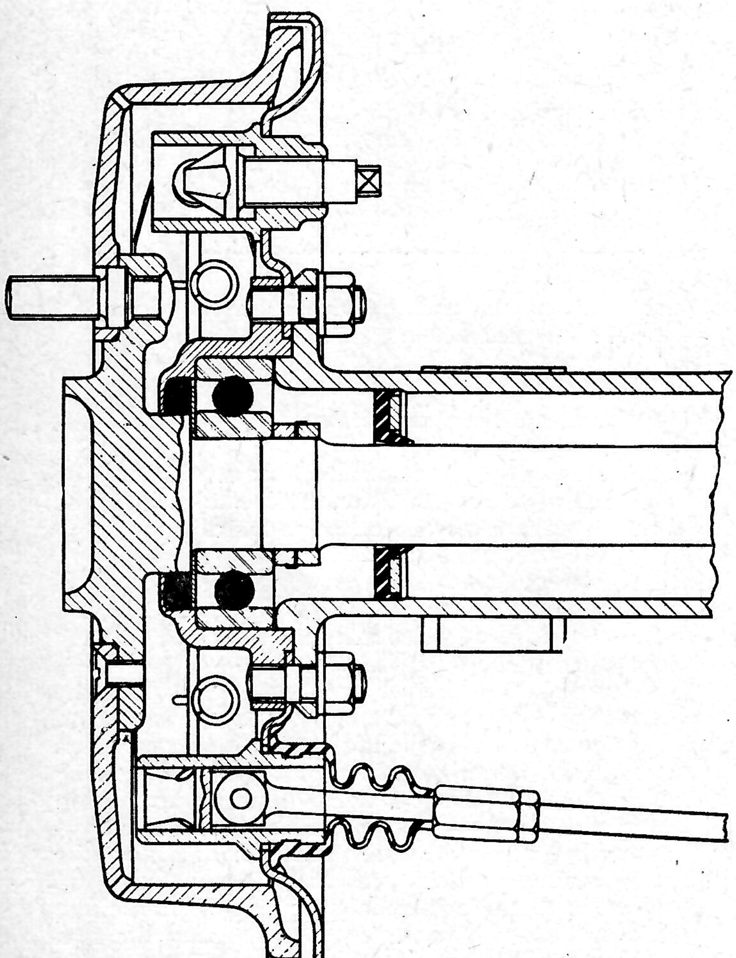


FIG. 1.—Section of Series 4A rear hub.

Lifting jacks or blocks should then be placed under the chassis frame at a position level with the front end of the rear road springs. The chassis must then be jacked up until the rear road wheels are clear of the ground, and blocks placed in position to support the chassis weight when the jacks are removed.

Remove the road wheels and the lifting jacks.

Disconnect the brake rod.

Remove the four nuts and bolts securing the buffer carriers to the chassis frame and remove the buffer carriers complete.

Disconnect the top end of the shock absorber links.

Disconnect the petrol pipe line from the tank.

Withdraw the rear axle from the chassis frame by lifting the axle unit towards the side of the chassis, passing one brake drum assembly through the aperture of the wheel arch and the chassis frame. This end of the axle unit will be drawn towards the centre of the aperture of the wheel arch and the chassis frame. The rear axle unit may then be withdrawn end-ways from beneath the chassis.

To Dismantle.

Remove the rear axle drain plug and drain out the oil.

Release the two countersunk screws securing the brake drums to the rear hubs and remove the brake drums (two extractor holes are provided).

Remove the brake shoes.

Remove the four nuts and shakeproof washers securing the rear hub assembly to the axle case and withdraw the rear hub, bearing housing and bearing together with the axle shaft.

Release the tab washer and locknut securing the bearing housing and bearing to the rear hub and withdraw the bearing housing and bearing together. Remove the bearing and washer from the bearing housing. The rubber moulded oil seals can remain in position but care must be taken when withdrawing and replacing the axle shafts not to distort the rubber sealing surfaces.

To Remove and Strip the Differential Assembly.

Remove the four nuts and bolts securing the universal joint to the differential drive flange; remove the bolts around the pinion housing flange thus allowing the complete differential to be taken out of the axle after the axle shafts have been withdrawn clear of the differential centre.

To strip the differential, bend back the locking tabs on the main differential case bearing caps—taking care to mark the caps in order that they can be reassembled in their original positions. Then remove the cap bolts together with the caps. This will then allow the crownwheel, the carrier and the bearings, with shims, to be removed from the main housing.

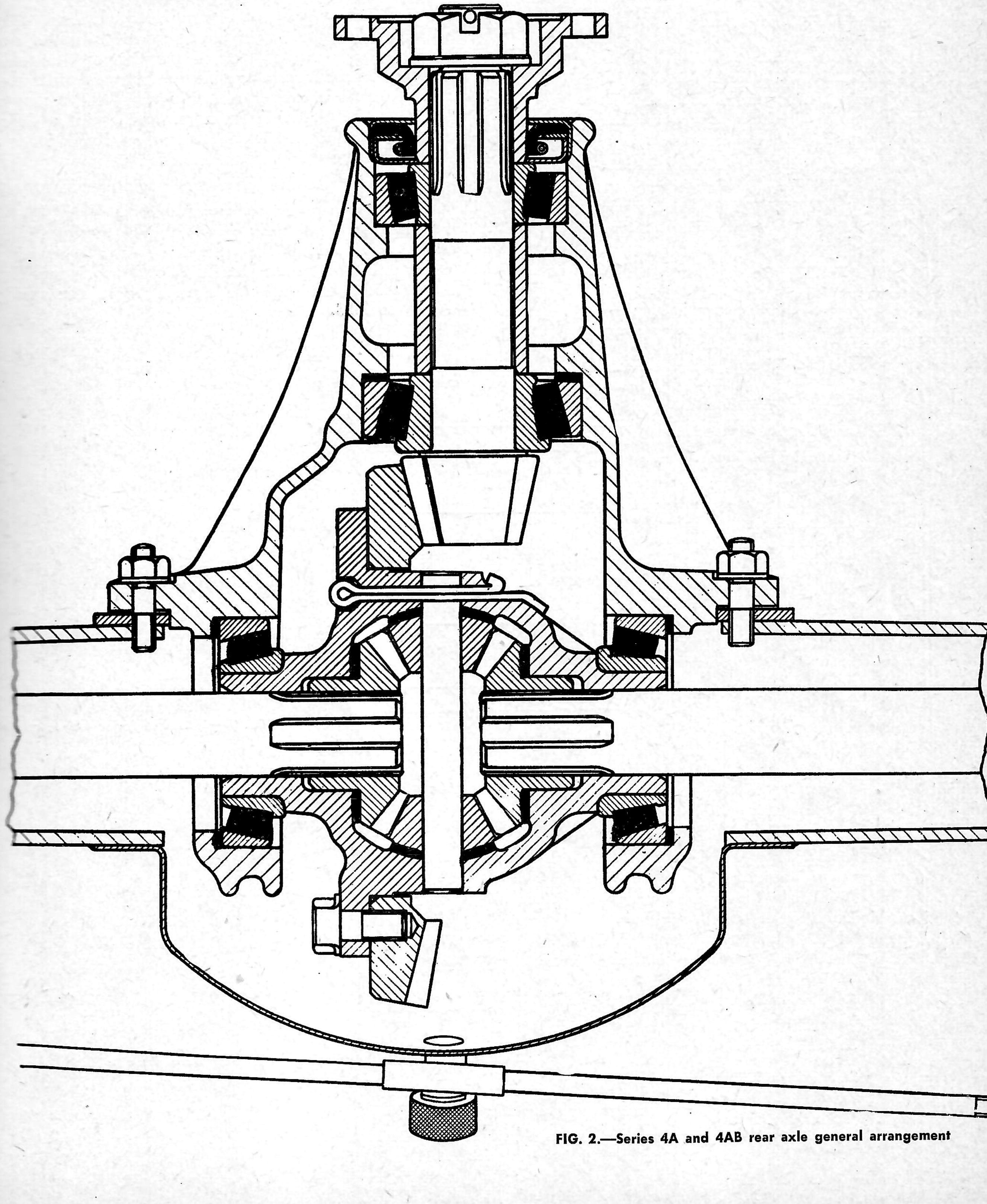


FIG. 2.—Series 4A and 4AB rear axle general arrangement

Extract the bevel pinion and universal joint coupling by releasing the four setpins and spring washers which secure the bevel pinion bearing sleeve to the axle bearing case. Withdraw the sleeve, bevel pinion and universal joint coupling. Remove the split pin and locknut securing the universal joint coupling to the bevel pinion; remove the coupling and withdraw the bevel pinion. Extract the distance piece and bearings from the bevel pinion sleeve.

Remove the differential case and bevel wheel from the axle bearing case by releasing the two setscrews in the bearing case which secure the differential bearing adjusting ring. Release the two tab washers and remove the four nuts securing the bearing case caps, remove the caps and mark them, to be quite sure when reassembling that they are returned to their correct positions. The two adjusting rings and the differential and bevel wheel assembly can now be removed from the axle bearing case.

To extract the differential bearings, lever the outer rings of the bearings upwards and extract the inner cage and bearings very carefully, to ensure that the balls are not lost in the process. Remove the six split pins, bolts and nuts securing the bevel wheel and two halves of the differential case, and remove the bevel wheel. Tap out the six differential pins, thus releasing the two halves of the differential case, together with the differential pinions and the two axle shaft pinions. This operation is most easily carried out by supporting the differential case on the splined end of an axle shaft which has been secured in the vice because the shoulders of the differential pins prevent their being driven out by supporting the differential case on the vice.

SERIES 4A AND 4AB.

To Remove.

Remove the nuts, bolts and washers securing the universal joint flanges. The propeller shaft may then be removed entirely.

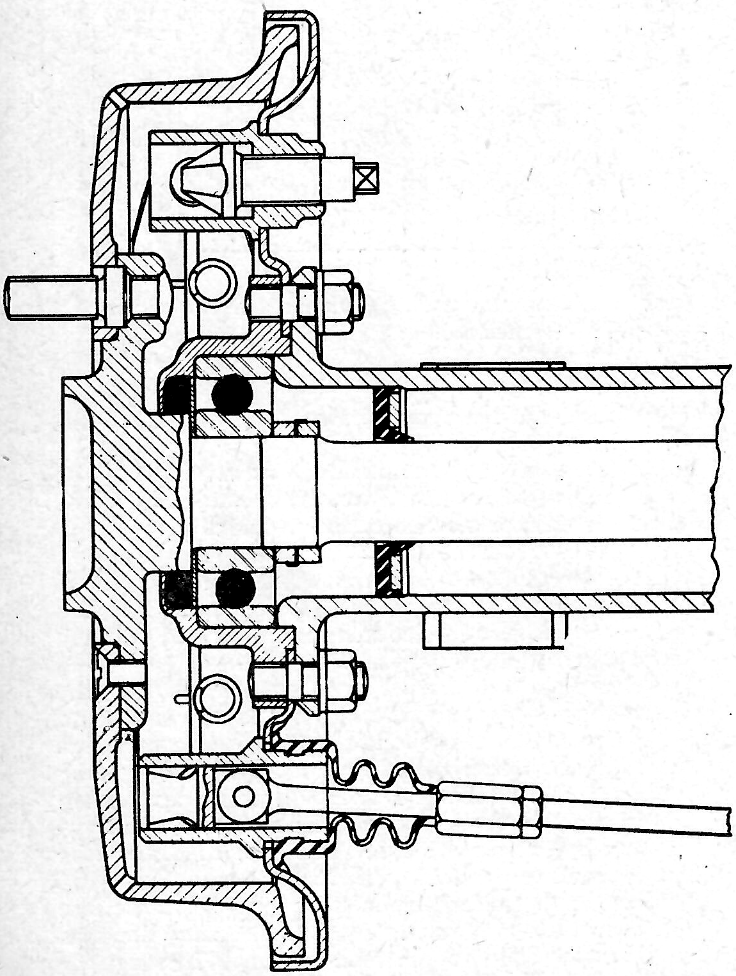


FIG. 1.—Section of Series 4A rear hub.

Lifting jacks or blocks should then be placed under the chassis frame at a position level with the front end of the rear road springs. The chassis must then be jacked up until the rear road wheels are clear of the ground, and blocks placed in position to support the chassis weight when the jacks are removed.

Remove the road wheels and the lifting jacks.

Disconnect the brake rod.

Remove the four nuts and bolts securing the buffer carriers to the chassis frame and remove the buffer carriers complete.

Disconnect the top end of the shock absorber links.

Disconnect the petrol pipe line from the tank.

Withdraw the rear axle from the chassis frame by lifting the axle unit towards the side of the chassis, passing one brake drum assembly through the aperture of the wheel arch and the chassis frame. This end of the axle unit will be drawn towards the centre of the aperture of the wheel arch and the chassis frame. The rear axle unit may then be withdrawn end-ways from beneath the chassis.

To Dismantle.

Remove the rear axle drain plug and drain out the oil.

Release the two countersunk screws securing the brake drums to the rear hubs and remove the brake drums (two extractor holes are provided).

Remove the brake shoes.

Remove the four nuts and shakeproof washers securing the rear hub assembly to the axle case and withdraw the rear hub, bearing housing and bearing together with the axle shaft.

Release the tab washer and locknut securing the bearing housing and bearing to the rear hub and withdraw the bearing housing and bearing together. Remove the bearing and washer from the bearing housing. The rubber moulded oil seals can remain in position but care must be taken when withdrawing and replacing the axle shafts not to distort the rubber sealing surfaces.

To Remove and Strip the Differential Assembly.

Remove the four nuts and bolts securing the universal joint to the differential drive flange; remove the bolts around the pinion housing flange thus allowing the complete differential to be taken out of the axle after the axle shafts have been withdrawn clear of the differential centre.

To strip the differential, bend back the locking tabs on the main differential case bearing caps—taking care to mark the caps in order that they can be reassembled in their original positions. Then remove the cap bolts together with the caps. This will then allow the crownwheel, the carrier and the bearings, with shims, to be removed from the main housing.

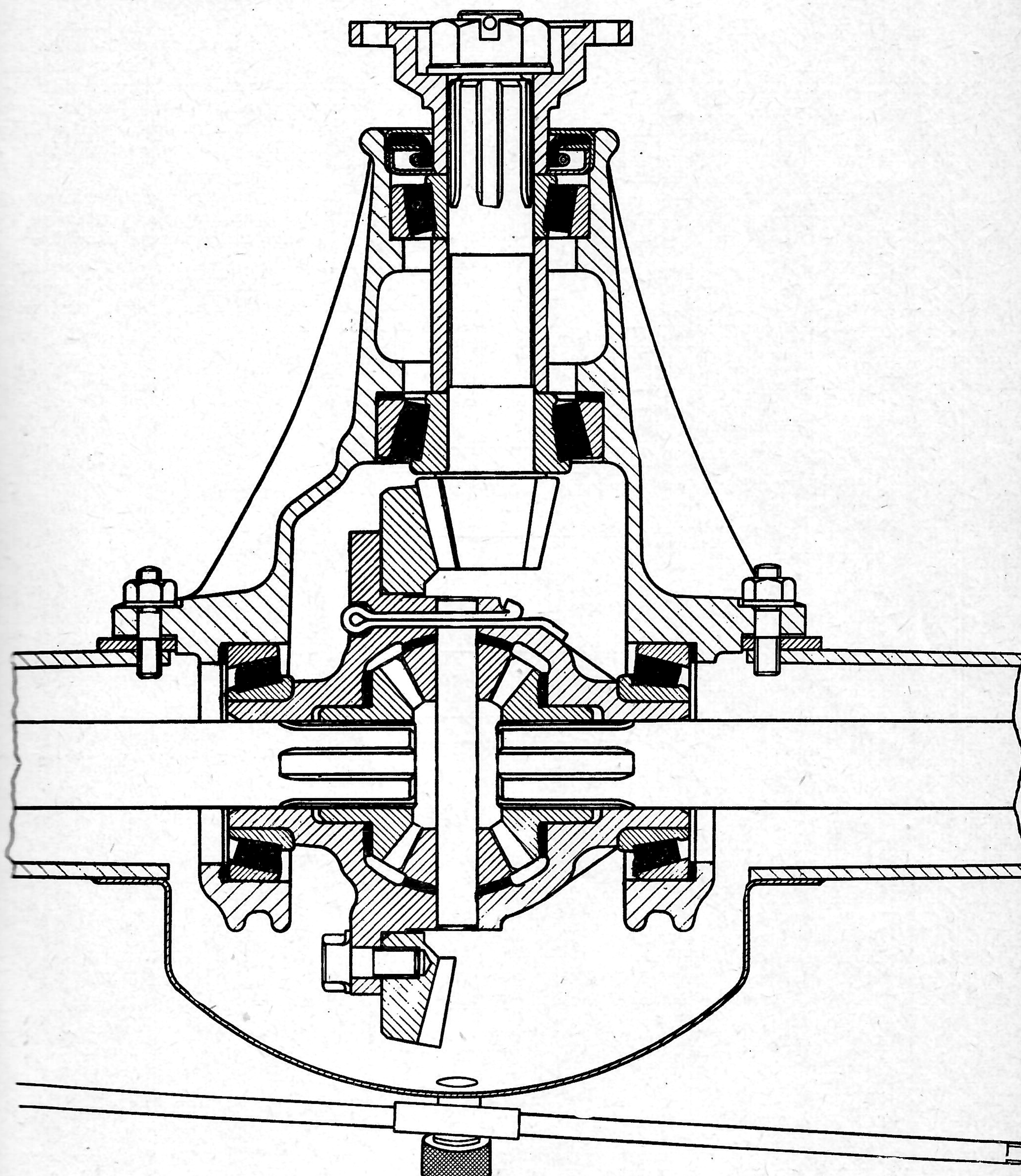


FIG. 2.—Series 4A and 4AB rear axle general arrangement

Next remove the split pin from the nut on the end of the pinion shaft, and remove the nut. To prevent the flange from rotating while the nut is being removed, hold the flange with a two peg spanner located in the two opposite holes in this flange, then draw off the flange.

The spiral bevel pinion can then be pressed out of the rear bearing and pinion housing.

To extract the differential case bearing use a drag fitted behind the inner thrust face of the taper bearing and tighten the drag screw against the end of the differential case, thus removing the bearing from the case. This will, of course, apply to both ends of the differential case.

The crownwheel can be removed from the differential case by releasing the two tab washers and hexagon bolts at the back of the flange. The small hexagon screw is for the differential cross pin which locates the pinions and, after this has been removed, the cross pin, the differential pinion, and the differential wheels together with the thrust washers can be taken from the differential case.

The outer races of the spiral pinion bearings can be removed from the main housing by means of the extractor slots through the abutment shoulders.

When assembling the unit, care should be taken to see that the correct backlash and tooth marking is obtained. The backlash should be in the region of .006 to **.008.**

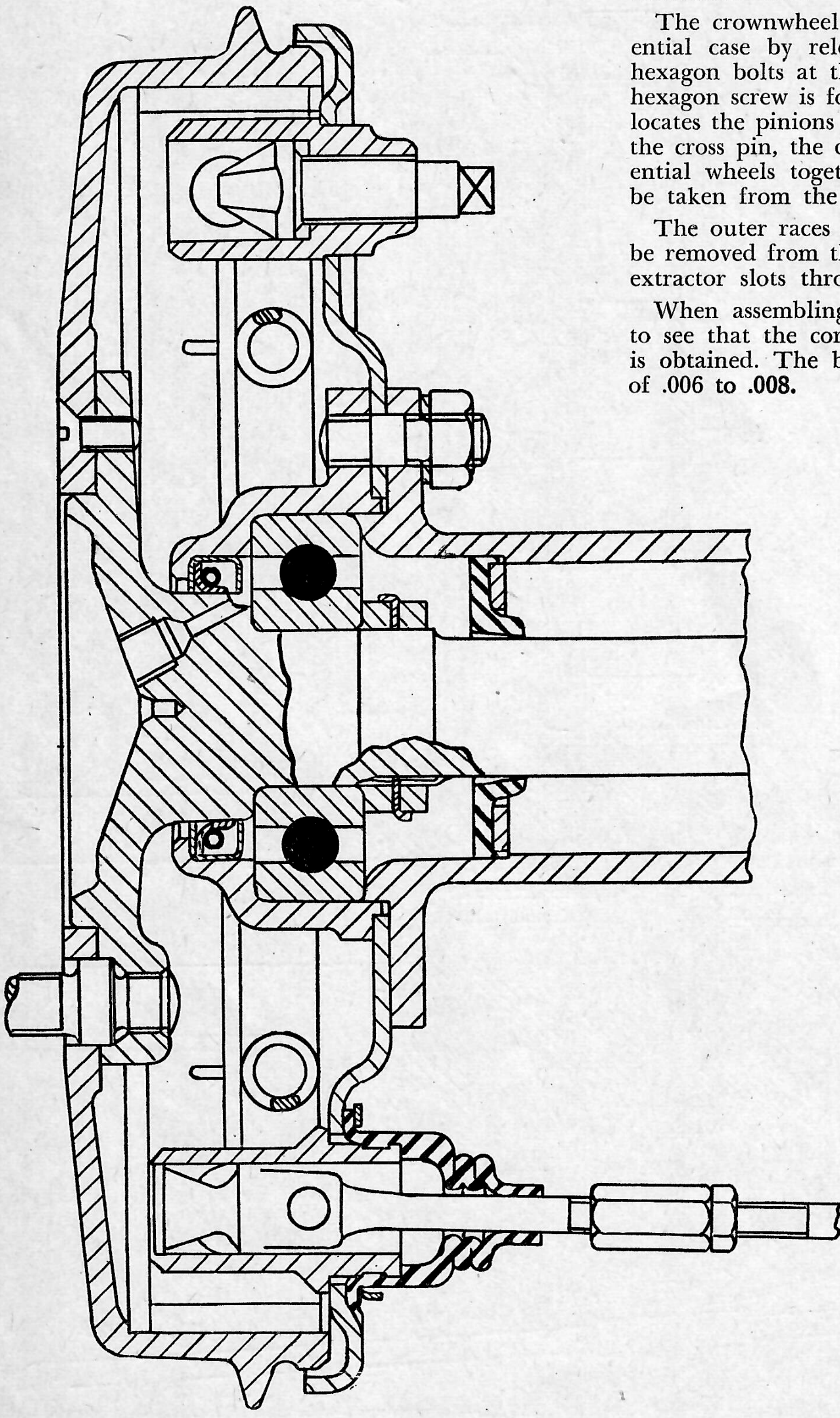


FIG. 3.—Section of Series 4AB rear hub.

SECTION F

BRAKES

Type :	
Foot brake	4A—Girling mechanical. 4AB—Front—Girling hydraulic. Rear—Girling mechanical.
Handbrake	Mechanical.
Drums:	
Material	Alloy cast iron.
Diameter (front)	8.00 (4A). 9.00 (4AB).
Diameter (rear)	8.00 (4A). 9.00 (4AB).
Drum to lining clearance	Minimum.
Master cylinder diameter	$\frac{5}{8}$ (4AB).
Brake pedal clearance	$\frac{1}{2}$.
Lining:	
Material	MR19.
Width	$1\frac{1}{4}$.
Thickness	$\frac{3}{16}$.
Length per wheel	$14\frac{1}{4}$ (4A). $17\frac{1}{2}$ (4AB front). 16.0 (4AB rear).
Brake lining area	$71\frac{1}{4}$ sq. ins. (4A). $83\frac{3}{4}$ sq. ins. (4AB).

9 H.P. ROADSTER AND SERIES 4A.

The brake shoes are pressed from solid drawn "T" section steel, and are operated by an expander. The hardened steel cone which is actuated by the pull rod causes the plungers to move outwards. Hardened steel rollers are interposed between the cone and the plungers to reduce friction to a minimum. The plungers engage directly with the brake shoe webs. The whole expander mechanism is enclosed in a die cast housing which contains a supply of lubricant (Duckham's Keenol Grease K.G. 20) and provides a slight frictional contact. The housing does not withstand any of the stresses set up by braking as it virtually floats between the brake shoes. In view of this fact it will be realised that the brake shoes are self-centering under the influence of the brake shoe pull-off springs. It will be noted that the rollers are freely mounted and roll up grooves in the plunger and down the inclined face of the cone. When shoes are removed for relining, the pin retains the plungers in position in the housing. This type of shoe expander provides a high step up ratio and multiplies the low input effort of the pull rods very considerably.

Adjustment for brake lining wear is made by the brake shoe adjuster. One of these is found on each back plate. This is the only adjustment required, and provided, in the whole system.

Reference to Figure 3 shows the method by which lining wear is taken up. A hardened steel cone, the spindle of which is screwed with a fine thread, is carried in a steel housing which is spigotted and bolted firmly to the back plate. On the outside end of the cone spindle are machined flats which enable a spanner to be used, and on its inner face four flats of a pre-determined depth are cut.

The cone engages two plungers, also with a bearing in the housing which have inclined faces. On the outer ends of these plungers grooves are formed in which the brake shoes are carried. The housing and cone are both cadmium plated to prevent rust, and the thread of the cone spindle remains inside the housing at all times, thus preventing damage.

For adjustment, the rotation of the cone in a clockwise direction causes it to move inwards, forcing apart the plungers and expanding the fulcrum ends of the brake shoes. All cones operate in a clockwise direction.

When adjustment is made, rotate the cone with a spanner until a resistance is felt (this is the shoe coming into contact with the drum), then slack back the cone one full notch or two clicks, which can be felt and heard quite plainly. All drums should be treated in a similar manner. Adjustment for lining wear should take place with the car in its running position, which is on the ground. Jacking up is not recommended, and is also unnecessary for this operation. The car should stand on a flat and level surface and the handbrake should be released before any attention is given. **THIS IS MOST IMPORTANT.** After adjustment is completed, it is advisable to give the brake pedal a firm application before test in order to ensure that the expander is centralised and the shoes quite free in the drums. **THIS IS THE ONLY ADJUSTMENT REQUIRED. DO NOT TIGHTEN UP THE BRASS EXPANDER NUTS ON THE OUTSIDE OF THE BLACK PLATE. THESE SHOULD BE ONE TURN SLACK. THE ALUMINIUM HOUSING MUST BE FREE TO FLOAT.**

Do not forget the double coil springs under these brass nuts.

Do not forget to check all plungers in the adjuster and expander units for easy working.

Do not forget the adjuster plungers in the inclined type are right and left-hand. If wrongly fitted, the four clicks representing one full turn will not be heard.

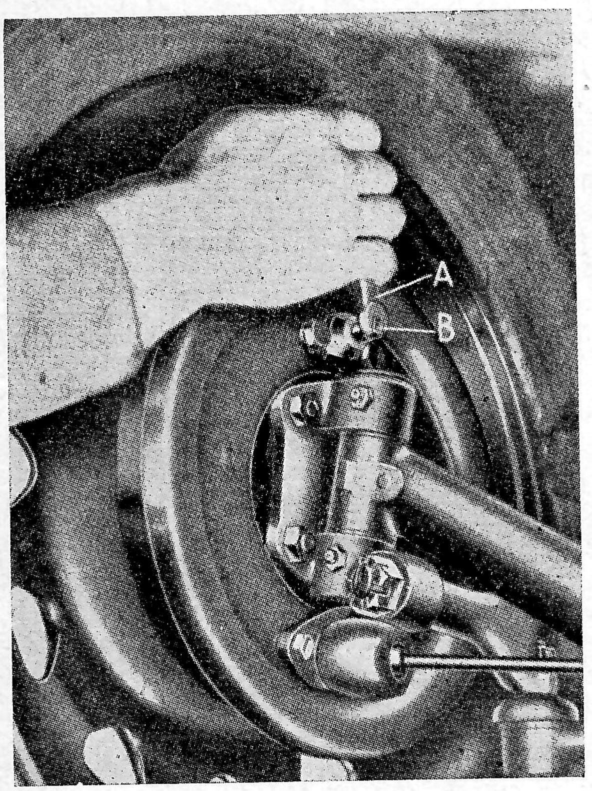


FIG. 1.—Adjusting the front brake on the 9 h.p. Roadster and Series 4A.
A—Spanner; B—Adjusting bolt.

Do not handle the linings with greasy hands. Keep them as clean as possible.

Do not over-stretch the shoe pull-off springs when removing or refitting the shoes.

Do not forget when relining or checking the brakes, that to ensure a correct clearance between the shoes and the drum it is a good policy to always

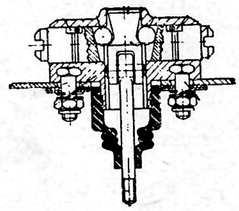


FIG. 2.—Rear brake shoe expander unit (9 h.p. and 4A).

reset the adjuster housing. The holes in the back plate for the two $\frac{3}{8}$ fixing bolts are given clearance to allow a slight radial movement of this housing and this will counteract any slight variation of the shoes which may occur during manufacture.

Do not forget that Duckham's Keenol Grease K.G.20 is recommended for all brake lubrication when necessary, i.e., when reassembling.

The Girling brake requires very little lubrication or attention of any sort whatever. The adjuster and expander housings retain an adequate supply of lubricant and the balance levers pivot on self-lubricating bushes. Holes in the brake rod jaws are appreciably larger than the pins which fit them, but

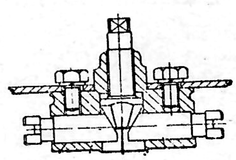


FIG. 3.—Brake shoe adjuster (9 h.p. and 4A).

no rattle is present as the entire linkage is loaded by a light spring in the pedal assembly. This type of joint is also very efficient.

To Reline the Brakes.

Jack up the car and remove the road wheels.

Remove the drums. The method of mounting each drum is on a spigot with small countersunk screws. Take out these screws and the drum can be withdrawn.

To dismantle the brake, all that is required is a large screwdriver. Rest the screwdriver against one of the back plate fixing bolts, and it will be found quite easy to prise one shoe out of the groove in the plunger at the expander end. Both shoes and springs can now be removed, leaving the expander and the adjuster units in position on the back plate. Do not detach these units from the back plate. Do not overstretch the shoe springs when removing the shoes.

Clean down the back plate, check the expander unit for free float. **THIS IS IMPORTANT.** Check the adjuster for easy working, and slack it back (anti-clockwise) to the full "off" position. Lubricate where necessary with Duckham's Keenol Grease K.G.20. Inspect the shoe pull-off springs and replace if they are stretched or damaged.

To refit the new shoes, detach the springs from the old shoes and refit them to the new shoes. Be sure that the springs are between the shoe webs and the back plate, otherwise the shoes will not be flat on the back plate. Keep all grease off the linings and do not handle the linings any more than necessary. Place the shoes with spring attached against the back plate. The shoes have half-round slots at one end. Fit these slots to the adjuster plungers, then insert the other end of the one shoe in the expander plunger. Place the screwdriver under the web of the remaining shoe and against the bolt on the back plate. Ease the shoe into the plunger groove.

Refit the drums, making sure they are clean and free from grease and dirt.

To ensure correct clearance between shoes and drums, slack off the setpins that hold the adjuster unit to the back plate (not more than one complete turn) and lock up the brake shoes in the drum by turning the adjuster cone spindle in a clockwise direction. Screw up the adjuster setpins tightly and slacken off the adjuster cone spindle one full notch or two clicks, which can be felt and heard. Give the brake pedal a firm application to ensure the shoes have centralised at the expander end. The drums should now be quite free.

Refit the road wheels and jack down.

Always fit Girling replacement shoes. These are correctly riveted, and ground to the correct periphery, which ensures a fast and easy bed-in to the drums.

The Mechanical Linkage.

Check the brakes as previously described for full and correct adjustment. Assuming the brakes have received the above attention and are correct, the first points to receive attention are the balance units situated as follows:—

1. On the front axle to balance the right side and left side front wheels.

2. On the rear axle to balance right side and left side front wheels.

3. On the brake pedal to proportion the braking effort on the front wheels and rear wheels.

Having checked the balance units No. 1 and No. 2 for free working, connect the transverse rods from the brakes to the compensators, beginning this operation by first screwing the rods into the screwed sockets on the end of the brake draw links which protrude from the expander units. Be sure when screwing these rods home that they screw right into the sockets and butt up against the ends of the draw links. Now tighten firmly the locknuts, using two spanners for this operation. At the compensator end of each transverse rod will be found a screwed fork end. By this means the position of the balance unit is set; the main body of the fulcrum must be vertical to the axle and the long lever which carries the longitudinal rod should be approximately $\frac{3}{4}$ before a line parallel to the centre line of the front axle and $\frac{3}{4}$ behind a similar line to the rear axle.

By setting the long lever in this position first, it automatically sets the position of the two small bottom levers, these being machined integral. Now connect the transverse rods to the two small levers, taking care to retain the long lever in position. The flat link connected to the axle must be parallel to the longitudinal rod, a position obtained by adjustment on the screwed fork ends of the transverse rods, but still maintaining the position of the long lever. Do not make any adjustment whatever at the coupling on the rear transverse rods close to the brake expander. The next operation is to connect the longitudinal rods to the long levers of each balance unit on the front and rear axle. Where there are any connecting or swinging links, see that these are lying approximately $\frac{3}{4}$ towards whichever axle they belong. Now to arrive at the pedal. First see that the pedal is in its highest position, keeping this position by either tying it back or supporting it in some way. Carry forward the work of connecting the longitudinal rods to the pedal rocker. Situated on the pedal are two small rocker arms, and the pedal boss is drilled to take a small spring plunger. When correctly adjusted there is a $\frac{1}{16}$ gap between these rocker arms and the pedal boss. The spring plunger is the means of obviating rod rattle.

Adjust the front longitudinal rod until the required $\frac{1}{16}$ gap is at the front rocker arm. Adjust the rear longitudinal rod until there is $\frac{1}{16}$ gap at the rear rocker arm. Now adjust the control spring through which the rear longitudinal rod passes. This should be adjusted to a length of $1\frac{11}{16}$. The adjustment is now completed and the car should be quite satisfactory to drive away for all conditions.

SERIES 4AB.

