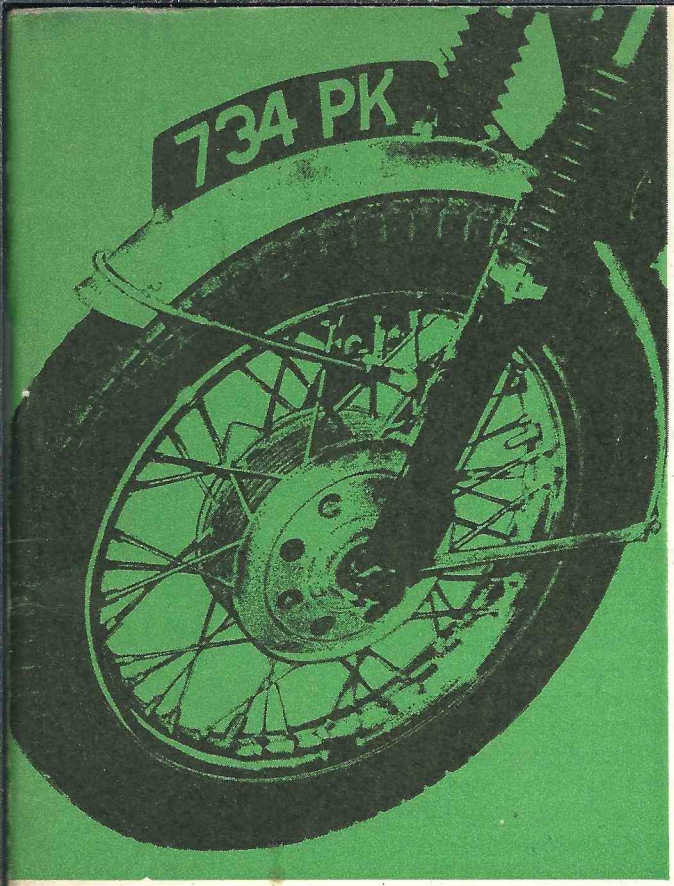
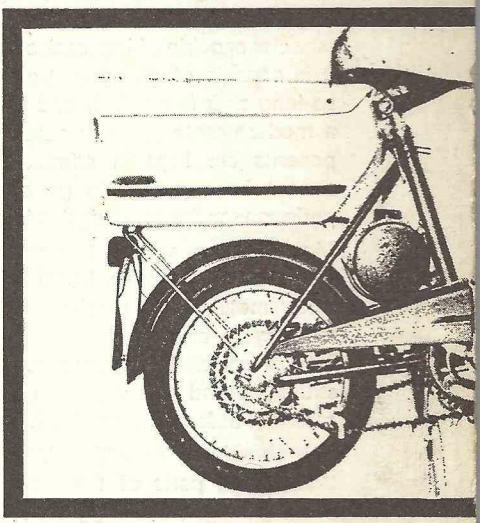
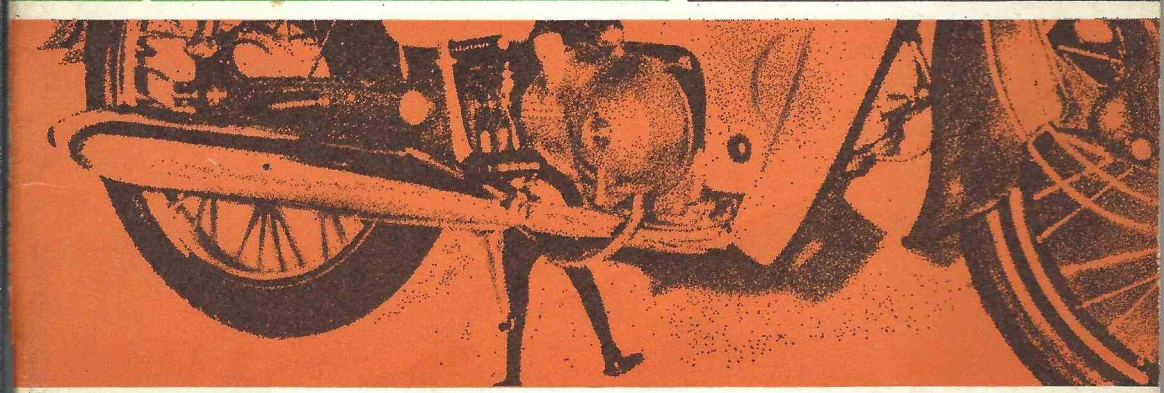
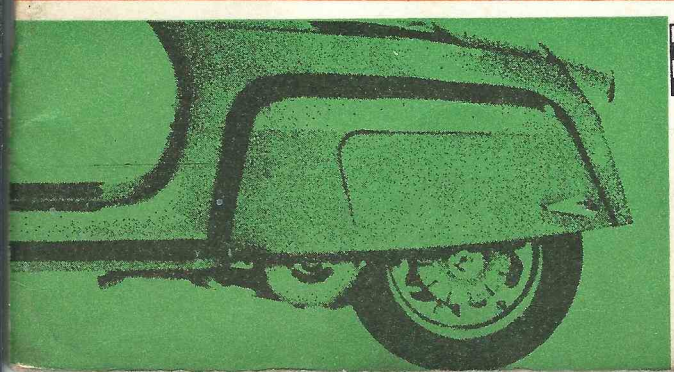


two wheeler care







CARS and CAR CONVERSIONS

SPEED SPORT MOTOBOOKS

a handbook on the workings of the modern two-wheeler

3/-

a guide to trouble-free riding

When the Marquis de Mouzilly St. Mars presented his Tourist Trophy in 1907, for an Isle of Man race aimed at improving the reliability of motorcycles 'as sold to the general public', he started a train of development which has gone on ever since. Lessons learnt in the T.T. Races and other sporting events, together with advances in engineering knowledge, have made the modern two-wheeler capable of impressive performance and reliability. It is capable of giving that good service, however, only so long as it is regularly and efficiently maintained. Even a modern motorcycle or scooter demands that its components are kept in correct adjustment. Otherwise it cannot be expected to go on producing reliable high performance for any length of time.

Most owners are all too ready to attempt their own machine maintenance. But their enthusiasm is not necessarily matched by mechanical knowledge. The modern motorcycle or scooter is quite a complicated piece of mechanism and a reasonable understanding of its construction, and the work each component must do, is essential before the tool-kit is brought into use.

This completely new 'Two Wheeler Care' book describes the various parts of the machine, tells what they are designed to do, and suggests the best course of action for looking after them. Used intelligently, it can save a lot of time, money and frustration.

published by Castrol

contents

Castrol Limited thank the motor cycle industry for their co-operation in the production of this handbook.

the frame

TUBULAR

frames, used for the majority of motorcycles and mopeds, derive from the days when a powered two-wheeler was no more than a bicycle with an engine added to augment or replace pedal propulsion. Such frames effectively combine light weight with strength and, in the event of damage, they are easy to repair. Weight saving, and cheaper production, can be achieved by the use of welding instead of brazing where tubes have to be joined and engine or other lugs added to the main frame.

CRADLE

or semi-cradle frames have the engine located at the bottom of a loop or "box" of tubing. With the engine plates in which it is mounted, the engine in many cases forms an integral part of the main frame. In other cases—the "featherbed" Norton is the classic example—the engine merely "sits" within a complete double loop of tubing. Being complete assemblies in themselves, frames of this type appeal strongly to builders of "specials" as they will usually accommodate a wide variety of power-units without major modification.

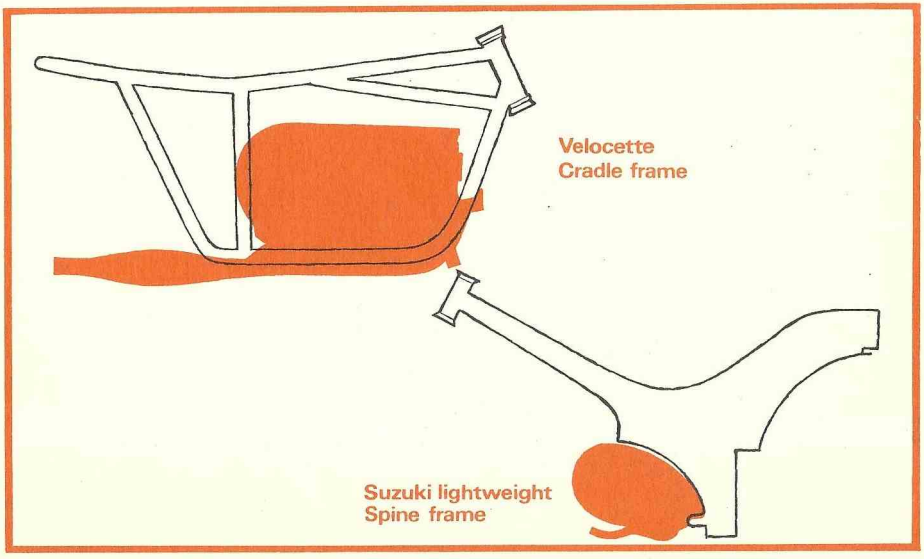
SPINE

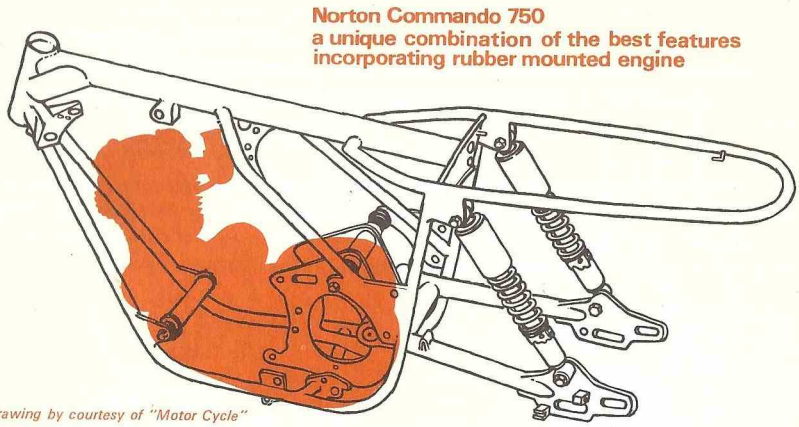
frames have a single large-diameter tube, or welded box-section, which forms the backbone of the motorcycle. The engine is usually attached cantilever-fashion to the backbone, or suspended from it; although some designs incorporate the engine as part of the sub-frame carrying the rear wheel and springing.

SCOOTERS

almost invariably employ a form of spine frame reversed to provide the "open" layout which has always made this type of machine popular with girls who have no desire to dress up in breeches or trousers whenever they go for a ride.

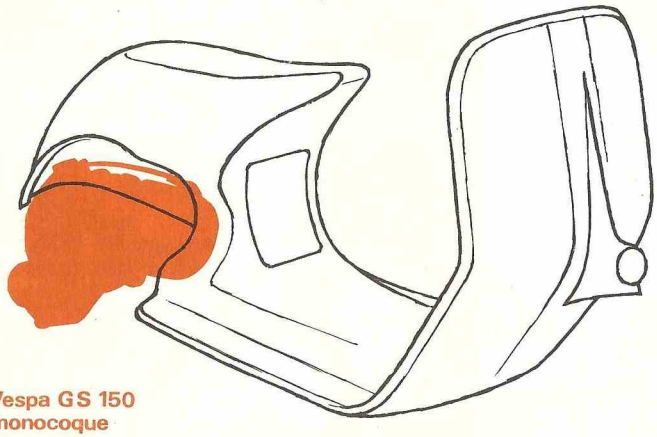
It should just be added, perhaps, that there are as many two-wheelers with frames which incorporate some characteristics of both cradle and spine designs as there are others which fall conveniently into one class or the other.





Norton Commando 750
a unique combination of the best features
incorporating rubber mounted engine

drawing by courtesy of "Motor Cycle"



Vespa GS 150
monocoque

HOW YOU CAN HELP

There is a strong temptation to say "Don't"—and to leave it at that. Frame repairs are beyond the scope of even a skilful home mechanic. Special jigs are required to check alignment, while tube-bending, welding or brazing are all tasks for the craftsman rather than the amateur. Wheel alignment can be checked (see STEERING) but if your machine has been involved in an accident, or has even suffered a heavy fall, and you suspect that the frame may be bent, get an expert to check it. When doing so, remember that a mechanic's time often represents the biggest item in a repair bill. If you are capable of putting everything back where it came from, strip the frame right down and clean it before taking it in for checking and possible repair.

Otherwise, regular cleaning will enable you to spot tube, weld or brazing failures—none of which, in fact, are likely to occur on anything other than a very old machine—and to check the tightness of nuts where a frame is of partly bolted-up construction. Front and rear forks, which do call for routine maintenance, are dealt with separately.

2 the engine

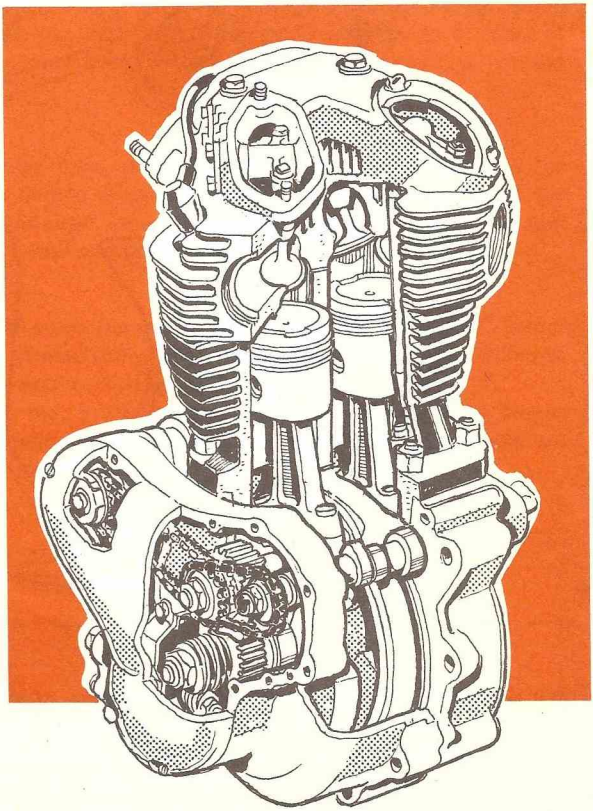
IN THE BEGINNING –

efforts to power a motorcycle—more exactly, a tricycle—were by steam. With a vehicle on which the rider necessarily sits in close proximity to the engine, high-pressure steam had its disadvantages and hazards, however, and it needed the coming of the small, reasonably reliable, internal-combustion engine to launch the motorcycle era, some 70 years ago.

TYPES OF ENGINE

Although other types such as the NSU Wankel rotary unit have appeared in experimental form, all commercially produced motorcycle engines have an internal, reciprocating piston, or pistons, and use petrol as their fuel. They fall into two distinct groups, those employing the 4-stroke cycle and those that work on the 2-stroke cycle.

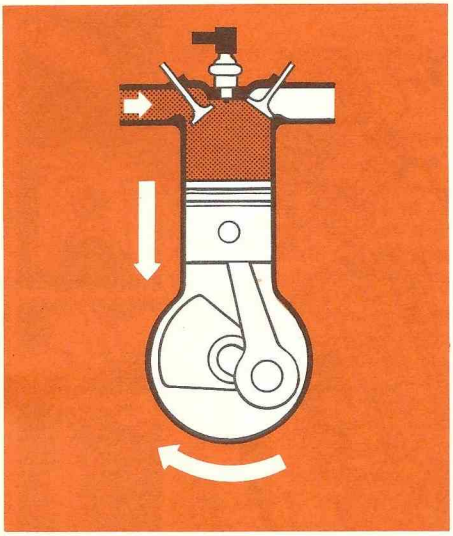
Norton 750cc Atlas engine—one of the biggest and most powerful in production



FOUR STROKES OR TWO

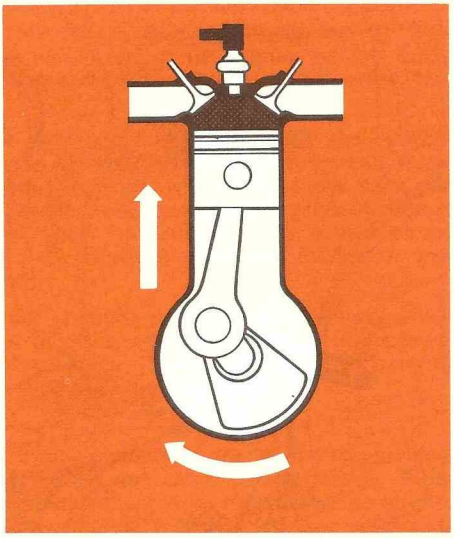
In the car world nearly all engines work on the 4-stroke cycle; with motorcycles both types are equally popular and must be dealt with in the same detail. First in the field, and still almost universal for the bigger, high-performance machines, is the 4-stroke. The term means that there are four stages in the power-producing operation of the piston. In the course of this the crankshaft will have completed two full rotations (a point to bear in mind when you come to reading about engine and ignition timing).

