BENTLEY.

INSTRUCTION BOOK.

Mrs. Osborn

THE

4½ LITRE BENTLEY

INSTRUCTION BOOK.

BENTLEY MOTORS

(1931), LIMITED.

Service Department:

KINGSBURY ROAD,

HENDON, LONDON, N.W.9.

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Service

BENTLEY MOTORS (1931), LTD., Service Department, is situated at KINGSBURY WORKS, KINGSBURY ROAD, HENDON, N.W.9, to which address all communications with regard to the upkeep and running of a car should be sent. The telegraphic address is "*Benserdep, Phone, London*," and the telephone No., *Colindale 6371*.

The Company has a Service Depot at 112, North Street, Glasgow, and also a Representative working at Central Garage, Ltd., Randall Well Street, Bradford.

CHAPTER I.

STARTING THE ENGINE AND HINTS ON HANDLING.

INSPECT OIL LEVEL.

Make certain that there is the correct level of oil in the engine. The oil level indicator will be found on the near side of the engine close to the oil filler. The gauge is of the float and rod type, the position of the rod being observed through a cylindrical glass tube in a plated container on which are two marks. When the top of the rod is level with the upper mark, the sump is full and contains 2½ gallons; it must not be filled further than this. When the top of the rod is level with the lower mark, the oil in the sump is at the lowest level to which it should be allowed tofall. The quantity of oil necessary to raise the float from the lower to the higher mark is 1½ gallons. When it is found necessary to replenish the oil, it must be poured into the engine through the filler with the cylindrical gauze filter in position. Aero Shell Oil is recommended. (*See page 5*).

STARTING PROCEDURE IN BRIEF.

Summarised, the starting procedure is as follows:—

Turn on the fuel. Switch on both magnetos. Put throttle in closed position. Fully retard ignition. Put mixture control full rich. Give four charges of Ki-gass Injector. Press starter switch. If engine

does not fire immediately slightly advance ignition. On firing gently dab accelerator. Put mixture control ¼ turn rich. Allow engine at least 3 or 4 minutes to warm up. **Do not forget to screw home the Ki-gass plunger. Do not race the engine when cold.**

DRIVING.

It is not intended in this book to give detailed instructions on driving a car, but only to give hints and tips which may be useful in getting the best results from the " 4½ LITRE " Bentley in particular.

CHANGING " UP."

To enable a quick " change up " to be effected, a clutch stop is fitted. This is so adjusted as to be fierce in action when the clutch pedal is pressed fully out. By this means a change gear can be made at high engine revs. without the change speed lever dwelling for long in neutral. When the clutch pedal is slightly depressed, the clutch stop is so adjusted as to be light in action, so that in order to get a silent change, it is necessary to delay in neutral, particularly when going from first to second and from third to top. The clutch stop is easily adjusted, should it not suit any individual driver's requirements. (*See page 10*). A little practice will soon enable any driver to make a perfect change.

CHANGING " DOWN."

When changing " down " it is necessary to " double declutch " in order to make a silent change. The clutch is disengaged, the gear lever moved into neutral, the clutch re-engaged and at the same moment the accelerator dabbed (which has the effect of speeding up the clutch shaft), the clutch again disengaged and the gear lever moved into the lower gear. No difficulty will be experienced in accomplishing this after a little practice and the driver has become accustomed to the feel of the engine, but only practice can make perfect. The amount which the engine must be accelerated with the gear lever in neutral depends on the road speed of the car and the ratio of the lower gear to which it is desired to change down.

IGNITION CONTROL.

To obtain the best results, intelligent use of the ignition lever must be made; this should be retarded when the engine is under load up to 20 m.p.h., and even when running light the acceleration will be better at low engine speeds with the ignition nearly fully retarded, and advancing it as engine revs. increase.

WARNING—Re Brakes.

After a car has been washed and water may have penetrated the brake drums, the brakes will partly lose their efficiency; it is, therefore, important, when starting out, to apply the brakes two or three times in order to dry the water off the linings.

OIL PRESSURE.

The correct engine oil pressure as shown by the gauge on the instrument board should be approximately 15-20 lbs. at 30 miles per hour, after the car has been on the road for about an hour and the oil is thoroughly hot. The pressure will be considerably greater than this when the oil is cold. *(For adjustment of oil pressure, see page 10)*. A high oil pressure is not harmful.

TESTING MAGNETOS.

The two magnetos fire independent sets of sparking plugs and are synchronised to fire simultaneously. They have independent switches. Occasionally, they should be tested to make certain that they are both firing regularly and that all sparking plugs are in order. When running at about 25 miles an hour on top speed with the engine pulling against a slight gradient, both magneto switches being on, the magnetos should be switched off alternately, when it will immediately be felt, by the irregularity of the engine, if either magneto or any plug is misfiring. Care must be taken that both magnetos are not switched off at the same moment, as immediately one or both are again switched on, an explosion in the silencer will be caused, due to the unburnt gasses which have passed into it, and the silencer may be damaged. Ordinarily the engine must always be run with both magnetos in operation, as running with one of these instruments switched off will damage it, and the plugs operated by that instrument may get sooted up. If, however, one magneto should fail, the engine can run on the other until a replacement can be obtained.

MAXIMUM ENGINE REVS.

An engine is liable to be damaged if it is run above a certain limit of revs. per minute. This limit depends upon the design and in the " 4½-LITRE " Bentley it is 3,500 r.p.m. In a car which has not a revolution counter fitted the road speeds corresponding to 3,500 r.p.m. on various gears can be ascertained by requesting the information from the Service Department, the chassis number being quoted.

CHAPTER II.

PERIODICAL LUBRICATION AND ATTENTION.

On reading through this chapter it will be realised that only a very small amount of time has to be spent on lubrication, general chassis lubrication being required only once in three months or every 2,500 miles. If, however, any part of the chassis shows obvious signs—audible or otherwise—of lack of oil, it must be given the necessary attention immediately, though this will not be likely if the instructions are carried out at the specified intervals. It should be realised that lack of lubrication causes excessive and rapid wear which is costly to the owner and unsatisfactory to the manufacturers.

SYSTEM OF CHASSIS LUBRICATION.

The chassis is designed for lubrication with oil, grease only being used for lubricating the water pump spindle and both ends of the dynamo armature spindle. Tecalemit nipples are fitted to all the oiling points, so that, with the Tecalemit gun, lubrication can be carried out quickly and cleanly. The gun forces oil at high pressure so that undue force in its use is not desirable. Chassis lubrication, as a whole, need only be carried out every three months or every 2,500 miles, the various parts being designed so as to form reservoirs which carry sufficient oil for lubrication over such a period.

RECOMMENDED OILS.

Aero Shell Oil is recommended for use in the engine. This oil is easily obtainable at home, and in most towns abroad; failing this, Triple Shell should be used. If these oils are unobtainable, the following are suitable:—

Prices Motorine "B" de Luxe (Summer). Prices Motorine "C" de Luxe (Winter).

Castrol X.L. Summer and Winter Grades.

Mobiloil B.B. Summer and A. Winter.

Veedol, extra heavy.

Filtrate, extra heavy.

Oils of different brands should not be mixed, except in emergencies: if mixed, an early opportunity must be taken of changing the oil in the engine. Other well-known brands may be used if desired, but the Service Department's approval must first be obtained and their advice asked concerning the correct Grade.

TOURING ABROAD.

When touring abroad great care must be exercised that only oil in *sealed tins* is put into the engine. This is a very important point. Shell Oil, Mobiloil and Veedol are obtainable in most places on the Continent, but should an unknown brand have to be used it should be borne in mind that a fairly heavy oil suits the engine best.

ENGINE LUBRICATION.

The oil level gauge (*see page 1*) must be looked at daily and the oil replenished to the correct level, care being taken never to allow the level to get below the lower mark on the gauge. Replenishment should be made after the engine has been at rest for some time so that the oil in circulation will have had time to return to the sump. When the engine is running there is approximately half a gallon in circulation so that the level as shown by the gauge will rise a distance corresponding to this amount after the oil has drained back. The gauze in the filler must always be in position when refilling. Engines vary somewhat in oil consumption but 1,000 miles per gallon may be expected.

GEARBOX LUBRICATION.

The level of oil in the gear box must be examined every three months or every 2,500 miles. To do this it is necessary to remove the lid. The oil should be half way up the lay or lower shaft. To replenish, Golden Shell oil should be used. Failing this, a light gear oil is suitable. A plug is fitted for draining the gear box. On a new car this should be done after the first three months, after which it need only be done about every 10,000 miles.

BACK AXLE LUBRICATION.

The oil level in the rear axle must be examined every three months or every 2,500 miles. For this purpose it is necessary to remove the plug on the goose-neck filler on the rear of the axle casing banjo. With the car standing on level ground, the correct level of oil is half an inch below the top of the filler. Golden Shell Oil should be used for replenishing. After the first three months the oil should be drained out by removing the plug at the bottom of the goose-neck filler. After this, draining out need only be done about every 10,000 miles. It is of great importance that the axle should not be filled above the correct level, as should this be done, there is a likelihood of oil getting through the axle on to the brakes which will destroy their efficiency, and if it is left on the liners for any length of time it will necessitate the liners being renewed.

TECALEMIT LUBRICATION SYSTEM.

Tecalemit nipples are fitted to all oiling points throughout the chassis, so that, with the oil gun provided, lubrication can be carried out quickly and cleanly.

The correct method of using the oil gun is to unscrew the nose-piece and draw the plunger by means of the pistol grip right back into the barrel of the pump, then fill the barrel with oil and replace the nose-piece. Having slid the connection on to the nipple fitted on the part to be lubricated, apply pressure to the grip, the plunger will then force oil into the nose-piece and at the same time the spring of the nose-piece plunger will be compressed, this action forcing oil at high pressure into the nipple. The pressure on the grip being released, the plunger spring carries the plunger outwards and another charge of oil is sucked into the nose-piece from the barrel. In the connection end of the pump is a spring loaded ball valve which will prevent oil leaking out of the pump except under pressure. The pump can therefore safely be carried, when charged, in the tool box. The tops of the oiling nipples are hexagonal and the pump is slid on, the slotted portion of the connection engaging the top of the nipple.

GENERAL CHASSIS LUBRICATION.

The lubrication of the chassis is straightforward if the summary on page 8 is followed.

If Golden Shell Oil is unobtainable use a mixture of Gear Oil and Engine Oil in equal parts, with the exception of the gearbox, which should have one part Gear Oil to two parts Engine Oil. Nipples are fitted on both ends of the propellor shaft, through which the joints can be charged. A specially prepared lubricant must be used for the universal joints. This can be obtained in 2-lb. tins from the Service Department.

BRAKE CAMSHAFTS.

Much oil must not be forced into the brake camshafts as the oil-ways have a direct connection with the back axle, consequently any surplus will tend to overfill this part. The oilways are purposely designed thus, as otherwise, too much pressure would force the oil into the brake drums and so on to the brake liners, destroying their efficiency.

