

WOLSELEY

21/60 H.P.

SIX-CYLINDER
CAR

"COUNTY" MODEL DE LUXE

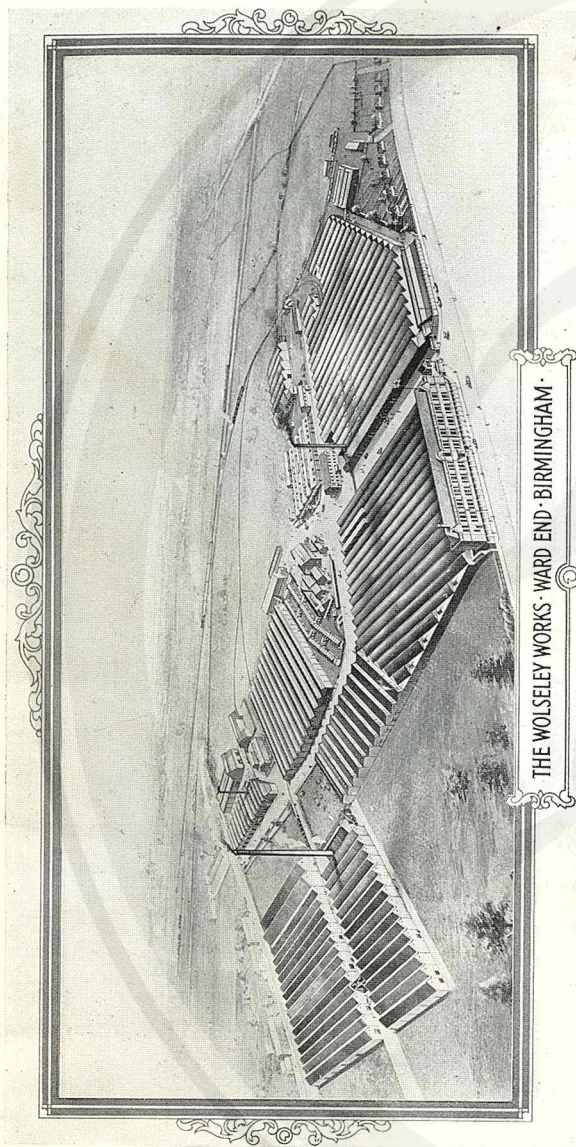
INSTRUCTION MANUAL

SECOND EDITION

WOLSELEY MOTORS (1927) LTD.
BIRMINGHAM

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THE WOLSELEY WORKS - WARD END - BIRMINGHAM

INSTRUCTION MANUAL

for the

WOLSELEY 21/60 H.P. SIX-CYLINDER CAR

“COUNTY” DE LUXE MODEL

WOLSELEY MOTORS (1927) LTD.

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INTRODUCTION

THIS Manual has been compiled to provide owners of the Wolseley 21/60 h.p. six-cylinder cars with the necessary information for the proper care and maintenance of the car.

The first part of this book contains all the necessary instructions for the ordinary running and driving of the car, while the second portion deals with running adjustments and maintenance of the various component parts.

It has been assumed that the reader has some knowledge of the working and control of motorcars, but if he is a novice we should recommend him to obtain and study one of the excellent handbooks published by the motor press.

The owner of a Wolseley naturally desires to get the best out of his car, and to do this it is well worth while to spend a few minutes every week in giving the car the small amount of attention required.

The car is very carefully tested and adjusted before leaving the Works, and the owner will be well advised to avoid interference with the adjustment without good cause.

We have endeavoured, by the liberal use of illustrations, to make the instructions as simple and clear as possible; at the same time we realise that there may be occasions when the owner finds himself in some difficulty. We are always pleased to give such cases our special attention, and to reply as fully as possible to any queries our customers may raise.

WOLSELEY MOTORS (1927) LTD.



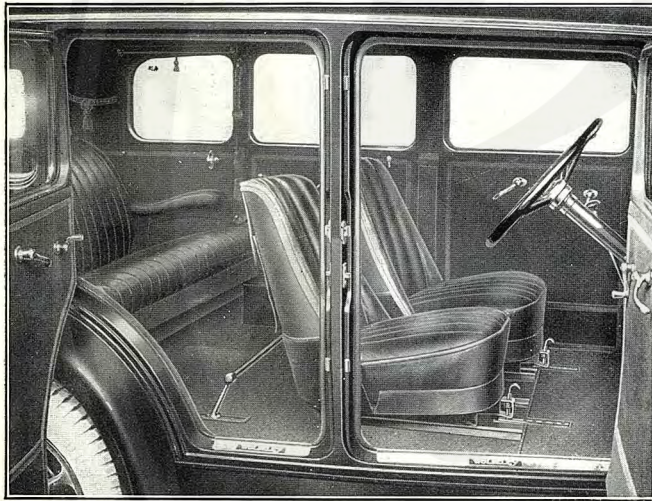
CHAPTER I

How your Wolseley is Controlled

WHEN the new car comes into your possession you should first of all make yourself familiar with the position of all controls, and to assist in this matter we will assume that the car is ready for the road, with the petrol, oil and water duly replenished.

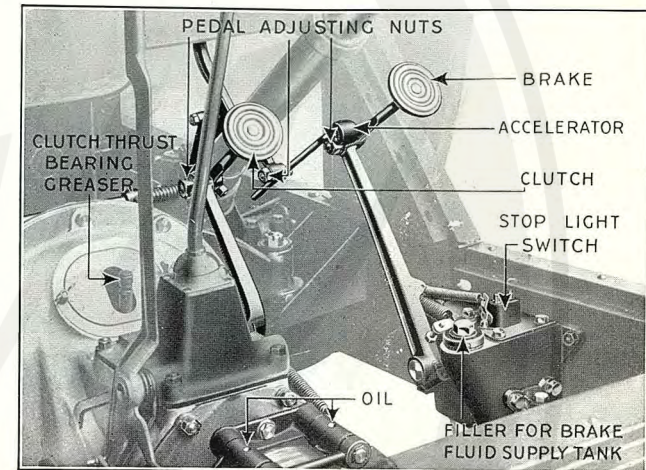
Adjustment of Seat and Pedals.—A considerable range of adjustment can be obtained to suit drivers of different stature by the adjustment of the seat or pedals, or both.

The front seats can be moved backwards or forwards while in the seat, by the operation of a trigger at the front of each seat.



The clutch, brake, and accelerator pedals can be very easily adjusted both as to reach and height. The adjusting nuts are accessibly placed under the bonnet, and to make the adjustment it is only necessary to loosen the nut, which will allow the pedal pad spindle to swing through any angle or slide the spindle up or down as required; care should be taken to see that sufficient clearance has been allowed between pedal and toe board when pedals are fully depressed.

Engine Control.—From the driver's seat two knobs will be noticed on the instrument board, the knob nearest the steering column or right-hand side being the hand throttle control, while the other knob is for the jet control. The hand throttle control sets the minimum or idling speed of the engine. It may be mentioned here that the position varies slightly on different cars, but once set it need seldom be altered, except perhaps to suit climatic conditions, e.g. the setting may require slight alteration for winter or summer running. This is adjusted before the car leaves the Works, so that when rotated to the left it allows the engine to tick over when it is warm, but for starting the engine from cold the knob should be turned as far as possible to the right. The jet control is fully described on page 45, wherein it will be seen that its main function is to ease the starting of the engine from cold.



Pedal Adjustment.

Starting Engine.—Turn on the petrol. The cock will be found under the "Autovac" on the pipe leading to the carburetter. The handle of the cock points downwards in the "on" position.

Rotate the hand throttle control knob as far as possible to the right.

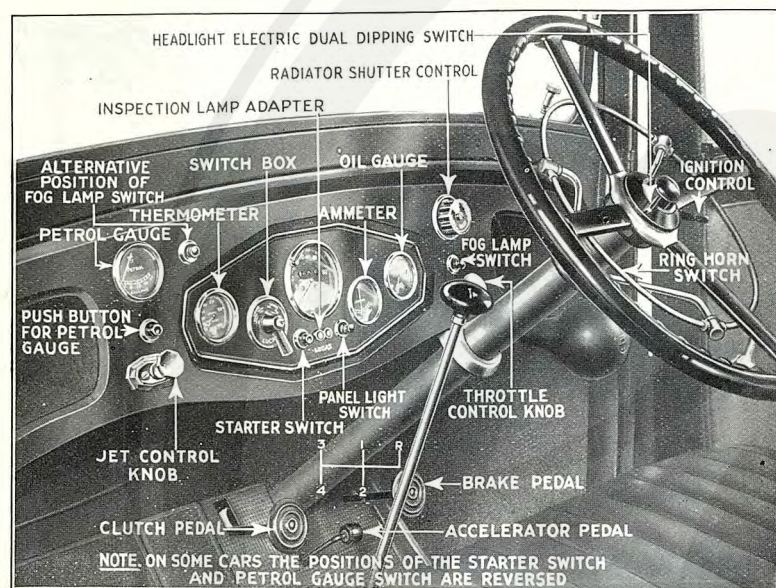
Pull out and hold the carburetter jet control knob in the starting from cold position.

Set the ignition lever on steering wheel to half to three-quarters advanced.

Switch on ignition.

Push in the starter relay switch smartly and release immediately the engine fires.

When the engine starts, push in the jet control knob to such a position that the engine will continue to fire evenly, and as soon as possible push in the knob to its full extent, which is the normal running position when the engine has warmed up. This is very important, because if the engine is run on a rich mixture the plugs will become fouled and cause misfiring besides other troubles which may ensue.



Controls.

Engine Running.—The oil pressure gauge will now start to register, and it will be noticed that at first a high pressure is indicated, especially in cold weather. This is due to the oil being more viscous when cold, and it will not, in consequence, flow so freely through the pipes. For this reason the engine should not be raced as soon as it is started, but should be allowed to run at a moderate speed, say 1000 r.p.m., for a short time to get the oil circulating properly. The practice of running an engine to warm it up before starting on a journey is not advisable.

The pressure on the gauge will eventually fall to a minimum of 20 lb. (1.4062 kg. per sq. cm.) with the engine running slowly and thoroughly warmed up, while it should normally be about 60 to 80 lb. when running at 35 miles per hour, or 4.216 to 5.62 kg. per sq. cm. when running at 56 km. per hour.

If the oil pressure gauge fails to register or behaves irregularly the engine should be stopped at once and the cause investigated. (See page 17.)

Moving from Rest.—Depress the clutch pedal to its fullest extent, and after waiting a few seconds move the change speed lever to the right and forward into first speed. The hand brake lever should now be released and the clutch gently engaged by raising the toes of the left foot. At the same time the accelerator pedal should be gradually depressed with the right foot to speed up the engine.

When moving from rest on a level road or slightly falling gradient it is permissible to start in second speed.

Second Speed.—When the car has gained some speed, say 5 to 6 miles (8 to 10 km.) per hour, the change to second gear should be made as follows :

Depress the clutch pedal and at the same time release the pressure on the accelerator pedal. The change speed lever should then be pulled back into the opposite position.

Note.—No force should be used in making this change. Let in the clutch gently and accelerate the engine as before.

Third and Top Gear.—The change from second to third and third to top speed should be made when a speed of about 10 miles (16 km.) per hour and 20 miles (32 km.) per hour respectively has been reached.

The same procedure should be followed as when changing from first to second, with the exception that the change speed lever must, of course, be moved into the position corresponding with the gear required. The positions are marked on the change speed knob.

Changing Down.—When changing down from top to third, third to second, or second to first speed, depress the clutch pedal, but in this case the accelerator pedal must be kept slightly pressed down. The change speed lever should be moved into the neutral position and the clutch pedal released. After pausing momentarily for the engine to gain speed depress the clutch pedal again, move the change speed lever into the next lower speed and release the clutch pedal.

With a little practice the length of the pause in neutral required to effect a noiseless change can be determined. The steeper the hill on which changes are made the less time must be occupied in making the change.

To get the best results from the use of the gearbox when climbing hills, and to make a fast climb, the change down from top gear to

third should be made at 38 miles (62 km.) per hour, from third to second at 25 miles (40 km.) per hour, and from second to first at 15 miles (24 km.) per hour.

Reversing.—The use of the reverse gear should not be attempted until the car can be effectively controlled in the forward direction.

Before attempting to engage the reverse gear the car should be brought to rest. The clutch pedal should then be depressed, the change speed lever pulled upwards and to the right simultaneously and then moved forwards to engage the reverse gear. The reason for pulling upwards is to lift the lever over the guard which prevents the accidental engagement of the reverse gear. When disengaging the reverse gear the lever need only be moved back and then pushed to the left, when it will ride over the guard.

General Hints on Gear Changing.—Bear in mind that the engine speed should be increased when changing to a lower gear, and decreased when changing to a higher gear.

If first speed cannot be engaged from rest at the first attempt release the pressure on the clutch pedal and again declutch. It may be necessary to do this more than once before the gears are brought into proper alignment with each other, but when they are so the change speed lever will go forward with very little pressure.

If a bad change has been made, with the result that the lever cannot be got into the desired position, do not use force, but stop the car and start again from neutral. By this course damage to the gears will be avoided and additional practice obtained.

Anyone finding it difficult to change down should practise on a level road until it can be done quickly and confidently.

Ignition Control.—The Lucas magneto fitted to this car is provided with an automatic advance and retard mechanism in addition to the hand control. The automatic advance is arranged to operate in the lower range of engine speeds, e.g. between 500 r.p.m. and 2000 r.p.m. The hand control on the steering wheel provides a further range of advance for the higher engine speeds.

When starting the engine the ignition control lever should be set at half to three-quarters "advanced" position.

We would point out that the hand control does not alter the range of the automatic device, but only extends the range of advance obtainable from the magneto.

For normal running the hand control lever should be left in the advanced position, but should be retarded when accelerating from low speeds or when the engine is pulling slowly on full throttle, such as when climbing hills.

Stopping the Car.—The car is fitted with four-wheel brakes which will bring the car to rest quickly in an emergency. For ordinary use they should be used with discretion. The brakes should never be applied so hard that the wheels are locked, because not only does this cause excessive wear of the tyres, but the braking capacity is considerably reduced.

To stop the car, decelerate, declutch and apply the brake gently. When the car has stopped put the hand brake hard on, the change speed lever into neutral, release the clutch pedal and switch off the ignition.

Descending Steep Hills.—When approaching a very steep hill the car should be slowed down and a low gear engaged **before the descent is begun**. If the foot is then taken off the accelerator pedal and the clutch left in engagement the engine will act as the main brake, leaving the hand and foot brakes as additional braking power.

Electrical Equipment.—Having now described briefly the controls necessary for driving the car, we may draw attention to the electrical switchbox which is mounted on the instrument panel.

To examine the connections take out the instrument panel, loosen the five nuts which will be found behind the panel, remove pipe to oil gauge and speedometer cable. The panel can now be pushed back and dropped down for inspection. The switchbox can be opened for inspection by loosening the circular clips, which will allow the back portion of the switchbox to be withdrawn, and thus expose all the connections.

We will confine ourselves here to the operation of the switches and the function of the ammeter, referring the reader for a more detailed description of the electrical equipment to page 74.

Switches.—

- | | |
|--|--|
| Magneto : | Key switch in centre of switch handle. |
| Summer Half : | Dynamo on half charge. |
| Winter Full : | Dynamo on full charge. |
| Side : | Dynamo on full charge, side and tail-lamps on. |
| Head : | Dynamo on full charge, head, side and tail-lamps on. |
| Pull out switch on right-hand side : | Dash panel lights. |
| Push button switch on left-hand side : | Relay starter switch. |

Panel Lamps.—The instrument panel is illuminated by reflected light from two concealed lamps, which are controlled by a switch next to the ammeter. The bulb holders are mounted on hinged brackets at the back of the panel. When it becomes necessary to replace a bulb, the bracket can be moved upwards leaving the bulb holder readily accessible.

Battery Charging Period.—It is difficult to lay down any rigid rules as to the length of time during which the battery should be charged, as the conditions under which cars are used vary considerably, and obviously the amount of charging the battery will require is directly dependent upon the number of starts made, and the extent to which the lamps are used.

The following remarks are given as a guide (see also page 81).

(1) Under normal conditions, providing the lamps and starter are used a fair amount, the battery should be kept on full charge all the time during the winter.

(2) The battery is automatically on full charge when the head or sidelamps are in use.

(3) If the car is used for long tours in the daytime and not at night, the switch should be kept on "Summer half"; this will prevent overcharging of the battery and consequent reduction of the acid level.

Special attention is directed to page 81 for important instructions on the care of the battery.

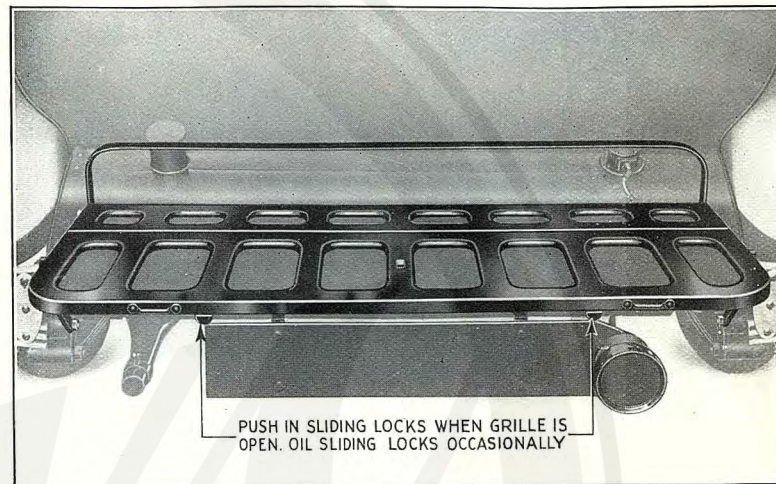
Ammeter.—When the engine speed rises to a rate corresponding to approximately 9 miles (15 km.) per hour on top gear the automatic cut-out switch (see page 79) will close the generator to battery circuit and the dynamo will commence to charge the battery.

When this takes place the ammeter will start to register. The ammeter is a centre zero instrument and shows the current flowing into or out of the battery.

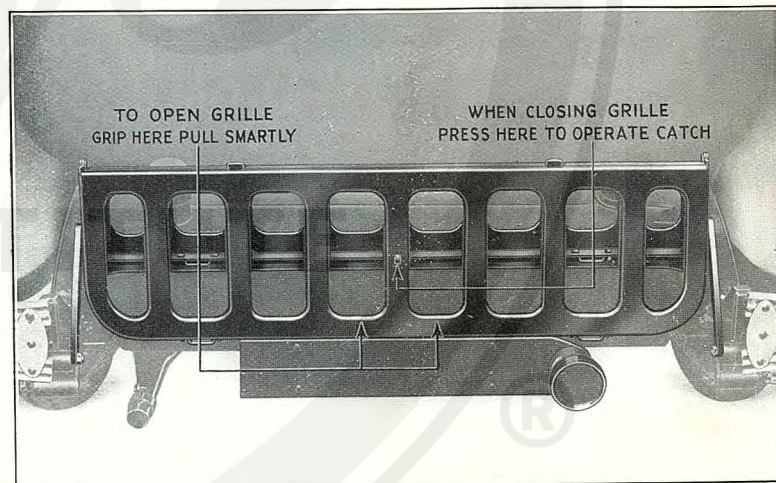
In other words, this type of meter shows at a glance whether the dynamo is giving sufficient output to keep the battery charging when the different circuits which are consuming current are switched on; thus, if the lamps are on and take 6 amperes, and the dynamo is charging at 8 amperes, the ammeter shows 2 amperes, this being the current in excess of the lamp load which is available for charging.

The current taken by the starter is not registered, nor is that taken by the auxiliary fittings, cigar lighter, horn, etc., owing to the fact that the current used for these fittings is only intermittent and the load comparatively heavy.

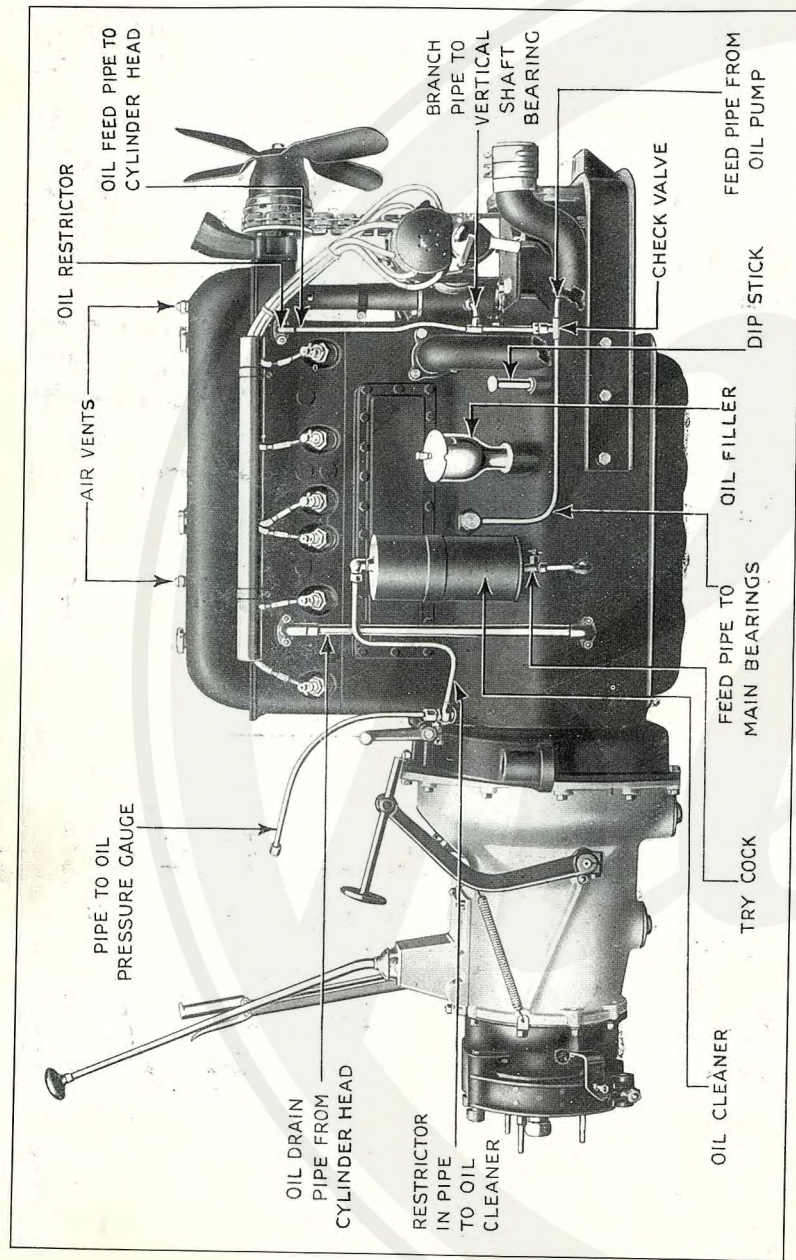
Luggage Grille.—The carrying capacity of the luggage grille is 80 lb. (36 kg.). This weight should not be exceeded, as the effect of excessive overhanging load is to set up severe strain on the rear end of the chassis.



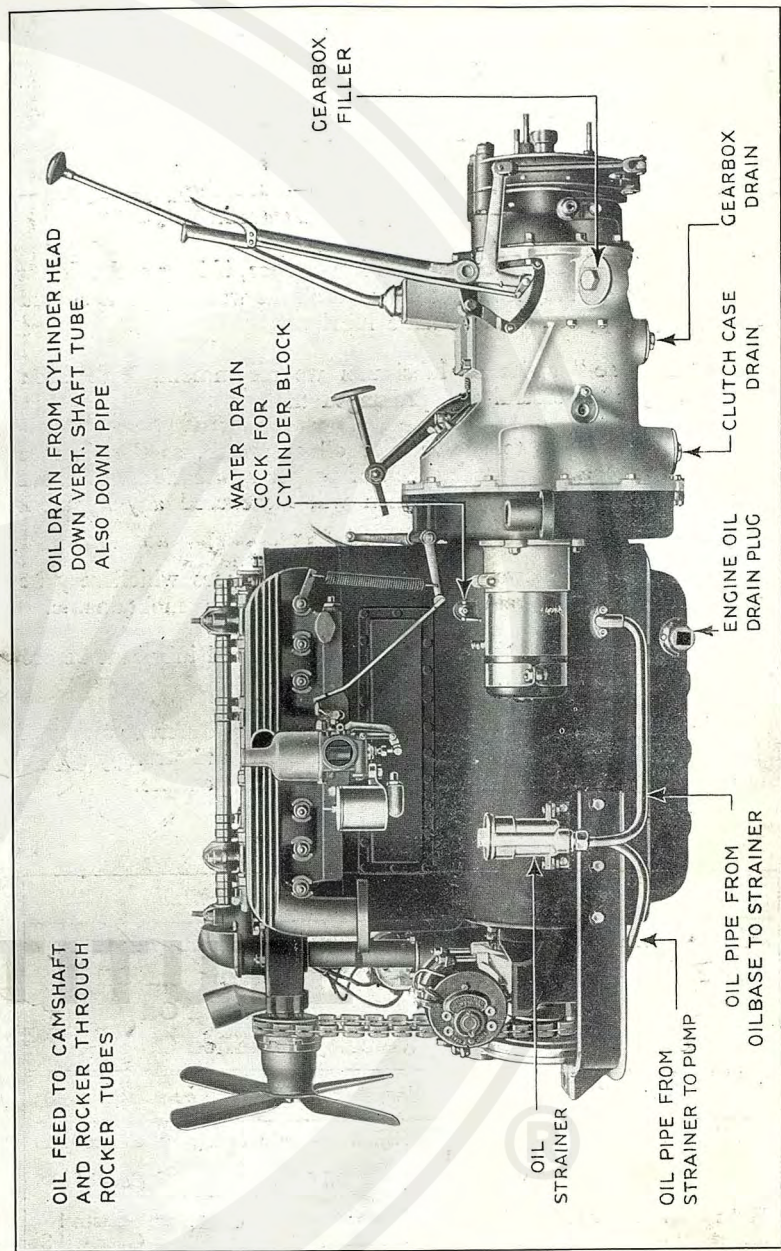
Luggage Grille Open.



