HANDBOOK OF
The Model 26 Albion

Albion
COMMERCIAL MOTORS

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Introduction

In a Handbook of this type it is impossible to cover all the points which may arise in the running and upkeep of a modern motor vehicle, but we believe that the information contained herein will be sufficient to enable users and drivers to obtain satisfactory running from their vehicles.

Purely descriptive matter has been almost entirely avoided as we consider that the photographs and drawings reproduced, together with a study of the actual detail will enable a clear understanding of any part of the chassis to be obtained. Owing to the fact that several different types of this model are produced and that slight alterations of design are occasionally made, the diagrams and text may after a time require alteration. This book has been compiled primarily to suit the 29-Seater Bus' Chassis, Type P.K. 26, but the points wherein other types differ from this have been noted where necessary.

One of the most important points in the running of a motor vehicle and one which is frequently neglected is the adequate lubrication of all parts of the chassis. We take this opportunity, therefore, of stating most emphatically that the instruction on this subject cannot be neglected without causing, in the long run, very serious consequences, and we suggest to owners that a definite time should be set aside each week, to enable their drivers to give the necessary attention to this matter.

We shall be pleased to receive suggestions from our clients as to ways in which the usefulness of this book from their point of view could be increased, and to supply any advice or assistance in the difficulties which may arise in the running of their vehicles.

ALBION MOTOR CAR CO. LTD.

October, 1926.

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The Model 26 Albion

Manufactured under Albion and Murray Patents

Constructional Points

The Albion Chassis are designed on sound engineering principles and essentially for commercial purposes, the finished job showing the result of over 25 years' manufacturing experience. Nothing is embodied on the chassis of an experimental nature, every detail having been thoroughly tested before being adopted as a standard fitment.

Our ideals are reliability and economy of upkeep, coupled with simplicity and accessibility. Right through the design of the chassis every effort has been made to cut down the number of parts, but nothing has been sacrificed to this end which would in any way affect the efficiency of the whole. The reduction in parts, of course, is reflected in the lowering of upkeep expenses. All materials used are made to special specifications issued by ourselves, and samples are tested in our own laboratories, so ensuring that the most suitable materials are used in Albion construction.

Model 26 Albion 29-Seater 'Bus Chassis.

Engine

THE Model 26 Albion Engine (Figs. 1 & 2) is of the four cylinder water cooled type, with detachable cylinder heads and side by side valves. The cylinders which are cast in one block are bolted to the aluminium crank case and are provided with twin cylinder heads which, being readily detachable, allow of easy access to the piston crowns and valves for decarbonising and valve grinding. An extension of the cylinder block covered by a detachable door encloses the valve springs and tappet adjustment. The compression joint between the heads and cylinders is made by means of a copper asbestos joint, while separate rubber joints are fitted to the water transfer passages.

The crank shaft is carried by the upper half of the crank case in three large diameter white metal lined bearings the caps of which are dowelled and bolted to the crank case. At the rear end of the shaft the flywheel is secured to a flange and on the front end is keyed a helical pinion which transmits the drive to the cam shaft and magneto spindle. The cam shaft is carried in three plain bearings in the crank case and operates the valves through adjustable tappets working in cast iron guides.

The cam shaft is driven by a toothed wheel at its forward end meshing with the pinion on the front end of the crank shaft. These two gears, together with a third which drives the magneto spindle, form the "timing gear" and are enclosed by a cover at the front of the engine (see Fig 3).

The steel connecting rods, of conventional design, are fitted with split white metal lined bronze bushes at their big ends, each bearing cap being held in position by two bolts. At the small end the rod is split and clamped to the gudgeon pin which takes its bearing in the bosses of the aluminium alloy pistons. The pistons are fitted with three rings the lower one being a scraper ring, and holes are drilled through the piston walls to allow the oil caught by the scraper ring to drain back to the sump.

The lower half of the crank case, usually termed the sump, is detachable and is used as a reservoir for the engine lubrication system which, as will be explained later, is entirely automatic, the only requirement being to maintain a sufficient quantity of lubricant in the sump.

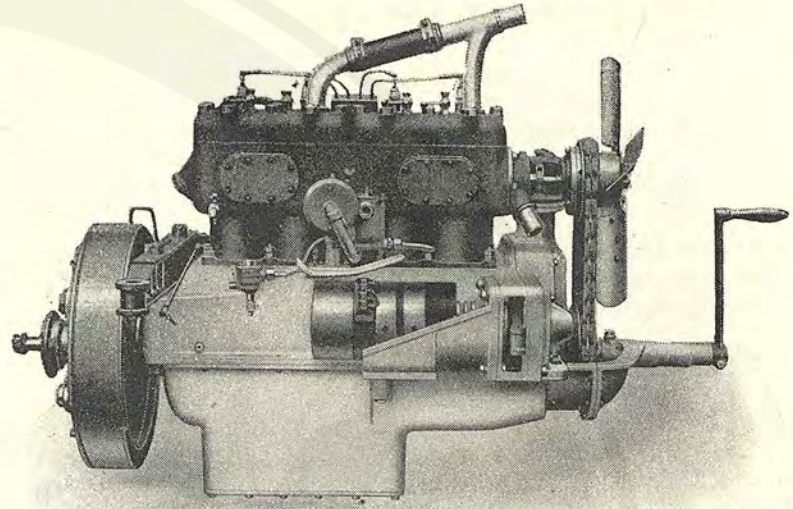


Fig. 1—Offside of Engine.

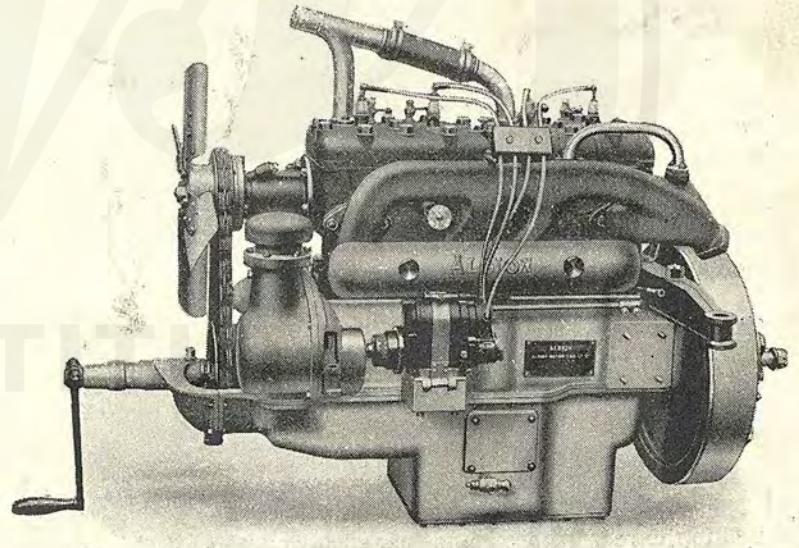


Fig. 2—Nearside of Engine.

A centrifugal governor is fitted to the magneto spindle and operates, through a suitable system of levers, a butterfly valve contained in a casing interposed between the carburettor and the inlet passage cast in the cylinder block. The governor valve is controlled entirely by engine speed and, as all the operating gear is enclosed, can not be easily tampered with.

"It is necessary, however, to warn users that our guarantee only applies so long as the governor mechanism and setting as made by us are not altered."

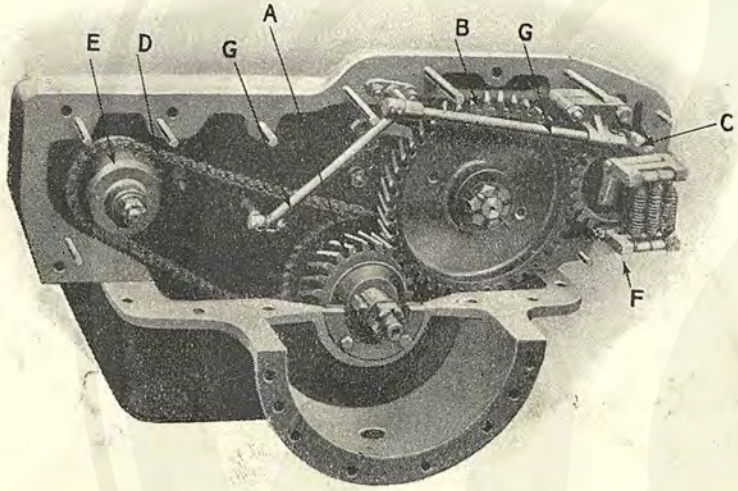


Fig. 3—Engine Timing Gear.

A Crankshaft Pinion.
B Camshaft Wheel.
C Magneto Driving Pinion.
D Dynamo Driving Chain.
E Dynamo Sprocket.
F Governor.
G Governor Valve Actuating Gear.

The dynamo of the electric lighting set is carried in a cradle bolted to the rear of the timing gear casing on the off side and is driven by roller chain from a sprocket on the crank shaft. Provision is made for fitting an electric starter to the near side of the engine; the starter, however, is not a standard fitment.

Overhauling.—When after long service it becomes necessary for the engine to undergo a complete overhaul, it must first be removed from the frame. The following notes indicate the method to be employed in carrying out this operation.

1. Remove the bonnet, radiator, bonnet supporting angle, tie bar to the dash and side woods bolted to the frame.
2. Remove the steering column (see page 45) and the extension of the sump carrying the starting handle.
3. Uncouple the clutch shaft distance piece and remove the clutch pedal shaft and brackets.
4. Disconnect the petrol pipes, suction pipe to the autovac and dynamo and starter leads.
5. Uncouple the exhaust pipe from the expansion chamber.
6. After the four holding down bolts have been removed from the ends of the engine bearers, the engine can be lifted with suitable tackle and pulled forward far enough to clear the flywheel and clutch from the dash; the engine can then be hoisted straight out and removed to the bench.

NOTE.—The above applies only to "bonnet type" chassis. The removal of the engine from an overtype chassis requires special gear and should not be undertaken unless this is available.

Engine Details

IN this section instructions are given for carrying out the adjustments and some of the repairs which may be required between complete overhauls. Most of these can be done by a driver who has had experience in carrying out the usual running repairs, but the more serious jobs, such as removing the cylinders and pistons, should only be undertaken by one who has had considerable experience of this class of work.

Cylinder Heads.—Preparatory to grinding in the valves or decarbonising, the cylinder heads must be detached:—Drain off the water from the cock on the connection from the pump to the bottom of the radiator and disconnect the rubber connection between the front cylinder head outlet and the radiator top tank. After removing the two water circulating bends bolted to the cylinder heads and the nuts from the holding down studs, the cylinder heads may be lifted. If difficulty is encountered in parting the joint, the heads can be eased up by inserting a screwdriver between the lugs cast on the heads and cylinder block for this purpose. Care should be taken not to injure the copper asbestos joints when lifting the heads and also to preserve the small rubber water jacket joints.

Valve Grinding.—To ensure that the valves are maintained in good condition they should be examined and, if necessary, ground in every 5,000 miles. If, however, before this distance has been covered, engine power begins to fall off and loss of compression is noticeable in one or more cylinders when turning over the engine by hand, it is probable that the valves require grinding in. This should be done at the first opportunity or the valves and valve seats may be so badly burned that replacement of the valves and recutting the valve seats will be necessary.

It is important that all traces of grinding compound be cleaned from the valve seats and valves before these are replaced after grinding. Should any of the abrasive used, work down into the valve guides, abnormal wear will result, with consequent difficult starting due to air leakage past the inlet valve stems.

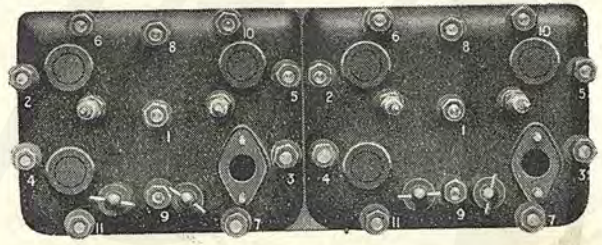
After the valves have been ground four or five times, it will be found that a ridge has been formed on the valve faces; this must be removed, either in the lathe or by filing while the valve is rotated in a drilling machine, and unless these facilities are available the work should be handed over to a skilled repairer. The cylinder block should at the same time be faced round the valve seats with a slightly convex cutter until the width of the exhaust valve seat is reduced to $\frac{1}{8}$" and the inlet valve seats to about $\frac{3}{32}$", otherwise it will be impossible to obtain a proper seating when grinding in the valves.

Valve Tappets.—To maintain the correct clearance between the valve stems and tappets, the latter must be adjusted after grinding the valves. The adjustment should be checked after a further 200 miles have been run, as the valves are liable to "bed down" slightly after grinding in. The clearance which should be from ·004" to ·006" for the inlet valves, and ·008" to ·01" for the exhaust valves, can be set with a feeler gauge of this thickness by slacking the lock nuts and screwing the tappet heads in the required direction. It is important to note that the tappet being adjusted is at the lowest point of its travel; to ensure that this is the case the engine should be turned over for about half a turn after the valve in question has closed. The clearance should be checked after tightening up the lock nut, as this operation frequently upsets the previous adjustment. The tappets should always be adjusted when the engine is thoroughly warmed up.

Decarbonising.—Unless the engine is consistently overlubricated, or the piston rings and cylinders are very badly worn, it will be sufficient to remove the carbon deposit from the cylinder heads and piston crowns whenever the valves are ground. If, however, the engine shows signs of overheating, or pinking, i.e., emitting a

sharp metallic knock when pulling on a hill, even with the ignition retarded, or continues to fire irregularly after switching off, the cylinder heads should be detached and the engine decarbonised.

Replacing Cylinder Heads.—Examine the copper asbestos joints and see that they are not damaged in any way; if damaged replace with new ones. Clean the faces of the cylinder block, cylinder heads and joints, paying particular attention to removing all particles of carbon from round the base of the studs. Apply a coat of "gold size" to each side of the copper asbestos joints and press these down into position over the studs. See that the eight rubber water joints are in position in their recesses in the cylinder block, and gently lower the heads into position. Screw down all the nuts until they just begin to grip and then tighten them down a little at a time, in the order indicated in Fig. 4 until fully home. All nuts should be finally pulled up after the engine has been run for a time and is thoroughly warmed up.



Fig, 4—Plan of Cylinder Heads.

Lifting Cylinder Block.—Should it be necessary to examine the pistons or piston rings, the cylinder block must first be removed:—Drain the cooling system and remove the radiator, bonnet, supporting angle and tie bar from the dash. Detach the carburettor, fan belt and cylinder heads; disconnect the exhaust pipe and remove the expansion chamber and the nuts from the cylinder holding down studs. The cylinder block can then be slung by small links fixed over the cylinder head studs and lifted with suitable tackle, taking care that the piston rings are not jammed during the process and that the pistons do not fall over against the tappets, when they come clear of the cylinder bores.

It is not advisable to attempt to lift the cylinder block without reliable lifting tackle.

Piston Rings.—If the piston rings are removed for purposes of cleaning or inspection, they should be replaced in the grooves from which they were taken. The bottom edge of the bottom ring is checked out to act as a scraper and it is important that the ring be replaced with this edge downwards.

