









MANAGEMENT.

	l.	Engine.	 Gargoyle Mobiloit "BB." Fill through the breather to the mark on the screwed dipper. A full charge is 1³/₄ galls. Drain oil from crankcase after first 500 miles, and replace with fresh oil every 3000 miles.
	2.	Gearbox	Gargoyle Mobiloil " BB." A full charge is 3½ pints. Remove the oil level indicator and add oil.
	3.	Rear Axle.	Gargoyle Mobiloil " C.' A full charge is 1½ pints. Remove the oil level indicator and add oil.
	4.	Clutch Spigot Bush.	Engine oil. Remove inspection cover and give a few drops about every 300 miles.
	5.	Torque Ball Link.	Use "ENOTS" Grease-Gun.
	6.	Rear Wheel Hubs.	Gargoyle Mobiloil "C." Remove the counter-sunk screw under wheel and add oil.
	7.	Front Wheel Hubs.	Gargoyle Mobiloil "C." Remove the counter-sunk screw under hub cap and add oil.
	8.	Steering Column.	Engine oil. A few drops of oil occasionally.
	9.	Steering Gearbox.	Gargoyle Mobiloil " C."
	10.	Brake Cross and Camshafts.	Use "ENOTS" Grease-Gun.
)A	11	Brake Pins and Con- nections.	Engine oil. A few drops occasionally.
	12.	Stub Axle Pins.	Use "ENOTS" Grease-Gun.
	13.	Steering Drag Link.	Engine oil. Remove the brass plug and add oil.
	14.	Steering Cross Track Rod.	Use " ENOTS " Grease-Gun.
	15.	Shackle Pins.	Use "ENOTS" Grease-Gun.
	16.	Fan and Pump Shaft.	{VACUUM heavy transmission grease. Keep full.
	17.	Starting Handle Shaft.	{VACUUM light transmission grease. {Keep full.
	18.	Change Speed Lever Shaft.	Engine oil.
	19.	Dynamo.	Sewing machine oil.
	20.	Magneto.	Engine oil.

Type "F.K."

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15-9 H.P. CAR. Type "F.K."



VIEW OF ENGINE UNIT WITH GEAR BOX (FROM CARBURETTER SIDE).



VIEW OF ENGINE UNIT WITH GEAR BOX (FROM MAGNETO SIDE).



ENGINE POWER CURVE

INTRODUCTION.

THIS Instruction Book has been prepared, and placed at the disposal of car owners, with the idea of presenting in a clear and simple form the construction and the method of operating our cars to the best advantage. It is not published to instruct owners to dismantle and assemble the car.

The necessity of a book of this kind is appreciated after an inspection of cars returned for overhaul to the Manufacturers' works, the repairs in the majority of cases being due to some quite elementary oversight on the part of the owner or driver.

It is impossible to embody, in the book, the necessary instructions to enable a new owner to attempt to make all the adjustments and inspections which the car requires; but a careful study of the contents and the diagrams will familiarise the reader with the mechanical details, so that he can give it the necessary attention.

In case of accidents requiring skilled attention, or for replacements, it is advised that the car be taken, preferably into the nearest Agent's garage, or for attention at the Manufacturers' works

15'9 h.p. TYPE "F.K." CAR.

GENERAL INSTRUCTIONS.

Before leaving the Factory all cars are inspected and checked, both for mechanical adjustments and equipment.

The purchaser should make a careful examination of the car on its arrival, and if any damage has been sustained in transit it should be at once reported to the Agents, or direct to the Arrol-Johnston Co.

In correspondence, invariably quote the Manufacturers' number and type of car, which will be found on a small brass plate fixed to the instrument board.

The various diagrams in the book should be carefully studied; by so doing the owner will familiarise himself with the principal parts of the car, and it will help him to follow out the instructions.

The life of the car will be considerably protonged by moderating the speed for the first 1000 miles to 25/30 m.p.h., thus allowing the working surfaces to become well bedded down.

Bear in mind the old adage "Let well alone," and when the car is running satisfactorily, do not allow any experimenting with a view to making it run better.

DRIVING INSTRUCTIONS.

Before taking a new car out for a run, it is recommended :---

(1) That the chapter devoted to lubrication be carefully read over.

- (2) That the correct quantity of oil is in the sump, gearbox, and rear axle.
- (3) That a sufficient supply of petrol is in the tank.
- (4) That the radiator is filled with water up to just below the filler cap.
- (5) That the head lights are in order and all lamps burning brightly.
- (6) That the types are properly inflated.

TO START ENGINE.

The engine is arranged to start either by hand or by electric motor.

The motor is capable of turning the engine about 200 r.p.m.

It is recommended that the electric motor be generally used; the hand-starter to be used as an auxiliary in cold weather.

Pull out the magneto plunger switch.

Turn on the petrol, opening the cock on the AUTOVAC Tank fitted under the bonnet (on dash).

Flood the carburetter by means of needle valve extending through cap of float chamber.

Advance the ignition control lever on the steering wheel to the full extent of travel—outwards.

Open the throttle slightly (*i.e.*, outwards) by means of the control lever on the steering wheel. The best position for starting can only be determined by experience, but the lever should never be advanced so far as to cut out the sound of the petrol being sucked in from the pilot jet. Pull out the air strangler button and turn slightly to the right or left. If the engine fails to start in the first twelve revolutions, do not exhaust the batteries by uselessly keeping the switch in, but investigate the cause.

Continuous discharge of current at a high rate will cause disintegration of the plates, buckling, &c., and eventually destroy the battery, whereas it is quite capable of standing the heavy load imposed on it by the starter for comparatively short periods. Ten minutes' rapid discharge of continuous current, through the starter, would completely exhaust the cells, and probably place them beyond repair.

ENGINE.

Always open the throttle gradually, and never leave it very far open when the car is standing and the engine running light. Racing the engine, especially when it is cold, is most injurious.

The engine should be kept clean. The regular use of a stiff brush and a soft cloth moistened with paraffin is all that is necessary.

HAND STARTING.

Proceed as before, but in place of using the "starter" switch, push in the starting handle to engage with the crankshaft ratchet and pull up sharply against the compression—never under any circumstances press down (as in the event of a back-fire you run the serious risk of a badly sprained wrist)—and the engine will start; then gradually close the throttle until car is ready to drive.

CHANGE-SPEED QUADRANT.

There are four forward speeds and one reverse, the forward speeds being so arranged that the top gear is on the direct drive. Before starting the car for the first time, it is necessary to learn by heart the positions of the change-speed lever for the various speeds.

The change-speed lever is in the neutral position when directly vertical and opposite the gate in the quadrant.

For the forward speeds, the ball on top of gearchanging lever should not be touched; this is only used



FOOTBOARD, SHEWING VARIOUS CONTROLS.

when moving the lever through the gate or when changing into reverse. The gear positions are clearly shewn on illustration of Footboard given on previous page.

TO START CAR.

Release the hand-brake (which should always be put on when leaving the car), press forward the left or clutch pedal firmly; wait a moment so as to give the clutch shaft time to come to rest, then push the changespeed lever into the first speed position; it will slip into gear quite noiselessly if the clutch shaft has had time to come to rest. Occasionally, however, it happens that the teeth of the two gear wheels come directly opposite one another, and if this occurs, do not try to force the gear in, but bring the gear lever back to the neutral position. release the clutch pedal as before, and try the gear again. By this means the clutch shaft has revolved to a different position, and the gear will mesh. Release the clutch pedal slowly with the left foot, at the same time slowly depressing the accelerator pedal with the right foot, and the car will glide gently forward ; no initial shock should be felt if the clutch is properly manipulated.

LOW SPEED.

As soon as the car starts moving off on the 1st gear (i.e., on the low speed) lose no time when on the level in changing up to 2nd as follows:—Press down the accelerator pedal slightly with the right foot to increase the speed of the engine, at the same time gently releasing the pressure on the clutch pedal.