The brakes fitted to the front wheels are the Girling hydraulic leading shoe, sliding shoe type. The shoes are not pivoted but slide on their abutment and expander ends. This action, produced by the rotation of the brake drums, increases the braking efficiency. The shoes are operated by two wheel cylinders fitted to the inner side of each brake plate and diametrically opposed. Each cylinder is fitted with one piston protected by a dust cover. The rear of each cylinder casting is an inclined steel faced abutment slotted for locating the shoe. Each shoe abuts on one cylinder and is expanded by the piston of the other, thus bringing the leading edge of each shoe into initial contact with the drum, thereby increasing the efficiency and giving more even liner wear. Each shoe is held in position by a return

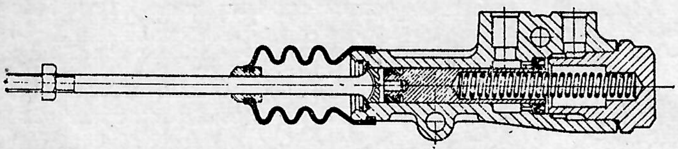


FIG. 4.—Section through the master cylinder (4AB).

spring anchored to the bottom end of the shoe and to a hole in the back plate. The two wheel cylinders are interconnected by a bridge pipe passing from

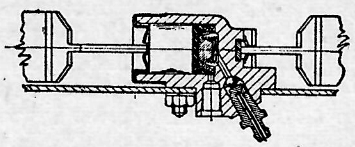


FIG. 5.—Brake shoe hydraulic expander unit (4AB).

cylinder to cylinder on the outer side of the brake plate with a bleed valve on one cylinder only.

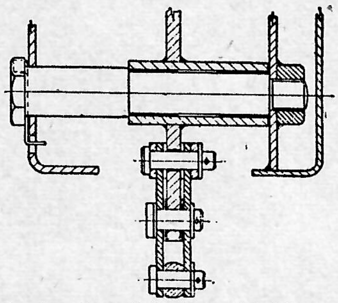


FIG. 6.—Section through brake pedal fulcrum pin (4AB).

Each wheel cylinder consists of a seal retaining spring, a bakelite seal spreader, a seal and piston. The bleed valve, fitted to one cylinder only, is provided with a steel ball which normally is seated firmly on its valve opening in the cylinder, and when partially opened, fluid can escape. NOTE.—Do not use excessive pressure when tightening up the bleed valve as this may cause the steel ball to become embedded in the cylinder body.

The Hydro-Mechanical Principle.

Upon inspection of the braking system, it will be seen that the brake pedal is carried on a short transverse shaft, mounted in a bracket on the frame of the car. The upper end of the balance beam is coupled to a very simple type of hydraulic master cylinder, the pressure pipe lines from which are coupled to the front brake wheel cylinders. The lower end of the beam is coupled to a tie rod which runs backwards to the rear brakes.

When pressure is applied the pedal moves forwards, and so the balance team, carried by the short lever on the pedal shaft (Figure 9(b)) also moves bodily forward. The effect on this is to pull the back brakes on through the tie rod, and to push the plunger into the master cylinder so that the hydraulic front brakes are also applied, the forces of the two applications being equalised by the balance beam.

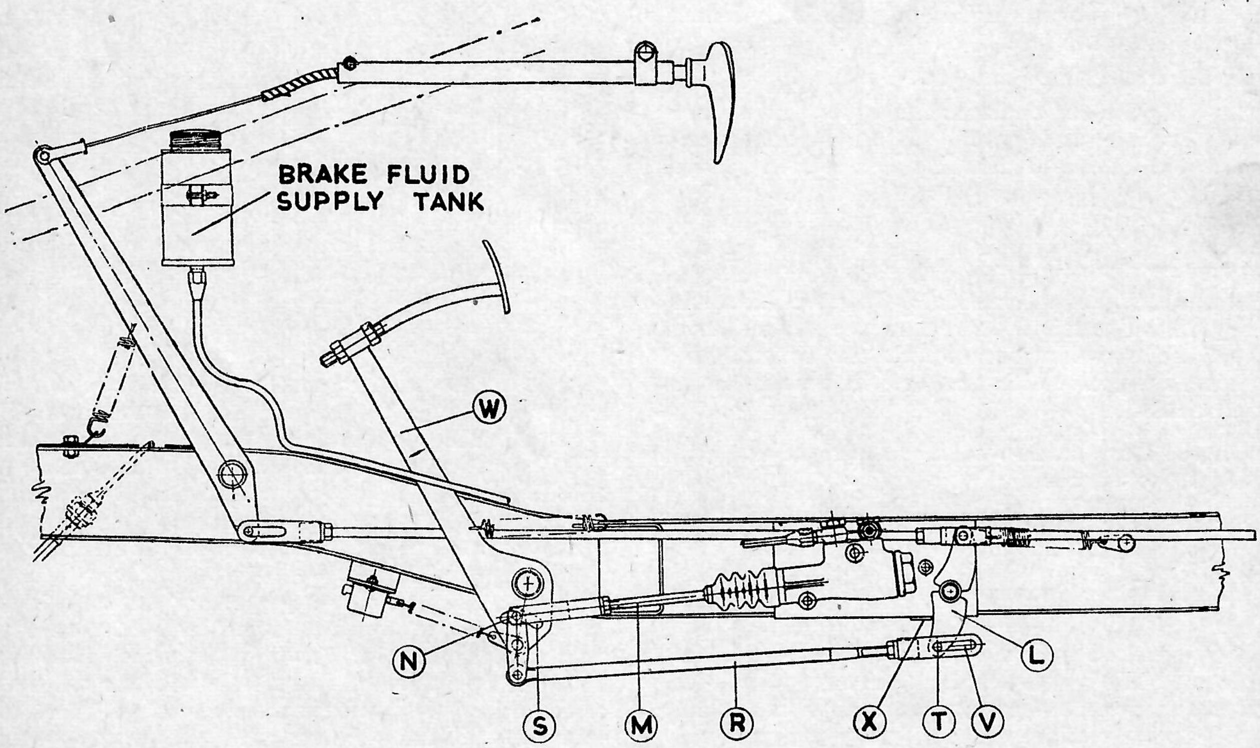


FIG. 7.—Layout of linkage and master cylinder (4AB).

If accident or any other cause should bring about a failure in the hydraulic system (Figure 9 (c)), the plunger of the master cylinder will travel freely over its short stroke, and will reach an internal stop provided for the purpose. The stop provides an abutment for the upper end of the balance beam, and at once, the mechanical operation of the rear brakes comes into play and the whole effort applied to the pedal will be transmitted to the rear brakes. On the other hand, if the rear brake rods should fail from any cause, a stop is provided on the short lever of the pedal shaft (Figure 9 (d)) against which the lower end of the balance beam will be arrested, and the hydraulic operation of the front brakes will be maintained. Thus, in this equipment there are two sets of brakes which are balanced together, and yet each set can operate independently of the other.

General Maintenance.

The brakes are adjusted for lining wear only. The adjustment is made at the brakes themselves, and no alteration should be necessary to the operating linkage.

Front Brakes.

To adjust, jack up the car until the front wheel is clear of the ground, and release, in an anti-clockwise direction, both hexagon-headed adjuster bolts on the brake plate. Turn one of the adjuster bolts in a clockwise direction until the brake shoe touches

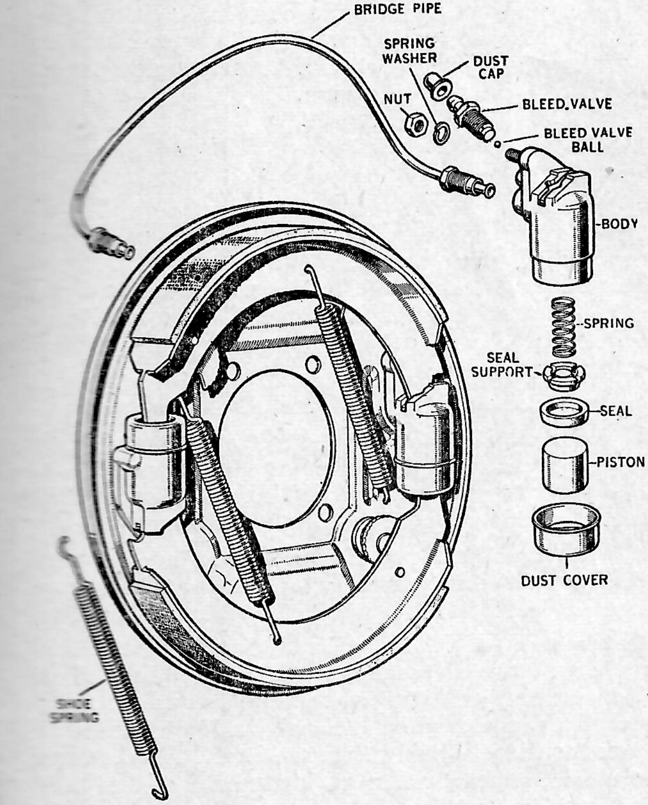
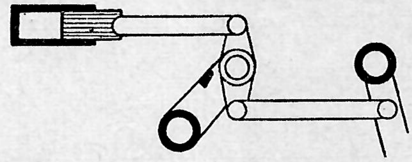
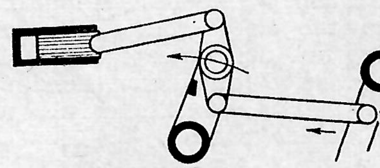


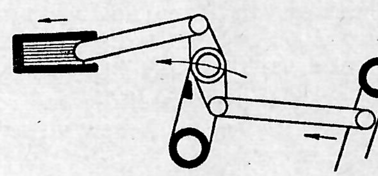
FIG. 8.—Exploded view of front brake (4AB).



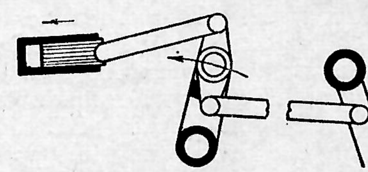
(a) Showing the relative position of the balance lever and stop in the "off" osition.



(b) On application of pedal pressure, the rear brake linkage is pulled on whilst the plunger is forced into the bore of the master cylinder.



(c) Should a hydraulic failure occur, half the pedal travel is taken up to carry the piston to the end of the cylinder bore. This then becomes a solid unit, and further pedal travel operates the rear brake linkage.



(d) In the event of a defect occurring in the rear linkage, the balance lever swings over into contact with the fixed stop, and becomes a fixed lever, operating in the master cylinder only, thus applying the front brakes.

FIG. 9.

the brake drum. Repeat the procedure for the second adjuster and spin the wheel to check that the brake shoes are quite free of the drum. Repeat the adjustment for the second front wheel. The adjusters, operating snail type cams against the shoes, are frictionally held in position and require no locking device.

When replacement shoes have been fitted, release the adjuster by one additional click from the normal setting to allow for expansion of the new linings. When the shoes have "bedded" down, the brakes should be re-adjusted to the normal setting.

The Master Cylinder.

The master cylinder consists of a cast iron housing with a highly finished bore into which is assembled the plunger, complete with return spring, recuperating seal, outer seal and seal retainer. The plunger is operated by means of a push rod with a hardened ball end rotating in a hardened steel seating. The

To Balance Front to Rear Brakes (Figure 7).

Jack up the car until all four wheels are clear of the ground, and adjust the brake shoes so that they all bear hard against their brake drums.

Disconnect the long intermediate rod from the long lever on the chassis cross member.

Check that the brake pedal (W) is being kept hard up against the floorboards by the pull-off spring.

Adjust the length of the master cylinder push rod (M) so that the pin (N) working in the slot (S) is approximately in the position shown. Remove the rubber boot to check this condition.

Draw the lever (L) forward so that it bears against the stop (X) and adjust the rod (R) so that with the push rod bearing lightly against the piston of the master cylinder, the pivot (T) is $\frac{1}{16}$ from the front end of the slot (V).

Maintain the linkage in this position, and adjust the long rod so that with the long lever pulled fully forward, the clevis pin can just couple the rod to the lever.

The linkage can now be considered to be correctly adjusted. Normally this adjustment should not be necessary since it is correctly set before the car leaves the factory and should, therefore, need no attention unless replacement parts to the linkage have been fitted or a complete overhaul of the braking system has been caried out.

SECTION G

FRONT SUSPENSION

Front Suspension

Type	Roadster and 4A—Beam axle. 4AB—I.F.S.
Type of springing	Roadster and 4A—Semi-elliptic. 4AB—Coil and wishbone.
Leaf—Roadster and 4A:	
Number of leaves	7.
Width of leaves	$1\frac{1}{2}$.
Distance between eyes: Laden	29.0.
Load rate	164 lbs. in.
Working load	440 lbs.
Free camber	$4\frac{3}{8}$.
Laden camber	$1\frac{1}{16}$ at load of 440 lbs.
Coil—4AB:	
Inside diameter	3.71.
Outside diameter	4.65.
Wire diameter	.470.
Number of free coils	7.
Spring rate	139.5 lbs. per inch.
Static laden length	$6\frac{3}{4}$.
Load	716 lbs.

Steering

Type	Burman Douglas.
Steering wheel:	
Diameter	$14\frac{1}{2}$.
Number of turns from lock to lock	$1\frac{3}{4}$.
Toe-in	$\frac{1}{8}$.
Castor	2° (with two passengers).
Camber	1° (with two passengers).
King pin inclination	9° Roadster and 4A. 7° 4AB.

ROADSTER AND SERIES 4A.

The front springs on the Roadster and Series 4A are mounted on rubber bushes of a special type; they do not require lubrication and MUST be kept free from oil or grease.

When removing the shackle bolts, it will be noticed that these bushes are slack enough to be easily removed, and when refitting it is important to see that all nuts are fully tightened up to the shoulder of the bolts. This will impose the necessary pressure for expanding the rubber.

Steering and Front Axle.

The only attention the steering box requires is the periodic replenishment of the oil level. No adjustment is provided in the steering box itself, but slackness or backlash in the steering column can be corrected by adjustment at the top of the column.

This adjustment should only be carried out by a skilled mechanic; but in order that the owner should be fully conversant with the adjustment, the following is a brief description of the bearing assembly at the top of the column.

The top bearing consists of a cup and cone ball race and the adjustment takes the form of a threaded cone and locknut. To obtain access to the adjusting nuts, release the pinch bolt securing the trafficator switch stator tube to the steering box bottom cover and draw the switch assembly out about 12 inches. Next mark the position of the trafficator switch

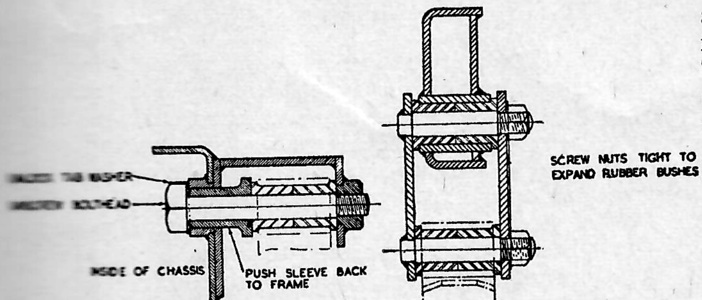


FIG. 1.—Section through a spring shackle.

actuating cam in the hub of the steering wheel and detach the cam by removing the screw securing it. Then remove the nut holding the steering wheel to the steering mast just sufficiently to allow a thin spanner to be applied to the locknut. Having released the locknut, the lower hexagon-headed cone can be tightened until the backlash is eliminated, but great care must be taken in carrying out this adjustment, as excessive tightening of the cone will result in stiff steering and damage to the ball race. Tighten the locknut and reposition the wheel and trafficator switch after the adjustment has been made.

Track Rod and Drag Link.

This assembly should require very little attention other than applying the grease gun to the grease nipples fitted to the ball joints every 5,000 miles.

The universal joints of the track rod and drag link are self-adjusting and provided they are lubricated in the manner advised, should require no further attention.

If the front tyre wear appears excessive or the steering feels unsteady it is advisable to check the alignment of the front wheels. When correctly adjusted these should "toe-in" $\frac{1}{8}$ at the front—this measurement being taken from the inside of the rim to the inside of the other rim at a height of

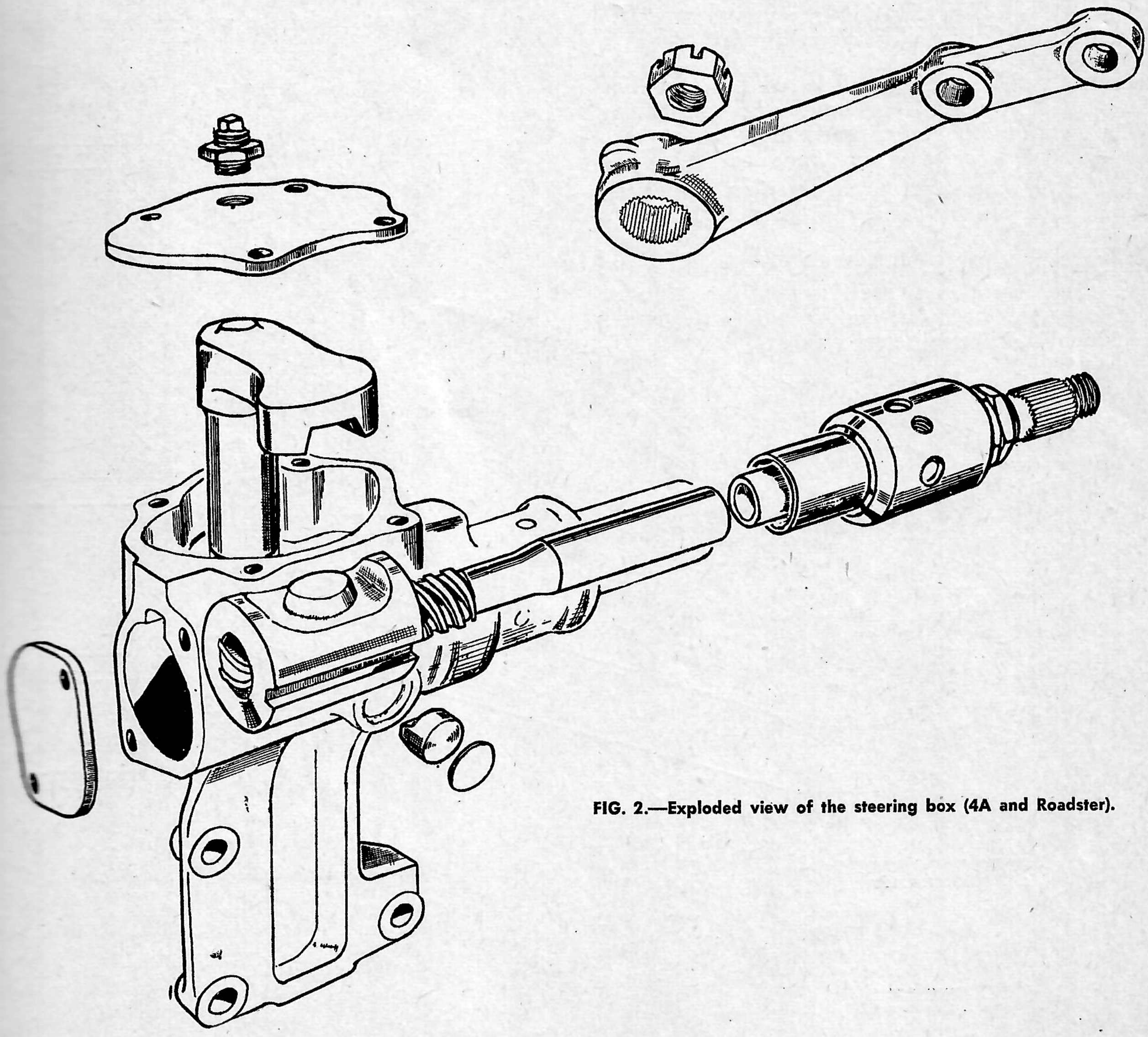


FIG. 2.—Exploded view of the steering box (4A and Roadster).

approximately one foot from the ground. If this toe-in is not correct, proceed as follows:—

Release the locknuts on each end of the coupling track rod, and turn the rod in the required direction to shorten or lengthen it, to obtain the required $\frac{1}{8}$ toe-in of the front wheels. This procedure is possible since the ends of the rod are threaded with right and left threads. On the completion of the adjustment and before retightening the locknuts make sure that the end faces of the joints are in the same plane, and thus avoid cross binding.

To Dismantle the Front Axle.

Remove each road wheel from its hub by removing the cover plate, and the four wheel nuts.

Release the two screws securing the brake drum to its hub and remove the brake drum.

Remove the split pin and nut and withdraw the hub assembly from the stub axle.

Dismantle the hub by releasing the two screws securing the bearing housing to the hub, and extract the two bearings, distance piece and oil retaining washers.

Remove each stub axle, track rod and the coupling tube. First release the four bolts, nuts and spring washers securing the brake back plate to the stub axle, and remove the plate and brake shoes complete.

Release the nuts securing the track rod and coupling tube ball joints to the swivel levers, and remove both ends.

Remove the nut and washer from the cotter pin which secures each swivel pin through the axle beam, knock out the cotter pin and withdraw the swivel pin, thereby releasing the stub axle.

SERIES 4AB.

The front suspension is a fully independent coil and special wishbone system controlled by an Armstrong telescopic type of shock absorber with integral bump and rebound stops and anti-roll bar. Moulded rubbers are used at all anchorage points to help damp out road noises and to reduce the number of lubrication points. Where lubrication is necessary, that is at all swivel pins and trunnion bushes, rubber sealing glands are provided for retaining grease and excluding dirt and moisture.

To Check and Rectify "Toe-in".

Check and correct the tyre pressures.

Check the toe-in of each wheel by means of one of the proprietary types of checking gauge available, and if it is not $\frac{1}{16}$, reset as follows:—

Set the steering so that the steering lever of the steering box and the idler steering lever occupy the position shown in Figure 7.

Measure by means of a trammel the distance between the centres of the steering box rocker shaft

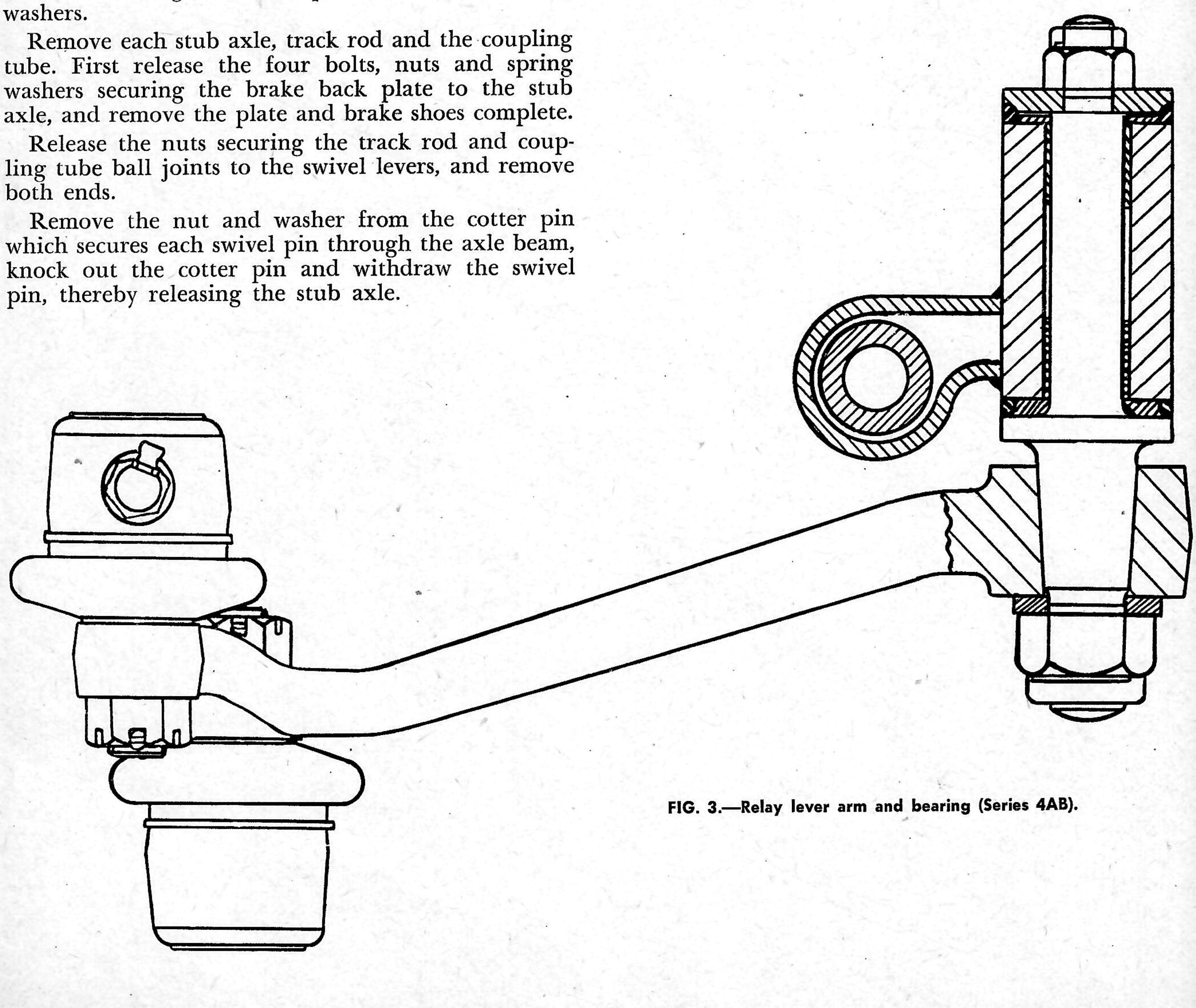


FIG. 3.—Relay lever arm and bearing (Series 4AB).

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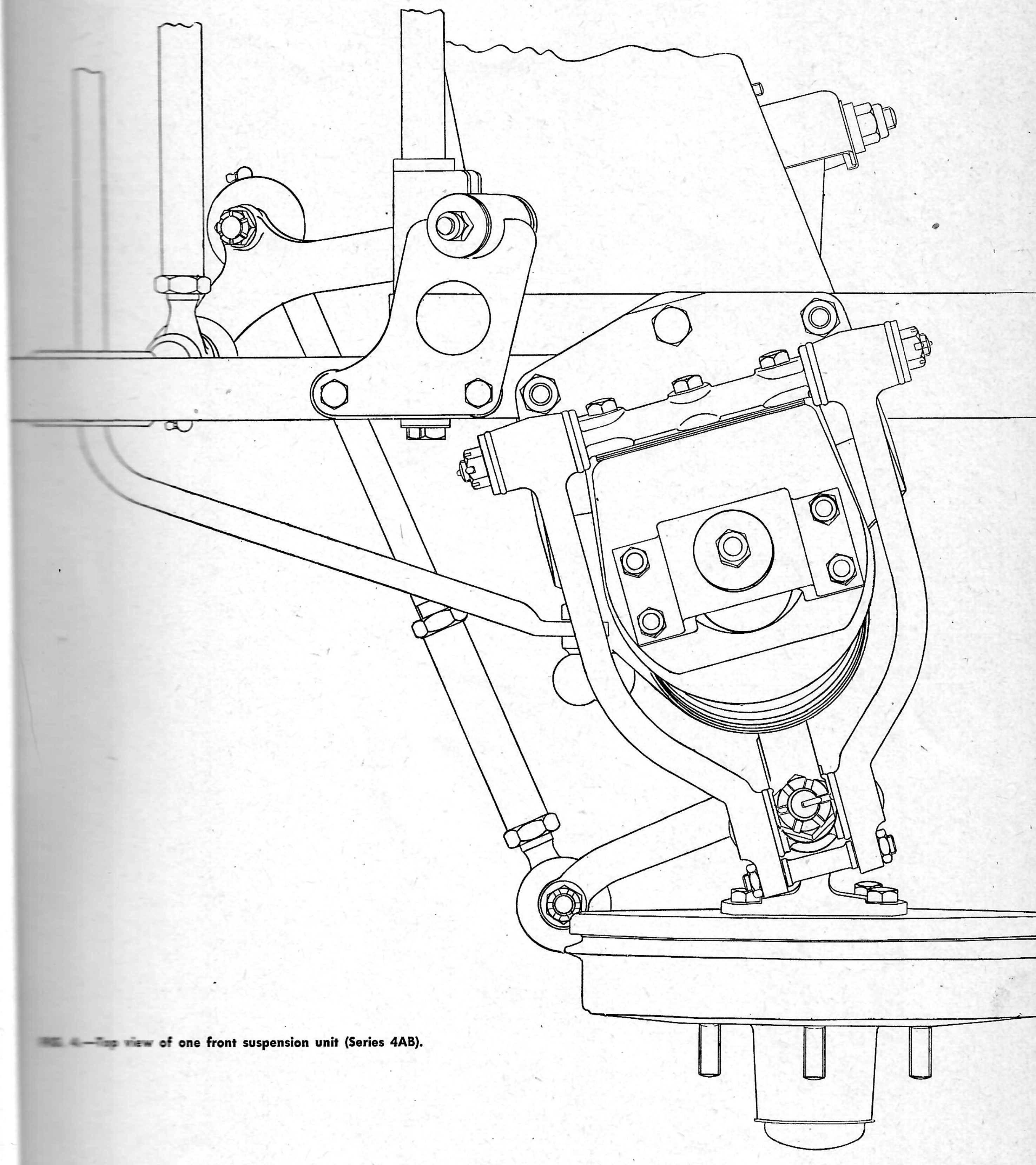


FIG. 4.—Top view of one front suspension unit (Series 4AB).

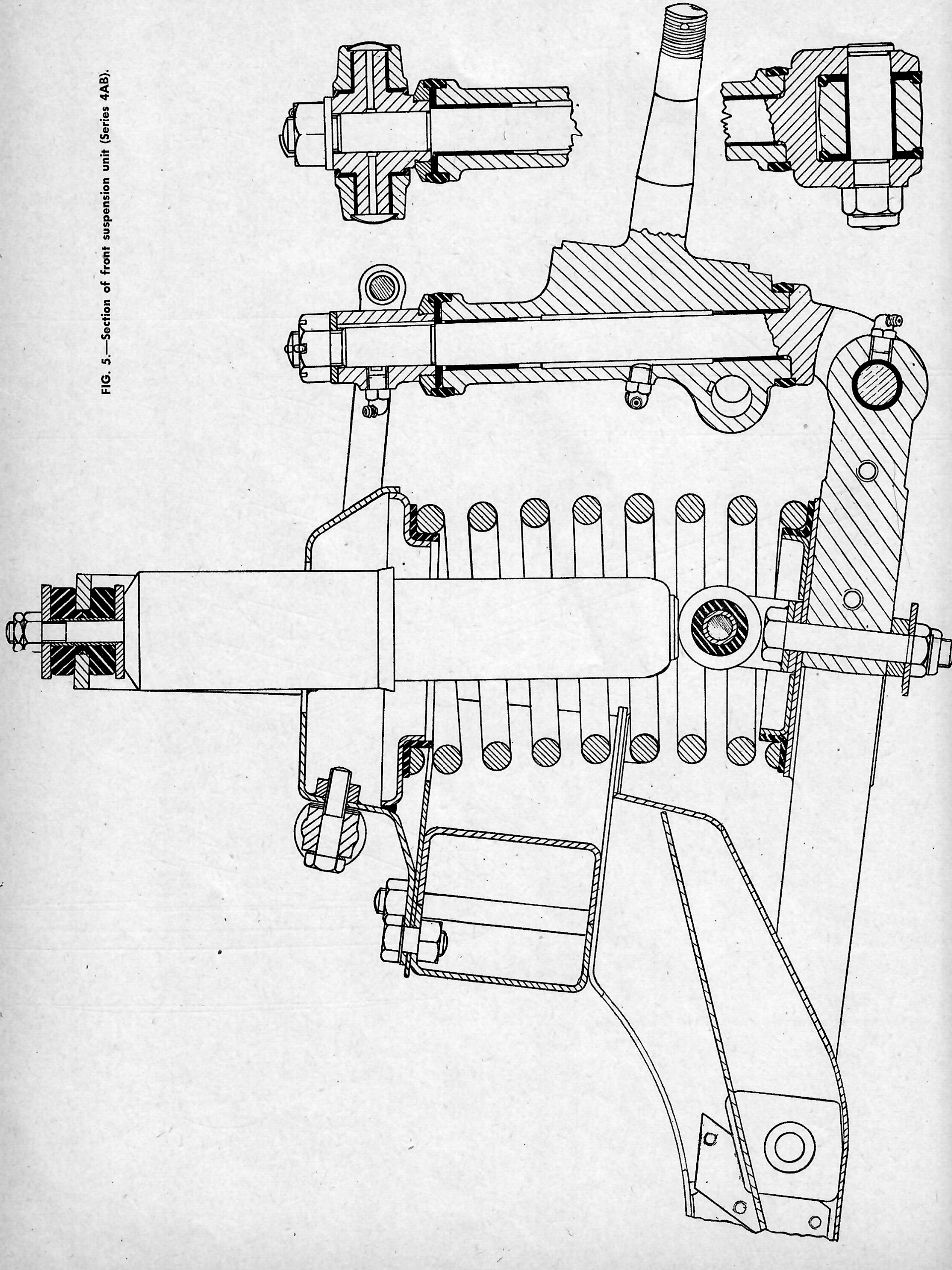


FIG. 5.—Section of front suspension unit (Series 4AB).