If the gap in the rings when fitted in the cylinder is excessive, i.e., more than $\frac{1}{16}$", loss of compression will result and new rings should be fitted. The new rings should have a gap of from ·002 to ·003", when in position in the cylinder barrel.

Pistons.—The hollow gudgeon pins are fixed in the split small ends of the connecting rods by the clamping screws C (see Fig. 5) which are in turn locked by the upturned tongues on the locking washers D. These tongues must be turned down flat before the locking screw can be withdrawn and it is necessary to completely remove this screw before the gudgeon pin can be removed.

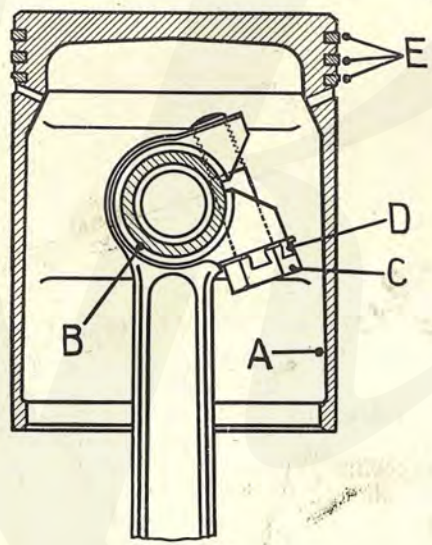


Fig. 5—Arrangement of Piston.

A Piston.
B Gudgeon Pin.
C Clamping Bolt.
D Locking Washer.
E Piston Rings.

Before attempting to drive out the gudgeon pin, the piston should be heated by placing a hot block of metal on the crown. If this is not done there is grave risk of scoring the piston bosses, as, due to the high coefficient of expansion of the alloy used the fit of the gudgeon pin is very close when the pistons are cold. When refitting the pistons, it is more convenient to heat them by immersion in boiling water or hot oil and care should be taken that the pistons and gudgeon pins are replaced in the same relative positions exactly and that the clamping screws are pulled up tight and securely locked in position. It is advisable that new locking washers be fitted whenever the pins are removed as the tongues become brittle and liable to break off if used more than once.

Removal of Sump.—To obtain access to the main and big end bearings, the oil pump and cam shaft, the sump must be removed. After detaching the undershield, the extension of the sump carrying the starting handle should be unbolted ; the sump can then be dropped straight down, after the nuts along each side and the bolts along the front have been removed.

Connecting Rod Bearings.—If it is necessary to open up the big end bearings for inspection or refitting, after removing the sump the main gallery oil pipe should be detached, the nuts on the big end bolts being somewhat inaccessible when this is in position. The piston and connecting rod can be removed only by drawing upwards through the cylinder barrel, after the heads have been detached.

In refitting the big ends, it should be noted that the rods, caps and both halves of the bearing shell are numbered and that they must be replaced so that these numbers register. Notice, also, that the small oil joints are in position on the main bearing caps before replacing the oil gallery pipe.

Crank Pins.—The opportunity should be taken whenever the big end bearings are dismantled to remove the plugs and clean out the hollow crank pins. If a big end bearing should by any chance run out **it is essential that the hollow crank pins be cleaned out** as small particles of white metal always find their way into the oil ways and if allowed to remain will cause serious trouble.

Valve Timing.—If the cam shaft has been removed, care should be taken when it is being replaced that the timing wheel is meshed correctly according to the marks on it and on the crank shaft pinion. If the wheel has been removed from the camshaft, it must, of course, be replaced in the same position with respect to the feather on the end of the shaft. Failure to observe these points will upset the valve timing which should, in any case, be checked

by means of the marking on the flywheel, after the camshaft has been replaced.

Dynamo Driving Chain Adjustment.—The dynamo chain should be adjusted after the first 2,000 miles running, thereafter it will require attention only at very long intervals. The adjustment is effected by moving the dynamo and cradle bodily away from the crank shaft, after slackening the nuts on the three studs holding it to the timing gear casing and the bolt which passes up through the bracket cast on the sump (see Fig. 6).

When in correct adjustment there should always be a small amount of slack in the chain—about $\frac{3}{8}$" of up and down movement in the centre of the straight part of the chain, gives the right tension.

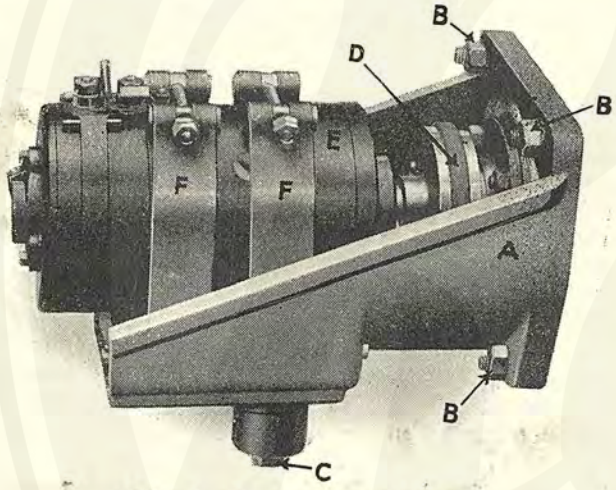


Fig. 6—Dynamo and Cradle.

A Dynamo Cradle.
B Nuts holding A to Timing Gear Casing.
C Bolt holding A to Sump.
D Dynamo Coupling.
E Dynamo.
F Fixing Straps.

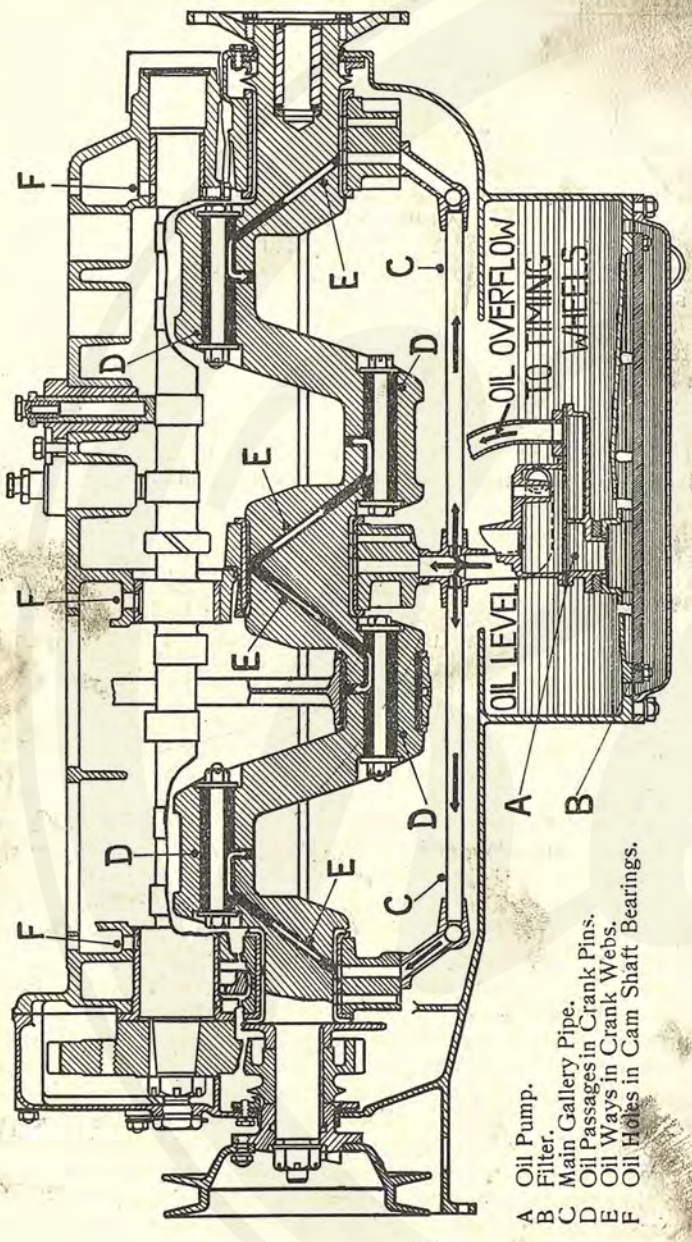
It is advisable when making the adjustment to turn over the engine and try the slack with the chain in several positions, as very often it will be found that the chain has stretched more in one part than in another. Note, also, that the dynamo cradle must be bolted hard up in position when the adjustment is being checked, because tightening up the nuts may move the cradle slightly.

Engine Lubrication

ALL the main parts of the engine are lubricated automatically by the oil pump which draws oil from the supply carried in the sump, and beyond regular replenishment and occasional cleaning the system should require no attention. The oil filler is situated on the near side of the engine on the timing gear cover and is provided with a strainer and an easily detachable cover. An oil level cock is situated on the sump where it can be observed while filling up; a drain cock is also provided. Fig. 7 shows diagrammatically the lubrication system of the engine.

Oil Pump.—The oil pump which is submerged and therefore self-priming, is driven by skew gear from the cam shaft. The pump is of the gear type and is provided with a pressure relief valve which is accessible for adjustment through an inspection door in the side of the sump. The valve is set to the correct pressure before leaving the works and should seldom require attention. After dropping the sump and disconnecting the main gallery pipe union and the feed pipe to the timing gears, the complete pump can be removed by detaching the nuts from the three studs holding it to the crank case.

Oil Circulation.—The oil pump draws its supply through a very large filter which is bolted to a false bottom cast in the sump. The dirt and sludge trapped by the filter collects in the shallow chamber formed between the filter and the bottom cover plate of the sump and can be drawn off from the drain cock. From the delivery side of the pump the oil is forced to the main gallery pipe which feeds direct to the three main crankshaft bearings. Oil ways are drilled from the main journals of the shaft to each of the four hollow crank pins, through a small hole in which the oil is forced to the big end bearings. The surplus oil from the big ends is thrown on to the cylinder walls and serves to lubricate the pistons and small end bearings. Oil holes are drilled through the piston bosses to ensure that these bearings are adequately lubricated. The cam shaft bearings also are lubricated through oil holes by the big end splash. The surplus oil by-passed by the front relief valve is fed through a pipe to the front of the engine and there discharged over the timing gears. Holes are drilled from the valve chest into the crank case so that the valves and valve springs are lubricated by oil mist. After passing through the bearings the oil falls back to the bottom of the sump for recirculation.



A Oil Pump.
B Filter.
C Main Gallery Pipe.
D Oil Passages in Crank Pins.
E Oil Ways in Crank Webs.
F Oil Holes in Cam Shaft Bearings.

Fig. 7.—Engine Lubrication System.

Oil Filter.—Access to the oil filter is obtained by removing the detachable cover forming the bottom of the sump. The filter should be detached every 10,000 miles by removing the nuts from the studs holding it in place, and thoroughly washed in paraffin with a stiff brush to remove all traces of grit and carbon which have accumulated. The filter should be carefully examined before being bolted into position, to see that it is not damaged in any way.

Replenishing.—The oil consumption of this engine is remarkably small, but, to ensure that the oil level does not fall dangerously low, the sump should be filled up to the level cock every 500 miles. This should preferrably be done when the engine is hot, as the oil then flows more freely from the level cock and the risk of over-oiling is lessened.

To counteract the dilution of the oil by leakage of petrol past the pistons, one pint should be run off from the drain cock on the sump every 1000 miles and the level made up with fresh oil. In this way the quality of the oil is kept up and at the same time any foreign matter trapped by the filter is removed.

Draining and Refilling.—If the above instructions on replenishing are carried out, it will be sufficient to drain off the used oil from the system every ~~10,000~~ 5000 miles. At the same time the filter should be detached and cleaned and the system refilled to the correct level with new oil. About $2\frac{1}{4}$ gallons will be required.

Oil Gauge.—An oil pressure gauge is fitted on the instrument board and is connected by a pipe to a union at the rear of the crank case which is fed from the main gallery pipe.

Failure of Oil Pressure.—When the engine is running the oil pressure gauge should show a reading of about 15 lbs. per sq. in.; when ticking over this reading will fall to about 5 lbs. per sq. in. If, however, the gauge does not register or fails to rise when the engine is speeded up some fault in the lubrication system is indicated and the engine should be stopped immediately.

To test if the oil is circulating, uncouple the oil gauge pipe from the union on the crank case and turn the engine over smartly about a dozen turns. If oil flows from the union the circulation is correct and the fault must be in the oil gauge or pipe. The engine can in this case be safely run, after refixing the oil pipe and noting that it is not fractured. The oil gauge should, however, be put into working order as soon as possible, as without it, no check on the oil circulation is available. If, however, no oil flows from the union when the engine is cranked the trouble should be looked for in the pump or internal oil pipes, and the engine should not be run until these have been dismantled and any faults rectified.

Cooling System

THE cooling water is maintained in circulation through the water jackets and radiator by an impeller pump driven by a 'V' leather link belt from a pulley on the crank shaft. The pump spindle runs in ball bearings mounted in the pump body which is bolted to the front of the cylinder block, and carries at its forward end the four-bladed radiator cooling fan. Fig. 8 shows a section through the pump and fan.

Radiator.—The radiator should be flushed out occasionally to remove the sludge which gathers in the bottom tank. The water level should never be allowed to fall below the top tube plate; if it does, it becomes impossible to tell the exact water level and shortage of water will cause overheating and serious damage to the engine. Avoid, if possible, using "hard water," as this rapidly clogs the tubes and lowers the efficiency of the radiator.

It is a useful precaution to examine and fill up the radiator each morning while the engine is warming up.

Packing Gland.—The pump spindle is provided with a packing gland where it passes through the pump body. In the event of leakage occurring here, the packing gland nut should be tightened up with a tommy bar inserted in the holes drilled in the nut for this purpose. The gland nut should not be tightened more than is necessary to prevent leakage, or excessive wear and possibly seizure of the spindle may result. New packing can be inserted when required without dismantling the pump, by unscrewing the gland nut completely and slipping it back along the shaft.

Fan Belt.—It is most important that the fan belt be kept tight and free from oil. If this is not attended to belt slip will occur, resulting in overheating, boiling, and consequent loss of water. The belt can be tightened by screwing the rear flange L of the belt pulley forward, by means of the special "C" spanner provided in the tool kit, thus causing the belt to rise higher in the groove; holes for the use of a tommy bar are drilled in the flange. The three nuts M on the locking ring N must be slackened before this adjustment can be made, and it is advisable to turn the engine over so that the belt settles itself in the pulley before the adjustment is fixed by tightening up the three nuts again.

After this adjustment has been carried out several times, it will be found the belt is not entering fully into the groove in the pulley. In this case a link should be removed from the belt and the adjustment altered to suit.

Lubrication.—Two oil gun nipples lubricating the packing gland and the ball bearings which carry the spindle, are fitted on the water pump body. The oil gun should be applied to each every 1000 miles.