Before attempting to change into 2nd speed, let the car gain some headway.

2nd SPEED.

As soon as the car is well under way, release the accelerator pedal, press the clutch pedal slightly and pull the change-speed lever back into 2nd position; engage the clutch at once, and accelerate the engine as before.

3rd SPEED.

The change from 2nd speed to 3rd speed is made in a similar manner to that in the preceding paragraph.

4th SPEED.

Accelerate the engine until the car is moving forward rapidly, disengage the clutch and release the accelerator pedal. Move the lever lightly until you feel the top gear dog engages properly. The car is now in its normal driving gear.

To change "down "—*i.e.*, from a higher to a lower gear going uphill—the engine should not be allowed to slow down until it labours; the correct speed at which to change can only be learned by practice. In changing down, the clutch pedal should be only slightly pressed and the speed lever moved as quickly as possible, and until one is very proficient in changing, the foot should not be taken off the accelerator going from 3rd to 2nd. The change from 2nd to 1st should not be made until the car is going at not more than about 10 miles an hour. If the car is starting on an up-grade, it should be held on the side brake until the clutch begins to engage.

The easy gear-change is one of the features of ARROL-JOHNSTON cars, and if the foregoing instructions are carried out, no difficulty will be experienced in effecting the gear-changes noiselessly, and with a degree of ease hitherto unapproachable.

Do not attempt to start the car when the gears are in the 3rd or 4th position; to do so places a severe strain on the clutch and the driving parts.

Do not attempt to change gears until the clutch is disengaged.

In changing from a lower to a higher gear, it is necessary that the speed of the car be accelerated just before making the change, so that the two gears to be meshed are running at practically the same speed.

Practice will teach the driver not to accelerate too quickly. The engine will pull better if the accelerator pedal is pressed down slowly so that the throttle is opened gradually.

When the engine slows down owing to, say, a heavy gradient, practice will teach when and how the accelerator should be opened. If opened full, it is quite possible, in cases, for this action to reduce the engine power instead of increasing it.

TO STOP CAR.

Take foot off accelerator, press clutch pedal with left foot and brake pedal with right foot until the car stops, bring the change-speed lever to the neutral position, then release clutch pedal, put on the hand brakes, and if the car is to be left standing, switch off the current from the magneto.

By bringing the car to rest without using the brakes, the tyres will be saved to a considerable extent.

It will be readily realised that the foot brake is the handier brake of the two; therefore it is advisable to make a practice of using the foot brake whenever possible. Thus, when necessary, both brakes can be used together with ease and comfort.

TO STOP THE ENGINE.

Press home the plunger magneto switch and open the throttle slightly to allow the engine to take in a full charge of gas before coming to rest, and move the ignition control lever to the starting position. This will facilitate the re-starting up of the engine. In case of the car stopping a short time only, the engine may be kept running at its slowest speed—just ticking over.

TO REVERSE.

The car must be completely at rest before the reverse is put in.

Press the clutch pedal fully, press down the ball on top of the change-speed lever, pull the lever inwards through the gate and pull it backwards into the reverse notch, then very carefully release clutch pedal and accelerate cautiously until you feel that you have the car completely under control.

BRAKES.

The hand brake should always be put on when the car is stationary.

In going down long and steep hills, the hand and foot brakes should be used in conjunction, as the braking strain is thereby divided and there is less likelihood of the brakes running hot. On known dangerous hills or particularly long and steep descents such as are met with in Scotland, the engine forms an excellent brake. The engine speed-setting device is set until the throttle is almost shut (the current switched off), and the gear lever brought back to 2nd speed, or even 1st for very steep grades; the car is then easily kept in check with very slight application of either the hand or foot brake. This method of braking is not only very efficient, but is easy on the car and tyres, and, moreover, helps to cool the engine; but the engine speed should not be allowed to get too high—keep it down with one or other of the brakes.

SKIDDING.

If the brakes are applied suddenly, especially on slippery roads or when turning corners, the car is apt to skid. The only way to avoid skidding is to drive slowly, but when a skid does occur, release the brake momentarily and turn the steering wheel in the direction the car is skidding, but keep the clutch in gear.

GOOD DRIVING.

Consideration for passing vehicles and pedestrians. Quiet and easy acceleration. Minimum use of brakes. Slowing down when taking corners. Not over-lubricating.

BAD DRIVING.

Racing the engine unnecessarily. Jamming on the brakes at the last moment. Driving on the clutch. Using the brakes instead of slowing down when taking corners. Moving steering when car is standing.

CARBURATION.

PETROL SUPPLY (AUTOVAC FEED SYSTEM).

This consists of a storage tank of 10 gallons capacity practically built in to the chassis frame at the rear of car, and fitted with inlet plug, and filter over outlet pipe; air ventilator and copper piping to AUTOVAC tank under the bonnet, with piping connections to carburetter fixed direct on the engine block.

A descriptive booklet of this system is supplied with each car. This booklet contains the necessary information for installing and the working of the system, with numerous illustrations shewing in detail the working parts and their adjustment, with instructions when and how the various details should be cleaned.

CARBURETTER.

A Cox "Atmos" carburetter is specially made for the car, and is so arranged that the mixture flows from the carburetter through the passage in the centre of the cylinder block to the inlet valves, thus ensuring the mixture being heated up before it enters the cylinders.

The Makers' booklet is supplied with each car, and contains a full description of the design and working of the carburetter, with instructions for setting, in order to obtain the most economical results from the engine, but it is advisable to leave adjustment of carburetter as delivered from our Factory.

All joints in connection with the carburation system must be perfectly air-tight, to ensure easy engine-starting and slow running. The accelerator lever, fitted on the steering wheel and connected to the carburetter barrel throttle valve, regulates the quantity of mixture admitted to the cylinders and is arranged to give a fine control for slowrunning, allowing at the same time sufficient travel to open the throttle to its maximum.

Benzole can be used in place of petrol, with slight adjustments, but it is recommended that a mixture of not less than 25% benzole and the rest petrol be used to give the best results.

The main storage tank is fitted with three filters one in the filler and one in the outlet of tank; in addition, the AUTOVAC tank is also fitted with a filter. Thus the fuel is filtered three times before its entrance into the carburetter.

The filter fitted to the inlet of the storage tank, and the filter in the AUTOVAC tank, can readily be removed for cleaning purposes.

IGNITION.

The ignition is by a British high-tension clockwise magneto mounted on the near side of the crankcase, and driven by chain from the camshaft through a shaft fitted with a SIMMS-VERNIER coupling.

The magneto and throttle control rods are carried up the centre of the steering column, the operating handles functioning on a quadrant bracket carried on an extension of the column inner tube. The lower ends of the rods are fitted with levers for the rods coupling up to the magneto and carburetter.

Make and Break.

The platinum points when correctly adjusted are half a millimetre apart, or the thickness of the spring portion of special spanner. A booklet dealing specially with the magneto is supplied by the Makers. It is recommended that this booklet be carefully read through in order to familiarise the owner with the working parts of the magneto and its correct setting, as also with the necessary care to be taken to keep it in good order.

Ignition is controlled by the left-hand lever fitted to steering wheel, thus enabling the driver to advance or retard the time of ignition in the cylinders. When going full speed the ignition should be advanced (*i.e.*, outwards to its full limit).

SWITCH.

A two-way switch of the Plunger type is fitted to the instrument board for operating the magneto. When the switch is in the "PULLED OUT" position the magneto is functioning; in the "PUSHED IN" position, it is out of action.

WIRING.

If dismantled for any purpose, the wires should be carefully marked to ensure their being replaced in



proper sequence; otherwise the engine will not run correctly. The order of firing is as follows :—1, 3, 4, 2. No. 1 cylinder is nearest the radiator (see illustration).

BRAKES.

Both hand and foot brakes are adjustable, and operate on the large drums of the rear wheels ; each drum being fitted with two brakes, one operated by hand and one by foot.