SPRING SHACKLES AND STEERING PARTS.

When lubricating the shackles and steering parts, oil should be forced in until it exudes, showing that the oil has penetrated right through. Golden Shell Oil is used for these parts. The stub axles are designed with an air vent, so that oil exudes when it has reached the highest point in the stub axle pins.

CLUTCH.

There are two nipples on the clutch thrust sleeve through either of which a little oil should be forced. Only one nipple should be used and very little oil. The clutch itself requires no attention.

FRONT AND REAR HUBS.

The front hubs are packed with grease on assembly and will run indefinitely without further lubrication. No grease may be put in the rear hubs, no lubricaton being required.

GREASERS.

There is one greaser on the engine and two on the dynamo. The former is on the water pump to grease the pump spindle. This should be filled with heavy grease and given a turn about every 500 miles. This greaser must not be neglected. The greasers on the dynamo are for lubricating the armature spindle bearings. One is to be found on the engine side of the dash inside the bonnet, the other is mounted on the rear end of the dynamo. These should be packed with heavy grease and given a turn every 2,000 miles. Shell R.B. grease is the most suitable.

MAGNETOS.

The main bearings of the rotor are packed with grease and require no attention. The plain bearing on the distributor spindle should be lubricated with machine oil, for which purpose a ball-valve oiler is fitted on top of the instrument. Give two drops every 1,000 miles or so; do not over lubricate. A spot of thin oil should be placed on the end of the contact breaker pivot pin about every 2,500 miles. Oil must not be allowed to get on the contact points.

CARBURETTORS.

A little " 3 in 1 " oil or light sewing machine oil should be put in the top of both suction chambers about every 2,500 miles, having first removed the screw caps.

The carburettor pistons must always fall freely by their own weight. This can be tested by lifting a piston with a finger inserted into the intake orifice of the carburettor. If a piston is found to be sticky a little paraffin should be put in the top of the suction chamber and the piston worked up and down; when free a few drops of light oil may be put in.

SUMMARY OF CHASSIS LUBRICATION INSTRUCTIONS.

Part.	Lubricant.	Remarks.
GEAR BOX	Golden Shell Oil	*Fill to centre of lay shaft.*
BACK AXLE	Golden Shell Oil	*Fill to half-inch below lip of filler.*
PROPELLER SHAFT JOINTS	Special lubricant	*Charge through nipples at either end of propeller shaft.*
STEERING BOX	Golden Shell Oil	
BRAKE CAM-SHAFTS (Rear)	Golden Shell Oil	*Do not over-lubricate.*
SPRING SHACKLES, etc.	Golden Shell Oil	*Lubricate till oil exudes.*
PERROT SHAFTS	Golden Shell Oil	*Force oil until it is felt exuding into leather stockings.*
CLUTCH THRUST BEARINGS	Golden Shell Oil	*Lubricate sparingly every 5,000 miles.*
WATER PUMP	R.B. Grease	*Turn greaser every 500 miles*
FRONT HUBS	No lubrication	*These will run indefinitely on the grease which is applied when the parts are assembled.*
REAR HUBS	No lubrication	*No lubrication is required.*
DYNAMO	R.B. Grease	*Turn greaser every 2,000 miles. Do not over lubricate.*
MAGNETOS	"3 in 1" or Sewing Machine oil	*Do not over-lubricate.*
CARBURETTOR		*Remove screw cap on Suction Chamber and pour in a little oil every 2,500 miles.*

CHAPTER III.

MINOR RUNNING ADJUSTMENTS AND HINTS.

In this chapter instructions are given for carrying out such minor adjustments as the driver of a " 4½-LITRE " Bentley may be called upon to do from time to time in the ordinary course of running. It does not include instructions for the more skilled jobs such as adjusting tappets and synchronising magnetos, etc., which are included in another part of the instruction book and which are only necessary at comparatively infrequent intervals.

ADJUSTING FOOT BRAKE.

To take up the wear in the foot brake a single adjustment is provided under the front floorboards at the bottom of the brake pedal. The lock nut is slacked back, *i.e.*, towards the front of the car, and the butterfly nut screwed in a similar direction. After adjustment the lock nut must be screwed up. The normal adjustment is for the brakes to come into operation after the pedal has been depressed not less than 1 inch. If adjusted up closer than this the front brake on the inside of the lock when the wheels are fully locked over will bind slightly.

ADJUSTING HAND BRAKE.

The adjustment for taking up wear in the hand brake is situated at the lower end of the brake lever. The butterfly nut is screwed in a clockwise direction and is automatically located in position every half revolution. The standard adjustment is for the brake to be hard on when the lever is vertical.

CLUTCH PEDAL ADJUSTMENT.

There must be not less than half an inch of movement between the clutch pedal and the floor board when the clutch is fully engaged. This is important, as, if the pedal is allowed to touch the floorboard, the clutch will commence to slip and it will eventually suffer damage. This clearance should be particularly observed on a new car, as the wear on the clutch lining is greater at first until the lining has a polished surface. The method of adjustment is simple, the position of the clutch pedal being easily altered by slacking back the nut which clamps the pedal to the short clutch arm underneath the floorboards.

CLUTCH STOP ADJUSTMENT.

The clutch stop can be adjusted to suit individual requirements and to take up wear. The hexagonal lock nut is slacked back and the knurled hand-wheel is screwed in a clockwise direction to make the clutch stop fiercer in action. This adjuster wheel should not, however, be forced as it cannot be turned more than a certain distance. Ample range of adjustment is provided for.

CLEANING OIL FILTER.

The oil filter is mounted on the flange of the crank case on the nearside of the engine. On a new engine the filter should be cleaned after the first 1,000 miles after which it need only be cleaned every 5,000 miles as the gauze is of ample size. The gauze is very simply removed and replaced. The hexagonal nut is unscrewed, then the steel cap is removed, disclosing the gauze which can be withdrawn. To clean, it should be washed in petrol with a brush. When replacing care must be taken that the joint washers are replaced and that the nut is screwed tight otherwise an oil leak will result.

CHANGING OIL IN ENGINE.

The oil consumption of individual engines varies to some extent. When the consumption is over 1,000 miles per gallon, a gallon of oil should be drawn off from the sump every 1,000 miles, through one of the drain plugs in the side of the sump towards the rear, and a gallon of new oil poured in. The sump should be completely emptied and refilled with new oil every 5,000 miles, and after the first 2,000 miles on a new engine.

To enable the sump to be drained, two plugs are fitted at the rear. To drain completely, the front of the car should be jacked up. It is most important that, when the sump is drained, no paraffin should be poured in as is sometimes done, as it is almost impossible to make certain that all paraffin has been drained out, and a small percentage of this in the oil has a bad effect on the latter. The plugs can then be replaced and fresh oil poured in to the correct level, as shown on the indicator.

ADJUSTING OIL PRESSURE.

After the engine oil has been in use for some time, or in very hot weather, it may be found that the oil pressure drops below 15 to 20 lbs. per sq. in. at 30 m.p.h., which is the correct pressure. This can be easily adjusted. The adjusting plug is mounted on the flange of the crankcase on the near-side of the engine close to the oil filter. The lock nut is slacked back and the plug screwed downwards (*i.e.*, clockwise) to increase the pressure and upwards to decrease it. This adjustment should only be made when the oil is hot after the car has been on the road not less than an hour. When the oil is cold the pressure will always be higher than normal.

RECTIFYING LOSS OF OIL PRESSURE.

In the unlikely event of the oil pressure falling very much below normal, or disappearing altogether, immediate steps must be taken to rectify the matter; the cause will be either a choked oil filter *(to clean, see page 10)*, or a foreign body under the oil pressure release ball valve, which is the more likely cause. To remedy this the oil pressure adjusting plug must be removed by unscrewing the two screws securing the flange; the flange, plug, lock-nut, and spring coming away as a unit; the ball valve can then be withdrawn by means of the special tool provided in the tool kit. The split end of this tool is pressed down on top of the ball and is expanded over it, enabling its withdrawal. The ball seating must then be cleaned. This can be done by wrapping a piece of non-fluffy rag round the end of the tool for removing the ball and rotating it backwards and forwards on the seating. The ball is then replaced, also the spring and plug.

TO CLEAN PETROL FILTER.

A Zenith petrol filter is fitted and is mounted on the front side of the dash underneath the Autovac. It should be cleaned every 2,500 miles. To do this the knurled nut underneath the filter is unscrewed and the stirrup supporting the filter cup pulled forward, the cup at the same time being removed. The filter consists of a large number of laminations or thin discs, every disc having small ridges on one face which separate them one from the other an infinitesimal amount, sufficient to allow fuel to pass between them, but not enough to allow any foreign matter to pass. The discs are clamped together by the pressure of a plate and a small knurled nut. This nut should be slacked back as far as it will go, the discs can then be separated and cleaned, the knurled nut then being screwed up, clamping the plates together again, and the cup being replaced, having first cleaned the sediment out of it. In the top of the filter is an air release knob to dispose of an air lock in the filter should one be experienced. The knob should be unscrewed as far as it will go until the air has escaped, the tap under the Autovac controlling the fuel supply being on. The release knob must then be screwed down tightly.

FLOODING CARBURETTOR.

A flooding carburettor may be caused by:—

(1) Punctured float.

(2) Sticking float needle.

(3) Foreign matter on needle seating.

(1) To ascertain whether this is the cause of the trouble the float chamber cover must be removed and the float lifted out, then by shaking the latter it can be found whether there is fuel inside it. If this is the case another float should be obtained as soon as possible, a

temporary repair being made by drilling a hole in the float enabling the fuel to drain out and then soldering the hole. By holding the float in hot water any punctures can be found, as bubbles will come out as the air inside heats and expands. Any garage would be able to carry out a repair of this nature satisfactorily.

(2) This is unlikely to be the cause of the trouble except on an old carburettor where a ridge may have formed on the taper of the needle and the toggles may be worn. The matter can be attended to by any mechanic.

(3) This is the most likely cause of the trouble and can frequently be rectified by gently twisting the needle on its seating. If this fails the needle and float should be removed and the needle seating and float chamber cleaned.

STICKING CARBURETTOR PISTON.

The efficiency of the S.U. Carburettors depends on the piston in which the taper needle is fitted being quite free to slide up and down; after a considerable mileage the piston rod may become sticky so that it is important to test occasionally whether the piston is functioning freely by inserting a finger into the carburettor air intake and lifting it, when, on being released, it should slide downwards without hesitation.

If stickiness is apparent, remove the cap nut from the top of the suction chamber and pour in a few drops of paraffin. Then work the piston up and down with the finger until it is free. A few drops of thin oil, such as sewing machine or Three-in-one oil, may then be put in, but under no circumstances should a heavy lubricant such as engine oil be used. No oil may be used on any other part of the suction chamber.

In an obstinate case when paraffiin will not effect a cure, the suction chamber can be easily removed by taking out the two screws securing it to the body of the carburettor; the pistons can then be cleaned. When replacing, the main air shrouds should be removed, and it should be made sure that the pistons return to their lowest position under their own weight. Care must be taken to tighten each screw equally.