Luggage Grille Closed.



Off-side View of Engine and Gearbox.



Near-side View of Engine and Gearbox.

CHAPTER II

General Running Instructions

Lubrication—Radiator Replenishment—Fuel Supply—Tyres— Battery—Washing and Polishing

Lubrication.—It is of the utmost importance, if long and efficient service is to be secured from the car, that all the working parts should be regularly supplied with suitable lubricant.

The “Filtrate” series of lubricants we recommend have been selected only after careful and prolonged trial.

It is false economy to use inferior oil or grease, as the damage caused to the working parts by lack of proper lubrication will entail expensive repairs, the cost of which will far exceed any apparent saving made.

The table below shows alternative oil and greases which may be used, should the “Filtrate” series of lubricants be unobtainable.

It is most essential to thoroughly drain off the old lubricant before introducing a new brand.

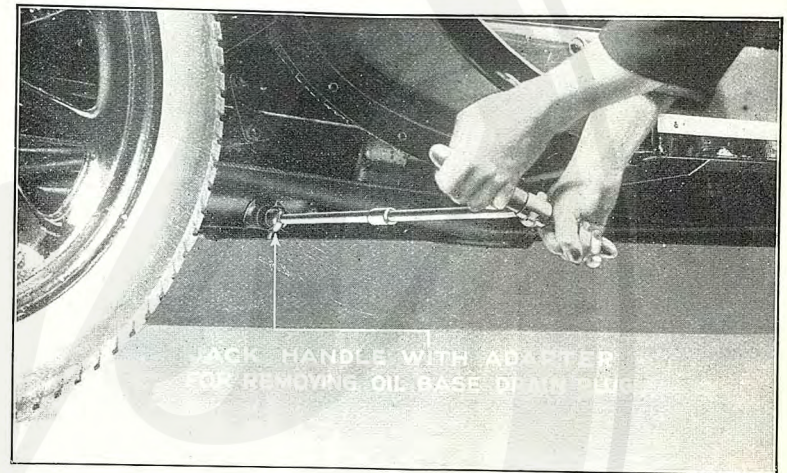
We would emphasise the fact that the mixing of different makes of lubricant will have a detrimental effect on the car, and strongly advise the continuity of the same brand of oil if at all possible.

TABLE OF LUBRICANTS

<i>Unit</i>	<i>We recommend</i>				
Engine	Wolseley Extra Heavy Filtrate				
Gearbox and Back Axle	Wolseley Filtrate Gear Oil				
Hubs	Wolseley Solidified Oil				
Greasers	Wolseley Solidified Oil				
<i>If unobtainable the following alternatives may be used</i>					
Engine ...	Vacuum BB	Triple Shell	Adcol NP ₃	Castrol XL	
Gearbox and Back Axle }	Vacuum C	Shell Gear Oil	Adcol Hydro-carbon N	Castrol D	
Hubs ... }	Mobilubri-	Shell Motor		Castrol	
Greasers ... }	cant Soft	Grease Soft	Adcolatum	Gear Oil S	

Engine.—Every morning, before starting up, pull out the oil level dip rod to see whether the oil level in the crankcase is correct. The level should lie between the two marks engraved on the rod—never above, never below. **Note.**—The dip rod should be wiped dry before taking reading. If the level shows signs of becoming low the crankcase should be replenished through the oil filler with **Wolseley Extra-Heavy Filtrate Oil**, or, if unobtainable, an alternative oil (see page 14), until level with the upper mark on the rod.

The oil in a new engine rapidly becomes dirty, carrying in suspension minute particles of foreign matter, and it is essential that this



Draining Oil from Engine.

oil should be drained off and replaced by fresh oil after, say, about 500 miles (800 km.). **Do not wash out with paraffin.**

To drain off the old oil—use the lifting jack handle, fitted with adapter provided in the tool kit—insert in drain plug as shown in illustration, and the plug will readily unscrew.

The oil strainer must now be opened. Take out the strainer gauze and insert it in a vessel containing sufficient clean paraffin to submerge the gauze, shake the vessel so that all dirt is removed. It will be noticed that the dirt or foreign matter is trapped in the interior of gauze. The oil in strainer body will not drain off as it acts as a “header” for oil pump; however, a few turns of the engine by hand will be found sufficient for the pump to pull this oil through.

Replace the gauze in strainer body and fill with new oil—this is most necessary. A joint washer is placed between the cap and the strainer body to make an airtight connection; to ensure this, screw down the cover securely, but without undue force.

In addition to this strainer, an oil cleaner is fitted on the off-side of the engine. This cleaner is placed in a by-pass circuit of the main feed pipe, and is so arranged as to filter the whole of the engine oil about eight times in an hour at average touring speeds of the car. The cleaning element is of such capacity as to remain effective for about 10,000 miles (16,000 km.), and in order to determine its condition a try-cock is situated at the base of the instrument. If, when the engine is running, this cock is opened and clean oil passes from it, it may be assumed that the cleaner is working effectively. Should there be no flow of oil, it may be that the restrictor in the pipe leading from the rear of the engine to the top of the oil cleaner has become choked with fine sediment. Take off this pipe, remove the oil restrictor which will be found at the end fitting the oil cleaner, wash out with paraffin, replace the pipe and the restrictor, and if still no flow of oil from the try-cock, it may be assumed that the cleaner requires renewal. Under ordinary driving conditions it should be necessary to renew the cleaner once a year.

Renewal cartridges for the oil cleaner can be obtained at all A.-C. Sphinx service depots. The type to order is model A1.

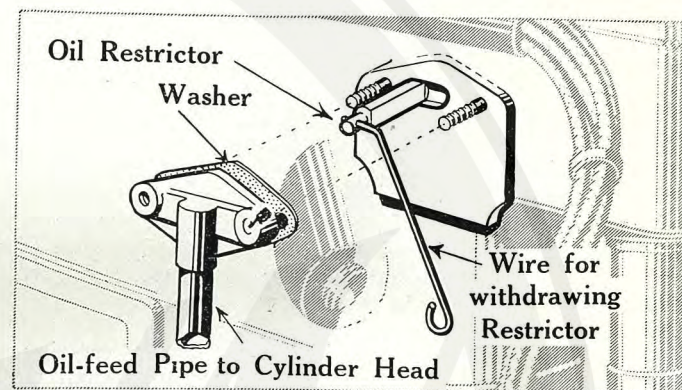
To fit this cartridge unscrew top and bottom connection, remove clip which holds the cleaner to the engine case. Put the renewal cartridge in position and refix clip; now replace top and bottom connections, fitting the new joint which is supplied with every new cartridge. Run the engine till warm and retighten connections.

It will become apparent to the new owner, after a few days, that the oil consumption is very small and that the engine only needs replenishment about every 400 miles (640 km.). In spite of this we repeat the advice to the new owner to inspect the oil level daily until he is quite accustomed to the car, and to add oil fairly frequently (say every 200 miles (320 km.)) in order to maintain it at the level of the upper mark on the dip rod.

The experienced owner will soon become familiar with the approximate consumption of oil, and he may with advantage, instead of filling up when the oil gets low, entirely drain off the old oil and fill up to the proper level with fresh oil.

The engine should be drained and new oil added every 1500 miles (2400 km.); also the strainer taken out and cleaned.

About 8 pints (4.54 litres) of oil will be required to refill the engine to the upper mark on dip rod.



View of Cylinder Head, with Oil Restrictor partly removed.

The cylinder head oil restrictor shown in illustration should be withdrawn and cleaned, say, every 1500 miles (2400 km.). A piece of wire hooked at one end should be used to withdraw the restrictor. If this is neglected the restrictor is liable to "gum," making it difficult to remove. Do not in any way alter the shape or size of the flat on restrictor.

The oil pipe flanges must be securely screwed down to prevent oil leaks.

The plug which will be noticed on the dynamo and magneto drive housing directly below fan is **not** for lubrication purposes, and is only required for inspection of gears.

Loss of pressure may be due to lack of oil in the crankcase sump, a choked strainer, or a leaking union, or possibly the strainer cover is not making an airtight joint. There is one other possible cause of loss of pressure, but the chance of this arising is extremely remote. This is the sticking up of the oil relief valve (illustrated on page 38). If this is in default it should be taken out and cleaned.

ENGINE DAMPER

The engine damper which is fitted to the 21/60 h.p. model is of the dry type, and therefore does not require any attention, and on no account should oil or grease be applied. It is situated at the front end of the engine (see page 42).

The Grease Gun.—Grease connections are fitted to all parts of the chassis which require grease lubrication. These connections are all very accessible and it only takes a few minutes to replenish them.

The question will arise in the mind of the owner—How often is replenishment necessary? The answer to this depends largely upon the use made of the car. If the car is taken out every day it will obviously require more attention than if it is only used at longer intervals.

The owner who uses his car every day should make a practice of greasing up every week, while those who use their cars less frequently will not find it necessary to do this so often.

The best advice we can offer is to add a little often; the grease will then always be fresh and clean, and will go in easily, while if the job is neglected, not only will serious wear take place, but it will be found much harder to force in the new grease.

Charging the Grease Gun.—Unscrew the cap carrying the telescopic extension from the barrel and pull out the plunger as far



Filling Grease Gun.

as it will go, when the barrel can be filled with grease by any suitable means. We recommend **Wolseley Filtrate Solidified Oil**, which can be obtained in special 1, 2, or 7 lb. tins for use with the grease gun, a disc with a hole in the centre being provided to facilitate charging the gun, as shown in illustration.

To fill the gun by this method unscrew the cap carrying the telescopic extension from the barrel and press in the plunger as far as it will go. Place the open end of the gun over the hole in the disc and exert an even pressure. The entry of the grease into the barrel

will be facilitated if the plunger is slowly pulled out whilst the pressure is maintained on the barrel of the gun.

Having now charged the gun, refer to illustrations showing where grease is required. It is only necessary to fit the gun to grease connection and push the handle. About two strokes of the gun is

sufficient, although at the spring pins and shackles it is a good plan to force in the grease until all the dirty grease is expelled from the ends, when it can be wiped off.

It is quite probable that a greaser may be continually overlooked; we suggest that it is a good plan to deal with each side of the car as shown below:—

Front of Car.—Nine gun greasers.

Front spring pins	2 greasers
Swivel axle pins	4 greasers
*Steering cross tube	2 greasers
*Steering connecting tube (front end) ...	1 greaser

Near-side of Car.—Three gun greasers, one screw-down greaser.

Front spring shackles (under bonnet, see illustration)	2 greasers
Clutch thrust bearing (under footboards) ...	1 screw-down greaser (half a turn only)
Rear spring pin	1 greaser

Rear of Car.—Four gun greasers.

Rear spring shackles	4 greasers
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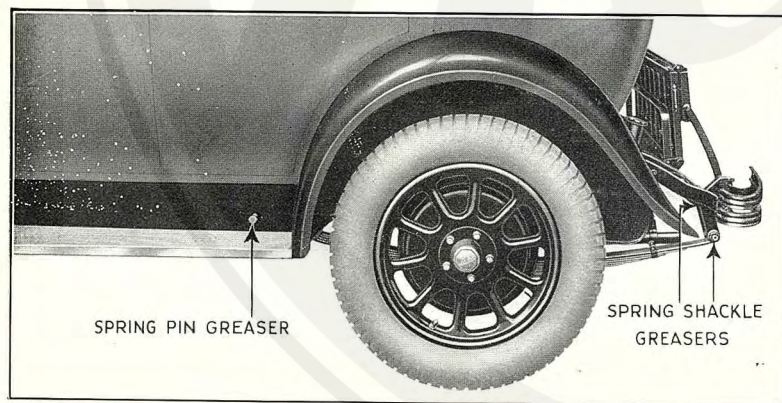
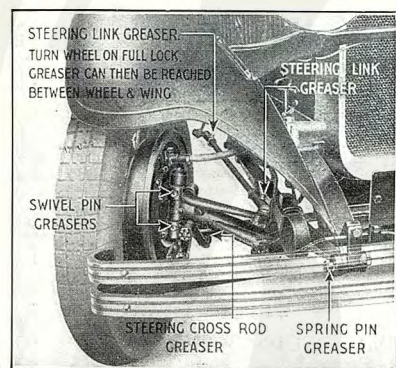
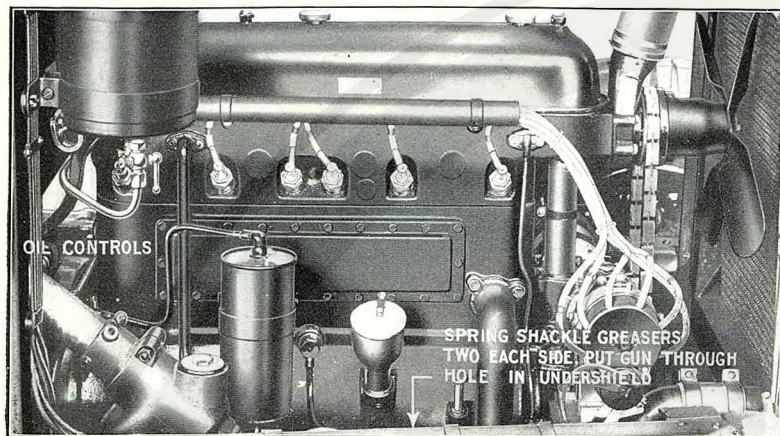
Off-side of Car.—Four gun greasers.

Rear spring pin	1 greaser
Front spring shackles (under bonnet, see illustration)	2 greasers
*Steering connecting tube (rear end) ...	1 greaser

* When Flexi-lubri covers are fitted to the steering connections they are filled with lubricant at the Works, which should be sufficient to last for 12 months or 8000 to 10,000 miles.

The clutch withdrawal thrust race is fitted with a screw-down greaser. This must be used sparingly, an occasional turn being quite sufficient.

The front axle swivel pins can be more thoroughly lubricated when the front axle is jacked up, thus removing all loads from the bearings so that the grease will readily pass through. To complete the work the road wheels should be turned on each lock several times, giving one stroke of the gun on each lock.



Greasing the Car.

A practice should be made of going round the car with an oilcan periodically, putting a drop on the following places, using **Wolseley Extra Heavy Filtrate Oil**.

Control rod joints, hand brake, clutch pedal shaft and operating levers, bonnet catches and hinges, door locks and hinges, and hood-stick and luggage grille joints.

In addition to these there are two points to which a spot or two of oil should be added occasionally. At the centre of the fabric universal joints at each end of the propeller shaft there is a ball centring piece which, if allowed to become dry, may squeak.

The magneto should not be lubricated too frequently. Pour about three drops of engine oil into the oil well at the distributor end of the magneto every 1000 miles. This lubricates the distributor gear wheel bearing.

Road Wheel Hubs.—The hubs should be kept full of **Wolseley Filtrate Solidified Oil** (see page 14), primarily to lubricate the bearings, but also to combat any tendency towards the condensation of moisture. Rust is a great enemy to ball bearings, but it will not attack them if they are kept well lubricated.

Steering Gear.—Keep the steering worm box full of **Wolseley Filtrate Gear Oil** (see page 14) to the bottom of the threads of the large plug hole on top of the steering worm box. (See page 68.)

Gearbox and Rear Axle.—The gearbox and rear axle are lubricated with **Wolseley Filtrate Gear Oil** (see page 14). As both these components are fitted with oil retainers there is little possibility of any leakage of oil, but it is advisable when the car is delivered to inspect the oil level to make certain that it is up to the filler hole in both the gearbox and rear axle, and to make it up if necessary.

When the car has run about 1000 miles (1600 km.) drain off the oil by removing the respective plugs from underneath and swill out the casings with paraffin, afterwards filling up to the filler holes with fresh oil. Care should be taken to see that the speedometer gears are supplied with fresh oil. A priming plug will be found in the rear cover for this purpose. The best time to drain off the oil is immediately after a run, when the oil is warm and will flow more easily. Repeat this procedure after, say, 5000 miles (8000 km.), but at intervals of, say, every 2000 miles (3200 km.) inspect oil level and fill up if necessary.

RADIATOR AND COOLING SYSTEM

The water in the radiator will not normally evaporate very quickly, but it should be added to as found necessary.

It is important that the radiator should be filled only with clean rain water. Do not use hard water under any circumstances, as

the use of such water results in a deposit of lime or magnesia, which reduces the efficiency of the cooling system.

While the engine is warming up, after filling the radiator with cold water, a small quantity of water will run down the overflow pipe owing to the expansion of the water on being heated, but this overflow will cease as soon as the engine reaches its normal working temperature. It will also be noticed that a certain amount of water is lost down the overflow pipe when applying brakes hard at high speeds.

Flushing-out System.—It is advisable about every six months to flush out the cooling system. This should be done when the engine is warm. Drain off the water by turning on the cock on the bottom water pipe, close cock, and fill up with a strong boiling solution of washing soda (approx. 4 gallons (18.16 litres) are required), with about a pound of soda to the gallon. Run the engine to circulate, drain off, and then, when the engine has cooled down somewhat, flush out the system with a hose. Do not allow the soda solution to get on the paintwork.

Frosty Weather.—In frosty weather, unless the car is stored in a warm building, the system must be drained before leaving the car for the night or for any period long enough for the water to be frozen. After the water has been drained it is possible for a small quantity of water to still remain around the lower portion of the cylinder block; this must be drained off by opening the small cock on the near-side of the engine (see illustration on page 13). If the water freezes there is great risk of bursting the radiator and cylinder jackets.

A list showing service depots for radiator repairs will be found on page 96.

When refilling it is an advantage to use hot water, because not only is this more free from substances which cause furry deposits but it also facilitates starting in cold weather.

Thermometer.—The thermometer on the dash indicates the temperature of the water in the radiator in degrees centigrade. Best results will be obtained when the instrument is recording about 90°. The temperature may be regulated by operating the radiator shutters.

WATER PUMP OR IMPELLER

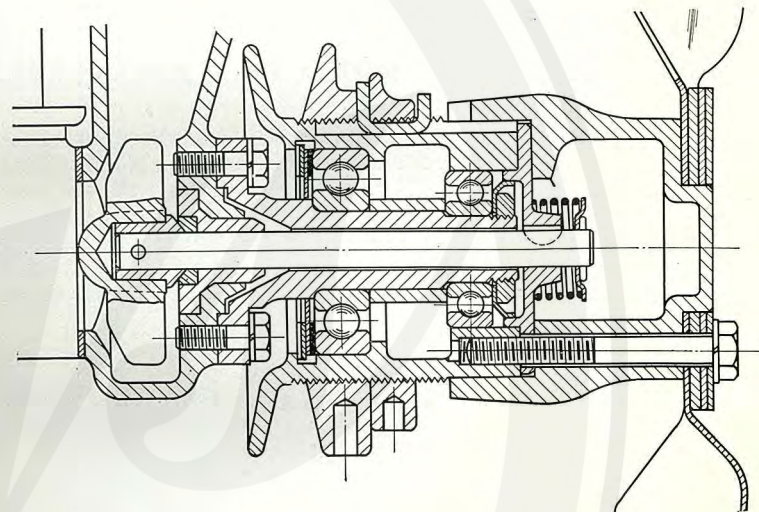
A water pump or impeller is mounted inside the water outlet pipe, between the cylinder head and the radiator.

The impeller is driven by a spindle carried through the centre of the fan pulley (see illustration on page 23).

It is packed with grease when the car leaves the Works, and should not require any attention for many thousands of miles.

FAN BELT ADJUSTMENT

To adjust the fan belt unlock the circular nut on the fan pulley with a tommy bar. Rotate the forward flange which constitutes one half of the "V" belt pulley. After adjustment the pulley must be securely locked by the circular nut, and care must be taken to see that the locking key is engaged in a slot. The belt must not be adjusted too tightly or excessive load will be put on the bearings. It should be just possible to turn the fan by hand when the belt is correctly adjusted.



FUEL SUPPLY

When filling the fuel tank always tip the tin with the spout at the top to avoid splashing the coachwork.

Keep clean all the strainers in the fuel system. Strainers will be found at the following points:—Fuel tank drain plug, fuel inlet to the "Autovac" (see page 51, Fig. 2), and carburetter float-chamber (see page 46).

In spite of the interposition of these fine gauze strainers, a considerable amount of sediment finds its way into the "Autovac." This sediment is precipitated to the bottom of the "Autovac," and if allowed to remain is carried over into the carburetter float-chamber. It is generally too finely divided to restrict the supply of fuel to the engine, but it is a frequent cause of flooding carburetters by reason of its presence on the needle valve seat. It is therefore necessary

to open the "Autovac" drain cock periodically to allow the sediment and water to escape.

Do not allow the vent holes in the "Autovac" to become stopped up.

The fuel tank should be drained occasionally, as a certain amount of water and sediment usually collects in the course of time.

PETROL GAUGE (Smith's Electric)

The petrol gauge is situated on the instrument board. It is controlled by electric current which is supplied from the car lighting system. The gauge in its normal position will read zero. **To operate the gauge**, press the button switch which will be found on the instrument board. The position of the button is arranged so that it may be operated from the driver's seat.

It is not advisable to attempt to open the dashboard gauge or the instrument on the petrol tank.

If the dashboard gauge registers zero when the button switch is operated, and it is known that the petrol tank contains several gallons of petrol, examine the cable connections and see that all the connections are securely made. The failure to function may be caused by a sticking float, which will automatically rectify itself by running the car and filling up several times. Should, however, the trouble continue, we recommend the owner to write or call on Messrs. Smith & Sons. (See page 97.)

WINDSCREEN WIPER

To put the "Smith" mechanical wiper into operation, push knob or switch button to the right, and vice versa. Switch off when wiper arm almost reaches the end of its upward stroke.

When the car is stationary the wiper arm can be operated as an emergency measure by hand. To do this, pull out the handle and keep it pulled out while moving the wiper as desired.

Tension.—The spring should be tensioned so that the rubber just leans over and makes edge contact as it wipes. It should not turn right over. Adjustment can be made by sliding the spring mount along the spindle, or by slightly bending the spring.

Lubrication.—*Driving Gears on Side of Gearbox.*—Move shutter piece and insert thick oil or thin grease about every three thousand miles. *Flexible Shaft.*—Disconnect the two screwed collars and temporarily remove slotted washer at lower end; the flexible shaft can then be pulled out a short distance at the top. Force some thick oil down the flexible shaft casing. This should be done about every three thousand miles. *Screen Control Box.*—This is filled with grease when manufactured, and should not need lubricating under ten thousand miles. On no account should the control box lid be removed while wiper operates. See list of Messrs. Smith and Sons' Service Stations on page 97.

TYRES

The tyres are such an important item in the upkeep of a car that they should receive very careful attention in order that the best service shall be secured from them. In the first place it is very necessary to see that all tyres are fully inflated to the correct pressure. A Schrader gauge for testing the pressure in the tyres will be found in the tool kit. The following are the tyre maker's pressures for our six-cylinder cars, which are fitted with Dunlop tyres (5.50 in. for 18 in. rims).

TYRE PRESSURES (Car fully laden)

Front wheels	34 lb. per square inch.
Rear wheels	34 lb. per square inch.

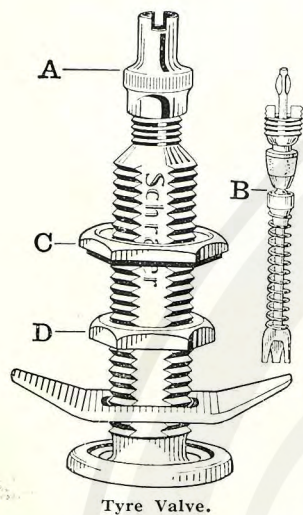
To Remove Tyre.—First completely deflate by removing all valve parts, and push the tyre edges into the base of rim at part diametrically opposite valve, then lift the cover edges near the valve over the rim edge. The small lever which is supplied with the car may be used, but it is not essential. No force is required to do this, but the edges of the cover opposite the valve must be in the base of the rim.