THE FOUR-STROKE CYCLE spark ignition



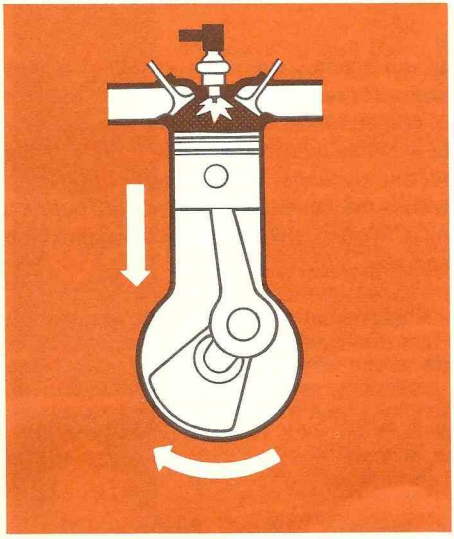
1 INDUCTION

The first half turn of the crankshaft draws the piston down the cylinder. At the same time the inlet valve opens and the petrol/air mixture is sucked into the cylinder.



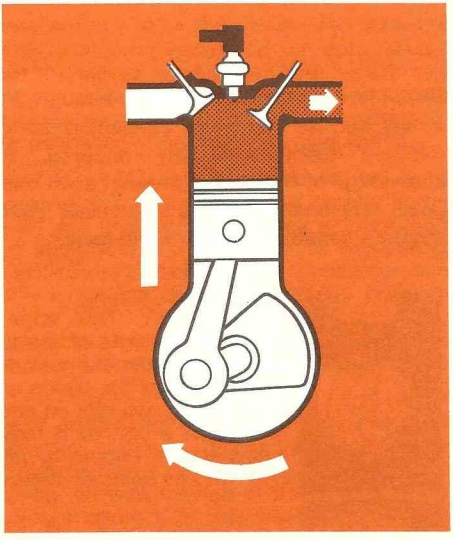
2 COMPRESSION

On the next half turn of the crankshaft the inlet valve shuts and the piston slides up the cylinder compressing the mixture.



3 POWER

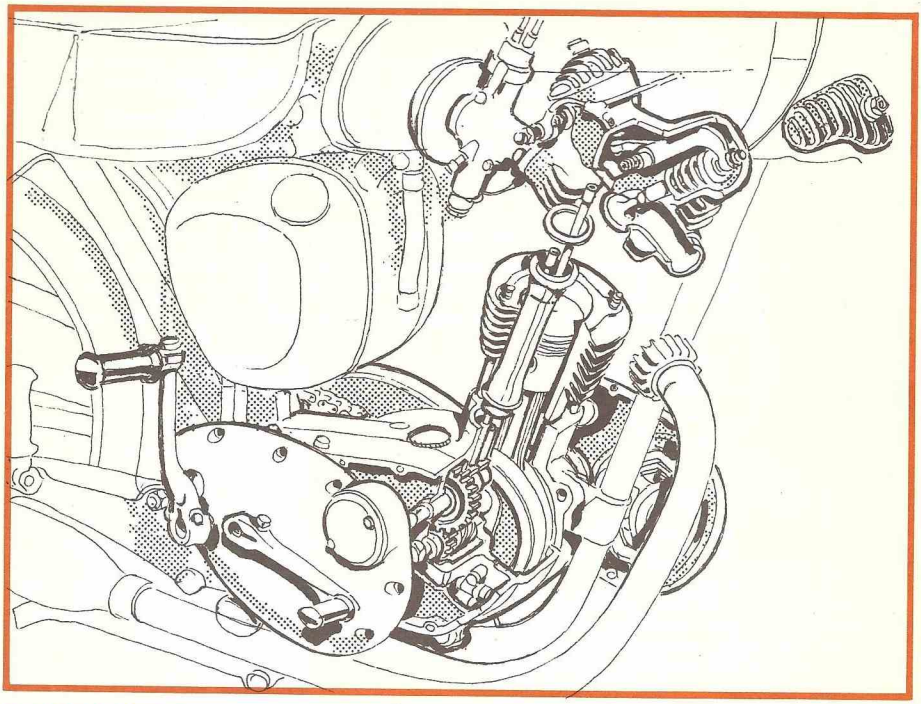
The sparking plug fires the compressed fuel mixture and the gas expands rapidly forcing the piston down the cylinder.



4 EXHAUST

The exhaust valve opens as the piston moves up the cylinder and forces out the spent gases. When the piston reaches the top of its travel the exhaust valve shuts, the inlet valve opens and another cycle begins.

3 engine components (4-stroke)

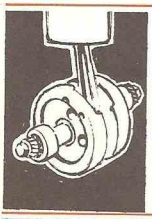


WHAT EACH COMPONENT DOES

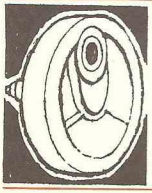
The 4-stroke cycle is simple enough in theory but, for it to work efficiently, many different components are required. A knowledge of these, and of what each one does, will enable you to appreciate your engine's capabilities and requirements.

MANY VARIETIES

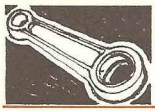
Single-, twin-, even four-cylinder engines and many types of valve layout and method of operation make for a considerable variety of 4-stroke design. Some are more suitable for one particular use than others but, even within the limits set by price and purpose there is often a wide choice of engine type and size.



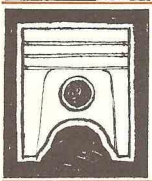
CRANKSHAFT With a single–cylinder engine, the crankshaft assembly consists of the two mainshafts, the flywheels and the crank-pin, offset from the centre-line of the engine to provide the leverage which enables the piston and connecting-rod to turn the shaft assembly. With a twin-cylinder engine there may be a one-piece crankshaft, similar to that of a car, or it may be built up with two separate crank-pins. Allowing the engine to labour is more likely to cause damage to the shaft and its bearings than will continuous high revving.



FLYWHEEL(S) A heavy, carefully balanced wheel or wheels, incorporated in the crankshaft assembly, or carried on the mainshaft outside the engine in some instances, provides the momentum to keep the shaft turning smoothly between power strokes. Flywheels do not break or wear out but one that is even slightly out-of-balance or not rigidly mated to crank-pin or shaft will cause vibration that will rapidly wreck the mainshaft bearings.

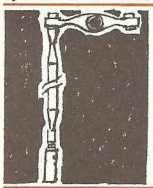


CONNECTING ROD This rod is attached at its top, or "little end", to the underside of the piston and at its bottom, or "big end", to the crankshaft. Over-revving and faulty lubrication can break con. rods.



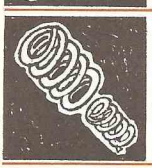
PISTON This component slides up and down inside the cylinder altering its volume. The piston is grooved to accept flexible rings, which are of two types: compression rings, which form a gas-tight seal between the piston and the cylinder wall, preventing combustion gases from blowing by into the crankcase; and scraper rings, which scrape surplus oil from the cylinder wall. Faulty ignition and lubrication can cause burning of the piston face.

CAMS The cams, or camshaft on most vertical twin engines, driven at half engine speed by chain or gears, open the valves at the correct moment. Valve springs shut them again. (See Chapter 4.) Over-revving can cause damage to the hardened surfaces of the cams.

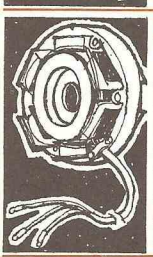


CAM FOLLOWERS, PUSHRODS, ROCKERS AND TAPPETS Some or all of these components are needed to provide a means of transmitting the lift from the cams to the valves. More vulnerable to the effects of maladjustment than most other parts of a motorcycle engine they have, nevertheless, had their working conditions vastly improved since the general adoption of full enclosure and positive lubrication of the valve gear some 30 years ago.

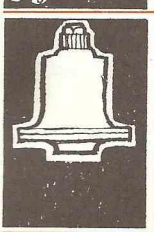
VALVES The valves control the flow of gases into and out of the cylinders. The valves and valve gear are amongst the most sensitive components in the engine. Leaking valves seriously reduce power, economy and the life of the components themselves.



VALVE SPRINGS These springs force the valves shut after the cams have opened them. Springs, broken or weakened through old-age or over-revving, will fail to shut the valves quickly and fully, which will cause power loss. Check spring for weakness by placing suspect spring end-on to a new spring, and compressing them in a vice or clamp. If spring is weak, it will compress noticeably more than the new spring.



ALTERNATOR OR MAGNETO The once almost universal magneto, driven by chain or gear at half engine speed, is rapidly being succeeded by the alternator—an AC instrument that has a crankshaft driven magnetic rotor spinning freely within a ring of coils, generating its electricity without recourse to delicate carbon brushes. Fundamentally different, both types of instrument need a contact-breaker to produce the ignition spark at the right time. The alternator is, in itself, almost trouble-proof and damp or defective wiring should be first suspected in the event of any fault. Most likely magneto troubles are a dirty pick-up or slip-ring.



OIL PUMP This is a universal component for 4-stroke engines, and may be of either gear or plunger pattern. It circulates oil under pressure to all the vital bearing surfaces and, on the majority of motorcycles which have a separate oil tank instead of the engine sump that is customary for cars, it has a return side which extracts surplus oil from the crankcase—hence the term "dry sump"—and pumps it back to the oil tank to provide constant circulation of lubricant as soon as the engine is turning. It is extremely rare for an oil pump to give any trouble.

CARBURETTOR See Chapter 6

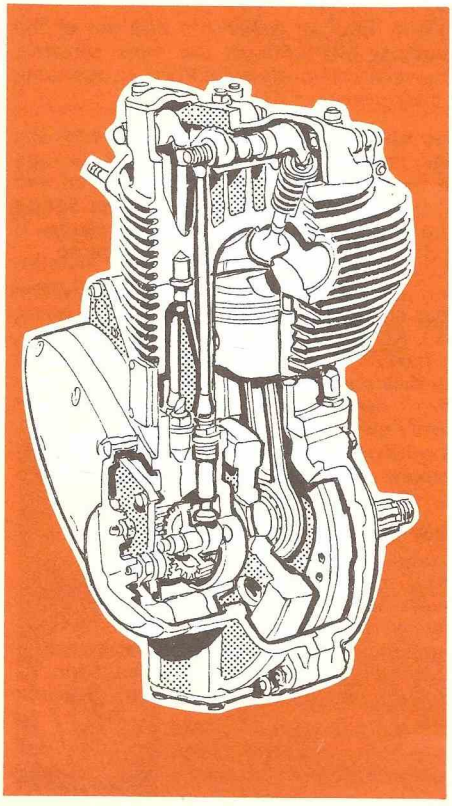
CONTACT-BREAKER, PLUGS See Chapter 7

4 valve disposition

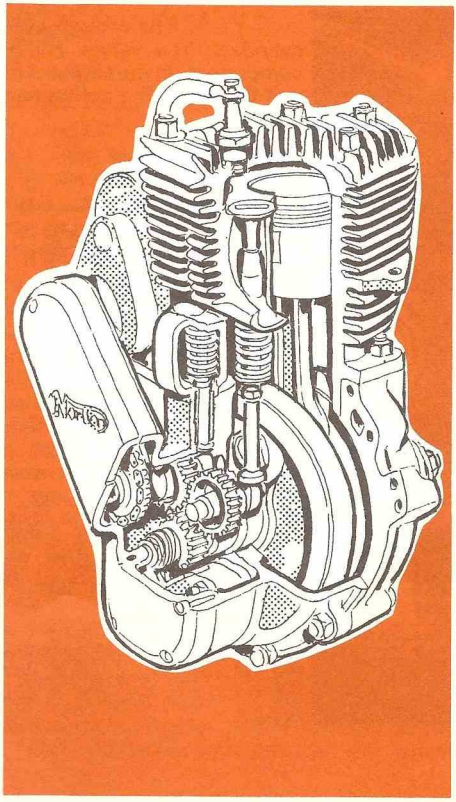
SIDE-VALVE

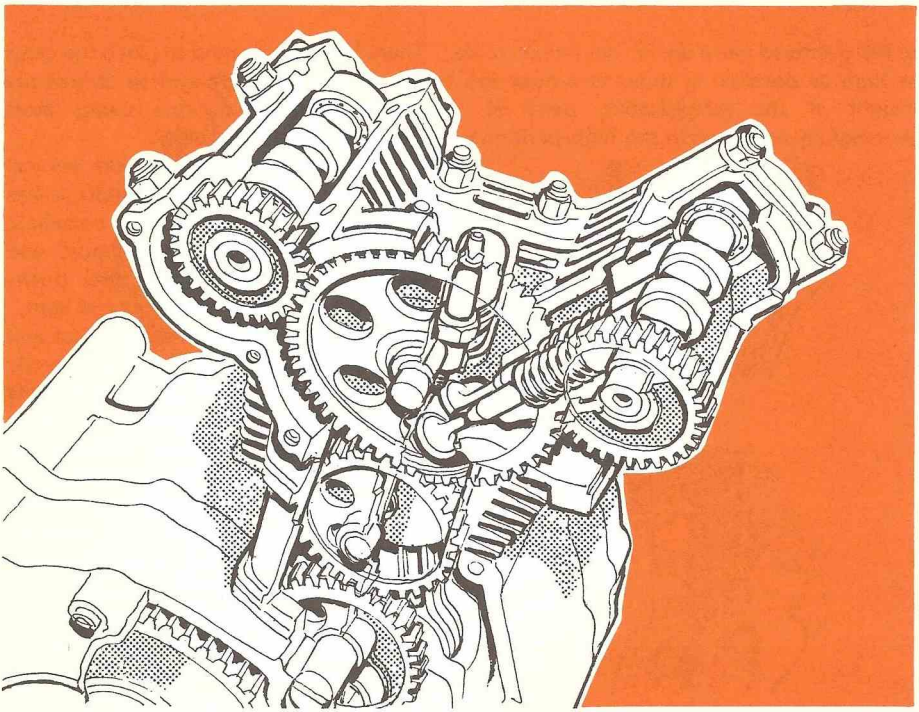
engines became popular because they were simple, comparatively cheap to produce, and suffered from none of the problems of pushrod breakage or bending that beset some earlier designs before the metallurgists caught up with the design engineers. In its simplest form, the side-valve needs only two cams, each driven at half engine speed from an idler pinion driven from the mainshaft, and two valves and springs. If both cams are located on a common spindle, pivoted cam-followers are necessary if the valves are to be spaced so that they have parallel movement; and in most designs hardened steel tappets are interposed between the cams or cam-followers and the valve ends, with provision for adjustment of clearance. As with earlier arrangements, it is difficult to obtain a symmetrical combustion chamber shape with a side-valve engine and, where air-cooling is employed, there are problems of dissipating the heat in the vicinity of the exhaust valve. Some very efficient engines of this type have been made, however, even for racing. The big vee-twin J.A.P. was a notable example. And watercooling can effectively offset practically all the disadvantages, as has been proved by the success of the Velocette LE twin.

Overhead valve BSA Gold Star



Side-valve Norton 16 H





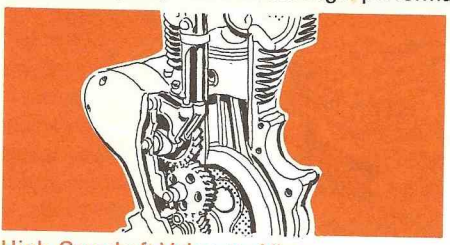
Intricate valve gear of the Overhead Cam 4 valve Honda CR110

OVERHEAD

location of both inlet and exhaust valves enables a perfectly symmetrical combustion chamber to be used and overcomes all the cooling problems. It is now employed for the vast majority of motorcycle engines. The big snag, for many years, was that most of the valve operating mechanism—the push-rods, rockers and valve springs—had to be left out in the fresh air to keep them cool; whereupon it became extremely difficult to keep the bearing surfaces between these components adequately lubricated. As, at that period, much the same problem presented itself with the lubrication of the valve stems on s.v. engines this was not regarded as quite such a disadvantage as it would be today. Frequent use of a grease-gun loaded with high melting point grease was the accepted routine. But as modern pressure lubrication of engines developed, the valve gear could be enclosed and adequately lubricated, so that these problems disappeared. At long intervals, it is still advisable to renew springs to maintain the full efficiency of an engine, and clearances should still be checked—and re-set, if necessary—from time to time. But the day is long past when a motorcyclist had to carry a feeler-gauge in his pocket and adjust the tappets after every fast run. Where cam and rocker surfaces do wear rapidly, the fault is far more likely to be attributable to failure to change the oil, or to clean or renew the oil filter, at the recommended interval than to any fundamental weakness in the design or manufacture of a modern o.h.v. motorcycle engine.

REFINEMENTS

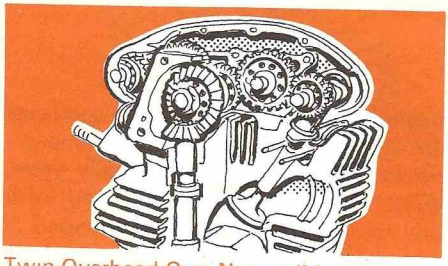
of the overhead valve design are innumerable. There has been a trend to place the cams as high as possible in order to reduce the length of the pushrods and so reduce the weight of the reciprocating parts of the valve mechanism, this being most successfully exploited in the high-performance single-cylinder Velocettes.



