THE BOOK OF THE

DOUGLAS

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THE BOOK OF THE DOUGLAS

A COMPLETE GUIDE FOR OWNERS AND PROSPECTIVE PURCHASERS OF DOUGLAS MOTOR-CYCLES

BY
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DEALING WITH EVERY PHASE OF THE SUBJECT, INCLUDING CHAPTERS ON DRIVING, TOURING, LEGAL MATTERS, INSURANCE, TRACING FAULTS, AND OVERHAULING

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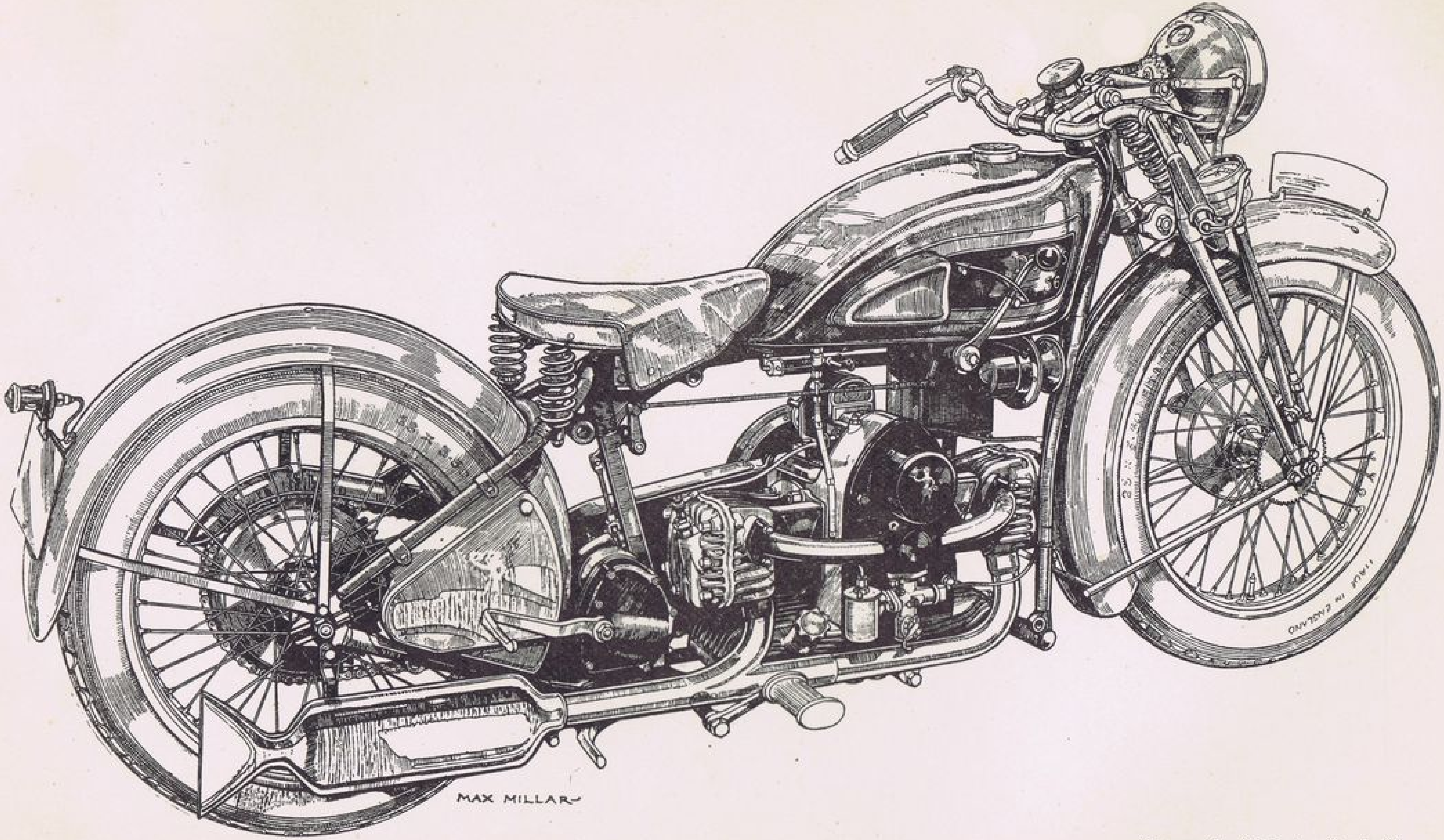


(*Frontispiece*) (*From the " Motor-Cycle "*)

THE STRIKINGLY ORIGINAL 500 C.C. AND 600 C.C. DOUGLAS

BOOK OF THE DOUGLAS

CHAPTER I

THE VARIOUS DOUGLAS MACHINES

For about 20 years the Douglas horizontally-opposed twin cylinder engine has stood as a concrete example of efficient multi-cylinder power unit design. The fundamental principle of opposing the cylinders at an angle of 180° has been proved correct in the most convincing manner, and, although during the subsequent years various alterations and modifications have been made, the basic principle of the engine has remained unchanged.

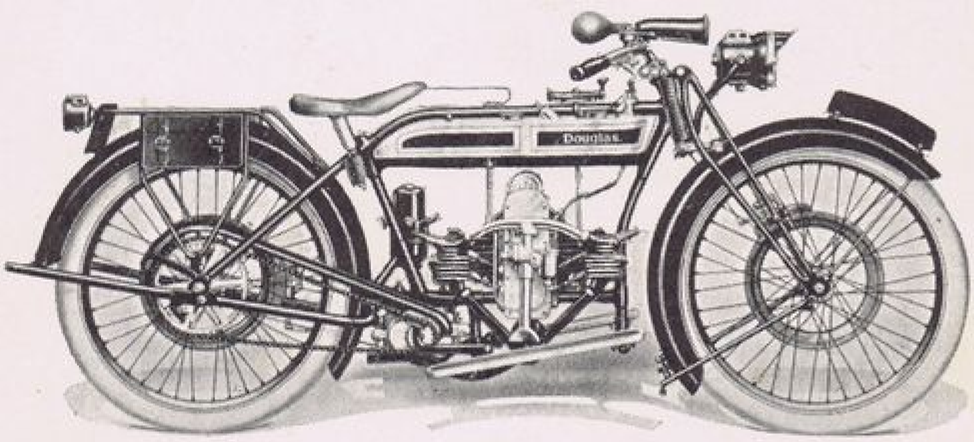


Fig. 1.—The First All-chain Drive Douglas Produced in 1925

There are indeed few, if any, other motor-cycle manufacturers who can truthfully claim to have evolved a type of machine and an engine whose basic design in the first instance was of such outstanding merit that it has remained substantially unaltered except in detail since its inception. The Douglas of the motor-cycle world may indeed be likened to the Avro of the aircraft world. The attributes of sound design are simplicity and permanence, and the first Douglas had both.

Historical. The first Douglas motor-cycles were produced round about 1907, and their even torque and vibrationless running soon resulted in their attaining universal popularity in spite of the rather crude methods of engine installation, transmission, and springing existing at that period. The absence of a clutch on a low compression flat twin in those early days of motor-cycling, was not nearly such a drawback as in the case of the numerous high compression singles of other firms. The process of evolution rapidly continued, and with increased demand the Bristol factory was steadily enlarged. From 1923 to 1925 the output was confined almost exclusively to the production of 350 c.c. belt-driven models with countershaft gear-boxes, which gave remarkable service, and many of the old veterans are still in use to-day. The same years saw the introduction of experimental overhead valve racing machines which have done perhaps more than anything

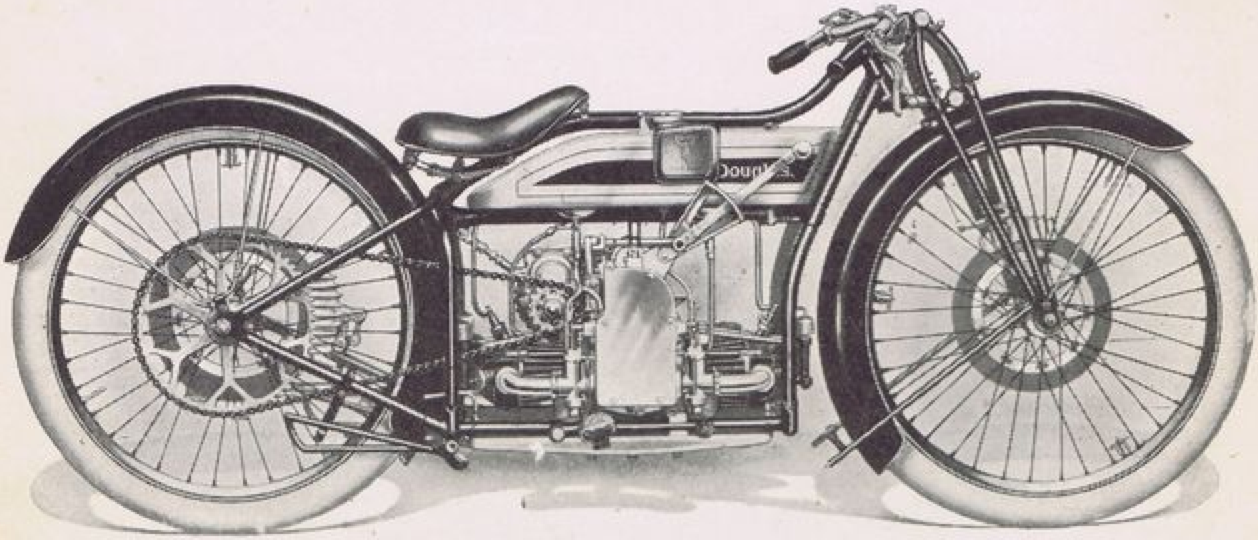


Fig. 2.—1923-4 I.O.M. Model with Overhead Valves

This model, officially known as Model R.A.23, was a special speed mount, and was a worthy forerunner of the present-day Douglas Speed models which are not unlike this mount in many respects

else towards " improving the breed." These machines were raced in the Isle of Man with much success, and some of their engines were credited with attaining some 6,000 revs. per minute without " blowing up "; this was at the time a phenomenal performance, and aroused widespread interest. In the year 1923 F. W. Dixon, mounted on one of these models, was victorious in the sidecar T.T. races, whilst the Senior race was won by Tom Sheard. It is interesting and pleasant to note that the former rider, whose name is a household word where engine tuning is concerned, is now engaged by Douglas Motors in a responsible position. Ever since the Douglas I.O.M. racers appeared the Douglas firm has wisely devoted every year much of its time and money towards furthering the cause of racing, and Douglas riders have participated in all the more important national and international contests. No person of sound experience in motor engineering nowadays would doubt for a single moment the value of racing, especially road racing, from the point of view of testing materials and trying out new designs with a view to increasing the performance and structural strength of the ordinary machines sold to the general public. It is a significant fact that nearly all the more successful motor-cycle manufacturers are, or have been, ardent devotees of racing, and recognize its commercial value.

The year 1925 also saw the beginning of the total eclipse of belt transmission, and the first all-chain driven Douglas arrived. Soon afterwards the belt lost even its role of secondary transmission. Chain drive had, of course, previously been used on the racing models, but not on the popular production models. During the following year the E.W. Douglas made its debut at Olympia, and the Douglas showed signs of remarkable all-round improvement, especially as regards appearance, but although the type was ordered in thousands it undeniably did not give such entire satisfaction to many sporting and hard riders as did the later models produced in 1927, when the workmanship was far superior. In 1927 a 4·94 h.p. Douglas with dry sump lubrication and dual carburettors lapped Brooklands at a speed of over 103 m.p.h., and numerous world and class records were subsequently established. In Sept., 1929, a Douglas motor-cycle attained on Southport sands a speed of no less than 110·74 m.p.h., a record performance. Since then progress has been exceedingly rapid, and the Bristol factory now employs approximately 2,000 men working at full capacity. In 1927 two rather serious fires took place in the works, but fortunately the experimental department and the bulk of the new plant were saved from destruction. Production was not seriously impaired, and ten models were offered to the public—five side-valve models and five overhead valve.

Present Tendency. Last year nine models were listed—four side valve and five overhead valve. The most popular of these was model B.29, a 350 c.c. s.v. machine with dry sump lubrication, and embodying many new improvements, including saddle tank, new frame to house it, improved gear change (fixed to frame) and better silencing. In the year now closed the famous 500 c.c. dirt track racer came into being. So satisfactory has the B.29 been found on the road that this year the manufacturers have decided to adopt the policy of "fewer but better models." There are still nine models available, but there are really only six distinct types, for in three instances it is purely the question of an additional 100 c.c. engine capacity. Further, of these six types two are speed models. The 350 c.c. class is represented by only two machines, both of which have side-valve engines, and they are developments of last year's B.29 model. The other two popular production models include a standard 600 c.c. s.v. model with an entirely redesigned engine and two sports versions of this model with a similar engine of 500 and 600 c.c. It will thus be seen from the foregoing that overhead valve engines have been dropped as far as the standard production models are concerned, and are utilized only in the case of the special speed models. The latter are further developments based on last year's dirt track machine, which practically monopolized the world's leading dirt-track markets, and they are expected to prove all-conquering during the summer months when dirt-track racing is again in full swing. The new 500 c.c. and 600 c.c. Douglas power units are immensely

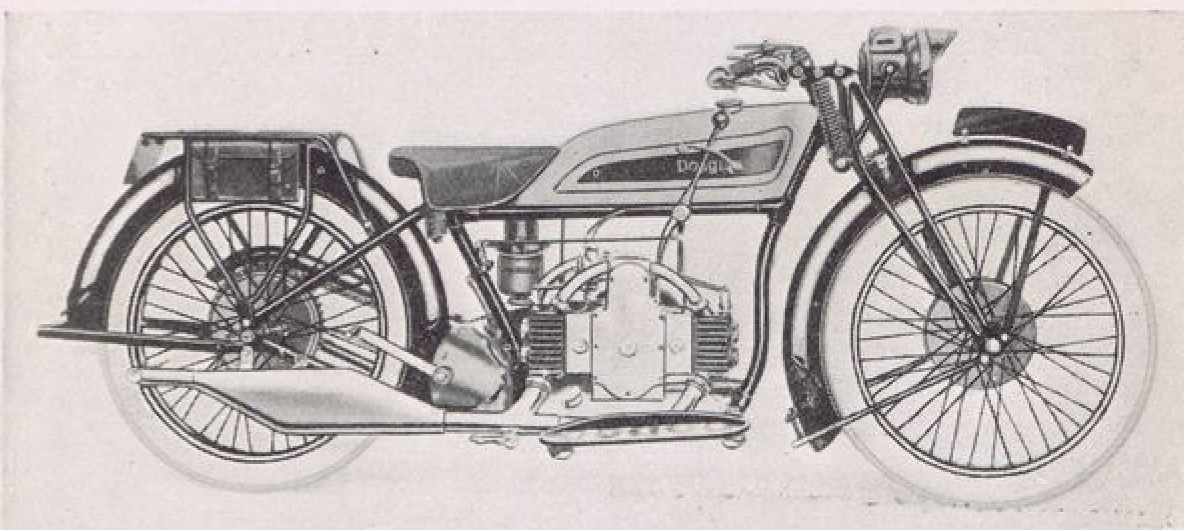


FIG. 3.—LAST YEAR'S SUCCESSFUL B.29 MACHINE ON WHICH THE 1930 350 C.C. DOUGLASES ARE MODELLED

powerful and very fast with exceptional acceleration, and *accessibility* is their keynote as will be understood later.

A point of more than ordinary interest in connection with the Douglas programme this year is the fact that overhead valve engines are now installed only in the four special speed models as already mentioned. The reason for this is undoubtedly because with the present high degree of flexibility, power, smooth running, and acceleration obtainable with a s.v. flat twin engine the extra complication and expense incurred by the O.H.V. engine is not justified except for record breaking purposes, where speeds over 80 m.p.h. are commonplace, crashing acceleration is wanted, and where ease of dismantling and low upkeep costs are not of primary importance. It need not be imagined, however, that the sportsmen will find the new s.v. engines " wooly." They are designed to satisfy the most unmerciful of riders. The new 500 c.c. and 600 c.c. flat twins are all a tough proposition to beat on the straight and still more so on give-and-take roads. An engine capacity of

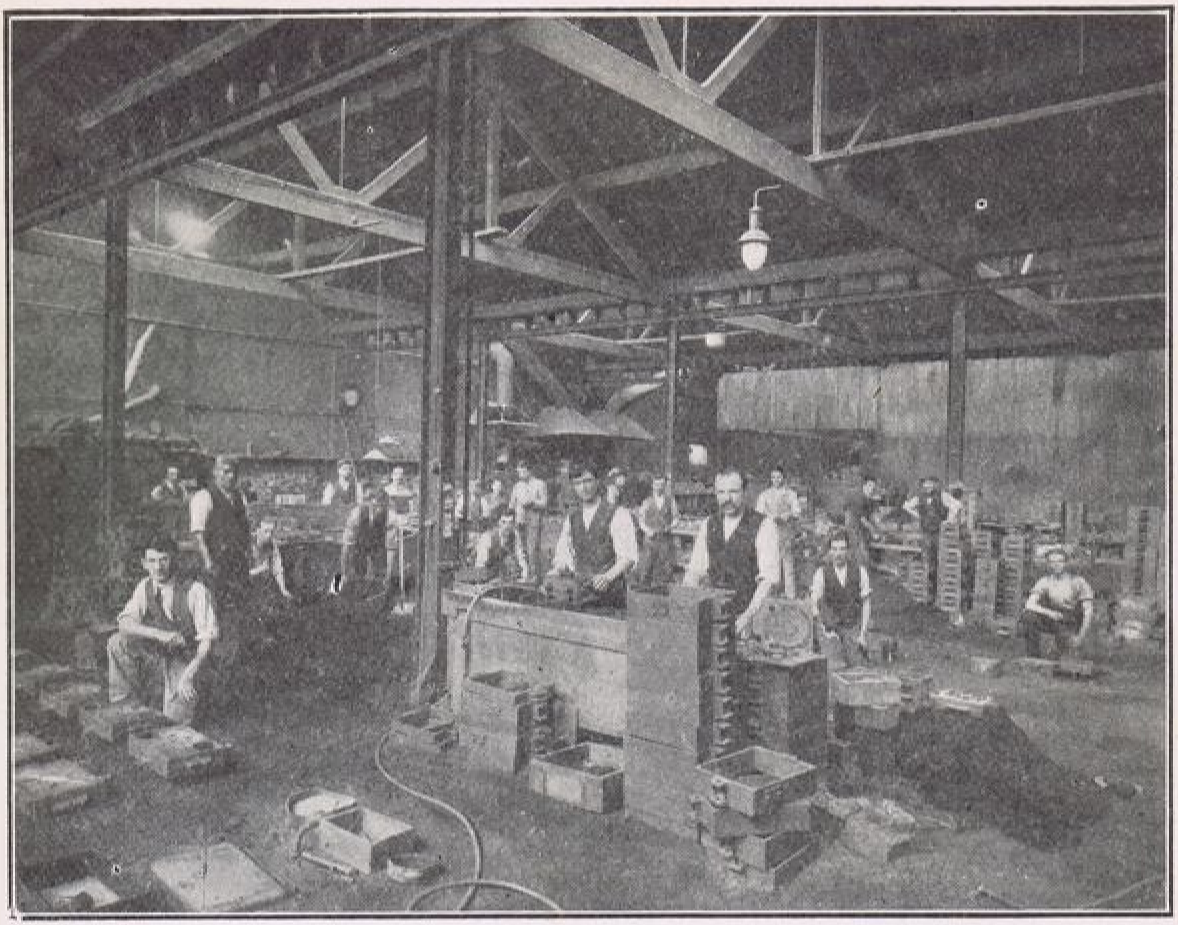
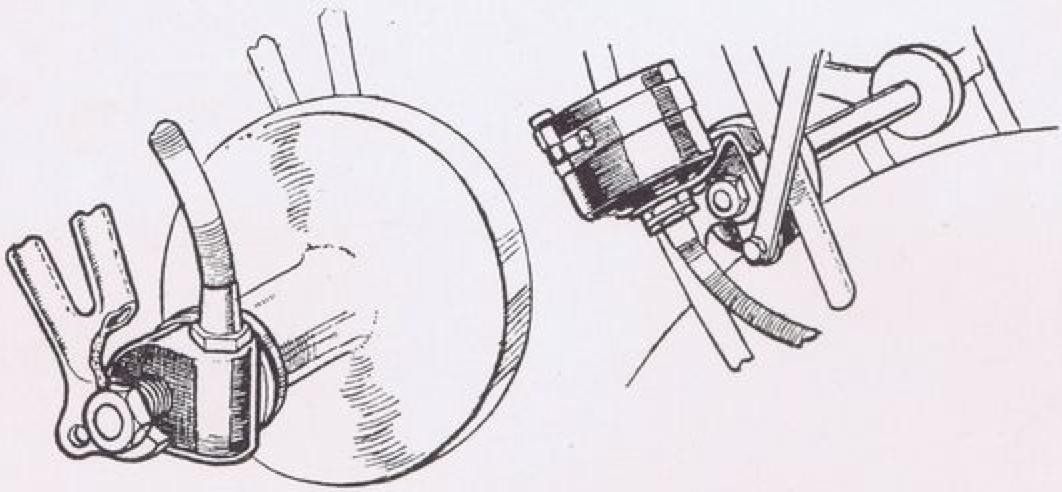


Fig. 4.—The Douglas Foundry where the Castings are Made

Fig. 5.—A Bay in the Machine Shops

500 c.c. which, of course, means 5 h.p. according to A.C.U. rating, is sufficient to allow the rider at all times to have a large reserve of power in hand, so that the engine is seldom working at anything approaching its maximum. The 350 c.c. models are also capable of really hard going, and with a sidecar if desired, but the 500 c.c. and 600 c.c. mounts are recommended for the high-speed long-distance sidecar tourist. Before dealing with the individual machines and specifications a summary of the more important recent Douglas improvements applicable to all the s.v. models is given as follows—



(*From "The Motor-Cycle.*")

FIG. 6.—THE NEW DOUGLAS SPEEDOMETER FITTED TO LOWER FORK SPINDLES WITH ENCLOSED DRIVE

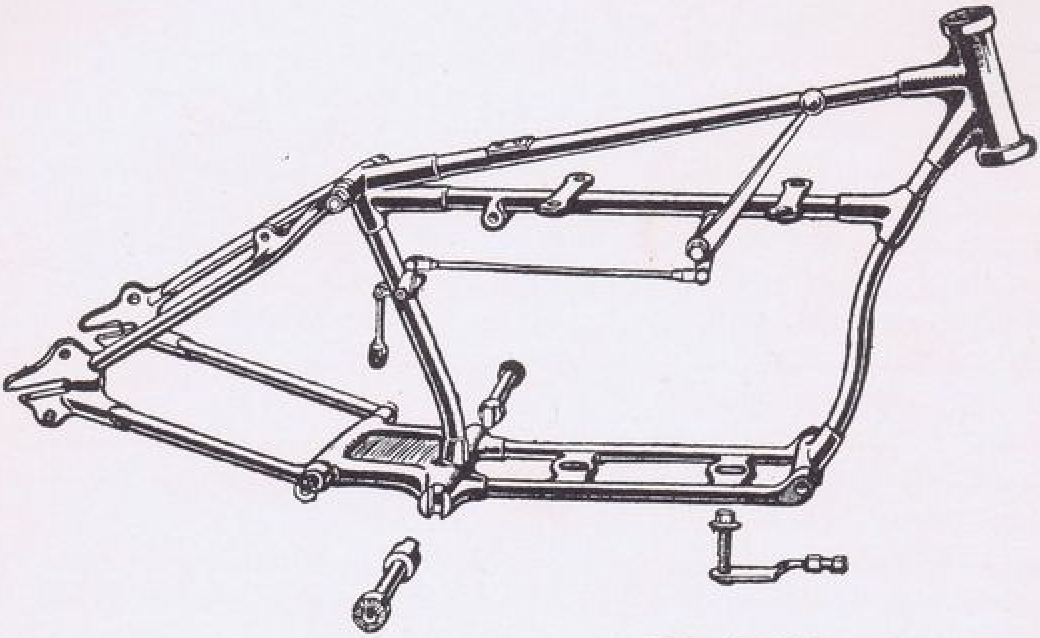
SOME NEW FEATURES IN DESIGN

Saddle Tanks. Those to whom the shape and appearance of the petrol tank is all-important will be pleased to note that handsome saddle tanks constructed of welded steel and of very graceful contour are now fitted as standard to all the new 350 c.c., 500 c.c., and 600 c.c. S.V. models, with fuel capacities of 2½ and 3 galls. respectively. Tank mounted speedometers have *not* been adopted. (See Fig. 6.)

Freedom from road shocks is ensured by the fitting of rubber pads which completely " insulate " the tank fıom the frame, and damps out all vibration.

New Frames. In order to satisfactorily house the new tanks it has been necessary to remodel the frames, and the modified version is shown in Fig. 7. It will be seen that the lines are distinctly pleasing. The bolted joint between the chain stays and gear-box bracket is now made solid, and footrest hangers are dogged to the ends of the lugs. The gear-box is a *fixture* in the frame, primary chain adjustment involving the displacement of the engine itself.

This is not the serious proposition that one might at first imagine. It is necessary merely to unslack two bolts and give a turn or two to the adjusting screw when it will be found that the unit slides bodily along the pair of bottom rails. You may ask, "What about the exhaust system, chain cases, etc.?" The answer is that these automatically look after themselves. The exhaust pipe telescopes into the silencer, the chain guards also slide! This is a strikingly original idea, and in practice functions excellently. Its chief merits are, of course, the fact that the gear and brake controls are quite undisturbed when effecting primary



(*From the "Motor-Cycle"*)

FIG. 7.—THE FRAME EMPLOYED ON THE 3½ H.P. MODELS

chain adjustment. Serrated lugs are securely brazed for attaching pillion footrests.

On the high-powered Douglas an improved duplex cradle frame of the pattern adopted last year houses the power units, and primary chain adjustment is effected as in the case of the 350 c.c. machines. Taper roller bearings are used in the steering head.

New Forks. On standard sports models an entirely new type of front forks are fitted (see Fig. 31). The two blades seen from the side constitute a symmetrical form. They have been based largely on experience and data collected during the past season's dirt-track racing (who said this was useless?), and have a central compression spacing with a guiding sleeve running down the centre. Sensitiveness of control and sufficient castor action to give inherent stability are the principal characteristics of the new pattern, and they also decisively enhance the handsome appearance of the machines.

Improved Gear Change. No longer is the old type of gear-control mounted on *top* of the tank prior to 1929 employed. The system has been substituted on all mounts by the more popular and undoubtedly more convenient gate-change method placed at the *side* of the tank. The lever pivots on a lug fixed to the lower tank rail and the bush is renewable. Three-speed gears with patent flywheel clutch are specified for all machines, but in the case of the D.T.R. models a clutch is not included.

Chromium Plating. This year, in common with most other motor-cycle manufacturers, Douglas Motors, Ltd., have decided to abolish the usual nickel-plated finish in favour of a chromium finish for bright parts, which was reflected in all its glory on practically every stand at last year's Olympia exhibition, and which is destined to last, and will save riders a vast amount of trouble in the cleaning of their machines, and help to reduce annual depreciation materially. The advent of chromium plating, although from a production point of view, perhaps not at present the cheapest method of finishing the bright parts owing to the cost of the metal, will no doubt be enthusiastically received by all riders who value the appearance of their machines and dislike cleaning them.

Petrol tanks with the exception of that fitted to the cheapest model L.3 are chromium plated in addition to the usual hitherto nickel-plated items.

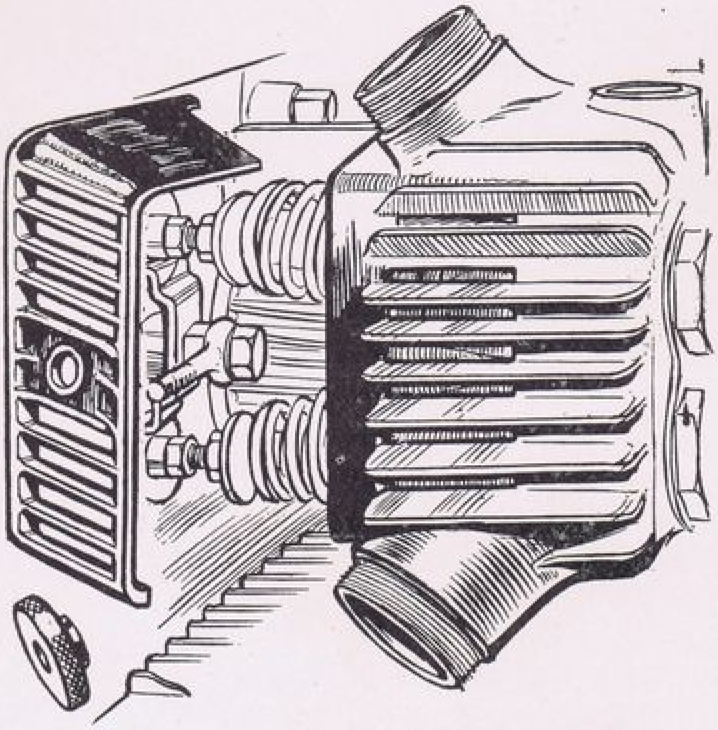
Engine Improvements. Apart altogether from the fact that the 500 c.c. and 600 c.c. engines have been for practical purposes redesigned, there are also numerous detail improvements to be found throughout the side-valve range.

The cylinders, which all have improved and modified detachable heads which can be removed for decarbonization without disturbing the valves, are finished in dull black on the "three-fifties," and dull plated on the "five-hundreds" and "six-hundreds."

Flange fitting Amal carburettors with throttle stops are now used, and the petrol systems include new cork-seated petrol taps. The induction manifold on the new engines is still further improved having regard to the heating of gas entering the cylinders, and it is actually integral with the timing case cover. Special metallic induction pipe joints prevent any possibility of air leaks on 350 c.c. engines, which are fatal to the good functioning of a horizontal twin.

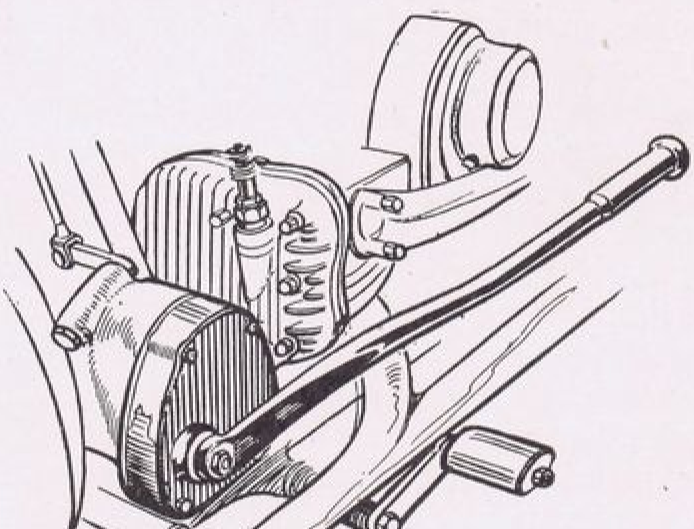
The timing gear is now more sturdy, and is made independent of the timing case cover, so that the former does not run amock when the latter is removed, as happens so often on some machines.

Improved valve tappets and guides of oil retaining pattern are to be found, and the valve gear is protected and silenced by



(*From the "Motor-Cycle"*)

FIG. 8.—THE NEAT SLOTTED VALVE COVERS ON THE 350 C.C. MODELS



(*From the "Motor-Cycle"*)

FIG. 9.—THE NEW OPTIONAL HAND STARTER

well-designed covers. Aluminium alloy 4-ring pistons are used on this year's 500 c.c. and 600 c.c. models.

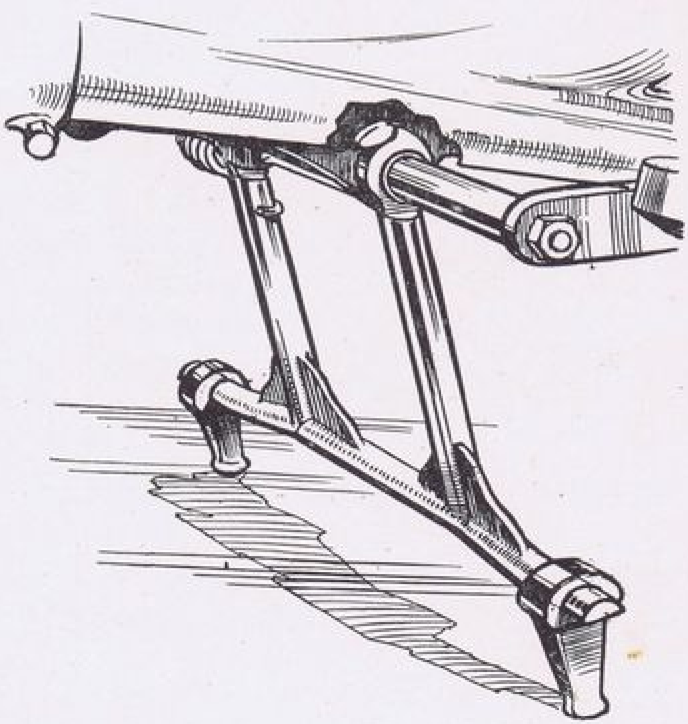
Hand Starter. A new form of engine starting is now obtainable. A system that has been developed in connection with certain aircraft engines where kick starters are unheard of is employed. The device which is an optional fitting on all models and illustrated in Fig. 9, takes the form of a pull-up lever much resembling the " joystick " or control column of an areoplane, and undoubtedly it will thus be nick-named. One complete pull-up rotates the engine through about one and a quarter revolutions (equivalent to two compressions), which is sufficient if the engine be first put on compression to effect an instantaneous start. The alternative starting device is, of course, the orthodox kick-starter. In both cases the starter ratchet mechanism is *within* the gear-box housing.

Dry Sump Lubrication. All Douglas S.V. engines are lubricated on the well-known dry sump principle, which last year was tried out with unqualified success on model B.29. The latest D.S. lubrication lay-out is the essence of simplicity and highly efficient. Untidiness due to exterior oil piping is abolished, and even oil distribution and low consumption are notable features. This system is fully illustrated and explained on pages 17 and 75. There is no separate oil tank other than the aluminium oil reservoir to which the engine proper is bolted. The fitting of the oil reservoir below the engine has the advantage of keeping the centre of gravity of the machine low in spite of the saddle tank above the top tube. It should be mentioned that the present pump embodied in the lubrication system attends to the proper lubrication of valves, front chain, clutch, etc., in addition to the working parts of the engine.