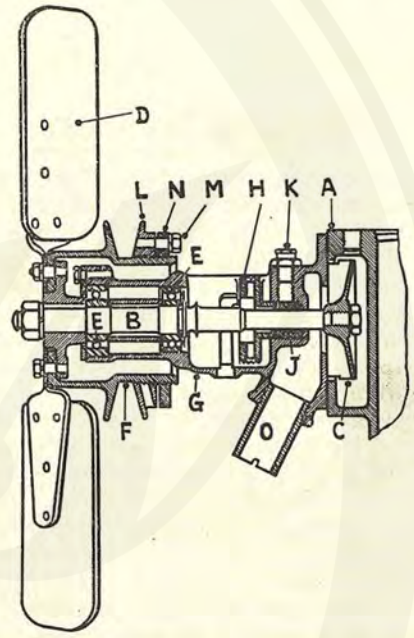


Fig. 8—Section through Fan and Water Pump.

A Cylinder Block.
B Fan and Pump Spindle.
C Pump Impeller.
D Fan
E Ball Races.
F Belt Pulley.
G Pump Body.
H Packing Gland Nut.
J Packing.
K Oil Nipple.
L Adjustable Flange of Belt Pulley.
M Clamping Nuts.
N Locking Ring.
O Inlet to Pump.

Drain Cocks.—A drain cock is fitted to the elbow pipe connecting the bottom of the radiator to the pump. A second cock, to enable water trapped in the water jacket to be drained off, is fitted towards the rear on the offside of the cylinder block.

Frost.—In frosty weather, to guard against possible damage by freezing up, the cooling system should be drained if the vehicle is likely to stand for more than two or three hours in the open or in an unheated building.

It will materially assist starting up if the cooling system is filled up with hot water when the vehicle is again required for service.

Ignition System

Magneto.—A high tension magneto fitted with impulse starting gear is mounted on the near side of the engine and driven through a vernier coupling. The impulse starting attachment which greatly facilitates starting by producing a good spark when the engine is being cranked, operates in the following manner :—The driving flange of the magneto drives the armature through a strong clock spring contained in the cover enclosing the trip gear. Two pawls are fixed on the back plate of the spring cover which is attached to the armature shaft, and when the magneto is turned over slowly, these pawls engage with a stop fixed to the end cover of the magneto. As the driving flange rotates, the armature shaft is thus held stationary, the relative motion between the two parts being absorbed in winding up the spring, until a cam on the driving flange releases the pawls allowing the armature to rotate rapidly for about a quarter of a turn under the influence of the spring. When the magneto is running at speeds in excess of 100 r.p.m. approx., the pawls are held out of engagement by centrifugal force and the magneto functions in a normal manner. The ignition point is variable and is controlled by a lever on the steering column.

Removing Magneto.—In order to simplify replacement and ensure that the "Timing" is not upset, it is most important that the following **precautions be taken before removing the magneto.**

1. Turn over the engine until one piston, say No. 1, is at the top of its firing stroke. This point may easily be determined by observing that both exhaust and inlet valves of No. 1 cylinder are closed and that the marks on the flywheel show "1 & 4 T.D.C." under the pointer which projects from the rear engine bearer.
2. Remove the distributor cover and note the position of the brush.
3. Mark the vernier coupling so that the two flanges and the serrated rubber coupling can be replaced in the same relative positions.
4. Mark the high tension leads and the distributor cover terminals to which each corresponds.

The magneto can be removed after slacking off the fixing strap and disconnecting the earth wire and also the control link from the timing lever.

Replacing Magneto.—If the precautions enumerated above have been taken, the magneto can be easily replaced by again bringing No. 1 piston to the top of its firing stroke, turning the magneto until the distributor brush is in the correct position and finally re-engaging the coupling so that the marks register. If, however, the coupling has not been marked or if a new magneto is being fitted, the magneto must be retimed.

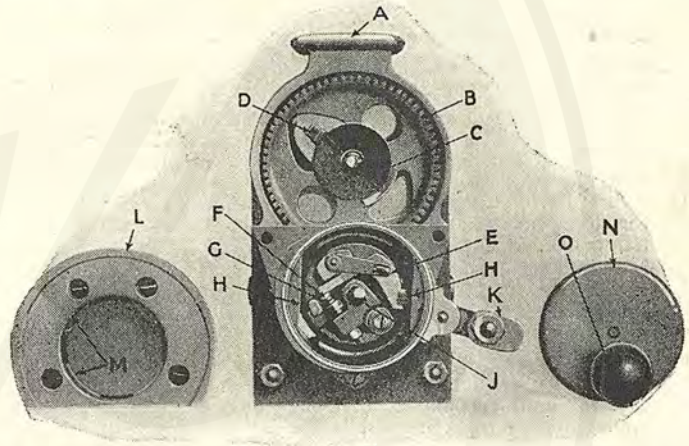


Fig. 9—End View of Magneto with Distributor and Contact Breaker Cover removed.

A Oil Cup.
B Distributor Gear Wheel.
C Distributor Brush Holder.
D Distributor Brush.
E Contact Breaker Bell Crank Lever.
F Platinum Point on Bell Crank Lever.
G Adjustable Platinum Point.
H Contact Breaker Cams.
J Contact Breaker Fixing Screw.
K Timing Lever.
L Distributor.
M Distributor Segments.
N Contact Breaker Cover.
O Switch Wire Terminal.

Retiming Magneto.—When the magneto is correctly timed and the ignition fully retarded, the spark should occur when the piston is on "Top Dead Centre." It is extremely important that the magneto be coupled up to the engine so as to give this timing. If

replaced with the timing very far wrong, any attempt to start up the engine will be accompanied by violent back firing and explosions in the exhaust manifold and inlet pipe; if the timing is only slightly incorrect, the engine may run, but defects such as overheating, knocking, excessive petrol consumption and lack of power will be noticeable.

The following procedure should be followed when retiming the magneto :—

NOTE.—**Forward** rotation of the engine or magneto will be taken to mean rotation in the **normal running direction** i.e., clockwise as viewed from the front of the engine and the driving end of the magneto. Backward rotation will, of course, be in the opposite direction in both cases.

1. Turn over the engine until No. 1 piston, say, is at the top of the firing stroke as indicated above.
2. Retard the ignition fully by rotating the housing which carries the contact breaker cams as far as possible in the forward direction.
3. Turn the magneto spindle **backwards** until the distributor brush is on the segment corresponding to the lead to No. 1 plug and the heel of the bell crank lever of the contact breaker is just passing off the cam, allowing the points to close. If the armature is turned too far, it may be found on attempting to return to the correct position that the contact breaker and armature shaft do not rotate with the driving flange of the magneto.

   This means that the impulse starting gear has been engaged and the driving flange should be turned until the armature shaft trips; the driving flange can then be rotated back until the contact breaker is in the correct position.
4. Without disturbing this setting of the armature shaft, place the magneto in position on the carrying platform and turn the rubber coupling until it can be simultaneously engaged with the teeth on the engine and magneto flanges.
5. Check this setting by rotating the fly-wheel back until the T.D.C. mark is about 1" to the off side of the pointer. Pull the flywheel slowly over forwards, until the contact breaker points just begin to open, and note the position of the pointer which should be on T.D.C. mark. Should this not be so the coupling must be engaged at a different tooth and the check repeated until the contacts open exactly on top dead centre.

Due to the fact that the magneto flange has one more tooth than the engine flange, it will be found that rotating the coupling three teeth forward on the engine flange and re-engaging the magneto flange three teeth back from its original position, will have the effect of advancing the ignition by about ½", as measured on the flywheel.

The high tension leads should be connected up to the distributor according to the marks made before removing the magneto, or, if this precaution has been omitted, by finding the position of the distributor brush when No. 1 piston, say, is at the top of the firing stroke and attaching the lead from No. 1 plug to the corresponding

segment. The other leads should be connected up in the positions relative to No. 1, as shown in the wiring diagram Fig. 10.

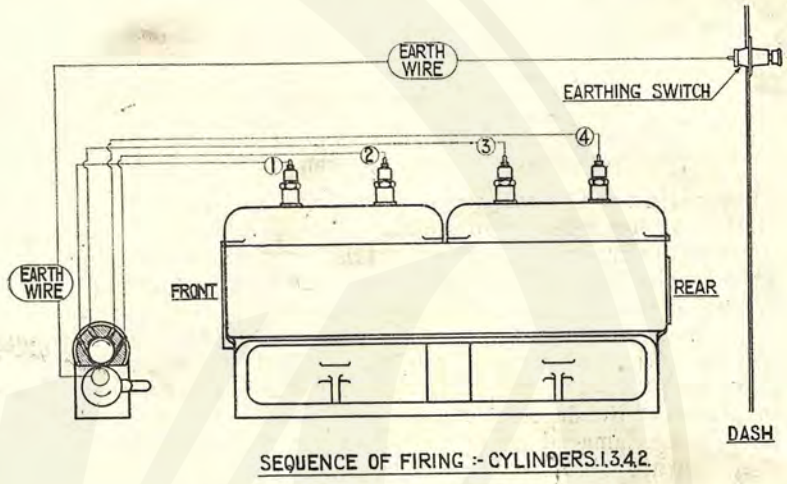


Fig. 10—Ignition Wiring Diagram.

Care and Adjustment.—The following details should be attended to every 5,000 miles.

1. **Contact Breaker.**—The contact breaker can be removed as a unit after removing the cover and central fixing screw. It may be necessary, if the contact breaker is a very tight fit, to gently prise it from the end of the armature shaft after removing the housing which carries the cams and timing lever.

   When refitting the contact breaker, care should be taken to see that the small key is entered in the keyway in the armature shaft and that the fixing screw is screwed right home.

   The platinum points should be examined to see that they are free from oil and dirt; if the points appear ragged or pitted they should be filed smooth and square with a very fine magneto file or piece of fine emery cloth. The bell crank lever should move freely on its pin; if not it should be removed and a trace of vaseline smeared over the pin, all surplus being removed after refitting the lever.

   The gap between the platinum points should be ·4 m/m. or ·015" when the fibre heel is on the highest point of the cam, and should, if necessary, be set to this figure with the gauge attached to the magneto spanner. The adjustment is made by slackening the lock nut and screwing the movable contact in the required direction. The lock nut should be tightened when the adjustment is complete.

2. **Distributor.**—The distributor cover should be removed and the track and segments cleaned with a cloth moistened with petrol. All loose carbon dust should be wiped with a dry cloth from the carbon brush and brush holder; the brush holder should be withdrawn and cleaned, as oil often collects on the stem if the magneto is over lubricated.

3. **Slip Ring.**—The dust cover at the slip ring end of the magneto should be detached and the brush and brush holder withdrawn and cleaned. The slip ring and flanges should be cleaned by pressing a dry rag between them while the engine is turned slowly. When carrying out this latter operation a piece of wood should be used to press the rag against the ring, otherwise an unpleasant shock will be experienced when the magneto armature shaft trips.

Lubrication.—The magneto is one of the few points where over lubrication has a detrimental effect. Only the armature shaft and the distributor wheel bearings require lubrication and it will be sufficient to keep these in good condition if two or three drops of engine oil are put into each lubricator every 1000 miles. On no account should the magneto be over lubricated, otherwise oil will certainly find its way into the contact breaker, fouling the platinum points and so causing misfiring and faulty running. The insulation of the distributor brush holder and of the slip ring is also liable to be damaged by excess of oil, and if oil finds its way into the armature windings, total breakdown will probably result.

Location of Faults

(a) Failure of Spark.—If difficulty is experienced in starting up the engine or if the engine stops suddenly when running, the following tests will reveal whether the ignition system is at fault or not:—Detach one of the sparking plug leads and hold it with the brass end piece about $\frac{1}{4}$" away from the cylinder head; when the engine is rotated by hand a spark should jump across the gap so formed once every two revolutions. If no spark occurs the undermentioned lines of investigation should be followed.

1. Clean the distributor and slip ring and see that the carbon brushes are free in their holders and making good contact.
2. Examine the contact breaker and see that the points are clean and properly adjusted. Occasionally the fibre bush of the bell crank lever swells and seizes on the fulcrum pin. In this case the hole in the bush should be enlarged with a reamer or a piece of fine emery cloth wrapped round a match, care being taken not to enlarge the hole unduly or irregularly.
3. Detach the switch wire from the terminal on the contact breaker cover; if the magneto functions correctly with the wire disconnected a "short circuit" in the wire or the switch is indicated. The most probable cause of such a "short" is chafing of the insulation of the

switch wire allowing the wire to come in contact with some part of the engine or dash; the wire should accordingly be examined and any damage made good with insulating tape. If this does not effect a cure the switch should be thorougly overhauled.

If, after attention to the above no spark can be obtained when the engine is cranked, it is probable that some detail of the magneto has failed. In this case, the magneto should be sent to our nearest Service Depot where arrangements for its repair or replacement will be promptly made. On no account should a person without considerable experience and skill attempt to dismantle or overhaul the magneto.

(b). Regular Misfiring.—If the engine misfires regularly the fault is usually due to a defective sparking plug which can be easily located by "shorting" each in turn with a wooden handled screwdriver; when the faulty plug is shorted no difference in the irregular beat of the engine is noticeable but if a plug which is functioning correctly is shorted the misfiring becomes more pronounced.

Removing a suspected plug from the cylinder and noting that it sparks correctly when tested in air should not be taken as a certain indication that the plug is in good condition. It is quite possible that a plug which sparks when tried in this way will fail to do so when under compression in the cylinder where the resistance to the spark is much greater.

The following are the most usual faults found in sparking plugs:—

1. **Sooting up.**—If the engine is over oiled or if the piston rings and cylinders are badly worn, oil will work up into the combustion space and burning there form a heavy carbon deposit which short circuits the points of the sparking plugs. This loose carbon should be scraped from the points and the plug washed in petrol. If this does not effect a cure it is probable that the plug is short circuited with carbon inside the insulator and it should be replaced with a new one.
2. **Points too far apart.**—The gap between the electrodes tends to become greater during service due to the points burning away. The correct clearance is ·5 m/m. or ·02" (approx.) and the gap should be maintained at this figure by periodical adjustment. A plug with too wide a gap will cause difficult starting and misfiring at low speeds but may spark perfectly at high speeds.

(c). Irregular Misfiring.—This may be due to either the ignition or fuel systems and is very difficult to trace systematically. Some of the probable causes are tabulated on page 60.

Fuel System

THE petrol tank is slung on brackets outside the offside frame member thus bringing the filling orifice into a very accessible position. The capacity of the tank is, on "Coach" Chassis 20 gallons, and on "'Bus" Chassis 25 gallons. Petrol is drawn from the main tank by an "Autovac" vacuum feed tank situated on the forward side of the dash, and feeds from there, through a stop cock at the bottom of the tank and a petrol filter bolted to the crankcase, to the carburettor float chamber.

Autovac Feed Tank.—This fitting, which is entirely automatic in operation, utilises the suction in the engine induction pipe to draw fuel from the main petrol tank. The makers booklet which is issued with this handbook contains a very full description of this auxiliary.

Petrol Filters.—Three petrol filters are incorporated in the fuel system and should be cleaned periodically to avoid stoppage of the fuel supply.