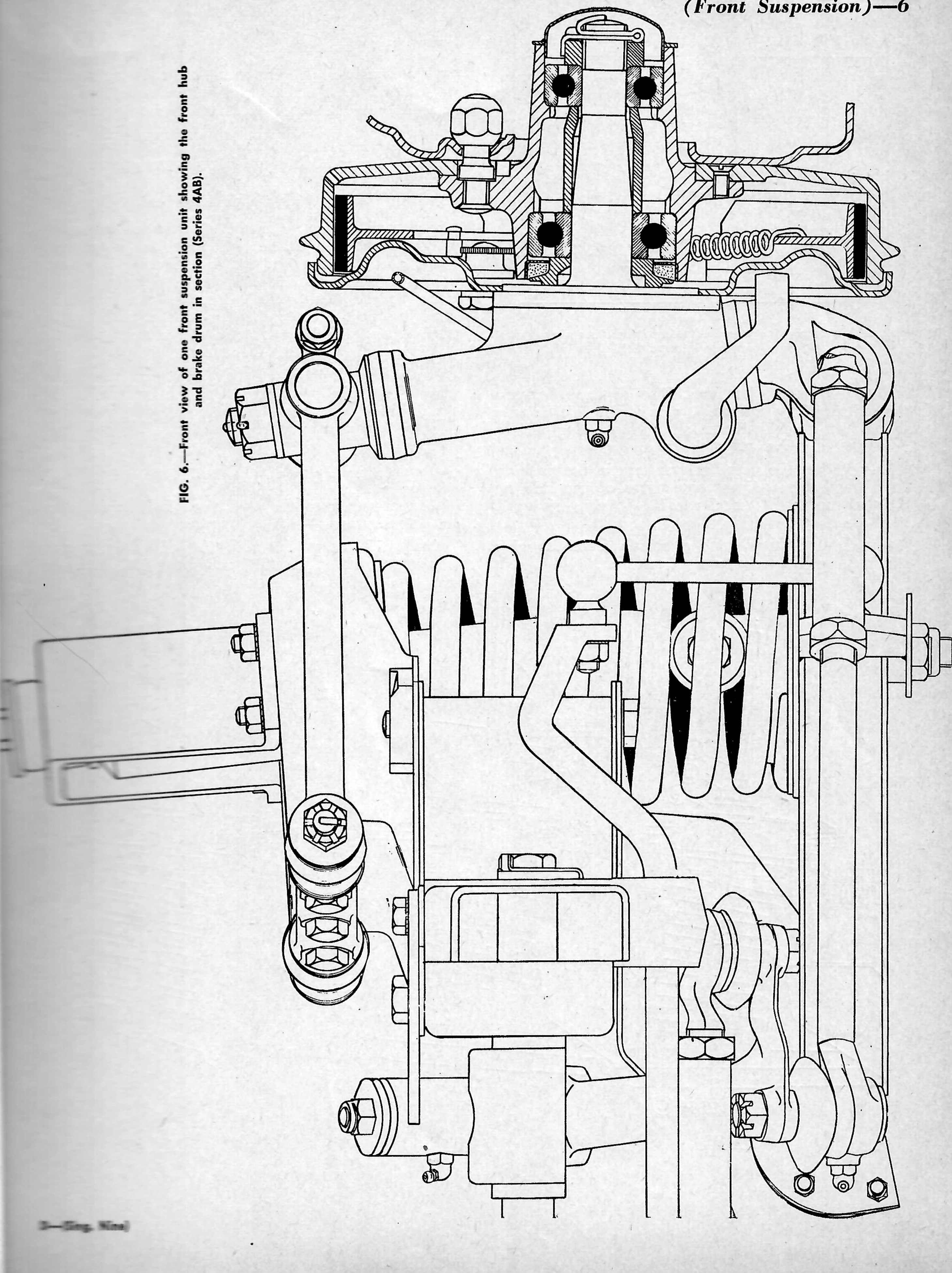


FIG. 6.—Front view of one front suspension unit showing the front hub and brake drum in section (Series 4AB).

spring. Make sure that the square of the bottom joint of the extractor fits into the square formed in the bottom carrier of the spring. Insert the original distance piece between the arm of the carrier and the wishbone and secure the bottom joint of the extractor by means of the long bolt "C" and the original spring washer. Now tighten up the nut "D" down to the shoulder of the rod "A".

Stage 2.—Insert the securing bolts "E" through the holes in plate "B" and screw them into the nuts welded to the bottom carrier bracket. Lock the bolts with the nuts "F". Remove the nut "H" and the swivel axle and swing the top wishbone, complete with trunnion, upwards and off the swivel pin. Then allow the swivel pin and hub assembly to pivot downwards out of the way. Remove the nut "C" and withdraw the rod assembly "A" out of position. Remove the five securing bolts "G"—four long ones inserted from underneath and one short from above, and withdraw the spring top support bracket complete with the top wishbone and spring.

Stage 3.—Secure the assembly in a vice, insert the rod "A" and secure the lower joint with the short bolt "J". See that the nut "D" is tightened down on to the shoulder of the rod, and then remove the bolts "E". Release the nut "D" when the various parts can be dismantled.

Reassembly is carried out in the reverse order to dismantling, and on completion the wheel camber should be checked and if necessary corrected.

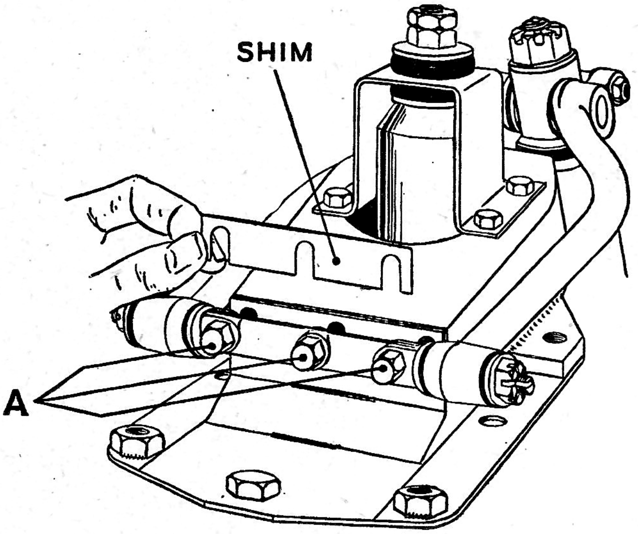


FIG. 9.—This drawing shows the location of the camber settings shims on the Series 4AB.

THE BURMAN STEERING GEAR (4AB).

This type of steering gear consists of a single-start worm on the lower end of the steering column, which is supported on two ball races in the steering box and one in the steering wheel end of the column. Engaging in the worm is a spherical ended peg, mounted on ball bearings in the rocker shaft. As the follower peg moves out of the plane of the worm, the rocker shaft is moved in so as to keep the peg in contact with the worm by means of a cam controlled by an adjuster screw in the cover plate.

Should wear take place in any part, this can be taken up by adjustment of the adjuster screw, and if end play is found in the column due to wear, this can be taken up by removing one or more of the shims between the lower end of the boss and the end plate.

To Dismantle.

To dismantle the steering gear it is necessary first to remove the drop arm, which is held by taper splines on to the rocker shaft with a nut. After removing the nut it is essential to remove the drop arm by means of an extractor, as trying to hammer the drop arm off will inevitably result in damage either to the worm or to the ball bearings on the follower peg, or both. If no extractor is available, the cover plate should be removed, exposing the interior of the gear.

The steering gear should then be turned over and the cover plate face suitably supported, leaving the rocker shaft free, which can then be driven through the drop arm by using a soft metal hammer. The follower peg is retained in position in the rocker shaft by a split ring. Removal of the split ring allows the follower peg complete with its ball bearing to be taken out and dismantled.

To remove the inner column, it is necessary first to remove the stator tube by undoing the nut holding the gland, and then the screws holding the end plate in position can be removed. The outer ball race with its balls may then be removed, the inner race being part of the column. The column can then be withdrawn through the bottom of the steering box.

To reassemble, the reverse procedure should be followed. The ball race can be held in position by using a thick grease; the column can then be inserted and the lower ball race inserted by similar means.

The packing shims should be so used that there is no end play on the column, and it is recommended that the column races should be slightly pre-loaded by removing a shim after contact adjustment has been effected. It should be possible to rotate the column without undue effort (with the steering wheel removed) by gripping the spline.

Having replaced the follower peg, again by holding the balls in position with grease, and inserting the split ring, the rocker shaft may now be dropped into position, seeing that it is a good fit in its housing and that the oil seal at the lower end of the trunnion is making good contact.

The adjuster in the cover plate should be slacked off by removing the lock plate and loosening the locknut. The cover plate can then be fitted, making sure an oil-tight joint is obtained, and the adjuster screwed down and slightly pre-loaded to a point where a pull on the drop arm end of between 10 and 30 lbs. is necessary to start the gear.

When the adjuster is finally locked in position, the lock plate should be replaced and the drop arm refitted in such a way that the locating line coincides with the similar line on the end of the rocker shaft.

After replacing the stator tube, the steering gear should be finally filled with an ordinary gear oil. Make a final test to ensure that movement is free on locks, and note that the tight spot resulting from pre-load should be just felt in the straight ahead position.

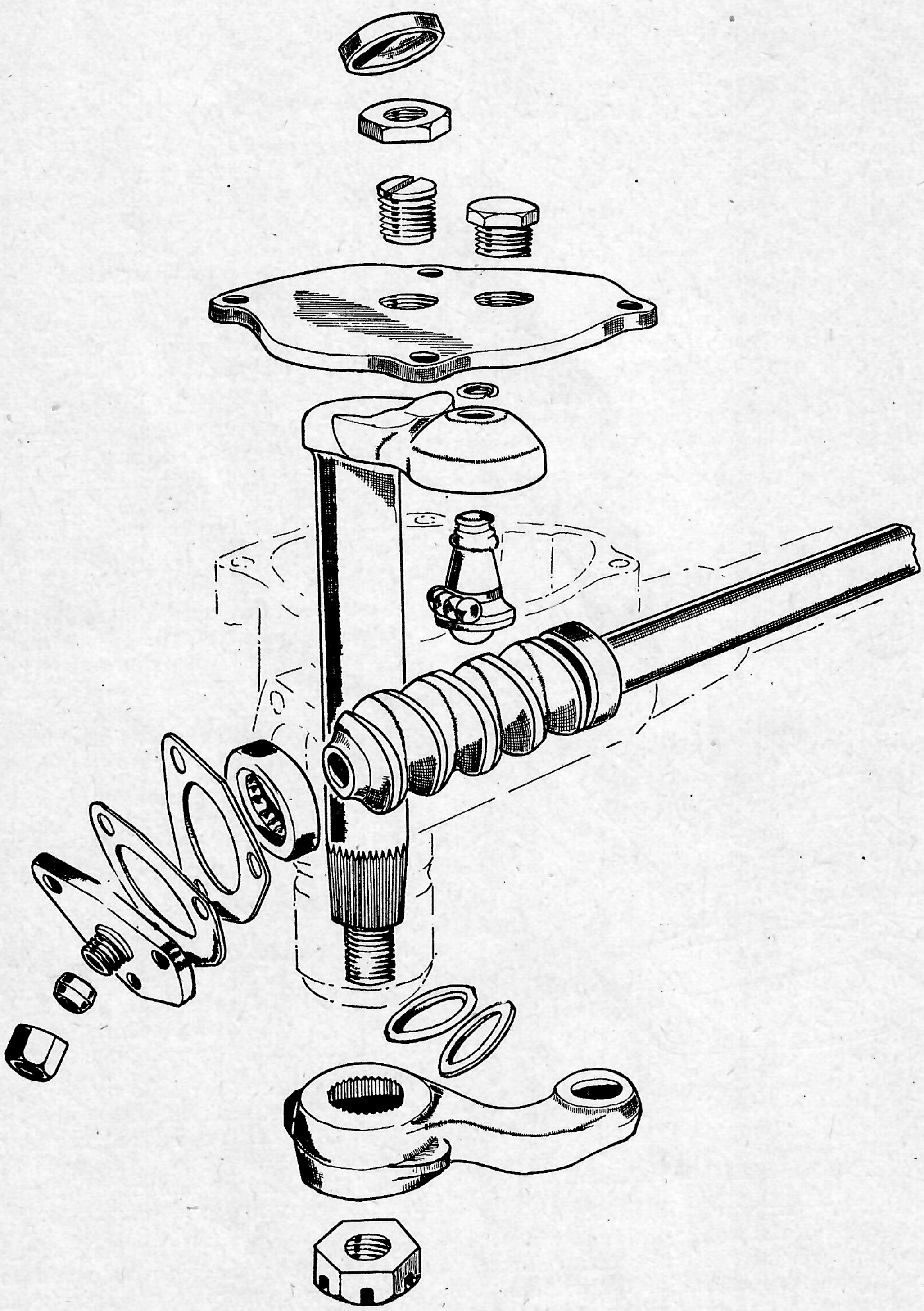


FIG. 10.—Exploded view of the steering box (4AB).

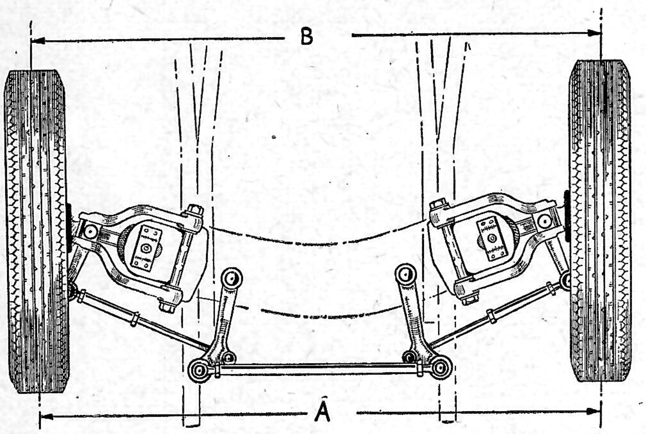


FIG. 7.—This sketch illustrates the toe-in setting. Dimension A must be $\frac{1}{8}$ less than B (Series 4AB).

and that of the idler lever. The distance between the centres of the inner ball pins of the side tie rods should be of this dimension. If not, lengthen or shorten the tie rod to make it so.

Ensure that the steering levers are in the position shown and then adjust the lengths of the side tie rods so that each wheel toes-in $\frac{1}{16}$, thus giving a total toe-in of $\frac{1}{8}$.

Set the lock-stops on the chassis frame to give maximum equal locks to right and left.

Tie Rod Adjustment.

To adjust the length of the tie rods, release the locknut at each end of the central tube and turn the tube in the required direction for lengthening or shortening. Retighten the locknuts, and before doing so make sure, to avoid cross-binding on locks, that the tie rod joints are in the same plane.

To Remove the Front Shock Absorbers.

Jack up the car on the side to be treated by placing the jack pad of a bottle jack under the lower wishbone and just clear of the nut securing the lower member of the shock absorber to the wishbone. Remove the front wheel. Remove the four bolts securing the shock absorber top bracket to the spring top support bracket, and also the nut securing the lower member of the shock absorber to the wishbone. The shock absorber complete with top bracket can now be withdrawn. Note the distance piece between the arm of the spring bottom carrier bracket and the wishbone, also the spring washer under the head.

To Remove the Coil Springs.

For convenience the operation has been divided into three stages:—

Stage 1.—Insert the rod "A" of the extractor, complete with plate "B" and nut "D", into the

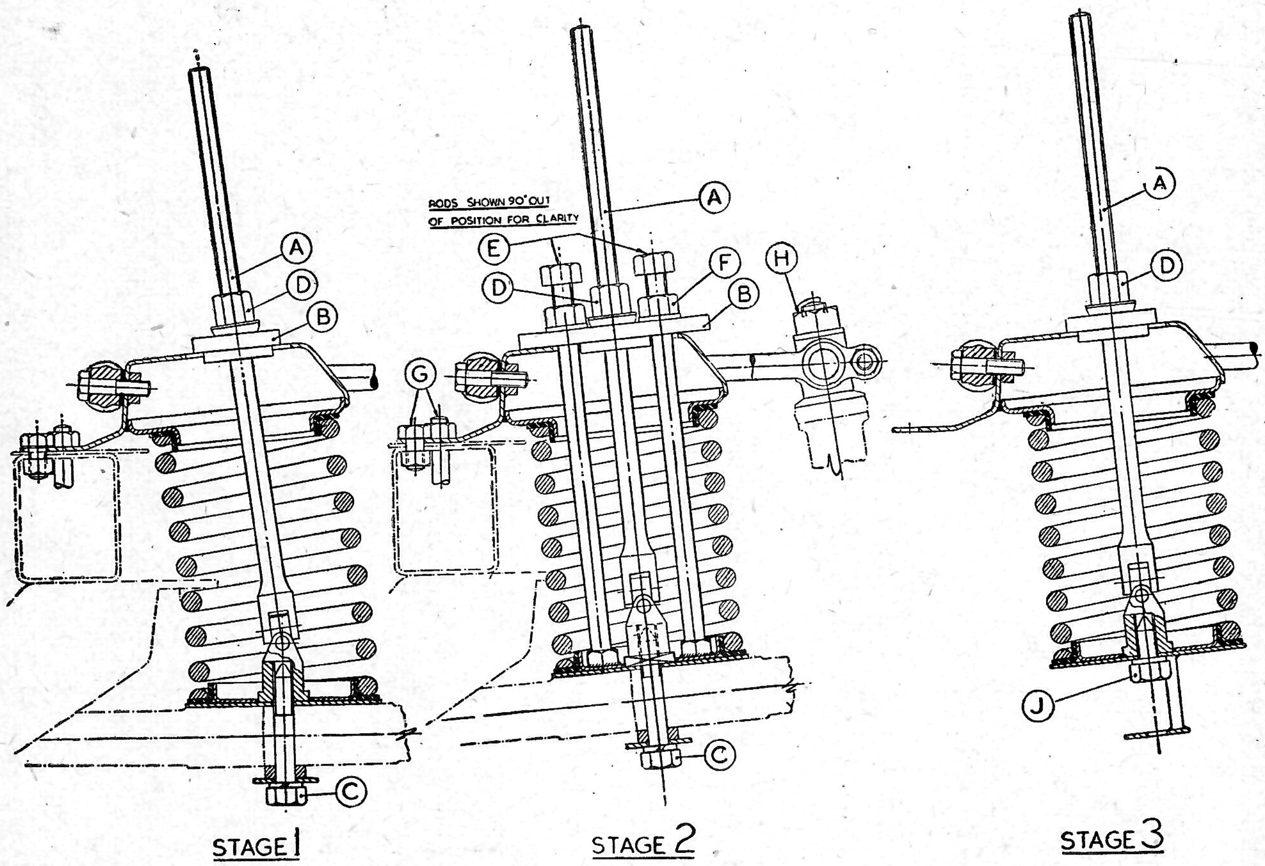


FIG. 8.—The three stages of front suspension spring removal (Series 4AB).

SECTION H

PROPELLER SHAFT

Type	Hardy Spicer.
Number of universal joints	Two.
Length between centre lines of joints	4′ 2″.

Test for Wear.

Wear on the thrust faces is located by testing the lift in the joint, either by hand or by using a length of wood suitably supported.

Any circumferential movement of the shaft relative to the flange yokes indicates wear in the needle roller bearings, or the sliding spline.

To Remove.

Support the propeller shaft near the sliding joint by wood blocks or by a sling from the chassis.

Remove all the nuts and bolts from the companion flange at the sliding spline joint end. Unscrew by hand the dust cap at the rear of the sliding joint. Slide the splined sleeve yoke about half an inch towards the propeller shaft.

This disengages the pilot flange and allows the front end of the shaft to be lowered carefully on to the support.

Remove the nuts and bolts from the companion flange at the fixed joint end and lower it carefully to the ground.

Remove the front end support and lower the shaft to the ground.

To Dismantle.

Having unscrewed the dust cap, pull the sliding joint off the shaft. Clean all enamel from the snap rings and the tops of the bearing races. Remove all the snap rings by pinching their ears together with a pair of pliers, and prising them out with a screwdriver. If a ring does not snap out of its groove readily, tap the end of the bearing race lightly to relieve the pressure against the ring. Hold the joint in the left hand with the splined sleeve yoke lug on top and tap the radius of the yoke lightly with a copper hammer. The top bearing should begin to emerge. Now turn the joint over and finally remove it with the fingers. If necessary, tap the bearing race from the 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 splined sleeve yoke can now be removed. Rest the exposed trunnions on wood or lead blocks and remove the two remaining bearing races.

To Examine for Wear.

The parts most likely to show signs of wear are the bearing races and the spider journals. Should looseness in the fit of these parts, load markings or distortion be observed, they must be renewed complete, as no oversize journals or bearing races are provided. It is essential that the bearing races are a light drive fit in the yoke trunnions. In the event of wear having taken place in the yoke cross hole, the yokes must be removed.

When wear of the cross holes in a fixed yoke, which is part of the tubular shaft assembly, takes place, the part should be replaced by a complete tubular shaft assembly. The other parts likely to show signs of wear are the splined sleeve yoke, or splined stub shaft. A total of .004 circumferential movement, measured on the outside diameter of the spline, should not be exceeded. Should the splined stub shaft require renewing, this must be dealt with in the same way as the fixed yoke, i.e., a replacement tubular shaft assembly fitted.

To Replace.

Wipe the companion flange and flange yoke faces clean. This ensures that the pilot flange will register properly and the joint faces bed evenly all round. Insert the bolts and see that all the nuts are evenly tightened and securely locked. The dust cap must be screwed up by hand as far as possible. The sliding joint is always placed towards the front of the car.

SECTION I

CARBURETTER

Series 4A and 4AB

Make	Solex.
Type	30FAI.
Choke size	22.
Main jet	115.
Air correction jet	230.
Pilot jet	45.
Pilot jet air bleed	1.5.
Starter air jet	4.0.
Starter petrol jet	115.
Air cleaner type	A.C. Sphinx 1574518.

9 h.p. Roadster

Make	S.U.
Type	Downdraught.
Size	$1\frac{1}{8}$.
Needle	AH2 Standard, S5 Rich, QW Weak.

SOLEX 30FAI

The Solex "bi-starter" unit is a small auxiliary carburetter integral with the main carburetter to ensure easy starting from cold and to assist "get-away" until the engine is warm enough to function satisfactorily without its aid.

It has two adjustable units to provide a correct balance of air and petrol.

The air jet meters the air supply. The petrol jet meters the petrol.

It is to be emphasised that the bi-starter should be operated in two positions during the process of starting from cold and driving away, as follows:—

(a) To start the engine when cold, pull out fully the dashboard control to which the bi-starter lever is connected. In this position, it gives a very rich mixture, which is essential for cold starting.

(b) Almost immediately after starting, the engine begins to warm up and the dashboard control should be pushed into the "bi-starter" position, i.e., approximately half way, when a marked resistance will be felt, indicating that the control position has been reached as determined by the location of the spring ball in a notch in the rotating valve disc provided to register at the correct position. At this stage the mixture strength is considerably reduced, for the volume of air inspired by the engine increases proportionately with the rise in engine speed as it continues to warm up, whilst the petrol supply is restricted. The mixture strength is thus sufficient to ensure immediate "get-away" without risk of the engine stalling as the accelerator is depressed.

(c) As soon as the engine is warm enough (usually after driving a few hundred yards), to dispense with the aid of the bi-starter, the dashboard control must be pushed fully home, thus putting the starting device completely out of action.

Normal Running.

For normal running above idling speed the engine is provided with the correct mixture for all speeds by the main spraying assembly. The petrol is provided by the main jet and the main air supply for disintegration of the petrol by the choke tube. The correct balance of mixture is further automatically maintained by an additional air supply from the air correction jet.

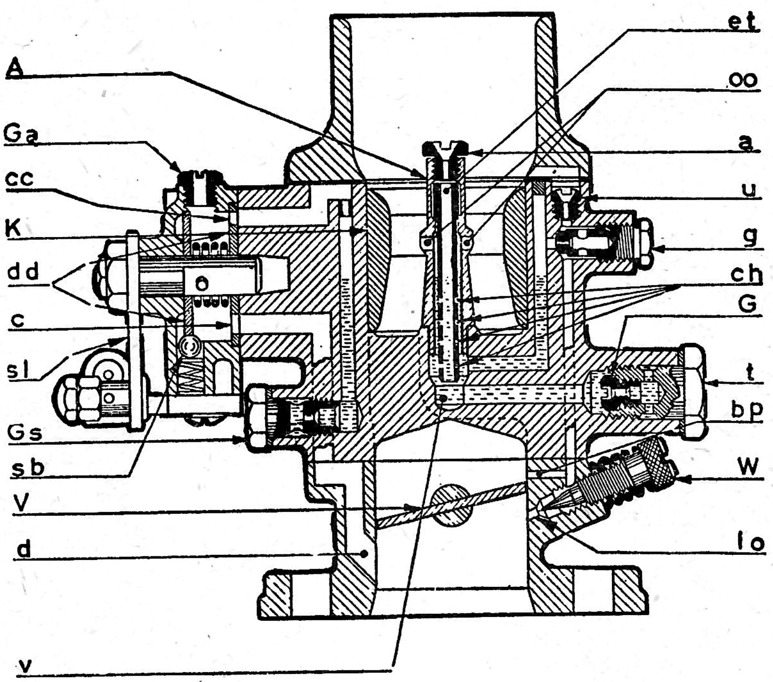
It is not possible in Figure 1 to show the float chamber, but it is of conventional design, carrying a float which closes a needle valve when the petrol from the float chamber passes through the main jet into the spraying well via the reserve well where it meets air drawn downwards via the calibrated air correction jet. This passes out through the emulsion holes into the annulus, where an emulsion is formed with the petrol, and the resultant mixture rises to the four spraying orifices, of which two are shown in the waist of the choke tube. Here the emulsion is absorbed by the main air current and passes down to the induction pipe of the engine via the butterfly throttle.

Slow Running (Fig. 1).

When idling the mixture is provided by the pilot jet, the air bleed and the volume control screw, the last decreasing the mixture strength by clockwise rotation and vice versa.

The idling is effected by petrol drawn from the reserve well via a small channel which will be seen emerging therefrom immediately above the larger horizontal lead from the main jet. This it will be noted, turns upwards and eventually passes through the pilot jet into the downwards tract communicating with the idling hole controlled by the spring-loaded and knurled-headed taper screw. It will be noted that this hole is on the engine, i.e., suction side, of the throttle butterfly. A branch lead communicates with another hole which enters the airway slightly on the atmospheric side of the almost closed throttle.

When the throttle is in the idling position, this duct, which is termed the by-pass, acts as an air bleed upon the idling petrol supply and therefore prevents over-richness when the engine is actually



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

FIG. 1.—Section of the Solex 30FAI carburetter.

KEY TO FIG. 2.—SOLEX 30FAI CARBURETTER.

1—Throttle spindle end nut.
2—Throttle lever.
3—Throttle spindle abutment plate.
4—Throttle running adjustment screw spring.
5—Slow running adjustment screw.
6—Throttle butterfly.
7—Throttle butterfly fixing screw.
8—Volume control screw spring.
9—Volume control screw.
10—Main jet.
11—Choke tube fixing screw.
12—Pilot jet.
13—Main jet carrier washer.
14—Main jet carrier.
15—Emulsion tube.
16—Pilot jet air bleed.
17—Air correction jet.
18—Banjo bolt.
19—Washer.
20—Filter.
21—Union.
22—Washer.
23—Float chamber assembly screw.
24—Float chamber cover.
25—Needle chamber washer.
26—Needle valve.
27—Choke tube.
28—Float chamber cover gasket.
29—Float.
30—Starter valve complete.
31—Cable support fixing screw.
32—Starter cable locking screw.
33—Cable support.
34—Starter valve locating ball spring.
35—Starter valve locating ball.
36—Bi-starter body.
37—Starter lever with cable swivel.
38—Starter cable swivel screw.
39—Starter spindle washer.
40—Starter body fixing screw.
41—Starter spindle nut.
42—G.S. petrol jet (starter).
43—G.S. petrol jet washer.
44—G.A. air jet (starter).
45—Float chamber assembly.
46—Throttle chamber gasket.
47—Throttle chamber.
48—Flange washer.
49—Throttle chamber fixing screw washers
50—Throttle chamber fixing screws.
51—See item 23.
52—Throttle spindle.
53—Throttle stop screw.
54—Throttle stop screw locknut.

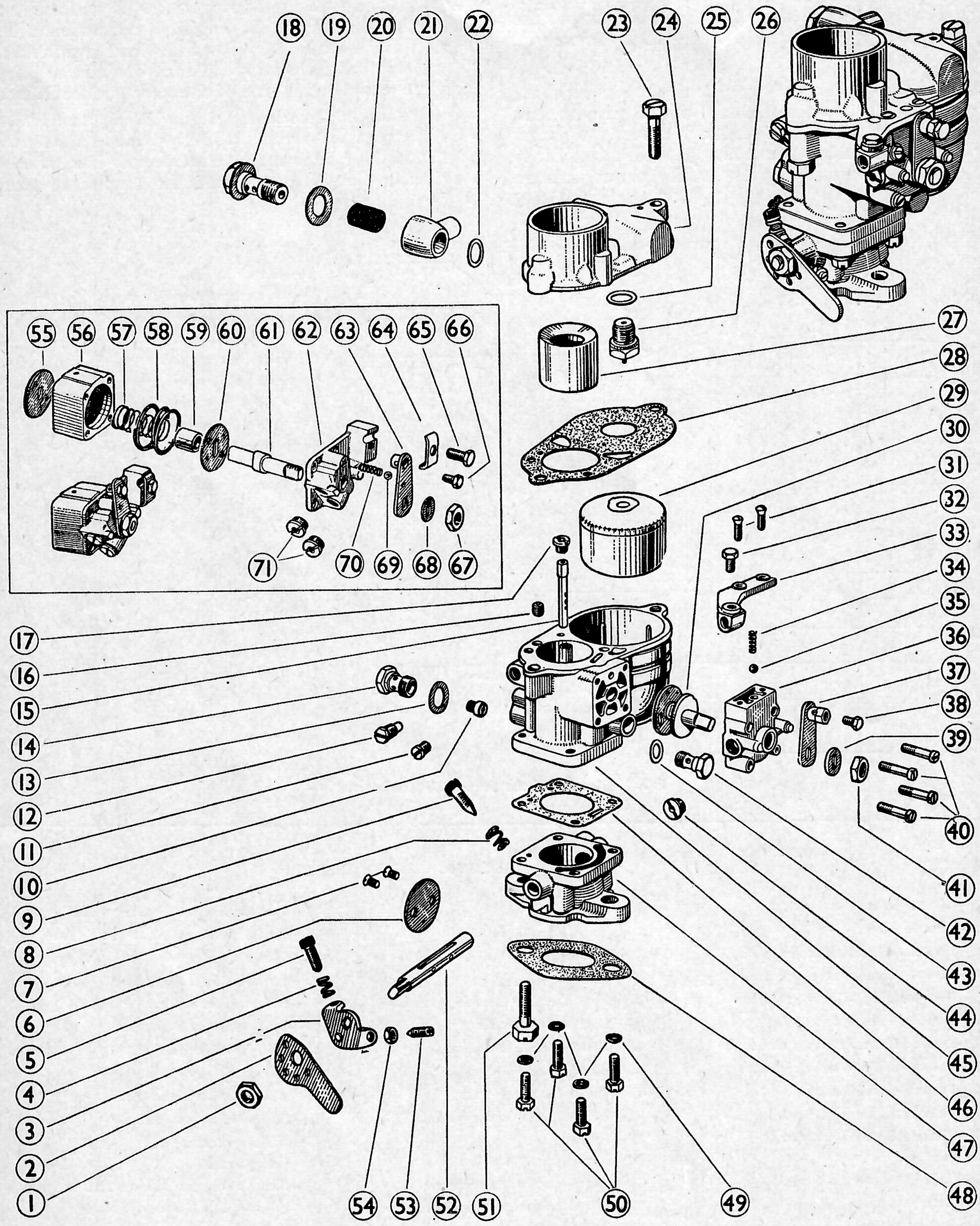


FIG. 2.—Exploded view of the Solex 30FAI carburetter.

idling. Directly the throttle opens, the butterfly passes to the atmospheric side of the by-pass hole, so that both function as petrol delivery holes, thereby proportionately enriching the output at the transfer position between the pilot and the main supplies and preventing a lean spot which might otherwise occur.

This adjustment is of considerable importance and depends upon the mechanical perfection of the engine. Compressions should be equal, ignition in good order, and the induction system free from air leaks. The throttle "pull-off" spring must pull the throttle back to the closed position and all nuts and screws used in the assembly of the carburetter must be tight. Note particularly that the volume control screw has not been broken or distorted by over-tightening. If it has, a new screw must be obtained.

Normal adjustment is carried out as follows:—

1. Wait until the engine is hot.
2. Set the throttle adjustment screw until the idling speed is on the high side.
3. Slacken the volume control screw 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 screw to slow it down to an idling speed of about 500 r.p.m.
6. This may cause a resumption of slight hunting. If so, then turn the volume control screw gently in a clockwise direction until the idling is perfect. These adjustments must never be made with a cold engine.

S.U. CARBURETTER

The tuning of the S.U. carburetter is simple if it is understood that all jets are of standard size. The only adjustment possible is fitting the right size of needle with the jet adjusting nut set correctly for idling. It cannot be emphasised too strongly that it is of no use whatever trying to adjust the carburetter in any other manner.

Should the engine run badly, after having previously given good results, do not change the needle, for this cannot be the cause of the trouble.

It is of the utmost importance that the carburetter should be adjusted by means of the jet adjusting nut in such a way that the correct mixture is obtained when the engine is idling—that is to say, it should be made to fire as evenly as possible. This can be noted by listening to the exhaust. If the engine has a constant uneven beat (known as "hunting") this is due to a rich mixture. If the exhaust note is irregular and splashy, the mixture is too weak.

This adjustment not only adjusts the carburetter for idling, but for the whole range of speeds.