Central Stands. Ingenious spring-up stands, located immediately in front of and just below the gear-box, replace the old back mudguard type. The new stands provide a normal lift of approximately three-quarters of an inch. When, however, it is necessary to carry out wheel or tyre repairs, a sufficient lift to enable the wheel to be drawn right out is provided by attaching two small extension feet, as shown in Fig. 10. These extensions are included in the tool kit. As an instance of the commendable ease with which the stand can be placed in position, it may be mentioned that it is unnecessary for the rider to vacate the saddle. This point in itself is meritorious, for all riders hate manipulating the old-fashioned type of stand when once having started up the engine.

Brake Operation. Besides improving the means of quick hand adjustment for the front 8 in. semi-servo brakes, the makers have this year done what should perhaps have been done previously, that is, replaced the unorthodox heel operated rear brake by a toe operated brake. It stands to reason that toe operation is preferable, for the toe is far more sensitive and stronger than the heel, and less likely to slip off when the boots are wet. Nowadays one's life depends largely on brakes, and nothing should be left undone to make these as efficient and safe as possible.

Dynamo Lighting. Special attention has recently been given in regard to the provision of electric lighting equipment, as this form of lighting is nowadays always preferred to acetylene gas

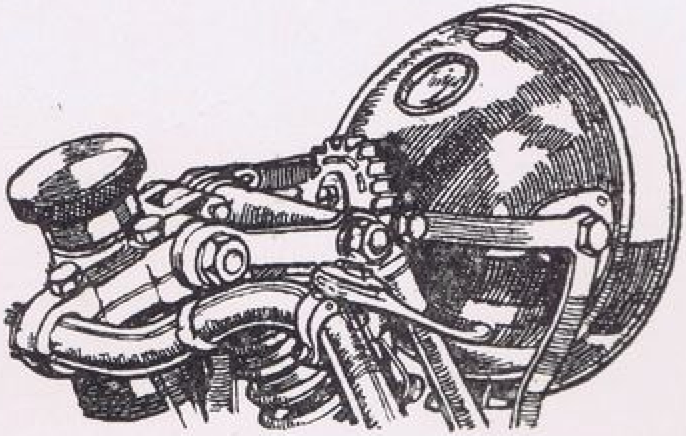


(*From the "Motor-Cycle"*)

FIG. 10.—CENTRAL SPRING-UP STAND WITH EXTENSIONS FITTED

lighting, and its installation is carried out at a remarkably cheap figure by the Douglas Co., who now fit to order a B.T.H. separate dynamo lighting system on any solo model for £5 10s., and sidecar for £5 15s. This B.T.H. system is designed as part of the machine, the dynamo which is mounted on the timing cover being driven by spur gearing. Lugs are provided on the frame for the mounting of the battery and cut out. The wiring is led in a neat manner, the bulk of it being cunningly concealed in the tunnel of the tank, which serves the dual purpose of tidiness and protection from chafing and also the weather. The head-lamp has a front glass measuring 5¾ in., and is provided with a separate dimming bulb and a 12 watt main bulb.

The dynamo output and lighting control switch forms part of the lamp, and is thus mounted in a most convenient position for operation. An ammeter is housed very neatly at the top side of the lamp, as shown in Fig. 11, and indicates *charge* and *discharge*. After dark this ammeter is illuminated from the lamp interior. Resistance is provided in the head-lamp which functions when the switch is at charge position, without lights being on. The object of this resistance is to lower the dynamo output so as to prevent damage to the battery due to overcharging. The dynamo is of a permanent magnet type, and breakage of connections cannot injure it. On the three new Douglases an extra powerful dynamo and larger capacity battery are fitted. Finally, it should be



(From the "Motor-Cycle")

Fig. 11.—Showing Location of Ammeter and Lamp Switch

pointed out for the benefit of those buying a Douglas that anyone with but the most elementary knowledge is capable of fitting the B.T.H. set just described. (See Fig. 69.)

Electric Horn. There are two excellent electric horns that can be fitted in conjunction with the B.T.H. electric lighting set. They are known as the Klaxon Kifonet (which is a vibrator type), and the Kloxet (a motor-driven type), and their prices are 10s. and 15s. respectively.

New Silencers. The 1930 Douglas engines exhaust their gases into a new type of silencer which renders the machines very quiet indeed, certainly quiet enough to satisfy the law, and cause no annoyance to the general public. Although numerous internal baffles are employed, choking is almost impossible, and power curves with and without a silencer show no marked difference.

Clutch. The Douglas patent flywheel clutch is standardized on all models, and this year has undergone slight modifications, and now has a simplified and strengthened withdrawal mechanism. Roller bearings are employed, and the withdrawal mechanism is enclosed. For fuller details see page 31.

Saddle Mounting. A lower and more natural riding position is obtained by recent alteration of the saddle mounting. This includes attachment of the saddle springs direct to the chain stays. The new mounting also renders the machines still more stable on treacherous road surfaces.

THE 1930 DOUGLAS PROGRAMME

The 1930 programme will now be considered in greater detail and complete specifications given. The touring models will be dealt with first, then the sports and, finally, the speed models. Below is a summary of the 1930 range, in which the main characteristics of the machines may be noted.

The Douglas Guarantee. A point worthy of mention here is the guarantee which Douglas Motors give in connection with all new machines. This guarantee, which holds good for a period of six months from the date of purchase provides that any part which may fail or sustain damage due to causes other than neglect or misuse shall be replaced free of charge, provided that the owner forward the faulty component or components carriage paid to the works and state all the necessary information as to date of purchase, engine number, etc.

Hire Purchase. Any of the Douglas models may now be obtained on the hire purchase system, provided that the purchaser is a responsible householder, or can induce a householder to act as guarantor.

The system of payments is fixed for all machines, and the actual payments may be arrived at by the following calculation. Decide upon the model you want. Take the cash price and add the cost of any accessories, then divide the total by four, which will give the amount of deposit. Add 8 per cent to the balance, which will be divided into twelve equal monthly instalments.

All hire purchased machines must be insured, and the premium is payable to Douglas Motors, Ltd., and is an extra.

SUMMARY OF 1930 DOUGLAS MACHINES

Model	c.c. (approx)	Bore and Stroke (mm.)	Valves	Lubrication	Gear Ratios	Tyres
L.3	350	60·8 × 60	S.V.	Dry S.	15, 8·9, 6·2	25 × 3
H.3.	350	60·8 × 60	S.V.	,,	15, 8·9, 6·2	26 × 3·2
T.6	600	68 × 82	S.V.	,,	12·1, 7·13, 5	26 × 3·5
S.5	500	62·2 × 82	S.V.	,,	12·78, 7·54, 5·28	26 × 3·5
S.6	600	68 × 82	S.V.	,,	11·52, 6·79, 4·76	26 × 3·5
S.W.5	500	62·2 × 82	O.H.V.	Mech. Pump	—	28 × 2·5
S.W.6	600	68 × 82	O.H.V.	,, ,,	—	28 × 2·5
D.T.5	500	62·2 × 82	O.H.V.	,, ,,	9 to 1 top	28 × 2·5
D.T.6	600	68 × 82	O.H.V.	,, ,,	9 to 1 top	28 × 2·5

The Touring S.V. Models. These comprise models L.3, H.3, and T.6, and their prices are £39 10s., £43 15s., and £49 10s. respectively. Models L.3 and H.3 are both improved versions of the famous B.29 machine (illustrated by Fig. 3), and are really remarkable value for money. L.3 incidentally qualifies for the 30s. p.a. tax for lightweights. This lightweight should meet with wide approval, and it is very cheap indeed considering what a handsome and mechanically sound piece of work it is, with its chromium plating for bright parts, its saddle tank, and its dry-sump lubricated engine. Those who detest manhandling a motor-cycle will find the new central spring-up stand a most commendable feature.

Model H.3 differs from model L.3 in that it has been largely designed for duty overseas, where far more strenuous road and climatic conditions prevail than in this country, and where a 500 mile run across country is considered quite ordinary. In consequence larger mudguards, tyres, heavier clutch, silencer, and carrier are specified. The machine, however, is not unduly heavy, and is a comfortable tourer.

With regard to model T.6, this is the standard large capacity Douglas fast touring machine, and it is also one of the three new models which are brimful of interesting and excellent features, no effort having been spared to produce a machine that is comfortable, fast, and quiet. Moreover, it has real stamina (the most important thing of all) and is very accessible. Coupled with an unusually fine performance is a beauty of line and cleanliness of design that need be seen before they are fully appreciated.

MODEL L.3

The specification of this mount is as follows—

The 350 c.c. S.V. Engine. This is a 348 c.c. Douglas horizontally opposed vibrationless twin cylinder unit with the valves arranged side by side. The bore and stroke are 60·8 m.m. and 60 m.m. respectively, and the rated h.p. $3\frac{1}{2}$.* Inlet and exhaust valves which are of the mushroom pattern with single coil springs and collet fixing and reciprocate in detachable cast-iron guides, converge at a slight angle in the cylinder head, as shown in Fig. 12. The timing gear itself comprises as may be seen the engine pinion, two half-time wheels, and above these three the pinion driving the magneto armature at half engine speed. This year both timing wheels and spindles are more massive, and the two spindles are now supported by an outrigger plate at their outer ends, thus relieving the timing case cover of all responsibility in connection with the retention and bearing of these members.

* 100 c.c. equals 1 h.p.—A.C.U. formula.

No rockers are interposed between the cams and the tappets which have hardened steel feet and bear directly upon the respective cam faces.

The tappets have screwed adjustable steel heads with lock nuts.

No exhaust valve lifter is fitted, for the comparatively low compression Douglas engine has no need of such a fitment.

The crankshaft itself is a built-up job with two large balance weights very similar to that of the new engines which is illustrated in Fig. 28, where the method of construction may be clearly observed. It rotates in large and efficient ball bearings, that on

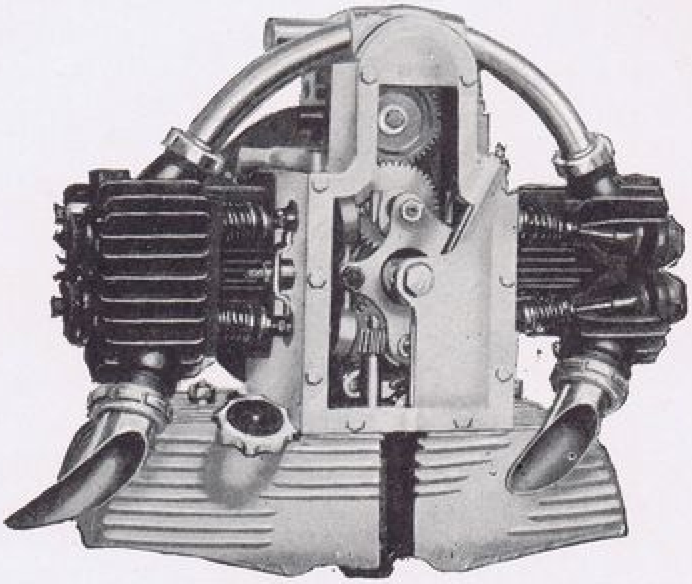


Fig. 12.—The 1930 350 c.c. Douglas Engine

the driving side being of a heavy double row pattern, to receive the transmission stresses, and that on the timing side a single row type. The heavy rimmed flywheel, which is external, as has always been the case with Douglas engines, and constitutes part of the patent clutch described hereafter, is attached to the mainshaft by friction alone, a slow thread nut holding it secure against a ground taper projection. Original Douglas flywheels were keyed to the shaft, but this proved somewhat unsatisfactory on account of the risk of seriously damaging both shaft and flywheel in the event of the securing nut being insufficiently tightened. Keyed flywheels are still used, however, in the case of the dirt-track models where exceptional crankshaft stresses prevail. Engine crank pins are provided with renewable roller bearings for the connecting rods, which are of case-hardened steel and of H section.

The two pistons are of cast iron. They are designed to conduct heat away as rapidly as possible, and are provided with two narrow gas rings and two scraper rings which prevent oil in any quantity working its way up into the combustion chamber and unduly carbonizing up the piston. Case-hardened gudgeon pins of large diameter are employed, and they are fully floating, the possibility of local cylinder scoring being obviated by the use of soft brass end caps. The large diameter of these pins definitely ensures a long life for the small end bearings which are of phosphor bronze, and are, of course, readily pressed out of the connecting rods when excessive play indicates that they require to be removed.

The finning of the cylinder is altered. Ample heat radiation and connection is provided by numerous fins, all of which are placed horizontal. The valve parts are designed to create good gas turbulence and rapid induction and exhaustion of the charges.

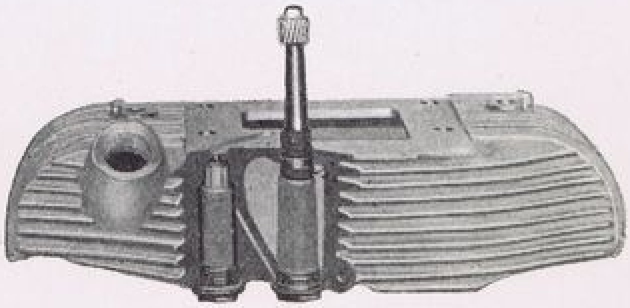


Fig. 13.—The Oil Reservoir Forming the Engine Bed
It is partly cut away to show pump parts and filter

All interior surfaces are close finished and polished. Copper cylinder gaskets ensure freedom from compression escape, and the usual four stud cylinder and cylinder head fixing is used.

Gas is supplied to the two cylinders via the carburettor, and a semi-circular induction manifold. Metallic and absolutely gas-tight couplings attach this manifold to the two cylinders. The flange fitting carburettor itself is bolted in the usual position to a large bore pipe situated at the top of and leading to the semi-circular manifold. Unlike the ordinary single-cylinder engine, the carburettor has to be placed some considerable distance away in the case of the 350 c.c. Douglas engine from the cylinders and, therefore, does not receive much heat by conduction. The designers have allowed for this by including a fairly long air intake pipe, the orifice of which is located directly over and practically touching the rear cylinder head. Air entering the carburettor is therefore effectively pre-heated by the radiating fins, and mixture heating is maintained correct almost immediately after starting up.

The sparking plugs are located in a vertical position directly over the inlet ports, and are very accessible.

The anti-clockwise magneto (as may be noted from Fig. 12) is driven at half engine speed, and has two cams on its cam ring, since a spark is required every engine revolution, and the pinion by which it is driven is keyed to the armature. The high tension leads from the distributor are very neatly led to the sparking plugs. The electrical generator which can be fitted as an extra (see page 11) and has been designed for attachment to the timing cover, is driven by a metallic coupling off the half-time magneto pinion. This metallic dog-type coupling allows of the timing cover being withdrawn complete with dynamo.

Engine revs. at 60 m.p.h. . . .	Approx. 4,850
Valve clearances (cold) . . .	Inlet, ·006 in., exhaust, ·006 in.
Magneto advance	31 degrees before T.D.C. (= approx. $\frac{5}{16}$ in. on stroke).

Dry Sump Lubrication. As on last year's model the engine bed constitutes an oil tank, or perhaps sump would be the better word, of spacious dimensions, and this aluminium casting, illustrated by Fig. 13, is heavily finned so as to dissipate the heat received from the crankcase proper and from the oil returning after circulation through the engine. In this sump a vane-type pump, which can readily be unscrewed from the container, is submerged and is driven by a worm from the exhaust cam wheel spindle. It pumps oil through oil-ways direct to the big-ends via drilled passages and a drilled crankshaft. All other working parts of the engine receives its oil by splash and afterwards drains back to the sump through holes drilled in the top for that purpose. There is no actual piping used whatever. The timing gears are taken care of by the fact that oil is supplied to the timing case and allowed to overflow back into the engine at a level which ensures the bottom cam wheel constantly running in oil.

An improvement on the 1929 D.S. system is that oil has, when leaving the pump, to permeate through a second fine mesh wire gauge which can from time to time be removed for cleaning. There is also a pulsating type of tell-tale indicator protruding from the front of timing cover, and an occasional glance at this is all that is required as far as attention to engine lubrication is concerned, other than periodically replenishing the oil sump which has an oil capacity of half a gallon. The orifice is situated close to the off-side foot rest, and a funnel will assist pouring in the oil.

During its passage the oil must first raise the indicating device approximately half its full distance. A point of special interest is that oil is forced to the centre of the middle portion of the crankshaft, and thence is led to each big end. This ensures even oil distribution. On the old splash lubricated Douglases centrifugal force always endowed the rear cylinder with a more liberal oil supply than the front one with, of course, much detriment to the plug concerned. A diagram of the D.S. lubrication system oil feed to crankshaft and timing gear will be found on page 74.

To take care of crankcase pressure and to create a depression in the crankcase a rotary valve, of the type shown in Fig. 26, is provided, which is driven from the top cam in such a manner that it is closed on the downward stroke of the pistons and open on the upward. The oily vapour which is thus expelled from the crankcase with each revolution is directed to the primary chain. It will thus be seen that the Douglas D.S. lubrication is the simplest imaginable and most efficient.

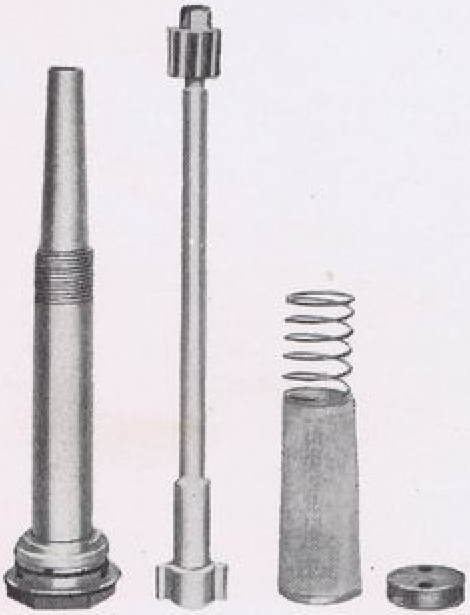


Fig. 13a.—The Pump Components
(They are identical on all models)

All the usual cycle parts are provided with grease gun lubrication.

Carburettor. This is a two-lever clip-fitting B. & B. pattern with a special intake pipe, and the type number is 123/5/N. The jet fitted as standard is a No. 75 jet with a taper in the throttle valve. This combination gives excellent tick-over, fierce acceleration, and a high maximum speed. Hints on tuning the carburettor and details of its construction will be found on page 91. A top petrol feed is used, and control is by handlebar lever of the orthodox type.

Ignition. Both the dynamo (see page 11), which can be fitted as an extra together with the twin bulb anti-dazzle head lamp and tail lamp with battery, and also the high tension magneto are of B.T.H. manufacture. They are high-grade instruments embodying all the latest features of modern electrical equipment.

The battery itself may be secured with its carrier to lugs provided on the frame, which enables it to be tucked away in a neat and sheltered position.

Single-point sparking plugs of well-known make are used. They are of standard reach pattern, and the recommended gap between the electrodes is ·020 in. (= $\frac{1}{50}$ in. or $\frac{1}{2}$ mm.). Terminals are of the standard screw pattern, not of the quick action spring type.

Frame and Forks. The frame (illustrated by Fig. 7) is of the sturdy build, and designed to give a low centre of gravity and riding position. Serrated lugs are securely brazed for attaching pillion footrests. There are only three bolted joints.

The forks fitted are almost identical to those utilized on the 1929 $2\frac{3}{4}$ h.p. Douglases. The shackle pins are adjustable for taking up side-play where it develops.

Gear-box and Clutch. The gear-box which is a fixture in the frame is of Douglas design, and gives three speeds. The standard ratios are as follows—

Low, 15·12 to 1. Middle, 8·9 to 1. Top, 6·25 to 1.

Low reduction gears suitable for exceedingly hilly districts can be supplied as an extra, and in this case the ratios are—

Low, 18·2 to 1. Middle, 10·7 to 1. Top, 6·2 to 1.

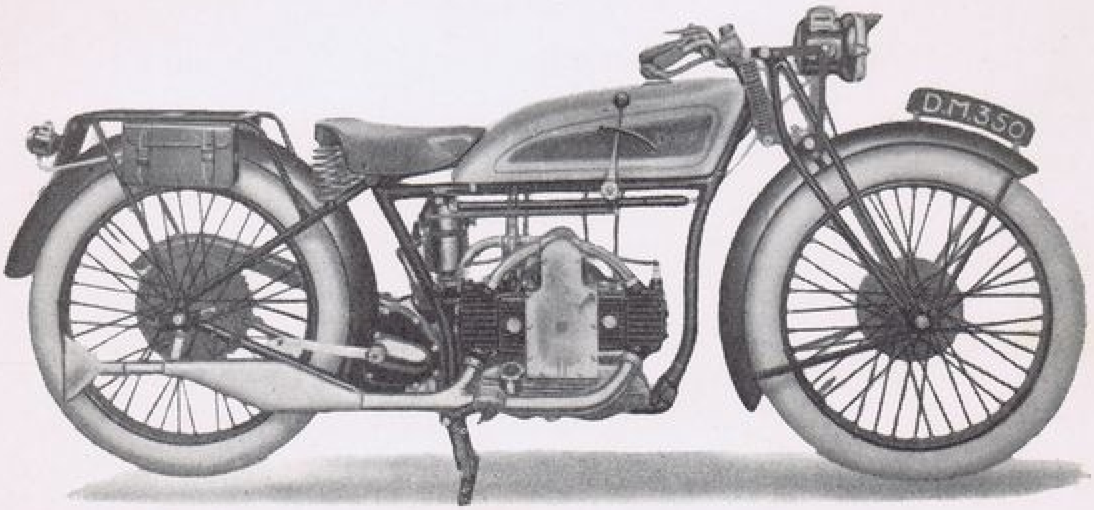


Fig. 14.—The 350 c.c. S.V. Model L.3

A diagram of the Douglas gear-box contents appears on page 78, and adjacent to it will also be found a description of its method of working. Sufficient it is here to enumerate a few of its salient features. It is a countershaft pattern of the constant mesh type with the mainshaft and layshaft rotating in ball bearings. On the driving side a heavy thrust bearing is used to receive the secondary transmission thrust. Top and bottom gears are obtained by the engagement of dog clutches, and middle gear by the meshing of pinions.

Control of the selection mechanism is by a universal coupling to a short rod running parallel to the rear down tube, and thence by a double lever to the long tie rod which runs below the tank and is connected to the gear lever itself. The latter operates on a spindle attached to the frame and not to the tank. The bush is replacable. The gate change quadrant is bolted to the tank, however, and the gear lever positions from rear to front are: Top, Second, Neutral, Bottom. This order is the standard as recommended for universal use by the Motor-Cycle Manufacturers' Union, who recently have gone into the question of

TANK. This is of welded steel, and holds $2\frac{1}{2}$ galls. of petrol. It is insulated from the frame by means of rubber pads, and has improved cork-seated taps which are guaranteed against leakage. The tank is cellulosed in standard Douglas colours, with blue panel. Knee grips are not included in the standard specification, but may be obtained as an extra.

SILENCER. The dual exhaust pipes which have metal couplings to the ports converge rearwards to a common exhaust manifold, and the gases after entering this, pass straight into a silencer of large capacity. Little back pressure is caused. Ultimately they

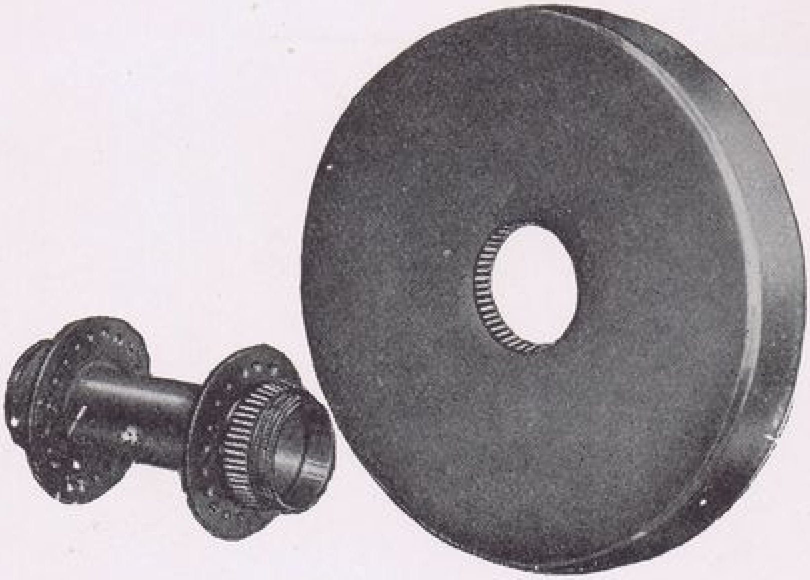


FIG. 16.—HUB AND BRAKE DRUM USED ON ALL MODELS

emerge into the atmosphere from a large fish-tail, which still further reduces noise. The whole exhaust system is chromium plated.

BRAKES. These comprise the toe operated rear brake with pedal on the near side, and the hand-actuated brake with inverted lever on the right-hand side of the handlebars. Both brakes are of the semi-servo pattern (described on page 76) with drums 8 in. in diameter, and the front has hand and the back spanner adjustment. Powerful pressure need not be applied in order to secure good retardation, for the area of the Raybestos friction surfaces in each case is no less than 25 sq. in. The drums themselves may be detached from the hubs (see Figs. 16, 18, and 19), for renewal when required.

WHEELS AND TYRES. The wheels are of massive construction, and are fitted with 9 gauge spokes of equal length. The tyres fitted as standard are 25 in. × 3 in. wired on Avons with Schräder valves on the tubes. The hubs have roller bearings and will withstand very heavy work.

Sundry Equipment. Strong foot rests are provided, and they are detachable and adjustable over a wide range by positively locking the serrations. The shafts are of mild steel, and placed so that in the event of a skid they bear the brunt of the damage. They may be readily straightened or renewed.

The saddle is a Terry specially designed for Douglas machines with a new spring mounting which gives extreme comfort. The height from the ground is 2 ft. 3½ in.

A new central spring-up stand (Fig. 10) is included which requires very little physical exertion to bring into operation.

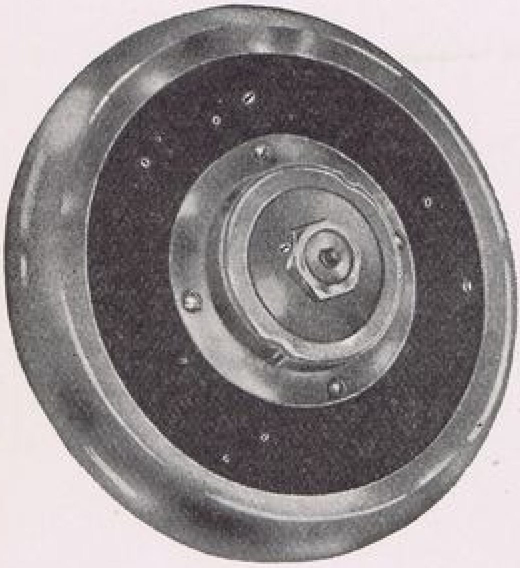


Fig. 17.—Douglas Patent Flywheel Clutch

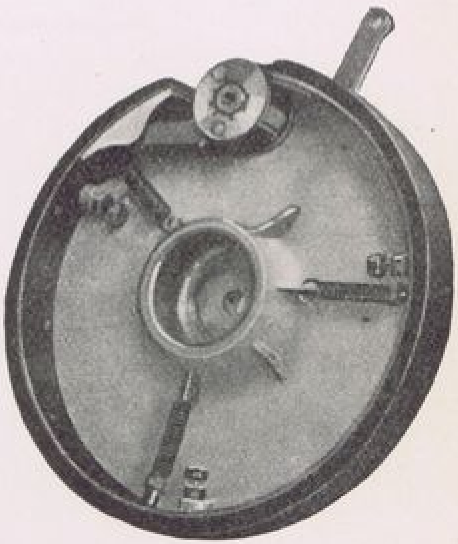


Fig. 18.—Brake Anchor Plate

Other equipment includes a good celluloid pump, strong carrier, efficient mudguards, two pannier bags slung one on each side, and a full kit of tools.

Acetylene head and rear lamps with generator may be obtained as an extra for £1 5s., or a complete B.T.H. electric lighting set for £5 10s. extra.

Maximum speed	Approximately 55-60 m.p.h. solo 40-45 m.p.h. sidecar.
Weight	Under 224 lb.
Overall Length	6 ft., 9½ in.
Ground Clearance	5 in.

MODEL H.3

The specification of Model H.3, which is a de luxe and overseas edition of model L.3, differs from the cheaper machine as follows—

The carburettor is an Amal type 4/007 flange fitting instrument with two lever control pilot jet and throttle stop (see page 69). The standard jet used is a No. 60 with 65 and 55 as spares. The needle is in the third groove from the top with a 4/5 valve. For further details and tuning advice see pages 69 and 93.

Adjustable clip-fitting handlebars, fork shock absorbers, new type flywheel-clutch, and larger saddle. The tank is chromium plated with black and gold panel, and is fitted with knee grips; a Douglas designed steering damper is mounted on the steering head; extra deep and sturdier mudguards cover the wheels which have wired-on tyres measuring 26 in. × 3·25 in.; a larger capacity

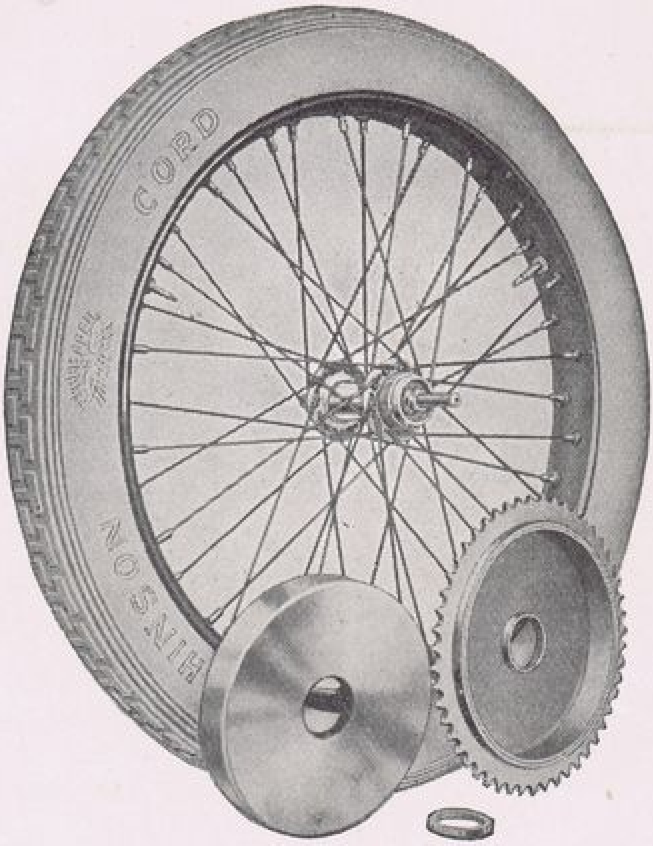


FIG. 19.—WHEEL SHOWING DETACHABLE BRAKE DRUM

silencer is employed; the carrier has an additional stay; cast aluminium, rubber studded easily detachable and adjustable foot boards are used, and twist grip carburettor control is optional.

Maximum Speed	Approximately 55-60 m.p.h. solo, 40-45 m.p.h. sidecar.
Weight	With acetylene lighting 240 lb., with electric lighting 254 lb. approximately.
Overall Length	6 ft. 10½ in.
Ground clearance	5 in.

MODEL T.6

Finished in black enamel and chromium plating the Model T.6 Douglas (see frontispiece) is one of the outstanding machines of the year. The symmetrical appearance and cleanliness of design are quite beyond the ordinary, and it bristles with originality and cleverness. There is little in common between this and the 350 c.c. models, although general Douglas practice is, of course, adhered to in regard to many of the details. The major portion of the design, however, is entirely new, as may be seen from the specification which is given below in considerable detail for the benefit of those readers who wish to familiarize themselves

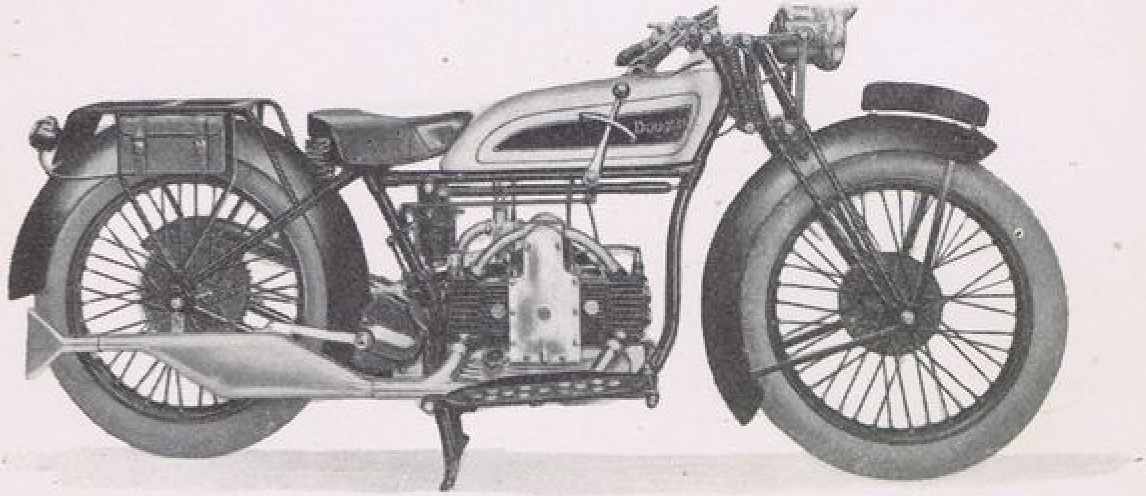


FIG. 20.—THE 350 C.C. DE LUXE MODEL H.3

with the technical details of this most interesting and comparatively low-priced machine, in whose production F. W. Dixon has been one of the leading spirits.

Engine. Designed to give a minimum of two years' service without replacements, the 596 c.c. engine is of very robust build, but although the factor of safety of all parts is high its weight is not excessive. The bore and stroke are 68 mm. and 82 mm. respectively, and the rated h.p. 6. The general lay-out is, of course, much the same as that of the smaller engines, but there are marked differences in methods of construction.