You cannot pull the tyre edge at "A" over the rim edge until the tyre edge at "B" is pushed off the rim shoulder "C" down into the well "D," then tyre edge at "A" comes over the rim easily. Remember the tyre edges are inextensible—force will only damage the tyre and cannot stretch the edge.

To Fit Tyre.—Push one edge of the cover over the edge of the rim. It will go quite easily if you see that the part of the edge first put on is pushed right down into the rim base. Very slightly inflate the inner tube—do not distend it—place it in cover, with valve through hole in rim. (Take care that valve, which is fitted on side of tube, is on right side of rim.) Commence to fit second edge of cover at a point diametrically opposite the valve by placing it over the rim and pushing down into the base of the rim.

The small lever may be used for the last few inches, but it is not essential. On no account use large levers. Force is unnecessary and may damage the cover edges.



Tyre Valve.

Inflation.—Whilst inflating see that the edges of cover are seated evenly round the rim.

"A" Valve Cap.—Screw on tightly by hand only.

"B" Valve "Inside."—When necessary to renew, unscrew by using the slot in the valve cap as a screw-driver.

"C" Rim Nut.—Screw down on to the rim. Holds the valve rigidly and prevents entry of water.

"D" Hexagon Nut.—Important. Always tighten this nut with a wrench before fitting the tube in the tyre.

Do not let oil or grease get on the tyres, as they have a destructive effect on rubber.

We always recommend owners to carry, in addition to the spare wheel, one or two spare inner tubes for replacement in case of more than one puncture, as it is not always possible to effect a satisfactory repair to a punctured tube at the roadside.

A few spare valve "insides" should also be carried.

SPARE WHEEL

When a spare wheel has been taken off and is being replaced on the wings, it should always be allowed to rest on the supports on the wings, so that the bracket arm does not take the weight of the wheel.

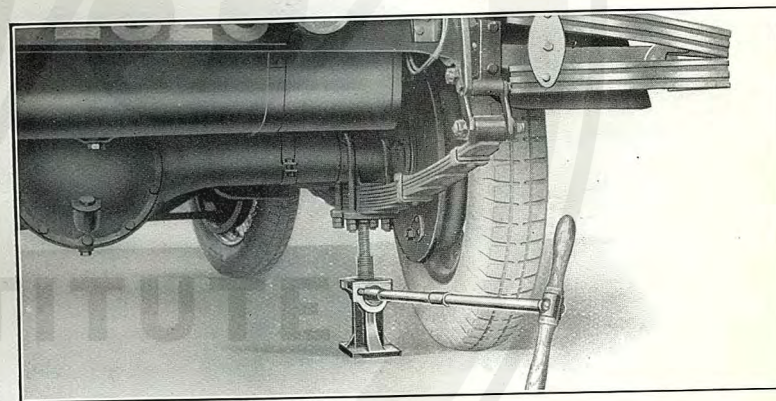
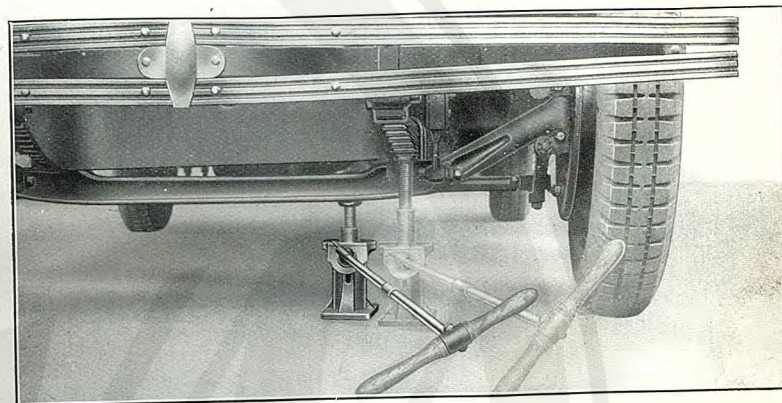
BATTERY

Inspect the level of the electrolyte or acid solution every month, and if necessary make up the level to the bottom of the filling tube with pure distilled water. (See notes on battery, page 81.) Specially note that this requires doing more frequently in the summer.

If the car is stored away for a long period the battery should be fully charged and afterwards inspected every month to see that the gravity and level of the electrolyte is correct. Give a freshening charge from an external source at least every three months. Do not store a discharged battery.

JACKING THE CAR

When jacking up the front of the car it may be found that, under some conditions—such as a badly cambered road—it is not possible to put the jack under the front axle. The jack may be placed under the bottom leaf on the road spring, as illustrated in "ghost."



Should it be necessary to jack up the rear axle on a steep gradient, the front wheels should be "scotched," owing to the fact that the hand brake operates on the transmission; thus the freeing of one wheel by lifting will make it possible for the car to move, due to the action of the differential gear.

CHAPTER III

General Hints on the Care of a Wolseley Six-Cylinder Car

Before starting a journey make sure there is sufficient fuel in the tank to feed the engine at least as far as the next pre-arranged stopping place. (See page 23.)

Replenish the oil in the engine sump and see that the lubrication system is working properly. (See pages 12 to 17.)

Fill up the radiator. (See page 22.)

The brakes should be examined to see that they are working freely and are properly adjusted. (See pages 58 to 64.)

The tyres should be pumped if necessary, not forgetting the spare. (For suitable pressures see page 25.) See that the detachable wheels are properly fixed, and are readily removable if found necessary.

Make sure the spares are sufficient and are reasonably accessible.

Hints on Driving.—Don't try to start the engine with the throttle too far open. (See page 5.)

Don't flood the carburetter.

Don't open the throttle too far or too quickly until engine is sufficiently warm, otherwise you may have a "pop back," and if the carburetter has been flooded a more or less serious fire. (See page 45.)

Don't slip the clutch unduly.

Don't accelerate the engine after changing up until the clutch is home.

Don't hang on to the high gears too long when ascending hills. It is a good rule to change down when the engine speed has dropped to about 1700 r.p.m. (See page 7.)

Hints on Care of Car.—Don't assume the car is at fault when trouble is experienced, as it may be due to omission on the part of the driver.

Don't neglect the tyres. (See recommendations by tyre makers.)

Don't allow a chipped place on the wheels or axle to get rusty, as the rust will eat under the surface of the surrounding enamel and blister it off. Use black japan to touch up any parts so chipped. This should be laid on as thinly and evenly as possible.

Don't let the door locks, hinges, dovetails, screen, hood and grille joints get rusty for want of a little oil.

Don't lean upon the doors of a car when open. Shut the doors with sufficient smartness to ensure that the slam lock engages fully.

When cushions get wet, remove and dry them as soon as possible, and don't put them back until the leather is thoroughly dry.

The car should not be left dirty longer than is absolutely necessary.

Hoods should be left up when the car is not in use.

Hints on Cleaning Car.—See page 91.

Exterior fittings are chromium plated (metal polish must not be used). Use only soap and water, and thoroughly dry with a soft duster. This should be done frequently.

For cleaning nickel plating the best silver polish should be used, ordinary metal polish being too abrasive.

Do not attempt to polish the lamp reflectors with metal polish. (See page 85.)

Use only soap and water for cleaning hoods, and ordinary liquid metal polish for celluloid lights.

To destroy or prevent moths in woollen upholstery use paraffin and camphor. This mixture should be placed in a saucer, and if a closed body is fitted the carriage should be completely shut up.

If the car is kept standing for any length of time it should be covered by a large dry sheet of sufficiently fine texture to keep the dust off without excluding the light.

Hints for Cars in Regular Service.—The following hints may be found useful where a car is in regular service, assuming a daily run of about 100 miles :—

Daily	Fill up fuel tank.
or every	Fill up radiator if necessary.
100 miles.	Check oil level in crankcase with dip rod. (See page 15.)
Weekly	Lubricate the chassis parts with the grease gun and oilcan.
or every	Oil bonnet hinges, bonnet catches, door locks and hinges, and hood joints.
600 miles.	Test compressions. (See page 35.)
	Adjust tappets if necessary. (See page 34.)
	Test tyre pressures. (See page 25.)
Monthly	Remove and clean oil and petrol strainers.
or every	Examine and clean contact breaker.
2500 miles.	Remove wheels and clean and oil brake joints.
	Lubricate the hubs. (See pages 14, 21, 65, 66.)
	Check level of oil in gearbox and rear axle.
	Drain off engine oil and replenish with fresh supply.
	Adjust brakes if necessary. (See page 61.)
	Check level of fluid in brake supply tank. (See page 58.)

WASHING THE CAR

Never put the car away in a dirty state if you desire to keep the appearance in new condition for the longest possible period.

When a car has been washed with a hose it is possible for a small quantity of water to find its way on to the brake-shoes ; this will somewhat impair the efficiency of the brakes for the moment, but if the brakes are applied fairly hard for a short time with the car running at, say, 30 m.p.h. (50 km.) the efficiency will be restored.

Chromium plating should not be left in a wet state. (See page 29.)

Full instructions are given on page 91 for dealing with the coachwork, and in order to keep a new appearance on the car these instructions should be carefully carried out.

Table of Oil and Water Capacity

	<i>English</i>	<i>Metric</i>
Capacity of Petrol Tank 21/60 h.p.	15 galls.	68.2 litres
Amount of water required when refilling system	4 $\frac{3}{4}$ galls.	22.6 litres
Amount of Engine Oil required when refilling lubricating system	8 pints	4.54 litres
Amount of Gear Oil to be put into Gearbox after draining	2 pints	1.13 litres
Amount of Gear Oil to be put into Rear Axle after draining	2 pints	1.13 litres

Principal Chassis Dimensions of 21/60 h.p. Six-Cylinder

	<i>English</i>	<i>Metric</i>
Bore	2.95 in.	75 mm.
Stroke	4 in.	101 mm.
Cubic capacity	163 cu. in.	2700 c.c.
Normal revolutions per minute	1700	—
Wheelbase	9 ft. 6 in.	2.89 metres
Track	4 ft. 8 in.	1.42 metres
Overall length	14 ft. 1 $\frac{1}{2}$ in.	4.32 metres
Overall width	5 ft. 6 in.	1.65 metres
Road speeds at engine speed of 1000 revs. per min. (with 28 in. \times 5.50 in. tyres) } m.p.h. k.p.h.	1st 4.4 7.08	2nd 8.3 13.4
	3rd 11.6 18.65	4th 17.6 28.3
	Reverse 4.4 7.08	
Tyre size	28 in. \times 5.50 in.	
Treasury rating	20.9 h.p.	

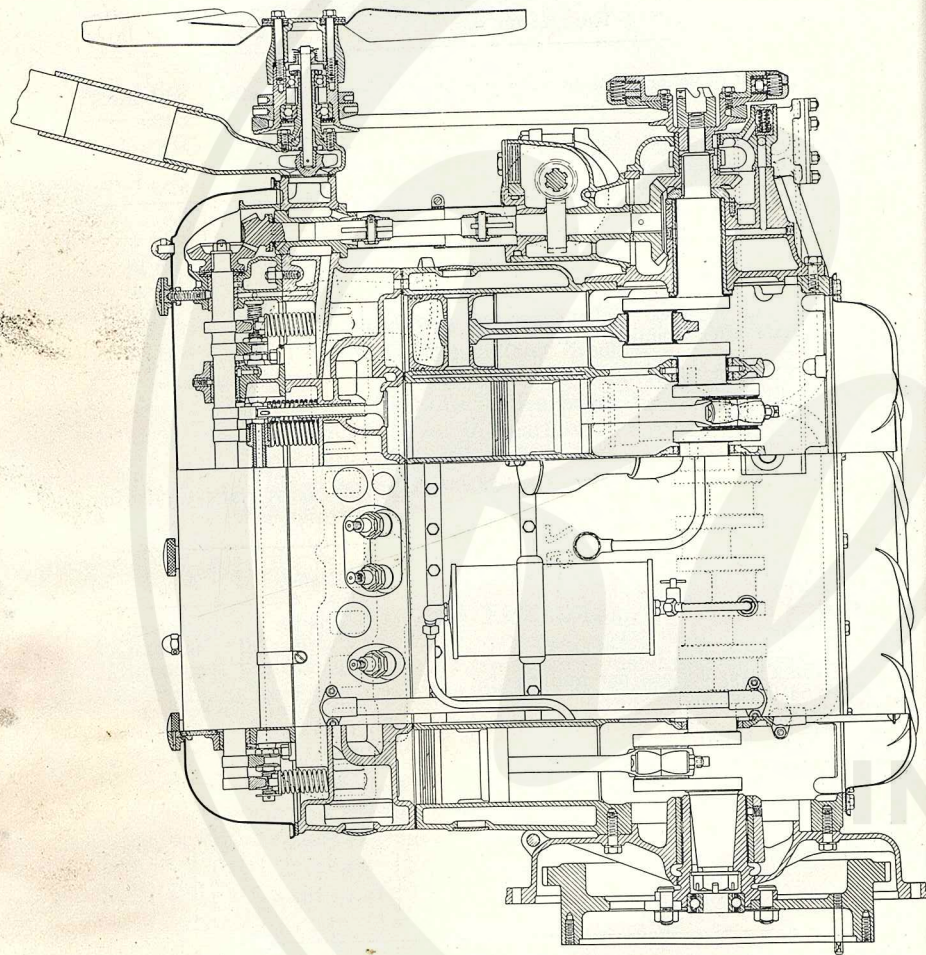
ADJUSTMENTS AND MAINTENANCE OF THE WOLSELEY SIX-CYLINDER CAR

The following portion of the book deals more in detail with the necessary running adjustments and maintenance of the various component parts of the car.

There are many small adjustments of a simple nature which the majority of owners will desire to do for themselves, and instructions sufficient to enable the owner to carry them out, with the help of the tools provided in the kit, are given in the following pages. We also devote considerable space to instructions for the removal of the cylinder head for the purpose of decarbonisation and valve grinding.

Immediate attention to any adjustments or replacements that may be required will not only keep the car in good order but also reduce the upkeep cost to the minimum, as if one portion of the mechanism fails to do its work properly, undue strain is thrown on other parts, with the consequent risk of sudden breakdown.

A word of warning may not be out of place, however, against inexperienced persons attempting repair work beyond their capacity.



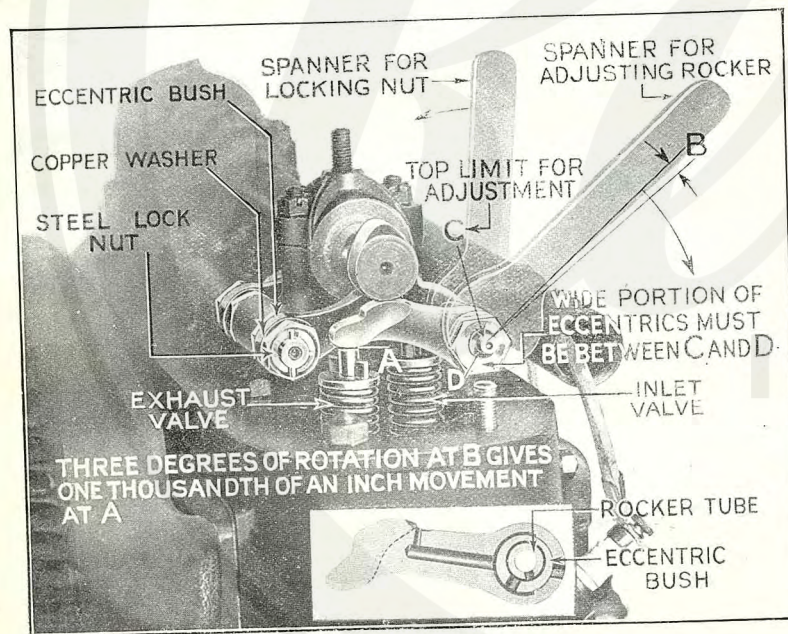
I. Engine Adjustments

Valve Tappet Adjustment.—The top cover of the engine is easily removed and will expose the valve-operating gear. The jointing material is riveted to the cover, and care should be taken to see that this is not detached or you may experience trouble with oil leakage.

The rockers which actuate the valves are mounted on eccentric bushes, by the rotation of which, in the proper direction, the clearance between the rockers and valves may be adjusted. The thick side of the bush should always be towards the centre of the engine (except when at the top and bottom). No useful purpose will be served by turning the bush the other way, as if this is done the oil supply to the cam will be stopped.

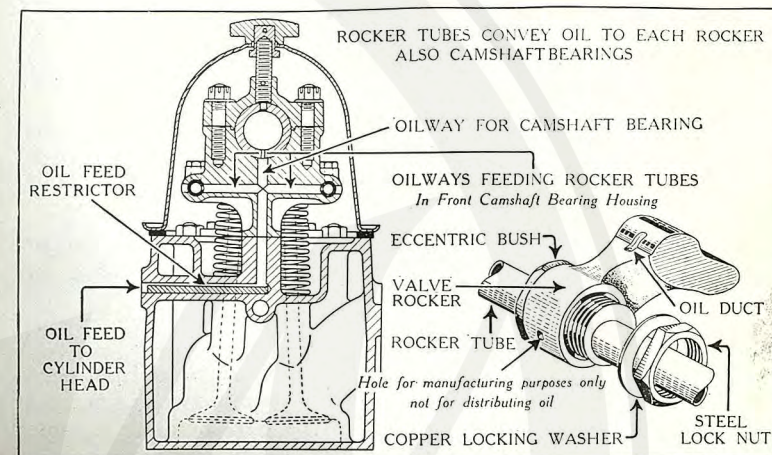
It is advisable after making these adjustments to run the engine at about 1000 r.p.m. with the top cover removed, and ascertain if oil is being delivered to each rocker.

The clearance should be checked occasionally with the feeler gauge provided in the kit. The gauge is .003 in. (three-thousandths of an inch) (.076 mm.) thick and should just slide through between the rocker and the heel of the cam when the engine is cold.



Valve Tappet Adjustment.

When checking the valve clearance the peak of the cam operating that particular valve should be vertically upwards. If the clearance is not sufficient, i.e. .003 in. (.076 mm.), the valve will not go down on its seat, which will cause a loss of power (see below); if, however, the clearance is allowed to become too great the tappets will develop a noise.



Diagrammatic Drawing showing Lubricating System for Camshaft and Rockers.

To adjust the tappets loosen the steel lock nut, turn the bush until the clearance is correct and tighten up the lock nut, afterwards checking the clearance again. A thin soft copper washer is placed under the lock nut to prevent the nut working loose.

Test Compressions.—The engine should be turned by hand two or three times a week to check compressions; if these are unequal, perhaps one or more of the tappets are too close, in which case there will be a serious loss of power in the engine, and, in the case of the exhaust valves especially, the head of the valve will rapidly burn away.

Sparkign Plugs.—The sparking plugs should be taken out and cleaned by washing with petrol about every three or four thousand miles, and the gap between the electrodes checked and readjusted if necessary. The gap should be between .015 in. (.380 mm.) and .020 in. (.508 mm.). One of the most apparent effects of fouled sparking plugs is difficult starting.

If other means are not available, .015 in. can be measured by using the magneto spanner gauge (.012 in. thick) together with the valve tappet gauge (.003 in. thick).

Magneto.—The contact breaker cover should be removed from time to time to see if the contact points are clean and free from oil, and also to check the distance between the points when separated by the action of the cam.

If the contact points are dirty they may be most conveniently cleaned, after pulling off the contact breaker housing, by slightly pressing down the fibre block of the contact breaker lever, when the points will open and they can then be cleaned with a small brush.

The correct distance between the points when open is .012 in. This can be checked with the gauge on the magneto spanner, and if incorrect should be adjusted by moving the contact screw. Be sure to re-lock the screw before running the engine.

The distributor cover should be removed occasionally and the interior wiped out to remove any dust which may have collected.

DECARBONISING

A deposit of carbon may be formed in the combustion chamber and on the top of the pistons after the engine has been running for a considerable time.

No hard and fast rule can be expressed either in mileage or time as to when it is necessary to decarbonise.

When a car is used for long fast runs, the engine should not need to be decarbonised for thousands of miles, whereas the engine of a car used for town running may need to be decarbonised at more frequent intervals.

The presence of excessive carbon deposit is usually indicated by falling off in power and "pinking" when the engine is labouring on a hill or picking up on one of the high gears, but this must not be confused with the similar noise made when the ignition is too far advanced. To remove the carbon deposit proceed as follows:—

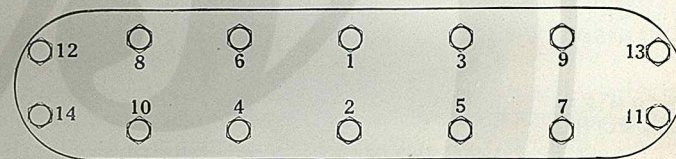
Removing the Cylinder Head.—Remove the bonnet. Empty the radiator and detach the water connection complete with fan from the cylinder head. Disconnect the throttle control and petrol pipe from the carburetter and remove inlet pipe (with carburetter attached) and exhaust pipe. Disconnect the ignition wires from the sparking plugs and take out the sparking plugs. Disconnect the oil feed and drain pipe from cylinder head. Loosen the clip and telescope the upper half of the vertical shaft cover tube into the lower half. This will expose the upper coupling sleeve of the vertical shaft. If the tube is tight do not use gas pliers or the tube may be distorted and cause oil leaks. Instead, push the clip up the tube and re-tighten. The clip can then be gripped by the hand and used to twist the tube down into the lower half. Take out the split pin from the clamping bolt, remove the bolt and slide down the coupling sleeve on to the middle section of the vertical shaft. It is not necessary to release the lower coupling. Take off the camshaft cover and undo the nuts securing the cylinder head to the cylinder block, and the cylinder head will be ready for lifting off.

It will be observed that some of the nuts cannot be entirely removed from their studs while the head is down. The procedure to be adopted with these is to unscrew them as far as possible and then lift the head until it reaches the nuts. If the head is then packed up temporarily, the nuts can be unscrewed right off the studs.

The head may be stuck down firmly, but it can be easily loosened by smartly rapping in two or three places with a mallet, or a hammer with a piece of wood interposed. Take care not to damage the copper-asbestos jointing washer when lifting the head.

The surface of the combustion chamber and the top of the pistons, and the joint faces of the cylinder and head, must be thoroughly scraped and cleaned. Do not use a file for this purpose. While the cylinder head is off examine the valve and seats. If these exhibit a pitted surface they should be ground in, according to the instructions on page 39.

Replacing the Cylinder Head.—If the old joint has not been damaged it may be used again, but it is advisable to have a new one ready in case of accident. Dress the joint on both sides with gold size or parboiled linseed oil and replace it carefully on the studs. Then put on the cylinder head and fasten down evenly by tightening each nut a little at a time, not forgetting to put on the nuts which were removed with the head partly lifted, before fastening down. Screw on all nuts finger-tight and then finally tighten down in the sequence indicated in the illustration of the top of the cylinder head.

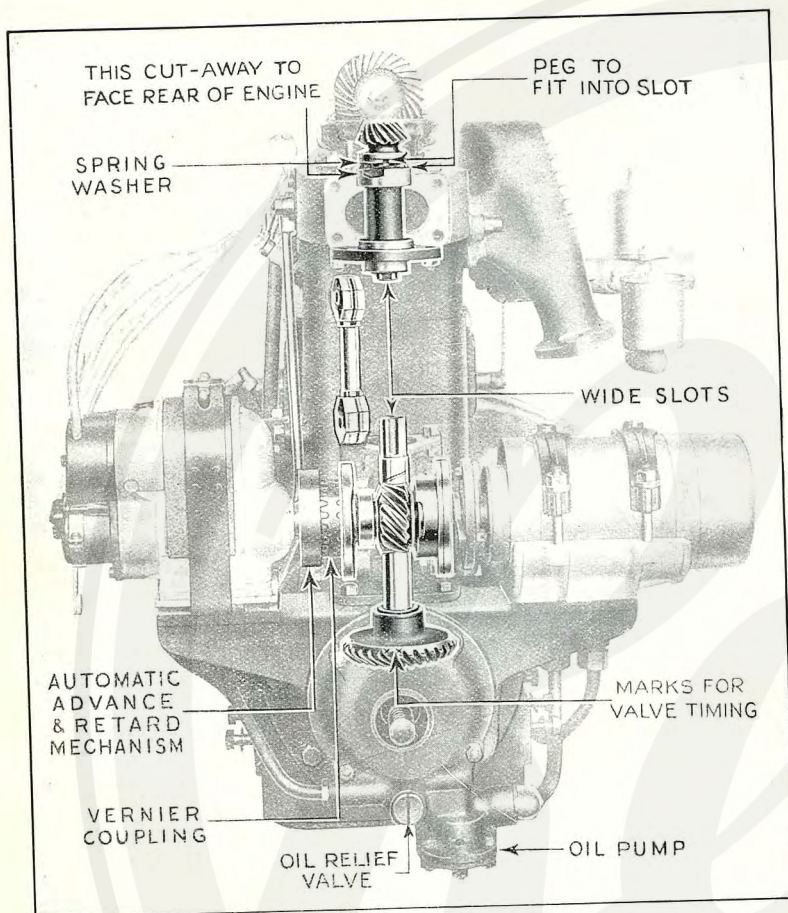


Order of Tightening Cylinder Head Nuts.

