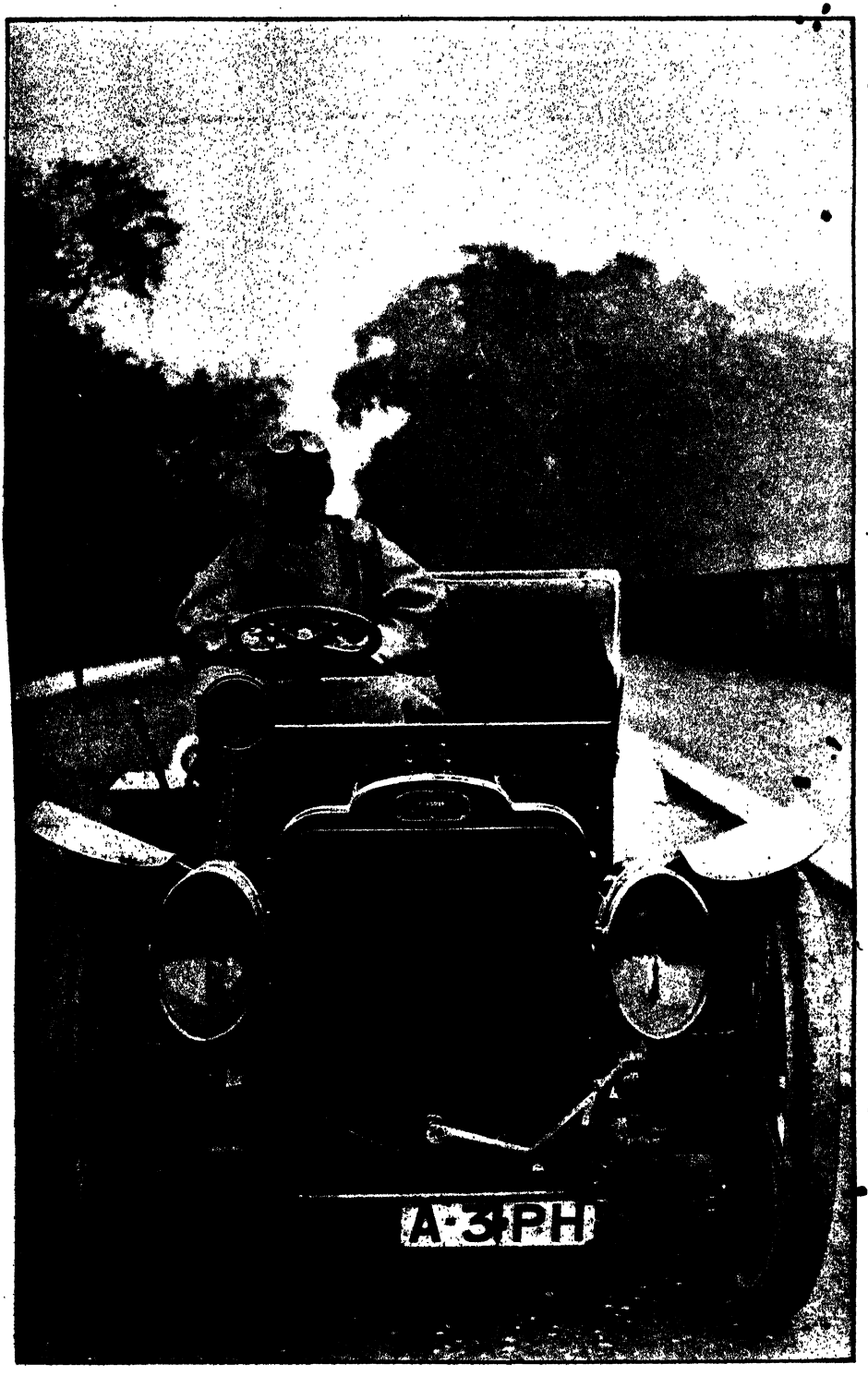
THE CAR LIBRARY.

CARS & HOW TO DRIVE THEM.—PART I.

(Third Edition.—Completely Re-written.)



CAPTAIN CECIL BANBURY ON HIS 40 H.P. MORS.

THE CAR LIBRARY.

Cars and How to Drive Them.

PART I.

(Third Edition.—Completely Re-written.)

EDITED BY

THE HON. JOHN SCOTT MONTAGU, M.P.

CONTRIBUTORS :

CAPTAIN CECIL BANBURY, J. E. HUTTON, S. F. EDGE, F. W. LANCHESTER,
C. W. DIXON, G. F. PEDLEY, CAPT. CORBET, CECIL EDGE, H. AUSTIN,
A. M. THOMSON, A.M.M.E., F. COLEMAN, J. W. STOCKS,
W. L. MC BRIDE, F. G. LEWIN.

LONDON

"THE CAR—ILLUSTRATED," LIMITED,

PICCADILLY MANSIONS, 17, SHAFTESBURY AVENUE, W.

CONTENTS.

INTRODUCTORY.

THE third edition of Part I. of *Cars and How to Drive Them* has been rendered necessary by the success which has attended the previous editions. For the new volume the articles have been completely re-written, and in every case the text has been amplified by illustrations of the various parts of the mechanism so as to more readily acquaint the reader with the details of each car.

The writers of the various articles are men well qualified to give reliable instruction as to the handling of the cars, and as they are almost without exception men who are very busily occupied, it was no small task for them to write special articles for this book. The fact, however, of having so many contributors necessarily led to some delay in completing the volume.

It is obviously impossible to treat at full length mechanical details in an unpretentious work of this description, but sufficient information will be found to give a novice much useful instruction in the care and management of his car, and the experienced automobilist can also learn of other systems, and possibly further instruct himself in a knowledge of his favourite machine. Again, those wishing to compare one kind of automobile with another will be able to do so.

I have kept the articles to a medium length, as I do not think that any particular car needs a volume to be written on it nowadays. The writers, being thorough masters of their subject, have been able to summarise into these articles a considerable amount of information, and thus the idea of the book has been well carried out.

Of course; no amount of book learning will make a skilful motorist either from a mechanical or purely from a driver's point of view. Daily experience in the shed and on the road is the only way to thoroughly understand a motor-car; but a book which gives initial hints and deals with peculiarities of special systems is sure to be useful.

My best thanks are due to the several writers who have assisted me in the compilation of this volume, and I trust that my readers will duly profit from these pages.

J. S. M., *Editor*

THE MORS.

By Captain Cecil Banbury.

SIMPLICITY is surely one of the chief objects to be sought after in the construction of motor-cars, since reliability is almost entirely dependent upon it, provided, of course, that first-class material and workmanship are employed. I hope to be able to point out that in this respect Mors cars are at least equal to any of their competitors, not only with reference to their engines, but also in their gear-box, etc. Their history and records have been so constantly before the motoring world that it seems unnecessary to refer to them again here, and so I will endeavour to describe the present models and to give a few hints to the uninitiated as to how to drive them.

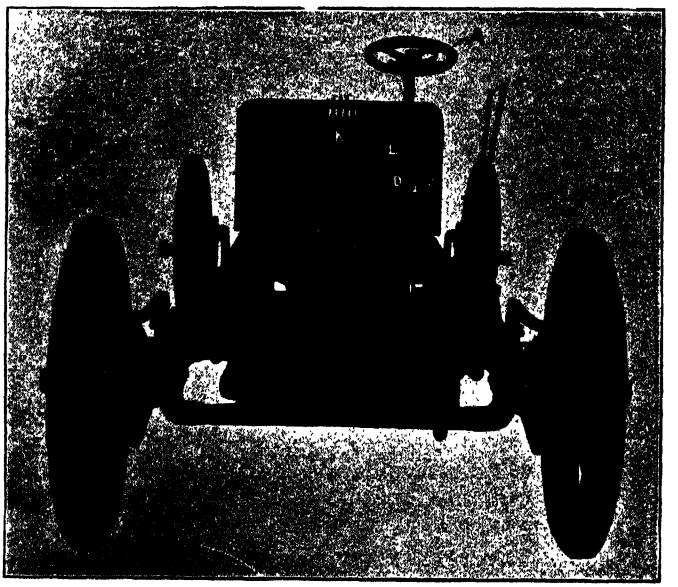


FIG. I. THE MORS CHASSIS.

A, *Hand lever for accelerator.* C, *Clutch.* D1, *Clutch pedal.* D2, *Brake pedal.* D3, *Accelerator pedal.* E, *Gear-box.* F, *Water tank.* G, *Silencer.* H, *Brake drums.* K, *Sight feed lubricator.*

Several different sizes exist, all of which are fitted with four-cylinder engines. They are as follows:—12-16 h.p., with a bore of 87 mm. and a stroke of 110 mm.; 14-19 h.p., with a bore of 87 mm. and a stroke of 124 mm.; 19-24 h.p., with a bore of 106 mm. and a stroke of 128 mm.; 24-32 h.p., with a bore of 108 mm. and a stroke of 150 mm.; 40-52 h.p., with a bore of 125 mm. and a stroke of 150 mm.; and a racing car.

To suit the various tastes of all kinds of motorists any of the following modifications can be applied:—(1) lengthened *chassis* for side entrance; (2) *chassis* raised behind with special springs; (3) the motor placed under the driver's seat;

(4) steering column arranged so as to be in interior of body. From this it will be seen that any kind of body can be fitted to a Mors *chassis*. There are also Mors omnibuses, vans, and boats, but as the engines are all built on more or less the same principles, let us confine our attention to the various touring cars.

Figs. I. and IV. are general views of a 24-32 Mors *chassis*. I have selected this one to illustrate, as it is the middle size of the five usual models. The motor has its cylinders cast in pairs, and is fitted with low tension magneto on the Mors system. The advance spark lever is entirely dispensed with, and the engine can be started without fear of back fire. When the engine is running the voltage of the magneto varies directly as the speed, and the temperature of the spark as well as the rapidity of combustion vary accordingly. The Mors was the first to be fitted with low

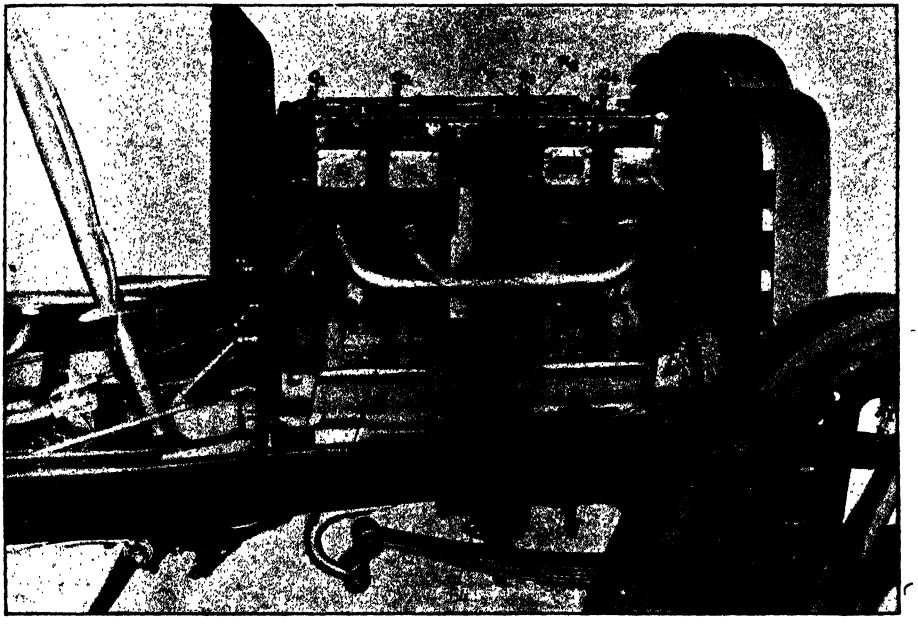


FIG. II. MORS ENGINE VIEWED FROM THE RIGHT SIDE.

A, *Radiator.* C1, 2, 3, 4, *Water jacket inspection plates.* D, *Inlet pipe.* F1, *Carburetter.* F2, *Extra air inlet valve.* F3, *Throttle valve.* F4, *Thumb screw securing jet.* G1, *Accelerator pedal spring.* G2, *Throttle spring.* H1, *Radiator pipe.* H2, *Water pipe warming carburetter.* K1, *Wire from magneto to insulated distributing rod.* K2, *Insulated distributing rod.* K3, *Knife switch.* K4, *Plug.* L, *Tap for regulating oil level in crank chamber.* M, *Steel wire connecting accelerator pedal to throttle valve.* N1, *Outside arm of tappet.* N2, *Tappet spring.* N3, *Vertical rod which lifts tappet.* O1, 2, 3, 4, *Inlet valve stems.* P1, *Place of oil pump.* P2, *Lubricator sight feeds.* Q1, 2, 3, 4, *Compression taps.*

tension magneto. The advantages of this system are, among others—(1) the abolition of accumulators, induction coils, and commutators; (2) and the reduction of the wiring system to only one wire (Fig III. K1) connected from the magneto to the insulated rod (Fig. III. K2), from which the current is distributed (Fig III. K3) to the four cylinders. The

magneto (Fig III. M 1) is placed on the left side of the engine and is very easily detached by simply undoing one nut, raising the band (Fig III. M 2) and lifting the magneto bodily from its seating.

The system consists of a magneto-electric rotary machine, combined with a series of mechanical contact breakers. The armature of the magneto (Fig. III. M 3) is driven by gear wheels from the exhaust valve cam-shaft and revolves at the same pace as the engine. The breaks of contact are produced in the explosion chambers by small rocking arms called tappets (Fig. II. N 1), of which the inside arms are alternately pressed by springs (Fig. II. N 2) against the surface of the ignition plugs within the cylinders, and thence removed by the action of the cams, the vertical rods (Fig. II. N 3) from which lift the outside arms of the tappets (Fig. II. N1).

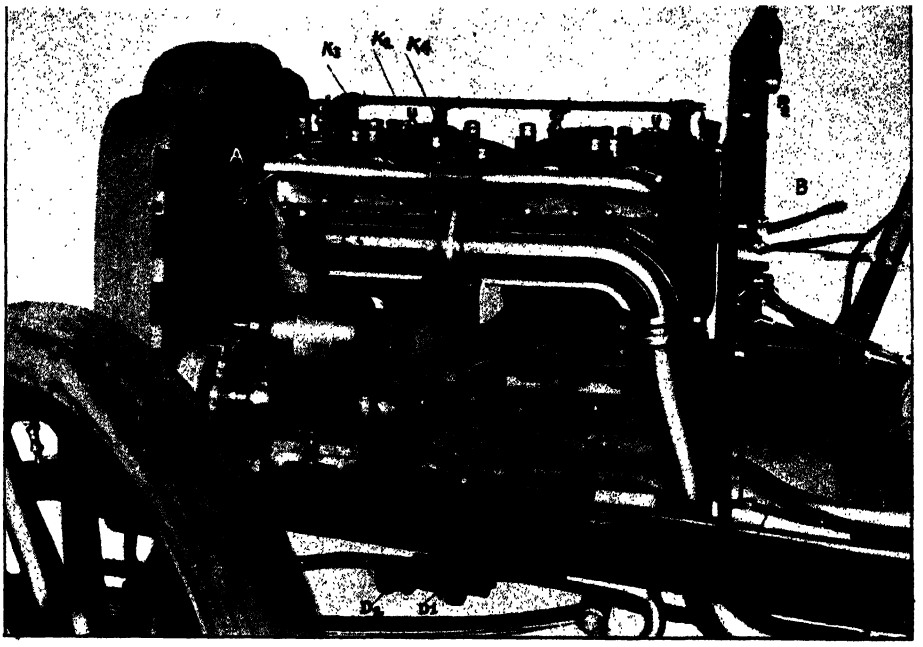


FIG. III. MORS ENGINE FROM THE LEFT SIDE.

A, *Radiator.* B, *Various pedals.* C, *Flywheel.* D1, *Water pump.* D2, *Greaser for water pump.* D3, *Water circulation pipe.* E1, 2, 3, *Exhaust valve stems.* E4, *Exhaust pipe.* K1, *Wire from magneto to insulated distributing rod.* K2, *Insulated distributing rod* K3, *Knife switch.* K4, *Plug.* M1, *Magneto.* M2, *Band fixing magneto.* M3, *Extremity of armature.* P2, *Lubricator sight feeds.*

The regulation of the plugs is a very simple matter. Loosen the lock-nut at the bottom of the plug (Fig. III. K4), and screw it down until it presses sufficiently on the inside arm of the tappet to raise the outside arm (Fig. II. N 1) the thickness of a piece of cigarette paper above the lowest point of the vertical rod (Fig. II. N 3) which lifts the tappet. This is easily done in about a minute, and when once regulated, need not be touched for months, and then only to clean the plug.

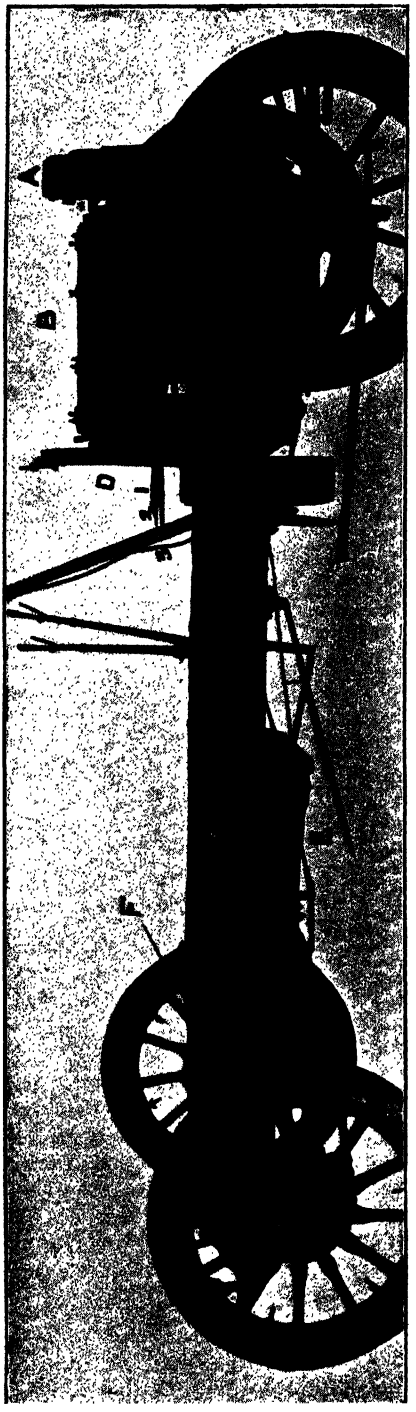


FIG. IV. SIDE VIEW OF THE 24-32 H.P. MORS CHASSIS.

A, *Radiator.* B, *Engine.* C, *Flywheel.* D1, *Clutch pedal.* D2, *Brake pedal.* D3, *Accelerator pedal.* E, *Gear-box.* F, *Watertank.*

A button is placed on the steering wheel (on the left of the wheel Fig. I.) to cut the current when pressed, and so stop the firing of the charge in the cylinders, which is in many ways a great convenience. The magneto is found to give a "fatter" spark than an accumulator, to be practically inexhaustible, and, of course, to be far simpler than any other form of ignition for the reasons already referred to.

No centrifugal governor is fitted; the throttle valve (Fig. II. F 3) being closed as soon as the driver puts his foot on the clutch pedal. In the same way the engine can be accelerated by either a foot pedal (Fig. I D 3) or by a hand lever (Fig. I. A) placed on the steering wheel, which opens the same butterfly valve in the carburetter that is closed by declutching. The carburetter (Fig. II. F 1) is fitted with an extra air inlet valve (Fig. II. F 2), which ensures a perfect mixture at all speeds of the engine. The petrol falls by gravity to the carburetter, which latter is warmed by a pipe connected from the water cooling apparatus.

The cooling of the cylinder is effected in the usual manner by a pump (Fig. III. D 1), which forces water, already cooled by the radiator (Fig. III. A) through the water jackets. This pump (Fig. III. D 1) will be found very reliable and efficient in action and ensures a good circulation of the cooling water. Like the magneto, the pump is in a most get-at-able position, and is easily detached for cleaning, etc.

It is driven direct off either the inlet valve or the exhaust valve

cam-shaft and is attached by a bayonet joint. By removing one nut, and giving half a turn to the body of the pump, the latter is detached. No fan is fitted either to the flywheel, or behind the radiator, it having been shown by experiment, that the best fan obtainable cannot produce a current of air of a velocity greater than eight miles an hour. Now the radiator is but very little cooled by this slow current of air when the car is at rest, for the motor heats very little when turning at that slow speed; and when the car is travelling quickly the fan is useless, as in my opinion it offers a back pressure to the natural current of air.

Lubrication is effected by a small pump (Fig. II. P 1), analogous in construction to the water-circulating pump. An oil reservoir is provided, the capacity of which allows of a two days' journey without attending to the lubrication. This pump (Fig. II. P1) is conveniently placed underneath the bonnet, and is actuated by the valve lift mechanism. It forces the oil into a set of sight-feeds (Fig. I K) on the dashboard, from which the oil falls by gravity. These sight-feeds are the only things fitted to the dashboard, which is otherwise quite clear, as seen in the illustrations.

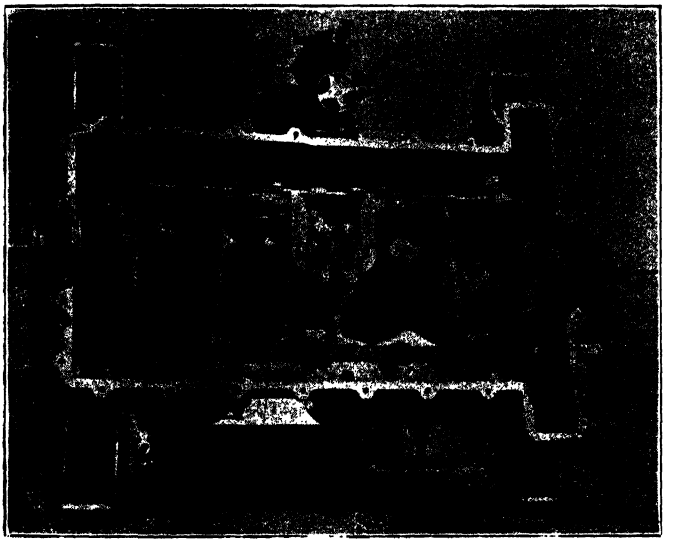


FIG. V.—UPPER PART OF CRANK CHAMBER.

A, *Crank shaft.* B, *Central bearing for crank shaft.* C, *Connecting rod.* D1, *Exhaust valve cam-shaft.* D2, *Inlet valve cam-shaft.* E1, *Spur-wheel driving exhaust valve cam-shaft, water and oil pumps.* E2, *Spur-wheel driving inlet valve cam-shaft and magneto.* F1, *Place for starting handle.* F2, *Continuation of crank shaft for flywheel.* G, *Carburetter.*

The clutch (Fig. VI. F) is extremely simple; the male cone turns freely on a prolongation of the crank shaft, and is, therefore, always in line. A spring (Fig. VI. F_2), the tension of which is regulated by a screw, presses the male cone against the female cone, and the thrust is taken by a ball bearing. The first motion shaft (Fig. VI. M1) of the gear-box is coupled to the crank-shaft (Fig. VI. L) by two spherical cardan joints; any relative movement of the gear-box, therefore, has no effect on the clutch or the motor bearings. The whole of the engine is protected underneath by an aluminium shield.

As regards the change-speed gear, which is fitted throughout with ball bearings, there is a direct drive on the fourth speed, and a direct drive only once removed on all the other speeds. In nearly all other cars the direct drive is twice removed on the lower speeds, and by a simple and an ingenious arrangement the Mors principle avoids the use of an extra pair of cog-wheels, and consequently

gains power and runs more silently. The principle, as a rule, is to drive from the first motion shaft on to the second motion shaft, and back again on to the first motion shaft, and so to the differential shaft through the bevels. In the Mors gear-box there are two sets of bevel wheels (Fig. VI. B1 and B2) on the differential instead of one. The bevel wheels (Fig. VI. B2) connecting the second motion shaft (Fig. VI. M2) to the differential are used for the lower speeds, and the bevels (Fig. VI. B1) at the end of the first motion (Fig. VI. M1) shaft for the fourth speed.

In Fig. VI. the gear-box is clearly shown with the third speed in mesh, and this will do to explain the drive on all the lower speeds. The drive is taken from the first motion shaft (Fig. VI. M1) by the spur-wheel (Fig. VI. G1) on to the spur-wheel G_2 on the second motion shaft. From here the drive goes direct through the bevel wheels (Fig. VI. B 2) on the differential countershaft. Now the other pair of bevel wheels (Fig. VI. B1) on the differential will be revolving, but then are merely running idle on ball bearings and in oil, so that there is no friction. On the fourth speed the claw-clutch (Fig. VI. G3) connects the first motion shaft to the bevel wheels (Fig. VI. B1) on the differential. In this case the drive is direct from the engine shaft (Fig VI. L) to the bevel wheels (Fig. VI. B1) on the differential. The second motion shaft (Fig. VI. M2), which takes the drive of the lower speeds, will still revolve, but in its turn is now running idle in oil on ball bearings, so that there is no friction. The box (Fig. VI. D1) contains the differential gear. The 40-52 h.p. Mors car and the 90 h.p. differ in some ways from the smaller models as regards the engine (Figs. II., III., IV.).

The vertical axis of the Mors engine, I might mention, is not coincident with that of the crank-shaft, the cylinders being displaced slightly to the right, towards the magneto side. The object of this is to reduce the friction between the pistons and the cylinder walls on the explosion stroke, the obliquity of the connecting rods being less. This, moreover, is not the only advantage gained, since it is then possible to use shorter connecting rods, and therefore shorter and lighter cylinders. Consequently the mechanical efficiency of the engine is thereby increased.

Of course, the obliquity of the connecting rods, and consequently the friction of the piston against the cylinder walls, is increased by this method on the compression stroke. However, the pressure on the piston during the explosion is about 280 lb. to the square inch, whereas on the compression stroke it is only 60 lb. to the square inch.

Another novelty is the manner in which the time of the lift of the valves and ignition stems is varied. As a rule the cams are cut, tempered, and keyed on to their respective shafts, and have to be regulated one by one. By this method the workman has to file and adjust continually, until all the twelve cams are properly regulated. Moreover, should a cam wear out and have to be replaced, it is extremely difficult for an amateur to adjust it. The rod which lifts the valves is no longer placed immediately over the cam, but is pivoted at the end of a lever, in the middle of which a roller is fixed. This roller is raised by the cam, the valve spring causing it to descend again.

The relative position of the lever and cam is variable, being regulated by a screw and lock-nut outside the crank chamber; in other words the roller is moved to and fro, so as to receive at an earlier or later period its impulse from the cam.

By this means the time of the closing of inlet and exhaust valves, and the advance of the spark, can be regulated to a nicety without any dismantling whatever.

The same arrangements for automatically throttling the engine are fitted to the 40 h.p. and 90 h.p. models as those used on the smaller models. However, in addition, the larger cars have an arrangement by which the lift of the inlet valves

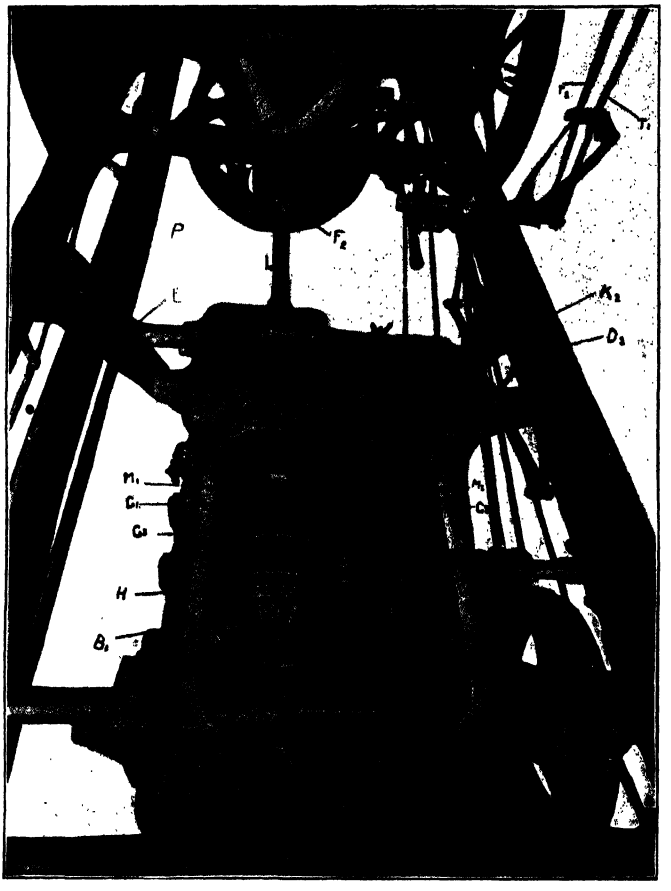


FIG. VI.—THE GEAR-BOX.

B1, *Bevels for fourth speed.* B2, *Bevels for lower speeds and reverse.* D1, *Box containing differential gear.* D2, *Return water pipe from carburetter.* E, *Exhaust pipe.* F, *Clutch.* F2, *Clutch spring.* G1 *and* G2, *Spur wheels for operating the third speed,* G3, *Claw clutch.* K1, *Band brake on differential countershaft.* K2, *Connecting rod for brake on back wheels.* L, *Engine shaft.* M1, *First motion shaft.* M2, *Second motion shaft.* P, *Lubricating pipe for gear-box.* T1, *Hand brake lever.* T2, *Change speed lever.*

can be easily reduced. This is done very effectively by two cams joined together by an inclined plane. In one position a lift of 12 millimetres is obtained, in the second position only 4 millimetres. A lever placed near the steering column

causes the whole of the cam-shaft to slide along horizontally, and brings the different steps of the cam underneath the rollers attached to the valve-lifting mechanism. The spur wheel keyed to the crank-shaft has to be constructed of twice the normal thickness so as to drive the cam-shafts in both positions.

A very interesting improvement has been applied to the steering mechanism, which takes up automatically all back-lash. There are in all five causes of back-lash in a worm and wheel steering gear:—(1) The play in the joints of the rod connecting the two front wheels, adjustable by spherical joints at the two ends of the connecting rods; (2) The play in the joints of the rods connecting the two front wheels with the steering gear owing to spring devices to absorb road shocks (this play does not exist in Mors cars as no such springs are applied); (3) The vertical play between worm and wheel (adjustable by screw under the steering column); (4) The side play of the wheel sector (adjusted by side screw); (5) Finally the play between the teeth of the wheel and the screw thread, which has been remedied by the following device:—

It has been observed that the screw thread becomes worn in its middle part and never at the ends, as the former is nearly always in contact with the wheel sector. This being so, the Mors firm designed a movable sector, attached to the fixed sector by a screw, and which is always pressed home against the screw-thread by a wedge under pressure of a spring. In this manner the wear can be taken up, and back-lash avoided.

The brakes are three in number, and of an ingenious design. There is an ordinary band brake on the differential countershaft operated by pedal. Another pedal controls a contracting brake on the two back wheels, this brake being compensated. Thirdly, an internal expanding brake on the back wheels (also compensated) is applied by a side lever. The latter brake alone puts the engine out of gear.

The frame is suspended by two semi-elliptical springs placed longitudinally, and by a spring placed transversely uniting the two latter springs. Most firms arrange this system of suspension so as not to leave sufficient play for the springs, but on the Mors *chassis* we find both longitudinal and transversal springs, supported on ball-joints at the end of a rod some 4 in. in length uniting the two. This allows full play in all directions. Another great advantage is that by merely removing a few nuts the whole of the base of the crank chamber can be removed, thus allowing a complete inspection of its contents.

In conclusion, let us devote a few general remarks as to driving. First of all see that there is oil in the lubricator, gear-box and wheel caps, grease in the various grease boxes, and the water tank filled. See that the speed lever is in the neutral notch. Put the plug into the switch on the dashboard (Fig. I.). Then pull forward the little accelerating ring on the left of the starting handle. Give the handle a couple of turns and release the accelerating ring.

To start the engine the exhaust valves are kept slightly lifted during the compression stroke. This is arranged by moving the cam-shaft horizontally, and allowing differently shaped cams to raise the exhaust valves. When once the motor is started, the usual cams come into action again.

Put your foot on the clutch and then open the accelerating lever on the steering wheel a little, and put in the first speed. All you have to do afterwards to change speed is to unclutch and move the speed lever. The ignition and mixture are regulated automatically, and declutching automatically throttles the engine. Let in the clutch again and the engine is automatically accelerated. You can accelerate further by either the lever on the steering wheel or by the foot pedal. To stop the engine you have only to press the button on the steering wheel or to take out the plug on the dashboard.

THE MERCÉDÈS.

By J. E. Hutton.

By common consent the Mercédès is universally recognised as being in the very front rank. Since 1901, when this car made its first public appearance and astonished the motoring world by winning everything at Nice, it has held the proud position of "the leading car." To Herr Jellinek-Mercédès, after whose daughter the car is named, must be credited the conception, and to the clever engineers of the Daimler-Motoren-Gesellschaft, headed by Herr Maybach the carrying out of the ideas.

The old works which were located at Cannstatt, near Stuttgart, were completely destroyed by fire in 1903, and replaced by probably the finest works in the world devoted to motor car construction at Anterturkheim. Their annual output is about 900 complete cars and chassis.

The Mercédès was the first "silent" petrol car. Those who were fortunate enough to be at Nice in the Spring of 1901 will recollect the extraordinary contrast between the 35 h.p. Mercédès and all petrol cars of other makes. While the thrumming "cut-out" was at that time all the fashion the Mercédès glided along the Promenade des Anglais with hardly a sound. Everyone stood amazed—but from that day to this the great French makers have made it their business to copy the specialities of the Mercédès even to its external appearance. There is no need to go into historical details here, and I will now proceed to deal with the main features of the cars, referring at first more particularly to the smaller models.

Engine.—All engines used on Mercédès cars have four cylinders and, being very carefully balanced, run with a minimum of vibration. The bearings are lined with white metal. The exhaust and inlet valves, which in all types, other than 1903, are located at either side of the cylinders, are mechanically operated. The cylinders are cast in pairs, the water jackets being cast in one piece with the cylinders. A simple centrifugal governor is fitted, designed to maintain the speed of the motor constant. The throttle, operated from the steering column, and in the later 28 and 40 h.p. cars by a foot pedal, can be adjusted at will to slow the engine to any desired speed, the governor keeping the speed constant, within certain limits, with varying load. In the 70 h.p. the throttle is also operated by the clutch pedal. The action of depressing the pedal automatically closes the throttle, obviating the necessity of removing the right hand from the steering wheel. In the 70 h.p. model the governor is completely encased on the front end of the engine. A "decompressor," or in other words an apparatus for reducing the compression in the cylinders, is now fitted on all Mercédès cars, thus facilitating the starting considerably.

Ignition.—The now well-known low tension magneto system is exclusively employed and has proved very satisfactory. Too much lubricating oil should not be used in the magneto machine, as it renders the insulation liable to become rotten. The magneto system being so arranged that a fault or short circuit on any one cylinder will completely disable the rest, a small plug switch-board is provided, enabling the engine to be very easily tested. Keep all connections clean and tight, and should the motor fail to start easily, remove two plugs and try starting on the other two cylinders. Should this fail, test each cylinder separately until the faulty one is found. Too much or too heavy oil in the engine causes sooty deposit to form on the magneto tappets, instantly establishing a short circuit. But if the driver exercises ordinary care in lubricating, and overhauls the ignition system occasionally it will be found that little or no trouble will be experienced. The main thing to avoid is excessive lubrication or the use of unsuitable oil, as this generally leads to trouble. The Mercédès ignition system is very reliable if handled in an intelligent way

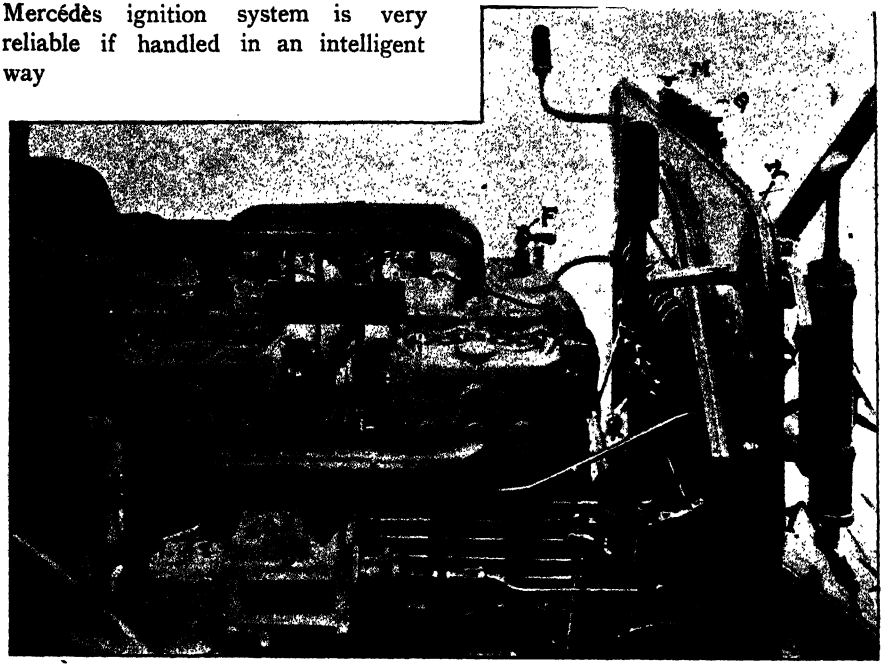


FIG. I.—THE MERCEDES 28-32 H.P. MOTOR, VIEWED FROM INLET VALVE SIDE.

B^1, *Pressure gauge.* E, *Radiator.* F, *Compression relief cocks.* H, *Water pipes.* L, *Pressure valve.* M, *Hand lubricator.* P, *Air pressure pump.* Q, *Pressure lubricators.* R, *Carburetter.* S, *Jet regulator.* T, *Float spindle.* V, *Igniters.* W, *Plug switch board.*

A simple form of "stand-by" ignition may be quickly fitted, consisting of a 6-volt accumulator and low tension coil, so that in the unlikely event of the magneto failing, the engine may be run several hundred miles on the accumulator. On very large engines, this auxiliary ignition set may also be found to facilitate starting.

Cooling.—The water for cooling the cylinders is caused to circulate rapidly by a gear-driven pump. This pump requires practically no attention. The radiator consists of a large number of fluted tubes sweated together. Should a leak occur, insert a little red lead. If this fails to stop it, plug the tube with putty or wood. If the leak is at the extreme end of the tubes it will require soldering up. This should not be attempted by an unskilled man, there being a danger of loosening the surrounding tubes.

The necessary draught of air is obtained by the flywheel, provided with arms cast in the form of a fan. The faster the engine runs the greater the draught of air. As this induced draught depends on the bonnet and casing being air-tight, care should be taken to see that the bonnet is closed. All holes in the dashboard and elsewhere should be covered inside with felt or leather.

FIG. II.—THE 28-32 H.P. MERCEDES MOTOR, EXHAUST SIDE.

A, *Exhaust valve and spring.* A^1, *Exhaust valve plunger guide.* B, *Exhaust pipe.* C, *Decompressor.* D, *Bridge holding down caps on exhaust valves.* E, *Radiator.* F, *Compression relief cocks.* G, *Cage for collecting hot air for carburetter.* H, *Water pipes.* J, *Magneto cover.* K, *Steering worm case.* L, *Pressure valve.* M, *Hand lubricator.* N, *Two-way tap on lubricator.* O, *Grease cup to pump.* P, *Air pressure pump.* Q, *Pressure lubricators.*

Clutch.—This important item requires careful attention. A powerful coil spring is supported in the fly wheel boss, in the centre of which lies the end of the gear shaft, to which is attached a drum known as the "body." To one end of the spring is attached the "hammer," which is operated by a cone sliding on the gear shaft. The clutch can be adjusted by slacking off the nuts and giving a slight turn to the slotted drum, thereby causing

the cone to engage the "hammer" earlier or later, as required. This adjustment is very delicate, and should never be moved more than an eighth to a quarter of an inch.

Too much importance cannot be attached to the necessity of thoroughly lubricating all the working parts. The clutch spring itself should run in a bath of oil—it will not slip from this cause. The latest models are now fitted with a special two-way tap on the hand lubricator mounted on the dash-board, so that the clutch can be thoroughly lubricated at intervals. The clutch should never be allowed to slip. Drive the car with the engine either wholly in or out of gear. It is as well to carry a spare clutch coil-spring in case of accident, as these may not always be instantly obtainable, except from London.