Perhaps the most noteworthy of these is to be found in the case of the induction manifold. This member with flange-fitting extremities is cast integral with the timing case-cover, and the whole induction system is thus adequately heated. Details of this induction system may be clearly seen by referring to Figs. 21 and 47. A special single lever fully automatic vertical carburettor of flange fitting type with top petrol feed is bolted centrally to a central short boss projecting vertically downward from the transverse pipe. The whole arrangement is exceedingly compact, and the length of induction pipe employed is thus reduced to an absolute minimum with consequently a less risk of condensation occurring, more efficient gas distribution, and fuller charging of the cylinders, with freedom from air leaks. Moreover, a more uniform engine temperature is to be attained by this means, and varying climatic conditions have little effect. The air intake of the carburettor is situated directly over the foremost exhaust pipe, and thus the air entering the instrument is preheated to a certain extent. A choking valve for starting from cold and warming up is provided, and has four positions. This device which may be operated by the foot enables the machine

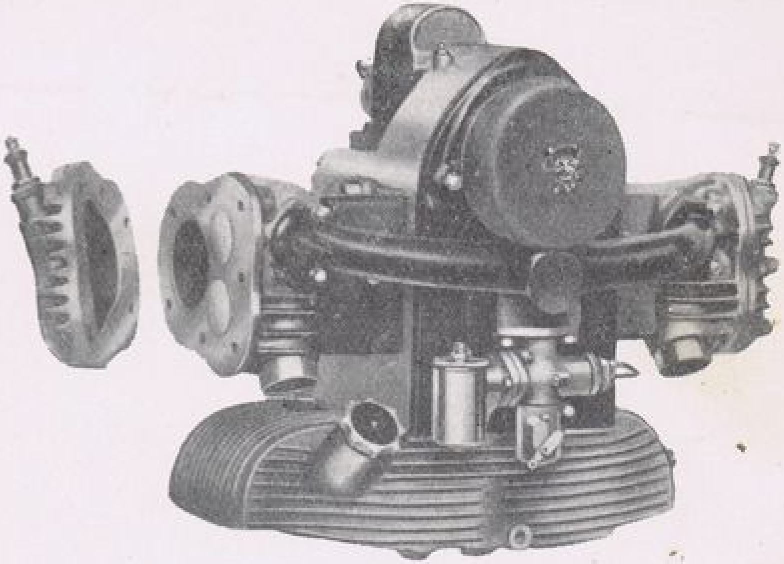


Fig. 21.—General View of 500 and 600 c.c. Engine
Showing detachable head, dynamo, and induction system

to be driven straight away from cold without any choking or misfiring occurring. A standard Amal air control can also be fitted if desired.

The angle between the inlet and exhaust port outlets in this engine is acute and not obtuse, as on the 350's, and the ports and valve chests are cast integral with the cylinder barrels which are very massive and finned throughout longitudinally, as are the detachable cylinder heads which may be removed for decarbonization without disturbing either the valve gear or the induction system—a unique feature. The whole is *dull* plated, so that little loss is suffered in heat radiation due to the brightening of parts. In any case contrary to a widespread and ridiculous misconception the I.C. air-cooled engine diffuses approximately 70 per cent of its superfluous heat through convection, not radiation. The cylinder heads (see Fig. 47) are of interesting design, and are retained in position on the barrels by a seven-stud fixing without any kind of annular spigot. A large copper gasket is, however, used, and the joint is thus absolutely gas tight and of considerable area.

The cylinder heads are of semi-turbulent pattern, and are so shaped that when the exhaust valves are lifted the hot exhaust gases do not rush past the valve heads, but are deflected under them on their way through the ports into the exhaust pipes, and in this manner freedom from pitting of the contacting surfaces is obtained. Indeed, thanks to the foregoing fact and by reason of the massive cylinder heads and the high quality steel used for the valves the large capacity Douglas engines are capable of a whole season's running without the necessity of valve grinding. The acid test, however, lies in the compression. As soon as this diminishes out should come the valves. The valves themselves

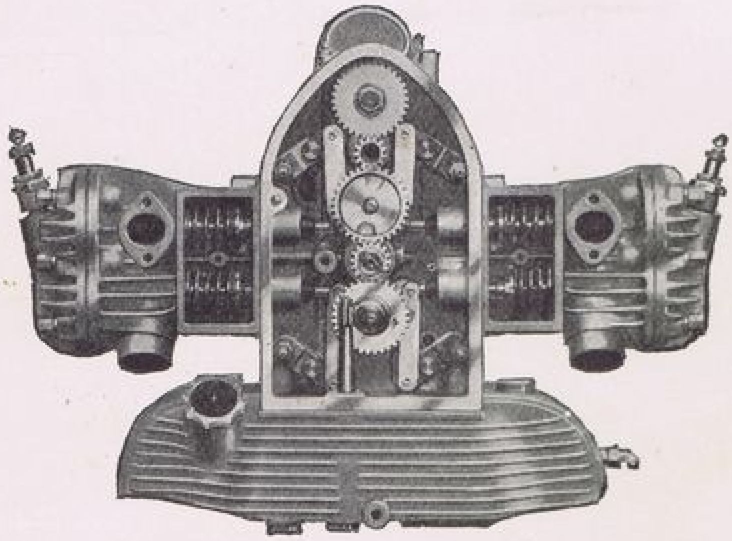


FIG. 22.—VIEW OF 500 AND 600 C.C. S.V. ENGINE WITH TIMING COVER REMOVED

Showing valve lifter, links, and oil feed to cam spindles

show signs of considerable thought and originality. The valve guides and valve components are illustrated by Fig. 23, and it will be observed that the valves which are both placed parallel to the cylinder axis, themselves embody the means whereby valve clearance is effected. The valve spring abutts against a castellated member which screws on to the base of the valve stem and serves the dual purpose of a spring cap and a lock nut for the valve clearance adjusting nut with hardened head immediately preceding it. This is an excellent idea, for it does away with all cotters and simplifies refitting the springs. The guides are extremely long and are guaranteed to keep the valves rock steady for thousands of miles without replacement. The whole of the valve gear is enclosed and lubricated (see Fig. 57) from the crankcase, the valve chests being connected to the timing case in such a manner that oil is supplied to these to a predetermined level. The tappets themselves are plain metal rods of very hard steel and have no heads. They reciprocate in guides of the type illustrated by Fig. 24. These guides are pressed into the aluminium crankcase. There is no exhaust valve lifter provided.

The timing gear is somewhat different to that of the 350 c.c. engines, a small pinion being interposed between the inlet cam

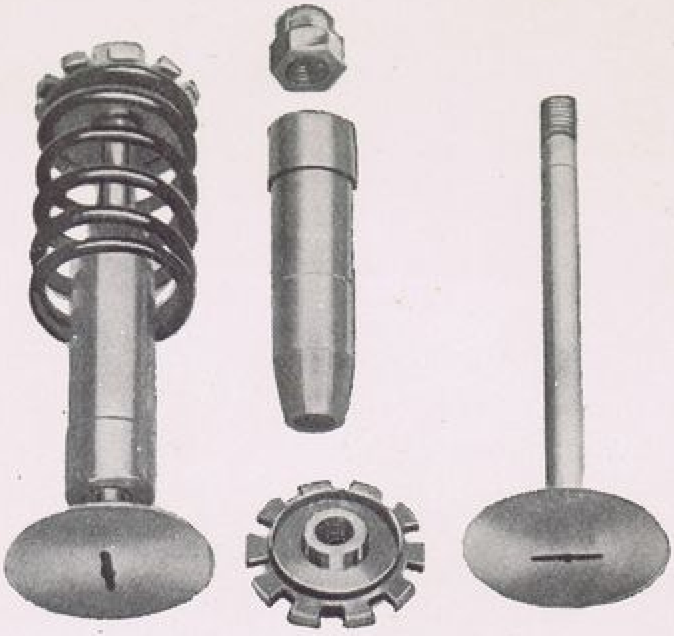


FIG. 23.—SHOWING VALVE AND VALVE GUIDE COMPONENTS

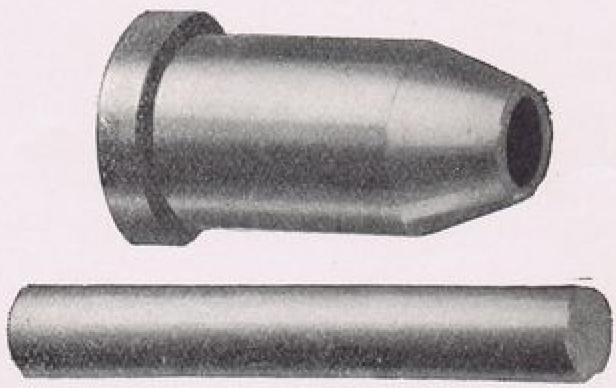


FIG. 24.—TAPPET AND TAPPET GUIDE ON 500 C.C. AND 600 C.C. S.V. ENGINES

wheel and the magneto pinion. This pinion, however, is fitted to a live stub shaft at the outer end of which fits a serrated female coupling into which a corresponding male member attached to the dynamo fits. The dynamo itself may readily be detached from the timing case cover. All these details are very clearly shown in the illustration on page 61, and the reader is advised to study this drawing very closely, as it shows the relationship between the various parts in a most clear manner. Rockers are interposed between the cams and the tappets, and each rocker carries two rollers, one to bear upon the tappet and one to follow the cam contour. A large outrigger plate which has bearings for the various shafts renders the whole of the timing gear quite independent of the timing case cover. Finally, it should be mentioned that all pinions are marked so that in the rare event of a complete dismantling being required they may be replaced without fear of upsetting the valve timing.

The crankshaft assembly is a sturdy piece of work. It is supported on the driving side by a ball race, and on the timing side

FIG. 25.—THE CAMS AND TIMING GEAR USED ON THE 500 C.C. AND 600 C.C. S.V. ENGINES

by a large plain bearing, to which oil is fed under pressure through an annular groove. Fig. 27 shows the assembly which contains two balance weights and a central member into each end of which fits a crank pin. The big-end bearings of the " H " section connecting rods are of the roller pattern and are replaceable. The small end bearings are, of course, plain and of large diameter to receive the big fully floating case-hardened gudgeon pins which have brass end caps to prevent scoring. The pistons (Fig. 27) are of aluminium alloy, and have flat tops to the crowns. There are two compression and two oil scraper rings. The walls of the pistons are of very considerable thickness to avoid distortion, and the coefficient of expansion of the alloy is not such that there is any noticeable piston slap with a cold or nearly cold engine. The piston skirt incidentally is $\frac{1}{2}$ in. longer than on previous 600 c.c. engines.

The high tension magneto, which is mounted on a small platform and raised clear of the crankcase so as to be kept at a low temperature, is provided with a single dog flexible metallic coupling, so that neither the drive proper nor the timing need be disturbed when the instrument is removed for inspection or cleaning. Also this method of driving the magneto prevents any possibility of oil reaching the armature. The distributor leads run out on each side to the sparking plugs, which are slightly pocketed in the cylinder heads and are inclined at a small angle to the vertical (see Fig. 47). Screw terminals are employed.

The bed of the engine as on the "three-fifties" constitutes a finned oil reservoir (see Figs 13 and 47) of cast aluminium, and in this reservoir is the Douglas oil pump which is the chief and most original part of the new lubrication system fitted to all S.V. engines.

Engine revs. at 60 m.p.h. . . .	Approx. 4,150.
Valve Clearances (Cold) . . .	Inlet ·006, exhaust ·008.
Magneto Advance	Degrees before T.D.C. $35\frac{1}{2}$ (= $\frac{23}{64}$ in. on stroke approx.)

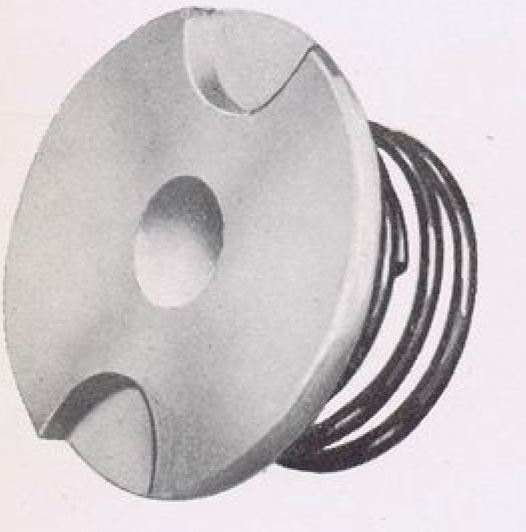


Fig. 26.—Rotary Breather Disc Used on 500 c.c. and 600 c.c. S.V. Engines

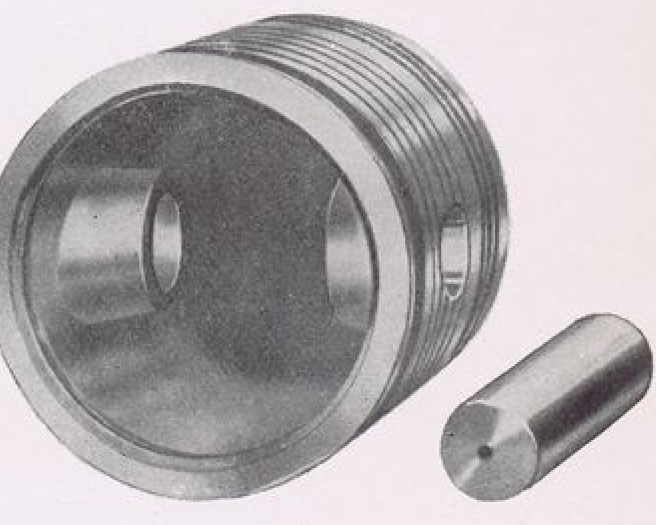
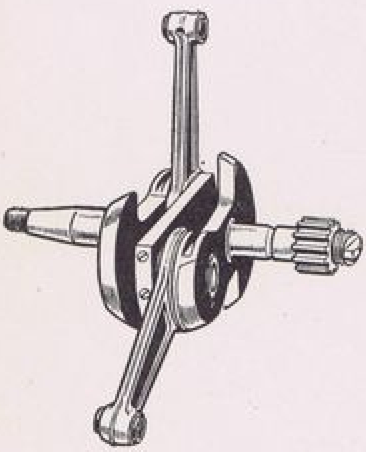


Fig. 27.—Aluminium Alloy Piston, with Large Diameter Gudgeon Pin

Dry Sump Lubrication. The lubrication system fitted to Model T.6 is precisely similar to that employed on the 350 c.c. models (described on page 17), but oil is fed not only to the main bearings but also direct to each of the cam pinion bushes. The valve chests are also connected to the timing case in such a manner that oil is supplied to these to a predetermined level. Primary chain lubrication is attended to by a rotary breather, which also ensures a uniform air pressure being maintained within the crank-case. This fitting, shown in Fig. 26, is of considerable importance, for on its proper functioning depend three things—proper front chain lubrication, a clean engine, and absence of resistance to the two pistons on their downward strokes, which occurs, of course, simultaneously. A tell-tale pulsating indicator shows whether the gear-driven pump is working satisfactorily. All the usual cycle parts are grease gun lubricated.

Carburettor. The carburettor is a new design of single lever with twist grip control Amal which is fully automatic, and has a flange fitting. Its type number is 5/116/S, it has a $\frac{7}{8}$ in. bore, and the standard main jet used is 120 with 5/3 throttle valve and jet needle in second groove from top. A top petrol feed is utilized and a horizontal throttle barrel is to be found instead of the more usual vertical type. The effective area of the intake may be varied by means of a foot operated butterfly valve. Further particulars of this instrument and some notes on tuning will be found on page 71.

IGNITION. The gear-driven clockwise magneto, which runs at engine speed, is of B.T.H. manufacture, and is capable of quick removal without disturbing the ignition timing.


(From the "Motor Cycle")
FIG. 28.—CRANKSHAFT

Standard reach one-point sparking plugs are fitted, and the gap recommended is $\frac{1}{50}$ in. or $\frac{1}{2}$ mm., or, more accurately, ·020 in.

FRAME AND FORKS. The frame is a powerful structure of the duplex cradle type with lugs throughout, giving ample clearance for colonial conditions and strengthened to withstand the roughest usage. The engine mounting has been designed to obviate any tendency for the engine to rock sideways at low speeds, and the usual Douglas method of sliding the engine backward or forward for primary chain adjustment is used. The frame is not unlike the type fitted to the 1929 " six-hundreds," but extra stout tubes still further eliminate any whip that might tend to occur. The engine oil sump is grooved underneath, and rests upon two rails which are part of the frame. By slackening off a few accessible bolts and giving a few turns to a drawbolt, the desired chain tautness may be obtained.

The forks are almost identical to those used on last year's 600 c.c. Douglas. They are of the Douglas patent type with two coil springs in tension, and have adjustable shackle pins to compensate for wear. The steering head is of massive construction, the thrust being countered by heavy taper roller bearings. A steering damper is incorporated above the head, and is operated by a neat knurled wheel. The machine, however, is so inherently stable that except for sidecar purposes a damper is unlikely to be required until a speed of over 45 m.p.h. is attained. After this speed a damper is advisable over bad roads, as it greatly relieves the strain of keeping the machine steady when negotiating bumps or hollows.

Gear-box and Clutch. The three-speed countershaft gear-box is bolted down rigidly, and does not, of course, have to be moved. The internal parts (see page 78) have been strengthened, especially the kick-starter mechanism which is enclosed. The kick-starter itself may readily be removed and the new handle starter (Fig. 9) fitted in its stead. This when out of use lies horizontally. The gear-box which in general lay-out and principles is the same as that fitted to the smaller Douglas machines gives the following standard ratios—

Low, 12·8. Middle, 7·5. Top, 5·28.

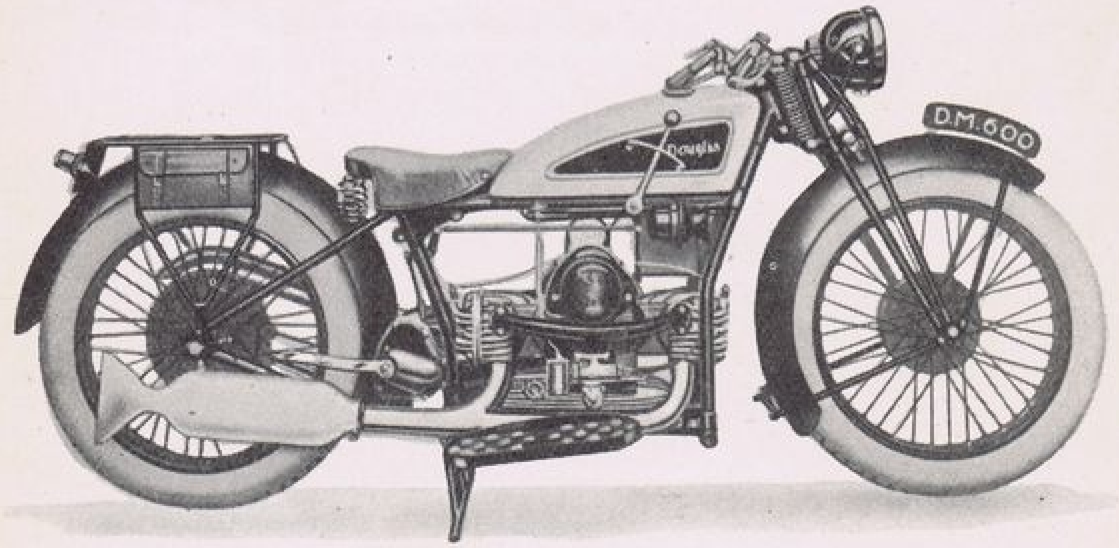


Fig. 29.—The Standard 600 c.c. S.V. Model T.6

Instead of the standard ratios, special low reduction gears may be obtained as an extra. These gears provide ratios as follows—

Low, 14·2. Middle, 8·3. Top, 5·28.

If a sidecar is specified with the machine the gear ratios are—

Low, 16·4. Middle, 9·65. Top, 6·8.

The gear-box operating lever is fitted to the side of the tank and is of sturdy construction. The cross-shaft on the tank tube is considerably improved and provided with renewable bushings.

The flywheel clutch (Fig. 17) has been greatly improved. The friction surfaces are provided by two steel discs and one of Raybestos. Pressure is obtained by the agency of six springs, and once the clutch has been properly assembled there is no need to tamper with its adjustment. The withdrawal mechanism has been strengthened and simplified, and requires less effort to operate from the handlebar lever than did the old pattern. The flywheel assembly runs on a large roller race, whilst a special ball race receives the thrust stresses.

Transmission. Coventry Ultimate roller chains are used throughout. These new chains have already proved their merit in the racing world, and they undoubtedly give long trouble-free service. The primary chain measures $\frac{1}{2}$ in. × $\frac{5}{16}$ in., and the secondary $\frac{5}{8}$ in. × $\frac{1}{4}$ in. In the former case adjustment is effected by sliding the power unit, and in the latter case by adjusting the rear wheel in the usual manner. An effective shock absorber is provided on the gear-box sprocket, and the front chain is effectively lubricated by a breather from the crankcase.

Neat aluminium chain guards are provided. The front guard (Fig. 30) is a new design, the inner section being a cast aluminium fixture to which the outer member is secured by a single central stud which screws into a projecting boss as illustrated. The rear guard protects the upper half of the chain only, and allows of the chain being lubricated and inspected with ease.

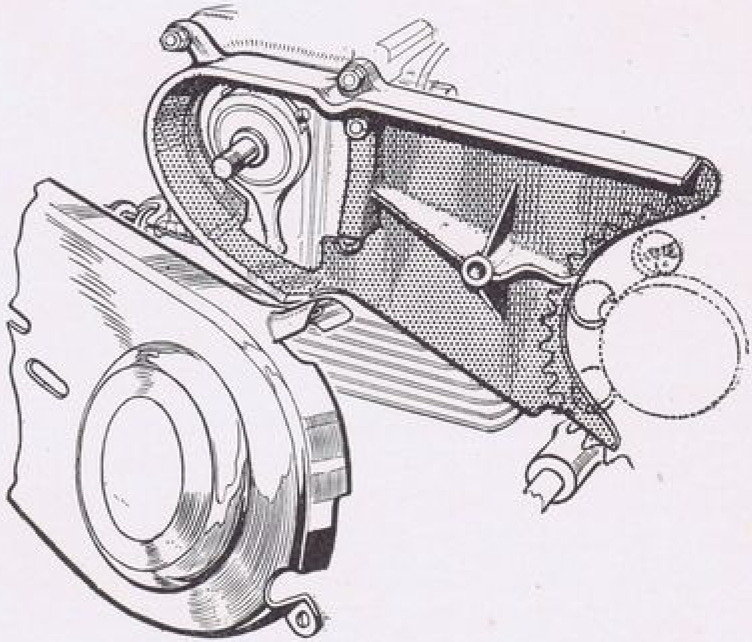
Tank. The welded steel saddle petrol tank is of most pleasing appearance, and is chromium plated all over with the exception of the usual Douglas panel which is in black with a gold lining. The tank has a capacity of 3 galls., and is mounted on rubber blocks to damp out vibration. A new type of filler cap $2\frac{3}{4}$ in. in diameter is used, and knee grips are fitted as standard. A tank mounted speedometer is not included (Fig. 6).

Silencer. An exhaust system has been evolved which is both very efficient and harmonizes well with the general lines of the machine. The exhaust pipes are a push-on fit on the ports, the whole silencing system being removable by undoing two bolts which are very accessible. The silencer is made up from steel pressings and has internal baffles. The fish-tail is not detachable, but has been made integral with the silencer itself, which is coupled to the chain stay by a swivelling bracket which alters its position when the primary chain is adjusted. The whole of the exhaust system is chromium plated.

Brakes. These are of the Douglas patent semi-servo pattern (see page 76), and have a diameter of 8 in. The front brake is operated by an inverted lever placed on the right-hand side of the handlebars, and the rear by a toe operated pedal adjacent to the near-side footrest. The riveted friction linings are of Raybestos, and in each case the effective area of the surfaces is 25 sq. in. The large area used ensures that only a slight physical effort is required to check the speed of the machine. The braking effect, however, is smooth and progressive. Hand-adjustment to the front brake and spanner to the rear is provided. The brake drums are detachable from the hubs (see Fig. 16).

Wheels and Tyres. The wheels are built up with 9-gauge spokes, and are immensely strong with hubs mounted on adjustable roller bearings. They are shod with 26 in. × 3·5 in. wired-on Avon tyres. The brake drums may readily be detached.

ELECTRIC LIGHTING. Model T.6 may be had with or without electric lighting equipment (see page 11). The small difference in price, however, is likely to induce most purchasers to specify electric lighting without any hesitation. Where model T.6 has no dynamo a protective cover-plate is bolted to that portion of the timing case cover exactly facing the intermediary pinion of the magneto drive from which the dynamo is driven, and by removing this plate the dynamo may be affixed in its stead within a few minutes.



(*From the "Motor Cycle"*)

FIG. 30.—PRIMARY CHAIN GUARD OF 500 C.C. AND 600 C.C. MODELS

On the electric lighting models very great care has been taken to make the wiring as inconspicuous as possible. The three leads from the headlamp are in one moulded circuit, and where the single wire emerges from the B.T.H. dynamo it is arranged to run alongside the one external pipe, the petrol pipe. Even the cable of the rear lamp is visible for only a few inches, for it is carried in a special channel of the mudguard strengthening web. The battery and horn are mounted over the foremost cylinder with the cut-out immediately above between the front down tubes. Actually the cut-out is in a recess in the tank, and although cleverly hidden it is quite accessible. Altogether the tidying-up has been done most thoroughly; one might almost imagine that a feminine element had had a hand in it!

SUNDRY EQUIPMENT. Cast aluminium, rubber studded footboards are standard, but these are detachable, and may readily be replaced by adjustable footrests when required.

The saddle is an extra large spring-top Terry with chain stay spring anchorage specially designed to give a comfortable riding attitude. The height from the ground is the same as on the $3\frac{1}{2}$ h.p. models. Adjustable handlebars are provided.

Carburettor and ignition controls are twist grip with levers optional. Other equipment includes central spring-up stand, a sturdy carrier, extra deep section mudguards, pump, and a complete kit of tools in the pannier bags.

Complete acetylene lighting may be had for £1 5s., and an electric set for £5 10s.

Maximum Speed	Approximately 65-70 m.p.h. solo, 50-55 sidecar. (According to gear ratio).
Weight	With gas and electric lighting approx. 333 lb. and 344 lb. respectively.
Overall Length	6 ft. $11\frac{1}{2}$ in.
Ground Clearance	$4\frac{3}{4}$ in.

The Sporting S.V. Models. These are two in number, with the official type numbers S.5 and S.6, and their respective prices are £50 10s. and £51 10s. Both models have specifications differing only to a very small extent from that of the standard touring model T.6. These differences are confined to such details as gear ratios, forks, tool boxes, and footrests, where the needs of the sporting rider are markedly different to those of the tourist. Models S.5 and S.6 are identical with the exception that in the case of model S.6, as its name implies, the engine capacity has been increased to 600 c.c. The following specification, therefore, applies to both machines, and details of the modifications only are given.

MODELS S.5 AND S.6

Both of these models are exceedingly fast, but although of the sporting class they are thoroughly equipped and have ample mudguarding. They are not designed for speed and speed alone, but are intended for general sporting purposes, such as reliability trials, hill climbing, and so on. Comfort and appearance have nowhere been substantially sacrificed to the God of speed, although they are certainly redoubtable mile-eaters. The Douglas S.6 can be tuned to attain over 70 m.p.h.

ENGINE. The engine installed is exactly the same as that fitted to model T.6 and described on page 24. It has detachable cylinder heads, enclosed valves, D.S. lubrication, a new induction system and gear driven magneto. While the bore and stroke of S.6 remains the same as T.6 (i.e. 62·25 mm. × 82 mm.) the bore of S.5 has been decreased by 5·75 mm., bringing it down to 62·25 mm.

and giving an engine capacity of 494 c.c. The rated h.p. is 6 and 5½ respectively.

Engine revs. at 60 m.p.h. . . .	Approx. 3,708 r.p.m.
Valve Clearances (Cold) . . .	Inlet ·006, exhaust ·008.
Magneto Advance	Degrees before T.D.C. 21 ($\frac{9}{64}$ in. in stroke approx.).

GEAR-BOX. The three-speed countershaft gear-box gives the following standard ratios—

Low, 12·0. Middle, 7·0. Top, 4·75.

Low reduction gears as follows, can be supplied as an extra—
Low, 12·75. Middle, 7·46. Top, 4·75.

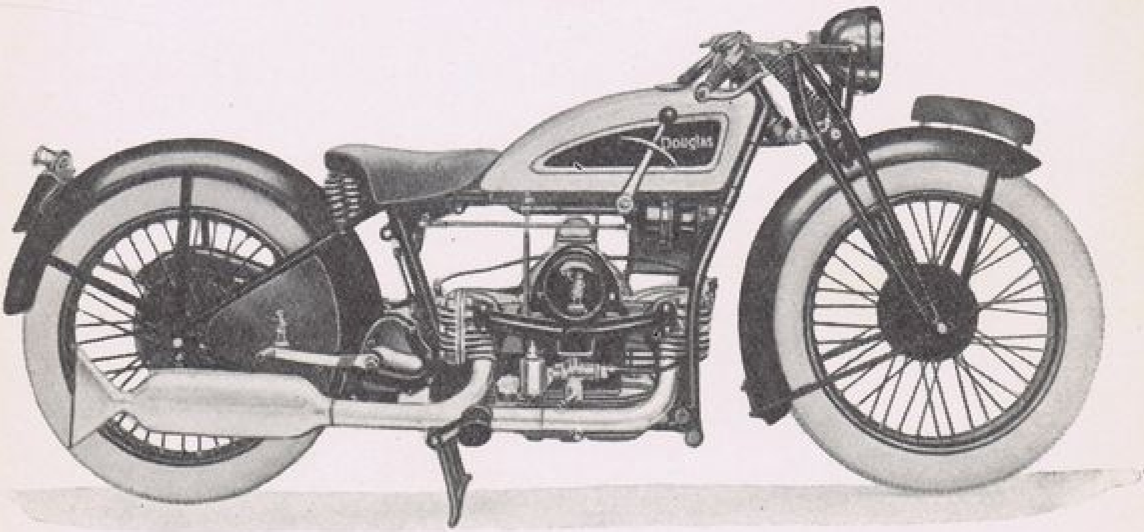


FIG. 31.—THE SPORTS S.V. MODELS S.5 AND S.6

Sidecar gears also can be obtained as follows—
Low, 15·0. Middle, 8·75. Top, 5·94.

FORKS. These have been specially designed for the sports models and are now fitted with heavier links, larger diameter rear blades, and have a powerful central compression spring with an efficient guiding sleeve running down the centre. Other refinements include adjustable dampers, steering stops and a new steering damper on top of the handlebars (Fig. 11).

FOOTRESTS. Adjustable footrests of new design are standardized.

TOOL BOX. Instead of two pannier bags as on the touring model there is a single commodious cast aluminium tool box located on the offside between the chain stays and the rear mudguard. This box is both accessible and pleasing in appearance.

Acetylene and electric lighting may be obtained as for the other models on the usual terms.

Maximum Speed	Approximately 70 m.p.h., S.6 65 m.p.h., S5 solo and 55 m.p.h. and 50 m.p.h. with sidecar respectively.
Weight	With electric and acetylene lighting 290 lb. and 304 lb. respectively.
Overall Length	6 ft. $11\frac{1}{2}$ in.
Ground Clearance	$4\frac{3}{4}$ in.

The Speedway O.H.V. Models. Douglas speed models have during the past few seasons come very much to the forefront, and the names speedway and Douglas are inseparably linked together. Especially is this so where dirt tracks are concerned. More and more star riders now demonstrate their prowess on the machines which for acceleration, speed, and broadsiding ability are indeed difficult to surpass. It is of interest to note in this connection that Douglas Motors during 1929 disposed of no less than 1,300 D.T. models, which speaks for itself. Two D.T. models are marketed, D.T.5, and D.T.6, and their respective prices are £85 and £90. Both have overhead valve engines which are improved versions of the original I.O.M. type (Fig. 2) with mechanical lubrication and dual carburettors. The two machines are identical except in regard to engine capacity where D.T.6 has an extra 100 c.c. Stub exhausts only are fitted unless the contrary is specified, so that the characteristic exhaust crackle which the speedway public loves is much in evidence. It is said that to a certain batch of fast D.T. Douglases recently delivered a propensity towards extra noise, flames, and smoke was imparted by special request! It is curious but understandable how a certain section of the public regards quiet speedway machines with disfavour.

The standard 500 c.c. Douglas D.T. engine running on petrol-benzole mixture develops on the average 27 b.h.p., but this power output can be increased to over $34\frac{1}{2}$ b.h.p. if the engine be super-tuned at the factory under the supervision of F. W. Dixon. The charge for the super-tuning is only £10. Below is an abridged specification of models D.T.5 and D.T.6.

Transmission. Coventry Ultimate $\frac{5}{8}$ in. × $\frac{1}{4}$ in. roller chains used throughout with shock absorber fitted to gear-box chain wheel. There are no chain guards provided. The usual means of adjusting chain tension is adopted, i.e. by sliding engine and/or back wheel. A snag hitherto causing much annoyance in occasional instances has been removed. The rear chain cannot now jump the sprocket, and convert certain victory into defeat at the eleventh hour, for a special metal guide prevents this entirely.

Tank. The fuel tank and oil tank, hold 2 galls. and 8 pints respectively. The auxiliary oil pump is on the off-side. The fuel recommended is 50-50 benzole mixture unless the compression ratio has been raised when special dopes may be necessary to prevent pre-ignition. The tank is finished in cellulose with the usual Douglas colours and panel.

WHEELS AND TYRES. The wheels are of exceptional strength, and have steel hubs serrated both sides in the case of the back wheel, so that the chain sprocket may be fitted when the wheel is reversed. The hubs have heavy axles and taper roller bearings which are capable of withstanding severe loads and side thrusts to which the normal road machine is rarely subjected. Tyres measure 28 in. × 2·5 in., and have special treads.

MISCELLANEOUS EQUIPMENT. No brakes are fitted, the provision of these being contrary to the rules governing the sport of

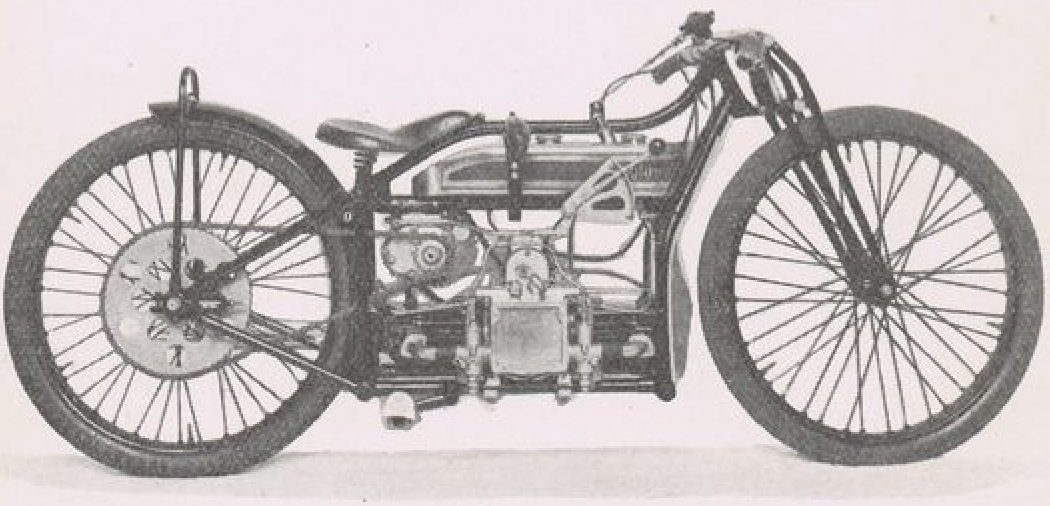


FIG. 32.—THE DIRT TRACK O.H.V. MODELS D.T.5 AND D.T.6

dirt-track racing. They are prohibited, of course, owing to the danger of uncontrollable skidding occurring with riders bunched together on the bends. Control of the D.T. Douglas models is greatly helped by a specially developed type of handlebars which gives maximum control of the machine at all speeds. A large knee hook also keeps the rider's body steady.