If the suction chamber is regularly oiled as instructed in the lubrication instructions, trouble from the above cause is unlikely to occur.

WATER OR DIRT IN CARBURETTORS.

Owing to the construction of the carburettors, the taper needle being continuously in movement in the jet, they clear themselves automatically of any small amount of water or dirt, perhaps only a momentary popping back being experienced. If, however, the engine continues to run unevenly, or stops, and this cause is suspected, the

petrol filter must first be cleaned (*see page 11*) and then the drain tap under the Autovac opened to let any dirt and water out. Then, having turned off the feed tap under the Autovac, the interior of the carburettor float chambers should be cleaned with a piece of dry absorbent rag and the drain plugs under the float chambers removed and replaced. Both suction chambers should then be removed by undoing the two screws securing them to the bodies of the carburettors. The chambers complete with pistons and needles can then be withdrawn. They must be handled carefully so as not to knock or damage the needle. The jet of each carburettor can now be seen. Having turned on the fuel, flood both carburettors by raising the float needles. If the fuel comes freely through the jets everything is in order, and the suction chambers may be replaced, great care being taken that there is no grit on the joint surfaces; if the engine does not then run properly the fault must lie elsewhere and may be a sticking carburettor piston (*see page 12*).

Should an exceptional occasion arise and it is found necessary to remove the jet to clear an obstruction, the greatest care must be taken to centre the jet correctly on replacement. For this reason the jet must not be removed unless it is certain that it is necessary. Instructions for centreing a jet will be found on page 44.

An obstinate case of a choked jet can nearly always be cured by starting up the engine, and then, with the throttle open, momentarily blocking up the air intake, so that a heavy suction comes on the jet, which will in almost every case remove any obstruction.

ENGINE CONTROLS.

The "U" clips and balls of the carburettor controls should occasionally be oiled with a few drops of oil from an oil can. They should be movable but without end play or float. If they get stiff or are too tightly adjusted they are liable to prevent the throttle coming back to the slow running position.

ADJUSTING FAN BELT.

The fan revolves on a spindle carried in a slot on the fan pedestal. By slackening the nut the position of the fan in the slot can be varied so as to enable the belt to be adjusted. It should be noted that a too tightly adjusted belt will be noisy.

ROAD WHEELS.

Every three months the road wheels should be removed and the splines and outside of the hubs greased. This is important, as if neglected it may lead to difficulty in withdrawing a wheel, when necessary, on the road, and also may cause a creaking noise, which is difficult to locate. To unscrew a locking ring it must always be

hammered in the direction in which the wheel revolves when the car is going forward. A copper hammer is supplied for this in the tool kit; a steel hammer must never be used, as it mutilates the ring and there is also a danger of fracturing the latter. After a wheel has been removed, the locking ring should be further tightened up after the car has done about 30 to 40 miles.

All locking rings should occasionally be tested to ensure that they are tight, as a loose ring allows the wheel to move on the hub, causing wear on the splines.

ADJUSTING SHOCK ABSORBERS.

"B and D" shock absorbers are fitted as standard.

The adjustment of these shock absorbers is very simple. There are three adjusting nuts, one at both pivot points, where the stabilizer is fitted to the frame and axle respectively, and the central friction disc. The correct method of adjusting is as follows:—A gauge 1/16th of an inch thick is provided, and this gauge should just slide under the star spring at the pivot points. The correct adjustment can be obtained by turning the nuts. These adjusting nuts on the pivot pins are self-locking every quarter of a turn, whereas the nut of the centre disc is provided with a pointer and index dial and is self-locking every one-sixth of a turn. The actual adjustment of the centre nut depends on the driver's requirements, and every driver should adjust the stabilizer to give the best results, taking into consideration the weight of the car, the speed at which it is usually driven, and the condition of the roads over which the car is used.

Stabilizers on near and off side should be adjusted equally.

BATTERIES.

The battery consists of a 12 volt unit. The efficiency of the whole electrical system depends upon it being in proper condition and it should be inspected not less than once a fortnight, the electrolite being replenished with *distilled* water until the top of the plates are covered.

For further information with regard to their upkeep, see pp. 33 and 34.

DON'TS.

DON'T race the engine when running free.

DON'T drive the engine at high revs. on any gear immediately after starting up from cold. It takes several minutes for the oil to circulate throughout the engine. This particularly applies if the engine has been lying idle for some days.

DON'T flood twin S.U. Carburettors, as owing to their position petrol may get into the cylinders and wash the oil from the walls.

DON'T forget to test occasionally the clutch pedal for clearance between it and the floorboards.

DON'T put any grease in the rear hubs and only a little in the front hubs, should the latter have been dismantled.

DON'T overfill the back axle.

DON'T forget that after a car has been washed, water may have got into the brakedrums, rendering the brakes temporarily inefficient. Two or three applications of the brakes will dry the water off.

DON'T forget that to remove a detachable wheel locking ring, the ring must always be hammered in the direction in which the wheel revolves when going forward.

DON'T run with one magneto switched off except temporarily for testing.

CHAPTER IV.

DESCRIPTION OF ENGINE. LUBRICATION, FUEL, COOLING AND IGNITION SYSTEMS.

ENGINE DETAILS.

The cylinders are cast *en bloc*, the cylinder heads not being detachable. The design is patented and provides for ample water space round the combustion heads and valves. In each cylinder there are two exhaust and two inlet valves, they are tulip-shaped and are small in diameter, which, combined with the efficient cooling, enables them to function for a very great mileage without requiring to be "ground in." The single camshaft is mounted centrally along the top of the cylinder block and runs in five white metal bearings. The valves are operated by duralumin rockers having at one end a hardened steel roller which bears on the camshaft, and at the other end a ball-ended tappet, which depresses the valve. The tappet screw is secured by a lock nut and the tappets can be simply adjusted (*see page 38*). The ball ends are flattened at the point where they bear on the valves and are free to rotate in the ends of the tappet screws, thus always bearing on the full surface of the end of the valve. There are two concentric springs to each valve, termed the inner and outer springs. The rockers are mounted in four aluminium caps, each cap being independently removable, and also serving the purpose of holding down the camshaft. The camshaft is driven off the front end of the crankshaft by means of a vertical shaft and spiral bevel gears.

The crankshaft is mounted in five white metal bearings, which fact, combined with its design, eliminates all whip. It is prevented from moving endways by a double thrust ball race, housed behind the starting handle bearing; this race also takes the thrust imposed by the withdrawal of the clutch. B.H.B. aluminium pistons are fitted, each having three rings and a scraper ring, all at the crown. The gudgeon pins float both in the piston bosses and in the little end bushes, which are of aluminium. The big end bearings have no brasses, the white metal being secured direct into the connecting rod end, thus keeping down weight. Three point suspension is utilised for the engine.

The oil pump, which is of the gear wheel type, is carried in the bottom of the sump and is driven through a vertical shaft by skew gearing off the front end of the crankshaft. The self-starter pinion engages in teeth cut on the starter ring, which is separate from the flywheel. Two independent magnetos are fitted and are carried on flange mountings on either side of the engine; they are

mounted at either end of a cross shaft driven by skew gear off the vertical shaft which drives the camshaft. The magnetos are synchronised to fire simultaneously, two sets of sparking plugs being fitted. The water pump is mounted just behind the radiator on the front portion of the vertical shaft housing; it is driven off the magneto cross shaft. Twin S.U. Carburettors are fitted and are mounted on the offside of the engine. On the near side is the exhaust manifold.

On the near side of the engine will be found the oil filler which contains a gauze filter, and close to it the oil level indicator which shows the amount of oil in the sump. In the flange of the crank case on the near side are the oil filter and the oil pressure adjusting plug. The dynamo is carried on a flange mounting on the rear side of the dash and is driven, through two flexible joints off the rear end of the camshaft, at half engine speed.

The starter motor is housed in the aluminium crankcase casting on the near side of the engine.

The radiator is mounted on trunnions with rubber bushes, and is free to swivel forwards and backwards without incurring any strain.

ENGINE LUBRICATION SYSTEM.

The oil pump, of the gear wheel type, is situated in the bottom of the sump at the front end. From the pump, the oil is forced to a cylindrical filter of fine mesh, mounted in the flange of the crankcase on the nearside. This filter is easily removable for cleaning. (*See page 10*). On being forced through the filter the oil is led both to the crankshaft bearings and to the over-head gear. To lubricate the former the oil is led back into the crankcase and through a pipe carried underneath and parallel with the crankshaft; a lead is taken off this pipe to each main bearing. It will be noted therefore that each main bearing has a separate feed and is pressure fed. The crankshaft is drilled so that each big end bearing is fed from its corresponding main bearing. After passing through the main and big end bearings the oil is flung off and lubricates by splash the cylinder walls, pistons, and gudgeon pins, afterwards dropping back into the sump through a gauze filter of large area.

The oil lead to the overhead gear is taken from the side of the crankcase, and is led to the rear of the camcase and is fed into the rear bearing. The camshaft is hollow, so that oil is forced throughout its length, lubricating each camshaft bearing through holes drilled in the camshaft and also the cams themselves through small holes drilled in the cams. The oil, on being forced out of the camshaft, lubricates the valve rockers and rollers, and camshaft drive, etc., returning to the sump through two drain pipes situated between the cylinders and connecting the camcase to the crankcase and through the vertical shaft housing.

The valve chest is so designed that it always holds a quantity of oil, with the result that the camshaft dips, the resultant splash liberally lubricating the rollers and tappet balls.

An oil lead to the gauge on the facia board is taken from the same union on the side of the crankcase from which the camshaft is lubricated.

COOLING SYSTEM.

The cylinder block water jackets are enclosed in stainless steel plates on both sides and at both ends. This makes the construction comparatively light and also enables a critical examination to be made of the casting before assembly. The water pump is mounted directly behind the radiator on the front of the magneto cross shaft housing and is driven by skew gearing off the cross-shaft. The water is delivered through a distributor located inside the jacket plate on the offside of the engine, and passes to the radiator through a connection on the nearside of the cylinder block. The very large radiator gives ample cooling, under all circumstances. On removing the radiator cap, a horizontal pipe will be seen inside the radiator; this is a distribution pipe through which water to the radiator is delivered. When cold the level of the water should not be above the top of this pipe.

IGNITION.

Two M.L. magnetos, Type E.R.4, are fitted, one at either end of the magneto cross shaft, which is driven by skew gearing from the vertical shaft. The magnetos are mounted on flanges on either side of the housing and are secured by three bolts, the holes in the flanges being slotted so that the instruments can be rotated to simplify synchronisation. (*See page 27*). Dampers are incorporated in the drive, which neutralise any oscillation that might be set up in the cross-shaft owing to the flick of the magnetos, particularly at slow speeds. Each magneto fires a separate set of plugs, and has a separate switch on the facia board. They are, therefore, quite independent and should one instrument fail the engine will run on the other until a repair can be made, or a replacement obtained. The order of firing of the cylinders is 1, 3, 4, 2, No. 1 being the front cylinder.