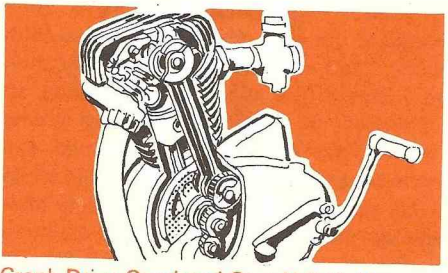
High Camshaft Velocette Viper

With the arrival of the popular vertical twin layout, pioneered by Triumph, it has been possible to use a car type camshaft, or separate camshafts for exhaust and inlet valves and, here again, the push-rods can be comparatively short and light. This aim of keeping down the number and weight of reciprocating parts is directly related to the adoption of progressively higher engine speeds. A motorcycle engine is working most efficiently when it is turning over fast and where 4,000 r.p.m. would have been high revving for a side-valve of the 1920s, 10,000 r.p.m. is by no means abnormal for some of today's light-weights, particularly if they have an over-head camshaft which eliminates the need for pushrods altogether. An o.h.c. engine has its camshaft, or shafts, driven by chain, a train of gears or a shaft and bevel gear, all of which have the advantage of possessing a continuously rotating movement instead of the start-stop-reverse movement of more conventional overhead valve mechanisms. Somewhere be-tween the pushrod design and a pure o.h.c. type comes the NSU "bell-crank" engine in which a connecting-rod with ring bearings takes the place of pushrods and their direct-contact tappet ends.

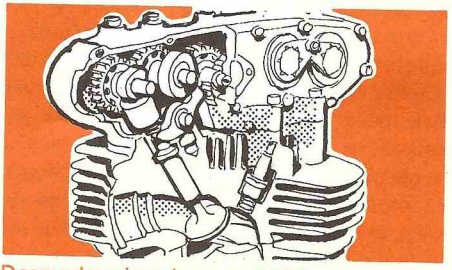
Chain Drive Overhead Cam AJS 7R



Twin Overhead Cam Norton 'Manx'

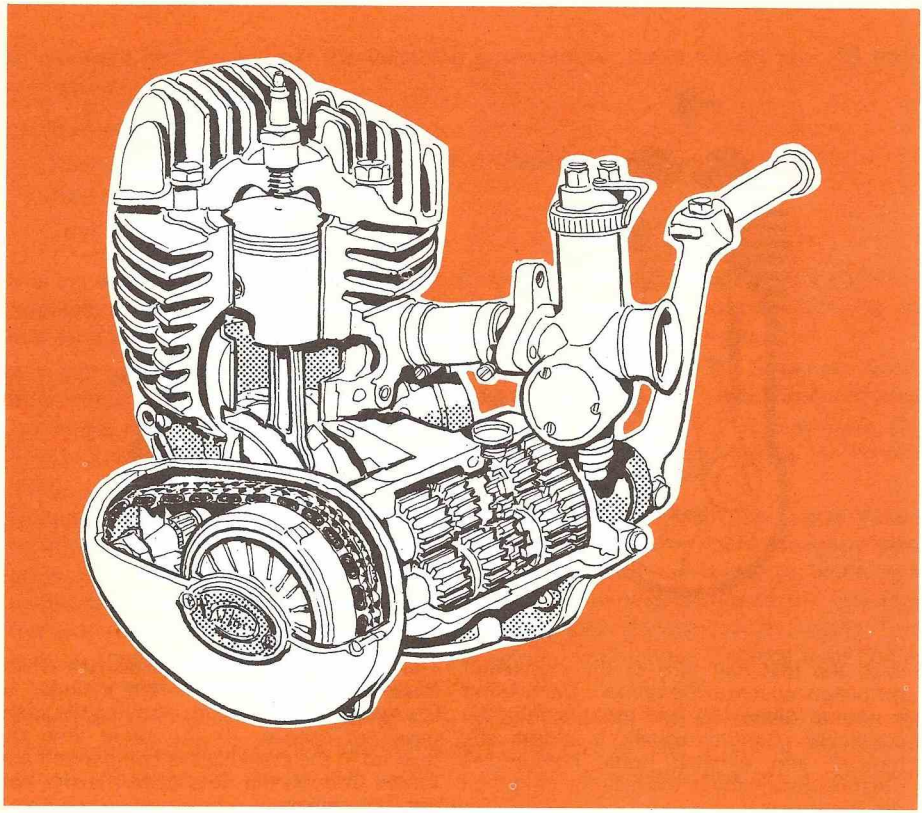


Crank Drive Overhead Cam N.S.U. Max



Desmodromic valve gear 1959 500 cc Norton

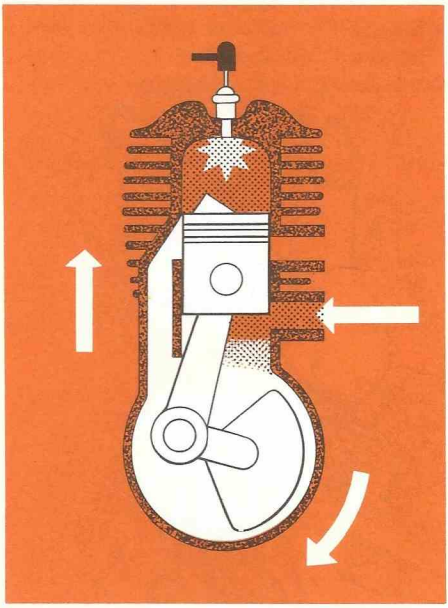
5 two-stroke engines



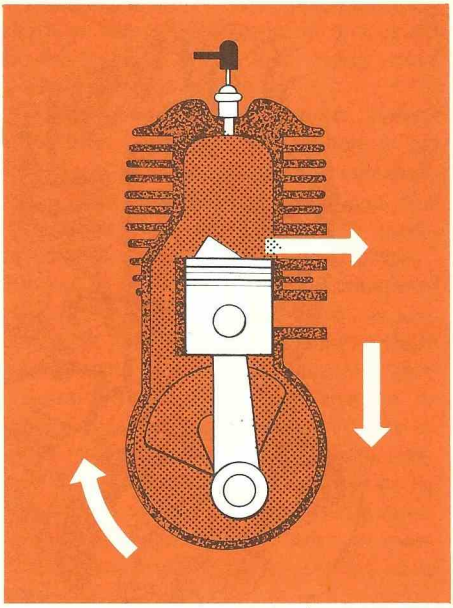
SIMPLICITY was for long the one big attraction of the two-stroke cycle. With a few notable exceptions, like the watercooled twin-cylinder Scott, engines of this type enjoyed most of their popularity because they were cheaper than the more complex four-stroke. They were robust, easy to maintain but, as a rule, not outstandingly powerful. In recent years the sports two-stroke has come into its own. Some of them can hold their own with the fastest four-stroke of the same size, or even surpass it—in miles per hour if not in miles per gallon.

SINGLE-, TWIN- and three-cylinder engines have all been produced commercially, and for racing there are even four-cylinder two-strokes. Basically, however, all the "multis" consist of two or more individual engines linked by a common driving shaft. This is because, in the motorcycle field, all two-stroke engines rely on crankcase compression to force a charge of gas through the transfer ports into the combustion chamber; and, short of having a horizontal-twin layout with the pistons travelling in exactly opposed directions, it would be impossible to achieve effective inlet and transfer port timings with a shared crankcase.

THE TWO-STROKE CYCLE



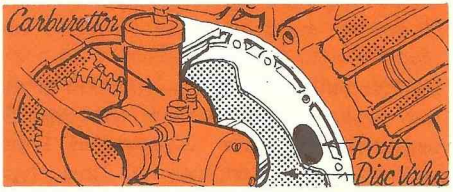
With the first half turn of the crankshaft the piston moves up the cylinder, uncovering a port to allow the fuel mixture into the crankcase. Simultaneously it closes the transfer and exhaust ports, compresses the mixture already in the cylinder, and then the spark fires it.



The burning fuel mixture forms gas which forces the piston down the cylinder to uncover the exhaust port, allowing the spent gases to escape. At the same time the mixture in the crankcase is compressed and forced through the now open transfer port into the cylinder.

SOPHISTICATED VALVE TIMING

The Puch 'split-single' is a high-performance engine. Its separate inlet and exhaust cylinders, with shared crankcase and combustion chamber give greater control over port timings. Use of an articulated connecting rod produces a 'dwell' between the two pistons at the top of their travel which aids efficient scavenging.



Modern improvements in materials and lubricants have made the rotary inlet valve a practical proposition. This allows for a wide range of port timing without upsetting a two-stroke's inherent simplicity by adding to the number of reciprocating parts. A typical example is the segmented disc controlling inlet opening and closing on Yamaha engines.

PETROIL LUBRICATION is achieved by adding a suitable ready-mixing oil to the petrol. It is a simple, yet remarkably effective means of lubricating a two-stroke engine. The oil goes into the crankcase with the fuel mixture, coming out of suspension as the petrol vaporises.

THE METHOD ADOPTED TO REFUEL A TWO-STROKE

is important and we suggest the following procedure for those owners who fill their own tanks:—

1. Turn off the petrol tap.
2. Pour in the correct amount of Castrol Two-Stroke Self-Mixing Oil.
3. Add the required quantity of petrol.
4. Turn on the petrol tap.

It is important to add the petrol after the oil, in order to create the necessary agitation to obtain a completely homogeneous mixture. If the petrol tap is not turned off, the oil may tend to run down the petrol feed-pipe and block the carburettor jets.

At many garages, of course, you will find the Castrol Two-Stroke Oil Dispenser. Apart from enabling a perfect mixture to be obtained in your tank, this dispenser also possesses an advantage over ordinary ready-mixed petroilers in that it enables the rider to see that the oil of his choice is mixed with the petrol of his choice, at the correct ratio.

Once the petrol and Castrol Two-Stroke Self-Mixing Oil have been thoroughly mixed together they will not separate, although evaporation of petrol could obviously take place if it was exposed to the open air. It is, however, advisable to empty the carburettor float chamber of some machines before garaging, owing to the fact that the warmth of the engine can cause evaporation and leave an unbalanced mixture. This is quite simply carried out by turning off the petrol a well-judged distance from home, so that the engine stops when the carburettor float chamber runs dry.

How much oil should be added to each gallon of petrol? Until recently easily the most commonly used mixture strength was 1 : 16, that is—half a pint to a gallon of petrol, and although this is still widely used there is a trend towards a reduction in the recommended proportion of oil to fuel.

Some well-known 2-stroke engine makers now recommend mixture proportions as "lean" as 1 : 50 (or 2 per cent.) for certain of their latest machines. This has been made possible by improved engine design—in the case of one type of engine the crankshaft main bearings are lubricated independently of the petrol mixture, while in another type the petroil mixture is routed so that it impinges directly on the crankshaft and big-end bearings.

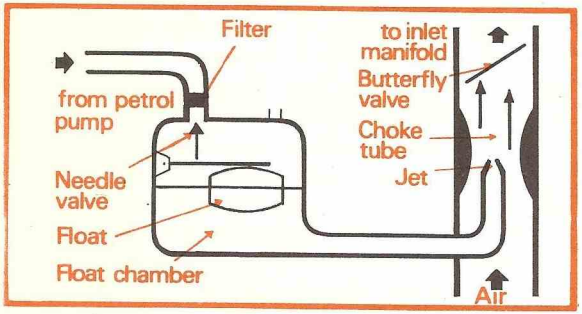
It must, of course, be remembered that when using Castrol Two-Stroke Self-Mixing Oil, which includes a diluent to help the mixture of the oil with the petrol, a slightly greater quantity has to be added to the petrol than is recommended by those manufacturers whose figures relate only to non-self-mixing oils.

The need for this slightly increased amount has already been taken into account with the 1 : 16 mixture strength wherever this is recommended. But where, for instance, 1 : 25 of non-self-mixing oil is recommended by the manufacturer, Castrol Two-Stroke Self-Mixing Oil should be used at 1 : 20 or two-fifths of a pint per gallon of petrol. Where the manufacturers recommend 1 : 20 of non-self-mixing oil, 1 :16 or half a pint of Castrol Two-Stroke Self-Mixing Oil should be used per gallon of petrol. For the newer machines where a 1 : 50 proportion of non-self-mixing oil is recommended, 1 : 40 or $\frac{1}{4}$ pint of Castrol Two-Stroke Self-Mixing Oil should be mixed with $1\frac{1}{4}$ gallons of petrol.

6 the carburettor

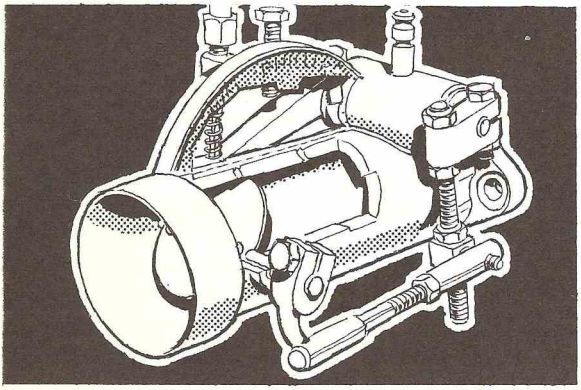
FUEL MIXING

Providing a correctly proportioned mixture of air and petrol, which together make the fuel on which your engine runs, is the carburettor's job. It also regulates the quantity of fuel that enters the cylinder through the inlet port, and so controls the power that the engine produces. Petrol flows from the tank to the float chamber, a reservoir with a float and valve—like the ball-valve in a plumbing system—which maintains a correct level of petrol at a nozzle (the 'jet') located in the choke tube or 'venturi'. The passage of air through the venturi when the engine is on its induction stroke is sufficient to suck enough petrol from the jet to create a combustible fuel/air mixture. To help starting from cold, an air slide or a strangler (both of which restrict the amount of air that can flow into the choke tube) can be employed to richen the mixture.



BUTTERFLY VALVES

The majority of automobile carburettors have a centrally hinged 'butterfly' valve to govern the amount of fuel mixture that can reach the engine. Instruments of this type, the Bowden in particular, at one time enjoyed some popularity with motor cyclists but, apart from an occasional SU-equipped Triumph and the Honda CB450, nearly all modern motorcycles have needle-and-slide carburettors like the British Amal.



INJECTION

Fuel injection, in the strictest sense, is a means of mechanically injecting fuel into the inlet tract. The Wal Phillips Injector is not quite the same thing, it is a very simple but effective device that dispenses with a needle valve but still works on the venturi principle.

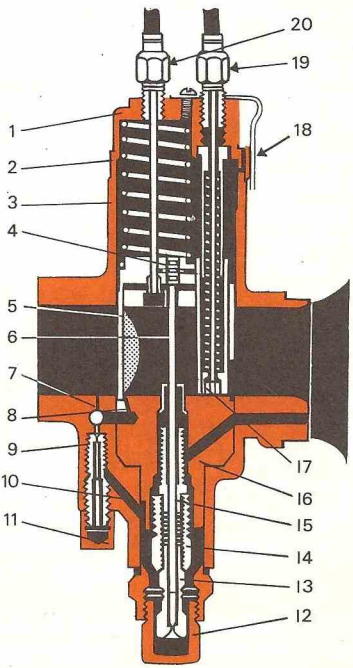
NEEDLE VALVE

carburettors—Amal, Villiers, Dell 'Orto, Bing, Mikuni, for example—have a slide, usually with a semi-elliptical cutaway, and a tapered needle that is raised or lowered in unison with the slide. Together these two components control the amount of mixture reaching the engine throughout most of its working range.

HOW IT WORKS

Whether it is centrally mounted beneath the mixing chamber, as with the latest Amal illustrated here, or has a side or remote mounting (as on many racing machines), the float chamber still has the same basic components—a bowl containing a buoyant float which controls a needle valve which admits the flow of petrol through the feed-pipe from the tank as the float chamber level drops, and shuts it off as soon as the chamber is full. Float level is set to provide a constant supply of petrol—but not too much, or flooding will occur—at the main and pilot jet. It is the pilot jet, located within a separate, very small air passage, that looks after tickover and slow running requirements. Then the cutaway on the slide and the slide itself progressively come into play, providing an increasing flow of air across the top of the needle jet through which a partially vaporised, very rich petrol air mixture is drawn from the main jet and primary mixing chamber below the needle jet. As the slide is further raised (or to use the more general term, as the 'throttle' is opened) the taper of the jet needle is the governing factor. Only in the last quarter of the throttle opening, when the slide is fully raised and the needle with it, does the size of the main jet have a direct bearing on engine performance.

Manufacturers' handbooks invariably give details of carburettor settings. It is wise to accept these as being the best for any particular engine used in a normal manner. A possible change of slide to one with a slightly different cutaway, or the raising or lowering of the jet needle could in some circumstances result in improved performance, whereas the fitting of a larger main jet is unlikely to do so.



1 Mixing Chamber Top
2 Mixing Chamber Cap
3 Carburetter Body
4 Jet Needle Clip
5 Throttle Valve
6 Jet Needle
7 Pilot Outlet
8 Pilot by pass
9 Pilot Jet
10 Petrol feed to pilot jet
11 Pilot Jet Cover Nut
12 Main Jet Cover
13 Main Jet
14 Jet Holder
15 Needle Jet
16 Jet Block
17 Air Valve
18 Mixing Chamber Cap Spring
19 Cable Adjuster (Air)
20 Cable Adjuster (Throttle)

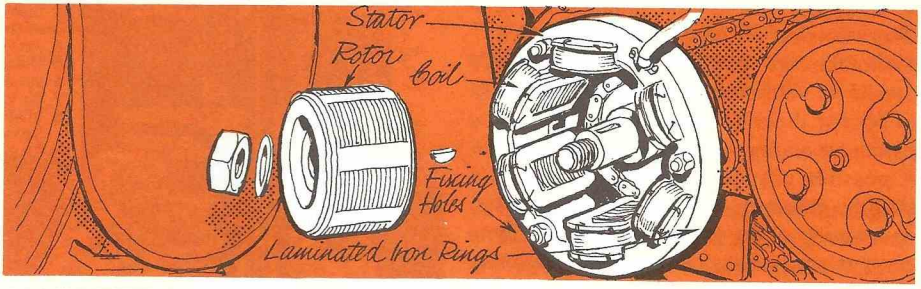
HOW YOU CAN HELP

Most carburettors incorporate a gauze filter and so do some petrol taps. Such filters should be cleaned periodically, as they trap flakes of rust and sometimes droplets of water, both of which will impede the flow of fuel. The float bowl and the jet well should be cleaned, say, every 5,000 miles. Pilot and main jets rarely need cleaning but, when a blockage is suspected, they should be cleared by blowing through from the 'exit' end—never by poking wire through them. Throttle and air slide cables must be kept lubricated and correctly adjusted. Items most likely to wear are the needle valve, much more likely than the needle itself, and on some older pattern carburettors, the float needle and the throttle slide (if it is made of brass). Air filters are of many types, often with replaceable and sometimes with washable elements—don't ignore the handbook instructions as a partially choked filter will affect performance. And remember that running with the filter removed, where one is normally specified, will have the effect of weakening the fuel mixture as well as allowing dirt to be drawn into the engine.