A right-hand footrest only is fitted, for D.T. races are mostly run in an anti-clockwise direction, and the inside leg is supposed to be trailed in the accepted fashion with the iron toe-cap gently brushing the cinders! Mudguarding takes the form of a half-guard fitted to the back wheel, and this guard is anchored to a sturdy pushing-off bar.

The exhaust system comprises two large diameter plated pipes, long or short as desired.

ACCESSORIES. Sold together with each machine at the inclusive price are two spare sprockets for altering the gear ratio, two valve springs, spare carburettor jets, a chain link, and a *complete* tool kit.

Weight	265 lb. D.T.5; 270 lb. D.T.6 approximately.
Overall Length	7 ft. ½ in.
Ground Clearance	5¾ in.

MODELS S.W.5 AND S.W.6

ENGINE. This is a 596 c.c. or 494 c.c. unit with overhead valves of exactly the same design as the D.T. engine, but a more efficient silencing system with fish-tail is included and no gauze screen, of course, is placed in front of the engine to protect it from dirt. The twin single lever Amal carburettors have twist grip control as on the D.T. models, but there is no ignition switch.

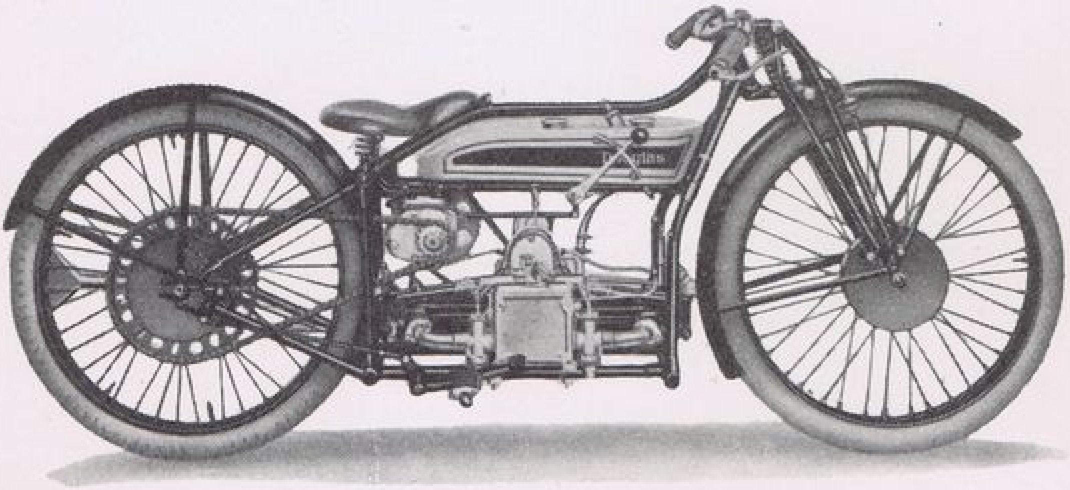


FIG. 33.—SPEEDWAY 500 AND 600 C.C. O.H.V. MODELS S.W.5 AND S.W.6

Engine revs. at 60 m.p.h. . . .	Approx. 3,500 r.p.m., S.W.6; 4,000 S.W.5.
Valve Clearances (Cold) . . .	No clearance.
Magneto Advance	45 degrees before T.D.C. (The above varies with compression ratio.)

GEAR-BOX AND CLUTCH. The three-speed countershaft gear-box which has no kick-starter gives the following top gear—

S.W.5 : 5·2
S.W.6 : 4·5.

The flywheel clutch is specially designed for this high-speed model.

BRAKES. Two brakes of the internal expanding semi-servo type with 8 in. drums are fitted, the front one being brought into action by an inverted lever on the right-hand side of the handle-bars, and the rear by a toe operated pedal adjacent to the off-side footrest. Means of quick adjustment are provided in both cases.

MISCELLANEOUS. All bright parts are nickel-plated, including the exhaust system. A silencer complete with fish-tail and light mudguards are fitted so as to enable the machine to be ridden to the venue of the speed events under its own power instead of having to be towed or otherwise conveyed. A sidecar (Fig. 37) may be attached if required.

Maximum Speed	90 m.p.h., S.W.5; 95-100 m.p.h., S.W.6 solo, and 75, 80–85 sidecar respectively.
Weight	280 lb.
Overall Length	7 ft ½ in.
Ground Clearance	4¾ in.

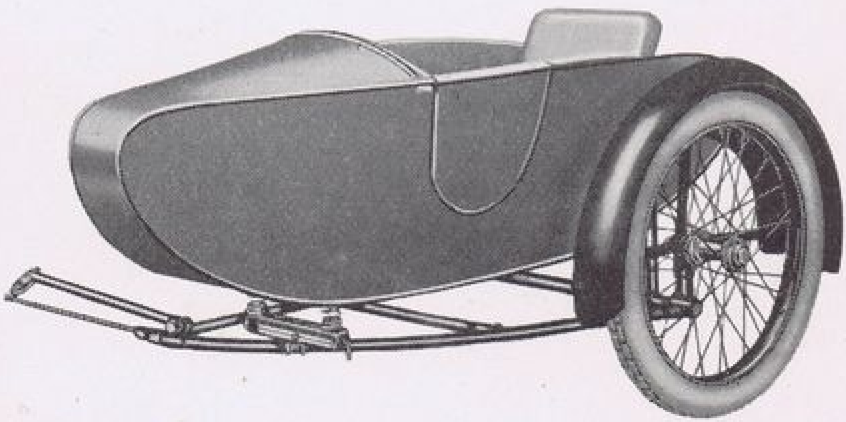


FIG. 34.—THE 600 C.C. SPORTS SIDECAR WITH DOOR
A 350 c.c. Light Sidecar, similar to above, without door is obtainable

The foregoing is a complete and accurate description of Douglas motor-cycles, and it will be agreed that the range is extraordinarily good, and represents remarkable value for money. No prospective purchaser can do better than buy one of these models, and the information given in this chapter it is hoped will help considerably towards deciding *which* model it shall be. In conclusion, passing reference will be made to the very comfortable and handsome looking sidecars which may be obtained at prices varying from £12 to £20.

It is generally agreed that where much passenger work is undertaken a sidecar is preferable to the pillion seat, which is so much abused by coroners but defended by such eminent medical authorities as Sir Arbuthnot Lane, who points out that in 1929 only 22 per cent of motor-cycling accidents occurred in connection with pillion riding. Below is a summary of the 1930 sidecars.

DOUGLAS SIDECARS

All 1930 Douglas models can be fitted with sidecars and those who require them should make sure of obtaining the sidecar specially designed for their particular model. A large percentage of accidents to combinations is due to the fitting of a sidecar unsuited to the machine. The case of a machine leaning in or out from the sidecar is generally the outcome of this fault, and, apart from the obvious danger, results in heavy wear on the tyres and generally in a distorted frame. By fitting sidecars and chassis specially designed for the machine, the rider will ensure both safety and satisfaction. Three types of sidecars are marketed by Douglas Motors, Ltd., the Sports, the Super-Sports, and the Touring. Of these, there are also special models for individual machines, thus the smaller models each have sidecars specially made for them,

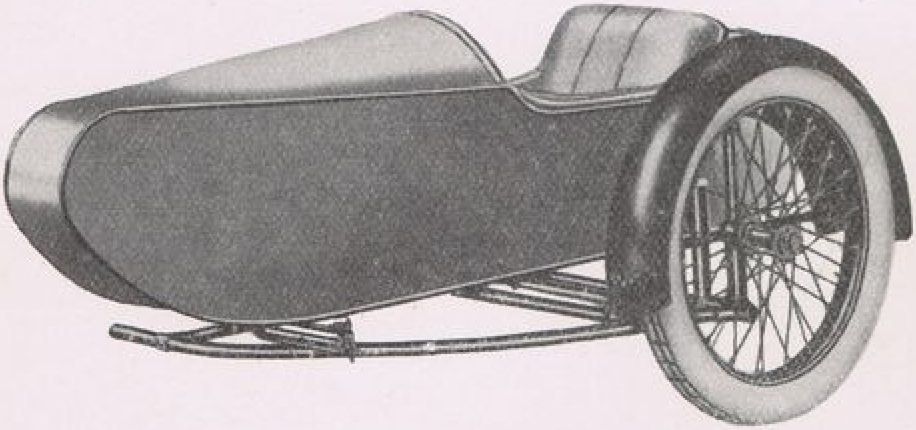


FIG. 35.—THE 600 C.C. SUPER SPORTS SIDECAR WITHOUT DOOR

as also do the racing models. The chassis for the models H.3, T.6, and S.6 are especially worthy of note. They are so constructed that they can be fitted in a very few minutes and are positively self-aligning, a valuable asset to the busy man. Following the Douglas principle, all lugs for sidecars are brazed on to the standard machine frame, thus obviating all unsightly and inefficient clips. Another very commendable feature is the method of attaching the mudguard to avoid vibration. On all 1930 sidecars the rear seat squab can be adjusted to four separate positions. The bodies of the sidecars can be fitted with numerous extras, such as luggage grids, hoods, etc. They are comfortably upholstered with well-padded American cloth, and are finished in Douglas blue. Special tradesman's bodies can also be supplied to order.

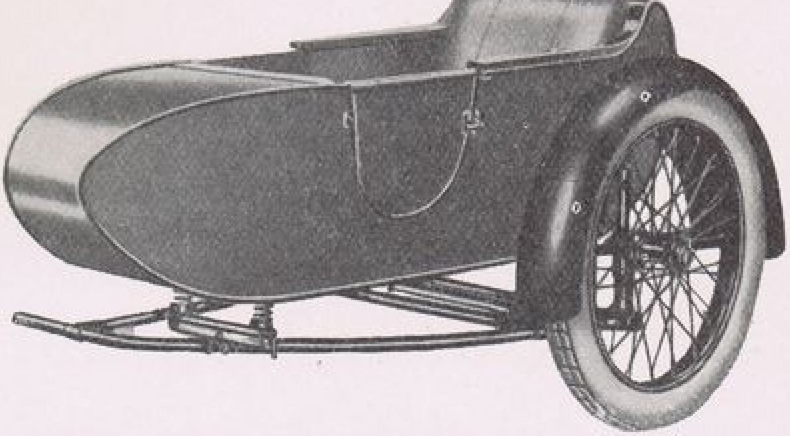


FIG. 36.—600 C.C. TOURING SIDECAR WITH DOOR

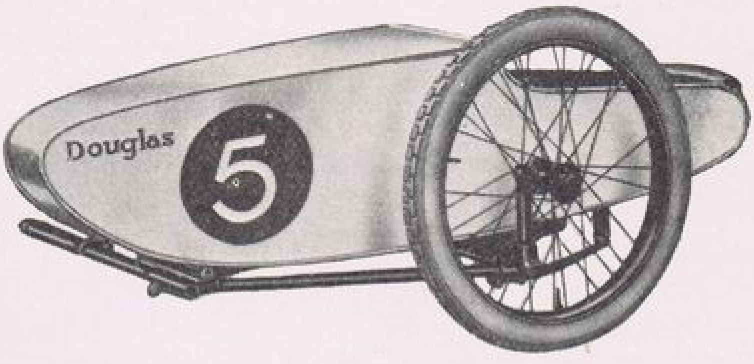


FIG. 37.—ALUMINIUM RACING SIDECAR, SUITABLE FOR S.W.5 OR S.W.6

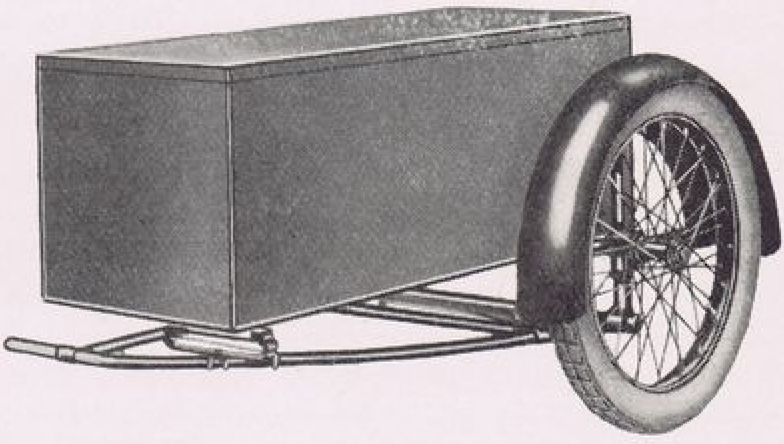


FIG. 38.—TRADESMEN'S BOX CARRIER, FOR 350 C.C. MODELS AND 600 C. C. MODELS

CHAPTER III

TAKING THE MACHINE ON THE ROAD FOR THE FIRST TIME

THE owner, having complied with all the necessary regulations, can now prepare the machine for its first journey in his possession. It is customary for the makers to send out the machine tuned up and ready for use with the exception of fuel and engine oil. The gear-box will have been filled at the works, so there is no need for anxiety on this score. Adjustments of a mechanical nature should not be necessary, and, as soon as the machine has been filled with petrol and oil, it should be in running order.

Lubrication. Cheap engine oil is money badly invested, for the performance and life of the machine can be greatly influenced by the quality of oil used. Messrs. Douglas recommend the use of a superior brand, particularly when the engine and bearings are stiff as the result of newness. To this end, therefore, it is better to over oil than under oil when the machine is new, say, until it has done 500 miles.

Insufficient lubrication may cause the moving parts to " seize up," and will certainly cause overheating of the engine, excessive noise, and rapid wear.

All the present models with the exception of the speedway models have dry sump lubrication, and the sole responsibility of the rider to ensure adequate engine lubrication consists of maintaining the oil in the sump at the correct level and keeping filters clean. As much lubricant should be poured in as the sump will take, and when the engine is running an occasional glance should be made at the indicator. This advice applies also to the 1929 350 c.c. models. After, say, 1,000 miles the sump should be drained and refilled with fresh oil.

Douglas machines prior to 1929 were fitted with two distinct oiling systems, and a careful study of them will repay the rider. The two systems (see Fig. 56) are—

1. A mechanical pump, which is situated on the inside of the timing chest cover, working through a sight-feed indicator on the top of the tank, and

2. A conveniently placed hand pump working through the same sight feed.

The earlier " E.W. " type machines were fitted with " suction " pumps, but the more recent models had the "pressure" system. The pumps are perfect in action if care is taken of them and all joints are kept perfectly airtight. All oil passing to the engine passes through the sight-feed glass.

The best rate of drip will be found by experiment. As a general indication, it may be said that there should not be a continuous stream flowing through the sight feed, but it should be adjusted so that one pumpful lasts about 5–7 miles.

Too great a rate will result in the emission of blue smoke from the exhaust pipe, the oiling-up of the sparking plugs, and excessive oil consumption. New engines require plenty of oil, and it should be borne in mind that on account of the necessary tightness of all moving parts, which is desirable in a new machine, the speed of the machine should not exceed 25-30 miles per hour on top speed, or 20 m.p.h. on second speed for at least the first 500 miles. This is most important.

As all oil eventually loses its lubricating properties, the stale oil in the crankcase should be drained out every 500 miles or so by means of the drain plug placed in the crankcase for this purpose.

This stale oil, however, need not be wasted as it can be used for many purposes where the use of a high grade oil is unnecessary. For instance, in overhauling the machine, all nuts and bolts could be left lying in a vessel of the oil so that when required they could be fitted together perfectly smoothly due to the presence of oil on the threads.

Oil is also useful for freeing an unusually tight nut or bolt; after placing a few drops on the thread and leaving for a few moments it will usually be possible to unscrew it.

Starting Up. See that the tank and oil sump are filled with petrol and oil respectively, and that the gear lever is in neutral.

(*a*) Turn on the tap in the pipe leading from the tank to the carburettor by turning the arm of the tap or pushing the button right forward, and then flood the carburettor by pressing down the "tickler" (the knob on top of the float chamber) until petrol is seen to drip from it.

(*b*) Advance the magneto by pushing the lever inwards about halfway.

(*c*) Close (push outwards) the carburettor air lever (the shorter of the two on the right-hand handlebar of the $3\frac{1}{2}$ h.p. machines).

(*d*) Open (push inwards) the throttle lever about a quarter of its full travel.

Stand astride the machine, raise the exhaust lifter (if fitted), depress the kick starter with the right foot, or pull up the "joystick" with the right hand, and at the same time drop the exhaust

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(*b*) Advance the magneto by pushing the lever inwards about halfway.

(*c*) Close (push outwards) the carburettor air lever (the shorter of the two on the right-hand handlebar of the $3\frac{1}{2}$ h.p. machines).

(*d*) Open (push inwards) the throttle lever about a quarter of its full travel.

Stand astride the machine, raise the exhaust lifter (if fitted), depress the kick starter with the right foot, or pull up the " joy-stick " with the right hand, and at the same time drop the exhaust

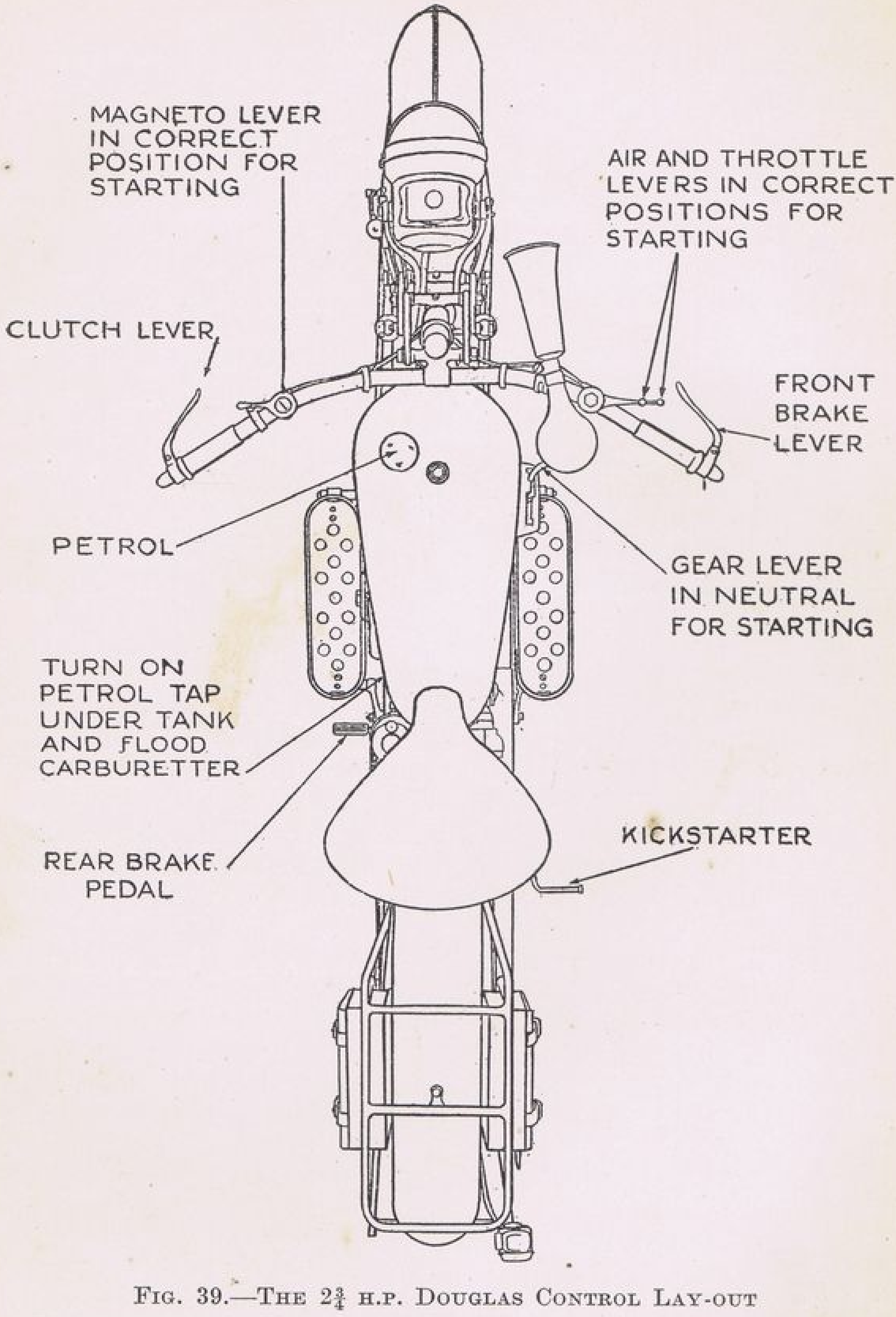


FIG. 39.—THE $2\frac{3}{4}$ H.P. DOUGLAS CONTROL LAY-OUT

The above is applicable to models L.3 and H.3. In the case of the more powerful machines, namely, models T.6, S.5, and S.6, the system is similar except that twist grip controls are provided, and there is no separate air lever. Exhaust valve lifters are not now fitted lever. The engine should then fire. This operation is simplicity itself after the knack has been acquired, so easy is the engine to kick over.

In the case of the large Douglases the strangler valve lever of the carburettor should be in the top position and gradually lowered as the engine warms up, until it is fully open, when normal temperature is reached.

Having started the engine, lift the clutch lever (the lever clipped to the left handlebar), and, holding it right up, move the gear lever into the required position. Slowly release the clutch lever and the machine will move forward. In starting out, do not be afraid to "rev" the engine or it will stop when the clutch is let in, but do not over race it, as this is bad for the bearings.

A little practice will make this operation perfectly simple. As soon as the machine is well under way, lift the clutch lever momentarily and pull the gear lever into the next notch and repeat this operation to get into top or third gear. The air lever should be opened to about two-thirds of its full travel, and the speed of the machine can then be controlled by means of the throttle lever. The exact position of the air lever depends on several factors: the size of jet, the temperature of the surrounding air and the load imposed on the machine. If the air lever is opened too far, loss of speed and power will be evident, with perhaps spluttering or "popping back" through the carburettor. If it is kept closed more than is necessary, irregular running and heavy petrol consumption will be the result.

If the rider keeps the air lever open as far as it will go without loss of power, he will not be far wrong. For starting purposes, it should, however, be completely or almost completely closed, and if an extra load comes on to the engine in the way of a steep hill or strong head wind, the lever may be slightly closed with advantage. Experience, however, will soon teach the novice the best position under varying conditions.

As a rule the magneto may be left fully advanced and, except when climbing very steep hills in top gear, it will not be necessary to retard it. If it is remembered that the faster the engine runs the more advance may be given, and vice versa, the question of advance and retard will be easily solved. Advancing the spark is effected by moving the lever on the left-hand handle bar inwards.

Do not alter the speed of the machine continually and unnecessarily. It is wasteful of petrol and it causes undue wear of the engine. Use the throttle lever in conjunction with the clutch, and, when slowing up, try and judge the speed of the machine, so that the least amount of usage of the brakes is necessary except in an emergency. Any difference in the speed of the machine, whether accelerating or slowing down by braking takes effect through the back wheel and the transmission to the engine. It is advisable therefore to make all movements of the throttle gradually. It imposes very considerable strain on all parts of the machine to try to accelerate quickly. It is equally advisable to shut off the throttle gradually and to slow the machine up gradually, finally applying the brake at the very end. Quick accelerations and decelerations literally eat up tyres, and are wasteful in petrol, and generally hasten wear and tear. They should, therefore, be avoided.

Always be sure to raise the clutch lever fully when changing gear, as any attempt to do so without fully disengaging the clutch will result in a noisy and destructive action of the gear-box.

Care of Tyres. The degree to which the tyres are inflated has a distinct effect on the performance of the machine, and the comfort of the driver. If the tyres are blown too tight, road shocks are transmitted throughout the frame, and the rider will feel every pothole, in spite of spring forks and a spring saddle. On the other hand, if the tyres are run in a flabby condition, excessive wear takes place and the rim of the wheel may be permanently damaged through coming into contact with the road. Compared with a push bicycle, the tyres of a motor-cycle may seem hard, but the extra weight, speed, and load must be borne in mind, and if the tyres are pumped to such a pressure that they bulge slightly when the weight of the rider comes on to the saddle, a good average pressure will have been given to them. In these matters it is well to be accurate. A Schräder gauge of the type which may be screwed on to the nozzle of the tyre valves may be bought for a few shillings, and is an extremely valuable acquisition. With this, the tyre pressure may be ascertained and kept to the correct figure. The back tyre should be inflated slightly more than the front (16 lb. per sq. in. approx.). A variation of 3 lb. either way is of no material concern.

Driving a Combination. A rider who has only ridden a solo machine will experience some uneasiness the first time he takes a motor-cycle and sidecar on the road. The camber of the roads and rise and fall of the sidecar wheel will give him the impression that he is losing his balance, and it takes a certain amount of mental discipline to avoid the very natural desire to move the handlebars in order to balance the machine. There is also a slight drag on the steering due to the sidecar being on one side of the motor-cycle, but this strangeness soon goes after a short spin on the road. If it is not possible to obtain the help of a friend who rides a combination, it is advisable to put a heavy weight in the sidecar, as it prevents any tendency of the tyre from bouncing or lifting from the road.

Turning Corners with a Combination. Right-hand bends may be taken at a speed practically only limited by the grip of the tyres on the road. Left-hand bends, however, must be taken with care as centrifugal force tends to make the sidecar lift and the combination may be overturned if the bend is taken too fast, especially if the sidecar is only lightly loaded or not loaded at all.

The sidecar passenger should always make it a practice to lean away from the motor-cycle when the combination is turning a left-hand bend, as this helps to prevent any risk of overturning at speed.

Stopping and Starting on Hills. On steep hills it is important to leave the machine facing uphill if placed on the stand, as this prevents any possibility of it rising off the stand by its own weight, as it may quite possibly do if left facing downhill.

Starting by kick-starting when facing uphill requires some practice and it is easy to "stall," i.e. stop the engine several times before one makes a clean getaway on a hill. It is necessary, with a clutch machine, to run the engine much faster than when getting away on the level. The procedure is as follows—

Stand, or sit, astride the saddle (according to whether it is a solo machine or combination) and, holding it by means of the brake, hold out the clutch and engage the lowest gear. As the clutch is engaged, and it must be let in slowly, the brake must be released and the engine speeded up as the machine begins to move on the road. This is not so easy as it sounds, and the novice will for some time either stop his engine or get away with a jerk that is by no means graceful, or desirable from the point of view of the undue strain placed on the transmission.

It is always best to do things in the easiest way, and it will be found a great help in starting on a hill if there is some means of holding the bicycle other than the brakes. For instance, if there is a pavement, the bicycle can be run down gently into the curb so that the wheel is scotched by the curb. It is then possible to start away quite simply without any difficulty, as the brakes need not be manipulated at all.

Use of Brakes. All motor-cycles must be fitted with two independent brakes in order to comply with the law. When going down long hills, use them alternately, in order to allow them to dissipate the very considerable heat generated when in use. The brakes must be used cautiously when riding on greasy surfaces, and especially is this the case when riding solo, in order to avoid the risk of skidding. Skidding usually only takes place when the wheel is locked, and to this end it is advisable to put the brakes on and off in a series of jabs as this tends to prevent the locking of the wheels. If the rider feels a skid commencing, he must release the brakes until he has regained his balance. A back wheel skid can often be " corrected " by skilful steering, but a front wheel skid when riding solo usually results in the rider being deposited in the road before he has time to appreciate what is happening. It is, therefore, a very sound rule *never* to use the front brake on skiddy roads. The engine also forms a useful brake on account of its compression, and it is frequently sufficient simply to close the throttle when running downhill. If this is not sufficient, it is possible to increase the braking power of the engine by changing into a lower speed. When descending winding hills, where caution is necessary, it is advisable to change down into that gear which has to be engaged to climb the hill. By so doing, the life of the brakes is considerably prolonged and the latter are left free for use in an emergency.

The Rules of the Road. Although the rider may, after two or three short runs, feel full of confidence, he should confine his runs to roads that he knows are free of traffic, sudden turns and hidden turnings, and to this end the early morning is perhaps the best time for practice spins. Stopping and starting, gear changing, turning corners, etc., should be practised assiduously. This, perhaps, may seem irksome to the beginner anxious to cover a lot of ground, but he should endeavour so to know his machine that it is, as it were, part of him, and to make all the various controlling operations such unconscious movements that he instinctively and always does the right one in any and every emergency. Not until then, for his own and other road users' sakes, is it advisable to venture amongst traffic.

When on the road, there are numerous precautions to be taken. Particular care should be taken when going round corners, especially if they are of the kind known as " blind." Cross roads are another source of danger, and the greatest care should always be taken when approaching them, warning being given to those behind by signalling with one hand as shown in Fig. 40.

Stopping in Traffic. With a clutch machine there is no need to stop the engine when coming to rest in traffic unless the stop is for more than three or four minutes. Slow up by using the back brake; disengage the clutch and put the gear lever into neutral, closing the throttle until the engine only just runs, or, as it is known, " ticks over."

CHAPTER IV

THE ENGINE AND HOW IT WORKS

THE Douglas engine is of the horizontally-opposed, twin-cylinder, four-stroke type, which means that it has two cylinders mounted so that they point in opposite directions, and that each cylinder "fires," or gives a power stroke once every other revolution.

For the benefit of those readers who are not familiar with the functioning of such an engine, a brief description is given. Each cylinder is, in effect, a pump so designed that it draws in an explosive mixture of petrol vapour and air and compresses it. An electric spark ignites the mixture and the resulting explosion drives the piston back down the pump, the energy so formed being made to revolve a flywheel which in turn drives the motor-cycle by a suitably arranged chain transmission system. The exploded mixture having given up the greater part of its energy to the flywheel, is of no further use, and is pumped out of the engine, and passes away via the silencer and exhaust pipe.

The spark is generated by a small machine known as the magneto, and the explosive mixture is provided by the carburettor, both of which will be dealt with in detail farther on in this chapter.

In order that the routine of events shall take place in the right order the passage of the mixture in and out of the engine is controlled by valves, the mixture passing in via the inlet valve and out via the exhaust valve. Considerable heat is generated whilst the engine is running and this heat is dissipated by means of radiating fins so placed that they are cooled by the rush of air past the machine as it runs on the road. If the reader refers to Figs. 43, 44, 45 and 46, he will see the working of the Douglas engine shown diagrammatically.

Reference to Fig. 43 shows on the *first stroke,* the inlet valve of the left-hand cylinder open and the descending piston sucking in the mixture provided by the carburettor (not shown). During this stroke, the exhaust valve remains closed. Whilst this is happening, the power stroke is taking place in the right-hand cylinder, forcing down the piston. During the power stroke, both inlet and exhaust valves are shut in order that all the pressure formed by the explosion may be conserved in the combustion chamber.

Fig. 44 shows the state of affairs on the *second stroke.* In the left-hand cylinder the mixture previously drawn in is being compressed in order to add to the power of the explosion, both valves being of necessity closed for this purpose.

In the right-hand cylinder the exploded mixture, having expended its energy, is being forced out of the cylinder, the exhaust valve being opened to allow it to pass away.

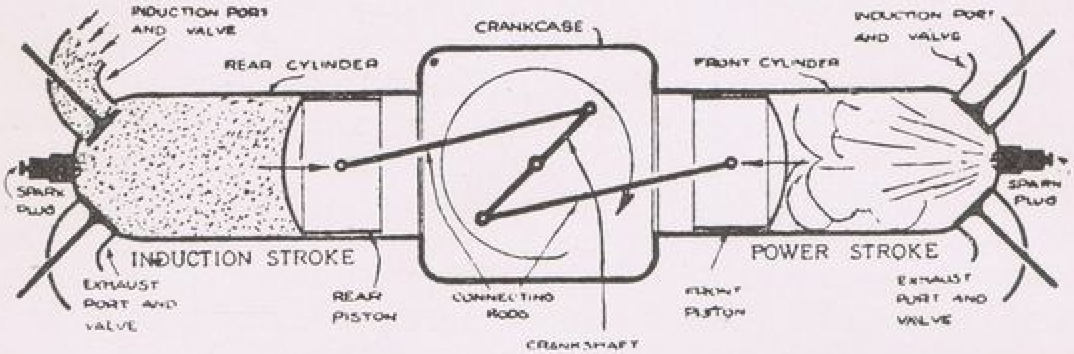


Fig. 43.—First Stroke

Rear Cylinder — Induction Stroke
Inlet valve opening, piston descending and sucking into the cylinder combustible mixture of petrol and air. Exhaust valve closed during the stroke.

Front Cylinder — Power Stroke
Piston forced down by expansion of gases which are ignited by a spark occurring at the points of the sparking plug when both valves are closed and when the combustion chamber is gas-tight.

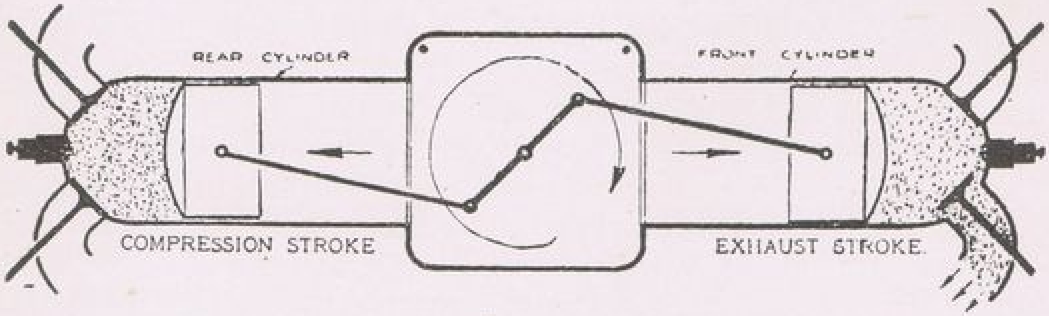


Fig. 44.—Second Stroke

Rear Cylinder — Compression Stroke
Both valves are closed and the piston ascends, compressing the explosive mixture into a confined space in the head of the cylinder.