The drums are rigid malleable castings of large diameter.

The brake shoes of cast-iron are lined with diepressed Ferodo. No lubrication is necessary.

The brakes can be adjusted by means of the turnbuckles under the floor-boards of the rear seat.

The back axle should be raised from the ground occasionally by means of lifting jacks and the brakes adjusted so that they act equally on both wheels.

TO REMOVE THE BRAKE DRUMS.

Make sure that hand and foot brakes are clear.

Jack up the car clear of the ground.

Remove the hub cap and wheel.

Draw out the axle shaft with driving dog.

Slack off the axle casing nut, locking plate and nut.

Withdraw the brake drum by hand. If stiff, fit a wheel puller on to the five wheel studs and tighten up the nuts equally all round, and the drum will come away.

CLUTCH.

The clutch is of the multiple disc type, functioning in the flywheel, and consists of a steel driving plate bolted to a hardened steel sleeve splined to slide on an extension of the gearbox primary shaft, and also on the crankshaft extension carrying the flywheel—the driving plate functioning between two Ferodo-lined plates.

The clutch is held in engagement with the flywheel by six helical springs contained in adjustable housings screwed into the fulcrum plate, and is operated by a foot pedal mounted on a cross shaft carried in the clutch chamber.

Two levers on the cross shaft are connected up by adjustable links to the trunnion bearing, which in turn regulates the adjustable fulcrum levers of the clutch.

When the foot pedal is pressed forward the six springs are compressed and the clutch is withdrawn from engagement. When the pedal is released the clutch automatically moves into gear.

An adjustable Ferodo-lined stop is fitted between the two levers on the cross shaft, arranged so that when the clutch is pressed out of gear the stop engages on the steel sleeve and brings the clutch to rest.

The clutch on an automobile should be either in or out absolutely.

Always engage the clutch gradually, and do not try to engage with a bang when the engine is racing.

It is better to throttle down the engine than to be constantly throwing out the clutch.

A well-adjusted clutch takes hold gradually, does not slip when engaged, and releases instantly when the pedal is depressed.

Oil or grease MUST NOT BE ALLOWED to get on the discs.

Slipping Clutch.—Provided the slipping is not due to oil or grease having got on to the discs, this can be taken up by means of the screwed caps.

To ensure the clutch operating properly, care must be taken in adjusting the screwed caps that the pressure is applied equally all round.

If oil or grease has got on the Ferodo discs, the clutch must be dismantled and the discs washed in paraffin.

To Adjust the Clutch.

If the clutch is worn and will not function-

- Adjust the three withdraw levers so that the point of the set screws strike the dowels on the fulcrum plate at the same time. This is done by means of the set screws at the end of the levers.
- (2) Adjust the three set screws so that when the clutch is in its normal position there is a space of 1 m/m between the points of the set screws and the dowel on fulcrum plate.
- (3) Lock the three set screws in place by the locking device arranged for that purpose.
- (4) The clutch pedal when properly adjusted should allow of a travel of about $l\frac{1}{2}$ before it commences to function or the pressure is appreciably felt.

LUBRICATION.

The splined end of the hub and the bush at the forward end are lubricated through a drilled hole in the clutch sleeve. A few drops of oil per day are required only. It must not be over-oiled.

SPEEDOMETER.

The speedometer registers the speed of the car in travelling, and also the total mileage run.

The speedometer drive is taken from the drive shaft immediately behind the universal joint through a pair of spiral gears, and connected by a flexible shaft to the speed dial fixed to instrument board.

The spiral gears are automatically lubricated from the change-speed gear box and through the small plug fitted on the top of the speedometer gear casing.

DETACHABLE WHEELS.

ROAD WHEELS.

Detachable steel spoke wheels are now fitted as a standard equipment.

It is most important that the wheels should be in correct alignment, otherwise there will be undue wear on the tyres, and the steering will be affected.

The front and rear wheels should "track" correctly, *i.e.*, they should both run in the same line.

FRONT WHEELS.

To assist the steering the front wheels are "cambered," that is, the wheels are set closer together at the bottom than at the top. They are also set inwards, *i.e.*, the distance between the centres of the tyre rims forward measured at the height of the centre of the wheel should be about $\frac{3}{16}$ " less than the distance measured at the rear. This set can be regulated by means of the cross tie-rod. In running, the wheels have a tendency to spread out, and if not enough or too much, the tyre treads grind.

The wheels are interchangeable, and are attached to the hubs by means of five studs and nuts (see illustration, page 31).

The fitting and detaching are simplicity itself. The only tools required are a special brace box spanner. and special lever, which facilitates the fitting of the wheel. These tools are supplied with the wheels, and are to be found in the tool tray.

To Change Wheels.

Jack up axle until wheel is clear of the ground. Unserew nuts by means of special brace provided. Pull off wheel

Fit spare wheel.

Replace and tighten nuts, taking care that these are screwed well home.

Grease hubs.



DETACHABLE SPOKE WHEEL AND FITTINGS.

ENGINE.

Four cylinders cast *en bloc*, of the internal combustion type on the 4-cycle system.

The cylinders are set to fire in the following order, viz. :--1, 3, 4, 2, cylinder No. 1 being nearest the forward end of the car.

Each cylinder has an inlet and exhaust valve operated by a camshaft through case-hardened steel tappets. The upper end of the tappet is arranged with an adjusting nut—locked in position by a split coned nut which binds on the tappet adjuster.

The tappets are of large diameter, working in phosphor bronze bushes, readily accessible for removal or adjustment.

The tappet guide bushes are lubricated from the crankcase and are held in place by strong yokes.

PISTONS.

Cast-iron pistons are fitted of special design, fitted with three split rings arranged to exert a constant pressure against the side of the cylinders.

REMOVING CARBON.

After the first 2000 miles, the combustion chamber and piston heads should be decarbonised. A rich mixture, or too much lubricating oil, will form a carbon deposit, an excess of which has a tendency to become incandescent and ignite the charges before the piston has finished its compression stroke, resulting in a knock in the engine.





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SKETCH SHEWING CAMBER AND RAKE OF FRONT WHEELS. The d stance "B" should be about 1³e" less than "A"—not more.

CYLINDER HEAD.

Is detachable, and water jacketed—arranged to take the sparking plugs, and containing the combustion chamber.

The exhaust pipe, water-cooled and ribbed, is also used as a cover for the induction pipe, which is thus jacketed, ensuring the gas mixture being heated before entering the cylinders.

VALVES.

These should be ground in periodically, as any defect in the seating of the valves means loss of power.

To Remove Valves :---

Remove detachable head, which is supplied with lifting lugs for easy handling.

Insert valve lifting tool to compress spring.

Withdraw cotter and remove collar.

Lift valve clear of cylinder.

To Grind Valves :---

Smear face of valve with emery compound.

- Replace valve, and, with screwdriver engaging slot of same, rotate backwards and forwards. Continue until a bright continuous line appears on the valve and seating. Do not continue to grind after this.
- Thoroughly clean with paraffin so as to remove all grit.

Re-insert valve and fit spring, &c.

Replace cylinder head (taking care that the studs are screwed down equally all round).

VALVE TAPPETS.

These are adjustable, and should be periodically, examined.

After engine has been running, test clearance between end of valve stem and face of tappet. The correct clearance between the face of the valve stem and the tappet should be 3-thousands of an inch for the inlet valve and 4-thousands of an inch for the exhaust valve.

Excessive clearance reduces free intake and exhaust of gases, with resultant loss of power and increased noise.

Insufficient clearance may mean that valves are not closing correctly, with resultant loss of power.

EXHAUST.

Consists of exhaust manifold, exhaust, and silencer. The silencer consists of a sheet-metal box fitted with baffles, perforated to direct the exhaust gases to travel the longest course, and impinging on the plate before finally leaving through the outlet pipe carried out to the back axle. This silencer should be taken down and cleaned once per year.

COOLING SYSTEM.