7 the ignition and battery

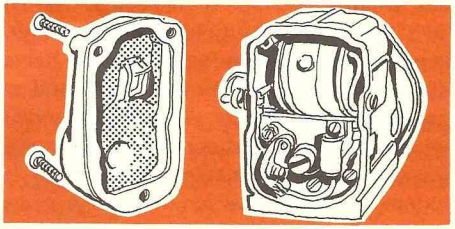
ALTERNATORS

More and more motor cycles have been equipped with alternators in recent years. Without becoming involved in too many electrical terms—guaranteed to baffle most riders—it can be said, simply, that these instruments have fewer, and far less fragile, working parts than the magnetos they are replacing. The coils, usually six in number, are mounted on a solid plate and remain stationary; while the magnetic rotor, carried on an extension of the engine mainshaft, revolves inside the loop formed by the coils. Anyone who learnt about electricity and magnetism at school will perhaps recall that a magnet passing a coil of wire will induce a current in that coil. The speed at which the rotor goes round and the number of turns of wire on the coils do the rest and the instrument produces a steady output of alternating current once the engine is running at, roughly speaking, quarter-throttle or more. For charging the battery—which demands direct current—a rectifier is incorporated in the circuit. This is a static device which, incidentally, hates vibration and likes to be mounted in a position where it enjoys a degree of air cooling. It has the effect of converting alternating to direct current. In the event of the battery being flat, there is an "emergency start" switch position which will enable the alternator to be used to feed current straight to the ignition coil, instead of via the battery. The coil is a vital part of the equipment, serving to step up the 6-volt or 12-volt low-tension current that the battery provides to the very high voltage, high-tension current that will produce a fat spark to ignite the fuel when the contact-breaker opens.



MAGNETOS

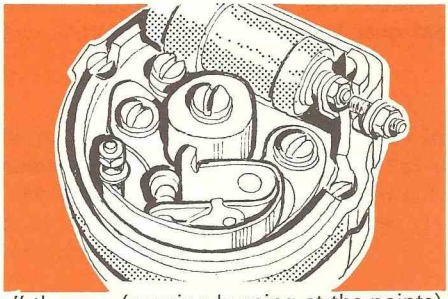
Until the considerable advances in battery design that have been achieved in the past 10-15 years, motor cyclists tended to shy away from coil ignition. The magneto, which itself produces a high-tension current, could be relied upon to keep the engine running, even if battery failure dimmed the lights. Now, the magneto that graced most four-stroke machines is a rarity . . . But many two-strokes still employ flywheel magnetos—perhaps because a two-stroke has to have an outside flywheel anyway, and it is therefore a simple matter to build a magneto of fairly generous proportions, often including additional low-tension coils for a battery-charging/lighting circuit similar to that of the alternator. The magneto, which can have the coil rotating inside the magnet or the magnet rotating inside the coil, delivers its current via a brass slip-ring and carbon pick-up brush and incorporates the contact-breaker as one of its own components.



HOW YOU CAN HELP

The alternator needs no attention. On a few early models, fitted to engines with bad vibration periods, the coils could come loose—then the only remedy was replacement. Generally, though, any failure of the alternator is more likely to indicate a disturbance of the critical air gap between rotor and coils; and that is a sign of a worn engine mainshaft bearing. As with any electrical equipment, all wires and connections should be kept clean. A magneto slip-ring requires cleaning at about every 5,000 miles—use clean rag wrapped round the end of a wooden pencil (or some other non-conductor, to avoid getting a shock) to remove carbon dust; and when the brush wears it must be replaced.

CONTACT BREAKER



Whether it is a component of a magneto or a separate unit incorporated in a coil-ignition circuit, the contact breaker performs the same function. By interrupting the flow of current in the low tension winding of the coil or of the magneto it causes a momentary surge of high-tension current to build up in the high-tension winding. A condenser is used to store and feed back current that might otherwise "jump" the gap (causing burning at the points) as the contact breaker is opened by its operating cam.

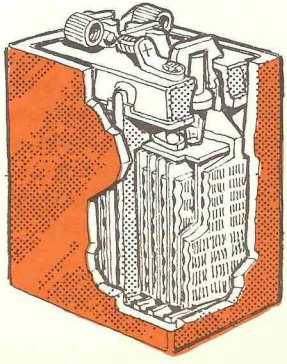
HOW YOU CAN HELP

The contact breaker—and distributor cap, with a twin-cylinder machine—must be kept clean and dry; and it is important that the recommended gap for the fully open position of the points is maintained. A feeler gauge is the only accurate means of checking this. Lubrication of the cam is necessary, and of the automatic advance and retard bobweights, if the contact breaker incorporates this refinement. But it must be done sparingly. Follow the maker's instructions carefully, as too much lubricant can be worse than none where electrical components are concerned.

BATTERY

The battery does not make electricity, it only stores it. Just how well it performs that function depends entirely upon the care it receives.

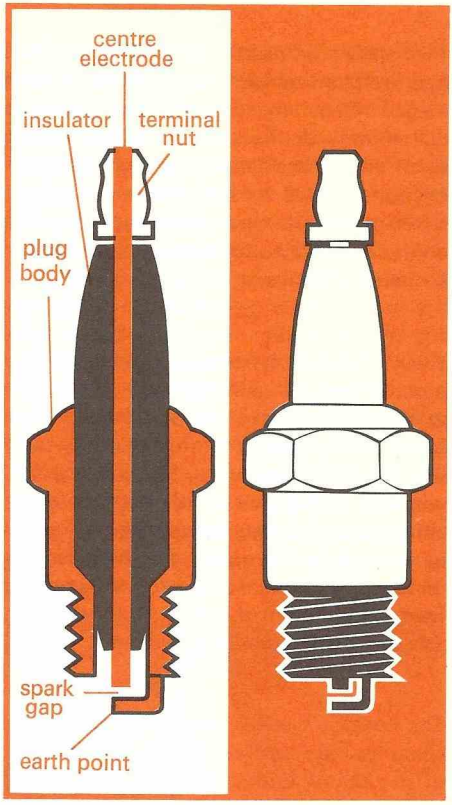
HOW YOU CAN HELP



Make sure that the battery terminals are clean and that connections are firmly made—a smear of petroleum jelly (vaseline) will guard against corrosion of the terminals—and keep the top of the battery dry and clean. Because a motor cycle battery has to be of compact size it contains a comparatively small amount of electrolyte (a mixture of distilled water and sulphuric acid) and so it is doubly important to check the level frequently. It should be just sufficient to cover the top of the plates. Inspect the level every week, or after every long run, and top up when necessary by adding more distilled water.

SPARKING PLUG

The high-tension current, carried by a stout cable from the coil or magneto pick-up brush to the insulated central electrode of the plug, causes a spark between the point of the electrode to the point (in some cases two or three points) on the metal outer body of the plug. This spark ignites the fuel in the combustion chamber.



HOW YOU CAN HELP

Use a plug of the correct type and length (see maker's handbook). Clean it regularly—every 3,000 miles on a four-stroke, every 1,000 miles on a two-stroke—with a wire brush; and re-set the gap if necessary, always by bending the outer point and never the central electrode. Many garages will clean and test plugs for you. Tighten the plug securely in its hole, but not so tight that the thread is strained—particularly if your machine has an aluminium head. It is far cheaper to replace the copper or copper-asbestos sealing washer to obtain a good gas-tight seal than to risk stripping the thread in the head. The leverage that can be exerted with the wrist, not with the whole weight of your body behind it, on the six-inch tommy-bar of a box spanner will seat the plug quite securely enough. Keep the outer surface of the insulator clean and dry and make sure there is a good, positive connection between the plug lead and the terminal. At one time sparking plugs were detachable for internal cleaning, now the majority are non-detachable or have an internal sealing washer of a complex shape which suffers damage if the plug is split. Plugs are not expensive and should be replaced every 10,000 miles, or even every 5,000 miles on a two-stroke or a high-performance machine.

8 lubrication

ENGINE LUBRICATION

Friction, Heat and Wear

When two surfaces rub against each other friction results, and this produces heat and wear. Consequently, by decreasing the friction, the heat and wear can also be reduced. This is the task of the lubricating oil. The oil forms itself into a film which keeps the two surfaces apart and, so long as the film is not overloaded to cause metal-to-metal contact, wear is virtually absent. But if an engine is run without oil it will be reduced to scrap in a few minutes.

Oil as a coolant

Where a continuous supply of oil is being pumped through bearings it acts as a coolant. This function is particularly important, because motorcycle engines cannot help but run at fairly high temperatures.

Viscosity

An important property of a lubricating oil is its viscosity. This is a measure of its resistance to flow, or its thickness. Oil becomes thinner (of lower viscosity) as it gets hotter. It is important, therefore, to choose an oil that will have a suitable viscosity at the normal operating temperature. The manufacturer's handbook will specify the most suitable grade of Castrol for every application.

SAE Numbers

The American Society of Automotive Engineers (SAE) has devised a number system for the classification by viscosity of engine oils. In this system, SAE 5W, 10W, 20W (in ascending order of viscosity) are thin oils, principally for winter use, since their viscosities are all defined as falling within a certain range at 0°F (−17.8°C). Continuing up the scale, SAE 20, 30, 40, 50 engine oils have their viscosities defined at 210°F (98.9°C)—nearly the temperature of boiling water. It is important to realise that the SAE classification refers only to viscosity, and gives no indication whatsoever of quality, or of an oil's suitability or lack of suitability to meet any given circumstances.

Multi-Grade Oils

A multi-grade oil is one for which the viscosity-temperature characteristics are such that the low temperature and high temperature viscosities fall within the limits of different SAE numbers. For example, Castrol GTX has a low temperature viscosity in the SAE 20W range and a high temperature viscosity in the SAE 50 range. This result is achieved by the use of an additive called a 'viscosity index improver'.

Because of the relatively small change of viscosity with temperature which is characteristic of multi-grade engine oils, they may be used throughout the year. On the coldest winter's day Castrol GTX, for instance, remains sufficiently fluid to be pumped instantly to the bearings when the engine is started; and the same oil retains sufficient body to lubricate the engine of a motorcycle coping with long journeys through hilly country or threading through the rush-hour traffic of a city on the hottest day of summer.

Resistance to oxidation

Engine oils are subjected to very high temperatures and, in lubricating the piston and cylinder walls, they become contaminated with the products of combustion. Unless checked, these substances would accumulate in the oilways, or they might be baked hard on to the ring zone of the piston. To reduce the process to acceptable limits, modern engine oils contain an oxidation-inhibiting additive. The oxidation-inhibitor used in Castrol engine oils is one of the most effective yet discovered.

Cleansing properties

The cleansing functions of an engine oil are performed by an additive known as a 'dispersant'. This dispersant 'captures' all solids while they are microscopically small and quite harmless, and keeps them in suspension in the oil. That is why a good quality engine oil, such as Castrol GTX, often rapidly becomes discoloured in service. It shows that the oil is doing its job properly. The most important secondary duty of a dispersant is that it neutralises acids. These sometimes form in the engine crankcase due to the condensation of combustion products which include water vapour and sulphur gases.

'Liquid Tungsten'

Wear occurs in an engine when the oil film, whose job it is to keep the moving surfaces apart, becomes unduly thin or breaks down altogether under extreme stress. Castrol research showed that under conditions giving rise to this 'thin film' (or as it is technically known, 'boundary' lubrication) certain special types of metallic compound would combine chemically not with the metal surfaces, but with constituents of another additive in the oil, to provide powerful localised protection precisely when and where it was needed. This reaction taking place by design entirely within the oil itself, involving only additives which are themselves wholly oil-soluble, was a novel concept. From the various possibilities presented, Castrol chemists sought the material which would give the maximum protection under the most extreme operating conditions. They found the answer in tungsten or, more specifically, in an oil-soluble long chain tertiary alkyl primary amine tungstate. This additive is exclusive to Castrol and is covered by British Patent No. 882,295. Its task whenever the stress at a given point in the engine becomes extreme, is to generate from within the oil itself an extra protective compound which in exhaustive laboratory and field testing has exhibited the most remarkable friction-reducing and anti-wear properties. It is called 'Liquid Tungsten' because it is a completely oil-soluble tungsten compound. There is no conceivable chance of it ever separating out or of producing undesirable deposits.

GEAR LUBRICATION

Although there are differences in the working conditions of oil used to lubricate an engine, where it encounters very high temperatures and becomes contaminated with the products of combustion, and a gearbox, where the oil is subjected to higher pressures but in a 'clean' environment, many motorcycle manufacturers recommend a Castrol engine oil for the gearbox. The additives in Castrol GTX, for example, are fully capable of providing complete protection against momentary overloading of the lubricating film between the gear teeth, and more recently the trend among manufacturers of the larger machines is to recommend an extreme pressure gear oil such as Castrol Hypoy.

TRANSMISSION LUBRICATION

The severest lubricating conditions on a car occur in the hypoid gears used in most back axles. And it is almost equally true to say that the most difficult component to lubricate adequately on a motorcycle is the counterpart of the car's shaft and back axle—the sorely abused chain which transmits the power from gearbox to rear wheel. Castrol Graphited Grease correctly applied to the rear chain will provide any necessary protection against wear. The primary chain, between engine and gearbox, also has its problems, although these can be largely overcome by frequent changing of the small quantity of oil contained in the primary chaincase.

LUBRICATING GREASES

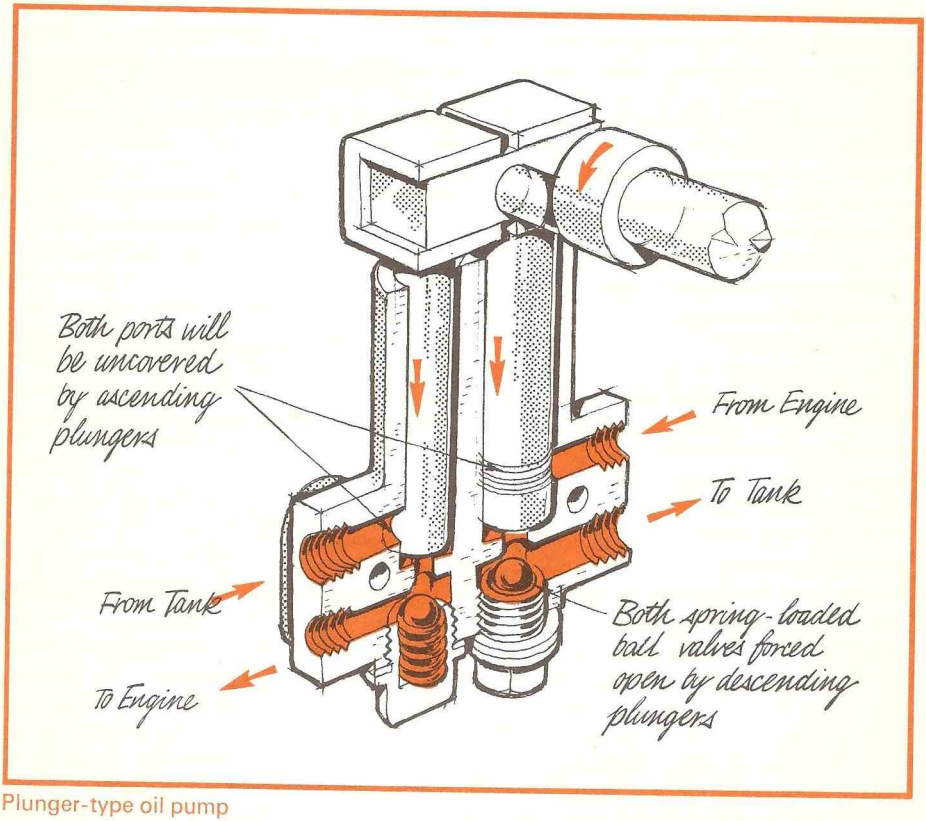
Their composition

Lubricating greases consist of mineral oils mixed with substances which, chemically speaking, are called 'soaps'. Included in the composition of these soaps are metallic elements such as calcium (lime), sodium (soda), or lithium, to mention only a few. Castrol LM, for example, is a grease made with a lithium soap. It is a general purpose grease combining good water-resistant qualities with a tolerance of high temperatures.