Front Cylinder — Exhaust Stroke
Exhaust valve open, piston ascending, forcing out the burned gases through the exhaust into the atmosphere to make room for a further supply of explosive mixture.

On the *third stroke* the explosion is taking place in the left-hand cylinder and the right-hand cylinder is on the induction stroke, i.e. it is drawing in a charge of mixture. (*See* Fig. 45.)

Fig. 46 shows the *fourth stroke.* In this the left-hand cylinder is being exhausted of its burnt mixture to make it ready for a new charge of explosive gas and the right-hand cylinder is compressing the explosive charge ready for the following stroke.

The cycle is thereby completed, and the cylinders and pistons are returned to their original starting point ready to recommence the operations through another cycle.

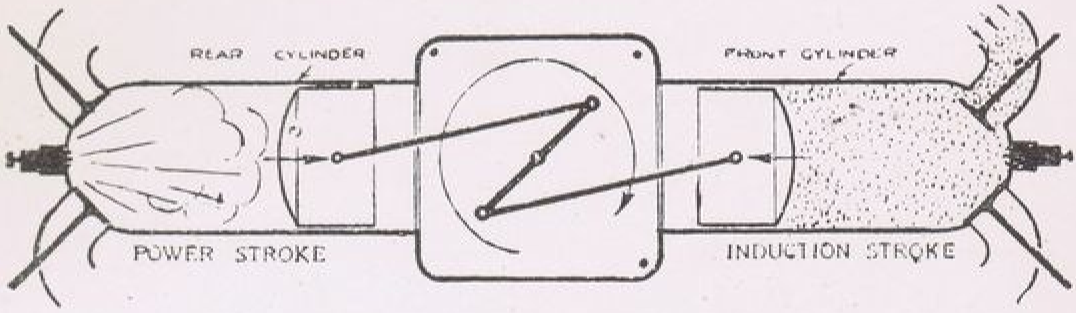


FIG. 45.—THIRD STROKE

REAR CYLINDER — POWER STROKE
Piston forced down by expansion of gases, which are ignited by a spark occurring at the points of the sparking plug when both valves are closed and when the combustion chamber is gas-tight.

FRONT CYLINDER — INDUCTION STROKE
Inlet valve opening, piston descending and sucking into the cylinder combustible mixture, petrol and air. Exhaust valve closed during the stroke.

These events follow one another in rapid sequence, the speed depending mainly on the strength and quantity of the mixture fed to the engine and the load imposed upon it.

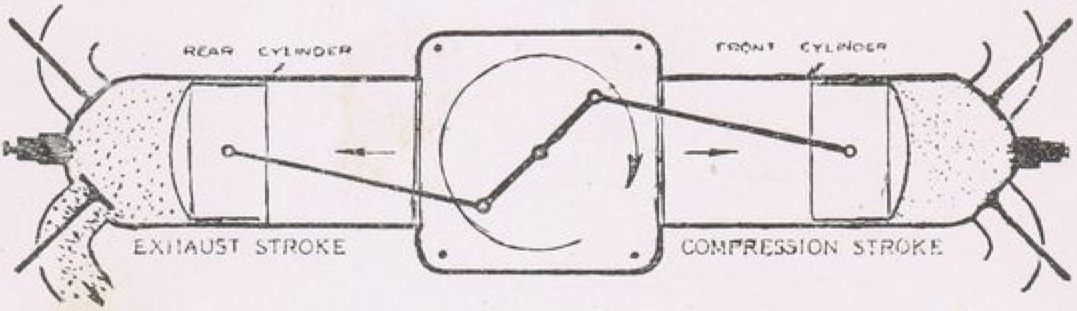
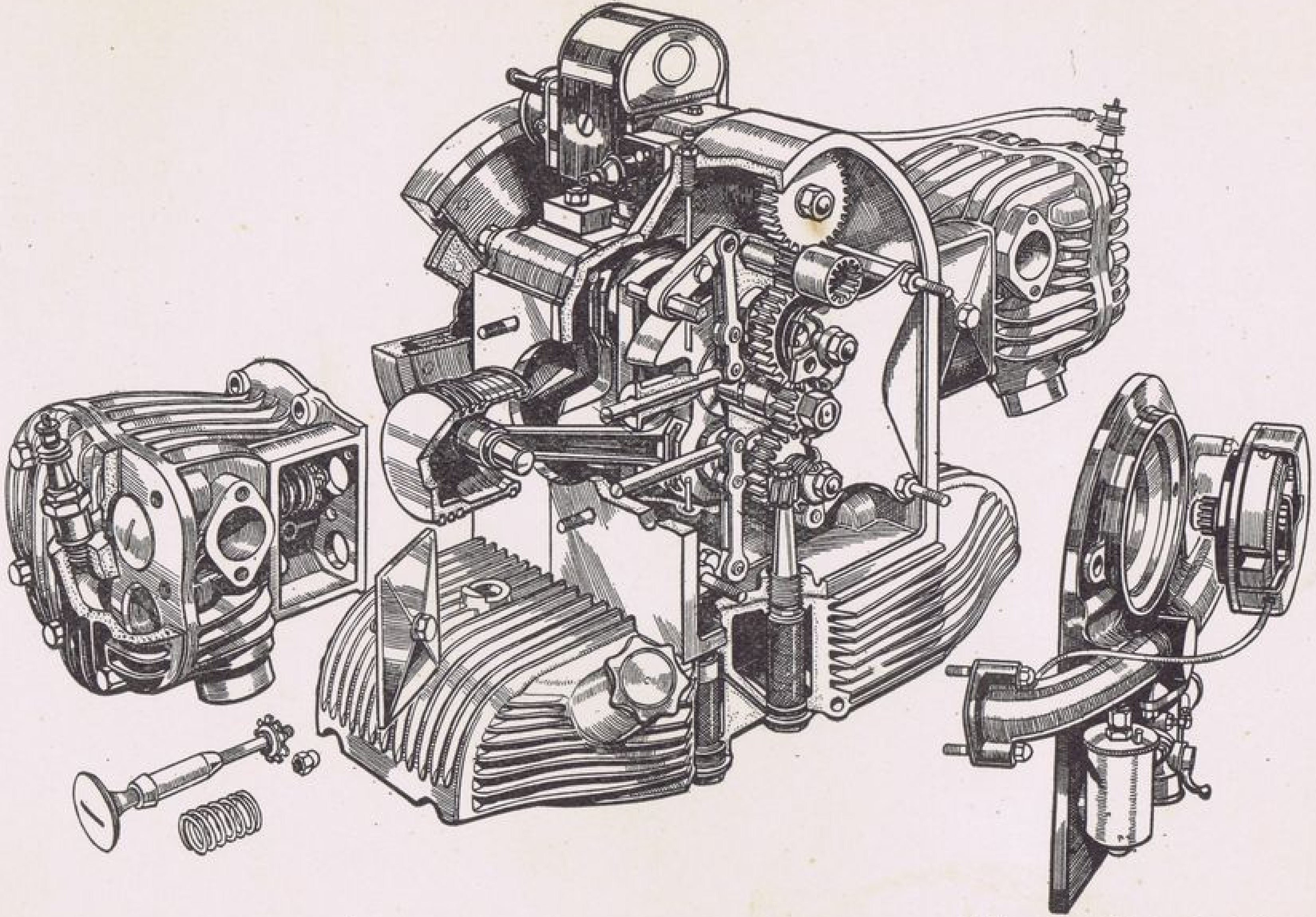


FIG. 46.—FOURTH STROKE

REAR CYLINDER — EXHAUST STROKE
Exhaust valve open, piston ascending, forcing out the burnt gases through the exhaust into the atmosphere to make room for a further supply of explosive mixture.

FRONT CYLINDER — COMPRESSION STROKE
Both valves are closed and the piston ascends, compressing the explosive mixture into a confined space in the head of the cylinder.

The horizontally-opposed engine has, from an engineering point of view, many desirable features, chief of which are the facts that vibration can be eliminated by the perfect balance of the moving parts, since the centre of gravity of the whole unit remains always in the same place, and from the fact that the impulses given to the flywheel by the explosions are at regular intervals, a fact which helps considerably towards smooth running and absence of wear and tear.



(*From the " Motor-Cycle "*)

FIG. 47.—THE NEW 500 C.C. AND 600 C.C. DOUGLAS ENGINE PARTLY SECTIONED SHOWING CONSTRUCTION

The Principle of the Carburettor. The duty of the carburettor is to measure out the required quantity of petrol, to turn the petrol into spray, to mix it with the correct amount of air and thereby to form an explosive mixture, or, as it is often termed, "gas," and to control the entrance of the latter into the cylinder at the will of the rider. The instrument primarily consists of a float chamber, a jet, a mixing chamber and a throttle. (Fig.48).

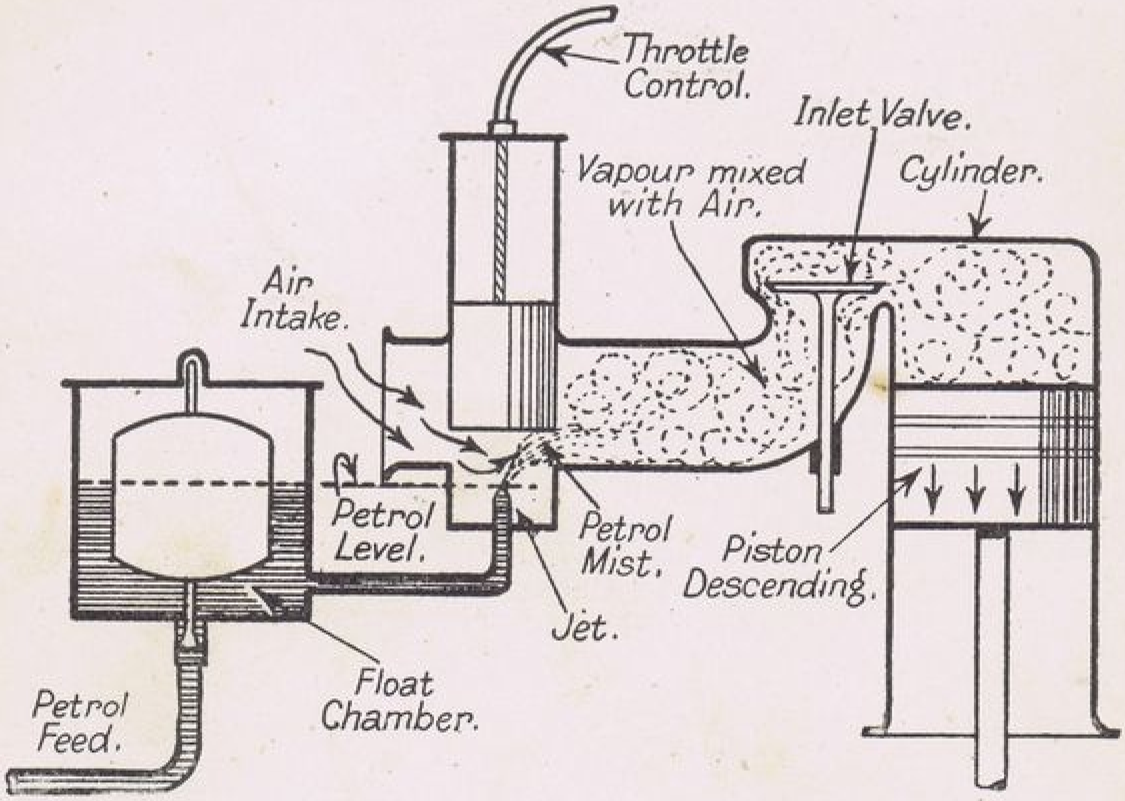


FIG. 48.—ILLUSTRATING PRINCIPLE OF THE CARBURETTOR

The float chamber feeds petrol to the jet, through a small hole in which it passes into the mixing chamber. Here it mixes with the air which is being sucked into the engine, the amount of mixture passing into the cylinder being controlled at will by means of the throttle, which is in reality a form of tap opened and closed by the throttle lever on the handlebar. The float chamber has in it a hollow float and a needle valve, which prevents the petrol from overflowing when it reaches a certain height, this height being slightly below the point at which the petrol enters the mixing chamber. If the petrol level is too high, petrol will dribble continuously from the jet and be wasted, and if too low, the running of the engine will be affected. Let it be assumed that the petrol in the float chamber is standing at the correct level. The suction stroke in the cylinder creates a partial vacuum in the mixing chamber and a fine stream of petrol sprays up through the jet. The level in the float chamber is reduced and the float no longer supported, drops to a lower level. This allows the needle valve to move away from the seating against which it was held by the upward pressure of the float. The needle no longer obstructing the flow of petrol into the float chamber, the latter can again fill; the float rises and moves the needle, thus cutting off the supply. By this means the float chamber regulates the level of the petrol with which the jet is supplied.

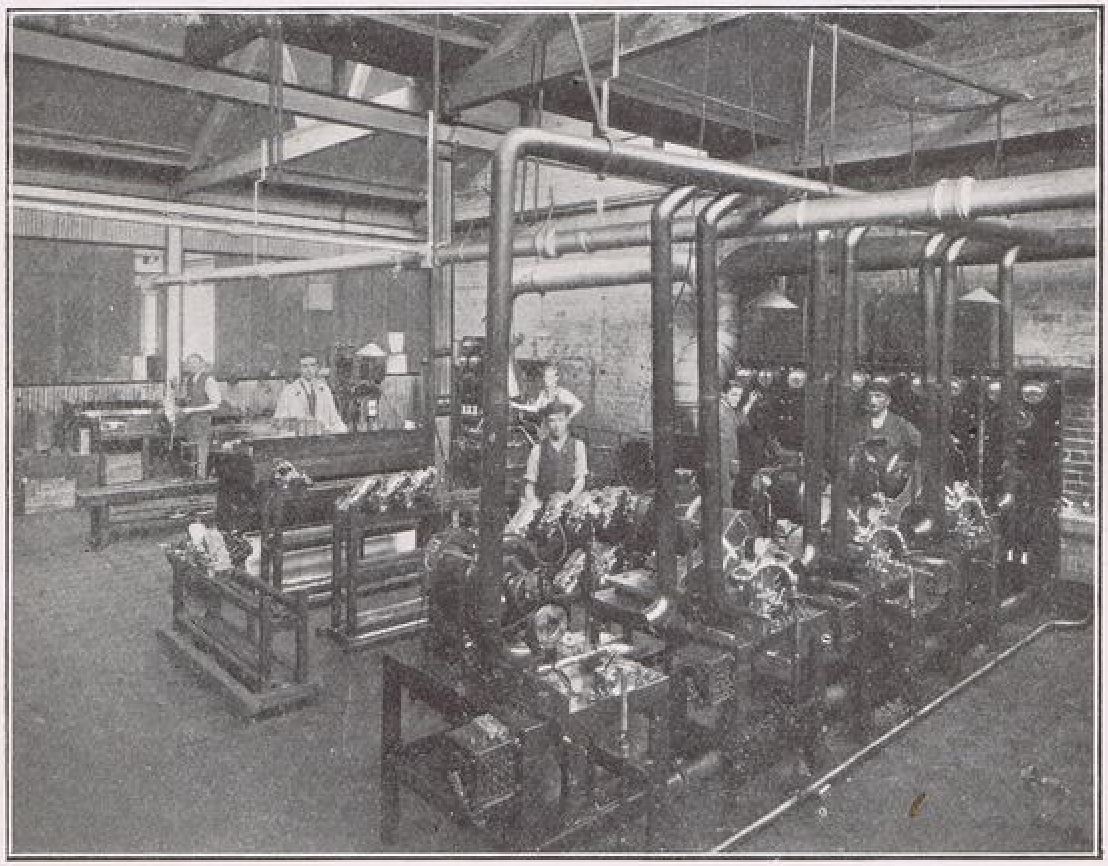


FIG. 49.—THE DOUGLAS ENGINE TESTING DEPARTMENT

The presence of dirt in the float chamber may be the cause of flooding of petrol from the carburettor, by preventing the needle from closing down properly on to its seating. Leaning the machine to one side or the other may also cause flooding by making it impossible for the float to act properly, and if the machine is left for any length of time and especially if leant against the curb or on the slope, the petrol tap should be turned off as a precaution against waste of petrol.

The size of the hole in the jet in the mixing chamber and other details have been carefully fixed after long experiments and should not, as a rule, be altered, except in exceptional circumstances. The jet is removable and another one can be substituted. All

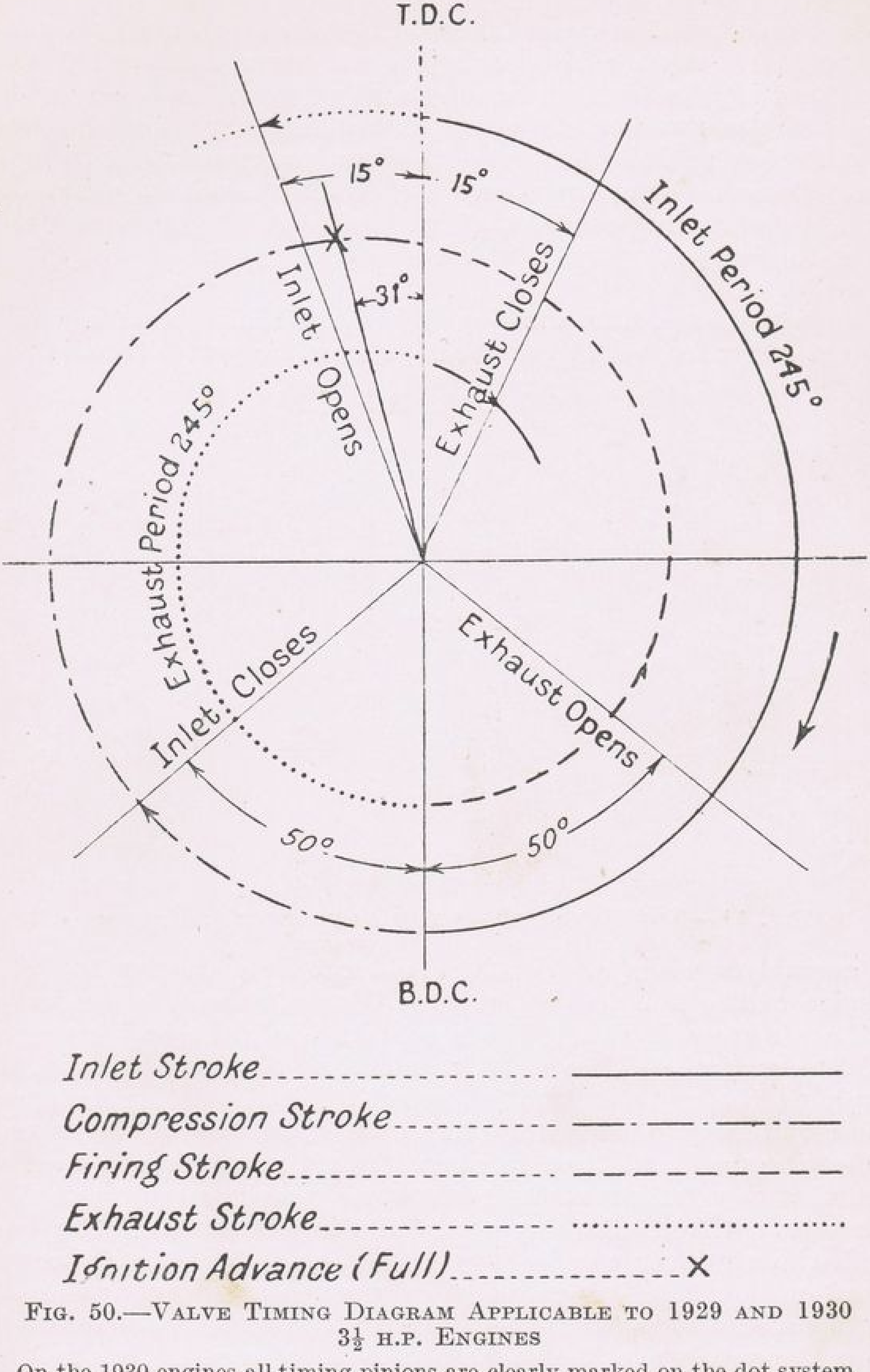


Fig. 50.—Valve Timing Diagram Applicable to 1929 and 1930 $3\frac{1}{2}$ h.p. Engines

On the 1930 engines all timing pinions are clearly marked on the dot system, and re-timing is simplicity itself. Valve clearances are ·006 in the case of both the exhaust and inlet valves with a *cold* engine. The magneto advance is given in degrees, since this is most accurate and the external flywheel lends itself to this method. 31 degrees advance is equivalent to approx. $\frac{5}{16}$ in. on the stroke before T.D.C. $\frac{3}{4}$ in. flywheel peripherial rotation equals roughly 10 degrees jets are numbered in accordance with their sizes, and a number will be found stamped on each jet. A lower number indicates a smaller, and a higher number a bigger jet, as the numbers represent the number of cubic centimetres of petrol which the jet will allow to flow through at a given pressure and in a given time. Some makers, however, stamp their jets with the diameter of the hole in thousandths of an inch. A higher sized jet is better for hilly country and a lower sized jet for use in a very flat district.

As temperature, hills and the slight extra stiffness of the engine when starting from cold require slightly more petrol than is used

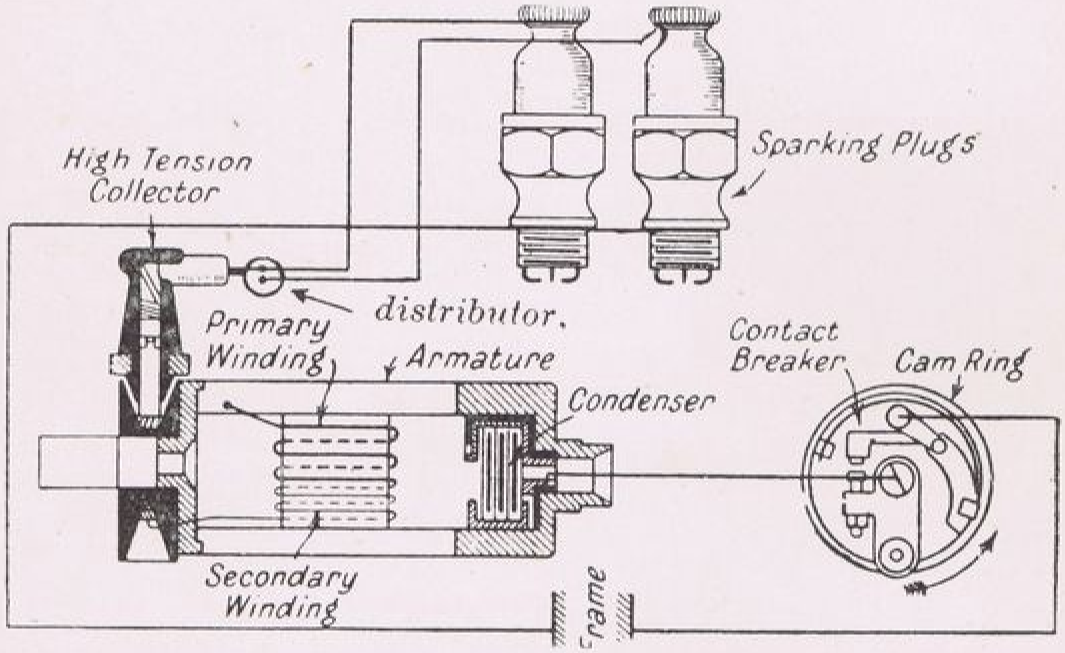


FIG. 51.—THE PRINCIPLE OF THE HIGH TENSION MAGNETO

for normal running, and, as it would not be convenient to alter the size of the hole in the jet each time, a second lever, known as the air lever, is fitted which enables the rider to increase at will the suction on the jet, this increased suction automatically supplying the extra amount of petrol. When starting from cold it is customary to close, or almost to close, the air lever until the engine fires and then to open it until a position is reached, such that any further movement causes uneven running and loss of power. When climbing steep hills or facing a strong head wind, the air lever can be closed *slightly*, but it should not be closed more than is necessary or uneven running and heavy petrol consumption will be inevitable. The exact position of the levers depends upon the make and type of carburettor and the way it is adjusted. Many modern carburettors dispense with the air lever altogether.

The Principle of the H.T. Magneto. The magneto primarily consists of three parts—(1) the *armature*, (2) a "U" shaped *magnet*, (3) the *contact breaker*.

The armature comprises an iron core or bobbin of "H" section, on which are two *windings*: firstly, a short winding of fairly heavy gauge wire, and secondly, on top of the former, a very big winding of fine wire. The first winding is known as the *primary* and the second as the *secondary*. The armature, which can rotate on ball bearings, is placed such that on rotation it periodically cuts across the *magnetic field* of the magnet, and creates a current in the primary winding. Incidentally, the contact breaker forms part of the primary circuit. This current, however, is at a very low voltage—far and away too small to produce anything in the nature of a spark. But if a *break* is suddenly caused in the primary by separating the platinum contacts when the current is at its maximum flow, a high voltage or tension current will be instantly *induced* in the secondary winding—sufficient to jump a small space, if the circuit be incomplete. In this circuit the sparking plug is included, and things are so arranged that, in order for the secondary circuit to be complete, the current must jump across the electrodes of the plug, or, in other words, a spark must occur. Now in the case of the twin cylinder engine, the points in the rotating contact breaker separate twice in every armature revolution (there being two cam peaks), and the armature to which the contact breaker is fitted being driven off the inlet cam wheel by a pinion of the same diameter runs at half engine speed; that is to say, a "break" takes place once every engine revolution, i.e. four strokes of each piston. And if the initial "break" be timed to occur when a piston is at the top of a compression stroke, all the other "breaks" (and therefore sparks) will occur at this point also, and thus the engine will go on firing correctly. Besides the "break" being timed to take place when the piston is in a certain position (which we call "timing the magneto," see page 103), it must also be timed to occur at the moment when the bobbin is having the greatest effect on the magnetic field. This, of course, is allowed for in the design of the design of the magneto, and does not really concern the reader. Also, it is essential that the primary circuit should be complete (i.e. the contacts must be properly closed) both before and after the "break" which should be of very short duration.

The *cam ring*, against which the cam of the contact breaker works, can be rotated by handlebar control through about 30°. thereby giving means of advancing and retarding the spark.

The *condenser* is a device for the purpose of eliminating "arcing," and the *distributor*, a "brush" mechanism for distributing the H.T. current collected off the *slip-ring* (which is connected to the secondary) to the two plug leads.

Function of the Gear-box. This is made clear if the simple principles involved are understood. The reader will agree that work done is proportional to horse-power developed (neglecting transmission losses). An engine may be called upon to do the same amount of work climbing a gradient a quarter of a mile long as it does on a level mile. The essential difference is that the rate of work is much greater in the former case; that is to say, the work is distributed over a shorter distance. Assuming the speed of the motor-cycle to be kept constant in both cases, four times as much work will have to be done in the same time. The number of firing strokes in the case of a direct driven machine is, of course,

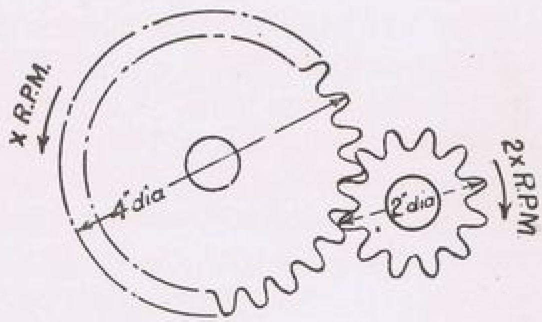


FIG. 52.—DIAGRAM EXPLAINING GEAR RATIO

the same in both cases, and therefore the power of each stroke will have to be increased by enriching the explosive mixture, i.e. by opening the throttle. But suppose that the throttle is wide open, and the output of work does not exceed the load imposed by gravity when climbing; then, naturally, the machine will slow up and probably stop. There is only one way out of the problem, and that is to increase the number of power strokes until the power output is quadrupled in the given time. This means, incidentally, quadrupling the engine revolutions, which can be done by incorporating a gear-box whereby the ratio of engine speed to rear wheel speed can be varied at the will of the driver. The principle on which all gear-box designs are based is the fact that the larger the circumference of a rotating wheel is, the greater is the speed of any point on that circumference relative to the axial speed. Thus a combination of wheels or pinions can be arranged on a countershaft (i.e. a shaft between engine and rear wheel) such that, by the engagement of different pinions of varying sizes, variations of the relative speeds of engine and rear wheel can be obtained.

SOME DOUGLAS FEATURES

The 1930 B. & B. Pattern Semi-automatic Amal Carburettor 123/5/N (Fitted to Model L.3). On early L.3 Models, B. and B. carburettors were fitted. Later type were fitted with flanged type

Amal. This two-lever instrument, which is a development of the original Brown and Barlow one used hitherto in connection with many side valve Douglas machines of 1928 and earlier vintage, embodies the well-known and highly successful Amal main jet needle arrangement, whereby the effective jet bore increases with the throttle opening. The particular carburettor supplied to Douglas Motors has a special air intake which extends over the rear cylinder. In other respects it is a standard Amal.

A sectional view of the carburettor is given by Fig. 53, and a sketch of the pilot jet system by Fig. 53A. From these the principal features of its design and construction may be noted.

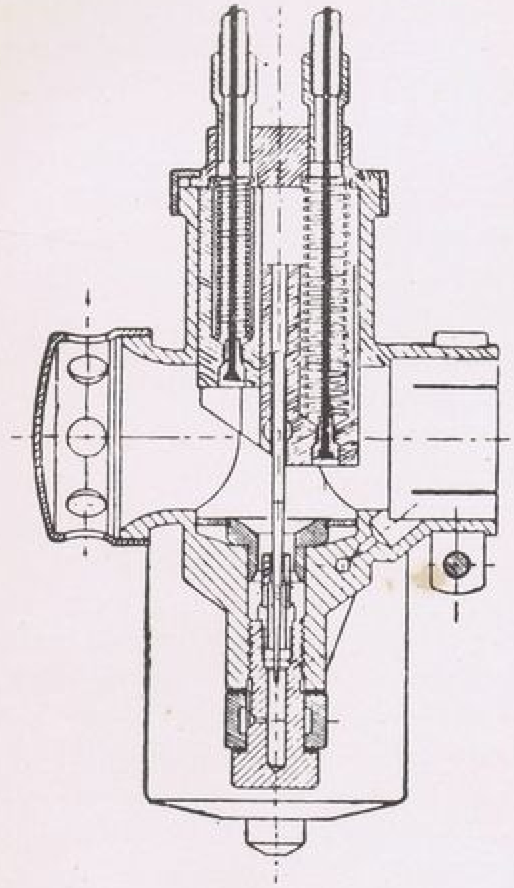


Fig 53.—The Variable Jet B. & B.

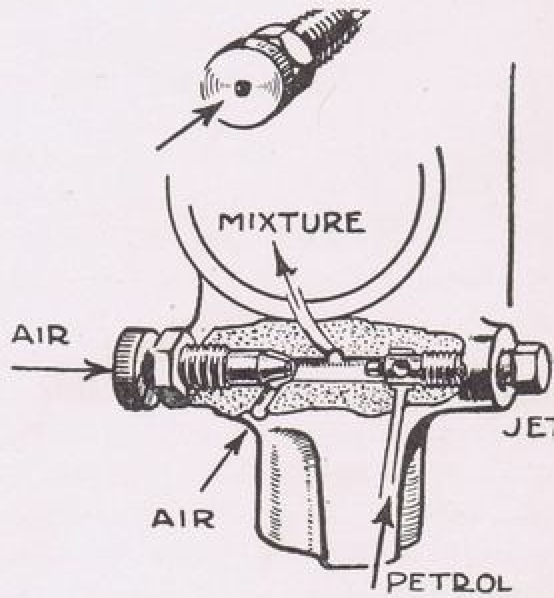


Fig. 53A.—The Pilot Jet System of the B. & B. Type Amal Carburettor

The carburettor has a tapered needle working in its jet orifice so that as the throttle valve is opened the jet orifice is opened proportionately with it. The position of the needle in relation to the jet can be adjusted to suit any particular requirements, such as extreme economy, when the needle is well set down, in which case the engine will be prone to knock and will be slow in acceleration. On the other hand, when the needle is moved up, the acceleration and power will be improved, with a proportionate increase in the consumption of petrol.

A pilot jet is fitted to this carburettor which functions only in the idling position and when the throttle is practically closed.

Referring to the sectional view of the pilot system, it will be seen that the pilot jet screws in from the right-hand side, and opens into a small chamber. This small chamber has a very small communicating hole in connection with the inlet pipe, and it is only when heavy suctions from the engine are available that it has any effect in this small chamber. The amount of suction that is transmitted from the inlet pipe to this small chamber is controlled by the adjusting screw on the opposite side of the hole, which can be moved in or out slightly, so as to put a greater or less depression on the pilot jet, as desired. When the adjusting screw is screwed home the pilot jet is giving its maximum supply of petrol in the idling position (this should only be possible when there are air leaks in the induction system). On the other hand, when the adjusting screw is screwed outwards three or four turns the supply from the pilot becomes practically negligible. Under no consideration should it exceed four turns. The setting up of this pilot to obtain slow running, provided that there are no air leaks, is simply a question of closing down the throttle valve to such a point that the minimum charge of air is taken on which the engine will run, and setting the adjusting screw to give the right mixture at this point. For further details on tuning see page 90. All Amal jets are known by their actual flow when measured by the B.E.S.A. Standards on a Flow meter, and not by drill sizes as hitherto.

The Two-lever Semi-automatic Amal Carburettor, 4/007 (Fitted to Model H.3). On early H.3. Models, B. and B. carburettors were fitted. Later type were fitted with flanged type Amal. This carburettor is perhaps the most popular of all at the present time, and Amalgamated Carburettors, Ltd., have incorporated all the best features of B. & B., Binks, and Amac types. The following description will enable the reader to comprehend its working.