DESCRIPTION OF CARBURETTORS.

Twin S.U. Carburettors of the vertical type are fitted, being mounted on a common induction manifold. This carburettor may be described as follows:—A taper needle is held centrally in the lower end of a piston. The upper end of the piston is connected by means of a piston rod which passes through the carburettor body to a suction disc which is an air-tight sliding fit in a suction chamber. A passage connects the latter with the induction system. A butterfly throttle is

fitted between the engine and this passage, the piston acting as an air controller in the induction pipe on the side of the passage further away from the throttle. The taper needle passes centrally through a movable jet, the position of which can be altered by the driver by means of a control on the instrument board. The suction chamber is set vertically to the carburettor and the chamber together with piston and taper needle can be withdrawn by removing the two screws which secure it to the carburettor body. A suitable mixture for slow running is obtained by a pilot jet quite separate from the main jet, which is controlled by an adjustable air sleeve. In conjunction with this, there is an adjustment on each throttle butterfly, which controls the pilot hole inside the carburettor. The slow running mixture is, therefore, entirely independent of the main supply. The carburettors are quite independent with the exception that they are mounted on the same manifold and the throttles are inter-connected.

ACTION OF CARBURETTORS.

When the engine is stationary the piston obstructs the air passage in the carburettor. On the engine being turned with the throttle slightly open a depression is caused in the air passage between the throttle and the piston. The suction chamber being connected with this part of the air passage the depression acts on the suction disc which rises, bringing with it the piston and taper needle. This allows air to be sucked in under the piston and over the jet which is partially opened by reason of the needle being tapered. A state of balance is maintained whereby the piston rises and keeps at a certain height dependent on the engine speed and throttle opening. When the engine is stopped the piston falls by its own weight.

The position of the jet relative to the needle can be adjusted from the facia board so that a rich mixture can be obtained in order that the engine may develop power before it has warmed up. Twisting the control in a clockwise direction lowers the jet, so that the needle being tapered, more fuel passes through. When starting from cold the control should be twisted about half a turn towards rich, but it must be turned to the full weak position when the engine has got warm as this is the standard running position at which the engine develops most power. Also, if left at rich, the sparking plugs may soot up and the fuel consumption will be excessive. It is important that the carburettors should never be flooded, as apart from this being unnecessary, the fuel will get into the cylinders and will wash the oil film from the walls.

EXHAUST SYSTEM.

The exhaust system consists of a single manifold on the cylinder block, a down pipe leading to a silencer and a large diameter tail pipe to the rear of the car. At both ends of the silencer are fitted pepper pots. The tail pipe is brought under the axle. The down-pipe from the engine to the silencer is lagged with asbestos.

FUEL FEED SYSTEM.

The feed of fuel to the engine is by Autovac. There is a sixteen gallon tank at the rear of the chassis. The Autovac is fitted in a small tank of half a gallon capacity, and is mounted on the off side of the dash, the cylindrical portion of the tank passing through the latter. In the unlikely event of the Autovac failing, a filler with a screw cap is fitted, so that the tank itself can be filled from an outside source in case of necessity. Underneath the tank a drain tap is provided; this should occasionally be opened to allow any sediment or water to escape. The tap being of small diameter it is possible that if there is much foreign matter it will not flow, and to free it it will be necessary to insert a wire or thin nail. A filter is fitted on the pipe between the Autovac and the carburettor and is mounted on the dash (*see page 11*). A tap to control the supply of fuel to the carburettor is under the Autovac tank. There are two connections to the top of the Autovac, one being from the main tank at the rear of the chassis and the other to the top of the induction manifold, whereby the necessary suction to operate it is obtained.

The Autovac is very reliable in action and it is very exceptional for it to require any attention. Very excessive fuel consumption may be traced to the fact that the suction valve on top of the instrument is not closing properly and is allowing fuel to be sucked straight through into the induction pipe. Should this fault occur it can be traced by disconnecting the suction pipe on top of the induction manifold immediately after the engine has stopped running, when, if fuel is being sucked through, the pipe will be found to be wet. This can sometimes be remedied by giving the top of the Autovac a few sharp taps with a piece of wood. If this is found to be of no avail it is not advisable to dismantle the Autovac, but the Service Department should be communicated with, and a replacement instrument will be sent. If at any time it is found necessary to dismantle the Autovac great care must be taken that the cork washers round the top are not damaged, as the whole action depends upon there being an air tight joint at this point.

CHAPTER V.

CLUTCH. GEAR BOX. BACK AXLE. TRANSMISSION. FRAME. ROAD SPRINGS.

DESCRIPTION OF CLUTCH.

The clutch is of the dry single plate type having a central duralumin disc or clutch ring, rivetted on each side of which is a halo liner. The action of the clutch is as follows:—

The driven friction ring, with the halo linings is mounted on a spigot bushed bearing containing a universal joint splined to allow fore and aft movement of the plate on the clutch shaft, the rear end of the latter being splined and fixed to the Hardy disc coupling of the gear box.

The clutch plate, which takes the pressure of six powerful coil springs, has four segments of gear teeth cut in its periphery, these segments being spaced equally at 90 degrees. These gear teeth engage in similar teeth cut on the inside periphery of the flywheel, which is cup-shaped. The plate can, therefore, slide backwards and forwards in the flywheel, but must turn with it owing to the engagement of the teeth. The clutch plate takes the pressure of six powerful coil springs, the other ends of which are encased in steel cups mounted radially in the clutch cover.

Three clutch withdrawal levers are pivotted on brackets bolted to the inside of the cover; the inner ends of these bear against the thrust bearing housing, and the outer ends are forked, the clutch plate withdrawal pins passing through the forks. The inner ends of the pins have shoulders, which take the pressure of the plate, the outer ends passing through the clutch cover.

A ball bearing is fitted in the outer end of the clutch thrust bearing housing; into this is fitted the thrust ring which takes the pressure of the withdrawal forks on the clutch pedal cross shaft operated by the clutch pedal. This fork is so compensated that each arm must bear with equal pressure on the thrust ring, so that there is no tendency to throw the clutch out of alignment.

The clutch plate is mounted on the three pins which are operated by the withdrawal levers. When the clutch is engaged, the plate clamps the ring, on which the halo is mounted, against the face of the flywheel. When the clutch pedal is depressed, the fork on the cross shaft bears against the thrust ring, the pressure being transmitted

through the bearing to the bearing housing. The ends of the three clutch withdrawal arms resting against the end of the housing are forced forwards, and the forks at the other ends are forced back, bringing with them the withdrawal pins on which is mounted the plate, thus releasing the pressure on the clutch ring.

Two oiling nipples are fitted in the gunmetal cover of the thrust housing. Two are fitted for convenience, but only one need actually be utilised. The clutch thrust bearing is lubricated at this point, and only a small quantity of oil may be forced in. The clutch thrust bearing is packed with lubricant when it is assembled, and only a little additional oil is required from time to time.

The clutch requires no adjustment apart from the adjustment of the clutch pedal, care being taken that this is not allowed to bear against the floorboards as the clutch lining gradually wears. The adjustment is on the lower end of the pedal, and is simple and straightforward.

The clutch spigot is lubricated automatically from the engine.

GEAR BOX.

The gear box is mounted on three point suspension. The front anchorage can be adjusted for height, so as to obtain correct alignment with the engine. The change speed lever and gate are a unit with the gear box, the former being carried on an extension bolted to the side of the gear box. These parts can therefore be lifted from the frame together and the "change speed" cannot be affected by a distortion of the frame. There are four speeds forward and a reverse. The main and lay shafts are very substantial in diameter, eliminating whip, and the gears themselves are of ample size. The selector gear is also strong enough to withstand considerable misuse. Ball bearings are used throughout. On no account may any adjustment be attempted on the gears or selector gear as this work can only be carried out satisfactorily by an expert, and great harm may be done by incorrect adjustment. The speedometer is driven from the gearbox, the drive being mounted on the near-side. It can be removed as a unit. The drive is taken off the third speed sliding gear on the main shaft. It is automatically lubricated from the gear box and no attention is necessary. The correct level of oil in the box is to half way up the lay or lower shaft. (*See page 5*). A drain plug is fitted underneath the gear box.

BACK AXLE.

The back axle is of the semi-floating type, the casing consisting of two steel pressings welded together. The driving shafts have two bearings; at the outer end an adjustable Timken roller bearing, and at the inner end, a ball bearing housed in the differential casing. The

wheel hubs are secured to the shafts by a key on a taper, the inner ends of the shafts having splines, which fit into the differential gears. The hubs can be withdrawn without altering the adjustment of the Timken bearings, and it is most important that these should not be adjusted except by an expert. With the axle shafts removed, and the rear joint of the propeller shaft disconnected, the differential and back axle nose-piece can be withdrawn without disturbing the adjustment of the gears. The thrusts of the crown wheel and pinion are taken by double thrust ball races, housed in the differential casing and nose-piece respectively. The differential casing and crown wheel run in two ball bearings. On the top of the back axle nose-piece is a plug which is sealed before the chassis leaves the Works. This plug covers the adjustment of the back axle pinion, and must not be removed; it has nothing to do with the lubrication of the axle. The four star wheels of the differential are enclosed in a cast iron cage, and the whole construction of the back axle is very rigid. The goose neck for examining and replenishing the oil is fitted on the rear of the axle banjo. (*For instructions with regard to lubrication, see page 5*).

UNIVERSAL JOINTS AND PROPELLER SHAFT.

The propeller shaft is made of weldless steel tubing. Being hollow, it is designed to act as an oil reservoir for the rear universal joint. (*See page 8*).

Universal joints are fitted at both ends of the propeller shaft. They are of the star type, having hardened steel bushes and pins, and are enclosed in dirt-proof covers. Lubricating nipples are fitted through which the joints may be oiled. These joints have a very long life, provided they are properly lubricated, and it is most important that the correct lubricant should be used. This is specially made up to suit these joints, and can be obtained from the Service Department. (*See page 6*). Wear in the joints will be considerably more rapid unless this special oil is used.

To allow for the plunging action of the propeller shaft as the rear axle rises and falls, the front end of the former is free to move endways in the joint, the drive being taken by splines.

STEERING GEAR.