9 lubricating systems

DRY SUMP

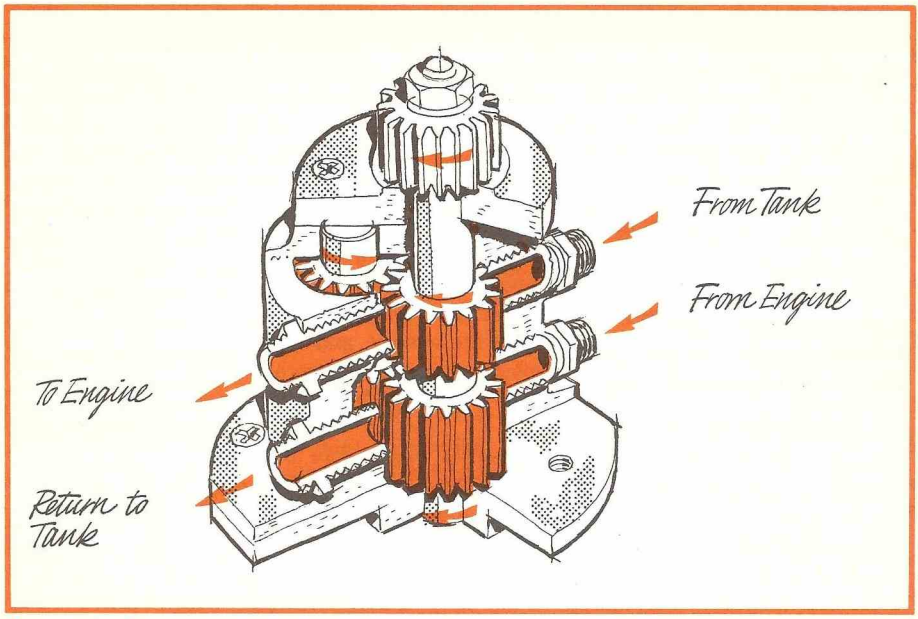
Most four-stroke motorcycle engines are lubricated on the 'dry sump' system. The oil is stored in a separate tank and is circulated by means of a pump to the main bearing surfaces. It returns by gravity to the bottom of the crankcase, or 'sump', and from there it is pumped back to the tank to repeat the cycle.



Plunger-type oil pump

HOW THE SYSTEM WORKS

Oil is fed by gravity from the tank to an engine-driven pump which distributes it under pressure to the main and big end bearings and to the valve operating gear. It returns by gravity to the bottom of the crankcase, from which it is drawn by a separate, larger-capacity pump—or in many cases by the scavenge side of the one double-acting pump which looks after delivery and return of the oil—and returned to the tank. A pressure release valve, usually of the spring-and-ball pattern, prevents the build-up of air pressure within the crankcase, and excessive frothing in the returned oil is often a sign that this valve is not functioning as well as it should—Cure: a sharp tap, administered with hammer and drift after the valve's 'breather' cap and spring have been removed, to re-seat the ball.



Gear-type oil pump

WET SUMP

The normal practice with car engines, the wet sump system is also to be found on some motorcycles, notably the Honda range and the flat-twin BMW. In this design, the oil is carried in a sump which forms the bottom half of the crankcase. A submerged pump delivers oil under pressure to the bearings and it then finds its way back by gravitity to the sump. Some engines, such as the Royal Enfield, have the oil reservoir forming part of the crankcase assembly, although separated from it by an internal wall. There are separate supply and return pumps, and an engine of this type looks as if it is of 'wet sump' design although it is in fact lubricated by the 'dry sump' system.

OIL FILTERS

Wire gauze filters at the tank end of the oil feed pipe and in the base of the crankcase guard against particles of metal or grit reaching the oil pump and causing damage. Many motorcycles also have a more elaborate filter, with a fabric element which can be removed and washed in clean petrol at the time of oil changes. Others have a centrifugal filter which can be dismantled and cleaned.

TOTAL LOSS

Early engines all relied on a system in which oil was delivered, drip by drip, by means of a hand pump, Timing of the drips was determined by the rider's ability to strike a happy medium between piston seizure (insufficient oil) and clouds of smoke from the exhaust (too much oil). This total-loss system became more effective as accurate mechanical pumps were developed and, for certain highly specialised engines—e.g. the Speedway JAP—it is still in use today.

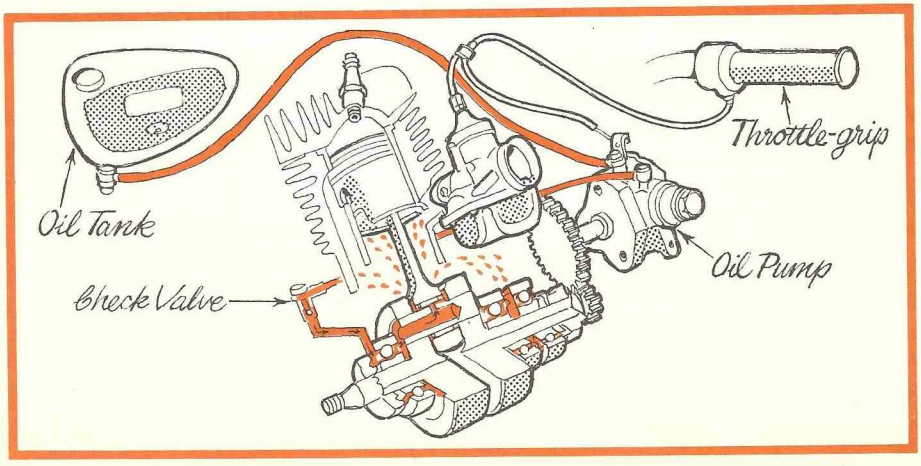
LUBRICATION OF TWO-STROKES

Because small two-stroke engines use crankcase compression, it is impossible to employ any form of lubrication—dry sump or wet sump—in which the oil is continually circulating. All must have total-loss systems and the majority rely on the very simple 'petroil' arrangement. This, as its name implies, is the mixing of oil with the petrol in the tank. When the "air/petroil" mixture is drawn into the crankcase and vaporised, the oil, having a higher viscosity than petrol, remains as tiny droplets which settle on all the fixed and moving components of the engine. After it has lubricated the revolving and sliding surfaces, the oil is burnt in the combustion chamber. All lubrication is, therefore, by clean oil which is being continuously renewed. The wise rider will always use a special two-stroke oil such as Castrol Two-Stroke Self-Mixing Oil, which has been developed to meet the special, and often exacting, requirements of two-stroke engines and which mixes automatically with all grades of petrol. Oil which has not become fully mixed will block a carburettor jet as effectively as water or dirt.

Refinements of the petroil system usually incorporate a throttle-controlled pump which supplies oil fed from a separate tank into the fuel intake in the form of a fine spray which varies in quantity according to the load on the engine. Sometimes, too, there is an auxiliary pump, which delivers oil to the most highly stressed parts of the engine, such as the long centre bearing on some parallel-twin designs, or the exhaust side of the piston on racing engines.

SEPARATE OILING

is nothing new. The aristocrat of two-strokes, the watercooled Scott, always had it, with a twin engine-driven pump—two pumps on some of the faster Scotts—to supply clean oil to the centrally disposed main bearings and, from there, to the crank assembly and pistons. It worked very well, especially if a very small quantity of oil was also added to the petrol, but the 'Posi-Force' system of the very fast modern Suzuki is an improvement on this, as it adds the merits of throttle-controlled delivery to separate supply oiling.



10 engine management

HOW COMBUSTION AFFECTS OIL

When Cold

When a gallon of petrol is burnt, chemical changes result in the formation of about a gallon of water, as well as carbon dioxide and carbon monoxide gases. While the engine is still 'cold' some of the water vapour condenses in the cylinder and seeps into the crankcase where it contaminates the oil. With the engine cold, the combustion processes are incomplete, and certain other substances blow past the piston into the crankcase. To counteract the harmful effects of these substances, oxidation-inhibitors and dispersants are used in engine oils. Without them, black, sticky deposits would soon collect in the sump and oilways, and deposits of gums and varnishes would become baked in the piston ring grooves.

When warm

As soon as the engine has reached its normal working temperature the exhaust gases leave the cylinder at a fairly high temperature, all water vapour exists as superheated steam, and most of it escapes harmlessly down the exhaust pipe to the atmosphere. With it go most of the other products of full combustion which are, in any case, comparatively harmless. When hot, the piston expands and fits more snugly in the cylinder, thus reducing the rate at which combustion products can blow by into the crankcase. However, since heat accelerates most chemical processes, any tendency for the products of combustion to attack the oil will be most noticeable on the piston. The oil film carries some of the heat to the cylinder wall, and more heat is conducted away by the oil mist in contact with the inner surfaces of the piston.

Benefits of 'balance'

Castrol engine oils are particularly effective in protecting the piston against contaminants even over thousands of miles of hot running. The 'balanced additive package' is able to inhibit the formation of high-temperature contaminants, as well as those which occur during 'cold' running.

CHANGING THE OIL

Why and when

Lubricating oil does not wear out but does inevitably become loaded with contaminants which reduce the effective concentration of important additives. If this process is allowed to continue for too long, the beneficial effects of the additives will be largely lost. Engine oil should always be changed at or before the recommended intervals to ensure that additive depletion cannot occur. Where severe adverse riding conditions apply, then more frequent oil changes are essential.

Flushing

After draining old oil from an engine, a residual film is usually left which, of course, carries a certain amount of impurities. Most of these can be removed by the use of Castrol Solvent Flushing Oil.

For flushing procedure see overleaf

The procedure is as follows:

1 When the engine is warm after a run, remove tank and crankcase drain plugs and allow oil to drain. Have a funnel ready in advance to catch the oil and guide it into a waste can, or you will have a messy cleaning job to do. Removal of the filler cap will speed the flow of oil.

2 Replace the drain plugs and approximately half-fill the tank with Castrol Solvent Flushing Oil.

3 With the machine on its stand, run the engine at a fast tickover, occasionally blipping the throttle to higher speeds, for about ten minutes.

4 Stop the engine. Repeat the draining procedure. Wash gauze filters in petrol (not paraffin) and allow to dry. Fabric filters should also be removed, washed in petrol, allowed to dry and then be soaked in engine oil before replacing; and they should be renewed at the mileage recommended by the manufacturer.

5 Replace the drain plugs.

6 Refill tank with the correct grade of Castrol to the maximum level marked on the tank or on the dipstick. Do not over-fill the tank, as it is essential to have some air space above the oil level.

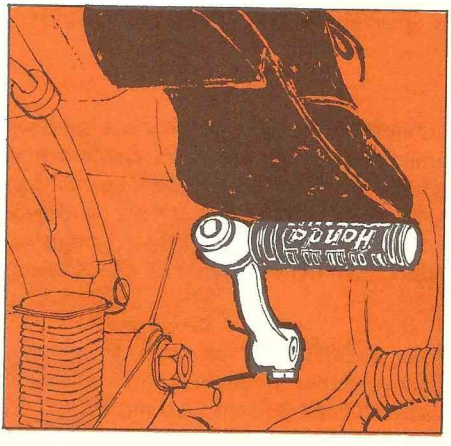
7 Turn the engine over several times with the kickstarter, without starting it. Then start the engine and, with the filler cap removed, check that the oil is circulating properly. It will come through the return feed in spasmodic jerks at low speeds but with the engine running faster, there should be a steady steam. Air bubbles are not an alarming sign, they are always present in the returned oil.

ON THE ROAD

Starting

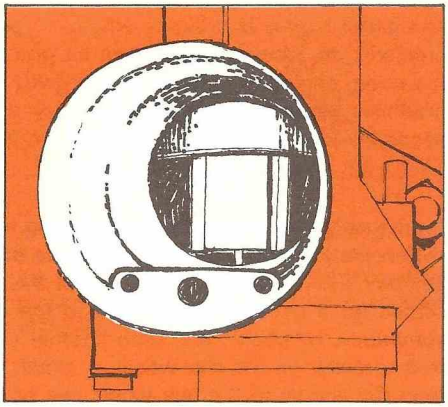
Starting from cold is the most critical time for an engine from the point of view of wear. Most of the oil will have drained off all the working surfaces, so during the first few revolutions only a thin residual film will be acting as the lubricant. This lasts until the pump can fill the oilways and replenish the bearings. The 'thinner' the oil the easier this is—one reason why multi-grade oils like Castrol GTX are popular.

The colder the engine, the more advisable it is, too, to turn it over two or three times with the kickstarter, before flooding the carburettor or attempting to start, to get fresh oil flowing from the pump through the oilways. And once under way, the engine should be kept turning over smoothly, not under heavy load, until it has reached normal working temperature.



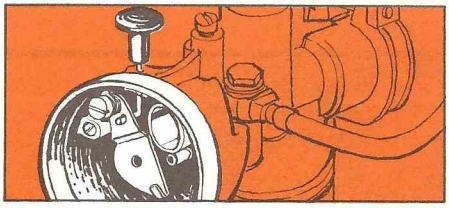
Use of the air slide

The air slide of a carburettor alters the fuel/air ratio to give a petrol-rich mixture for easy starting, the effect of this diminishing as the throttle is opened to raise the main slide, until at full throttle complete closure of the air slide accounts for no more than one increase in main jet size. So it follows that letting the engine tick over while still cold will result in more petrol condensing on the cylinder wall and washing off the residual oil film than is the case when it is allowed to turn over freely soon after it has been started. This does not mean that the air slide should be employed permanently to compensate for a weak carburettor setting: changes of slide, needle jet, needle position and main jet —in that order—will remedy the setting.



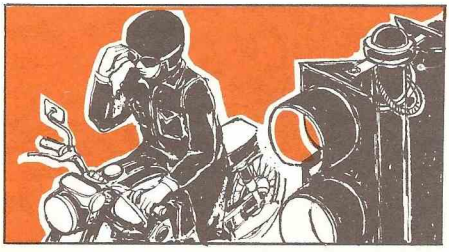
Strangler

Some carburettors, in most cases on small machines, have no air slide but rely upon a 'strangler' which blanks off the air intake to provide the petrol-rich mixture needed for starting. This device should be returned to the fully open position as soon as possible after starting, especially if it is fitted to a four-stroke engine which has no oil mixed with the petrol.



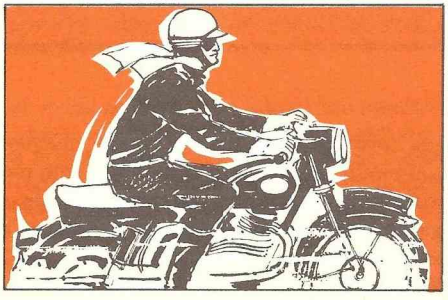
Start/stop riding

Many riders use their machines largely for start/stop riding—covering only very short distances between lengthy stops, such as going to and from work. This type of use is hard on the engine as it gets little opportunity to settle down to its normal working temperature. Such conditions will allow the oxidation-inhibitor and dispersant additives in the oil to be overwhelmed much more quickly than usual, so the oil should be changed more frequently.



Normal riding

Normal riding consists of starting and riding away with the minimum of fuss and loitering, then keeping the acceleration and speed well within the machine's capabilities. Ridden in this way, a motorcycle engine will achieve enormous mileages with very little wear.



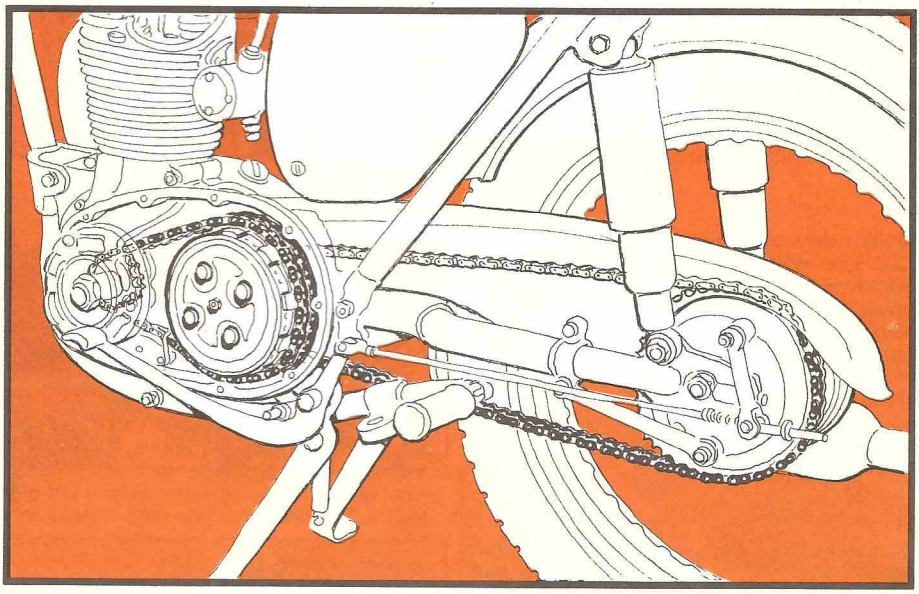
11 the transmission

WHAT IT DOES

The petrol engine is a highly efficient type of power unit for a motorcycle, yet special problems do arise in transmitting its power to the road. Unlike the electric motor and the steam engine, the petrol engine gives very little power at low revolutions, and only produces its best power within a very narrow speed range. A gearbox is, therefore, necessary to enable the engine to be run at its best power and speed.