WHEN REPLACING THE OIL-FEED PIPE TO CYLINDER HEAD SEE THAT THE OIL RESTRICTOR IS IN POSITION IN THE CYLINDER HEAD.

The flanges of the oil pipes must be firmly screwed down to prevent oil leaks.

The alignment of the vertical shaft should be checked during and after tightening down the cylinder head, as, although two of the studs are dowel studs, careless or irregular tightening of the nuts may slightly distort the head and upset the alignment. Try for alignment of the vertical shaft (with the wide slots in the two portions of the shaft opposite) by sliding up the coupling to connect the top portion of the shaft. If the coupling slides up easily the shafts are in line, but if not it will be necessary to loosen the nuts again and tighten them more carefully. Repeated tightening of the nuts is necessary to ensure a perfect joint.



Front View of Engine with Vertical Shaft superimposed.

After a new cylinder joint has been fitted and the head tightened down the engine should be run and the nuts followed up as the temperature rises. This procedure should be repeated at increasing intervals of time until no further tightening with the tools provided in the kit can be effected. It will be well to note, if a new copper-asbestos joint is used, that it does not burr up around the stud holes and that it is clear of the cylinder bores.

It has been mentioned that one of the slots in the vertical shaft is wider than the others, and this makes it an easy matter to reassemble in the right position for correct valve timing, although, as the two-to-one gearing is at the top of the vertical shaft, care must be taken to see that the camshaft is not half a revolution out of phase with the crankshaft.

To make certain of correct reassembly, presuming the ignition timing has not been upset, proceed as follows :—

Take off the distributor cover of the magneto and turn the crankshaft with the starting handle until the distributor electrode is opposite No. 1 segment and the contact breaker points are just opening. (See illustration on page 77.)

This is the firing position for the front cylinder (No. 1) when the ignition is fully retarded, and it will be noticed that the front piston is at the top of the stroke. Then turn one complete revolution farther to bring the piston to the top of the stroke again. The engine is now in a position corresponding to that in which the No. 1 exhaust valve (i.e. the right-hand valve looking from the front of the engine) is about to close.

Set the camshaft so that it would require to be turned $4\frac{1}{2}$ deg. in a clockwise direction to allow the front exhaust valve to close. No careful measurement of this angle need be made as in this position the wide slot in the vertical shaft will be opposite the wide key in the coupling, and the connection can be made.

¶ Before finally tightening the coupling it should be explained that the function of the spring washer "A" (page 41) is to provide for the relative expansion between the cylinder block and the vertical shaft, and not to force the bevel pinion into deeper engagement with the crown wheel on the camshaft. It is necessary, therefore, to slightly relieve the upward pressure of the bevel pinion before finally tightening the upper vertical shaft coupling, and this is most conveniently done in the following manner :—

The upper coupling should be pulled up nearly tight with the clamping bolt and a sharp tap given to the centre of the bevel pinion in order to knock it downwards about .005 in. (.127 mm.) against the pressure of the spring washer "A." The upper coupling should then be pulled up quite tight and the split pin replaced.

The correct timing of the valves depends solely on the form of the cam and the relation of the gear wheels, and cannot be altered by the owner to any advantage.

Valve Grinding.—Should the valves require grinding in, this operation should be carried out as follows :—

Remove the cylinder head. (See page 36.) Remove the camshaft, when the rockers can be swung out of the way. Release the valve springs by removing the cotters from above the spring cups and lift out the valves. The valves should then be smeared with a suitable grinding paste and ground to their seats by means of a screwdriver or brace and bit. When grinding in only slight pressure is necessary. A suitable paste is put up in convenient tins, which we can supply to order.

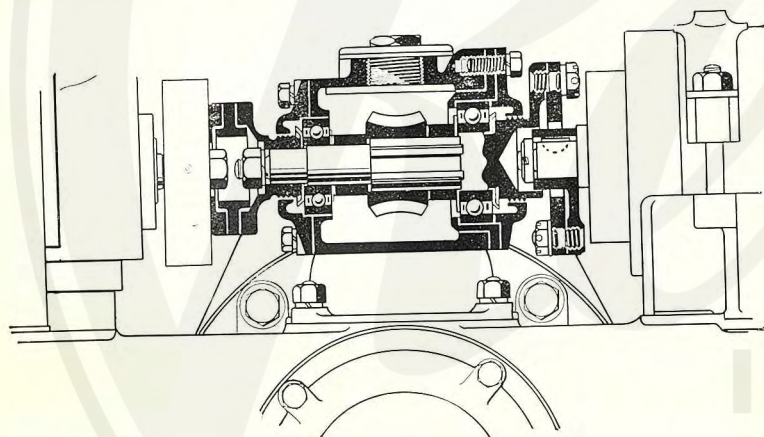
While grinding in, the valve should be frequently lifted and moved round at the same time, so that the seating may be ground quite true all over. A light spring under the valve head will be found to be of some assistance.

After this operation the valves and seats must be thoroughly cleaned with a material which does not leave fluff. Do not swill with petrol or paraffin, as it is liable to wash the grinding material into the working parts.

In the event of a new valve being fitted it will, of course, be necessary to grind it to its seat.

After grinding the valves the tappet clearance will require adjustment.

If after repeated grinding in the valve does not seat and give the correct clearance, and the full adjustment on the eccentric bush in the valve rocker has been used, then the end of the valve stem must be shortened until sufficient clearance is obtained. If this operation has removed the hardened portion of the valve end, it must be surfaced hardened before replacing in engine.



Dynamo and Magneto Drive.

Valve Timing Gear.—The valve timing gear is designed to permit of easy dismantling without disturbing other parts. The method of disconnecting the vertical shaft for the removal of the cylinder head has been described on page 36.

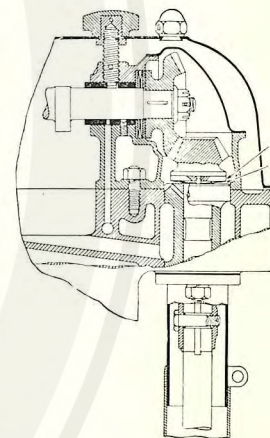
If it is desired to remove the gearcase, which contains the drive for the dynamo and magneto, proceed as follows:—

Remove the dynamo and magneto from their respective mountings. (Do not remove the dynamo cradle or difficulty may be experienced in obtaining the correct alignment again.) Loosen the clip and telescope the cover tubes of the vertical shaft. Take out the upper clamping bolt and slide the coupling down on to the middle section of the vertical shaft. Now move the cover tubes to the top and remove the lower clamping bolt, afterwards sliding the lower coupling up on to the middle section of the vertical shaft. The middle piece of the shaft can now be taken away, together with the cover tubes. The way is now clear for the removal of the gearcase by taking off the four nuts which secure it to the crankcase, after undoing the oil pipe connection.

To remove the bevel gears at the front end of the camshaft (this can be done without removing the cylinder head) take off the sheet-metal cover, undo the nuts securing the camshaft bearing caps and lift off the camshaft.

Disconnect the vertical shaft at its upper connection, as described previously, and this will allow the upper part of the vertical shaft to be lifted out.

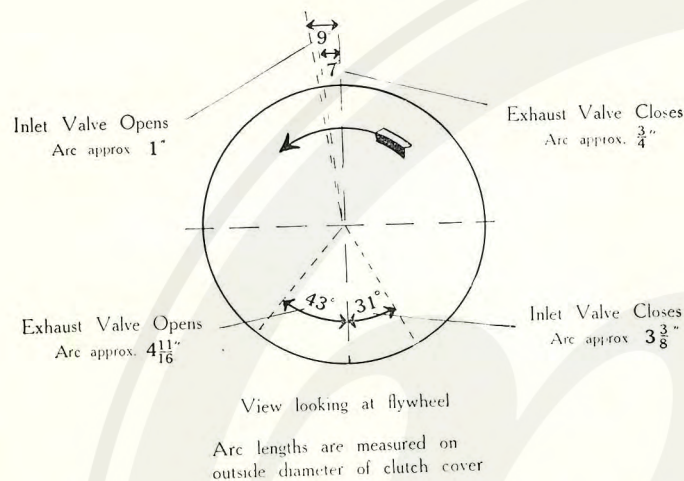
When reassembling the vertical shaft special care must be taken to see that the slots in the hardened steel thrust washer engage with the two pegs which project from the bearing bush when the shaft is home against the pressure of the spring washer. First put into position the spring washer "A" and then the thrust washer "B" on top of it with the pegs opposite the slots; now carefully replace the vertical shaft combined with the bevel pinion without moving the thrust washer. When the camshaft is replaced and the bearing caps are fastened down with the nuts the camshaft bevel wheel will exert pressure on the vertical shaft, **and unless the pegs are in engagement with the slots the parts will be damaged.**



Section of Top End of Vertical Shaft.

Before refitting read ¶ page 39.

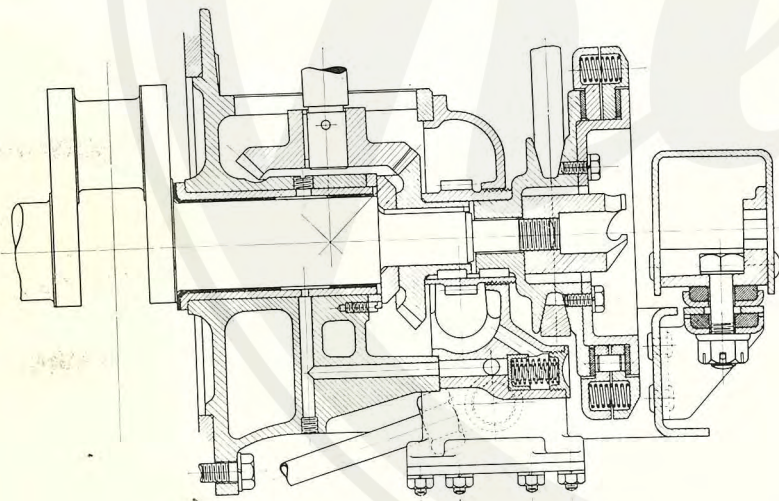
It is not necessary to remove the camshaft if it is only desired to inspect the upper part of the vertical shaft or its bearing. The bearing, together with the shaft, can be removed after taking out the middle section of the vertical shaft and removing the two nuts which secure the bearing to the underside of the cylinder head casting. Precaution to ensure that the two pegs engage with the thrust washer must also be taken before tightening up again.



Valve Timing Diagram.

Note.—The teeth of the valve timing gears are marked to facilitate correct reassembly.

Particular care must be taken when reassembling the timing gear to see that all packing shims are replaced in their correct positions



Sectional Drawing of Vibration Damper.

LOCATING AND RECTIFYING TAP OR KNOCK IN ENGINE

Check valve clearances and lubrication of cams (see page 34); if all correct, run engine slowly and put braking pressure on camshaft—a piece of hard wood may be used as a lever, placing one end between the cams, utilising the rocker tubes as a fulcrum, and exert a gentle pressure. Should the tapping cease during this operation, the vertical shaft coupling screw requires to be tightened. If the tapping still persists, put pressure on rear end of camshaft—a piece of hard wood should be used as a lever. Place one end against the dashboard and pull the lever against the rear end of camshaft—the disappearance of the noise during this operation would point to the camshaft gears being slack in mesh, owing to the Belleville washers being either weak or broken, or to the camshaft bearings being too tight.

The piston or the gudgeon pin may be the cause of the tapping or knock in the engine. To remove the pistons and connecting rods for examination is not a difficult matter, but a little care is required.

The 21/60 h.p. engine has been arranged so that the pistons and connecting rods must be withdrawn through the top of the cylinders.

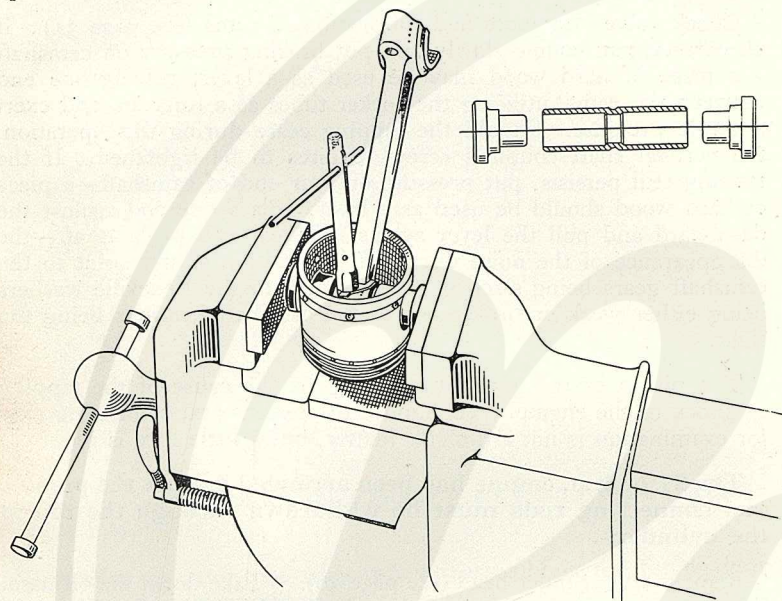
Remove the cylinder head (see page 36). Take down the oil base. The cap on the connecting rod should now be removed, which will leave the piston and connecting rod free to be pushed up the cylinder bore.

It will be noticed that each connecting rod and cap is paired and numbered accordingly. Do not change these about, as they are selected and weighed in pairs, and, therefore, if they are not replaced in their original position the dynamic balance of the engine may be interfered with. It is essential to reassemble the pistons and connecting rods in the same order and facing the same way as originally assembled. To assist in this matter the connecting rods are numbered 1, 2, 3, 4, 5 or 6, and also they have a letter stamped on an abutment on cap. This must face and be readable from the magneto side of the engine.

To remove the piston from the connecting rod is quite a simple operation when the gudgeon pin is of the floating type, i.e. the pin is free to move in both piston and connecting rod, and can therefore be pushed out quite easily.

When, however, the gudgeon pin is of the fixed type, special precautions are necessary. The fixed type of gudgeon pin is secured to the connecting rod by a set screw which is locked in position by a tab locking washer.

The illustration shows how the gudgeon pin must be held in a vice to remove the set screw. Do not hold the connecting rod or piston in a vice.



The plugs should be made as illustrated with a small diameter to insert in the bore of the gudgeon pin, and a shoulder of sufficient diameter to register against the end of the gudgeon pin. We can supply these plugs to order.

Having placed the plugs in position and secured the piston firmly in vice, bend back the tab on the locking washer and then remove set screw with a box spanner. The gudgeon pin can now be pressed or driven out.

It is advisable to use new tab locking washers each time the set screw is removed.

Note.—The set screw must not be screwed up too tight—use the small tommy bar supplied in tool kit; do not exert a great pressure on the tommy bar. Do not, under any circumstances, omit to lock the set screw. Bend up the tab on the locking washer against a side of the hexagon on the head of the set screw. This can be done with a cold chisel or a screwdriver.

II. Carburetter

The carburetter is of the S.U. controllable jet type, and the method of working is as follows. The area of the air passage or choke and the orifice of the fuel jet (see page 46) are automatically varied by means of a sliding piston ("P.N.") and a tapered needle valve ("N.V.") attached thereto. The piston is raised under the influence of the motor suction, its movement increasing as the engine accelerates, until it reaches its upper limit of travel at maximum engine speed. It will be seen that as the piston is raised a larger space is available for the passage of air, and at the same time the tapered needle is withdrawn from the jet to allow more fuel to pass. The piston and tapered needle in conjunction with a controllable jet ("J.T.") are so proportioned as to provide the correct mixture at all speeds and loads.

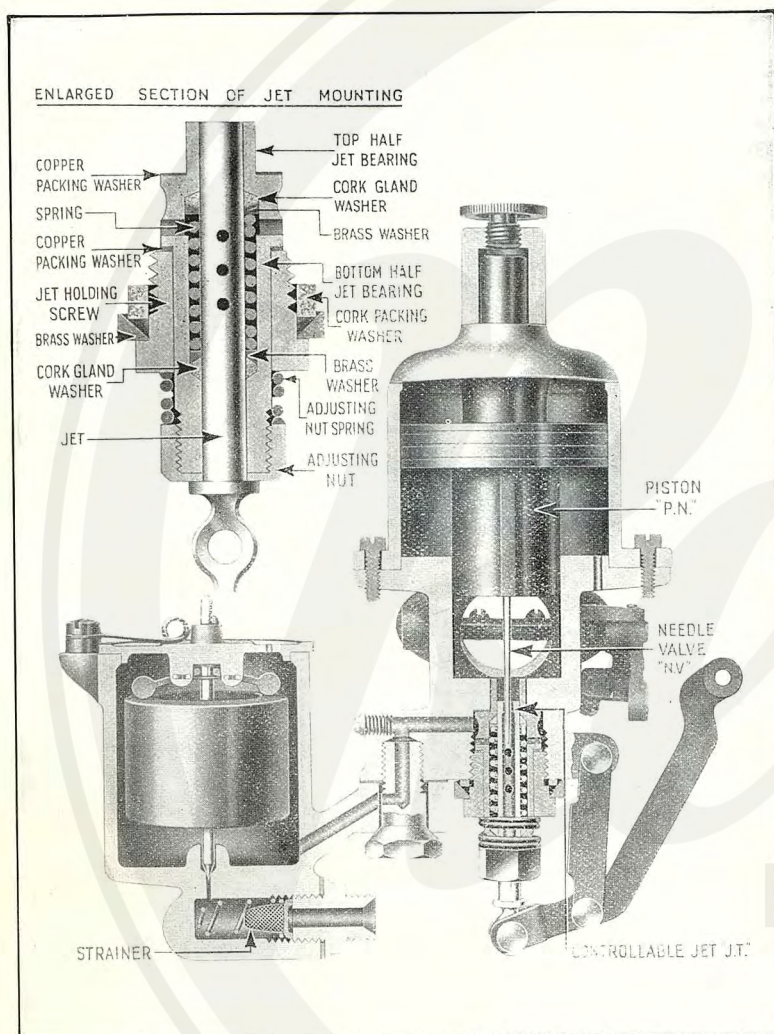
We would draw the attention of owners to the fact that the carburetter is adjusted to each individual engine before the car leaves the Works, and it is therefore unlikely that any further adjustment by the owner will be necessary. To provide for exceptional conditions of climate or weather, however, the setting of the jet for normal running may be varied by the adjustment of the jet adjusting screw (see illustration, page 46). Instructions for this adjustment are given on a subsequent page.

The Controllable Jet.—It is well known that a somewhat richer mixture is required when starting and while the engine is warming up than is required when the engine is hot. Provision is therefore made for controlling the effective orifice of the jet in relation to the tapered needle by means of a control knob on the instrument board.

The following are the main objects of the controllable jet :—

- (1) To place in the hands of the driver an easy means of controlling the strength of the mixture either on the road or when the car is stationary.
- (2) To facilitate starting.
- (3) To give the greatest economy of fuel.
- (4) To give good running, even when the engine is cold.

Starting from Cold.—To start the engine pull out the jet control knob on the instrument board and open the throttle slightly more than the normal slow running position when the engine is hot. **Do not flood the carburetter**, as this may give an excess of fuel, and starting will then be very difficult until this excess has been cleared, and **do not open throttle too wide**. As soon as the engine starts push in the jet control knob to such a position that the engine will continue to fire evenly, and as soon as possible push in the knob to its full extent, which is the normal running position when hot.



Carburettor.

Erratic Running.—There is a number of causes of bad running of the engine, the more common being enumerated below, but if the carburetter is at fault it can only be due to one of the following :—

- (1) Piston sticking.
- (2) Dirt or water in the carburetter.
- (3) Float-chamber flooding.

(1) **Piston Sticking.**—The piston should at all times rise and fall quite freely. Test this by inserting a finger in the air intake and lifting the piston to its full extent, when on being released it should fall rapidly to its seat. If it does not, remove the oil cap from the top of the suction chamber and pour a little paraffin into the orifice at the top, at the same time work the piston "P.N." up and down; when perfectly free put a little thin oil, such as sewing machine or bicycle oil, into the orifice and replace the cap.

(2) **Dirt or Water in the Carburetter.**—When this is suspected flood the carburetter by holding up the float-chamber needle, raise the piston to its fullest extent and watch the jet; if the fuel does not flow freely there is a blockage. To remedy this start the engine, open the throttle wide and block up the air inlet **momentarily**, without shutting the throttle—keep the throttle open until the engine starts to race. It is most important not to block up the air inlet for more than one or two seconds.

A strainer is provided in the float-chamber connection, and this should be inspected periodically to see that it is quite clear of foreign matter.

This trouble seldom arises with the S.U. carburetter, owing to the large size of the jet and fuel passage. If it happens the above method will nearly always clear it. Should it not do so, however, it may be necessary to remove the jet, but as the reassembling of this is a delicate operation every other possible cause of shortage of fuel should be carefully investigated and the jet only removed absolutely as a last resort.

First examine the "Autovac" with the aid of the instructions on page 50. Take off the petrol pipes and blow through them to make sure there is no obstruction. See that there is no sediment in the float-chamber, and no obstruction in the form of fluff or other foreign matter in the passage between the float-chamber and the jet.

If all this fails to remedy the trouble the only alternative is, of course, to remove the jet, which is done by unscrewing the large hexagon nut at the bottom of the body of the carburetter. The jet consists of several parts and care must be taken to reassemble in

the correct order (refer to the diagram of the jet parts). When the jet has been refitted into the carburetter make sure that the piston is perfectly free ; if it is not, slacken off the large nut and re-tighten. It may be necessary to do this several times before the piston is free.

(3) Float-chamber Flooding.—This can be seen by the fuel flowing over the float-chamber and dripping from the air inlet, and is generally caused by grit between the float-chamber needle and its seating. To remedy this turn off the fuel, remove the float-chamber lid and carefully clean out the chamber, paying special attention to the needle seat. After replacing the lid turn on the fuel and twist the needle round a few times on its seating. Do not grind the needle or its seating.

Other causes of erratic running are as follows :—

Plug Points—being too far apart, causing misfiring and popping in the carburetter when the engine is at full throttle, pulling hard on hills, also difficult starting from cold.

Oily Plugs—causing bad starting and misfiring.

Sticky Valves or Faulty Tappet Adjustment—causing misfiring and popping in exhaust and through carburetter.

Bad Joint—between the carburetter and the engine.

Worn Inlet Valves or Guides—causing bad starting, and engine will not idle well.

Blockage or Air Lock in Petrol Pipe—causing carburetter to give symptoms of weak mixture, i.e. lack of power and popping back through air inlet. This can be tested by removing float-chamber lid and float from carburetter to see if there is free flow through the fuel passage in the bottom of the float-chamber. If air bubbles come through, an air lock is the trouble, and it is generally due to shortage of fuel in the tank.

Adjustment for Idling.—The correct needle is fitted before the car leaves the Works ; the only adjustment is the setting for idling.

No adjustment should be attempted before the engine has attained its normal running temperature.

Adjust in the following manner. First screw up as far as possible the jet adjusting nut, which will be found at the base of the jet, and push in the jet control knob. In this position the mixture will probably be found to be too weak and the engine will not start or run. It should be enriched gradually by pulling out the jet control knob on the dash

until the correct idling mixture has been obtained. The jet adjusting screw should then be unscrewed until the base of this nut comes into contact with the jet head.

As previously pointed out, this is the one possible adjustment, and it is of no use whatever trying to adjust the carburetter in any other manner.

The jet itself is a standard size and never varies ; therefore on no account alter its size.

The correct adjustment having been found, the carburetter will continue to function indefinitely without alteration, but if after a period of satisfactory running the engine runs badly do not make alterations to the adjustment of the carburetter on the chance of putting the matter right, but seek the cause by the methods indicated on an earlier page.

Fuel.—No readjustment of the carburetter is necessary with different fuels, and it will function equally well with petrol, benzole, or mixtures of these in any proportions.

The fuel we recommend for these engines is a mixture of benzole and petrol in equal proportions.

“Pinking.”—“Pinking” is due to the spontaneous ignition of the residue of the charge after primary ignition has occurred round the sparking plug points, caused by the pressure rising to such an extent that the spontaneous ignition temperature of the mixture is attained.

As this pressure depends upon the initial compression, it follows that a high efficiency engine is more liable to “pink” than one having a relatively low compression.

The liquid fuels at present available vary considerably in their spontaneous ignition temperatures, and some of them have a comparatively low spontaneous ignition temperature, consequently the tendency to “pinking” is greater when using these fuels in a modern high efficiency engine.

A ready means of preventing “pinking” is, however, available. Benzole has a spontaneous ignition temperature several hundred degrees above that of any petroleum spirit, and if mixed with any type of petrol in equal proportions practically eliminates the tendency to “pinking.”