It is most important to oil the "spigot pin." A small hole will be found in the clutch shaft behind the "cone."

Gear.—The Mercédès gear is noted for its easy "changing." It is quite possible for even a tyro to change speed without a sound. The change speed lever moves in a slotted quadrant. Every speed has a positive position, and is clearly marked, the reverse being obtained by depressing the knob at the end of the speed lever. Care should be taken to lubricate the sliding sleeve to render its working smooth and easy.

Ball bearings are employed throughout, and give great satisfaction, showing no signs of wear after many years. The writer recommends the use of Vacuum Oil No. 2, or Dixon's graphite lubricant for use in the gear-boxes.

Frame.—The frames consist of stamped steel members riveted together, and are extremely strong and rigid. Up to the end of 1903 the standard lengths of frame were 2·10 metres and 2·20 metres. In the newer cars, however, the 2·20 metre has been abandoned, and 2·40 metre and 2·60 metre substituted. The 2·40 metre is provided with double elliptical springs; the 2·60 metre with single spring and long scroll irons.

The wheelbase of the 2·40 metre model is 10 ft. 3 in., and that of the 2·60 metre is 10 ft., the 2·40 metre model having the longer wheelbase, owing to the arrangement of springs and axles.

Brakes.—Every Mercédès car, except the 1903 18/22 h.p. and early 1904 18/28, is provided with four brakes, controlled from three points. The two brakes fitted to the back wheels are of the internal expanding type, operated by a side lever, which is pulled towards the driver. The lever does not disengage the clutch, as is usual in most types of cars, allowing the compression of the engine to be utilised as a brake when coasting down hill. Should these brakes tend to rattle, the small supporting screws inside the brake drum should be adjusted.

The two foot brakes are water-cooled and in the new types protected from oil splash by metal shields attached to the inside of the drums. The brake acting on the countershaft should be used in preference to that on the gear shaft. All brakes should be carefully used by those unaccustomed to Mercédès, as they are extremely powerful.

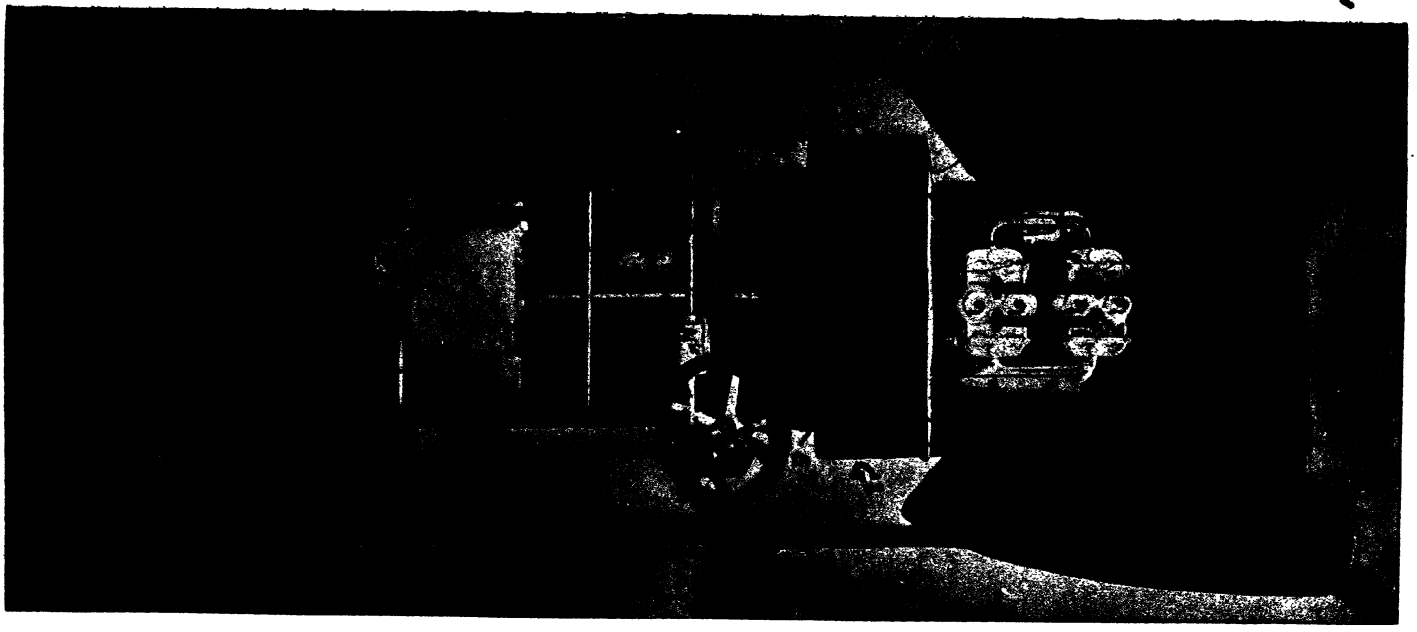


FIG. 3.—PLAN OF THE 28-32 H.P. MERCEDES CHASSIS.

B¹. *Pressure gauge.* D¹. *Clutch pedal.* E. *Radiator.* E¹. *Brake pedal (gear shaft).* E². *Brake pedal (differential shaft).* F¹. *Accelerator pedal.* G¹. *Lubricating oil reservoir.* G². *Water reservoir for cooling brakes.* G³. *Petrol tank.* H¹. *Silencer.* J¹. *Brake on gear shaft.* J². *Brake on differential shaft.* K¹. *Main petrol filler.* L¹ *and* L², *Throttle and ignition levers on steering wheel.* L³. *Change speed lever.* L⁴. *Brake lever.* K². *Aperture in tank for testing level of petrol.* M. *Hand lubricator.* M¹. *Elliptical springs.* N¹. *Gear-box.* N². *Differential box.* N³. *Differential shaft.* N⁴. *Box containing change speed gear control.* O¹. *Radius rods.* P. *Air pressure pump.* Q. *Pressure lubricator.* Q². *Crank chamber vents.* Z. *Petrol jet regulator quadrant.*

The 70 h.p. Car.—At the time of writing the new 70 h.p. car has just made its appearance and departs in some essential particulars from the 28 and 40 h.p. models. The motor follows the general lines of the 40/45 h.p., the cylinders being cast in pairs with the valves at either side, and a very long bearing in the centre gives it a less compact appearance. All the half-speed shaft gear wheels and the governor are now carried at the radiator end of the engine and are entirely encased in aluminium, as is the magneto timing gear. Small "safety valves" are fitted to the water jackets at the top of the cylinders which will at once make the presence of steam and overheating known to the driver.

The throttle is now operated by a foot pedal as well as by the lever on the steering wheel. The gear is considerably modified; the change speed proper being separated from the differential, though the two cases are connected by a strengthening aluminium strut. This renders the chains shorter—the *chassis* being 2·60 metres from dashboard to back.

Supply Tanks.—The petrol, oil, and water for brake-cooling are contained in tanks below the level of the frame. The contents are forced up by pressure obtained from the explosion (not exhaust) of the back cylinder. It is essential to see that every part of the pressure system is thoroughly tight. As a match cannot of course, be used to detect leakage, a little soap lather will quickly show the locality of any loss. To obtain the initial pressure, a small hand pump mounted on the dashboard is provided. An adjustable relief valve is fitted inside the engine bonnet, which can be regulated to keep the pressure constant at from 3 to 5 lbs.

Starting the Engine.—Pump up the pressure to say 3 lbs. Hold the top of the float spindle up until the petrol pours out of the overflow pipe, and the carburetter is thoroughly flooded. Retard the ignition and open the throttle to about one quarter its full extent. Place the jet baffle lever (on dashboard) to position marked "A." Smartly turn the handle, which should at once start the engine.

When using the "Decompressor," the moment the first explosion takes place, quickly push in the "Decompressor" lever.

In the 70 h.p. the action of engaging the starting handle, automatically releases the compression.

Driving.—Start on first speed, and until very proficient close the throttle when changing speed. With much practice, speeds can be changed with the throttle wide open. On cars fitted with foot accelerators these remarks hardly apply, as the car should be driven in traffic with the throttle lever on the steering wheel so adjusted that the engine will run sweetly and quietly, power for quick bursts of speed in traffic being obtained by depressing the foot accelerator. On the 70 h.p. the action of withdrawing the clutch closes the throttle.

To those accustomed to driving other cars, a word of warning should be given. The Mercédès runs so easily that objects and corners are approached more quickly than the driver thinks. Therefore "make haste slowly."

SIDE VIEW OF THE 28-32 H.P. MERCEDES CHASSIS.

G¹. *Lubricating oil reservoir.* L³. *Change speed lever.* L⁴. *Brake lever.* N¹. *Gear-box.* N². *Differential box.* R¹. *Protecting apron under engine and gear.* S¹. *Knob for actuating reversing gear.*

Data.

Consumption.

18/28 h.p., about 24 miles on the gallon.
28/32 h.p., about 18 miles on the gallon.
40/45 h.p., about 15 miles on the gallon.
70 h.p., about 10 to 12 miles per gallon.

Specific gravity of petrol must on no account exceed ·700.

Lubricating Oil.

Engine—Vacuum No. 1.
Gear—Vacuum No. 2 or Graphite.
Wheels—Thin grease (best).
Chains—Oil or graphite lubricant.

Engine Capacities.

H.P.	Type.	Bore.	Stroke.
18/22	1903	90	120
18/28	1904	100	130
24/28	1903	105	130
28/32	1904 1905	110	140
35/40	1903	116	145
40/45	1904 1905	120	150
60	1903	140	150
70	1905		
90	1904	170	150

Speeds. 28/32 h.p. model at 1,100 r.p.m.

No. of teeth on sprocket.	18	20	22
Gear No.	Miles per hr.	Miles per hr.	Miles per hr.
1st	10·0	10·9	12·1
2nd	20·8	23·3	25·5
3rd	32·4	36·1	39·8
4th	42·3	47·3	51·6

The above are calculated under consideration of the resistance of air of the complete touring car with touring body and four passengers, of a total weight of 3,100 lbs.

40/45 h.p. model at 1,100 r.p.m.

No. of teeth on sprocket.	22	24	26
Gear No.	Miles per hr.	Miles per hr.	Miles per hr.
1st	12·1	12·8	13·5
2nd	25·6	27·0	29·5
3rd	39·8	42·9	47·2
4th	51·6	55·0	60·0

The above are calculated under consideration of the resistance of air for the complete touring car with touring body and four passengers, of a total weight of 3,200 lbs.

Weights.

Chassis 1905.	28/32 h.p.	2·20 metre	960 kilos.
		2·40 metre	1070 kilos.
		2·60 metre	995 kilos.
1905.	40/45 h.p.	2·20 metre	978 kilos.
		2·40 metre	1100 kilos.
		2·60 metre	1025 kilos.

THE NAPIER.

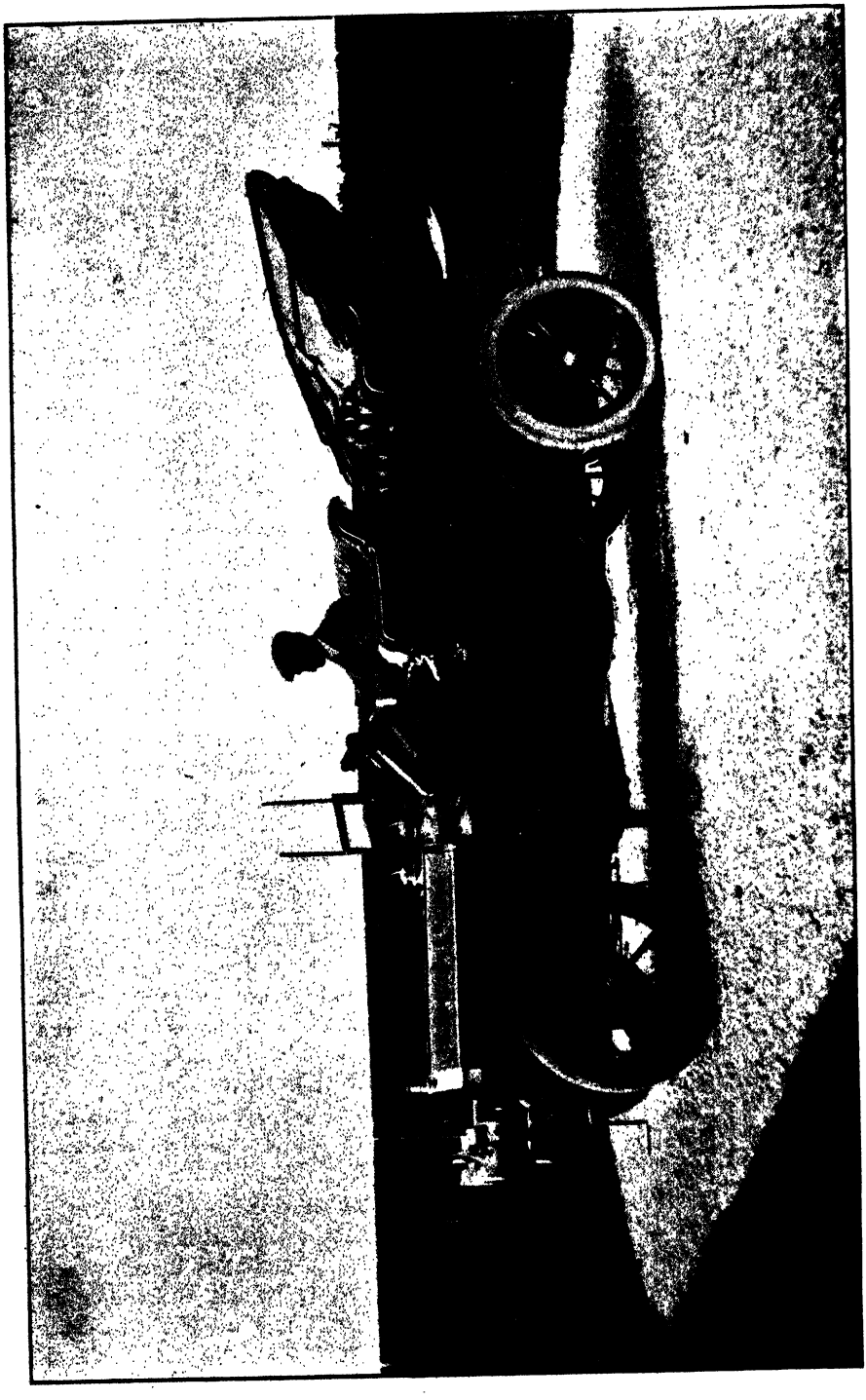
By S. F. Edge.

When asked to contribute an article to this series I rather demurred at first, as it seemed to me that, as I am interested financially in the success of the Napier car, anything in its favour, however innocently stated by me, must read too much like an advertisement. I must, therefore, ask all who read this article, not to take for granted anything that is said to the advantage of a Napier car, but only to believe such statements after an actual trial.

Perhaps a few words in regard to the history of the Napier, and its rapid rise to the position of the leading English car, may not at this moment be amiss. In 1899 I had the first 7 h.p. Napier engine fitted to my 6 h.p. Panhard car, and this gave such remarkable results that I approached Mr. M. S. Napier and asked him to make me a complete car for 1900. Such a proposal, however, was not practical, as the cost of making only one car was too great. After two or three months further use of the original engine, I felt that to leave the matter at that point was not reasonable, so after consultation with my partner in this matter, a definite proposition was made to Mr. Napier concerning the manufacture of a minimum number per year of Napier Motor Carriages, and in the spring of 1900 the first one was produced and driven by me in the Automobile Club's Thousand Miles Trial, with the result that for the first, and I am glad to say not the last, time an English car proved superior to all foreign cars of equal and in some cases higher horse-power. The sequel of this successful start is that to-day the Napier stands at least the equal of the best productions of automobile manufacturers in the world.

Leaving history behind and dealing with the actual Napier cars of the present day it may be mentioned that altogether there are six types, viz.:—four-cylinder 15 h.p., 24 h.p., and 40 h.p.; six-cylinder 30 h.p. chain driven and chainless type, 50 h.p. chainless; and in addition to these there are racing types of 80 and 90 h.p., four and six-cylinder respectively. All types are driven in exactly the same way, and the driver of one type can immediately drive any other without the slightest feeling of strangeness, as they only differ in dimensions and not in principle.

Briefly summarised the following is a general description of the Napier car. First there is in front the engine with four or six cylinders, which is covered with an aluminium bonnet; then comes the friction clutch, which is metal-to-metal on all the more powerful types, by which the power of the engine can be transmitted at will to the gear. The oil-tight gear-box, in which all the change speed gears and the differential run, is made of aluminium. All the bearings for this part of the car are lubricated directly independently, as well as from oil splash in the gear-box.



MR. S. F. EDGE ON HIS 24 H.P. NAPIER.

On each end of the differential shaft are fitted chain wheels and chains for transmitting the power from the gear to the road wheels. In the chainless type when the top speed is in there is absolutely a direct drive by propeller shaft on to the main driving bevel. The result of this convenient distribution of the parts places a nearly exact weight on each wheel. These portions of the car are securely bolted to the frame, which is, in turn, supported on very long steel springs attached to the wheel axles in order to prevent the vibration reaching either the machinery or the passengers.

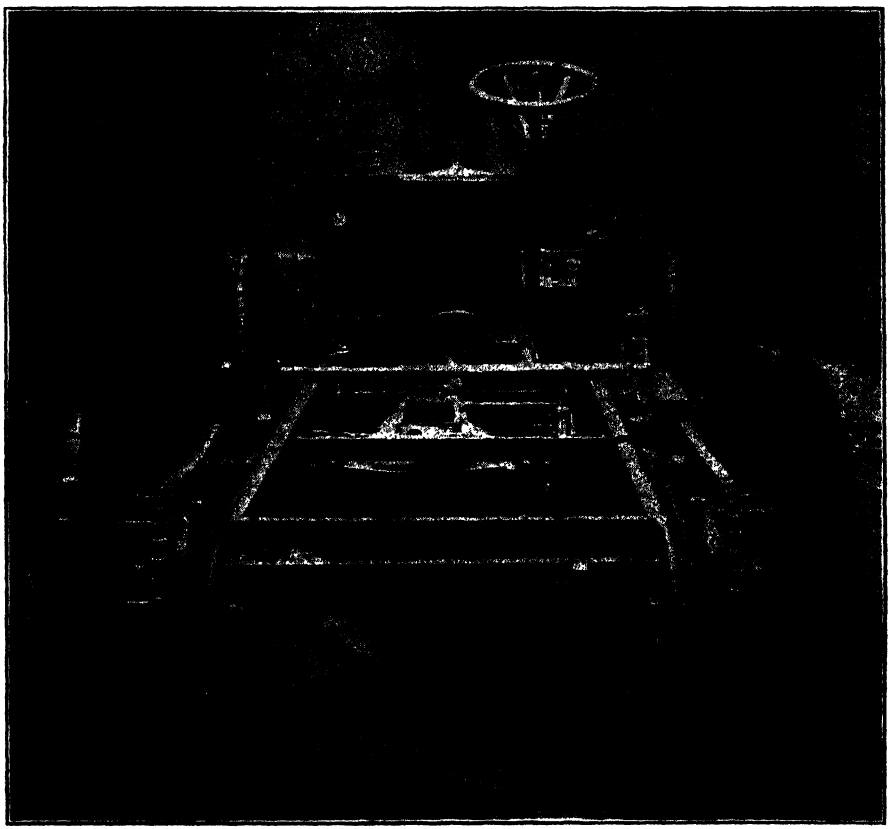


FIG. 1.—THE NAPIER CHASSIS.

1. *Throttle lever.* 2. *Box containing high tension synchronised ignition.* 3. *Clutch pedal.* 4. *Brake pedal.* 5. *Automatic lubricator.* 6. *Gear-box.* 7. *Foot brake.* 8. *Clutch and flywheel.* 9. *Water gauge.* 10. *Advance sparking lever.* 11. *Change speed lever.* 12. *Hand brake.*

One particular point about the Napier car that has always been striven after has been to ensure that the car will run many thousands of miles without the need of a repair shop, and it has been owing in some measure to this reputation that its success has been so rapid. For example, in regard to that most expensive part, the gear and gear-box, it has been

and is still the usual practice, in most cars, for the sake of cheapness to fit plain phosphor-bronze bearings and thrust blocks. While these are fairly satisfactory for some little time, they require renewing at rather frequent intervals; and though these parts are not costly in themselves to refit, yet the renewal involves a good deal of time and work being spent in sufficiently dismantling the car to reach the parts, and in subsequently re-erecting the machinery.

In the Napier, these plain bearings, wherever heavy stresses come, have ball-bearing thrust blocks and roller bearings fitted to the ordinary shafts, with the result that, if necessary, a guarantee of a life of 100,000 miles can be given for the gear wheels and bearings. My experience is that, though the original fitting of these bearings is costly, they pay for the initial outlay over and over again by abolishing the necessity for renewals and replacements.

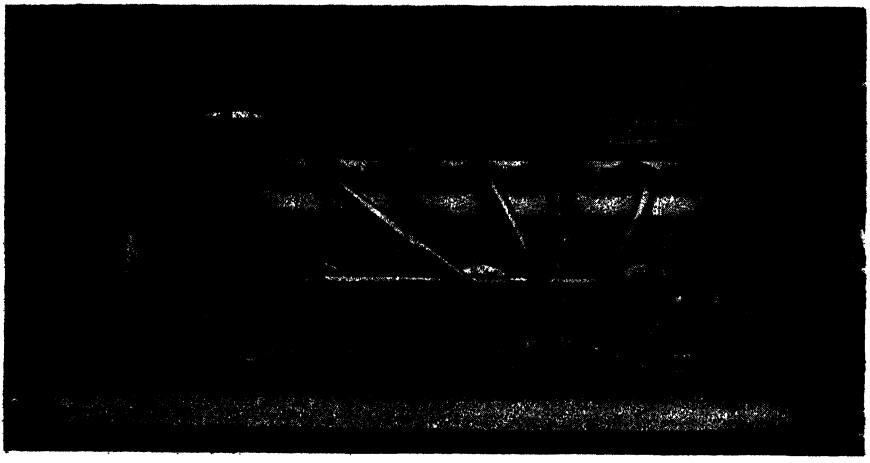


FIG. 2.—NAPIER SIX-CYLINDER ENGINE FROM "NEAR" SIDE.

1. *Compression taps.* 2. *Water pipe leading to water jackets from radiator.* 3. *Pipes for filling crank chamber with fresh oil.* 4. *Napier patent hydraulic air regulator.* 5. *Fan behind radiator.* 6. *Grease cup on direct driven water circulating pump.* 7. *Auxiliary cold air pipe to carburetter, with inlet on dashboard.*

Another point of Napier origin now extensively copied is a very solid and lasting engine, so far as crank-shaft, piston rods and brasses are concerned, yet extraordinarily light in a complete form owing to the use of aluminium for the whole body of the engine. This system of construction, involving the use of a light motor jacket of a different metal to that of the cylinder is recognised practice with high-class engines on motor cars where reduction of weight is an important factor.

Inlet Valves.—A further originality in Napier engines is the inlet valve. Each valve really consists of a cluster of three or four small valves, the reason for this being that the combined circumferential lengths of three small circles in a given space are greater than the circumference of one large circle occupying such space. As the quantity of gas passing at each lift of the valve to the same height depends on the length of the edge of the valve, the result of this arrangement is that a greater volume of gas is sucked in at each piston stroke, and greater power in the engine thereby results.

There is even now an improvement on this system of inlet valve, viz., the Napier Annular Inlet Valve, in which the valve has three rings or seatings, by which arrangement the gas has access through a much greater circumferential opening than is given by the ordinary valve seating with the same diameter.

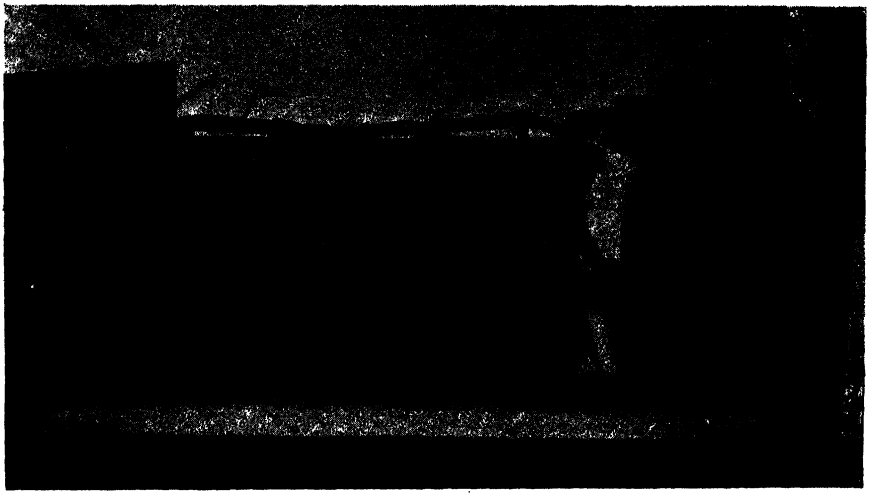


FIG. 3.—NAPIER SIX-CYLINDER ENGINE FROM RIGHT SIDE.

1. *Skew gear actuated from half-time shaft driving commutator.* 2. *The tappets actuating inlet valves.* 3. *Radiator.* 4. *Auxiliary tank to radiator.* 5. *The collector for hot air pipe of carburetter.* 6. *Fan behind radiator.* 7. *Tappet rods for mechanically operated inlet valves.* 8. *Large section high tension wire to sparking plugs.*

The superiority of this type of valve is obvious, as it tends to give either very quiet or very quick running with an efficient engine. All these points, although peculiarly technical, are interesting, as they are the result of experience gained by hard driving on the road by Mr. M. S. Napier, many users of Napier cars, and myself.

Governor.—The Napier is absolutely automatic, and acts upon the intake of the mixture in such a way as to keep the engine running as slowly as possible when doing no work. If work is being done the governor cuts off the gas as soon as sufficient power is developed to do the work that is required, even if this is only half the possible power of the engine. The principle of this is economical, highly efficient, and yet of great simplicity.

Ignition.—The Napier ignition is invariably electrical, and Mr. Napier was the first great constructor to have the courage to refuse to fit the dangerous tube ignition now obsolete. His position in this respect is a credit to the English industry. In using electric ignition the only source of trouble is failure to keep the accumulator fully charged, but one should no more call this a fault in ignition than omitting to fill the petrol tank should be brought forward as showing a faulty engine. The latest type of electric ignition as fitted to all types of Napier carriages is a high-tension synchronised ignition, by means of which only one coil and one trembler is used, so that regular firing in all cylinders is absolutely ensured.

Water-Circulating Pump.—This part of the car appears to me now to be almost perfect in use, and as there is a gauge fitted to the dash-board, to show if the pump is working, there is no excuse for damage to the engine by pump failure. I find from my diary that personally I have driven my last 11,000 miles without a single stoppage attributable to the pump, and with only three tyre punctures.

Lubricators.—These are automatic and absolutely act up to their name, and there is an arrangement by which the lubricator can be refilled from an auxiliary tank.

Control.—I may now deal with the control of a Napier car, from a driver's point of view, as one occupying the driver's seat. You have before you the steering, arranged in such a position as to give the maximum of power with comfort for driving over the longest distances. The steering wheel is connected to and actuates the front road wheels, all the various levers and parts necessary being adjusted to take wear; including the steering gear, every part of which is adjustable.

This point does not appeal to the beginner, but is really of the greatest importance, as for perfect control the smallest turn of the steering wheel should actuate the road wheels. Indeed, unless there is provision to take up the wear which must inevitably take place, there would be play and rattle in these important parts, with a resulting discomfort in use, to say nothing of the danger. It is the carrying out of important details of this sort which costs money, and helps to account for the great difference in price between motors with a reputation to keep up and those made merely to sell.

The Pedals.—On either side of the steel shaft that carries the steering, there are two pedals just rising above the floor boards, in the most convenient position for control by the driver's foot. The left one, when depressed, actuates the friction cone, by which the power of the engine

can be conveyed to the driving gear. The act of pressing it down cuts the power of the engine off from the gear. In gradually allowing it to resume its normal position, which it is forced into by a powerful spring, the engine is permitted to drive the car by more or less pressure, so that the speed of the car can, to a certain extent, be controlled.

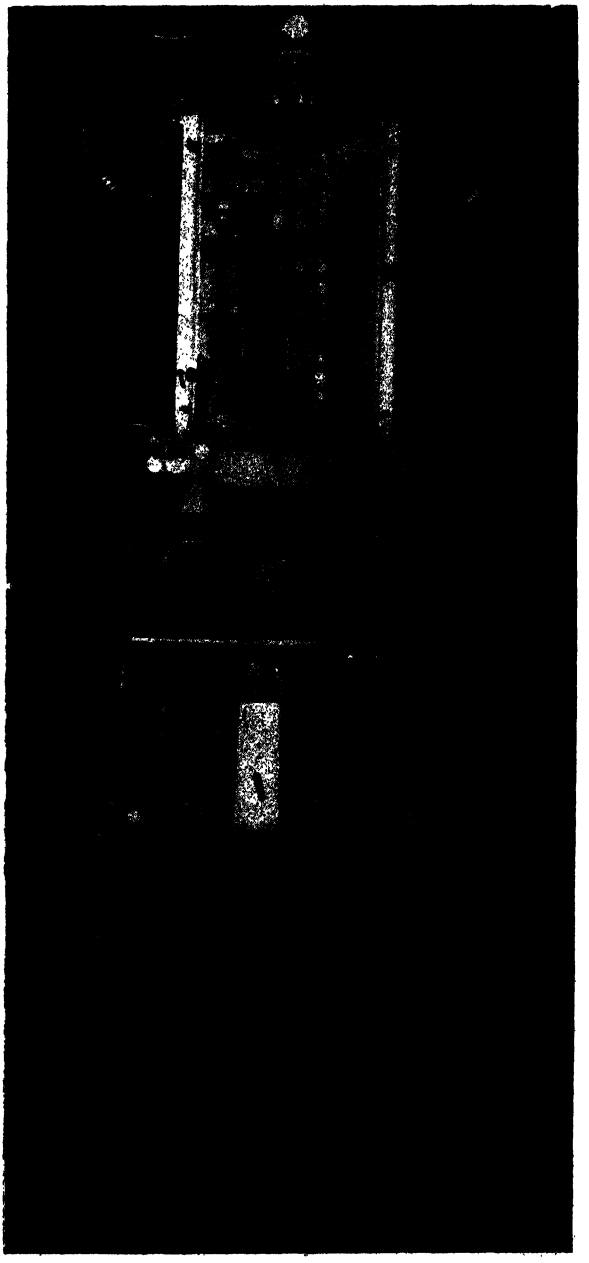


FIG. 4.—PLAN OF NAPIER CHASSIS.

1. Gear-box (3 speeds, direct drive on top). 2. Foot brake (metal-to-metal). 3. Universal joint between clutch and gear-box. 4. Clutch (metal-to-metal, running in oil). 5. Silencer. 6. Accumulator box. 7. Box containing high tension synchronised ignition, with one coil and trembler. 8. Water circulating pump (gear-driven). 9. Radiator (honeycomb pattern). 10. Carburetter and hydraulic air regulator. 11. Inlet valve tappets. 12. Fan behind radiator. 13. Internal brake (operated by hand).

On the right of the steering wheel shaft is another similar pedal; but this, when pressed down, actuates a brake on the differential shaft, and if heavy pressure is applied by the foot, the driving wheels can be absolutely locked. To the right of this pedal is another small one called the accelerator pedal, and by gentle pressure on this the speed of the engine can be increased from 250 revolutions per minute to over 1.000, and thus the speed of the carriage increases nearly four-fold on any one of the gears, the function of which I will shortly make clear.

The Accelerator.—The duties of the accelerator, as ordinarily fitted, are often not understood and it is frequently misused. On the Napier, the engine and governor are so arranged that if no pressure is put upon the accelerator the engine automatically runs at its very slowest, quietest, and most economical speed, does the least possible work that it can do, and yet keeps running. When the gear is connected the accelerator should only be used to keep the engine up to the power required from it, but should never be used to make the engine run so fast as to make a knocking noise. The Napier engine is so designed that, when doing its best, nothing more than a pleasant hum should be audible.

Dashboard.—In front of the driver on the dashboard are arranged the sparking coil, contact-breaker, paraffin pump for cleaning the inside of the cylinder, and the automatic lubricator which starts when the engine starts. This varies, according to the speed, the quantities of oil given to engine, and when the engine stops the lubricator stops as well. On the right-hand side of the driver are arranged two levers, the outside one being an extra very powerful brake, acting on both back wheels. The inside lever controls the three or four forward speeds and the reverse.

The speeds on a standard four-cylinder car are generally arranged as follows provided the engine is running at 900 revolutions per minute :—

First speed	...	...	...	12	miles per hour
Second speed	...	...	...	22	„ „
Third speed	...	...	...	32	„ „
Fourth speed	...	...	...	44	„ „

and a reverse is fitted giving up to twelve miles an hour.

The speeds can all be somewhat increased by the use of the accelerator at will or a hand throttle usually fitted on top of the steering wheel, and so the speeds can be reduced to exactly that pace at which it is desired to travel. In fact it can be said that the various types of Napier carriages between them offer every opportunity in the way of speeds for travelling at one mile or less per hour up to the racing rate of 110 miles per hour.

Care of the Car.—Dealing with the use and keeping in order of a Napier car, one of the chief points to be borne in mind is always to have at least two gallons of lubricating oil in the gear-box; if more is put in it causes no harm, it merely runs on the road. In the crank chamber there should always be half a gallon of oil, less half a pint; if the overflow pipe is opened any quantity in excess of this will flow away. All wheel

caps should be kept filled with an equal mixture of grease and oil, and all grease caps must be kept filled and screwed down. If these points are attended to, the motor and car will run many thousands of miles without any repair or renovation being required. A great point to be remembered is that the car and motor are much improved by being taken to pieces after a year's running of 10,000 to 20,000 miles. After that mileage a good overhauling at the works is desirable, but otherwise, if a car "lubricates" properly and regularly, nothing but chains and tyres require the workmen's attention.

Spare Parts.—I always carry a spare inlet valve complete, also an exhaust valve and spare sparking plugs, and with these I feel safe to go on almost any journey. Of course, they seldom fail, but if no spare parts are carried and a failure does occur, then one is sorry not to have them. In conclusion, remember that the Napier is London made, and the works are open for the fullest inspection, to enable anyone to see the wonderful care and skill employed in their construction. It is generally a great surprise to engineers in other branches of mechanical industry to see the beautiful work put into the best automobiles.

THE PANHARD.

By J. E. Hutton.

There is probably no car so well known in this country as the Panhard. The famous Paris house of Panhard et Levassor being the pioneers of the modern car, have steadily maintained an undoubted supremacy in the manufacture of the commercial pleasure vehicle. The Panhard has always justly been noted for its extreme reliability and simplicity, and probably no car made requires so little skilled attention.

The Motor.—The success of the car must be attributed very largely to the wonderfully efficient and simple motor. Originally of two cylinders, Panhard's were the first to introduce the four-cylindered motor. Up to the year 1903 the motors turned out by Panhard's were of the Phœnix pattern, with exhaust governing, and cylinder heads cast separate to the cylinders, much trouble being experienced with the cylinder head joints. The type was abandoned in favour of the Centaure, with waterjackets cast solid with the cylinder heads, and the governing arranged on the throttle. In 1904 a new type was again introduced, being a modified Centaure, the valves being arranged at either side of the cylinder heads. Mechanical inlet valves were also employed in all sizes, from 15 h.p. upwards. 1904 also saw the introduction of the three-cylinder motor, which, in spite of many adverse criticisms, has met with great success. The introduction of the three-cylinder motor caused a suspension of the manufacture of the two-cylinder 7 h.p. type.

The normal speed of Panhard motors is rated at 750 r.p.m., and it is interesting to note that above this speed the h.p. falls off, full power being obtained at normal revolutions. To this must be attributed the undoubted wearing qualities of the motor.

Little need be said as to the running of these motors, except to see that every part is thoroughly lubricated. An automatic lubricator mounted on the dashboard and driven by a small belt is provided for the purpose. The writer has found Vacuum Oil No. 1 very satisfactory and of suitable consistency.

The water circulation is maintained by a centrifugal pump, driven by friction off the flywheel. It is most important to keep plenty of lubricating grease in the stuffing box, in order to avoid water leakage and heating. I recommend the fitting of an independent Stauffer grease cap to every pump—the system adopted by Panhard's not being, in my opinion, reliable or satisfactory.

The exhaust valves should be ground carefully with finest flour of emery every thousand miles, the inlet valves requiring very little attention. In the case of motors fitted with automatic inlet valves, the springs should be renewed every two thousand miles.

Carburetter.—The introduction of the "Krebs automatic carburetter" marked a most important epoch in automobile motor construction. As everyone knows, the motor requires varying density of gas according as its speed and load are varied. The old type of Phœnix and Centaure carburetters answered admirably at full load, but were obviously unsatisfactory at very light loads. In fact it was impossible to run the motor at a speed as low as 180 r.p.m., which can now be obtained with the automatic air regulator.

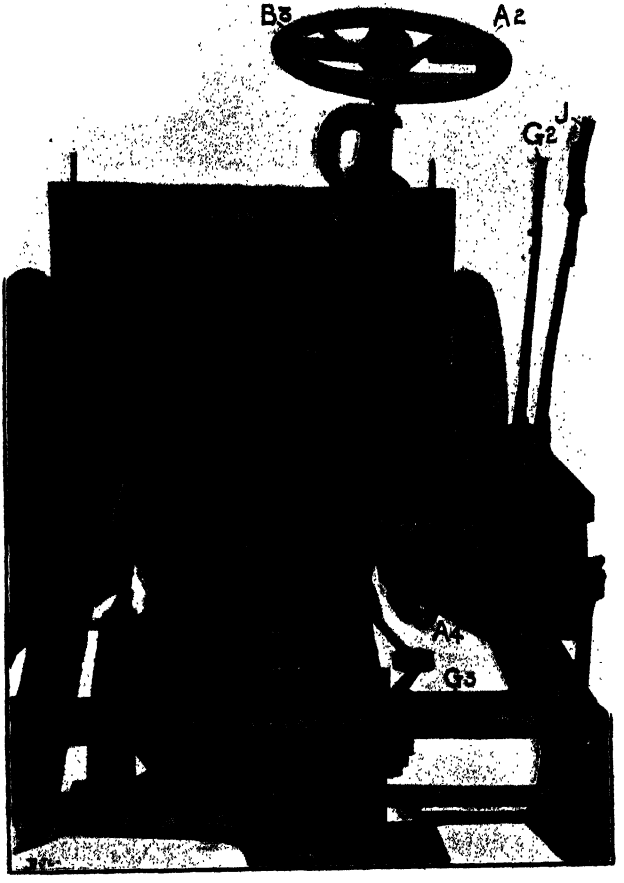


FIG. 1.—CENTRAL PORTION OF THE PANHARD CHASSIS.

A^2. *Hand accelerator.* A^3. *Accelerator pedal.* A^4. *Pipe to petrol tank.* B^4. *Casing enclosing magneto.* B^6. *Two-way switch.* B^7. *Battery box.* B^8. *Ignition handle.* C. *Exhaust pipes.* D^1. *Friction wheel to centrifugal pump.* D^3. *Water gauge.* E. *Lubricator for engine.* E^2. *Lubricating pump for crank chamber.* E^3. *Paraffin pump for cylinders.* G^1. *Gear-box.* G^2. *Change speed lever.* G^3. *Countershaft.* H^1. *Brake band.* J. *Hand brake lever.* J^1. *Transverse brake tube.* K. *Greaser.* L. *Steering gear.*

The "Krebs" carburetter may be described as the old "Centaure" with the addition of an automatic auxiliary air inlet. This automatic regulator is extremely simple, consisting of a rubber diaphragm, controlled by the suction of the engine, opening auxiliary air-ports in proportion to the speed of the motor. It is most important that this automatic valve should be carefully adjusted on its own motor, each motor requiring different regulation. In course of time the diaphragm perishes and must be renewed. To do this, unscrew the whole automatic portion of the carburetter, and first unscrew the brass check-nut which can be seen inside the barrel, and which serves to lock the valve, which is itself screwed on the centre spindle. This spindle is slotted at the end, but on no account must this be mistaken (as it is often done) for the reception of the screwdriver. Unscrew the

FIG. 2.—VIEW OF 10 H.P. PANHARD ENGINE FROM LEFT SIDE.