THE TYPICAL LAYOUT

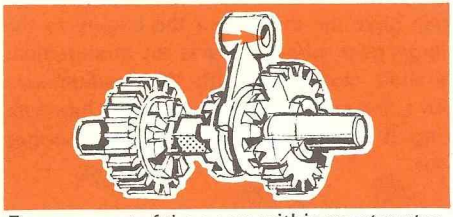
It took early motorcycle designers a long time to decide the best location for the engine within the limited confines of a bicycle frame; and as long again to find a home for a gearbox when it was recognised that this also was required. Most manufacturers have settled for a gearbox placed behind the engine, with primary drive by gear or, more commonly, by chain; and with another chain transmitting the drive from the gearbox to a sprocket on the rear wheel. A clutch (see Chapter 12) is needed so that the drive from the engine to the rear wheel can be interrupted; and while engine/shaft clutches are by no means unknown, and the clutch has sometimes been incorporated with the rear wheel sprocket, the usual layout is to have it on the 'input' shaft of the gearbox.



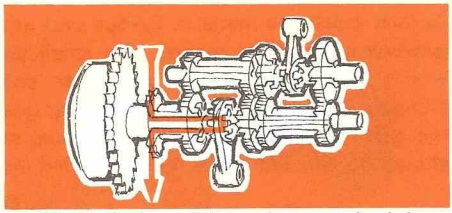
THE GEARBOX

The gearbox relies on the simple mechanics of toothed gearing—a small gear wheel will turn a larger wheel with more teeth more slowly but more powerfully: a large wheel will turn a smaller one faster but with less power. Thus, the power of the engine can be transmitted by the gearbox to give more power at less speed or more speed with less power at the rear wheel. There are other means of achieving the same objective, with expanding pulleys and a V-belt for example, and reference is made to these in Chapter 12.

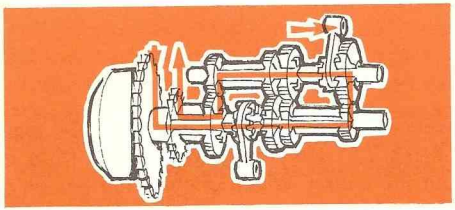
HOW A GEARBOX WORKS



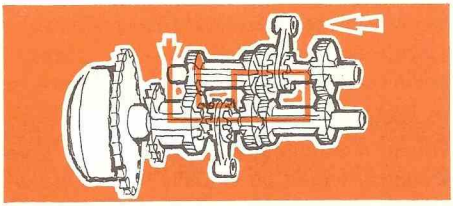
Engagement of the gears within most motorcycle gearboxes is effected by sliding dogs on the mainshaft and layshaft which are moved by selector forks, operated by a shaft or cam-plate which is itself moved by the ratchet mechanism behind the gear-selector pedal. The dogs engage with pinions on the face of the gear wheels and lock the selected wheels to their shafts so that the engine power is transmitted through them.



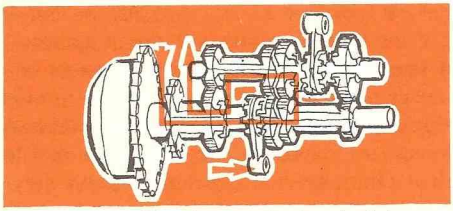
N. Neutral. No sliding dogs and pinions in mesh, so the intake sprocket runs light and no power is transmitted to the drive sprocket which forms a sleeve round the mainshaft.



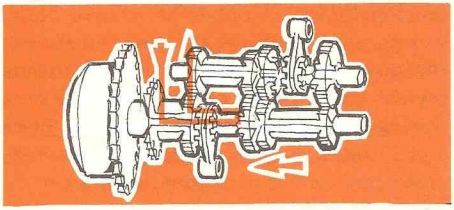
1 First gear. The highest ratio of engine speed to transmission speed to provide maximum power at the rear wheel.



2 Second gear. The dog is moved along the layshaft to engage second gear. The second dog, on the mainshaft, is still disengaged.



3 Third gear. The dog on the layshaft is now disengaged and the dog on the mainshaft moved to engage third gear.



4 Fourth or top gear. The dog on the mainshaft is now moved to engage top gear which forms an integral part of the drive sprocket, the effect being to lock the drive sprocket sleeve to the mainshaft to give direct drive.

HOW YOU CAN HELP

The gearbox will stand a remarkable amount of abuse so long as its lubrication needs are met. A few old boxes have to be packed with grease but nearly all in use today require an engine oil such as Castrol GTX or, where the makers specify an EP90 gear oil, Castrol Hypoy. It is important to maintain the oil level, so this should be inspected and topped up when necessary whenever the engine oil is being changed. Most gearboxes have a level plug and a separate filler plug : give the oil a minute or two to reach the level orifice, to avoid over-filling. Change the gearbox oil according to the manufacturer's recommendations, and if the gear selector mechanism is grease lubricated, apply grease gun or remove end cover and repack with grease, again according to the manufacturer's recommendations.

12 primary drive

GEAR DRIVE

Several machines made in Europe and in Japan have the drive from the engine to the gearbox effected by means of a small and large gear wheel. This is an arrangement which lends itself to the use of an engine-shaft clutch, as with the medium-size Hondas. On most machines employing gear drive, the engine oil also serves to lubricate the primary transmission and gearbox, making it doubly essential that oil changes should be effected at the recommended intervals.

OIL-BATH CASES

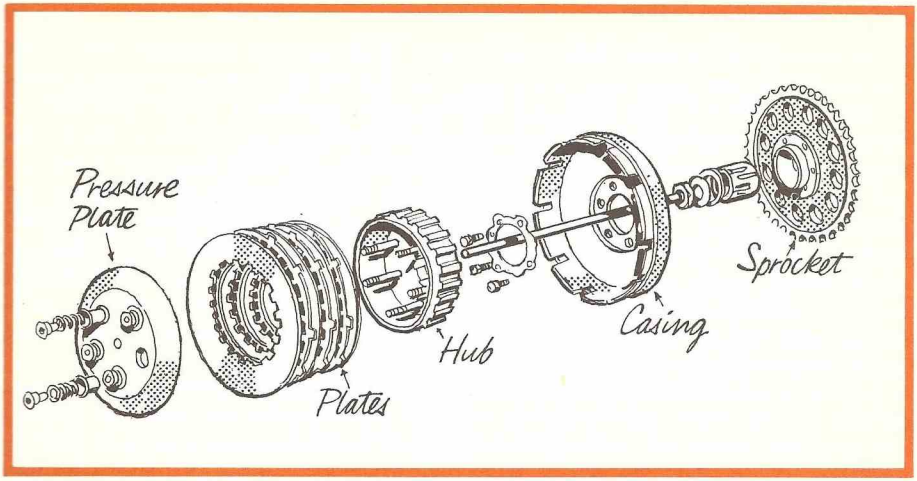
Roller chain remains the most popular method of transmitting the power from the engine to the gearbox, almost invariably with the chain enclosed in a case which provides for a small reservoir of oil. Because the chain is enclosed, its worst enemy is condensation. The best way of guarding against this is to change the oil and thoroughly clean the inside of the chaincase at regular intervals, being careful to refill it to the correct level with the grade of Castrol recommended by the manufacturer. A worn primary chain will not only make a smooth engine feel rough, it will also over-heat and by doing so, cause damage to the electrical windings of the alternator with which, to an increasing extent, it shares its case.

SHOCK ABSORBERS AND CLUTCH

Without some means of 'cushioning' the delivery of power from the engine to the rear wheel, a motorcycle would provide a very harsh and jerky ride. Moving off from a standstill would be virtually impossible without the clutch, which enables the engine's power to be fed gradually to the rear wheel via the gearbox. The illustration on the opposite page shows a typical motorcycle clutch.

The sprocket, driven by the engine through the primary chain, runs freely on a roller bearing located behind the splined clutch centre which is locked (usually by being keyed to the shaft) to the gearbox mainshaft. Forming a unit with the clutch sprocket, the outer drum is slotted and, by means of ears on the outer circumference of the friction plates which engage with the slots, causes these plates to rotate. Under normal driving conditions, spring pressure holds these plates in contact with interleaving metal plates which are toothed on their inner circumference, to engage with the clutch centre. So the drive goes from the chain, through the sprocket and the outer drum to the friction plates, frictional contact between these and the metal plates then transmitting the engine power through the splined clutch centre to the gearbox mainshaft. To enable the engine to run without rotating any of the internal mechanism of the gearbox, the spring pressure can be relieved by means of a pushrod, operated by a lever and cable, so that the friction and metal plates are no longer in contact. Progressive releasing of the lever produces progressively increasing contact between the two sets of plates, so that the engine power can be 'fed in' gradually to provide a smooth getaway.

The clutch is itself not a shock absorber, and continual slipping will cause over-heating and damage of the friction material. This should be borne in mind, even though quite remarkable advances have been made in clutch lining manufacture during recent years. Use the clutch for moving away from a standstill and for changing gear; but engage 'neutral' rather than stay in gear with the clutch disengaged when waiting at traffic lights.



Shock absorbers serve to take some of the harshness out of power delivered to the rear wheel by a beefy motorcycle engine. They are of two types. Particularly on big single-cylinder four-stroke machines, an engine-shaft shock absorber will often be found. This incorporates two face cams, one keyed or splined to the engine shaft, the other on the drive sprocket, maintained in contact with each other by means of a powerful spring so that a limited amount of over-riding occurs under sudden load. More common are the rubber cush drive shock absorbers incorporated in the clutch centre of many gearboxes, or in the back wheel.

HOW YOU CAN HELP

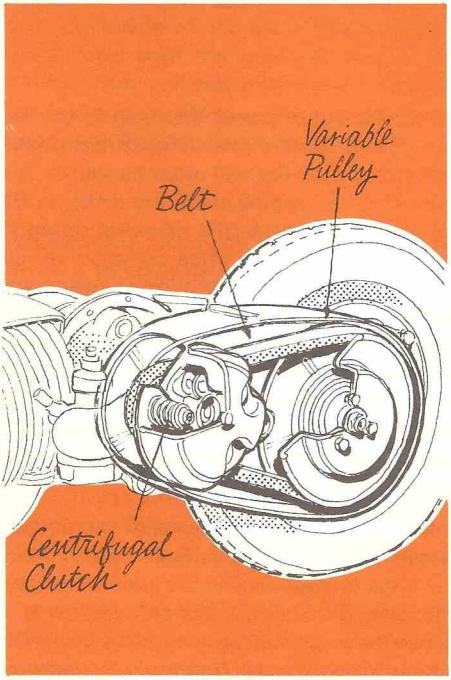
If your clutch is of the 'wet' type designed to run in oil—and with a modern machine it most probably is—make sure that the correct oil level is maintained in the chaincase. Remember, too, that the case contains a comparatively small quantity of oil: change it, and give the inside of the case a good clean at the same time, at least every 5,000 miles.

Assuming the clutch cable and operating arm are correctly adjusted, with the amount of free movement recommended by the manufacturer, clutch slip is due to worn, burnt or badly glazed linings; or weak clutch springs. Cork linings—not so common these days as they once were—are the most likely to suffer from burning, and the only remedy is to renew them. Glazed friction-material linings can be improved by very careful rubbing down but—watch it!—if you get them of uneven thickness the clutch will never work smoothly. The only sure way of checking the clutch springs is to compare them for length with a new one: if they have compressed appreciably (say 1/16-in) replace them.

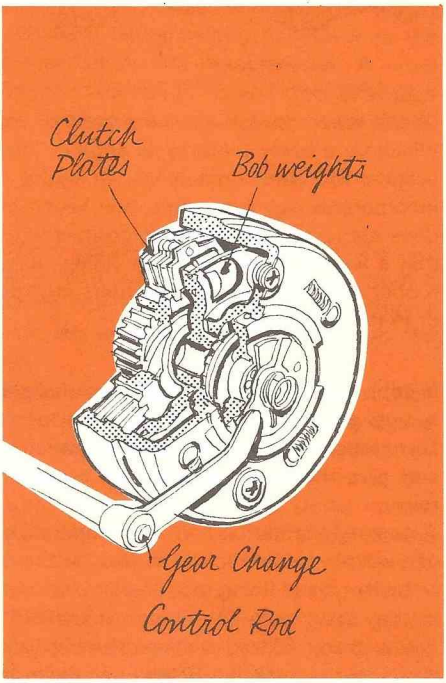
Clutch drag can be caused by nothing more serious than dirty plates (clean them with an old toothbrush and petrol, or fire-extinguisher fluid) or unevenly adjusted springs. The springs should be set so that the plates disengage and engage evenly all round, without tilting. A worn clutch push-rod, or more likely a worn ball between the push-rod and the thrust-pad on the clutch end-plate, will prevent the plates from freeing. Jerky clutch engagement could result from an ill-lubricated or damaged operating cable but could also be caused by wear on the outer 'ears' of the friction plates: with the clutch dismantled, they can be squared up with a smooth file.

PROGRESSIVELY VARIABLE

Some motorcycle clutches differ considerably from the type described. BMW and Velocette transverse twins have single-plate clutches similar to those commonly found on cars. The Vincent, now sadly out of production, employs a design with friction-surfaced shoes working inside a drum—rather like a brake. And many of the smaller Hondas have a centrifugal clutch which automatically frees itself as a gear is engaged and then transmits the drive progressively as the throttle is opened. The centrifugal clutch, designed to withstand considerable slipping without ill-effect, can in itself replace the gearbox as a means of varying the relationship between engine and rear wheel speeds, where the engine has only a modest power output. More popular as a simple form of primary transmission, however, is the V-belt and expanding pulley arrangement. One of the most successful examples of this is to be found on the Triumph T10 scooter, and on its predecessor the Tina.

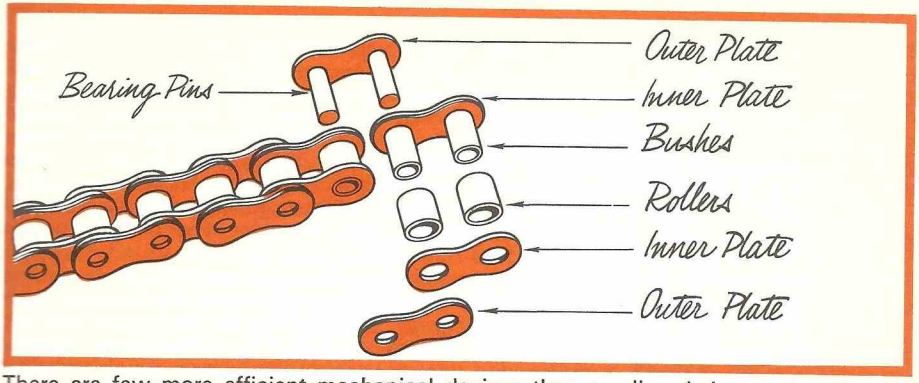


Triumph Tina belt drive



Honda automatic clutch

13 chains



There are few more efficient mechanical devices than a roller chain—*so long as it is correctly adjusted and lubricated.* In the case of the primary chain, already referred to, there is often a slipper tensioner to attend to adjustment and nearly always an oil-bath chaincase. The main enemy is condensation, which will cause rusting. Remedy: change the oil—and clean the case at the same time—every 5,000 miles or more frequently if condensation is a real problem. Some primary cases use the same oil as the engine, in others it will be found that a lighter grade, such as Castrolite, is more suitable. Where there is no slipper tensioner, and provision is made for adjustment by moving the gearbox back in its housing, the correct adjustment is $\frac{1}{2}$-inch movement up and down. This must be checked after the gearbox holding nuts have been re-tightened. Don't forget that primary chain adjustment will involve re-adjustment of the rear chain.

MAGNETO AND CAMSHAFT CHAINS

These run at higher speeds but under lighter load than the transmission chains. Generally, they enjoy the benefit of the same constantly circulating oil supply as the engine bearings, and they can be expected to give a long life. There are exceptions, such as the magneto chain on the old single-cylinder Norton—which relied on oil mist from the timing case passing through a small hole, but which could benefit from an application of Castrol Graphited Grease every 5,000 miles—and the long magneto chain on the vintage three-speed Scott, which was located directly beneath the carburettor and defied all efforts at lubrication.

CHAIN 'STRETCH'

As the pins and rollers of a chain wear, its overall length increases, which is why it needs periodic adjustment. When all available adjustment has been taken up, the chain can be shortened by removing two or three links with a rivet extractor, replacing them with one of the cranked or double-cranked links and a connecting link from a standard chain repair kit. It is false economy to keep a worn chain in service too long, however: a simple method of testing for wear being to attempt to bend the chain—gently—sideways after it has been removed and cleaned. A new chain will curve only slightly, a badly worn one will curve much more. Where a new chain is already kept in reserve for when it will be required, a better check can be made by comparing the 'stretched' length of the old one against that of the new. If it amounts to a complete link, throw the old one away. Most primary and camshaft chains are continuous and can only be replaced by removing one of the sprockets. Rear chains and some magneto chains are joined by a spring link: replace the spring with its closed end in the direction of travel.

THE REAR CHAIN

Few components of a motorcycle suffer more abuse than the rear chain. On a few, mainly European machines, it is lucky enough to be enclosed in an oil bath of its own. Generally, it is exposed to the elements and to road grit which, if the chain is not regularly lubricated, will soon work into the rollers and act as an abrasive. The sure way of prolonging the life of a rear chain is to remove it, soak in a bath of paraffin, allow to dry, and then to immerse it in warmed Castrol Graphited Grease. Used in town, when the weather is dry, a chain so treated will cover 2,000 miles without further attention. In wet weather, or when the motorcycle is ridden on dusty roads, regreasing should be repeated every 1,000 miles. Better, perhaps, than this rather messy procedure is the provision of a really efficient drip-feed oiler. Some manufacturers use oil mist from the crankcase breather for this purpose, allowing it to discharge into the primary chaincase and with the supply from there to the rear chain metered by a needle valve: it is a rather hit-and-miss arrangement, tending to provide too much or too little oil. Better, if you are at all handy with tools, is to make up a small separate oil tank from an old screw-cap tin. It needs a tap inserted into its base, to feed via an Amal jet holder and No 20 jet to a rubber pipe which is located so that it just wipes the lower run of the chain close to the drive sprocket. The tap must of course be turned off a mile or so before the end of the journey to avoid an oily mess on the garage floor but, with such an attachment, using Castrolite as the lubricant, a rear chain can have a remarkably long life and needs only very infrequent adjustment.