The steering is by worm and wheel, the former being mounted on two ball bearings and the latter being mounted on the steering shaft which also has ball bearings. Adjustments are provided for taking up wear, but it is important that none of these should be tampered with without the permission and advice of the Service Department, as the adjustments are very delicate, and improperly used may cause costly damage to the worm and wheel apart from the fact that the delicacy of the steering will be destroyed. The rake of the

steering column can be altered without difficulty if the instructions are followed. (*See page 43*). The large plug on the steering box covers the adjustment for taking up lift in the steering column, and is also for lubrication. Golden Shell oil should be used. The steering column, about half up its length, is supported by a bracket from the dash and rotates in a ball bearing. The control tubes operating the mixture, throttle and ignition controls, pass down the centre of the steering column. The drop arm is keyed to the outer end of the shaft, the fore and aft rod connecting the drop arm by means of two spring loaded ball joints to the stub axle arm. The track rod connects the two stub axles, similar joints being utilised. Both the fore and aft rod and the track rod, being hollow, are utilised as reservoirs for keeping lubricated the joints at either end of them. The track rod is easily adjustable for length, so that the track of the front wheels can be set, the correct setting being for the wheels to be pointing inwards three-sixteenths of an inch, the measurement being taken from the rim of the wheels. The stub axles are mounted on swivel pins held in tapers in bosses at either end of the front axle. The pins therefore are fixed and the stub axles swivel on them, plain bearings being utilised for these and for the thrust bearings at the top end of the pins.

ROAD SPRINGS.

Semi-elliptic springs are fitted front and rear, the former being on top of the axle and the latter being underslung. The front ends of the rear springs are attached direct to the frame brackets, large diameter phosphor-bronze bushes and shackle bolts being used. The rear ends of the springs are shackled to the frame, the same size bolts and bushes being employed. The front ends of the rear springs transmit the drive. Oiling nipples are fitted on the shackle bolts (*for oiling instructions, see page 6*). Spring gaiters are fitted and can be replenished with Golden Shell through the nipples fitted for this purpose. A safety stop is fitted to the frame immediately behind the rear brackets of the front springs so that in the unlikely event of a main leaf of a front spring breaking the axle cannot come back, thereby possibly causing an accident. Each spring is secured to the axle pad by four nickel-steel bolts, the nuts being split-pinned.

FUEL TANK.

The tank is mounted on trunnions and is carried between the rear dumb irons. Its capacity is 16 gallons. Baffles are fitted to prevent the fuel surging from one side to the other. There is a drain plug, incorporated with which is a large gauze filter, which enables the contents to be completely drained away, and there is also a small plug which should occasionally be removed to allow water and sediment to drain out.

PETROL GAUGE.

A Hobson K.S. Telegage is fitted. The indicating gauge is mounted in the facia board and is graduated in gallons and litres. It is very accurate and requires no attention. The installation consists of the Gauge, Tank Unit and Air Line. The Air Line is filled with air and connects the Tank Unit to the Gauge. The petrol tries to rise to the same level in the Tank Unit as it is in the Tank. This causes pressure in the Air Line which is communicated to the Gauge being recorded by the rise of red fluid in the glass tube. The tank unit is so designed as to always keep replenished the air in the Air Line, but the success and accuracy of the installation is dependent on all joints and connections being air tight. There is one gallon of fuel in the tank before the gauge begins to register.

BRAKES.

The four-wheel brakes are pedal operated and the hand lever operates separate shoes on the rear wheels only. They are entirely mechanical in operation, the shoes on the front wheels being of a patented Servo type. There is only one adjustment at the lower end of the pedal for taking up wear.

Once they are correctly compensated they will run for very long periods without any attention, except this one adjustment. A balance gear is fitted across the frame behind the gear box; this ensures that the braking effort is evenly distributed between all four brake drums. It consists of a hollow shaft mounted on spherical bearings and carrying three complete compensators. Each of these consists of two arms, through the top ends of which passes the cross tube. The sides of the arms are kept in contact with a distance piece by bolts having Thackeray washers at both ends, so that there is friction between the arms, but not sufficient to prevent movement between them; the relative movement of the two arms is controlled by a whiffle-tree or balance arm, so that as one moves forward the other moves backwards. The whole compensator shaft is centralised in the frame by springs fitted at either end. The compensator on the offside end of the shaft balances the braking action between the offside front brake and the offside rear brake. The compensator on the near side of the shaft balances the action between the near side front brake and the near side rear brake. The centre compensator balances the action between the near side front and near side rear brake, as one unit, and the offside front and offside rear brake, as one unit. Thus the brakes are compensated in pairs and as a whole. Through the centre of the hollow compensator shaft passes another shaft on which are mounted the arms which actuate the handbrake which acts on the rear drums only. This brake is not compensated. (*For instructions with regard to compensating brakes, see page 40*). The brake shoes are of aluminium and are lined with Halo. The liners on the front shoes are larger in area

than those on the rear. The cam actuating the front shoes is operated by a shaft having a star type uviversal joint at both ends, the inner end being mounted on a bracket on the top lip of the frame, and the design is such that allowance is made for the plunging action of the shaft as the axle rises and falls over a rough road and for varying conditions of load. Two pull-off springs are fitted between each pair of rear shoes, the method employed allowing the tension of the springs to be adjusted, though this is not ordinarily necessary, unless the shoes have been removed. The front shoes have a fulcrum pin at their lower ends, and have therefore only one pull-off spring.

SHOCK ABSORBERS.

Duplex Type "B. & D." Stabilisers are fitted front and rear. The lower ends are fitted to a bracket which is clamped between the saddle plate and the road springs and the upper ends to a bracket bolted to the side of the frame. The shock absorbers require no attention, except occasional adjustment to make up for wear in the friction discs. (*To adjust, see page 14.*)

CHAPTER VI.

M.L. MAGNETOS, TYPE E.R.4.

Two M.L. Magnetos are fitted as standard. These are driven one at either end of the same cross shaft. They are quite independent and are synchronised to fire simultaneously. They fire separate sets of plugs, one set on the exhaust and the other on the inlet side. The rotation of the offside instrument is clockwise and of the near side anti-clockwise. The magnetos are of the stationary armature type, the magnets revolving and the windings being stationary. This type of instrument has several advantages. The high tension winding and condenser are stationary, there is no slip ring and pick-up, and the contact breaker not revolving, it is not subject to centrifugal force. The only revolving portion of the latter is a small cam.

The distributor being of the jump spark type, there are no carbon brushes and no rubbing contacts in either high or low tension circuit, with the exception of a small brush on the axis of the distributor rotor where the rubbing speed is negligible.

The magnetos are flange mounted and are secured by three bolts on extensions of the aluminium cam casing. A damper is incorporated to nullify the flick of the magnetos on the cross shaft at low engine speeds.

CARE AND MAINTENANCE.

The magnetos are designed to reduce the necessity for attention to the minimum and must not be interfered with or dismantled unnecessarily. A little periodical care of the ignition system generally is, however, advisable, and may be summed up in the three words: Cleanliness, Adjustment, and Lubrication.

As regards cleanliness, while dirt, wet and oil will not hurt the exterior of the magnetos and are not likely to penetrate to the interior, they may, if allowed to collect on the distributor and high tension cables, cause leakage and give rise to difficult starting and irregular slow-running. These parts should, therefore, be kept clean and dry, and the cables should be renewed when the rubber shows signs of cracking and perishing. The contact breaker points should be examined periodically, and cleaned if necessary. These are not likely to get dirty unless subject to the action of oil or petrol vapour and unnecessary cleaning should be avoided. Any sign of rust on the contact breaker spring must be checked at once, as this is the most frequent cause of a broken spring.

The contact breaker can be removed by merely drawing it from the boss on which it is pivotted, and in a direction parallel to the axis of the instrument. Care must be taken when doing this that the spring blade exposed on removing the contact breaker is not strained, as this would cause a bad contact in the primary circuit.

LUBRICATION.

The main bearings of the rotor are grease packed on assembly and require no further attention. The plain bearing on the distributor spindle should be lubricated with fairly thin machine oil. A lubricator for this will be found on top of the instrument. Only one or two drops are required about every thousand miles. A drop of similar oil should be put on the end of the contact breaker pivot pin every 2,000 to 3,000 miles. Care must be taken that no oil gets on the contact breaker points. Do not over lubricate.

ADJUSTMENT.

The only part requiring occasional adjustment is the contact breaker and this only very seldom. The gap between the points must be checked with the feeler gauge on the magneto spanner, and if incorrect, set to gauge. After adjusting, be careful to make certain that the lock-nut on the long contact screw is tight. It is advisable to check the magneto for synchronisation about every 5,000 miles (*see page 39*). The sparking plugs will be found to require adjustment more frequently than the contact breaker and it is just as important that these should be correctly set. The plug points usually tend to enlarge their gaps; this increases the voltage required from the magnetos and not only makes starting more difficult but causes brush discharge inside the magnetos. This in time produces internal corrosion, diminishing the efficiency of the instrument until eventually a breakdown may occur. The gap between the plug points should be 0.5 mm. or .019 in. The plugs should also be examined to see that the surface of the insulation is clean and free from deposits of soot, oil, etc., as these may cause leakage and bad running, and the insulation should be examined for flaws. In damp weather, when the engine has been standing idle for some time, starting may be facilitated by wiping the exterior of the plugs with a dry rag to remove moisture.

TROUBLES AND REMEDIES.

If the small attentions asked for above are given it is unlikely that any trouble will be experienced with the magnetos, so that should misfiring or irregular running be experienced the high tension leads and plugs and the carburettor should be examined before deciding that the magnetos are at fault. It must not be assumed that because a plug sparks satisfactorily when out of the cylinder that it will do so when under compression, so that the only satisfactory test for a plug is comparison with one which it is known is in proper order.

It is generally possible to differentiate between a fault in a magneto and one in the rest of the system by holding the end of a high tension lead about one sixty-forth of an inch from the plug terminal while the engine is running slowly, or while it is being turned by the starter or by hand, and if a regular bright spark is seen the magneto is certainly not at fault.

Should this test point to the instrument being defective the contact breaker should first be examined. The points must open the correct distance under the cam, and the flat spring which retains the breaker inspection cover in place must press firmly and definitely on its seating. If these appear to be in order, remove the contact breaker and examine carefully. The points must be clean and the rocker arm move freely without any symptoms of sticking. The spring blade in the body of the magneto must make good contact with the brass segment at the back of the contact breaker moulding. A definite effort should be required when replacing the contact breaker to press the segment over the rounded end of the blade, and the blade should be deflected back at least one-sixteenth inch from its free position when it is resting on the segment.

If the fault is not discovered in carrying out the above, it must lie internally in the instrument in the winding or condenser. In this case the magneto must not be further dismantled, but the Service Department should be communicated with and a replacement instrument will be sent.

CHAPTER VII.

THE SMITH STARTING AND LIGHTING SYSTEM.

In this chapter a detailed description of the principal components is given, together with hints on troubles and how to locate and rectify them. The wiring system is of the earth return or single pole type.

Special attention is drawn to the section on battery maintenance. Ninety per cent. of the more serious troubles can be traced to neglect of the battery, which is the heart of the system and the only component which requires frequent and regular attention. These instructions should, therefore, be carefully read, and if they are carried out the equipment may be relied upon to give efficient service at all times.

The Starting and Lighting system consists of the following components:—*Dynamo, Starter Motor, Battery, Lighting Switch, Cut-out, Dynamo Switch, Junction Box, Lamps and Wiring.*

DYNAMO.