B[1]. *Insulating tube carrying high tension wires.* B[2]. *Chain driving magneto.* B[3]. *Timing spindle of magneto.* B[4]. *Casing enclosing magneto.* C. *Exhaust pipes.* C[1]. *Yokes above exhaust valves.* D. *Centrifugal pump.* D[2]. *Pipe to water gauge.* D[4]. *Belt for fan.* D[5]. *Tube carrying fan.* D[7]. *Adjustment slot for fan tube.*

valve completely. The diaphragm, together with the spindle, can now be removed from the top, the two small screws at the side being first withdrawn. To test the automatic valve, hold in the hand and blow strongly through the pin-hole in the top of the diaphragm case; the valve should then be seen to descend, quickly regaining its normal position. as soon as the pressure is removed. The valve may be gummy from dust and "back-fires." Remove and thoroughly clean with petrol. On no account must lubricating oil or grease be used, these causing clogging.

The jet may be viewed or removed by firstly detaching the automatic portion of the carburetter and secondly withdrawing the air nozzle fastened to the fly-wheel end of the carburetter by two screws. A special box-spanner is provided in the tool outfit for the jet. With petrol turned on and float held up with finger and thumb, a steady fountain should pass through the jet. A filter is provided at the base of the float chamber, to catch any impurities in the petrol.

Governing.—On the new 50 h.p. Panhards the throttle is operated by water-pressure taken from the motor cooling circulation, in place of the usual centrifugal governor. As, however, this water pressure depends upon the efficiency of a friction driven pump, the system appears open to criticism.

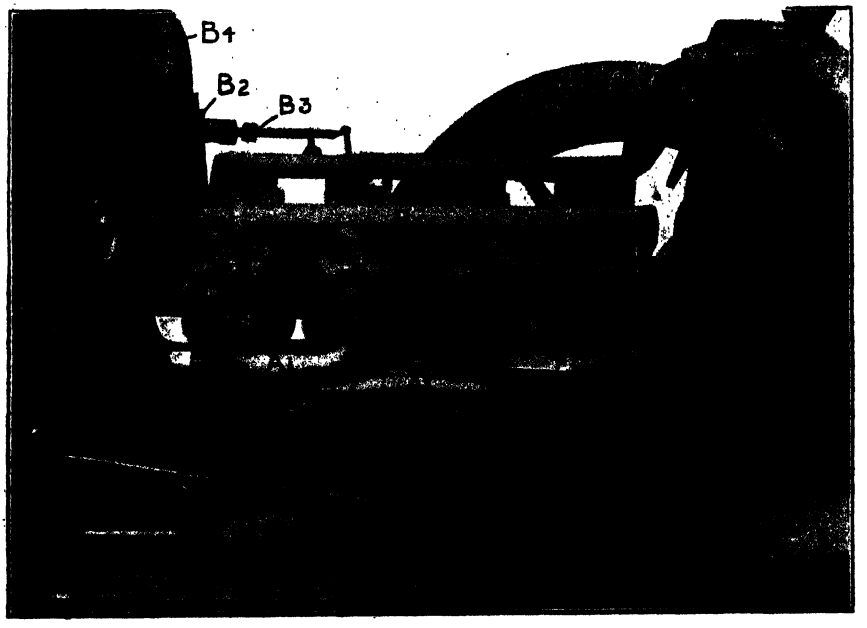


FIG. 3.—THE PANHARD ENGINE VIEWED FROM THE RIGHT.

A, *Krebs carburetter.* A^1, *Inlet pipe.* B, *High tension ignition plugs.* B^1, *Insulating tube carrying high tension wires.* B^2, *Chain driving magneto.* B^3, *Timing spindle of magneto.* B^4, *Casing enclosing magneto.* D^4, *Belt for fan.* D^5, *Tube carrying fan.* D^6, *Fulcrum for* D^5. D^7, *Adjustment slot for fan tube.*

Ignition.—The scope of this subject is too great to be more than lightly touched on in the limited space of this article, and the novice is referred to the author's chapter on this subject in the Badminton Library Book on Motoring (new Edition 1905). Messrs. Panhard retained the old-fashioned tube ignition until 1902, when it was finally abandoned for coils and accumulators, all models since 1904 being fitted with the Eisemann high tension magneto system. In this system electricity is generated by a rotary chain-driven magneto machine, at low voltage, and converted to high

voltage by a coil and condenser, the high tension current being distributed to each cylinder through a "high-tension commutator." The low-tension circuit is made and broken at the required moment by a device mounted in front of the magneto, two platinum pointed screws taking up the wear

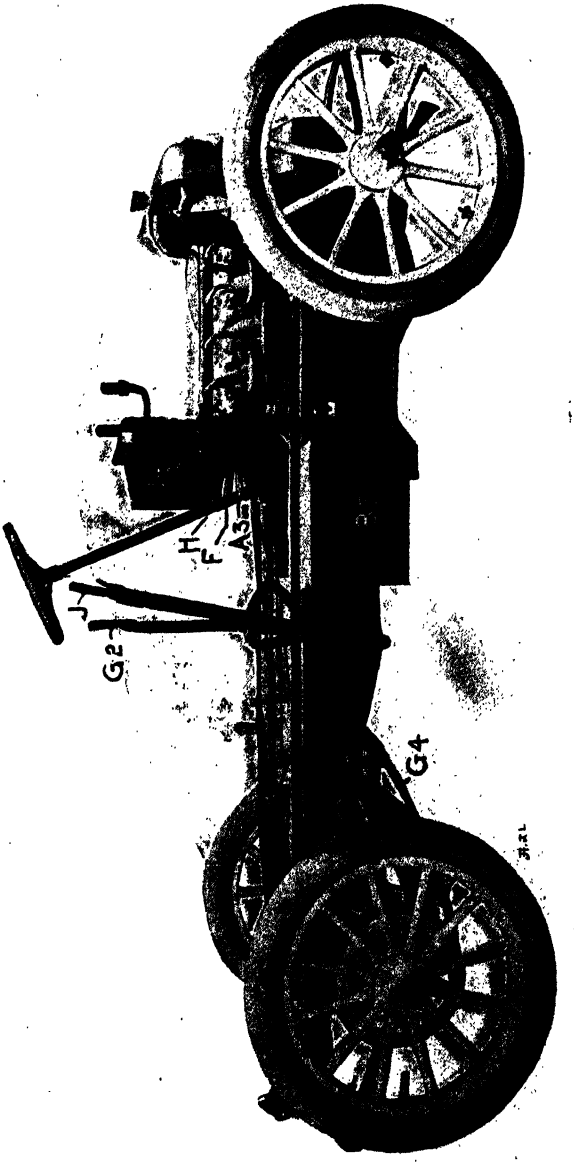


FIG. 4.—SIDE VIEW OF PANHARD CHASSIS.

A^3, *Accelerator pedal.* B^4, *Casing enclosing magneto.* F, *Clutch pedal.* G^2, *Change speed levers.* G^4, *Chains.* H, *Brake pedal.*

due to sparking. The adjustment of these contacts is most important and delicate, and they should run without any visible spark whatever.

The current from the armature of the magneto is collected by two carbon brushes, which must be renewed at long intervals. Very little oil

should be used on the magneto. The chain must be kept tight by the adjustments provided. Should the chain break, the novice may find a hint for its proper replacement useful. Turn the magneto until one of the brushes is in contact on the high tension commutator. Ascertain to which cylinder this belongs. Unscrew the small screw to be found in the centre of that cylinder head; and insert through the hole a piece of stiff wire. Now very gently turn the engine until the piston is at its highest point on the compression stroke, this position being indicated by the movement of the wire. This position may be taken as approximately correct and the chain replaced. During the above operation, the ignition control on the wheel should be set fully retarded.

The coil should be kept dry and should be of the new pattern provided with an electrical "bye-pass" or "safety valve" to take off the excess of current generated. Dry batteries are provided as a stand-by in case of failure of the magneto. The writer recommends the use of accumulators, the dry batteries being very unsatisfactory.

A switch is mounted on the dashboard marked—"Ar" Stop—"P" or "Ac" Battery—"Ma" Magneto.

Clutch.—The simple leather-covered cone clutch appears to give very little trouble, and a little castor oil keeps the leather in good condition. Never run the car with the clutch out of adjustment. As soon as any defect is noticed, it should at once be remedied. The adjustment can be taken as correct when the side brake lever has one inch of play before commencing to draw the clutch. The plate clutch as now fitted to the 1905 50 h.p. and all marine motors appears to be a very fine clutch and likely to give no trouble.

Gear.—The simple sliding sleeve type of gear, now universally known as the "Panhard" type, has stood the test of time, and is probably the best commercial type of gear on the market. No particular attention, provided ample lubrication is given, need be paid to it. The gear-box is fed with oil from the main mechanically-driven lubricator on the dashboard, but the gear box should be periodically inspected to insure there being sufficient oil to allow all the lower pinions to dip in it to the depth of their teeth.

The use of non-skidding devices on *one* driving-wheel only is to be deprecated, throwing undue strains on the differential gear and frequently causing seizing of the differential sleeves.

Bearings.—Up to 1905 plain bearings have been exclusively used, but are now being displaced in the wheels and certain parts of the gear by ball bearings, in cars of 15 h.p. and upwards.

Chains.—The chains used on Panhard cars give little or no trouble. After some ten years' experience the writer has quite given up any idea of satisfactorily lubricating them. Thoroughly soaking them in oil is the only way, and then, if the roads are muddy, such lubrication will not last fifty miles. Dixon's special graphite gives fairly good results.

When the chains stretch so much as to require a link removing, discard them, and put on a pair of new ones. Chains with "links out of them," are too much "out of pitch" to run sweetly. Chains as a rule will not run sweetly for more than two or three thousand miles.

Wheels.—These should be examined carefully and periodically to see that all is safe. Lubricate with a mixture of oil and grease or graphite. Examine the bolts which attach the driving sprocket to the back wheels, tighten up where necessary. Neglect of this may cause breakage.

Brakes.—Those on the countershaft controlled by the foot pedal give little trouble and are powerful. The back brakes have, however, always been a great weakness and the worst point on the Panhard car. The internal expanding fitted on the early three-cylinder cars, were very imperfect, occasionally seizing when travelling at high speed. The only remedy for this is to flood them with oil. Messrs. Panhard, have now, however, introduced a modified form of back brake which is much more satisfactory.

Hints on Driving.—The throttle and ignition controls on the steering wheel are very easily operated. The throttle is closed and the ignition retarded when the control is twisted towards the driver. The automatic lubricator should be set to give 15 drops per minute on the engine (right hand) sight feed and 10 drops on the gear (left hand) feed. On going up long climbs on first speed, give a few strokes to the pump on right of lubricator. After a long run, pump a compartment full of paraffin (not petrol) into the cylinders, giving the engine a couple of turns.

Drive on the accelerator, setting the hand control nearly closed, so that when the clutch is withdrawn the engine may run sweetly and without noise.

To test for misfiring, do not "break" the high-tension circuit, which is liable to damage the coil, but "short-circuit" the sparking plugs with a wooden handle screwdriver.

To get the *most* out of the car, keep the revolutions of the engine up. If the car seems unusually sluggish on hills, examine the Krebs carburetter.

Don't try and take the magneto to pieces; send for a man who really understands it—not one who merely *says* he does.

Pull the clutch well out when changing speed.

Examine and oil the steering gear periodically.

When changing speed do so with confidence, don't be afraid of breaking it; you won't.

"To hesitate is to be lost."

Above all, lubricate everything thoroughly.

[We are indebted to the "Automotor Journal" for the illustrations which accompany this article.]

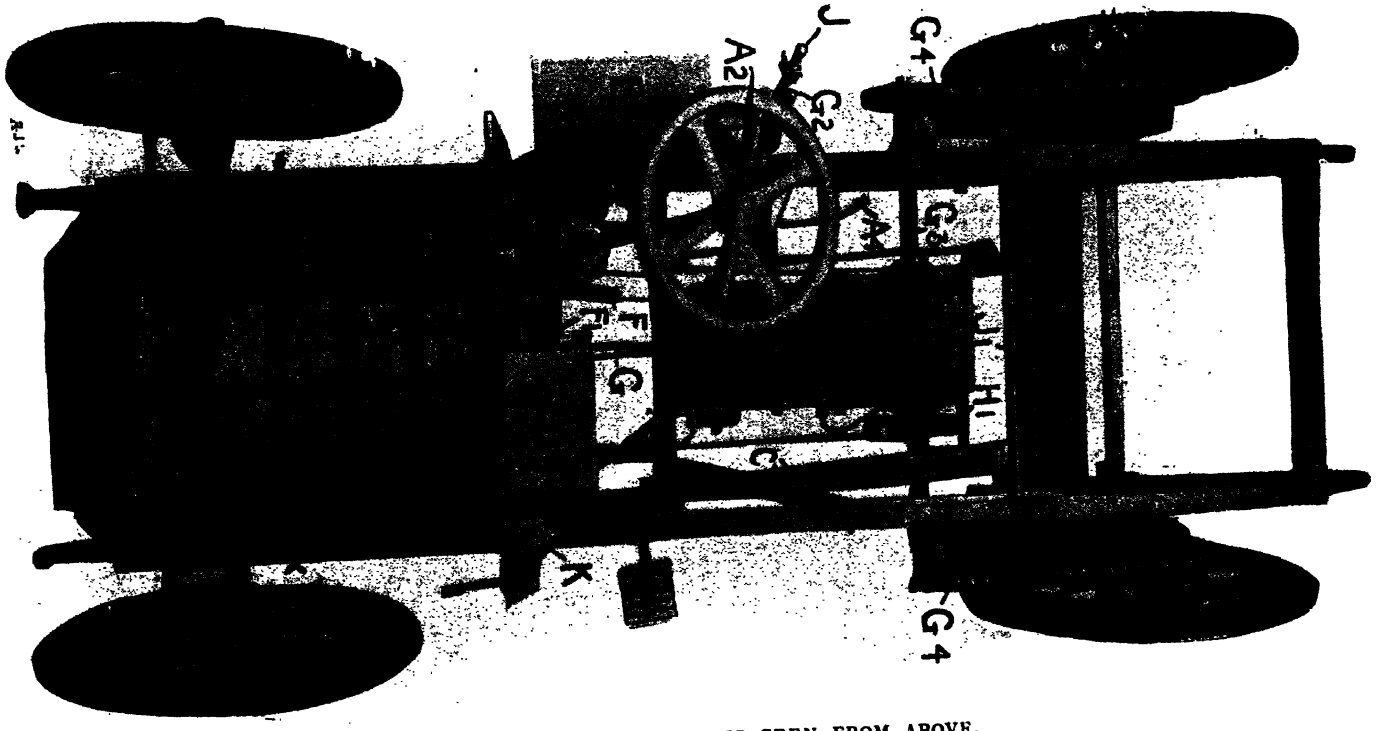
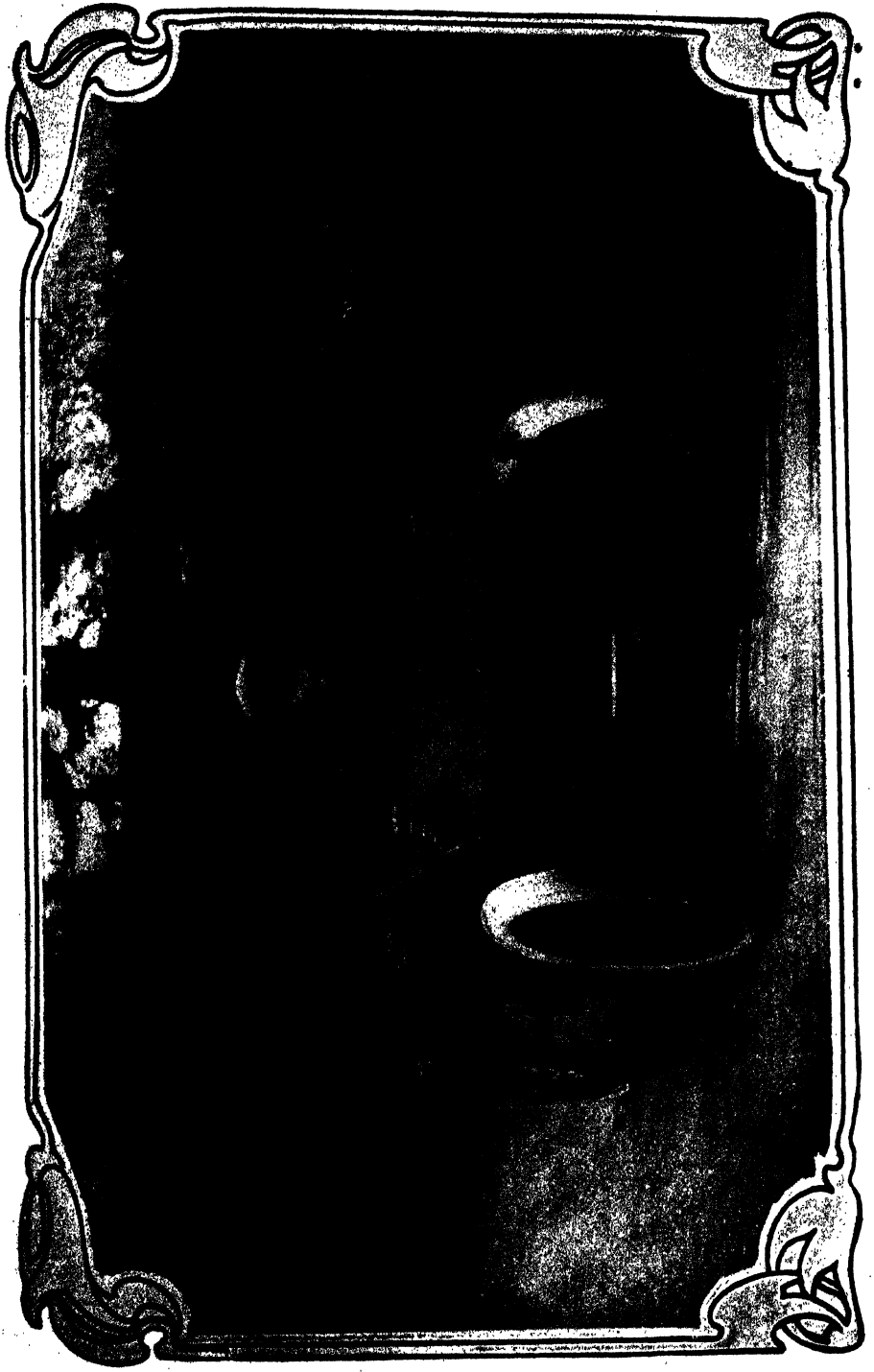


FIG. 4.—PANHARD CHASSIS SEEN FROM ABOVE.

A2, *Hand accelerator.* A3, *Accelerator pedal.* A4, *Pipe to petrol tank.* B4, *Casing enclosing magneto.* B7, *Battery box.* B8, *Ignition handle.* C, *Exhaust pipes.* C2, *Exhaust box.* F, *Clutch pedal.* F1, *Clutch cone.* G, *First motion shaft.* G1, *Gear-box.* G3, *Countershaft.* G4, *Chains.* H1, *Brake band.* J, *Hand brake lever.* K, *Greaser.*

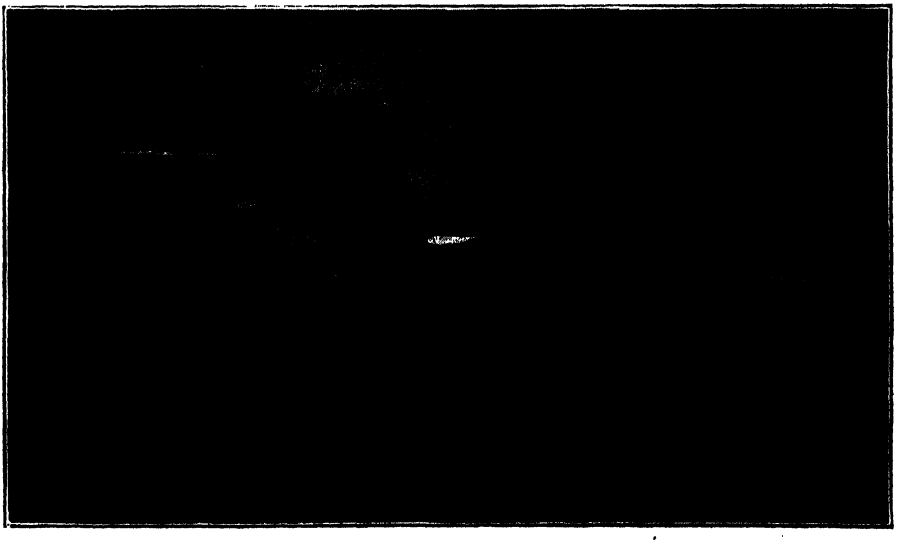


MR. C. W. DIXON ON HIS LANCHESTER CAR.

THE LANCHESTER.

By F. W. Lanchester.

The 12 h.p. water-cooled Lanchester is undoubtedly at the present time the most popular of the Lanchester cars. That it will find a formidable competitor in the firm's new 20 h.p. goes without saying, but a distinctive type of car that has established its reputation over many years and arrived at a point so near to mechanical perfection as the latest 12 h.p. model, may be relied on to command a prominent position in the market for some years to come.



THE FIRST LANCHESTER.

Built in 1895, it is claimed that this is the first complete car manufactured in England.

A point that strikes the uninitiated on meeting with a Lanchester car for the first time is the manner in which it differs from the generality of cars of other makes, and the question is frequently asked "Why should any firm have gone so far out of its way to introduce so many novel features?" To those who have but recently taken an interest in motors and motoring, this is a perfectly natural question, and is one which I propose, in a brief introductory note, to answer.

The original Lanchester 1895-6 is believed to be the first petrol car (excluding a petroleum tricycle) constructed in Great Britain, and in this car many of the distinctive features of the modern Lanchester had

their origin. At that time there was no established practice in motor car construction, and scarcely two firms built alike. Engines were in front, engines were behind. "Bath Chair" steering was fitted by some makers, and bicycle handle and wheel steering by others. All these things were common, and it was not at that time surprising that every new designer who came into the field took more or less a course of his own. Nor was the first Lanchester an exception.

As might be expected, this car was not in every way a success, and although some of its features were permanently adopted, there was much that had to be abandoned, and the success of the Lanchester may be said to date from the 1898 car, which was awarded a special Gold Medal at the Auto-Mobile Club Trials in 1899, and which may be styled the prototype of the

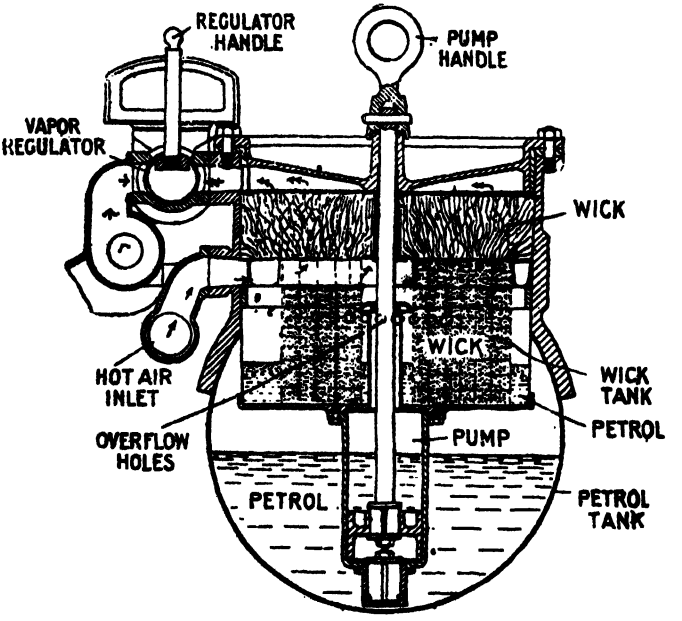


FIG. I—THE LANCHESTER WICK CARBURETTER.

modern Lanchester Car. This car was remarkable, inasmuch as it embodied many features novel at that date, and which have since been adopted by almost every leading maker both at home and abroad. The following points are in particular worthy of mention:—

Magneto Ignition.
Mechanically Operated Inlet Valves.
Automatic Lubrication throughout.
Direct Drive on High Gear.
Live Axle, with Central Gear Drive.

Beyond this, there are many other features common to the bulk of high-class cars to-day in respect of which the Lanchester can claim priority, and I have not the least doubt that there are many other points at present

ranking as idiosyncrasies of the Lanchester which will to-morrow become current practice. Already the long wheel base is universal; the worm form of drive is finding favour with quite a few firms, and other leading makers are experimenting with wire wheels built to the Lanchester specification. On the other hand, air cooling has been entirely abandoned on the Lanchester, in favour of the almost universal practice of water cooling, and in the 20 h.p. a four-cylinder vertical engine is employed in place of the special balanced type.

We see, then, that there has, in the history of the modern car, been a *rapprochement* between two types of totally distinct origin, and without doubt this *rapprochement* will continue as time goes on, especially so when the patents

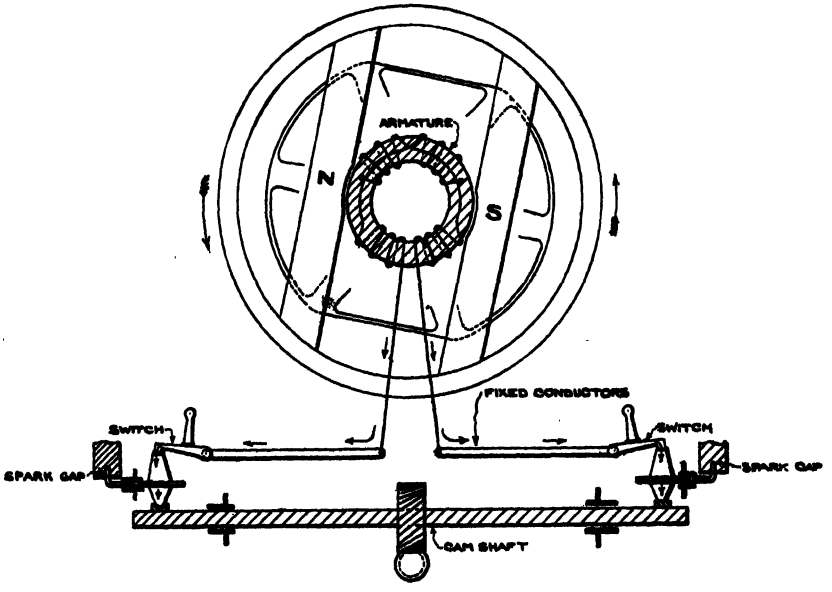


FIG 2.—THE IGNITION SYSTEM.

run out, on which the distinctive features of the Lanchester largely depend. It is too early at present to venture on any prophecy as to what finality in design will be, but if the past development can be taken in any sense as a gauge of what is to come, then the car of the future will certainly resemble the Lanchester of to-day as closely as it will anything else at present on the market.

As a preface to Mr. C. W. Dixon's interesting article on driving, I propose to give a few brief descriptive notes of the most prominent features of the modern Lanchester, dwelling more especially on those points in which, in the Lanchester, departure is made from common practice, finishing with a special short description of the new 20 h.p.

The Balanced Engine.—The engine fitted to all except the 20 h.p. side entrance car is balanced on the well-known Lanchester system of reverse rotation. This engine is of scientific as well as engineering interest, from its being

the first completely balanced reciprocating engine ever made, the complete absence of vibration being largely responsible for the remarkable smoothness of running for which the Lanchester has always being noted. Although it is only a two-cylinder engine, the special balancing arrangements render it, so far as sweetness of running is concerned, equal to a six-cylinder engine of the ordinary type. For a full description of this engine and system of balancing, reference should be made to the "Descriptive Manual," published by the Lanchester Motor Co., Ltd.

The Vaporiser or Carburetter employed on the Lanchester Cars of all sizes is of the wick type, made under patent 15045/95, and has several advantages over the spray type in common use, and possesses very few drawbacks. One of the advantages claimed for the Lanchester system is absolute safety; liquid petrol is not "piped" from one point to another,

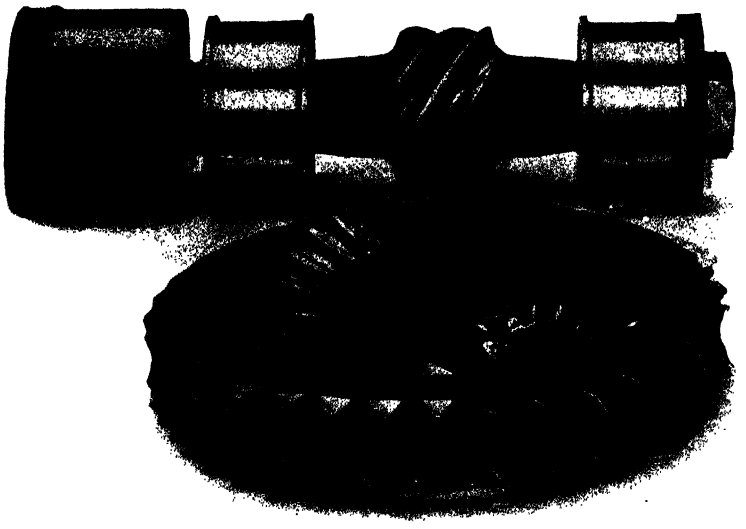


FIG. 3.—THE LANCHESTER WORM DRIVE.

and there is no danger of leakage; a further advantage is that there are no moving parts (floats, valves, etc.), and a constant mixture is obtained at all speeds without the addition of any mechanical regulator. A still further advantage is that the Lanchester wick vaporiser is not liable to be stopped by dirt or water; it has an amazing digestion, handfuls of mud and pints of water having not the least effect on its efficiency.

The illustration, (Fig. 1), shows the sectional view of the vaporiser, with parts named in place. This view shows the vapour regulator in the intermediate position, and arrows indicate the passage of the air through the various ports. The single-headed arrow shows the hot air entering from the heater, and the double-headed arrow the carburetted air passing into the vapour regulator, where it is mixed with cold air through a separate supply to form explosive mixture. The passage of the cold air is shown by broad arrows.

The tank from which the wick sucks is a vessel of about one gallon capacity, and is situated within the main supply tank. A pump is arranged, shown in the section, by which the petrol can be pumped from the main tank into the wick tank, and the overflow runs back into the main tank. The pump-handle is at the driver's left hand, and a few strokes of the pump are required every ten or fifteen miles. There is no fear of over-pumping, as the overflow is of very large area, and will carry away any surplus delivery.

Magneto Ignition.—With the exception of slight differences of design, the present magneto is exactly as first exhibited at Richmond Park in 1899, and is unique in its simplicity. The general disposition of this system is rendered evident from the diagram Fig. 2 of the magneto and electrical connections. It will be seen by referring to the diagram that the permanent

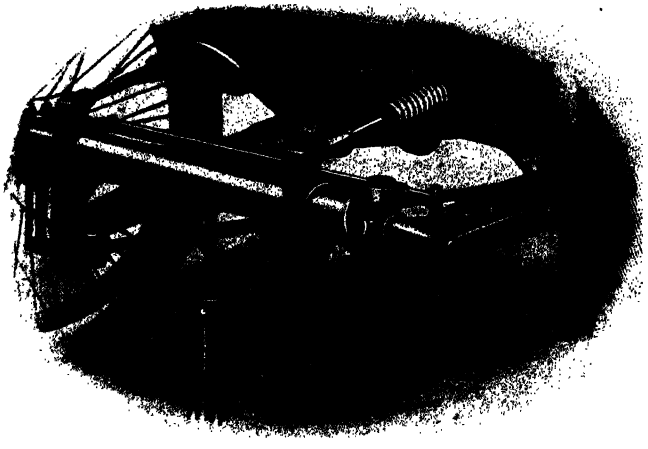


FIG 4.—FRONT AXLE OF THE LANCHESTER CAR.

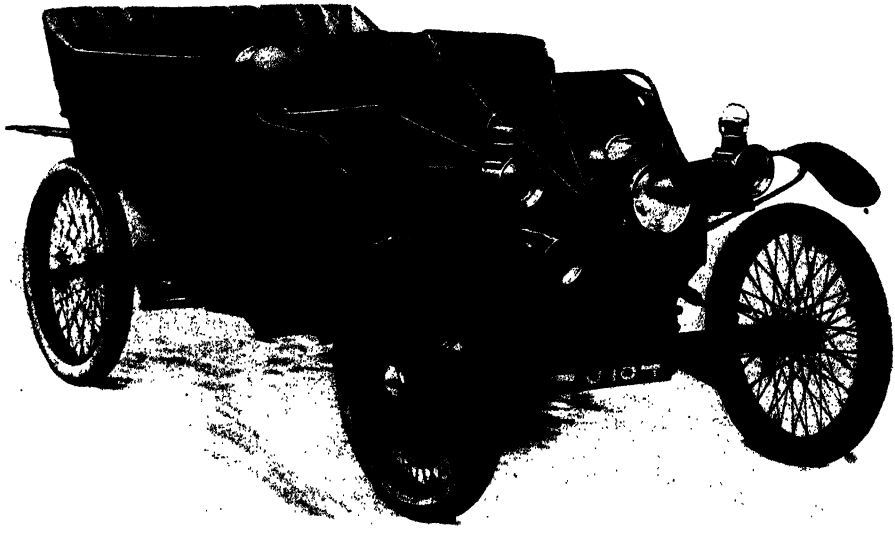
magnets are built up to form part of one of the motor flywheels. In this way the weight of the magnets is made to do duty as flywheel, so that massive magnets may be used without adding materially to the weight of the motor, the magnetic circuit being completed by the rim of the wheel, and the poles north and south being "consequent poles" formed at the middle of each magnet bar.

The armature is fixed relatively to the motor frame, and is supported by the motor crankshaft. The current is induced in the armature coils, as the poles of the magnet in passing them break the magnetic circuit. There are four coils on the armature, forming two independent circuits, each consisting of a pair of coils in series. One end of each of these circuits is connected to "earth," the other terminals of the coils being attached to

the fixed conductors by which the current is led to the igniters, connection being made by means of a switch. In the diagram portions are shaded to denote the "earth" connections, it being understood that all these shaded parts are in connection with the motor frame, and therefore with one another. For fuller details including description of the instantaneously detachable sparking plug, the reader is referred to the Manual.

The Worm Drive.—Until recently, the Lanchester car was the only one to employ the worm form of transmission. During the last few years other firms have shown their intention of adopting the worm drive, and consequently a review of the "pros and cons" is of special interest.

The worm drive was adopted in 1897 by the writer for two main reasons, *i.e.*, silence of running, and the great range of gear reduction available. These reasons have partially ceased to exist; the great reduction required on modern cars, owing to the much higher speed employed, is no



THE 12 H.P. LANCHESTER.

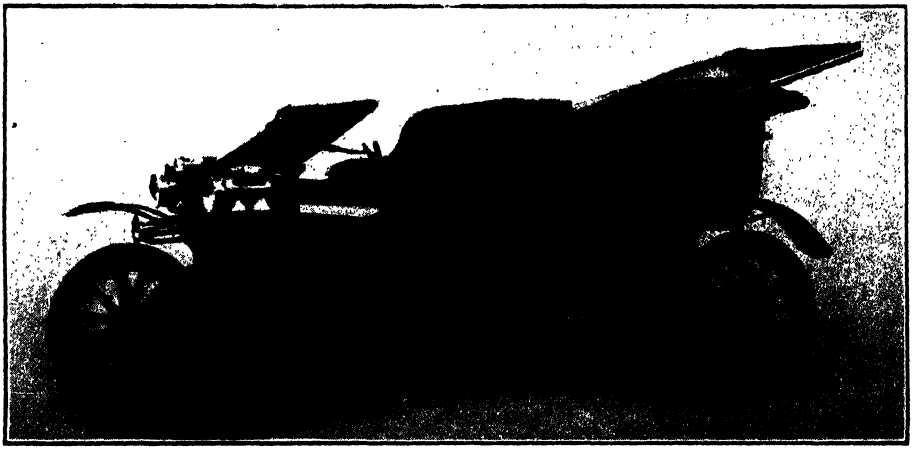
longer very great. Although the considerations that led to the original adoption of the worm have diminished in weight, new considerations have sprung up that render its advantages greater to-day than ever.

It is the employment of worm gear *arranged below the wheel axle* that permits of the floor level of the rear body being brought down to that of an ordinary horse drawn brougham, accompanied by a drop of 6 inches in the height of the centre of gravity, a point the advantages of which it is scarcely possible to overrate. The illustration, Fig. 3, shows the main components of the Lanchester worm drive exposed to view, and I need not go into details as to the method of working.

The Suspension.—The novel and ingenious system of suspension is perhaps the feature of all others that has been most widely admired in the Lanchester car. The main idea that this system is intended to carry out is that the side location of the body of the car should be as near the ground level as practicable, in order to diminish lateral vibration when passing over rough roads.

This is effected by mounting the springs on the body of the car instead of on the axle, and arranging them to act as cantilevers, the bearing on the axle being carried by a suspension bracket or hanger extending some distance below the centres of the road wheels (Fig. 4).

The 20 h.p. Lanchester.—This type differs materially from the other models, inasmuch as a four-cylinder vertical engine has been adopted, fitted in the fore part of the vehicle. This car has been especially studied to take a considerable range of bodywork of the now popular side entrance type, and is particularly well adapted to the ordinary "town" types such as coupé, landaulet, etc. It is well known that the requirements of this class are the most difficult to meet satisfactorily.



THE 20 H.P. LANCHESTER LANDAULETTE WITH ENGINE IN FRONT.

The special advantages claimed for the new type are:—great flexibility of engine (4 to 40 miles on high gear); small turning circle (will turn easily in 30 ft. road); absolute silence; perfect smoothness of running; side entrance exactly as in horse Brougham. The vapouriser, ignition, worm drive, suspension, steering as used in the 12 h.p. and 18 h.p. cars are retained, but certain detail improvements have been added, increasing the general handiness. Amongst these may be mentioned the single lever control, concentration of all regulating mechanism in one spot right under the hand of the driver, greatly enlarged suspension joints, etc.

The great improvement introduced in this car is, however, undoubtedly the *engine position*. This innovation, which appeared as an absolute surprise to the automobile world, is in reality the key to the whole arrangement of the

car. This will be understood on reference to the illustration on page 45, where the engine is seen to occupy a position in between the driver's and passenger's leg spaces, their respective seats being placed somewhat further apart than is customary. This engine position enables a greater proportion of engine weight to be thrown on the driving wheels, which is a great desideratum. In addition, a much more ample side entrance is available owing to its being possible to arrange the driving seat so much further forward.

Other salient features of the new car are:—the Lanchester multiple disc clutch, by which the car may be started sweetly and easily on the high gear; and the single lever control, in which it is impossible to put in two gears at once, and in which the motion of withdrawing the lever applies the brake, no matter what gear is in use. This is a point best appreciated by those who have practical acquaintance with the Lanchester car. A reserve brake, (in addition to the two brakes usually fitted) is provided, acting direct on the road wheels. This is of the internal expanding type, equally efficient in both directions, the frictional surfaces being, as in all brakes fitted to Lanchester cars, metal on metal.

The most noticeable point in driving the 20 h.p. Lanchester compared with the 12 h.p. touring type is that, owing to the extreme flexibility of the engine, it is rarely necessary to "unclutch." The ordinary traffic of the street can be followed with the greatest ease, either by the hand governor or foot accelerator, whilst ample "sprinting" power even on the highest gear is always at command.

Lubrication also differs from the 18 h.p. model. In place of the automatic lubrication with a system of distributing pipes, the whole of the motor lubrication is on the pressure system, worked by a pump in the crank case of the engine, by which oil is forced into all bearings. The crank case is fed from time to time from a tank, by gravity, under control of a valve. Whereas, in the touring 12 h.p. type, the front seat is the position of greatest comfort, on the new 20 h.p. model the rear seat is the most luxurious. It is, in fact, hardly possible to tell that there is an engine on the car at all, so smooth is the motion.

THE DRIVING OF THE LANCHESTER.

By C. W. DIXON.

Drivers and owners of the Lanchester car, and those who are considering the purchase of one, will be interested, I think, in the account of my experience in driving and the results obtained, both as to the methods of driving and the cost of running. I received my first car in January 1902, and have driven it many thousands of miles. I always drive myself, and, being an engineer, I do all the adjusting and small repairs, keeping no mechanic. A great part of the pleasure and satisfaction in this car is its smoothness and silence in running, and the ease with which the speeds are changed.

These alterations are so simple that a driver can soon learn to effect the change without the passengers knowing, except by listening to the increased or lessened speed of the engines. The driving of a Lanchester is quite different from that of any other car, in that there are no pedals with the exception of the accelerator. The forward speeds, reverse, and brakes are worked by hand levers lying between the two front seats conveniently to the left, the right hand being occupied entirely by the steering tiller.

