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The BOOK *of the* ROYAL ENFIELD

"R. E. RYDER"

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THE BOOK OF THE ROYAL ENFIELD

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

BY

"R. E. RYDER"

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

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PREFACE

THE purpose of this little book is to provide the reader with such information as every motor-cyclist should possess; with, in addition, all that which is of a more particular and exclusive value to the owner, or prospective owner, of a Royal Enfield machine. Provided that its pages have been read and their contents assimilated, the reader may consider himself as qualified to take charge of a motor-cycle; in so far as knowledge, *per se*, constitutes a qualification. He—or she—will also be not only acquainted with motor-cycle matters in general, but will possess, further, a specialized knowledge of the Royal Enfield machine.

A handbook of this kind is meant not only to be read through, but to be kept for reference. It should be studied fully by the novice before he takes to the road, and certain chapters, notably those relating to driving and to road laws and usages, must be fully understood. Other sections, for example, those dealing with mechanical troubles and their cure, will be found mainly of value for reference, as occasion arises.

To prepare a book that will, it is hoped, prove helpful to other users of Royal Enfield motor-cycles has been a pleasure, as it is always pleasurable to assist others to enjoy what one has oneself enjoyed. In addition to the Enfield that I now own, I have ridden many other models of the same make, some of them a great many years ago, and all with a great measure of satisfaction. The best that I can wish for the reader of this book is that his experiences of Royal Enfield motor-cycling will be as happy as have been my own—and that is a good wish indeed.

I should add that I have, of course, no interest either directly or indirectly in the Enfield Cycle Co., Ltd., or in any firm associated in any way with them. And I may remark further that my riding experience is not by any means confined to cycles of their make. I am, however, indebted to the company for the loan of photographs, and for other help given in the preparation of this volume.

"R. E. RYDER."

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BOOK OF
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CHAPTER I

BUYING A MOTOR-CYCLE

THE normal method of buying a motor-cycle is to conduct the transaction through the local agent for the make selected. There is no point in sending the order direct to the manufacturers, who will, in fact, merely forward it to their agent in the purchaser's district, as it is precisely for the purpose of dealing with customers on the spot that they have appointed him.

The Place of the Agent. The system of distributing manufactured goods through retail shops is in operation in practically all industries, and has been adopted, after long experience, as the most economical way of supplying the general public. In the case of motor-cycles, and of other goods that may require repair or adjustment after purchase, the system is of particular value, as is quite obvious. Reliable as motor-cycles of to-day are, they do occasionally need the attention of a thoroughly skilled man ; simple as they are, the novice, and even the fairly experienced rider, may be glad from time to time of advice on such points as may puzzle him. For the makers to provide the service—to use an all-embracing term—required by all the owners of their machines would be next door to impossible, and the need can only be met by the system of local agents. The man from whom the machine was bought, who has a strong interest in keeping in the good books of its owner, is obviously the man on whom the latter should be able to rely for service, and the agent should be, and in the vast majority of cases is, the guide and friend of his customers.

Used Machines. A second-hand (or more properly a " used ") machine is also best bought, as a rule, through the trade. On the whole, I do not think that it generally pays to buy a used machine as one's first mount ; the chance of minor breakdowns on the road is always greater than in the case of a new machine,

and renewals will have to be made earlier. I think that every schoolboy ought to be given an old crock to play with, as soon as he is old enough to hold a licence, merely in order to educate him in motor mechanics. But that is rather straying from the point; the man who is buying a motor-cycle for *use* had best make up his mind to invest in a new one while he is about it. If, however, a used machine is wanted, the local agent can probably obtain one without much difficulty, and he can be relied upon to take a helpful interest in it afterwards.

Very often, too, a good bargain can be picked up from a personal friend, in a machine of which one knows the history. Care should,

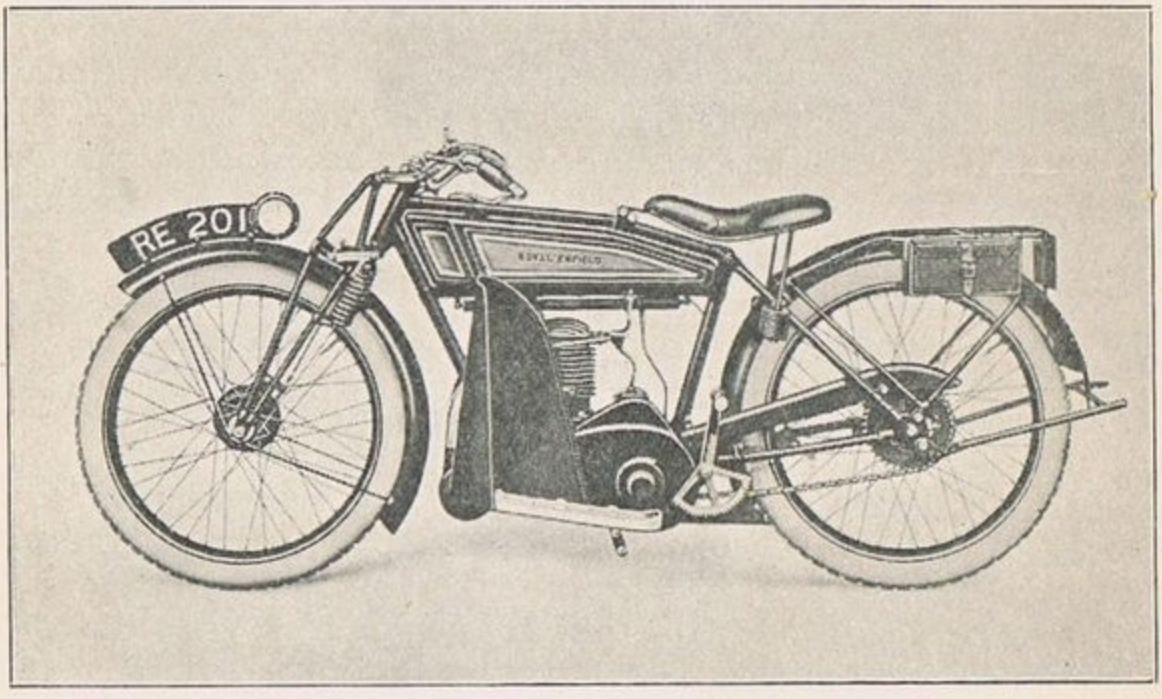

FIG. 1.—2¼ H.P. STANDARD TWO-STROKE
(Model 201)

however, be exercised in buying from total strangers, and the great disadvantage in all such cases is that the seller, unlike the motor-cycle agent, or one of one's personal acquaintances, cannot be relied upon to put matters right if the machine turns out to be a "dud" after the money has been paid over. It is always best, if the purchase of a used machine be seriously contemplated, to seek the advice of one of one's more knowledgeable motor-cycling friends.

It is advisable always to look at the licence book to see the past history of a machine before the deal is closed. This, moreover, enables the purchaser to be certain that the machine sold does belong to the seller. If this is not so, or the machine is being bought on the hire purchase system, the name of the true owner will appear in the book.

Payment by Instalments. Motor-cycles may be bought either for cash or on the deferred payment principle. The former, naturally, is the more economical for those in a position to afford it, but the extra cost involved by the deferred payment system is not high. It is, too, being employed nowadays by a vast number of people in all walks of life. The usual terms are the payment of one-quarter of the list price of the machine on the spot, the balance, plus 5 per cent for the accommodation, being paid in twelve equal instalments month by month. The machine has to be insured at the time of purchase, and the future owner

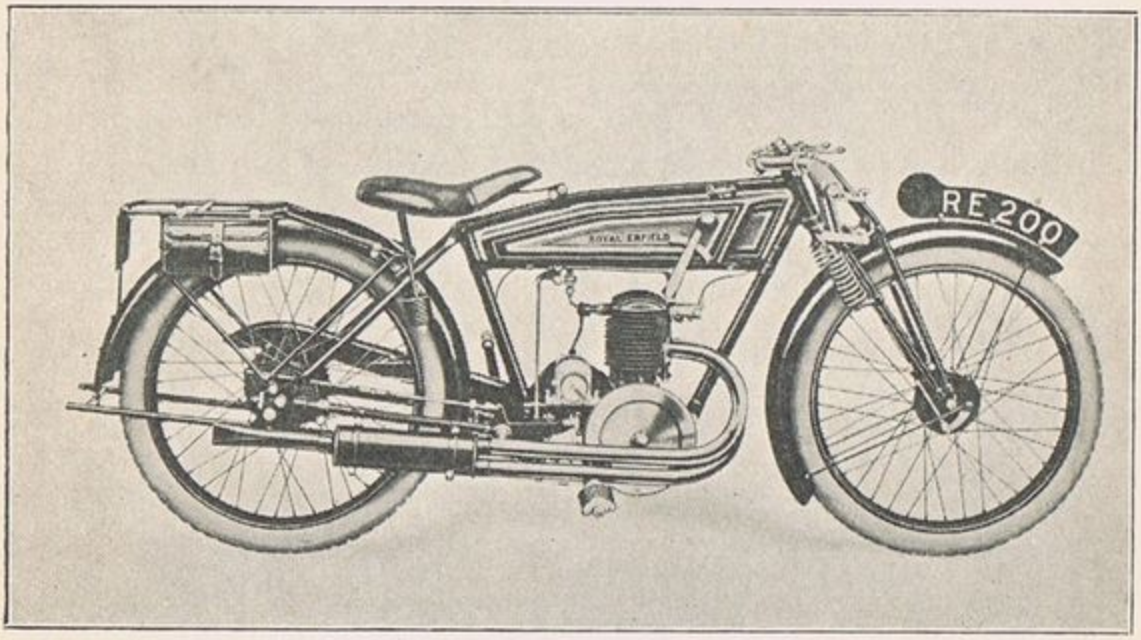

FIG. 2.—2¼ H.P. SPORTS TWO-STROKE
(Model 200)

can have such accessories as he requires included in the transaction. Two references are required, and would-be buyers who are under 21, or who are not householders, have to provide a guarantor. The form necessary in applying for a machine on these terms can be obtained from the agent. The Enfield Co. have formed a subsidiary firm to deal with this branch of their business, which is a point worth knowing, as buyers on deferred terms have sometimes found that their business had been placed in the hands of what was practically a money-lending concern.

Selling an Old Machine. A note may be added as to the best way of disposing of an old machine. If, as is most often the case, it is only being got rid of to be replaced by another model, the agent from whom the latter is bought will almost invariably accept the former in part payment, and will allow a fair price for it. Otherwise, a customer may be found among one's personal friends, or the machine may be advertised. Local papers can

generally be relied upon to prove fairly effective for this purpose, and there are, of course, also the *Motor Cycle* and *Motor Cycling*. Again, as in buying a used machine, discretion must be exercised in dealing with strangers ; machines have, for example, frequently been stolen by pretending inquirers who have foolishly been allowed to take them for trial spins, from which they have never returned. Again, most agents will accept machines for sale on commission, placing them in their showrooms, and doing their best to dispose of them on behalf of their owners. The arrangement made should preferably be written, and signed by both parties beforehand ; usually the owner allows the agent a fixed percentage on whatever he can realize on the machine, or alternatively he may fix a reserve price, leaving the trader to make what profit he can over and above that figure. In London, and in a few other cities, regular auctions of motor-cycles are held by firms specializing in that method of doing business, and machines can also be disposed of in this way, though my experience is that the prices obtained are usually less than might have been got by other methods.

CHAPTER II

TYPES OF ENFIELD MACHINES

PLEASURE MODELS

A TABLE of the modern Royal Enfield models on the next page gives the bore and stroke, the cubic capacity, and other particulars.

The Two-strokes. Of the two-strokes, Model 201 is the standard touring machine, fitted with footboards, leg-shields, and an Enfield two-speed gear-box, with a kick-starter. The machine is designed primarily for the man who needs a simple

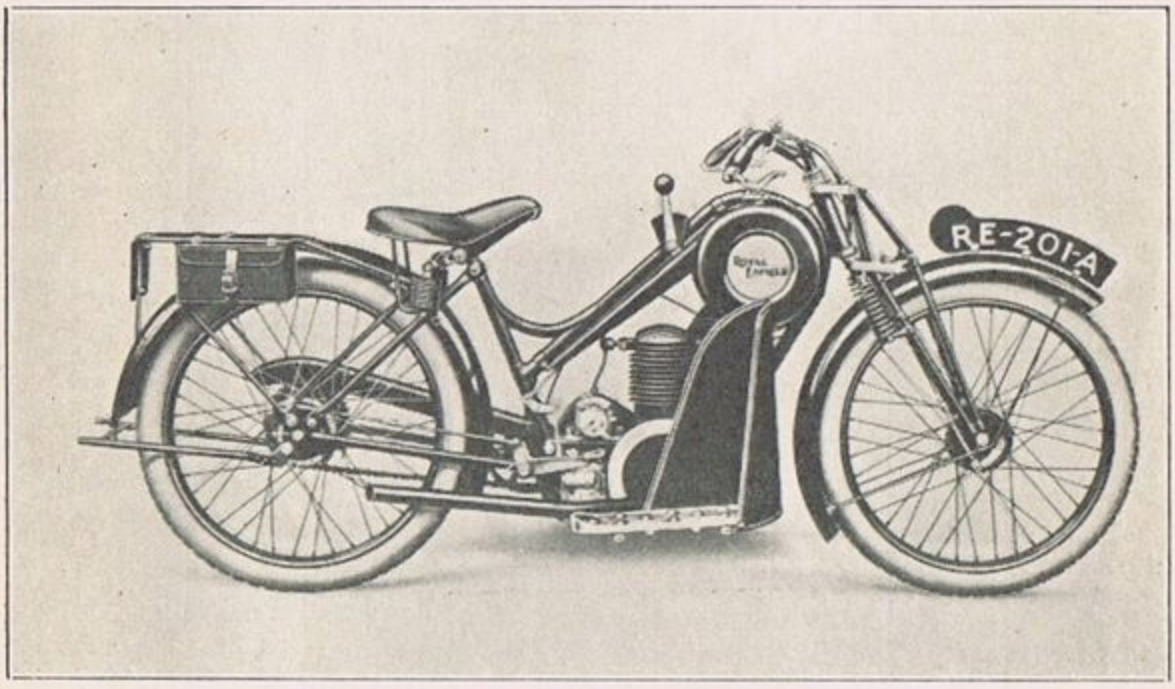

FIG. 3.—2¼ H.P. OPEN FRAME TWO-STROKE
(Model 201A)

means of transport over fairly short distances for use in all weathers, e.g. for use between his home and the station. This must not be taken to mean that the machine is incapable of covering long distances in the day, if called on to do so. Model 200 also has a Royal Enfield two-speed gear. Owing to the substitution of footrests for boards, and the omission of leg-shields, it is less mudproof than the previous model, but it is likely to be more comfortable over longish distances. Model 201*a* is an open-frame edition of Model 201, especially suitable for ladies' use, or for professional gentlemen who do not wish to wear special motor-cycling clothing.

TABLE OF ROYAL ENFIELD MODELS

H.P.	Model No.	Bore, Stroke, c.c.	Gear.	Brakes.	Tyre Size.	Remarks.
2¼	201	64 × 70 225	Enfield 2-sp. (hand)	Int. exp., both wheels	24 × 2¼	Standard 2-stroke. Leg-shields and footboards.
2¼	200	64 × 70 225	Enfield 2-sp. (hand)	Int. exp., both wheels	24 × 2¼	Sports 2-stroke. Footrests.
2¼	201A	64 × 70 225	Enfield 2-sp. (hand)	Int. exp., both wheels	24 × 2¼	Open frame.
2¾	350	70 × 90 346	Sturmey 3-sp.	Int. exp., both wheels	26 × 2½	Side-by-side valve.
2¾	351	70 × 90 346	Sturmey 3-sp.	Int. exp., both wheels	26 × 2½	O.H.V. sports, single-port.
2¾	352	74 × 80 344	Sturmey 3-sp.	Int. exp., both wheels	26 × 2½	O.H.V. two-port racing.
8	180	85·5 × 85 976	Sturmey 3-sp.	Int. exp., both wheels	700 × 80 or balloons	Standard combination.
8	190	85·5 × 85 976	Sturmey 3-sp.	Int. exp., both wheels	700 × 80 or balloons.	De Luxe model. Electric lighting, etc.
8	182	85·5 × 85 976	Sturmey 3-sp.	Int. exp., both wheels	700 × 80 or balloons	Sports combination. Light aluminium sidecar.

The Four-stroke Singles. The four-stroke single cylinder machines are heavier, faster, and more suitable for serious touring than the two-strokes. Model 350, with side-by-side valves, is

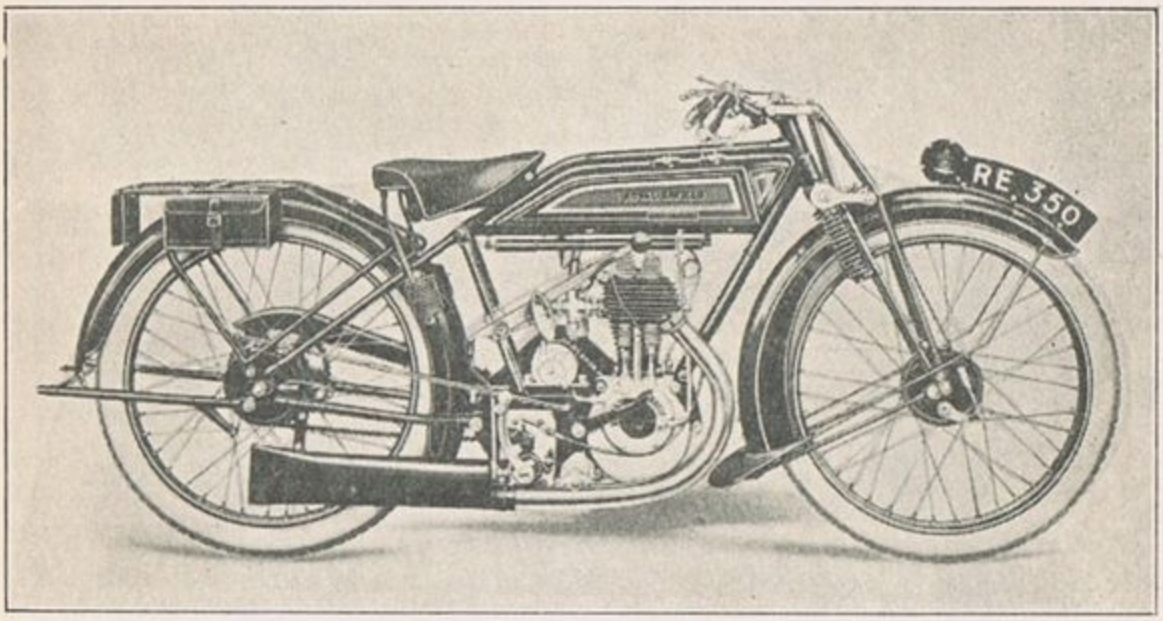

FIG. 4.—2¾ H.P. STANDARD
(Model 350)

fitted with a Sturmey-Archer three-speed gear-box, clutch, and kick-starter, and has a maximum speed of about 50 m.p.h. It is the most suitable mount for the man who wishes to ride solo

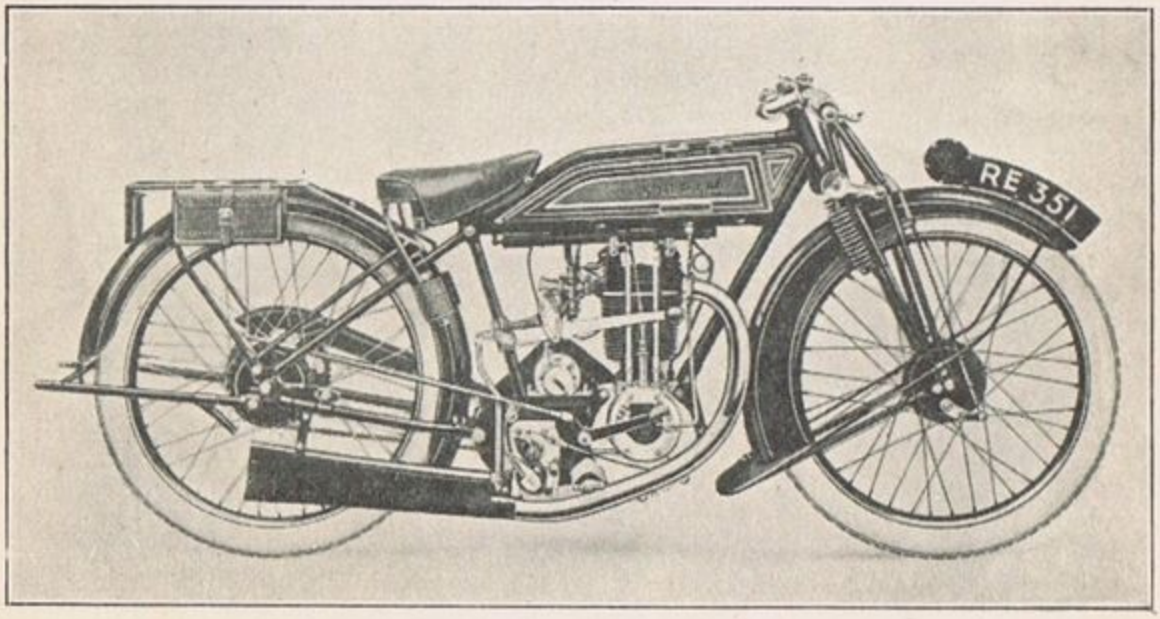

FIG. 5.—2¾ H.P. O.H.V. SPORTS
(Model 351)

only, who desires a machine capable of going anywhere and who, at the same time, does not wish to have to spend much time on the maintenance of his engine. While the side-valve engine is

less speedy and powerful than the overhead valve pattern, yet it requires less skilled driving on the road, and possibly less attention in the garage. At all events, the consequences of neglect are less serious.