The Smith Patent Constant Current Dynamo is designed to ensure that the current output shall be limited to the correct amount and shall remain constant over a wide range of speed. This regulation is electro-magnetic and entirely automatic; it depends on armature reactions only, no vibrators or other complicated devices being utilised.

THE DYNAMO SWITCH.

The dynamo switch is mounted on the switch plate together with the magneto switches. By means of it the dynamo can be put "on" or "off" charge. It is of the quick break type.

CUT-OUT.

The cut-out or circuit breaker operates as an automatic switch between the dynamo and the battery. Its sole purpose is to connect the dynamo to the battery as soon as the speed of the former is sufficient to enable it to charge the latter, and to open the circuit when the engine stops or slows down below the generating speed of the machine, thus preventing the battery from discharging back through the dynamo. The cut-out is of the magnetic type and is reliable under all conditions. It consists of an electro magnet with a spring controlled armature which carries the brushes for closing the electrical circuit. The magnet has two windings, one of many turns of fine wire, called the shunt winding, and the other consisting of a few turns of thick wire, called the series winding.

The shunt winding is connected directly across the main dynamo terminals, and when current is generated it energizes the magnet which attracts the armature when sufficient voltage is generated, and thus closes the main circuit through the series coils to the battery.

When the speed of the dynamo and consequently the voltage drops below the charging value, the reverse current from the battery, flowing in the series winding, neutralises the effect of the shunt winding, releases the armature and thus opens the circuit between the dynamo and the battery.

A fuse is provided on the cut-out base, which is connected in the dynamo field circuit and its object is to protect the machine against damage due to an accidental open circuit, or faulty connection between the dynamo and the battery. A spare reel of fuse wire is supplied to enable replacements to be made quickly when required. It is essential that no fuse wire except that provided should be used.

HEAD LAMPS.

Focussing is accomplished by turning the small screw at the back of the lamp which moves the bulb backwards or forwards in the reflector. The lamp front can be removed by pressing the rim inwards and turning to the left, then pulling it straight forward. The reflector can then be lifted out of the body after removing the bulb. The head lamps are mounted on their brackets by spherical mountings and are secured by a nut; by slackening this nut the lamps can be correctly aligned; they can also be swivelled through a wide angle, which is a useful point to be remembered when driving in fog, as they can thus be pointed downwards, and outwards towards the kerb.

WING LAMPS.

The wing lamps are similar in appearanee and construction to the head lamps only smaller, but the rim of the lamp is screwed on. They are mounted on the wing brackets which are specially designed for this purpose.

JUNCTION OR DISTRIBUTION FUSE BOX.

The junction box consists of a block of insulating material carrying a set of terminals and six fuses, to protect the battery against any short-circuits or defects in the lighting and auxiliary circuits, such as the lamps, electric horn, interior lights, etc. It may be used for connecting up any additional accessories required.

15 amp. fuses are used for standard lamp equipment and certain low current consumption accessories, while a 40 amp. fuse is employed for accessories with a high current consumption such as a cigar lighter.

MAINTENANCE AND RUNNING INSTRUCTIONS.

DYNAMO.

The dynamo requires little attention. Occasionally inspect the brushes. These should not require renewing oftener than every 10,000 miles. The commutator will wear almost indefinitely, but if dirty or rough it should be wiped over with a clean rag, and the surface may be smoothed with very fine sand or glass paper, but on no account may emery cloth be used for this purpose. The greasers fitted at either end of the armature shaft should be given a turn about every 1,000 miles. Do not over lubricate. The best grease for this purpose is Shell R.B.

STARTER MOTOR.

The starter motor, being only used occasionally and for very short periods, requires practically no attention, though as a precaution, an inspection should be made of the commutator and brushes to see that the former is clean and in good condition and that the latter are free in their holders.

BENDIX DRIVE.

The worm of the Bendix drive must always be kept clean. It must never be oiled, but should be cleaned occasionally with a brush dipped in petrol.

DYNAMO SWITCH.

The dynamo or charging switch is connected in the field circuit; when this circuit is closed the dynamo charges the battery, but when it is broken the dynamo ceases to generate.. Normally the battery should always be on charge and the dynamo need only be switched " OFF " when touring long distances, or under special conditions when the starter and lights are seldom used. So-called overcharging does no harm if the battery is properly cared for. On the other hand under-charging is most detrimental to the plates and is the cause of most battery troubles.

CUT-OUT BOX.

The cut-out does not require attention. It is carefully adjusted in the first instance and must not be tampered with. Only the wire supplied may be used for the field fuse. This is a most important point. Failing this wire, only wire which blows at 3 amps may be employed. The employment of heavier gauge wire may lead to serious damage to the dynamo. The wire must be stretched between the two contact strips on the fuse holder and carefully pressed down towards the bottom edge. When replacing the fuse holder the fuse wire must be properly gripped by the spring contacts.

STORAGE BATTERY.

The battery is the heart of the electrical system, and it is essential that it should receive proper care and attention. It must be inspected at regular intervals, at least once a fortnight, or more often if the car is in constant use. If the following instructions are conscientiously carried out, the life of the battery will be prolonged and the reliability and efficiency of the system ensured.

TESTING THE BATTERY.

The condition of the battery can best be determined by means of a hydrometer, the most convenient form being the hydrometer syringe. The purpose of the instrument is to test the specific gravity of the electrolyte or fluid in the battery. Each cell should be tested, and fully charged, they should have a specific gravity of about 1.28: if below 1.17 the battery is practically exhausted, and should immediately be charged up either by running the car or from an outside source. On no account should the starter motor be used until the gravity is restored to at least 1.20. The specific gravity of the various cells will seldom be exactly the same, but the difference should not be very marked. If the gravity in one cell is much lower than in the others, it will probably indicate that that particular cell is not in good order. Should any cell require more frequent filling than any of the others, a leak is indicated and the battery should be sent for repair.

If the battery is not in use for some considerable time it should be fully charged, and to keep it in good condition it should be given a freshening charge every four or six weeks. When a battery is again put into use after a period of idleness, it must be given a thorough charge.

The solution of electrolyte must always be kept above the top of the plates, and if below this, pure distilled water, only, may be added until the tops of the plates are covered. This must be done regularly. If some of the solution has been accidentally spilled, the loss must be made good by adding dilute acid, and the specific gravity must be tested with a hydrometer. Loss through evaporation must be made good only by adding distilled water. The battery and the box must be kept clean and dry; any spilt acid should be soaked up with blotting paper or a rag moistened with ammonia water. The terminals and connections must be kept coated with vaseline or grease.

TEST BY VOLTMETER.

An approximate guide to the condition of a battery can be given by means of a voltmeter. When testing by this means, take a reading with all lamps switched on; this gives the voltage with a load on the battery. Voltage readings taken when the battery is on open circuit are valueless, as the battery may be practically discharged and yet indicate the normal voltage, except when a cell is out of order. A

fully charged 12-volt battery should read from 12 to 13 volts when on load, and even with the full lighting load the voltage should not be below 12 volts. If the voltage when on load is below 12 volts it will indicate the battery is low and it should never be allowed to be below 11 volts without being given a thorough charge. The voltmeter, must, therefore, be used with intelligence and only a high-class instrument employed, as otherwise it is of doubtful accuracy.

The voltmeter will quickly indicate a faulty cell as this will show either a very low reading, or, if there is a short between the plates, no reading at all.

Before coming to any definite decision with regard to the state of a cell, a hydrometer test should be taken to confirm the conclusions arrived at by the voltmeter test.

A good substitute for the voltmeter is to use a lamp and note whether it glows bright or dull. After a little observation, the lights on the car will indicate fairly accurately the condition of the battery.

It must be remembered that an exhausted battery may easily show the normal voltage on open circuit, but will be incapable of supplying any current, and it is for this reason that when testing by voltmeter, it is necessary to allow the battery to discharge through a load such as a couple of the lamps on the car.

BATTERY REPAIRS.

Before returning a battery for repairs, the acid specific gravity should be taken and noted, then the acid should be emptied out, but under no circumstances whatever may the cells be filled with water. The specific gravity reading should be stated on a label attached to the battery, when forwarding to the repairers.

WARNING.

On no account may the engine be run when the battery has been removed or disconnected, unless the field fuse which is in the cut-out box has been removed. If this precaution is not taken the field fuse will blow or the dynamo or lamps will be burnt out. Details of the wiring of the chassis are given in the diagram (*see page 45*).

Do not abuse the system by unnecessarily frequent use of the self-starter, nor on any account use it to run the car along the road. Every operation of the starter motor represents a considerable drain on the battery, which it will require several miles of running to replace.

The starter motor should not be used if the battery is discharged or very weak.

If the car is only used at night, a few minutes' running of the engine cannot be expected to furnish sufficient current to replace that taken by the lamps and starter, so that under these conditions the battery should occasionally be charged from an outside source.

It must be borne in mind that for the satisfactory working of the system it is essential that the battery be kept in a charged condition.

LOCATING TROUBLES.

The following hints and tips on trouble location are given with a view to assisting the user to locate any troubles which may occur on the road. If possible always rectify the trouble at once; do not leave matters to get worse, as sometimes quite a trivial fault may ultimately cause serious damage to the system.

SYMPTOM.	PROBABLE CAUSE.
AMMETER DOES NOT INDICATE CHARGING CURRENT.	*Field fuse blow, indicating either a faulty or broken connection between dynamo and battery. Carefully trace all connections and locate fault before replacing fuse.*
ALL LIGHTS FAIL.	*Broken or bad connection between switchboard and battery or earth connection.*
AMMETER DOES NOT REGISTER THOUGH FIELD FUSE HAS NOT BLOWN.	*Dynamo out of order; examine brushes and see that they are quite free in their holders.*
AMMETER REGISTERS CURRENT WHEN CAR IS STATIONARY AND ENGINE NOT RUNNING.	*This is of rare occurrence and may be due to two causes:* (1) *Cut-out out of order.* (2) *A short circuit between the dynamo positive and battery positive terminals.* *To locate, disconnect cable from terminal 1 D on cut-out and note whether the ammeter needle returns to zero; if when replaced current is again registered examine for possible short between terminals 1 D and 4 S, also see that the armature of cut-out is not sticking.* *If the trouble cannot be remedied have cut-out returned for inspection and repair if necessary.*

SYMPTOM.	PROBABLE CAUSE.
Bulbs Glow Very Bright or Burn Out.	*Broken or faulty connections between dynamo and battery; the field fuse will also probably blow. Switch dynamo OFF, examine battery connections and do not charge again until fault has been remedied.*
Bulbs Dull or not up to Normal when Dynamo is not Running.	*Battery discharged; use lamps sparingly and do not use starter motor until battery has been recharged.*
One or more Lamps will not Light.	*Bulbs defective or worn out; try new bulbs, or examine for faulty contacts in bulb holder and adaptor, also earth connections, and examine fuses in fuse box and lamp connections on switchboard.*
Lights Flicker.	*Loose connection in lamp wires or adaptors, or loose connection on battery or earth.*
Starter Motor Turns Engine Very Slowly.	*Battery almost discharged or engine very stiff. Do not use starter motor until battery is properly charged. Also examine starter cable connections on battery and starter switch.*
Starter Motor does not Rotate.	*Battery entirely discharged, either through excessive use of starter motor or short circuit. Test battery, also examine starter motor connections.*
Starter Motor Rotates but does not Rotate Engine.	*Screwed sleeve of Bendix drive dirty or gummed with oil, etc. To remedy, clean with brush dipped in petrol and see that the pinion is quite free.*
Battery does not Hold Charge or is Always Weak.	*Defective cell or level of solution very low. Battery may be worn out or specific gravity of the electrolyte low. Test with hydrometer. The car may not be run enough for the dynamo to charge the battery and replace the current taken from it. To remedy, run car and do not use lights or starter motor until battery is properly charged again.*

SPECIAL NOTE.