To those who are accustomed to wheel steering only, the tiller may appear unsatisfactory, and perhaps unsafe, until it has been tried. To my mind, it cannot be improved. It is very easy to move, yet quite steady, with no lost motion in its mechanism, and is perfectly safe and certain, at any rate, up to any speed that a touring car is reasonably required to go on our main roads in England. The wheel base is very long and the gauge wide, but the car can be turned in a smaller circle than a leading French make that had a wheel base more than a foot shorter and a considerably narrower gauge.

The Motor.—The engines have two cylinders, each with an independent governor. The speed of the engines is controlled by levers, which, according to their backward or forward position, slacken or tighten the governor springs. Each can be worked separately. In case the driver thinks one of the cylinders is not working well, he can easily ascertain which by working each cylinder by itself. The ignition is magneto-electric, on the low tension system, the armature being stationary and the permanent magnets revolving in the fly-wheel. The current is taken to the two cylinders by metal bars, carried on studs screwed to the frame, and insulated by mica, consequently there is no trouble from the insulation giving way.

Carburetter.—The carburetter, of the wick type, is supplied with petrol by a hand pump, being sunk into the steel petrol tank under the front seat. This constitutes an extremely safe arrangement, as there are no pipes whatever for the conveyance of petrol. Four or five strokes of the pump will run in enough spirit for about ten miles. In starting the engine, the mixture lever is set to give a rather stronger mixture than is found to be the best, and after the car has been running some little time, the lever

can be set back until the best result is obtained. This is found by pressing the accelerator pedal while running steadily on the level, and finding at which point of the mixture lever the engines give the highest power. Then it is advisable to still further weaken the mixture a little, say from a quarter to half a division on the indicator, as the strongest mixture is not the most economical. When a hill comes in sight, a stroke of the pump will freshen up the carburetter and give a fillip to the car.

The igniters are quickly and easily removed from the cylinders for inspection by a quarter turn of a quick screw device, the electric connection being made by a substantial steel switch. There is a make and break contact with steel faces, which are very simply adjusted and kept clean.

Gears.—The various speeds and reverse are actuated by friction devices, the high speed by clutch direct, through to the worm drive, the middle, low, and reverse speeds by drum brakes on a patent gear, the wheels of which are only at work when the particular gear is being used. This principle results in great ease and smoothness in changing speeds, as all that has to be done is to take out one lever and put another in. Each lever in a forward position puts in its respective speed; in a midway position the engine runs free from the car; backward, the brakes are applied.

Brakes.—The main brake is similar in principle; that is to say, it consists of a revolving external cone which is pressed into an internal cone, which latter is fixed to the frame of the car and does not revolve. The external cone when forced into it by the brake lever, sets up friction, and so retards the car. The faces of the brake and clutches are all of metal, so that there is no danger of burning out and rendering the parts useless. I have driven down a three-mile hill at a good speed, ending up with a quarter of a mile of one in eight, with the brake on all the way, with perfect confidence and safety.

The brake acts with equal power, and with equal effectiveness, whether the car is going backwards or forwards. The car can be stopped with great ease and quickness by pulling out the high speed lever and drawing it back on to the brake at one movement; and yet there is no danger of putting it on too hard and spoiling the tyres, owing to the fact that directly the car is checked, the driver's body is thrown slightly forward, which causes him automatically to ease the brake. This, unconsciously on the driver's part, conduces to a smooth action of the brake. The opposite occurs with the pedal brakes, and with those applied with a lever which has to be pushed forward to apply the brake.

Cost of Working.—As regards cost of working, the figures for my second car, a 12 h.p. water cooled, come out at rather under 3¼d. per mile, including petrol, oil, grease, cleaning, licence, insurance, repairs and tyres, but not including any sum for depreciation, this for a distance of 5,170 miles. The car will run about 25 miles per gallon on average roads at a good speed. In connection with this, I may mention that the mixture lever, with its power of varying the proportion of petrol, vapour, and air, accounts to a considerable extent for the low consumption of petrol, which is remarkably good, as the car is not a light one.

I have made a consumption test on the London and Birmingham road, with the following results:—

Weight of car with passengers, spares and stores ...	27 cwt. 16 lbs.
Average speed throughout non-stop run	20·4 miles per hour.
Petrol consumed	4 gallons.
Distance run	138·5 miles.
Miles per gallon	34·6
Or gallons per ton mile ...	·021.

The roads were dry and not very dusty; the car was in first-rate condition; it was run at a speed of as nearly 20 miles per hour as possible on the level, rushed up the hills to avoid changing off the top speed, and coasted down the hills with the engine running free and dead slow. The engine was never stopped throughout the run.

Tiller Steering.—I have been told by friends who drive other makes of car that the Lanchester has two main defects, namely, tiller steering and the worm drive. When they come for a run on the car, however, they are all delighted with the great smoothness and silence of running and ease of driving, and apparently forget their two fatal objections. The tiller, of which I have already spoken, is pushed in the direction the car is intended to turn, consequently the steering is self-moderating, as the body of the driver tends to lean outwards as the car turns, and so straightens the tiller again, preventing over steering, and conducing to steady curves. The worm drive is perfect. It does not rattle or fizz, or stretch, or come off as chains do; it is perfectly silent and exceedingly efficient. On examination, the wear on the worm and wheel is quite invisible, and they are beautifully polished and run without heating.

Wire Wheels.—Wire wheels are often criticised, owing, I think, to their not looking so strong as the more customary wood wheel. The Lanchester wheels are very substantial as I know from experience, having in the earlier days had a bad side slip, which resulted in the back wheel coming in contact with a grass curb, forcing the tyre off the wheel and bending the axle. The wheel, however, remained quite true and sound. I have also seen a driving wheel with half the spokes torn out of one side (owing to a collision) which was driven home twenty miles and did not collapse. I hardly think a wooden wheel would be a nice thing to drive on with some of the spokes out.

I have sometimes heard it said that the Lanchester is not a good hill climber. Now, I have driven my car to the top of the Worcestershire Beacon, and having a gradometer fitted, stopped on the steepest part, which I found to be 23 per cent. or 1 in 4⅜. There was no difficulty in starting again on this gradient.

I have also driven a 10 h.p. air cooled car up a back road in St. Ives, Cornwall, called "Back Tarrant," which has a gradient for 50 feet of 27%, or 1 in 3⅜ rds. I stopped the car on the steepest part, backed it down, came up again, stopped and started it again.

The special advantages of the Lanchester are, silence in running, great comfort on account of the method of spring suspension, absence of chains, absence of vibration from imperfectly balanced engine, simplicity of driving and consequently but little fatigue, safety owing to broad wheel gauge and low centre of gravity, its perfect brakes, and an ignition system which does not develop faults. In conclusion, I would like to say that I have never seen any piece of complicated mechanism, such as a motor is, better designed or with better material and workmanship than the Lanchester. It is a great pleasure to me as an engineer to see attention paid to the working out of details to the same careful extent as is given to the more essential parts of the work.

THE COVENTRY DAIMLER.

By G. Foster Pedley.

In the opinion of those who have handled them there is perhaps less necessity for writing about the driving and management of the Daimler car than is the case with almost any other make on the market, this being due to its really wonderful simplicity, and to the fact that beyond steering and operating the one lever which regulates the speed of the engine, the driver has little else to occupy his attention, except the occasional necessity for changing speed in a hilly country.

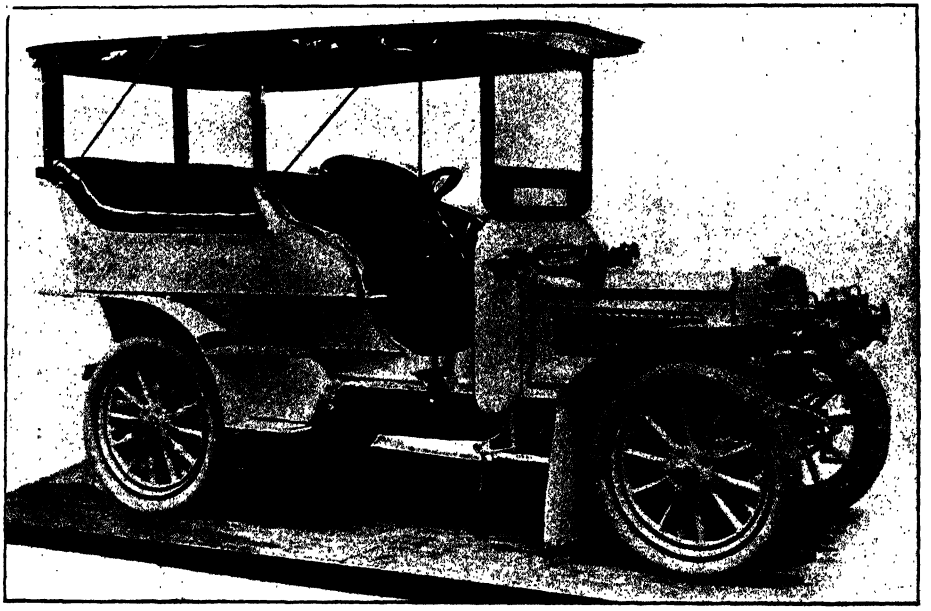


FIG I.—THE 28-36 H.P. DAIMLER, "WINDSOR" MODEL.

It is not, however, in the method of driving only, but in every single detail of the car that simplification is the dominant note, proclaiming itself even to the most uninitiated in motor matters. The numerous diagrams kindly lent to me by the Daimler Motor Company convey such a lucid idea of the general features of the mechanism of these cars that no long and wordy description is at all necessary.

Coventry Daimlers are nowadays built of no lower power than 28 to 36 h.p. and thus do not appeal to the man who wants a low-priced vehicle. This particular type is absolutely standard, and is turned out of the works at Coventry at the rate of ten to twelve vehicles every week. Where considerable speed

is required a somewhat larger engine of nominally 30 to 40 h.p. is used. The shortest wheel base is 8 ft. 8 ins., while for larger cars chassis with 10 ft. and even 11 ft. wheel bases are built.

The frame is constructed of wooden side members, strengthened by steel flitch plates, and is perfectly straight from end to end, although it is ingeniously constructed so as to be wider at the back end than in front. Spring carriers, or, as they are more often called, dumb irons, project from the front end of the frame and are supported by semi-elliptical springs upon a straight front axle. A similar axle, which is shown in Fig. 3, is used to support the rear end of the car, and the springs are carried in this case outside the frame.

The steering gear, which is such an important feature of a car, has obviously been designed with great regard for its strength, all the pins, joints, etc., being of ample dimensions and well secured, and furthermore being thoroughly protected from dust by leather covers. The steering wheel is sloped at a convenient angle and is surmounted by a lever which controls the speed of the engine.

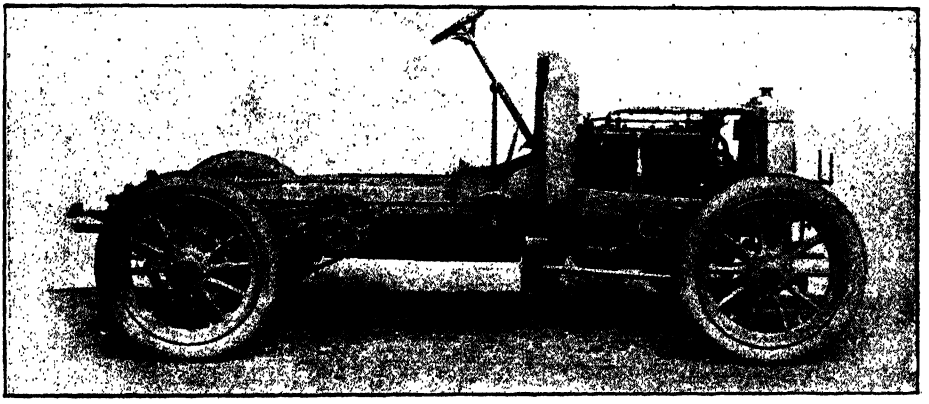


FIG. 2.—SIDE VIEW OF DAIMLER CHASSIS.

Fig. 3 shows the special form of hollow dashboard adopted for these cars. It will be seen that it is particularly clear of fittings, there being practically nothing upon it but the lubricator and pressure gauge. The side cupboards, one of which will be seen open in Fig. 3, form a particularly neat contrivance for the carrying of small spare parts and the various odds and ends, which in so many cars have to be mixed up with big tools in a common receptacle. The front end of the bonnet is formed by the radiator, and the bonnet proper is an exceedingly light construction of sheet steel which can be very quickly removed.

Two comprehensive views of the engine from either side are given in Fig. 2 and Fig. 6. The engine is a four-cylinder one with the cylinders and their water-jackets cast together in pairs, the only joint being a light aluminium cap above the water jackets. Differing from the practice on most engines the valves of a Daimler motor are sloped at a considerable angle, the reason for this being that a big water space is obtained round the valve seatings and the combustion chambers are much reduced in size.

Each of these valves can be got at by removing the screw plug which will be found immediately over it. Both induction and exhaust valves are on the same side of the cylinders and are operated by one camshaft. The forward end of this camshaft carries bevel wheels driving the vertical commutator and distributor for the electric ignition. This vertical shaft consists of two parts, a normally stationary outside portion, and an internal spindle which is rotating. This normally stationary sleeve is coupled up by means of a rod to the throttle valve in the induction pipe, and according as the throttle valve is opened or closed by means of

FIG. 3.—CHASSIS OF THE 28-36 H.P. DAIMLER.

A1. *Steering wheel with throttle and ignition levers.* D1. *Lubricators on dashboard.* F. *Clutch pedal.* H. *Gear-box.* H4. *Lower casting of gear-box.* H6. *Swing bolt securing gear-box to transverse member of frame.* M. *Brake pedal.* J9. *Chain.* K. *Change speed lever.* K4. *Reversing lever.* M1. *Countershaft brake.* N. *Transverse rocking shaft for hub brakes.* N2. *Compensating gear for hub brakes.*

the lever or the steering wheel, a slight rotary movement is given to the sleeve, on the top of which the distributor is carried, and thus the time of firing is altered in conjunction with the movement of the throttle valve.

The utility of this device has been subjected to considerable discussion, but it certainly takes away the necessity for much individuality on the part of the driver, or, in plain terms, not only is it intended to be, but it actually is, a fool-proof device, and one which very greatly reduces the chance of an inexperienced driver doing much harm to the engine.

One very good point about the bearings of this engine is, that they are all lined with white metal, which is not only easily renewed when worn but, in case of shortage of oil, there is much less chance of any damage accruing to the crank-shaft. The power of the engine is transmitted to the gear by a leather faced clutch of large diameter and the shaft between it and the gear-box is supplied with a flexible coupling. The whole of the gears run on ball bearings, which are automatically lubricated.

The gear-box itself is suspended from three points only, so that its alignment is not affected by any distortion of the frame. The differential shaft is also fitted with ball bearings, and carries a star arm at either end to which

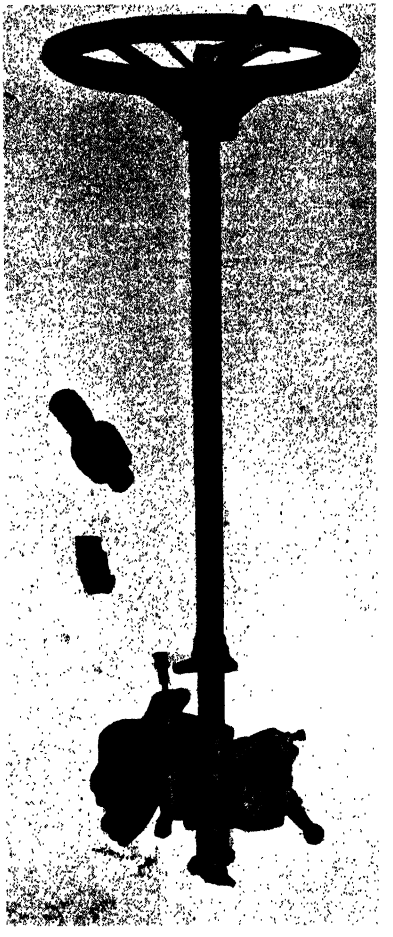


FIG. 4.—THE DETAILS OF THE STEERING GEAR.

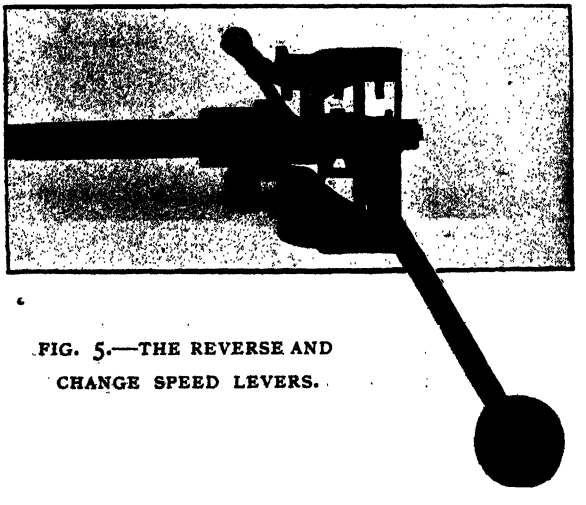


FIG. 5.—THE REVERSE AND CHANGE SPEED LEVERS.

the sprockets are bolted. It will be noticed that instead of fitting only one brake drum on the differential shaft, as is usual, two brake drums are used, one at either end of the shaft and close up to the sprockets, this arrangement being particularly efficient and putting very little racking strain on the gear, while owing to their position,

they are, furthermore, very easy of adjustment. Figs. Nos. 7 and 9 show these brake drums very clearly. The brakes on the rear wheels are of exactly similar construction and carefully compensated so as to put an equal strain on both wheels.

Having acquired his car, the first thing the owner should do is to acquaint himself with the position of every lubricator, whether oil or grease, on the vehicle, and make sure that these are properly filled. The oil lubricator on the dashboard supplies the cylinders and the base chamber of the motor. A reservoir for refilling this lubricator is contained out of sight under the bonnet. A certain amount of pressure from the exhaust is always maintained in this reservoir so that in order to fill the sight-feed lubricator on the dashboard all that is necessary is to pull on the small chain in front of the steering column. This opens a valve on a pipe connecting the reservoir and allows a fresh supply of oil to be forced up. Directly the lubricator is full the chain must be released. The

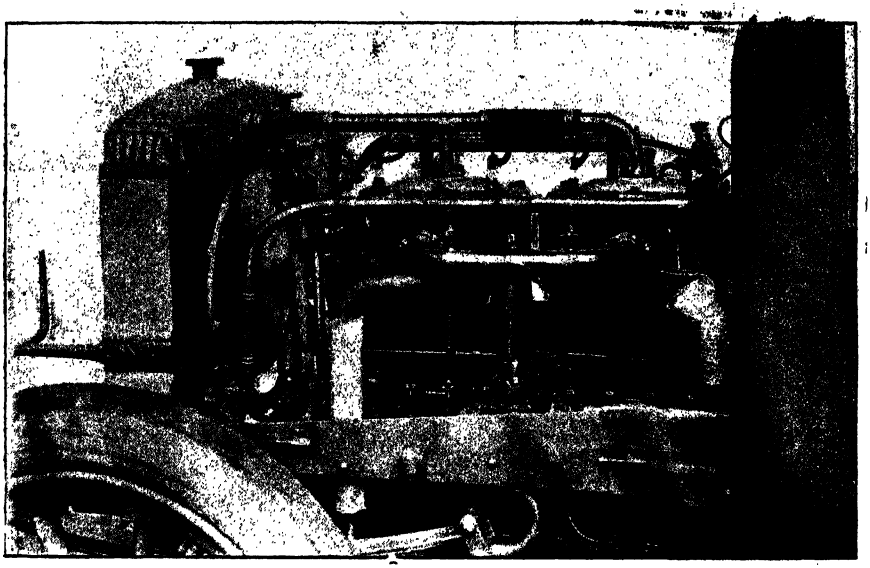


FIG 6.—SIDE VIEW OF THE 28-36 H.P. DAIMLER ENGINE.

cam-plate adjustment on top of this lubricator is used for starting or shutting off the supply to the engine, the intermediate notches being required only when the engine is running very slowly. The dashboard lubricator acts merely as a convenient distributor, and needs refilling as soon as empty. The reserve supply is contained in a reservoir which is placed out of sight underneath the bonnet.

All the water supply is contained in the combined tank and radiator, this radiator being so efficient that no anxiety need be felt with regard to the necessity of filling up during the longest day's run. Indeed, in ordinary weather the supply of water will be sufficient for several days. Petrol is supplied to the carburetter from the large tank in the rear of the frame, and is forced up by pressure. A small hand pump will be found inside the bonnet. When starting first a few strokes on this pump may be necessary, or until the mercury rises level with the first

side on the gauge which is situated on the right-hand side of the dashboard, in front of the driver. The effect of this is to secure a proper supply of petrol to the carburetter, but when once the engine is started this pressure is maintained by the exhaust, and regulated by the pressure valve.

Occasionally it is found that the mercury in the pressure gauge rapidly falls as soon as the pumping in of air by means of the hand-pump ceases. This may be due, however, to the filling cap on the lubricator, or on the petrol tank, not being screwed properly tight, the remedy for which is, of course, obvious. Or the leak may

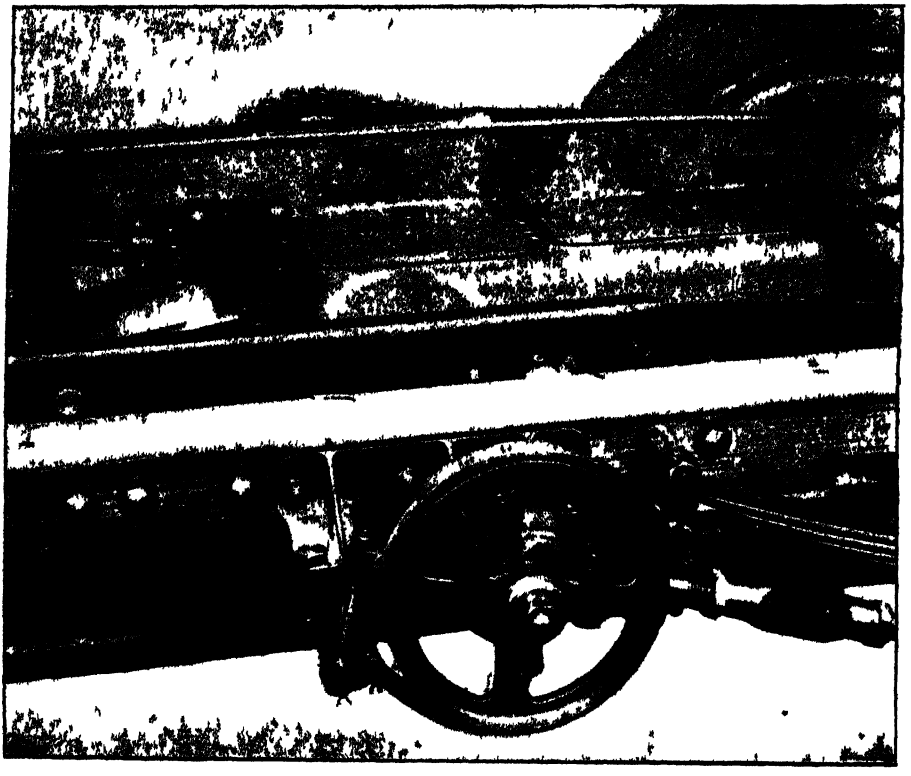


FIG 7.—PORTION OF CHASSIS, SHOWING BRAKE AND COUNTERSHAFT

take place through the pressure valve, which will be found in the small pipe that is connected with the right-hand exhaust pipe. In this case it is very often enough to turn the valve once or twice by the milled edge which will be found protruding through a slot on each side. If this is not sufficient the valve may need to be taken to pieces and cleaned. Sometimes the loss of pressure is very gradual, and does not take place until the engine is running. This is usually caused by the filter (which is contained inside a small T-shaped casting attached to the pressure valve) becoming clogged by residue from the exhaust, and thus preventing a sufficient amount of pressure passing through. The remedy for this is to take out the filter and wash it with a little petrol.

The lever immediately over the steering wheel regulates simultaneously the opening and closing of the throttle and the advancing or retarding of the ignition, so that by moving this forward the engine is given a full supply of gas and the ignition advanced, a reverse movement having the opposite effect, and slowing down the motor. The cut-out switch for the ignition will be found on the right-hand wing of the dashboard. When starting up the engine from cold the switch should be "off," and the throttle lever partly advanced, so that by giving a few turns on the starting handle the cylinders will be thoroughly charged. The lever should then be retarded and the current switched on. A half turn with the starting handle is then usually sufficient. After the engine is once hot it can be started again, in most cases, by merely switching on the current.

It is occasionally possible that mis-firing may occur with the ignition. If one cylinder only misses fire, either continuously or intermittently, it is most probable

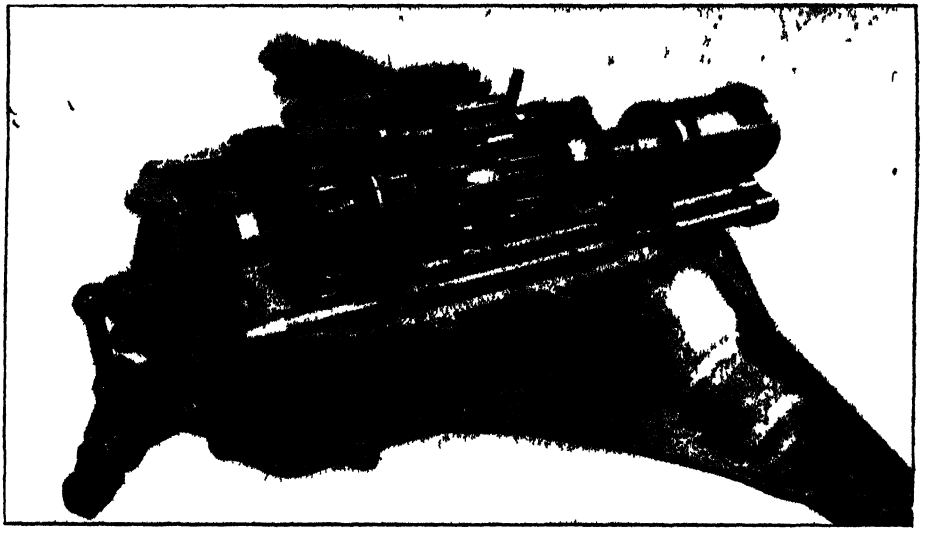


FIG 8.—THE DAIMLER GEAR-BOX (OPEN).

that the cause will be found to have emanated from a faulty sparking plug, but it sometimes happens that all four cylinders mis-fire at once for one or two revolutions. In this case the cause must be looked for in the coil, which probably needs slight adjustment.

The two levers by the side of the driver respectively operate the change speed gear and reverse. For going ahead the small lever should be in the forward position, while the long lever should be in the central position or out of gear. The low speed is obtained by first withdrawing the clutch, and then with a slight side motion, pushing the speed lever forward into the position marked plainly 1. Changing speed from first to second, third, or fourth should be done in a similar manner, always, of course, first withdrawing the clutch. When travelling fast with the throttle wide open, and it is desired to change the gear, the speed of the engine should be momentarily retarded by the throttle lever simultaneously with the act of withdrawing the clutch,

otherwise an undesirable racing of the engine takes place. In order to reverse, the change speed lever must be placed in the midway position, or out of gear, and the reverse is thrown in by pulling the short lever right over towards the driver. It must be remembered, however, that there is only one reverse speed, and that the change-speed lever must remain in the neutral notch.

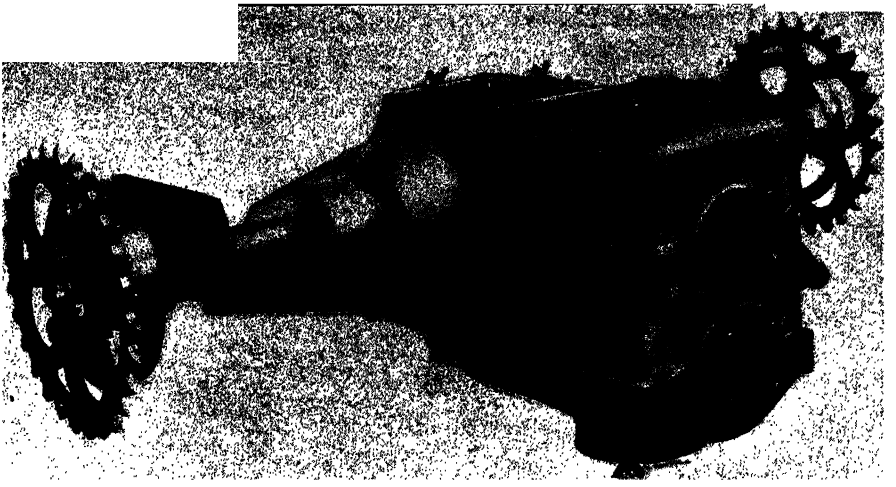


FIG. 9.—THE CROSS SHAFT AND GEAR-BOX (CLOSED).

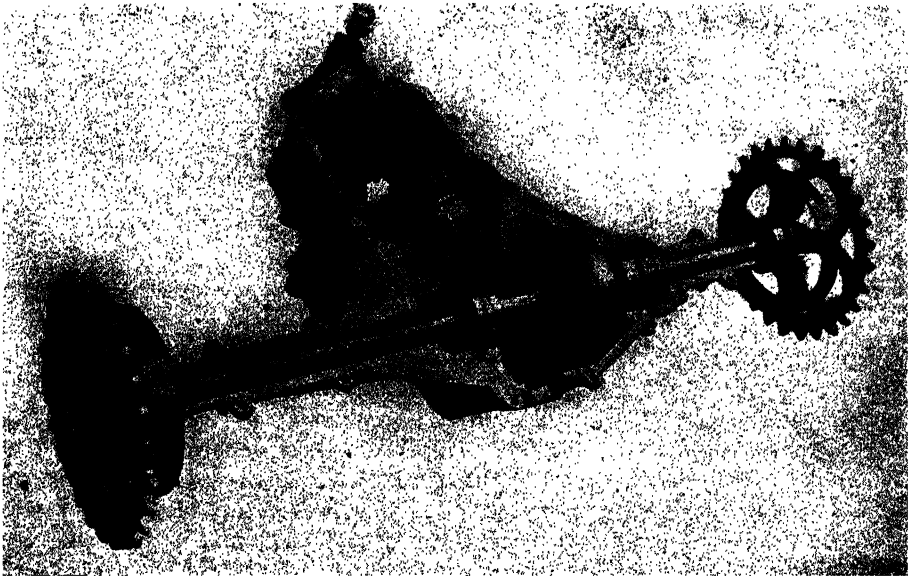
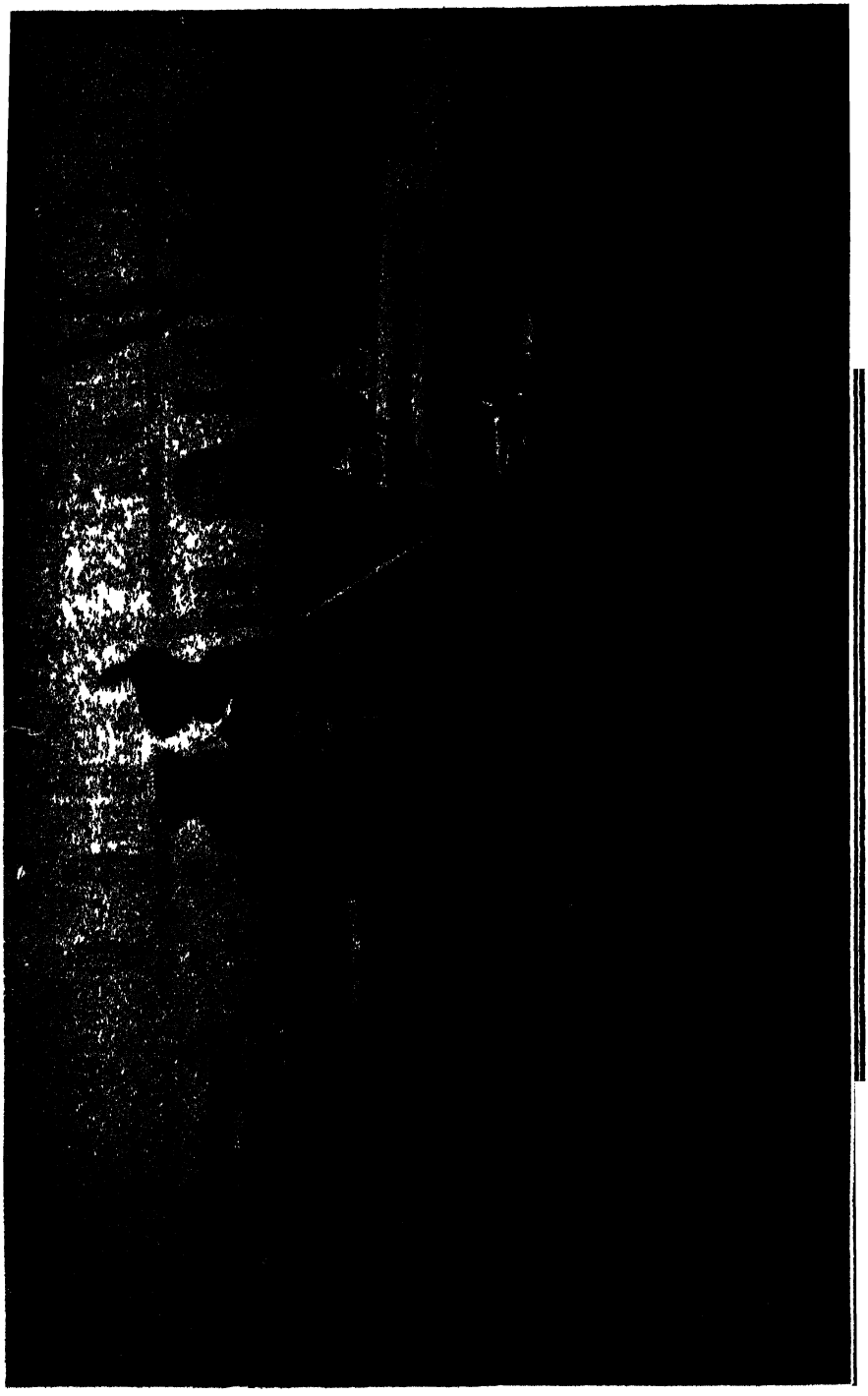


FIG. 10.—THE CROSS SHAFT CASE OPEN, SHOWING DIFFERENTIAL.

The brakes on the countershaft are operated by the right foot-pedal, while those on the road wheels are actuated by a small hand-lever on the side of the body. This latter brake is a very efficient one and well compensated, and should be used as much as possible rather than the foot brake.

There are some who find difficulty in driving in traffic without over-heating the water. This in all cases will be found to be due to the fact that the driver keeps his engine running too fast, and in order to regulate his speed withdraws the clutch, whereas he would find that these cars can be kept absolutely cool in traffic by closing the throttle lever as much as possible and running on the highest possible gear, as Daimler engines are so flexible that the car may be made to crawl along at five or six miles an hour even on the top speed.

A point which has a great deal to do with the sweet running of these cars is the proper lubrication of the chains. Most drivers are a great deal too much afraid of putting oil or grease on their chains owing to the slight amount of extra trouble entailed in cleaning the wheels and side of the body; but in wet weather a wonderful difference in the running of the car will be noticed, if a few minutes delay is made occasionally in order to lubricate the chains. No one who has ridden a bicycle can have failed to notice what an enormous difference a properly lubricated chain makes in the amount of exertion required to propel such a machine, and this object lesson alone should be enough to induce all good drivers to treat their motor-car chains with equal care.



CAPTAIN B. D. CORBET ON HIS 17-32 H.P. HOTCHKISS.

THE HOTCHKISS.

By Captain B. D. Corbet.

The Hotchkiss Ordnance Company, whose factory is situated at St. Denis, a suburb of Paris, are responsible for the car that bears their name. This celebrated gun firm made their first complete car in 1903, but several years prior to that they manufactured component parts for some of the largest automobile firms in France, and it was through the great satisfaction given by these components, and the experience gained in their construction, that they determined

FIG. I.—SIDE VIEW OF THE 17-32 H.P. HOTCHKISS CHASSIS.

to make motor-cars as well as the guns for which their name is famous throughout the world This firm for some time past have carried out exhaustive experiments in different metals, with the result that they are able to turn out a *chassis* with a maximum of strength and a minimum of weight. Simplicity, excellence of material, sound design, and splendid workmanship are all features of the Hotchkiss *chassis*.

When this car first made its appearance at the Paris Saloon in 1903, it attracted a great deal of attention, owing to the general conception of the design, its splendid finish, and to the fact that ball bearings were used systematically throughout the car, including the crank-shaft of the motor. This latter point met with a certain amount of adverse criticism, but the critics were not aware of the severe tests which led to its adoption, and now that some years have passed not one single instance has been recorded of the failure of a crank-shaft bearing, this notwithstanding the fact that the racing cars and marine motors are similarly fitted, thus fully justifying the innovation.

Several minor improvements and alterations have been made in the new model, tending to greater simplicity, ease of manipulation and access to every part of the engine, gears, etc. With the exception of the racing cars only two models are now made, the 17 h.p. giving about 32 h.p. on the brake, and the 30 h.p. giving over 45 b.h.p. As both these cars are identical, with the exception that the 30 h.p. has a larger bore and stroke, the following remarks apply equally to each.

The Chassis.—The *chassis* is made from one piece of pressed nickel steel, and is narrowed in front in order to give a large lock to the steering wheels. Very long dumb irons are fitted to carry the back springs. This admits of extra long springs, and is the secret of the extremely easy running of the Hotchkiss cars. The wheels are of the ordinary artillery pattern and run on D.W.F. ball bearings. This system of bearings I will explain later, as it is employed throughout the car.

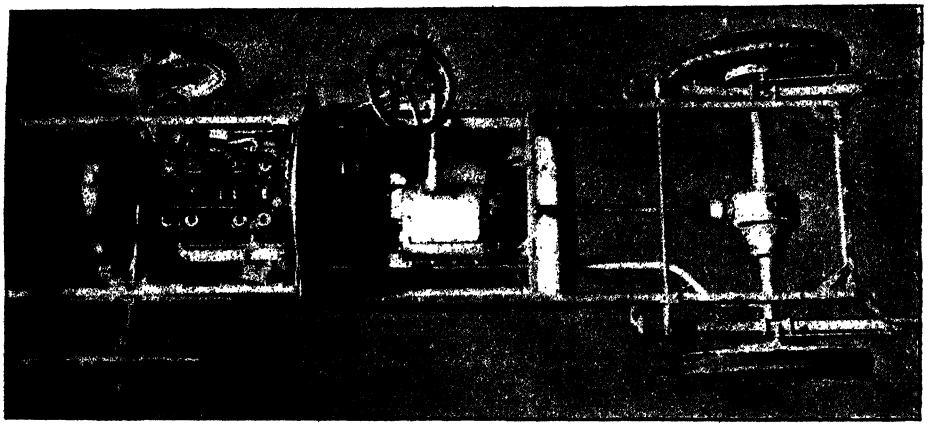


FIG 2.—PLAN OF HOTCHKISS CHASSIS.

Motor.—The motor consists of four water jacketed cylinders cast in pairs, having a bore of 112 mm. with a stroke of 120 mm., and in the 30 h.p. a bore of 125 mm. with a stroke of 150 mm. It is mounted on an aluminium base block, the lower section of which is supported on the side members of the *chassis*. Both the exhaust and inlet valves are mechanically operated, and are machined from nickel steel forgings, and are interchangeable. They are placed on opposite sides of the motor, and are actuated from the half-speed shafts, the pinions of which are enclosed in an aluminium casing in front of the motor, thus effectually protecting them from dust and dirt, and also muffling all noise.

Ignition.—The ignition is Simms-Bosch low tension. The magneto is placed on the near side of the motor, and is driven by the same half-speed shaft that operates the exhaust valves. It is controlled by a lever on the steering wheel. The ignition and tappets are mounted above the inlet valves, and can be readily removed for inspection or cleaning. This ignition is thoroughly reliable, and in conjunction with the perfect carburation the motor is so flexible that it admits variations from 200 to 1,400 revolutions per minute, or, in other words, the car can be driven on the fourth speed from four to forty-six miles per hour.

Lubrication.—The great annoyance of oil dripping on the footboards, common to so many systems of lubrication, has been entirely got over by placing the tank and filling plug in front of the dashboard and under the bonnet. This has also a second advantage, which is an important one, and that is, owing to the tank being near the engine the oil is always kept warm, so that no matter how cold the weather may be the oil never becomes thick, and consequently a regular and even lubrication is ensured. The drip glasses and sight feed are on the dashboard immediately under the driver's eye. The oil is forced through the drippers by means of an eccentric on the cam-shaft.