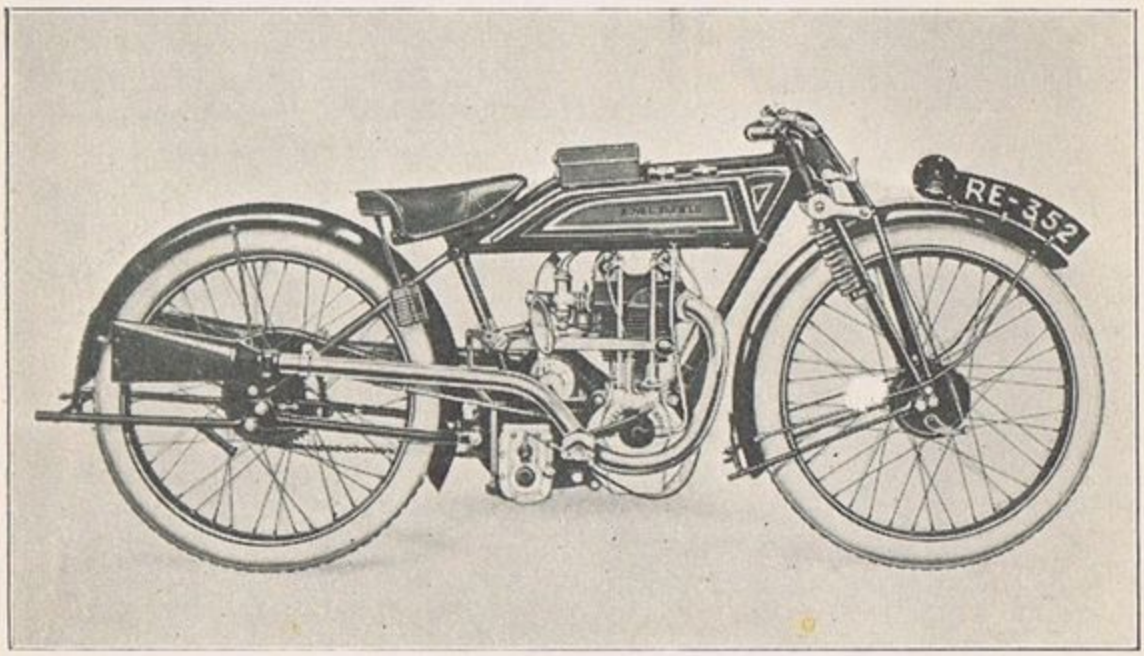

FIG. 6.—2¾ H.P. O.H.V. DOUBLE-PORT
(Model 352)

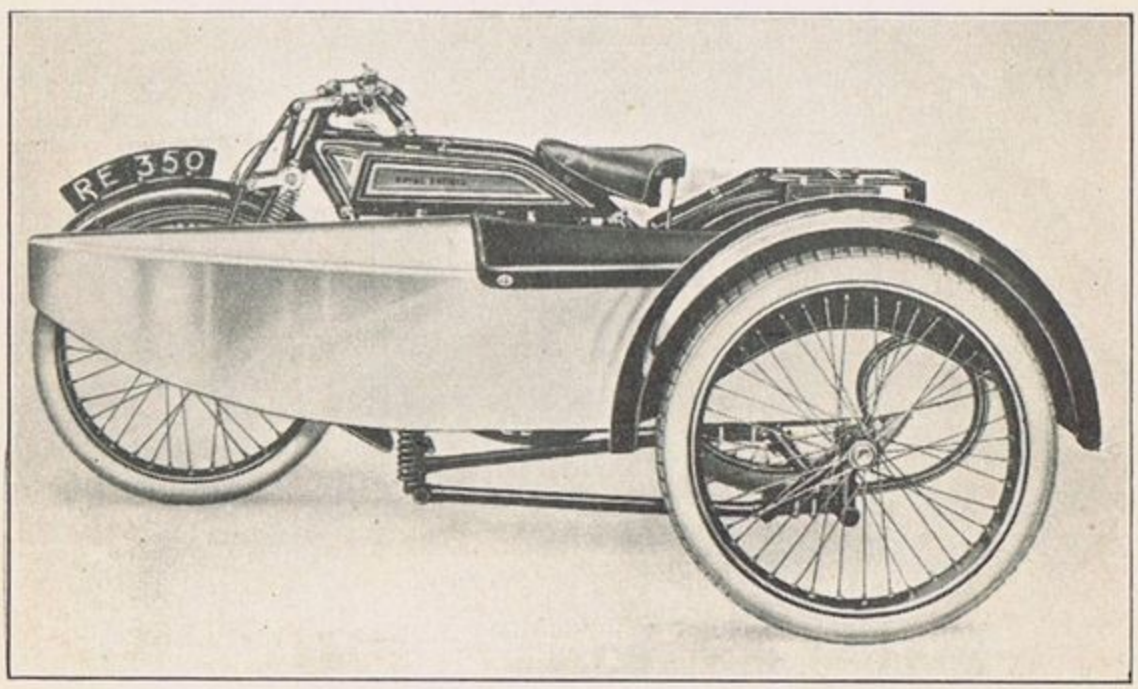

FIG. 7.—2¾ H.P. MODEL 350, WITH SPORTS SIDECAR

The O.H.V. Models. The overhead valve Model No. 351 is suitable for the man who is prepared to treat his machine as something of a hobby, and to give to it that attention which a

good engine may not need, but which it certainly deserves. The maximum speed is between 60 and 65 m.p.h. The two-port

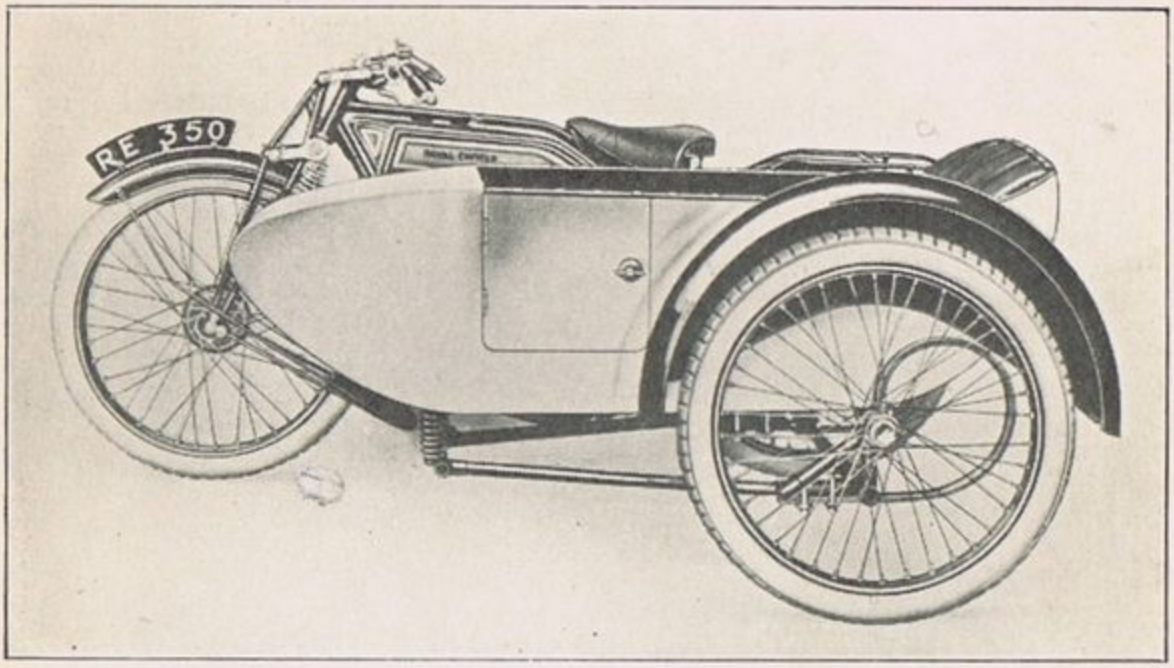

FIG. 8.—2¾ H.P. MODEL 350, WITH TOURING SIDECAR

Model No. 352 is purely a racing machine, and is not to be recommended for use for touring. The engine has a very high

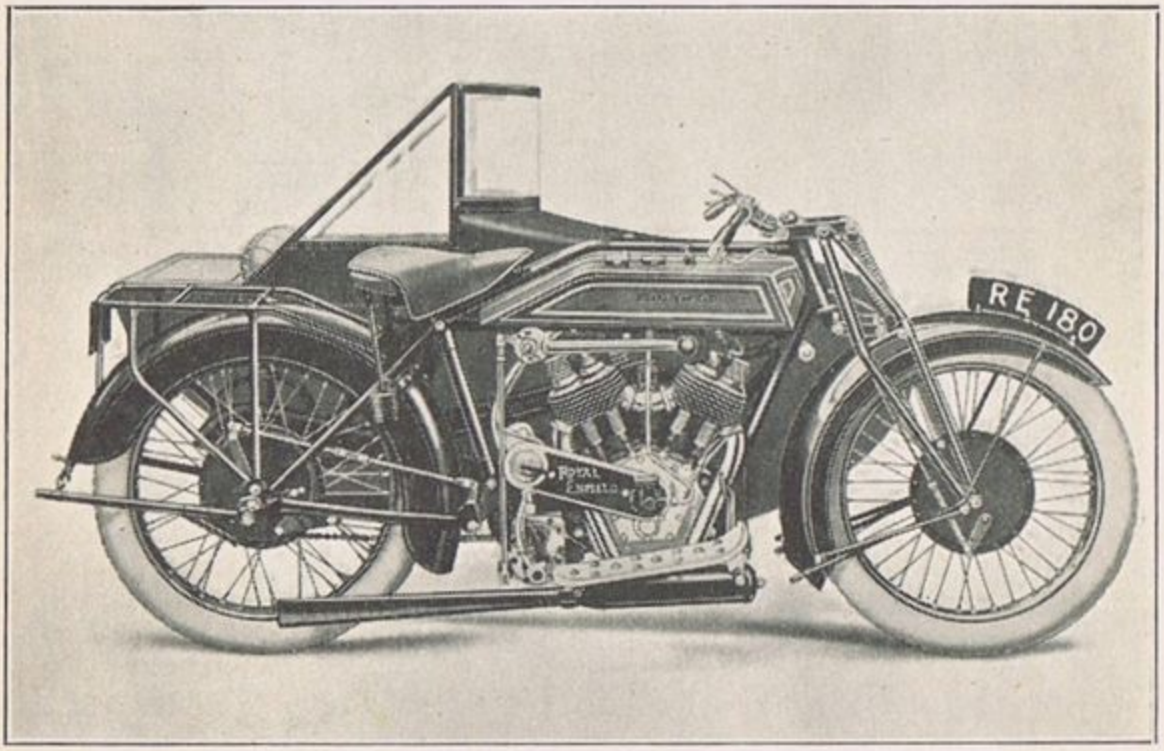

FIG. 9.—8 H.P. STANDARD COMBINATION
(Model 180)

compression ratio, so much so that it will not run on pure petrol, but on a mixture of petrol and benzol. When expertly tuned and ridden, the machine is capable of very high speeds, 80 m.p.h.

being well within its capabilities. But it is a thoroughbred, and should not be used as a hack.

The 350 c.c. models are perfectly capable of pulling a light sidecar, and two suitable types are made by the Enfield Co.; but for the family man, who needs a greater degree of comfort than a light-weight sidecar can provide, the 8 h.p. range is recommended.

Combinations. The engines of all the 8 h.p. models are similar, the differences lying in the equipment. Model 180, with Sturmey-

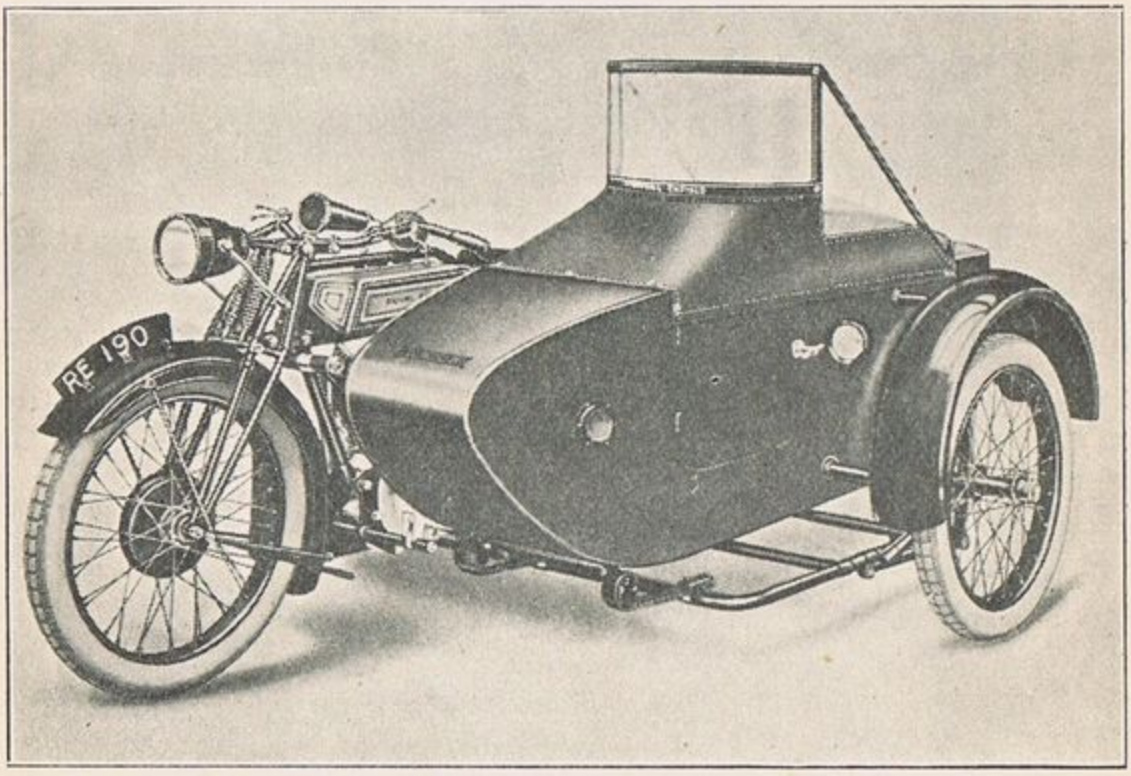

FIG. 10.—8 H.P. DE LUXE COMBINATION
(Model 190)

Archer three-speed gear, represents as good value for money as is obtainable at the present time. The machine is sold with a bare minimum of accessories. The De Luxe model, with Lucas electric lighting, lamps, horn, etc., is offered completely ready for the road, and is suitable for the man who needs a somewhat more luxurious machine than the cheaper model. The Sports model consists of the same cycle as the De Luxe, less electric lighting and other accessories, coupled to a handsome aluminium sidecar. Owing to the reduced weight of the sidecar, this model is capable of somewhat higher speeds than the other two.

All-weather equipment, making the sidecar into a totally enclosed compartment for bad weather, can be supplied at an extra charge. (*See* Fig. 12.)

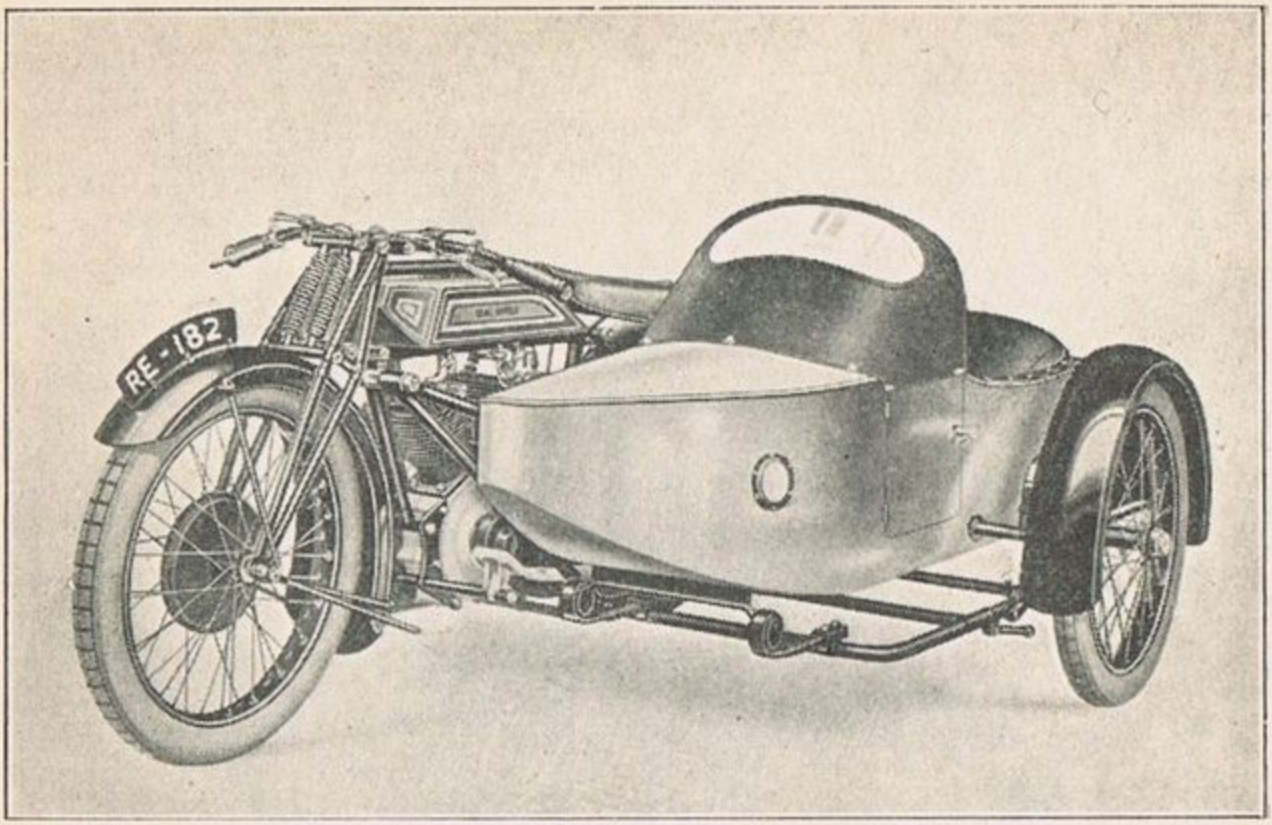

FIG. 11.—8 H.P. SPORTS COMBINATION
(Model 182)