Adjustment of the rear chain is obtained by moving the rear wheel backwards or forwards, sometimes by means of cycle pattern adjusters or adjusting screws that push instead of pull on the spindle, and sometimes by snail cams. Since rear springing has become almost universal, it is impossible to recommend a hard-and-fast setting for chain adjustment but only to suggest that the maker's handbook is consulted. As a rough guide, $\frac{3}{4}$-inch slack at the midway point between the sprockets with the rear wheel on the ground and the rider in the saddle should be approximately correct. Providing the front and rear wheels are in alignment and care is taken to turn each adjuster exactly the same amount, alignment will not be affected. If there is any doubt about it, however, check by the method described in Chapter 16.

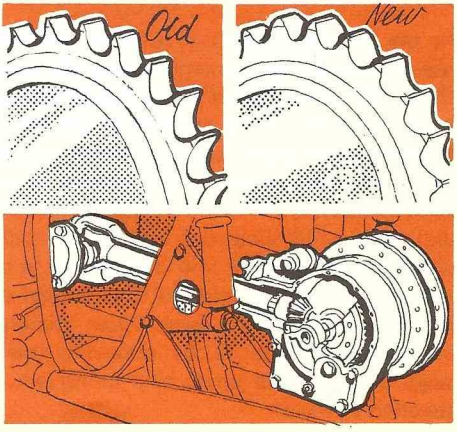
One final check: re-tightening the wheel spindle nuts may reduce the slack in the chain.

SPROCKETS

If you look after the chains, the sprockets will last a very long time. An over-tight chain, an ill-lubricated one or a badly worn one, on the other hand, will soon cause wear of the sprocket teeth. A glance at the diagram will show what the contour of teeth on a sound sprocket should look like and how they can become hooked through wear. There is no practicable way of repairing a damaged sprocket: replacement is the only answer.

SHAFT DRIVE

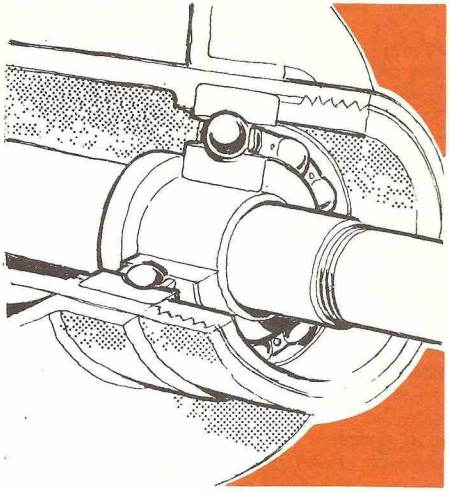
Almost from the beginning of motorcycles, there have been a few machines that employ shaft instead of chain drive to the rear wheel. The worm or bevel gearing that transfers the drive from the propeller shaft to the rear wheel is expensive but, correctly adjusted and lubricated, it will last as long as any component of the machine. Correct lubrication of this type of gearing is important, so follow the manufacturer's recommendation explicitly.



14 wheel hubs

WHEEL BEARINGS

often have provision for lubrication by means of a grease nipple, and sometimes there is an oil-cap located on the hub between the spokes. Because of the near-impossibility of checking just how much lubricant has been applied, it is probably safer to rely upon removing the wheel and re-packing the bearings with Castrol LM Grease every 10,000 miles. This will ensure that they are adequately lubricated, and at the same time ensure that grease does not work through to the brake linings. When re-packing wheel bearings with grease, remember that too much grease can be as harmful as too little. If all the available space is filled with grease, there is no room for it to expand under the churning effect of the rotating bearings. This can cause even a high melting point grease to break down and discharge its oil content onto the brake linings.



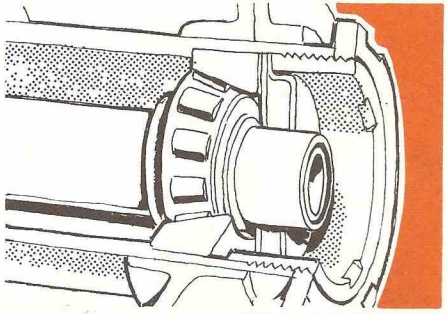
Non-adjustable bearing

NON-ADJUSTABLE

bearings (usually of the caged ball pattern) are used for the majority of motorcycles, but, in some cases, with a caged roller bearing on the drive or brake side of the hub and a caged ball bearing on the other. They have a very long life but should be replaced when there is more than $\frac{1}{8}$ inch side-play measurable at the wheel rim.

TAPER ROLLER

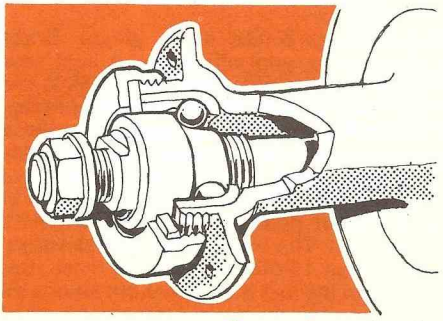
bearings allow for adjustment, which should be made so that there is just appreciable movement—but insufficient to be measurable—at the wheel rim. Although this side play should not be allowed to exceed $\frac{1}{8}$ inch without re-adjusting the bearings, they should never be over-tightened.



Taper roller bearing

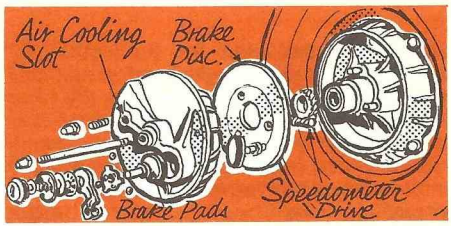
CUP AND CONE

bearings, with un-caged balls, are familiar to anyone who has owned a bicycle. Adjustment calls for sensitive use of spanners and, even more than with taper rollers, they should never be over-tightened or the races will become pitted. Maintain adjustment so that there is between $\frac{1}{16}$ inch and $\frac{1}{8}$ inch side movement at the wheel rim; and inspect the races for wear each time the bearings are re-packed with grease. Whatever the type of bearing used, it will almost certainly have some form of grease-retaining washer which also serves to prevent the ingress of water and dirt. It is advisable to renew these washers each time the bearings are re-lubricated.



Cup and cone bearing

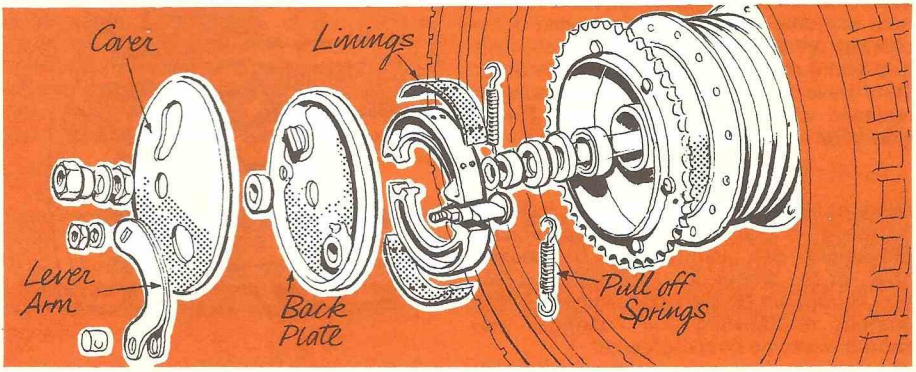
15 brakes



Disc brakes, in which caliper-operated friction pads operate against either side of a disc that rotates with the wheel, are still rare in the motorcycle world, but are now gaining popularity in the racing field. They are also fitted as standard within the front hub on many Lambretta scooters. Basic advantages are that disc brakes are not prone to brake fade due to better heat dissipation. On some of the more sophisticated disc brake systems hydraulic pressure is used, instead of the conventional operated cam, to actuate the disc pads. These systems also employ self-adjusting disc pads. The advantages of hydraulically operated brakes are that they are more efficient, greater braking pressure is exerted, and less maintenance is required.

Drum brakes, which are almost universal, have stationary shoes that can be pressed against the inside of a revolving drum attached co-axially to the wheel. Pressure on the handlebar lever or brake pedal pulls on the cable or rod, so moving a fulcrum lever which carries a cam on its pivot shaft. The cam, located between the two shoes, moves them outward until they make contact with the drum, a strong spring serving to pull them away from the drum as soon as pressure on the pedal or lever is relaxed.

In its simplest form the internal expanding brake, as this type of component is described, has two shoes pivoting on the same point and with a single cam operating against the opposite ends of the shoes. An improvement is to have separate pivot points for each shoe, so that more of the lining surface comes into contact with the drum. And a further sophistication is to have a separate cam and pivot point for each shoe, so that there are two leading shoes instead of one leading and one trailing.



HOW YOU CAN HELP

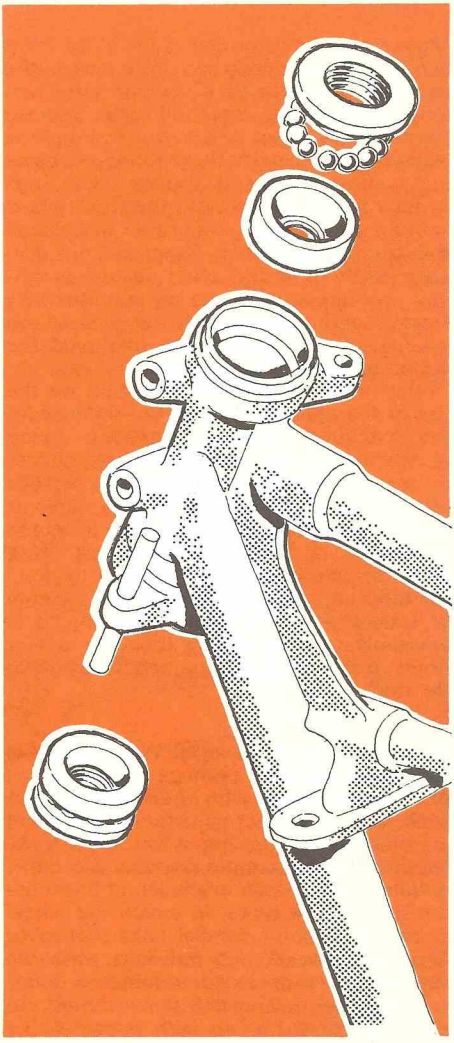
Brake linings dislike oil or grease. Brake operating mechanisms must be lubricated if they are to work efficiently. A light smear of high melting point grease—Castrol LM Grease—on the cams and pivot points inside the brake drum every 3,000 miles plus no more than a short stroke on the greasegun at the nipple on the fulcrum lever every 1,500 miles is all that is needed for the actual brake assembly. The pins that link the rear brake rod to the pedal and the fulcrum lever need a single drop of oil—Castrol Everyman—once a week, or after each run in wet weather; and the same applies to the pin connecting the front brake cable to the fulcrum lever. Use a greasegun regularly on the pivot point for the brake pedal: that is one point where over-lubrication will do no harm. The life of brake linings varies enormously but, on most machines, it should be between 15,000 and 20,000 miles. Because the brakes are so vital to safety—quite apart from the fact that with worn linings there is always the risk of rivets doing permanent damage to the drum—it is as well to renew the linings too soon rather than too late.

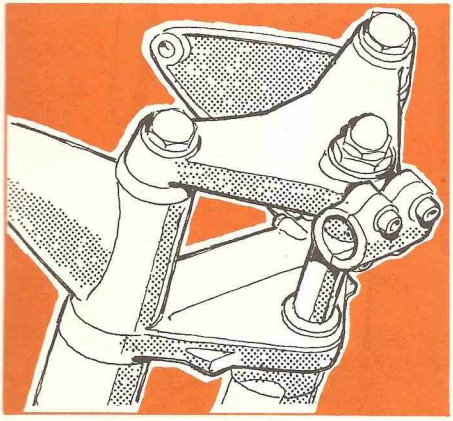
A competent amateur mechanic can re-line his own brake shoes; but as it is neither difficult nor expensive to have them re-lined professionally, that is probably the better course.

16 the frame and steering

STEERING HEAD

Adjustable bearings are provided for the steering head. They are usually of the cup and cone pattern although taper roller bearings are also used. With a new machine these may require adjustment after the first hundred miles or so, after that it should be needed only occasionally. Check for excessive play with the machine on its centre stand so that the front wheel is clear of the ground. Grasp the front forks firmly, in the region of the bottom yoke, and attempt to pull them up and out: if appreciable play can be felt at the steering head, adjustment is called for. The method of effecting this will vary from machine to machine, so the instruction book must be consulted, but a general rule is that the bearings should be tightened down so that the steering can still be turned although not quite freely, and the adjusting





nut then slackened rather less than 1/6th of a turn (one face of the hexagon) and held in that position while the lock-nut is tightened. Top and bottom bearings should be lubricated via the nipples provided, with Castrol Heavy Grease, every 2,000 miles. Over-tightening of the steering will cause pitting of the races which should, in any case, be inspected for wear every 20,000 miles or sooner if poor steering cannot be traced to other more likely faults. When renewing cup and cone bearings, remember that there should always be some space—roughly the width of one ball—between the balls.

This Chapter continues overleaf

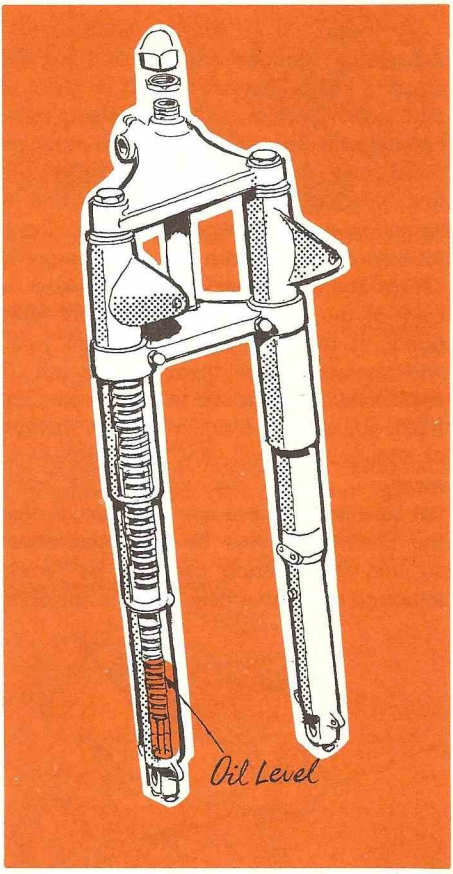
FRONT FORKS

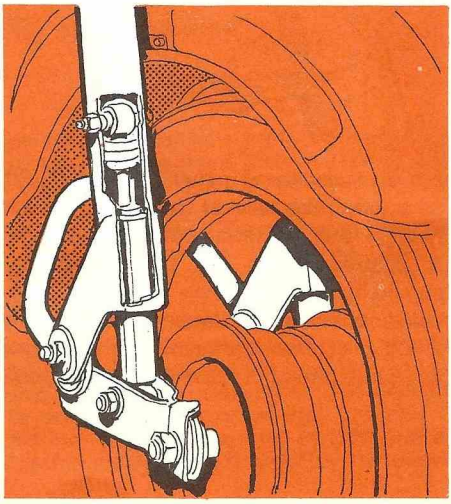
Most motorcycles on the roads today have some form of telescopic front forks, the essential ingredients of which are two long parallel tubes, attached to the steering head by the upper and lower fork yokes; sliders working inside these tubes and bearing against long coil springs, with lugs at their lower end to hold the front wheel spindle; and hydraulic dampers to balance the spring movement. There is considerable variety of design, and two-way damping—developed under racing conditions by Norton and subsequently introduced on road machines—has greatly improved the action of some of these forks.

"Teles" rely for efficient operation on the use of the right quantity of the right oil for the hydraulic damping, Castrolite being recommended for most of them. Unless oil seals need renewing, or there is obvious leakage from some other source such as the filling orifice, it should suffice to attend to the oil at 5,000 mile intervals. With most designs it is then necessary to drain the forks and refill with exactly the quantity of Castrol specified. When draining, it is advisable to operate the forks for a few times to remove all the oil before replacing the drain plug.

OTHER TYPES

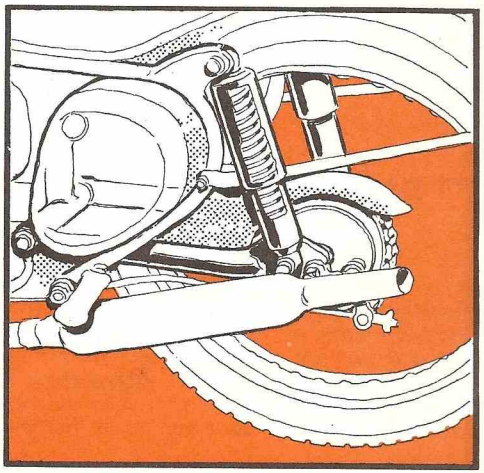
The once almost universal Webb girder is out of production, perhaps to the regret of some old-timers who knew how to keep such forks in correct adjustment, but there are other, newer designs which differ quite radically from the more popular telescopic pattern. Best known examples of these are the bottom-link types, in which the wheel is carried in short parallel links that pivot from the base of long fork legs, with the springs either enclosed within the forks, as with the trailing-link Ariel design, or anchored to them, as with some of the Greeves models employing that company's forward-link forks. One of the advantages claimed for bottom-link forks is that they reduce unsprung weight to a minimum.