If this adjustment is not made, consumption will be bad and probably the performance poor. Should the car not be satisfactory with regard to consumption or performance, look to this adjustment, and provided the correct size of needle is fitted it will put the matter right. If it does not, an incorrect

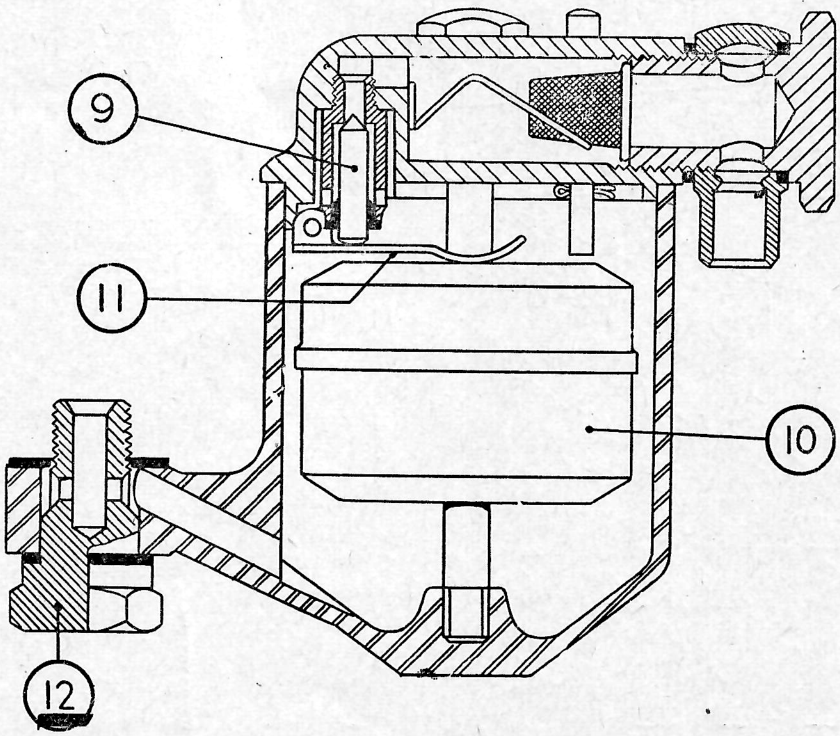


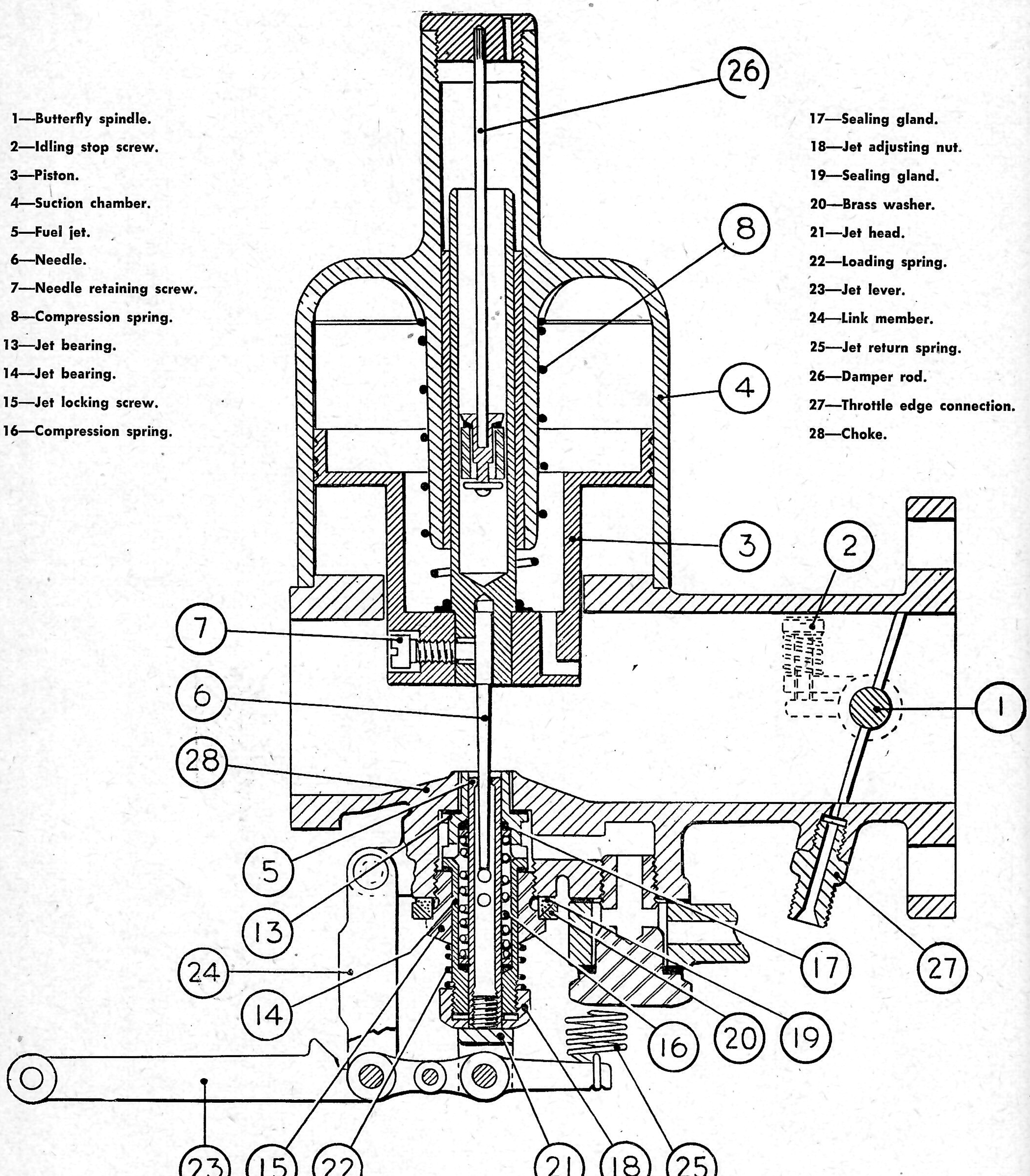
FIG. 3.—Float chamber details for the S.U. carburetter.

size of needle is fitted and it will have to be changed for one correcting the mixture as required. A larger needle will give a weaker, and a smaller needle a stronger mixture over the whole range of speeds.

Adjustment.

Run the engine until it attains its normal running temperature.

Adjust the jet to such a position that the engine



1—Butterfly spindle.
2—Idling stop screw.
3—Piston.
4—Suction chamber.
5—Fuel jet.
6—Needle.
7—Needle retaining screw.
8—Compression spring.
13—Jet bearing.
14—Jet bearing.
15—Jet locking screw.
16—Compression spring.
17—Sealing gland.
18—Jet adjusting nut.
19—Sealing gland.
20—Brass washer.
21—Jet head.
22—Loading spring.
23—Jet lever.
24—Link member.
25—Jet return spring.
26—Damper rod.
27—Throttle edge connection.
28—Choke.

FIG. 4.—Main details of the S.U. carburetter.

idles on the correct mixture. An easy way to do this is to adjust the jet up to a weaker position, then unscrew the jet adjusting nut until it brings the jet down to the position where the engine idles with an even exhaust.

A simple way to test for rich mixture when the engine is idling is to lift the piston up slightly, say $\frac{1}{32}$, and if, when this is done, the engine runs faster, the mixture is too strong.

If, after this adjustment has been made, the road performance is not satisfactory, a larger or smaller needle will be necessary as the case may be. If the car pulls better with the manual mixture control pulled out, a smaller needle is required.

Should it be necessary to change the needle, this can be done by removing the two screws holding the suction chamber in position. The suction chamber can then be lifted off and the piston removed. At the side of the piston will be seen a setscrew. When this is slackened off, the needle can be withdrawn and the new needle fitted. The position of the needle is with its shoulder flush with the face of the piston. When replacing, care should be taken that the keyway at the side of the piston registers with the key in the body. Great care should also be taken to see that all machined faces and parts are kept scrupulously clean.

There are a number of faults that will cause an engine to run badly, but if the trouble is due to the carburetter, it can only be one of the following:—

Piston sticking.
Dirt or water in the carburetter.
Float chamber flooding.
Float needle sticking.
Jet sticking.

Piston Sticking.

The suction piston comprises the piston, forming the choke, the needle and suction disc; into this is inserted the hardened and ground piston rod which works in the bearing of the suction chamber. The piston rod running in the bearing is the only part

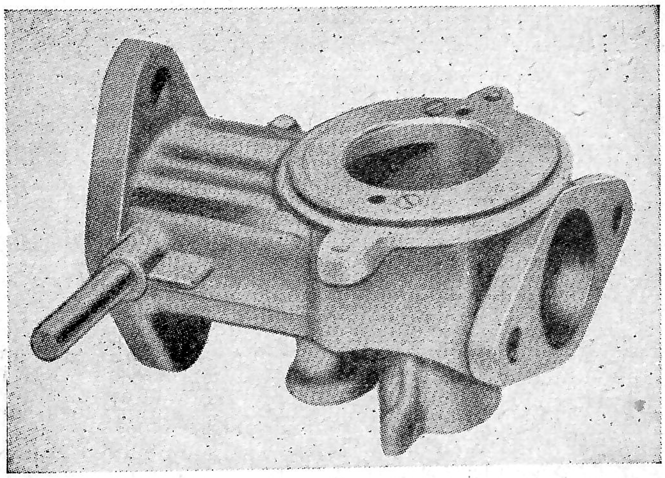


FIG. 5.—The body.

which is in actual contact with any other part — the suction piston and needle having clearance fits, and consequently should not cause sticking. If this does occur, the whole assembly should be carefully cleaned and the piston rod ONLY should be lubricated with a spot of thin oil. A sticking piston can be ascertained in a few seconds by inserting a finger in the air intake and lifting the piston, which should come up quite freely and fall right on to its seat when released.

Water or Dirt in the Carburetter.

When this is suspected, lift the piston with a pencil. The jet can then be seen. Flood the carburetter by depressing the tickler pin and watch the jet; if the petrol does not flow through freely there is a blockage. To remedy this, start the engine, open the throttle, block up the air inlet momentarily without shutting the throttle; keep the throttle open until the engine starts to race. This trouble seldom arises with the S.U. carburetter owing to the size of the jet and the petrol ways. When it does happen, the above method will nearly always clear it. Should it not do so, the only alternative is to remove the jet. This, however, should on no account be done unless it is absolutely necessary, as when refitting it has to be carefully centred to the needle, and it is practically impossible to assemble this part correctly unless it is first understood how this is carried out.

FIG. 6.—Throttle disc screws.

Float Chamber Flooding.

This can be seen by the petrol flowing over the float chamber and dripping from the air inlet, and is generally caused by grit between the float chamber needle and its guide. This can usually be removed by depressing the tickler pin, which allows the incoming petrol to wash the grit through the guide and into the float chamber.

Float Needle Sticking.

If the engine stops, apparently through lack of fuel when there is plenty in the tank, the probable cause of this is a sticking float needle. If it is, starvation has almost certainly been caused by the float needle sticking to its seating, and the float chamber lid should therefore be removed, the needle and seating cleaned and refitted. At the same time, it will be advisable to clean out the entire fuel feed system, as this complaint is caused by foreign matter in the petrol, and unless this is done it is likely to recur. It is of no use whatever replacing any of the component parts of the carburetter, and the only cure is to make sure that the pertol tank and pipe lines are entirely free from any kind of sticky substance capable of causing this trouble.

Jet Sticking.

It will probably be found that this trouble is due to stiffness in the manual control or in the jet mechanism itself. The most simple cure is to withdraw the jet to its fullest extent, oil the operating wire and/or linkages and grease the jet with vaseline or similar lubricant. The control should then be operated two or three times to ensure that the whole system is working freely.

It should be emphasised that the five troubles previously mentioned are the only ones that can be caused by the carburetter, and if these points are in order on no account take the carburetter to pieces or alter it in any way, but look for the trouble elsewhere.

Starting.

To start the engine from cold, bring the jet down to its lowest position by means of the jet control; open the throttle slightly more than the normal position when the engine is hot, the engine should then start immediately. The mixture control should not be kept at this strong position longer than is necessary.

To start when the engine is hot is not necessary to use the mixture control.

Carburetter Assembly.

The Body.

The carburetter is built up on the sub-assembly principle—that is, each of the several groups of parts is assembled first, and these groups are then put together to make the complete instrument. The order of assembly is as follows:—

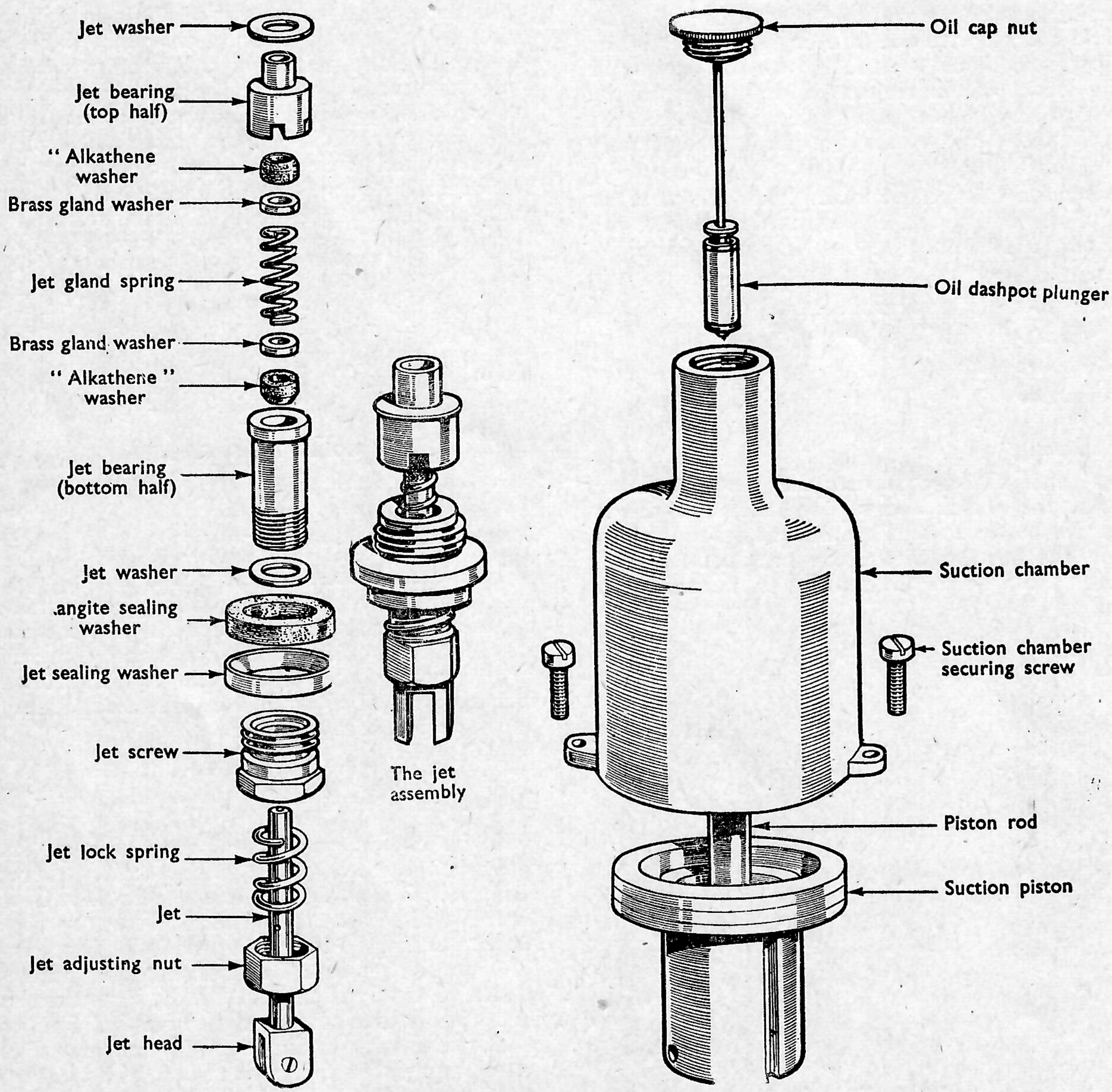


FIG. 7.—Jet assembly and suction chamber.

First—the body.
Second—the jet.
Third—the suction chamber and piston.
Fourth—the float chamber.

The annular ring on the upper part, known as the piston plate, is held in position by two 4 B.A. countersunk-head screws and, being fitted and machined in place at the factory, needs no further attention than perhaps to check the tightness of the screws.

The first job, therefore, is to fit the throttle spindle, with any levers or stops of the "pinned on" type ($\frac{1}{8}$ x $\frac{1}{2}$ taper pins) already in position. With the spindle turned so that the slot is in line with the carburetter choke, the butterfly can be inserted with the fingers or a small pair of pliers. The spindle should now be turned until the throttle is closed and adjusted endwise until the two holes in the disc correspond with those in the spindle. This will enable the two 4 B.A. screws to be fitted. These screws are self-locking by means of the 60° countersink of the head, and are also split at the end to provide a further safeguard. They should be opened out only just sufficiently to prevent rotation, as undue bending may cause fracture.

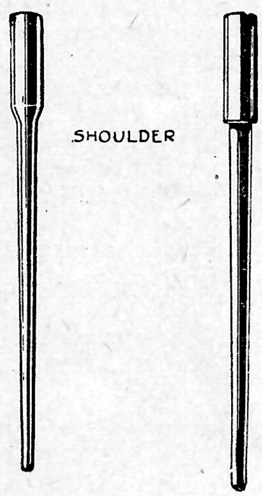


FIG. 8.—Jet needles.

The Jet.

Correct assembly of this is as follows:—

First assemble the jet bearing lower half, copper washer, jet screw, jet lock spring, and jet adjusting nut. Screw the jet adjusting nut up about five turns, insert the jet and fit the sealing ring, chamfer up, and its cork washer over the jet screw. Next comes the lower jet gland cork washer and the jet gland, chamfer down, both of which should be slid over the jet and pushed to the bottom of the jet bearing by the jet gland spring. Then comes the upper jet gland, chamfer up, the upper jet gland cork washer, the jet bearing, upper half, and finally its copper washer. The jet assembly is now complete and ready for fitting to the body. This should be done, to begin with, only finger tight, to allow the jet to be centred correctly.

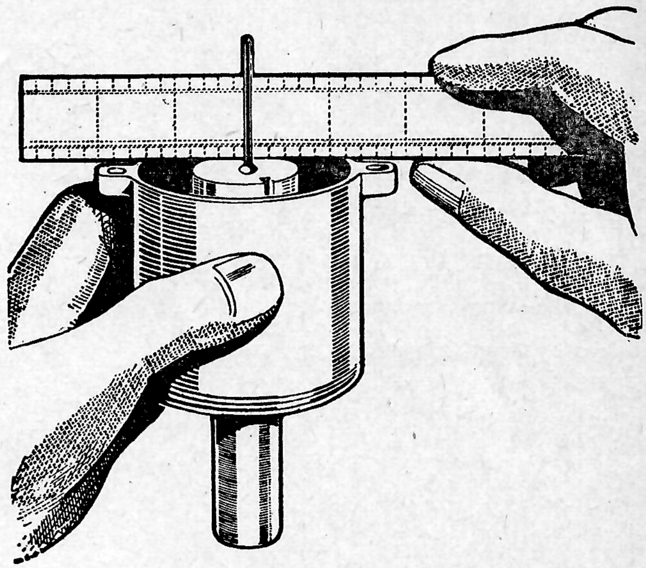


FIG. 9.—Setting the jet needle.

The Suction Chamber and Piston.

These are supplied only as an assembly, owing to the extremely fine limits to which they are machined, and should, therefore, never be separated except for inspection and cleaning. Besides fitting the jet needle grub screw, there remains only the jet needle itself to fit before the suction chamber and piston and the body are assembled together preparatory to centering the jet.

Jet needles are finished in two ways, either on a centreless grinder (this comprises the majority) or on a watchmaker's lathe. The former have a rounded shoulder, the latter square, but in every other respect they are identical. Both should be fitted with the shoulder level with the main face of the piston. If difficulty is experienced in placing the needle accurately by hand, it is permissible to tap it gently with a piece of wood, such as the handle of a screwdriver.

Certain types of suction chamber have the holes for the securing screws drilled symmetrically, whilst others do not. In either case, to fit the suction chamber and piston to the body, it is only necessary to see that the guide in the body corresponds with the slot in the piston, the needle slides freely into the jet, and the holes already referred to match up with those tapped in the body lugs. When this has been done, the securing screws can be tightened up and the oil cap fitted.

Centring the Jet.

Should it be essential to remove the jet, this can be done by unscrewing the jet holding screw. It must be understood that the needle is very nearly as large as the jet, and yet must not touch. When assembling, it is therefore necessary to carefully centre the jet to the needle, which is done as follows:—

First remove the pin at the base of the jet, attaching the jet head to the jet operating lever. Withdraw

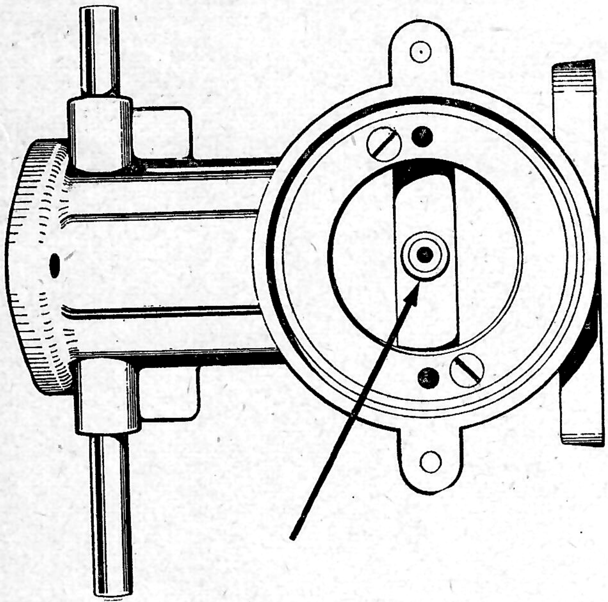


FIG. 10.—Position of the jet when it is off centre.

the jet completely and remove the adjusting nut and adjusting nut spring. Replace the adjusting nut, but without its spring, and screw it up to its highest position. When this has been done feel if the piston is perfectly free by lifting it up with the finger. If it is not, slacken the jet screw and manipulate the lower part of the assembly, including the projecting part of the bottom half jet bearing, adjusting nut and jet head. Make sure that this assembly is now slightly loose. The piston should now rise and fall quite freely because the needle is now able to move the jet into the central position. The jet screw should now be tightened, and a check should be made to determine that the piston is quite free. If it is not found to be so, the jet screw should be slackened, and the operation repeated. When complete freedom of the piston is achieved, the jet adjusting nut should be removed, together with the jet, the spring replaced, and the adjusting nut screwed back to its original position.

The Float Chamber.

First, the fixing stud should be fitted with the short length of $\frac{1}{4}$ Whit. thread in the float chamber base, and the longer portion of $\frac{1}{4}$ B.S.F. thread at the top to take the fixing stud nut. The float chamber lid comes next and is assembled in this order. Slide the tickler pin spring over the tickler pin, insert the pin in the hole provided, so that the spring falls into the recess, and fit the brass cotter on the other side. The float needle seating follows and is screwed in without a washer. Then the float needle and the forked lever and its hinge pin. The lid is completed by the banjo bolt, its two fibre washers and the brass filter which the bolt holds in position in its recess. The bolt should be fitted with only a few threads in contact, as it will be necessary to remove it again to fit the fuel pipe. Before fitting the lid to the float chamber, the forked float lever must be adjusted so that the level of the float end, and therefore of the fuel in the float chamber and jet, is correct. This is done by sliding a round bar, $\frac{7}{16}$ diameter, between the lever and the spigot on the lid, the position of the lever being such that it touches the bar at the same time as it holds the needle on its seating; if it does not, adjustment must be made by bending. The float can be slipped into the chamber either way up, and the lid fitted and held in position by the fixing stud nut and washer. This nut should be left finger tight until the fuel pipe is fitted.

The whole float chamber is now ready for fitting to the body by means of the holding up bolt with its cork washer and its fibre washer. The cork washer should first be fitted in the annular recess in the head, then the bolt fed through the hole in the float chamber arm, and the fibre washer slipped over the end. Lastly the bolt must be screwed into the hole tapped in the boss on the underside of the body. To begin with, the bolt should not be done up too tightly, as it may be necessary to swing the float chamber to accommodate the fuel pipe. When the pipe is in place, however, it should be well tightened so that the fibre and cork washers make a good seal and the latter is forced right into its recess. The bolt itself will then make direct contact with the float chamber arm, thereby taking the stress of maintaining it in position.

The carburetter is now complete, with the exception of the jet and throttle levers and links.

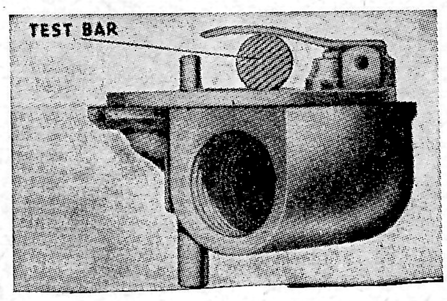


FIG. 11.—Method of locating the test bar when checking the float level.

SECTION J

FUEL PUMP

Make	A.C.
Type	Mechanical.
Delivery pressure	$1\frac{1}{4}$ to 2 lbs. per sq. in.
Priming time	36 secs. at 60 r.p.m.

Operation.

As the engine camshaft (G) revolves, the eccentric (H) lifts, through the push rod, the pump rocker arm (R) pivoted at (E) which pulls the pull rod (F) together with the diaphragm downward against spring pressure (C), thus creating a vacuum in the pump chamber (M). Petrol is drawn from the tank and enters at (J) into the sediment chamber through the filter gauze (L), and suction valve (N) into the pump chamber (M). On the return stroke, spring pressure (C) pushes the diaphragm (A) upwards, forcing petrol from the chamber (M) through the delivery valve (O) and opening (P) into the carburetter.

When the carburetter bowl is full the float will shut the needle valve, thus preventing any flow of petrol from the pump chamber (M). This will hold the diaphragm (A) downward against spring pressure (C).

It will remain in this position until the carburetter requires further petrol and the needle valve opens. The rocker arm (R) then operates the connecting link. This construction allows idling movement of the rocker arm when there is no movement of the fuel pump diaphragm.

The spring (S) keeps the rocker arm (R) in constant contact with the push rod and the eccentric (H) to eliminate noise.

To Clean the Filter.

The filter should be examined every 2,000 miles and cleaned if necessary. Under conditions of dust laden atmosphere, this mileage interval should be reduced as conditions dictate. Access to the filter is gained by removing the dome cover, after unscrewing the retaining screw, when the filter gauze itself may be lifted off its seating. Remove the drain plug and clean out the sediment chamber. Clean the filter gauze in an air jet or petrol. The cork gasket under the filter cover should be replaced if broken or if it has hardened.

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

Check the pump mounting setscrews and petrol pipe unions for tightness.

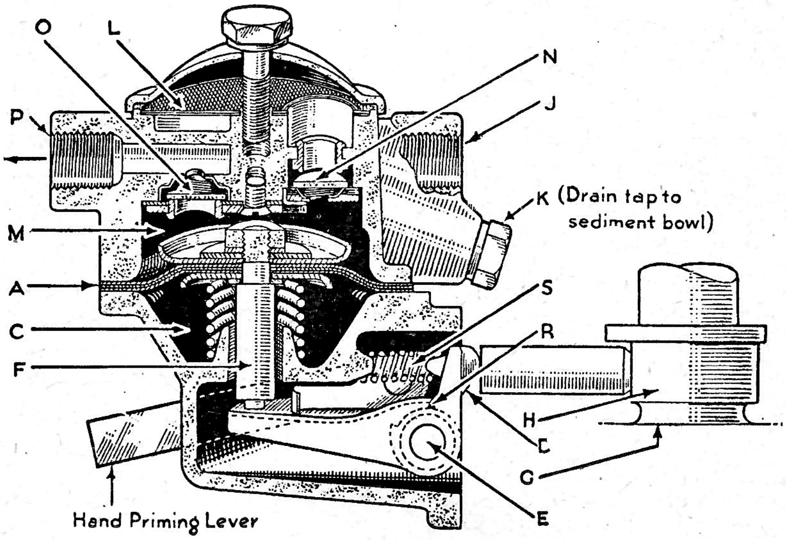


FIG. 1.—Sectional view of the fuel pump.

To Test.

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

To Remove.

Firstly, the pipe unions should be disconnected, the two setscrews fixing the fuel pump at the crankcase should then be unscrewed, after which the fuel pump will come away readily.

To Dismantle.

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

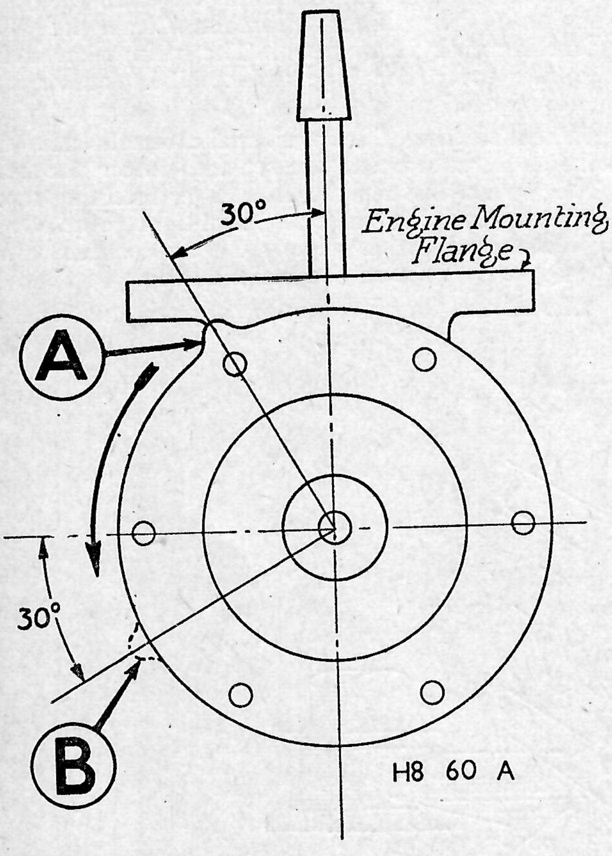


FIG. 2.—When first fitting the diaphragm to the pump body, the locating tab (A) on the diaphragm must first be in the position shown. After engaging the notches in the bottom of the pull rod, with the slot in the link, turn the diaphragm until the tab is at position (B).

To Inspect.

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

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

Upper and lower castings should be examined for cracks or damage, and if the diaphragm or engine mounting flanges are distorted, these should be lapped to restore their flatness. Badly worn parts should be replaced, and very little wear should be tolerated on the rocker arm pins, the holes and engagement slot in the link and the holes in the rocker arm. On the working surface of the rocker arm, which engages with the push rod and engine eccentric, slight wear is permissible, but not exceeding .010 in depth. The valve seat incorporated in the valve plate should be examined and if at all roughened should be carefully lapped on a smooth carborundum stone. Similarly, the corresponding outlet valve seat incorporated in the upper casting should be examined and if worn unevenly to the slightest degree, both the upper casting and valve seat assembly must be replaced. It is not practicable to refit new valve seats into the castings as this calls for special equipment. Fuel pump valves should be replaced if at all worn, although in an emergency they can be turned over to provide a fresh surface to the valve seat. Valve springs should preferably be replaced, although they can be refitted providing they do not bear undue evidence of rubbing away on the outside diameter. In no circumstances should the valve springs be stretched in an endeavour to increase their strength. Diaphragm springs seldom call for replacement, but where necessary, ensure that the replacement spring has the same identification colour and consequently the same strength as the original. All gaskets and joint washers should be replaced as a matter of routine.

To Reassemble.

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

Place the valve plate gasket in position.

The valves should be swilled in clean kerosene before assembly. Apart from the cleaning effect, this improves the sealing between the valve and seat.

Fit the outlet valve spring in the centre of the four cast webs.

Put the outlet valve on the spring.

Place the inlet valve on the valve seat located in the upper casting.

Put the valve spring on the centre of the inlet valve.

Place the retainer on the top of the inlet valve spring.

Place the valve plate in position and secure it with the three screws. (At this stage, use a piece of wire to make sure that the valves work freely).

Place the filter screen in position on top of the casting, making certain that it fits snugly.

Fit the cork gasket, cover, fibre washer and retaining screw.

To assemble the lower half, proceed as follows:—

Assemble the link, packing washers, rocker arm and rocker arm spring in the body. Insert the rocker arm pin through the hole in the body, at the same time engaging the packing washers, link, and the rocker arm, then spring the retaining clips into the grooves on each of the rocker arm pins. The rocker arm pin should be a tap fit in the body, and if, due to wear, it is an easier fit, the ends of the holes in the body should be burred over slightly.

Note.—The fitting of the rocker arm pin can be simplified by first inserting a piece of .240 diameter rod through the pin hole in one side of the body far enough to engage the rocker arm washers and link, and then pushing the rocker arm pin in from the opposite side, removing the temporary rod as the pin takes up its proper position.

To Fit the Diaphragm.

Place the diaphragm spring in position in the pump body.

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

Press downwards on the diaphragm, at the same time turning the assembly to the left in such a manner that the slots on the pull rod will engage the fork in the link, ultimately turning the assembly a complete quarter turn to the left, which will place the pull rod in the proper working position in the link, and at the same time permit the matching up of the holes in the diaphragm with those on the pump body flanges. When first inserting the diaphragm assembly into the pump body, the locating "tab" on the outside of the diaphragm should be at the 11 o'clock position. After turning the diaphragm assembly a quarter of a turn to the left, the "tab" should be at the 8 o'clock position.

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

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

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

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

Use a screwdriver to hold the rocker arm at its outward position, and while so held tighten the cover screws diagonally and securely.

To Test after Assembly.

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

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

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

When the above apparatus is not available, the petrol pump should be tested, using a pan of clean kerosene, as follows:—

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

To Refit.

Reverse the procedure outlined for removal from the engine. Ensure that the rocker arm is correctly positioned against the push rod to the camshaft. After refitting to the engine, the engine should be run for a short time and the pipe unions and pump examined for the possibility of fuel leakage.

plunger assembly is protected from dirt and dust by a rubber dust cover packed with Wakefield Rubber Grease No. 4.

To Dismantle the Master Cylinder.

Drain off the brake fluid by disconnecting one of the flexible pipes on the front wheel brake plate, lowering the open end into a clean container and pumping the brake pedal until no further fluid enters the container. Reconnect the flexible hose. Disconnect the two pipe unions on the top of the master cylinder and the master cylinder piston rod from its connection to the bisector. Remove the two bolts securing the unit to the chassis, when the cylinder can be withdrawn.

Unscrew the end cover complete with gasket. Withdraw the plunger return spring, remove the rubber boot, disconnect the circlip retaining washer and withdraw the push rod. The plunger complete with seal retainer and end seal can now be pushed out from the pressure end of the cylinder. Remove the recuperating seal from the body.

Examine the various parts carefully and renew any that appear worn or damaged. Renew all seals which are perished or damaged.

To Assemble the Master Cylinder.

Fit the recuperating seal with the lips facing the pressure end. Make sure the seal is correctly seated. Assemble the end seal and the retainer with the wider end of the seal next to the plunger. Mount it into the cylinder from the operating end. Smear the seal and plunger with clean brake fluid. Reassemble the push rod, circlip, return spring, end cap and the gasket. Screw the end cover firmly into position and replace the rubber boot on the cylinder, packing it with Wakefield grease. Refit the master cylinder to the chassis and connect up the two pipe unions and the piston rod.

To Replenish the Hydraulic Fluid.

Inspect the supply tank at regular intervals. Maintain the level of the fluid to about three-quarters full by adding Girling Crimson Brake Fluid. When doing so, exercise great care to prevent dirt entering the system.

Important.—Girling Crimson Brake Fluid has been specially prepared and is unaffected by high temperatures or freezing. Never top up the system with any other fluid, for serious consequences may result from the use of incorrect fluid.

To Fit Replacement Shoes.

To remove the old shoes, jack up the car, turn the adjusters anti-clockwise to the full off position, and remove the road wheel and brake drum. Lift each shoe out of its abutment slot and release. Detach the shoe return spring. To stop the wheel cylinder pistons from coming out, place a rubber band around the cylinder.