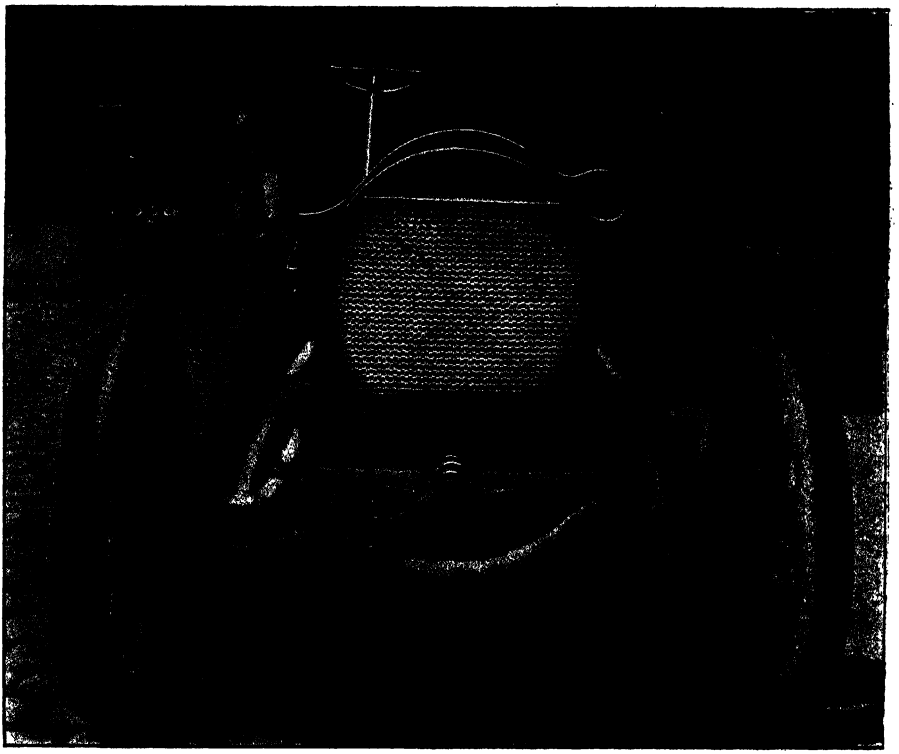


FIG 3.—FRONT VIEW OF HOTCHKISS CHASSIS.

The Radiator.—The radiator is of the honeycomb type, and is built up of a number of triangular tubes. These are assembled in such a manner that the entire surface of each is utilised for cooling purposes. A high speed fan driven by the motor ensures a constant circulation of air.

Ball Bearings.—The crank-shaft is of hardened nickel steel turned up out of the solid. It is mounted on three sets of ball bearings of special design. It is impossible for these bearings to heat or seize, and being practically frictionless they increase to a marked degree the efficiency of the motor. These balls are of extra large diameter, and each is tested to several tons pressure. Between each ball is a spring faced with a metal disc, and in each of the springs a piece of tow

is packed, which, by being continually splashed with oil from the revolving cranks is kept thoroughly saturated, thus ensuring the perfect lubrication of the ball race. This form of bearing also enables the race to be made in a solid ring. To insert the balls it is only necessary to place them in the ball race, depress a spring and insert one in the race between each ball; this holds them in securely. In the ordinary race a gap has to be left in the outer ring in order to insert the balls, which, of course, considerably weakens the race.

The Clutch and Gear-box.—The clutch is of the ordinary cone pattern, with an extra deep face. A double universal joint is fitted between the clutch and the gear-box. This ensures the clutch being correctly centred in the flywheel. The gears are of the Panhard type, but placed side by side. The teeth are carefully

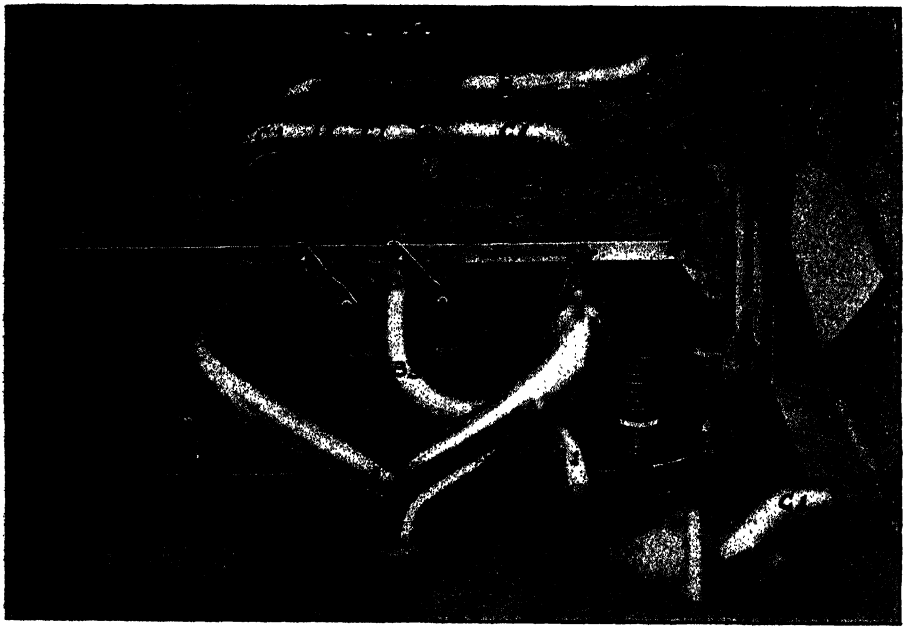


FIG. 4.—SIDE VIEW OF THE 17-32 H.P. HOTCHKISS ENGINE.

A, *Carburetter.* A^2. *Induction pipe,* A^5. *Induction pipe fitting.* A^7. *Throttle lever.* B^1, *Ignition plug.* B^2. *Rocking lever.* B^{14}. *Spring for* B^2. C. *Water pump.* C^1. *Water pipes.* D. *Lubricating tank.* D^1. *Lubricating pump spindle.* D^3. *Pump plunger.* E^1. *Ignition distributing board.*

rounded at the edges, which enables the gears to engage easily and noiselessly. There are four speeds, with a direct drive on the top speed. The shafts in the gear-box are made of nickel steel and are mounted on ball bearings.

Transmission.—The transmission is by cardan shaft and live axle, the teeth on the driving pinions being of extra size and strength. The differential casing is assembled horizontally, which makes the gears very accessible. The driving wheels are mounted on ball bearings, secured to a hollow back axle, and inside

this tubular axle or sleeve is the driving shaft, so that all road shocks are taken up by the hollow axle, and the driving shaft is subject to torsional strain alone.

Brakes.—There are two brakes. The foot brake acts on the main shaft of the gear-box. This brake is metal-to-metal, and is coupled up to the clutch, so that when the brake is put on the clutch is simultaneously withdrawn. The hand or side brake is a metal-to-metal expanding one, and acts on two drums fixed to the driving wheels. This brake does not draw the clutch, and this, in my opinion, is the right practice, as it greatly facilitates starting on a hill. The car can be held by the brake whilst the clutch is let gently in, and as soon as the

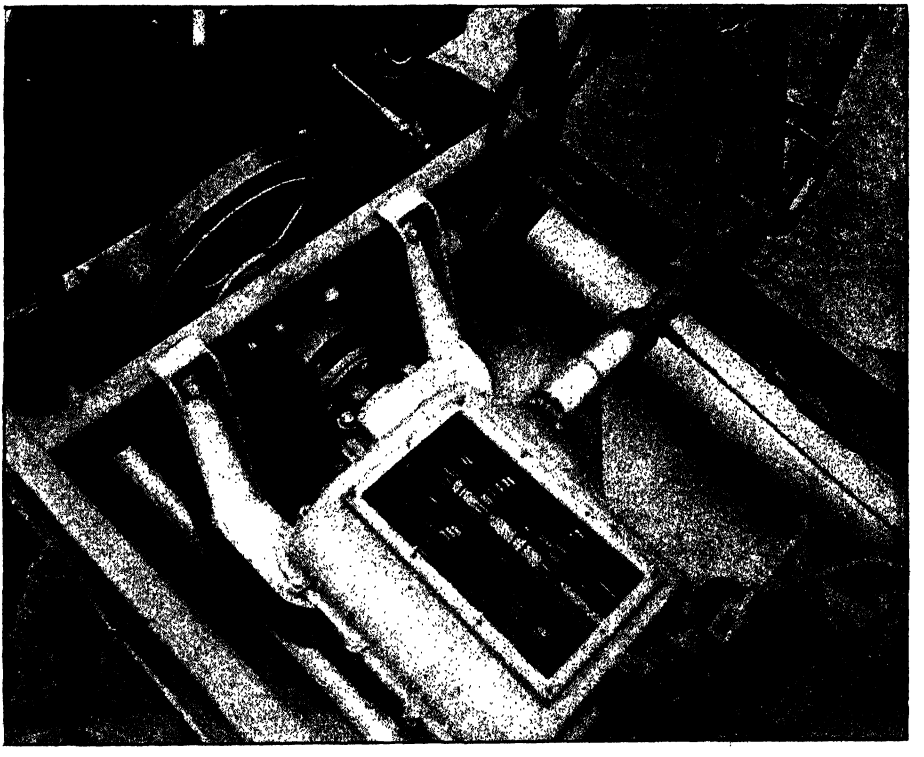


FIG 5.—THE GEAR-BOX OPENED.

clutch commences to grip, the brake is released and the car will start gently away, and without the jerk and consequent strain on the gears and differential which are unavoidable if both brakes are connected to the clutch. A sprag facilitates starting on a hill, but in these days of good and powerful brakes this should never be necessary.

Driving and Manipulation.—First make sure that the petrol tank and radiator have been filled, that the differential, gear-box, grease pots and lubricating reservoir contain an ample supply of oil and grease; then see that the speed lever is in the out of gear notch, and that the side brake is on. Next, look at the

two levers on the steering wheel; the short one is the ignition lever, and should be at the top of the sector, as when in this position the ignition is retarded. The second lever is the throttle control. This should be about 1 in. from the end of the sector.

Now give the starting handle one or two vigorous turns, and, the motor having started, immediately bring back the throttle lever to the top of the sector. This, by reducing the supply of gas, makes the engine run silently. Having taken your seat at the wheel, place both feet on the pedals, release the side brake, advance the ignition lever about a quarter way down the sector, then place the change-speed lever in the first notch, take your right foot off the brake pedal, and slowly raise the left foot so as to let the clutch in gently. The car will then commence to glide quietly away without that jerk which comes from letting the clutch in suddenly, and which is most disagreeable to your passengers and a strain on the car.

FIG 6.—REAR WHEEL SUSPENSION.

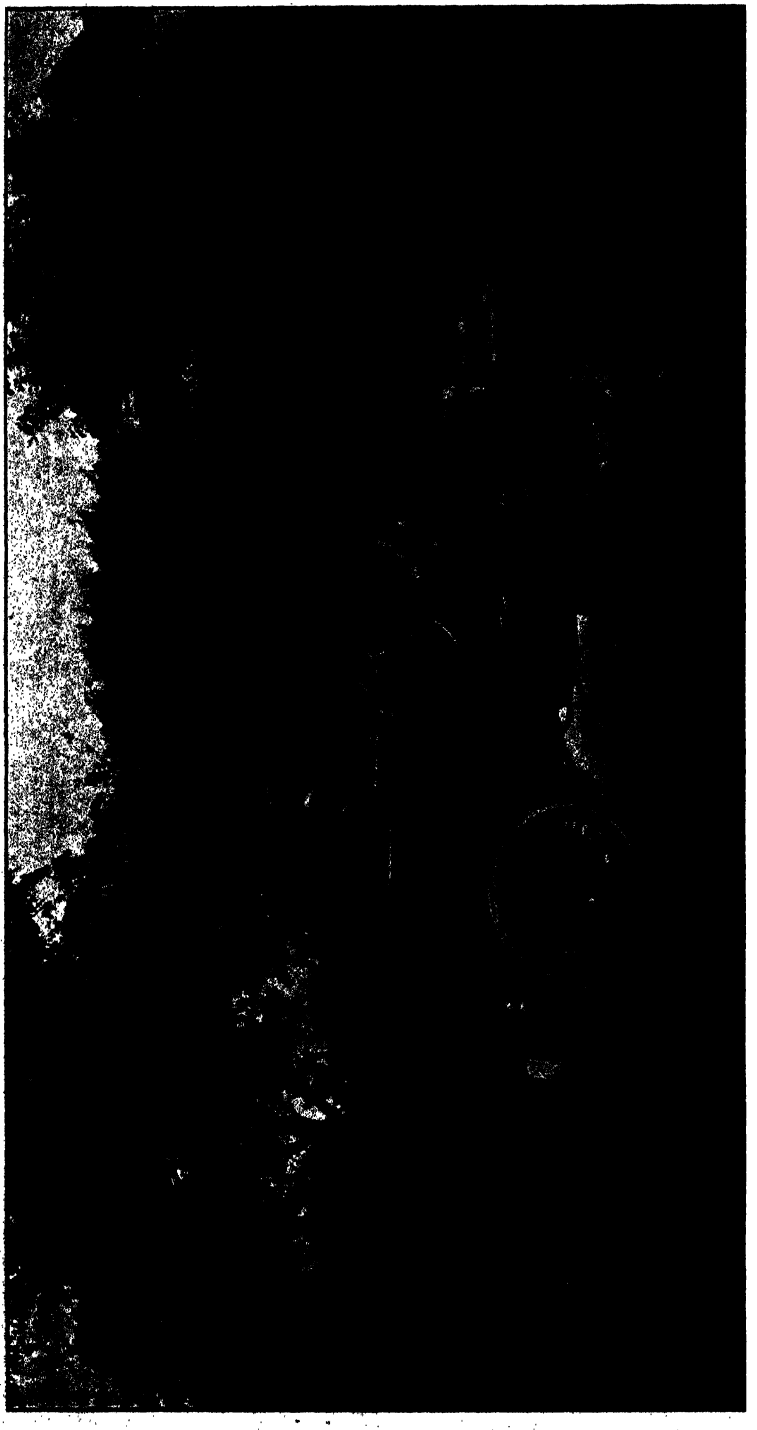
Next press the accelerating pedal slightly and put in the second-speed, and so on to the third and fourth. After a little practice on the Hotchkiss car you will be able to go straight from your first speed through the second and third to the fourth, as the engine is so flexible that it is possible to drive on your top speed at about four miles an hour. To increase your pace, depress your accelerating pedal, which, by giving more gas to the engine, increases the speed.

The cars pick up speed very quickly. One of the chief reasons of this is the use of ball bearings throughout, more especially on the crank shaft. In changing from the high gear to the lower one the lever should be brought back quickly and without hesitation. The gears will then engage easily and without noise.

For driving in traffic it will be found that the accelerating pedal is most convenient, as it leaves the right hand free to use either the horn or side brakes; but when on the open road the hand lever on the steering wheel is used, for with this the engine can be set to run at any speed, and it also obviates the necessity of keeping the foot on the accelerating pedal.

Be sure that all working parts are kept well lubricated. The bottom of the car being well covered in it is an easy matter to keep the motor clean. Lubrication and cleanliness are two of the most important items in the life and successful running of a motor, but, in many cases they receive but scant attention and with dire results. With proper care and attention, the car should give no trouble.

The only likely cause of trouble is an oily or worn plug, a worn tappet or a broken tappet spring. In the first instance, remove the plug; if oily clean it, and if worn replace it with a new one. Have the old plug turned down, when it will be as good as new. Tappets can be faced up and used again, and a broken spring replaced in a few seconds.



MR. CECIL EDGE ON HIS GLADIATOR.

THE GLADIATOR.

By Cecil Edge.

When first introduced to the public some years ago, Gladiator cars attracted a well-merited degree of attention by reason of their extreme simplicity of construction and ease of management, and these two essential points have always been before the designers of the car in their endeavours to keep the vehicle thoroughly up-to-date.

The present type of Gladiator is so constructed that there is no obstacle whatever in the way of the veriest tyro in motor matters obtaining a complete knowledge of the whole car, and the way it should be driven, in the course of a few hours' instruction. The limits of this article make it necessarily brief, so that only a very general idea of the car's construction can be given.

The motor in all models is of Aster make, and in the higher powered cars the cylinders are separated, thus giving most ample water circulating space. The inlet and exhaust valves are mechanically operated, and are arranged respectively upon each side of the engine. The automatic carburetter is so designed that the speed of the engine regulates the admission of the correct proportion of air to the mixing chamber, thus obviating troublesome hand adjustment of the gas mixture.

High tension magneto ignition has been adopted and is extremely satisfactory, as no matter at what speed the engine is running the ignition spark is of the same high intensity. A supplementary high tension ignition by accumulator and coil is also fitted, and can be connected up should the magneto fail at any time.

The lubrication of the engine is effected by means of a pump driven off the cam-shaft, which distributes the oil only when the engine is running. This system does away with all possibility of the engine being flooded with oil at any time.

The centrifugal pump for water circulation is gear driven, and ensures a thorough and complete circulation of the cooling water. The high-powered cars have in addition a belt-driven fan fixed behind the radiator, which, however, is not necessary upon the small cars.

Notwithstanding a rather general adoption of the pressed steel type of *chassis* frame, the Gladiator Company still continue to fit the armoured wood frame, although it is considerably more costly to produce. The armoured wood frame is more flexible, and in their opinion is of greater strength than the other type. The frame of the Gladiator *chassis* is narrowed towards the front end to admit of a sufficient lock of the front wheels.

The brakes are three in number, and all metal-to-metal; one actuated by the foot acts directly on a drum fixed on the driving shaft close by the gear-box; the other two are of the internal expanding type within drums bolted upon the back wheels, and are worked by a hand-lever placed conveniently to the driver's right hand.

There is a most excellent improvement in connection with the transmission gear. The change-speed gear proper is contained within a small box close up to the clutch, and is connected with the cross shaft and differential gear by means of a short supplementary shaft, easily removable. This arrangement admits of the cross shaft being carried back close to the back wheels, and, of course, the chains are necessarily very short. The many advantages of this system are at once apparent, and an advance in the reduction of loss of power in transmission is effected by the provision of large ball bearings to the shafts in the gear-box.

The clutch is of the metal-to-metal type, progressive in action, and works in a bath of oil. The action of the clutch is extremely nice to feel, and it is impossible, even with the most careless driver, to experience any of the unpleasant shocks inseparable from the use of the leather-coned clutch hitherto used.

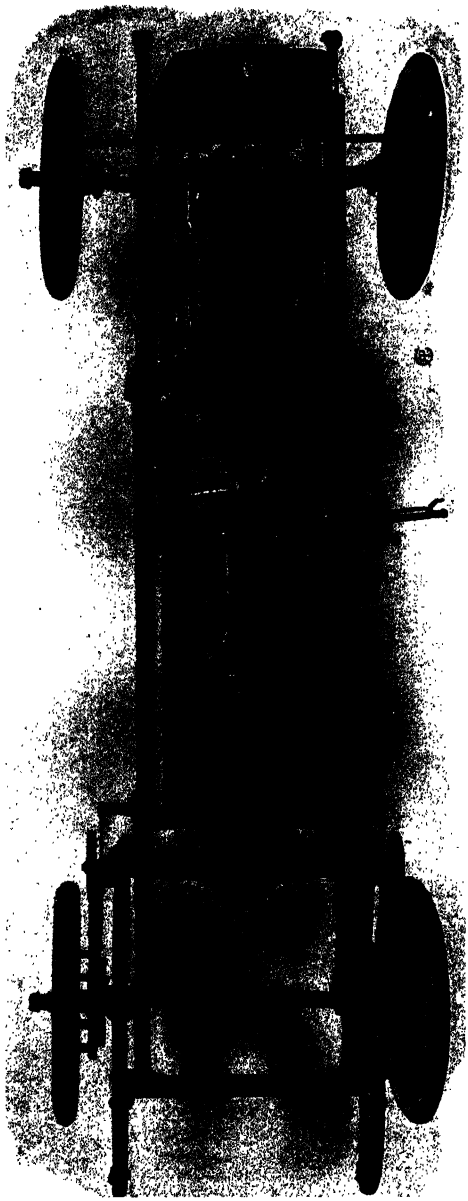
All these improvements are carried out upon the high-powered cars, and the small cars have also been brought thoroughly up-to-date. The driver once seated and the engine running, all the operations of control can be attended to by him quite easily. The changes of speed—four forward and one reverse—are worked by one lever at the right-hand side, close by the "back brake" lever. To operate the reverse, the driver has to give a half-turn to the handle grip of the speed lever before pulling back, so that it is impossible for him to do this by mistake. The clutch, foot-brake and accelerator pedals being at the driver's feet, it is readily seen how easily the car can be managed.

The speed of the engine is controlled entirely by the throttle and spark arrangements on the steering wheel, while the application of the accelerator pedal cuts the governors out of action, and allows the engine to attain the maximum speed.

The flexibility of the engine is wonderful, and it is possible, by judicious use of the throttle, spark and accelerator to regulate the speed of the car when on the top gear from four miles an hour up to 30, 40 or 50 miles an hour, as the case may be, according to the size of the engine. Meanwhile the lubrication of the cylinders and circulation of the cooling water are being automatically attended to, while within easy reach upon the dashboard is the large force pump that supplies grease to various bearings about the car. This pump needs to be screwed down tight about every 50 miles or so. The wheels have independent lubrication, as the hub caps are fashioned to hold a mixture of grease and oil.

In regard to the actual driving and manipulation of Gladiator cars a few remarks will amply suffice to render this perfectly clear. Ease of control

has been a point considered well worthy of consideration, and as motors become more general, so does it devolve more upon the constructor to design a car which the veriest tyro in matters relating to automobilism can face with confidence. And now to come to the point.



CHASSIS OF THE 16-20 H.P. GLADIATOR.

Let us suppose that the motor—having been started with a touch of the switch—is running without a falter, as a properly-looked-after engine should. The driver mounts to his seat and faces the various pedals and levers. The correct position of the levers for starting is—the air lever on the carburetter almost completely closed (bear in mind that O stands for open, and F for closed); the throttle lever on the steering column, half or one-third open; the ignition lever (also on steering column) retarded to avoid all risk of premature ignition, and its resultant damage to the manipulator of the starting handle or to the engine itself.

Once the engine is in motion, advance the ignition lever a few notches, namely, to about half-way up the sector, and now, taking the steering wheel in the left hand, depress the extreme left of the three pedals, thus actuating the clutch, and by so doing disconnecting the motor from the gears, and consequently any action on the road drive. Now lift the nickel sleeve on the change-speed lever and place the lever in the first notch on the quadrant in front of that which the lever occupied when the car was motionless (notch known as "neutral").

The car is now "in gear," and by letting the clutch pedal gently up, the inner cone of the latter grips the outer cone, and thus connects the engine with the gears. The power is now travelling through the clutch to the gear shaft, the gears are revolving, thus driving the differential shaft. This in turn actuates the sprockets which drive the rear road wheels by means of chains. The car moves forward. Now the driver knows what is happening when he accomplishes the simple movement of depressing the clutch pedal, slipping his change speed lever into the first notch, and by gently letting the clutch in, starts on his initial trip. The rest is easy.

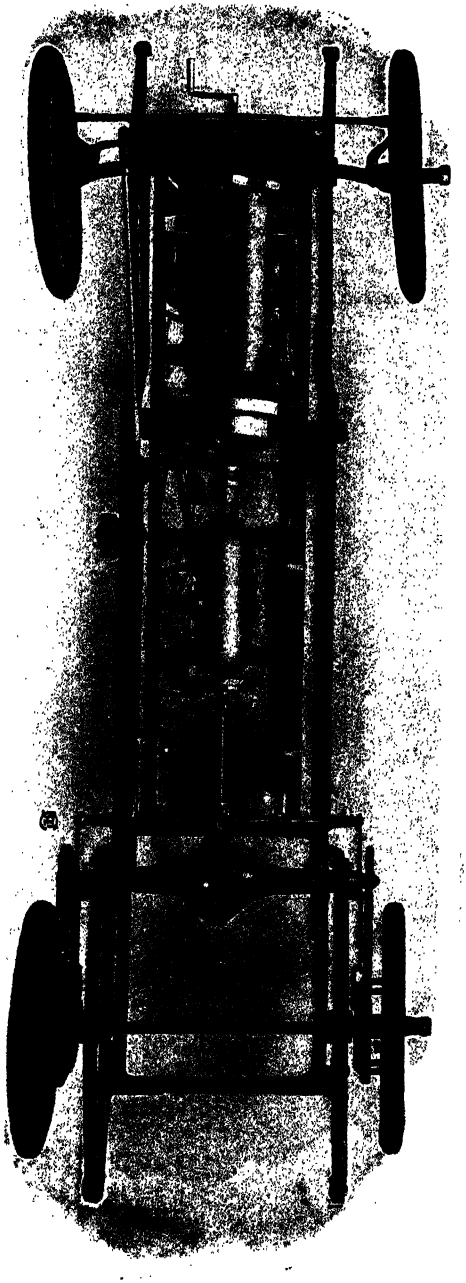
To change speed properly, however, requires experience, and is accomplished thus. First of all the clutch pedal must be depressed, and then the lever can be moved forward as before into the second, third or fourth speed, as the case may be. But note the following points: as the clutch is let in, slightly accelerate the engine to enable it to take up its work properly, and thus avoid stopping it altogether. When changing speed the clutch may be allowed to re-grip more swiftly than when first starting on first speed, as the car has gathered way, and is not starting from a dead point. When the clutch pedal is depressed to change the gear, let up the accelerator pedal to avoid racing the engine, which will occur if the pedal is kept down, as it follows that when the load is taken off the engine gathers speed at once.

The accelerator pedal is the small pedal on the extreme right, and its function is to stop the action of the governors, which in their turn act as follows. When the speed of the engine attains a certain number of revolutions the governors come into play, and automatically cut off the inlet of gas, and when the engine slows down, so the governors slow in unison, and the engine once more gathers speed. The action of the governor may be best described to the uninitiated as similar to that of a string with a weight at each end. Swing this round, and the faster it revolves the further out swing the weights. So on a petrol engine, as the arms of the governor swing out, they actuate rods which throttle the carburetter inlet. The accelerator cuts off the action of these governors, and so the engine runs at its own speed, governed, as it were, by the load it pulls.

It is well to bear in mind that an engine, if properly treated, serves its driver properly. If on an incline the engine starts thumping, or technically "develops a knock" (the sound is easily heard and recognised) it is more than time to change to a low speed. Experience will, however, soon lead to that inner knowledge which teaches one to know exactly where to change speed, and, indeed, the speed of the engine tells its own tale, and should regulate the driver's hand. Never let it slow down too much, or the ignition occurs too soon, and the pistons start hammering. Supposing one to be almost on the crest of a slight incline, and the engine seems likely to soon complain of its gear, judicious manipulation of the ignition lever may obviate the change in gear for just the few yards left.

As to lubrication, the lubricator on the dashboard is automatic in its action, that is to say, the engine, once in motion, and the drips feeds once turned up, providing the tank is full, the oil feeds the engine without further

attention. The number of drips per minute may be regulated by the little lever on each tap, eight to ten drips per minute being the proper number. The hand pump which pumps oil into the crank case should be called into use every 25 miles or so. Always be sure that the water-circulating pump lever is properly filled up with thick grease, and see that the large greaser on the dashboard has its proper amount of thinner grease, and is sufficiently screwed down to be working through to the bearings which it feeds.



THE GLADIATOR CHASSIS VIEWED FROM UNDERNEATH.

To slow the car in traffic the clutch, of course, comes into action, although on a four-cylinder Gladiator the engine is so remarkably flexible that the throttle almost entirely serves as a control, and top gear is possible even through London's thickest traffic. The hand-brake lever at the driver's side by the change speed lever actuates two bands on drums on the back wheels. When going down a long hill it is as well to let the engine have a rest by taking the clutch out, letting up the accelerator pedal, and allowing the car to run on its own momentum.

A few hints on various little points may be of use. When starting the engine, after seeing that the petrol tap is on, just tickle the float by means of the little plunger on the float chamber to let the petrol flow through freely. This enables the motor to start better, as for the first few explosions it is better to have a greater proportion of petrol to air, for the mixture does not

evaporate so soon or ignite so easily. On the four-cylinder car a few turns of the handle and then switch on, and the engine will start. With a two-cylinder car one must switch on first, and note always to see that the ignition lever is well retarded, and be careful to pull the starting handle *up* quickly, and on no account push it *down* over compression, or a back-fire will soon convince one of the point of these remarks and the pain caused by a damaged wrist or arm. These can only result from pushing the handle down (instead of pulling it up) with ignition lever too far forward.

Always keep an eye on the water gauge, which is on the dashboard, to see that the pump is working as it should, and the water thus circulating freely. When starting the car on a steep hill, care must be taken to avoid stopping the engine. Of course, it must be borne in mind that the natural tendency of the car in this case is, when the brakes are released, to follow the laws of gravity, and consequently run down the hill backwards. Therefore, assuming the foot-brake pedal (the centre one of the three pedals) to be pressed down, and the brake, therefore, in action, then depress the clutch pedal, place the lever in the first notch, gradually let up both the clutch and foot-brake pedals, and thus counteract the backward tendency of the released car by the pull of the engine. Let the engine pick up well before thinking of changing to a high gear.

THE WOLSELEY.

By H. Austin.

The Wolseley car owes its popularity in a very large measure to the policy adopted and maintained by the makers from the time of its introduction, by which nothing of a complicated nature has been allowed to enter into its design or construction, the chief aim in view being to obtain the highest possible efficiency in combination with few working parts and sound construction. It is interesting to note that the main features in the design of these cars have remained the same up to the present time from when the "Wolseley" was first introduced in 1900, and is eloquent testimony to the correctness with which the lines of these cars have been laid down from the beginning.

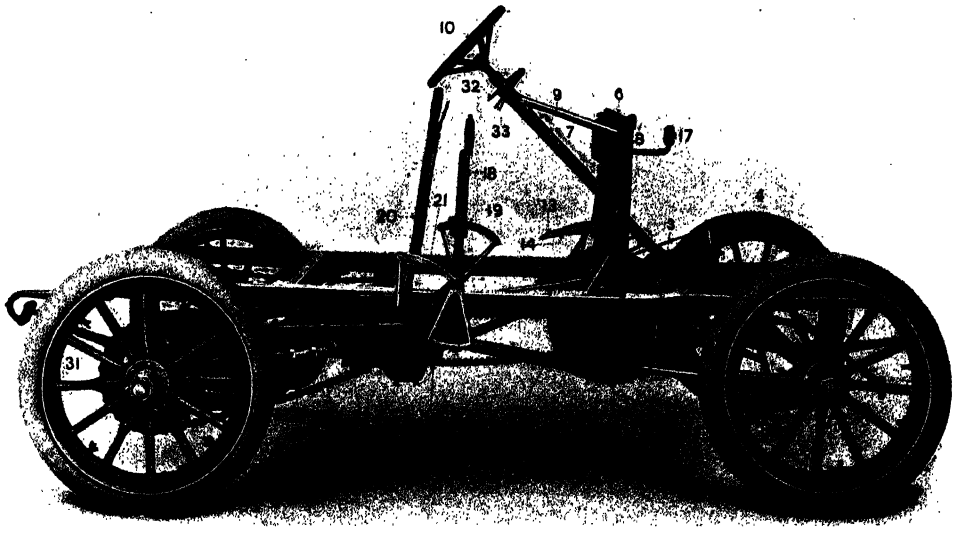


FIG. I. SIDE VIEW OF 6 AND 12 H.P. WOLSELEY CHASSIS.

3. *Box containing steering gear mechanism.* 4. *Float feed chamber.* 6. *Dashboard.* 7. *Oil reservoir.* 9. *Steering column.* 10. *Steering wheel.* 11. *Flywheel.* 13. *Brake pedal.* 14. *Clutch pedal.* 16. *Chain transmitting power from engine to gear-box.* 17. *Lamp bracket.* 18. *Gear changing lever.* 19. *Gear change quadrant.* 20. *Brake lever.* 21. *Brake quadrant.* 22. *Sprocket wheels.* 23. *Radius rod.* 24. *Rear spring hanger.* 27. *Silencer.* 31. *Band brakes.* 32. *Ignition lever.* 33. *Throttle lever.*

The history of the "Wolseley" covers the whole period since the self-propelled traffic movement revived in this country. It was during 1895-96 that the idea of the Wolseley car was first put into a practical form, but it was not till nearing the end of 1896 when the law was amended in this country, and cars were permitted to travel on the highway at a reasonable rate of speed, that practical

MR. H. AUSTIN ON HIS 16 H.P. WOLSELEY

experiments under working conditions could be made. Very rapid developments took place during the next four years, and several cars were built, each of which was an improvement on its predecessor, until when, the famous 1,000 miles tour of the A.C.G.B. and I. was undertaken in 1900, a 3½ h.p. "Wolseley" voiturette (which could claim to be entirely of British design and manufacture) took part, and gained the highest award of its class. The promise of success thus indicated has been well fulfilled.

The distinguishing features in a "Wolseley" car are:—firstly, the use of a horizontal motor; secondly, flexible transmission from motor to gear-box by means of a silent running chain; thirdly, arrangement of water cooling pipes so that they form the front and two sides of the bonnet, all water being carried above the motor, so that in case the pump should fail, thermo-syphon cooling can be maintained.

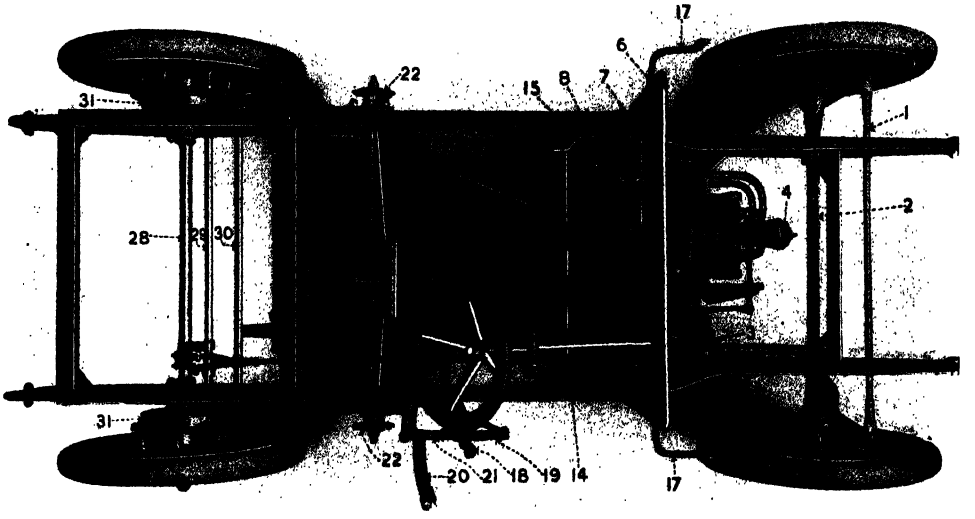


FIG. 2.—PLAN OF WOLSELEY CHASSIS.

1. *Steering rod.* 2. *Front axle.* 3. *Steering box.* 4. *Float chamber.* 5. *Air bottle.* 6. *Dashboard.* 7. *Oil reservoir.* 8. *Motor.* 9. *Steering column.* 10. *Steering wheel.* 11. *Flywheel.* 12. *Crank case.* 13. *Brake pedal.* 14. *Clutch pedal.* 15. *Commutator.* 16. *Chain transmitting power from engine to gear-box.* 17. *Lamp bracket.* 18. *Gear changing lever.* 19. *Gear change quadrant.* 20. *Brake lever.* 21. *Brake quadrant.* 22. *Sprocket wheels.* 25. *Gear-box.* 26. *Exhaust pipe.* 27. *Silencer.* 28. *Back axle.* 29. *Internal brake rod.* 30. *Band brake rod.* 31. *Band brakes.*

The various types of pleasure cars constructed comprise:—

6	h.p.,	1	cylinder,	4½	ins.	diameter,	5-in.	stroke,	800	revolutions per minute.
12	„	2	„	4½	„	„	5-in.	„	800	„ „
24	„	4	„	4½	„	„	5-in.	„	800	„ „
8	„	2	„	4	„	„	4-in.	„	900	„ „
16	„	4	„	4	„	„	4-in.	„	900	„ „
32	„	4	„	5	„	„	5-in.	„	900	„ „

This range, to which any style of carriage body may be fitted, will be seen to cover the requirements of all classes of automobilists.

Dealing with the question of driving, it is as well to first indicate the method of transmission. This is clearly shown in the line drawing (p. 79), and, taking the details in their order, we will briefly describe them as follows :—

The Motor.—This is, as before mentioned, of the horizontal type, the breech ends being towards the front of the car, so that the valves and ignition plugs are easily accessible. The bottom half of the crank case is made detachable, so that examination can be made when required without disturbing the alignment of the crank shaft. Wear or slackness in any of the motor bearings will be indicated by a knocking sound when the motor is running. This warning should never be neglected, but careful examination made at once to discover the fault. Proper lubrication is absolutely essential to a motor's good running, and the various supply pipes to bearings should be periodically examined to see that they are quite clear.

The cylinder liner is a high-grade close-grained iron casting. A watertight joint is made at the crank chamber end of the jacket by means of a special packing, which is forced into a groove turned in the liner to receive it. The water joint at the combustion chamber end is conical and "ground in." The combustion chamber joint is also made in the same manner, and the chamber itself is held in position by the same bolts that secure the liner.

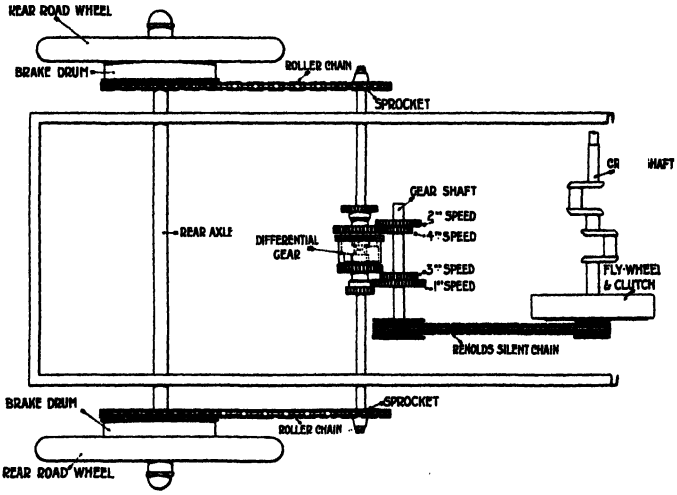
In this way the water space round the liner is separated from that round the combustion chamber, and makes it possible for the combustion chamber to be easily removed for examination purposes. Two separate water joints not only prevent any possibility of water getting into the combustion space, but also permits of rapid access to the piston for inspection. The piston is also of cast iron and provided with three rings carefully pegged in position, so that no loss of compression can result through them working round.

A novel method is employed in coupling the connecting rod to the piston, which effectually prevents any possibility of the gudgeon pin working loose and scoring the sides of the liner. The crank shaft is forged from cast steel, and below it is fitted a half-speed shaft, which operates the exhaust valves, commutator and pump. The valves are placed vertically, the inlet valve being uppermost. It is quite enclosed and works atmospherically. The exhaust valve is immediately beneath, and actuated by a rocker, which takes its motion from the half-time shaft, the return of the valve to its seating being effected by means of a flat spring built up of laminated steel plates. Mounted on an extension of the crank shaft is a flywheel which also forms the female member of a cone clutch, the male member being also mounted loosely on the crank shaft, and brought into engagement by means of a strong volute spring.

Steering.—The steering is another point in which "Wolseley" cars vary somewhat from the usual motor car design. The steering mechanism is arranged so that it is self-locking, that is to say, no obstruction on the road can deflect the steering wheels from the angle they may be set to by the driver. Steering is effected in the usual manner by means of a hand wheel and inclined pillar, which

latter is reinforced by a bracket attached to the dashboard. At the lower end of the steering pillar, bevel gears are placed which in turn actuate a worm gear placed on the front axle and controlling the front road wheels.

Water Circulation.—The water system is arranged as follows:—two aluminium water bottles are placed in front of and at either side of the dashboard, and are connected one with the other by means of radiating pipes of copper on which are mounted brass gills to provide the necessary amount of cooling surface. Circulation is maintained by means of a rotary pump which is driven direct from the cam shaft, and placed at the lowest point of the cooling system in order that no trouble need be caused in the event of it failing. As all the water is carried above the motor, it is possible, if the pump should fail, to maintain the cooling on the thermo-syphon principle. A tap is fitted to the pump so that the water may be drained off when desired.