1. This filter is situated in the elbow of the Autovac feed tank to which the pipe from the main petrol tank is attached. It can be removed, after uncoupling the petrol pipe and removing the bridge piece which holds the elbow, by prising out the latter from the taper hole in the tank into which it fits.
2. In this case the filter consists of a small disc of wire gauze contained in a brass chamber bolted to the crankcase. After unscrewing the cover of the filter chamber, the gauze can be lifted out and cleaned; at the same time all water and dirt should be drained off, and the interior of the chamber washed out with petrol. Before replacing the cover see that the spring which holds the gauze down on its seating and the leather washer on the cover are in position.
3. Attached to the adaptor for the petrol feed pipe, and situated in a pocket below the float chamber of the carburettor, this filter is readily detachable by removing the petrol pipe and screwing out the adaptor.

Hot Spot.—To assist in vaporising the fuel an exhaust jacketed passage through which the mixture must pass before reaching the valve pockets, is bolted on the near side of the cylinder block. The supply of heat passing to the jacket can be adjusted by means of a screw-down valve to suit different conditions. No definite instructions can be given for adjusting the heat supply but in general more heat will be required in cold weather and with heavy fuels. The best position of the valve can be easily found by trial and error and the adjustment fixed by means of the lock nut fitted on the valve stem.

Carburettor.—A horizontal carburettor is bolted direct to the governor valve casing on the offside of the engine. The cowl fitted to the air intake is connected to the valve chest by a pipe through which a small quantity of heated air is drawn to assist in vaporising the fuel. The section Fig. 11 shows clearly the construction of the carburettor. Detailed instructions for tuning up the carburettor should, if required, be obtained from the makers handbook; the following adjustments, however, which are likely to be required in service are dealt with here.

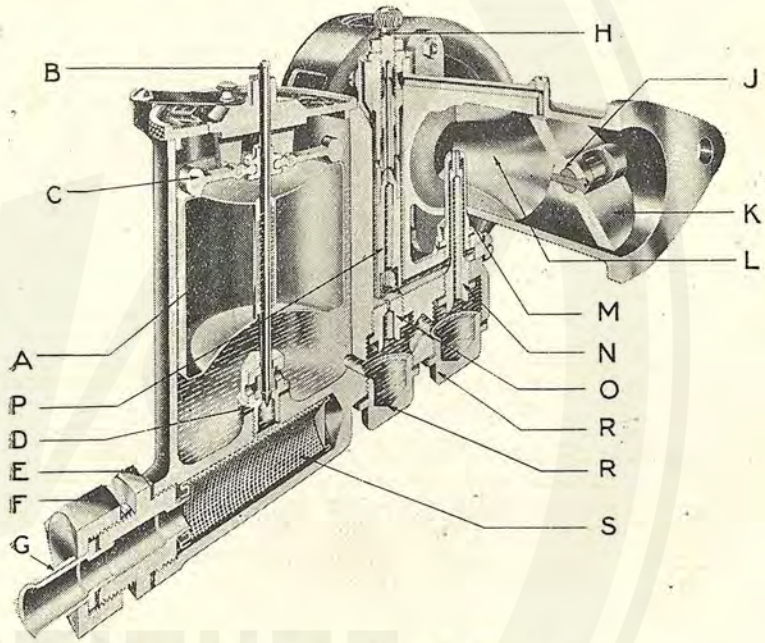


Fig. 11—Section through Carburettor.

A	Float.	K	Throttle Butterfly Valve.
B	Needle Valve.	L	Choke Tube.
C	Balance Weights.	M	Main Jet Cover.
D	Needle Valve Seating.	N	Main Jet.
E	Filter Adaptor.	O	Compensating Jet.
F	Petrol Union Nut.	P	Slow Running Jet.
G	Petrol Pipe Nipple.	R	Plugs under Main and Compensating Jets.
H	Milled Head of Slow Running Adjustment.	S	Filter.
J	Throttle Spindle.		

Detaching.—The carburettor can be detached, after uncoupling the petrol pipe and throttle control rod, by removing the two nuts from the studs which hold it to the governor valve casing,

Replacing.—When replacing the carburettor, be sure that the joint between the carburettor flange and governor valve casing is undamaged and in position over the studs. The hot air pipe fitted to the air intake cowl must be entered into the hole in the valve chest before the carburettor is bolted up. It is very important that all joints about the carburettor and induction system are tight, as even the slighest air leakage will cause great difficulty when starting the engine.

Removal and Cleaning of Jets.—Should it be necessary to clean or change the main or compensating jets, this may be easily carried out by removing the two hexagon jet plugs and unscrewing the jets with the special jet key provided in the tool kit. Particles of dust or water which lodge in the jets can usually be removed by blowing through the jet; if this does not remove the obstruction a piece of wire may be used, but great care should be taken not to enlarge or in any way damage the jet orifice. The jet orifices are very carefully calibrated and on no account should they be knocked up or enlarged.

Replacing Jets.—In replacing jets see that the fibre washers are in place against the shoulder of the jets and screw the latter fully home. Washers are also fitted to the hexagonal jet plugs and should be replaced with these.

Throttle Stop Screw.—This screw is carried by the small lever operating the throttle valve spindle and regulates the amount of throttle opening remaining when the hand control lever on the steering column is pulled right back to the closed position. To adjust, close the hand throttle until the engine runs at a suitably slow speed for idling, then advance the stop screw until it touches the boss cast on the carburettor body and tighten up the lock nuts.

Adjustment of Slow Running Jet.—Should the engine be inclined to misfire and stop when running light with the throttle closed, it is probable that the slow running mixture requires to be made slightly richer. To accomplish this the lock nut should be slackened and the milled head of the slow running jet adjustment screwed down until the engine picks up and runs regularly. If on the other hand the mixture is too rich, the engine will "hunt," i.e., run irregularly, alternately speeding up and slowing down, and the milled head should be screwed out until the engine runs regularly. It should be noted that the above adjustment must be carried out when the engine is thoroughly warmed up and that it is

impossible to obtain satisfactory slow running by adjusting the mixture strength, if the valves, piston rings, and magneto are not in good condition.

Carburettor Setting.—The following setting has been standardised after careful experiment, both on the test bed and under actual road conditions.

Main Jet ... 125.
Compensating Jet 135.
Choke Tube ... 27.

Location of Faults

(a). Failure of Fuel Supply.—If on attempting to start up the engine petrol fails to feed to the carburettor, attention to the following will usually reveal the fault.

1. Note that the petrol cock below the Autovac tank is turned on; the handle should be parallel to the pipe,
2. See that the needle valve and balance weights of the carburettor work freely.
3. Make sure that there is a supply of petrol in the Autovac.
4. Examine the petrol pipes and filters between the Autovac and the carburettor for obstructions. If the vehicle has been laid up for some time and it is found that there is no petrol in the Autovac, this may be due to leakage and evaporation. The correct functioning of the system can in this case usually be restarted by filling up the float chamber of the carburettor and starting up the engine on this supply. If, however, the vehicle has been recently in service, the absence of petrol in the Autovac indicates the failure of this fitting or its pipe lines and the following points should be looked to:—
5. Note that there is plenty of petrol in the main tank.
6. See that the small air holes in the main tank filler cap are clear.
7. Examine, and if necessary, clean the feed pipe from the main tank to the Autovac, also the filter in the union elbow.
8. Examine the suction pipe from the Autovac to the engine induction pipe for air leaks.

If, after attention to the foregoing, the fuel does not feed correctly, the Autovac must be at fault and should be dismantled, full details of the necessary operations being given in the makers' booklet.

It is most important that all unions be screwed up tightly when reassembling the various pipes; they should be gone over with a spanner when petrol has been standing in the pipes for an hour or two, and any leaky joints rectified.

(b) Flooding of Carburettor.—If the carburettor floods, i.e., petrol drips copiously from the float chamber and from below the jets, look to the following probable causes:—

1. A particle of grit may have lodged on the needle valve seat. This can usually be removed by lifting the valve and allowing the rush of petrol to wash away the obstruction.
2. The balance weights may be sticking on their fulcrum pins, not allowing the needle valve to close.
3. The float may be damaged and fuel logged so that it cannot lift the balance weights and close the needle valve. Should this be so, a temporary cure can often be effected by removing the float and immersing it in boiling water. This vaporises the fuel contained in the float and drives it out through the puncture which was the prime cause of the trouble. If soldering gear is available, a small blob applied to the puncture will render the repair permanent. Note that if the above repair is carried out only the smallest possible amount of solder should be used, or the petrol level in the jets will be upset.
4. Needle valve bent or ridged. Should the needle valve be bent, a new one should be procured and fitted. If the needle valve is slightly ridged it should be ground in on to the seat, using a mixture of jewellers' rouge and "Brasso" as the grinding medium. If, however, the needle valve is badly ridged, it and also the detachable valve seat should be replaced with new parts.

Petrol Consumption.—Users very often do not fully realise that external influences, such as road surface, gradients and atmospheric conditions, have a marked bearing on petrol consumption. A little consideration, however, will show that in winter when the road surface is soft after continuous rain, a higher petrol consumption is to be expected than in summer, when the roads are usually hard and dry. Similarly, routes which include many stiff gradients or entail frequent stopping and starting in heavy traffic will always cause a high petrol consumption. On the other hand, excessive petrol consumption is very often due to a poor adjustment of some part of the vehicle itself, in which case the location and cure of the fault will restore the petrol consumption to a normal figure. Notes on petrol consumption are given on page 61.

Clutch

THE clutch is of the single dry plate type the faces being lined with renewable friction fabric. Very light pedal load and the resulting ease of operation are ensured by the design of the withdrawal gear. Fig. 12 shows clearly the construction of the clutch and operating mechanism.

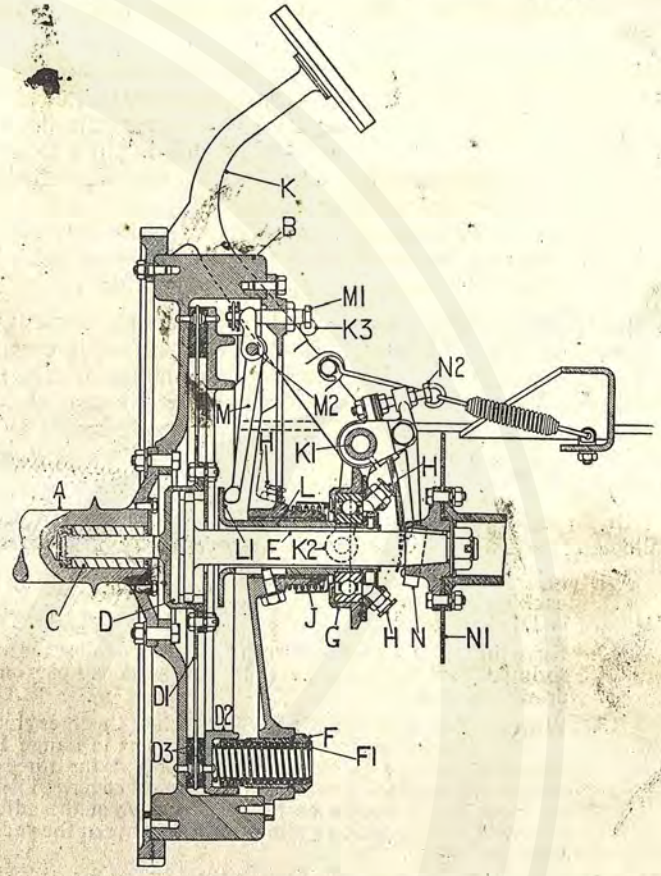


Fig. 12—Arrangement of Clutch.

A	Crankshaft.	K1	Withdrawal Shaft.
B	Flywheel.	K2	Withdrawal Levers.
C	Roller Bearing.	K3	Pedal Stop Pin.
D	Clutch Shaft Front Universal Joint.	L	Withdrawal Sleeve.
D1	Floating Plate.	L1	Flange on Withdrawal Sleeve.
D2	Pressure Plate.	M	Clutch Finger.
D3	Friction Linings.	M1	Adjusting Screw for Finger.
E	Clutch Shaft.	M2	Fulcrum Pin for Finger.
F	Clutch Spring Cap.	N	Clutch Brake Lever.
F1	Clutch Spring.	N1	Clutch Brake Disc.
G	Withdrawal Muff.	N2	Adjusting Screw for Clutch Brake.
H	Oil Nipples.		
J	Anti-Chatter Spring.		
K	Clutch Pedal.		

Clutch Shaft.—The drive is taken from the clutch to the gear box through the clutch shaft, a short shaft universally jointed at each end. The front joint, of the annular gear type, carries the floating plate of the clutch and is centred by a spigot running in a roller bearing in the crankshaft. Both the roller bearing and the universal joint are packed with grease when assembled and should require no attention for very long periods. They should, however, be re-packed whenever the clutch is dismantled for overhaul. The rear joint is of the fabric type and requires no attention.

Adjustment.—When the clutch is in correct adjustment it should be possible to move the pedal from ½" to 1" before it engages with the withdrawal muff. If more than this amount of free motion is permitted, the clutch may not disengage when the clutch pedal is fully depressed; on the other hand, if no clearance is allowed, the clutch will be prevented from engaging fully and slipping and rapid wear of the clutch linings will result.

In adjusting the clutch the following procedure should be followed:—

1. Press down the clutch pedal about ½" and fix in this position by packing between pedal K, and the stop pin K3 carried on the offside pedal shaft bracket.
2. Force the clutch withdrawal muff G forward against the anti-chatter spring J, until the face engages the two hardened pins on the withdrawal levers K2.
3. With the muff in this position, adjust each of the three clutch fingers M until their inner ends are just clear of the flange L1 on the withdrawal sleeve L, by screwing in or out the three adjusting screws M1 equally spaced round the clutch cover. The lock nuts on these screws should be tightened up when the adjustment is complete and the packing removed from between the pedal and the stop pin.

Clutch Slip.—This may be caused by any of the following defects.

1. Grease or oil present on the friction faces. This may be cured by squirting petrol between the faces of the linings.
2. Clutch not engaging fully due to wear. See note on adjustment.
3. Decrease in clutch spring load due to excessive wear of linings and ageing of springs. In this case a temporary cure can be effected by withdrawing the six spring caps and packing up the springs with washers about ⅛" thick. This should, however, be regarded merely as a first-aid measure and the clutch should be dismantled and the worn parts renewed at the earliest opportunity.

Lubrication.—The oil nipples fitted to the clutch cover for the lubrication of the withdrawal sleeve and to the withdrawal muff, should receive attention every 1,000 miles. At the same time the clutch finger fulcrum pins should be oiled through the oil holes in the fingers.

Dismantling Clutch.—Should it be considered necessary to dismantle the clutch, attention to the following will be of assistance.

1. Unbolt the clutch withdrawal cross shaft brackets from the rear engine bearer; the brackets and shaft can be lifted away together.
2. Uncouple the fabric universal joint and unbolt the distance piece from the flange on the clutch shaft.
3. Remove the clutch springs and the set screws holding the clutch cover to the flywheel.

The clutch unit can then be drawn back far enough to disengage the spigot and can be dropped down, if the undershield be first removed.

Replacing Clutch.—Before replacing the clutch the spigot roller bearing should be packed with grease. To preserve the balance of the clutch the pressure plate and the clutch cover should be assembled with the marks stamped on their edges in line.