Clean down the brake plate and assemble the replacement shoes in the reverse order to dismantling and with the swan neck end of each spring through the hole in the back plate. Replace the shoes independently. Smear the brake shoe steady rests, operating and abutment ends of the shoes with Girling Brake Grease before assembling. Adjust the brakes.

To Bleed.

Bleeding must be done after any portion of the hydraulic system has been disconnected, or if the level of the brake fluid has fallen so low that air has entered the master cylinder. Unscrew the bleed nipple about three-quarters of a turn and operate the brake pedal with slow full strokes until the fluid entering the jar is free of air bubbles. During a down stroke of the pedal, tighten the bleed nipple and replace the dust cover. Check on the supply tank during the bleeding, since a full level must be maintained throughout the operation. Should air reach the master cylinder from the supply tank, the bleeding operation will have to be carried out again. The bleeding must be repeated at each front wheel.

After bleeding, top up the supply tank to the correct level of approximately three-quarters full and adjust the front brakes. Always use GIRLING CRIMSON BRAKE FLUID and never use fluid that has been bled from a brake system for topping up the supply tank, for this fluid may contain air. Stand the fluid for a few hours to allow the air to disperse before using again. Extreme cleanliness is essential when dealing with any part of the hydraulic braking system, particularly the brake fluid. On no account add dirty fluid to the system.

General Advice.

Always exercise extreme cleanliness when dealing with the hydraulic system.

Always use clean brake fluid or alcohol for cleaning the internal parts of the hydraulic system. Petrol or kerosene must not be allowed to contact these parts.

Always examine all seals carefully when overhauling and replace any which show the least sign of wear or damage with genuine Girling spares.

Always take care not to scratch the highly finished surfaces of the cylinder bores and pistons.

Always use Girling Crimson Brake Fluid, obtainable from all Girling Service Agents or direct from the manufacturers, Messrs. C. C. Wakefield Ltd.

Important.—If it is suspected that incorrect fluid has been used, all seals in the master and wheel cylinders must be changed and the components and pipe lines thoroughly cleaned and flushed with alcohol or clean Girling Crimson Brake Fluid. Never use petrol or kerosene. If an incorrect fluid has been used in the system for any length of time, replace the high pressure hoses to the front brakes.

SECTION K

SPARKING PLUGS

Make	Champion.
Model	L10S.
Reach	Short.
Size	14 mm.
Gap at electrodes	.025.

To obtain the best engine performance and the most economical running, the sparking plugs must be kept clean and correctly adjusted. They should be removed and cleaned after the first 500 miles of use in a new engine. This is advisable since the slower engine speeds and the conditions of the running-in period have a tendency to cause fouling of the plugs.

Plugs should subsequently be removed for inspection, cleaning and adjustment after each period of 3,000 miles.

When sparking plugs are removed from the engine, their gaskets should be removed with them and replaced on the plugs, which should be replaced in a suitable holder. It is advisable to identify each plug with the number of the cylinder from which it was removed so that any faults can be traced back to the cylinder concerned. The plug stand is of simple construction, it being only necessary to have four holes to admit the upper ends of the plugs.

When examining the plugs, note the condition of their gaskets. A large proportion of the heat from the insulator is dissipated to the cylinder head by means of the copper gasket between the plug and the cylinder head. Plugs not screwed down tight become overheated, causing pre-ignition, short plug life and pinking.

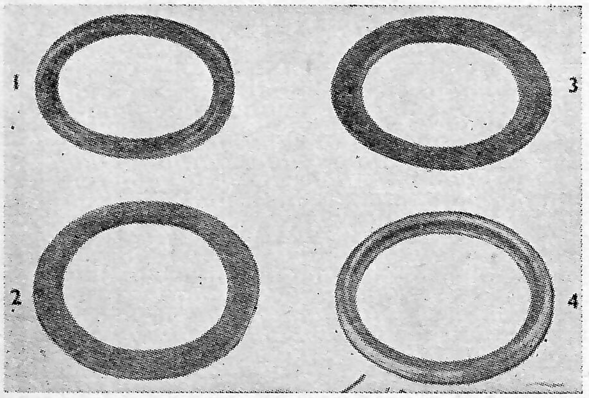


FIG. 1.—This illustration shows plug gaskets in various conditions.

1—Indicating insufficient tightening down of the plug.
2—Over-tightening of the plug.
3—Correct degree of tightening.
4—New gasket before use.

Gaskets in different conditions are illustrated. The upper left-hand gasket was obviously not properly compressed, owing to the plug not being tightened down sufficiently.

On the other hand it is unnecessary and unwise to tighten up the plugs too much. What is required is a good seal between the plug and the cylinder head.

The lower left-hand gasket clearly indicates that the plug was pulled down too tightly or has been in service too long. Note its distorted condition and the evidence of blow-by, which is a prolific cause of plug overheating.

The right-hand upper gasket demonstrates a gasket in good condition, providing an adequate seal and a good path for heat dissipation.

Inspection.

After removal of the plug, the condition of the electrodes and deposits on the insulator and plug body should be examined.

If the insulator is brown in colour, the electrodes grey and the plug body dry or covered with a thin layer of soot, the engine condition and mixture strength are satisfactory.

A dry, greyish-yellow or brown insulator with a thin layer of light fawn powder deposit indicates the use of a leaded fuel or a rich mixture.

When the insulator is dry and fawn or white in colour, and the electrodes are corroded and burnt at the tips, the plug temperature is too high. This is caused either through the use of an unsuitable plug; by a weak mixture; or by high combustion temperatures.

Soot deposits, forming a black velvety coating on the insulator and plug body, show that the plug does not reach a self-cleansing temperature. This may be due to a mixture which is too rich, but if the deposit is wet it indicates that oil is also reaching the combustion space in excessive quantities. Correct operation may be restored by adjusting the mixture, but an overhaul of the engine is necessary to reduce the amount of oil passing the pistons.

After cleaning, examine the plugs for cracked insulators and the lower ends for wear produced through previous cleaning.

Whenever possible, sparking plugs should be cleaned in a special plug cleaner of the type supplied by the plug manufacturer. Oily plugs should be washed with petrol first. A compressed air jet should then be used to remove any abrasive from the interior of the plug body and the insulator. If a plug cleaner is not available, a wire brush is the best substitute. This should also be used to clean any accumulation of carbon from the threads. The thread portion of the plug body is often neglected when cleaning owing to the fact that it is not generally realised that, like the gaskets, the threads are an important means of heat dissipation and that when they are coated with carbon it retards the flow of heat from the plug and leads to overheating.

Cleaning the thread will also facilitate refitting of the plug and avoid the use of unnecessary force on the plug spanner.

Having ensured that the plug is thoroughly clean and still serviceable, the electrodes should be reset. A combination gauge and setting tool produced by the makers of Champion plugs greatly facilitates the correct and easy setting of the sparking plug points, but care should be taken to avoid a false reading through distortion of the points by burning.

When resetting the points, the side electrode only should be adjusted to give the correct clearance.

Never bend the centre electrode.

Remember that electrode end corrosion and the development of oxides at the gap area vitally affect the sparking efficiency. The special plug cleaner can remove oxides and deposits from the insulator, but the cleaner stream does not always reach this area with full effect owing to its location, and cannot necessarily deal with corrosion effectively as this sometimes requires too strong a blast for proper removal.

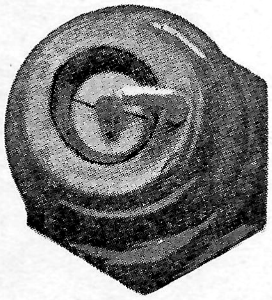


FIG 2.—Here is shown a plug with a cracked insulator.

When plugs appear worthy of further use it is good practice to dress the gap area on both centre and side electrodes with a small file before resetting them to the correct gap. The intense heat, pressures, explosion shock, electrical and chemical action to which the plugs are submitted during miles of service are so intense that the molecular structure of the metal of the points is eventually affected. Plugs then reach a worn out condition where resetting of the points no longer serves a useful purpose and where plug replacement is called for. Every 12,000 miles new plugs should be fitted.

Before replacing a used plug in the engine, test it for correct functioning under air pressure in a plug tester, following out the instructions issued by the makers of the tester. Generally speaking, a plug may be considered satisfactory if it sparks under a pressure of 100 lbs. sq. in. with the gap between the points set at .022.

While the plug is under pressure in the tester it should be inspected for leakage by applying oil round the terminal and insulator. Leakage is indicated by the production of air bubbles, the intensity of which give an indication of the degree of leakage. The leaking gases have a "blow-torch" effect when the engine is running, which rapidly raises the temperature of the plug to above its heat range, thus producing overheating, pre-ignition and rapid electrode destruction.

The top half of the insulator is also frequently responsible for poor plug performance due to the following faults: Splashes, accumulation of dirt or dust, cracked insulators, caused by a slipping spanner, over-tightness of the terminals. Examine for a cracked insulator at the shoulder and the terminal post and remove any accumulation of dirt and dust.

Since each engine design has its own particular working temperature and pressure inside the cylinder, it is essential that only sparking plugs recommended by the car maker be used. A plug designed for a hot dry engine will not function satisfactorily in relatively cool oily engines, as it will constantly oil up and cause trouble. On the other hand, a plug suitable for the oily engine will not function in the hot type engine as the points will overheat and cause pre-ignition.

The threaded portion or reach of the plug is also important since it determines the position of the points in the combustion chamber and may produce pre-ignition if the threads on the plug body protrude beyond the cylinder head.

SECTION L

WHEELS AND TYRES

	Front	Rear
Wheels		
Type	Wellbase, easy clean (4A). Pressed disc (4AB).	
Size	3.00D x 16.	
Tyres		
Size	5.00 - 16.	
Normal pressure	20 lbs. per sq. in.	22 lbs. per sq. in.
Fully laden with passengers and luggage	20 lbs. per sq. in.	25 lbs. per sq. in.

General.

One of the principal functions of the tyres fitted to a car is to eliminate high frequency vibration. They do this by virtue of the fact that the unsprung mass of each tyre—the part of the tyre in contact with the ground— is very small.

Tyres must be flexible and responsive. They must also be strong and tough to contain the air pressure, resist damage, give long mileage, transmit driving and braking forces, and at the same time provide road grip, stability and good steering properties.

Strength and resistance to wear are achieved by building the casing from several piles of cord fabric, secured at the rim by wire bead cores, and adding a tough rubber tread.

Part of the work done in deflecting the tyres on a moving car is converted into heat within the tyres. Rubber and fabric are poor conductors and internal heat is not easily dissipated. Excessive temperature weakens the tyre structure and reduces the resistance of the tread to abrasion by the road surface.

Heat generation, comfort, stability, power consumption, rate of tread wear, steering properties and other factors affecting the performance of the tyres and car are associated with the degree of tyre deflection. All tyres are designed to run at pre-determined deflections, depending upon their size and purpose.

Load and pressure schedules are published by all tyre makers and are based on the correct relationship between tyre deflection, tyre size and load carried and inflation pressure. By following the recommendations, the owner will obtain the best results both from the tyres and the car.

Inflation Pressures.

Pressures should be checked when the tyres are cold, such as after standing overnight, and not when they have attained normal running temperatures.

Tyres lose pressure, even when in good condition, due to diffusion of the compressed air through the tube walls. The rate of loss in a sound car tyre is usually between 1 lb. and 3lbs. per week, which may average 10 per cent. of the total initial pressure.

For this reason, and with the additional purpose of detecting slow punctures, pressures should be checked with a tyre gauge applied to the valve not less often than once per week.

Any unusual pressure loss should be investigated. After making sure that the valve is not leaking, the tube should be removed for a water test.

Do not over inflate, and do not reduce pressures which have increased owing to increased temperature.

Valve Cores and Caps.

Valve cores are inexpensive and it is a wise precaution to renew them periodically.

Valve caps should always be fitted, and renewed when the rubber seatings have become damaged.

Tyre Examination.

Tyres should be examined for:—

Inflation pressures.

Degree and regularity of tread wear.

Misalignment.

Cuts and penetrations.

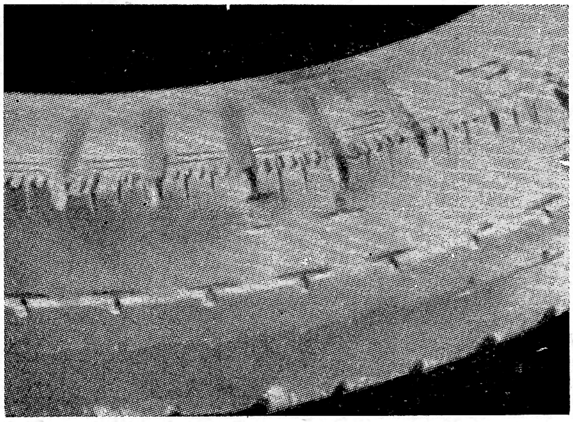


FIG. 1.—Excessive tyre distortion from persistent under-inflation causes rapid wear on the shoulders and leaves the centre standing proud. If the effects of under-inflation are aggravated by other factors such as camber and excessive braking, irregular and rapid wear will be more pronounced.

Small objects embedded in the treads, such as flints and nails.

Impact bruises.

Kerb damage on walls and shoulders.

Oil and grease.

Contact with car (tyre tread to car or tyre tread to track rod, etc.).

Oil and grease should be removed by using petrol sparingly. Kerosene is not sufficiently volatile and is not recommended.

Repair of Injuries.

Minor injuries confined to the tread rubber, such as from small pieces of glass or road dressing material, require no attention other than the removal of the objects. Cold filling compound or "stopping" is unnecessary in such cases.

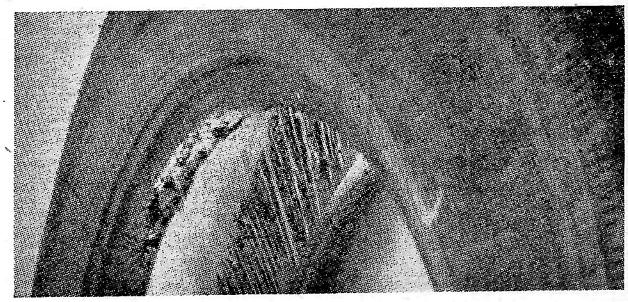


FIG. 3.—Running deflated has destroyed this cover and tube.

More severe tread cuts and wall rubber damage, particularly if they penetrate to the outer ply of the fabric casing, require vulcanized repairs.

Injuries which extend into or through the casing except clean nail holes, seriously weaken the tyre. Satisfactory repair necessitates new fabric being built in and vulcanized. This requires expensive plant and should be undertaken by a tyre specialist or by the tyre maker.

Loose gaiters and "stick-in" fabric repair patches are not satisfactory substitutes for vulcanized repairs and should be used only as a temporary "get-you-home" measure if the tyre has any appreciable tread remaining. They can often be used successfully in tyres which are nearly worn out and are not worth the cost of vulcanized repairs.

Clean nail holes do not necessitate cover repairs. If a nail has penetrated the cover the hole should be sealed by a tube patch attached to the inside of the casing. This will protect the tube from possible chafing at that point.

If nail holes are not clean, and particularly if frayed or fractured cords are visible inside the tyre, expert advice should be sought.

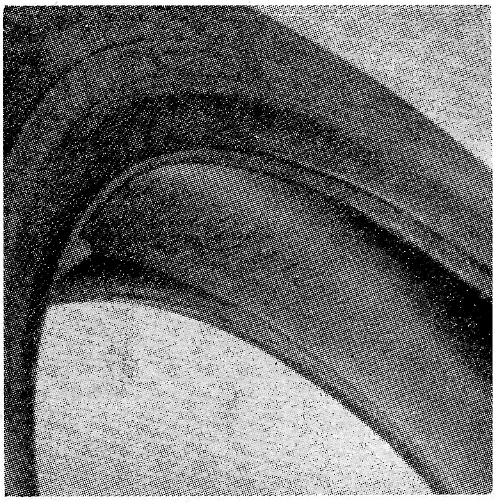


FIG. 2.—The casing is breaking up due to overflexing and heat generation.

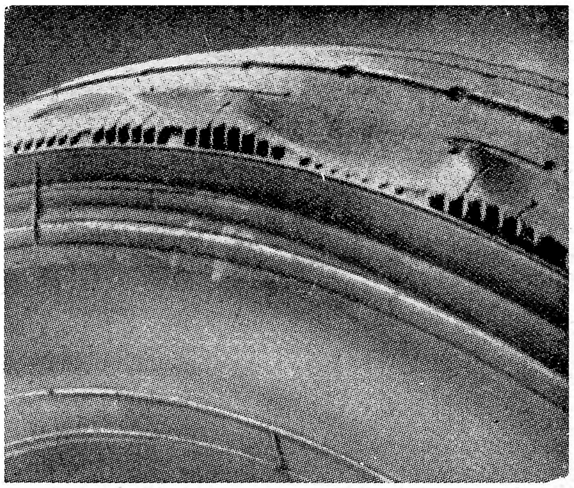


FIG. 4.—This local and excessive wear is due to brake drum eccentricity.

Factors Affecting Tyre Life and Performance.

Inflation Pressures.

Other things being equal, there is an average loss of 13% tread mileage for every 10% reducition in inflation pressure below the recommended figure.

The tyre is designed so that there is minimum pattern shuffle on the road surface and a suitable distribution of load over the contact area of the tyre when deflection is correct.

Moderate under-inflation causes an increased rate of tread wear, although the appearance of the tyre may remain normal. Severe and persistent under-inflation produces unmistakable evidence on the tread. It also causes structural failure due to excessive friction and temperature within the casing.

Pressures which are higher than those recommended for the car reduce comfort. They may also reduce tread life due to a concentration of the load and wear on a smaller area of tread, aggravated by increased wheel bounce on uneven road surfaces.

In any event, cold tyres should not be inflated to pressures higher than the maximum figure recommended. Excessive pressures over-strain the casing cords, in addition to causing rapid wear, and the tyres are more susceptible to impact fractures and cuts.

Temperature.

Air expands when heated and tyre pressures increase as the tyres warm up. Pressures increase more in hot weather than in cold weather and as the result of high speed. These factors are taken into account when designing the tyre and in preparing load and pressure schedules.

Pressures in warm tyres should not be reduced to standard pressures for cold tyres. "Bleeding" the tyres increases their deflections and causes their temperatures to climb still higher. The tyres will also be under-inflated when they have cooled.

Speed.

High speed is expensive and the rate of tread wear may be twice at fast at 50 m.p.h. as at 30 m.p.h.

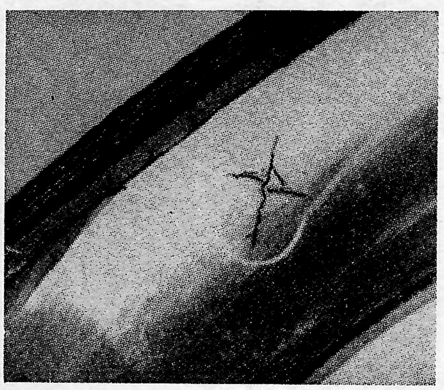


FIG. 5.—A severe impact has fractured this casing.

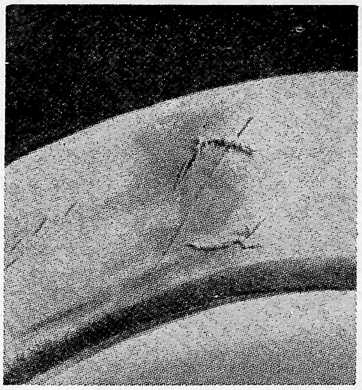


FIG. 6.—A double fracture caused by the tyre being crushed between the rim and an obstacle, such as the edge of a kerb.

High speed involves:

1. Increased tyre temperatures due to more deflections per minute and a faster rate of deflection and recovery. The resistance of the tread to abrasion decreases with increase in temperature.
2. Fierce acceleration and braking.
3. More tyre distortion and slip when negotiating bends and corners.
4. More "thrash" and "scuffing" from road surface irregularities.

Braking.

"Driving on the brakes" increases the rate of tyre wear, apart from being generally undesirable. It is not necessary for wheels to be locked for an abnormal amount of tread rubber to be worn away.

Other braking factors not directly connected with this method of driving can affect tyre wear. Correct balance and lining clearance, and freedom from binding, are very important. Braking may vary between one wheel position and another due to oil or foreign matter on the shoes even when the brake mechanism is free and correctly balanced.

Brakes should be relined and drums reconditioned in complete sets. Tyre wear may be affected if shoes are relined with non-standard material having unsuitable characteristics or dimensions, especially if the linings differ between one wheel position and another in such a way as to upset the brake balance. Front tyres are very sensitive to any condition which adds to the severity of front braking in relation to the rear.

"Picking-up" of shoe lining leading edges can cause grab and reduce tyre life. Local "pulling-up" or flats on the tread pattern can often be traced to brake drum eccentricity. The braking varies during each wheel revolution as the minor and major axes of the eccentric drum pass alternately over the shoes. Drums should be free from excessive scoring and be true when mounted on their hubs with the road wheels attached.

Climatic Conditions.

The rate of tread wear during summer can be twice as great as during winter.

Water is a rubber lubricant and tread abrasion is much less on wet roads than on dry roads. Also the resistance of the tread to abrasion decreases with increase in temperature. Increased abrasion on dry roads, plus increased temperatures of tyres and roads cause faster tyre wear during summer periods.

When a tyre is new, its thickness and pattern depth are at their greatest. It follows that heat generation and pattern distortion due to flexing, cornering, driving and braking are greater than when the tyre is part worn. Higher tyre mileages will usually be obtained if new tyres are fitted in the autumn or winter rather than in the spring or summer. This practice also tends to reduce the risk of road delays because tyres are more easily cut and penetrated when they are wet than when they are dry. It is therefore advantageous to have maximum tread thickness during wet seasons of the year.

Road Surface.

The extent to which road surfaces affect tyre mileage is not always realised.

Present day roads generally have better non-skid surfaces than formerly. This factor, combined with improved car performance, has tended to cause faster tyre wear, although development in tread compounds and patterns has done much to offset the full effects.

Bends and corners are severe on tyres because a car can be steered only by misaligning its wheels relative to the direction of the car. This condition applies to the rear tyres as well as the front tyres. The resulting tyre slip and distortion increases the rate of wear according to speed, load, road camber and other factors.

The effect of hills, causing increased driving and braking torque with which the tyres must cope, needs no elaboration.

Road camber is a serious factor in tyre wear. This subject is discussed in a later paragraph.

Impact Fractures.

In order to provide adequate strength, resistance to wear, stability, road grip and other necessary qualities, a tyre has a certain thickness and stiffness. Excessive and sudden local distortion such as might result when striking a kerb, a large stone or brick, an upstanding manhole cover, or a deep pot-hole may fracture casing cords.

Impact fractures often puzzle the car owner because the tyre and road spring may have fractured by the blow and the weakened tyre fails some time later; there is usually no clear evidence on the outside of the tyre unless the object has been sufficiently sharp to cut it.

Special Types of Irregular Tread Wear.

"Heel and Toe" and "Saw Tooth" Wear.

This is a condition where one end of each pattern segment or stud is worn more than the other. To some extent it is latent in any non-skid pattern design and severe service conditions may cause it to develop.

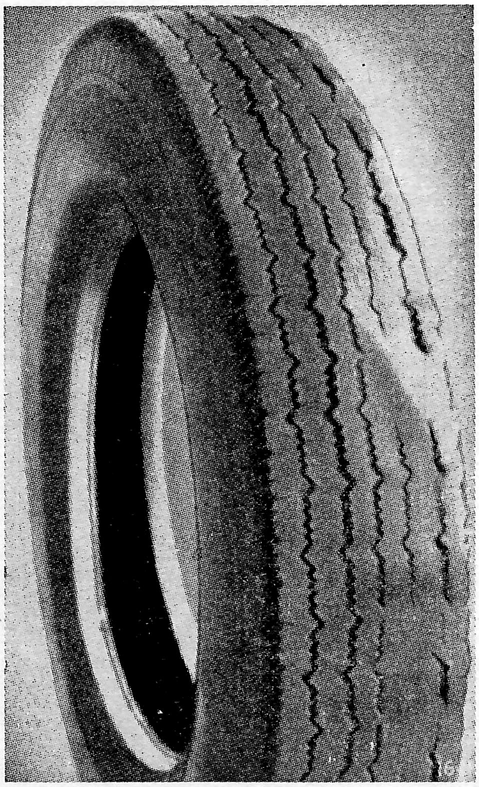


FIG. 7.—Irregular "spotty" wear, to which a variety of causes may contribute.

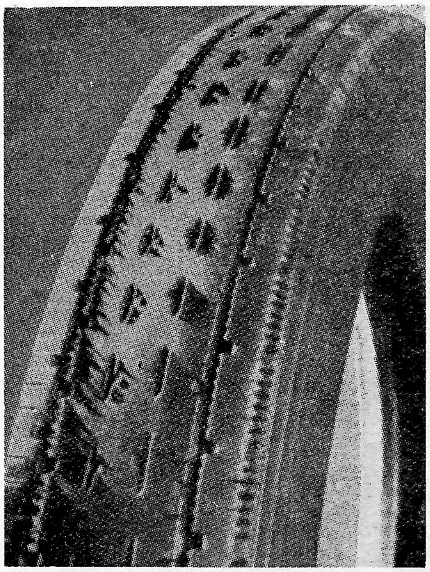


FIG. 8.—Fins or feathers caused by severe misalignment. With minor misalignment, probably aggravated by road camber, the ribs may have sharp edges instead of upstanding fins. These conditions will usually be accompanied by heel and toe wear across the tread due to its being distorted and worn away laterally instead of in a true rolling direction.

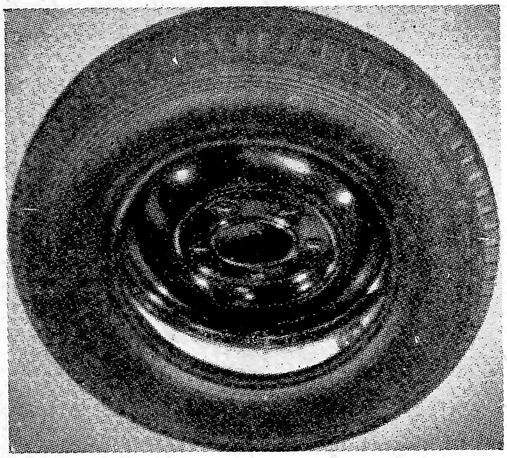


FIG. 9.—Correct fitting relationship of Dunlop covers and tubes.

When each successive portion of a running tyre comes under load the tread is flattened and there is limited pattern distortion and shuffle on the road surface. Additional movement is caused by braking, driving and the tyre's own rolling resistance, which acts as a constant retarding force.

On rear wheels the effects of braking and rolling resistance are offset by the effects of driving. Rear tyres usually wear evenly if they are properly maintained. Front tyres are at a disadvantage in this respect and their pattern displacement tends to be always in the same direction. If the tyre is assumed to be on a locked wheel and sliding forward, the abrasive road surface may be likened to a file passing across the tread. The manner in which the flexible rubber studs will be worn is clear. There is a similar but less marked effect when the tyre is revolving but trying to "hang back" under the forces of braking and rolling resistance.

Modern type patterns designed for use on hard road surfaces are very stable. In normal conditions "heel and toe" wear should be absent or barely noticeable, but any localised forces such as from eccentric brake drums, fierce or binding brakes, incorrect brake balance and severe front braking will usually cause this type of wear to appear amongst other evidence of these troubles. An unsuitable tyre contact area and distribution of load, resulting from road camber, wheel camber or excessive deflection, will also produce "heel and toe" wear.

Regular interchanging of tyres will prevent or reduce irregular wear.

"Spotty" Wear.

Irregular wear sometimes develops on front tyres and particularly on the left-hand side of front tyres. The causes are difficult to diagnose, although evidence of camber wear, misalignment, under-inflation or braking troubles may be present.

It has been explained that the front tyres are at a disadvantage due to their fore and aft slip and distortion being in one direction. Front tyres are

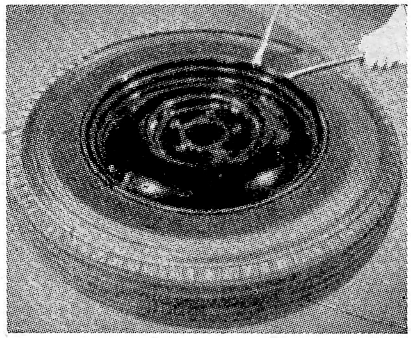


FIG. 10.—Freeing the bead from the rim.

connected to the car through swivelling stub axles and jointed steering linkage and they are subjected to complicated movements resulting from steering, spring deflection, braking and camber. Load transference during braking causes increased loading and pattern displacement on front tyres, and adds to the severity of front tyre operation.

Unbalance of the rotating assembly may also contribute to a special form of irregular wear with one half of the circumference more worn than the other half. Unbalance alone does not cause this type of "spotty" wear, but the unbalance usually becomes progressively worse as the irregular or unequal wear develops.

The nature of "spotty" wear—the pattern being much worn and little worn at irregular spacings round the circumference — indicates an alternating "slip-grip" phenomenon, but it is seldom possible to associate its origin and development with any single cause.

It is preferable to check all points which may be contributory factors. The front tyres and wheel assemblies may then be interchanged, which will also reverse their direction of rotation, or better still, the front tyres may be interchanged with the rear tyres.

Points for checking are:—

(a) Inflation pressures and the consistency with which the pressures are maintained.

(b) Brake freedom and balance, shoe settings, lining condition, drum condition and truth.

(c) Wheel alignment.

(d) Camber of both front wheels.

(e) Play in hub bearings, swivel pin bearings, suspension bearings and steering joints.

(f) Wheel concentricity at the tyre bead seats. Tolerances provide for a radial throw not exceeding one-tenth of an inch.

(g) Balance of the wheel and tyre assemblies.

Corrections which may follow a check of these points will not always effect a complete cure and it may be necessary to continue to interchange wheel positions and reverse directions of rotation at suitable intervals.

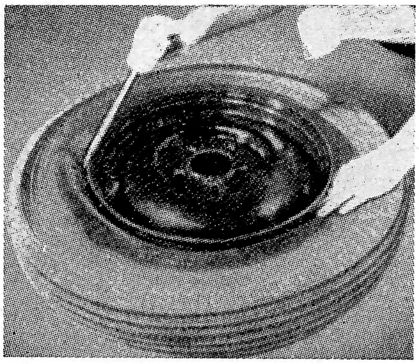


FIG. 11.—Pressing the bead into the rim opposite the valve.

Irregular wear may be inherent in the local road conditions such as from a combination of steep camber, abrasive surfaces, and frequent hills and bends. Driving methods may also be involved. Irregular wear is likely to be more prevalent in summer than in winter, particularly on new or little worn tyres.

Wheel Alignment and its Association with Camber.

It is very important that correct wheel alignment should be maintained. Misalignment causes a tyre tread to be scrubbed off laterally because the natural direction of the wheel differs from that of the car.

An upstanding sharp "fin" on the edge of each pattern rib is a sure sign of misalignment and it is possible to determine from the position of the "fins" whether the wheels toe-in or toe-out excessively.

"Fins" on the outside edges of the pattern ribs—nearest the car—and particularly on the left-hand side tyre, indicate toe-in. "Fins" on the outside edges, particularly on the right-hand side tyre, indicate toe-out.

With minor misalignment the evidence is less noticeable and sharp pattern edges may be caused by road camber even when wheel alignment is correct. In such cases, it is better to make sure by checking with an alignment gauge.

Road camber affects the direction of the car by imposing a side thrust and if left to follow its natural course the car will drift in the direction of the camber. This is instinctively corrected by steering towards the road centre.

As a result the car runs crabwise. The left-hand side tyres are very sensitive to too much toe-in and offside tyres to toe-out. From this it will be seen why "fins" may appear on the one tyre, but not on the other, and the direction of misalignment can be determined by noting the position of the "fins". Severe misalignment produces clear evidence on both tyres.

The front wheels on a moving car should be parallel. Tyre wear can be noticeably affected by quite small variations from this condition.

The left-hand front tyre sometimes persists in wearing faster and more evenly than the other tyres even when the mechanical condition of the car and tyre maintenance are satisfactory. The more severe the average road camber the more marked will this tendency be. This is an additional reason for the regular interchanging of tyres.

Precautions when Measuring Wheel Alignment.

The car should have come to rest from forward movement. This ensures as far as possible that the wheels are in their natural running position.

Alignment MUST be checked with the car laden.

With the conventional base-bar type alignment gauge measurements in front of and behind the wheel centres should be taken at the same points on the periphery of the tyres. This is achieved by marking the tyres where the first reading is taken and moving the car forward half a road wheel revolution

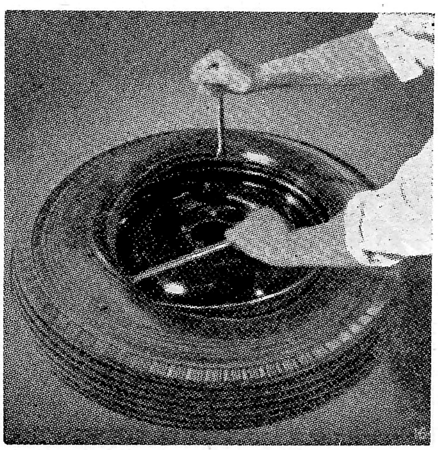


FIG. 12.—Removing one side of the cover in small steps.

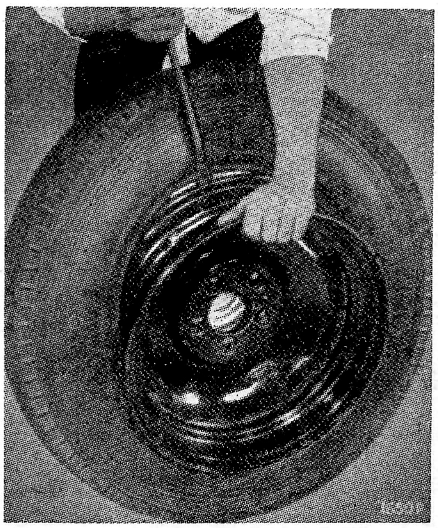


FIG. 13.—Removing the tyre, final stage.

before taking the second reading at the same points. With the Dunlop Optical Gauge two or three readings should be taken with the car moved forward to different positions—180° road wheel turn for two readings and 120° for three readings. An average figure should then be calculated. Wheels and tyres vary laterally within their manufacturing tolerances, or as the result of service, and alignment figures obtained without moving the car are unreliable. It should be remembered that this type of gauge will give the toe-in at the wheel rims and not at the tyre periphery.