The cooling is effected by means of a radiator, a centrifugal pump, and fan mounted on the same spindle, and driven by belt from an extension of the camshaft.

The centrifugal pump delivers the water through the cylinder jackets to the cylinder head (the water passages being of large area at all points), and thence to the top of the radiator (*see* Power Unit at end of book).



ARRANGEMENT OF COOLING SYSTEM.

The radiator, fitted in front of the engine, is secured to the cross member of the chassis frame by spring bolts and the top stayed to the dash, and provides a substantial support for the front end of the bonnet.

To prevent overheating, see that the radiator is filled with clean water, the fan belt tight, and the water connections in good order.

The radiator is of cellular construction, having extra large surface to ensure efficient cooling under all conditions.

The aluminium fan is fitted immediately behind the radiator, providing a continuous circulation of cool air.

The "V" driving pulley on the pump and fan spindle is made in halves, and is adjustable to allow the belt slack to be taken up.

To tighten up the driving belt, slack back the two screws between the fan bosses, and, holding the rear half of the pulley in one hand, rotate the fan with the other. The adjustment amounts to over a belt link.

Be careful to replace the screws, and screw them hard home.

To empty the radiator, open the small tap fitted in the lowest part of the suction pipe.

The correct water level is just below the level of the filler cap.

GEAR BOX.

Internal combustion engines develop power in ratic to the speed—the higher the speed the more H.P. The change-speed gear is designed to take advantage of this, inasmuch as at times a car requires more power at low speeds than at high speeds, the gear box being used so that the high speed of the engine may be ratio'd down to the speed of the rear wheels in proportion to the gear ratios of the gear box.

When the change speed lever is in the neutral position, the constant speed mesh wheels are in gear only; hence the main (or secondary or sliding) shaft will not turn.

1st SPEED.

When the change-speed lever is moved into the lst speed notch, the low speed wheel on the secondary shaft meshes with the low speed wheel on the layshaft, and the car will move forward slowly.

2nd SPEED.

When the change-speed lever is moved into the 2nd speed notch, the 2nd speed wheel is moved forward and meshes with the 2nd speed wheel on the layshaft (the 1st and 2nd speed wheels on the secondary or main shaft are riveted together).

3rd SPEED.

The 3rd speed wheel on the secondary shaft is moved backwards, and meshes with the 3rd speed wheel on the layshaft.

TOP SPEED.

The 3rd speed wheel on the secondary shaft is moved forward, and engages with the stude on the end of the primary shaft.

REVERSE.

When the change-speed lever is moved into the reverse position, the reverse pinion slides into mesh with the 1st speed wheel on the secondary shaft, which again meshes with the 1st speed wheel on the layshaft.



ARRANGEMENT OF TORQUE BALL AND LINK.

TRANSMISSION.

The transmission comprises those parts commencing with the change-speed gear box to the rear road wheels. The drive is transmitted from the gear box through the drive shaft, and thence through a spiral bevel pinion and wheel to the axle shafts.

DRIVE SHAFTING.

The drive shafting transmits the power from the gear box to the back axle.

This shafting is in two parts, and made of special steel.

The short intermediate length fitted with flexible couplings connects up the gear box to the rear driving shaft which is enclosed in a steel torque tube, the forward end swinging on a universal joint to compensate for the rise and fall of the road wheels.

The forward end of the shaft is carried on a TIMKIN bearing housed in the universal joint.

The after end is carried on a TIMKIN bearing and housed in the flanged end of the torque tube.

DIFFERENTIAL.

The differential is an automatic device to allow the road wheels to revolve at different speeds when the car turns a corner, although both are driven by the engine.

The Differential Unit comprises the malleable housing with TIMKIN bearings and adjustable nuts, crown wheel, crown pinion, cross-piece pinions, and axle shaft wheels.

To Remove the Torque Tube and Differential Unit :---

- (1) Remove the three bolts of the spider coupling on the forward end of the rear drive shaft.
- (2) Remove the cover of the universal joint.
- (3) Slack off the nuts of the bolts connecting the differential case to the axle casing.
- (4) Draw back the axle shafts.
- (5) Draw out the unit.

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To Adjust the Mesh of the Crown Wheel Pinion :---

- Remove the six nuts of the studs in the torque tube flange connecting up to the axle casing.
- (2) Slack back the torque tube, and insert a thin shim or remove as required.

This adjustment should be made by an experienced mechanic.

To Adjust the Crown Wheel :--

Remove the axle centre casing cover.

Slack off the locking pin and plate of the bearing cap nut.

Adjust the nut.

After making adjustments, the locking devices should always be replaced before testing.

These adjustments should be made by an experienced mechanic.

The crown wheel runs in a continuous oil bath, ensuring ample lubrication to the differential gears, the erown pinion, and bearings.

REAR AXLE.

This is of the full floating type, the axle shafts transmitting the torque without carrying the load.

The axle housing consists of two solid drawn steel tubes, the inner end of each tube riveted and brazed into a malleable cast centre casing containing the differential or compensating gear. The outer ends are carried on TIMKIN bearings housed in the rear wheel hubs and secured in place by lock nuts and washers. The axle shafts float within the housing.



GENERAL ARRANGEMENT OF STEERING GEAR AND CONTROLS.

The inner end of the shafts are splined to take the pinion meshing with the driving pinions of the differential; the outer ends, tapered and fitted with a clutch gearing into the wheel hubs, transmitting the revolutions of the shaft to the road wheel.

The rear wheel hub plates house helical springs to prevent the shafts moving outwards.

The malleable cast centre casing is provided with a large portable door to allow access and inspection of the differential.

FRONT AXLE.

The front axle is a special steel forging " H " section. The stub axle is a one-piece drop forging of special steel.

The swivel pins are case-hardened and work in two gun-metal bushes top and bottom, the space between the bearings forming a lubrication reservoir supplied by "ENOTS" system.

STEERING GEAR.

The steering wheel is attached to a long tube forming the steering column—the lower end carrying a single thread worm engaging in a worm sector in the steering gear box; the sector shaft carrying the drop lever, to which is attached the drag-link connecting up to the steering yoke of the front axle.

The lower ends of the steering and column tube are carried on ball bearings, the end movement being taken up by a thrust washer. Steering Gear Controls.— The steering wheel is fitted with a quadrant on which is mounted control levers for the carburetter and ignition; the top of the steering tube fitted with a button for the horn.

FRONT SPRINGS.

The front springs are semi-elliptic, long and very elastic, mounted above the axle.

The centre of the springs is attached direct to the axle by spring clips; the forward ends to the dumb iron, the rear end to the chassis frame by shackle links and swivel pins, with large bearing surfaces.

REAR SPRINGS.

Semi-elliptic underslung, long and very elastic. The centre of the spring is attached direct to a bracket swivelling on the axle tube. Both ends are secured to the frame through strong \square shackle links, with large bearing surface for the swivel pins.

The springs are carefully designed to give easy riding at all speeds, and are fitted with leather gaiters to exclude dust and water.

SPRING CLIPS.

In the case of a new car, tighten up the clips after the first 500 miles, and afterwards examine them occasionally. Loose clips and bolts are almost invariably the cause of broken spring leaves; hence the necessity of making sure that the cap nuts are tight in place.

ELECTRICAL EQUIPMENT.

The starting and lighting are separate units. (For full particulars *see* Makers' booklet.)

DYNAMO.

The dynamo commences to charge at 700 r.p.m., and gives a maximum output of 9 amps. when cold, the output being slightly less after being thoroughly warmed up.

The dynamo is bolted up to an extension of the chain casing on the off side of the engine, driven from the crankshaft by a roller chain, and is mounted on an eccentric flange spigoted into the casing, with slots for holding-down bolts. The rim of the flange is notched for a spanner.

To adjust the chain, the four nuts of the holdingdown studes are slacked back slightly and the eccentric flange turned to suit. The full adjustment is equal to one chain link.