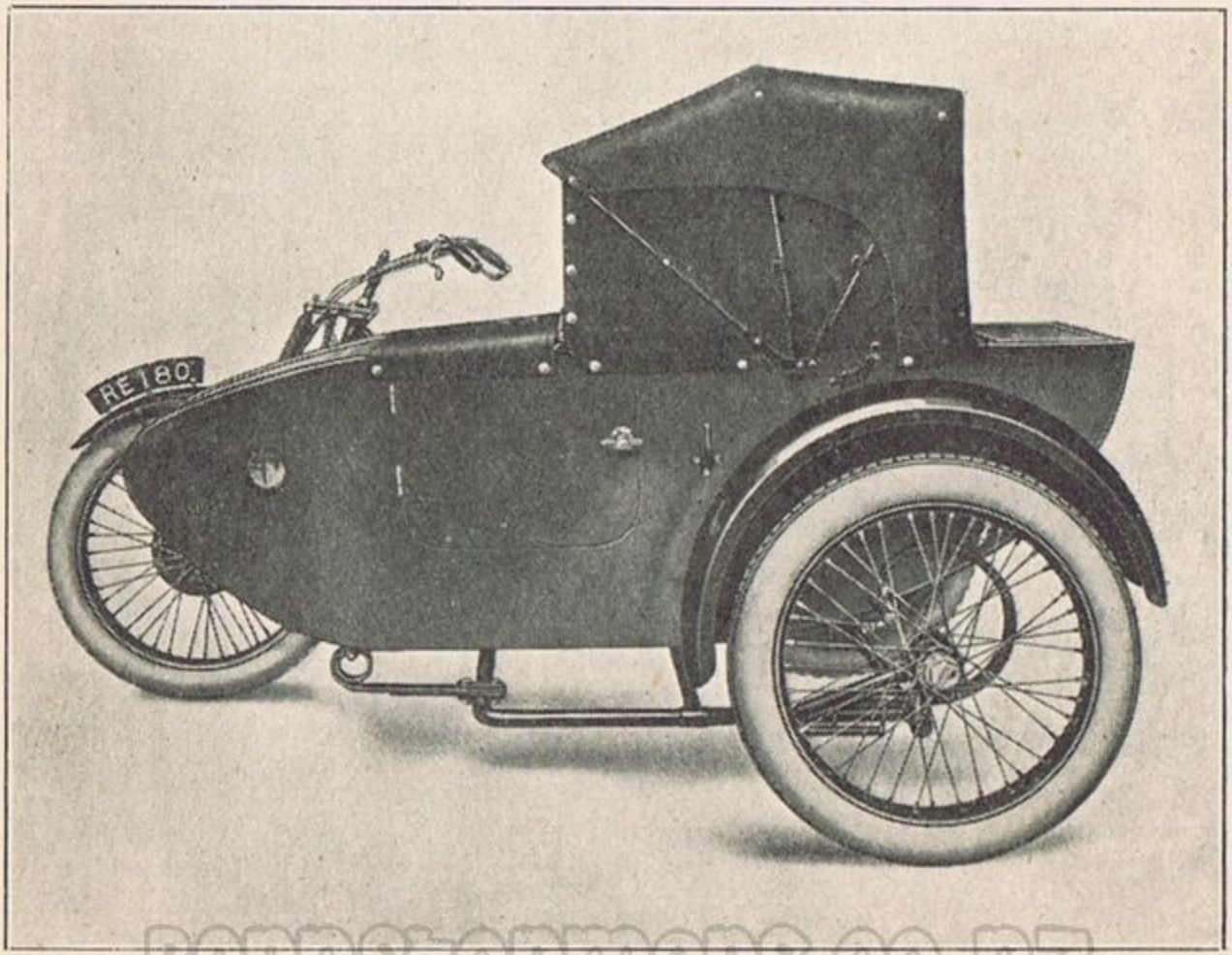

FIG. 12.—ALL-WEATHER EQUIPMENT OF HOOD AND WINDSCREEN

COMMERCIAL MODELS

In addition to the above types, the Enfield Cycle Co. make a number of commercial patterns. These are usually attached to

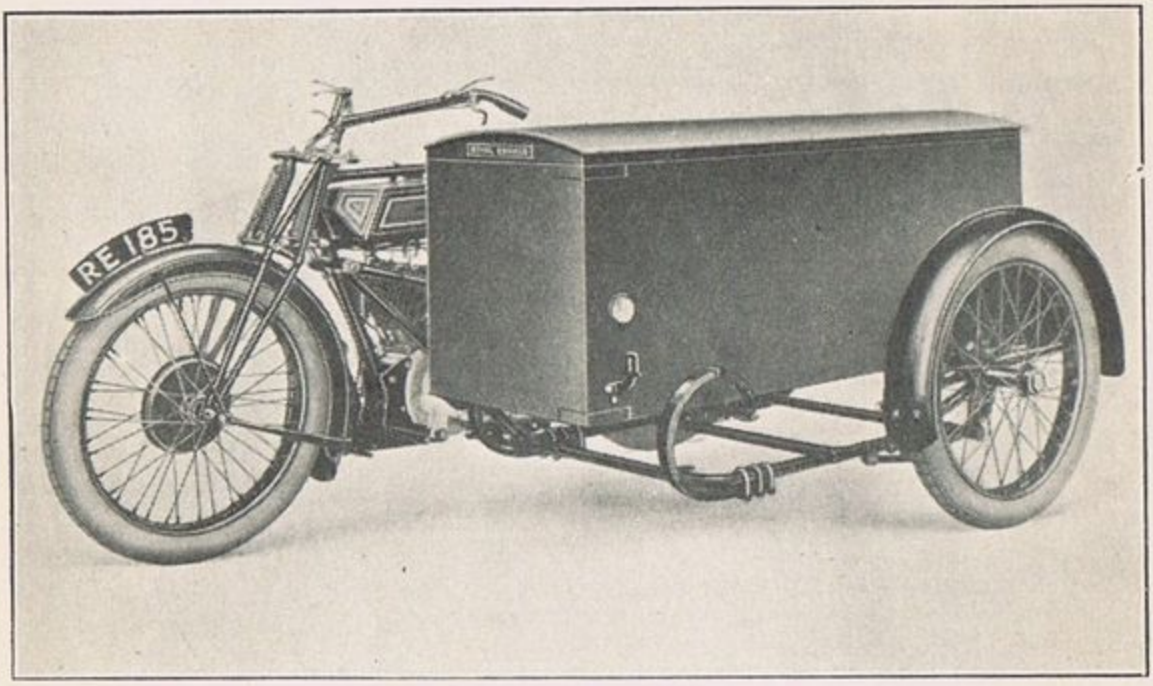

FIG. 13.—8 H.P. STANDARD DELIVERY COMBINATION
(Model 185)

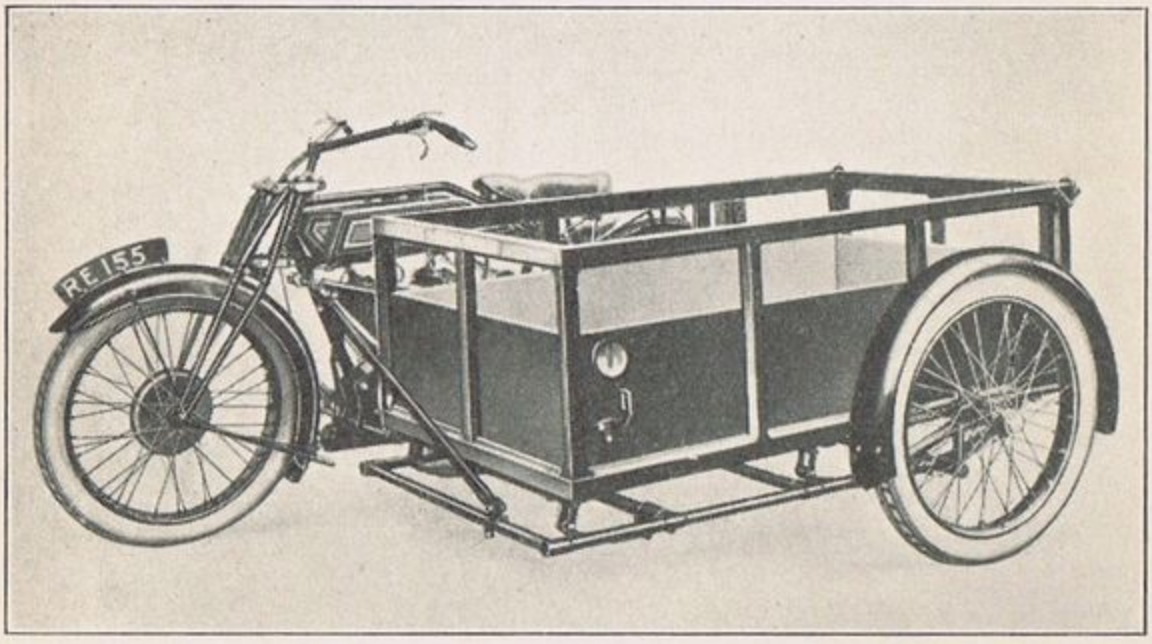

FIG. 14.—8 H.P. WIDE MILK FLOAT COMBINATION
(Model 165)

the standard Model No. 180 cycle, the standard box-carrier, which has a capacity of 13 cu. ft., being mounted on the standard sidecar chassis. A milk-float to carry two churns can also be mounted

on this chassis, while a specially wide chassis, with a five-point attachment, is made to take a float carrying three churns. The

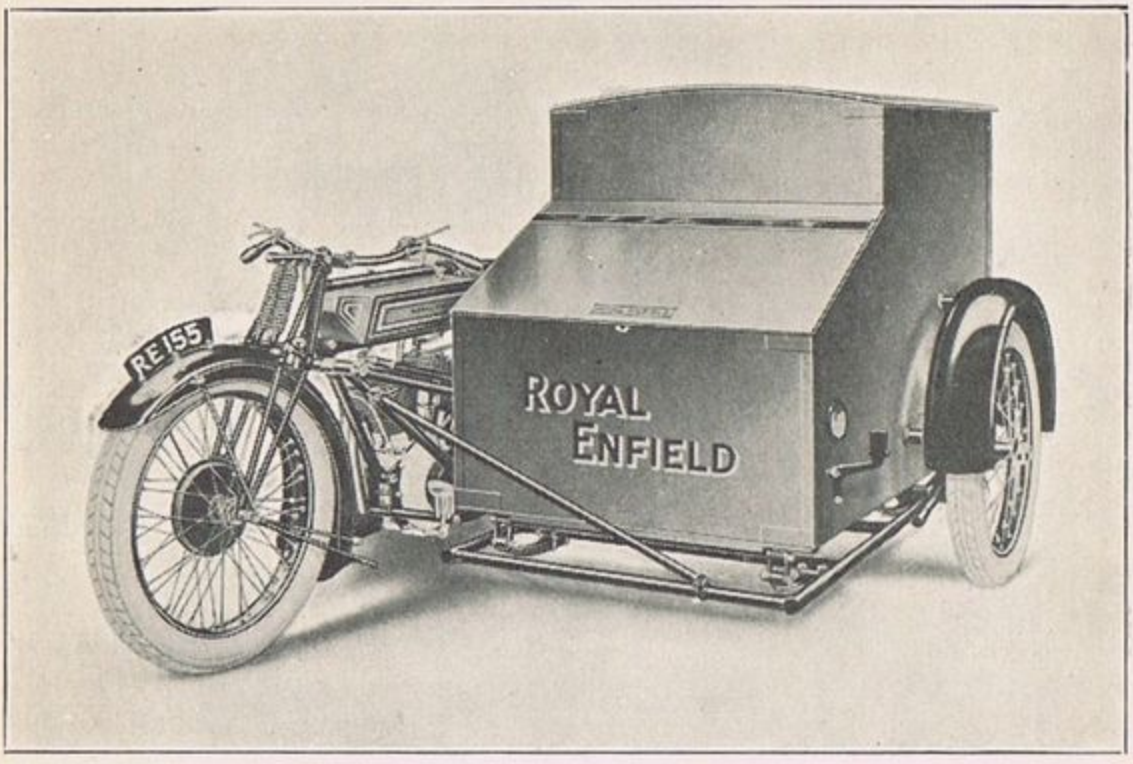

FIG. 15.—8 H.P. G.P.O. VAN
(Model 155)

wide chassis can also be fitted with two types of box-carrier, the larger of which, designed for the G.P.O., has a capacity of 31 cu. ft., and carries 4 cwt. of goods.

CHAPTER VII

THE CARBURETTOR AND MAGNETO

THE CARBURETTOR

THE carburettor, as will have been inferred from the previous chapter, is a device for converting liquid petrol into a readily explosive fuel mixture. Since petrol, in the liquid form, will not ignite sufficiently readily to run an engine efficiently, it is necessary to convert it into vapour, and to mix this vapour with the amount of air necessary for its complete combustion in the

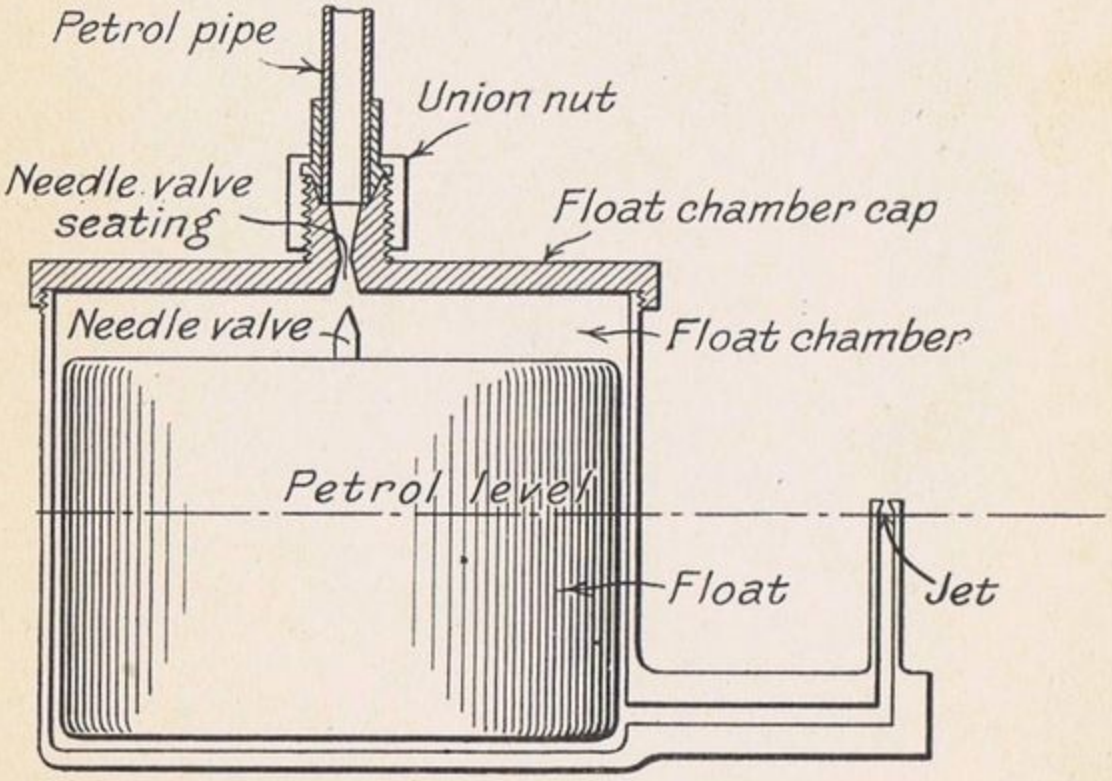

FIG. 22.—PRINCIPLE OF WORKING OF CARBURETTOR

cylinder. This is most simply done by causing the petrol to pass through a very fine jet into a current of air, since a fine spray evaporates very much more readily than a mass of liquid, and, essentially, a carburettor is nothing but a jet projecting into a tube at right angles. Since, however, it is necessary to be able to regulate the speed at which the engine is to run, a " throttle," consisting of a device for cutting off, more or less, the supply of mixture to the engine, is added, together with a similar device, the purpose of which is to vary the amount of air passing over the jet. These throttle and air slides are controlled from the

right handlebar by Bowden cables, the upper (short) lever being the air control, and the other the throttle.

If petrol were allowed merely to flow from the tank directly through the jet, a great deal too much would come through, and not only would a large quantity be wasted, but also much too

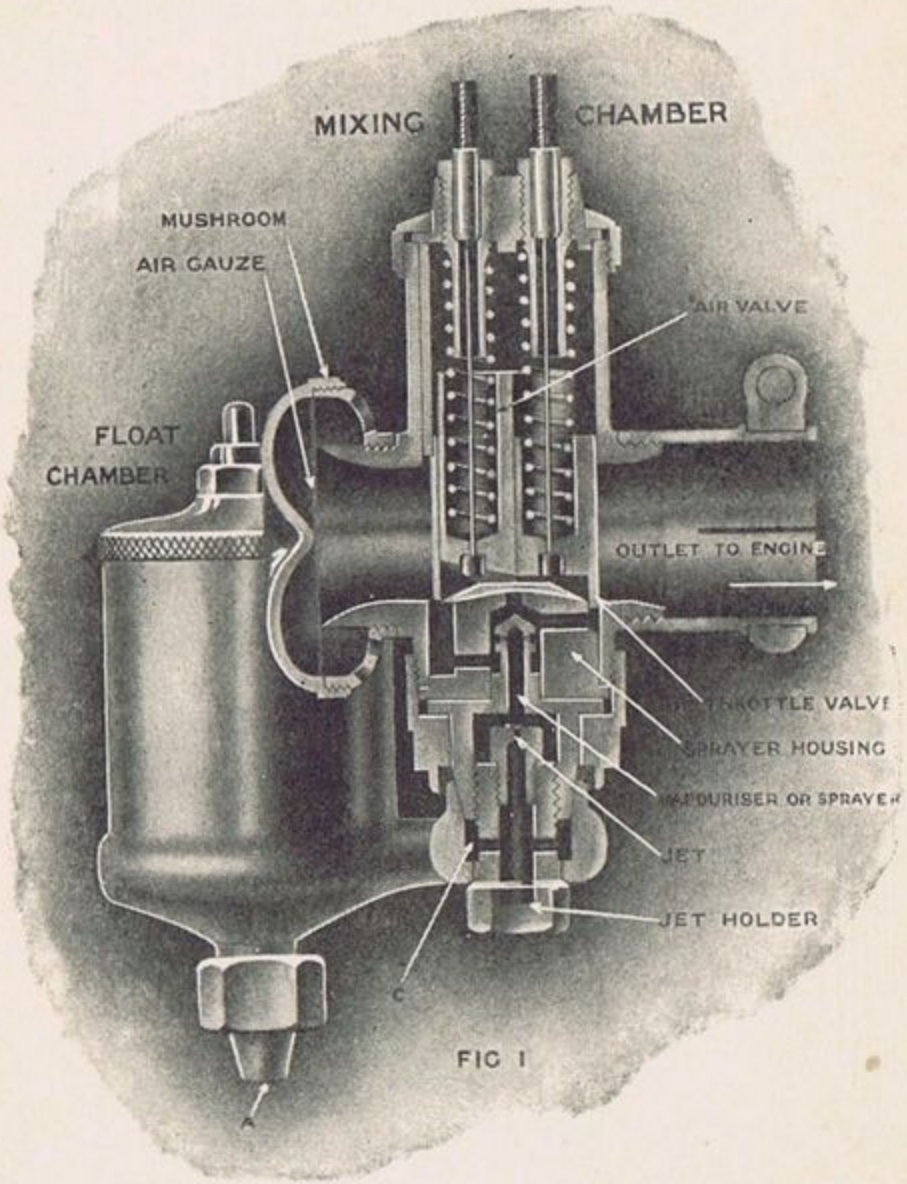

Fig. 23.—Cut-away View of the Amac Carburettor

large a proportion of petrol would be carried by the air into the engine. So a chamber is added beside the jet into which the petrol pipe from the tank is led. In this chamber is a brass float, mounted on a needle with a conical end, which fits into a conical hole in the lid of the float chamber, through which comes the supply of petrol. When the level of the petrol in the float chamber has risen to a certain level the float, carrying with it the needle, rises. The point of the needle enters the hole in the

lid, and so cuts off the petrol supply until the level in the chamber has fallen again. A narrow passage runs from the side of the float chamber, at a point just above the bottom, to the bottom of the jet, and the level in the float chamber is arranged to be about $\frac{3}{32}$ in. below the top of the jet. Thus, if the machine is left standing with the petrol turned on, no leakage will take place by way of the jet.

Amac Carburettor. A part-sectional view of the Amac carburettor, fitted to Royal Enfield 8 h.p. machines, is shown in Fig. 23. It will be seen that, immediately above the jet, is a " sprayer " having in it a number of small holes, for the purpose of still further atomizing the petrol. The manner in which, when the throttle and air slides are opened, air is drawn from the air intake to the engine across the top of the sprayer, sucking the petrol up from the jet, will be evident. The Amac carburettor is normally run with the air lever wide open, except for slow running, when the air is nearly closed.