With a toe-in of $\frac{1}{8}$, measured at the tyre periphery, with the vehicle laden, the reading measured at the wheel rim, will be between $\frac{1}{16}$ and $\frac{3}{32}$.

Camber.

No attention is required unless the front suspension has been disturbed by a severe impact or abnormal wear of front end bearings. It is always advisable to check the camber if steering irregularities develop.

Wheel camber, usually combined with road camber, causes a wheel to try to turn in the direction of lean, due to one side of the tread attempting to make more revolutions per mile than the other side. The resulting increased tread shuffle on the road and the off-centre tyre loading tend to cause rapid and one-sided wear. If wheel camber is excessive for any reason the rapid and one-sided tyre wear will be correspondingly greater. Unequal cambers introduce unbalanced forces which try to steer the car one way or the other. This must be countered by steering in the opposite direction which results in still faster tread wear.

When tyre wear associated with camber results from road conditions and not from car conditions, little can be done except to interchange or reverse the tyres. This will prevent one-sided wear, irregular wear, and fast wear from developing to a maximum degree on only one tyre, usually the left-hand front.

FIG. 14.—Fitting the cover. Note that the bead is pressed well into rim.

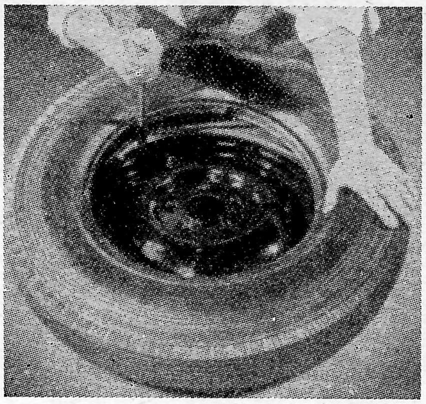


FIG. 15.—Final fitting of one bead with a lever.

Tyre and Wheel Balance.

Static Balance.

In the interests of smooth riding, precise steering and the avoidance of high speed "tramp" or "wheel hop", all Dunlop tyres are balance checked to predetermined limits.

To ensure the best degree of tyre balance the covers are marked with white spots on one bead, and these indicate the lightest part of the cover. Tubes are marked on the base with black spots at the heaviest point. By fitting the tyre so that the marks on the cover bead exactly coincide with the marks on the tube a high degree of tyre balance is achieved. When using tubes which do not have the black spots it is usually an advantage to fit the covers so that the white spots are at the valve position.

Some tyres are slightly outside the standard balance limits and are corrected before issue by attaching special loaded patches to the inside of the covers at the crown. These patches contain no fabric, they do not affect the local stiffness of the tyre and should not be mistaken for repair patches. They are embossed "Balance Adjustment Rubber".

The original degree of balance is not necessarily maintained and it may be affected by uneven tread wear, by cover and tube repairs, by tyre removal

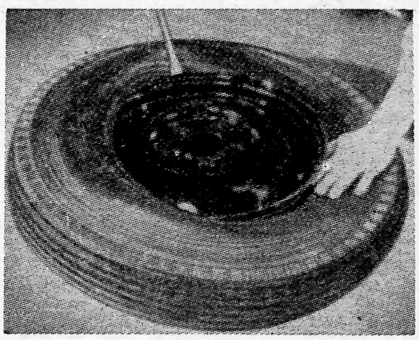


FIG. 16.—Note that this last operation is started at the bead diametrically opposite the valve.

and refitting, or by wheel damage and eccentricity. The car may also become more sensitive to unbalance due to normal wear of moving parts.

If roughness or high speed steering troubles develop, and mechanical investigation fails to disclose a possible cause, wheel and tyre balance should be suspected.

The importance of static wheel balance cannot be over-emphasised, as if the front wheel and tyre assemblies are not in static balance steering kick and roughness will result.

Dynamic Balance.

Static unbalance can be measured when the tyre and wheel assembly is stationary. There is another form known as dynamic unbalance, which can be detected only when the assembly is revolving.

There may be no heavy spot—that is, there may be no natural tendency for the assembly to rotate about its centre due to gravity—but the weight may be unevenly distributed each side of the tyre centre line. Laterally eccentric wheels give the same effect. During rotation the offset weight distribution sets up a rotating couple which tends to steer the wheel to right and left alternately. Dynamic unbalance of tyre and wheel assemblies can be measured on good tyre balancing machines and suitable corrections made when cars show sensitivity to this form of unbalance. Where it is clear that a damaged wheel is the primary cause of severe unbalance, it is advisable for the wheel to be replaced.

Changing the Position of Tyres.

There have been references to irregular tread wear and different rates of wear between one tyre and another. It has also been stated that irregular wear is confined almost entirely to front tyres and that left-hand side front tyres are likely to be more affected than right-hand side front tyres.

The causes may lie in road conditions, traffic conditions, driving methods and certain features of design which are essential to the control, steering and driving of a car. Close attention to inflation pressures and the mechanical condition of the car will not always prevent irregular wear.

It is therefore recommended that the front tyres be interchanged with the rear tyres at least every 2,000 miles. Diagonal interchanging between left-hand front and right-hand rear and between right-hand front and left-hand rear provides the most satisfactory first change because it reverses the directions of rotation.

Subsequent interchanging of front and rear tyres should be as indicated by the appearance of the tyres, with the object of keeping the wear of all tyres even and uniform.

Wheels.

Wobble.

The lateral variation measured on the vertical inside face of the flange should not exceed 1/10 inch.

Lift.

On a truly mounted and revolving wheel, the difference between the high and low points, measured at any location on either tyre seat, should not exceed 1/10 inch.

Radial and lateral eccentricity outside these limits contribute to static and dynamic unbalance respectively. Severe radial eccentricity also imposes intermittent loading on the tyre. Static balancing does not correct this condition which can be an aggravating factor in the development of irregular wear.

A wheel which is eccentric laterally will cause the tyre to "snake" on the road but this in itself has no effect on the rate of tread wear. At the same time, undue lateral eccentricity is undesirable and it affects dynamic balance.

There is no effective method of truing eccentric pressed steel wheels economically and they should be replaced.

Wheel nuts should be free on their studs. When fitting a wheel all the nuts should be screwed up very lightly, making sure that their seatings register with the seatings in the wheel.

Final tightening should be done progressively and alternately by short turns of opposite nuts to ensure correct seating and avoid distortion.

Wheels with damaged or elongated stud holes, resulting from slack nuts, should be replaced.

Rim seatings and flanges in contact with the tyre beads should be free from rust and dirt.

Tyre Fitting.

Note.—Inextensible wires are incorporated in the beads and no attempt must be made to stretch the beads over the rim flanges. Excessive force is unnecessary and may be dangerous, as it merely tends to damage the cover beads and serves no helpful purpose. Fitting and removing will be quite easy if the wire beads are carefully adjusted into the rim well. If it is found to be difficult, the operation is not being correctly performed.

The operations are more easily carried out if the cover beads are lubricated liberally with water, preferably with a little soap added. Levers should be dipped before each insertion.

To Remove.

Remove the valve cap and core to deflate the tyre and place these parts where they will be free from dirt and grit.

Free each bead in turn from its bead seat as follows:—

Insert a lever between the bead and rim, with the hollow side of the spoon or the inwardly turned end against the rim. Press the lever handle towards the tyre.

This provides a space into which a second lever may be inserted.

Insert the second lever close to the first, the hollow side of the spoon or the inwardly turned end against the bead. The tip of this lever must apply pressure on the bead close to the rim seat. Pull the lever handle away from the tyre.

Repeat at intervals round the tyre until the bead is free. Two or three circuits of the tyre may be necessary.

Insert a lever AT THE VALVE POSITION and, while pulling on this lever, press the bead into the well of the rim diametrically opposite the valve position.

Insert the second lever close to the first and prise the bead over the rim flange, holding the removed portion of the bead with the first lever.

Remove one lever and re-insert it a little further away from the first lever. Continue round the bead, PROCEEDING IN SMALL STEPS until the bead is completely removed.

Remove the tube from the cover.

Stand the wheel upright and insert a lever between the remaining bead and the rim flange, and pull the cover back over the flange. If it is difficult to remove, maintain the pressure on the lever and tap the beads with a rubber mallet where they pass over the top of the flange.

To Fit.

Before a used cover is refitted, it should be examined externally and internally for nails, flints, cuts or other damage. New and used covers should be checked to make sure no loose objects have been left inside.

Always use the correct size of tube, which should bear the same size description as the cover.

Rim seatings and flanges in contact with the tyre beads should be free from rust and dirt. Dirty rims, after being cleaned, should be treated with rim paint.

Dunlop covers and tubes marked with balance spots should be fitted so that the white spots near the cover bead coincide with the black spots across the base of the tube. This achieves a high degree of tyre balance.

Place the cover eccentrically over the rim, positioned so that when the cover and tube are fitted the white spots near the cover bead will coincide with the black spots on the tube. Press the lower bead by hand as much as possible into the well of the rim.

Insert a lever as closely as possible to the point where a bead passes over the flange and lever the bead over the flange. Repeat until the bead is completely over the flange.

Inflate the tube until it is just rounded out, i.e., without stretching it. Too much air will make the fitting operation difficult.

Dust the tube with French chalk and insert the tube in the cover with the valve through the hole in the rim, taking care that the valve, which is fitted on the side of the tube, is on the correct side of the rim.

Press the bead into the well of the rim diametrically opposite the valve and insert a lever as closely as possible to the position where the bead passes over the flange and lever the bead over the flange. Repeat until the bead is completely over the flange, finishing at the valve position.

Push the valve inwards to make sure that the tube adjacent to the valve is not trapped under the bead. Pull the valve firmly back into position and during inflation see that the valve protrudes squarely from the rim. If not, deflate the tyre and adjust the position of the cover and tube on the rim.

Inflate the tyre and see that beads are seated PROPERLY. Check the concentricity of the fitting line on the cover with the top of the flange, to ensure that the beads are seated correctly.

Remove the valve core to deflate the tube completely, but do not disturb the beads of the cover. Then re-inflate to the recommended pressure. The object of double inflation is to permit any stretched portions of the tube to re-adjust themselves in the cover and relieve any strains in the tube.

SECTION M

SHOCK ABSORBERS

Make		Armstrong and Girling.
Type		Hydraulic.
4A—Piston type, front and rear.		
4AB—Piston rear, telescopic front.		
SETTING	FRONT	REAR
Compression	820 lbs. in. (4A)	320 lbs. in. (4A) 400 lbs. in. (4AB)
Rebound	1,000 lbs. in. (4A)	340 lbs. in. (4A) 1,100 lbs. in. (4AB)
Leak (total)	90 lbs. in. (4A)	220 lbs. in. (4AB)

Note.—Six inch test stroke used.

ARMSTRONG DAMPERS ON THE 9 H.P. ROADSTER, SERIES 4A AND REAR SUSPENSION ON SERIES 4AB.

Construction (See Figure 1).

The body (A) is a zinc die casting and bolts directly on to the frame of the car, the two cylinders (B and C) being connected by passages (E and F). The double crank (G) and arm (H) are a force fit on serrated portions of the spindle (I), which rotates in the body on generous double bearings. Connecting rods (J) connect the crank to the pistons (K), to which non-return recuperating valves (N) are fitted. The arm (H) is connected to the axle of the car by a link (L).

Operation.

As the axle moves to and from the car frame, so the pistons move in and out of their respective cylinders pumping oil from one to the other. The interior of the body is filled with oil to within $\frac{3}{8}$ of the top of the cover, any shortage of oil beneath the pistons is instantly made good through the recuperating valves.

The flow of oil, however, is governed by the orifice relief valve.

As the axle moves towards the car frame, oil is pumped from cylinder (B) to cylinder (C), passing through a hole between the disc (W) and the valve (V), which has been set to a pre-determined resistance. When this leak resistance is exceeded, the excess pressure opens the spring-loaded valve (V) and the oil passes to the cylinder (C) at a constant pressure. On the return or rebound stroke, oil is pumped from the cylinder (C) to cylinder (B), and as the valve (V) only operates in one direction the oil must find its way to the cylinder (B) through the holes in the valve (V) and through the orifice as previously described. The disc (W), held up to the face of the valve (V), by means of a spring located on the stem (X), provides the spring-loaded valve which operates in the manner described above, but in the opposite direction. This arrangement of valve provides for separate and independent adjustment in each direction, so that the compression and rebound resistance may be equal or unequal as desired, or single acting in either direction. All this depends on the strength of the springs.

For the correct functioning of these shock absorbers, it is essential that Armstrong super shock absorber oil only is used.

GIRLING DA TYPE DAMPERS ON THE FRONT SUSPENSION OF THE SERIES 4AB.

The body of the damper is telescopic, and it forms a strut between the axle assembly and the frame of the car. It consists 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. Inside this cylinder is a piston carried on a long piston rod. This has a rubber-bushed eye or screwed stem at its top 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 a 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.

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 cap 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 to the reservoir tube. The cylinder is normally completely full of fluid and the reservoir tube is full to within $1\frac{1}{2}$ inches from the top.

Operation (Figure 2).

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 the 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

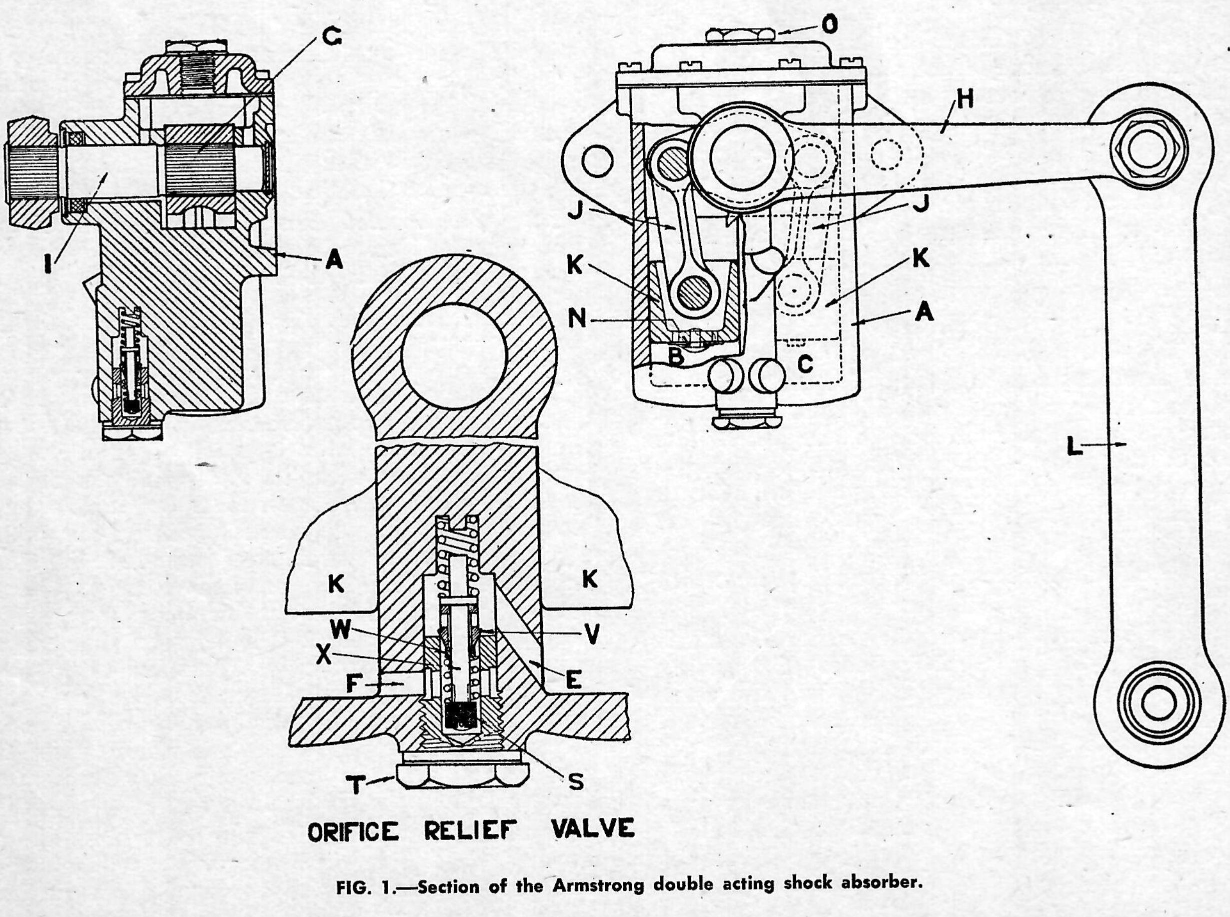


FIG. 1.—Section of the Armstrong double acting shock absorber.

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 laminated spring washer will be opened. When the car wheel is over the bump, the road spring commences to return to the 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

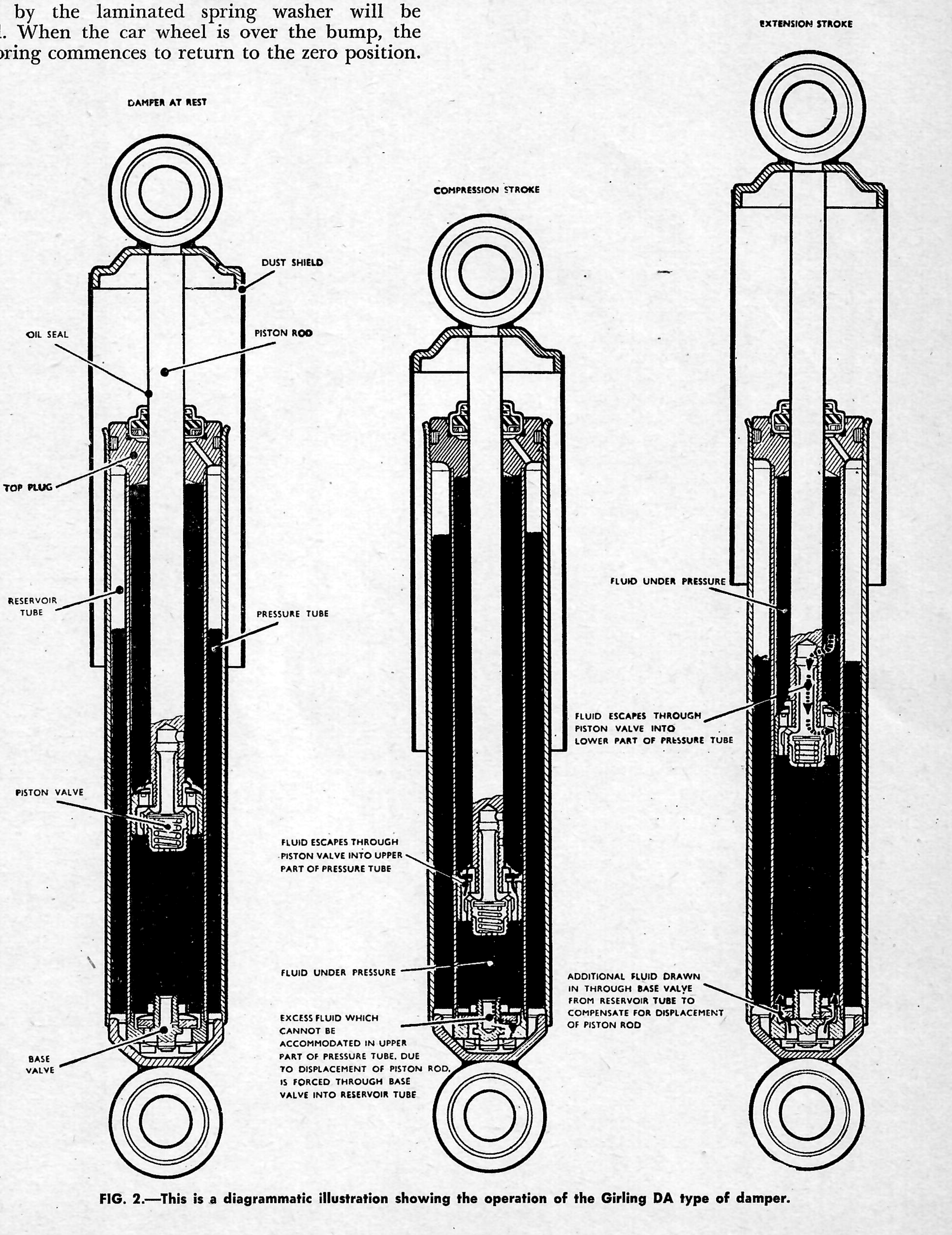


FIG. 2.—This is a diagrammatic illustration showing the operation of the Girling DA type of damper.

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.

Road Depression.

Next can be considered operations when the damper is in the 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.

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. The 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 the damper compression caused by a wheel passing over a bump.

The foregoing gives an illustration of the cycle 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.

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 the 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.

General Servicing.

Complaints of Bad Riding.—It is unfortunate that a very large number of motorists have a completely mistaken idea as to the correct function of the damper, and if the "ride" of the car is not just as they think it should be, they might immediately attribute this to inefficient dampers.

An endeavour has been made to explain the true functions of these units, and when a vehicle is riding badly, it is essential that all factors affecting the suspension be examined carefully.

When describing the function of the damper a brief reference was made to the fact that the tyres form a part of the suspension system. It is not generally appreciated how important a part they play. The most perfectly sprung car may be made uncomfortable if the tyre pressures are not correct. One of the first items to check, when the riding is uncomfortable, is the tyre pressure. All tyre pressures should be set according to the information in the data given in the Tyre Section.

The road springs and shackles play a vital part in the suspension system, and badly weathered springs will ruin the "ride" of the vehicle. These should be examined and replaced where necessary.

Always ensure that all "U" bolts and shackle pins are tight.

Testing the resistance of dampers by hand.—The damper connecting links should be disconnected and the lever arms worked by hand. The resistance should be uniform in any one damper throughout the stroke of the lever and the left side and right side approximately the same. It should be noted that the word "approximately" is used. This is because when moving the lever by hand, it can be moved at only a very slow speed; under these conditions the "feel" is influenced by such things as gland friction, etc., and the actual amount of hydraulic resistance which is exerted at road speeds may not be truly represented. Providing the resistance is uniform throughout the stroke and the right side and left side do not differ widely at hand speeds, they may be taken as satisfactory.

Investigating noisy dampers.—The bolts which secure the dampers to the chassis should be checked for tightness. The anchorage of the lower end of the connecting links to the axles and the connecting link bearings are further points which should be looked at. If the various bolts are tight, the damper connecting links should be disconnected and each lever arm moved by hand. If there is free movement of the arm it denotes lack of fluid, by the piston or vane slapping against the fluid after passing through the air gap. The remedy is to top-up with the recommended fluid and work the lever by hand to expel the air and recuperate the working chamber. A case may be met, however, where no free movement is present, or where topping-up with fluid has dispelled the free movement of the arm and the resistance is uniform throughout the stroke—but the noise continues. Obviously a further search must be made. It is well known how difficult it is to locate the noise whilst driving, and a simple method of determining if the noise is in the dampers or not, is to take a short run on the road with each damper connecting link in turn disconnected. If a noise is present when one of the links is connected and absent when it is disconnected (and the fixing bolts are tight and the linkage correct), the noise is located as being in that particular unit. The noisy damper should be removed, and if it cannot be corrected by the usual maintenance methods it should be returned to the manufacturers, as some internal mechanical fault will have developed. A loose lever arm may also cause noise.

A word here of the importance of expelling air from the pressure chambers of the piston type units before refitting them to the car. It is imperative that all air be expelled by working the lever arm up and down through the full stroke, and furthermore, after expelling the air, the unit must not be left lying on its side before fitting, otherwise air will re-enter. When all the air has been removed, the unit should straight away be bolted into its place or stood in its working position until it can be fitted.

Rolling on corners.—A further trouble which may be encountered is rolling on corners. It should be clearly understood that the dampers are not intended to act as an anti-rolling device. A little thought will show why this is so. We have already explained that hydraulic resistance increases with speed: now, rolling is a slow movement and this causes the dampers to offer only a low resistance to prevent slow speed roll, the amount of damping for normal straight ahead conditions would be excessive and the result of rolling does not come into the sphere of the damper's duty.

SECTION N

THE BODY

So far the main object of this book has been to point out the necessity of bestowing the utmost care and attention upon the mechanical side of the car, but at the same time the appearance and general upkeep of the body and fittings must not be overlooked.

The exterior of the body is finished with cellulose and dust can always be removed by means of a soft cloth, but mud must always be removed by washing either by a pressure pump or by a large sponge and plenty of water. Afterwards the body should be dried with a leather and then polished. The appearance of the cellulose finish is actually improved by frequent polishing and there are many excellent polishes on the market, which if used in accordance with the directions printed on the container, give very satisfactory results. On no account should metal polish be used.

Upholstery can best be cleaned with a good soap and plenty of water, but never use petrol or kerosene for this purpose.

Do not use metal polish on the chromium plate fittings—these should be cleaned by washing and, when the dirt has been removed—polishing with a soft duster.

Thoroughly brush out the floor carpets at least once a week and the instrument panel can be kept in good appearance by the occasional use of a very small amount of ordinary household wax polish.

Inspect the door hinges periodically and apply a little oil to ensure they are working easily. It is also advisable to smear the door catches and striking plates with a little grease at the same time as the hinges receive attention. Do not put too much grease on the catches and striking plates otherwise clothing may suffer on entering the car and leaving. Check over the body bolts occasionally and keep the floor and pedal boards tight—the latter are a frequent cause of rattles and a little care will always prevent them from working loose.

See that the spare wheel is kept tight in the rear locker and that tools are always replaced and kept tight in their containers.

The best and correct way of washing road wheels is to remove them from the car. They can be washed in position if water is applied by means of a brush or large sponge, but if water is forced on to the wheels at high pressure, there is a very big change of it entering the drums and causing a certain amount of inconvenience so far as braking is concerned.

To Stow the Hood and Side Curtains.
Roadster and Series 4A.

The erection, lowering and stowing away of the hood and side curtains is quite a straight-forward matter, but the following hints are given which may be found useful. Assuming that the hood and curtains are erected, the procedure for lowering and storing away of hood and side curtains is as follows:—

Release the press studs inside the car for the side panels of the hood.

Release the zipp fasteners in the side panels of the hood.

Release the lift-the-dot fasteners from the front windscreen, and throw the hood back over the hoop sticks.

To release these fasteners, insert the tips of the fingers of one hand behind the piping of the hood material and, while drawing the hood forward, raise the fasteners with the other hand.

Unscrew the knurled nuts on the hoop stick props.

Pull the back squab forward.

Lower the hoop sticks and neatly fold back, into the recess in the body, the rear light of the hood; at the same time pull the material from between the hoop sticks to prevent creasing.

Place the left side curtain in the recess at the back of the rear squab with the pegs pointing downwards and the inside of the curtain facing forward.

Place the right side curtain in the recess with the outside facing the rear squab board and, as before,

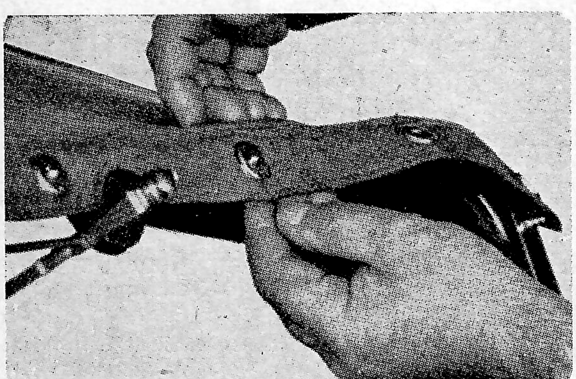


FIG. 1.—Releasing the fasteners.

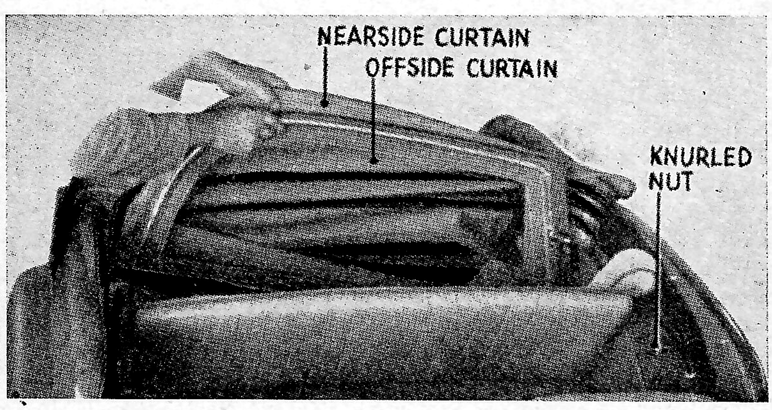


FIG. 2.—Fitting the side curtains in their stowage.

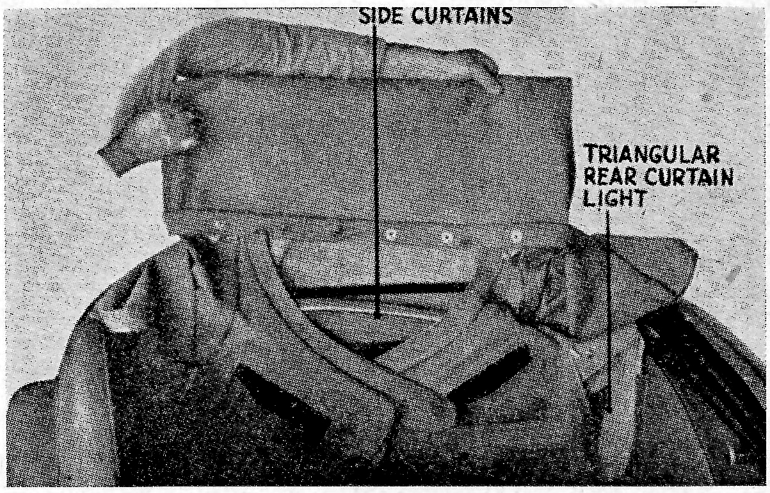


FIG. 3.—Curtains fitted in recess.

with the pegs pointing downwards. It may be necessary to lift the left side curtain slightly to ensure that both curtains can be inserted well towards the bottom of the recess.

Note.—When glass side curetains are being stored, position the rear side curtains between the rear panel of the body and the outside of the left side glass side curtains.

Fold inwards the right side rear side curtain along the seam of the triangular light, and place the complete rear side curtain against the right side curtain.

Similarly treat the left side curtain.

Fold for about 6 inches both the side edges of the hood and also the front edge for about a foot. The hood should now be folded over the two side curtains in the recess and tucked well in between the curtains and the forward wall of the body recess.

Replace the back squab into position and fasten first the central lift-the-dot fastener on cars with nine fasteners, and the two central studs simultaneously in cars with ten fasteners.

The remainder should then be fastened alternately on either side.

If these instructions are carefully carried out, the rear squab will go back sufficiently far enough to allow the cover to be fastened satisfactorily. A slight amount of tension, however, in this cover may be present, and is necessary to eliminate rattle.

To Fit the Tonneau Cover.

Roadster and Series 4A.

The zipp fastener on the tonneau cover must be closed.

Fit the tonneau cover completely across the scuttle.

Fit the tonneau cover to the left side rear corner stud, and then to the corresponding stud on the right side.

Note.—The studs referred to above are the rearmost studs of the three on each side of the body.

Fit the cover to the centre stud on the car with nine studs, and on a car with ten studs to the two centre studs.

Fit the cover to the rear studs—left first, then right.

Finally, fit the cover to the studs on the sides of the body.

If the driver requires to use the tonneau cover for the protection of the remainder of the car while on the road, then the zipp fastener should be released and the tonneau cover removed from the driver's seat.

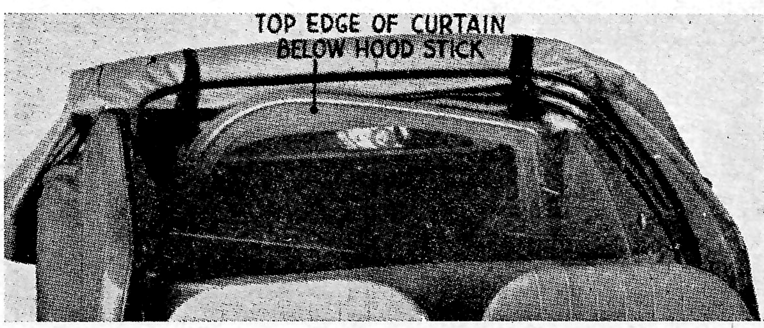


FIG. 4.—Method of folding the hood.

SECTION O

ELECTRICAL

Coil

Make	Lucas.
Model	Q12-10.
Service number	45020A.
Current consumption:	
Running	1.4 amps.
Stall	2.7 amps.

Distributor

Make	Lucas.
Model	DKY4A.
Service number	40192.
Direction of rotation	Clockwise from top.
Contact point gap	.010 to .012 (.014 to .016 since 1951).
Condenser capacity	.18 to .23 microfarads.
Initial advance	5° to 10° B.T.D.C. (full retard).
Automatic advance:	
Type	Centrifugal.
Commences at	200 to 300 r.p.m.
Maximum advance	16° to 18° at 1,500 r.p.m.
Cam angle	Closed 49° ±4°. Open 41° ±4°. Closed 60° ±3° } Since Open 30° ±3° } 1951.

Bulbs

	Volts	Watts
Headlamps	12	36/36
Sidelamps	12	6
Stop-tail	12	6
Ignition warning light	2.5	.5
Trafficators	12	3

Fuses

Number used	2.
Rating	35 amps. each.
Circuit	Ignition and auxiliary ignition.

Starter

Make	Lucas.
Model number	M35G.
Service number	25022B.
Voltage	12.
Lock torque	10 lbs. ft.
Lock voltage	7.6.
Lock current draw	430 amps.
Brush spring tension	32 to 40 ozs.
Number of pinion teeth	9.
Direction of rotation, commutator end	Counter-clockwise.

Dynamo

Make	Lucas.
Model	C39PVL.
Service number	22250F.
Voltage	12.
Maximum output	17 amps. at 13.4 volts.
Cut-in speed	1,050 to 1,200 r.p.m. at 13.0 volts.
Field resistance	6.1 ohms.
Brush spring tension	22 to 25 ozs. at moment of lift.
Direction of rotation, commutator end	Counter-clockwise.