STARTING MOTOR.

The starting motor is a separate unit, and bolted to the change-speed gear box flange to the crankcase, and is coupled up direct to the accumulator.

The armature spindle is provided with a pinion which engages with a toothed ring on the periphery of the engine flywheel. Immediately the engine commences to fire, the pinion is automatically thrown out of mesh.

There are two sets of cables, one for the lighting system and one for the starting motor. All cables are in one length without joints or splices, and are carefully clipped to chassis frame to prevent whipping.

CIRCUIT DIAGRAM.

The internal wiring circuits of the electrical equipment are shewn on the circuit diagram. Disconnect the lead from the storage battery terminals before attempting to change any connections at the back of the lighting switch box.

AMMETER.

This instrument allows the owner to check the efficiency of the electrical system. It registers the nett amount of current generated by the dynamo when the engine is running and delivered to the storage battery, and also registers the amount of current the battery is furnishing to the lights when the engine is out of action.

BATTERY.

The battery is enclosed in a box fixed inside the chassis frame — near-side — and alongside the gearbox, and connected up to the dynamo and the electric system by heavy insulated cables.

Regular attention should be given to the battery. It should be inspected monthly for the purpose of checking the level of the electrolyte, the correct height being approximately $\frac{1}{4}''$ above the plates. Only distilled water should be added to replace the loss of the electrolyte.

BATTERY CHARGING.

The amount of charging which the battery requires depends upon the number of starts made and the extent to which the lamps are used. In winter the battery should be kept on charge all the time, and at about half the daytime running in the summer. Always keep the battery charging switch on when the head-lamps are in use.

For every tour in the daytime it is not necessary to keep the charging switch on all the time, as it will cause overcharging of the battery and a following reduction of the acid level.

WIRING.

The wiring should be periodically examined to see that there is no chafing and that all the terminals are tight. This applies specially to the battery.

TIMING.

ENGINE.

It is sufficient to time No. 1 cylinder, *i.e.*, the cylinder next the radiator.

- (1) Remove the sparking plugs.
- (2) Turn the engine clockwise until No. 1 crank is on the top centre.
- (3) Adjust the tappets so that there is 3 thous. clearance between the end of the inlet valve stem and tappet rods, and 4 thous. between the end of the exhaust valve and tappet rods.
- (4) Turn the engine round slowly. With the crank
 on top dead centre, the exhaust should be just closing and the inlet opening.
- (5) The magneto is set to fire on the top dead centre when in the fully retarded position.

On the face of the flywheel next the engine, the positions of No. 1 crank are marked.

When marking the flywheel be careful to turn the engine one way only, i.e., clockwise.

The tappets are fitted with adjusting nuts and locking device, so that once the correct clearances are obtained the tappet is locked in place.

MAGNETO.

Be careful to turn the magneto in its direction of rotation when setting distributor motor to No. 1 terminal

Examine the valves to be certain that No. 1 cylinder is on its firing stroke. Turn the engine slowly by hand until the crank of No. 1 cylinder is before top centre.

The timing lever of the magneto should be fully advanced and the magneto armature revolved in the proper direction until the fibre heel on the contact breaker touches the cam and the platinum points are just about to open.

The magneto driving shaft is fitted with a SIMMS-VERNIER Coupling arranged to allow fine adjustments—

- (1) If it is desired to alter timing of magneto with engine, remove bolt and slide engine half coupling out of engagement with rubber clutch.
- (2) Rotate magneto spindle together with rubber clutch a distance of one tooth in the desired direction; mesh rubber clutch with engine half coupling and rotate magneto spindle only a distance of one tooth in the opposite direction.
 - Rotating the magneto spindle to the right, in respect to the engine, retards it on a R.H. magneto.
 - Ditto to the left, advances it on a R.H. magneto
 - Rotating magneto spindle to the right, in respect to the engine, advances it on a L.H. magneto.

Ditto to the left, retards it on a L.H. magneto.

- The half couplings have 19 and 20 teeth respectively, and the adjustment is therefore 1/19-1/20 =1/380th part of a revolution, or rather less than 1°.
- (3) Bring up both rubber clutch and engine half coupling to mesh with magneto half; mesh and bolt up as before.
- (4) Allow 0.5 m/m total play in Rubber part of Magneto coupling.

All cables are carefully clipped to chassis frame to prevent whipping.

The spark should always be so regulated that the engine will not knock or lose power. With a retarded spark and running for any length of time, the engine will heat up.

All cars are supplied with a copy of the magneto Makers' instruction book, which details clearly the working parts and the method of handling and upkeep of same.

SPARKING PLUGS.

The correct gap between the plug electrode is '030'.

" ENOTS " HIGH-PRESSURE LUBRICATING SYSTEM.

Attention to regular and systematic lubrication is absolutely necessary to ensure comfortable riding and car efficiency. The "Enots" system comprises a grease gun, flexible tube, and lubricating nipples to all shackle pins and to the rear spring swivel bearings.

Charging the Gun.—Unscrew the knurled cap from the barrel; withdraw the plunger (a strong pull is necessary). Spin the cap down the screw to its utmost limit until it covers the cup leather plunger. Fill the gun with grease, packing as solid as possible. The cap should be replaced and screwed down by hand only, until it is tightly home. The grease-gun is then ready for use. Soft clear grease is essential, and is more efficient than heavy grease.

The flexible tube allows easy access to lubricating points, which ordinarily are somewhat difficult of access and thus are liable to be forgotten or overlooked.

Before applying the gun, make sure that the nipples are quite clean, and that no dirt of any kind is forced into the bearings.

The patent Quick Detachable Pressure-tight Coupling at the end of the tube is attached to the connection nipples. The handle of the gun is given a few turns, as required, at each part to be lubricated. Use hands only in operating gun. A pressure of 600 lbs. can be exerted on the bearings if required, and all old, dirty grease expelled.

Immediately the patent coupling is disconnected, the grease flow is instantaneously stopped, and no matter what pressure be then put on the gun the extrusion of grease becomes impossible.



The flexible tube should always be kept as straight as possible ; it should not be bent round unduly sharp corners.

All flexible connections are tested to pressure of 1000 lbs. per sq. inch before being despatched from the Works.

In the event of the valve leaking, remove nut immediately behind Connector Body (14), remove spring (12) and valve (13), carefully clean seating of each, and replace. Leakage will not occur if clean grease is always used.

All spring shackle pins and the rear spring swivel bearings are fitted on this system.



OPERATING "ENOTS" GREASE GUN.

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GENERAL LUBRICATION.

This subject is of the utmost importance to the owner-driver, and by adhering strictly to the following instructions he may rely upon efficient running, absence of wear in running parts. and all-round general comfort and efficiency.

Referring to the Diagram at the end of the book. the following summary will readily be grasped :--

ENGINE.

The ARROL-JOHNSTON system of forced feed engine lubrication has been the subject of special attention for many years, and has been improved and developed until it is undoubtedly the most satisfactory system in present-day use.

A full charge of oil, amounting to 14 pints, is first poured through the filler breather into the crankcase. A gear pump with suction filter driven from the crankshaft is fitted in the lowest part of the crankcase, and circulates the oil continually through a combination of pipes and through the drilled crankshaft and crankpins to the main bearings and connecting rod big ends.

An ample supply of oil escapes from these bearings to thoroughly lubricate the cylinder walls, gudgeon pins, camshaft, tappet rods, and guides.

The CAMSHAFT, DYNAMO, and MAGNETO Driving Gears are arranged to run constantly in oil (see Power Unit print at the end of book).

The front and rear spring shackle pins and the rear spring swivel bearings are arranged for the "ENOTS" grease-gun system.

LUBRICATION.

The oil, after passing through the different bearings, falls into the crankcase and finds its way into the oil sump, in which is placed the oil pump, and, passing through the filter, is again pumped through the system, the oil being used over and over again. With a new car it is advisable to drain off the oil after running about 500 miles, and replenish with new oil.