ARRANGEMENT OF WOLSELEY TRANSMISSION.

Petrol and Lubrication.—The petrol is contained in a tank which is fitted immediately in front of the dashboard, underneath the bonnet, from which the spirit is fed to the carburetter by gravity. The supply is controlled by a three-way tap on the driver's side of the dashboard, to which is attached a gauge glass so that the contents of the tank may be noted at any time. Lubrication is also by gravity, and all main bearings are supplied from a reservoir fitted to the dashboard, with separate pipes leading to each one, a sight feed being provided so that the number of drops per minute may be adjusted according to requirements. The pump spindle, clutch, steering, &c., are lubricated by grease cups, which should be filled with solidified oil of a high grade.

Brakes.—The two sets of brakes are operated by hand-lever and foot-pedal. The former controls bands working on drums, which are turned and form part of the chain wheel casting fitted to the rear road wheels. The foot-brakes are of the expanding metal-to-metal type, cast-iron shoes being fitted inside drums, which are also part of the driving wheel chain casting. On the 6 h.p. car, band brakes are operated both by hand-lever and foot-pedal, as this car is fitted with a live axle. The main brake is that operated by the left pedal, and works on a drum formed on an extension of the differential gear-box casting fitted to the back axle. The hand-brake also actuates bands fitted to the rear-wheel hubs. This type of brake is probably the simplest form in use, and needs very little attention. The pull rods may require occasional adjustment.

Driving.—The driving of a "Wolseley" car may be very quickly learned, although, as with any make of car, in the case of those who have never driven before, it is almost essential that they should have the services of an expert for the first few runs.

The sequence of operations when taking the car out is as follows:—

Turn on lubricators and petrol tap, which are conveniently placed on the dashboard. Put the half-compression cam into action. This is operated by a handle placed on the near side (left) of the motor close to the starting handle bracket. The starting handle is then placed in position, and the ignition switch closed, while the ignition control lever on steering wheel is retarded to its latest position, and the throttle lever half opened. Then with two or three turns the motor will start.

The starting handle is then removed, and the half compression released. The driver now mounts his seat, and after releasing the side brakes he depresses the clutch pedal with his right foot, and pushes the gear lever into the first speed. The motor is then accelerated by means of ignition lever, and the clutch pedal gradually released until the motor has picked up its work, and as the speed increases higher gears may be engaged in turn.

Speed changing requires practice in judging the correct moment at which to make the change. Should a gear be found not to engage easily, it is worse than useless to keep trying to force it as this will only grind away the teeth. Before a pair of gears running at different speeds can be brought into mesh with one another, it is obvious that their speeds must be equalised, as any variation will only cause them to grind one against the other, and prevent them engaging. It is only by practice that the right moments for changing will be found, and it will be found easier to engage a higher gear than to reduce from the highest gear to the lower ones.

The operations in themselves are perfectly simple, and consist of first depressing the clutch pedal and pulling the gear lever to free position between two gears. Then, when the proper moment has arrived, quickly engage the next gear, and let the clutch in again. There should be no delay in changing, otherwise the car will lose its momentum. It is sometimes possible to coax a car up a fairly steep gradient without changing speed, by skilful use of the clutch and careful manipulation of the ignition lever. The novice should always get thoroughly acquainted with his car by practising on quiet roads. When in traffic both feet should be kept lightly resting on the pedals in case of need for sudden action. The brakes should never be applied too fiercely, as this is not only liable to damage the mechanism, but may pull the tyres off the wheels, and cause a bad accident. A driver cannot be considered expert until steering becomes as much an instinct as walking, and it is only when he can manipulate correctly without conscious effort of will the throttle, ignition, clutch, brakes, &c., that the car can be said to be safely in his charge.

The Wolseley Company have from the first recognised the need for a private track on which learners may acquire driving practice, and both at their Birmingham and Crayford works special tracks have been laid down for this purpose. That the "Wolseley" is a very easy car to drive is shown by the fact that many ladies are using these cars at the present time. The facilities

offered by the firm should, if possible, be availed of, and a visit to the factory cannot fail to be of interest to the motorist who intends to take up the pastime thoroughly.

With proper care Wolseley cars will be found to be singularly free from trouble, and the simplicity of the system upon which they are based will appeal strongly to all who may desire to look after their cars without skilled assistance.

THE ARGYLL.

By A. M. Thomson, A. M. Mech. E.

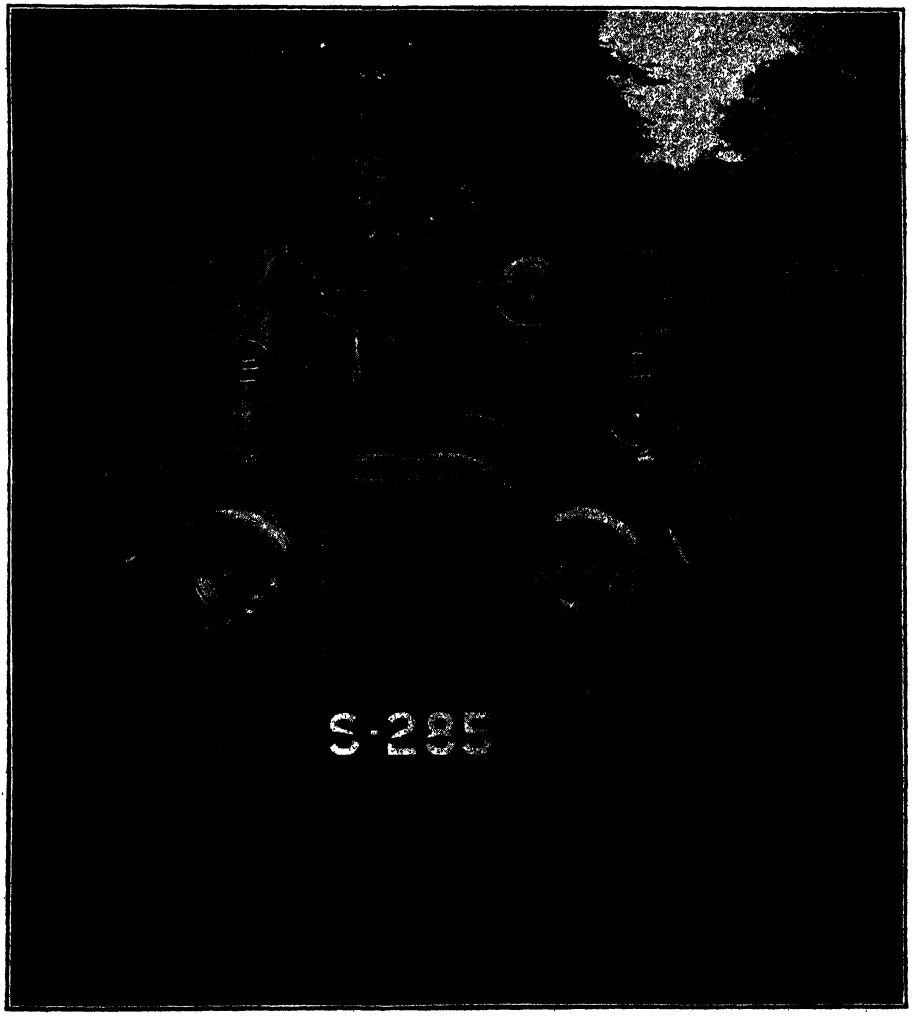
General Description.—The Argyll, one of the best known of British built cars, is justly renowned for the great simplicity of its mechanism, and the ease with which it can be handled even by one with little or no mechanical knowledge. This car is built in two, three, and four cylinder models rated at from 10 to 24 h.p. The engine is a vertical one set under a bonnet in front; the clutch is arranged in the fly-wheel, and the gear-box, which is an especially strong feature of the Argyll, is after the patented designs of Mr. Alec Govan, the Managing Director of the Hozier Engineering Co., Ltd. The drive is by Cardan shaft with universal joints at each end and bevel gear to the live axle. The frame of the car is of pressed steel of ⊓ section, designed with a view to lightness and strength. In the latest models the front road wheels are carried on ball bearings, while the live axle is supported by four roller bearings. The radiator is arranged across the frame in front and is of the honeycomb pattern. It is assisted by a fan driven from the crank shaft by a belt.

In the two cylinder 10-12 h.p. car no pump is fitted, the water being circulated by thermo-syphon action. This cooling system is found to be perfectly satisfactory. Indeed, one of these cars can be driven for a day without adding water to the radiator, provided, of course, there is no loss due to leakage. The ignition is by the ordinary accumulators with induction coils, wipe contact commutator, and sparking plugs. The accumulators, of which it is advisable to have two, are located below the driver's seat and are wired up to a two-way switch on the dash, from which the current is conveyed by wires encased in fibre insulating tube to the commutator which is driven by the half-time shaft, that is the cam-shaft. Below the front seat is placed the petrol tank. This is of sufficient capacity for 120 miles run. A float is provided to indicate the quantity of petrol. The illustration Fig. 1, gives a good general idea of the arrangement of the mechanism of an Argyll car, and the compact manner in which the parts are placed cannot fail to attract attention.

Engine.—As already stated, the engine is of the vertical type, and may have two, three or four cylinders. The piston is of ample depth, and four piston rings are provided, the bottom ring holding the wrist pin in position and thus dispensing with the use of any small screws, which are liable to get loose. The connecting rod is machined from a steel stamping, and the crank-shaft is made from a high quality of nickel steel, the balance weights being made solid with the crank-shaft. It is worth noting here that there is a bearing between each crank, and furthermore that these bearings are the same size and are interchangeable with the connecting rod end bearings.

The valves are all interchangeable and alike; a little point that will be appreciated by the tourist. Both the inlet valve and the exhaust valve are mechanically operated by the cam-shaft which is driven by the two-to-one gear.

The valve lifters are all provided with anti-friction pulleys and work very smoothly. The lifts of the valves can be adjusted with great nicety by a pin and



THE ARGYLL CAR WHICH MADE A RECORD RUN FROM LAND'S END TO JOHN O'GROATS.

locknut. From an outside view of the engine it may be readily observed that the inlet pipe and the exhaust pipe are held to the cylinder heads by means of "dogs," and are quickly and easily detached. A large diameter fly wheel is provided, and contributes in making the car a good hill climber. Inspection doors are fitted at both sides and bottom of the crank-

chamber. The engine is suspended direct from the main frame in a very effective manner. It is thoroughly lubricated on the splash system, and the bearings are provided with oil pockets insuring the proper distribution of the lubricant.

Clutch.—Until quite recently, all the Argyll cars were fitted with a conical leather-lined clutch of the ordinary type. This clutch is very satisfactory in use and has several good features. It is self-contained, and as it all turns together when running, no end thrust is transmitted to any bearing unless when the foot pedal is depressed and the clutch thrown out, whereupon a ball bearing comes into action. Any wear that may occur on the leather face can be taken up readily by drawing in the ring by means of screws. Care requires to be taken, however, to keep the ring parallel to the wheel.

In the later Argylls a metal-to-metal clutch is fitted, and this is arranged in the flywheel, as shown in section, Fig. 2. It runs in an oil bath and consists of a series of thin plates engaging alternately with the pins K and with projections from the disc I. The plates are held in frictional contact by the coil springs D, and are released by the action of the push pedal which pulls out disc C by means of part M acting on ball thrust N. There is extremely little wear in this clutch and what does take place can be taken care of by tightening the screws H. It will be noted that the driven shaft J is carried on ball bearings. As this clutch runs in oil it needs but little attention, and unlike the leather variety it cannot be damaged by slipping. Indeed, if desired, the car may be allowed to move quite slowly—the clutch slipping—while the top gear is in and the engine at its normal. This is especially useful when driving the car in traffic as it obviates the annoyance of constant gear changing.

Gear-Box.—The gear-box on all Argylls is of the same design. Three speeds forward and a reverse are provided, the top speed being a direct through drive. Fig. 3 shows the box with lid removed. The dog clutch A is driven by the engine. This part is in one with the wheel E, and is discontinuous with the square shaft carrying wheel F and brake drum D. As shown, the gear is in the neutral position. When clutches K and K^1 are meshed by moving F on the square shaft the top speed is obtained, meantime the countershaft C runs idle, as does also the loose wheel G and half clutch K^3. To get second speed, wheel F is moved on square so that clutch K^2 meshes with K^3, and the drive is now from pinion E to wheel H and by shaft C to wheel J and from it to wheel G, and by clutches K^3 and K^2 to wheel F, which being on square shafts causes it to rotate and drives the car. To get the first speed the pinion I is slipped along the square countershaft until it meshes with F, and the drive is then got from E to H and from I to F. The reverse is obtained on slowest speed by causing the long idler wheel A^1 to roll down and mesh with I and F.

The great feature of this box is the provision for changing the gears. The lever which is used to slip wheel F is discontinuous at one point and acts through a couple of spring links. The effect of this arrangement is, that if when the handle is pushed home the clutches do not happen to be in line, then there is none of the clattering and grating experienced with some

gears. The springs in the flexible lever are simply extended,—the change speed handle goes fully over at once, and as soon as the clutch prongs come opposite the corresponding spaces the springs act and pull the clutches fully into mesh.

Back Axle.—The Argyll being a gear driven car is fitted with a live axle. This consists of right and left-hand portions with the differential or compensating gear arranged between them. The construction is well

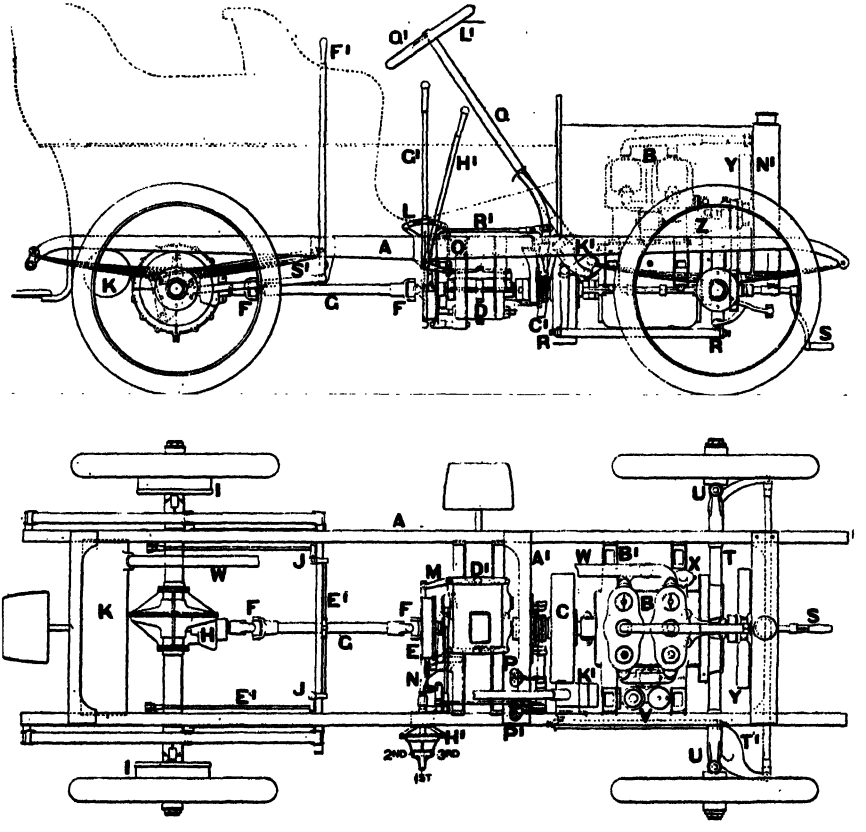


FIG I.—PLAN AND ELEVATION OF THE 10 H.P. ARGYLL CHASSIS.

A. *Frame.* A1. *Frame crossbar.* B. *Engine.* B1. *Engine carriers.* C. *Flywheel and clutch.* C1. *Clutch disengaging levers.* D. *Gear-box.* D1. *Gear-box clamps.* E. *Main shaft brake drum and sprag.* E1. *Back brake compensating rods.* F. *Universal joints.* F1. *Brake lever.* G. *Propeller shaft.* G1. *1st 2nd and 3rd speed lever.* H. *Live axle.* H1. *Reverse speed lever.* I. *Driving wheel brake drum (internal).* J. *Back brake compensating lever.* K. *Silencer.* K1. *Enclosed irreversible steering gear.* L. *change speed quadrant.* L1. *Steering wheel.* M. *1st speed bell crank.* N. *2nd and 3rd speed bell crank.* N1. *Radiator.* O. *Reverse speed bell crank.* P. *Clutch pedal.* P1. *Brake pedal.* Q. *Steering pillar.* Q1. *Ignition and throttle levers (top of steering wheel).* R. *Steering ball joints.* R1. *Foot brake rod.* S. *Starting handle.* S1. *Radius rod.* T. *Front axle.* T1. *Steering bell crank.* U. *Front axle swivel.* V. *Carburetter.* W. *Exhaust pipe.* X. *Commutator.* Y. *Fan.* Z. *Fan bracket.*

designed. Power is conveyed from the engine to gear-box and thence by the cardan shaft to the bevel gear in the back axle. This consists of a pinion meshing with a wheel which in turn is bolted to the differential cases. The pinions are thus turned by the wheel, and the motion given to bevel wheels on the end of the nickel steel shafts and thus to the road wheels. The running portion of the axle is supported within the case by roller bearings. The whole space around the wheels and shaft is filled by solidified oil forced in by a grease injector, supplied for the purpose. Every part is thus well lubricated.

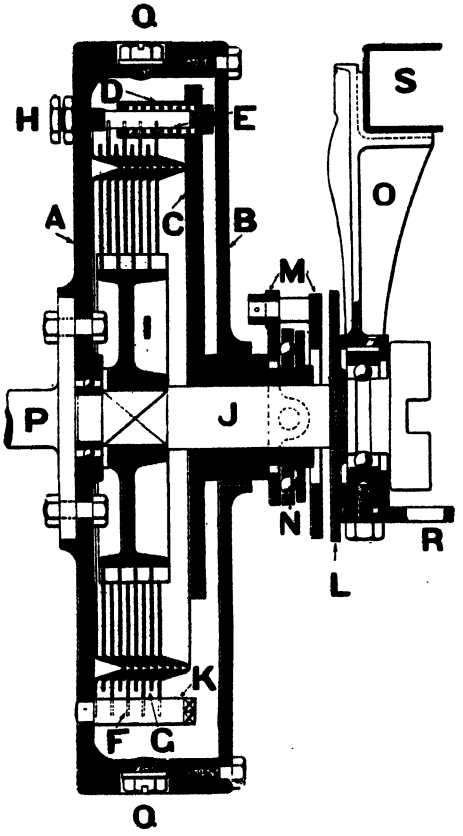


FIG 2.—THE ARGYLL METAL-TO-METAL CLUTCH.

A. *Flywheel.* B. *Flywheel disc.* C. *Pressure plate.* D. *Pressure spring casing.* E. *Pressure spring.* F. *Outer friction plate.* G. *Inner friction plate.* H. *Adjusting stud.* I. *Clutch shaft driver.* J. *Clutch shaft.* K. *Friction plate driving pin.* L. *Clutch shaft brake disc.* M. *Fixed brake Disc.* N. *Actuating ball race.* O. *Clutch shaft bracket.* P. *Engine shaft.* Q. *Oil plugs.* R. *Stay.* S. *Frame crossbar.*

Ignition System.—The ignition system of the two-cylinder Argyll is very simple; and the three- and four-cylinder cars are just the same except for the larger number of connections. As will be seen the current is taken from the positive pole of one or other of the woven glass cells and led to the primary winding of the induction coil. From this it passes to the contact piece in the commutator corresponding to that coil and its respective cylinder, and when the roller within the commutator completes the circuit the current flows to the car frame, thence to the switch and back to the negative pole of the battery on which the switch has been placed. The result of this flow of current in the primary winding is to induce a greatly intensified current in the secondary winding of the coil due to the very large number of turns in the secondary winding compared with the few in the primary. This high tension current flows from the terminals to the sparking plug corresponding to that coil and hence to "earth" and then by way of commutator and wire which is common to both primary and secondary circuits back to the coil terminal. In order that there may be a series of sparks and not merely one when contact is made, it is

necessary to have a rapid make and break of the primary circuit, which excites a corresponding series of flashes of current in the secondary circuit and across the sparking plug gap. To do this a trembler is introduced. The action of this is simply to break the circuit whenever current flows and to make it again as soon as it ceases to flow. It consists of a little blade carrying a platinum contact and held against a platinum tipped screw by a light spring; whenever current flows the trembler is pulled from the screw by an iron core which is magnetised by the current. This opens the circuit, then the core looses its power, and the spring closes the circuit again.

To start the Car.—When about to start up the engine of your car, note that the change speed handles are each at neutral position, *i.e.*, the longer or forward lever in the T slot should be at the middle notch and

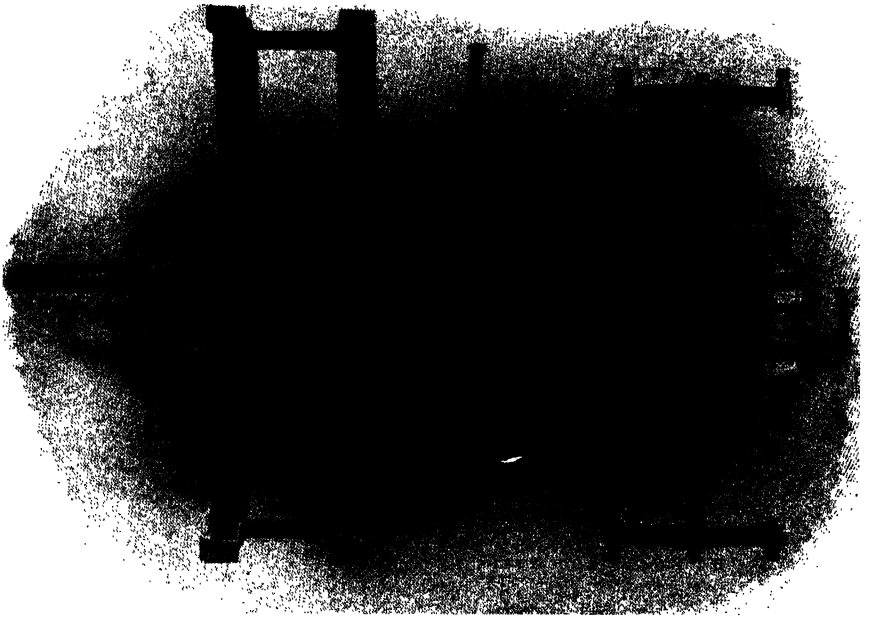


FIG. 3.—THE ARGYLL GEAR-BOX.

A. *Universal sliding coupling.* B. *Main shaft.* C. *Countershaft.* D. *Brake drum and sprag ratchet.* E. *3rd speed pinion and shaft.* F. *1st speed wheel.* G. *2nd speed wheel.* H. *Countershaft speed wheel.* I. *1st speed pinion.* J. *2nd speed pinion.* K. *3rd speed clutches.* K^1, *3rd speed engaging clutches.* K^2, *2nd speed engaging clutches.* K^3, *2nd speed clutches.* L. *Actuating fork (main shaft).* L^1, *Actuating fork (countershaft)* M. *1st speed bell crank.* N. *Sprag ratchet.* O. *2nd and 3rd speed bell crank.* P. *Clutch shaft.* Q. *Bearing joint bolts.* A^1, *Reversing pinion.* B^1. *Gear box cover.* C^1, *Reversing spindle.* D^1. *Gear-box cover clamps.*

the shorter or reverse lever should be at the front end of the quadrant. The engine control levers are arranged in the steering wheel; the right-hand or ignition lever acts on the commutator, the left or throttle on the

governor spring. Set the ignition lever back to the third or fourth notch from the end of the quadrant (be careful about this or you may get a back fire and a broken wrist), and the throttle lever about 60 degrees from the front. If the carburetter is fitted with control levers brought to a quadrant on the dashboard, arrange these as follows: the lower or carburetter throttle (a different part from that mentioned above as the governor throttle) full down, *i.e.*, full open; the upper or extra air inlet, full up, so cutting off all the auxiliary air.

Next press the button on the top of the carburetter float chamber and so splash up petrol through the spraying nozzle. This provides a rich mixture for starting. Put on the switch and give the engine a quick turn over the compression by hand. It should fire at once and go on running. Advance the spark lever forward a few notches and the speed of the engine will increase rapidly, and ought now to be controlled by the centrifugal governor, the speed at which this latter comes into action being determined by the position at which the left-hand control lever on the steering wheel is set.

Having previously assured yourself that you have an adequate supply of petrol in your tank, that the lubricator is filled and is dripping properly, and that the radiator contains the necessary water, and that the tyres are fully inflated, you are now ready to run the car. Taking your seat, you advance ignition lever until it is about 60 degrees from front, the throttle lever being in a similar position, and now the engine ought to be running nicely. Depress the foot pedal, thus throwing out the clutch, remove the side brake if it has been on, and gently push the speed lever outwards. Should it refuse to go, change the relative positions of the gear wheels by allowing the friction clutch to momentarily revolve; this will bring the teeth of one wheel opposite spaces in the other, so permitting you to get them into mesh. The car is now on its low gear.

Raise the foot slowly, when the clutch will get to work, and the car will move forward slowly and without any jerk. Open out the engine control levers a little further, and when the car is going freely on the low speed and you feel confident of your position, change to second speed by depressing the left pedal, and then pulling the speed lever inwards and back to second speed notch, as soon as gear is in let the clutch home gently. Whenever the engine is again running freely as shown by the even beat, change to top speed. Your car ought now to be travelling at anything up to 30 miles per hour, and your endeavour will be to get along without changing gear until forced to do so by having to climb a hill, or go dead slow for traffic, or to negotiate a difficult part of the road.

Note how flexible your engine is, and how it answers to the movements of the control levers. Try as much as possible to fix the speed by the left hand governor lever, and keep the spark well advanced. Do not let your engine knock, however. To do so is to subject it to heavy stresses and to run the risk of a bent or twisted crank-shaft. As soon as the engine is going well, try opening the auxiliary air, bring down the lever of the quadrant on dash-board until you get the position at which the engine runs sweetest. Your aim ought to be to keep this air supply as far open as you can, as to so do is to save petrol and keep the engine running cool.

From time to time note that the oil is dripping freely in the sight feed lubricator; five to six drops a minute is the correct amount for each of the engine feeds and three to four for the clutch. The engine casing contains oil to such a height that the cranks just dip into it when at the bottom of their stroke. This supply is automatically augmented by the drips from the lubricator. Should there be any indication of the engine not running freely a further supply may be put in by means of the small hand pump on the side of lubricator. A similar pump with reservoir is fixed to the dash on the left-hand side by means of which a supply of heavy oil may be injected into the gear-box. The level of the oil in this should be kept at the under side of shaft. A couple of strokes of the pump every 100 miles keeps this level about right.

Hill Climbing and Gear Changing.—Sooner or later on your run you will come to a hill which proves too much for your engine on the top gear, and then it begins to slow up. When this occurs, leave the governor lever full open, retard the spark to prevent knocking, and as soon as the engine shows signs of labouring drop down to a lower gear by withdrawing the clutch and changing the lever. This must be done quickly and neatly, but needs no force.

As soon as the engine picks up, open out the ignition again, and whenever the speed of the car has increased owing to the incline becoming easier, you can get back to top gear. When it is necessary to go down to the first speed, more care is required in changing than when getting into the second, because you require to mesh together the teeth of two wheels and do not have the springs to help you as in the case of the second and top gears.

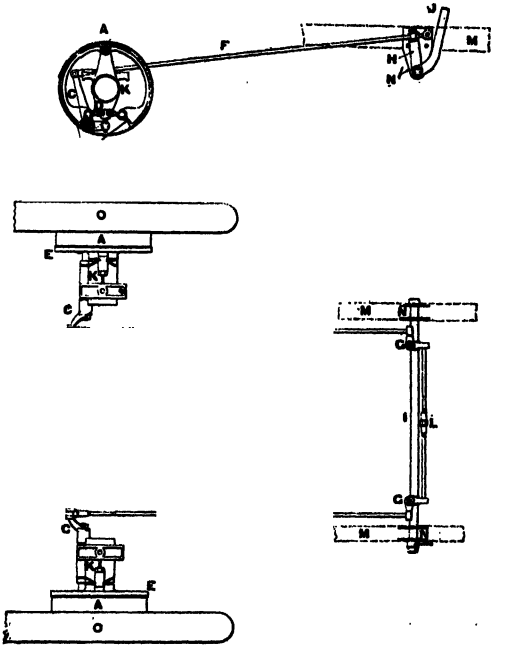


FIG. 4.—THE BRAKE MECHANISM.

A. *Brake drum.* B. *Brake bands or shoes.* C. *Actuating lever.* D. *Brake band adjustable toggle.* E. *Dust-shield.* F. *Compensating brake rods.* G. *Compensating bell cranks.* H. *Compensating bell cranks pivot lever.* I. *Brake shaft.* J. *Brake hand lever.* K. *Spring and brake carrier bracket.* L. *Adjusting coupling.* M. *Frame.* N. *Brake shaft bracket.* O. *Road wheel.*

There is a knack in doing this successfully, which, however, is easily learned if a little care is taken. Press down the clutch smartly, then lightly but firmly push speed lever outwards. Whenever the sliding wheels come together a slight tremor will be felt coming up the handle. This will continue until the teeth in the one wheel are opposite the spaces in its

mate. The instant this occurs push the handle over and let clutch in. Do not try to force the lever over; to do so is to destroy the edges of the wheel teeth, yet do not hesitate at the right instant, otherwise you will fail to get the gear in.

In changing gear from top or second, note that the gear wheel is following the handle and that the movement of the lever is not being got merely by stretching the springs in the flexible connection. Should this happen, you will feel a steadily increasing drag and a want of freedom of movement, caused by the jaw clutches remaining in mesh. To overcome it, shake the lever a little when they will come free. If you do not do this you are liable—when changing from second to first—to get two gears in at one time, so locking them and bringing the car to a dead stop and possibly doing some damage. It is obvious also that you must not put in the reverse gear while the forward gear is in mesh, or even so long as the car is moving forward, as to do so will almost certainly mean a broken part somewhere.

When climbing a very steep hill, it is wise to let down the sprag—in old cars a bar catching the roadway, in later designs a pawl engaging with notches in the edge of the drum on the driving shaft—before beginning to climb. Then, should the engine stop from any cause the car will not run backward down hill. This use of the sprag is merely a precautionary measure, as the Argylls are splendid hill climbers and can tackle any hill ordinarily met with. Should the car from any cause start to run backwards down a hill do not attempt to let the sprag grip, as to do so is liable to upset the car and cause a smash. Trust to your brakes to slow you up.

Descending a Dangerous Hill.—When descending steep, dangerous hills, I recommend that the descent be made on the second speed, or even the first speed, if the hill is very dangerous. In this way the car cannot run away and the brakes are reserved for any emergency. Of course, ordinary hills can be descended with the engine running free. Never allow the car to get out of control. Always know that it can be stopped immediately if necessary. The brake power provided is more than ample, but it should not be abused. When driving in the ordinary way allow plenty of time to stop, as sudden application of the brakes is sore on the mechanism, and should only be done to avoid an accident.

General Care of the Car.—It is advisable now and again, after running say 500 miles, to inject a little paraffin into each of the cylinders and then give the engine a few sharp turns to cause the oil to move about, and thereby remove any "gumminess" from the valves, cylinder walls, *et cetera*. When giving the car a proper look over, which should be done at least once a month, the plugs should be removed from the valves and the cylinders washed out with paraffin by pouring about a cupful into each and working the engine until the oil finds its way into the crank case, from which it can be drained off along with the old oil, after which a new supply of lubricant must of course be added to the crank case. The oil used must be of a very high flash point and have a good body, and be free from deposit at high temperatures.

Never allow looseness to gather in any of the engine bearings, but on the least sign of such have them seen to. Should you find the compression becoming weak, examine the valves, and more especially the exhaust valve, for "pitting" and consequent leakage. As soon as this occurs, re-grind the valve on its seat. To do this the easiest and quickest way is to bend a short piece of wire so as to form a bow, flatten one end to a screw-driver point and place a ferrule on the other. Use this to rotate the valve while grinding. Before closing up the engine see to it that you remove all traces of emery, otherwise some grains may get into the cylinder and cause scoring.

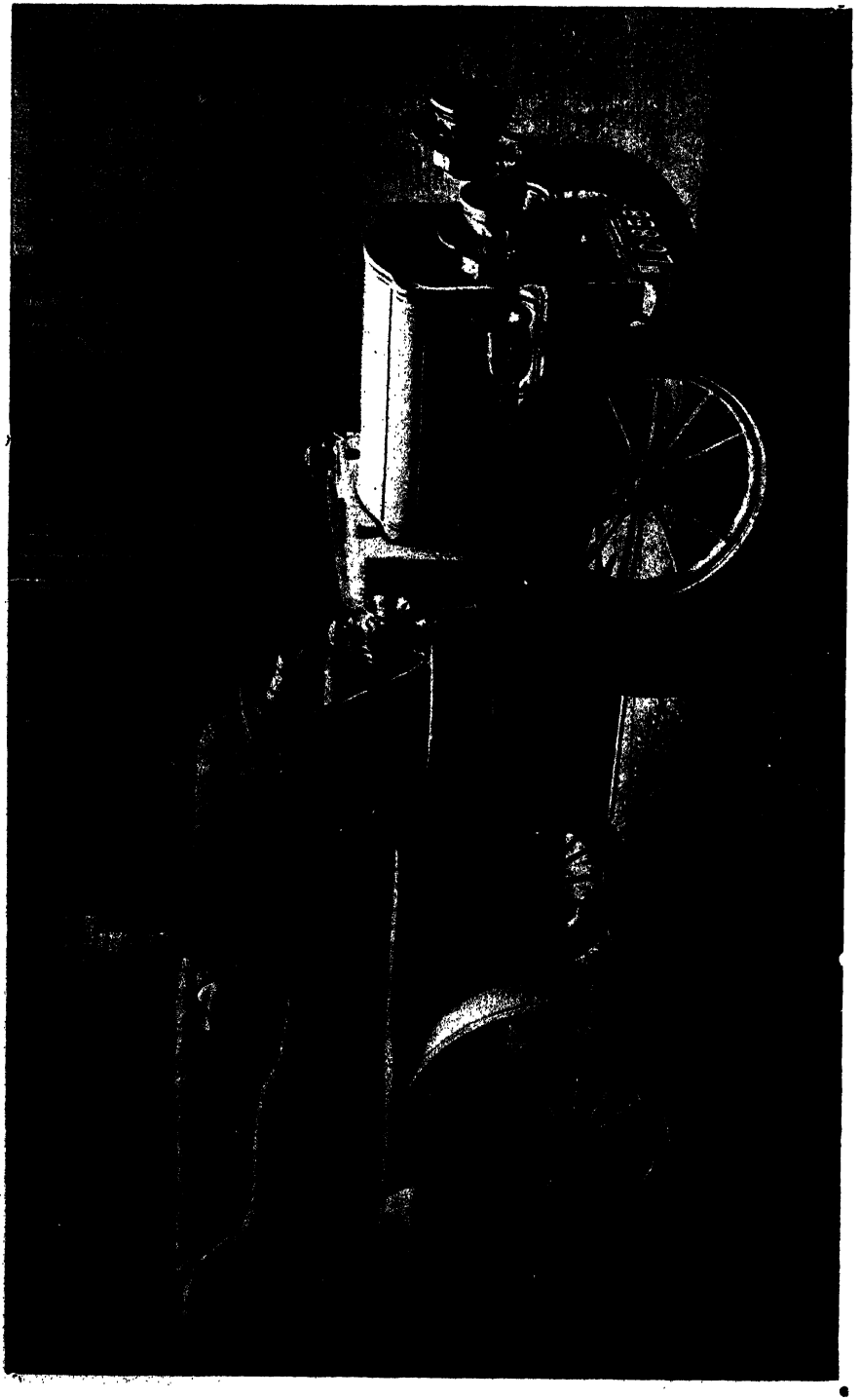
Should there be loss of compression, with the valves in good order and no leakage at any of the joints, examine the piston rings; if they are acting properly they will be smooth and polished all over their working face. Should, however, there be any dull black places on them you may be sure that the gases have been escaping past them and that they require to be renewed. Loss of compression may also be caused by the plug at top of the cylinder barrel leaking to the water-jacket. When this occurs water finds its way into the cylinders and leads to the detection of the trouble.

Valve Fittings.—When an engine is in proper order, the inlet valve should open when the piston is at the top of its stroke and just as suction begins. It should remain open until the end of that stroke, when it should be closed.

With the ignition control lever in its middle position the roller should just touch the edge of the contact when the piston is at the top end of the compression stroke. At $\frac{7}{16}$in. from the end of the explosion or working stroke, the exhaust valve should begin to open, and should remain open during the upward scavengering stroke, closing just as the piston again reaches the top of the cylinder, having completed a cycle.

Care of the Leather Clutch.—This clutch is not at all troublesome but there are one or two points which need attention. See to it that the ball bearings get a good supply of oil every time the car goes out, and that the oil way leading to the bearings is kept clear and delivers its supply of oil properly. Otherwise the steel sleeve forming this bush is sure to "fire" on to the engine shaft and give trouble. From time to time treat the leather of the clutch to a dose of castor or linseed oil so as to keep it in good condition. Should it slip apply a little Fuller's Earth. If it is too "fierce" and starts the car with a jerk, even when let in gently, give a little lubricating oil, but do so sparingly, else it will slip badly.

Persistent slipping of the leather-faced clutch may be caused either by the operating spring having broken or by the male portion not sliding freely on the engine shaft, due to want of proper lubrication of the sleeve.



MR. FREDERIC COLEMAN ON HIS 15 H.P. WHITE STEAM CAR.

THE WHITE STEAM CAR.

By Frederic Coleman.

This article is written with the idea that the reader will have a fundamental knowledge of the White car, at least such as can be gained either from a perusal of the catalogue issued by the White Company or from half-an-hour's inspection of the car itself. I have purposely avoided going into technical details, so as to make the matter all the more clear for the beginner; and it will be found, after a brief study, that the car is very simple in its mechanism and management.

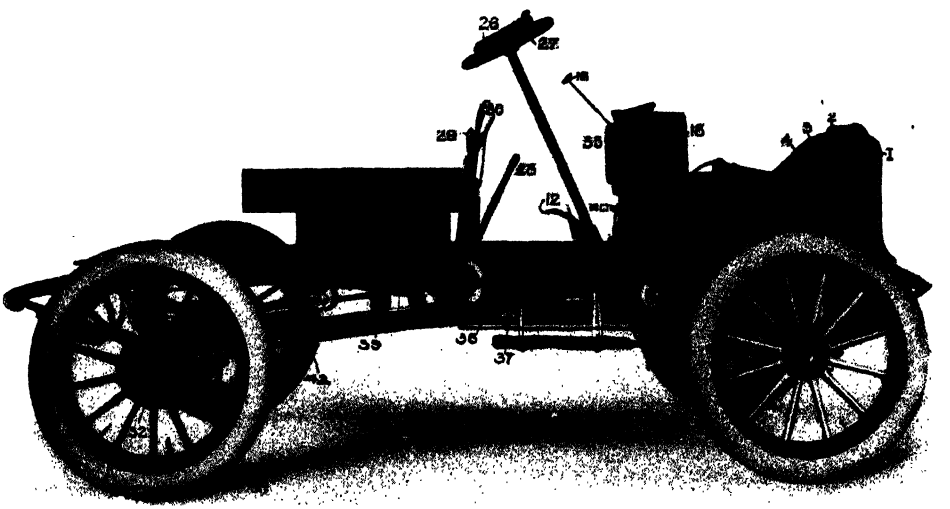


FIG. I. SIDE VIEW OF THE WHITE CHASSIS.

1. *Condenser, or cooler into which the steam passes after doing its work in the cylinders.* 2. *Overflow pipe.* 3. *Exhaust pipe.* 4. *Fan bracket.* 6. *Grease cup.* 7. *Engine.* 12. *Simpling pedal.* 14. *Water tank.* 15. *Steam Generator.* 24. *Main steam pipe.* 26. *Throttle wheel.* 27. *Steering wheel.* 28. *Emergency lever.* 29. *Reverse lever.* 30. *Brake lever.* 31. *Brake rods.* 32. *Brake drums.* 35. *Automatic cylinder lubricator.* 37. *Blow-off cock.* 38. *Main burner valve.* 39. *Sub burner or pilot light.* 40. *Fuel valve.* 42. *Reach rods.* 49. *Main water pipe.* 50. *Blow-off cock.*

The general system of steam generation need be but touched upon here. The water tank, holding twelve gallons of water, (a sufficient quantity for a run of from 150 to 200 miles), may be filled with any water no matter how hard or how soft. An ordinary suction pump, actuated by an eccentric on the engine crank-shaft,

takes the water from the tank and forces it into the generator. Entering the top coil of the generator, it is forced down through each of the succeeding eleven coils, and emerges in the form of superheated steam from the bottom coil.