“AUTOVAC” FUEL FEED SYSTEM

The “Autovac” tank is divided into two chambers. A vacuum is created in the upper chamber by the suction of the engine which draws fuel from the main tank until a pre-determined level is reached,

when the mechanism opens an atmospheric valve and allows the fuel to flow into the lower chamber, from which it passes to the carburettor by gravity.

The "Autovac" should require no attention other than flushing with clean fuel every two or three months and keeping all the connections tight.

To flush out first open the drain cock (this opens in an upward direction); if no fuel runs out the cock may be stopped up by sediment, but can be cleared with a piece of wire.

Unscrew the nut "Y" on the top of the "Autovac" which holds the clamp in position, remove the clamp and take out the fuel supply connection "Z," after first disconnecting the pipe. This connection, being a push fit, can be readily removed by tapping gently and twisting round in any direction.

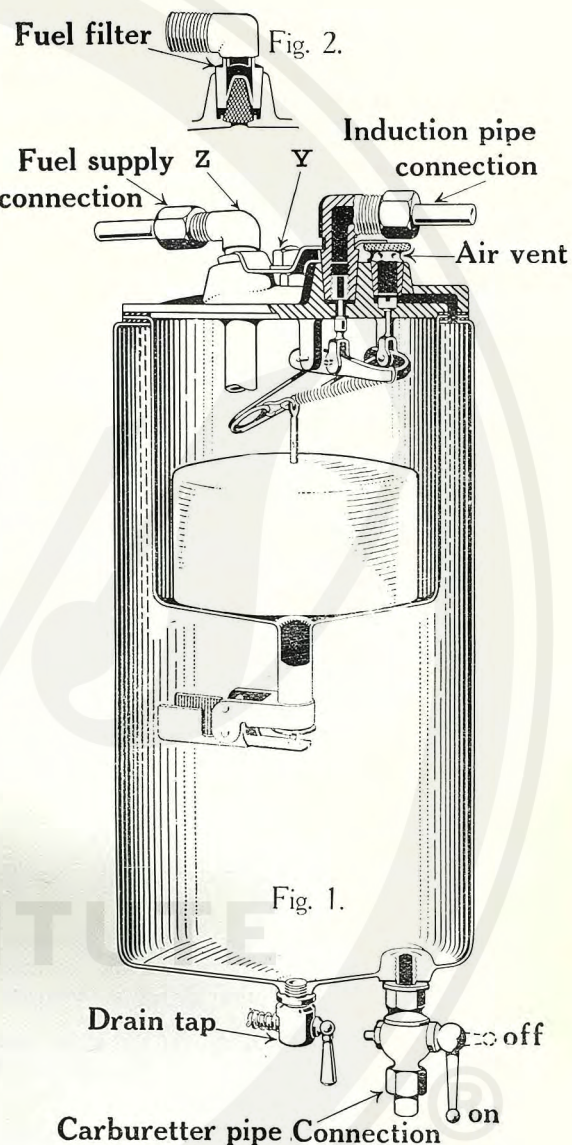
On removing the elbow (see Fig. 2, page 51) the filter will be exposed. Remove this and clean. Then thoroughly wash out the tank with clean fuel through the hole normally covered by the filter. Replace the filter and elbow, pushing the latter well down to ensure an airtight joint, and then replace the clamp, seeing that it bears evenly on all three joints. Do not overtighten the retaining nut.

Hints with regard to failure or irregularity of the "Autovac."—Should any trouble be experienced it will most probably be of such a nature that it can be rectified very easily if the following hints are studied :—

"Autovac" fails to operate after the car has been standing idle for some length of time (say two or three weeks).—Fill the carburettor float-chamber with fuel and start the engine. By the time this fuel is used up the "Autovac" will have started to operate normally.

"Autovac" fails to deliver fuel or the delivery is irregular.—Remove the carburettor float-chamber cover and, if no flow of fuel is visible :—

- (1) Ascertain if the main tank contains any fuel.
- (2) See that the fuel tap between the "Autovac" and the carburettor is turned on.
- (3) Make sure that the vent in the main tank at the rear is free, also the vent on the "Autovac." (This is important.)
- (4) See that all connections are airtight, especially those on the pipe running from the top of the "Autovac" to the induction pipe.



Sectional Drawing showing "Autovac."

III. Chassis Adjustments

Clutch.—The clutch is of the single dry plate type, having a light steel driven member which is gripped between two fabric facings. (See illustration on next page.)

If the clutch is allowed to slip continuously, the centre driven plate quickly becomes very hot, and the heat and friction set up will rapidly wear away the surface of the fabric facings.

Periodically remove plug under clutch and drain off any oil or grease which may have collected.

The clutch plate centre, which is carried on the splined end of first motion shaft, may occasionally stick. A spot or two of paraffin or light oil on the spline will rectify this trouble, care being taken not to overdose or to allow any paraffin to reach the fabric.

The clutch itself does not require any lubrication. A greaser is provided for the thrust bearing. This connection projects through the cover of the clutch and flywheel housing, and is therefore very accessible after lifting the front floorboard. **Do not force in an excessive amount of grease.**

OVER-LUBRICATION AT THIS POINT MAY PUT THE STARTER OUT OF ACTION, DUE TO CLOGGING OF THE SLIDING PINION BY THE GREASE THROWN OFF.

The fulcrum pins of the three clutch operating levers should be oiled about every 1000 miles, as if these become dry or rusty they are liable to stick and cause the clutch to slip. A few spots of oil on the felt washers, allowed to soak in, will be sufficient.

Oil holes are provided in the clutch pedal bearings, access to which is obtained by removing the cover from the flywheel housing.

Important.—The adjustment of the three clutch operating levers "A" with relation to the bearing housing "B" should be checked from time to time; more frequently when the car is new. Lack of attention at this point will cause the clutch to slip and the fabric will then be rapidly worn away.

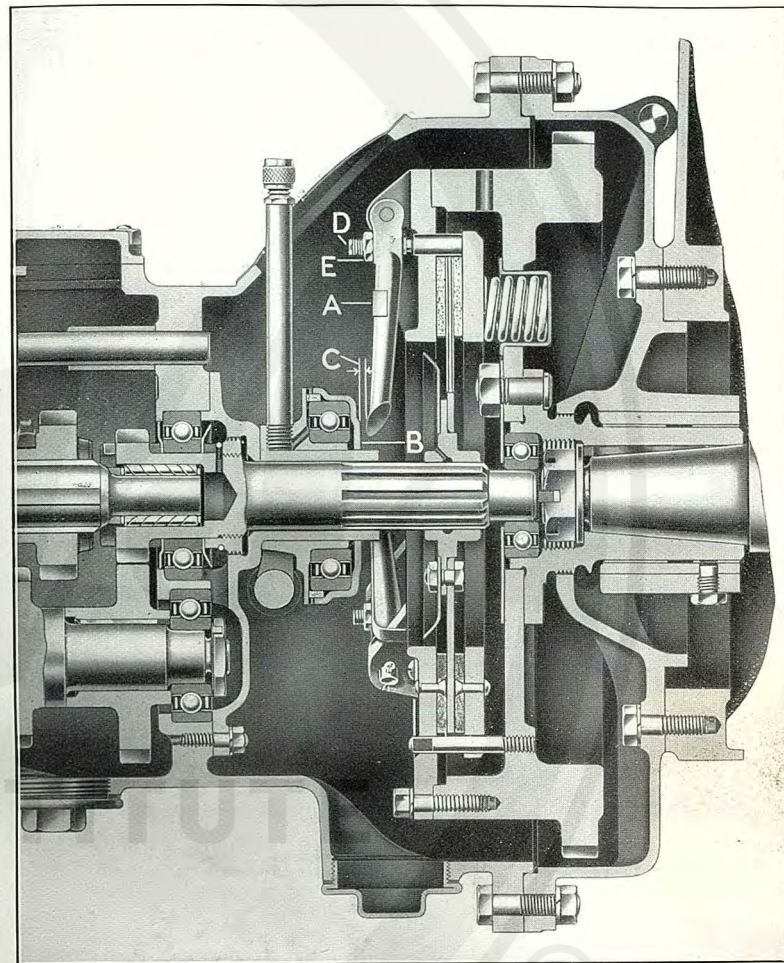
The clearance "C" between the ends of the levers and the face of the bearing housing may gradually alter, owing to the wear on the fabric facing or on the pins and screws. It is very important to see that the clearance referred to is never allowed to become less than $\frac{1}{16}$ in. (1.6 mm.) or more than $\frac{1}{8}$ in. (3.18 mm.).

To check the clearance insert a gauge between the tips of the levers and the face of the bearing housing ("C" in the illustration). Any clean piece of strip metal will do for a gauge of a thickness not less than $\frac{1}{16}$ in. or more than $\frac{1}{8}$ in. (3.18 mm.).

If the clearance is less than $\frac{1}{16}$ in. the three clutch operating levers "A" must be adjusted by means of the screws "D," which should be screwed outwards after loosening the lock nuts "E."

The clearance should not be made more than $\frac{1}{8}$ in., and great care should be taken to see that all three levers have the same clearance. This, of course, you can check carefully with the gauge referred to above.

Lock the screws with the lock nut after adjustment and again check the clearance.



Clutch Mechanism.

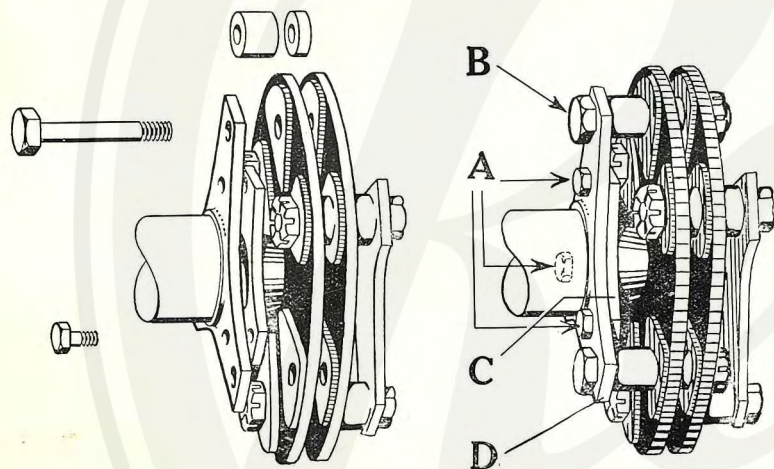
NOTE TO REPAIRERS.—The flywheel web has two tapped holes $\frac{3}{8}$ in. B.S.F. for the purpose of screwing in bolts to force the flywheel from the flywheel centre.

GEARBOX

The gearbox is constructed in unit with the engine and provides four forward speeds and reverse. A sectional view is illustrated on page 57.

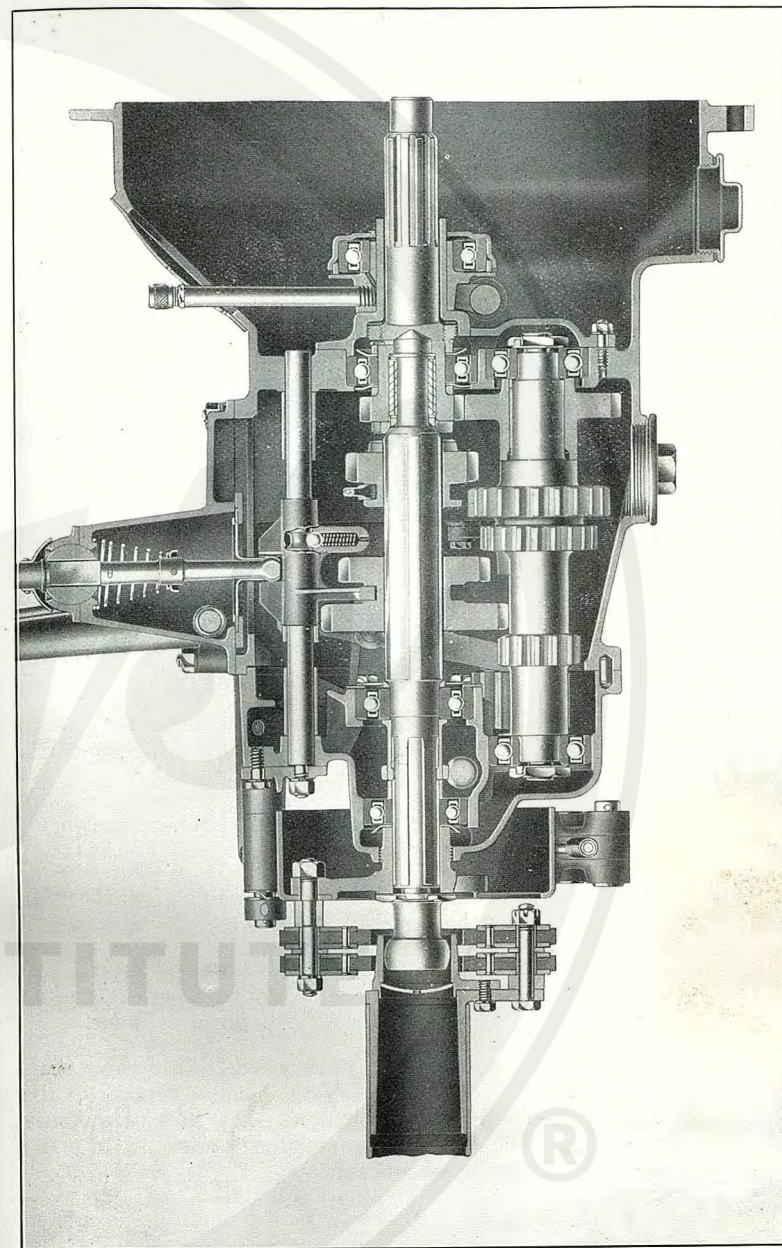
Propeller Shaft.—The drive from the gearbox to the rear axle is by a tubular propeller shaft provided at each end with a fabric universal joint. At the centre of each of these joints is a ball centring piece to which a spot or two of oil should be added occasionally, as if allowed to become dry they may squeak.

The nuts on the universal joint spiders should be tested periodically for possible slackness.



The propeller shaft can be readily taken down if desired. Unscrew the set screws marked "A" in illustration. Separate the centring piece "C" from the universal joint spider "D," and push the centre in as far as it will go.

Remove the bolts "B." When these operations have been carried out at both ends, the propeller shaft will be free to take down. While replacing the propeller shaft it is most essential to notice that the bolts "B" should be assembled with their heads butting against the universal joint spider, and the distance piece replaced, as shown on illustration.



BRAKES

Foot Brake.—The foot pedal operates simultaneously a pair of brake-shoes on each road wheel. The control is by the Lockheed Hydraulic system.

How the Hydraulic System Functions.—It should be known that “pressure exerted upon any portion of a fluid enclosed in a vessel is transmitted undiminished equally to all surfaces.”

When pressure is applied to the foot pedal, the piston in the master cylinder is forced forward and causes the fluid to flow through the entire pipe line; the pressure created is given to each road wheel cylinder with equal and undiminished force.

The fluid in the wheel cylinder being thus put under pressure, forces out the wheel cylinder pistons and so causes the brake-shoes to engage with the brake-drum.

The action of the brake-shoe return spring forces the fluid back to the master cylinder when the pressure on the foot pedal is released.

A feature of the design is the ease with which the brakes can be inspected, the brake-drums being fitted to the outer side of the hub flanges. After taking off the road wheel, the removal of three screws will allow the brake-drums to be drawn off and the whole of the interior mechanism will be exposed.

The Supply Tank.—The supply tank is mounted on the chassis frame and carries the foot pedal on a splined spindle which operates a lever inside the supply tank.

The master cylinder is fixed inside the supply tank, as shown on illustration. (See page 61.)

The supply tank must be kept more than half full of fluid; this forms a reserve supply for the system.

The supply tank must be replenished with brake fluid. The use of any other liquid would have a detrimental effect on the component parts of the master cylinder and the wheel cylinder.

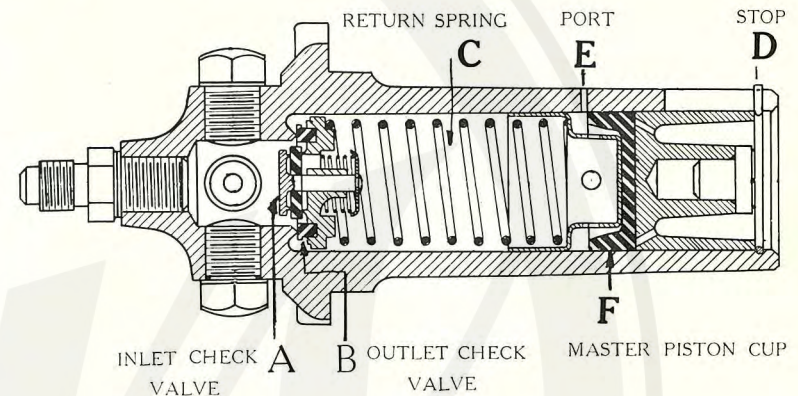
The filler plug is fitted with a breather valve. This valve seals the tank, and prevents the evaporation of the alcohol content in the fluid, and the ingress of any foreign matter. **Do not allow any dirt or foreign matter to enter the system when filling the supply tank or examining the level.**

The level of the fluid in the supply tank should be examined approximately once a month.

The Master Cylinder.—The master cylinder is submerged in the fluid, thereby protecting the system at this point from any danger of taking in air, dirt or water.

It is arranged for a pressure of 8 lb. per square inch (.5625 kg. per sq. cm.) to be maintained in the system when the brakes are off.

This pressure acts on all the rubber cups and ensures a complete sealing of the system.



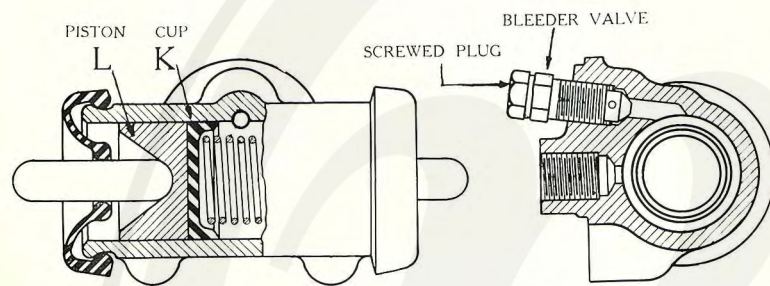
Sectional Drawing showing Master Cylinder.

When the foot brake pedal is depressed, the master cylinder piston is pushed forward, which opens the inlet check valve “A” and transmits the pressure applied throughout the system.

When the foot brake pedal is released, the master piston is returned to its “off” position by spring “C” and against the stop “D.” Simultaneously the brake-shoe return springs are forcing the fluid out of the wheel cylinders and, as the pressure in the pipe is now greater than in the master cylinder, the outlet check valve “B” opens and the fluid flows back into the master cylinder until the pressure balances the force exerted by the master cylinder return spring “C,” when the outlet check valve closes.

Should, for any reason, the return of fluid be insufficient to equal the displacement caused by the return of the master piston, a partial vacuum is created in the master cylinder, which will make the master piston cup “F” turn in at the lip, and allow fluid to by-pass from the supply tank to the master cylinder. The port hole “E” is provided as a release for fluid should expansion take place as a result of a rise in temperature. The check valve functions differently when “bleeding” or filling the system. (See page 63.)

The Wheel Cylinder.—The wheel cylinder is mounted rigidly on the brake carrier and is fitted with opposed pistons "L." In front of each piston is a rubber piston cup "K," held in position by a spring. The pistons are directly connected to the top end of the brake-shoes. On the top and in the centre of the wheel cylinder a bleeder valve is provided.



Sectional Drawing showing Wheel Cylinder.

The Pipe Line.—The pipe line is arranged as shown in illustration. The flexible hose which connects the pipe line is specially made of fabric material with a rubber core.

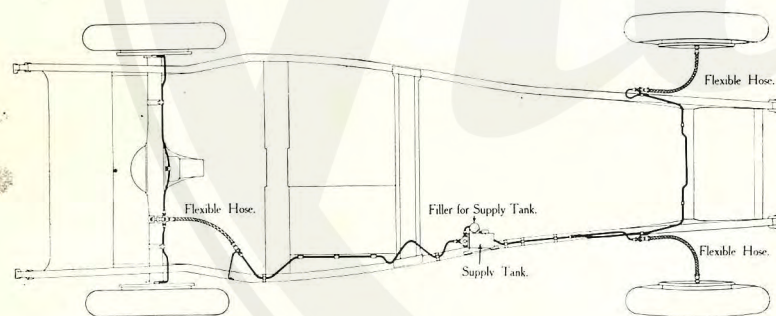
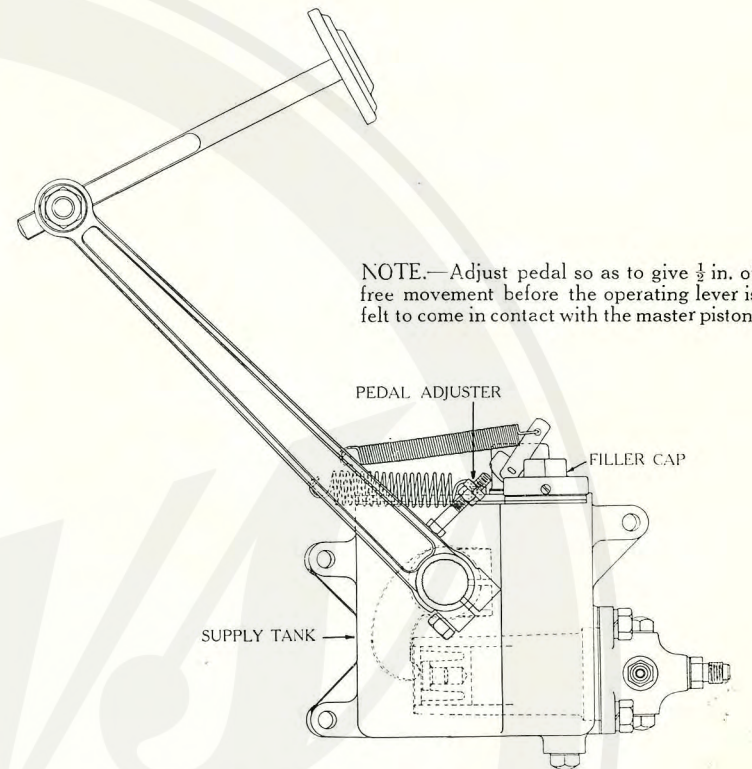


Diagram showing Pipe Line.



NOTE.—Adjust pedal so as to give $\frac{1}{2}$ in. of free movement before the operating lever is felt to come in contact with the master piston.

Brake Pedal Adjustment.

Adjustment of Brakes.—The brake pedal must be set so that the master piston cup is back or clear of the port "E" when the brakes are in the "off" position.

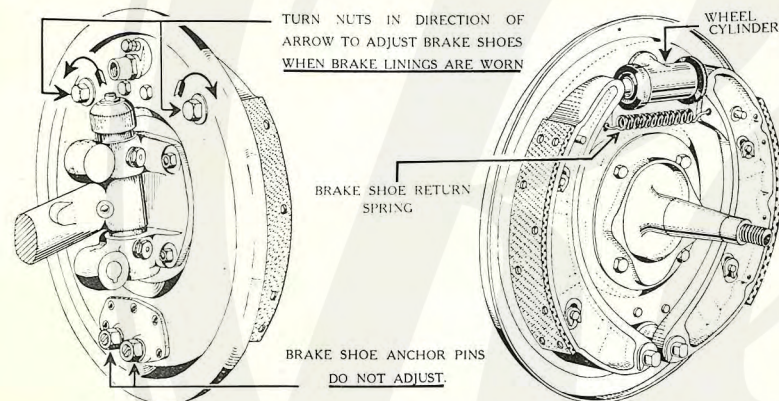
The master piston cup will automatically return so that the port "E" is clear, unless its movement is restricted by the pedal lever. In order to avoid any restriction it is necessary to adjust the pedal so that at least $\frac{1}{2}$ in. (12 mm.) of travel can be given to the pedal without feeling any movement of the master piston.

No adjustment is required for equalisation of pressure on brake-shoes. The only necessary adjustment of the brake-shoes is that required to compensate for wear of the brake linings. When this adjustment is necessary it will be indicated by the fact that the foot pedal can be depressed a good portion of its travel without the resultant effect of the brakes.

It should be mentioned here that the adjustment provided limits the amount of travel of the brake-shoes to their "off" position, and so regulates the amount of travel required to move the brake-shoes to their "on" position.

The adjustment can be readily made by using a spanner on the two nuts shown in illustration below. Jack up the car until the wheel is free. Turn the nuts in the direction indicated on the illustration until the brake-shoes can be felt to be contacting with the brake-drum. Now turn the nuts in the opposite direction just sufficient to free the brake-shoes from the brake-drum, so that the road wheel can be rotated without feeling any appreciable drag. Repeat this operation on all four road wheel brakes.