The pressure in the system depends upon the quality of oil and its temperature. On first starting up in cold weather with thick oil, the pressure may be 140/150lbs. per sq. in. Once the engine is warmed up, the pressure will average from 15 to 20 lbs. per sq. in. with the car running 25 miles per hour.

The filter is so placed as to exclude foreign matter from the oil circulation, and should be thoroughly cleansed with paraffin before replenishing the crankcase with oil.

To Adjust Oil Circulation.—The oil pump forces the oil through the spring-loaded bypass valve, through a combination of pipes and drilled holes, through the crankshaft and crankpins to the main bearings and connecting rod big ends. An ample supply of oil escapes from these bearings, and which is thrown up by the rotating parts to thoroughly lubricate the cylinder walls, gudgeon pins, tappet rod rollers and guides. The volume of oil passing through the system is regulated by the spring-loaded bypass valve. To increase the flow, screw down the nut "A," compressing the spring. To decrease the flow, slack back the nut "A." Once the volume is settled, the spindle should be carefully locked. All the oil drains back into the crankcase, and must pass through the pump filter before it again circulates through the system.



OIL PRESSURE RELIEF VALVE.

Tighten locknut after making adjustments.

Excess lubrication will cause smoky exhaust, and will probably give rise to sooty sparking plugs.

Insufficient lubrication may cause the bearings to "run" or the pistons to seize in the cylinders.

CRANKCASE.

To check the level of the oil, unscrew the oil gauge rod situated on the near-side at the end of the crankcase behind the magneto and in front of the flywheel. The rod is provided with a knurled head for ease of handling, and is marked shewing the correct depth of oil in the crankcase. If the oil level is found to be below the graduated mark, add sufficient oil until it reaches the mark, but not higher.

To drain the crankcase, slack off the drain plug.

The crankcase should be drained when the oil is hot, immediately after a run, in order to draw off all foreign matter which may be in suspension in the oil. Draining the crankcase when cold allows foreign matter to separate and adhere to bottom and sides of sump.

When all the oil is drained out of the erankcase, pour in half-a-gallon of paraffin. Motor the engine round for about 30 seconds with the self-starter, the engine switched off. Give a few turns of the startinghandle and motor round a second time for a further 30 seconds. Afterwards drain off the dirty paraffin, and pour into the crankcase a quart of lubricating oil. Motor the engine round about a minute, and then drain off the oil and paraffin, and fill up the crankcase with oil. Valve Spindles.—In the event of the exhaust valves shewing signs of sticking, provision is made on the induction pipe to allow injecting oil or paraffin on to the valve stems. A little oil drawn in through the carburetter occasionally is useful in preventing sticking valves. Introduce the oil through the carburetter air intake pipe, using the oil-can for this purpose.

CLUTCH.

The clutch withdrawal gear joints and pins should be given a few drops of oil regularly.

GEAR BOX.

A full charge of oil amounts to 31 pints.

. The correct oil level is marked on the dipper housed inside the casing.

If the oil is found to be below this mark, add the requisite quantity to bring it to the correct level, but not higher.

Every six months, or after two thousand miles' running, the old oil should be drained off by removing plug at the bottom of casing. Clean out with paraffin and fill in new oil.

The change-speed gear shaft bearings should be lubricated occasionally through the small holes provided for that purpose.

REAR AXLE.

A full charge of thick oil for the axle casing is $l\frac{1}{2}$ pints.

The correct depth of oil is marked on the dipper housed inside the casing.

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To replenish the axle casing, remove the rear seat cushion and lift up the hinged seat; remove the cover of the oil filler immediately beneath the seat.

To ascertain if additional oil is required, screw out the dipper and note if the oil level is below the mark. Add sufficient oil to bring the level up to the mark, but not higher.

The correct time to check the oil level is after a run, when the oil is warm and in a freely liquid state.

Be careful to screw the dipper hard home when replaced.

The lubricant finds its way along the axle shafts, automatically lubricating the ball and thrust bearings.

Provision is also made for lubricating the hub roller bearings through a tapped hole covered by the road wheels.

Drain the rear axle every 3000 miles; wash out with paraffin and refill to the correct level. Gear oil is easily poured by warming before use.

SPEEDOMETER GEAR.

Automatically lubricated from the change-speed gear box and through the small plug fitted on the top of the speedometer gear casing.

HAND-STARTING BRACKET.

Examine regularly, and fill the lubricator with cil when required.

Occasionally apply a few drops of oil to keep the celluloid grip from binding on the starting handle.

FRONT AXLE.

Thin grease should be well packed into the hubs and the hub cap filled, so that, when screwed into place, the grease will be forced well back into the inner bearing.

This should be done monthly in order to prevent possible ingress of mud and dirt into the delicately adjusted ball bearings.



STEERING RODS.

Additional provision is also made for lubricating the hub roller bearings through a tapped hole in the corner of the hub covered by the hub cap nameplate.

The vertical swivel pins are lubricated by "ENOTS" grease (see oiling chart).

STEERING RODS.

The ball and socket joints are automatically lubricated from the oil reservoir contained in the end of the hollow rods (see illustration), and should be examined and refilled after 500 miles' running.

SPRINGS.

The leaves of the springs are well greased when assembled, and being completely covered in by gaiters, do not require to be re-greased until after 5000 miles on the road.

By jacking up the frame, slacking back the box shackle pins and the clip bolts securing the spring to axle, the springs can be taken down, and the leaves separated and re-greased.

STEERING GEAR BOX.

Should be replenished with thick oil (see Chart).

The operating spindle should occasionally be given a few drops of oil through a small hole drilled just above the footboard covered with a spring clip.

BRAKES.

The way-shafts, fitted under the chassis frame and carrying the intermediate brake levers, run in oil-less bearings.

The brake lever pins should be given a few drops of oil occasionally.

It is most important that the lubrication of the brake-gear parts should be carefully and methodically attended to.

FAN.

A screwed lubricator is fitted to the bearing, and should be attended to daily and kept packed with grease.

PUMP-WATER.

A screwed lubricator is fitted to the pump bearing,

and should be attended to daily and kept packed with grease.

CONTROLS-MAGNETO AND CARBURETTER.

A few drops of oil occasionally are necessary on the joints and pins.

EXHAUST BOX.

This should be examined for obstructions every twelve months, taken down, and thoroughly cleaned.

MAGNETO.

Depending upon the make of magneto.

Fellows.—Arranged for automatic lubrication, and will last for several years without having to be replenished.

DYNAMO.

The end of the motor next flange is fitted with a grease cup.

HOOD HINGES.

A few drops of oil monthly.

DOOR HINGES.

A few drops of oil monthly.

DOOR LOCKS.

A few drops of oil monthly.

"VACUUM" OILS SUITABLE for LUBRICATION of ARROL-JOHNSTON CARS.

ENGINE.

Gargoyle Mobiloil "BB" for Summer.

GEAR BOX AND BACK AXLE.

Gargoyle Mobiloil "C."

HUB-FRONT.

Vacuum Transmission Grease (Light).

SPRINGS-FRONT AND BACK.

Gargoyle Graphite Grease (Medium).

OTHER PARTS.

Vacuum Transmission Grease (Light).

IMPORTANT.

OWNERS OF "ARROL-JOHNSTON" CARS REQUIRING ADJUSTMENTS OR OVERHAULS ARE STRONGLY ADVISED TO HAVE THESE CARRIED OUT, WHERE POSSIBLE, BY ACCREDITED ARROL-JOHNSTON AGENTS.

TOOLS AND ACCESSORIES

FOR

15.9 h.p. ARROL-JOHNSTON CAR, TYPE "F.K."