" B. and B." Carburettor. The carburettor fitted to the Royal Enfield $2\frac{3}{4}$ h.p. and $2\frac{1}{4}$ h.p. models is the " B. and B," in which the jet is surrounded by a choke tube covered by a vaporizing gauze, through which the petrol and air from the jet and choke tube respectively have to pass. A pilot jet is fitted to the four-stroke type. This is controlled by an adjusting screw and varies the strength of the mixture as necessary.

Senspray Carburettcr. Fig. 24 shows a section of the Senspray carburettor fitted to certain earlier Royal Enfield two-stroke models. In this case the throttle consists of a horizontal rotating barrel drilled through from side to side. The most notable feature of the Senspray is that the tip of the jet fits into a small vaporizer in the centre of the air intake proper. In this way the air across the tip of the jet attains a great velocity, and good vaporization is assured. A rotatable sleeve inside the vaporizer has a hole drilled in the side which can be made to register with a hole in the outer sleeve. By this means the sensitivity of the carburettor to the air lever can be varied at will.

Carburettor Maintenance. Every thousand miles or so it is as well to remove the float, and to clear out the dirt which accumulates in the float chamber. This precaution may save a choked jet on the road. It is also occasionally necessary to remove the throttle and air slides, and to clean them with metal polish, as road dust is apt to accumulate on them and may possibly

cause them to stick. It is no use oiling the slides, as any lubricant is quickly washed off by the petrol vapour.

Carburettor Tuning. In these days, except for racing purposes, carburettor tuning is reduced simply to the question of finding the correct jet, which is best done by trial. Do not, however,

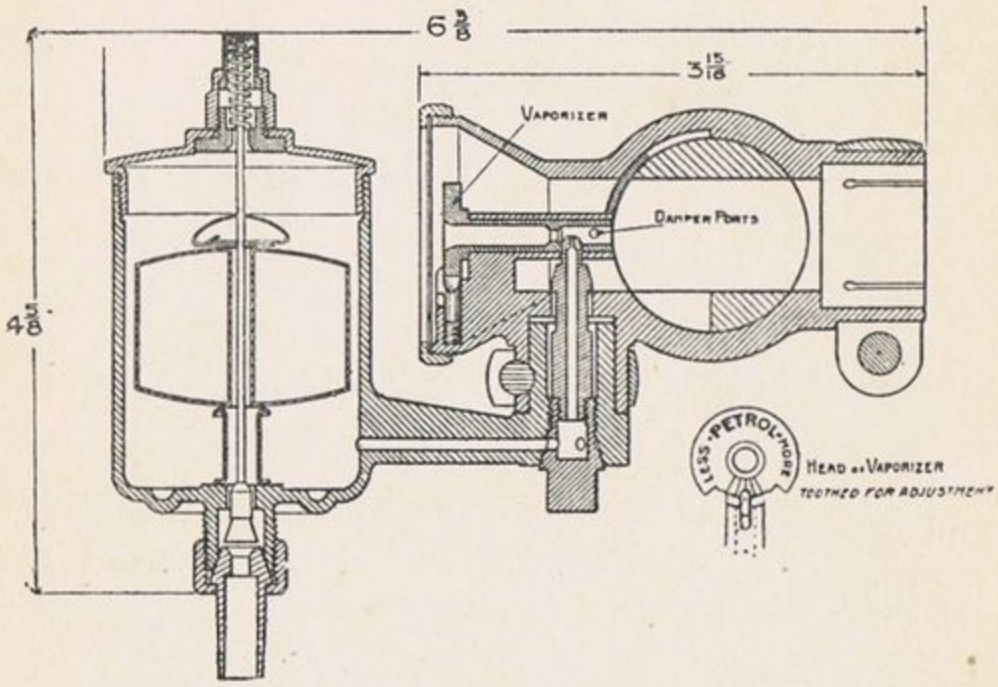

FIG. 24.—SENSPRAY CARBURETTOR

make the mistake of thinking that a very small jet will be more economical than the correct size ; the results of running with too small a jet are spitting back, overheating, difficult starting, and high consumption.

Especially is it fatal to fit too small a jet on the O.H.V. models, for nothing leads more certainly to overheating, and eventual breakage of the exhaust valve, than does running on a weak mixture.

With the Amac, " B. & B.," and Senspray carburettors, the correct jet for touring is that with which, to get the maximum speed when the throttle is fully opened, the air lever has to be closed back *slightly*. On smaller throttle openings the signs of too small a jet are spitting back and too great sensitiveness to the position of the air lever ; of too large a jet, difficult starting *when hot*, and the emission of *black* smoke from the exhaust, when the air lever is open.

Every jet is stamped with a number denoting its size and, with most carburettors, the larger the number, the larger is the size of the jet. Thus size 29 is smaller than size 30.

THE MAGNETO

The magneto is the instrument which provides the electric current for igniting the fuel mixture in the cylinder. Since the current has to jump across the gap between the points of the sparking plug, it will be evident that it must be at a considerable voltage (electrical pressure). The magneto has, therefore, to combine the functions of an ordinary dynamo with those of an induction coil, and it contains also a contact breaker which causes the spark in the cylinder to take place at the correct moment.

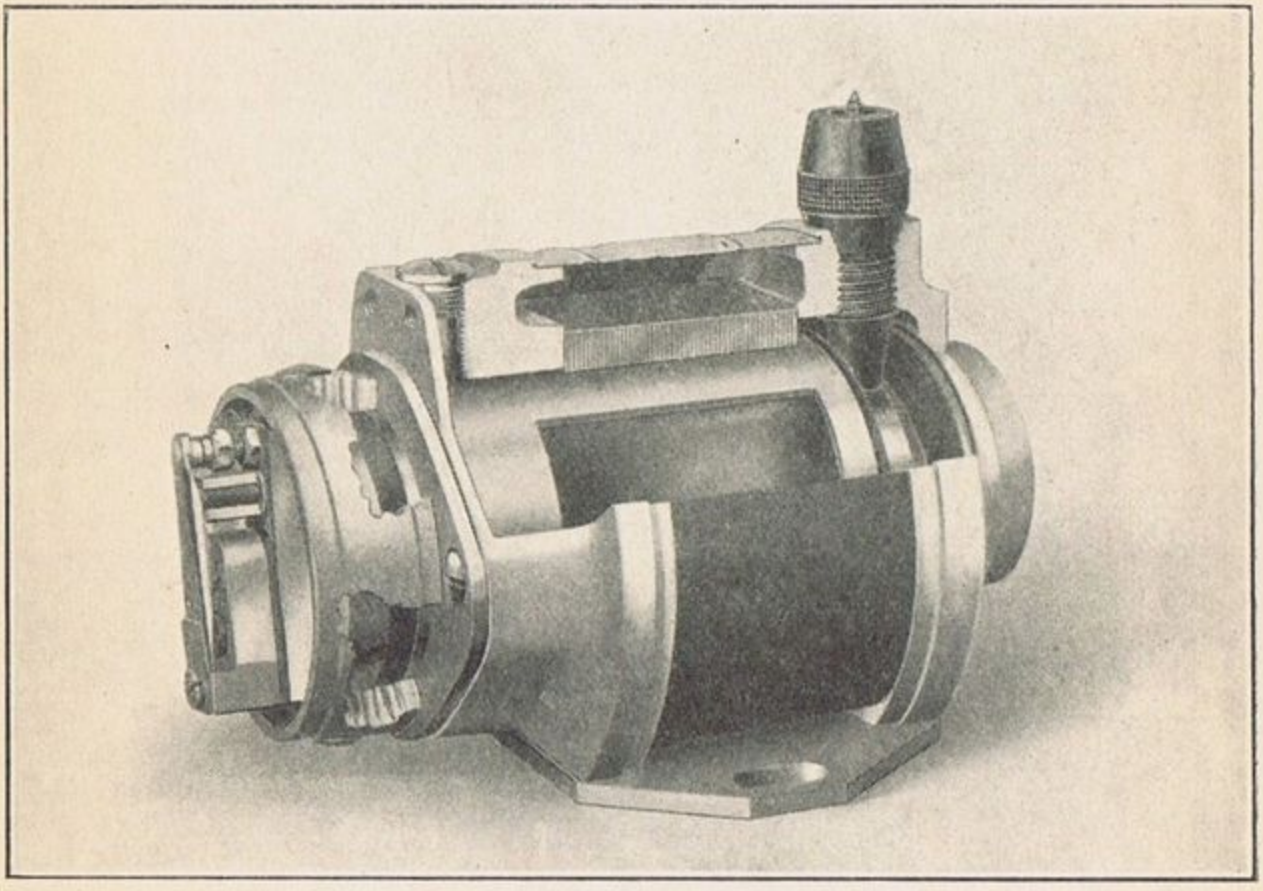

FIG. 25.—MAGNETO (PART SECTION)

It is unnecessary here to discuss the electrical theory underlying the working of the magneto, and it will be enough to describe briefly its component parts.

The magneto (Fig. 25) consists of a large horseshoe magnet which forms part of the outer casing, between the poles of which rotates a shaft carrying an iron armature having two coils wound upon it, one above the other. One end of the armature shaft is tapered and carries the driving sprocket. To the other end is attached the contact breaker, which is shown in Figs. 26 and 27.

When the armature rotates, a low tension current is generated in the primary winding, and passes through the platinum points

of the contact breaker. At a certain point in their revolution these points are separated by a raised portion, or cam, in the contact breaker cover. This suddenly interrupts the primary current, and thus " induces " a very large voltage in the secondary

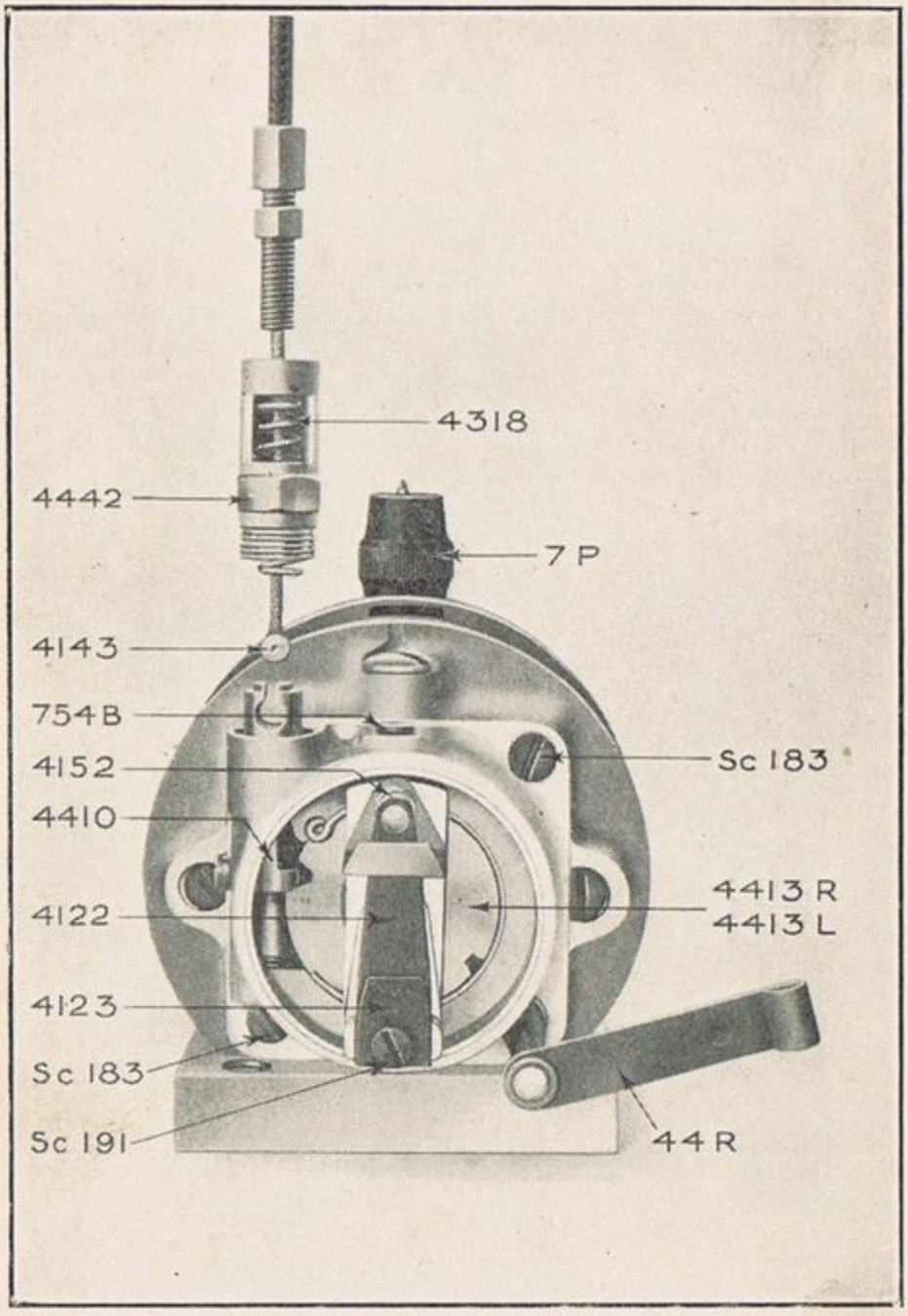

Fig. 26.—Magneto

winding of the armature. This current passes from the winding to the slip-ring at the drive end of the armature, where it is collected by a brush, which is a block of carbon, one end of which is kept in contact with the slip-ring by the action of a spring, and the other end of which is attached to a high-tension cable. The current then passes along this high-tension wire to the central electrode of the sparking plug, jumps across the points,

and returns through the engine and frame of the machine to the armature winding, the other end of which is connected, through a second carbon brush, to the base of the magneto.

In the majority of magnetos, the contact breaker cover, which carries the cam, may be rotated at will through a few degrees by means of a Bowden cable, which is connected to the spark-control lever on the handlebar. In this way the exact moment at which the spark passes can be varied somewhat while the machine is in motion. The object of this control is explained in the chapter on driving.

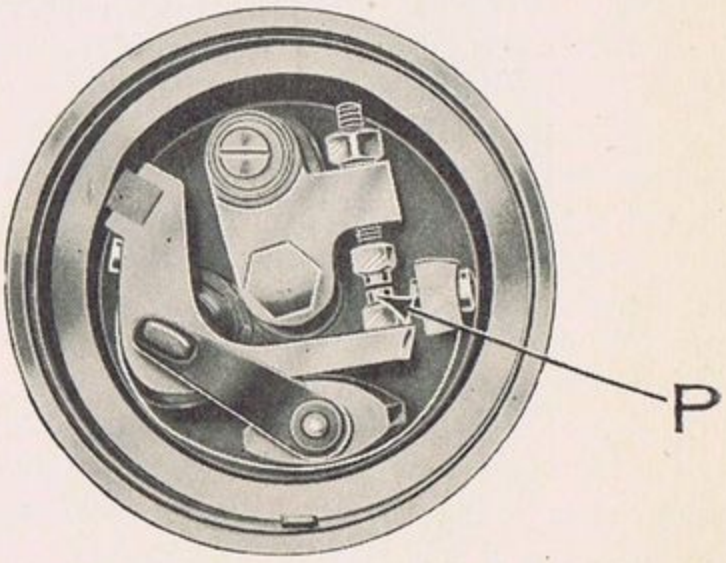

FIG. 27.—THE CONTACT BREAKER OF THE MAGNETO
P = CONTACT POINTS

Timing. When assembling the machine it is necessary to time the magneto so that the spark takes place at the right time. This is done as follows. The magneto driving sprocket on the engine shaft or camshaft should be tight on its taper, so that it is a fixture, and the magneto sprocket should be quite loose. Turn the engine until the piston is at the top of the stroke, being careful to observe, with four-stroke models, that it is the compression stroke, i.e. that neither valve has been open while the piston was rising. Set the handlebar lever to the fully retarded position. Turn the contact breaker until the platinum points are just opening. Drive the magneto sprocket firmly on to its taper, and lock up with the nut.

With the twin cylinder models the *front* piston should be set on top dead centre, and care must be taken to see that, when the points open, the fibre segment in the contact breaker is resting on the cam numbered 2. The front cylinder of a twin is always number 2.

Some riders prefer to put the handlebar lever at *full advance* with the piston at top dead centre, and then to turn the engine *back* until the piston has receded a certain amount, which is measured either in inches, through the compression tap hole, or in degrees by means of a protractor temporarily mounted on the engine shaft. The last is probably the best way of all. A table of magneto timing for all models is given at the end of this chapter.

Magneto Maintenance. The modern magneto needs very little care, and, if any serious trouble should occur, the only thing to do is to send it back to the makers. The platinum points in the contact breaker must be kept so adjusted that they open to an extent equal to the thickness of the gauge on the magneto spanner in the tool kit. One of the points will be found to be adjustable, and care must be taken to slacken the lock-nut before attempting to move the point. The contact breaker can be removed by taking out the central bolt and prising it gently off the shaft. The contact breaker is designed to run without lubrication and, therefore, although it must always be kept clean, it must not under any circumstances, be oiled.

Occasionally, if the machine has been kept in a damp place, the fibre bush on which the rocker works will swell and cause the rocker to stick. Under these circumstances the engine cannot be started, for no spark can take place. The best cure is to remove the contact breaker, remove the small spring retaining screw, remove the rocker (it may be necessary to prise it off its standard), and to rub all round the inside of the rocker bush with the head of a live safety match, which usually effects a cure. In very bad cases something rather rougher may be needed.

Some magnetos are provided with oil holes above the ends of the armature. A *few* drops of ordinary thin cycle oil should be put in every 1,500 to 2,000 miles.

Sparking Plugs. The sparking plug consists of three principal parts. In the centre is a metal rod, usually of nickel, but in racing plugs frequently of copper. This rod carries a terminal for the high-tension wire at its upper end, and extends right through the plug. It is surrounded by an insulating material which, in the cheaper plugs, may be either steatite or porcelain, and in the more costly types, suitable for hot-running engines, mica. Surrounding the insulation is a steel body, the lower part of which screws into the cylinder, having at its lowest extremity one or more points, to which the spark jumps from the tip of the central rod. In some types of sparking plug the central electrode, with its insulation, is made separate from the outer body, and the two parts are held together by a gland-nut. Internal cleaning is thus rendered easy, as the central point may be removed.

Choice of Plugs. Care must be taken always to use a plug of a type suitable for the engine, as much damage may be done by the use of unsuitable plugs. For the 8 h.p. and the 346 c.c. side-valve models, almost any reputable plug, such as the three-point

Lodge, the A-C Sphinx, or the "G" range of K.L.G. models, will be suitable. For the two-stroke, a plug should be chosen the electrodes of which are of considerable size, for the plug of a two-stroke engine has to withstand a great deal of heat, and thin electrodes soon get red hot and cause serious pre-ignition.

For the overhead valve models the plug must be selected with the utmost care, since pre-ignition, if allowed to continue for long, may result in the breakage of the exhaust valve, which usually wrecks the engine. An unsuitable plug will, in any case, cause overheating, knocking, loss of power, and sometimes apparent seizure. The cheaper and commoner types of plug are to be avoided at all costs, and only single-point plugs of the highest quality should be used. This applies to single-port engines. The double-port engine, owing to its high compression ratio, demands the use of special racing plugs.

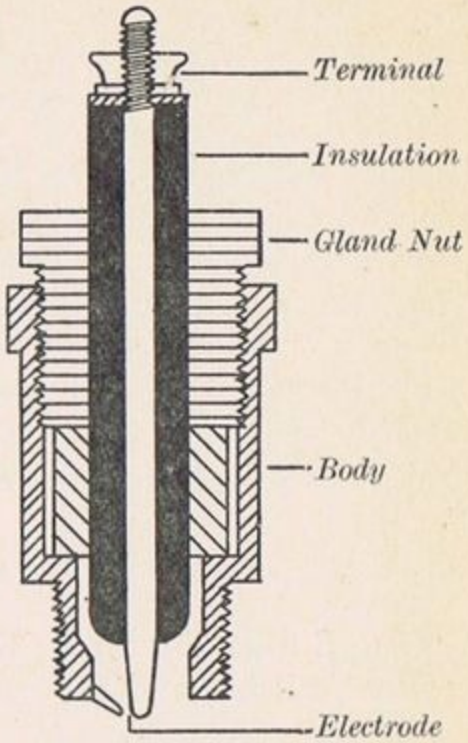

FIG. 27A.—SECTIONAL VIEW OF SPARKING PLUG

MAGNETO TIMING FOR ROYAL ENFIELD ENGINES

Model.	Timing: Advance before Top Dead Centre.	
	Inches.	Degrees.
201, 201A, 200	$\frac{5}{32}$	26
350	$\frac{7}{32}$	35
351	$\frac{1}{8}$	40
352	$\frac{7}{32}$	45
180, 182, 190	$\frac{3}{8}$	35

CHAPTER VIII

MECHANICAL DETAILS OF ENGINES. CARE AND MAINTENANCE

In this chapter will be described, first, those points in which the various types of engines fitted to Royal Enfield machines differ from one another, and then those points of engine maintenance which are common to all engines. The mechanical details of the various engines will be made clear in the course of the chapter. The two-stroke engine will be dealt with in a separate section at the end of the chapter, since it has few points of resemblance to the others.