The opening of the throttle allows the steam to pass into the engine. There it does its work, first in the high pressure cylinder, and then in the low-pressure cylinder, when it is exhausted into the condenser, which cools the steam and turns it into water again. A power pump, run by the engine, pumps the water from the bottom of the condenser back into the tank where it is then ready to begin another journey through the generator.

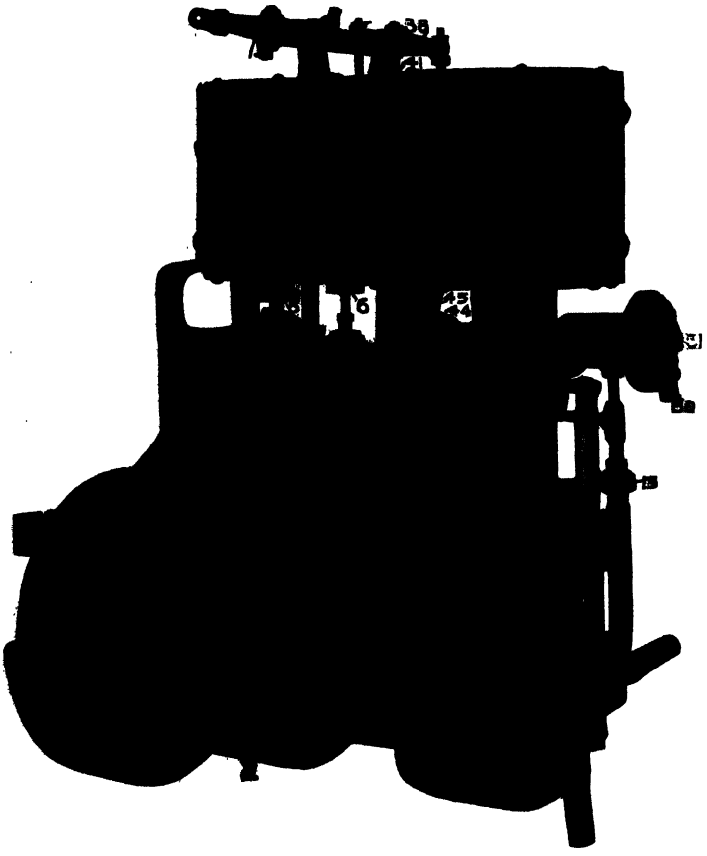


FIG. 2. RIGHT SIDE OF WHITE ENGINE.

1. *High-pressure cylinder.* 2. *Low-pressure cylinder into which the steam passes from the high-pressure cylinder, and thence to the condenser or cooler.* 4. *Aluminium crank case.* 5. *High-pressure piston rod gland.* 6. *High-pressure slide valve rod gland.* 7. *Low pressure slide valve rod gland.* 8. *Low-pressure piston rod gland.* 13. *Flywheel.* 15. *Water pipe connections.* 16. *Pipe to hand by-pass* 19. *Water regulator.* 28. *Part of the power water pump (see Nos. 20-29., fig. 3.)* 33 *to* 37. *Return pump condenser to water tank connections.* 42. *Main steam connection..* 43. *Crosshead guides.* 44 *to* 48. *Power air pump's parts.* 49, 50 *and* 51. *Link motion.* 53. *Adjusting aperture.* 61. *Power air pump.* 62. *Drain plug.*

The other essential for steam production—viz., the fire, is obtained by forcing fuel, by a moderate air pressure, through a vaporizer, and igniting it in gaseous form as it emerges therefrom.

Thus is steam obtained.

The assurance that the right amount of steam is maintained rests with the automatic regulation.

The fire must not become too hot or damage to the coils by overheating and damage to the engine by the introduction into it of "red hot" steam might result. Hence a fire regulator is introduced by means of which the full supply is automatically cut down, and consequently when the temperature reaches a given point the heat is kept from increasing beyond that certain point by the automatic action of the regulator.

In other words, when the temperature at the bottom of the generator reaches 370° Centigrade, the fire is shut down. Nothing will bring it on again but a drop in the temperature, and nothing will lower the temperature save the introduction of water into the generator.

Likewise, the necessity for regulation of the water arises. To continue to throw water into the generator no matter how much heat is underneath it would result in abnormally and unnecessarily high steam pressures. Consequently, the water is so regulated by a diaphragm valve that when the steam gauge registers 375 lbs. pressure or thereabouts, a by-pass is opened and the water is pumped in a circle.

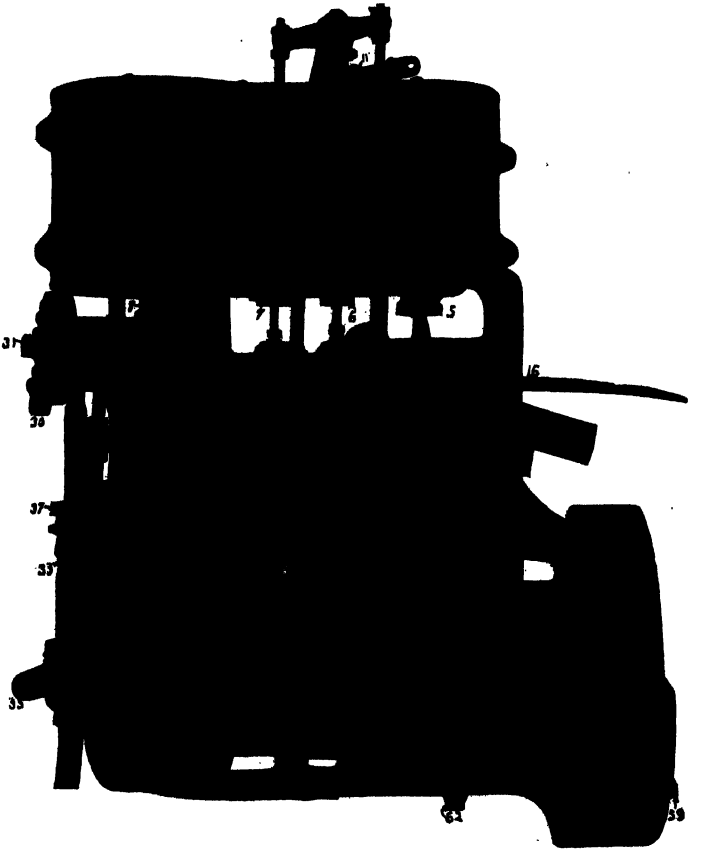


FIG. 3. LEFT SIDE OF WHITE ENGINE.

1. *High-pressure cylinder.* 2. *Low-pressure cylinder.* 3. *Exhaust pipe.* 4. *Aluminium crank case.* 5. *High-pressure piston rod gland.* 6. *High-pressure slide valve rod gland.* 7. *Low-pressure slide valve rod gland.* 8. *Low-pressure piston rod gland.* 9, 10 *and* 11. *Simpling valves.* 12. *Supports.* 13. *Flywheel.* 14^1. *Suction hose.* 14^2. *Delivery hose.* 15. *Water pipe connections.* 16. *Pipe to hand by-pass.* 17 *and* 18. *Pump casting.* 19. *Water regulator.* 20 *to* 29. *Parts of power water pump.* 30 *to* 32. *Water regulator parts.* 33 *to* 37. *Return pump condenser to water tank connections.* 38 *to* 41. *Rocking lever for simpling valves.* 52. *Simpling valve plugs.* 53. *Adjusting aperture.* 61. *Power air pump.* 62. *Drain plug.*

These two regulators work with each other, but do not have any direct connection with each other.

And now I think I cannot do better than briefly describe the operations which must be performed in order to get the car going.

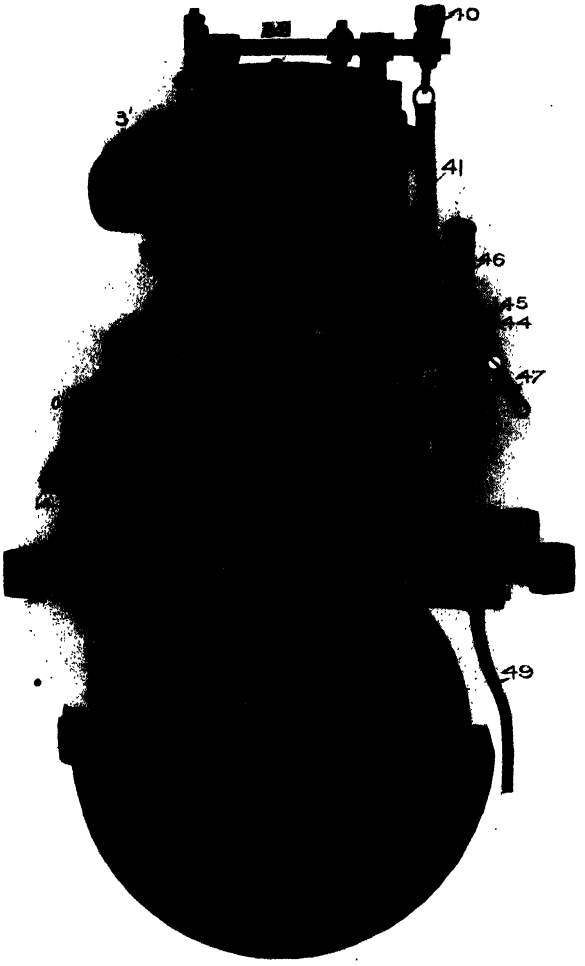


FIG. 4.—BACK VIEW OF WHITE ENGINE.

1. *High-pressure cylinder.* 3. *Exhaust pipe.* 5. *High-pressure piston rod gland.* 6. *High-pressure slide valve rod gland.* 12. *Supports for engine.* 13. *Flywheel.* 14^1. *Suction hose.* 14^2 *Delivery hose.* 19. *Water regulator.* 20 *to* 29. *Parts of power water pump.* 39 *to* 41. *Rocking lever for simpling valves.* 44 *to* 48. *Power air pump parts.* 49, 50 *and* 51. *Link motion.* 52. *Simpling valve plugs.* 53. *Adjusting aperture.* 54 *and* 55. *Foot brake inside the flywheel.* 56 *to* 60. *Driving shaft connections.* 61. *Power air pump.*

When I wish to take my White car for a run I go to where it is standing in the stable and proceed as follows: I first ascertain whether the car is supplied with fuel and water, and, if so, with how much.

The water one can see by removing the lid of the tank. The amount of fuel can be discovered by trying one or more of the three little gauge cocks on the fuel tank.

Next I see that I have at least ten or fifteen pounds of air pressure showing on the air gauge. As the air pressure is bottled up when the car is put away after a run there should always be enough air to allow one to light up even though the car has been standing idle for a week.

Lighting up is a simple process. Letting a teaspoonful or more of fuel into the drip cup, a match is applied. A minute or so later the main supply valve to the pilot light may be opened and the tiny flame watched through the door in the generator casing, and from two to three minutes later the little cast-iron cone on top of the pilot light will become red hot. This means that the vaporizer is sufficiently hot to vaporize the fuel, and the main burner may now be turned on. Steam will at once show on the gauge.

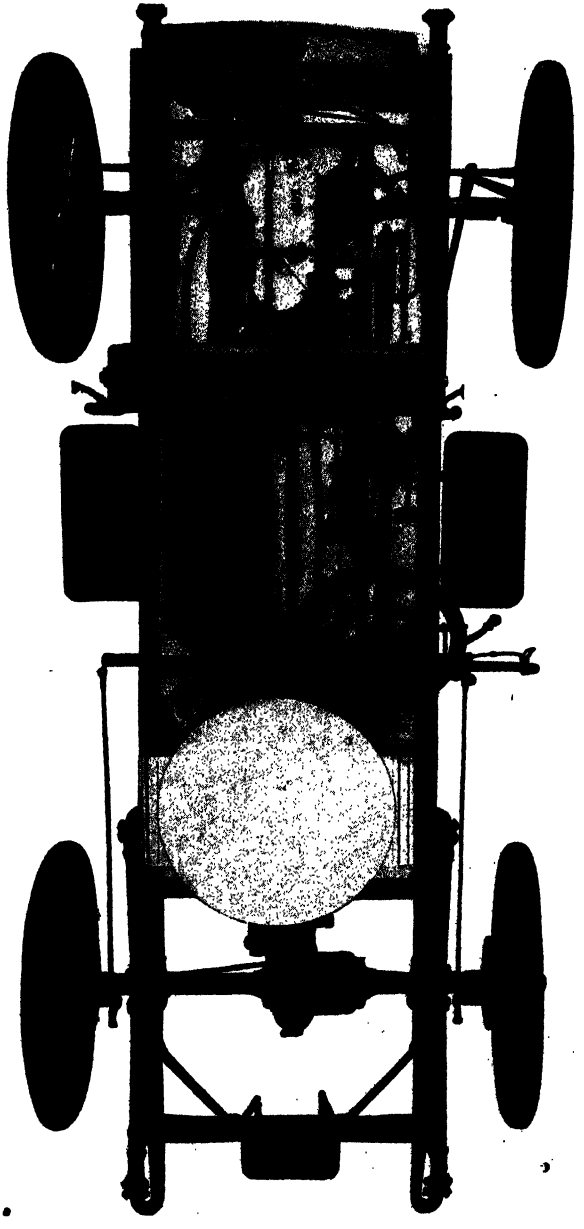


FIG. 5.—PLAN OF WHITE CHASSIS.

Letting it rise to 250 lbs or thereabouts, the blow-off cock should be opened. At this the steam will drop, rising again upon the cock being closed, when the blow-off cock should again be opened. In half a dozen seconds dry steam will

come out of the blow-off cock when it is opened, showing that the water has all been drained from the steam pipes.

Steam is now "up."

Depressing the "simpling" pedal, so that the steam will enter both high pressure and low pressure cylinders simultaneously, I open the throttle a little way. Steam should be admitted gradually, allowing the engine to run free and work out all the water in the cylinders. After the engine has turned over a few times, the "simpling" pedal should be released. If but little water was in the generator when the car was lit up and the steam pressure is very low, the hand water by-pass should be closed, as this means that both power water pumps are throwing into the generator. If, on the other hand, the pressure is high, the hand by-pass should be opened, leaving but one pump throwing into the generator.

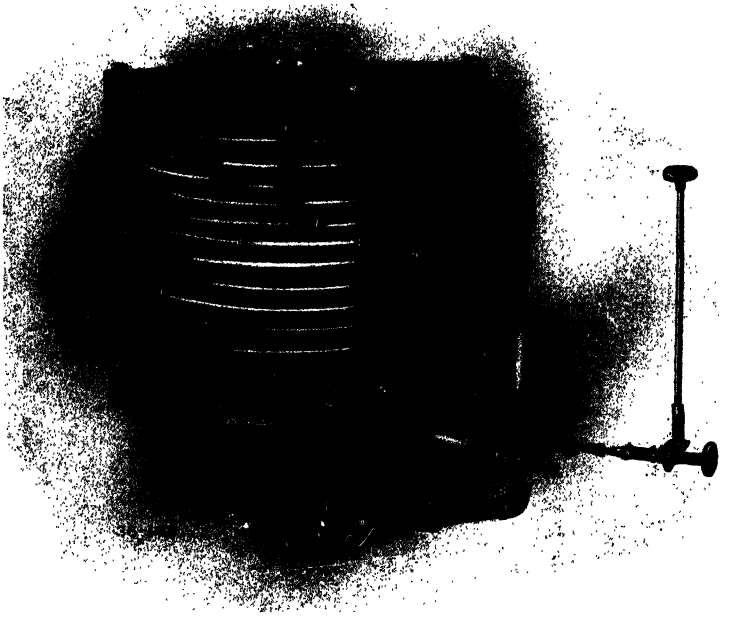


FIG 6.—THE WHITE GENERATOR.

A few moments' running warms the engine. To start away, I close the throttle, release the brake, slip in my emergency lever, and opening the throttle, the "simpling" pedal being depressed for the moment of starting, move gently away. Usually I find it wise to close the hand water by-pass when starting cold, and only opening it when my fire comes on strong.

It is well to always remember that the sound of the fire coming on strong, which one can soon learn to hear if one listens for it, is evidence that the generator has enough water and to spare. Consequently, for all ordinary cases, I always have the hand by-pass open when my fire is on.

Now the beauty of the automatic regulation is demonstrated. The fire burns until a temperature of 370° centigrade is reached, and then shuts down. If the steam pressure is below 375 lbs., the pumps throw water into the generator, which, as it reaches the lower coils, brings down the temperature. The fire comes on again, and raises the steam pressure above 375 lbs., when the pumps no longer throw into the generator, but through the by-pass. As no water is entering the coils the temperature soon rises again to 370° and the fire again shuts down. The pressure gradually falls below 375 lbs., as the steam is being used, and the introduction of more water into the generator brings on the fire as before. So it goes on *ad infinitum*. The system saves the driver from all worry, and it enables power to be produced in a most effective manner, no matter what may be the calls made upon the engine.

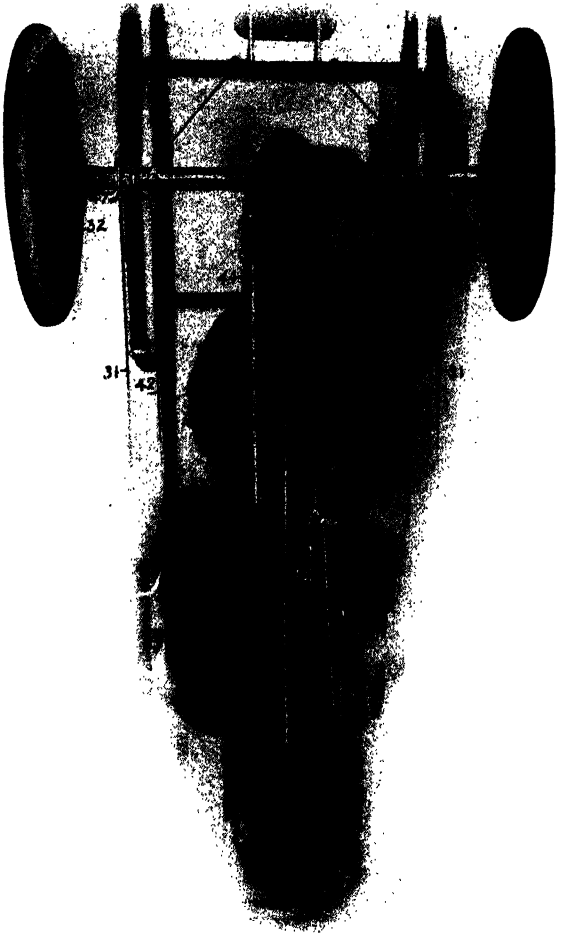


FIG. 7.—THE TRANSMISSION GEAR OF THE WHITE CAR.

7. *Engine.* 21. *Fuel tank.* 31. *Brake rods.* 32. *Brake drums on the back wheels.* 36. *Differential gear lubricator.* 42. *Reach rods.* 43. *Driving shaft which transmits the motion from the engine to the live axle and thus through the differential gearing to the road wheels.* 44. *Axle stay.* 45. *Emergency lever rod.* 46. *Engine crank case.* 47. *Axle keeps.* 48. *Universal joint.*

All I watch, when driving, is the road. The throttle is manipulated by the hand. Open it a bit and the car goes faster; close it a bit and its speed decreases. One's right foot has no duty to perform unless the powerful foot-brake is to be used. One's left foot presses the simpling pedal at the moment of starting and when running depresses the air pedal momentarily when the air gauge shows less than 30 pounds pressure on the fuel tank. Not less than thirty nor more than forty pounds of air pressure is a good radius. Thirty pounds is enough for town use, but forty is required for very rapid running.

The reverse lever quadrant has four notches, and to economise the steam by increasing the cut-off, the lever may be placed in the second or third or even the fourth notch when the car is moving rapidly. It is a good plan when on a long run to notch down the stroke as far as one can without any labouring on the part of the engine or any noise therefrom.

The reason why I never watch the steam gauge when running my White car, unless it is to see that the gauge does not register more than 750 lbs. pressure, is because no benefit can come from so doing. I run my car by the "feel" of the throttle, just as I drive a horse by the "feel" of the reins. What horseman would not scorn the suggestion that he place a gauge on his reins showing the number of pounds his horse was pulling?

With but one pump throwing into the generator I know I cannot "flood" my car, *i.e.*, get wet steam; and when but one pump is in use I know that stopping my car as suddenly as I like will not cause the pressure to rise to 750 lbs. before the fire will automatically shut off.

When the fire is off, if I wish to increase the pressure I open the throttle and press my car on until the pump throws sufficient water into the generator to bring on the fire, whereupon I close the throttle a bit to let the fire catch up again, and again shut off. This is soon done by the driver of a White car almost involuntarily, although for ordinary running at speeds of from, say, fifteen to thirty miles an hour, no such manipulation is necessary.

For ordinary running the throttle can be placed in one position and left there, and the fire and water will take care of themselves. When one comes to a hill and needs a drop more water, a turn of the wrist shuts the hand water by-pass, the generator gets a double supply of water, the fire comes on, the by-pass is opened again so that dry steam is assured, as one *can* get *too* much water with both pumps throwing, and one sails up hill with surprising speed.

With reference to the actual amount of steam pressure showing on the gauge, this means less than one might imagine. Sometimes my gauge shows 200 lbs., sometimes 300 lbs., and sometimes 400 lbs.; on other occasions even more or less than any of these figures, and yet the cars may be run at very much the same speed on all of them. It is not the amount of steam in actual pounds that is the chief point of importance, but the quality of the steam, which if well superheated, is always powerful, and the all-important feature is the continuity of its supply.

Of the emergency gear, by which the ratio of the engine to the road wheels may be changed from three to one to seven to one, I need say but little. There are not half a dozen hills in Great Britain up which the White car will not carry its full load without leaving its three to one ratio. The emergency gear was designed for the mud holes and bad roads of America. The only rule I can give for its use is to change to the seven to one if the engine seems to be straining, as it eases the pull by one half. I never use it save when starting stone cold from the foot of a steep hill, when it certainly is a blessing. Seven revolutions instead of three mean seven strokes of the pump instead of three, so that the use of the hand pump is unknown to the White, no matter how steep the hill or how awkward the conditions.

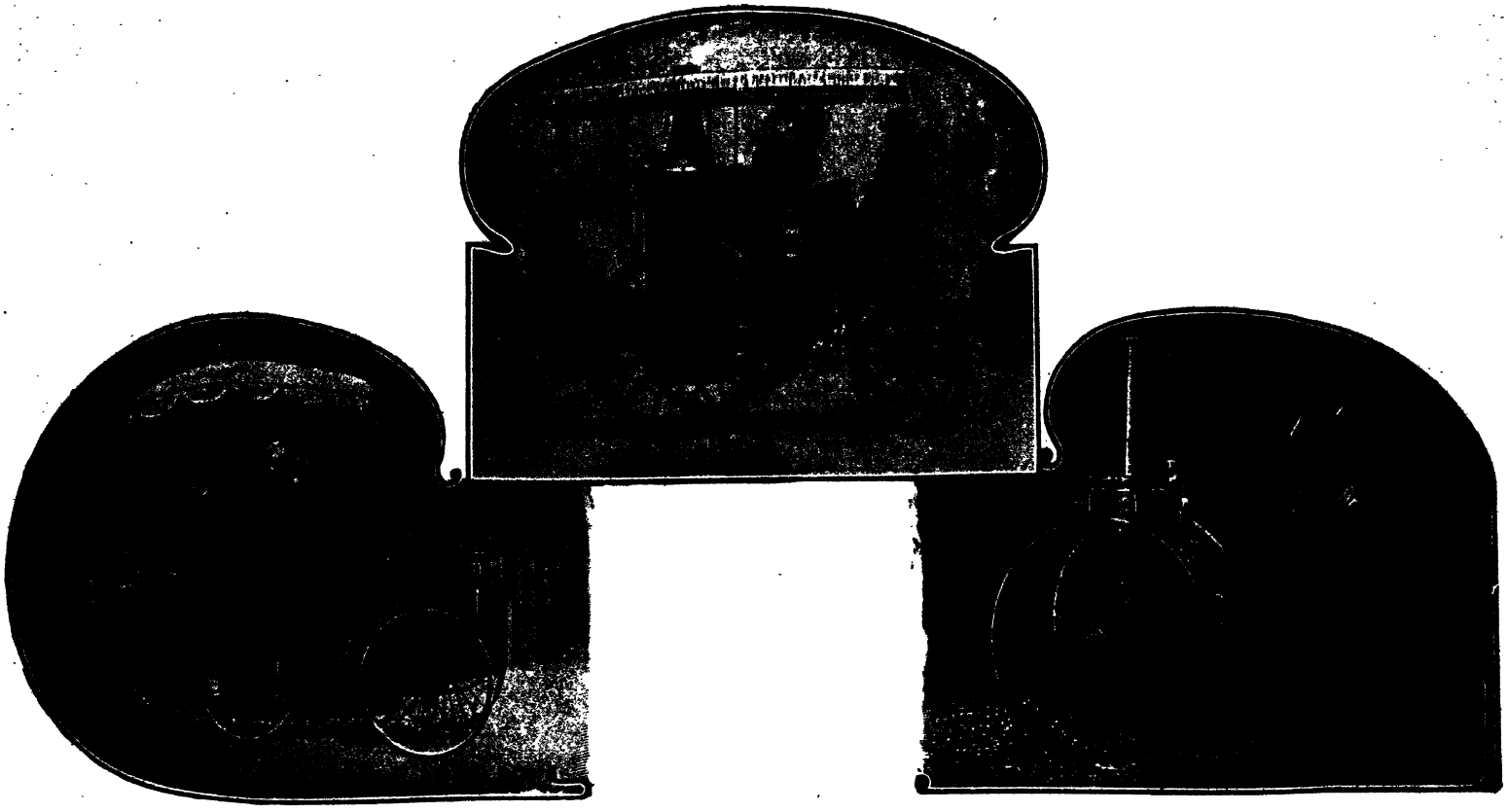
My final advice to all who would learn to drive the White car may be summed up in a few sentences.

See that your fire shuts down frequently, as this means you have sufficient heat, without which no White car will run well.

Watch your lubrication.

Open the throttle slowly, making the strain on the engine crank-shaft, especially in starting, a gradual one.

Follow that advice religiously and freedom from trouble will be your reward.



EARLY STEAM VEHICLES CONSTRUCTED BY MARQUIS DE DION.

THE DE DION.

By J. W. Stocks.

To deal with the origin, rise and progress of the huge business which has been built up by Messrs. De Dion Bouton et Cie. would be to give a history, in its general lines, of the motor car industry from its very beginning. I will, therefore, content myself by giving a list of various patterns of De Dion cars which have been introduced from time to time.

The frontispiece depicts the first little steam car with belt transmission, which started running in 1883. In 1885 a quadricycle was built, with four seats and a phaeton body, with the boiler at the rear, two engines, and transmission by chain to the back wheels. This quadricycle distinguished itself by beating its only competitor, the Serpollet, in the first motor car race ever held, in 1885, between Paris and Versailles.

In 1887, Count (now Marquis) De Dion brought out his famous steam tricycle which attained the remarkable speed, for that period, of 40 miles an hour; but it can easily be imagined that the work of firing the boiler and frequently replenishing the fuel and water supplies was not calculated to make this vehicle practical or popular. All sorts of vehicles were experimented with, from the lightest to the heaviest, and in 1894 the De Dion Bouton vehicles again showed their unquestionable supremacy by arriving first in the trials from Paris to Rouen.

Having already had a good deal of experience with the steam tricycle, Count De Dion saw that this type of vehicle would become extremely popular if it could be fitted with a petrol motor. To make it a success, however, the motor would have to be fitted with electrical ignition, and the De Dion Bouton firm were the first to employ this ignition on small engines and to show that it could be made reliable and practical. The motor was designed and adapted to the tricycle in 1895. The machine at once jumped into popular favour, and from that moment dates the success of the De Dion engine, which on account of its extreme lightness compared with the engines then in use, set a new fashion in the automobile world.

Following the tricycle, the 3½ h.p. voiturette was introduced with engine over the back axle; then the 4½ h.p. and 6 h.p. with engines in the same position, succeeded by De Dion cars with engines under a bonnet in front, and in turn cars with twin-cylinder engines were placed on the market. In 1904 there were 6 and 8 h.p. single cylinder engine cars, and 10 and 12 h.p. cars with twin-cylinders. The same sizes still remain, in addition to which a 15/20 h.p. car with four-cylinder engine has now made its appearance.

"How long will it take me to learn to drive a motor car?"—This is a question very frequently asked by the prospective motorist when he has arrived at the stage of making inquiries. To anyone with average intellect

the time occupied in learning to drive is comparatively short. Some beginners will take the steering wheel right away after having the levers explained, and come through with flying colours; but this is frequently an expensive method of gaining knowledge. The better way is to sit beside a competent driver while he is negotiating the traffic for an hour or two, and closely

FIG. 1.—THE DE DION TWO SPEED GEAR.

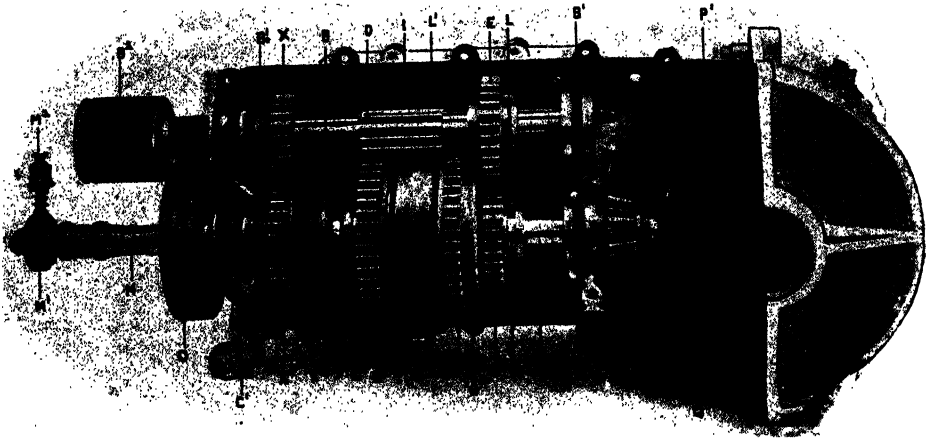


FIG. 2.—THE DE DION THREE SPEED GEAR.

observe the starting and stopping of the car, the changing of speeds, and the necessary movements of the levers to increase or decrease the speed of the engine. Then the novice should take charge in a comparatively quiet thoroughfare, make himself accustomed to the weight of, and the distance required to bring the car to a standstill at various speeds and under varying conditions of road surfaces.

It is common to refer to "driving" a car. I prefer the word "handling." Briefly, anyone can learn to *drive* a car in two or three hours, but it is as many days before he can *handle* it in a manner to obtain the best results, although this depends upon the make of car which is decided upon.

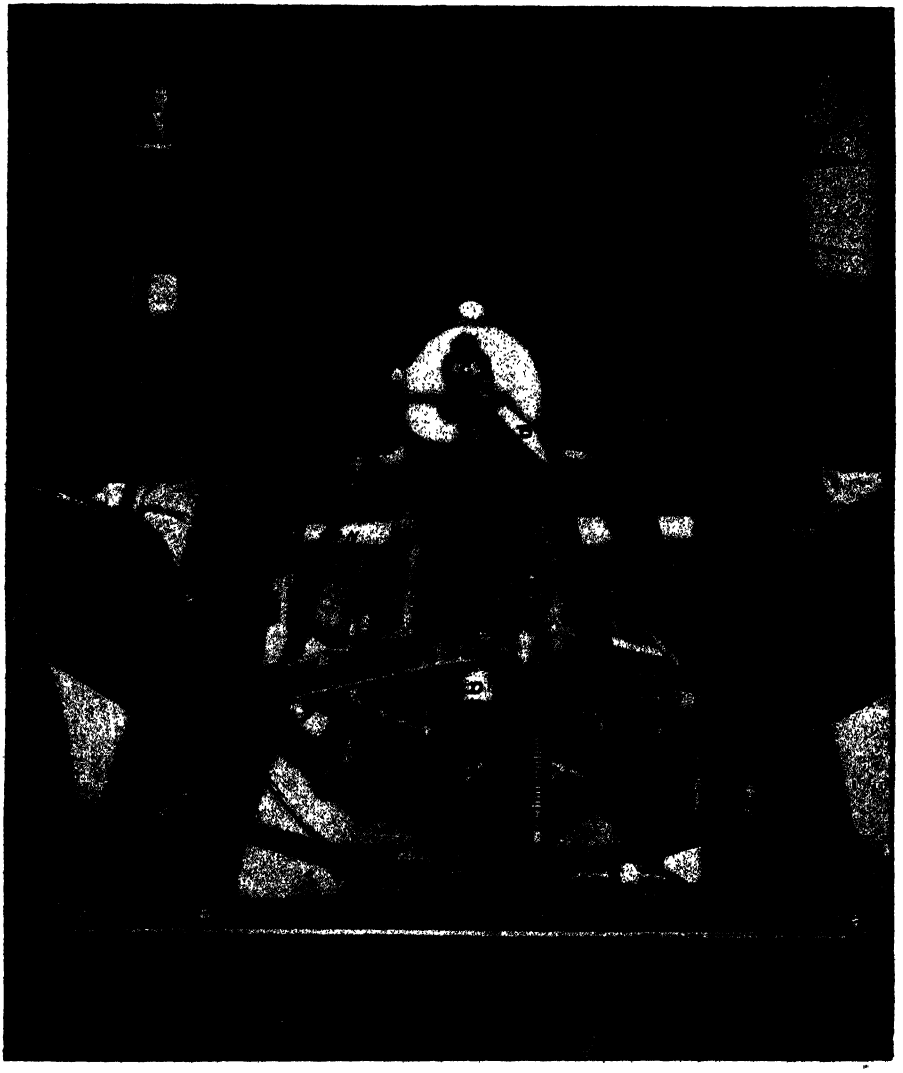


FIG. 3.—FRONT VIEW OF 6 H.P. ENGINE.

A. *Carburetter.* B. *Inlet pipe.* C. *Inlet valve dome.* D. *Contact breaker.* E. *Sparking plug.* F. *Exhaust valve.* G. *Exhaust pipe.* H. *Lever for actuating exhaust valve regulator.* I. *Water pump.* K. *Spring drive for water pump.* L. *Watertank.* M. *Lubricating tank.* N. *Lubricating pipe.* O. *Insulated holder for wire to the sparking plug.*

The 6 h.p. De Dion is invariably referred to as "the novice's car" because the easiest possible way of changing speeds is by means of expanding clutches. Illustration No. 1 shows a simple 6 h.p. gear with two forward speeds, but without a reverse. (I have chosen this illustration because the later models which are now fitted with gears giving three forward speeds as well as a reverse, but made on the same principle, look rather more complicated.)

The top shaft, which makes the same number of revolutions as the engine, has permanently fixed on it two cogwheels. On the bottom shaft, which is hollow, there are also two cogwheels, which run loose on the shaft, and are always in mesh with the cogwheels on the top shaft. The cogwheels on the bottom shaft are attached to hollow drums, inside which are two pairs of expanding segments, the fit being a very close one, without, however, the surfaces coming in contact.

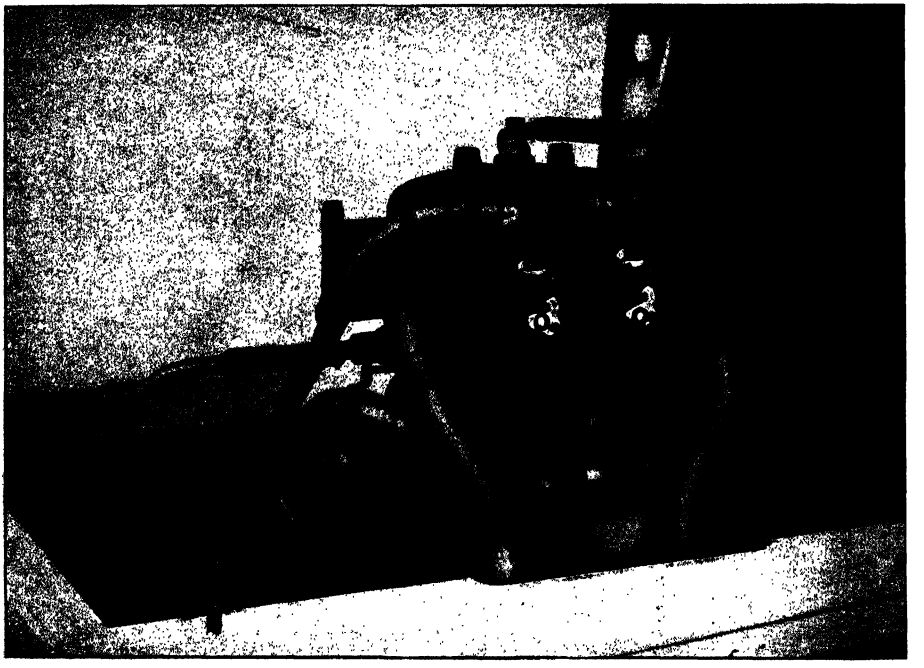


FIG. 4.—THE 10 H.P. TWIN-CYLINDER ENGINE ATTACHED TO CHASSIS.

B. *Inlet pipes.* C. *Inlet valve domes.* D. *Contact breaker.* E. *Sparking plug.* F. *Exhaust valves.* G. *Exhaust pipes.* H. *Half compression lever.* I. *Water pump.* K. *Spring drive of water pump.* L. *Water tank* M. *Lubricating tanks.* N. *Water pipes.* O. *Insulated holders for high tension wires.* P. *Water by-pass for heating carburetter (not shown).* R. *Cock to shut off water from tank.* S. *Hot air pipes to carburetter.*

These segments are fixtures on the bottom or counter-shaft, and can be expanded alternately by a rack and pinion arrangement in the centre of the bottom shaft, and which is worked by a lever on the steering standard. When expanded, the vulcanite fibre with which the bearing surface is

FIG. 5.—SIDE VIEW OF 15 H.P. DE DION CHASSIS.

A. *Water tank filler.* B. *Water tank.* C. *Accumulator box.* D. *Coil.* F. *Water gauge.* G. *Steering column* H. *Clutch pedal.* I. *Change speed lever.* K. *Brake lever.* L. *Gear-box.* M. *Silencer.*

covered, makes firm contact with the inside of one or other of the drums securing this to the bottom shaft. When the change-speed lever on the steering column is in a central position neither pair of segments is expanded, and consequently the cog wheels with their clutch drums are free to revolve on the bottom shaft.

When, however, the lever is pulled backwards, the segments which fit inside the drum attached to the larger free cogwheel, are expanded, and gripping, thereby make the cogwheel in question one with the bottom shaft. The power of the engine is, therefore, communicated through the cogwheel on the top shaft to the cogwheel meshing with this on the bottom shaft

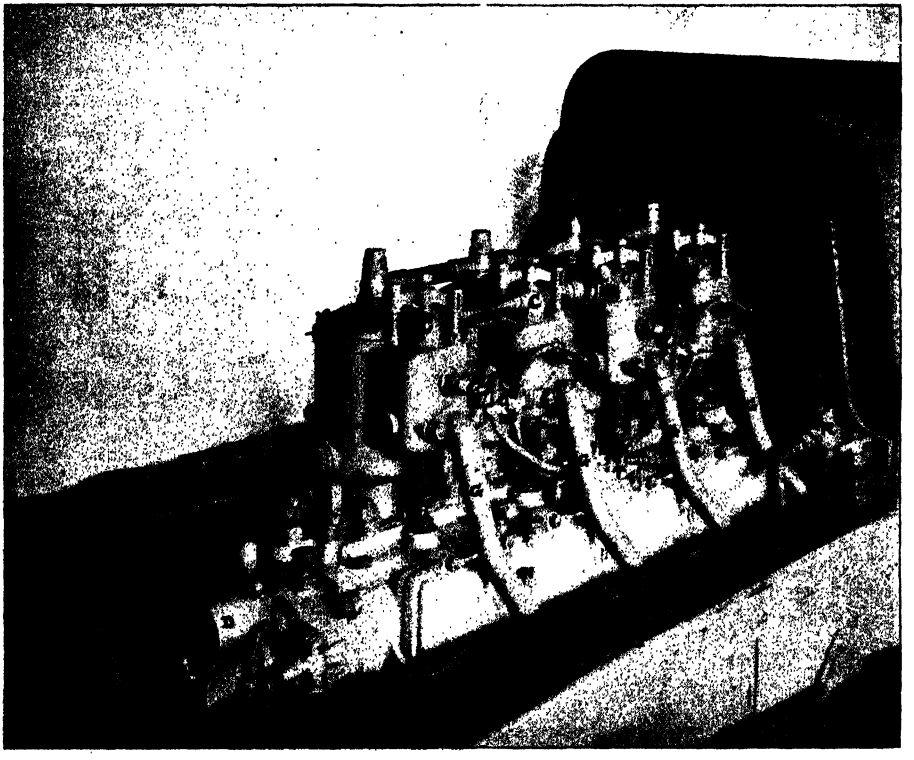


FIG. 6.—THE 15 H.P. ENGINE.