It is not necessary to make this adjustment absolutely equal on each brake. The action of the hydraulic system gives equal pressure on each set of shoes irrespective of the amount of travel required to bring the brake-shoes into action.



Brake-Shoe Adjustment.

Note.—The brake-shoe anchor pins should not be adjusted or interfered with in any way, except when a new brake-drum or brake-shoe is fitted.

The adjustment provided for on the pins is to centralise the brake-shoes to the brake-drum, and as this is done when fitting the brake-drums, no advantage can be gained by further adjustment.

To examine the brake-shoes or the wheel cylinders, take off the road wheel and remove the three countersunk-head screws, which will allow the brake-drum to be removed, thus exposing the brake-shoes.

To remove the wheel cylinder from the front-wheel brakes, disconnect the flexible hose at the frame end, remove the nut and lock washer. This is to allow the hose itself to rotate when unscrewing it from the wheel cylinder.

Rotate the cam adjustment nuts so that the brake-shoes can be swung back when the brake-shoe return springs are unhooked. The wheel cylinder can now be dismantled by removing the two nuts from the outside of the brake carrier.

To remove the wheel cylinder from the rear-wheel brakes follow the above instructions, except that the copper pipe must be disconnected at the cylinder inlet. Care should be taken not to bend the copper pipe.

The wheel cylinder pistons will be forced out by the spring when the wheel cylinder rubber boots have been removed. See notes on page 64 regarding cleaning, etc.

Filling and Bleeding the System.—Bleeding the system is only necessary when some portion of the hydraulic system has been disconnected, or the fluid in the supply tank allowed to fall, so that the master cylinder is not submerged. In other words, air has been allowed to enter the system, and owing to the fact that air can be compressed, whereas a fluid is practically incompressible, this air must be removed. The action of removing the air is termed "Bleeding."

To Bleed the Line.—Fill up the supply tank with fluid; exercise great care to prevent any dirt getting in.

Take one brake at a time, remove the screwed plug from the bleeder valve (see illustration on page 60), and screw in its place the rubber tube with a union end, which will be found in the tool kit. Now obtain a clean glass vessel into which the open end of the rubber tube can be placed. Using the special spanner supplied in the tool kit, pass the rubber tube through the centre of the spanner and then unscrew the bleeder valve about $\frac{3}{4}$ of a turn.

Depress the foot pedal by hand, allowing the pedal to return to its "off" position by the pressure exerted by the master cylinder return spring.

Approximately ten strokes of the pedal will be necessary to bleed each wheel cylinder, and no air bubbles will now be seen escaping from the end of the rubber tube.

Repeat this procedure on the other three wheel cylinders.

The fluid which passes through the rubber drain tube into the vessel mentioned above can be used to refill the supply tank, provided it is perfectly clean.

After the bleeding operation has been performed, the supply tank must be filled and the filler plug screwed down tightly.

When cleaning the various units of the brake mechanism:—

Do not use paraffin or petrol on the rubber parts or on the inside of the cylinders.

Use only alcohol or brake fluid.

The cup and the piston should be dipped and cleaned in the brake fluid before inserting into the cylinder.

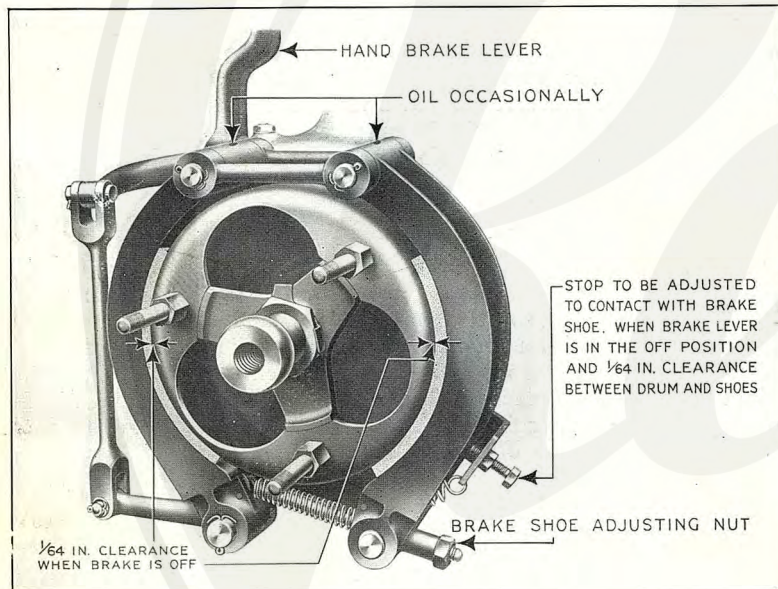
Do not make pipe joints with packing compounds; clean metal-to-metal joints only should be made.

Do not allow the supply tank to be less than half full of brake fluid.

Do not allow grease, paint, oil or brake fluid to come in contact with the brake lining.

The brake-shoe linings used throughout must be of the same type on all brake-shoes.

When the pipe line has been disconnected the unions and joints must be carefully protected to prevent the entry of dirt or foreign matter.



The Hand Brake

The hand brake operates a pair of brake-shoes on a drum, which is carried on an extension of the mainshaft at the rear of the gearbox.

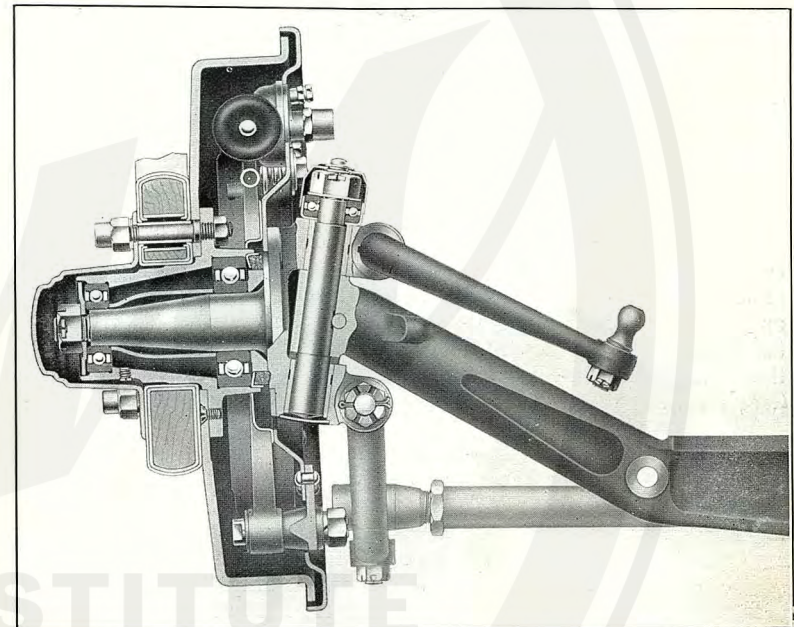
This brake is primarily intended for use as a "standing" brake, but it is actually a highly efficient brake and is capable of holding or stopping the car under all running conditions.

This brake should not be used as a service brake except in the case of emergency.

FRONT AXLE

The front axle is a steel drop forging, carrying the swivel pins in bronze bearings, with ball thrust bearings to take the weight of the car. These bearings are lubricated with the grease gun, and a film of lubricant should always appear outside the swivel pin bearings.

It is important that these bearings should be adjusted so that they are free to move nicely, otherwise the constant hammering will eventually result in each ball embedding itself in one spot in each case, so that a series of equally spaced depressions is formed in the ball paths. Considerable pressure is required on the steering wheel to deflect the front wheels, since the load has to be lifted out of the depression by rolling the balls up the walls of the indentations. This will set up "flap" especially on a pot-hole or rough road.



Front Hub and Swivel Axle.

The front hubs are filled with Wolseley Solidified Oil. (See page 14.) Every three months the hub cover should be taken off and the small plug in the hub taken out. Where wire wheels are employed the removal of the wheel will expose the small plug referred to. Screw in the greaser connection which will be found in the tool kit, and give about six strokes of the grease gun. Remove grease connection and replace the plug.

The hub bearings are not adjustable.

REAR AXLE

The rear axle drive is by spiral bevel gear. All the driving gears and bearings are lubricated by the oil in the centre casing. (See page 21.)

Timken adjustable taper roller bearings are fitted to the bevel pinion and also to the differential gear housings.

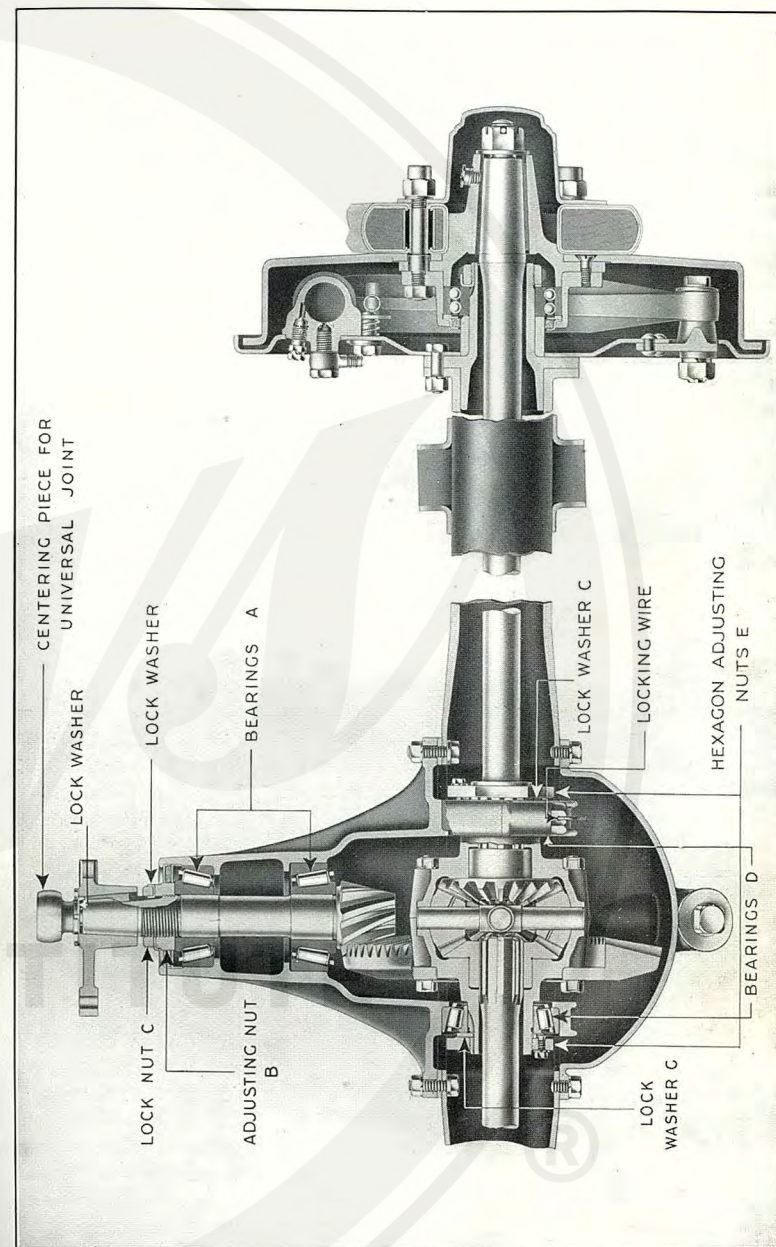
Adjustment of these bearings should not be necessary for many thousands of miles. When, however, adjustments are necessary it is essential that the work should be done by a competent repairer. We strongly advise that when **adjusting Timken bearings a certain amount of freedom** must be given to the bearings. If they are adjusted too tightly they will cause serious trouble, due to expansion, as the temperature of all the components rises when transmitting motion to the car.

The bearings "A" of the bevel pinion are adjusted by means of the nut "B," which is normally held fast by the lock nut "C."

The bearings "D" of the bevel wheel and differential gear are adjusted by the hexagon nuts "E." These nuts are locked in position by set screws, the dowel end of the set screws engaging in one of the twelve slots in washer "G." Great care must be taken, when adjusting these bearings, that the endwise location of the bevel wheel in relation to the bevel pinion is not upset by unequal adjustment, or else the gears may become very noisy through being forced too far into, or out of, mesh. The correct amount of backlash between the teeth of the gears is between four and five thousandths of an inch (.127 mm.).

Rear-Wheel Bearings.—The method of lubrication is by Wolseley Filtrate Solidified Oil (see page 14), which is applied by grease gun to connection. Access to this grease connection is obtained by removing hub cover. Where wire wheels are employed the greaser will be exposed by removing the road wheel. The bearing is well filled with grease when the axle is assembled, so that it is only necessary to apply the grease gun to this connection about every 2000 miles; give four or five strokes of the gun only.

The hub bearings are not adjustable.



Rear Axle

STEERING GEAR

The steering gear is of the worm and wheel type, of simple design, and not likely to get out of order.

It is important to keep the steering worm box full of **Wolseley Filtrate Gear Oil** (see page 14), which is introduced through the large plug hole on top of the steering worm box. The joints of the steering tube, and also those of the cross rod behind the axle, must be frequently lubricated with the grease gun.

Exceptional provision has been made for the adjustment of the working parts to compensate for wear, but unless the owner is quite competent to undertake such work it is wiser to entrust the job to a qualified man. Wear is hardly likely to develop for many thousands of miles, but the following hints may be useful when circumstances demand :—

End play in the steering column may be eliminated by loosening the locking bolt "A" and screwing up the bearing "B" (see illustration on page 69). Do not screw this up too tight but just enough to take out the end play and yet leave the steering column free to rotate easily. This should be tested with the front wheels jacked up clear of the ground. After adjustment tighten up the locking bolt again, but do not overstrain this or it will cause the steering to become stiff.

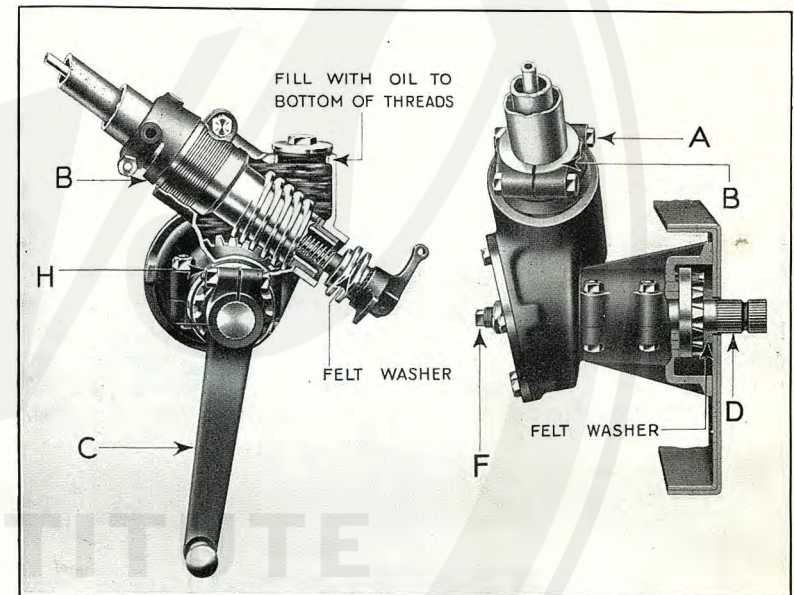
Backlash in the steering gear—that is, movement of the steering wheel without a corresponding movement of the front wheels—may be brought about by two things, of which wear in the worm and the wheel is one, and wear in the various joints of the steering links the other. The latter will not cause any trouble until the ball joints are worn out, as they are spring loaded and the springs will keep the ball cups up to their work. If any looseness of these joints ultimately develops, the balls and cups should be renewed. Backlash in the teeth of the worm and wheel may be detected by careful rotational oscillation of the steering wheel. If the movement of the steering wheel is excessive before the steering lever "C" begins to move it may be necessary to bring into use a new set of teeth of the steering worm.

It will be noticed that although the worm wheel is a complete wheel, only a portion of the teeth are used to give full steering lock ; therefore when wear has taken place it is only necessary to turn the worm wheel so as to bring the unused portion of the wheel into mesh with the worm. It is advisable, however, before turning the worm wheel, to ascertain if there is any appreciable end movement of the worm wheel shaft "D." This will be indicated if the steering wheel can be moved each way sharply and no corresponding motion observed at the front wheels, or, the road wheels may be oscillated sideways,

which causes an up and down motion on the steering column ; this, however, must be hardly perceptible, and any excess motion can be taken up by adjusting screw "F." Do not tighten this screw too tightly or the steering will be stiff. Care must be taken to lock screw "F" after adjustment.

If the backlash is still excessive a new third of the worm wheel may be brought into use as follows :—

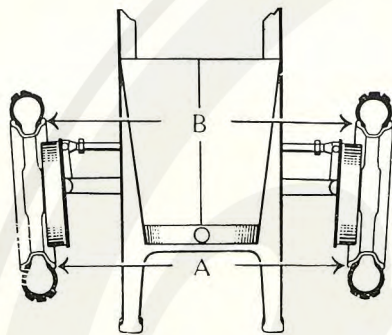
Loosen the clamping bolt "H," and withdraw the steering lever "C" from the shaft. Turn the steering wheel three complete turns and then replace the steering lever. The backlash will now, in all probability, be about half an inch at the rim of the steering wheel, which is the correct amount.



Steering Gear.

The nuts securing the steering arms to the axle swivels should be periodically examined and tightened up if necessary, as if they are at all slack the excessive strain caused by the consequent hammering is liable to cause fracture by fatigue, and may result in a serious accident.

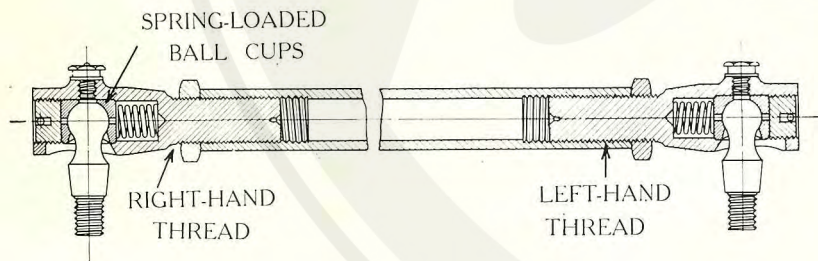
It is important, to prevent undue strain on the steering gear and wear of front tyres, that the front wheels should be correctly set. The correct setting is that the measurements from rim to rim, at



Diagrammatic View of Front Wheel Setting.

lines passing through the centre of the wheels, should be equal if possible, or be $\frac{1}{8}$ in. (3.18 mm.) less at the front ("A") than at the back ("B"). This should be checked after striking the kerb or after a collision.

When a car is stationary the wheels should never be forced round by the steering wheel. This causes unnecessary strain to be placed on the steering gear unless assistance is rendered by someone also pulling the road wheels in the direction required. When manoeuvring the slightest movement of the car is sufficient to prevent this strain.



Steering Cross Rod.

LUVAX HYDRAULIC SHOCK ABSORBERS

The shock absorber has been designed primarily to control the recoil of the road springs (the compression being unaffected). Consequently, when the road wheels hit a bump, the blow will be absorbed in the road springs without harshness; the energy thus generated will, however, be quickly thrown out in the recoil, and it is this action, if not properly checked, which throws the passengers upwards off the seats and makes riding uncomfortable. On a "wavy" road the spring-loaded ball valve gives a checking double action which will gently absorb the oscillations set up by the road springs. The loading and lift given to the release valve in the reacting block tend to make it comparatively slow in its action, but on a hard bumpy road a sudden movement will lift this valve off its seat, and it is easily kept there by the sudden rush of oil, thus allowing a perfectly free movement until the shock absorber takes control of the recoil, and allows the road spring smoothly to regain its normal position.

The general design is very simple and consists of a vane rotor working in a pressure chamber; this chamber being divided by the reacting block, in which is incorporated the regulation and control.

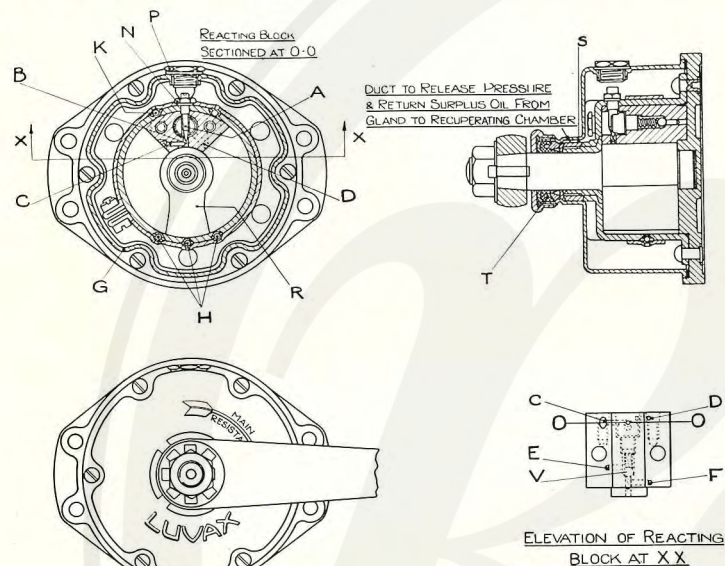
As the road spring compresses, when the wheel hits an uneven road surface, the lever arm moves and rotates the rotor "R" in the working chamber, which drives the oil in at "F," lifting the ball valve "V" off its seating, and through "E" to the other side of the reacting block. This action is generally free and offers no resistance to the spring.

The energy generated in the road spring will now be checked on the return movement by the shock absorber as follows:—

The orifice "E" being located above the ball valve "V," oil will force the ball valve on to its seating and close this means of return, the only other way being through "C" and the orifice "B" (which is regulated by a very fine threaded screw "A") and out through "D." This regulator "A," which is tapered at the end, gives a very fine degree of adjustment, the resistance being greater as it is screwed inwards. When properly set, the screw will be locked in place by the nut "N," facilities for this regulation being provided through filler "P."

An important point will here be noticed. That the oil is *not* passed from one chamber to another, but simply flows from one side of the reacting block to the other, consequently, if rotor "R" moves, the volume of oil swept out must first pass through the valve and take up the space behind the rotor.

This is a very important point, as it ensures that the rotor can never make the slightest movement without the oil being there to control it—whereas, if the oil had been passed into another chamber, it is probable that it would not get back in time, on a very quick movement of the actuating lever.



Diagrammatic illustration of Shock Absorber.

To safeguard against any possible loss of oil in the pressure chamber, a means of automatic recuperation is provided by the outer chamber "G" which carries a large supply of reserve oil which will be taken into the pressure chamber through oil valves "H," the air being discharged through air valves "K" which are specially designed to allow all air to escape whilst preventing any loss of pressure or oil.

With this design all valves fall naturally on to their seats when the absorber is doing *no work*, thus preventing any loss of oil from, or entry of air into, the pressure chamber.

The working chamber being completely surrounded by the recuperating chamber prevents any possibility of leakage, and any oil which may pass up the rotor spindle bearing is returned to the recuperating chamber by the passage "S."

This passage is arranged so as to put only enough pressure on the gland ring "T" to press it against the spindle on the inside and the case on the outside.

Connecting Link.—A tilting bearing is used in the connecting links between the lever arm and the spring. These bearings consist of a square block of rubber carrying at the centre a bush formed of graphite and cotton and obviate the use of ball joints. With this construction they do not require any attention whatever, such as lubrication, etc.

These shock absorbers are very carefully adjusted before leaving the factory. Facilities for re-regulating are, however, given through the filler plug "P" which, when removed, uncovers the regulator. To adjust, slacken off the lock nut "N" and turn the regulator screw "A." As this is screwed inwards the control action becomes greater, and a very fine degree of adjustment can thus be obtained. When properly set, the screw must be locked by tightening the nut "N."

Do not move regulator "A" more than a quarter of a turn at a time.

Maintenance.—*The recuperator chamber must not be allowed to become empty, otherwise air will enter the working chamber, and affect the action of the shock absorber by mixing with the oil and forming an emulsion.*

Use only Luvax oil for refilling the recuperator chamber, through the hole provided, in which is a screwed plug, about every 8000—10,000 miles' running. Use no other oil as Luvax shock absorber oil is a special grade mineral oil having properties essential for efficient working under all conditions.

There are no joints to lubricate, and the rubber tilting bearings are easily removed for renewal by taking out the small pointed grub screw in the side of the boss end.

Luvax oil may be obtained from any of Messrs. Lucas's Service Stations (see page 94).

Road Springs.—The clips which secure the front and rear springs to the axles are made of a material which may stretch under prolonged vibration. **It is necessary, especially when the car is new, to try the nuts on these clips to ensure that they are always kept tight.**

Silencer.—After the car has run a considerable distance the holes in the silencer centre tube may require cleaning. This tube can be drawn out of the silencer after removing the exhaust pipe from the engine. A choked silencer results in loss of power.

IV. Electrical Equipment

MAGNETO

The magneto fitted is a Lucas GJ6 type. These magnetos are guaranteed by the makers for two years. All that is necessary to ensure that the magneto gives its best service is to follow the instructions regarding cleaning and oiling.