LUBRICATION SYSTEMS

The 8 h.p. Twin. As in all the four-stroke Royal Enfield models, oil is carried in a compartment of the petrol tank, at the bottom of which is a tap from which a pipe leads to the mechanical oil pump on the magneto chain cover. Attached to the top of the tap, and therefore inside the tank, is a tube of copper gauze, which acts as an oil filter. The tap, complete with filter, should be unscrewed from the tank every three months or so, and the filter well washed in petrol. The tap is fitted to prevent the possibility of oil leaking through the pump and flooding the engine, and should be turned on just before starting on a run, and turned off when the machine is put away for the night.

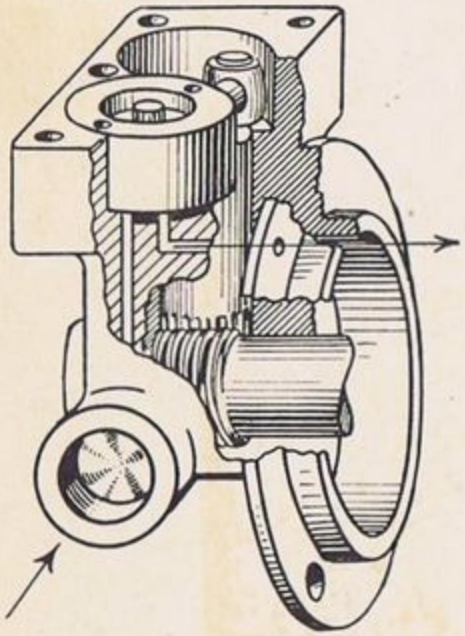

FIG. 28.—MECHANICAL OIL PUMP

The mechanical pump is driven by worm gearing from the end of the camshaft, the worm being formed as an integral part of the nut which holds the magneto sprocket to the shaft. It is of the oscillating type, and is set to deliver the correct amount of oil for normal running. It is shown in Fig. 28.

If, for any reason, a greater quantity of oil is needed by the engine, or if the crankcase has been drained and needs refilling, oil can be given by means of the hand pump which projects from the top of the tank. To do this unscrew the pump plunger, draw

it up slowly, press it down, and screw it into position again. It is advisable to give a pumpful in this way when the machine is being started for the first time after leaving the factory.

The oil from the mechanical pump is forced through a passage way drilled across the apex of the timing half of the crankcase, between the bases of the cylinders. In the centre of the crankcase this passage is met by another, running at right angles, to the base of the front cylinder. From the end of this hole the piston skirt picks up oil at the bottom of each stroke and carries it up into the cylinder, while the surplus oil falls into the crankcase. There it is picked up by the flywheel rims and thrown into the back cylinder, and on to the big end and main bearings.

In the wall of the crankcase, between the crankcase proper and the timing gear case, are two non-return disc valves. When the pistons descends oil mist is blown through these valves into the timing gear, which is thus lubricated. To prevent flooding of the timing gear with oil, a small pipe is set near the bottom of the crankcase wall. This pipe is bent downwards, and clears the bottom of the timing case by a fraction of an inch. On the up-stroke of the pistons the partial vacuum in the crankcase sucks back any surplus oil. Since the timing gear must be kept at atmospheric pressure, a breather pipe is led from the top rear corner of the case to the front chain, which thus has a certain amount of oil blown on to it.

Underneath the crankcase, at the lowest point, will be found the crankcase drain plug. After every thousand miles' running, and, in the case of a new machine, after the first five hundred, this plug should be removed, and the old oil drained out. About a pint of paraffin should then be put into the crankcase, and the engine rotated several times with the kick-starter, the crankcase drained, and refilled with four pumpfuls of fresh oil. After a certain amount of use, oil becomes thick and gummy and loses its lubricating properties, and must be replaced for this reason. Only high grade lubricating oil should be used for the Enfield engines.

The 2¾ h.p. Models. On engines up to 1922, the oil is delivered to the engine either through a union at the apex of the crankcase, or else at the back of the cylinder neck, at a spot where little is normally thrown by the flywheels. After lubricating the piston skirt it falls to the oil sump, and is forced thence by the pressure set up by the downstroke of the piston into an oil box cast on the crankcase below the timing gear, where it is stored under pressure. From here it passes up a pipe to the timing side main bearing bush, and thence through the drilled flywheel and crankpin to the big end. The timing gear is lubricated by

oil escaping from the main bearing and also by oil issuing from a non-return disc valve, situated in the inner wall of the timing case.

On engines built after the beginning of 1923, the oil is delivered first to the timing gear, and the non-return valves are transferred to the oil box. The timing case and crankcase are in free communication, so that oil is pumped liberally over the cam gear. The oil then drops into the oil box, where it is trapped by non-return valves, and kept at atmospheric pressure by a relief pipe. The vacuum caused by the up-stroke of the piston draws oil through a pipe to the timing side main bearing and big end.

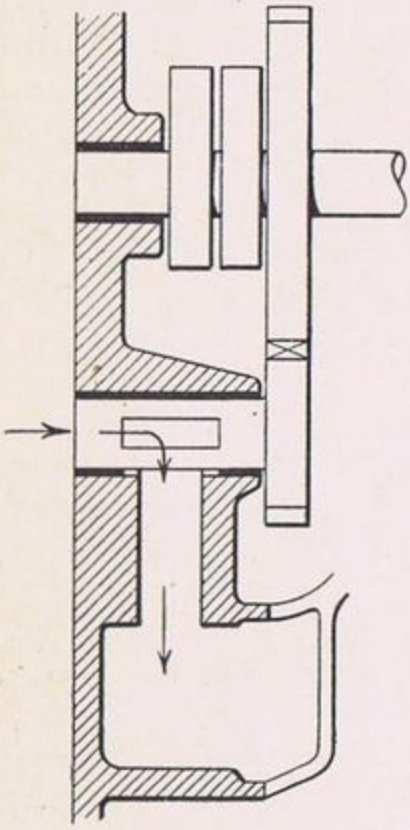

FIG. 29.—TIMED RELEASE VALVE

On the two-port racing engine this system is further modified by the abolition of the vacuum valves, and the substitution therefor of a timed release valve, shown in Fig. 29. A vertical passage between the timing case and the oil box is closed at the upper end by an horizontal sleeve, which is rotated at engine speed by the camwheel, and is plugged up at the driven end. The inner end of this sleeve communicates with the crankcase, and when a slot in the sleeve comes opposite the vertical passage, oil is forced into the oil box by the descending piston. The valve is timed so that the slot has just passed the oil box opening when the piston is 25° past bottom dead centre.

On the latest $2\frac{3}{4}$ h.p. side-valve engines, the lubrication is as the 8 h.p. described above, but the oil is fed straight into the timing gear, from whence it is sucked into the crankcase. From here it is sprayed into the timing gear again through three non-return valves as breathers.

Most of the lubricating oil makers have brands specially suited to Enfield machines, and some of those whose announcements appear in this book publish charts, which the reader is advised to obtain, giving summer and winter grades of oil for every type of machine. When using a vegetable oil, care must be taken, if it is decided to change over to it from a mineral oil, carefully to wash out both tank and crankcase, since mineral and vegetable oils cannot be mixed. The attempt to do so not infrequently leads to seizure, since the oil film is apt to break down at the junction between the mineral and the castor-base oils.

Timing Gear : 8 h.p. Twin. Until 1924, the timing gear of the 8 h.p. models had two camwheels, one for each cylinder. The more recent engines have one camshaft with three cams. Of these, the outer, next the wheel, is the front cylinder inlet ; the centre, the exhaust of both cylinders ; and the innermost the back inlet. The rockers are carried on three steel pegs, screwed into the inner wall of the timing case, the front and rear pegs taking the front and rear inlet rockers, and the central one both exhaust rockers and an additional one which lifts the rear exhaust valve. Care must be taken when reassembling the timing gear to see that the rockers are correctly replaced.

Dismantling. To dismantle the timing gear, remove the three screws holding the oil pump to the magneto chain cover. Then remove the oil pump. A countersunk screw is then disclosed behind the oil pump flange, through which the oil flows to the crankcase from the pump. Remove this with the three nuts holding on the chain cover ; then take off the latter. Remove the nuts on the ends of magneto armature shaft and camshaft. Remove both magneto sprockets by levering them from behind with long screwdrivers, and tapping the ends of the shafts with a lead or copper hammer. Do not use a steel hammer, or the heads of the threads will be damaged. Small sprocket pullers for this purpose can now be bought. Remove the Bowden cable from the valve lifter arm. (This is slotted.) The valve lifter arm is held to its shaft by a steel taper pin. Drive this out *from below* by tapping with a hammer. Remove the nuts which hold on the timing cover and remove the timing cover itself. The timing cover is cast in one with the back half of the magneto chain cover.

It will be necessary to lift one of the valves with a screwdriver, as well as to get the engine in the correct position to remove the camwheel, but this position will easily be found by experiment. The camwheel and rockers can then be pulled out. When reassembling, see that the punch-marked teeth on the camwheel and the mainshaft pinion mesh together.

Valve Lifter. The external arm is attached to a rocking shaft which carries on its inner end a flat cam. One end of this cam bears on the front exhaust rocker, the other on an extra rocker, which rests against the rear exhaust rocker When the cam is rotated this extra lever and the front exhaust rocker are forced apart, and the valve rockers forced to bear hard on the tappets, which then lift the valves. An external adjustment is provided for taking up stretch in the Bowden cable.

Single-cylinder Models. The camshaft carries one inlet and one exhaust cam. The timing gear is dismantled as above, except that it is not necessary to remove either the oil pump, which comes away with the timing cover, or the magneto sprockets, since the magneto is driven from the other side of the engine.

Valve Lifter. To remove the cable from the valve lifter, turn the engine until the exhaust valve is raised by the cam. Below the cable adjuster is a knurled cap, and below this a long sleeve (*see* Fig. 30). Hold the sleeve down and lift the cap, which is slotted. When the cap is clear of the sleeve, over which it fits, pull it away. Slide the sleeve up the cable, and the nipple at the end of the wire will be disclosed, resting in a slotted hole in the valve lifter proper. The nipple and wire can then be removed.

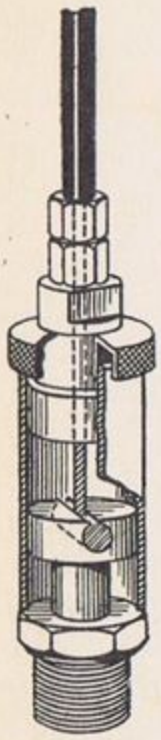

FIG. 30.—VALVE LIFTER

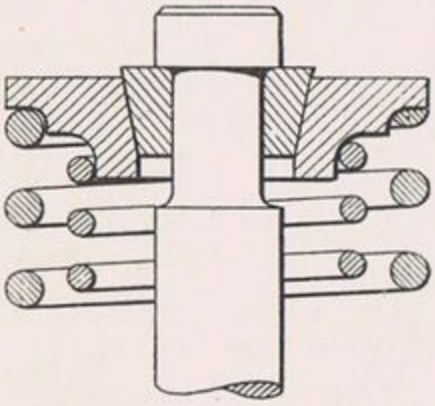

FIG. 31.—METHOD OF FIXING O.H. VALVE BY SPLIT COLLAR

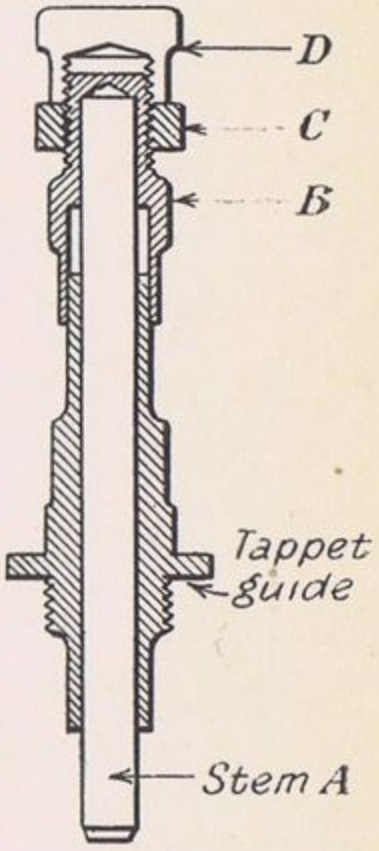

FIG. 32.—TAPPET ADJUSTMENT (Side-valve models)

Valves. On all side-valve Royal Enfield models, as well as on the single-port overhead valve engine, the inlet and exhaust valves are interchangeable. On the two-port racing model the valves, although their actual diameters are the same, are of different material, and should not be interchanged. To decrease the risk of valve breakage on the overhead valve engines, the valve stem, instead of being drilled for a cotter pin, is recessed near the end. A split taper-collar lodged in the recess bears the pressure of the valve spring collar, which is tapered inside to correspond (Fig. 31). A special tool for removing the valves is obtainable from Messrs. J. A. Prestwich, Northumberland Park, Tottenham, N.17.

Tappet Adjustments : Side-valve Models. Fig. 32 shows an

adjustable tappet fitted to the side-valve engines. The tappet stem *A* is solid with a hexagon head *B*, which has a threaded portion *E*, on to which is screwed the tappet head *D* and a lock nut *C*. To adjust, slack off *C*, screw *D* up or down as requisite, and holding *B* with a third spanner, lock *C* up tightly against *D*. The clearance between the valve foot and the tappet must be checked over frequently *while the engine is hot*, and must be kept adjusted to a gap of ·004 in. It is better to buy a set of feeler gauges for this purpose rather than to use makeshifts such as visiting cards, which are so often recommended.

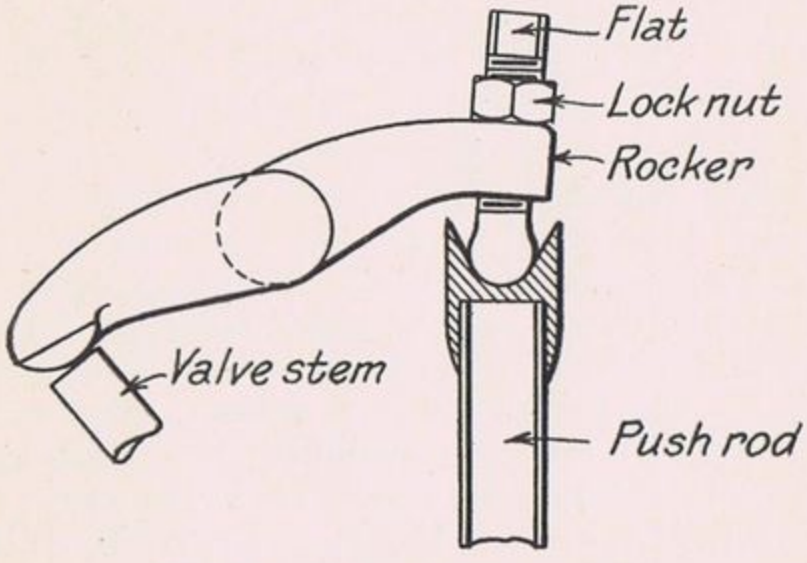

FIG. 33.—TAPPET ADJUSTMENT
(O.H.V. models)

Overhead Valve Models. The ends of the overhead rockers carry ball-ended screws which are fitted with lock nuts. The ball ends of the screws work in the cupped upper ends of the push-rods. The gap between the rocker face and the valve stem should be adjusted to ·002 in., when the engine is *cold*. The lubricating cups for the overhead rockers should be filled with engine oil as often as possible—every hundred miles at least. The cups at the top of the push-rods should be oiled liberally at the same time. It is essential that *oil* be used in these cups. Owing to the heavy stresses, grease and graphite are not of much use. The tappet adjustment is shown in Fig. 33.

Valve Springs. Inlet and exhaust springs are interchangeable on all models. It is advisable every few thousand miles to fit new valve springs, even though the old ones are apparently in good order, because valve springs, owing to the heat to which they are subjected, gradually lose their temper. The fitting of

new springs sometimes makes a most astonishing difference to the performance of an engine.

Removal of Valves. Side-valve Engines. With the cylinder off the crankcase, remove the valve cap, invert the cylinder on the bench, placing a large nut or similar object under the head of the valve. With a long screwdriver press the collar up the valve stem clear of the cotter. Remove cotter, collar, spring, and valve.

If the cylinder is on the crankcase remove the valve cap, and place under it a large nut or small stone. Screw down the cap lightly on to the nut. A special spring-compressing tool is provided in the Royal Enfield kit, which renders it easy to remove the cotter.

Overhead Valve Models. The cylinder head must be detached. Place it on the bench with some object underneath to hold the valves on to their seatings. Using two screwdrivers, or a two-pronged fork-tool with the rocker as the fulcrum, force the spring collar down clear of the split taper collar. Remove this and release spring. This is apt to be a difficult job when tackled for the first time, and it is as well to have some help. When replacing the split collar, grease the recess in the valve stem. This will hold the first half-collar in place while the other is being put in.

Grinding In Valves. If either the face of the valve or the seating in the cylinder are pitted, the valve must be ground in. (Slight pits show as black marks.) Smear the face of the valve with grinding paste, which can be purchased at any garage, replace it on its seat, and rotate it by means of a screwdriver placed in the slot on the valve head. The valve should not be turned round and round, but backwards and forwards, being lifted and given a half-turn every now and then. Repeat this with fresh paste as requisite, until a smooth surface results. Do not attempt to grind in a very badly pitted valve, but send it to the Enfield works at Redditch to have a new seating cut. Excessive grinding wears away the seating in the cylinder, and causes loss of power through "pocketing" of the valve (*see* Fig. 34).

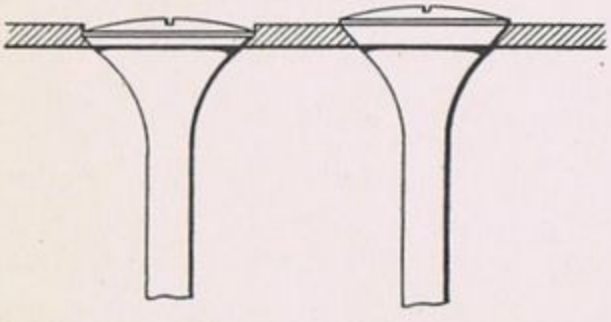

FIG. 34.—SHOWING HOW VALVES BECOME POCKETED AFTER FREQUENT RE-GRINDING

Removal of Cylinder. Side-valve Engines. Remove the carburettor, inlet pipe, exhaust pipe, valve caps, sparking plug, compression tap, and any controls which may get in the way, e.g. valve lifter wire on the single-cylinder models. At this stage the writer prefers to remove the entire engine from the frame, since it is more comfortable to work on the bench than on the floor; but on all Royal Enfield models it is quite easy to remove the cylinders while the engine is in the frame. In either case the procedure for removing the cylinder is the same. Remove the nuts which hold down the cylinder, put the piston at bottom dead centre, and raise the cylinder clear. Take care that the piston skirt does not knock violently against the connecting rod, lest a piece be chipped out of the skirt. It will be necessary to tilt the cylinder in order to get enough clearance to free the piston, and the novice will probably feel that it is as well to have an assistant. On the twin-cylinder model, one cylinder should be dealt with at a time, since, although the cylinders are interchangeable, it is advisable always to replace them in the same position.