Battery

Make	Lucas.
Voltage	12.
Model	GTW7A.
Capacity	38 amps. at 10 hour rate.
Earth terminal	Positive.
Number of plates per cell	7.
Height	$9\frac{1}{4}$.
Width	$6\frac{7}{8}$.
Length	$10\frac{3}{4}$.

Horn

Make	Lucas.
Model	HF1235.
Service number	70036A.
Current consumption	3.0 amps.

Windscreen Wiper

Make	Lucas.
Model	CW1 BP73.
Service number	732687.
Current consumption	Total 2.5 amps. Field .8 amp.

Description.

The electrical equipment is of the 12 volt type, incorporating constant voltage control for the charging circuit. The positive earth system of wiring is employed.

The battery is mounted on the dash under the bonnet and is readily accessible for examination and maintenance attention.

The dynamo is mounted on the left of the cylinder block and driven by endless belt from the engine crankshaft. A hinged mounting enables the belt tension to be adjusted.

The control box is sealed and should not normally need attention. The fuses are carried in external holders, as are the spare fuses, so that there is no need to remove the control box cover to gain access to them.

The starter motor is mounted on the flywheel housing on the right-hand side of the engine unit and operates on the flywheel through the usual sliding pinion device.

The headlamps are fitted with double filament bulbs.

The Battery.

Routine Maintenance.

In order to keep the battery in good condition, a periodical inspection should be made and the following carried out:—

(1) Topping Up.

About once a week, 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, otherwise the excess electrolyte will be thrown out of the cell. An hydrometer will be found useful for topping up, as it prevents distilled water from being spilled on the top of the battery.

Note.—In very cold weather it is essential that the car be used immediately after topping up the battery to ensure that the distilled water is thoroughly mixed with the electrolyte. Neglect of this precaution may result in the distilled water freezing, with consequent damage to the battery.

When examining the cells, do not hold naked lights near the vent holes, as there is a danger of igniting the gas coming from the plates.

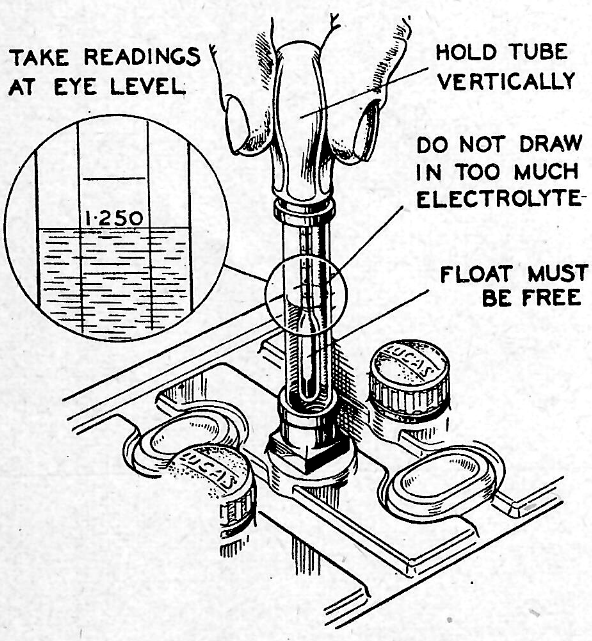


FIG. 1.—Method of using the hydrometer.

(2) Testing the condition of the battery.

Occasionally examine the condition of the battery by taking hydrometer readings. There is no better way of ascertaining the state of charge of the battery. The hydrometer contains a graduated float on which is indicated 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 to 1.300—Battery fully charged.

About 1.210—Battery about half charged.

Below 1.150—Battery fully discharged.

These figures are given assuming an electrolyte temperature of 60°F. If the temperature of the electrolyte exceeds this, .002 must be added to the hydrometer readings for each 5°F. rise to give the true specific gravity. Similarly, .002 must be subtracted from the hydrometer readings for every 5°F. below 60°F.

The readings for each of the cells should be approximately the same. If one cell gives a reading very different from the rest it may be that the electrolyte has spilled or has leaked from one of the cells, or there may be an internal fault. In this case, it is advisable to have the battery examined by a battery specialist. Should the battery be in a low state of charge, it should be recharged by taking the car for a long daytime drive or by charging from an external source of D.C. supply at a current rate of 5 amperes until the cells are gassing freely.

After examining the battery, check the vent plugs, making sure that the air passages are clear, and screw the plugs into position. Wipe the top of the battery to remove all dirt and moisture.

Storage.

If a battery is to be out of use for any length of time, it should first be fully charged and then given a freshening charge about every fortnight.

A battery must never be allowed to remain in a discharged condition, as this will cause the plates to become sulphated.

Initial Filling and Charging.

Usually the battery will have been filled and initially charged. If, however, it should be found necessary to prepare a new battery, supplied dry, proceed as follows:—

(a) Preparation of electrolyte.

The specific gravity of the electrolyte necessary to fill the new battery, and the specific gravity at the end of the charge, is as follows:—

Climate	S.G. of Filling Acid	S.G. at End of Charge
Ordinarily below 80°F.	1.350	1.280 to 1.300
Between 80°F. to 100°F.	1.320	1.250 to 1.270
Over 100°F.	1.300	1.220 to 1.240

Note.—These figures are corrected to 60°F.

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 stirred with a glass rod. Never add the water to the acid, as the resulting chemical reaction may have dangerous consequences.

To provide electrolyte of the correct specific gravity, use the following proportions of acid and distilled water:—

To Obtain Specific Gravity (Corrected to 60°F.)	Add 1 Part by Volume of 1.835 S.G. Acid to Distilled Water by Volume as Below
1.350	1.8 parts
1.320	2.2 parts
1.300	2.5 parts

Heat is produced by the mixture of acid and water, and it should, therefore, be allowed to cool before pouring it into the battery, otherwise the plates, separators and container may become damaged.

(b) Filling in and soaking.

The temperature of the filling in acid, battery and charging room should be above 32°F.

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). The quantity of electrolyte required to half fill a two volt cell is ½ pint.

(c) Duration and rate of initial charge.

Charge at a constant current of 3.5 amps. until the voltage and temperature corrected specific gravity readings show no increase over five successive hourly readings. This period is dependent upon the length of time the battery has been stored since manufacture, and will be from forty to eighty hours, but usually not more than sixty.

Throughout the charge the acid must be kept level with the tops of the separators in each cell by the addition of acid solution of the same specific gravity as the original filling-in acid.

If, during charge, the temperature of the acid in any cell of the battery reaches the maximum permissible temperature of 120°F., the charge must be interrupted and the battery temperature allowed to fall at least 10°F. before charging is resumed.

At the end of the first charge, i.e., when specific gravity and voltage measurements remain substantially constant, carefully check the specific gravity in each cell to ensure that it lies within the limits specified. If any cell requires adjustment, some electrolyte must be removed, 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. After such adjustment the gassing charge should be continued for one or two hours to ensure adequate mixing of the electrolyte. Recheck, if necessary, repeating the procedure until the desired result is obtained. Finally, adjust the electrolyte to the correct level.

The Dynamo.

To Test on the Car.

The cutting-in speed is from 1,050 to 1,200 r.p.m. at 13 dynamo volts. The output is 17 amps. at 1,800 to 2,000 r.p.m. at 13.5 dynamo volts taken on a resistance load of 0.8 ohm without the regulator.

(a) Make sure that the driving belt is not slipping, and it should be capable of being deflected approximately ½ inch at the centre of its run between the pulleys with moderate hand pressure. If the belt is too slack, tightening is effected by slackening the two bolts attaching the dynamo end plate extensions to the cylinder head, loosening the bolt attaching it to the slotted adjustment link and gently pulling the dynamo outwards by hand until the correct tension is obtained. The slotted link bolt must then be tightened, followed by the two upper bolts.

(b) Check that the dynamo and control box are connected correctly. The dynamo terminal D should be connected to the control box terminal D, and the dynamo terminal F connected to the control box terminal F.

(c) After switching off all lights and accessories, disconnect the cables from the terminals of the dynamo.

(d) Connect the two terminals with a short length of wire.

(e) Start the engine and set it to run at normal idling speed.

(f) Clip the negative lead of a moving coil type voltmeter, calibrated 0 to 20 volts, to one dynamo terminal and the other lead to a good earthing point on the dynamo yoke.

(g) Gradually increase the engine speed, when the voltmeter reading should rise rapidly and without fluctuation. Do not allow the voltmeter reading to reach 20 volts. Do not race the engine in an attempt to increase the voltage. It is sufficient to run the dynamo up to a speed of 1,000 r.p.m.

If there is no reading—check the brush gear.

If the reading is low (approximately 1 volt), the field winding may be faulty.

If the reading is approximately 5 volts, the armature winding may be faulty.

(h) Remove the dynamo cover band and examine the brushes and commutator. Hold back each of the brush springs and move the brush by pulling 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 no longer bear on the commutator, or if the brush flexible has become exposed on the running face, new brushes must be fitted. 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. Retest the dynamo; if there is still no reading on the voltmeter, there is an internal fault and the complete unit should be replaced, if a spare is obtainable.

If the dynamo is in good order, leave the temporary link in position between the terminals and restore the original connections, taking care to connect the dynamo terminal D to the control box terminal D, and the dynamo terminal F to the control box terminal F. Remove the lead from the D terminal on the control box and connect the voltmeter between this cable and a good earthing point on the vehicle. Run the engine as before. The reading should be the same as that measured directly at the dynamo. No reading on the voltmeter indicates a break in the cable to the dynamo. Carry out the same procedure for the F terminal connecting the voltmeter between cable and earth. Finally remove the link from the dynamo. If the reading is correct test the control box.

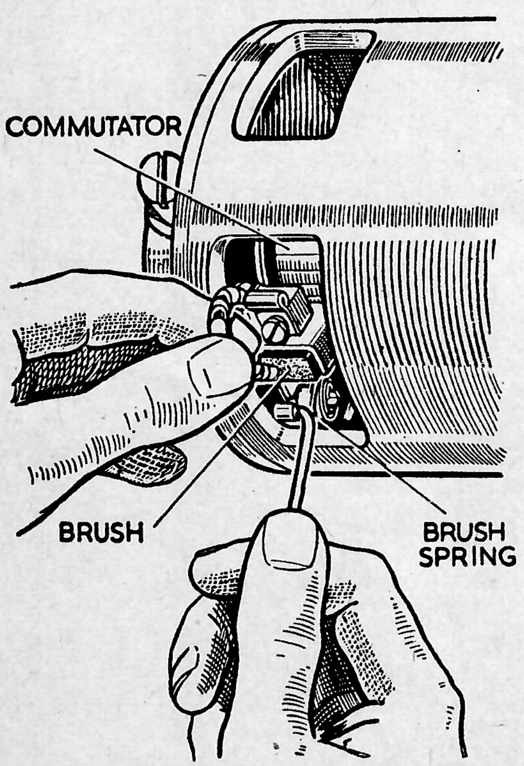


FIG. 2.—This drawing shows how spring pressure on the brush may be released.

To Dismantle.

Take off the dynamo pulley.

Remove the cover band, hold back the brush springs and remove the brushes from their holders. Unscrew the locking nuts from the through bolts at the commutator end.

Withdraw the two through bolts from the driving end.

Remove the nut, spring washer and flat washer from the smaller terminal (i.e., the field terminal) on the commutator end bracket and remove the bracket from the dynamo yoke.

The driving end bracket, together with the armature, can now be lifted out of the yoke.

The driving end bracket which, on removal from the yoke, has withdrawn with it the armature and armature shaft ball bearing, need not be separated from the shaft unless the bearing is suspected and requires examination; in which case the armature should be removed from the end bracket by means of a hand press.

To Service.

Brushes.

Test if the brushes are sticking. Clean them with petrol and, if necessary, ease the sides by lightly polishing with a smooth file. Replace the brushes in their original positions.

Test the brush spring tension with a spring scale if available. The correct tension is 20 to 25 ounces. Fit a new spring if the tension is low.

If the brushes are worn so that the flexible is exposed on the running face, new brushes must be fitted. Brushes are pre-formed so that bedding to the commutator is unnecessary.

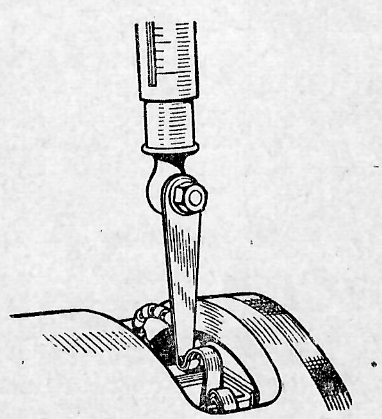


FIG. 3.—Testing brush spring tension.

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 it at high speed and take a light cut with a very sharp tool. Do not remove more metal than is necessary. Polish the commutator with very fine glass-paper. Undercut the insulators between the segments to a depth of $\frac{1}{32}$ with a hacksaw blade ground down to the thickness of the insulator.

Field Coils.

Test the field coils, without removing them from the dynamo yoke, by means of an ohmmeter. The reading on the ohmmeter should be between 6.0 and 6.3 ohms. If an ohmmeter is not available, connect a 12 volt D.C. supply with an ammeter in series between the field terminal and the dynamo yoke. The ammeter reading should be approximately 2 amps. If no reading is indicated, the field coils are open-circuited and must be replaced. To test for earthed field coils, unsolder the end of the field winding from the earth terminal on the dynamo yoke and, with a test lamp connected from the supply mains, test across the field terminal and earth. If the lamp lights the field coils are earthed and must be replaced.

When replacing the field coils, carry out the procedure outlined below, using an expander and wheel-operated screwdriver.

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

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

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

(d) Draw the pole shoes and coils off the dynamo yoke and lift off the coils.

(e) 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.

(f) Locate the pole shoes and field coils by lightly tightening the fixing screws.

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

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

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

Armature.

The testing of the armature winding requires the use of a voltage drop tester and growler. If these are not available, the armature should be checked by substitution. No attempt should be made to machine the armature core or to true a distorted armature shaft.

Bearings.

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

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

(a) Press the bearing bush out of the commutator end bracket.

(b) Press the new bearing bush into the end bracket, using a shouldered mandrel of the same diameter as the shaft which is to fit in the bearing.

Note.—Before fitting the new bearing bush, it should be allowed to stand completely immersed for twenty-four hours in engine oil. This will allow the pores of the bush to be filled with lubricant.

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

(a) Knock out the rivets which secure the bearing retaining plate to the end bracket and remove the plate.

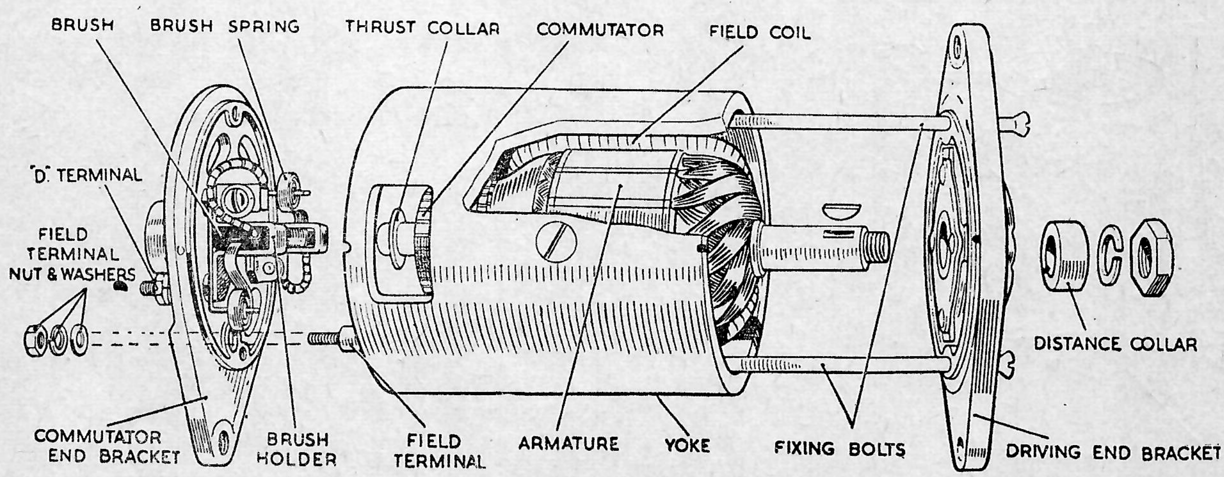


FIG. 4.—The dynamo components.

(b) Press the bearing out of the end bracket and remove the corrugated washer, felt washer and oil-retaining washer.

(c) Before fitting the replacement bearing, see that it is clean and pack it with a high melting point grease.

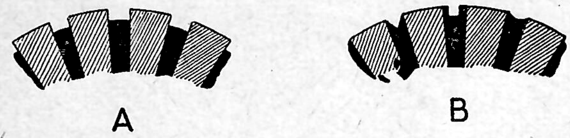


FIG. 5.—Method of undercutting the commutator insulation.

(d) Place the oil-retaining washer, felt washer and corrugated washer in the bearing housing in the end bracket.

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

(f) Fit the bearing retaining plate. Insert 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.

To Reassemble.

In the main the reassembly of the dynamo is a reversal of the operations described.

Before fitting the dynamo to the vehicle, unscrew the lubricator from the commutator end bracket, lift out the felt wick and spring and refill the cap with high melting point grease. Replace the spring and wick and screw the lubricator in position in the end bracket.

The Starter.

Type.

The identification marks are stamped on the yoke of the starter. When ordering replacements, always quote these numbers.

The lock torque is approximately 9.3 lbs. ft. with 300 to 350 amps. and 7.5 to 8.0 volts.

To Test on the Car.

Switch on the lamps and operate the starter control. If the lights go dim, but the starter is not heard to operate, an indication is given that current is flowing through the starter windings, but that the starter is meshed permanently with the geared ring on the flywheel. This has probably been caused by the starter being operated while the engine was running. In this case, the starter must be removed from the engine for examination.

Should the lamps retain their full brilliance when the starter switch is operated, check that the switch is functioning. If the switch is in order, examine the connections at the battery, starter switch and starter, and also check the wiring between these units. Continued failure of the starter to operate indicates an internal fault in the starter, and the starter must be removed from the engine for examination.

Sluggish or slow action of the starter is usually caused by a poor connection in the wiring which produces a high resistance in the starter circuit. Check as described above.

Damage to the starter drive is indicated if the starter is heard to operate but does not crank the engine.

Switch.

The starter switch is fitted on the engine side of the bulkhead and is operated by pulling the control knob in the instrument panel. The knob is connected to the switch by means of a cable. At the back of the starter switch are two terminals, from one of which two cables are connected, the heavy one to the battery and the other to the ammeter. From the second terminal a heavy cable is taken to the terminal on the commutator end bracket of the starter.

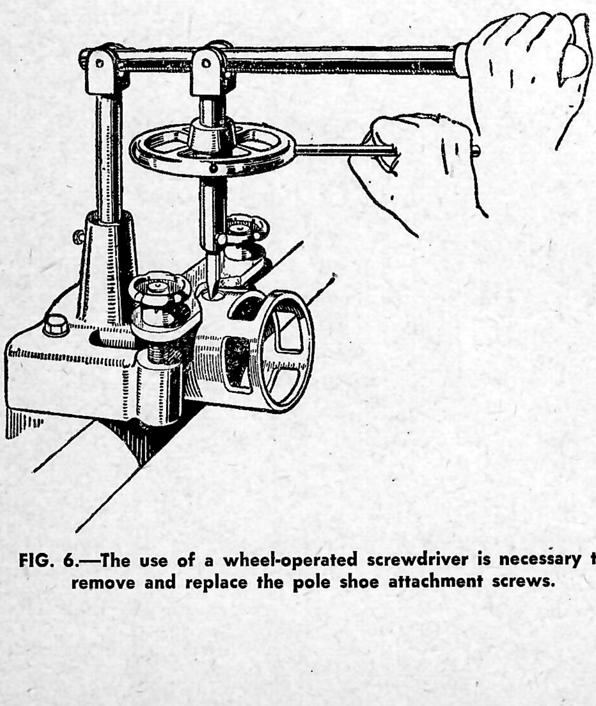


FIG. 6.—The use of a wheel-operated screwdriver is necessary to remove and replace the pole shoe attachment screws.

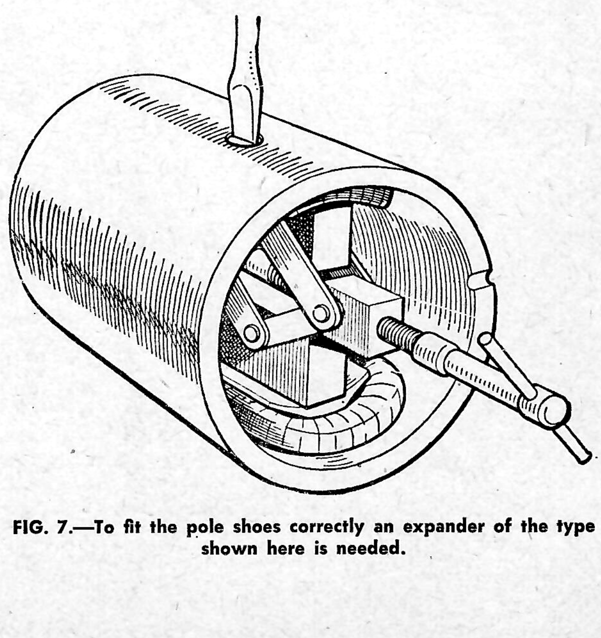


FIG. 7.—To fit the pole shoes correctly an expander of the type shown here is needed.

The Commutator and Brush Gear.

Inspect the commutator and brush gear in the manner described for the dynamo. The brush spring tension should be 30 to 40 ounces. This operation should be carried out every 12,000 miles.

In the unlikely event of brush replacement being necessary, this must be carried out by a Lucas Service Agent, as the operation entails dismantling of the starter.

The Drive.

It is recommended that the starter drive be examined every 12,000 miles, taking particular care to ensure that the pinion moves freely on the screwed sleeve. Any dirt or other foreign matter on the sleeve must be washed away with kerosene.

When the starter is operated, the rotation of the armature screws the pinion along the sleeve to mesh with the flywheel teeth. As soon as the engine starts firing, it will drive the flywheel faster than it is being driven by the starter. This will cause the pinion to screw back along the sleeve and so draw out of mesh with the flywheel teeth. A pinion restraining spring is fitted over the shaft to prevent the pinion from being vibrated into mesh when the engine is running.

In the event of the starter drive being jammed in mesh with the flywheel, it can usually be freed by turning the starter armature by means of a spanner applied to the shaft extension at the commutator end. This is accessible by taking off the small cap which is secured by two screws.

If the pinion is found to be damaged or worn, it must be replaced together with the screwed sleeve.

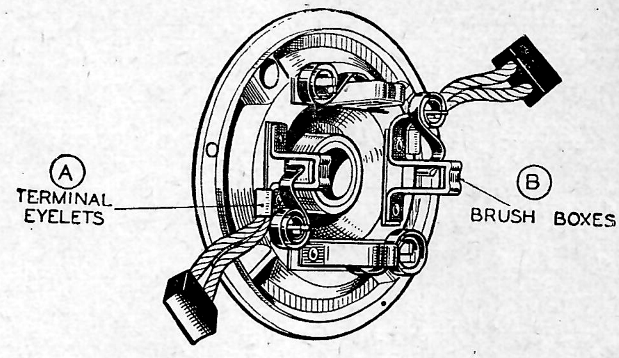


FIG. 9.—The starter end cover.

Similarly, if the main spring is broken, or the restraining spring weak, or broken, replacement must be made.

To Service the Starter.

Examination of the commutator and brush gear.

Remove the starter cover band and examine the brushes and the 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 the brushes in their original positions. If the brushes are worn so that they no longer bear on the commutator or if the brush flexible has become exposed on the running face, they must be replaced.

If the commutator is blackened or dirty, clean it by holding a petrol-moistened cloth against it while the armature is rotated.

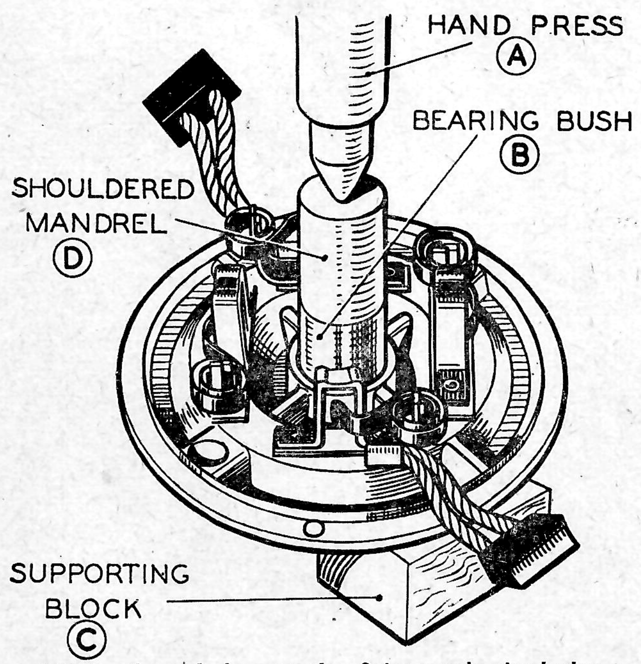


FIG. 8.—The method to use when fitting new bearing bushes.

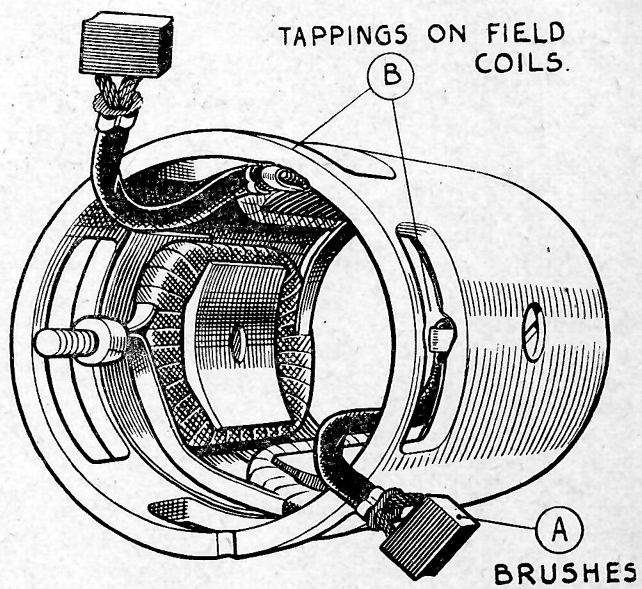


FIG. 10.—Brush connections for the starter.

To Dismantle.

Take off the cover band at the commutator end, hold back the brush springs and take out the brushes from their holders.

Withdraw the two through bolts and remove the armature complete with driving end bracket.

Remove the terminal nuts and washers from the terminal post at the commutator end bracket and remove the commutator end bracket.

Brushes.

(a) Test the brush springs with a spring scale. The correct tension is 30 to 40 ounces. Fit a new spring if the tension is low.

(b) If the brushes are worn so that they no longer bear on the commutator, or if the flexible connector has become exposed on the running face, they must be replaced. Two of the brushes are connected to terminal eyelets attached to the brush boxes on the commutator end bracket, and two are connected to a tapping on the field coils.

The flexible connectors must be removed by unsoldering and the connectors of the new brushes secured in their place by soldering. The brushes are pre-formed so that bedding of their working faces to the commutator is unnecessary.

Drive.

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

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

(c) Remove the split 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.

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

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

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

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 previously described and remove the armature from the end bracket. Now mount the armature in a lathe, rotate it at a high speed and take a light cut with a very sharp tool. Do not remove any more metal than is absolutely necessary, and finally polish with very fine glass-paper.

The insulator between the commutator segments must not be undercut.

Field Coils.

The field coils can be tested for an open circuit by connecting a 12 volt battery, with a 12 volt bulb in one of the leads, to the tapping point of the

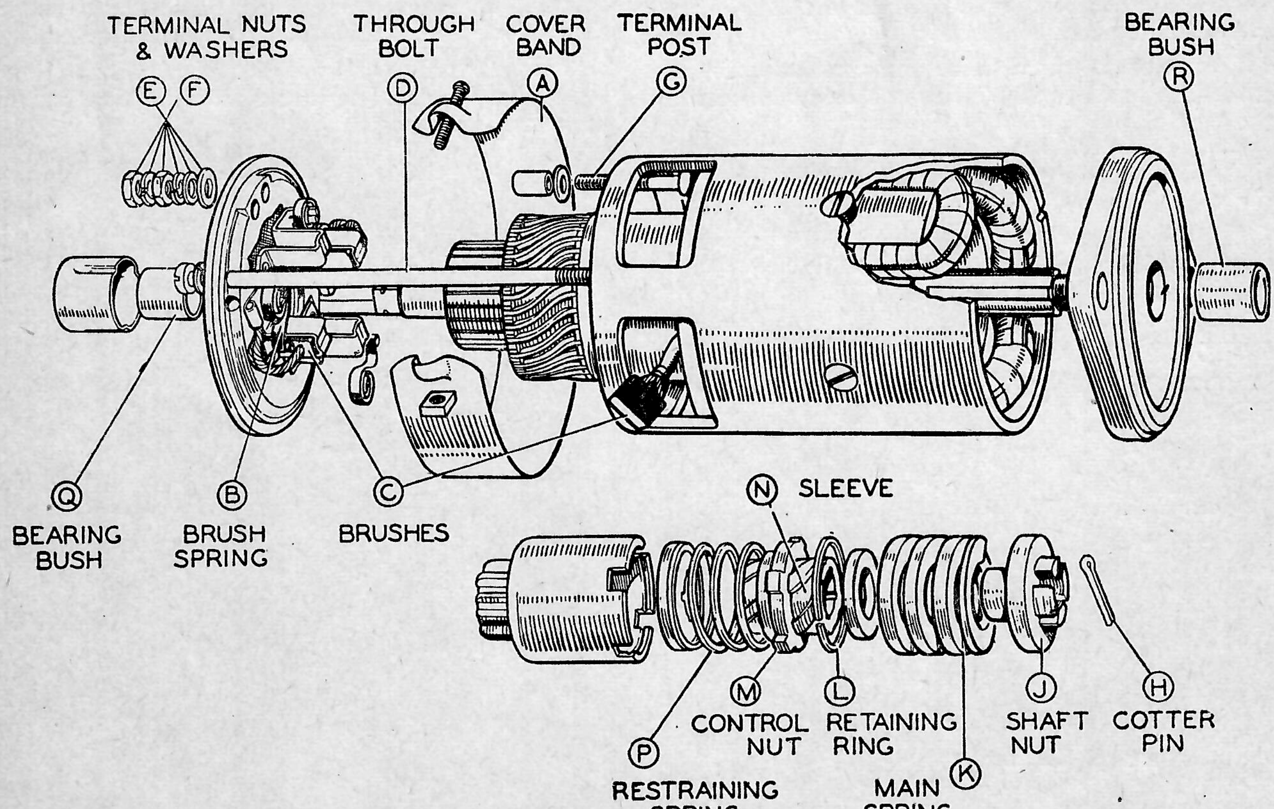


FIG. 11.—The component parts of the starter.

field coils to which the brushes are connected, and the field terminal post. If the lamp does not light, there is an open circuit in the wiring of the field coils.

Lighting of the lamp does not necessarily mean that the field coils are in order, as it is possible that one of them may be earthed to a pole shoe or to the yoke. This may be checked by removing the lead from the brush connector and holding it on a clean part of the starter yoke. Should the bulb now light it indicates that the field coils are arthed.

Should the above tests indicate that the fault lies in the field coils, they must be replaced. When replacing the field coils carry out the procedure detailed.

Armature.

Examination of the armature will in many cases reveal the cause of failure, e.g., conductors lifted from the commutator due to the starter 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.

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 bush, proceed as follows:—

(a) Remove the old bearing bush by pressing it out of the end housing, using a suitable shouldered mandrel in the press.

(b) Press the new bearing bush into the end bracket, using a shouldered mandrel of the same diameter as the shaft which is to fit in the bearing. Do not damage the bearing face.

Note.—The bearing bushes are of the porous phosphor-bronze type and before fitting them they should be allowed to stand completely imersed for 24 hours in thin engine oil in order to fill the pores of the bush with lubricant.

To Reassemble.

The reassembly of the starter is a reversal of the operation described earlier.

Note.—Secure the body of the starter in a vice and test by connecting it with heavy gauge cables to a battery of the correct voltage. One cable must be connected to the starter terminal and the other held against the starter body or end bracket. Under these light load conditions the starter should run at a very high speed.

The Control Box.

Regulator Adjustments.

The regulator is carefully set before leaving the works, to suit the normal requirements of the standard equipment, and in general it should not be necessary to alter it. If, however, the battery does not

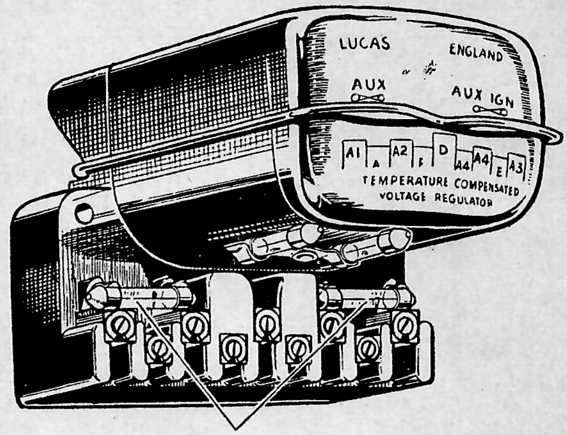


FIG. 12.—The control box.

keep in a charged condition, or if the dynamo output does not fall when the battery is fully charged, it may be advisable to check the setting and if necessary to re-adjust it.

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.

To Check and adjust the electrical setting.

Refer to Figure 13).

The regulator setting can be checked without removing the cover on the control box.

Withdraw the cables from the terminals marked A and A1 at the control box and join them together. Connect the negative lead of a moving coil voltmeter (0 to 20 volts full scale reading) to the D terminal on the dynamo and connect the other lead from the meter to a convenient chassis earth.