Clutch Brake.—A clutch brake is fitted to assist the quiet engagement of gears. A small fabric faced lever N is brought into contact with a disc N1 carried by the clutch shaft, by the downward movement of the clutch pedal, thus rapidly slowing up the clutch shaft and attached pinion shaft.

Clutch Brake Adjustment.—The point in the clutch pedal travel at which the clutch brake comes into operation can be varied to suit individual requirements by means of the small set screw N2 situated at the top of the clutch brake lever. The adjustment can best be carried out by pressing down the clutch pedal slowly until the clutch is just disengaged, a point that can be determined by noting that the clutch shaft can be turned by hand when the clutch is free. Then with the clutch pedal in this position set the clutch brake lever by means of the set screw No. 2 until the friction pad N is almost touching the brake disc N1.

Gear Box and Speed Change

THE gear box is of the sliding pinion type providing four speeds forward and one reverse, "top" being a direct drive. The gear shafts are short and stiff to avoid whip and are carried in large diameter ball-bearings. A ball thrust bearing is fitted to the rear end of the mainshaft to take up any end thrust which may arise from the foot brake or cardan shaft. The gears are case hardened and ground and are exceptionally wide, thus ensuring long life and silence in operation.

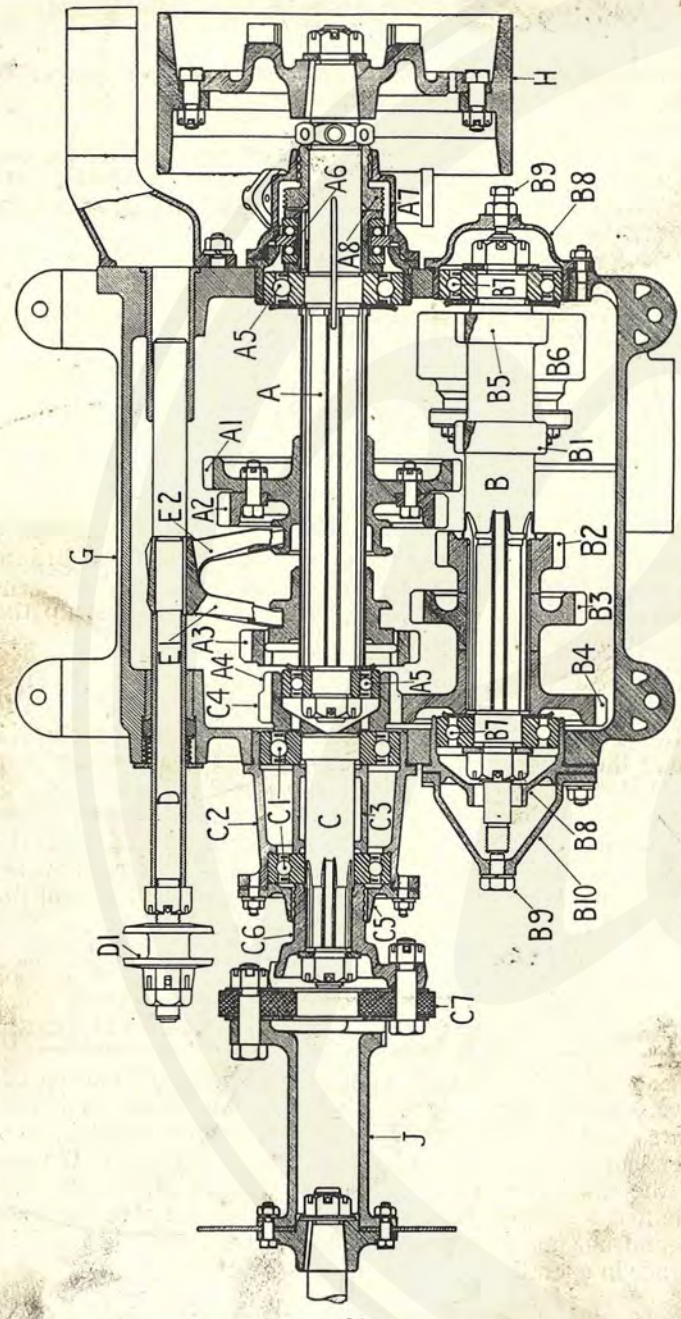


Fig. 13—Sectional Plan of Gear Box.

Removing Gear Box.—Given sufficient lubrication the gearbox will run for very long periods without attention. Should, however, it be necessary to dismantle the gears or gear shafts, the complete box should first be removed from the chassis, this being a quicker and more convenient method than attempting to withdraw the shafts with the box in position. In removing the gear box the following operations will be necessary :—

1. Uncouple the clutch shaft fabric universal joint.
2. Follow directions for removing cardan shaft, see Page No. 37, so far as is necessary to clear the front universal joint from the foot-brake drum.
3. Disconnect the foot brake pull rod and the pipe from the frame nipple union to the air pump, if fitted.

Fig. 13—Sectional Plan of Gear Box.

A Mainshaft.
A1 First and Reverse Speed Wheel on Main Shaft.
A2 Second Speed Wheel on Main Shaft.
A3 Third Speed Wheel and Top Speed Clutch on Main Shaft.
A4 Top Speed Clutch on Pinion Shaft.
A5 Ball Bearings for Main Shaft.
A6 Ball Thrust Washers on Main Shaft.
A7 Housing for Ball Thrust Washer and Cover for Oil Return Screw.
A8 Oil Return Screw and Mileage Recorder Driving Worm.
B Countershaft.
B1 First Speed Wheel on Countershaft.
B2 Second Speed Wheel on Countershaft.
B3 Third Speed Wheel on Countershaft.
B4 Constant Mesh Wheel on Countershaft.
B5 Reverse Wheel on Countershaft.
B6 Reverse Wheel on Reverse Shaft.
B7 Ball Bearings for Countershaft.
B8 Housing for Ball Bearings.
B9 Locating Screws for Countershaft.
B10 Cover for Countershaft Housing.
C Pinion Shaft.
C1 Ball Bearings for Pinion Shaft.
C2 Housing for Ball Bearings.
C3 Distance Piece.
C4 Constant Mesh Wheel on Pinion Shaft.
C5 Cover for Oil Return Screw.
C6 Spider for Fabric Universal Joint and Oil Return Screw.
C7 Fabric Disc of Clutch Shaft Universal Joint.
D Selector Rod.
D1 Adjusting Collar on Selector Rod.
E1 Top and 3rd Speed Striking Fork.
E2 1st, 2nd and Reverse Speed Striking Fork.
G Gear Case.
H Foot Brake Drum.
J Clutch Shaft Distance Piece.

4. Unbolt the distance recorder bracket from the frame. If a speedometer is fitted remove the drive shaft from the housing at the rear of the gear box. A long box spanner will be required to reach the nuts holding the flange of the drive in position.
5. Lower the rear half of the undershield.
6. Uncouple and remove the section of exhaust pipe which passes under the air pump.
7. Remove the nuts from and drive out the four supporting bolts which hold the gearbox to the longitudinal carrying members, after arranging slings round the pinion shaft housing at the front and the foot brake drum at the rear.
8. Lower the box carefully, noting that the selector rods come away from the speed change gear and that the air pump clears the frame.

Overhauling.—The sectional plan Fig. 13 shows clearly the construction of the gear box and should be studied carefully before attempting to dismantle the box. The following gives an outline of the method to employ when withdrawing the shafts.

1. **Pinion Shaft.**—This should be withdrawn complete with its housing by driving out forwards, after removing the nuts from the studs holding the housing in position.
2. **Main Shaft.**—After removing the brake drum, the mileage recorder drive, the nuts from the rear bearing housing and the spigot bearing, the shaft may be drawn out to the rear, each gear being lifted out as it comes clear of the front end of the shaft. It is advisable to mark the gears and the shaft so that they can be replaced on the same castellation when reassembled.
3. **Counter Shaft.**—The counter shaft can be removed with all gears in place, after drawing the housings and bearings from both ends of the shaft, by moving it to the rear far enough to enable the front end to be lifted up through the cover.
4. **Reverse Shaft.**—This can be driven out from inside after removing the cover plate from the rear face of the box.

IMPORTANT.—In reassembling it is most important to see that all nuts are drawn up tight and that all split pins or other locking devices are in position.

Meshing of Gears.—It may be found after the gear box has been overhauled, that the gears do not mesh properly when the gear lever is placed in each gear position. If this be so, the adjusting collars on the ends of the selector rods should be screwed in the required direction until each pair of gears bears across the full width of the teeth when the gear lever is placed in the appropriate notch. The locking devices—a lock nut and split pin—which must, of course, be removed before the adjustment is carried out, should be replaced when this is completed.

Lubrication.—The oil consumption of the gear box is practically negligible and unless there is serious leakage it will be sufficient to remove the cover and examine the oil level every 2,000 miles, filling up, if required with heavy gear oil to the level of the cock on the side of the casing. **On no account should grease be used** instead of oil in the gear box. Filling up is best carried out when the gear box is warm after running; the lubricant is then fluid and flows more readily from the level cock. The oil level should not be carried above that indicated or oil will be thrown out over the foot brake drum rendering the brake very ineffective.

The old oil should be drained off from the drain plug on the underside of the box every 20,000 miles and the box washed out with paraffin and refilled with new oil.

Mileage Recorder.—This is carried on a bracket bolted to the nearside frame member and is driven by flexible shaft from an enclosed worm and wheel at the rear of main shaft. An oil nipple is fitted to the mileage recorder and should receive attention every 500 miles.

Speed Change Gear.—The gear lever and gate are carried by a bracket bolted to the chassis frame at the right of the driver. The gear lever is located in each gear position by notches cut in the sides of the slots in the quadrant and operates through the necessary shafts and wypers, the selector rods which carry the striking forks in the gear box. Interlocking gear to prevent the engagement of more than one gear at once is provided and a safety catch—operated by lifting the knob of the gear lever—is fitted to prevent the accidental engagement of the reverse gear. The position of each gear is clearly marked on the quadrant.

Lubrication.—Oil holes are provided on the bearing caps of the speed change operating shafts and should be given a few drops of oil every 1000 miles. All moving parts of the speed change gear should be gone over with an oil can at the same intervals.

Cardan Shaft

THE cardan shaft is of the open type, divided into two approximately equal sections, the rear end of the forward section being supported by a self-aligning roller bearing of large diameter. This bearing is carried in a dust and water proof housing which is suspended from a substantial frame cross member. Universal joints,

to accommodate any slight frame flexure or movement of the rear axle when traversing uneven road surfaces, are fitted at the front of the forward section and at each end of the rear section of the cardan shaft. The universal joints are of the "Hooke" type and are provided with all-metal oil-tight covers. Fig. 14 shows the arrangement of the cardan shaft.

Dismantling Cardan Shaft.—The following indicates the method of dismantling the cardan shaft.

1. Remove split collars from behind the universal joint covers and slip covers back along the shafts.
2. Uncouple rear universal joint by removing the caps holding the saddle bushes to the driving flange on the rear axle worm shaft.
3. Similarly, uncouple the centre joint and slip the fork back along the castellations until the front end is clear of the driving flange. The rear shaft can then be lowered to the ground.
4. Disconnect the front universal joint by removing the caps bolted to the driving flange at the rear of the gear-box main shaft.
5. Uncouple from the union in the frame, the flexible oil pipe which feeds the centre bearing housing.
6. Withdraw the four bolts fixing the centre bearing housing to the stay tube bracket and remove the shaft by sliding it towards the rear until the front universal joint clears the foot brake drum.

This procedure must be modified slightly in the case of the Coach Chassis, Types P.C. 26 and P.F. 26, due to minor differencies in construction.

Type P.C. 26.—The short wheel base of this chassis makes it possible to use a single cardan shaft and this may be dismantled by following the directions given above for removing the rear shaft.

Type P.F. 26.—In this case the forward shaft passes through the pressed steel cross member which carries the centre bearing housing, thus necessitating a different method in its removal. For note (6) above, the following should be substituted.

> Remove the nut holding the driving flange in position at the rear end of the front shaft and force off the driving flange. Remove the bolts fixing the bearing housing to the frame cross member and pull off the bearing and housing, after unscrewing the nut which holds the bearing against the shoulder on the shaft. Slide the shaft back until the front end can be dropped down and remove the shaft by pulling forward through the frame cross member.

NOTE.—It is most important that all caps and bushes be marked in such a way that they can be reassembled in the same positions that they occupied before dismantling. Failure to do this may throw the shaft off the truth and so cause harmful vibration at high speeds.

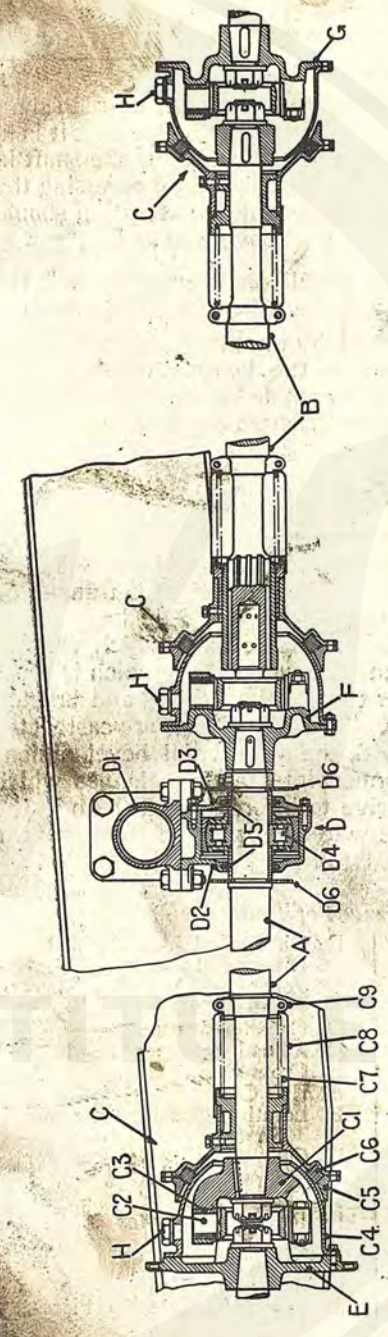


Fig. 14—Arrangement of Cardan Shaft.

A Forward Shaft.
B Rear Shaft.
C Universal Joints.
C1 Fork.
C2 Saddle.
C3 Saddle Bushes.
C4 Spherical Housing for Universal Joint.
C5 Joint Cover.
C6 Hemp Packing.
C7 Retaining Spring for Joint Cover.
C8 Cover for Spring.
C9 Split Collar.
D Centre Bearing.
D1 Frame Stay Tube.
D2 Roller Bearing Housing.
D3 Cover for Housing.
D4 Roller Bearing.
D5 Felt Dust Washers.
D6 Mud Throwers.
E Driving Flange on Gearbox Mainshaft.
F Driving Flange on Forward Cardan Shaft.
G Driving Flange on Rear Axle Worm Shaft.
H Oil Filling Plugs.