B. *Inlet pipes.* C. *Inlet valve domes.* D. *Contact breaker.* E. *Sparking plugs.* F. *Exhaust valves.* G. *Exhaust pipes.* I. *Water pump.* K. *Spring drive for water pump.* L. *Water tank.* M. *Lubricating tank.* N. *Water pipes.* O. *Insulated holders for high tension wires.* R. *Cock to shut off water from tank.* S. *Vacuum valves to crank chamber.* T. *High tension distributor.* V. *Throttle lever.* W. *Fasteners for bonnet.*

which in turn revolves the bevel wheels, and consequently the road wheels. The low gear is thus brought into action. Similarly, when the lever is pushed forward, the segments in the low-speed drum contract, while at the same time the segments in the high-speed drum expand, and gripping, bring the high gear into operation.

Fig. 2 shows the new three-speed gear as fitted to the later model 6 h.p. cars. The expanding segments in their normal position are inside the boxes H and X^2 giving the high and second speeds respectively. When the low speed is required, a pedal on the footboard is depressed which brings the clutch box G, over the segments formerly in clutch

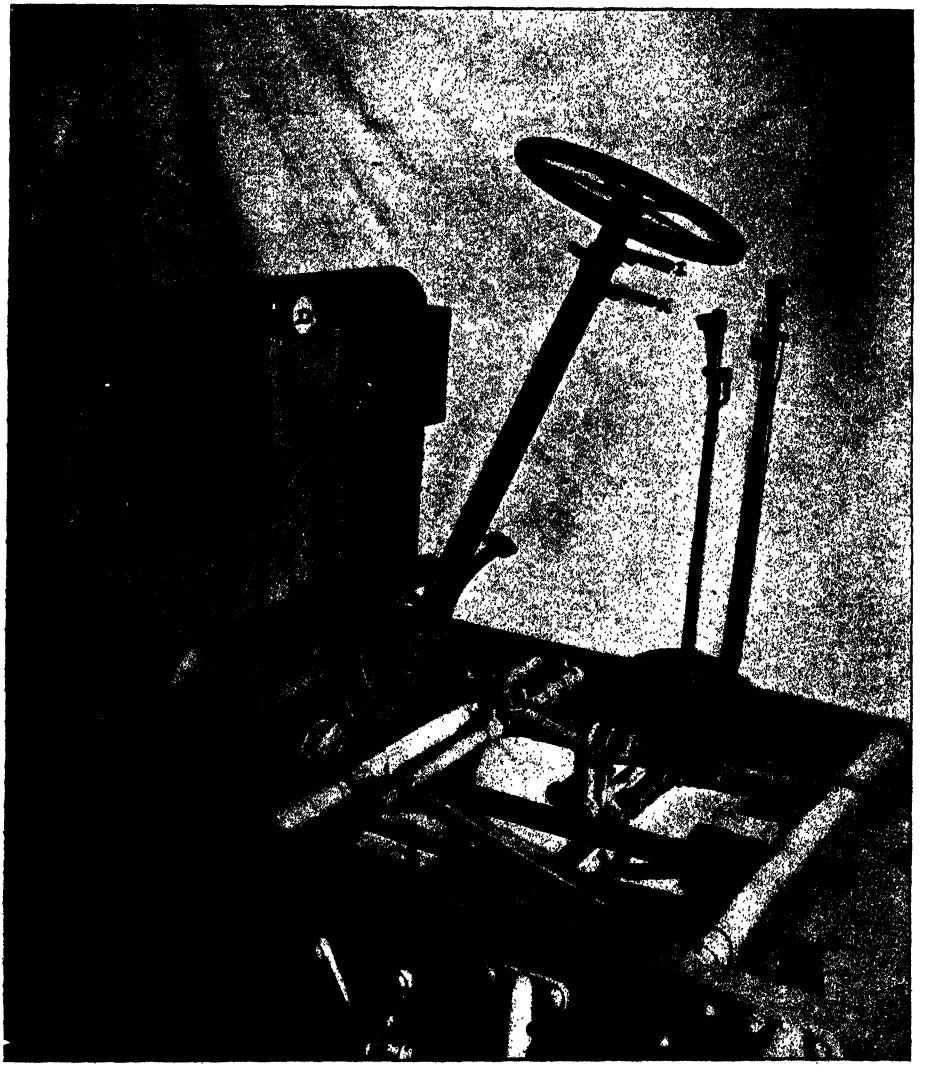


FIG. 7.—THE DASHBOARD AND CONTROLLING LEVERS.

A. *Accumulator box.* B. *Induction coil.* C. *Lubricating pump.* D. *Water gauge.* E. *Foot pedal controlling speed of engine through exhaust, and for applying brake on countershaft.* F. *Pedal brake.* G. *Clutch casing.* I. *Ignition lever.* K. *Air lever.* L. *Change speed lever.* M. *Brake lever.*

box H. Expanding the segments has the effect of conveying the power from the engine through the gear wheels D and D^1, thus giving the low gear. The reverse is brought into action by moving a small lever (fixed at the right side of the car) forward, which moves gear wheel E out of mesh with E^1, and engages an intermediate pinion (not shown) between the two cogwheels D and F^2, thus giving the reverse movement to the latter, and consequently to the driving wheels.

I will now presume we are conversant with the vital working parts of the car, and so let us start the engines. But we must first satisfy ourselves that there is sufficient petrol and water in their respective tanks, and a full clean charge of lubricating oil in the crank case of engine, and sufficient lubricating oil in the gear-box to reach the overflow hole.

FIG 8.—THE NEW DE DION CONTACT BREAKER.

Then agitate the float in the carburetter by means of a small nipple provided (this assists to vaporise the spirit) and before switching on, retard the sparking and advance the mixture levers. Relieve the compression by pressing the button at top of inlet valve dome, and give the engine a few smart turns with the starting handle. Then release the button, switch on the current, and pull the engine by means of the starting handle smartly over the compression stroke (always pull the starting handle upwards) when it will immediately commence to work. Now we are ready to take the driving seat, and proceed on our journey on the lines already suggested.

The 12 h.p. engine is made on precisely the same lines, but has a 100 m/m bore and 120 m/m stroke (similarly the 8 h.p. engine is the same as the 6 h.p. from an illustration point of view). The above types are so generally well known that I think further description is unnecessary, so I will proceed to the latest introduction, the 16 h.p. car. Fig. 6 gives a fair illustration of the *chassis* with near-side wheels removed. It will be observed that the frame itself is made of pressed steel.

The new contact breaker, Fig 8, deserves detailed notice. It will be seen that there is only one contact blade B, and one platinum or nickel pointed screw A, this giving perfect synchronized ignition. C is the cam with four projections on it at equal distances from each other. These raise the rocker D, thus causing the blade B to make contact with A. E is the contact breaker plate, the position of which can be altered by means of rod G. H is the axle upon which E turns, and the latter can be almost instantaneously removed by pulling out the pins F, which are held in position by springs. (Similar contact breakers are now fitted to all models, with varying cams for the different number of cylinders).

To obtain the best results from any motor car, and to keep the cost of repairs and replacements as low as possible, it should be carefully cleaned and thoroughly lubricated regularly. The moving parts of any car which are neglected, or not properly lubricated, will never work satisfactorily, and the car itself will rapidly deteriorate and be a continual source of trouble and expense.

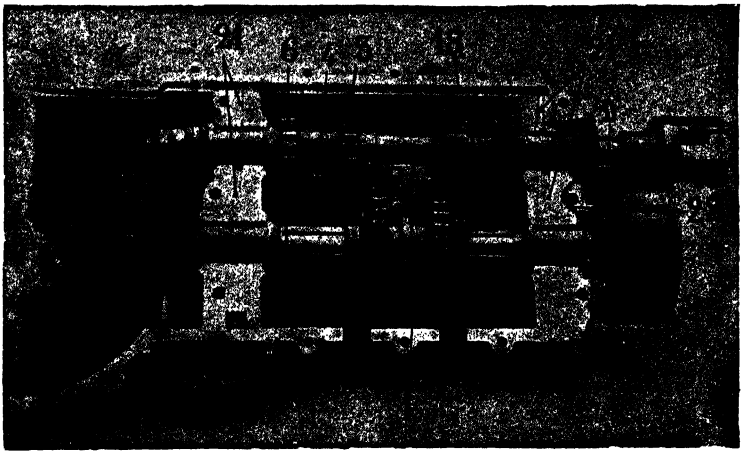


FIG. 9.—SLIDING PINION GEAR AS FITTED TO ALL 1905 PATTERNS OVER 6 H.P.

1. *Collar in which fork for sliding gear engages.* 2. *Low speed gear wheel on countershaft.* 3. *Low speed gear wheel on main shaft which drives* 2. 4 *and* 5. *Intermediate pinions of different sizes for reverse.* 6. *Pinion driving* 4 *and* 5, *and thence* 2, *giving reverse.* 7. *Countershaft.* 8. *Brake drum.* 9. *Bevel driving pinion.* 10. *Bevel wheel attached to differential.* 16. *Pump for circulating lubricating oil.* 18. *Channel along which the lubricating oil is pumped.* 19. *Shaft of lubricating pump through which the oil is forced along* 18. 21. *Lubricating grooves.* 22. *Channel which returns overflow of lubricating oil from main shaft to countershaft bearing.*

The two-cylinder De Dion engines are provided with a special lubricating oil reservoir fitted on the side of the engine, which, when fully charged with lubricating oil, will keep the engine well lubricated for 12 hours, though additional oil may be poured into the crank case earlier, if convenient, to keep it up to within an inch of the top of the gauge.

In all the later pattern De Dion Bouton gears there is an overflow hole placed about one-third of the way from the bottom of the differential case. Before starting out on a ride it is necessary to pour oil into the gear until it begins to overflow from this hole (first having removed the screw plug or spring oil hole cover provided) then replace the plug or spring. A charge of oil every two hours will generally be found sufficient to replace all the oil which finds its way out of the bearings or is used up with the ordinary friction.

Wheels, axles, and all other moving parts, such as steering rods, ignition and mixture levers, brakes, joints, etc., should be regularly lubricated, say every 100 or 200 miles. Without such attention the user must not expect the car to work up to its proper form.

THE RENAULT.

By W. L. McBride.

No car, I think, has had such a period of successful and rapid growth as the Renault, evolved from the results of a youth's hobby, who as a pastime constructed a car. He especially applied himself in devising a method of change-speed and gear drive which should be satisfactory and at the same time do away with the belt drive, at that period so much in vogue.

The success of this method is now well known, and up to the present date the principle is the same, though of course several details, as is always the case in a process of evolution, have been altered and improved. The Renault has obtained the name of being one of the quietest and sweetest running automobiles of the day, as is seen by the repeated increase of production year by year, which in verity is phenomenal. For some years past the firm at Billancourt has been turning out more than 1,000 cars a year, and there is every prospect of the output for the future being greatly increased when the new factory which is in course of construction is complete.

The different types made now are the 8-10 h.p., two-cylinder; 10-14 h.p., two-cylinder; 10-16 h.p., four-cylinder; 14-20 h.p., four-cylinder, and 20-30 h.p., four-cylinder. Each of these cars is made in two types, one for any open tonneau, or double phaeton body, and having side door entrance, the other for a body of the brougham or landaulette type, this latter chassis being of course lengthened and specially reinforced all round to stand the extra weight of such bodies.

The Motor.—The Renault motor has most of the latest features which are considered as up-to-date. The four cylinders are cast in pairs. The crank shaft is carried on three bearings, and is turned out of the solid. If you look when standing in front of the car towards the motor, you will find both inlet and exhaust valves on the right, both being actuated from the same cam-shaft, which is turned out of the solid, thus doing away with split pins and slot keys, which are ever likely to wear, and consequently are a source of never ending trouble. The lift of the inlet valves is so made that they can be varied by hand control from the steering wheel, giving more or less mixture as desired, and thus operating in the way of a throttle, save that the engine becomes much more supple from this arrangement.

Clutch.—The clutch is leather faced on the male cone, and the other part is cut in such a manner as to leave four tongues pointing down towards the centre, which take up the first drive of the car and allow a very gradual progressive picking up of the car.

Lubrication.—Every part of the motor is lubricated with oil of the usual fairly thin consistency by a gear driven pump.

Ignition.—The ignition is obtained by a Simms-Bosch magneto with ordinary sparking plugs, thus doing away completely with accumulators and coil and the consequent wiring. Practically no trouble is given by the ignition apparatus on the Renault, and it requires very little attention.

Carburation.—The new Renault carburetter possesses the advantage of being absolutely automatic, giving as the speed increases or decreases more or less air in such a manner that, when running absolutely at full speed, a minimum amount of petrol is being consumed. It is simple in construction, and dispenses as much as possible with the valves, pistons and flexible valve

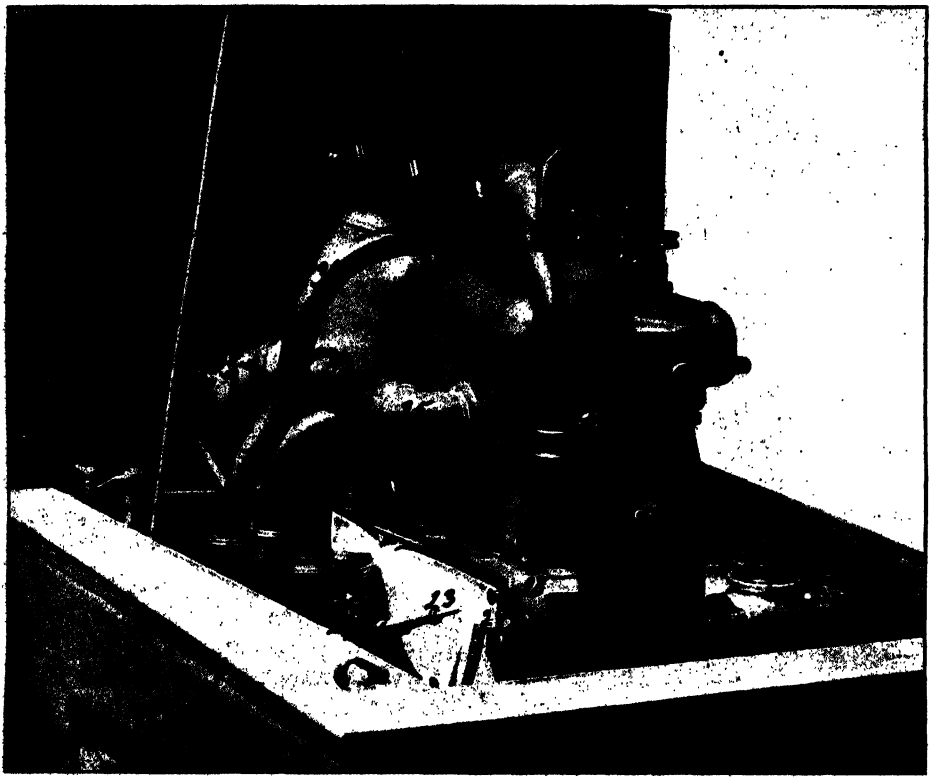


FIG. I.—FRONT VIEW OF RENAULT ENGINE.

15. *Simms-Bosch magneto.* 20. *Compression taps.* 21. *Carburetter.* 23. *Governor rod.* 24. *Float chamber.* 25. *Cold water return from tank to cylinder.* 26. *Current distributor.* 28. *Platinum screw point cover.* 29. *Oil hole and release compression cap.* 30. *Inlet pipe.*

seatings usually employed, and which are often a source of trouble. The air lever which was fitted previously on Renault cars is now entirely done away with, as the carburetter is quite automatic in its mixing function.

Change-Speed.—The change-speed of the Renault is indeed remarkable for its extreme durability. Instead of the usual sliding type, there is an epicyclic and spur sliding action in one movement, which allow the respective

pinions to take up a position exactly opposite to each other before going into mesh. Consequently, when the gears meet, they have the full width of the teeth on which to wear, whereas, as is the case in the ordinary sliding type, the teeth mesh first on the corners, which naturally present a much less surface of metal to each other. Hence the wear is much greater than in a gear of the Renault type. Furthermore, the gear-box in the Renault car is much smaller, and consequently one carries much less weight than is otherwise generally the case. When running on top speed with a Renault the motor drives direct on to the back axle through a cardan shaft, without the intervention of pinions, thus permitting an exceedingly silent running transmission and gear, and entirely suppressing the usual humming noise that emanates from ordinary gear-boxes.

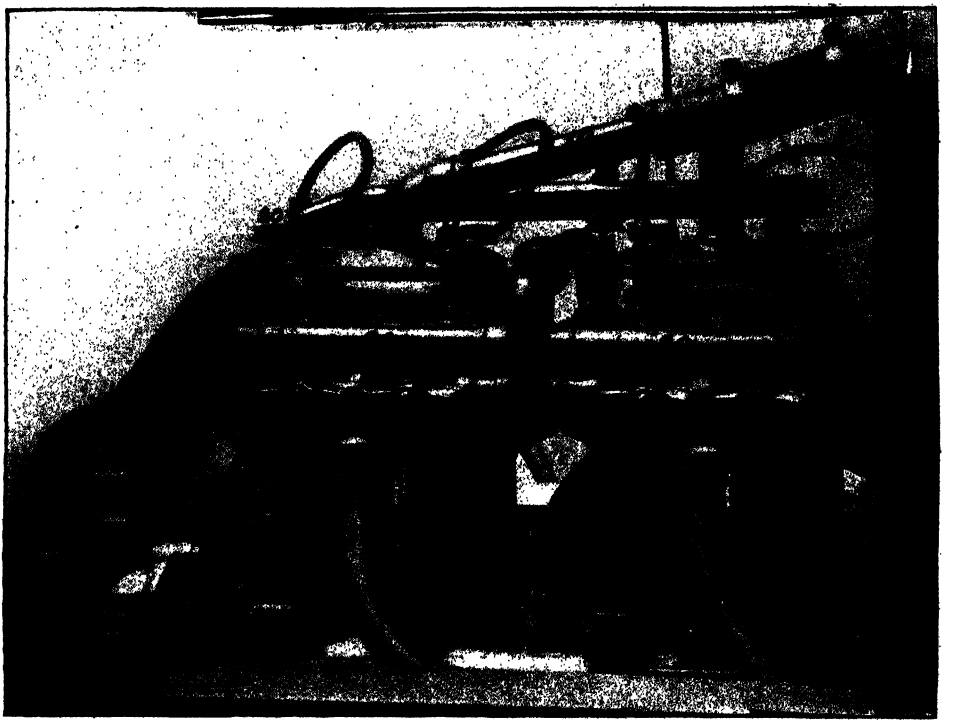


FIG. II.—SIDE VIEW OF RENAULT ENGINE.

15. *Simms-Bosch magneto.* 18. *Inlet valve lift-covers.* 19. *Hot water return tube to tank.* 20. *Compression taps.* 22. *Hot air pipe to carburetter.* 30. *Inlet pipe.* 31. *Exhaust pipe.*

Back Axle.—The back axle of a Renault is built up of two sleeves, through which run the steel live axles, on which turn the wheels. These axles are mounted on ball bearings, there being one on each side of the differential and two between the differential box and wheels on each side, making six in all.

Brakes.—One hand and one foot. The Renault brakes are of the internal expanding type, having cast-iron shoes running in steel drums; there are two on the hubs of the back wheels worked by a hand lever, and one fitted on the gear-box end of the cardan shaft, and fluted round its circumference to allow of quick cooling. This is worked by foot-pedal.

Cooling.—The cooling of the Renault motor is effected by means of the thermo-syphon principle of circulation, that is, by natural means, from the fact that hot water is lighter in density than cold, and consequently rises. The heated water flows into a tank and then passes into a radiator, in which it is chilled. Thence it goes into the motor, where it again heats and rises, thus maintaining a constant circulation. This is worked absolutely without a pump, and hence does away with the troubles, extra weight, and loss in power from the driving of such a pump.

That this circulation is a success cannot be doubted, from the fact that Messrs. Renault Frères are employing it on their cars, and have employed it successfully on all their types since the first motor they

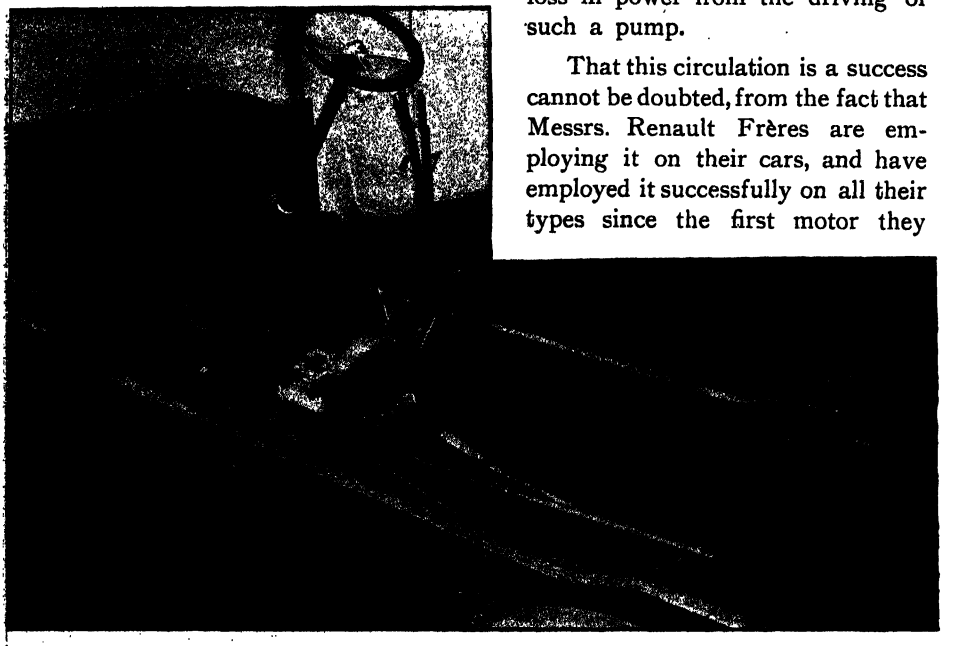


FIG. III.—CHASSIS OF THE 14 H.P. RENAULT.

1. *Female cone of clutch.* 2. *Male cone of clutch.* 3. *Foot brake.* 4. *Clutch pedal.* 5. *Foot brake pedal.* 6. *Accelerator pedal.* 7. *Change-speed lever.* 8. *Hand-brake.* 9. *Variable lift lever to inlet valves.* 10. *Fan on flywheel.* 11. *Rod working oil pump for lubricator.* 12. *Gear-box.* 13. *Cardan shaft.* 14. *Back axle showing differential box and sleeves.*

turned out. The efficiency of this radiation is greatly increased owing to the Renault being fitted with a fan on the flywheel. This, when the motor is started up, creates a suction which, drawing from an almost air-tight bonnet, save just a small portion of the radiators which are exposed, creates a temporary vacuum; air must go to replace this, and consequently goes where it can get most readily, namely, through the exposed portion of the radiators. It then passes out underneath, thus causing an exceedingly rapid circulation of air through and around the water circulating tubes.

Driving.—When the driver is sitting in his seat he has the lever for the change-speed on the right hand side. In operating for the purpose of changing speed, it is necessary to push the lever smartly forward (without touching the button) against the resistance one will feel in sliding the lever on its quadrant, and then, after passing the resistance or notch, pull back smartly and you will find yourself in first speed. Repeat the above operation for second speed. For third or top speed it is only necessary to push the lever forward and it will at once fall into its holding slot.

For changing back, it is necessary, owing to the difference in gear between third and second, to slow down the speed of the car somewhat, so ensuring a sweet and noiseless change, and to depress the button on top of lever, immediately releasing button on freeing of the notch, and then pull back smartly. This will bring you into the second speed notch, and likewise from second to first this operation must be repeated, taking care always to release the button on the lever immediately the notch is freed, so as not to overshoot the gear.

For reversing, be careful to first stop the car completely; then, depressing the clutch to the full extent, pull lever sharply to its full course backward on the quadrant and you will be in a position for reversing.

Care must be taken when operating the brakes to apply them very gradually, as they are very powerful and should not be applied too suddenly.

THE PEUGEOT.

By F. G. Lewin.

It is indeed with great pleasure that at the request of the publishers of this book, I take upon myself the task of trying to help the many prospective automobilists to choose and drive a car suitable to their means and to the purposes for which they require it I have now been associated with the Peugeot motor carriage for some years, and can say that they

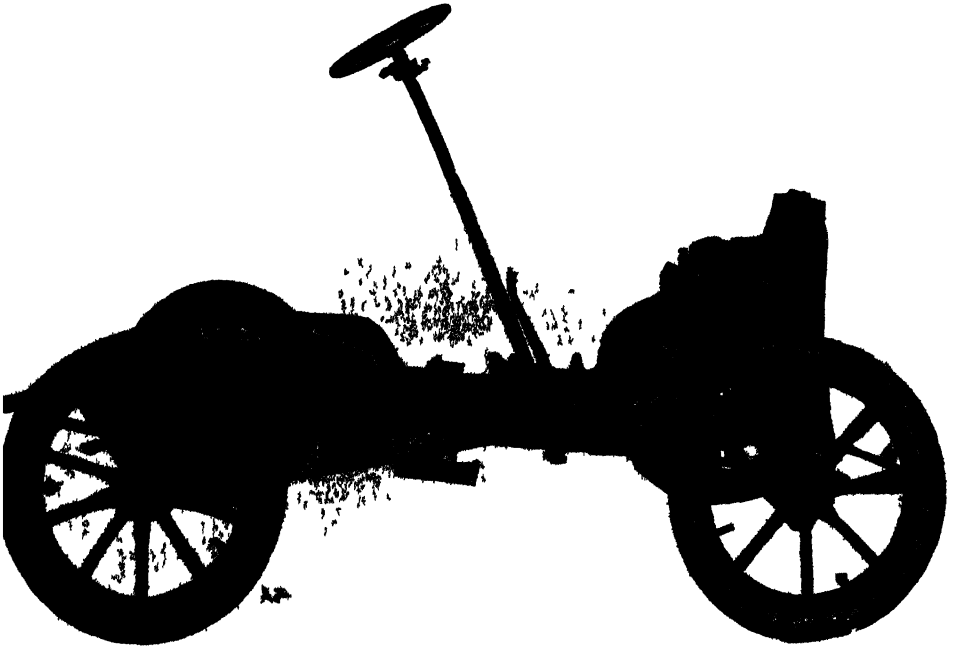


FIG I.—SIDE VIEW OF BABY PEUGEOT CHASSIS.

have justified in every respect the confidence I placed in them at the beginning. In fact, it is a favourite saying of mine that Peugeot carriages will still be running when many of the other makes are on the scrap heap

Before commencing upon the serious part of the article, it will be interesting to note the following particulars respecting the career of this firm. Messrs. Peugeot are well known as one of the largest engineering firms in France. They have been established over a century, and are manufacturers of every conceivable thing in the hardware line, from the little pepper mill (found in every restaurant) to motor cars, agricultural implements and the

gigantic steam mills that may be seen in all parts of the world. With the development of modern requirements they have become manufacturers of chains, cycles, motor cycles and motor cars, and were the manufacturers of the first and original motor car made in France, fitted with the Phœnix engine made by Herr Daimler in Germany. The various works are situated in Valentigny, Beaulieu and Audincourt in the south, and Paris and Lille in the north, over 3,000 workmen being employed. Monsieur Armand Peugeot was presented with the Légion d'Honneur by President Loubet at the Automobile Salon of 1904, held in Paris. and this may be taken as evidence of the high esteem in which the manufactures of Messrs. Peugeot are held by the people of France.

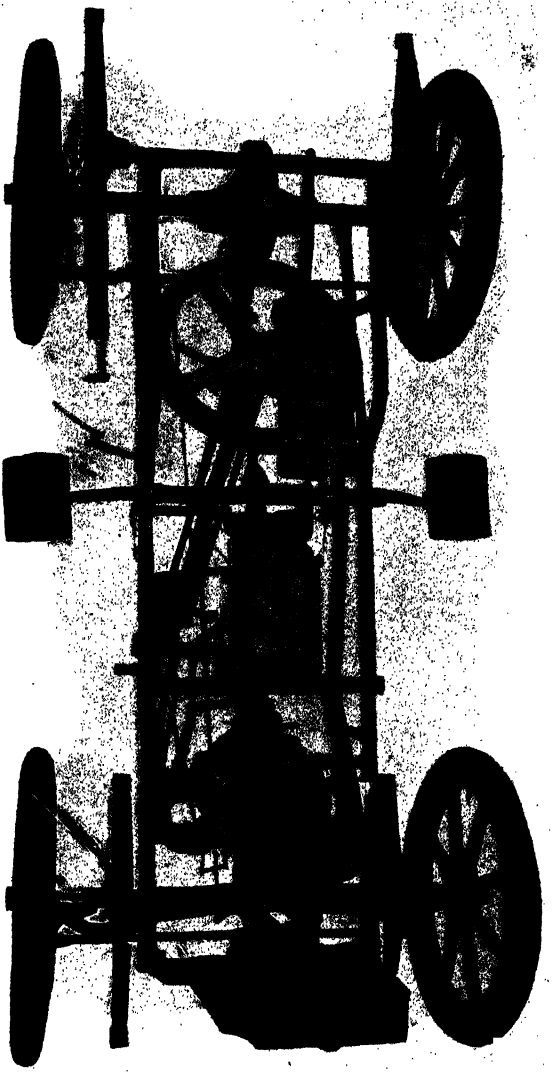


FIG. II.—PLAN OF THE BABY PEUGEOT CHASSIS.

And now to turn to the portion of this article most interesting to our readers. Messrs. Peugeot are making for this year five different types of carriages, of which we give a brief description below, in the order of their horse power and price, and leading off with the little car, the "Baby" Peugeot, now so well known all over the world.

The Baby Peugeot is fitted with a single cylinder 6½ h.p. vertical and water cooled engine in front, high tension ignition, three speeds forward and reverse, and one foot and one hand brake. Artillery wheels are fitted. The weight of the car is about 7 cwt.; length, 7 ft. 3 ins.; width over all, 3 ft. 10 ins.

The 7-9 h.p. model is fitted with a two cylinder vertical engine in front; water cooled by pump and honeycomb radiators; motor governed by ordinary ball governors acting on admission of gas; magneto ignition; automatic

lubrication to all parts of the engine and the gear-box by water pressure. Transmission is by gear, and there are four speeds forward and reverse actuated by one lever; the top speed acting direct on the differential gear. Two brakes (hand and foot), effective backwards or forwards, are fitted. The approximate weight is 10 cwt. (*chassis*); wheel base 6 ft. 3 ins., and width over all 4 ft. 9 ins.

The 10-12 h.p. model is fitted with a two-cylinder vertical engine in front, water cooled by pump and honeycomb radiator with fan. Rotary magneto or high tension ignition is employed, and all the valves are mechanically operated and are interchangeable. The ball governors work on the inlet pipe, with a retarding lever on the steering pillar, to be worked

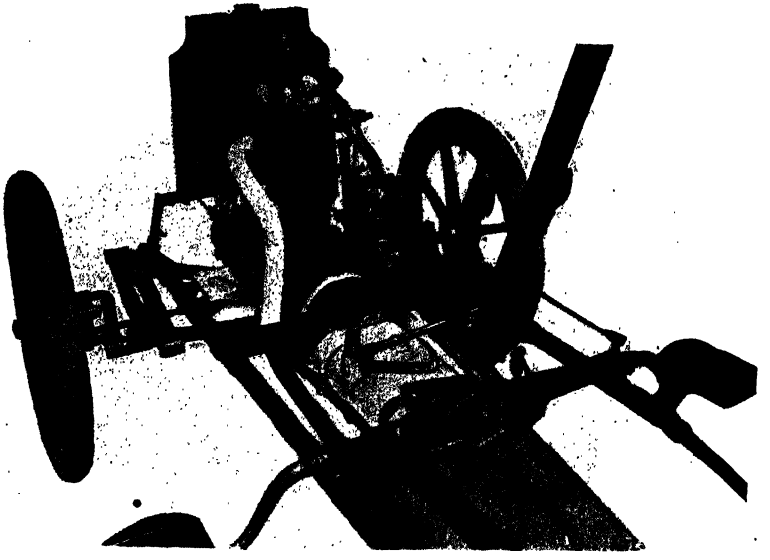


FIG. III.—FORE-PART OF THE BABY PEUGEOT CHASSIS.

by the hand. There are four speeds, forward and reverse, worked by one lever, the fourth speed acting direct on the differential. Two hand-brakes acting backwards and forwards are fitted. The chassis is of wood, armoured with steel. The weight of the chassis is 12½ cwt. The width is 5 ft., and the length 10 ft. 2 ins. over all.

The 12-16 h.p. model is fitted with a four-cylinder vertical engine, water cooled by pump and honeycomb radiators with fan. All the valves are mechanically operated, as also is the lubrication. In other respects this carriage is similar to the 10-12 h.p. machine, but a detailed description of the engine is given below. Messrs. Peugeot are also making this year 18-24, 25-32 and 30-40 h.p. models. The above carriages are all fitted with the Truffault springs, and are all upholstered in leather.

Generally to the 12-16 h.p. models two forms of ignition are fitted, viz., high tension through the ordinary coil, and low tension magneto. There has been a great deal of controversy about high tension ignition, but I have usually found that most of the troubles that occur in this method are very

often traceable to the coil, therefore I think that the low tension magneto which does away with that part of the apparatus is preferable. One complaint against magneto in days gone by was that you had to rotate the engine very fast before you could get an explosion. On fitting the rotary magneto this trouble was immediately done away with. The engine should start on half a turn if the carburation is right.

With regard to the ignition. There is a small lever to advance and retard this, operated above the steering wheel, the system of advancing being worked by a movable cam with a diagonal face. This operates on the inlet valve cam-shaft. Each cylinder can be tested by means of a little "tell-tale" on the top of the engine in the form of a "cut-out." The commutator, instead of being chain driven as heretofore, is now gear driven on the inlet valve shaft, and is easy to get at should necessity arise.

Messrs. Peugeot are fitting on their large power cars a carburetter of new type, which is fitted with hot water jacket and hot air chamber. I never find any difficulty in starting when using this new carburetter, provided all the other parts of the machine are in order. The automatic air inlet through which the air passes when the engine is running, and which opens out on the revolutions of the motor increasing is enclosed in a case from which all dirt is excluded. The jet in the carburetter has four holes operated on by the governor, and as the engine increases in speed, if it has no load, one jet is closed up, and as the load is put on, or as the car moves, the other holes automatically open. There is also an auxiliary air inlet operated from the dashboard.

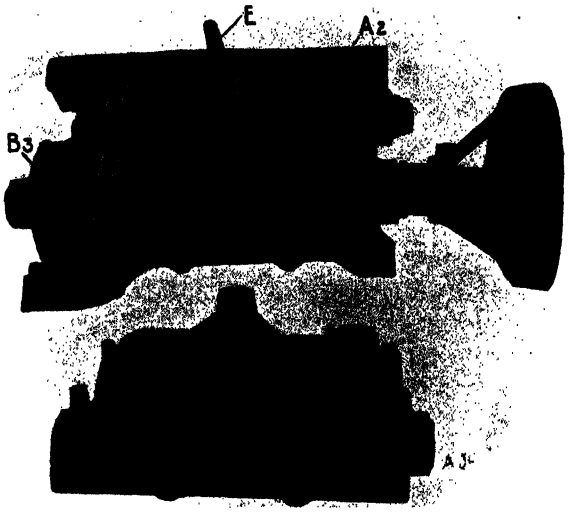


FIG. IV.—CHANGE-SPEED GEAR OF THE BABY PEUGEOT.

The lubrication of the gear-box bearings, which heretofore has been a difficult problem to solve, is done now by means of a drip feed lubricator from the dash, which runs into the channel between the two halves of the gear-box, and as it approaches the "brasses" it is carried by a chain ring round them and effectually keeps them lubricated; and thus the trouble of worn-out "brasses" is now very much minimised. In the majority of the Peugeot cars lubrication is effected by water pressure off the ordinary circulation. Extra pump lubrication is, however, fitted on the dash in order to fill up the crank chamber should it be emptied from any cause.

Water circulation is effected by means of a gear-driven pump, driven off the exhaust cam-shaft. A high speed fan is provided just inside the radiator, and this has been found in practice to be the best and most effective method of keeping the engine cool. All the governor, magneto and pump gear is enclosed in an oil case carried just behind the radiator. Ball bearings are almost universally used—sprocket shafts being now run on this system; and after long experience this has been found to be the most satisfactory method.

The spring of the latest Peugeot cars is improved by the adoption in the larger cars of the Truffault suspension. The back wheel brakes are all internal, thus shielding them from the evil effects of dirt and grit. Special attention has been paid to the covering in of the cars underneath, and the cover is now taken right back to the gear-box.

DRIVING HINTS.

In giving a few practical hints on the treatment and driving of Peugeot carriages, I shall only deal with the car fitted with 12-16 h.p. engine, as that is the most popular type, and of which the largest number have been sold, although many of my remarks will apply to the other models as well. It is impossible, in the space at my disposal, to refer in detail to all of them.

The maximum speed of the 12-16 h.p. Peugeot is about 40 miles per hour, the manufacturers aiming at silence and reliability in preference to the attainment of very great speed. Magneto and high tension ignition are provided, but it will be found that the first-mentioned is usually all that is required.

In starting the Peugeot car it is necessary to see that the switch is on, connecting up whichever ignition you intend using. Of course, it will be desirable, where it is possible to advance your magneto, to see that the lever on the control wheel is in retard position. This will be found in the majority of cases on the right, just by the throttle lever.

Put your throttle lever to the left (thus giving the full amount of gas to start) and the magneto lever to the right (bringing back your time of firing to the last point). The carburetter being of the "float feed type," it can easily be ascertained whether you have petrol or not by moving the float spindle up and down. The action of moving this float spindle should be similar to that of drawing a stick through water—you will feel the float resisting the petrol.

Where no "half-compression" is fitted it will be sometimes necessary to give a sharp turn when attempting to start the engine. If, as sometimes happens, the engine does not start, do not put it down to the magneto. Open your compression taps and put a little petrol down—a few drops will suffice. Or it may be that the air inlet is working stiffly; but if you manage to get the engine going the air inlet will mechanically operate itself.

Having started your engine, bring your throttle lever back to normal position, advance your magneto—the central position on the quadrant will generally suffice for both. When you wish to get your car on the move, depress your clutch pedal, bring your first speed (which is the lowest speed) in, then let the clutch rise gently, and your car will proceed to move. With each alteration of speed by gear the clutch pedal MUST be depressed; but when you attain the top speed the Peugeot car is controlled from the steering wheel by the opening or closing of the throttle, and by the use of the foot accelerator pedal.

There will be found two pedals—one of which we have described as working the clutch. The other is the brake pedal acting on the brake on the countershaft. Apart from the foot brake there is a lever which operates both internal brakes on the back wheels.

In bringing your car to a standstill the same operation of depressing the clutch must be performed, and the speed lever put into the neutral notch, the side brake put on for security, the throttle brought back to the right, and the spark retarded. If it is necessary to stop the engine, simply turn off the switch.

There are many hints which can be given as to the drip feed lubrication. It will of course be understood that the lubrication of the gear-box does not require such frequent dripping as does the engine.

With the water-fed lubricator it is easy to see by the amount of water in the gauge whether you have come to the end of your lubricating oil. To fill the lubricator it will be necessary to let the water out; turn the two-way cock to allow this. When all the water is out of the lubricator you can fill it with oil, turn the cock to its right position, and the water will start flowing through again directly the pump works; and according to the speed of the engine so will the lubrication be.

You cannot learn to drive "by the book," but if the novice will learn to drive without using his brakes too much he will save his machine and his tyres.