Referring to Fig. 54 showing a sectional view of the instrument, *A* is the carburettor body or mixing chamber, the upper part of which has a throttle valve *B*, with taper needle *C* attached by the needle clip. The throttle valve regulates the quantity of mixture supplied to the engine. Passing through the throttle valve is the air valve *D*, independently operated and serving the purpose of obstructing the main air passage for starting and mixture regulation. Fixed to the underside of the mixing chamber by the union nut *E* is the jet block *F*, and interposed between them is a fibre washer to ensure a petrol-tight joint. On the upper part of the jet block is the adaptor body *H*, forming a clean through-way. Integral with the jet block is the pilot jet *J*, supplied through the passage *K*. The adjustable pilot air intake *L* communicates with a chamber, from which issues the pilot outlet *M* and the by-pass *N*. An adjusting screw is provided on the mixing chamber

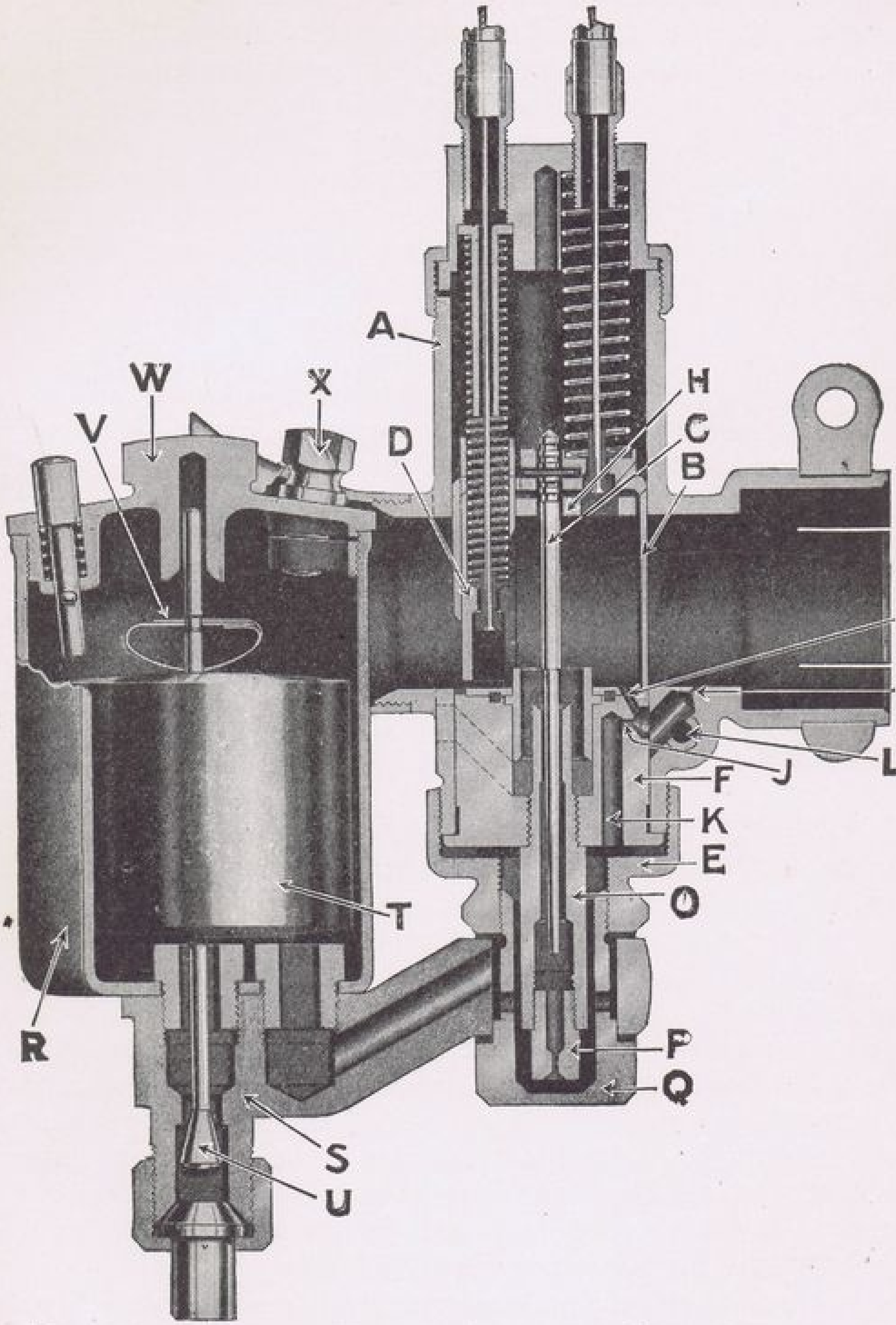


FIG. 54.—SECTIONAL VIEW OF STANDARD AMAL CARBURETTOR

The above carburettor which is identical to the 1930 model is showed with a clip fixing. Actually, however, the carburettor fitted to Model H.3 has a flange fixing wall, by which the position of the throttle valve for tick-over is regulated independent of the cable adjustment. The needle jet *O* is screwed in the underside of the jet block, and carries at its bottom end the main jet *P*. Both these jets are removable when the jet plug Q, which bolts the mixing chamber and the float chamber together, is removed. The float chamber, which has bottom feed, consists of a cup *R* suitably mounted on a platform *S* containing the float *T* and the needle valve *U* attached by the clip *V*. The float chamber cover *W* has a lock screw *X* for security.

The petrol tap having been turned on, petrol will flow past the needle valve *U* until the quantity of petrol in the chamber *R* is sufficient to raise the float *T*, when the needle valve *U* will prevent a further supply entering the float chamber until some in the chamber has already been used up by the engine. The float chamber having filled to its correct level, the fuel passes along the passages through the diagonal holes in the jet plug Q, when it will be in communication with the main jet *P* and the pilot feed hole *K*; the level in these jets being, obviously, the same as that maintained in the float chamber.

Imagine the throttle valve *B* very slightly open. As the piston descends, a partial vacuum is created in the carburettor, causing a rush of air through the pilot air hole *L*, and drawing fuel from the pilot jet *J*. The mixture of air and fuel is admitted to the engine through the pilot outlet *M*. The quantity of mixture capable of being passed by the pilot outlet *M* is insufficient to run the engine. This mixture also carries excess of fuel. Consequently, before a combustible mixture is admitted, throttle valve *B* must be slightly raised, admitting a further supply of air from the main air intake. The farther the throttle valve is opened, the less will be the depression on the outlet *M*, but, in turn, a higher depression will be created on the by-pass *N*, and the pilot mixture will flow from this passage as well as from the outlet *M*. As the throttle valve is farther opened the fuel passes the main jet *P*, and this jet governs the mixture strength from seven-eighths to full throttle. For intermediate throttle positions the taper needle *C* working in the needle jet *O* is the governing factor. The farther the throttle valve is lifted, the greater the quantity of air admitted to the engine, and a suitable graduation of fuel supply is maintained by means of the taper needle. The air valve *D*, which is cable-operated on the two-lever carburettor, has the effect of obstructing the main throughway, and, in consequence, increasing the depression on the main jet, enriching the mixture.

Tuning and maintenance hints will be found in Chapter V.

The Single Lever Automatic Amal Carburettor, 5/116/S (Fitted to Models T.6, S.6, S.5). The automatic carburettor fitted to the large 5 h.p. and 6 h.p. Douglases is an entirely new product and a very interesting one. A sectional view of it is shown at Fig. 55. It is exceptionally compact and designed specially to fit the new Douglas engines with the cast induction manifolds (Figs. 21 and 47). The general design is similar to that of other Amal instruments, but in this particular case the choke tube and throttle slide are arranged horizontally instead of vertically. No air slide is included, but the lever seen at the base of the instrument operates by gentle pressure of the foot a butterfly valve in the air intake, directions for the use of which will be found on

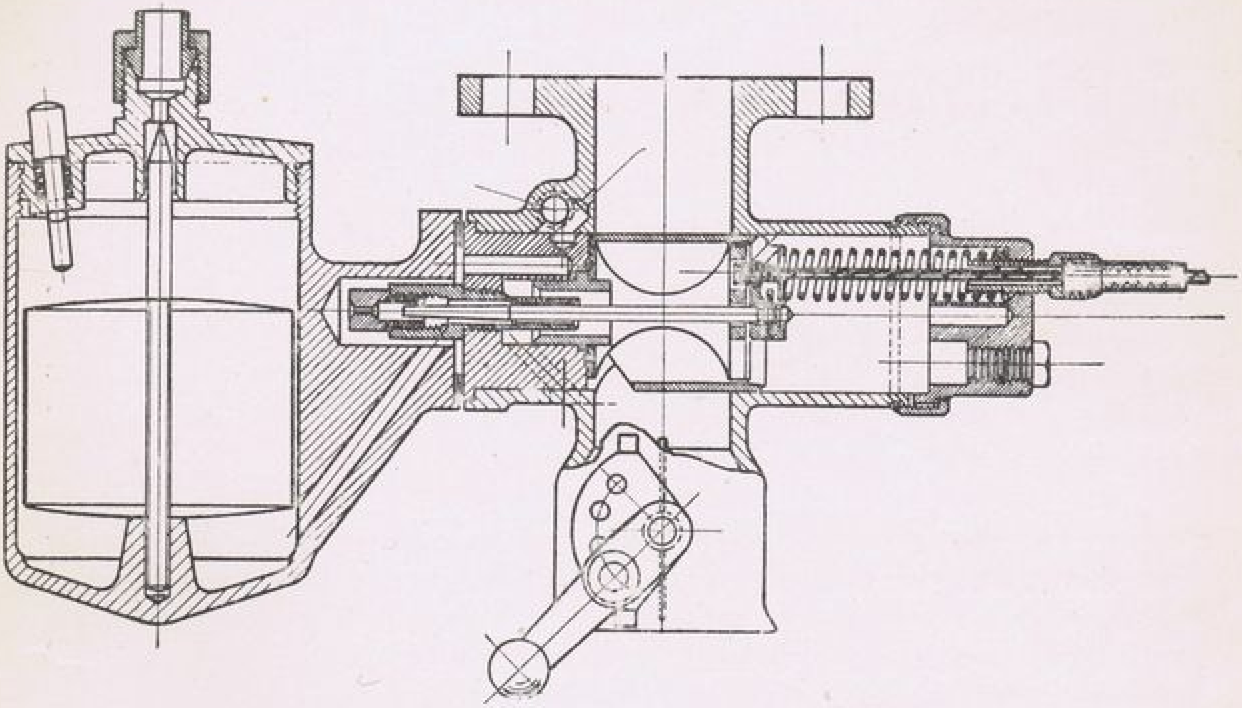


FIG. 55.—THE SINGLE LEVER HORIZONTAL AMAL CARBURETTOR

pages 49 and 50. Air slide with control lever may be supplied as an extra. This valve constitutes what is generally known as an air strangler, a device used only when starting up from cold.

There are two jets, a main jet and a pilot jet, the latter being situated immediately above the main jet. Petrol is supplied direct to the main jet through a narrow channel which enters the jet bore at right angles, the normal petrol level being, of course, slightly below this point. The petrol well surrounding the main jet is also in communication with the pilot jet, but owing to the difference in level between the two jets the pilot jet cannot possibly come into operation until there is a very strong suction indeed over its orifice. This strong suction can only occur with the simultaneous closing of the throttle (when the taper needle reduces the main jet orifice) and the strangler intake valve. It will thus be seen that for normal road use the pilot jet does not operate but comes into use when the throttle is completely closed. When in action the petrol vapour enters the mixing chamber high up via a special by-pass, and air is supplied by another by-pass at the back of the jet in addition to that which passes through the almost closed air intake. All this is clearly demonstrated by Fig. 55. For notes on tuning refer to page 90. It is tuned the same as the 4/007 type.

The Dual 6/001 Automatic Amal Racing Carburettors (Fitted to Models D.T.5, D.T.6, S.W.5, S.W.6). Each of the Speedway Douglases has two Amal racing carburettors with single lever control and interconnected throttles. The instrument used has been primarily designed to meet the conditions imposed by track racing and the use of alcohol fuels, but it will also give excellent service with petrol and petrol-benzole mixtures. It is of the plain jet pattern, and incorporates a pilot and by-pass to guarantee easy starting. The through-way is unobstructed and designed to permit of the maximum volumetric efficiency being obtained.

On the side of the carburettor is an air valve for regulating the mixture strength without obstructing the main gas passage, and this is invaluable for those riders who visit foreign speedways and find marked variations in climate and atmospheric pressure due to altitude. See page 90 for tuning.

The Mechanical Oil Pump with Auxiliary Hand-pump (Fitted to 1928 359 c.c. Machines). This type of mechanical oiling system has two pipes leading to the timing cover, and one delivery pipe from the sight feed lubricator to the front cylinder. The pump is double acting, and driven off the crankshaft.

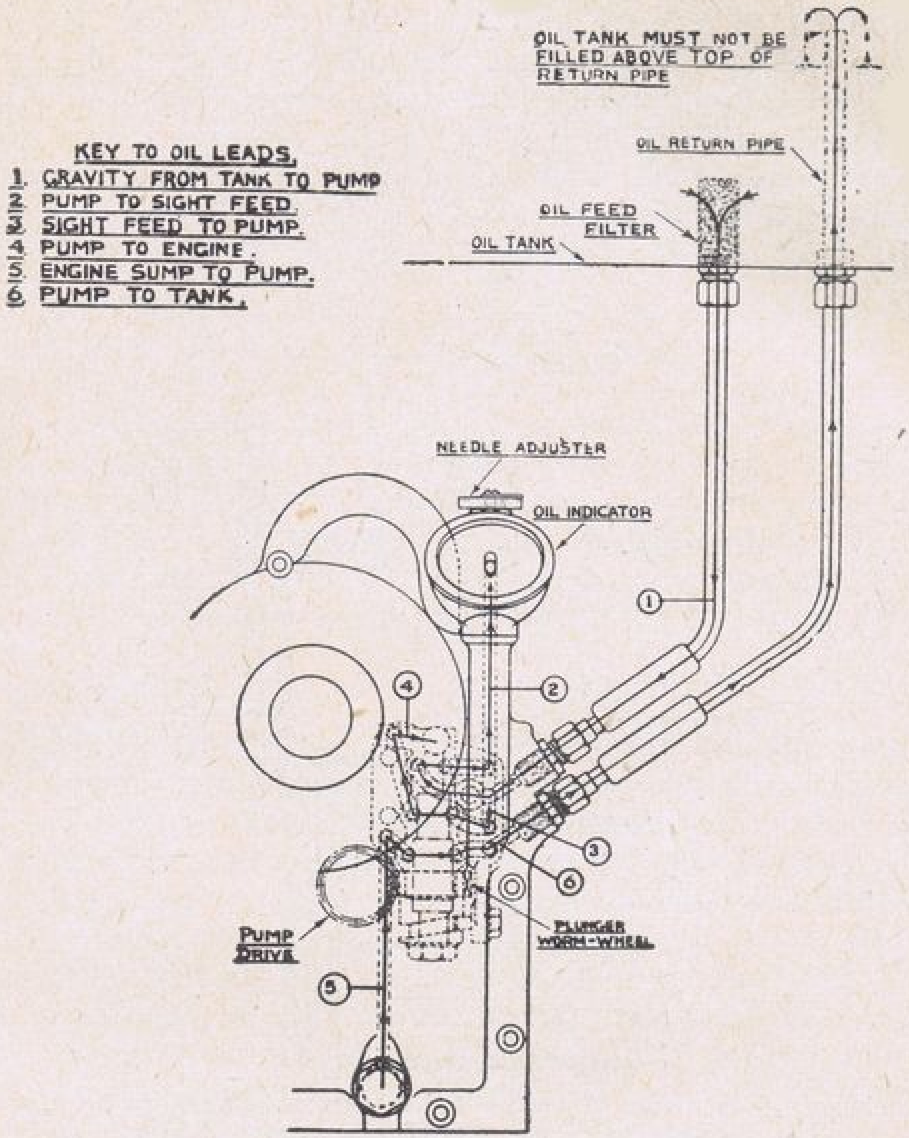
Oil flows by gravity from the tank through the tap and oil feed pipe to the upper part of the pump, which forces it back through the other pipe to the sight feed, where the flow to the engine can be regulated by turning the dial of the needle valve.

Surplus oil, which reaches the timing case from the crankcase is picked up by the lower pump, and forced through a nozzle to the passages in the crankshaft which lead to the big end bearings.

When the tap handle points downwards, the mechanical pump is working, and the hand pump can also be used. When the tap handle points backwards, only the hand pump can be used.

The hand pump should be used when starting, in order to fill the oil pipes. As with the mechanical pump the whole of the oil supplied to the engine passes through the sight-feed lubricator, and so the rate of flow is always under the rider's control.

When using the hand pump, adjust the sight feed valve so that a pump full of oil lasts from 5 to 8 miles, at an average speed of 20-25 m.p.h. When using the mechanical pump adjust the valve so that the oil flows at the same rate.



(From "The Motor Cycle")

FIG. 5.—THE SEMI-DRY SUMP LUBRICATION SYSTEM ON 350, 500, AND 600 C.C. MODELS

On the later Douglas models with semi-dry sump lubrication, oil is gravity fed from the tank to a three-plunger pump of the four-start, worm-drive type and is forced by one plunger through a regulating needle up into the sight feed. A second plunger then forces the oil through a pipe which conveys the oil direct to the big-ends Surplus oil drains to the base of the crankcase and is returned by the third (scavenge) plunger to the oil tank for further circulation. The capacity of the scavenge pump is greater than that of the delivery pump, and this ensures that excess oil does not accumulate in the crankcase. Suitable oilways inside the timing cover reduce the number of joints and external pipes to the absolute minimum, hence the "cleanliness" of the Douglas lubrication system

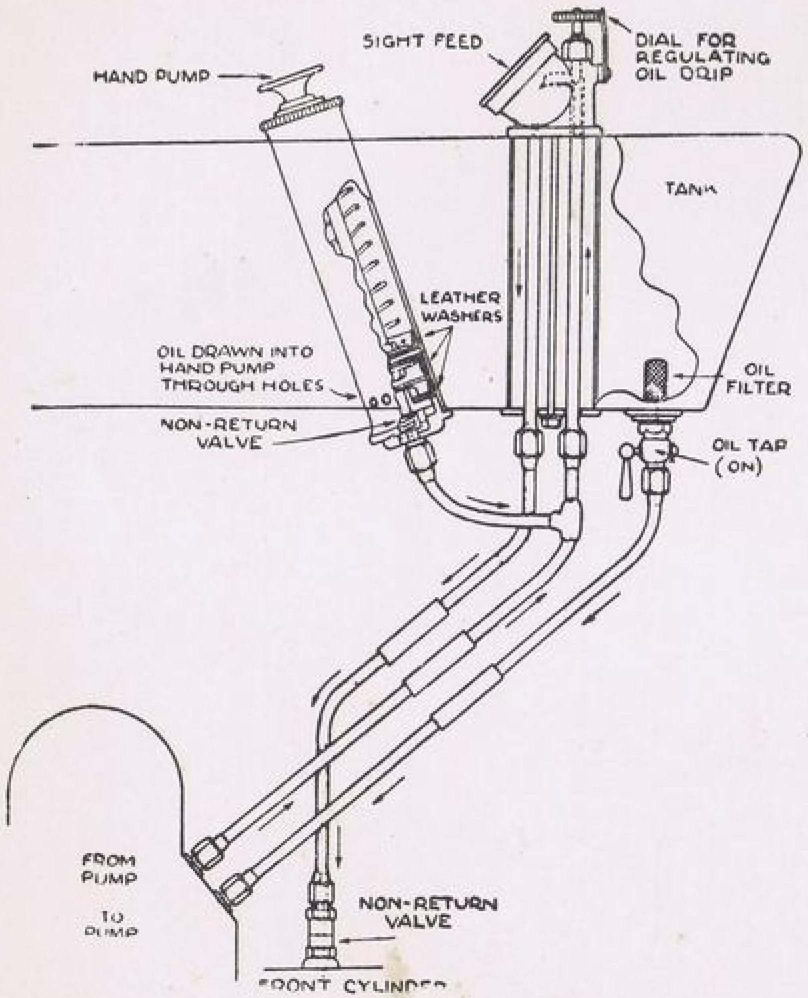


Fig. 56.—The Oiling System as Fitted to 1928 350 c.c. Machines

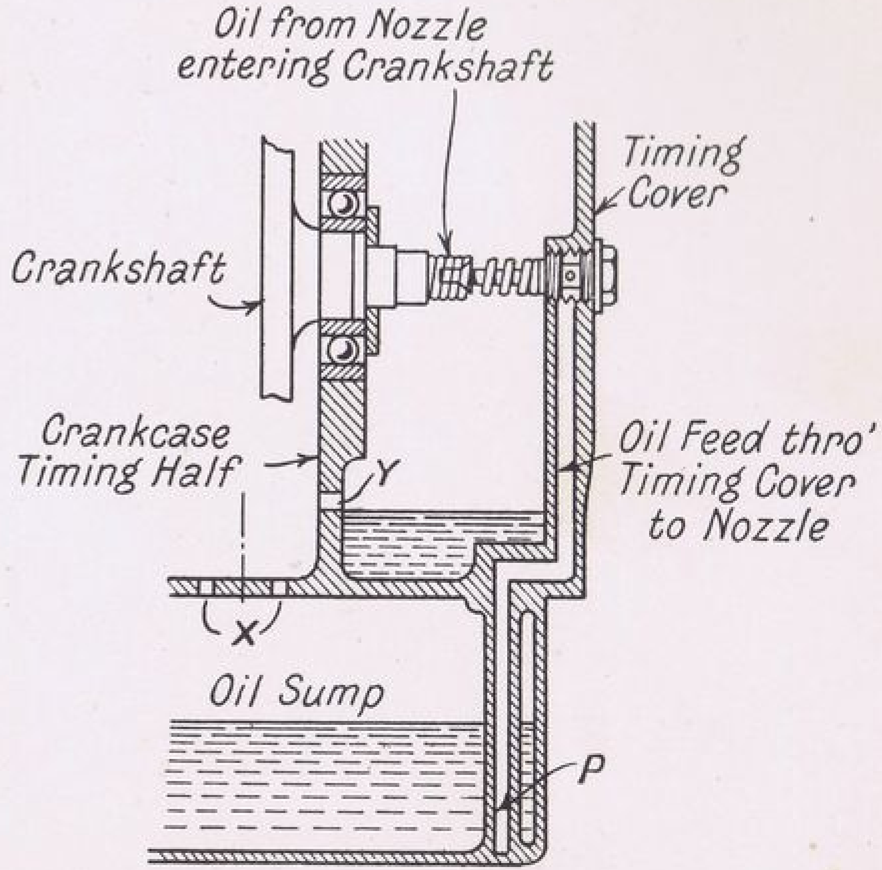


Fig. 57.—Detail Showing Oil Feed to Crankshaft and Timing Gear on 1930 D.S. Lubricated Models

At this point a few words concerning the working of the auxiliary hand-pump will not be amiss. Pulling the pump handle upwards against the spring inside it fills the pump barrel with oil, the spring forcing the pump handle down again, and with it the charge of oil to the engine. The speed with which the oil passes down the pipe depends on the adjustment of the knurled screw of the sight feed, and provided that grit or fluff does not find its way into the oil, it is unlikely that the pump will give trouble.

Always pass the oil through a gauze-lined funnel when filling the tank, and wipe away any dirt on the filler caps before pouring in the oil.

Ignoring actual breakage, there are only two faults that can occur, failure of the pump and the oil not passing to the engine. If oil cannot be seen through the window to be dripping from the sight feed nozzle, although the pump handle is going down, it shows that oil is passing from the lower to the upper side of the pump washers. The lower washer acts as a non-return valve, and should this get hard or break, the pump will refuse to work and a new washer should be fitted.

The Dry Sump Lubrication System (Fitted to 1929 3½ h.p. and All 1930 Models). The general lay-out and principles of this system have already been described on pages 10 and 17. It remains to deal with the actual method of oil feed used for the crankshaft and timing gears. Fig. 57 illustrates this very clearly. Oil is supplied to the passage P by the pump after raising the indicator approximately ¼ in. and forced up until it reaches a special spring loaded nozzle communicating with the hollow crankshaft and big ends. Oil is also supplied direct to the timing case, the correct level which ensures that the gears are lubricated being determined by drain holes positioned at Y. All surplus oil finally drains to the sump via the holes at X, and it is then recirculated through the engine *ad infinitum.* It is advisable to drain the sump, clean the filters, and refill again after, say, 1,000 miles running.

Douglas Semi-Servo-acting Brake Operation (All Machines). The Douglas low-pressure brake operates on a controlled Servo principle—the amount being limited by the design employed—this is somewhat less than that required to overcome the pressure of the various return springs which comprise the spring steel band which in its natural state is contracted, three small springs uniting this to the anchorage plate and a spring on the pedal itself. Fig. 58 illustrates diagrammatically the action of the Douglas Servo brakes. On depressing the pedal or lever, as the case may be, the bobbin B is rotated in the same direction as the wheel which forces the ends of the band apart, and so expands it, whereas the leading end is drawn closer into contact, the other end tending to be dragged off, this latter being opposed by the link whose longitudinal axis is now closer to the diametrical axis of the bobbin. There is sufficient leverage for the link to react on the bobbin and tend to rotate it anti-clockwise by suitably proportioning the various details (see page 100).

Sufficient Servo action occurs to allow of exceedingly low-pressure operation; this is assisted by the comparatively large area of the frictional surfaces (25 sq. in.).

The Patent Douglas Flywheel Clutch (All Machines). One of the most interesting features of the new Douglas models is the

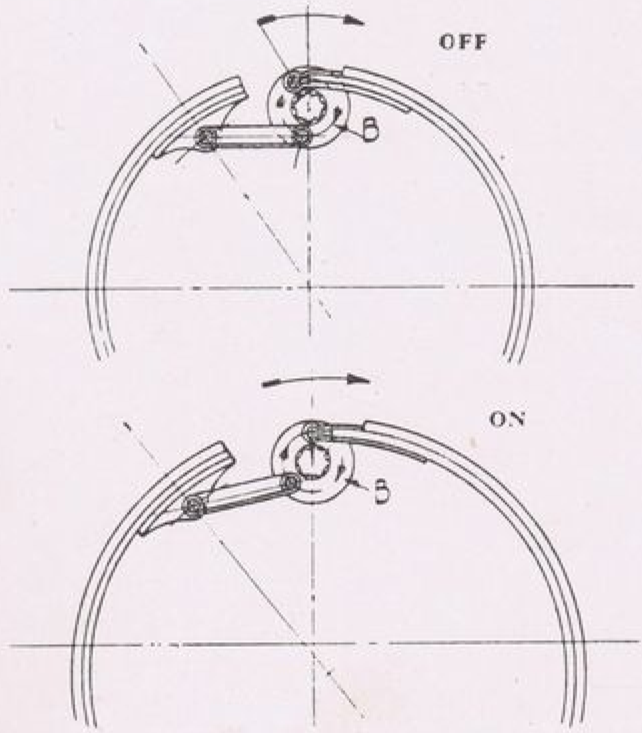


FIG. 58.—DIAGRAMMATIC REPRESENTATION OF SEMI-SERVO BRAKE ACTION

flywheel clutch. For motor-cycle work this is an innovation that will be greatly appreciated, as a clutch of this type has many advantages over existing types of clutches, which are generally embodied in the gear-box design.

The task of putting all the desirable features of an ideal clutch into a flywheel, yet retaining its perfect and inherent balance, together with accessibility and ease off adjustment, had been found one of some difficulty. These features, however, have been obtained after very considerable thought and careful experiments. From the illustration it will be seen that there are only six main parts in the clutch—the flywheel, which also acts as a clutch body, the back plate, the centre plate, which is a driven plate, and the pressure plate, upon which the springs act. To alter the load capacity of the clutch, the nut on the outside has merely to be adjusted to give the required grip. The pressure plate is driven by two pins (Model L.3, clearly shown in the sketch), and has a bearing of large diameter on the flywheel boss. The large

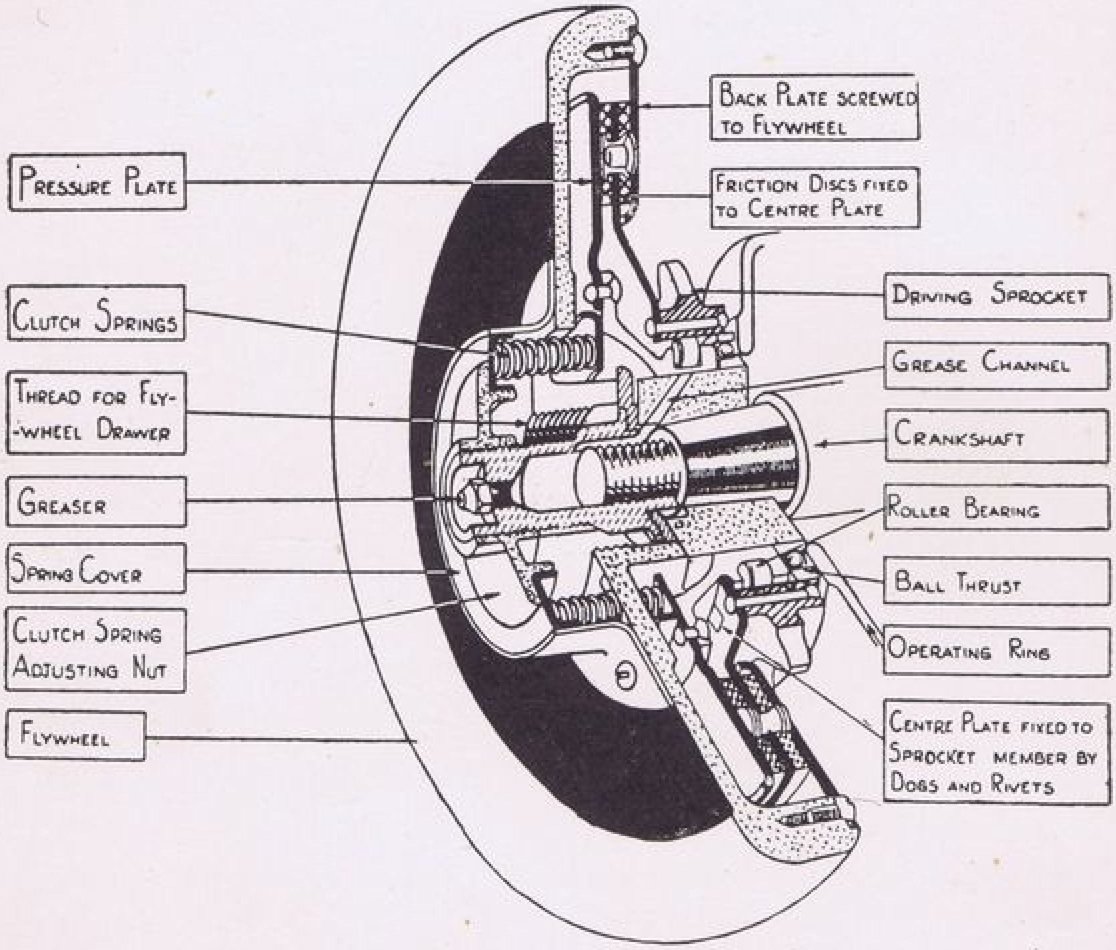


Fig. 59.—Section of Flywheel Clutch
(As fitted on Model L.3)

bearing prevents one of the commonest troubles found in clutches —the binding of the pressure plate on its key or castellation.

The boss must have careful attention at any time the clutch is dismantled, because, if the pressure plate does not slide freely on this bearing, the working of the clutch will be very seriously interfered with. If it be carefully assembled, it should give no trouble for at least 10,000 miles. Lubrication of this bearing is provided for by a special nipple for grease gun lubrication, situated in the centre of the main clutch adjusting nut. The various parts which require lubricating are fed by centrifugal force. The pressure plate is made with deep radial ribs to provide great rigidity, so that when the spring pressure is applied, there is no distortion or whipping, the whole of the spring pressure being passed on to the driven member. The driven member is a very light, steel plate, riveted to the sprocket and provided with a certain degree of flexibility so as fully to receive the drive from the pressure and back plates. The Raybestos friction linings are riveted one on each side of the centre plate.

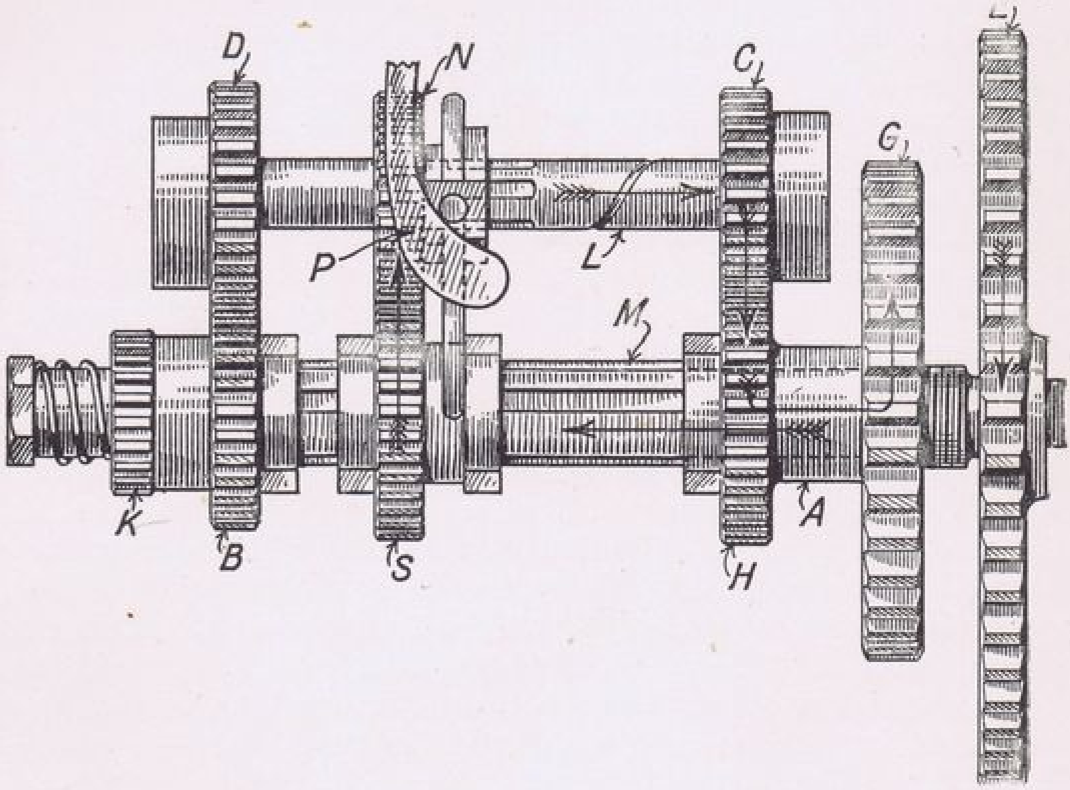


FIG. 60.—DIAGRAM OF THE DOUGLAS GEAR-BOX OPERATION

M—Mainshaft
L—Layshaft
G—Sprocket for primary drive
E—Sprocket for secondary drive
H—High-gear dog wheel on sleeve *A*
S—Sliding pinion
P—Selector striking rod
B—Low-gear dog wheel
K—Pinion for kick starter ratchet.

The sprocket is mounted on a roller bearing, the inner race for which is cut in the boss of the pressure plate. When the drive is taken up by the clutch the whole is locked rigidly together. A special thrust bearing is provided for clutch release, which in turn relieves the friction surfaces of all spring pressure. For clutch maintenance and overhauling see page 101.