DO NOT INTERFERE with the adjustment of the dynamo or cut-out. The dynamo is set to give its correct output at the Factory and needs no further alteration at any time. The cut-out is also carefully adjusted, and the adjusting screws are sealed. If any fault is suspected in any of the apparatus have it carefully examined by a competent electrician, or return for inspection to the Service Department.

CHAPTER VIII.

ADJUSTMENTS.

In this chapter detailed descriptions of various jobs are given. These jobs do not require the skill of an expert and can be carried out without in any way affecting the Guarantee on the chassis, and no difficulty should be experienced if the instructions are carefully followed.

TO ADJUST TAPPETS.

The design of the overhead gear is such that the tappets seldom require attention, but should a noisy tappet be suspected the method of adjusting is as follows:—

The aluminium cam-case cover is held in position by 6 nuts which must be unscrewed, and two end plates which must be released. The cover can then be lifted off. Care must be taken not to damage the cork washer which makes the joint between the cover and the cam-case. Each tappet screw is secured by a lock-nut, to fit which a ring spanner is supplied in the tool kit together with a key which fits into the end of the tappet screw, thereby affording means of adjusting the clearance between the ball end of the tappet screw and the end of the valve stem. Before commencing adjustment, the engine must be thoroughly hot. As the tappets are adjusted for each individual cylinder, that cylinder must be at top dead centre on the firing stroke, this position being marked on the flywheel. For instance, when adjusting for No. 1 cylinder, the marks T.D.C.1 and 4 on the flywheel must be in line with the centre of the cylinder block, the actual cylinder which is on the firing stroke being ascertained by inspecting the position of the magneto distributor. The correct clearance is .019 inches. A Feeler gauge of this thickness is supplied in the tool kit. After adjusting and tightening up the lock-nut the clearance should be finally checked. It must be realised that the ball ends of the tappet screws are free to rotate so that care must be exercised when adjusting that the flats on the balls bear on the valve stems. No trouble is likely to be experienced in this respect unless for any reason the tappet screws are slacked back considerably, as it is not until this is done that the balls could rotate sufficiently for the flats to become uppermost. When replacing the side plates and cover, the nuts must be tightened up evenly and in no circumstances must any jointing material be used apart from the washers.

Should a squeak develop in the overhead gear after the engine has been idle for a considerable period, it is probably due to a dry or rusty tappet screw ball and it is these parts which should be oiled with a view to curing the trouble, though the noise will automatically wear off.

CHANGING A MAGNETO.

In the event of a magneto proving defective and the fault not being curable without taking the instrument apart, a replacement instrument should be obtained from the Service Department. The procedure of changing a magneto is as follows:—

Disconnect the advance and retard control, and the sparking plug leads. Turn the flywheel so that Mag. 1 and 4 are uppermost. No. 1 cylinder should be on the firing stroke which can be ascertained by inspecting the magneto distributor. Unscrew the nuts on the three bolts on the magneto flange and remove the bolts. The magneto can then be withdraw, complete with anti-vibrator. The latter parts will have to be fitted to the replacement instrument. To do this the nut on the spindle must be slackened, then with the dog held in a vice the nut (which is now loose on the spindle) must be given two or three hard taps with a copper drift which will have the effect of loosening the dog on the taper of the armature spindle, and then having completely unscrewed the nut, the dog and anti-vibrator can be removed as a unit. The object in not removing the nut completely in the first instance is to prevent the screw threads at the end of the spindle being damaged by hammering, and it also prevents the instrument falling when the dog has been started on the taper. It will be noticed that there is a key-way cut in the taper of the spindle, but no use is made of this, the magneto drive being taken by the taper only. When fitting the dog to the replacement instrument, it should first be put on hand tight and the approximate position found by offering the machine on to its flange so that the timing is about correct with the three securing bolts registering in the centre of their slots. This will allow sufficient movement of the magneto forward or backward to obtain accurate synchronisation. Having obtained this position, the nut on the spindle must be thoroughly tightened to avoid any possibility of the dog slipping on the taper. It must be realised that the near side and off side magnetos are not interchangeable as their direction of rotation is different, hence the importance of stating for which side of the engine the magneto is required when another instrument is ordered. There is a castellated split pinned nut on the magneto cross drive housing, just behind the flange, which must on no account be touched. When replacing a magneto, care must be taken that the slots of the anti-vibrator register in the corresponding slots in the sleeve, otherwise damage will be done when the instrument is tightened up to the flange.

SYNCHRONISING MAGNETOS.

After a magneto has been changed it will be necessary to synchronise the two instruments. The procedure is as follows:—

First check the contact breaker gap which should be .012 inches; turn the flywheel until the mark "Mags 1 and 4" are at top dead centre. Set one magneto on its flange so that in the fully advanced

position the contact points are just separating. Set the other magneto similarly. Turn the flywheel backwards about quarter rev. Place a piece of tissue paper between the contact points of each magneto. Turn the flywheel forward, *i.e.*, in the direction of rotation of the engine, until "Mags 1 and 4" are again on top. The two pieces of paper should be released simultaneously—if not any slight variation can be rectified by rotating one magneto on its flange. The magneto controls must be so adjusted that both instruments are fully advanced when the mark "Mags 1 and 4." are at top dead centre. Though in the factory the magnetos are synchronised electrically the above method is quite simple and gives very accurate results.

CHANGING A DYNAMO.

Should a dynamo prove defective and it cannot be rectified by inspection and simple adjustment (*see page 32*), it is advisable to ask for a replacement instrument in order that the defective one may be returned to the makers for repair without it first having been opened up. The method of removing a dynamo is as follows:—

The dynamo drive cover on which the spare sparking plugs are carried must first be removed. This is secured to the dash by four bolts. The front Hardy disc which is thereby disclosed must then be disconnected; two bolts have to be removed, the wire securing the nuts having been withdrawn. The screws of the clip securing the greaser pipe to the front end of the dynamo must be slacked back and the pipe withdrawn. The dynamo can then be removed by undoing the three bolts which secure it to the dash. Should the dynamo be returned for repair or replacement the driving dog must be removed and retained as the new machine will be forwarded without this part.

COMPENSATING AND ADJUSTING FOUR-WHEEL BRAKES.

(1) Raise all four road-wheels clear of ground by jacking up on wooden blocks under front axle and rear spring saddle plates.

(2) Disconnect the four foot-brake pull rods at the wheel ends and see that all four road-wheels revolve quite freely. The hand-brake lever should be in the "off" position against the "stop."

(3) Set compensator levers parallel, with the aid of a short tommy bar, until the quarter inch clamping bolts are central in slots. This also applies to the central compensator with the long single lever; the two halves of this compensator should be set parallel bringing the clamping bolts central in slots.

(4) Remove split pins from compensator clamping bolts and tighten nuts dead tight to put compensators out of action.

(5) Adjust main adjustment (when pedal is back on the floor board) so that main compensator lever lays at approximately 12 degrees from the vertical; then connect all brake rods and adjust so that all wheels can be just rotated by hand and so that it requires

the same amount of energy to rotate each wheel. At this point slack off main adjuster so that foot brake pedal has 1 inch to 1½ inch free travel, *i.e.*, from the foot-board to the moment the brake comes into operation. This allows main compensator lever to fall back to about 14 degrees, which is the correct angle of this lever when foot-brake pedal is at rest against foot-board. After making these adjustments, it is important to be certain that at least half-inch of threaded end of pull rods remains screwed into each fork end.

(6) Turn steering wheel full lock first one side and then the other, and see that both front wheels revolve freely. In both positions of steering wheel, brake pedal must be in the "off" position, against pedal-board. Should hard rubbing or binding of brakes on front wheels occur on either offside or nearside full steering lock, see that the pull rod connecting the brake pedal to compensator shaft is in top hole of the two on the pedal and the top hole of the two on long lever on compensator shaft, and slightly increase pedal travel by letting out hand adjustment (which is incorporated in this pull rod) until both front wheels revolve freely on either lock.

(7) Put compensators into action by slacking off clamping bolts. Particular care should be taken in the adjustment of these bolts. The two bolts on the centre compensator should be tightened until the spring washers under nut and bolt heads are only just fully compressed. The bolts on each outer compensator should be tightened half a turn more than bolts on the centre compensator.

(8) Replace all split pins, tighten all lock nuts, tighten locking lever on hand adjustment, lower car to ground by jacks.

NOTE.—Periodical cleaning and lubrication of brake gear, including all pull rod fork ends, with occasional checking of compensator clamping bolts, will ensure faultless braking action over long periods.

TO RECTIFY SCRAPING SOUND IN BRAKES WHEN CORNERING.

Usually this is caused by the aluminium dust cover which is over the inside of the brake drum rubbing on the brake drum itself. It should be eased back with a big screwdriver or knocked back with a hammer.

CLUTCH SLIP.

First make sure that there is about ½-in. clearance between the clutch pedal and the front floor-boards at the point where the pedal comes through the boards. If the floor-boards are pressing on the pedal when the clutch is home, slip is bound to develop. A new car should, in particular, be watched for this. Should the above not be the cause of the slip, it will be necessary to dismantle the clutch. This should be undertaken, if possible, by the Service Department.

TO REMOVE REAR HUBS.

Undo hub cap, remove the split-pin inside which passes through the castellated nut on the end of the axle shaft. Pull on hand-brake hard and remove nut in usual way, *i.e.*, turn to left to undo. Then screw on to hub, the hub drawer supplied in the kit. (*Note.*—This is double ended, one for the off-side and one for the near-side.) Next screw in the set screw in the centre of the hub drawer, using a box spanner and long tommy bar. Give the set screw several hard taps to loosen the hub on the taper of the axle shaft. Immediately the hub is "started" on the taper, put the hand-brake in the "off" position or damage will result to the plate behind the drum. When withdrawing the hub take care not to interfere with any axle adjustment. When replacing carefully clean the taper and smear with vaseline.

TO CLEAN SPARKING PLUGS.

After running, the sparking plug points tend to open out; it is, therefore, advisable to remove the plugs every 3,000 miles and set the points to the gauge on magneto spanner or .019 inch.