In the event of any fault developing during the first two years, the defective magneto or part should be returned to the nearest Lucas Service Depot, addresses of which are given on page 94. It should be noted that the liability consists of making good the defect at the Lucas Works or Depot, and in no case do we or Messrs. Lucas Ltd. hold ourselves responsible for contingent expenses.

These magnetos are fitted with an automatic advance mechanism which eliminates the necessity for constant adjustment of the timing lever when driving. This ensures greater engine efficiency, particularly at low road speeds on top gear and during acceleration. Another advantage is that the magneto is automatically fully retarded when the engine is stopped, thus ensuring easy starting and freedom from the danger of back-firing. The device is a coupling fixed to the magneto shaft containing a centrifugally operated mechanism by means of which the ignition is advanced in proportion to engine speed. The mechanism is packed with grease during assembly, and no lubrication will be required until after considerable service, when two drops of oil should be added to the lubricator about every 2000 miles (3200 km.).

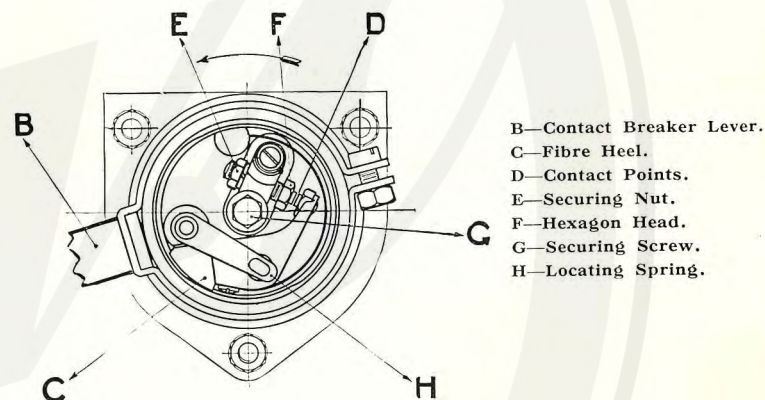
Cleaning.—About every 5000 miles' (8000 km.) running, examine the magneto, and, if necessary, clean those parts referred to below.

Distributor.—Remove the distributor, and any dust or deposit on the inside of the distributor moulding, on the metal segments or on the rotating metal electrode, should be wiped away with a cloth moistened with petrol.

Slip Ring and Pick-Up.—Remove the aluminium driving end cover, and then withdraw the pick-up, which is secured to the magneto body by means of two screws. The pick-up should be cleaned and polished with a fine dry cloth, and the carbon brushes should be examined to see that they slide freely in their holders and that they are not unduly worn. Clean the slip ring track and flanges by holding a soft cloth by means of a suitably shaped piece of wood on the ring while the engine is slowly turned over by hand.

Contact Breaker.—Remove the contact breaker cover by swinging aside the retaining spring, and the contact breaker is exposed to view. If when the contact points are examined it is found that they are burned or blackened (owing, probably, to the presence at some time or other of oil or dirt) they may be cleaned with very fine emery cloth, and afterwards with a cloth moistened with petrol. Care must be taken that all particles of dirt and metal dust are wiped away.

To render the points accessible for cleaning it is necessary to withdraw the contact breaker from its housing by unscrewing the hexagon-headed securing screw "G" by means of the magneto spanner. The whole contact breaker can then be pulled off the tapered shaft on which it fits. Now push aside the locating spring "H" and prise the rocker-arm off its bearing, when it will be possible to begin cleaning the points. When replacing the contact breaker care should be taken to ensure that the projecting key on the tapered portion of the contact breaker base engages with the keyway cut in the armature spindle.



View of Contact Breaker (clockwise direction magneto when viewed from the driving end).

Lubrication.

The armature is mounted on ball bearings which are packed with grease before leaving the Works and consequently do not require any attention. The distributor gear bearing should be lubricated about every 1000 miles by adding about three drops of oil through the lubricator provided. The reader is cautioned that far more trouble is caused by excessive oiling than by too little. Provision is made for the oiling of the cam-rings in order to reduce fibre heel wear, and consequently to enable the magneto to give longer periods of service without the need for altering the setting of the gap of the contact points. The oiling arrangement consists of a pocket in the contact breaker housing containing a length of felt soaked in oil.

A small hole in the cam-ring filled with wick is provided to enable the oil to find its way on to the surface of the ring. About every 5000 miles the cam-ring should be withdrawn and a few drops of thin machine oil placed on the felt.

Adjustment of Contact Breaker and Sparking Plugs.

The contact points only need adjustment at long intervals, and, unless the gap varies considerably from that of the gauge, the owner is warned that it is not desirable to alter the setting. The gap should be about twelve thousandths of an inch, and, if necessary, should be carefully adjusted to this dimension as follows :—

Turn the engine slowly by hand until the points are seen to be fully opened, then slacken the nut "E" and rotate the contact screw by its hexagon head "F" until the gap between the contacts is set to the gauge on the magneto spanner. After the adjustment tighten the nut "E."

The plug electrodes are bound to burn away slightly, and thus in time the gap width increases. It is a good plan to examine and clean them at intervals, adjusting them if necessary to the right setting ; this should be about twenty thousandths of an inch.

The Detection and Remedy of Ignition Faults.

If misfiring occurs in only one cylinder see that the high-tension cable shows no signs of wear or cracking, and that the sparking plug gaps are correct (about twenty thousandths of an inch) (.508 mm.).

Should the engine refuse to fire the following test should be made before the magneto is suspected of being the cause of the trouble. Without disconnecting the high-tension cables remove the sparking plugs, lay them on their sides on the cylinder and observe whether sparks occur at the points when the engine is cranked by hand. If sparking does not take place, first examine the cable leading from the magneto to the cut-off switch ; it may be accidentally earthed owing to severed or worn insulation. Inspect and clean distributor and contact points as previously described.

Misfiring on hills, or during full throttle acceleration, is probably due to the plug gaps being too wide.

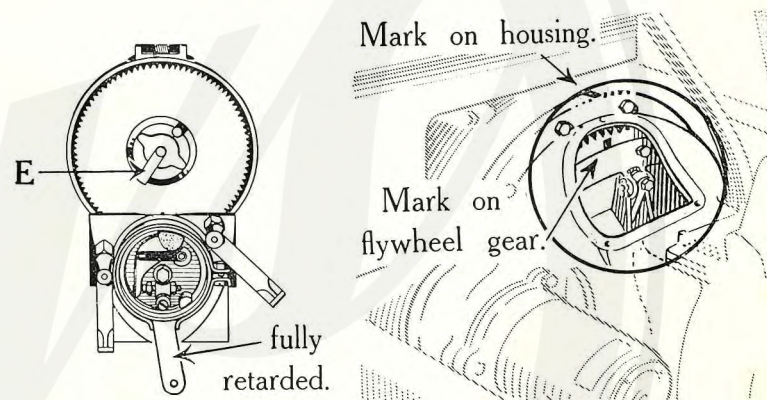
If the owner is still in any doubt or difficulty about his ignition system he is strongly advised to consult the nearest Lucas Service Depot.

Timing the Magneto to the Engine.—If the magneto has been removed, or it becomes necessary for any other reason to check the timing of the magneto, it may be carried out in the following manner :—

There are marks on the starter gear ring to indicate the position of the top dead centre of the respective cylinders. Revolve the engine by hand until the mark "1 and 6" comes to the top and in line with the mark on the flywheel housing, on the stroke when both valves of No. 1 cylinder are closed (i.e. compression stroke).

The spindle of the magneto should be rotated, with the timing lever in the fully retarded position, until the distributor electrode is opposite No. 1 segment on the distributor, and the contacts are just opening.

It should be noted that the direction of rotation of the magneto spindle is clockwise, looking on the driving end (as indicated by the arrow), and that the distributor electrode, when viewed from the distributor end, also rotates in a clockwise direction.



Timing the Magneto.

Both the engine and magneto are now in the firing position for fully retarded ignition, and the magneto coupling should be connected and the magneto strapped down.

The coupling is of the vernier type, and a fine setting can be made by adjusting the rubber centre piece until the projections on each side are in line with the recesses in the two halves of the coupling.

After connecting, the setting should be checked to ensure that no movement has taken place.

The cables to the sparking plugs should be connected as shown on the diagram on page 90.

LUCAS LIGHTING AND STARTING EQUIPMENT

Dynamo.—The dynamo requires very little attention to keep it in good order. The commutator cover strap should be removed occasionally for the purpose of inspecting the brush gear and commutator. The brushes should slide quite freely in their holders, but if they do not it is probably due to the accumulation of dust or oil, and in these circumstances they should be removed and cleaned. The brushes should have sufficient tension to be firmly pressed against the surface of the commutator when running, and present a smooth highly-polished surface over the whole area where they rub on the commutator.

Brushes.—Inspect the three brushes and see that they work freely in their holders. This can easily be ascertained by holding back the spring lever and gently pulling each flexible lead, when the brush should move without the slightest suggestion of sluggishness. The brushes should be clean and "bed" over the whole surface—that is, the face in contact with the commutator should appear uniformly polished. Dirty brushes may be cleaned with a cloth moistened with petrol.

If any of the brushes are badly worn they should be replaced. To obtain the best results, only Lucas replacement brushes should be fitted.

The angular position of the shunt brush must not be altered, as its exact position controls the output of the dynamo, governed by the position of the charging switch (see page 83).

The commutator should be wiped free of dust occasionally, and should at all times present a perfectly smooth surface. A slight deposit of carbon from the brushes is unobjectionable provided the commutator is not rough or oxidised.

A dirty commutator, or one burned by over-lubrication, will cause the output of the dynamo to be reduced. The best way to clean the commutator is to insert a fine duster, held by means of a suitably shaped piece of wood, against the commutator surface, causing the armature to be rotated at the same time. If the commutator has been neglected for long periods it may need cleaning with fine glass paper, but this is more difficult to do and should not be necessary if it has received regular attention. The grooves between the commutator segments should be examined occasionally, and any deposits of copper or carbon dust may be cleaned out by means of a thin saw blade or similar article. Petrol or other inflammable spirit should on no account be used owing to the danger of fire when the machine starts working. Do not allow any oil or grease to get on to the commutator.

The armature is mounted on ball bearings, which are packed with grease before leaving the Works. After the car has run, say, 10,000 miles the machine should be sent back to the nearest Lucas repair depot (see page 94) for cleaning, adjustment and repacking with fresh

grease. A few drops of oil, however, may be added through the lubricators, say, every 1000 miles. The reader is cautioned that far more trouble has been caused by excessive oiling than by too little. (See note on page 82—**Earth Dynamo when Battery is removed.**)

Starter.—To start the engine push in the relay switch smartly and release immediately the engine fires.

The starter drives the engine by means of a sliding pinion which works upon a screw thread on the starter shaft, the pinion engaging with the gear ring on the flywheel. When the press switch is depressed and the starter shaft commences to turn, the inertia of the pinion causes it to slide along the shaft and engage with the flywheel gear. Conversely, when the engine fires, the pinion overruns the starter shaft and slides out of engagement.

If the starter races out of engagement with the flywheel, as may sometimes happen—for instance, when the engine fires and then stops—switch off and allow the starter to come to rest before restarting. **Before attempting to start** make all the carburetter and ignition settings as described on page 5, as omissions in this respect cause needless discharge of the battery. If the engine does not fire within a reasonable time do not keep the starter running and so exhaust the battery, but look for ordinary engine faults. If for any reason the pinion wheel on the motor does not engage with the flywheel teeth, examine the screwed sleeve on the armature spindle to see that it is free from dirt; if necessary, wash over with paraffin. Occasionally give it a few drops of thin machine oil.

The starter requires practically no attention save an occasional cleaning.

The bearings are packed with grease, and as the total running time is relatively very small this lubricant will last a very long time.

The commutator and brushes seldom require attention during the life of the car, but they may be examined occasionally, the same remarks applying in this respect as for the dynamo.

It should be remembered that the power of the starting motor is derived entirely from the battery, and that the condition of the battery depends to a great extent upon receiving ample and regular charging; thus, if the starter becomes gradually weaker in action the fault may really be due to the battery being run down for some reason, or else to dirty battery terminals.

Automatic Cut-out Switch.—This is mounted in conjunction with the fuse box, on the forward side of the dashboard, and is provided for automatically closing the generator to battery circuit as soon as the dynamo is driven at sufficient speed to cause its voltage to rise above that of the battery. The reverse action breaks the circuit when the generator voltage falls below that of the battery, thereby preventing the battery discharging through the dynamo windings.

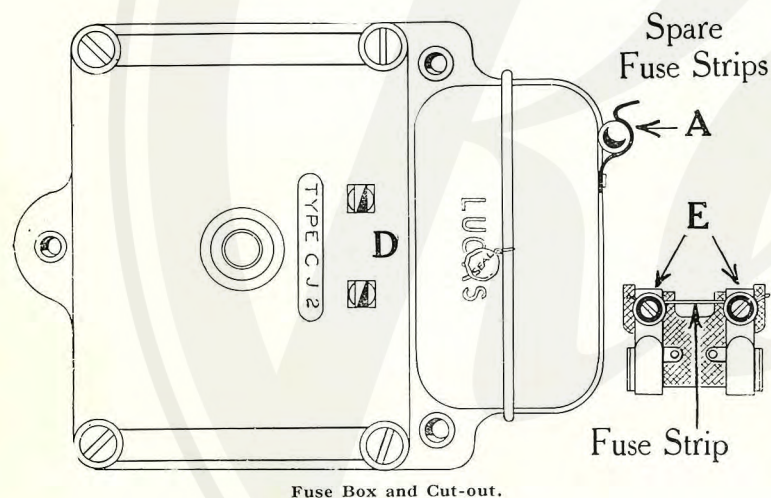
The cut-out switch is carefully adjusted by the makers, and then sealed, and as it is unlikely to get out of order it should not be tampered with or adjusted.

The cut-out does not switch off the dynamo when the battery is fully charged, and no such automatic device is provided.

Fuse.—The indication that the fuse has blown will be the failing of the stop light and the interior lights.

Occasionally examine the fuse in order to ascertain that it is held tightly in position.

If it becomes necessary to replace the fuse first withdraw the fuse holder from its posts "D." Loosen the screws "E" and remove any remaining pieces of fuse wire. Take the length of spare fuse wire from the carton "A" and wrap the end once round one of the screws "E" underneath the washer, taking care that the wire does not cross. Tighten this screw, then stretch the wire lightly across



the holder and wind it round the second screw, taking the same precaution as above. When this screw is tightened, the remaining length of wire may be cut off and the fuse holder replaced in position.

Should it be found that the fuse is continually blowing do not use more than one strand of wire at a time to prevent this occurring, but have the equipment thoroughly overhauled to find out the cause.

Battery.—It is absolutely essential, for the efficient working of the electrical equipment, that the battery is kept in good condition.—The care of the battery may be summed up in the following rules :—

- (1) Add nothing but pure distilled water to the cells, and do this often enough to keep the plates always covered.
- (2) Take frequent specific gravity readings with the hydrometer. (See below.)
- (3) Give the battery a special charge whenever the gravity readings are below 1.150.
- (4) Keep the battery clean, and the filling plugs and connections tight.

Adding Water.—The electrolyte consists of pure sulphuric acid diluted to the correct specific gravity with pure distilled water. The water evaporates from the electrolyte, and it is necessary therefore to add water from time to time to make up the level to $\frac{3}{8}$ in. above the top of the plates. This should be done once a month, because if the plates are exposed for any length of time they may be very seriously damaged.

The cells need replenishing with water more frequently in the summer than in winter.

Testing the Specific Gravity.—The specific gravity of the electrolyte is ascertained by means of a hydrometer of the syringe type. To use this instrument enough electrolyte is drawn up into the glass tube to lift the hydrometer float about 1 in., thus enabling the readings to be taken. Care must be taken that the stem of the float does not touch any part of the barrel or bulb while the reading is actually being taken. After the reading has been observed the electrolyte must be returned to the cell from which it was taken, as otherwise the specific gravity and the level of the electrolyte will be affected.

Hydrometer readings should be taken after a run on the car, when the electrolyte is thoroughly mixed.

When the cells are in good condition, fully charged, and the electrolyte is at its correct level, the specific gravity will be 1.285 to 1.300 (1.270 to 1.285 in tropical climates) in each cell. If these specific gravities are about 1.210 (1.195 in tropical climates) the cells are approximately half discharged. Such condition may be due to excessive use of lights or starter, or running without the dynamo switched on for a sufficient length of time, or it may be due to leakage in the system. The remedy is to keep the dynamo switched on and to use the lights and starter sparingly until the gravity rises. If the gravity does not rise in a reasonable time, look for defects in the system.

If the gravity falls to 1.150 (1.135 in tropical climates) the battery is exhausted, and should be removed at once from the car and given a long steady charge from an external source. The reason for the exhaustion should be ascertained.

A "TROPICAL CLIMATE" IS DEFINED AS ONE IN WHICH WATER NEVER FREEZES.

If the gravity of one cell is much lower than the others the cause should be investigated. It may be due to a leakage of electrolyte, or a short circuit in that cell.

Battery Hints.—Never add acid except to compensate for spillage.

Keep the battery clean, and if any water or acid has been spilt it must be dried off at once.

Keep the connections tight. Any corrosion of the metal should be removed and the parts smeared with vaseline. This is very important, as corroded terminals are often responsible for trouble with the starter.

Never bring a naked light near the battery.

Keep the vent holes clear.

See that the battery is held firmly in position to prevent jolting, or the connections will be broken.

Earth Dynamo when Battery is removed.—It is very important that when the battery has been removed and it is intended to run the engine (even if only for a short period) that the small piece of cable which will be noticed standing out from the dynamo must be coupled to the dynamo positive terminal. This will prevent burning out of the field windings. When the battery is again connected this wire must be removed from the terminal, otherwise no current will be generated.

The energy of the battery can be very considerably conserved and its life prolonged if on cold mornings, **before switching on the ignition**, you turn the engine a few times with the starting handle, which will be found secured in clips on the dashboard. The reason for this is that in cold weather the oil on the pistons becomes stiff, and if the electric starter is used before the preliminary turning by hand a great strain is put upon the battery in overcoming the initial stiffness of the engine. No great effort need be expended in doing this as it is not necessary to turn the engine quickly; it is sufficient to engage the starting handle at the bottom and pull up two or three times. Lady drivers will not usually find this is beyond their capacity.

It is generally considered desirable to keep a battery fully charged, but it should also be remembered that regular charging and discharging provide the best means of maintaining a battery in a healthy condition.

The discharge through the starter is, of course, comparatively heavy, but as a rule the time factor is very low. If we assume that the engine is started twenty times a day, it is very unlikely that the average duration of each discharge would be more than ten seconds, or in the aggregate say three minutes.

The switch is arranged so that for summer running an automatic slow charging system is always in operation. This allows sufficient current to be generated to keep the battery in a healthy condition after allowing for the average use of the starter and horn. For daytime running in the winter, the switch should be put on winter full; when the lamps are switched on the dynamo is automatically put in full charge.

Batteries Shipped Abroad.—On cars dispatched abroad the battery is sent dry and uncharged, and before being put into service the cells must be filled with electrolyte and given a long charge. The results obtained from the battery depend largely upon this initial charge, and it is therefore necessary that the following instructions are carried out in detail:—

- (1) Remove the filling plugs and fill the cells to about $\frac{3}{4}$ in. above the top edge of the plates with pure brimstone sulphuric acid which has been previously diluted with pure distilled water to the specific gravity of 1.285 at 60 deg. F. (1.270 in tropical climates). The proportion is roughly one part of acid to 2.8 parts of water by volume.

It is important in mixing to pour the water into the vessel first, adding the acid slowly and stirring thoroughly to assist diffusion. A mixing vessel made of glass, glazed earthenware or lead should be employed, and a glass rod used for stirring the solution. The mixture must be allowed to cool to approximately atmospheric temperature before use (should not exceed 90 deg. F. as a maximum).

After filling, the battery may with advantage be allowed to stand for a period not exceeding 12 hours before charging. It is not essential, however, to soak the plates in this way, and no harm will result if the battery is put on charge immediately after being filled with acid, provided that the temperature does not rise above 100 deg. F. In tropical climates the temperature of cells can be kept down by lowering the charging rate by 25 per cent., and allowing a period of rest after 12 hours' charging.

No dry or uncharged accumulator should be filled with acid solution unless the charge be commenced within the period of time indicated above.

- (2) For charging, direct current only must be used, and not alternating current. Connect the positive (+) terminal of the battery to the positive terminal of the charging source, and the negative (—) terminal of the battery to the negative of the charging source.

Arrange resistance in the form of lamps, or otherwise, in series with the battery so that the charging rate will be 4.5 amperes.

The maximum rate of charge for the first charge is 4.5 amperes and should be continued for 36 hours. At the end of this period it will be found that gas is being produced at the surfaces of all the plates, and the density of the electrolyte is at its maximum.

Towards the end of the first charge take careful hydrometer readings of the electrolyte in each cell. If in any cell the reading is above 1.300 (1.285 in tropical climates), after correction for temperature (see below), withdraw some of the electrolyte and add distilled water, continuing the charge meantime.

The temperature correction referred to above is as follows :—
For each $2\frac{1}{2}$ deg. F. above 60 deg. F. add .001 to the hydrometer reading, and subtract .001 for each $2\frac{1}{2}$ deg. F. below 60 deg. F.

Subsequent Charge.—On completion of the first cycle (i.e. charge and discharge) the battery will be put into regular working condition by charging at 7 amperes until the specific gravity remains constant at 1.300 (1.285 in tropical climates).

Headlamps.—These lamps are provided with an anti-dazzle device arranged for operation by a switch. When the switch is moved the headlamp beams are dipped and turned to the near-side of the road, thus causing no discomfort to approaching traffic.

The dipping of the headlamp beam is effected by a movement of the reflectors. These are made in two parts, the centre portion being pivoted on ball bearings in a fixed rim which is in turn secured to the headlamp body. The movement of the reflector is controlled by means of a solenoid and plunger, which, when the current is switched on, tilts the reflector to give the dipped beam.

Should the car be run in countries where the rule of the road is right-hand, the reflector can be arranged to dip and turn to the right by simply fitting it so that the slot in the rim marked "R" engages with the top support.

Removing the Lamp Front and Reflector.—To remove the front, slacken the fixing screw and swing it aside from the slot in which it fits. The front can then be withdrawn from the body of the lamp.

The reflector can be removed by simply withdrawing it from its supports.

When replacing the dipping reflector, locate the slot marked "L" or "R" with the top support, according to whether the reflector is to dip to the right or left. Then press the rim over the other two supports, locating each support with the slot provided in the rim.

To replace the front, press it on the body, locating the top of the rim first. Finally swing the fixing screw into the slot and tighten it to lock the front in position.

Adjusting and Focussing.—The lamps are provided with universal mountings which allow the beam of light to be adjusted on the road to the best advantage. This adjustment is obtained by slackening the locking screw, turning the lamp to the desired position, and locking by tightening the screw.

The very accurate formation and particularly high polish on the surface of the reflectors is the result of many years of research work, manufacturing experience and prolonged night driving observations on the road. If, however, the bulb is not correctly focussed the advantages of this scientific design are lost; it is therefore essential that the filament should be approximately at the focus of the reflector.

To enable the correct focus to be obtained, the bulb holder is arranged so that it can be moved backwards or forwards when the clamping clip at the back of the reflector is slackened. Care should be taken to tighten the clip after adjustment.

The best method of adjusting and focussing the lamps is to take the car on a straight level road, and then to adjust the lamps and focus the bulbs as described above, until the best road illumination is obtained.

Fuses.—A fuse is provided with each electrical dipper unit to protect the equipment in the event of the reflector failing to function properly. Spare fuse wire is provided in a carton which is with most lamps clipped to the back of the reflector.

The method of fitting a new fuse wire is as follows :—Slacken the two securing screws and remove any remaining traces of fuse wire. Take the length of spare fuse wire from the carton and wrap the end once round one of the screws underneath the washer, taking care that the wire does not cross. Tighten this screw, then stretch the wire lightly across to the second screw, taking the same precautions as above. Tighten the screw and cut off the remaining length of wire.

If the fuse should blow repeatedly, and the cause of the trouble cannot be found, do not use two or more strands to prevent this occurring but have the reflector examined at the nearest Lucas Service Depot.

Cleaning.—The reflectors are protected by a transparent and colourless covering, which prevents tarnishing and enables any accidental finger marks to be removed with chamois leather or a soft cloth without affecting the surface of the reflector. Do not use metal polishes on Lucas reflectors.