Slowly increase the speed of the engine until the voltmeter needle flicks and then steadies; this should

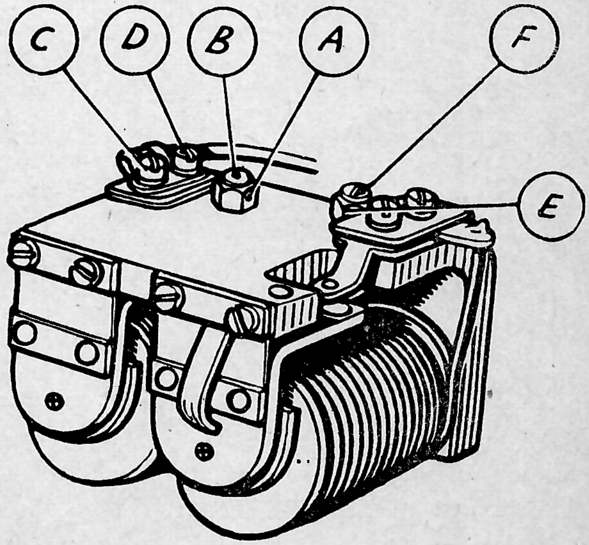


FIG. 13.—The cut-out and regulator assembly.

occur at a voltmeter reading between the limits given below for the appropriate temperature of the regulator:—

Setting at 50°F.—16.1 to 16.7 volts
Setting at 68°F.—15.8 to 16.4 volts
Setting at 86°F.—15.6 to 16.2 volts
Setting at 104°F.—15.3 to 15.9 volts

If the voltage at which the reading becomes steady occurs outside these limits, the regulator must be adjusted.

Shut off the engine, remove the control box cover and release the locknut A, holding the adjusting screw B. The screw turns in a clockwise direction to raise the setting or in an anti-clockwise direction to lower the setting. Turn the adjusting screw a fraction of a turn in the required direction and then tighten the locknut.

When the dynamo is run at a high speed on open circuit it builds up a high voltage. When adjusting the regulator do not run the engine up to more than half throttle or a false voltmeter reading will be obtained.

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, refer to Figure 14 and proceed as follows:—

(a) Slacken the two armature fixing screws E. Insert a .018 feeler gauge between the back of the armature A and the regulator frame.

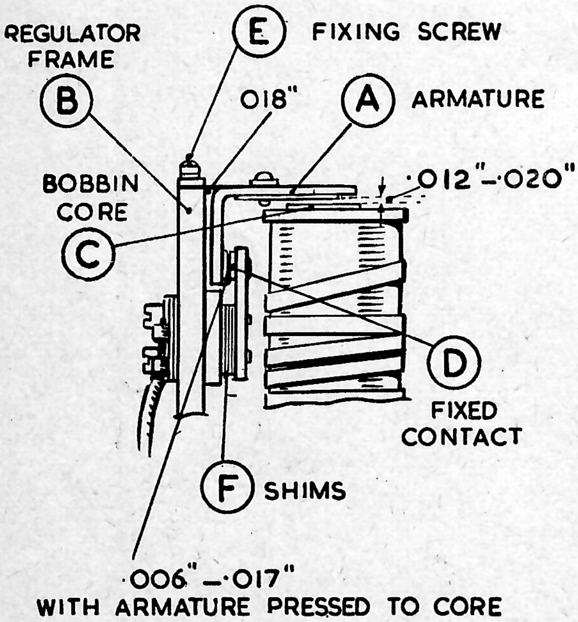


FIG. 14.—Mechanical adjustment points for the regulator.

(b) Press back the armature against the regulator frame B and down on to the top of the bobbin core C with the gauge in position, and lock the armature by tightening the two fixing screws.

(c) Check the gap between the underside of the arm and the top of the bobbin core. This must be .012 to .020. If the gap is outside these limits, correct it by adding or removing shims F at the back of the fixed contact D.

(d) Remove the gauge and press the armature down, when the gap between the contacts should be between .006 and .017.

To Clean the Contacts.

Slacken the screws securing the plate carrying the fixed contact. It will be necessary to slacken the upper screw a little more than the lower 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.

Cut-Out.
To Adjust.

If it is suspected that the cutting-in speed of the dynamo is too high, connect a voltmeter between the terminals at the control box and slowly raise the engine speed. When the voltmeter reading rises to between 12.7 and 13.3 the cut-out contact should close.

If the cut-out has become out of adjustment and operates at a voltage outside these limits, it must be reset (see Figure 13). To make the adjustment, slacken the locknut E, turn the adjusting screw F a fraction of a turn in a clockwise direction to raise the operation voltage or in an anti-clockwise direction to lower the voltage. Tighten the locknut E after making the adjustment.

To Clean.

To clean the contacts remove the cover, place a strip of fine glass-paper between them and then, closing the contacts by hand, draw the paper through. This should be done two or three times, with the rough side towards each contact.

Radio Suppression.

When it is desired to fit suppressors for radio equipment, make sure that this is done in accordance with recommended practice. Suppressors and capacitors wrongly fitted may cause damage to the electrical equipment.

Windscreen Wiper—Type CW.

The motor is a three-pole wound armature type running in a two-pole field. A celeron plate carries the brush gear for two carbon brushes which bear on the commutator.

If the wiper fails to operate or operates unsatisfactorily, proceed as follows:—

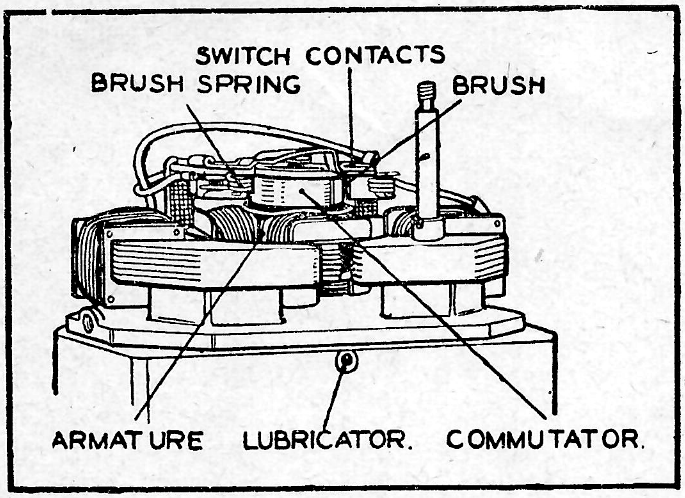


FIG. 15.—Details of the screen wiper motor.

Ascertain if the battery is supplying current to the wiper by switching on and noting if the ammeter responds.

Examine the fuse protecting the wiper. If it has blown, examine the wiring for evidence of short circuits or chafed leads. If, on replacing the fuse, it blows again, remove the wiper from the car. Momentarily connect the wiper to a battery and see if the wiper then operates satisfactorily.

1. Switch setting out of adjustment or switch contacts dirty.

If the cover of the wiper has been damaged, or if the switch has been tampered with, the contacts may be remaining permanently open. Remove the cover and see that the switch control moves freely—when the cover is removed the switch contacts should remain closed. Examine the contacts and if necessary clean them with fine emery cloth.

2. Loose or broken connections.

Remove the wiper cover and examine the wiring of the motor. If necessary, resolder any connections which are loose or broken.

3. Brush worn out or not bearing on commutator.

The brushes are carried in small boxes and are pressed against the commutator by means of springs. See that the springs press firmly on the brushes and that they do not foul the sides of the brush boxes. The brushes must be clean and move freely in their holders. To remove the brushes for examination, hold back the springs by means of a bent piece of wire and gently lever the brushes from their holders.

If the brushes are dirty or greasy, causing them to stick in their holders, clean them with a cloth moistened with petrol.

When refitting the brushes, replace them in the same boxes and in the same positions as originally fitted, in order to preserve the brush bedding.

If the brushes have become worn to such an extent that they no longer make good contact with the commutator, they must be replaced. Replacement brushes can be obtained from any Lucas agent.

4. Armature binding or bearings stiff.

Turn the armature by hand for several revolutions —if it is consistently tight the wiper probably needs lubrication. If the armature is only tight occasionally, the stiffness is probably in the gearbox or is caused by dirt or other foreign matter in the air gap between the armature and the pole shoes. Remove the wiper back plate and examine the gears and links for evidence of stiffness.

5. Commutator dirty.

Clean the commutator by means of a cloth moistened with petrol. Carefully remove any carbon dust from between the segments of the commutator.

6. Brush gear short-circuited.

This may be caused either by damage to the wiper cover or to a stray conductor making contact with the brush gear. Rectify the damage to the wiper cover or fit a new cover and remedy any other damage.

7. Armature damaged.

If, after following the preceding examination, the wiper still does not operate or its performance is unsatisfactory, the fault may be due to the armature being damaged. Fit a replacement armature.

8. Lubrication.

If the rotor is consistently stiff when turned by hand, add a few drops of thin machine oil to the lubricator provided. When examining the gearbox, if necessary, lightly pack the gears with a good quality high-melting zinc-oxide grease, such as Duckham's Keenol KG.25.

The Fuses.

The fuses are accessible without removing the cover over the cut-out and regulator.

Fuse marked "AUX.".

This fuse protects the accessories which are connected so that they operate irrespective of whether the ignition switch is "on" or "off".

It is of 35 amp. rating.

Fuse marked "AUX. IGN.".

This fuse protects the accessories which are connected so that they operate only when the ignition is switched on.

It is also of 35 amp. rating.

Units protected.

The units which are protected by each fuse can readily be identified by referring to the wiring diagram.

Blown fuses.

A blown fuse is indicated by the failure of all the units protected by it, and is confirmed by examination of the fuse, which can easily be withdrawn from the spring clips in which it fits. If it has blown, the fused state of the wire will be visible inside the glass tube. Before replacing a blown fuse, inspect the wiring of the units that have failed for evidence of a short circuit or other fault which may have caused the fuse to blow, and remedy the cause of the trouble. This is essential or the fuse is liable to blow again on replacement.

The Headlamps (Series 4A and 4AB).

Each headlamp incorporates a Lucas light unit, which consists essentially of a reflector and front glass assembly. The bulb, which is a Lucas "pre-focus" type, is located accurately in the reflector and is secured by a bayonet-fixed backshell which also provides the contact to the bulb. The design of the bulb and of its holder is such that the bulb is correctly positioned in relation to the reflector and no focussing is required when a replacement bulb is fitted.

Bulb replacement.

To gain access to the bulb, slacken the screw at the top of the lamp and remove the front rim and light unit assembly. Twist the back shell in an anti-clockwise direction and pull it off. The bulb can now be removed from the rear of the reflector. Place the replacement bulb in the holder and engage the projections of the back shell with the slots in the bulb holder, press on and secure by twisting to the right.

The Headlamps (9 h.p. Roadster).

On this model the earlier type of lamp is fitted and the bulbs may be moved in their holders to obtain the correct focus. To move the bulb it is only necessary to undo the clamping clip on the bulb holder.

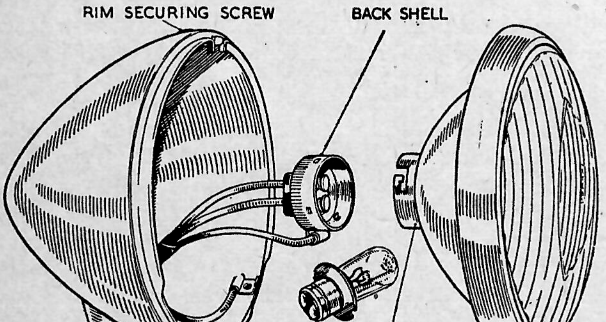


FIG. 16.—Component parts of the headlamp as fitted to Series 4A and 4AB.

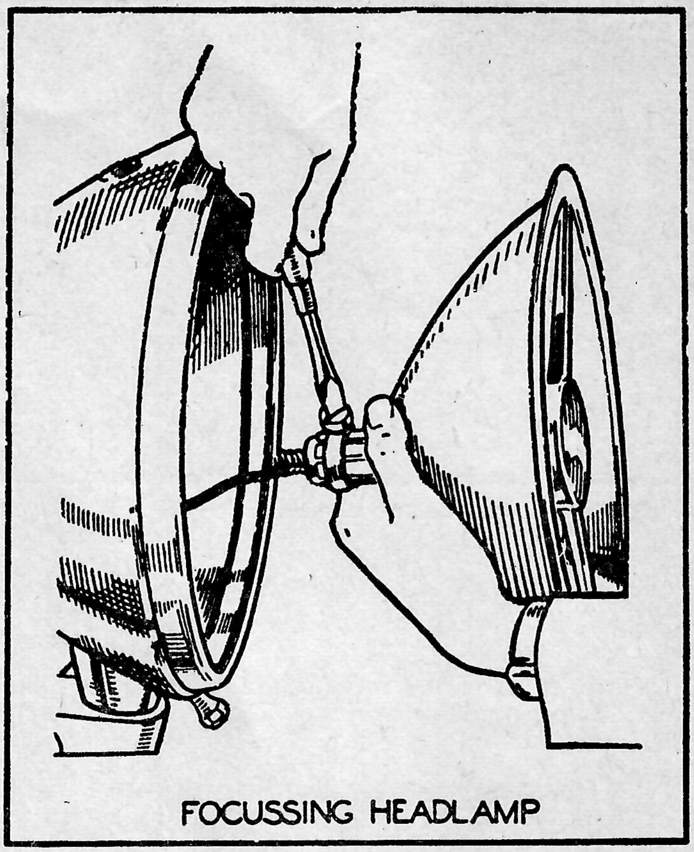


FIG. 17.—Method of setting the focus of the headlamp as fitted to the 9 h.p. Roadster.

Setting the Headlamps.

Lucas beam setter.

All Lucas service depots and many service agents now include among their special testing facilities an apparatus known as the Lucas beam setter. This is a specially designed instrument by means of which headlamps can be set with extreme accuracy, thereby ensuring the maximum efficiency from the lamps.

If it is not possible to have the lamps adjusted by this method, the procedure for setting is as follows:—

Each lamp must be set so that the main driving beam is parallel with the road surface, or in accordance with the local regulations. To make the adjustment, slacken the single fixing nut at the base of the lamp and move it on its adjustable mounting to the required position. Finally tighten the locknut.

Ignition Equipment.

Locating the Cause of Uneven Firing.

To test with the sparking plugs in position.

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

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

(c) 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.

(d) 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 new replacement plug.

(e) If there is no spark or if it is weak and irregular, examine the cable from the sparking plug to the distributor. After a long period of service, the rubber insulation may be cracked or perished, in which case the cable should be replaced. Finally, examine the distributor moulded cap, wipe the inside and outside with a clean dry cloth, see that the carbon brush moves freely in its holder and examine the moulding closely for signs of breakdown. After long service, it may have become tracked, that is, a conducting path may have formed between two or more of the electrodes or between one of the electrodes and some part of the distributor in contact with the cap. Evidence of a tracked cap is shown by the presence of a thin black line in the places indicated. A replacement distributor cap must be fitted in place of one that has become tracked.

Testing Low Tension Circuit.

To test in position.

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

(b) Check that the contacts are clean and free from pits, burns, oil or grease. Turn the engine and check that the contacts are opening and closing correctly and that the clearance when the contacts are fully opened is as set out in the data section. Correct the gap if necessary.

(c) Disconnect the cable at the contact breaker terminal of the coil (C.B.) 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.

To locate a fault.

(a) Having determined, by testing as previously described, 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.

(b) Refer to the wiring diagram and check the circuit with a voltmeter (0 to 20 volts) as follows:—

Note.—If the circuit is in order the reading on the voltmeter should be approximately 12 volts.

(c) **Battery to starter switch terminal.** Connect a voltmeter between the starter switch terminal and a good earthing point. No reading indicates a damaged cable or loose connections.

(d) **Starter switch to ammeter (brown lead).** Connect a voltmeter to the ammeter terminal and the ignition coil terminal SW and to earth. No reading indicates a damaged cable or loose connections.

(e) **Ammeter.** Connect the voltmeter to the other ammeter terminal and earth. No reading indicates a faulty ammeter, which must be replaced.

(f) **Ammeter to control box terminal A (brown with white lead).** Connect the voltmeter to the control box terminal A and earth. No reading indicates a faulty cable or loose connection.

(g) **Control box terminal A1.** Connect the voltmeter to the control box terminal A1 and earth. No reading indicates a fault in the series winding of the control box.

(h) **Control box terminal A1 to lighting and ignition switch terminal A (brown with blue lead).** Connect the voltmeter to A terminal on the switch and earth. No reading indicates a faulty cable or loose connections.

(j) **Lighting and ignition switch terminal IG.** Connect the voltmeter to IG terminal on the switch and earth. No reading indicates a fault in the switch, which must be replaced.

(k) **IG terminal to control box terminal A3 (white lead).** Connect the voltmeter to A3 terminal on control box and earth. No reading indicates a faulty cable or loose connections.

(m) **Ignition coil.** Disconnect the cable from the CB terminal of the ignition coil and connect a voltmeter to this terminal and to earth. No reading indicates a fault in the primary winding of the coil and a replacement coil must be fitted.

(n) **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. No reading indicates a damaged cable or loose connections.

(o) **Contact breaker and condenser.** Connect the voltmeter across the contact breaker points. No reading indicates a fault in the condenser.

High Tension Cables.

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

(b) To fit the cables, thread the knurled moulded terminal nut over the lead, bare the end of the cable for about $\frac{1}{4}$ inch, thread the wire through the brass washer removed from the original cable and bend back the strands over the washer. Finally, screw the nut into its terminal.

(c) The cables from the distributor to the sparking plugs must be connected in the correct firing order, which is 1, 3, 4, 2.

Contact Breaker Mechanism.

After the first 500 miles and subsequently every 3,000 miles, check the contact breaker as follows:—

(a) Turn the engine until the contact breaker points are fully opened, and check that the gap agrees with the figures given in the data section. If the gap is correct, the gauge should be a sliding fit. Do not alter the setting unless the gap varies considerably from the gauge thickness.

To adjust the setting, keep the engine in the position which gives maximum opening of the contacts and then slacken the two screws securing the fixed contact plate. Adjust the position of the plate until the gap is set to the thickness of the gauge and then tighten the two locking screws.

Remember that the cam only keeps the contact points fully open over 10° and that care must be taken to ensure that the points are in the fully open position.

(b) If the contacts are dirty or pitted, they must be cleaned by polishing them with a fine carborundum stone, and afterwards wiping them with a 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.

(c) Check that the moving arm moves freely on its pivot. If it is sluggish, remove the moving arm and polish the pivot pin with a strip of fine emery cloth. Afterwards clean off all trace of emery dust and apply a spot of clean engine oil to the top of the pivot.

The contact breaker spring tension should be between 20 to 24 ounces measured at the contacts.

Distributor Lubrication.

To be carried out after servicing the distributor, and at intervals of about 3,000 miles.

(a) Give the cam a light smear of grease and apply a slight trace of oil to the top of the contact breaker lever pivot pin.

(b) Lift the rotor arm off the top of the spindle and add a few drops of thin machine oil through the lubricating passage provided in the spindle to lubricate the cam bearing and distributor shaft. (Do not remove the screw in the top of the spindle as an oil-way is provided). Refit the rotor correctly and push it on to the shaft as far as it will go.

(c) Add a few drops of thin machine oil through the hole in the contact breaker base through which the cam passes, in order to lubricate the automatic timing control. Do not allow any oil to get on or near the contacts.

To Remove the Distributor.

Disconnect the low tension lead from the terminal on the side of the distributor body. Spring back the two retaining clips and lift off the distributor head, which can be lodged on the cylinder block.

To facilitate replacement, turn the engine over until the rotor arm is pointing to the segment in the cover for No. 1 cylinder plug lead.

Remove the locking wire from the dowel bolt holding the clamp plate to the cylinder block and take out the bolt. Disconnect the bounding wire from the cylinder block to the clamp and then the distributor can be lifted straight out.

It should be noted that the drive tongue on the end of the distributor shaft is offset. This is to ensure its correct replacement on reassembly and avoid the possibility of the timing 180° out of phase.

Provided the engine is set as indicated and not disturbed, subsequently no difficulty will be encountered in correctly timing the spark when the distributor is replaced.

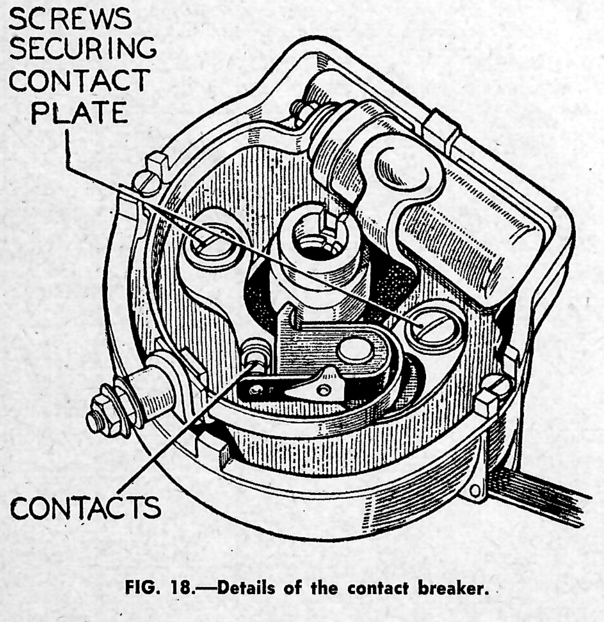


FIG. 18.—Details of the contact breaker.

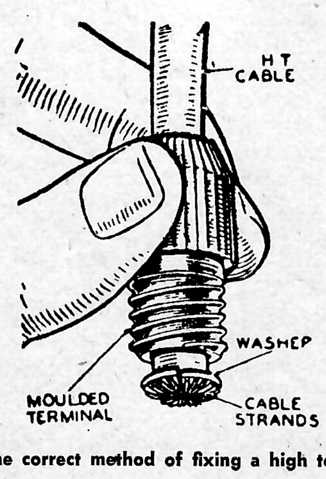


FIG. 19.—The correct method of fixing a high tension cable.

To Dismantle the Distributor.

Before dismantling, carefully note the positions in which the various components are fitted so they can be replaced correctly, then:—

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

(b) Lift the rotor off the top of the spindle. If it is a tight fit it should be levered off carefully with a screwdriver.

(c) Slacken the nut on the terminal post and lift off the end of the contact breaker spring which is slotted to assist removal. Lift the contact breaker lever off its pivot pin and remove the insulating washer. Take out the two screws, complete with spring washers and flat steel washers, from the plate carrying the fixed contact and remove the plate.

(d) 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.

(c) Unscrew the condenser terminal nut, lift off the spring washer and remove the connector strip. Soften the solder securing the condenser in its clip, with a hot iron, and remove the condenser by applying pressure at one end.

Note.—The condenser should not be removed unless absolutely necessary.

(f) Drive out the parallel driving pin passing through the collar of the driving tongue member at the lower end of the spindle, and withdraw the driving tongue from the spindle. Note that the driving tongue itself is offset and that the small offset is towards the front of the engine when the slot for the rotating arm faces the condenser in the distributor body.

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

The Condenser.

The best method of testing is by substitution. Disconnect the original condenser and connect a new one between the low tension terminal of the distributor and earth.

Should a new one be necessary, it is advisable to fit a complete condenser and contact breaker plate assembly, but should a condenser only be available, use a hot iron to soften the solder securing the defective unit in the clip and remove it by applying pressure at one end. Care must be taken not to overheat the new condenser when soldering it in position.

The capacity is .2 microfarad.

To Fit New Distributor Bushes.

In order to ensure easy runing of the distributor shaft when the shank has been rebushed, the new bushes must be fitted so they are in correct alignment. The bushes must be fitted by means of a vertical drilling machine or hand press, using a mandrel and a packing block.

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

(b) To remove the bushes, a sleeve must be fitted over the mandrel to build it up to the required size. With this sleeve fitted in position, force the old bushes out of the shank by applying a steady pressure. Before new bushes are fitted they should be allowed to soak for tweny-four hours in thin engine oil.

(c) 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.

(d) Locate the end of the mandrel through the packing piece and press the mandrel downwards, taking care that both bushes enter the distributor

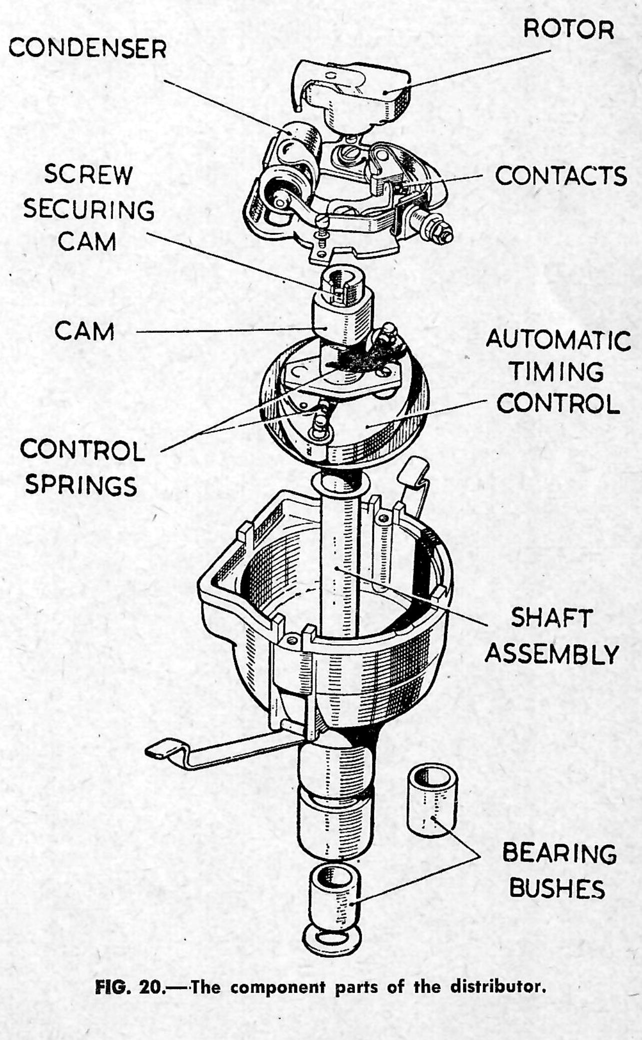


FIG. 20.—The component parts of the distributor.

shank squarely. Continue forcing the bushes into the shank until the mandrel reaches the end of its travel.

(e) After fitting, the bushes must not be opened out by reaming or any other means, as this would tend to impair the porosity of the bushes, and so prevent effective lubrication being obtained.

To Reassemble the Distributor.

Note.—Before assembly, 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.

(a) Assemble the automatic timing control, taking care that the parts are fitted in their original positions and that the control springs are not stretched. Two holes are provided in each toggle; the springs must be fitted to the inner hole in each case. Place the cam on its spindle and secure by tightening the locking screw.

(b) Fit the shank in its bearings and replace the driving member. Remember that the small offset of the driving tongue lies towards the front of the engine when the slot for the rotating arm in the cam faces towards the centre of the engine (or towards the condenser in the distributor body), fit the driving pin and burr over the collar each side to retain it in position.

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

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

(e) Position the plate carrying the fixed contact on the contact breaker base and secure it by replacing and lightly tightening the two screws, placing 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 over the pivot 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 the dimension as laid down in the data section.

Note.—If it becomes necessary to renew the contacts a replacement set comprising fixed and moving contacts must be fitted.

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

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

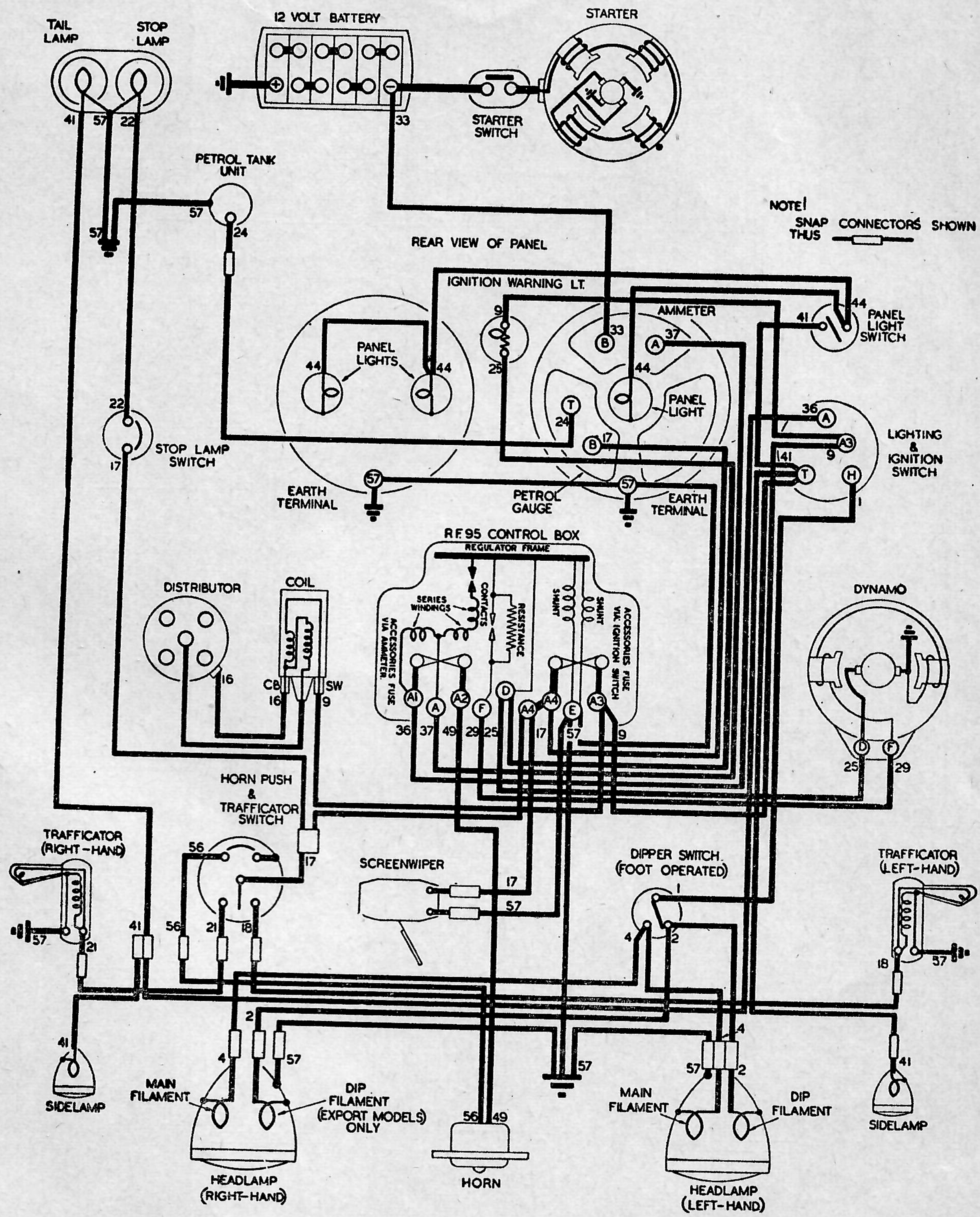
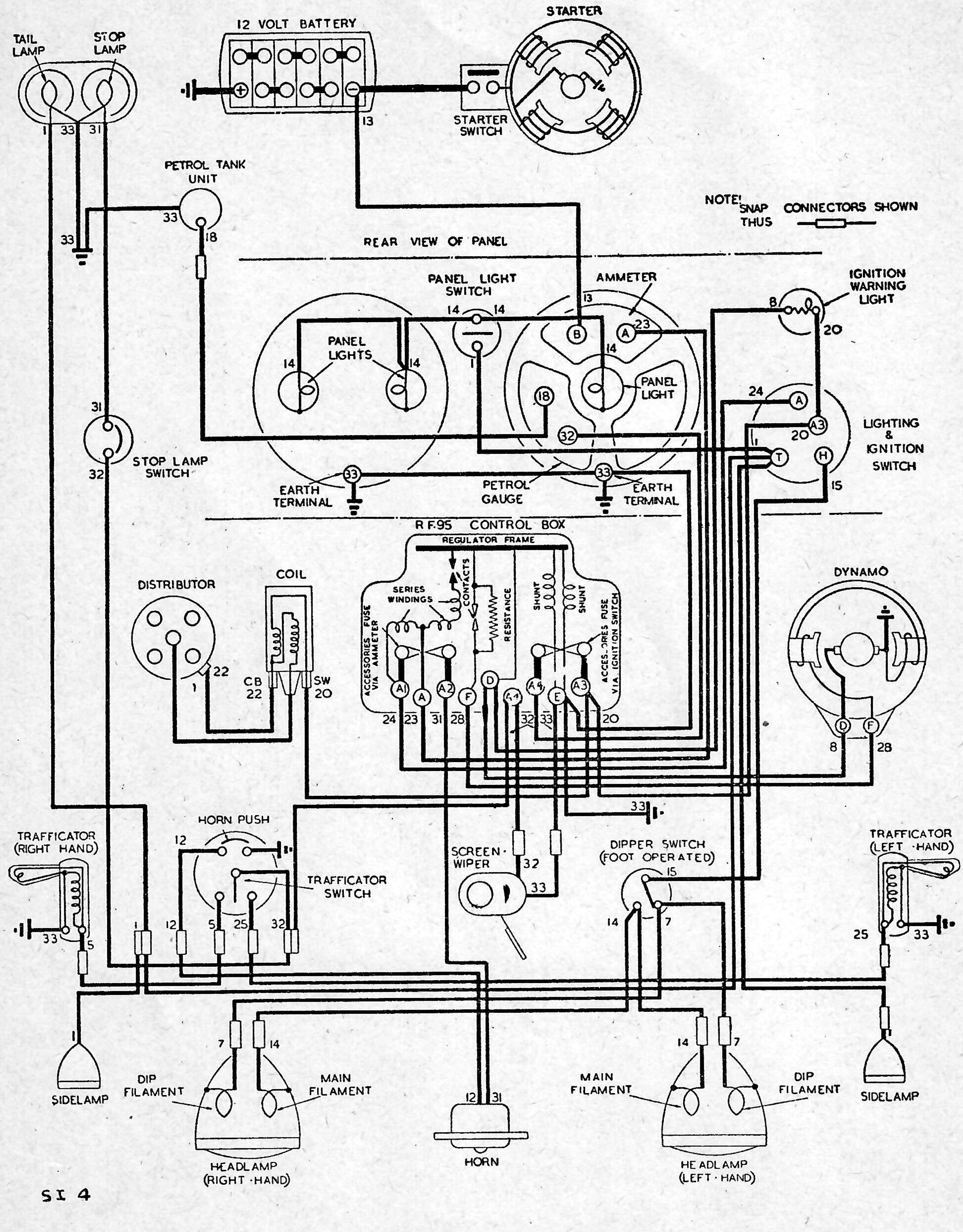


FIG. 21.—Wiring diagram for the Series 4A and 4AB.



SI 4

FIG. 22.—Wiring diagram for 9 h.p. Roadster.