The Douglas Gear-box. This is a countershaft box of normal design but, of course, minus the usual clutch mechanism. An external view of the 350 c.c. gear-box is shown at Fig. 15, and a diagrammatic illustration showing the method of working at Fig. 60. It will be observed that in the case of the Douglas gear-box the countershaft, or layshaft as it is more usually called, is placed *above* and not below the mainshaft. These two shafts are shown at *L* and *M* respectively. The layshaft has three pinions, namely, *D*, *N*, and *C*, all of which, except *N*, are rigidly attached to the shaft. Pinion *N* is free to slide and rotate on the layshaft, but can be locked to the shaft, which is splined at the centre only.

On the mainshaft there are four pinions, *K*, *B*, *S*, and *H*. *K* is provided solely for the purpose of the kick starter, and grips the mainshaft when rotated in an anti-clockwise direction. *B* is the low-gear dog wheel, and is free to rotate on the mainshaft, although always in constant mesh with the layshaft pinion *D*. Adjacent to the low-gear dog wheel *B*, and sliding on the splined portion of the mainshaft, is the sliding pinion *S* controlled by the selector mechanism *P*. To the right of this sliding pinion, which has dogs on either side and is always in mesh with the layshaft pinion *N*, which slides simultaneously with the mainshaft pinion *S*, is the high-gear dog wheel *H* in constant mesh with the layshaft pinion *C* and rigidly fixed to sleeve *A*, which can revolve independently of the mainshaft. Also attached to this sleeve is the sprocket *G* transmitting the secondary drive to the rear wheel. It will thus be seen that whenever the rear wheel is in motion, the layshaft also is in motion. The speed of the layshaft does, in fact, determine the speed of the rear wheel, and alterations in this speed are effected by means of the sliding pinions, *S* and *N*. Let us see how this is done, taking first the case illustrated by Fig. 60. *E* is the gear-box sprocket, which receives the primary drive direct from the engine flywheel clutch sprocket and transmits it to the mainshaft. Now pinions *S* and *N* being in engagement, and pinion *N* locked to the layshaft, the drive is transmitted to the layshaft and back through the high-gear dog wheel to the rear wheel drive sprocket *G*. Pinion *B* rotates idly. The gear reduction that occurs is due almost completely to the difference in size between pinions *C* and *H*, and is roughly proportional to the difference between their diameters. Pinion *S* is slightly larger than pinion *N*, and therefore a slight increase in layshaft speed occurs, but a very considerable reduction takes place at the gear-box sprocket *G* due to the difference in size between pinions *C* and *H*. This is *middle* or second gear.

When the sliding pinions are moved right over to the left so that the layshaft dogs engage with those of the low-gear dog wheel we have two distinct gear reductions, that which takes place between pinions *B* and *D* and that due to pinions *C* and *H*. From the sizes of the pinions in the illustration it is at once clear that the resultant gear ratio, i.e. *bottom* gear is approximately twice as low as middle gear. The specifications show that this is so.

Neutral gear (i.e. clutch in, machine stationary with engine running) is obtained by moving the sliding pinions half-way over to the left until the layshaft pinion is clear of the splines and the mainshaft pinion dogs not in contact with the low-gear dog wheel. In this case the mainshaft alone revolves, and when the clutch is lifted both shafts become stationary. It is thus impossible to cause damage when going from neutral into first or bottom gear so long as the engine is declutched and the rear wheel is slightly moved to allow the dogs to engage.

Top gear is attained simply. The sliding pinions are carried right across to the right until the dogs on the lower pinion mesh with those of the high-gear dog wheel *H*. The sleeve *A* then becomes locked to the mainshaft, and the two chain sprockets rotate at the same speed. The layshaft, of course, runs idle.

The gear-box selector plunger, consisting of a spring and ball in the middle gear pinion, automatically holds the gear in full engagement as the ball is forced by the spring into countersunk holes in the mainshaft. The mainshaft has roller bearings of self-aligning type and the layshaft the usual ball bearings.

The above illustrates fairly concisely and clearly the action of the 1930 Douglas countershaft gear-boxes, and concludes a survey of the more important features of Douglas design.

CHAPTER V

OVERHAULING

If a machine is to be kept in efficient condition and its depreciation and repair bill reduced to the absolute minimum, it is essential that the rider should devote some considerable time to its periodic overhaul. Overhauls are of two types—(1) the complete overhaul, (2) the ordinary overhaul. A *complete overhaul* is usually undertaken once every 8,000 miles, or about once a year. This overhaul should be treated seriously, and the whole machine should be dismantled completely. Every component should be cleaned, scrutinized, and, if necessary, replaced. The engine and gear-box must, of course, be removed from the frame for this operation. Special points to be noted in the complete overhaul are set out herewith—

Frame. Alignment, existence of flaws or cracks, play in spring forks, looseness of steering head, wear caused by friction of all attached parts, condition of enamel.

Wheels. Condition of balls, cones, and cups, truth of wheels, alignment, loose spokes, condition of rims, wear of tyres.

Chains. Excessive wear, cracked or broken rollers, joints.

Engine. Oil leaks, compression leaks, main bearings, valves, valve guides and tappets, overhead valve rockers, valve springs, valve seats and faces, cotters, condition of cylinder bores, pistons, piston rings, play in big-end and small-end bearings, timing wheels, shafts and bearings, oil pump.

Gears. Condition of teeth on sprockets and pinions, damaged ball races and loose parts generally.

The examination should also include all control rods and cables, sump filters, clutch and brake linings, etc. To sum up, everything should be dismantled and readjusted.

An *ordinary overhaul* should be undertaken about every 2,000 miles. This should comprise decarbonization of the engine, valve clearance adjustment, adjustments of contact breaker and plug points, valve grinding, general lubrication, and sundry adjustments.

Apart from these overhauls the rider should make a point of regularly going over the various nuts with a spanner. Vibration frequently loosens them. All working parts must also be kept well lubricated (see lubrication chart, Fig. 61), and odd adjustments made as they are needed. The rider who callously runs a machine until " something happens " is asking for trouble and.

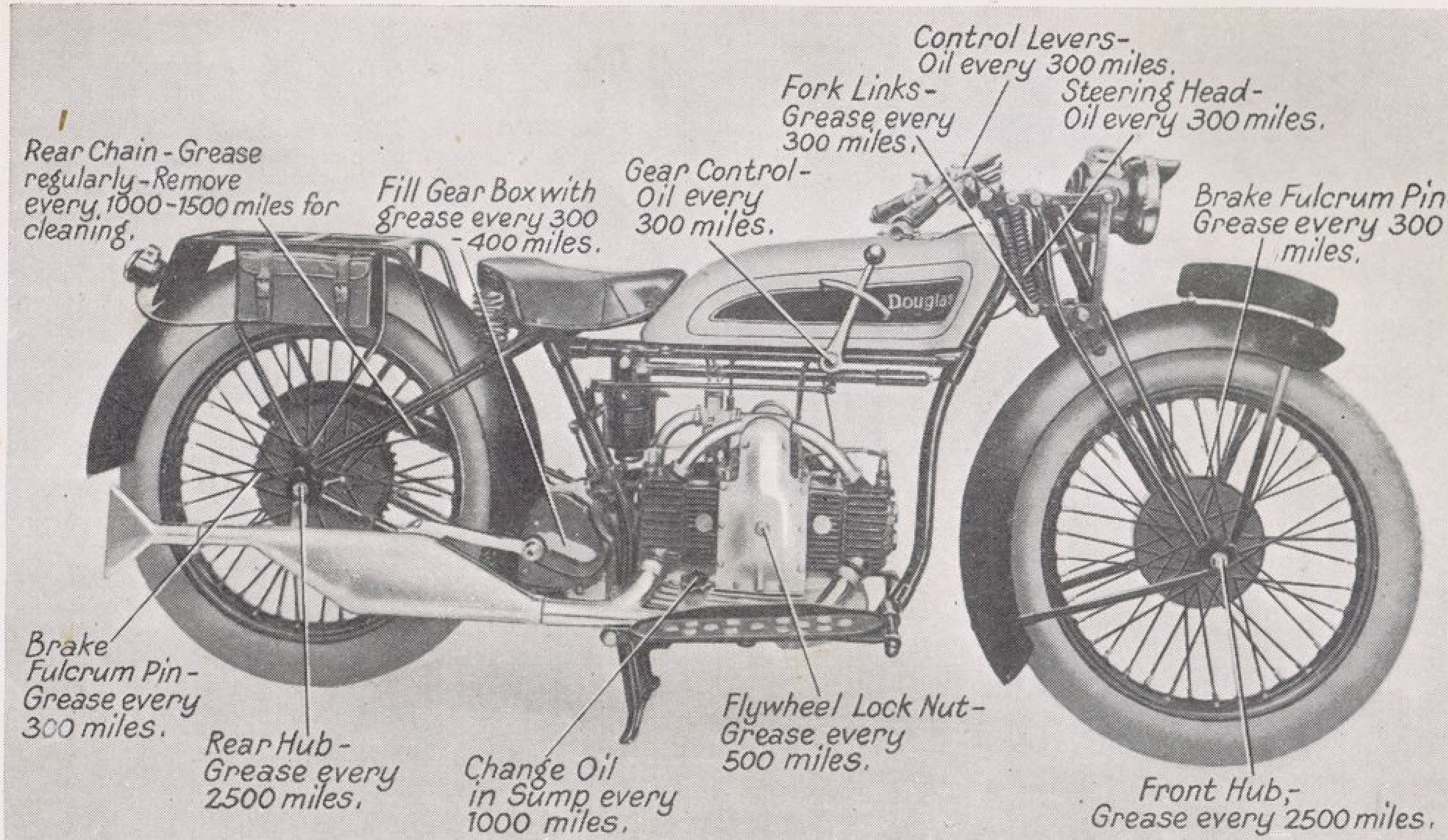


FIG. 61.—THE IMPORTANT PARTS REQUIRING LUBRICATION

The above chart, depicting an H3 Douglas, is intended as a general guide and need not be, and certainly will not be, strictly adhered to. The above chart is applicable to the whole of the 1930 range. In the case of the speedway models there are additional points such as the O.H.V. actuating gear requiring lubrication.

moreover, will assuredly get it! If a machine is properly overhauled and cleaned the owner will be amply rewarded for his pains by the machine giving long service, perfect running at small cost. Overhauling is by no means as tedious a business as appears on paper; experience and common sense soon enable all overhauling to be done rapidly and easily, as it is required. For the guidance of those who are not yet proficient in the art of overhaul, or those who wish to have a work of reference, we will conclude this chapter by giving detailed instructions appertaining to all types of overhaul of Douglas motor-cycles.

Cleaning. Cleaning the machine is highly important; it is a necessary preliminary to overhaul. If neglected it renders overhaul difficult and results also in great deterioration of the plating and enamel, and the machine soon becomes shabby, and its market value rapidly falls. After a dirty ride in wet weather cleaning may occupy at least an hour. It entails the use of stiff bristle brushes and paraffin for removing the filth from the lower part of the machine, together with cloths, leather, and polishes for the bright upper surfaces. On no account should the machine be left soaking wet overnight. A serious amount of rusting may occur. If the rider has not the time available for systematic cleaning, the machine should be thoroughly greased all over before use.

It should be noted that chromium plating does not require the application of metal polish. This is in fact definitely harmful to the surface and the degree of oxidation that occurs with this particular finish is negligible. The chromium plated parts should be treated in the same way as the enamel.

Valve Clearances. If the rider desires high engine efficiency it is of the utmost importance that he should regularly (say once every 300 miles) check over his valve clearances with a feeler gauge as supplied in the tool kit. Excessive valve clearance produces noise and lack of power, while too small clearances usually result in an over sensitive engine and overheating with consequent preignition. Valve clearances it should be remembered affect both valve lift and valve timing. The correct clearances and the means of adjustment are shown at Fig. 62, which illustrates the adjustment on both 350 c.c. and 600 c.c. engines. Valve adjustment on the speedway engines is different to either of these, but the management of the O.H.V. Douglases is quite beyond the scope of this book.

It is important to note that the clearances recommended by the manufacturers are for a *cold* engine.

To adjust the valve clearance starting with the rear cylinder proceed as follows. Remove the slotted valve cover or valve chest cover, as the case may be, by undoing the milled disc X (Fig. 62). Having got this out of the way, proceed to put the piston on T.D.C. by rotating the engine until full compression is felt. Now undo the lock nut *L* (in the case of the 500 c.c. and 600 c.c. engines it

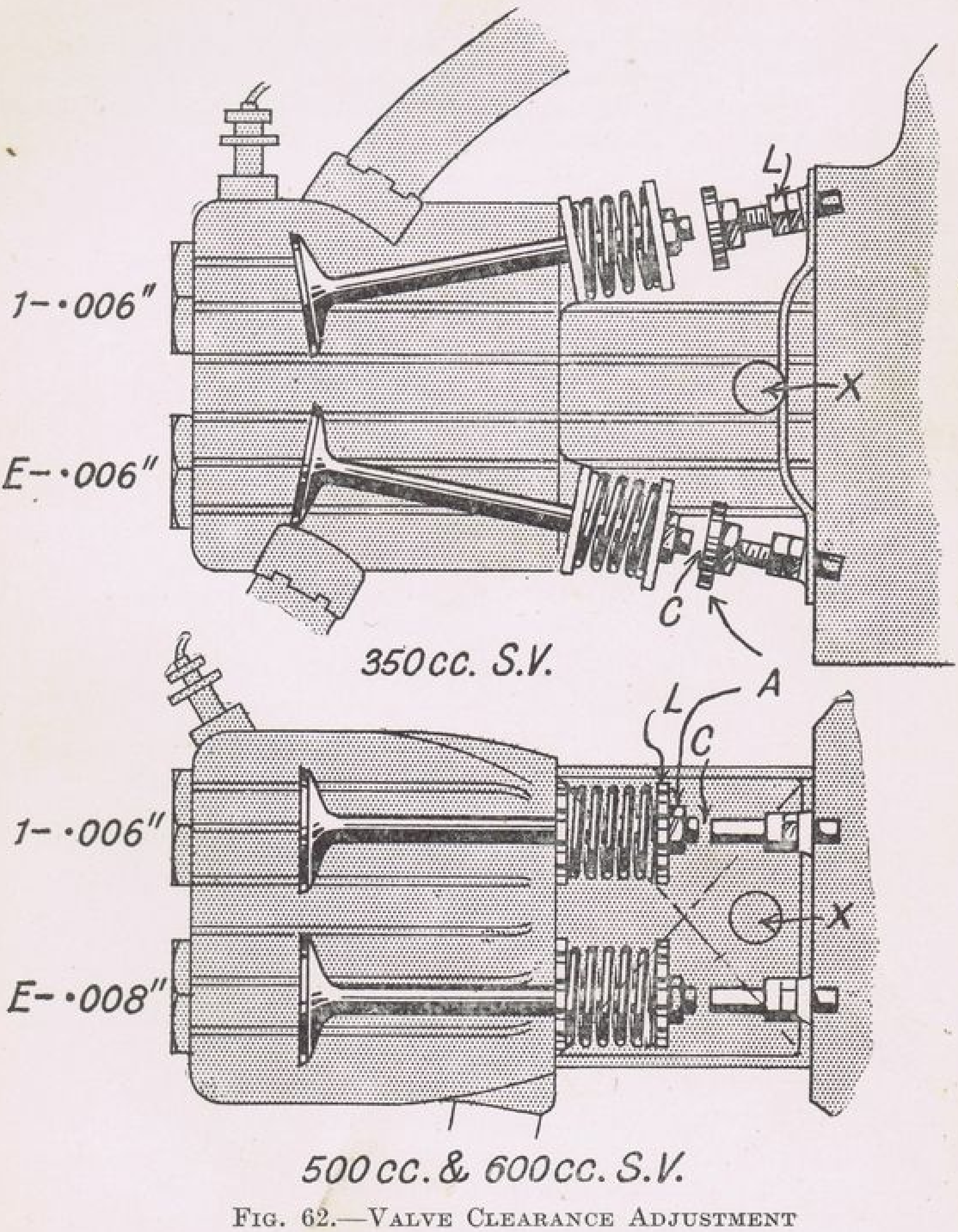
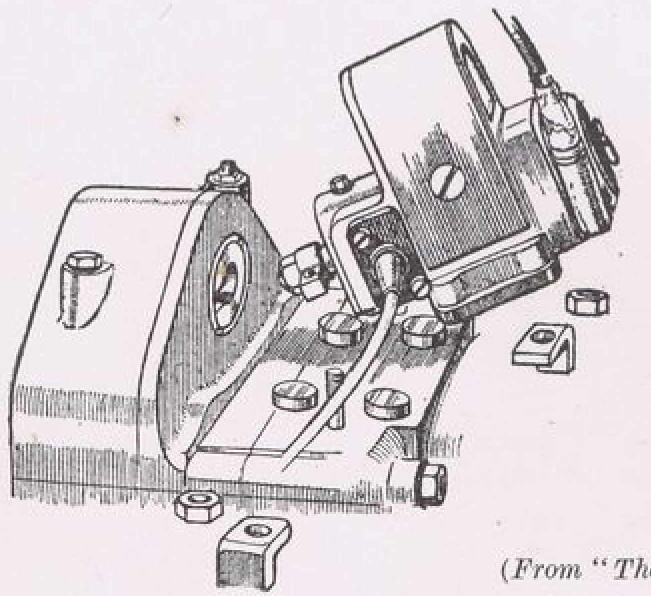


Fig. 62.—Valve Clearance Adjustment

will be noticed this forms the castellated spring cap and does away with the need for tiny collets) and adjust the disc *A* or head *A* (screwed to the valve stem on the 500 c.c. and 600 c.c. engines) until a feeler gauge of the right magnitude will just pass into the clearance at *C* without binding. Finally retighten the lock nut and check over again. The act of retightening the lock nut often upsets the adjustment. Now replace cover and adjust the front cylinder tappets similarly.

Attention to Sparking Plugs. Even more important than the gap between valve and tappet is the gap between the plug electrodes. For 1930 A.C. plugs are standard on 350 c.c. S.V. models, whilst Lodge H.1 are used on the 500 and 600 c.c. models. Should the rider change to Lodge or K.L.G., two well-known makes, the



(*From "The Motor-Cycle"*)

FIG. 63.—SHOWING HOW EASILY MAGNETO MAY BE REMOVED

On the 500 c.c. and 600 c.c. Douglas, a dog with a spring-loaded ball couples up the magneto, and the latter may be removed by undoing two nuts. The timing is undisturbed.

plugs recommended are types H.1 and H.S. 4a respectively. For sports models a special K.L.G. plug model 244 can be obtained. Before starting on a long distance run it is worth while removing the plugs, cleaning them with petrol, and scraping the electrode points lightly with a sharp pocket knife, finally checking and, if necessary, adjusting the gap between them. This should be ·02 in. (= roughly $\frac{1}{2}$ mm. or $\frac{1}{50}$ in.). Do not think in terms of visiting cards. They vary as much as the people who own them.

The reach of the sparking plug is also of importance. Therefore always use the correct plug. Frequent inspection of the sparking plug should be made, as it is susceptible to oiling up. Moreover, the electrode points gradually get eaten away by the millions of sparks that pass between them, and it is necessary to readjust the gap if difficult starting is to be avoided.

Care of the Magneto. The B.T.H. magneto is provided with ball bearings throughout, which are packed with grease before

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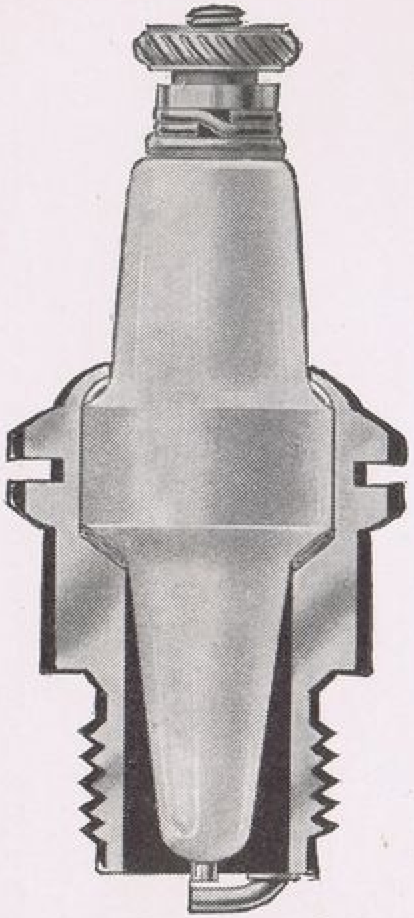

Fig. 64.—Part Sectional View of A.C. Sphinx Sparking Plug

Fig. 65.—Showing the Construction of the K.L.G. Plug

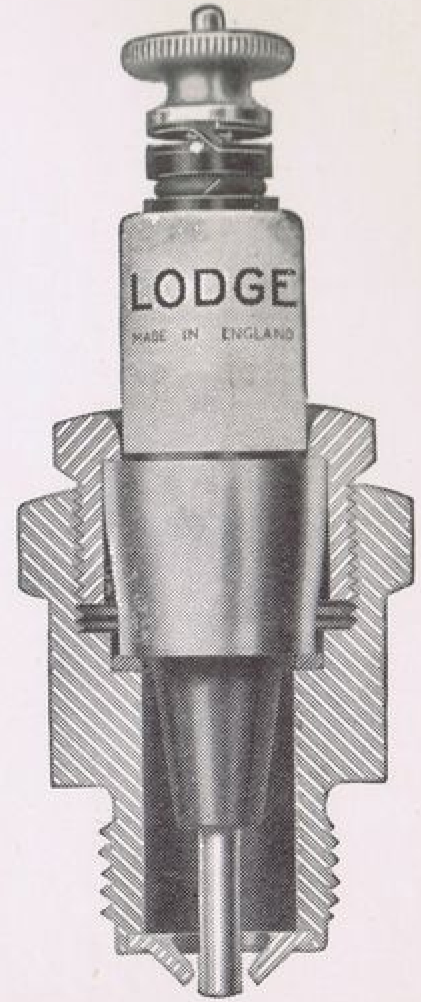

Fig. 66.—Model C.3 Type Lodge Sparking Plug

leaving the manufacturers. Fresh lubricant should not be required under normal circumstances until the machine has covered some 12,000 miles.

The platinum contacts of the contact breaker should be examined about every 1,000 miles and, if the " break," shown by the arrow (Fig. 67), should be more than will just hold a ·011 in. blade of a feeler gauge, they should be adjusted. Too great a gap will advance the timing. A special magneto spanner is provided, which includes a gauge for checking the " break." It is unnecessary to remove the contact breaker to make this adjustment. If it is necessary to take the contact breaker off for some reason, unscrew the long taper fixing screw, and withdraw the contact breaker bodily. The contacts only need attention at long intervals, and the reader should not interfere unnecessarily with them. The platinum points must only be dressed with a dead smooth file if the surfaces have become at all pitted, and then the least possible amount taken off. The greatest care must be exercised, as platinum is a very expensive metal. Always keep the contact breaker scrupulously clean.

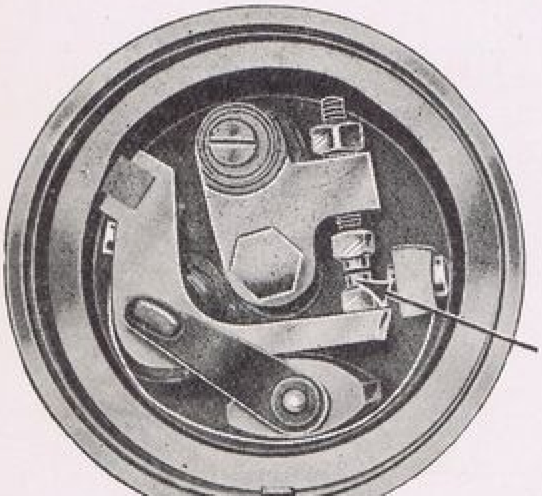

FIG. 67.—THE CONTACT BREAKER

It will prevent misfiring and render starting easier if the slip-ring is cleaned occasionally. This is done by taking off the H.T. terminal and, while the magneto is being revolved by slowly turning the engine over, inserting a lead pencil the end of which is covered with a clean rag moistened with petrol. The pencil should be pressed against the rotating slip-ring.

Beyond the above-mentioned points, the magneto should not be interfered with. If internal trouble develops, return the instrument to the makers for repair.

Engine Lubrication. On the dry sump lubricated engines which includes all the 1930 side-valve models and also Model B.29, no attention is required other than draining and replenishing the oil sump every 1,000 miles and occasionally, say every 2,000 miles, withdrawing the pump unit complete with spindle, worm drive, and filters for the purpose of draining. Filter on pressure side of system should be cleaned at least every 1,000 miles. Paraffin should be used for cleaning these items, but it should not be used for swilling out the engine. This is a thoroughly reprehensible practice, because it is obviously impossible to drain the engine completely, and the fresh oil becomes diluted. Remember the oil supply to the D.S. engine bears a constant ratio to the engine speed and additional oil cannot be supplied.

Every now and again the crankcase rotary breather should be inspected and, if necessary, cleaned and its spring adjusted. Whether or no this is functioning can be gauged by the condition of the primary chain. It should be well oiled but not dripping with oil.

Pressure Grease-gun Lubrication. All Douglas motor-cycles are arranged for pressure grease-gun lubrication to the cycle parts, and those parts which require periodical attention (see lubrication chart on page 82) should not be neglected. The gun should be used

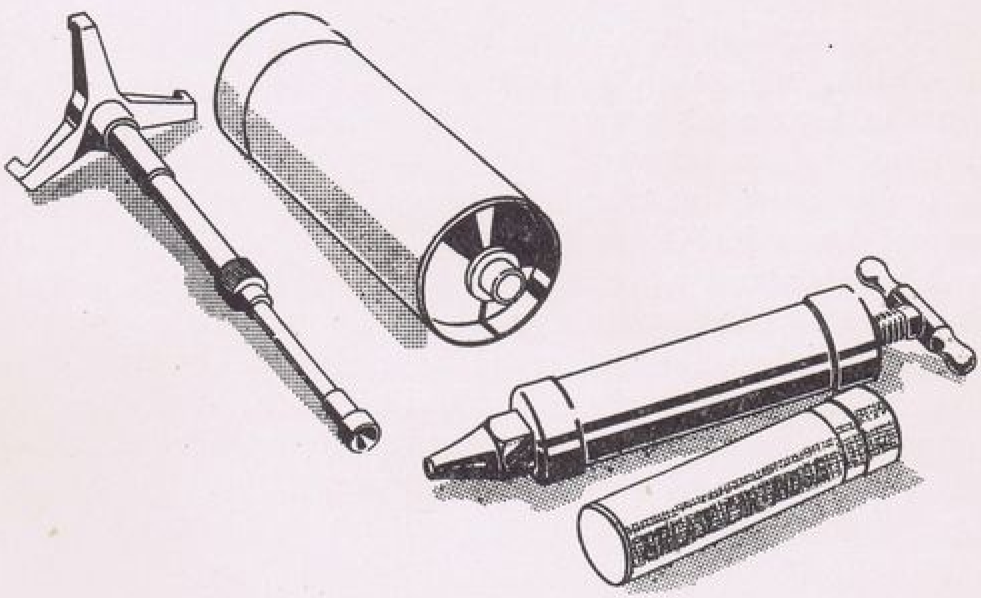

FIG. 68.—WAKEFIELD (LEFT) AND SPEEDWELL (RIGHT GREASE GUNS
Suitable for Douglas Machines

thoughtfully and regularly, care being taken to see that the lubricant employed is of high-class make, as much damage may be done to the delicate mechanism, especially ball and roller bearings, by the use of grease having a comparatively big free acid and alkali content. Two suitable grease guns are illustrated by Fig. 68.

Attention to Gear-box. The Douglas gear-box described on page 78 is of massive construction, and requires the injection of grease not oil. This should be done every 300-400 miles. Owing to the fact that the box is a fixture in the frame and the operating lever works on a frame lug, adjustment of the selector gear is rarely necessitated. Should the gear-box suffer internal damage the wisest course is to send it along to the Douglas repair department.

The Primary Chain. On all 1930 models this is automatically lubricated, and its tension adjusted by sliding the power unit along its two base rails. The adjusting bolt and nut for the engine unit will be found in the centre of the bottom front cross-tube of the frame. The engine should be slid backward or forward until it is found that at a point midway between the engine and gear-box sprockets it is possible to give the underpart of the chain a total and maximum deflection of $\frac{3}{8}$ in. To make this adjustment satisfactorily remove the front chain guard cover. In the case of machines built prior to 1929, primary chain adjustment is effected by slackening the four fixing bolts below the gear-box frame lug and rotating in a clockwise direction the draw bolt at the back of the box.

The Secondary Chain. Adjustment of this chain (there should be $\frac{3}{4}$ in. deflection) on all machines is effected by sliding the rear wheel in the fork ends backward. Care should be taken that the chain adjusters are screwed up exactly the same amount each side, so as to keep the wheels in track. The spindle nuts of the back wheel have left-hand threads, and special care must be exercised when slackening off these nuts if stripped threads are to be avoided. The secondary chain should be regularly oiled with a mixture of grease and graphite, and about every 1,000-1,500 miles it should be removed and soaked in paraffin. If time permits, it is a good plan to heat up the grease and graphite in a receptacle, and allow the thinned mixture to permeate all the chain roller bearings. For oiling the chain in position on the machine a grease gun is eminently satisfactory.

Tyre Pressures. If long and satisfactory tyre life is desired it is most important always to run at the correct pressures or at any rate approximately correct. There is only one really correct method of checking pressures, and this is by means of a pressure gauge which can be instantly clapped on to the valve ends. The tyre manufacturers are always ready and willing to give advice on this subject. A rough and ready method is to inflate the rear cover, so that bearing the full laden weight of machine and rider it bulges at the bottom just perceptibly. The front tyre may be inflated at a considerably lower pressure (16 lb. per sq. in.).

Bowden Controls. Always keep the extremities of the cables lubricated as far as possible, and always take up slack by means of the adjusters as soon as it develops. Nothing so spoils the performance of a good machine as sluggish and incomplete action.

Care and Maintenance of B.T.-H. Lighting Generator. The armature is of the drum type, with wave windings. Two brushes only are used, and these are set at 90 degrees to each other, the negative brush being connected to the frame of the generator. The general construction is very simple and comprises four assemblies, viz. housing armatures, commutator end shield, and cover. The housing is provided with a spigot which locates in a recess provided in the timing case cover of the engine. The generator is secured by two stout bolts, the heads of which are exposed on removing the aluminium cover. The spigot on the generator housing is machined

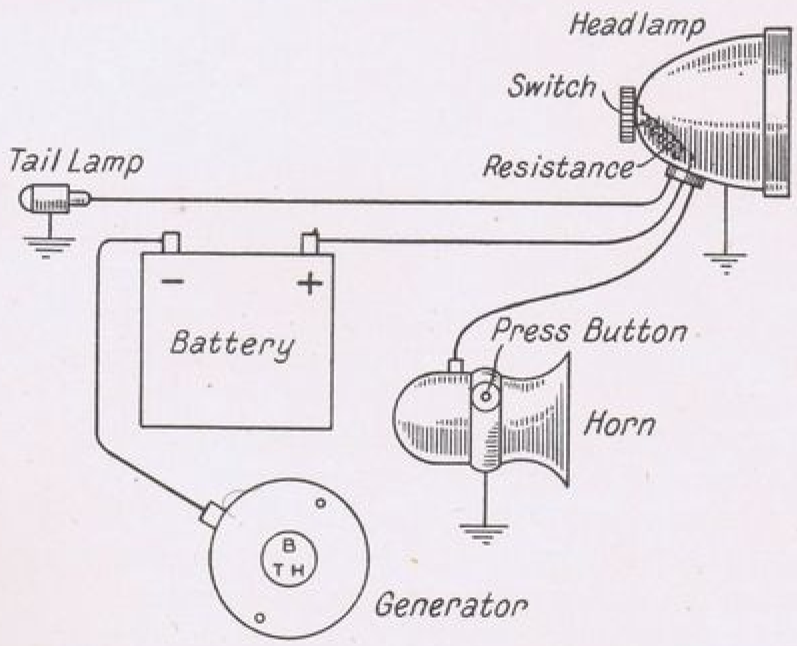

Fig. 69.—Wiring Diagram of B.T.-H. Electrical Equipment

In the above diagram the electro-magnetic cut-out switch acting between the generator and battery is not shown. Its object is to prevent discharge from the latter when current is not being generated.

$\frac{1}{64}$ in. eccentric with the armature spindle, thus by simply turning the generator on its spigot the gear meshing can be varied, and by means of the series of tapped holes in the timing case cover, secured by two fixing bolts, in the desired direction. (This does not apply to 500 and 600 c.c. models.) Turning the generator in a clockwise direction when looking at the front, tightens the meshing and vice versa.

The commutator end shield carries the brushes, and slots are provided so that the end shield can be turned about the generator axis to adjust the brush position for the best commutation. This adjustment, however, is effected by the makers, and is best left alone. The generator commences to charge at about 12 m.p.h. in top gear, and gives an output of 2 to 2·5 amperes at 25 m.p.h. Fig. 69 shows a diagram of the wiring system, and it will be noticed that head-lamp, tail-lamp, and electric horn are all connected in parallel. Overcharging of the battery is definitely prevented by the incorporation of a powerful resistance within the head-lamp.

The cover should be removed from the generator about every 2,000 miles, and attention paid to the following points—

1. Examine the brushes to see that they are free in the boxes and that the springs are bearing on the ends of the brushes. If the brushes are badly worn, the spring pressure will be weak, and new brushes should be fitted. It is very important that only the correct grade of brush is fitted, otherwise the commutator may be badly and permanently damaged. Replacement brushes should therefore be obtained from the manufacturers only.

2. Wipe away any brush dust from around the brush boxes and the inside of the cover, using a piece of clean cloth moistened with petrol. The commutator may also be cleaned in this way, the cloth being lightly pressed against the commutator, whilst the engine is gently rotated.

3. Any brush dust in the slots in the commutator should be removed with a small splinter of wood. Care must be taken, however, not to damage the armature connections when cleaning the commutator.

4. The armature must not be removed from the generator housing, otherwise the complete generator will have to be returned to the manufacturers for re-magnetizing.

5. Inspect the battery regularly, say once a month, and add distilled water where evaporation has occurred.

6. See that all leads are coupled to the correct terminals, and that the battery terminals are occasionally greased to prevent corrosion.

7. When removing generator take great care that the metal dog coupling is inserted on reassembly.

CARBURETTOR TUNING

The 1930 B. & B. Pattern Amal (L.3). In tuning this instrument there are three distinct things to be dealt with, (*a*) the pilot jet, (*b*) the taper needle, (*c*) the main jet. They should be taken in this order.