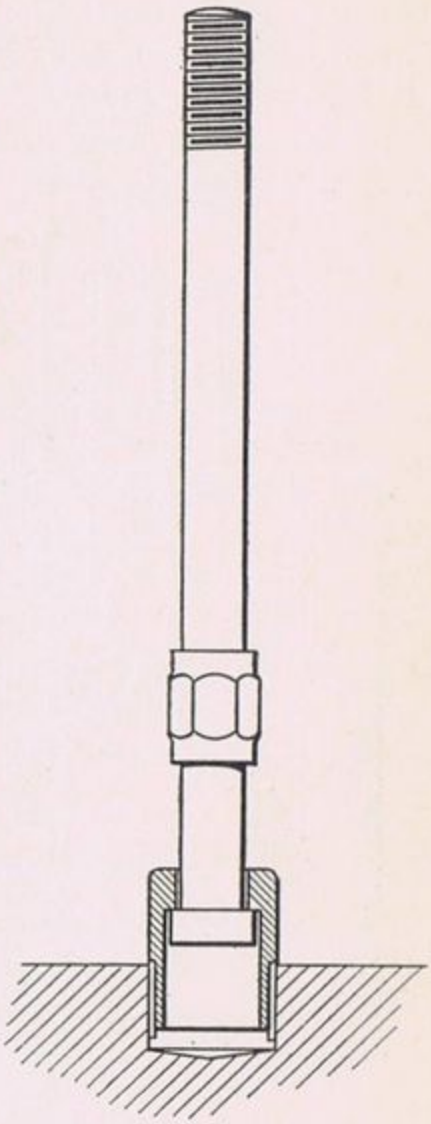

FIG. 35.—CYLINDER HOLDING-DOWN BOLT (Two-port model)

Overhead Valve Engines. On the single-port model the cylinder head is held on to the barrel by four studs which screw down into the barrel. When these are removed the head can be lifted from the barrel. A copper gasket between the two makes a gas-tight joint. On the two-port model, the holding-down bolts, which are illustrated in Fig. 35, screw *up* into the cylinder head.

Decarbonizing. After the machine has run about 1,000 or 1,500 miles, it will be necessary to remove the deposit of hard carbon which forms on the piston and cylinder head. The process requires a certain amount of patience, as the carbon has to be chipped off the cylinder head with a long screwdriver. It should also be scraped out of the inside of the ports, until the whole interior of the cylinder is perfectly clean. The cylinder should then be washed out with paraffin and wiped clean with a clean rag.

Pistons. The pistons fitted to Royal Enfield four-stroke machines are of aluminium alloy. The gudgeon pins are of the "floating" type, i.e. they are a push fit in the piston bosses, in which they are free to rotate, and which thus form part of the small end bearing. To prevent the steel pin scoring the cylinder walls, aluminium caps are pressed into the gudgeon pin ends. These caps should not be removed. To remove the piston, push out the gudgeon pin until it is clear of the small end bush, and lift the piston clear.

In handling aluminium pistons it must be remembered that they are composed of soft metal, in which grit is very liable to become embedded, to the subsequent detriment of the cylinder walls. Such pistons should only be touched with clean hands, and when removing carbon they should be scraped only gently, the last traces being removed with metal polish.

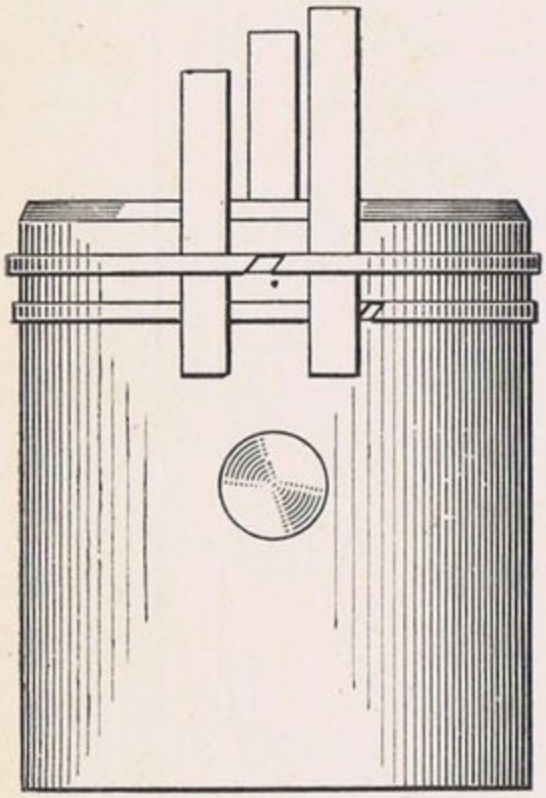

FIG. 36.—METHOD OF REMOVING PISTON RINGS

It is usually best to remove the piston rings and to clean out the grooves behind, especially if metal polish has been used on the piston head. If care is exercised this can be done by gently forcing the ends of the ring apart, until it is possible to spring it out of the groove, when it may be slid off the piston. The other way is to insert three strips of thin metal behind the ring, sliding them round from the ends, and to slip the ring up these strips (Fig. 36). The rings may be replaced by a similar method. Rings, when in perfect condition, show equally bright all the way round, and any ring which is not in this condition should be replaced, especially if it is burnt brown at any point.

If the piston is removed from the connecting rod, both the end cap of the gudgeon pin and the corresponding boss inside the piston should be marked, so that the piston and pin are replaced in the same position. The reason is that pistons become "bedded down" in the cylinder after a few hundred miles running, and then hold compression better when the same surfaces always rub together, since no cylinder is truly circular.

Bearings. When the cylinder is off the opportunity should

be taken to examine the bearings. A certain amount of side play in the connecting rod, at the big end, is quite in order, but no up and down play in a vertical direction should be tolerated. The small end bearings should be quite free, without any " shake." It should be impossible to move the engine shaft up and down by pulling on the driving sprocket, but it should be possible to pull this shaft in and out for about $\frac{1}{16}$ in. in the direction of its length.

Reassembling. After replacing the piston rings, space out the gaps equally round the piston. Replace the piston on the connecting rod. Smear both piston and inside of the cylinder with engine oil, and lower the cylinder gently on to the piston, compressing the rings so that they enter the piston easily. The piston should be on bottom dead centre. It is as well to have an assistant to lower the cylinder. Bolt the cylinder down gently and evenly, tightening the nuts equally and alternately, doing the final tightening with not more than a quarter of a turn at a time. If this is not done, the cylinder neck and flange will be strained through the uneven tightening, and may break off when the engine becomes warm.

It is hardly necessary to say that the most scrupulous cleanliness is necessary during the whole of the above operations.

Valve Replacement. The replacement of the valves is simply a reversal of the process of removing them.

Starting Up After Assembling. If the opportunity has been taken to wash out the crankcase during the decarbonizing operations, three pumps of oil should be given with the hand pump before starting up the engine.

THE TWO-STROKE ENGINE

Lubrication. Since, on a two-stroke engine, the fuel mixture from the carburettor is first drawn into the crankcase, it is possible to lubricate the engine by dissolving the oil in the petrol. The oil is thus brought into the crankcase by way of the carburettor in the form of a fine spray, and part of it is carried with the mixture up the transfer passage to lubricate the piston. The system has the advantage that it is entirely automatic, and that all oil pumps and piping are dispensed with.

A cup will be found attached to the inside of the petrol-filler cap. This cup is an oil measure, and eight cupfuls must be added to the fuel for every gallon of petrol in the tank. After adding the oil it is advisable to rock the machine slightly from side to side, to ensure that the oil is thoroughly mixed with the petrol.

Removing Cylinder. Remove the petrol pipe and carburettor, then the sparking plug. Unscrew exhaust pipe nuts and clamping nut on release valve body. Detach Bowden control wire (the cable stop is slotted). Now remove valve body and exhaust pipes. The unscrewing of the clamping nut allows the dome covering the valve to be removed. The valve, complete with its seating, can then be unscrewed from the cylinder, by applying a spanner to the large nut on the seating, in the same way as a sparking plug. Compress the valve spring, take out the cotter pin, which releases the collar and spring. The valve can then be removed. If necessary, scrape the valve itself, and any other parts, free from carbon, and grind in the valve in the way described for four-stroke engines on page 54. Remove the four cylinder holding-down nuts. Turn the engine until the piston is just beginning to rise on the upstroke ; then, lifting the cylinder gently, tilt it forward and turn it slightly to the right. In this way no damage will be done to the connecting rod.

Decarbonizing. After the cylinder has been removed, the hole in the crankcase round the connecting rod should be filled in with a clean piece of rag, to prevent carbon from the piston falling inside. The gudgeon pin is not of the floating type, as on the four-stroke models, but is secured in one of the piston bosses by a set-screw which passes through the boss and pin, and is itself secured by a split pin inside the gudgeon pin. It is not advisable to attempt to remove it, unless this course is absolutely necessary. The piston is of cast-iron, and will not be damaged by being decarbonized while in place. Care must be taken that nothing falls into the crankcase.

A single step-cut piston ring is fitted. It is usually as well to remove this and to clean out the groove behind it. Piston rings on two-stroke engines sometimes become " gummed up " in the groove owing to excessive carbon deposit, and are then difficult to remove. The remedy is to soak them in paraffin. If the piston is in place on the connecting rod, surround it with a rag soaked in paraffin. The paraffin will then work round behind the ring and soften the carbon. The cylinder is decarbonized in the usual way, as described for four-stroke engines. A certain amount of carbon will also be found to have accumulated round the exhaust port, and this must be scraped off, and at the same time the exhaust manifold should be scraped out.

Compression Release Valve. Occasionally, the cause of a loss of compression which cannot be traced in any other way will be found in the pitting of the compression release valve. This valve is similar to an ordinary four-stroke poppet valve in appearance, but is smaller, and has a much lighter spring. It seldom requires

grinding in, but if it is desired to " touch it up " without removing the body, etc., from the cylinder, it can be rotated by removing the sparking plug and inserting a long screwdriver through the orifice. The slot in the head of the valve can be engaged and the valve gently turned on its seating.

Magneto Timing. On the fixed ignition models, with the piston 4 mm. before top-dead centre, the platinum points in the contact breaker should be just separating. On certain sports models which had variable ignition, the piston should be 8 mm. before T.D.C., with the handlebar lever in the fully advanced position, and the points just separate.

General Maintenance. The two-stroke engine requires very little attention. It should be decarbonized every 800 miles or so, and the silencer should be taken apart at the same time and cleaned out. Loss of compression or chronic back-firing is usually caused by a gummed-up piston ring, which in turn is most frequently due to the use of inferior oil. A section of the two-stroke engine is shown in Fig. 21.

CHAPTER IX

THE TRANSMISSION, FRAME, AND WHEELS

THE power developed by a petrol engine does not depend only on the pressure exerted on the piston head by the explosions of the gases, but also on the number of explosions per minute. Thus, when an engine is running slowly, the power developed is comparatively small, and the maximum output is not reached until the engine is running at a high rate of revolutions—usually between 4,000 and 5,000 revolutions per minute (r.p.m.). With the engine running slowly, say at about 800 r.p.m., the power will be sufficient to propel the machine on the level, but when a hill is encountered, the engine, in addition to moving the machine forward, has also to lift it up, and hence more power is required. Now, while this extra power is only to be obtained by making the engine revolve more rapidly, the additional load imposed by the hill tends to slow it down, and so to lessen the power available. It is not possible to avoid the slowing of the machine on the hill, and hence the only way to obtain the extra power is to insert some mechanism which will allow the engine to rotate more rapidly *relatively to the road wheels.* This mechanism is the gear-box.

Principle of the Gear-box. It will be evident that, if two pinions of unequal size are meshed together, the circumferences of both wheels must run at the same speed, and that the smaller must rotate at a higher number of revolutions per minute than the larger. A gear-box has, therefore, to contain two shafts on which the pinions are mounted. Instead, however, of driving one shaft, and taking the drive to the back wheel from the other, it is found that a smaller and more efficient box can be made by making the reduction of gear in two steps. A large pinion on one shaft drives a smaller one on a second shaft. This small pinion drives a large one on the same shaft, which drives the other end of the first shaft through a fourth (small) pinion. In this way all the pinions can be made smaller, and it is also possible to arrange for a direct drive on top gear, when the power does not pass through any of the pinions. The shaft in a gear-box which takes the drive from the engine, and from which the power is transmitted to the back wheel, is called the " mainshaft," and the other shaft is called the " layshaft."

The Sturmey-Archer Gear-box. The internal parts of the box —mainshaft, layshaft, and pinions—are shown in Fig. 37. The

clutch is keyed to the tapered end of the mainshaft, and the chain sprocket for the rear chain is attached to the high-gear pinion *A*. The central part of the mainshaft has a number of keyways cut in it, and inside the second-gear pinion *B* are cut corresponding keyways, so that the pinion, although it is free to move laterally, cannot revolve independently of the shaft. The

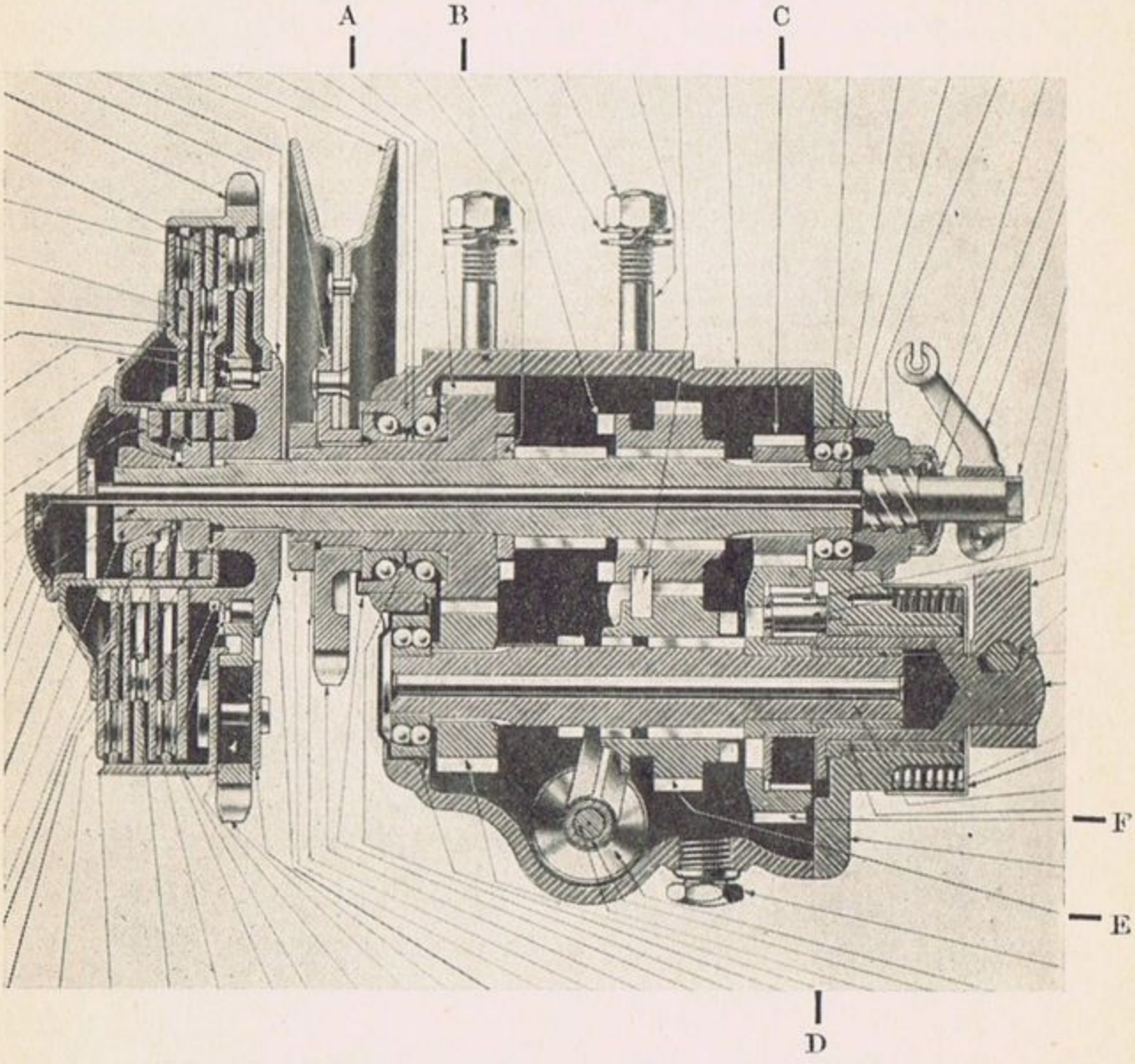

FIG. 37.—SECTIONAL VIEW OF THE STURMEY-ARCHER THREE-SPEED COUNTERSHAFT GEAR

high-gear pinion *A*, and the low-gear pinion *C*, revolve freely on the mainshaft, not being keyed to it in any way. The corresponding layshaft pinions, *D* and *F*, are keyed to the layshaft, which has cut upon it in the centre a set of clutch dogs, which may be meshed with corresponding dogs in the sliding pinion *E*. When not so meshed, *E* revolves free on the shaft, and both *B* and *E* move always together, being connected by a forked plate. All pinions are constantly in mesh.

High Gear. The sliding pinions are moved to the left, when dog clutches on the faces of *A* and *B* engage, so that *A* is locked to the mainshaft, giving a solid direct drive. Provision is made whereby *E* can rotate freely on the layshaft.

Second Gear. The sliding pinions are moved to a central position, so that *E* engages with the layshaft dogs, while *A* is free to revolve. The drive from the engine is then taken through the mainshaft to *B*, from *B* to *E*, *E* driving the layshaft and *D*, which drives *A* and the back wheel.

Low Gear. The sliding pinions are moved to the right, when a dog clutch on the right side of *B* engages with corresponding teeth on *C*, which is thus locked to the mainshaft. *C* then drives *F* and the layshaft, causing *D* to drive *A* and the back wheel.

Control. In the boss of each of the sliding pinions is cut a groove, in which rests one end of the forked connecting plate. Across the bottom of the box, at right angles to the shafts, lies a spring-loaded rocking shaft, carrying a rocking fork, the two arms of which extend up either side of the box. At either side of the forked plate is a small boss, which rests in small forks formed on the ends of the arms of the large rocking control fork. The rocking shaft carries, at the rear end, an external control lever. It will be seen that when this external lever is moved, the large control fork will move in a direction at right angles to the frame of the machine, i.e. parallel to the main- and layshafts, and that it will thus move the forked plate and sliding pinions along the shafts.

The small lever on the gear-box is connected by means of yoke pieces and a rod to the end of the gear lever, which, on Royal Enfield machines, is carried either on the saddle tube or, on the 8 h.p. model, on the tube below the tank. The rod is threaded and provided with lock nuts for the yoke pieces, so that its length can be varied somewhat to adjust the gear control.

The Clutch. The purpose of the clutch is to enable the driver to disconnect the engine from the gear-box and road wheels. The load is thus taken from the pinion teeth and dog clutches for gear changing, and can be put on gradually when starting away from rest, enabling the engine to take it up properly. In theory the clutch consists of two plates, one connected with the crankshaft of the engine, and the other with the driving wheel. These are kept pressed together by springs, and when in this state one revolves with the other as if it were one piece. By neutralizing

the pressure the plates are separated, and are free to rotate separately the one from the other. In designing a clutch it is advisable to have as large a surface of plate in contact as is possible, so that there may be no slipping. This result is usually obtained by multiplying the number of plates rather than by increasing the size of one.

The clutch is carried inside the gear-box primary chain sprocket, and consists of a number of circular plates, having large holes in the centre. Alternate plates have splines on the outside and inside edges, and these splines slide in keyways provided in the sprocket and on the central shaft. This shaft is the one which carries the mainshaft high-gear pinion. Every plate which has outside splines, i.e. which is carried by the sprocket, has a number of " Ferodo " inserts let into it, to provide a good friction surface. The other plates are plain. The sprocket itself runs on a caged roller bearing, and has cork insets, with a plain backing plate behind it.

A long tapered nut on the end of the mainshaft bears on a tapered washer, which retains a powerful spring, the other end of which bears on the clutch cover and on the outermost plate, and so holds all the plates in close contact. In this way the " inner " (plain) plates, carried by the mainshaft, are frictionally locked to the " outer " plates carried by the sprocket, and sprocket and mainshaft high-gear pinion revolve together.

Clutch Control. It has been said that the clutch spring bears on the outermost plate through the clutch cover. It will therefore be evident that, if the cover is forced outwards, away from the plates, the spring will no longer hold the plates in contact, and that the sprocket will revolve freely without carrying round with it the mainshaft pinion. The mainshaft is drilled, and a steel rod passes through its centre. One end bears on the clutch cover, and the other end on a quick-thread screw passing through the cover of the gear-box at the opposite end to the clutch. This screw carries a small lever, which is operated by a Bowden control from the handlebar. When the control is operated, the screw bears hard on the end of the rod, which forces the clutch cover and spring away from the plates.