Reassembling Cardan Shaft.—Before replacing the cardan shaft examine the hemp packing in each joint cover to see that it is in good condition and thread the covers and springs on to the shaft in their correct positions. The shaft can be replaced by reversing the operations carried out when dismantling, and due attention should be paid to the points enumerated in the above note.

Lubrication.—The filling plugs should be removed and the universal joint casings half filled with gear oil every 2,500 miles.

The centre bearing is lubricated by an oil gun nipple on the offside frame member, connected to the bearing housing by a flexible tube. The oil gun should be applied every 500 miles and lubricant forced in until it begins to drip from the housing.

Rear Axle

THE rear axle is of the full-floating worm driven type, the cross shafts transmitting torque only, while the weight is transferred from the road wheels direct to the forged steel axle body. The worm wheel is bolted to the differential casing which runs in adjustable taper roller bearings and the worm shaft which is fitted with a double ball thrust washer to take the driving and braking thrusts, is carried in ball bearings. The cross shafts are castellated at their inner ends to engage with the differential bevel pinions and at their outer ends are formed into toothed flanges which engage with, and transmit the drive to internally cut teeth in the hub caps which are bolted to the wheel hubs. Fig. 15 shows the construction of the rear axle.

Fig. 15—Arrangement of Rear Axle.

A Axle Body.
A1 Worm Wheel Housing.
A2 Oil Filler.
A3 Cover.
A4 Housing for Ball Thrust Bearing.
A5 Cover for Drain Hole.
B Worm Shaft.
B1 Ball Bearings for Worm Shaft.
B2 Double Ball Thrust Bearing.
B3 Oil Return Screw.
B4 Driving Flange.
B5 Packing Gland.
B6 Packing.
C Worm Wheel.
D Differential Casing.
D1 Differential Bevel Wheels.
D2 Differential Jockey Pinions.
D3 Differential Saddle.
D4 Roller Bearings for Differential Casing.
D5 Caps for Bearings.
D6 Adjusting Nuts for Bearings.
E Cross Shaft.
E1 Hub Cap.
E2 Locating Spring for Cross Shaft.
E3 Oil Retaining Washer for Cross Shaft.
F Wheel Hub.
F1 Roller Bearings for Hub.
F2 Felt Washer.
G Brake Drum.
H Brake Shoes.
J Tyre Valve Extension Pieces.

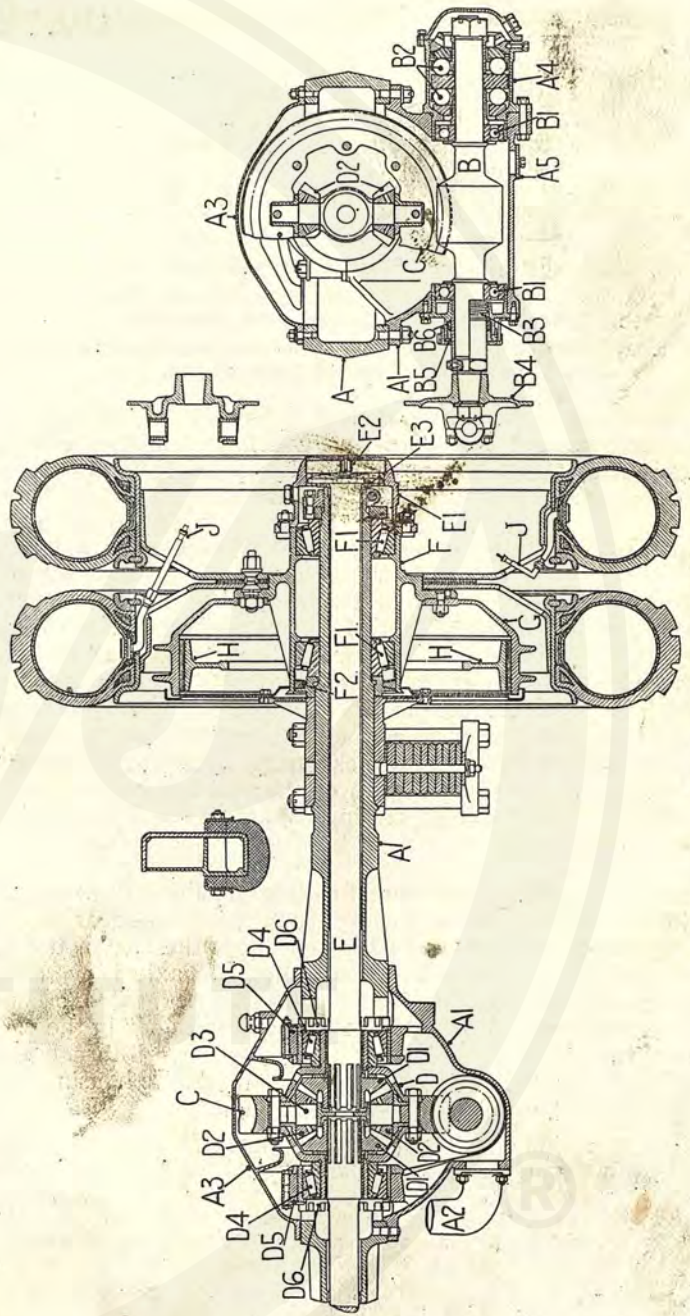


Fig. 15—Arrangement of Rear Axle.

Removal of Worm Wheel Housing.—The whole of this assembly which includes the worm shaft, worm wheel, and differential can be removed as a unit after the following preliminaries have been carried out.

1. Drain oil from axle casing.
2. Uncouple the rear cardan shaft universal joint.
3. Remove hub caps and draw out cross shafts about 8".
4. Arrange slings round the front end of the worm shaft and the ball thrust bearing housing at the rear of the worm shaft.
5. Remove the nuts holding the worm wheel housing to the axle body and lower the assembly carefully to the ground.

The above applies only to the underslung worm type axle. With the overhead worm type axle which is fitted to the "Coach" Chassis of this Model, the complete axle must be removed before the worm wheel housing can be dismantled.

Overhauling.—In the event of its being necessary to dismantle the differential or worm shaft, it is of the utmost importance that all components be marked so that they may be replaced in the correct position when reassembling. When assembled the worm must bear centrally on the worm wheel which can be moved laterally by adjusting the roller bearings until the correct "mesh" is obtained. The bearings must be carefully adjusted and the notes given under roller bearing adjustment, page 50, apply equally in this case. When replacing the cross shafts, see that the oil retaining washers are in place in the ends of the axle body tubes and that the small locating springs are in position in the hub caps before these are bolted up.

Lubrication.—The cover should be removed from the filling orifice at the rear of the axle body every 2,500 miles and gear oil added, if necessary, until the level rises right up to the face of the filler. This operation is best carried out when the axle is warm after running and the oil to be added should also be heated, otherwise trouble will be experienced due to the oil "freezing" in the narrow neck of the filler. A filling plug is fitted to the ball thrust bearing housing on the overhead worm type axle, and the housing should be filled up at the same intervals as the axle body.

The used lubricant should be drained off after each 20,000 miles running and the casing filled up with new oil to the correct level.

Front Axle and Road Springs

THE front axle is a heavy H section steel forging the spring seats being integral with the axle body. Hardened steel bushes are pressed into the jaws of the stub axles and form the bearings for the pivot pins which are driven up from below and keyed to prevent rotation in the axle body. Ball thrust washers are fitted at the upper ends of the pivot pins and serve to transfer the load from the front axle to the stub axle. Fig. 16 shows a section through the pivot pin bearing and wheel hub.

Pivot Pins.—If the pivot pins have been removed, care should be taken when refitting that the felt washer is in place between the bottom jaw of the stub axle and the face of the axle body. A clearance of from ·005" to ·01" between the top of the axle body and the boss on the top jaw of the stub axle should be allowed when tightening up the nut at the top of the pivot pin.

Lubrication.—Oil nipples are fitted to each of the pivot pin bushes, those on the upper caps serving also to lubricate the ball thrust washers. The oil gun should be applied every 500 miles, and in wet weather grease should be smeared round the felt dust washer to assist in excluding water from the lower bush.

Road Springs, Lubrication and Attention,—The small amount of attention which is required to keep the springs in good condition will be amply repaid by the increased riding comfort of the vehicle and freedom from spring breakages.

The springs should be lubricated with a mixture of graphite and grease whenever signs of rust are noticed at the edge of the leaves. The lubrication is best carried out by dismantling the spring and cleaning and greasing each leaf as it is reassembled. If the time required for this operation is not available the frame should be jacked up to take the weight off the springs and the leaves opened up with a thin wedge and grease spread between them.

The three spring pins fitted to each spring, front and rear, are lubricated by oil nipples and should have the gun applied at 500 mile intervals.

NOTE.—Due to the petrol tank being hung on the offside of the vehicle, it has been found necessary to make the offside front spring with one leaf more than on the nearside. Care should be taken, therefore, when refitting the springs that they are replaced in their correct positions. The bolts fixing the springs to the axle should be tightened hard up and should be gone over occasionally with a spanner; failure to keep these tight will inevitably lead to broken spring leaves.

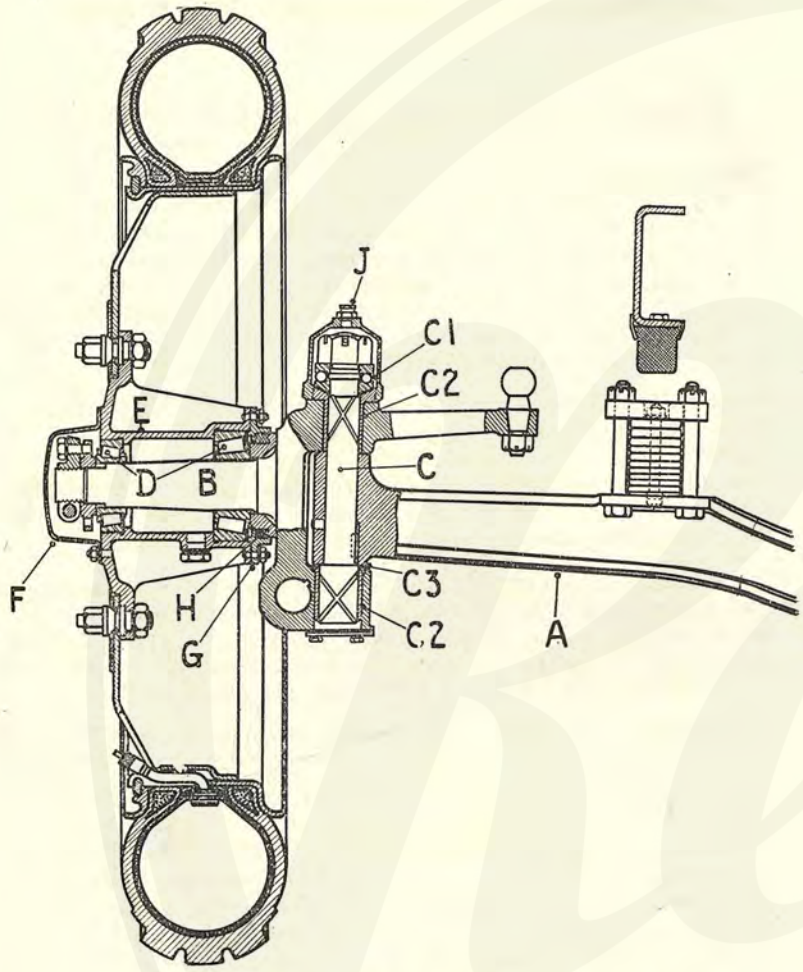


Fig. 16—Section through Front Hub and Pivot Pin.

A Axle Body.
B Stub Axle.
C Pivot Pin.
C1 Ball Thrust Bearing for Pivot Pin.
C2 Pivot Pin Bushes.
C3 Felt Washer on Pivot Pin.
D Roller Bearings.
E Hub.
F Hub Cap.
G Dust Cover.
H Felt Washer.
J Oil Nipple.

Steering Gear

THE steering gear is of the worm and sector type, both worm and sector spindles being carried in plain bearings in the steering box which is bolted to the frame. A ball thrust washer is fitted at the lower end of the worm spindle to take up the thrust of the worm and prevent end play on the steering column.

Spring loaded ball joints are fitted at both ends of the steering tie rod and steering connecting rod.

Removal of Steering Column.—The method of removing the steering column for overhaul or as a preliminary to lifting out the engine is as follows :—

1. Uncouple the steering connecting rod from the ball pin on the steering wyper.
2. Remove the steering wyper and the two feathers from the steering segment spindle.
3. Remove the steering wheel, also the petrol filter attached to the crank case.
4. Uncouple the ignition and throttle control rods, and remove the five bolts holding the steering box to the frame and the bracket on the rear engine bearer.
5. Drop the undershield.
6. Push the steering box in towards the engine to disengage the segment spindle from the frame and lower the box down.

Refitting.—When refitting the steering column, great care should be taken that all nuts are tightened up and have their respective locking devices in position. This applies particularly to the nut holding the steering wyper in position, unless this is tightened hard up, there is a grave risk of the feathers shearing and causing a serious breakdown.

Adjustment of Front Wheel Alignment.—If it has been necessary to remove the steering tie rod or if the front axle has been involved in an accident, it is advisable that the alignment of the front wheels be checked. When in the straight ahead position, the distance between the inner edges of the wheel rims, measured in front of the axle at the height of the wheel centre, should be $\frac{1}{2}$" less than the corresponding dimension measured behind the axle. The effective length of the steering tie rod can be altered, if necessary, to correct the alignment, by fitting washers behind the springs in the tie rod ends. Faulty alignment of the front wheels will affect the steering and cause very rapid wear of the front tyres.

Lubrication.—The steering box should be half filled with gear oil every 2,500 miles. Oil nipples are fitted to all ball joints on the steering rods and to the end of the steering segment spindle and should be attended to every 500 miles.

A few drops of oil should be applied to all joints and bearings of the ignition and throttle controls at 1000 mile intervals.

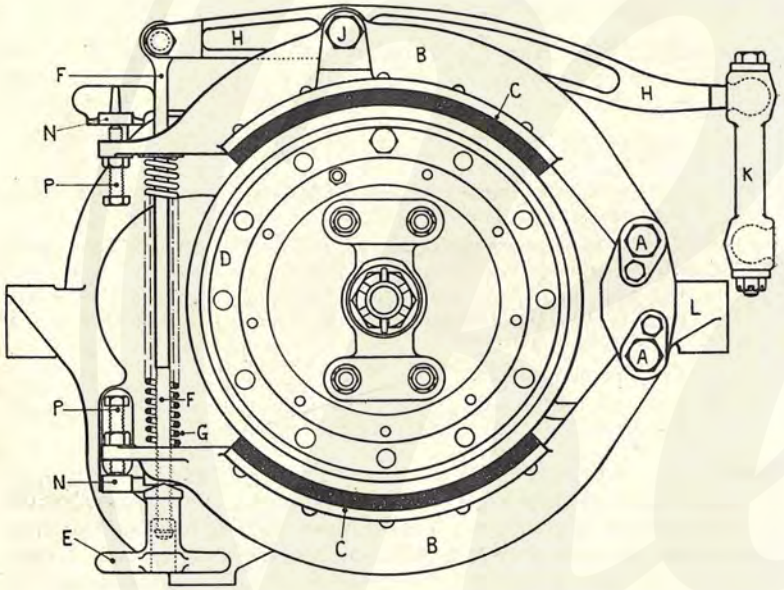


Fig. 17—Arrangement of Foot Brake.