(*a*) The knurled screw on the side of the bottom of the throttle which controls the pilot air supply should be screwed clockwise into its closed position, so as to put the pilot jet under its maximum richness. The engine should then be started up, with the air lever closed and throttle lever opened about a quarter. When the engine has commenced running, the air lever should be opened out fully, after which the throttle lever should be closed as far as possible without stopping the engine. If everything is airtight the engine will probably start misfiring through an over-rich mixture. The knurled adjusting screw on the side should be unscrewed a certain amount until this richness disappears, which will probably be accompanied by an increase in engine revolutions. The throttle should then be still further closed, when the rich symptoms will be probably repeated, but to a lesser degree.

The operation should then be repeated until the minimum amount of charge that the engine will run on is reached, but in so doing one will probably overstep the mark of weakening the pilot, in which case the screw should be slightly screwed back again to the required richness (i.e. in a clockwise direction).

The point to emphasize is that it should be appreciated that the pilot jet setting and the throttle position are dependent one upon the other, for the final results—one cannot be moved in the slow running position without affecting the other.

If it is desired that the engine should be made to tick over idle with the throttle lever fully closed, this result can be obtained by unscrewing the throttle adjusting bush situated on top of the spraying chamber cap. As this adjusting bush is unscrewed so the engine will run faster, and the throttle lever should then be closed sufficiently to compensate for this. This operation should be continued until the desired result is obtained. The whole of these adjustments should, of course, be made with the engine running. With the carburettor set as above, it should not be possible to stop the engine by the throttle lever, as this has been set for the slow running position, and when brought to the shut-off position there is enough mixture going through the carburettor to carry the engine over at no load. It can, of course, be made to close right off by screwing the cable adjuster down further.

It should be borne in mind that if there is an air leakage in the induction system the engine can only function on the pilot jet with the throttle fully closed, and this leak, if of any magnitude, makes slow running impossible.

(*b*) To vary the settings of the main supply from standard, take out the throttle valve and slacken the screw which lies in the hole in the valve. The needle can then be moved up or down, as desired, moving it up, that is to say, pushing it up the valve, enriches the mixture, and the reverse procedure weakens it. It should be borne in mind, however, that the control obtained by the needle does not affect the all-out position.

(*c*) Fit the smallest main jet which will give the maximum power and speed on full throttle. The size of this jet chiefly concerns the latter half of the throttle opening (i.e. half open to fully open) and has little effect on the petrol consumption, as most of the driving takes place with the throttle less than half open, during which period the petrol supply is governed by the setting of the taper needle, which can be adjusted up or down as desired.

The brass jet in which the taper needle operates is always the same size with any restricted jet, unless the carburettor is arranged for use with "dope."

The Standard Amal Carburettor (H.3). Should the setting of the instrument not give entire satisfaction for particular requirements, there are four separate ways of rectifying matters as given herewith, and the adjustments should be made in this order: (*a*) Main jet ($\frac{3}{4}$ to full throttle). (*b*) Pilot air adjustment (closed to $\frac{1}{8}$th throttle). (*c*) Throttle valve cut-away on the air in-take side ($\frac{1}{8}$th to $\frac{1}{4}$-throttle). (*d*) Needle position ($\frac{1}{4}$ to $\frac{3}{4}$ throttle). The diagram (Fig. 70) clearly indicates the part of the throttle range over which each adjustment is effective.

(*a*) To obtain the correct main jet size several jets should be

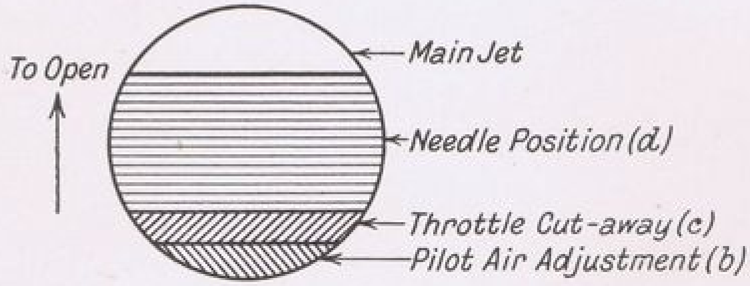

Fig. 70.—Range and Sequence of Adjustments—Amal Carburettor

experimented with, and that selected should be the *smallest which gives maximum power and speed* on full throttle.

(*b*) To weaken slow-running mixture, screw pilot air adjuster outwards, and to enrich, screw pilot air adjuster inwards.

Screw pilot air adjuster home in a clockwise direction. Place gear lever in "neutral." Slightly flood the float chamber by gently depressing the tickler until fuel begins to escape from the mixing chamber. Set magneto at half advance, throttle approximately $\frac{1}{8}$th open, close the air lever, start the engine, and warm up. After warming up, reduce the engine revolutions by gently throttling down. The slow-running mixture will prove over-rich unless air leaks exist. Very gradually unscrew the pilot jet adjuster. The engine speed will increase and must again be reduced by gently closing the throttle until, by a combination of throttle positions and air adjustment, the desired "idling" is obtained. It is occasionally necessary to completely retard the magneto before getting a satisfactory tick-over, especially when early ignition timing is used. If it is desired to make the engine idle with the throttle quite closed, the position of the throttle valve must be set by means of the throttle stop screw, the throttle lever during this adjustment being pushed right home. Alternatively if the screw is adjusted clear of the throttle valve, the engine will be shut off in the normal way by the control lever.

(*c*) Given satisfactory " tick-over," set the magneto control at half-advance with the air lever fully open. Very slowly open the throttle valve, when, if the engine responds regularly up to one-quarter throttle, the valve cut-away is correct.

A weak mixture is indicated by spitting back through the air intake, with blue flames, hesitation in picking up, which disappears when the air lever is closed down, and this can be remedied by fitting a throttle valve with less cut-away. A rich mixture is shown by a black sooty exhaust, and the engine falters when the air valve is closed. The remedy for this is a throttle valve with greater cut-away. Each Amal valve is stamped with two numbers, the first indicating the type No. of the carburettor, and the second figure the amount of cut-away on the intake side of the valve in sixteenths of an inch, e.g. 6/4 is a type 6 valve with 4/16 in. or $\frac{1}{4}$ in. cut-away.

(*d*) Open air lever fully and the throttle half way. Note if the exhaust is crisp and the engine flexible. Close the air valve slightly below the throttle when the exhaust note and engine revolutions should remain constant. Should popping back and spitting occur with blue flames from the intake, the mixture is weak, and the needle should be slightly raised. Test by lowering the air valve gently. The engine revs. will rise when the air valve is lowered slightly below the throttle valve.

If the engine speed does not increase progressively with raising of the throttle, and a smoky exhaust is apparent with heavy laboured running, and tendency to light-stroke, the mixture is too rich and the needle should be lowered in the throttle valve. Having found the correct needle position, the carburettor setting is now complete, and it will be found that the driving is practically automatic once the engine is warmed up. For speed work the main jet may be increased by 10 per cent when the air lever should be fully open on full throttle.

DECARBONIZING

If after about 2,000 miles on the road the exhaust note becomes " woolly," instead of being a crisp " bark," and the engine sluggish and very prone to " knock," these symptoms clearly indicate that the time has arrived when the engine must be decarbonized, that is to say, all carbon deposits on the piston head and in the combustion chamber must be removed. Carbon deposits, incidentally, are due to three things—(1) incomplete combustion of fuel, (2) carbonization of road dust entering the cylinder, (3) burnt lubricating oil. When decarbonizing it always pays to inspect the valve faces and seats, and grind in the valves if necessary. In any case, removal of the valves enables the combustion chamber and also the ports to be very thoroughly cleaned. Before decarbonizing, it is first necessary to remove the cylinders.

We shall consider the side valve models only. In no case is it necessary to remove the power unit from the frame, and unless it is wished to inspect and remove the pistons it is also unnecessary to remove the cylinder barrels. It should be pointed out, however, that in the case of the 500 c.c. and 600 c.c. engines the barrels and valve ports (see Fig. 47) are integral. In the case of the 350 c.c. engines removal of the cylinder heads entails removal of the valves automatically.

We will consider the case of a thorough decarbonization involving piston and valve removal.

Initial Preparations. Jack the machine upon its stand and get out the tool kit. If the engine exterior is very dirty go over it with a rag damped in paraffin, taking special care to clean the parts about to be dismantled and see that a clean box or other receptacle is at hand in which to place the various parts prior to reassembly. And here is an important piece of advice. Treat the engine as though it comprised two single cylinder units and *work on one cylinder at a time*, commencing with the rear. This will avoid the danger of mixing up the components (although some are marked) and the grave risk of wrongful replacement of the parts which though theoretically are interchangeable but in practice are not.

Put the cylinder on which you are about to work on compression and begin " clearing the deck " for action. Disconnect the H.T magneto leads and remove the sparking plugs. In the case of the 350 c.c. engines undo the induction and exhaust manifold union nuts by means of the special hooked spanner provided in the tool kit. In the case of the 500 c.c. and 600 c.c. engine undo the two pairs of studs holding the induction manifold faces against the inlet parts, and break the joints with the utmost caution; any damage here will cause well-nigh irreparable induction leaks. The exhaust pipes on these engines are push-on fits and, therefore, the silencing system support brackets must be loosened. A few gentle taps with a mallet at the front ends will accomplish the rest. Now take off the valve covers.

In the case of 350 c.c. models, valve caps are occasionally very obstinate (see page 105), and before removing a cylinder head it is worth while slackening these off in position, when they may be gripped firmly. Everything is now ready for removing the heads and ultimately the barrels.

Removing the Cylinder. Undo the seven-stud fixing to the head and gently prise this off with the aid of a screwdriver (unnecessary in the case of the 500 and 600 c.c. models), being careful not to use one of the cooling fins as a fulcrum. So much for the cylinder head. Rotate the engine three-quarters of a turn until the piston of the rear cylinder is roughly at B.D.C. on its firing stroke. Owing to the early opening of the exhaust valve, it is advisable to increase the clearance of this valve (see page 84) so that it is not lifted by its cam. Undo the four nuts holding the cylinder bars to the crankcase and withdraw from the piston gently with a backward and upward motion. On no account allow any binding to take place, and be most careful not to allow the piston and connecting rod to strike sharply the edge of the annular hole in the crankcase. Such a misadventure is quite likely to distort or fracture some part. A clean rag should be wrapped around the connecting rod to prevent the ingress of dirt or foreign articles into the crankcase. If a nut or other part enters the crankcase it may, if unobserved, do untold damage, and even if located it may be an appalling job to extract it. Make a practice of replacing nuts on the studs or bolts from which they are taken. Promiscuous replacement is to be strongly deprecated.

Piston Removal. On all Douglas engines the gudgeon pins, which have brass end caps to prevent cylinder scoring, are fully floating, and can be pressed out of the piston boss by gentle pressure. Do not hammer out with a naked tool. Some soft material should be interposed. Push it out from the driving side and mark both piston and pin if necessary to secure correct replacement. On no account replace the piston in a position different to that whence it was removed.

Removing the Valves. Valves of the side-by-side type can, if desired, be removed without disturbing the cylinder barrel, though perhaps not quite so readily. Take off the valve caps and insert in each hole the hooked end of the special valve extracting and fitting tool, the slotted end of the " U " piece being made to grip the valve stem immediately below the spring cap. Compress the spring lightly and then lock the tool by means of the notches on one of the arms. It remains now to release the spring anchorage (see Fig. 62).

In the case of the 350 c.c. engine grasp the special pen steel valve collet tongs and take out by their aid the split collet. The valve can now be pushed out through the valve cap aperture.

In removing 500 and 600 c.c. valves, the end cap should be unlocked from the spring collar and the valve screwed out, leaving spring and other parts to be removed. Refit vice versa. The exhaust valve is usually tinted at its base due to oxidation and heat (water is thrown off in combustion).

Removing the Carbon. Procure an old screw-driver, or similar tool, and scrape off all carbon from the piston head. The latter may then be polished with very fine emery cloth, but do not touch the sides of the piston at all. If the deposit is very hard it may be necessary to allow the piston to soak in paraffin in order to soften the carbon. Now scrape off all deposits in the cylinder head, being careful not to scratch deeply the walls of the combustion chamber during this operation. Incidentally, it should be mentioned that carbon deposits form less rapidly on smooth surfaces, and therefore it is worth doing the job thoroughly. On

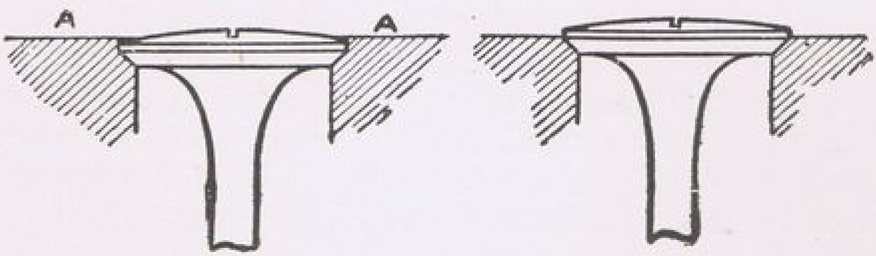

Fig. 71.—Diagram Illustrating how Valves Become Pocketed after Frequent Regrinding

no account use emery cloth or, indeed, any abrasive on either the combustion chamber or cylinder walls. Any abrasive particles left would cause very serious damage in the event of their finding their way between the piston and cylinder. Chip off all deposits around the valve pockets and the ports, afterwards wiping all surfaces over with a clean rag slightly damped with paraffin. The valve seats and faces should now be inspected.

Grinding-in the Valves. Should the valves or valve-seats show signs of "pitting," the valves will have to be ground-in. This requires considerable patience and care. Stuff a rag into the combustion chamber to prevent dirt getting in, and then place the head firmly on a bench with valve seats uppermost. The best preparation for valve-grinding is one of the ready-made compounds such as Carborundum. This is supplied in two grades, coarse and fine. Smear the valve face lightly with a little of the coarse Carborundum paste, and insert the valve on its seat. Only use a little of the compound at a time. Now oscillate the valve repeatedly under moderate pressure with the aid of a screw-driver or a screw-driver blade gripped in a brace. Lift the valve at intervals, and turn it round a few degrees before dropping it again. Remove it at intervals, wipe and inspect the face. If there are still signs of " pitting," apply more paste and carry on. When there is a bright ring contact all the way round, and the little brown or black pock-marks have disappeared, the valve is a good fit again, and may be refitted. It is a refinement to finish off with a fine grade of abrasive, or even with rouge or metal polish. After grinding-in both valves, carefully remove every particle of abrasive from the cylinder head. Never attempt to grind-in a very badly pitted valve; it should be returned to the makers to be refaced. To grind-in such a valve effectively would cause very bad wearing down of the valve seat, and would ultimately result in the valve becoming " pocketed," with consequent loss of power (see Fig. 71).

Ginding-in overhead type valves is very similar to the procedure described above; but, of course, the valves, instead of being pressed down upon their seats, have to be pulled up against them. For this purpose a special tool is provided.

Having ground-in the valves and thoroughly cleaned out all dirt and abrasive, as well as any fluff on the valve seats, proceed to replace the valves and valve springs, together with the valve caps or rocker mechanism, as the case may be. When replacing valve caps, smear a jointing medium, such as " Metalestine," on the threads, also see that all copper asbestos washers are in sound condition.

Immediately after valve grinding there may be noticeable some considerable loss of compression. This temporary phenomenon is common to most engines, and is usually due to some foreign particles having lodged between the valve seats and faces. After a brief mileage the engine regains its normal degree of compression.

Valve Spring Tension. As the result of the heat to which the valve springs are subjected, they may be found to have lost some of their initial strength after a long spell of work. Particularly so is this the case with exhaust valve springs. In this event they should be replaced by new ones, as weak valve springs have a marked effect on the performance of the machine.

Examining and Removing Piston Rings. The piston rings are the main guard of the compression. They must, therefore, be full of spring, free in their grooves, and set with their slots equally spaced round the piston, i.e. at distances of 120°. If all the rings are bright all the way round they are obviously being polished against the cylinder walls, and are perfect, and should be left alone. If, on the other hand, they are dull or stained at some points, they are not in proper contact with the walls of the cylinder. Perhaps they are stuck in their grooves with burnt oil, and will function properly if the grooves are cleaned. If vertically loose in their grooves or very badly marked, the rings must be renewed. Piston rings are of cast-iron, and being of very small section must be handled very, very carefully. If not, they will certainly be broken. They cannot safely be opened out wider than will allow them to slip over the crown of the piston. Therefore, to put them on or remove them requires the insertion of small strips of metal, about $\frac{1}{4}$ in. wide, which are placed in the manner illustrated by Fig. 72. When fitting new piston rings, thoroughly clean the grooves into which they fit, as any deposit left at the back of new rings forces them out, and makes them too tight a fit. Paraffin usually loosens stuck piston rings. Piston rings are made to very accurate dimensions, and it is very bad practice to attempt to "fit" oversize or undersize rings unless you know exactly what you are doing. Lapping-in oversize piston rings is a skilful job, and unless the slot sizes are exactly right the rings will not function well, and may even produce an engine "seizure." Therefore, always use piston rings guaranteed to be of Doulgas manufacture.

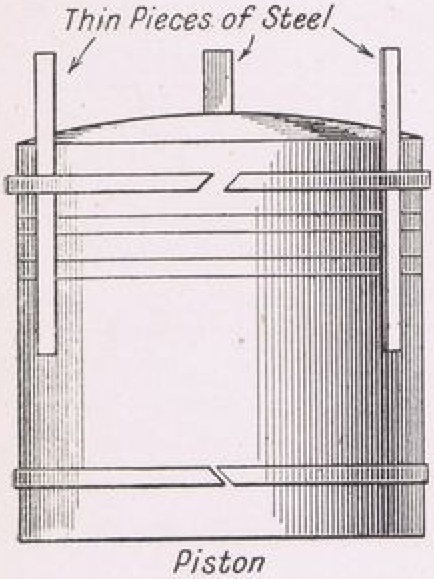

FIG. 72.—HOW TO REMOVE PISTON RINGS

The above is the accepted method, unless one has a special tool available

Take care that the two scraper rings, one on the crown and one on the skirt of the piston are correctly replaced. They have special bevelled edges, and should be fitted with bevel towards top of piston.

Reassembly of Engine. After all this has been done, the rear cylinder may be reassembled. Care should be taken to replace the copper gasket. The piston should be oiled before being attached to the connecting rod with the gudgeon pin. Hold the cylinder in the rear angle of the frame, and place the piston a little before B.D.C. on the firing stroke. By pressing the rings in with the fingers without disturbing the slot positions, the barrel may be slid over the piston and the nuts uniformly tightened up afterwards diagonally. Before the barrel is replaced the valve gear may be reassembled in the reverse order in which it was dismantled. Leave plenty of exhaust valve clearance so that when tightening the barrel down no resistance is offered to the exhaust valve stem by the tappet. Replace the cylinder head, screw up the valve caps hard, and finally replace the sparking plug and its H.T. lead. Be sure the right one is connected.

Proceed similarly with the dismantling and reassembly of the front cylinder, and finally adjust the valve clearances (see page 83), and replace the valve covers, afterwards replacing exhaust and induction pipes. If the rider prefers it he may, of course, dismantle and reassemble front and rear cylinders simultaneously, but this is not recommended by the author unless the owner has plenty of accommodation, and has time on his hands to complete the overhaul straight off. As previously mentioned, however, it is possible to decarbonize the pistons in a remarkably short period of time by removing the cylinder heads alone. It is only when the pistons and valves need attention or inspection that the job of decarbonization is a lengthy one, and even then it may be accomplished in a few hours.

VARIOUS ADJUSTMENTS AND DISMANTLING OPERATIONS

Maintaining Compression. If piston rings and valves are O.K. the only other possible sources of leakage are the valve caps and the sparking plugs (presuming the head is firmly bolted down). The washers belonging to these parts should be replaced as soon as they become at all worn or distorted, and a jointing medium should be utilized when screwing up the plugs and valve caps. If suspected, test for compression leakage by putting thick oil on to the sides of the joints and noting the presence or absence of bubbles with the motor running.

Air Leaks in Induction System. The chief source of air leaks, apart from leaks at induction pipe connections and carburettor, is at the inlet valve guides. Should these guides become badly worn they must be renewed or the engine will run irregularly at low speeds. It is sound practice to fit one of the proprietary valve attachments, such as the "F.E.W." or "Flexekas." These devices enable the valve stems to be continually and amply lubricated, thereby ensuring long life for the valve guides, and at the same time they eliminate all air leaks. (The valve stems on the 500 and 600 c.c. models are lubricated from engine.) Induction pipe air leaks are usually due to careless refitting of the induction system or to the use of excessive force.

Testing for Spark at the Plug. The accepted method of doing this is to place a wooden-handled screw-driver with steel blade across the terminal and just touching the cylinder fin. Now jump on the kick-starter and see if there is any sparking at the blade tip. It is just possible that the plug insulation is defective if the foregoing experiment produces a "juicy" spark, and yet the engine refuses to fire, assuming there are no carburation troubles. In this case take the plug out and lay it on the cylinder head, taking care that the terminal is insulated from the cylinder, and reconnect the H.T. lead. Now repeat the "jumping business," and see if anything happens. If no spark occurs now, we may take it that the plug is faulty, and it should be scrapped.

If it is noticed that the engine is firing on one cylinder only, the faulty one can readily be detected by shortcircuiting the plug

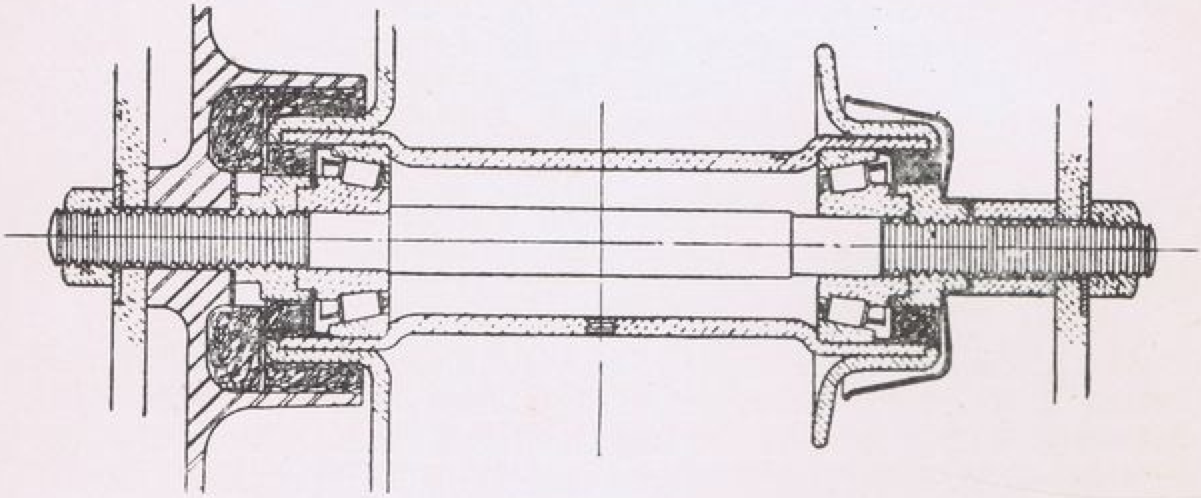

Fig. 73. Sectional View of Rear Hub

to the engine with the screwdriver. When the faulty plug is shorted, no difference will be noted, but the engine will stop if the good plug is "cut out" in this manner.

Cleaning Silencer. After a very considerable amount of running the silencer is liable to get partially choked with soot from the exhaust and cause undue back pressure and a "wooly" engine. Once a year it should be taken off, taken apart, and thoroughly cleaned out with paraffin and a stiff wire brush.

Synchronizing Magneto. See that the cams on the contact breaker are of equal height, as shown by measuring the gap between the platinum points at each "break." For this purpose use the "feeler" gauge. If the gaps differ, get them both to the exact distance recommended by the makers (·02 in.) shown by the gauge on the magneto spanner.

Brake Adjustment. In order to derive the best action from the semi-Servo brakes not too much backlash should be permitted, the expanding friction band (see Fig. 18) best being as close as possible to the drum contacting surface without actually impeding rotation with the brake off. The front brake is adjusted in this manner by operating the milled disc by hand and the rear brake by the use of a spanner.

Wheel Bearings. Great care should be taken in adjusting the taper roller wheel bearings, on no account should they be screwed up tight. All bearings must have a small running clearance, which is naturally greatly magnified if checked at the tyre. In other words, the bearings should be adjusted so that there is perceptible play present when the wheel is grasped by the tyre and rocked to and fro.

Use the grease gun upon the hub nipples every 2,500 miles, and frequently " shake " the wheels for play.

For strenuous competition work it is advisable to fit two security bolts to the back wheel and one to the front. This is unnecessary for ordinary touring.

Clutch Adjustment and Dismantling. Periodical adjustment of the clutch is necessary.

It is important to remember that as the adjusting screw is screwed up to accommodate wear of the friction material, the releasing arm must be likewise adjusted, by lengthening the Bowden wire, otherwise the spring pressure is exerted on the ball bearing, and on the cam face instead of the pressure plate. *This is very important, and there should be at least $\frac{1}{16}$ in. of play between the operating cam and the release thrust race.* In other words, have a small amount of slack on clutch control lever before applying any pressure by hand to release the clutch.

Another point to note is that after overhauling, the clutch should be cleaned out. Raybestos and other lining materials form a considerable amount of dust, and unless this is removed from the clutch body it will gradually pack up between the periphery of the clutch plate and the inside of the flywheel, and eventually prevent the clutch functioning.

In assembling the clutch, the whole of the parts, with the exception of the springs, flywheel nut, and washer, or driving key, and the adjusting nut, can be assembled and placed on the crankshaft as a single unit. There should be at least $\frac{1}{16}$ in. clearance between the end of the shaft and the face of the flywheel boss, with the flywheel forced on the shaft. With this correct, insert the driving key ($2\frac{3}{4}$ h.p. models), which acts as a washer to the flywheel lock nut, then screw up the lock nut. It is essential that this nut is absolutely tightly secured. With the lock nut in place the four springs should be inserted, their retaining washer put into place, and the adjusting nut screwed on. Under no circumstances should the adjusting nut be screwed tighter than is necessary. It is well to try the clutch three or four times.

and adjust until all slipping is prevented. Care should be taken that as this nut is screwed up the cam operating lever is allowed to go back towards the crankcase, by lengthening the Bowden operating wire.

It is advisable to remove the Bowden wire nipple from the operating arm, and allow the arm to fall free, until the required adjustment of the spring pressure has been obtained. It will be appreciated that as the Raybestos plate wears, so the spring pressure will require adjustment, and the operating lever resetting accordingly.

In dismantling, all that is necessary is to remove the adjusting nut, the springs and ring, the flywheel lock nut, and then the driving key. The flywheel, together with the remainder of the clutch, can then be removed from the shaft with the withdrawal tool. Screw the tool into the boss until it is against the end of the crankshaft. Hammer it round one turn and then strike it sharply with the hammer, when the shock will loosen the flywheel from the taper of the shaft. The flywheel of H.3 500 c.c. and 600 c.c. is self-extracting by unscrewing flywheel nut.

In the case of the H.3 500 c.c. and 600 c.c. clutches, adjustment and dismantling is similarly effected.

Occasionally, say every 500 miles, charge the bore of the flywheel lock nut with grease. This applies only to L.3.

TYRE REPAIRS

Punctures. Given reasonable luck, 4,000 or 5,000 miles should be covered with new tyres of good quality before the first puncture should be experienced. Bursts or severe cuts due to broken glass require the attention of someone skilled and equipped for this work.

The repair of an ordinary puncture or small cut is a simple matter, provided a few rules are observed. As in soldering, perfect cleanliness of the parts to be joined is essential. Repair outfits suitably equipped for the motor-cyclist can be obtained from any accessory dealer.

The type of repair patch favoured by the author is the moulded type, in which the side to be stuck to the tube is specially prepared and also protected from dirt by means of a piece of cloth or stout paper, which is removed only when the patch is to be fixed. Clean the tube for at least an inch all round the puncture. This is best done by means of glass paper, or a wire brush. Wipe the spot with petrol and smear on some rubber solution, working it into the tube with the finger tip. When it begins to be " tacky," place the tube on one side, taking care to keep all dirt away from the tube, strip the covering off the patch—which should cover the faulty place with at least ½ in. to spare all round—smear on a *very little* solution, and when tacky apply the patch to the tube. If the solution is neither too dry nor too liquid, the patch will adhere immediately. The solution should be given a minute or two to harden, after which the patch and the surrounding tube should be rubbed with French chalk to prevent any adhesion to the cover when it is replaced.

Depending on the make, these directions vary very slightly, but full instructions are invariably printed on the repair outfit.

Removing Tyres. To the novice, this is at first a difficult task, as it is easy to damage the inner tube and possibly the rim of the wheel. It will, of course, be necessary first to remove the wheel. Most tyres are marked on the side which should be removed, and this side should be eased off with tyre levers. It is best to commence operations at the point opposite the valve, by inserting a tyre lever between the rim of the wheel and the edge of the cover. Two levers should be inserted about 6 in. apart, and depressed, so that the edge of the cover is raised above the rim of the wheel. When a third lever is inserted on either side of the other two, the middle one may be removed and the process repeated. The tube may now be withdrawn.

TIMING, ETC.

Magneto Timing. Should the magneto be removed from the engine or the timing gear disturbed it will be necessary to retime it. Even if this is unnecessary it is advisable to check it if in doubt. Correct magneto timing is very important if high efficiency is desired. It is therefore better to time by degrees of flywheel rotation rather than by fractions of an inch on the piston stroke. The external flywheel on the Douglas lends itself particularly well to the degree method of spark advance setting, as the full advance and T.D.C. positions may be marked on the edge of the rim. The degree method is, of course, far more accurate, since there is no "dead" position as is the case where the upper limit of the connecting rod stroke is concerned. To check the timing proceed as follows—

(*a*) See that the platinum contacts are breaking to extent of ·011 in.

(*b*) Fully advance magneto lever (fully inwards).

(*c*) Open contacts and insert between a *thin* strip of paper.

(*d*) Turn engine over until the points grip the paper, then turn engine very gently forward, at the same time pulling the paper gently, until it is released. At this position the flywheel should have rotated until its T.D.C. position is 31 degrees in advance of the true vertical on its diametrical axis (or the piston is $\frac{5}{16}$ in. before T.D.C.) in the case of 350 c.c. engines and in the case of the 500 c.c. and 600 c.c. units $35\frac{1}{2}$ degrees and $\frac{23}{64}$ in. respectively.

Should the timing be found incorrect it will be necessary to remove the timing case, loosen the magneto sprocket, and adjust until the timing is correct.

Engine Timing. On all modern Douglases this is best left well alone, except possibly by absolute experts and speedmen. Douglas Motors, Ltd., it may be reasonably agreed, have done their best to give their engines the best performance having regard to average conditions, and their setting has been arrived at both by theory and experiment. All pinions are marked so that correct replacement is ensured. The dot system is used. The only occasion when it is excusable to alter the valve timing is when the cams are thoroughly worn out, and by that time the whole system is senile, and best exchanged, or sold, if anyone will buy it! The best advice is to leave the valve timing strictly alone.

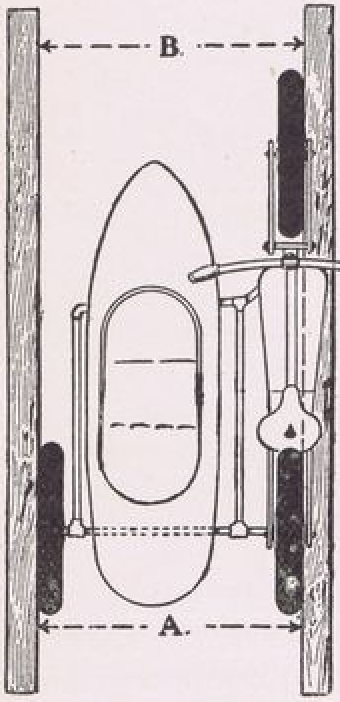

FIG. 74.—SIDECAR ALIGNMENT

The distance A and B must be equal

Wheel Alignment. If undue tyre wear occurs and the machine becomes unsteady on grease, the most probable explanation is that the wheels are out of alignment. In the case of a solo machine it may be due to two things—(*a*) a distorted frame (caused by a bad crash and difficult to remedy), (*b*) misalignment of the rear wheel in the forks. In the latter case the remedy is obvious. To check alignment place the machine on its stand or stretch a cord so that it just touches the tyres of the wheels at four points. If alignment is faulty this four-point contact is impossible.

In the case of a sidecar, bad alignment has a very adverse influence indeed upon tyre wear. Check by means of straight-edges or cords placed across the wheels. Needless to say the axis of all three wheels must be parallel. The method of procedure is self-evident (Fig. 74). The cycle should be fixed so that it stands dead upright.

Maintenance of Lamps. Acetylene generators must be kept thoroughly clean throughout if proper gas generation is to be effected. Also the burner must be pricked out with fine wire frequently. An acetylene lamp must not be allowed to burn out, but should be blown out; otherwise the burner will very soon become choked with carbon. In the unfortunate event of the rider's lamp blowing out when no matches are available, the sparking plug may be used to light the lamp.

When a machine has an electric lighting set, the accumulators should always be kept on charge, or they will rapidly deteriorate and become useless. When not in use, alternate slow charging and discharging keeps them in good condition.

Coupling up a Chain. Always reconnect a chain with the spring link on the sprocket. This makes the operation very simple, as all tension is taken by the sprocket teeth. The closed end of the link should face the direction of rotation.

Chain Repairs. Chain repairs are rarely necessary. When they are, they may be readily effected with the aid of a box of spare links, and the rivet extractor in the tool kit.

Play in Steering Head. All play in steering head should be taken up by means of the split lug and lock-nut adjustment. The adjustment should not be too tight, or the balls in the steering head may be damaged. Keep this bearing well lubricated.

Removing Tight Studs. Obstinate studs may be removed for the purposes of replacement as follows: Two nuts are locked together, and a spanner used on the bottom one to unscrew the stud.

Paper Washers. These are useful in preventing leakage, and may be made by placing a sheet of paper over the part for which the washer is intended and rubbing round the edge. A clear impression is thus made on the paper, and the portions not required may be then cut away. The washer should be oiled before insertion.

Removing a Tight Valve Cap. A valve cap that has resisted ordinary methods of removal may sometimes be removed by the introduction of a little paraffin oil round the threads of the cap when the engine is hot, the spanner being applied immediately. The remaining method of removal, if absolutely necessary, is to drill a series of holes across the diameter of the cap. Never use excessive force with the cylinder head in place. It may strain or distort the cylinder.

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