To clean the plugs unscrew the brass nut just above the main body of the plug; the whole of the inside of the plug then comes away and can be cleaned with a rag. The centre part or electrode of the plug can be replaced when worn out.

GREASING SPRINGS.

To grease the springs remove the gaiters and jack up the frame so that the axle hangs on the spring. Remove the "D" clips on No. 4 spring leaf and separate the leaves either by a special tool, which can be bought from any accessory dealer, or by inserting a screwdriver into the gap between the leaves. Put some grease on a hacksaw blade and smear it over the separated surfaces. When replacing the gaiter, smear the inside with grease, as this will work in between the leaves of the spring on the road and will also prevent rust. It is advisable only to do this work once a year.

TO RECTIFY NOISY SPRING SHACKLES.

When a car has done a considerable mileage a "clicking" sound may be set up when going round corners. This is due to side play in the rear-shackles of the front springs. Steel shims can be obtained for taking up this wear. The method of fitting them is as follows:—

Jack up front of car by the dumb iron so as to take the weight off the spring, remove split pin from castellated nut on shackle bolt, unscrew bolt and place a shim or flat washer in between the spring eye and the shackle, replace nut and split pin. The above method applies when shimming all shackles.

RECTIFYING LOW SPEED STEERING WOBBLE.

Make sure the track, *i.e.*, the alignment of the front wheels, is correct. This distance from the inside of the front part of the front

wheels (*i.e.*, from the rim and not the tyre) should be 3-16ths of an inch shorter than the distance between the inside of the rims at the rear of the front wheels. In other words the front wheels should point inwards 3-16ths of an inch. Having checked this, proceed as follows:—When the car is issued from the Works the front wheels are balanced by means of lead and wood discs mounted on four bolts equally spaced round the wheel rim. If, however, other tyres have been fitted rebalancing may be necessary. Proceed as follows:—Jack up one front wheel and test for balance. If the wheel is heavier at one point, that point will naturally fall to the bottom. Alter the distribution of the discs on the bolts so as to get perfect balance. Treat the other wheel in the same manner. It is of great importance to make certain that there is not any excessive play in the joints at either end of the fore and aft rod. (The fore and aft rod is the rod which connects the drop arm from the steering box to the stub axle arm.) These joints are spring loaded ball joints, and too much movement in the springs can be the cause of steering wobble. The maximum movement should be ½-mm. backwards and forwards in each joint. To reduce the movement it is only necessary to remove the split pins and caps at either end of the rod; unscrew the caps and insert a suitable number of washers behind the springs, afterwards replacing the caps and split pins. The joint can be tested for movement by gently turning the steering wheel to and fro and watching the ball joint.

TO ALTER RAKE OF STEERING.

On the off-side of the dashboard will be found the steering column support, with two slots cut in it through which are passed two bolts. Loosen these bolts and also the "pinch bolt" underneath the bracket, which allows the latter to slide up and down the column. Next on the steering drop arm side of the steering box are four nuts on studs which pass through slotted holes. Loosen these and drop or raise the column. If the position of the column is altered to any considerable extent, a wedge-shaped packing piece should be placed between the steering column bracket and the dash.

NOTE.—Altering the rake of the column necessitates the magneto controls being adjusted as follows:—Set the hand lever fully advanced on top of the steering column. At the bottom of the latter is a short rod which is attached to a single lever on the magneto control cross rod. Undo the "pinch bolt" on this lever and push both magneto controls fully advanced, then tighten up again. By this method it is impossible to interfere with the synchronisation of the magnetos. The hand throttle control requires similar adjustment (*see page 39*).

THROTTLE NOT CLOSING PRORERLY.

If it is found that when taking one's foot off the throttle, the engine still continues to race unless the accelerator is lifted up with the toe, examine all the carburettor control "U" clips and connections. A tight "U" clip would be sufficient to cause this trouble. Work the

throttle by means of the hand control and lubricate the sleeve which slides on the hand control rod from the steering box. Also lubricate all " U " clips and joints.

CARBURETTOR JET, TO CENTRE.

It is described on page 12 how to clear the carburettors of water and dirt. Should the methods described fail and it is found necessary to remove the jet great care must be exercised in centreing it on replacement, as the taper needle must be exactly central otherwise it will rub against the side of the jet and its movement will not be free, so that the carburettor will not function properly. Centreing the jet is a delicate operation and must not be undertaken unless there is no doubt that its removal is necessary, and even then it should be left to a skilled hand if possible. To remove the jet the link control on the carburettor body for raising and lowering its position must first be disconnected. The large hexagonal screw which fits into the body at the back of the jet should be unscrewed and the jet can be removed. When replacing, it must be realised that the tapered needle is very nearly as large as the jet, yet for correct working it must not touch it; hence the importance of having the jet correctly centred. To do this, proceed as follows:—Screw the jet adjusting nut to its top position and work the jet right up until the jet head is up against it. Then refit the jet, taking care that the jet parts are assembled correctly. When this is done, feel if the piston is perfectly free by lifting it up with the finger and allowing it to drop. If it is not, slacken the jet screw and try again. It may be necessary to do this several times before the piston falls freely. When this has been done, move the jet adjusting nut back to its original position. Great care must be taken not to bend the needle, as should this happen the piston will inevitably stick. The link control can then be reconnected.

CARBURETTOR SLOW RUNNING.

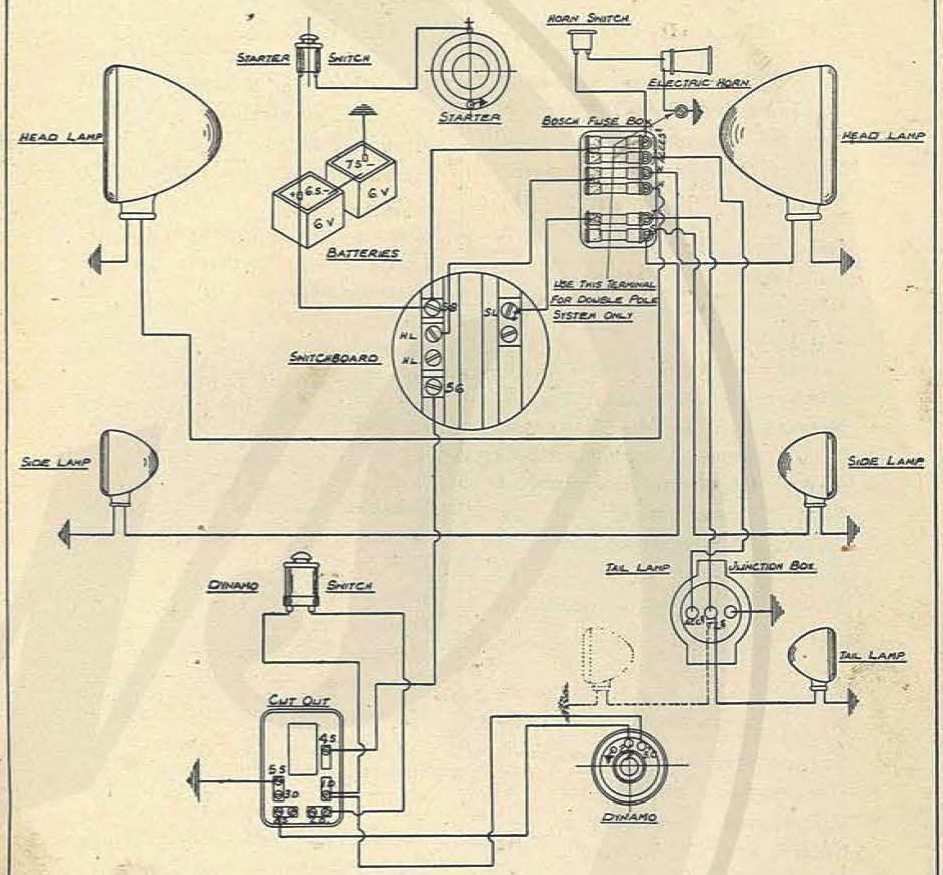
The slow running is carefully adjusted before the chassis leaves the Works, and its construction is such that no further adjustment should be necessary.

The slow running assembly consists of a pilot jet which is controlled by an adjustable air sleeve, in conjunction with which there is an adjustment on each throttle butterfly which controls the pilot hole inside the carburettor. The pilot jets can easily be removed by taking out the plug underneath each (with the ring spanner supplied in the tool kit), and removing the jets themselves with a small screwdriver, noting the presence of a small fibre washer on each. If desired, they can then be cleaned and replaced without any further adjustment.

The adjustment to the slow running consists of screwing the air sleeves down to strengthen the mixture and up to weaken.

It is important that the main plug holding the float chamber to the body of the carburettor should be tightened up securely after replacement.

THE SMITH STARTING & LIGHTING SYSTEM (EARTH RETURN)
WIRING DIAGRAM WITH BEZEL OPERATED SWITCHBOARD
& CENTRE ZERO AMMETER



WIRING INSTRUCTIONS

CIRCUIT	TERMINALS TO CONN.	TYPE OF CABLE	SIZE OF CABLE
DYNAMO TO CUT-OUT	2C TO 8S 3C TO 1D	SMITH'S THIN	35/.012" 35/.012"
CUT-OUT TO SWITCHBOARD	4S TO 5C	SMITH'S SINGLE	35/.012"
SWITCHBOARD TO BATTERY	GB TO BATTERY +	SMITH'S SINGLE	35/.012"
CONNECTIONS SWITCHBOARD TO FUSE BOX	CONNECT AS SHOWN	SMITH'S SINGLE	35/.012"
ALL LAMPS TO FUSE BOX	CONNECT AS SHOWN	SMITH'S SINGLE	14/.012"
DYN. SWITCH TO CUT OUT	DYNAMO SWITCH TO 1D & 2D	SMITH'S SINGLE	2-14/.012"
FUSE BOX TO T.L. JUNCTION BOX	CONNECT AS SHOWN	SMITH'S SINGLE	35/.012"

REMARKS

THE STARTER MOTOR IS DIRECTLY CONNECTED TO THE BATTERY THROUGH THE STARTER SWITCH.
USE SINGLE CABLE 37/.036" IF ADDITIONAL ACCESSORIES ARE FITTED THEY SHOULD BE CONNECTED TO THE FUSE BOX.
CARE MUST BE TAKEN THAT THE STARTER FLANGE & LAMP BODIES MAKE GOOD METALIC CONTACT WITH THE ENGINE OR FRAME OF THE CAR FOR LEADS FROM BATTERY TO EARTH USE SINGLE 35/.012" CABLE.
IT IS IMPORTANT THAT GOOD CONTACT IS MADE ON ALL EARTHED CONNECTIONS

4 CYL.R 100 BORE	TRACED L.A. CHECKED PASSED DATE 18.12.1928	BENTLEY MOTORS LTD LONDON. WIRING DIAGRAM (SINGLE POLE / 4½ LITRE)	PART No. B M 4000

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W. J. FOWLER & SON, LTD., CRICKLEWOOD—11298.