One " Enots " Grease-Gun. One Lifting Jack. One Tyre Inflator and Adaptor. One Pair of Pliers. One Screwdriver. One Valve Lifter Lever and Bracket. One Large Adjustable Spanner. Two Sets D.E. Spanners $(\frac{1}{8}'' \times \frac{3}{16}'')$; $(\frac{1}{4}'' \times \frac{5}{16}'')$. Two Sets D.E. Spanners $(\frac{3}{8}'' \times \frac{7}{16}'')$; $(\frac{1}{2}'' \times \frac{5}{8}'')$. One Magneto Spanner. One Combined Rear Hub Locking-Nut and Stub Axle-Spanner. Cylinder Nut Spanner. One Tubular Sparking Plug Spanner. One Tubular Spanner and Tommy Bar $(\frac{1}{4}'' \times \frac{5}{16}'')$. One Oil Can. One Screwed Oil Dipper (in crank case). One Brace for removing Detachable Wheel Nuts. One Hand Hammer. One Tool Box (under rear seat footboard). One Built-in Tool Box (rear seat). One Jack Handle (under front seat). Three Tyre Levers. Two Tappet Spanners. One Oil Filler.

TERRITORIAL DEALERS.

Aberdeen .		Claud Hamilton (Aberdeen), Ltd., 254 Union St.
Aberfeldy .		A. Mackerchar, Bank Street.
Altrincham .		J. Richardson & Son, Unity Garage, Dunham
		Road.
Andover .		Anna Valley Motors, Ltd.
Ayr		Claud Hamilton, Ltd., King's Garage.
Barnstaple .		F. W. Squire, Royal Mews Garage.
Belfast		Leslie Porter, Ltd., 24-30 Great Victoria Street.
Bexhill-on-Sea		L. Russell & Co., Station Road.
Birmingham .		John Chilton & Co., 71 Broad Street.
Blackburn .		Crompton & Davies, Ltd., Simmons Street.
Blackpool .		King's Hall Motor Co. (Blackpool), Ltd., Rigby
		Road.
Bolton		The Bolton Motor Co., Ltd., 3 Marsden Road.
Bournemouth		The Westover Garage, Ltd., Westover Road.
Bradford .		The Grange Motor Co., Woodhead Road.
Bristol		Kensington Motor Garage, Royal Park, Clifton.
Burnley .	· · ·	W. H. Harrison (Burnley), Ltd., The Motor
		House.
Cardiff		J. Parsons & Co., 155 City Road.
Carlisle .		The County Garage Co., Ltd., 14a Botchergate.
Channel Island	s.	Central Garage, Guernsey.
Chelmsford .		Pollard's Garages Ltd., Broomfield Road.
Cheltenham .		H. G. Norton & Co. (1917), Ltd., High Street.
Chester .		J. Pullan & Co., Ltd., 22 Frodsham Street.
Church Stretton	n.	The James' Garage, Ltd., High Street.
Cork		P. J. O'Hea, Patrick's Quay.
Crieff		Harold Barrington, Motor Agent.
Derby		Andrews' Garage, London Road.
Devizes .		Ward's Motors, The Brittox.
Dorchester .		E. Channon & Sons, High Street.
Dublin		L. S. E. Motor Co., Ltd., 46 Benburb Street.
Dumfries .		The Dumfries Motor Co., Ltd., 101 English St.
Dunfermline		J. Goodall & Co., 58-60 Queen Anne Street,

Edinburgh			Peebles Motor Co., Ltd., 89 Haymarket
			Terrace.
Egremont (Cumb.	.)	J. F. Stout, Market Place.
Forres .			Morayshire Motor & Engineering Co., Ltd.,
			Vulcan Works.
Glasgow			Claud Hamilton, Ltd., The Garage, Smith
			Street, Hillhead.
Grantham			The North Road Garage, Great Ponton,
Grimsby			Fred Llovd (Motors), Ltd. Nun's Garage
			Laceby Road.
Guildford			A. Grav & Co., Ltd., 7-8 Woodbridge Boad
Gullane			Arthur Stoddart & Co. Notor Agents
Hay (Herefo	rdshi	re)	T. J. Madigan Garage
Helensburgh			Macfarlane & Cilmour, Ltd. 1 West Clude St
Huddersfield			Sykes & Moorhouse 12-14 Albion Street
Hull		ċ	Nessrs Paragon (Hull) Noton Co. Itd
		•	Anlaby Road
Inverness			Douglas H. Hunton, Clonallym Canara V.
III VOI IICSS	•	·	Street
Irvine			B Korn & Song Itd. Calden Come O
nvinc .	•	•	Road.
Isle of Man			Athol Notor Garage Ltd Hill Street Douglag
Isle of Wigh	nt		Percy C Alford Vork Avenue East Cowos
Kendal			H. J. Croft. 90 Highgate
Lancaster		÷.	Ashton Motors Narket Square
Leeds	•	•	J. Mortimer, 9 Aire Street
Leicester	•	•	Norman Costes Ltd Market Street
Lerwick		•	Zetland Wotor Engineering Co. Commendate D.
Lincoln	•	٠,	Cilbert & Son Itd. 22 Della Statistical Rd.
Livernool	•	•	Tom Component de 20.22 Head
Llandrindod	Wolls		Tom Vorten, Ltd., 20-22 Hardman Street.
Llandudno	w ens	,	I landudna Matar & G. G. (D. 1 G.
Lianuuuno	•	•	Liandudno Motor & Garage Co. (Red Garages),
London			The Levenett Keenter Co. Ltd. 70 D.
Bondon.		·	Street Orferd Street W 1
			C Park Itd 116 Great D 11 1 2
,, ·	•	÷.	Demon K. Bran 159 H. Di land Street, W. 1.
,, ·	• 1	•	Dawson K. Bunn, 153 Upper Richmond Road,
Manahastar			Futney, S.W. 15.
Manchester	•	•	Tom Garner, Ltd., 12 Peter Street.
Midalesporou	gn	•	Fred Burr & Co., Ltd., 30 Newport Road.
Montrose			Archibald's, Ltd., Motor Dealers.

Nairn	Knowles & Cumming, 9-11 Bridge Street.
Newcastle-on-Tyne	Frank Scott, 84 Percy Street.
Newcastle (Staffs) .	Newcastle (Staffs) Motor Co., Ltd., Bagnall St.
Newport-on-Tay .	John T. Young, Ltd., The Motor House.
Norwich	Delves Motors, Ltd., The "Rinkeries" Garage.
Nottingham	Bennets (Nottingham), Ltd., 24 Shakespeare St.
Old Colwyn	Llandudno Motor & Garage Co., Olympia Red
	Garage, Abergele Road.
Penrith	H. J. Croft, The Garage.
Perth	J. Macfarlane & Sons, 11 York Place.
Peterborough	Brainsbys Ltd., Broadway.
Preston	Loxham's Garages, Ltd., Charnley Street.
Reading	Great Western Motors, Ltd., Station Road.
Salisbury	J. Bevins, Speedwell Garage, Southampton Rd.
Skegness	Carter & Rickett, Cavendish Garage, Roman
	Bank.
Southport	Central Garage (Southport), Ltd., 239 Lord St.
Southsea	A. J. Biggs, 76 Marmion Road.
Stirling	Central Scotland Motors, Ltd., 37 Barnton St.
Torquay	Messrs Charles Moxham & Co., Torwood St.
Truro	Taylor's Transport Co., Ltd., Lemon Quay.
Wellington (Salop)	C. A. Ensor, Bridge Road.
Whitchurch (Salop)	J. Hopley & Son, Dodington Motor Works.
Wigan	H. H. Timberlake, Ltd., King Street.
Wrexham	Wrexham Motor & Electrical Engineering Co.,
	Chester Street.
Yeovil .	F. F. Burge, Alexandra Garage.
York	Gibbs & Co., Fawcett Street, Fishergate.

SUB-AGENT5.

Burnley		Lees Motor Works, Harle Syke.
Dundee.		Midland Motors (Dundee), Ltd., Baffin Street.
Stafford		Boulton Bros., 11 Newport Road.
York .		The Northern Motor Utilities, Fosse Island
		Road.