Kick-starter. The layshaft low-gear pinion has an internal ratchet cut upon it, and the kick-starter shaft carries a spring-loaded pawl, which engages with the ratchet teeth only when the crank is depressed. On coming into action the pawl rotates the layshaft pinion, layshaft, mainshaft high-gear pinion, and so the engine.

Dismantling Gear-box. Disconnect the clutch control wire, then remove the seven cover nuts, and pull off the cover plate. Do not use a screwdriver or similar tool to part the joint, or the plate will not be oil-tight when reassembled. If the plate sticks, hit the kick-starter crank lightly inside. By disconnecting the

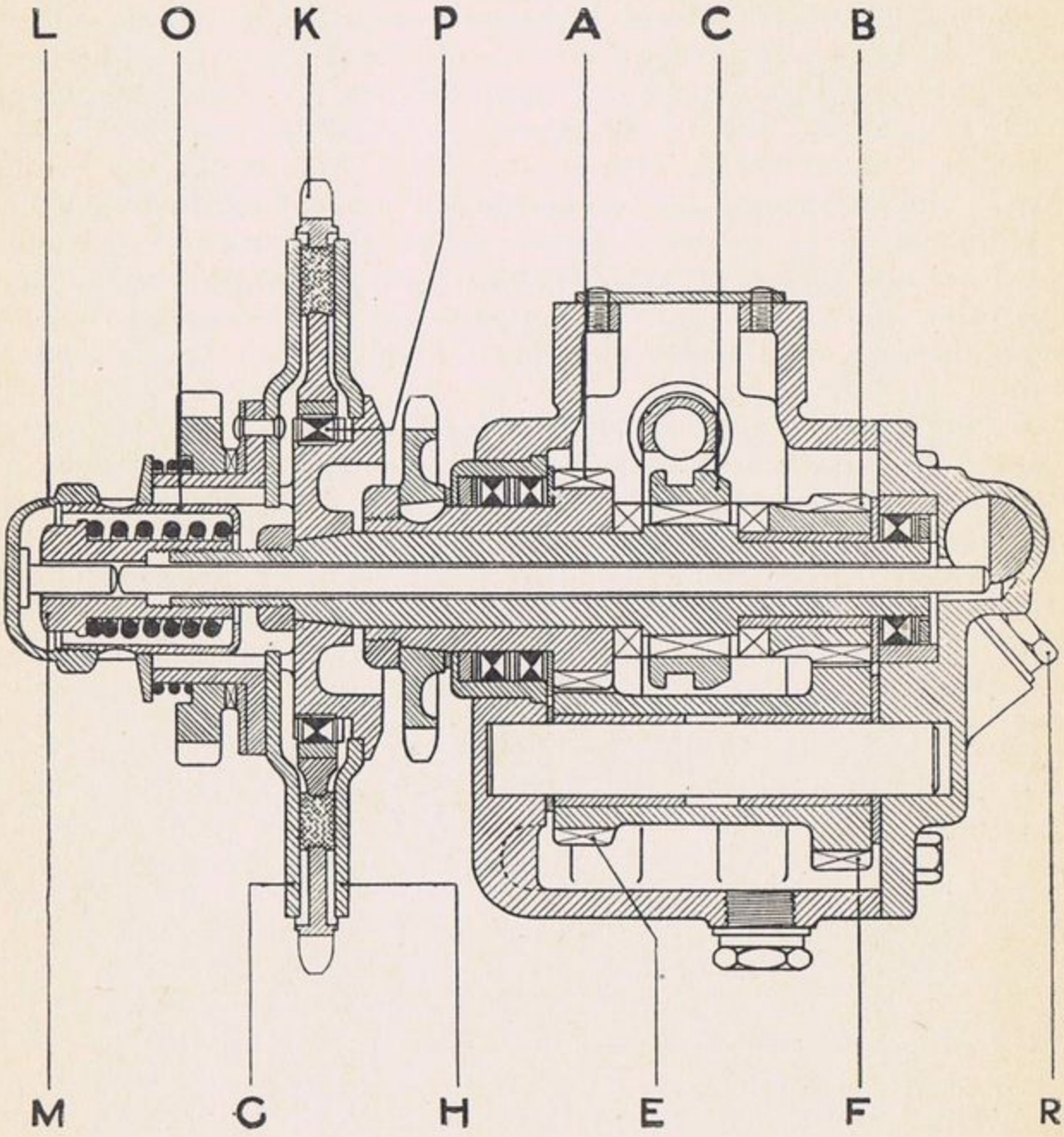

FIG. 38.—ENFIELD TWO-SPEED GEAR-BOX

gear control rod the low and middle gear pinions and the complete layshaft can be lifted out. When dismantling take care not to lose any of the small spring washers under the cover nuts, and not to break the brown-paper washer under the cover itself.

The Enfield Two-speed Gear-box. On 1926 Royal Enfield two-strokes, a new design of two-speed gear-box is employed.

Fig. 38 shows the inside mechanism of the new Enfield box. *A* is the high gear pinion ; *B*, the lower gear one ; *C* is the clutch member, which is moved by the gear control to engage the dog clutches on either the high or low gear pinions. *F* and *E* are the pinions on the layshaft, which transmit the drive when low gear is engaged. The clutch *K* is fitted with cork inserts, and is gripped by the outside plates *G* and *H*. To adjust the clutch, remove the cap *L* and the tension of the spring can be adjusted by means of the nut *M*.

The Enfield Expanding Band Type of Two-speed Gear. This gear (fitted on many thousands of earlier machines) works on a somewhat different principle from the Sturmey-Archer or the Enfield box, last described. The engine shaft carries two pinions, and two chains run to the countershaft. Since the engine sprockets are of different sizes, the gear ratio will be higher when the drive is taken through the chain running over the larger one, than when it is taken through the smaller. The Enfield gear consists of two sprockets, each having inside it a clutch, with a selector mechanism by means of which either clutch can be brought into action, locking the appropriate sprocket to the shaft which carries the sprocket for the back chain.

The interior mechanism of the Enfield gear is shown in Fig. 39. Each of the sprockets is mounted on a hardened steel drum *A*, inside which is a steel band *B*, having between its ends a split steel roller *C*. This band is mounted on a drum *D*, which is keyed to the shaft which carries the sprocket for the final chain. It will be seen that if the band *B* is expanded and forced into contact with the drum *A* on which the sprocket is mounted, the primary chain sprocket will carry round with it the central shaft of the gear and the final chain sprocket, thus driving the back wheel. This is accomplished as follows. Bearing on each of the two split rollers *C* is a short steel peg *E*. The other end of this peg rests against a sliding shaft *F*, which carries at its inner end, on ball-thrust bearings, a sleeve *G* on which is formed a raised cam. If now this shaft is moved so that the cam comes under either of the pegs, the peg is forced outwards against the roller. The roller is forced out between the ends of the band *B*, which are forced apart. The band, being thus expanded, grips the drum on which the sprocket is mounted, and the whole gear revolves solidly. If the cam is drawn away so that it is under neither peg, neither band is expanded, and a free engine position is attained, as shown in Fig. 36.

Actually, there are three cams on the shaft: 1 is the lowest, 2 is ·005 in. higher, and 3 ·010 in. higher, the purpose being to allow for taking up the slight wear which develops with use.

The shaft on which the cams are formed carries, at its outer end, a crosspiece *H*, on either end of which is a small roller.

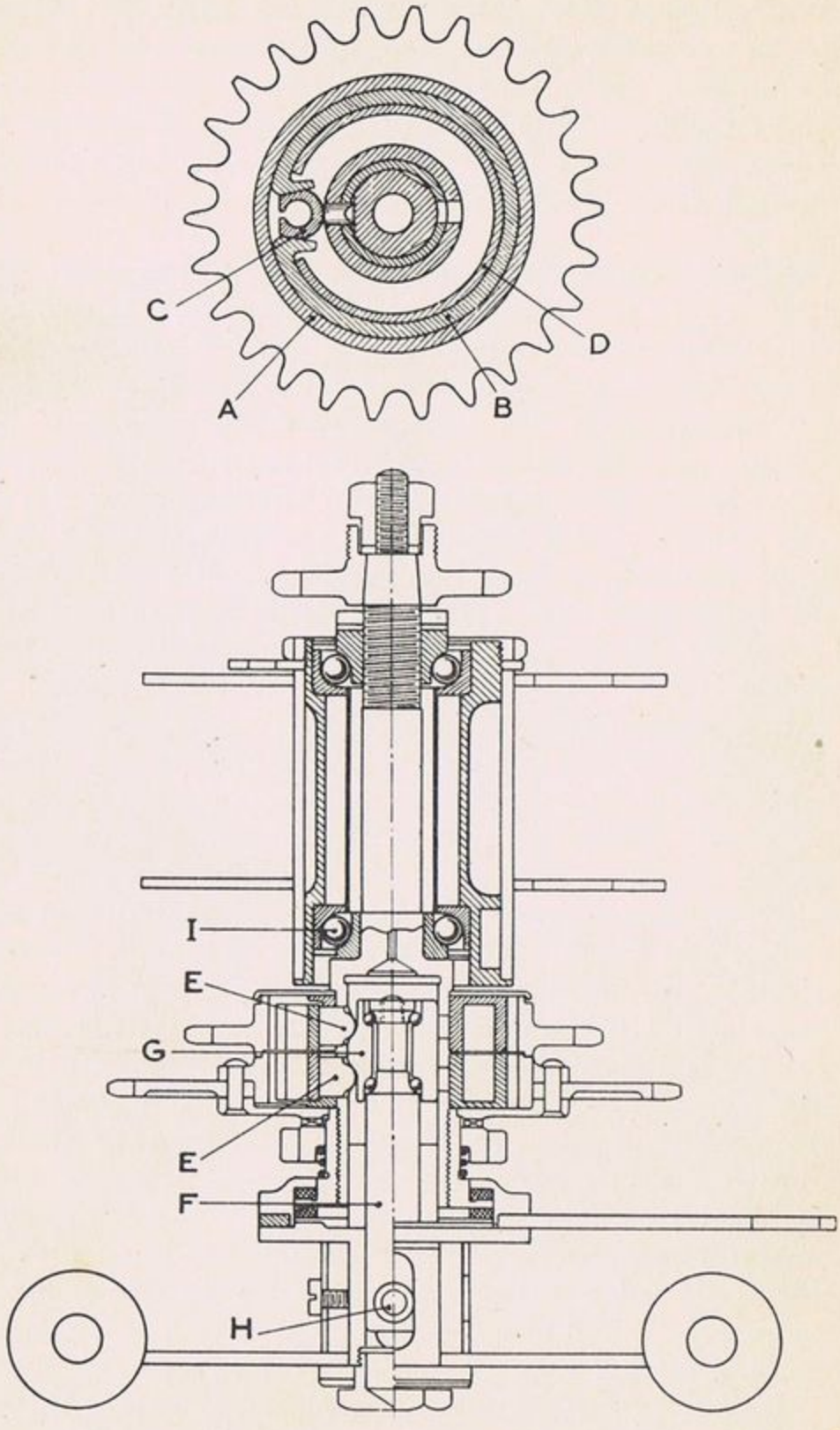

FIG. 39.—ENFIELD FOOT-OPERATED TWO-SPEED GEAR

These rollers run in two spiral slots, formed one at each side of a sleeve surrounding the shaft. The pedal is attached to the end

of this sleeve, and when one end of it is depressed the sleeve is rotated. The crosspiece (and the camshaft) is therefore forced in or out along the spiral slot, and the cam moved into position under the appropriate peg. Fibre thrust washers are provided on each side of the end plate of the sleeve to which the pedal is attached, to take the thrust resulting from the " screwing " action of the spiral slot.

An oiler is provided on the near side end-plate of the gear. Oil from this runs into the centre of the gear, any surplus being thrown out on to the two front chains, which are thus kept adequately lubricated. The central shaft of the gear is drilled, and the action of the camshaft, when going into top gear (when the shaft moves inward), pumps some oil through the hole directly on to the main countershaft bearing *I*. On the two-stroke model this is a ball bearing, but the heavier gear fitted to the 8 h.p. model is equipped with a roller race.

Certain Royal Enfield models have a hand control for the gear. In this case, a rack cut on the end of the camshaft engages with a pinion, which can be rotated by moving the hand control. In all other respects the two patterns are similar, except that with the hand control low gear is engaged by pulling the lever back, and with the foot control by pressing the pedal forward. On the 8 h.p. models the low gear is engaged by pushing the lever forward.

Chain Adjustment. On the three-speed models the front chain is adjusted by slacking off the nuts holding the gear-box to the frame, and moving the whole gear-box backwards or forwards until the tension is correct. On some models a drawbolt is provided for this purpose. It should be possible to lift the centre of the top length of the chain a full $\frac{1}{4}$ in. *when the gear-box nuts are tightened up*. For the back chain $\frac{3}{8}$ in., or even a little more, is not too much. The back chain is adjusted by slacking the spindle nuts, and moving the wheel back by means of the adjuster bolts on the fork lug. The anchor bolt for the brake plate on models with internal expanding brakes must be slackened before moving the wheel. This bolt passes through a slotted lug on the chain stays.

On the machines having the expanding band type of two-speed gear, the gear chains are adjusted by means of an eccentric in the bottom bracket, on the off side of the machine. On the end of the eccentric will be found a lock ring and an adjusting quadrant. Loosen the lock ring and the nut which holds the quadrant in position ; the eccentric may then be adjusted by means of the quadrant. The adjustment must be made with regard to the tightest chain.

Cush Hub. To avoid harshness in the drive certain cushioning devices are included in the Royal Enfield transmission. Fig. 40 shows the Enfield cush hub. Six rubber buffers rest between the vanes shown, three inside the sprocket and three on the hub itself. When the engine fires, these buffers are slightly compressed, and the " kick " of the explosion is thus prevented from reaching the tyre. This hub is fitted to all models.

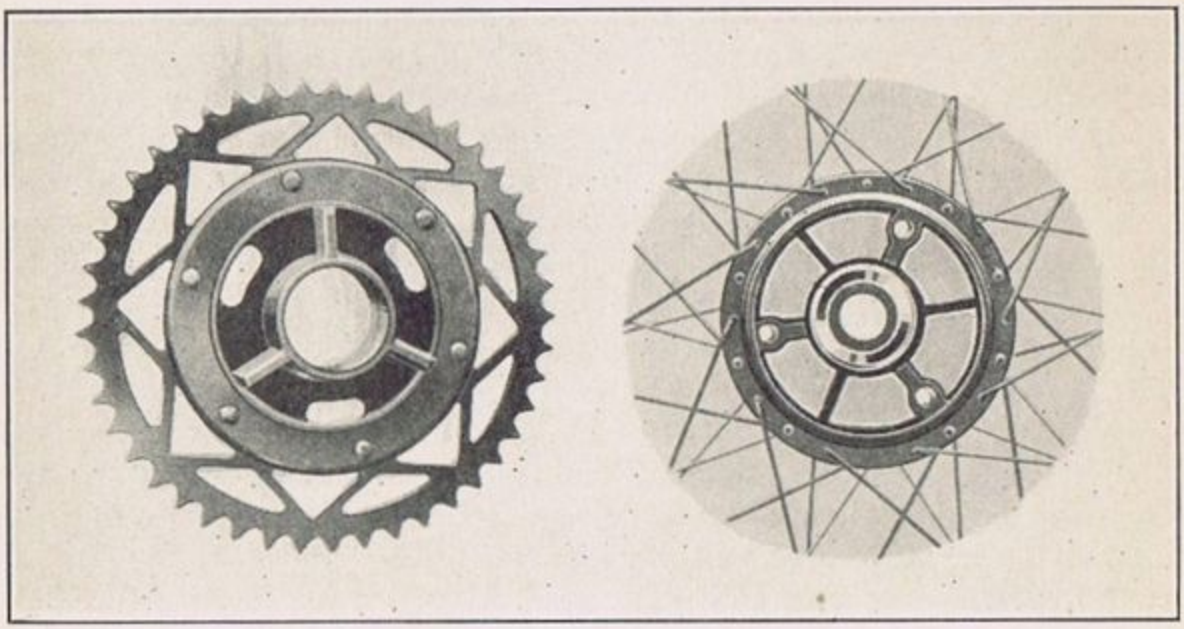

FIG. 40.—ENFIELD CUSH-DRIVE HUB

Slipping Clutch. On the two-stroke models up to 1925, in addition to the cush hub, a device called the " slipping clutch " is fitted to the engine shaft. The body of this clutch, which also carries the magneto sprocket, is keyed to the engine shaft, and the two driving sprockets are mounted on the body, to which they are held frictionally. As a result, they slip, when the engine fires, just enough to absorb the shock. The only maintenance needed is an occasional tightening of the (large) adjusting nut.

Wheels and Brakes. The wheels are of the ordinary type, with cup-and-cone ball bearings, adjustable by screwing up the near side cone, as on an ordinary bicycle.

Different types of brakes have been fitted to Royal Enfield machines. The two-strokes had dummy belt-rim back brakes, as had some of the earlier 346 c.c. side-valve machines, but the latter were fitted with internal expanding front brakes, instead of the stirrup type fitted to the two-strokes. These last need no explanation, since they are exactly similar to ordinary cycle brakes.

The belt-rim brakes, which were also fitted fore and aft to the

8 h.p. Model 180, up to 1925 were direct-acting at the back, operated by a heel pedal on the near side. The brake pivot bolt extended through a slotted lug on the chain stays, and was held in place by a nut. Adjustment is by slacking off this nut, and sliding the brake in the slot as requisite.

Remember that the back brake will require readjustment if the adjustment of the back chain has been altered.

The front brake on the Model 180 is foot operated by Bowden cable and toe pedal on the off side, and is adjusted similarly to the rear one.

The internal expanding brakes now fitted on all models are all somewhat similar, except that on the $2\frac{1}{4}$ h.p. model the drums

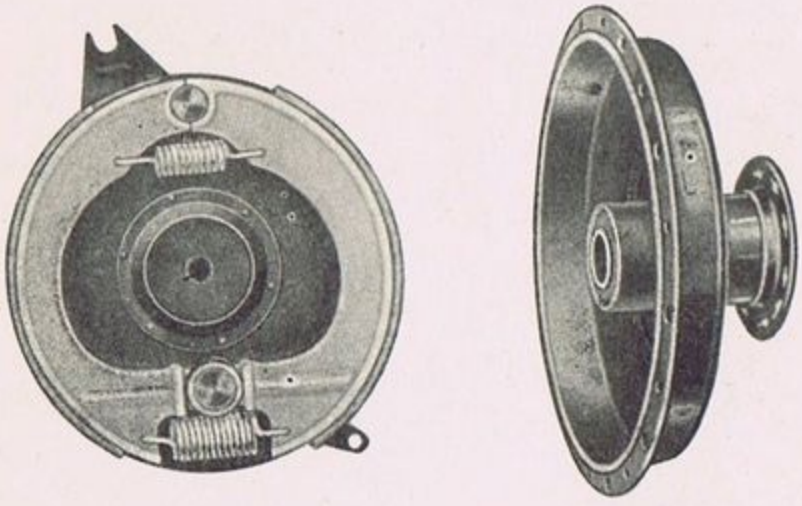

FIG. 41.—EXPANDING BRAKE (8 IN.)

are 4 in. in diameter; on the $2\frac{3}{4}$ h.p. models, 5 in. in diameter; and on the 8 h.p. models, 8 in. An 8 h.p. back brake is illustrated in Fig. 41. Adjustment is made by turning the strainer in the middle of the brake rod. One portion of the rod has a left-hand thread, and the other an ordinary right-hand thread. Adjustment is made by slacking off the two lock nuts at either end of the strainer and turning the strainer itself as necessary. Do not omit to tighten up the lock nuts afterwards. The adjustment for the front internal expanding brakes will be found on the stop for the Bowden cable on the brake drum.

Detachable Rear Mudguard and Carrier. This is shown in Fig. 42. To operate it, undo the nuts marked *A* in the illustration, and strike the back of the carrier sharply upward, when the forward ends *B* will come out of the lugs *C*, enabling the whole to be hinged forward, leaving the greater part of the rear wheel exposed. The nut *A* cannot be removed entirely from its bolt, and so cannot be lost.