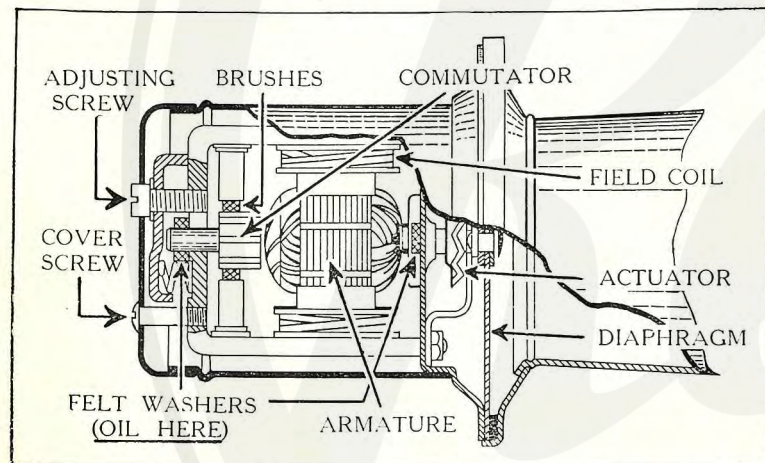
Ebony black lamps may be cleaned with a good car polish. For chromium-plated lamps see page 92.

ELECTRIC HORN

The note of the Lucas Sparton horn is produced by the rotation of the armature of a small electric motor. Fixed to the one end of the armature shaft is the actuator—a ratchet type of disc which presses against a stud mounted on the diaphragm. This causes the diaphragm to vibrate when the armature rotates, so producing the warning signal. The quality of the note largely depends upon the speed at which the armature rotates, and consequently it is essential that the bearings are kept oiled, and the commutator and brushes are clean.

To obtain the best results from the horn we advise that it should be inspected occasionally, say once in two months, and the following instructions carefully carried out.

To lubricate, clean or adjust the horn, loosen the pivot bolt on bracket and turn the horn so that the rear end is accessible.



Diagrammatic Drawing showing Electric Horn

Lubrication.—Unscrew the cover fixing screw and remove the cover. Oil the armature bearings with a good quality oil such as is used for typewriters, clocks and other light machinery. The oil should be added to the felt washers at both ends of the armature until they are saturated.

Cleaning.—Clean the commutator with a clean cloth moistened with the oil recommended above. The cloth should be pressed

against the commutator surface while the motor is set in motion by pressing the push.

Adjustment.—Although the horn will give long periods of service without adjustment, it is occasionally necessary to readjust. For instance, when the horn becomes uncertain in its action, or gives a poor note, it does not follow that the horn has broken down; it probably only needs adjusting.

In order to alter the tone of the horn the adjusting screw may be turned to the right or left as necessary (a coin will serve as a screw-driver). Turning to the right forces the armature towards the diaphragm, decreasing the clearance between the actuator and the diaphragm. This will increase the intensity of the tone.

Turning to the left increases the clearance between the actuator and the diaphragm, thus decreasing the sound intensity. The best position for the adjusting screw can readily be found by trial.

It is important not to adjust too tightly as in some circumstances the motor may fail to operate. The armature must always rotate easily when turned by the fingers.

Care must be taken that all bracket and cover screws are kept tightened.

Failure of the Horn.—If the horn fails to operate, first make certain that the trouble is not due to some outside source, e.g. a discharged battery, a loose connection or a short circuit in the wiring of the horn.

Do not dismantle the horn, but oil, clean and adjust it in accordance with the foregoing instructions.

If it still will not operate, we strongly advise the owner to call on or send the horn to our nearest Service Depot, see page 94.

In the event of any difficulty with any part of the equipment, no matter how trivial, we shall be only too pleased to give every assistance possible. The best course to adopt is to call at the nearest **Lucas Service Depot**, the addresses of which are given on page 94, when the equipment can be examined as a whole. The depots are not only at your disposal for repairs, overhauls and adjustments, but to give free advice. If it is necessary, however, to communicate, or when ordering spare parts, always give the type and number of the unit in question, as well as the type, h.p., and number of car.

Fault Location.—The following tables will assist owners to trace any faults in the electrical equipment:—

Lights Fault-Finding Table

LAMPS	—Insufficient illumination	—Lamp badly set on bracket.
		—Bulb discoloured through use.
		—Out of focus.
		—Dirty reflector or bulb.
		—Battery exhausted.
	—Light when switched on, but gradually diminish	—Battery exhausted.
		—Battery exhausted.
	—Brilliance varies with speed of the engine	—Acid level low.
		—Battery connection loose or broken.
		—Loose connection.
	—Lights flicker	—Lamp adapter contacts faulty.
		—Earthing of lamp body defective.
		—Battery exhausted.
	—Lights out	—Broken or loose connections.
		—Lamp filament broken.

Dynamo Fault-Finding Table

Dynamo not charging	— Broken or loose connections.		
	— Charging switch faulty.		
Charging intermittently or low output	— Dynamo	— Brushes	— Loose terminal nuts.
			— Greasy or dirty.
			— Worn.
			— Tight in holders.
			— No spring tension.
			— Shunt brush position altered.
		— Commutator	— Greasy or dirty.
			— Worn or rough.
			— Copper dust between segments.
	— Switchbox	— Loose connections.	
— Cut-out and fuse box			
Dynamo charging with excessive output	— Battery	— Shunt circuit	— Loose or broken connections.
			— Acid level low.
			— Brush position altered.
			— Brush not bedding properly.

Starter Motor Fault-Finding Table

Motor sluggish or fails to move engine			—Engine partially or entirely seized.
			—Oil too thick for winter use.
	—Motor	—Brushes	—Loose terminal nuts.
			—Greasy or dirty.
			—Worn.
			—Tight in holders.
			—No spring tension.
	—Commutator		—Greasy or dirty.
			—Worn.
	—Operating switch		—Loose terminal connections.
Starter motor rotates but fails to engage	—Battery		—Exhausted.
			—Bad connections.
			—Acid level low.
			—Sliding pinion screw thread dirty.

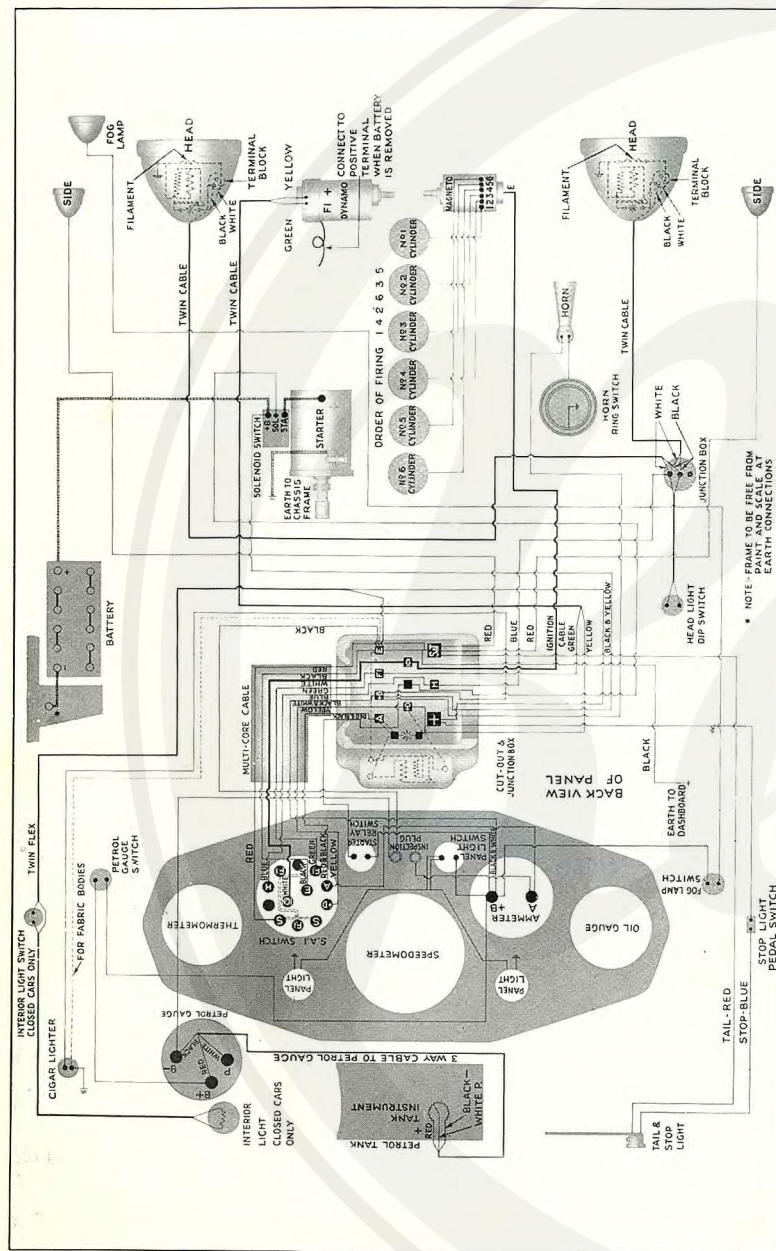


Diagram showing how the Electric Wiring is arranged.

V. Care of the Coachwork

Cellulose.—Cars having “cellulose finish” may be dusted with a dry duster without harming the surface, but mud, whether wet or dry, should be carefully washed off. Spots of mud from tar-sprayed roads, or spots of tar, may be very easily removed by a cloth damped with benzol.

The cellulose should be polished weekly with a special wax polish. This maintains the brilliant finish and makes it weather- and waterproof. “Cellusol” Wax Polish is recommended by us, and if this is not obtainable in your district, supplies can be ordered from our Service Department.

The polishing wax should be applied as sparingly as possible—a very little rubbed in with a soft pad and afterwards polished off with a clean polishing cloth, care being taken to clean all the polish out of the corners, edges of mouldings, etc. Soft stockinette cloths suitable for the above work can be obtained at most drysalters.

Fabric Bodies.—Soft soap and lukewarm water in the form of a lather should be applied with a sponge or soft rag. The lather should then be washed off with cold water and the fabric finally dried by rubbing with a clean soft rag.

Hoods.—When cleaning hoods use only soap and water. The hood should never be lowered when wet, neither should it be left folded when the car is not in use.

When the hood is lowered the fabric should be folded neatly and not allowed to lie bunched up. The hood should be securely strapped down to prevent chafing.

We can supply a waterproof dressing for black hood fabric. This is an excellent restorative and greatly improves the appearance of the hood.

All the joints should be oiled occasionally to ensure easy operation and prevent rusting.

Care of Upholstery.—When cleaning the car, water should not be allowed to splash on to the upholstery. A soft dry cloth should always be sufficient to remove superficial dust, and a brush can be used in awkward places. On no account must oil or oily rags be allowed to come in contact with the leather. A small spot of oil will develop and spread to a surprising extent. If by any chance the leather becomes spotted with oil or grease, it should be rubbed off at once with a wad of cotton wool.

A vacuum cleaner is very useful for removing dust from the upholstery of a car.

Side-Curtains.—Ordinary liquid metal polish will effectively clean the celluloid panels and remove light scratches or dulled portions of the panel.

When the side-curtains are not in use they should be packed away behind the rear seat squab. Linen sheets are provided to protect the celluloid against scratching, and one of these sheets should be alternated between each two curtains when packing.

If the side-curtains should show any tendency to rattle after a time, the eccentric sockets in the bodywork should be adjusted to prevent this.

Chromium Plating.—Metal polish must not be used to clean exterior fittings which are chromium plated. The parts should be washed with soap and water and thoroughly dried with a soft duster. This should be done frequently.

VI. Service

SPARE PARTS AND REPLACEMENTS

The illustrated spare part catalogue which is supplied with each car is arranged so that the possibility of ordering an incorrect part has been reduced to a minimum.

All communications relating to the car must refer to the car number, which will be found on the metal nameplate attached to the near-side frame member, adjacent to the bonnet.

Full instructions for ordering spares will be found in the preface of the spare part catalogue. In order to assist customers who desire to send a telegram, we give below the telegraphic codes referring to service matters :—

YUBUR	... 21/60 h.p. Six-cylinder Car No.....
SEREB	... Referring to your communication Service Manager dated.....
SEREM	... Referring to your communication Estimating dated.....
SEREP	... Referring to your communication General Office dated.....
SERFU	... Dispatch immediately per post and charge our account for Car No.....
SERGI	... Dispatch immediately per passenger train and charge our account for Car No.....
SERIM	... Dispatch immediately under terms of Guarantee for Car No.....
SERJO	... Dispatch per post direct to Customer and charge our account for Car No.....
SERKS	... Dispatch per passenger train direct to Customer and charge our account for Car No.....
SERLD	... Dispatch direct per post to Customer under terms of Guarantee for Car No.....
SERMY	... Advise delivery date for our Order No.....
SERNA	... Please quote but do not supply pending official order for following spares for Car No.....
SEROT	... Can you supply from stock for Car No.....
SERPS	... Returning original for repairs please send on loan at usual charge for Car No.....
SERSK	... Priced invoice to be sent with spares.
SERTE	... Complete with all fittings.
SERUS	... With studs and nuts only.
SERYL	... Complete with bearings.

MESSRS. LUCAS FOR ELECTRICAL EQUIPMENT

BELFAST	3-5 Calvin Street, Mount-pottinger	Telephone : Belfast 7017
BIRMINGHAM	Great Hampton Street	Telephones : Central 8401 (10 lines)
BRISTOL	245 Bath Road	Telephones : Bristol 8400 (3 lines)
CARDIFF	54a Penarth Road	Telephone : Cardiff 4603
COVENTRY	Priory Street	Telephones : Coventry 3068 and 3841
DUBLIN	41 Middle Abbey Street	Telephone : Dublin 653
GLASGOW	227-229 St. George's Road	Telephones : Douglas 3075 (3 lines)
LEEDS	64 Roseville Road	Telephones : Leeds 28591 (5 lines)
LIVERPOOL	450-456 Edge Lane	Telephones : Old Swan 1408 (3 lines)
LONDON	Dordrecht Road, Acton Vale, W.3	Telephones : Chiswick 3801 (18 lines)
LONDON	759 High Road, Leyton, E.10	Telephones : Walthamstow 2161 (3 lines)
LONDON	155 Merton Rd., Wandsworth, S.W.18	Telephones : Putney 5131 (4 lines) and 5501
MANCHESTER	Talbot Road, Stretford	Telephones : Trafford Park 1410 (3 lines)
NEWCASTLE-ON-TYNE	64-66 St. Mary's Place	Telephones : Central 3571 (3 lines)

Lucas Overseas Service Stations

AFRICA

EGYPT	CAIRO	Moring & Co., 1 Sharia El-Antik-Khana, El-Masria
GOLD COAST	ACCRA	Trading Association of Nigeria Ltd.
NIGERIA	LAGOS	West African Motors Ltd., Broad Street
	Jos	West African Motors Ltd.
UNION OF SOUTH AFRICA	CAPE TOWN	Stansfield Ratcliffe & Co. Ltd., 8 Waterkant Street
	DURBAN	Stansfield Ratcliffe & Co. Ltd., 467 Smith Street
	JOHANNESBURG	Stansfield Ratcliffe & Co. Ltd., 63 Anderson Street
	BULAWAYO	Sykes (Rhodesia) Ltd., Main Street
	EAST LONDON	Hubert Davies & Co. Ltd.
	KIMBERLEY	Auto Electrical Service Station, 44 De Beers Road
	PORT ELIZABETH	Hall & Co., Central Garage, Peel Street
	SALISBURY	Hubert Davies & Co. Ltd.

AMERICA

ARGENTINE	BUENOS AIRES	W. Stephan, Charcas 1339
PERU	LIMA	Alexander Eccles & Co., Casilla 1939

Lucas Overseas Service Stations—continued

BRITISH WEST INDIES

TRINIDAD	PORT OF SPAIN	F. J. Miller & Co., 17 Chacon Street
CANADA	TORONTO	A. Cross & Co., 45-47 Elm Street

ASIA

INDIA	BOMBAY	Bombay Battery & Elec. Co., 15 New Queen's Road
	CALCUTTA	Thornycroft (India) Ltd., 6 Lyons Range (Works—Diamond Harbour Road)
	DELHI	British Motor Car Co. Ltd., Kashmir Gate
	LAHORE	Walter Locke & Co. Ltd., The Mall
	MADRAS	Addison & Co. Ltd., Mount Road
IRAQ	BASRAH	Andrew Weir & Co.
BURMA	RANGOON	Watson & Son Ltd., 59 Phayre Street
CEYLON	COLOMBO	Walker, Sons & Co. Ltd., P.O. Box 166.
STRAITS SETTLEMENTS & F.M.S.	SINGAPORE	Malayan Motors Ltd., 209/212 Orchard Road
CHINA	HONG KONG	The Hong Kong & Shanghai Hotels Ltd., Queen's Road
	SHANGHAI	Auto Palace Co. Ltd., 484 Avenue Joffre
JAPAN	TOKYO	W. F. Horsley, P.O. Box F4, Central Post Office

AUSTRALIA

ADELAIDE	Hannan Bros. Ltd., 129 Angas Street
Sub-Stations in	BROKEN HILL, CRYSTAL BROOK and STREAKY BAY
BRISBANE	Elphinstones Ltd., Magneto House, Adelaide Street
Sub-Stations in	CAIRNS, CHARLEVILLE, CLERMONT, CLONCURRY, GORDON-VALE, HUGHENDEN, INNISFALL, IPSWICH, LONGREACH, MACKAY, TOOWOOMBA, TOWNSVILLE and WINTON
MELBOURNE	Lucas Sales & Service Pty. Ltd., 183-187 Queensberry Street, Carlton
Sub-Station in	GEELONG
PERTH	A. C. McCallum Ltd., 96 Murray Street
SYDNEY	Moody & Co., Magneto House, 15 Goulburn Street
Sub-Station in	NEWCASTLE
TASMANIA	Gray Sheddon & Co. Ltd., 19 Mereweather Street
HOBART	Medhurst & Sons, 95 Collins Street
LAUNCESTON	Medhurst & Sons, 59 Brisbane Street

NEW ZEALAND

AUCKLAND	W. Crosher & Sons Ltd., Lorne Street
WELLINGTON	L. M. Silver & Co. Ltd., 30 Tory Street
Sub-Stations in	HAWERA, HASTINGS, NAPIER, PALMERSTON NORTH and STRATFORD
CHRISTCHURCH	Woolf & Salvesen Ltd., 32/34 Lichfield Street
Sub-Stations in	ASHBURTON, DUNEDIN, INVERCARGILL and TIMARU

EUROPE

Available in most of the principal cities

SERVICE STATIONS FOR RADIATOR REPAIRS

ABERDEEN	FRANCIS CRAIGMILE & SON, 56 Gordon Street. Telephone : 3599
BELFAST	ANDREW MULLAN, 9 Corporation Square. Telephone : 5891
BIRMINGHAM	COVENTRY RADIATOR & PRESSWORK CO. LTD., 107 Pritchett Street. Telephone : Central 5823
BOURNEMOUTH	HANTS & DORSET SHEET METAL CO., 154 Ashley Road. Telephone : 2840
BRIGHTON	BRIGHTON MOTOR SHEET METAL WORKS, 50a St. James Street. Telephone : 2191 & 2192
BRISTOL	A. J. REES & SONS, Bishop Street, Moorfields. Telephone : 5174 (2 lines)
CARDIFF	SERCK RADIATORS LTD., 60a Clive Road, Canton. Telephone : 6124
COVENTRY	COVENTRY RADIATOR & PRESSWORK CO. LTD., Raglan Works, Lower Ford Street.
DUBLIN	GEORGE PAPPIN & SONS, 25 Whitefriars Street. Telephone : 5160
EDINBURGH	ALDER & MACKAY LTD., Stewart Terrace. Telephone : 61151-2
ESSEN	J. KEELING & SONS, Grand Garage, The Broadway, Leigh-on-Sea.
EXETER	SAUNDERS & BISS LTD., 172 Sidwell Street. Telephone : 113
GLASGOW, C.4.	JAMES C. URIE & CO., 399 Parliamentary Road. Telephone : Douglas 3062
HULL	BOWMAN'S HULL SHEET METAL COMPANY, Boothferry Road. Telephone : Central 5012
LEEDS	EXCELSIOR MOTOR RADIATOR CO. LTD., Oldfield Lane. Telephone : 24184
LEICESTER	VICTORY RADIATOR & WELDING WORKS, 60 Church Gate. Telephone : 3039
LIVERPOOL	LIVERPOOL RADIATOR CO., Fontenoy Street. Telephone : Central 382 & 383
LONDON	W. WATSON & CO. (LIVERPOOL) LTD., 9 Upper Duke Street. Telephone : 5480 Royal (4 lines)
MAIDSTONE	SERCK RADIATORS LTD., Palace Avenue. Telephone : 1035
MANCHESTER	PENDLETON RADIATOR CO., 72a Broad Street, Pendleton. Telephone : 709
NEWCASTLE-ON-TYNE	SERCK RADIATORS LTD., Skinnerburn Road (Off Water Street). Telephone : Central 5863
NORTHAMPTON	CENTRAL SHEET METAL CO., 12a St. Michael's Road. Telephone : 676
NORWICH	WM. F. SMITH & SONS, 90 King Street. Telephone : Norwich 30
NOTTINGHAM	MINERVA MOTOR RADIATOR CO., Boulevard Works, Radford. Telephone : 5631
PERTH	LESLIE & MURRAY, 14 Victoria Street. Telephone : 770
PLYMOUTH	EDMUND METAL WORKS, Sutton Road. Telephone : 2181

Service Stations for Radiator Repairs—continued

SHEFFIELD	W. H. TYAS & CO., Ball Lane, Carver Street. Telephone : 22869
SOUTHAMPTON	SERCK RADIATORS LTD., Ryde Terrace, Floating Bridge. Telephone : 3560
SUDBURY, SUFFOLK	SERCK RADIATORS LTD., Cornard Works. Telephone : 57
WOLVERHAMPTON	BAGGOTT'S MOTOR FITTINGS, Steelhouse Lane. Telephone : 110

Messrs. Smith & Sons for Clocks, Speedometers, Screen Wipers, etc.

LONDON	Cricklewood Works, London, N.W.2. Telephone : Willesden 2335
MIDLAND	179-185 Gt. Portland Street, W.1 Telephone : Langham 2323
NORTHERN	122 Alma Street, Birmingham. Telephone : Northern 2724
SCOTTISH	14a Jackson Row, Deansgate, Manchester. Telephone : Central 13
NORTHERN IRELAND	19 West Regent Street, Glasgow. Telephone : Douglas 2298
IRISH FREE STATE	H. A. Turnpenny & Co., 18 Sussex Place, Belfast. Messrs. Buckley Motors Ltd., 34 Lower Abbey Street, Dublin.

Messrs. Smith & Sons' Overseas Service Stations

AFRICA

EGYPT	E. & D. de PICCIOTTO MORING & Co. Rue Matrah 2, Alexandria, Egypt. Midan Suares, Cairo.
SOUTH AFRICA	AUTO ELECTRIC SUPPLY (CAPE) LTD. 20/22 Bree, Cape Town, S. Africa. AUTO ELECTRIC SUPPLY (NATAL) LTD. 199 Smith Street, Durban, South Africa.
	WM. OVER & CO. LTD. P.O. Box 441, Salisbury, Rhodesia. CONNOKS (S.A.) MOTOR CO. LTD. P.O. Box 2767, Johannesburg.

ASIA

INDIA	T. R. PRATT BREAKEY & Co. Hughes Road, Bombay. ADDISON & Co. 44 Free School Street, Calcutta. Mount Road, Madras.
BURMA	WATSON & SON P.O. Box 178, 59 Phayre Street, Rangoon, Burma.
CEYLON	C. A. HUTSON & CO. LTD. P.O. Box 337, Colombo, Ceylon.

Messrs. Smith & Sons' Overseas Service Stations—continued

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CHINA AUTO PALACE CO.	484 Avenue Joffre, Shanghai.

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BRITISH HONDURAS	HOFIUS & HILDEBRANDT, Belize.
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VII. Storage, Overhauling, etc.

Storage.—The motor house should be a dry, well-ventilated building, and preferably arranged so that it can be heated during cold weather. It should be kept clean and free from dust and should be sufficiently large to allow a gangway around the car for convenience of inspection, and also because the car is liable to suffer from dampness if it is placed too close to the walls of the house. As a safeguard against fire a chemical extinguisher should be kept handy. Fuel should be stored in a separate building. It is advisable to fill the tank when the car is outside the motor house.

When filling with fuel, water or oil, a gauze strainer should be used in order that no dirt may pass through.

Lubricating oil and grease may be stored in the motor house, preferably in steel drums, so that supplies may be drawn off as required.

To keep the floor of the motor house clean from any oil which may drop from the motor while standing, a sheet-iron tray should be kept under the motor and gearbox. Convenient dimensions for this tray are 5 ft. long by 2 ft. wide, with sides about 1 in. high.

To preserve the appearance of a car it should be washed down immediately it comes in from the road, and never left to stand dirty.

A dark garage is the best for the tyres. When the car is not in regular use it should be jacked up or put on blocks to take the weight off the tyres.

Don't run the engine in the garage with the door shut.

Overhauling.—It is convenient to have in the motor house an engineer's bench fitted with a parallel vice, and provided with a few tools, so that adjustments and small repairs may be done at once, instead of being neglected and only taken in hand when absolutely necessary.

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