A Fulcrum Pin for Brake Shoes.
B Brake Shoes.
C Brake Shoe Linings.
D Brake Drum.
E Brake Adjusting Handle.
F Draw Bolt.
G Push-off Spring.
H Brake Lever.
J Fulcrum Pin for Lever.
K Pull Rod.
L Bracket for Fulcrum Pins A.
N Stop Bracket.
P Stop Pins.

Brakes

THE foot brake pedal operates two wide, external contracting shoes which bear on a drum mounted on the main shaft at the rear of the gearbox, while the hand brake lever controls internal expanding shoes, taking effect on drums bolted to the rear hubs. In both brakes the area of the fabric lined friction surfaces is exceptionally large, thus ensuring long service before relining becomes necessary. Figs. 17 and 18 show details of the foot and hand brakes respectively.

Adjustment of Foot Brake.—Screw up the adjusting handle E, situated at the near side of and immediately below the bottom shoe, as far as possible, i.e., until both shoes are pressing on the drums, then slack back two full turns. This adjustment should be checked by observing that the foot brake pedal has 1″ to 1½″ free travel before the brake can be felt coming into operation.

Set the two stop screws P until both top and bottom shoes are clear of the drum, when the brake is off. This latter adjustment is most important and, if neglected, will cause overheating and scoring of the drum and excessive wear of the top shoe

Adjustment of Hand Brake.—The hand brake adjustment takes the form of screwed sleeves J at the forward ends of the pull rods K between the compensating shaft L and the wypers G on the actuating cams on the rear axle. The sleeves are fixed by small clamping bolts M and lock nuts, and, when these have been slackened back, the brake adjustment can be made by rotating the sleeves in the required direction. Although the brakes are compensated, it is advisable to take up the adjustment on each pull rod by an equal amount, so as to throw as little work as possible on the compensating gear. To avoid the possibility of the shoes rubbing when in the off position, the adjustment should be such, that the hand lever can move over four or five notches of the ratchet quadrant before the brakes begin to come on; for a full application of the brakes about two-thirds of the total travel of the lever will be required. To prevent the reverse faces of the operating cams from applying the brakes when the lever is in the full off position, and to ensure that the two sets of shoes come off by an equal amount, stop pins N are fitted and should be adjusted to be just clear of the lugs on the stirrups P, when the brake is off and when each wyper has travelled through approximately the same angle in moving from the full "on" to the full "off" position.

After adjusting the hand brake it is advisable to jack up the rear axle and see that both wheels rotate freely, when the brake is off.

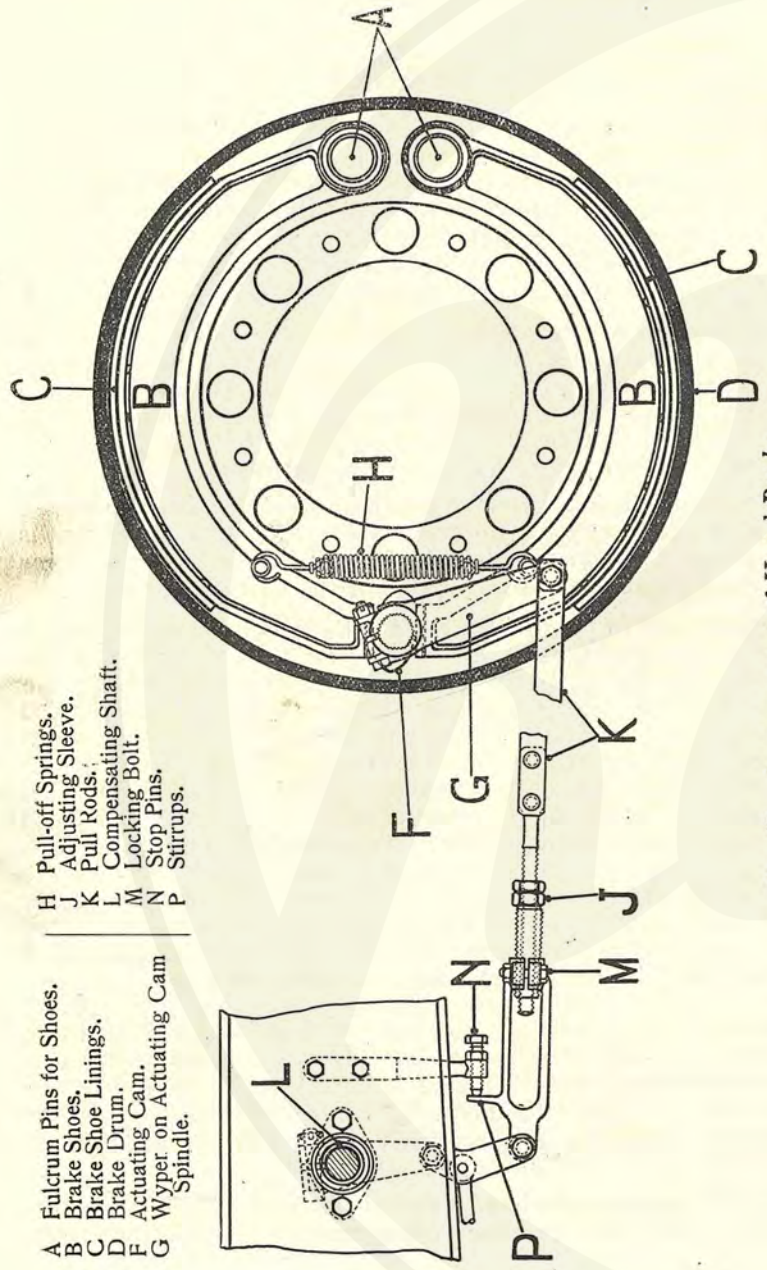


Fig. 18—Arrangement of Hand Brake.

Lubrication.—It is of great importance that all the brake operating gear be kept in good working order. Oil nipples are fitted to the foot brake pedal, the hand brake lever shafts, and the hand brake actuating spindles, and an oiler to the foot brake bell crank lever, all of which should receive attention every 1000 miles. In addition, a few drops of oil should be placed in all the oil holes and on all the pin joints about the brake operating gear.

Road Wheels

THE road wheels are of the detachable disc type, fitted with straight sided pneumatic tyres. The hubs of both front and rear wheels run on taper roller bearings and felt washers are fitted to all hubs and serve the double purpose of retaining grease and excluding dust and mud, both of which are fatal to bearings of this type. A clear idea of the construction of front and rear hubs can be obtained from Figs. 15 and 16.

Removal of Rear Hubs.—Remove the wheels, noting that the nuts fixing these to the hubs have right-hand threads on the offside, and left-hand threads on the nearside hubs. Remove the hub caps and withdraw the cross shafts and oil retaining washers from the ends of the axle tubes. Slacken back the clamping bolt and locking screw which fix the split adjusting nut and screw off the latter. After removing the locking washer and noting that the hand-brake lever is in the off position, the hub can be drawn off. It is important that the roller bearings be marked so that they can be replaced in the same outer races on reassembling.

Removal of Front Hubs.—The procedure is very similar to that for removing the rear hubs, an additional point being to remove the nuts holding the dust cover on the inside of the hub before drawing off the latter.

Replacement of Hubs.—It is of the utmost importance that, before the hubs are replaced, all traces of the old grease which may contain particles of grit be removed from the inside of the hubs. The rollers should be carefully washed in petrol and every possible precaution taken to prevent the ingress of dust, while assembling the hub.

The various parts should be assembled in exactly the sam positions that they occupied before dismantling.

Adjustment of Roller Bearings.—See Fig. 19). After replacing the hubs and **before these are packed with grease** the bearings should be adjusted. When in correct adjustment, the hubs should rotate freely without drag, but, at the same time, there should not be the slightest shake. The adjustment should be carried out thus:—Screw up the split adjusting nut A until no shake can be detected in the bearing. The locking screw C should then be inserted in that one of the three holes in the adjusting nut which most nearly registers with a hole in the locking washer D. After tightening up the locking screw and the clamping bolt B, the hub should again be tried for shake and should be spun round to see that it rotates freely without drag. If it is found that the hub does not rotate freely, the split nut must be slackened off slightly, until, when the adjustment is complete, the hub rotates freely and there is no sign of lift or shake in the bearing.

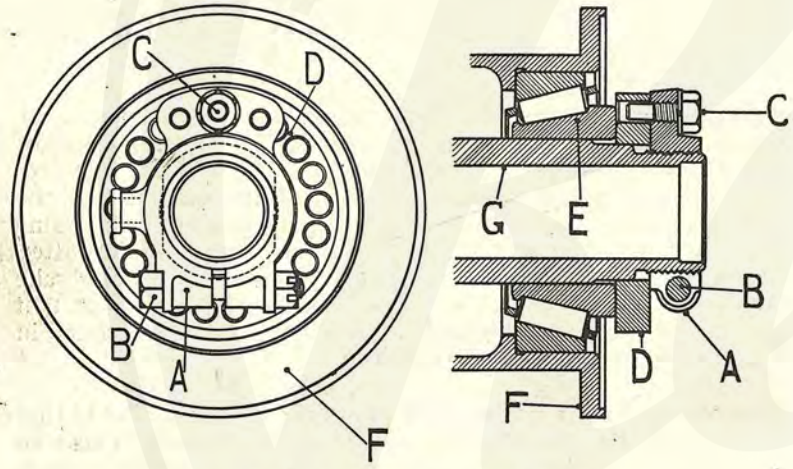


Fig. 19—Adjustment of Hub Bearings.

A Split Adjusting Nut.	E Outer Roller Bearings.
B Clamping Bolt.	F Flange on Hub to which Hub Cap is fixed.
C Locking Screw.	G Axle or Stub Axle.
D Locking Washer.	

After the positions of the locking washer and screw have been carefully marked, they, together with the adjusting nut and outer bearing, should be removed and the interior of the hub packed with grease.

The bearing and locking washer can then be replaced and the adjusting nut tightened up to the marked position and fixed by means of the locking pin and clamping bolt.

Important.—The success of bearings of this type depends on their correct adjustment and protection from abrasive material. On no account should a bearing be adjusted when it is packed with grease. When the lubricant is present it is impossible to tell when the adjustment is too tight or too slack, and if run in this condition very rapid wear of the rollers will result.

Lubrication.—After running 10,000 miles, each wheel should be jacked up and tested for radial shake. If no shake is noticeable the hub caps should be removed and the bearing repacked with suitable grease (see page 56). If, however, the slightest shake is noticeable, the bearing should be dismantled, examined carefully, and if found in good condition reassembled and supplied with fresh lubricant.

Electrical Equipment

AS several different lighting sets can be fitted to suit the different requirements of the various types of this Model, it is impossible to give detailed instructions for the maintenance of each set. The following notes, however, which are of general application should be of assistance in keeping the set in good working order.

Dynamo.—The dynamo can be removed from the engine without disturbing the driving chain, by detaching the carburettor and drip tray, disconnecting the leads and unscrewing the clamping bolts in the fixing straps. The flexible coupling disc should be removed with the dynamo.

The following points should be looked to every 5,000 miles:—

1. **Commutator.**—The commutator must be kept clean and free from oil, and if pitted should be cleaned up by pressing a piece of fine glass or carborundum paper gently against it while the armature is rotating. The paper should be kept moving to and fro along the commutator to avoid cutting grooves in the surface. After cleaning up the commutator in this way, the copper dust should be removed from between the segments with a thin rule or saw blade, taking care not to damage the insulation or raise burrs on the edges of the segments.
2. **Brushes.**—The brushes should move freely in their holders and should be firmly pressed on to the commutator by their springs. New brushes when fitted should be beaded down until they bear all over the face in contact with the commutator.

All carbon dust should be wiped from the brush gear and end covers and any oil which has exuded from the bearings should at the same time be removed.

3. **Lubrication.**—Oilers or grease cups are fitted to the shaft bearings and should receive a few drops of oil in the case of oilers, or two turns in the case of grease cups, every 1,000 miles. Do not over lubricate; oil or grease on the commutator or armature windings will impair the working of the machine and may ultimately cause a total breakdown.

Starter.—The starter, when fitted, will require the same attention as that noted above for the dynamo, but, as it does a relatively small amount of running, the commutator and brushes will not require such frequent attention.

Starter Pinion and Shaft.—If the starter pinion jams when in engagement with the flywheel, it can usually be released by rotating the flywheel backwards and forwards slightly. To prevent the occurrence of this fault, the starter shaft and screw should be washed in paraffin occasionally and lubricated with a thin engine oil. Stiff grease should be applied to the gear ring on the flywheel, to avoid unnecessary wear of the teeth.

Starter Switch.—The starter switch has to carry very heavy currents and it is important, in order to prevent burning of the contacts, that the switch be pressed very firmly home when using the starter.

Battery.—It is essential, if satisfactory service is to be obtained, that the battery be given regular attention.

1. **Topping Up.**—The level of the electrolyte in the battery cells should be examined weekly. If the level is low and the loss is due to evaporation, the level should be made up by adding pure distilled water, until the plates are covered to the depth of about ⅜"; if, however, the loss is due to leakage or spilling, acid of the same specific gravity as that remaining in the cell should be added up to the correct level. The specific gravity can be easily measured by means of a special battery hydrometer, an instrument which is also very useful for testing the condition of the battery.

   NOTE.—When acid is being made up to the correct strength by mixing pure sulphuric acid and distilled water, it is essential in order to avoid an explosion that the **acid be added to the water,** and not the water to the acid. The acid should be allowed to cool, and should be tested for specific gravity before being poured into the battery.

2.—**Testing.**—The condition of the battery should be frequently tested by measuring the specific gravity of the acid solution by means of a hydrometer. Voltmeter readings of each cell do not form a reliable indication of the condition of the battery unless special precautions are taken which make such tests unsuitable for the average owner, and on that account we do not recommend this test.

   Before measuring the specific gravity of the acid solution with the hydrometer, see that the acid is at its correct level. If the cells

have to be filled up, readings should not be taken until the vehicle has run for a few miles or until at least an hour after filling up, so that the acid has had time to attain a uniform density throughout.

In a fully charged Lucas Battery the specific gravity of the acid solution should be from 1·225 to 1·250 when the temperature of the solution is 60° F. In a half-charged condition the specific gravity should be about 1·200, and when fully discharged to the limiting voltage, the density should be about 1·150.

In the case of a C.A.V. battery, the specific gravity when fully charged should be 1·28 to 1·30, while a reading of 1·18 indicates that the battery is almost completely discharged.

3. **Period for which Battery should be charged.**—It is difficult to lay down rigid instructions on this subject as the conditions under which vehicles are used vary considerably. The following suggestions will, however, serve as a rough guide.