LICENCE APPLICATIONS.

The following information is necessary when applying for a licence :-

Type of Body :	Touring, All-Weather, or Saloon.
Colour :	
Engine :	Internal Combustion.
Make :	Arrol-Johnston.
Description of Car :	15.9 h.p., TYPE "F.K."
Number of Engine :	See number stamped on left-hand size of crankcase.
Number of Cylinders :	Four
Bore of Cylinders :	80 m/m.

120 m/m.

Stroke :

COMMON CAR TROUBLES.

Difficulty in Starting will be experienced under any of the following conditions :--

- (1) Petrol is not turned on, or not sufficient in tank.
- (2) Switch is not "on."
- (3) Throttle insufficiently open.
- (4) Throttle open too far.
- (5) Carburetter flooding.
- (6) Sparking plug points too far apart, or points dirty.
- (7) Valves sticking in guides.
- (8) Contact maker on magneto sticking--see that this works freely.
- (9) Induction pipe joints drawing air.
- (10) Switch wire to magneto "shorting"--disconnect this and try again.

The remedies for some of the above are obvious, and in the next few paragraphs the more common troubles are dealt with at length.

Short Circuit at the sparking plug may be due to the intense magneto spark melting the electrodes, forming small beads of molten metal which may bridge the sparking gaps. This is a fault which is readily seen and remedied by removing the metallic bead.

The sparking plugs may also be put out of action by carbon deposits on the electrodes. Plugs in this condition should be washed in petrol.

Ignition Fails Suddenly.—Usually due to a per manent short circuit brought about by the earthing

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cable from the terminal coming permanently in contact with the frame. To test this, remove the wire from the terminal on magneto. If this does not cure the fault, remove the distributor disc, inspect the distributor carbon brush and make sure the brush is in good order.

Irregular firing may be due to incorrect working of the contact breaker. Remove the cover, see that the locknut of the contact breaker is well tightened up, that the bell crank lever moves freely on its pivot (from which it is insulated by a fibre brush), and that the platinumpoints are \cdot 5m/m apart when the bell crank lever is rocked by one of the segments of the steel cam. If necessary, the contacts should be carefully cleaned, and any oil or grease removed. If the examination has not led to the discovery of the fault, and it is impossible to start the engine, the timing of the ignition should be verified. If the timing is correct, the magneto should be returned to the MAKERS; no further dismantling is advisable.

All the rubbing contacts and collecting brushes should be examined and carefully cleaned once a month.

Popping into Carburetter.—This is usually caused by (1) shortage of petrol, but may also be due to (2) pre-ignition from carbon deposit, (3) defective sparking plugs, (4) a wrongly connected wire on the magneto, or to (5) sticking valves. Examine petrol tank to see if petrol has run short, also the float chamber of the carburetter to see if water has got in—this is a very frequent cause of popping on cars not fitted with a petrol filter between tank and carburetter. The petrol filter should be cleaned once every week at least—petrol should never be put into the tank except through the fine gauze strainer. Knocking.—If intermittent, may be due to preignition caused by a small particle of carbon on the pistons or cylinder heads becoming incandescent. If continuous, when the engine slows down on an upgrade, may be overcome by changing at once to a lower gear. The engine should never be allowed to knock, the change to a lower gear being effected before it has a chance to labour.

Loss of Compression.-A frequent source of loss of power is faulty compression; this is especially marked on hills, as the efficiency of the engine is greatly reduced, Loss of compression is generally due to leaky valves. The easiest method of locating faulty compression is to switch " off " the ignition, open the throttle-control lever on the steering wheel to its fullest extremity, and then turn the engine round slowly. If the compression of one cylinder is "easier" than the others the trouble is here, and it should be at once rectified. The offending valve should be located, and then make sure that there is the correct amount of clearance between the valve stem and the adjustable tappet when the latter is at the lowest point of travel; if this is correct, the valve spring and cotter should be removed and the valve bodily removed from the engine. Carefully clean the valve and its seat with petrol, and then proceed to grind in the valve as per the foregoing instructions (page 32). It is also advisable to test all joints on the carburetter and inlet system by the same means when looking over the valve gearing.

Another source of loss of compression or power is sometimes the piston rings, which may possibly have turned round, allowing the slots to come in line, thus allowing the gas to leak past the pistons, or become stuck in their slots, due to too much oil. The remedy for this is to fit new ones. It will take some little time for the rings to become gas-tight; so, even if after fitting new ones the compression is not great, it will probably increase as the rings wear in.

BODY.

Consists of a wooden frame covered with steel panels, and is bolted down to the chassis frame. The holding-down bolts should be examined regularly and tightened down if required. By so doing, body squeaks are prevented.

WINDSCREEN.

The top half of the windscreen is of V-shape for Saloon and All-Weather cars, and adjustable by swinging the glass outwards, thumbscrews being fitted to hold the glass at any desired angle.

CARE OF THE CAR.

Frost.—If frosty weather is expected and the car is not kept in a heated garage, always drain the water off if it is to be left standing for any considerable time.

Split Pins and spring washers should always be replaced after dismantling any part. This is most important—should any be forgotten or left out, serious damage may result. If any part has to be taken down, all nuts and washers should at once be screwed loosely on their respective bolts, and, together with the other parts, placed carefully away in boxes to avoid any chance of loss. Nuts should always be slackened by means of the spanner provided, and NOT WITH A HAMMER AND CHISEL. Paraffin oil freely applied and allowed to soak into the threads, at the same time gently tapping with a hammer, will often help to loosen a nut that is jammed or rusted up.

Care of Tyres.—Reckless use of the brakes or clutch, and rounding corners at a high speed, bring severe strain on the tyres, thereby greatly shortening their life. Remember that to get the best results from your tyres it is absolutely essential to have them inflated to the correct pressure. (Each tyre manufacturer specifies scales of pressures.) They should be frequently tested by a tyre pressure gauge, which can be bought from any of the large tyre manufacturers at a reasonable price.

A punctured tyre must be attended to immediately, even though the car is a few yards from home; otherwise the cover, tube, and perhaps the rim, will be irretrievably damaged. The tread of the tyres should be examined from time to time, any stones embedded therein removed with the point of a knife, and the damaged place vulcanised or temporarily stopped with one of the various compositions made for the purpose, thus preventing wet getting in and rotting the canvas of the cover. Further information about tyres is given in the pamphlets issued by the various tyre companies.

Care of Coachwork .- There is no reason why a motor car cannot be maintained in a similar condition to a horse carriage. The secret of success in this respect is to use an abundance of clean water till every speck of dust and mud is removed. It is most important that the car should be hosed down before mud has time to dry on hard and cake, as nothing tends more to scratch paintwork and ruin the varnish. After hosing down carefully, wash the body over with one of the special sponges sold for the purpose, using plenty of clean water. The car should then be dried with chamois leathers which have previously been well soaked and wrung out. When the car is new the varnish may be slightly sticky and easily marked; nothing is better for hardening the varnish than plenty of clean cold water. The upholstery should be washed with a clean sponge every time the car is cleaned, and carefully dried with a chamois in the same way as the coachwork. A little paraffin may be used for removing grease or oil from the wheels. but should be sparingly employed, as it tends to take off the gloss. When cloth and lace are fitted they should be brushed with a good quality brush, having a short point to get into the corners.

Care should be taken that both the Touring Hood and the All-Weather Hood be carefully lowered and stored properly. Envelopes are provided for this purpose.

Never fold a hood when it is wet; see that it is thoroughly cleaned and dry before folding.

In Conclusion.— The time and work spent in keeping a car thoroughly clean and in spick-and-span condition will be more than compensated for by the pleasure and pride of owning such a vehicle, and by the smallness of depreciation which such care must inevitably entail.

We shall at any time be pleased to place the services of our technical staff at the disposal of any of our clients who experience any difficulty not covered by the foregoing instructions.