Steering Head. The adjustment for the steering-head ball races is by the large nut on top or under the handlebar, according to whether the handlebar is of the adjustable, clip-on type

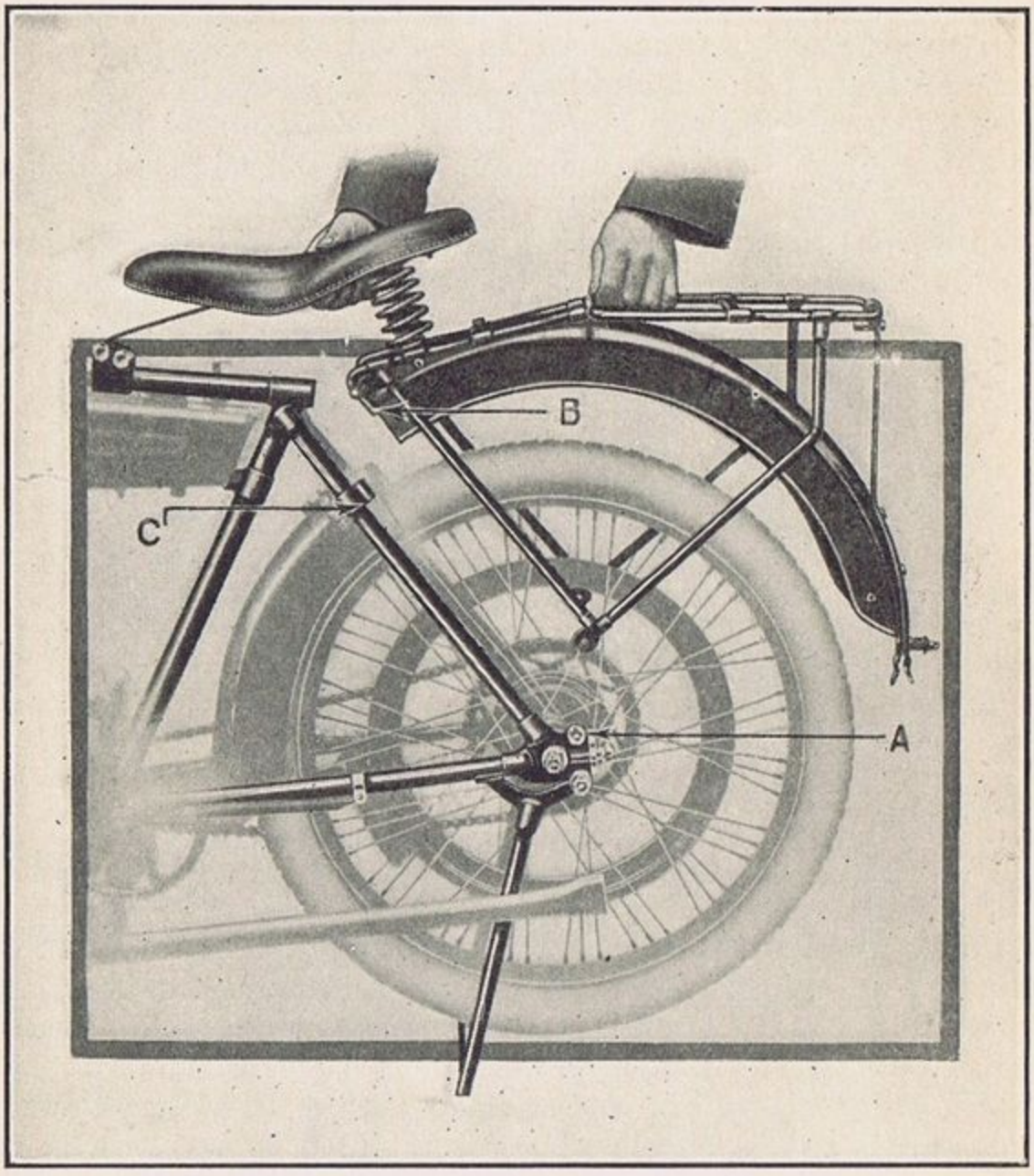

FIG. 42.—DETACHABLE GUARD AND CARRIER

or not. The balls should be greased annually, and the adjustment inspected periodically to ensure that no shake has developed. To test for shake, stand astride the front wheel, facing the saddle, and try to lift the machine by the handlebars. Any slackness in the ball races will then be easily perceptible.

CHAPTER X

CARE OF THE TRANSMISSION AND CYCLE PARTS

The Sturmey-Archer Gear-box. The best lubricant is a heavy oil, of one of the many special gear lubricants, and the box should be kept filled up to the lip of the filler plug, which will be found on end plate, near the kick-starter. *Do not use thick grease*, as it does not lubricate the ball races properly, nor does it cling to the teeth like oil. The drain plug at the bottom of the box should be removed occasionally, and the stale oil washed out with grease.

It is important that the gear control should be kept properly adjusted. Before proceeding to adjust the gear control see that the nut on the lever side of the rocking shaft (outside the box) is thoroughly tight.

The adjustment of the gear is effected by removing the pin from the top connection on the end of the control rod, and giving the connection one turn, or half a turn, on the thread up or down to lengthen or shorten the rod as required. When the gear is properly adjusted, the control lever should move an equal amount to either side of the neutral notch without engaging in either low or second gear. As a final check, the pin in the top connection should be just free to slide when in top gear.

Clutch. The clutch is designed to run dry, and should not be lubricated. Clutch slip, should it occur at any time, may be due to the lever on the clutch-worm bearing on the stop spring of the kick-starter crank, and so preventing the clutch from going right home. The lever is clipped to the worm. It should be loosened and moved forward slightly, the clutch wire being readjusted at the stop. Oil on the clutch plates will cause slipping, which is curable by injecting petrol between the plates while the clutch is held out.

If at any time it is found difficult to change gear, and especially to get into neutral, it is probable that the clutch wire has stretched. It should be adjusted at the gear-box stop.

The Enfield Two-speed Gear-box. This gear-box should be lubricated, about every 1,000 miles, with a thick engine oil of good quality through the filler *R* (*see* Fig. 38). The adjustment of the control rod is carried out by shortening or lengthening the rod, as is the case with the Sturmey-Archer.

The Enfield Expanding Band Two-speed Gear. Every two hundred miles the gear should be oiled at the oiler on the near-side end-plate. The oil injector supplied with the machine should be filled with oil, the nozzle inserted into the oiler, and the plunger pressed right down. One charge is the correct amount.

The only adjustment required by the gear is when it starts to slip owing to wear, and it is necessary to engage the second or third cam. To do this bring the gear lever into low-gear position as far as it will go, loosen the screws holding the end plates of the gear, and push the gear lever towards the neutral position. The end plate, with the pedal, will then come forward far enough to permit of the insertion behind it of a screwdriver. Place a screwdriver in this position, and pull the lever or pedal into the low-gear position, when the cam will be forced past the low-gear peg, and the bracket and cam will come away complete. Engage the next cam in alignment with the operating pegs, and re-assemble by a reversal of the above process. If the gear starts to slip when cam No. 3 is engaged, a slightly longer peg can be obtained from the Enfield Cycle Co., and the gear should then be reassembled with cam No. 1 in position. Before making any adjustment to the gear on the two-stroke model, be sure that the nut on the end of the slipping clutch on the engine shaft is sufficiently tight.

Chains. It is worth while, every few hundred miles, to remove the chains and soak them in paraffin overnight. The lubrication of exposed, or partially exposed, chains, is a somewhat thorny problem. Thick grease is of little use, since it collects dust and makes a remarkably fine grinding compound. Oil is very speedily flung off, especially from the front chains, and it is likely that the best solution is to heat the chains in a tin (a frying pan is useful), with one of the special graphite greases sold for the purpose. The grease becomes liquid with heat, and carries the graphite inside the rollers. Some experienced riders run their chains dry, arguing that they will then at any rate pick up no dust.

On the two-speed models with two gear chains, it may be found that the high-gear chain, which has most use, stretches so much more rapidly than the other that it becomes difficult to keep both in adjustment. A remedy is to use a low-gear chain, consisting of two pieces connected by two spring links, the larger section being the same length as the high-gear chain. The chain which starts life on the high gear can then be moved over to the low-gear sprockets as it starts to stretch, and thus both can be kept in good adjustment.

Wheel Bearings. Wheel bearings should be dismantled twice a year at least, at the beginning and end of winter, and washed out thoroughly with paraffin, being afterwards carefully dried. Cleanliness of the races is most important. The hubs should be packed with a fairly thick grease. Many riders use oil in their hubs, but, although oil is a somewhat better lubricant for ball races than grease, yet the presence of thickish grease undoubtedly helps to keep water and grit out of the hubs, and for this reason it is preferable. Moreover, it is no easy job to reassemble a hub bearing without grease to keep the balls in place while the spindle is being inserted.

The cones should not be done up too tightly. The correct adjustment, which, however, may take some time to get, is to have the spindle as free as possible without any shake. For ordinary purposes, it is enough to tighten up until the wheel is fairly stiff to turn, and then to slack back the cone a quarter of a turn.

Tyres. Little need be said about tyres, beyond the advisability of going over them occasionally and removing small stones from cuts. Large cuts should always be stopped with filling, which can be bought for the purpose. Royal Enfield sidecar models can now be had with balloon tyres, which are said to increase both the comfort and the braking power of the machine.

Cycle Parts. Many motor-cyclists are apt rather to neglect the cycle parts of their machines, while devoting all their attention to the engine. No greater mistake can be made, both from the point of view of the rider's comfort, and from that of selling value. The minor bearings, such as brake pedal pivots, saddle attachments, and especially the front forks, will well repay an occasional quarter of an hour with an oilcan. The best lubricant for these parts is a fairly light engine oil. Sidecar spring shackles are another point which repay occasional taking down and greasing.

Cleaning. To attempt to keep a motor-cycle clean is, in England at any rate, a most heartbreaking job, the more so since no satisfactory method of removing dry mud from enamel has yet been devised. None the less, it is worth while doing it now and then, for there is no quicker way of finding loose nuts and parts in need of adjustment. Such points as loose tank bolts, or number-plate nuts, are easily overlooked unless the machine is gone over thoroughly every now and then.

The most satisfactory cleaning medium is paraffin, with a stiff brush, but the enamel must be rubbed over after it is dry with a clean rag to restore the gloss. Do not use petrol or benzol, which are bad for the enamel.

SUPPLEMENT

SINCE this book was written, the Enfield Cycle Co., Ltd., have made certain changes in their production programme. Chapter II of the book, which deals with the various types of machines marketed by the company is, therefore, no longer fully up to date. In order to rectify this defect, the present Supplement is offered to the reader. It gives full information regarding the Royal Enfield range as it stands at present, and for convenient reference a summarized list of the machines available will be

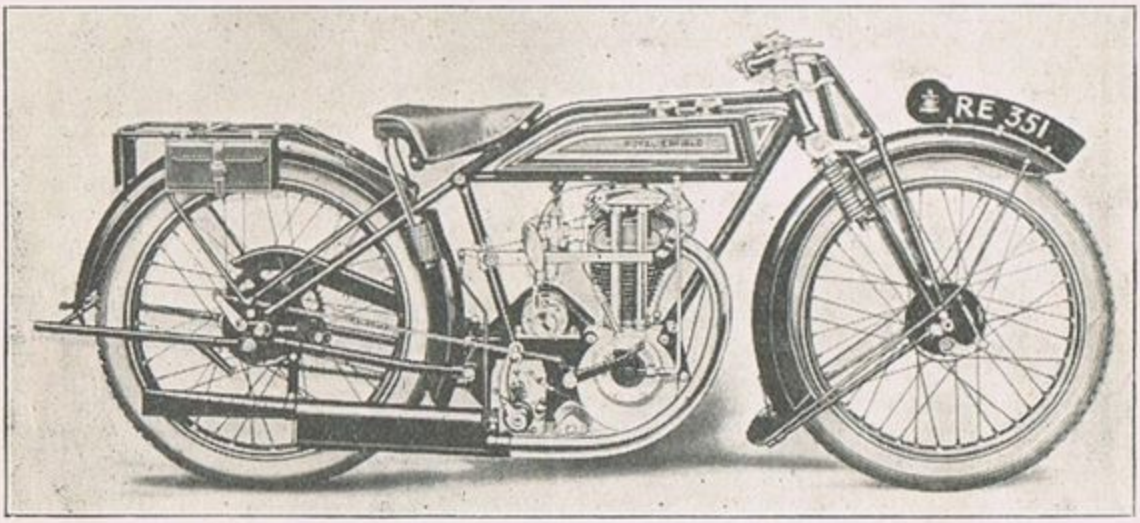

FIG. 45.—3·46 H.P. O.H.V. SPORTS.
(Model 351.)

found on the last page of this Supplement. It replaces that printed on page 6 of the book itself.

The Two-strokes. No changes have been made in these models, which remain as described on page 5.

The Four-stroke Singles. The standard 3·46 h.p. model (formerly described as the $2\frac{3}{4}$ h.p.) has been improved in various details, and notably as regards the silencer and the brakes. Otherwise it remains substantially as before. The estimate of this machine's speed, given on page 7, errs on the low side. My most recent experiences suggest that 55 m.p.h. is nearer the mark than 50, while I might also add that I have had very good results from this model during last season when fitted with a sidecar. Some motor cyclists are still dubious of the capabilities of the 350 c.c. combination, but it is perfectly satisfactory for all normal uses. Model 351, the o.h.v. sports, has been given a new engine,

of Enfield manufacture, and of very interesting design. It is really a very fine piece of work indeed ; possibly its most notable feature is the way in which the valve gear is totally enclosed,

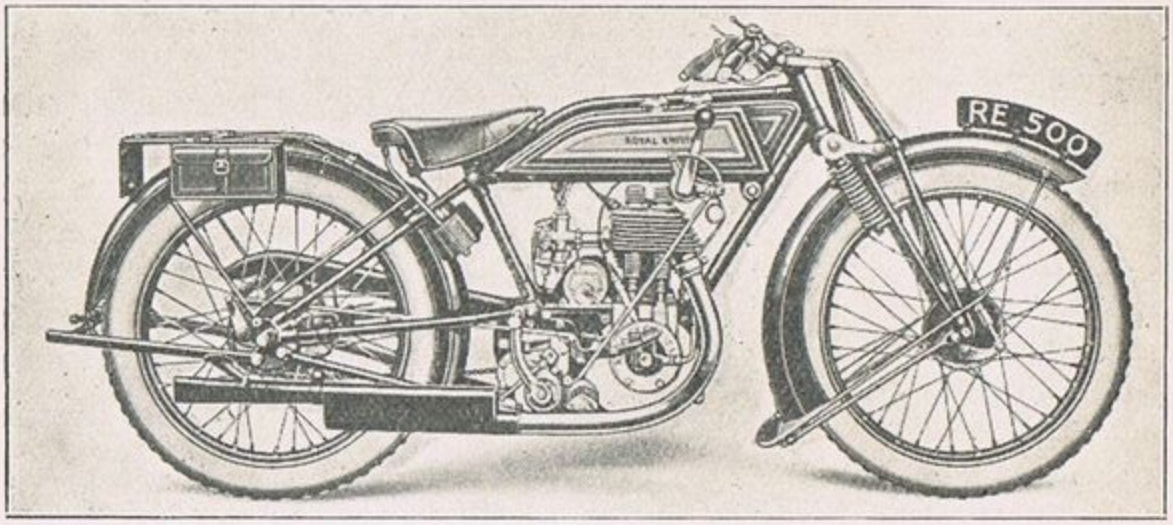

FIG. 46.—4·88 H.P. FOUR-SPEED.
(Model 500.)

giving greater cleanliness and more quiet running than is common with the average o.h.v. unit.

The Four-speed Single. An entirely new machine in the Enfield range is the 4·88 h.p. single. It is fitted with a side-valve engine,

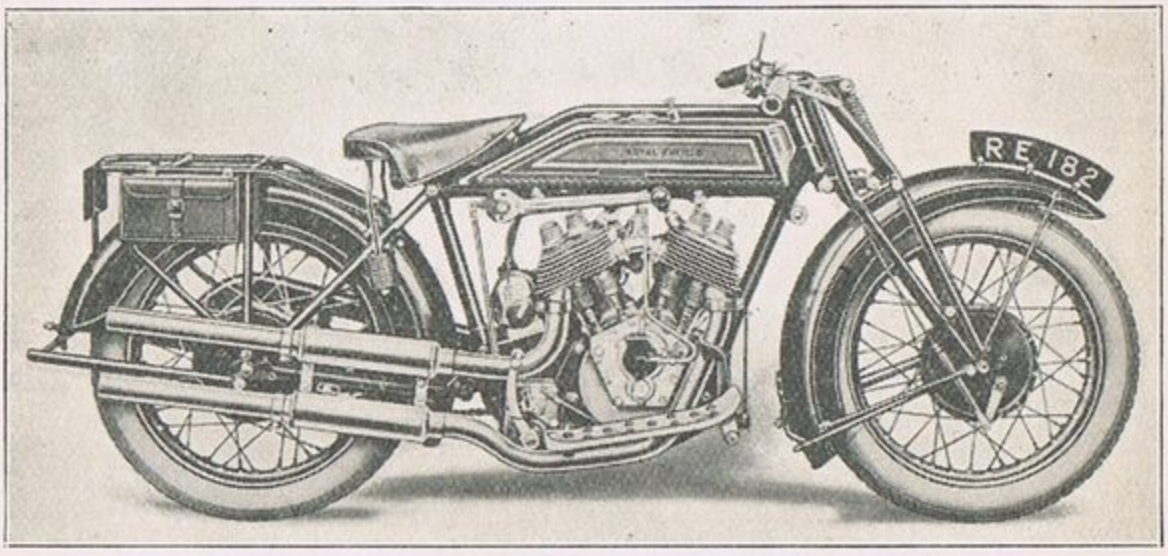

FIG. 47.—9·76 H.P. SPORTS
(Model 182.)

of a design that is generally similar to that of Model 350, and the general lines also follow fairly closely that of the smaller machine. The frame is, however, slightly different in its layout, and the somewhat unusual duplication of the members between engine and rear spindle is an excellent feature. This model has

also a four-speed gearbox, made by the Enfield Company. It is, indeed, difficult to over-estimate the value of a four-speed box to the driver prepared to make proper use of it. Such boxes are fairly common on cars, but their use for motor-cycle work has not yet become at all frequent. They enable the driver to maintain higher average speeds over a day's running, and they also allow of a reduced consumption of fuel, as a higher top ratio can be employed than would be advisable with a three-speed gearbox, while the middle ratios are also higher. Apart from that, the four-speed box is a delightful thing to use, and adds materially—at any rate, in my estimation—to the pleasure of driving. This new Royal Enfield model should prove a very likeable solo mount for really hard work. It is not too heavy, and it has an ample reserve of power, while its gearbox gives it, as I have said, an additional, and very real, advantage. It should also be a very capable machine for sidecar purposes ; again, its four-speed box will be a point very much in its favour.

The Twins. The 9·78 h.p. Royal Enfield (formerly the 8 h.p.) now has a re-designed engine, which has been improved in various details over the former unit. The silencer is also new, and the brake equipment has been modified. A very attractive sports model is available, in addition to the standard machine, and this should make a pleasant solo mount for those riders who like to bestride the largest class of cycle. The biggest of the Royal Enfields is, however, primarily a sidecar machine, and as a matter of personal opinion I think it unbeatable in its class, and at its price, for really heavy sidecar work, particularly of the " family transport " kind, I know of nothing to touch it. The company lists a number of sidecars of different patterns.

TABLE OF ROYAL ENFIELD MODELS

H.P.	Model No.	Bore, Stroke, C.C.	Gear, ratios.	Brakes.	Tyre size.	Remarks.
2·25	201	64 × 70 225	Enfield 8·1 and 5	Internal Expanding both wheels.	24 × 2¼	Standard two-seater. Leg shields and footboards.
,,	201A	,,	,,	,,	,,	Open frame.
,,	200	,,	,,	,,	,,	Sports.
3·46	350	70 × 90 346	Sturmey 5·9, 8·9, 17·3 or 6·7, 10, 19·5	,,	27 × 2·75	Side-valve.
,,	351	,,	Sturmey 5·3, 6·7, 10·1 5·9, 7·5, 11·3	,,	,,	O.H.V
4·88	500	85·5 × 85 488	Enfield 4·4, 5·7, 7·4, 13·6 5, 6·5, 8·5, 15·6	,,	,,	Side-valve.
9·76	182	85·5 × 85 976	Sturmey 4·2, 6·3, 12·1 4·7, 7·1, 13·6	,,	26 × 3·25	Sports.
,,	180	,,	Sturmey 4·7, 7·1, 13·6	,,	,,	Standard.