   For vehicles running regularly under normal conditions, the battery should be kept on charge for approximately two or three hours daily during day-time running. This time should be increased if there has been an extra drain on the battery, e.g., if the vehicle has been standing for longer periods than usual at night with the lights on. If it is found that with the amount of day-time charging decided on, the density of the acid is too high and that the acid level is apt to fall very quickly, or if when running it is found that the lamp bulbs are too bright and are liable to burn out, it is desirable to cut down the charging time. Similarly, if the battery density gets too low and the lights become dim, especially when standing, the charging period should be increased.

   This does not apply to those C.A.V. sets which are fitted with a voltage regulator.

General Maintenance.—

1. All terminals should be kept clean and tight. This applies particularly to the battery and starter terminals.
2. If it becomes necessary to dismantle any of the electrical equipment, all wires should be carefully marked, as if wrongly replaced serious damage may be done.
3. Examine all wiring where it is exposed and liable to mechanical damage and make good any faults in the insulation.
4. Fuses are provided in the various circuits and, if it is necessary to replace any of these, the wire used should be of the same gauge and material as that originally fitted.
5. On no account should the dynamo be run with the charging switch closed, when the battery is disconnected.

Special Features of Sets as fitted to Bus Chassis.—

1. **Lucas Sets.**—The dynamo uses the 'Third Brush' control system and has incorporated in it a resistance which can be placed in series with the field winding, thus reducing the

output to about half its normal value. The dynamo is put on half charge by closing the charging switch and the output is automatically increased to its full value when the side lamp switch is closed.

2. **C.A.V. Set.**—This set includes a "Constant Voltage Regulator" which renders the correct charging of the battery automatic. When the battery is discharged the current flowing into it is large : as the condition of the battery improves the current gradually falls of, until, when the battery is fully charged, the current is reduced to a negligible amount.

   Two switches only are fitted to the switchboard. The main switch on the left breaks the dynamo field circuit and disconnects the battery. No lights can be used when this switch is open. When the switch is closed the dynamo charges the battery or if the battery leads are disconnected will supply current direct to the lights. The switch on the right operates the side and tail lamps, while the head lamps are controlled by a separate tumbler switch situated on the instrument board.

WARNING.—On no account should the adjustment of the voltage regulator be tampered with.

Care of Tyres

TO obtain satisfactory service from pneumatic tyres it is essential that they be kept inflated to the correct pressure, and as slight leakage is constantly going on this should be checked at least once a week. The correct pressures for the tyres fitted to the different types of this model are shown below.

TYRE SECTION.	PRESSURE.	
	FRONT AXLE.	REAR AXLE
6 ins.	75 lb./sq. in.	75 lb./sq. in.
7 ins.	70 lb./sq. in.	85 lb./sq. in.

Air Pump.—A mechanically driven air pump is fitted as standard to all vehicles equipped with 7" section tyres, and can be fitted as an extra on all other types of this Model. The pump which is mounted on the near side of the gear box is driven by spur gear from the reverse shaft, and is lubricated automatically from the gear box oil supply. The method of using the pump is as follows :—

Remove the dust cap from the union in the main frame to which the copper pipe from the air pump is attached and screw on the flexible rubber hose; this union is situated immediately above the pump operating handle alongside the gear box on the nearside of the chassis. Declutch, and rotate the operating handle clockwise until the pump driving gear is engaged; on re-engaging the clutch the pump will be brought into action and the tyres can be inflated by attaching the adapter on the flexible hose to the tyre valves. The pressure should be checked by means of the Schrader pressure gauge supplied in the tool kit and not by reading the gauge attached to the flexible hose, as this latter very often shows a reading in excess of the actual pressure in the tyre.

When twin wheels are fitted on the rear axle the valve extension pieces are different on the inner and outer tyres (see Fig. 15). If the wheels are changed over at any time, the extension pieces also should be changed before the wheels are refitted.

Lubrication

THE importance of regular and adequate lubrication of all parts of the chassis cannot be too greatly emphasised. In the case of vital units—the engine, gear box, and rear axle—lack of sufficient lubrication will cause almost immediate breakdown; in the case of minor parts, however, neglect may not have noticeable effect for a considerable period, but will in the long run, undoubtedly cause excessive and unnecessary wear of the parts concerned.

Important.—The difficulty, under the ardous conditions now demanded by passenger carrying service, of finding opportunity to give the vehicle even slight attention is fully realised. It should be noticed, however, that the stated mileages, at which replenishments of the various lubricating points are necessary, have been made as large as is consistent with maintaining the vehicle in a reasonable state of efficiency. If they are exceeded at all, trouble with rapid wear and consequent breakdown of minor parts will inevitably result.

Choice of Lubricant.—The oils which are used in the engine, gear box, and rear axle, should be of a quality equal to the following.

MAKER	ENGINE	GEAR BOX & REAR AXLE
Shell Mex Ltd.	Triple Shell	Shell Gear Oil
Vacuum Oil Co. Ltd.	Mobiloil "A"	Mobiloil "C"
Prices Co. Ltd.	Motorine "D"	Olympia Gear Oil

For the hub bearings it is essential that a **pure unloaded grease of high melting point** be used, "Mobilubricant Soft," made by the Vacuum Oil Co. Ltd., is very strongly recommended for use at this point.

Oil Gun.—Either gear oil or a very light grease can be used successfully in the oil gun. Gear oil is to be preferred in most cases, as it is less liable to clog the oilways and penetrates more easily into the bearing surfaces; the two nipples on the water pump should, however, be supplied with grease, as gear oil when used at this point becomes thinned down by the heat from the cylinder block, and flows out of the bearings.

When using the gun, all mud and dust should be wiped from the nipples before applying the connector which must be pulled right home on the nipples to ensure that the hole in the leather pad registers with that in the nipple.

Lubrication Summary.—The mileages at which replenishments are necessary are summarised in the following table which should be used in conjunction with the lubrication chart Fig. 20.

Each 500 miles.—Replenish engine sump.

Apply oil gun to the following points:—Front and rear spring pins, pivot pins, steering tie rod, steering connecting rod, steering segment spindle, mileage recorder and cardan shaft centre bearing.

Each 1000 miles.—Drain one pint from engine sump. Apply oil gun to the following points:—Water pump spindle, clutch withdrawal sleeve, clutch withdrawal muff, foot brake pedal shaft, hand brake lever shaft, and hand brake actuating cam spindles.

The following points should be oiled:—Magneto, dynamo and starting handle. All oilers and oil holes on brake and clutch operating gear, throttle and ignition controls and speed change gear.

Each 2,500 miles.—Examine and if necessary replenish oil level in rear axle, gear box, and steering gear box.

Replenish cardan shaft universal joints.

Each 10,000 miles.—Drain engine sump, clean filter and refil with fresh oil.

Pack hub bearings with grease.

Each 20,000 miles.—Drain and wash out gear box and rear axle, and refil.

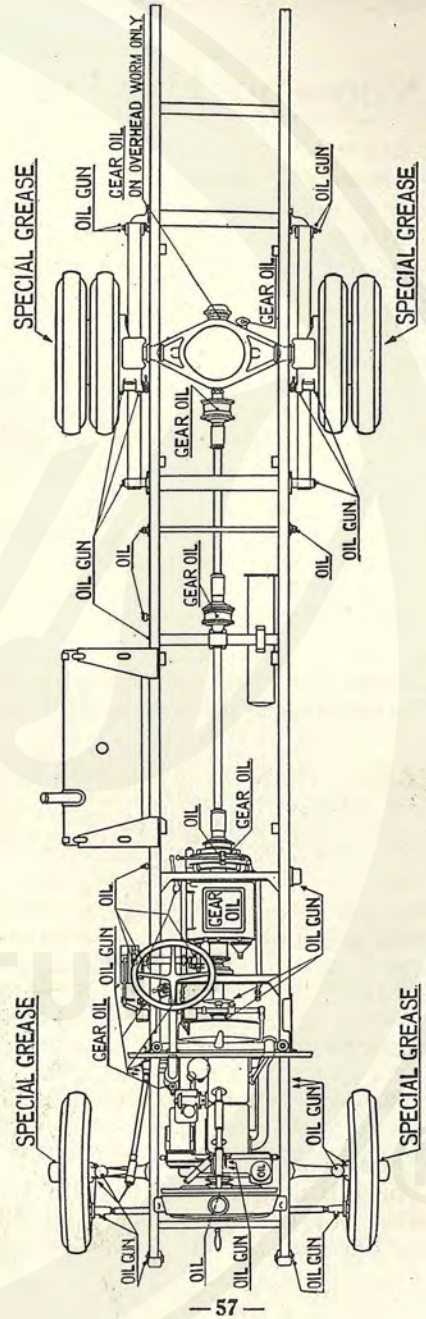


Fig. 20—Chart Showing Position of Oil Cups, Nipples, etc.

Notes on Driving

Starting up the Engine.—

1. Switch on ignition (switch pulled out).
2. Turn on petrol, and flood carburettor.
3. Open throttle slightly; a sucking noise should be noticeable from the carburettor when the engine is cranked.
4. The ignition may be left fully advanced as it is automatically retarded by the impulse starting gear.
5. Crank the engine until started.
6. In cold weather it may be necessary to prime the engine by pouring a small quantity of petrol into each cylinder through the compression cocks. The clutch should be held out while the engine is being cranked; this removes the load due to heavy oil in the gear box.
7. The engine should be allowed to run slowly, with the radiator covered up for five or ten minutes, after starting up from cold. This gives the oil a chance to become thin and work its way into the bearings before the engine is put on load.

Gear Changing.—When engaging 1st gear preparatory to starting away, a pause should be made after declutching and before the gear lever is moved into the 1st speed slot, so as to allow the clutch shaft and the attached parts to come to rest.

In changing up from a lower to a higher gear, the clutch should be pressed right out, and a pause made in neutral before engaging the higher gear. The duration of this pause will depend on the setting of the clutch brake which can be adjusted to suit the taste of individual drivers.

When changing down, to ensure that the changes are made silently, the **double declutching method must be employed** thus :—Declutch and move the gear lever into neutral, keeping the accelerator pedal hard down. Engage the clutch for an instant while the engine speeds up, declutch again and at the same time let the accelerator up, and move the gear lever into the lower gear position. Let in the clutch and accelerate again. This method, which seems complicated when described on paper, is used so that the pinions of the lower gear are brought to the correct speeds before being engaged, thus allowing them to enter silently.

Brakes.—The hand brake should not be treated as an emergency brake, but should be used frequently in the normal course of driving. If this is done the condition of the

brake will be constantly under observation and any faults can be detected and rectified at once.

On greasy roads the risk of skidding is considerably less if, when it is necessary to use the brakes, the clutch is left in engagement and the hand brake only is used. It is always advisable to use great caution when braking on greasy roads.

When descending long hills the brakes should be used alternately so as to give the drums and shoes a chance to cool down. Additional braking effort can be obtained when negotiating very steep hills by engaging one of the lower gears and keeping the clutch engaged. The speed of the vehicle should also be checked by means of the brakes to avoid "racing" the engine unduly.

Ignition,—The ignition should always be advanced as far as is possible without causing the engine to "pink"; pinking when the ignition is retarded is usually a sign that the engine requires decarbonising. The ignition point is controlled by the shorter of the two levers mounted below the steering wheel and is advanced by pushing the lever forward, i.e., away from the driver.

NOTE.—On overtype chassis, the ignition is controlled by the upper of the two levers mounted on the instrument board.

Throttle.—The throttle is controlled by the accelerator pedal and also by a hand lever on the steering column (on the instrument board in the case of overtype chassis). It will usually be found more convenient to use the accelerator pedal when driving, the hand lever being set sufficiently far open to keep the engine running slowly when the pedal is released.

General.—A good driver should be on the look-out for faults and should see that they are put right at the first opportunity. In this way very considerable damage will be avoided, as in many cases breakdowns can be traced to the neglect of some apparently unimportant detail. The cause of any unusual noises should be located at once and the fault if serious rectified immediately.

This applies particularly to the engine, gear box, and rear axle, and if there is any doubt as to the seriousness of a fault in any of these units, the vehicle should not be run until expert advice on the matter has been obtained.

IMPORTANT.—If a chassis is left standing for a long period, as for example at a Coach-builders, before starting, open the compression cocks and pour into each cylinder about a dessertspoonful of medium body oil. Close the cocks and start in the ordinary way. This ensures a supply of oil to the gudgeon pin bearings and will prevent seisure and damage. If the engine is abnormally stiff to turn when new do not be alarmed. This occasionally happens and the stiffness will slowly disappear.

Notes on Location of Faults

Engine will not start.—If the engine will not start the fault is usually to be found in the fuel or ignition systems, and the notes given under these headings should be referred to. If, however, the fuel feeds correctly and the magneto gives a good spark, the fault is probably due to an obstruction in one of the carburettor jets and these should accordingly be examined and cleaned. Difficulty will also be experienced, due to the reduction of the suction on the slow running jet, if the throttle is opened too far when starting up. On the other hand, if the carburettor has been flooded excessively, it may be necessary to open the throttle about half of the total opening before the engine will start.

Engine runs irregularly.—This is usually due to one of the following faults:—

1. Contact breaker bell-crank lever sticking.
2. Contact breaker points dirty or loose.
3. Slip ring or distributor dirty.
4. Sparking plug porcelain cracked.
5. Insulation of high-tension wiring defective.
6. Poor contacts in wiring system.
7. Jets choked or loose; water in petrol.
8. Air leaks in induction system.
9. Fuel feed obstructed.

Engine stops when on the road.—

1. No petrol.
2. Petrol supply or jets choked.
3. Switch shaken to off position.
4. Bell crank lever of contact breaker seized.
5. Insulation of magneto switch wire defective, allowing wire to touch some part of chassis or engine.
6. Seized piston.

Popping in Carburettor.—This may be due to any of the following:—

1. Starting away before the engine is warmed up.
2. Jets choked or water in petrol.
3. Fuel supply restricted.
4. Valve sticking.
5. Broken valve spring or cotter.
6. Tappet clearance incorrect, not allowing valves to close.
7. Ignition or valve timing incorrect.
8. Mixture too weak.

Overheating may be due to:—

1. Fan belt slack or broken.
2. Insufficient water in radiator.
3. Radiator choked with sludge or deposit due to using "hard" water.
4. Shortage, or poor quality of engine oil.
5. Engine dirty and requiring decarbonising.
6. Mixture too weak or too strong.
7. Ignition too far retarded.
8. Misfiring.

Petrol Consumption.—Heavy petrol consumption may be the result of:—

1. Leakage.
2. Heavy or hilly roads.
3. Routes entailing frequent stopping and starting.
4. Carburettor setting incorrect.
5. Misfiring.
6. Carburettor flooding.
7. Worn piston rings.
8. Valves in need of grinding.
9. Tappets incorrectly adjusted.
10. Bad driving; allowing engine to run for unnecessarily long periods on low gears, etc.
11. Brakes binding.
12. Driving with ignition too far retarded.

Loss of Engine Power may be due to:—

1. Worn cylinders and piston rings.
2. Valves in poor condition or not seating.
3. Tappets not correctly adjusted.
4. Jets partially choked.
5. Misfiring.
6. Overheating.

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