REAR SUSPENSION

When rear springing became fashionable—which is no more than two decades ago—it was mostly contrived by mounting the rear wheel in fork lugs which could slide up and down on sprung plungers. Movement was limited but what there was of it was at right angles to the chain line. This meant that there had to be a compromise setting for chain adjustment, somewhere between too tight at the limits of fork travel and too slack at the midway position, and imposed extra stress on that already ill-used component. So plunger springing gave way to the swinging fork, which has its pivot point close to the gearbox and therefore moves through much the same arc as the chain. Coil springs and hydraulic dampers control fork travel, the spring and damper being combined in one unit in many instances. Such units are sealed, so there is no question of checking oil level or topping up. Provision is sometimes made, by means of a cam adjuster, for varying spring tension according to the load carried. Otherwise, the only attention called for is greasing of the fork pivot bearing where a grease nipple is provided (in some cases, the bearing is of a type which requires no lubricant). Pivot bearings and spring units should need replacement only after very considerable mileages have been covered.



ALIGNMENT

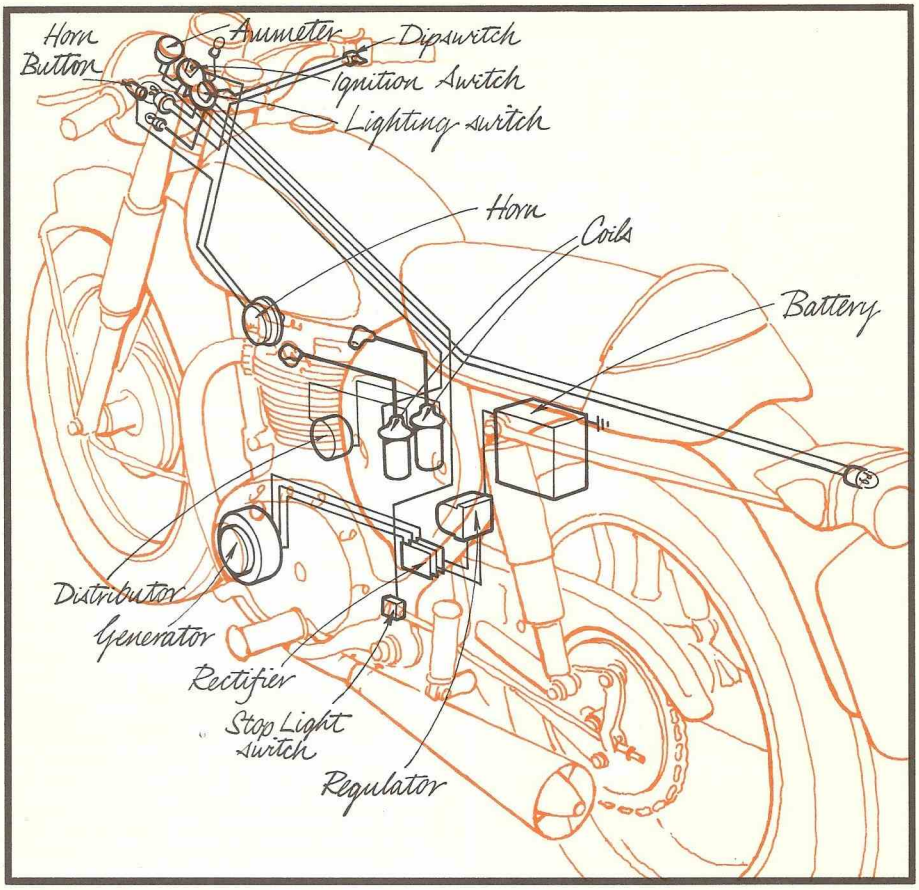
Without full workshop facilities it is impossible to check frame or fork alignment accurately; but unless the machine has been in an accident neither should be suspect. Wheel alignment can be checked if the wheels themselves are true and the tyres are properly fitted. A taut piece of string held so that it rests against the wall of the tyre at the rear and front of the rear wheel should also rest against the wall of the tyre and front of the front wheel . . . if both tyres are of the same section. Where the front tyre is of smaller section, there should be exactly the same gap between string and tyre at the front as at the rear of the front wheel.

Adjustment of the rear wheel by means of the chain tensioners should be carried out to bring the wheels into line. Don't forget to see that the chain is in correct adjustment when you have finished doing this.

A mis-shapen wheel will upset this alignment check. Use of a spoke nipple key will bring a wheel back to true, if you have a flair for wheel-truing. But however easy the handbooks may make this job sound, it is something of a craft and if spinning the wheel and checking the truth of its rim against a pointer shows that it is far from true, trundle it round to an expert, like the local cycle repairer, to have its shape restored.

The tyre should be seated in the rim so that the thin beaded line—moulded on the cover for this express purpose by its manufacturer—is equidistant from the edge of the rim all the way round.

17 the electrics

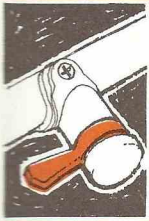


THE GENERATOR

Very few new motorcycles now employ a separate dynamo for charging the battery or supplying current direct to the lights and other electrical components. The flywheel magneto or alternator and rectifier fill a dual ignition and lighting role. But there are still some separate magneto machines in production, and sufficient older ones still in use, to justify reference to the dynamo. It requires little attention apart from occasionally cleaning the commutator and carbon brushes with a clean non-fluffy rag soaked in petrol, plus a single drop of thin oil on the commutator end bracket every 1,000 miles. Output from the dynamo is controlled by the cut-out and regulator unit, a component which can be adjusted by a knowledgeable electrician who knows the correct settings, but which its makers, perhaps wisely, seal against tampering by the inexpert. Damaged leads or loose or dirty connections are, in fact, much more likely to be the cause of a lighting failure than are the dynamo or the cut-out/regulator unit.

HEADLAMP

Nearly all modern motorcycles have a 'pre-focussed' headlamp, in which the bulb holder is integral with the reflector. Adjustment can be made only by altering the angle of the beam vertically, by slackening the headlamp holding screws and pivoting it up or down.



DIP SWITCH

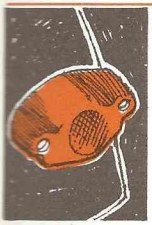
The headlamp bulb has two filaments, one for normal riding and the other giving a dipped light for use against oncoming traffic or for poorly lit town streets. Considerable advances have been made in dip switch design but, exposed to the weather as they inevitably are, even the best of them tend to become faulty after long use. As a black-out between 'head' and 'dip', or vice-versa, can be highly dangerous, replace the switch as soon as it becomes suspect.

PILOT LAMP

Because the pilot lamp gives only limited illumination, it is well to check that it is actually working if you switch on while riding home in the evening. It is easy to do this by reaching forward and placing the hand in front of the lamp. Always carry a spare bulb.

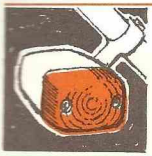
REAR LAMP

Again, if you are riding at dusk, check that the rear lamp is working instead of simply assuming that it is. And, again, carry a spare bulb.



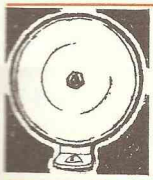
STOP LAMP

Many machines have a twin-filament bulb which serves as a combined stop and tail lamp. Others have two separate bulbs. In either case the brighter light is the one that should come on when the rear brake is applied. If it fails to light, suspect a dirty switch or broken lead before replacing the bulb; if it stays on when the brake is released, try the effect of a little Castrol Everyman oil on the exposed moving parts of the switch.



INDICATORS

Some Japanese machines have traffic indicator lights as standard equipment. Proprietary sets can also be bought for fitting to other machines. They are not self-cancelling, so if you use them it is important to remember to cancel them manually.



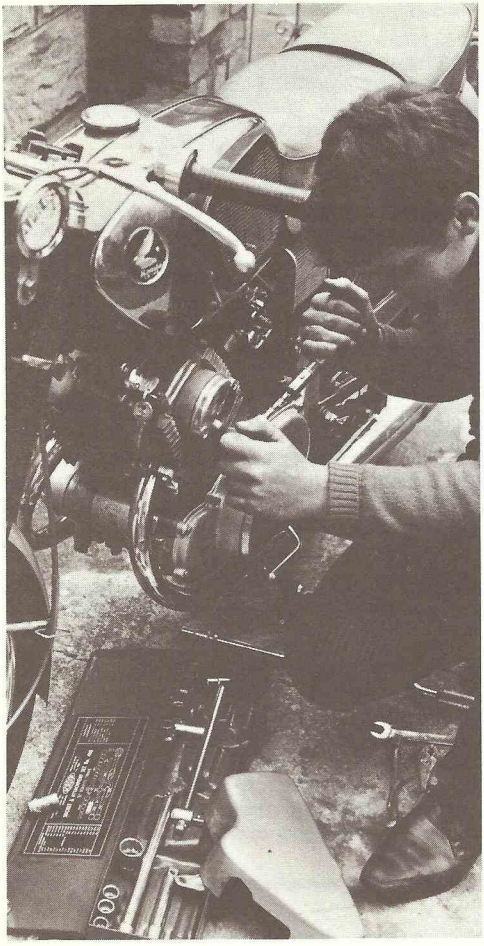
HORN

Few motorcycle horns are really effective instruments; and those that are may place quite a heavy load on the battery. Good connections, at the horn button and to the horn itself will help to keep it working. So will a horn mounting which insulates it, as far as possible, from vibration and jolting.

SPOT AND FOG LAMP

With the 12-volt equipment which is becoming more and more popular it becomes possible to supplement the standard lighting with fog and spot lamps. The best mounting for these is on a double-loop 'crash-bar' attached to the front down tube of the motorcycle.

18 your responsibilities



A STITCH IN TIME

The main aim of regular maintenance is to prevent troubles occurring on the road, and to rectify small faults before they develop into anything serious and expensive. The time, and the few shillings spent on regular maintenance, will be amply repaid in terms of reliability and peace of mind. The tasks and intervals suggested here are intended as a guide. The actual timetable for maintenance will depend upon the manner in which the motorcycle is used and will also be conditioned by the individual manufacturer's instructions. The importance of referring to the handbook published by the factory cannot be over-stressed, for it will cover in detail all points requiring attention. For those who have the ability to undertake more extensive work on their machines, it will be found that quite elaborate workshop manuals can also be purchased from most manufacturers.

DAILY *Before each journey* *Near end of journey* *After each journey*	Check tyres, rear chain and control cables visually. Clean lamp glasses. Free clutch by kicking over with lever held out. Turn on chain oiler (if fitted). Turn off chain oiler. Turn off petrol (with petroil lubricated two-stroke). Remove any small stones embedded in tyres. In wet weather, apply Castrol Everyman Oil to control cables and brake linkage. Wipe moisture from ignition cables, sparking plug(s) and contact-breaker cover.
WEEKLY *or at 250 miles*	Clean machine: the only sure way of discovering whether any nuts or screws have worked loose—tighten, *don't over-tighten*—where necessary. Check engine oil level, tyre pressures, rear chain adjustment. Lubricate cables. Top up battery, if necessary, and wipe battery top clean *and dry*. See that all lights are working.
MONTHLY *or at 1,000 miles*	Clean sparking plug and check gap, also contact-breaker gap. Clean filter(s) in petrol feed to carburettor. Check and, if necessary, adjust carburettor slow running after other items have been attended to. Check chain and control adjustments. Check tappet adjustment. Remove, clean and re-lubricate rear chain where no oiler is provided. Adjust brakes. Change engine oil (wet sump engine).
QUARTERLY *or every 2,500 miles*	Change engine oil (dry sump engine). Clean (or replace where advised) air and oil filter elements. Decarbonise silencer of two-stroke. Check gearbox oil level. Change primary chaincase oil. Remove wheel spindles and replace after lightly greasing; at same time check wheel bearing adjustment and lubricate brake bearings.
HALF YEARLY *or every 5,000 miles*	Decarbonise two-stroke engine (pay particular attention to exhaust port) and fit new piston rings and sparking plug. Grease and adjust steering head bearings and foot gear-change mechanism. Re-pack wheel bearings with grease and lubricate speedometer drive box. Strip carburettor and clean, replacing all washers that are disturbed. Check specific gravity of battery acid.
YEARLY *or every 10,000 miles*	Decarbonise four-stroke engine, fit new piston rings, sparking plug(s) and valve springs. Change gearbox oil. Renew h.t. lead(s) to sparking plug(s). Renew any lamp bulbs that have become badly blackened.
NOTE	The above routine maintenance suggestions are no more than a guide. Your first authority must be the official handbook issued by the manufacturer of your machine. Most motorcyclists enjoy working on their machines but if you are one of those who knows that his enthusiasm is not quite matched by his ability as a home mechanic, it is possible to arrange for regular servicing to be carried out by one of the manufacturer's appointed dealers. For quick reference to lubrication and maintenance points we produce Castrol lubrication charts for certain popular makes and models (see page 48). These lubrication charts are available free of charge from: Publicity Division, Castrol Limited, Marylebone Road, London, N.W.1.

19 tracing faults

KNOWING WHAT TO DO

Even the best maintained motorcycle may occasionally break down or—even more irritating—fail to start. Unless some mechanical component has suddenly broken, and this will usually make itself unmistakably evident, a loss of power or refusal to start must be due to a defect in either the electrical or fuel supply. Only very rarely will it be both simultaneously, although a third cause (of progressive rather than complete failure) may be a mechanical component getting out of adjustment. So, assuming that nothing vital like a connecting-rod has broken, tracing the cause of the trouble should take no more than a few minutes. Before describing the fault-finding routine, there are a few points worth mentioning that catch thousands of experienced riders every year.

The first is that over-flooding of the carburettor can wet the sparking plug so that a spark no longer occurs at the electrodes. A cure that often works is to turn off the petrol and kick the engine over as fast as possible on full throttle. Another is peculiar to two-strokes: over-flooding may over-fill the crankcase, so that a combustible petrol/air mixture no longer gets transferred to the combustion chamber. Cure?—there is a drain plug at the base of the crankcase: remove it and kick the engine over several times. Condensation, inside the contact-breaker cover or the plug terminal or even on the plug body, is another old snag—particularly on a machine which has been left standing in the rain or put away for the night without being wiped down after a wet ride. A clean, dry cloth will remedy this source of lost performance. With these points disposed of, the recommended fault tracing drill can be followed. You will not have to waste time checking laboriously through every part of the electrical and fuel systems—instead you go in a smooth, logical way through both systems until the trouble is located.

1

1. Petrol tap switched on, ignition switched on—use kickstarter.
2. If machine has coil ignition, check battery condition by switching on headlamp. If battery is flat, switch to Emergency Start and try again. If engine still fails to start, or if machine has magneto ignition, move to STAGE TWO.

2

1. Check fuel supply. If no sign of moisture around float tickler after it has been depressed, move to STAGE FOUR.
2. Petrol dripping from carburettor—suspect over-flooding. Switch off petrol, open throttle, open air lever or strangler—kick vigorously several times. If engine does not fire, move to STAGE THREE.

3

1. Remove sparking plug. If wet, dry with clean cloth. If oily, dry by soaking with petrol and burning off—well away from machine! In either case, operate kickstarter vigorously while plug is removed.
2. Dry, clean plug—attach h.t. lead and hold plug body firmly against cylinder fins while operating kickstarter. There should be a vivid blue spark across points.
3. No spark, or weak spark—check plug gap. With a two-stroke—especially if it has been running erratically before stopping—look for "whiskering", a build-up of metal between the electrodes which can be removed with a knife or nail-file.

	4	Still no spark. Check h.t. lead for chafing against cylinder. Make sure there is no moisture in the h.t. pick-up. Check battery and coil leads.
	5	Still no spark. Check contact breaker gap. A piece torn from a cigarette packet or a visiting card will serve as a rough check on gap, and will at the same time serve to clean c.b. points.
	6	Still no spark. Suspect faulty condenser or coil, either of which calls for replacement and not repair.
	7	Clean plug, good spark, but engine will not start—move to STAGE FOUR.
4	1	Good spark but engine will not fire, petrol reaching float chamber—probably choked jet. Remove carburettor base plug, check for blobs of water or rust (and oil if it is suspected that a two-stroke has just been refuelled incorrectly). If any of these are present, remove carburettor float bowl and clean. Remove main jet and clean by blowing through it (do not poke wire through it as this will cause irreparable damage). Re-assemble and machine should start.
	2	If no sign of moisture around float tickler after it has been depressed, check for a fuel restriction between fuel tank and float chamber. This may be a blocked fuel filter.
	3	Carburettor flooding. Cause may be a stuck or worn float needle, or a punctured float. There is no cure other than replacement, but a get-you-home dodge is to switch petrol on momentarily, then off, repeating this drill every time engine threatens to stop. One other cause of persistent flooding is that the carburettor has been re-assembled with float level higher than jet level (this cannot happen with Amal Monobloc or later carburettors or with Villiers carburettor), or the carburettor has been mounted at the wrong angle, thus causing the float to foul the side of the float chamber.
	4	Engine starts but stops after short interval—could be blocked filter in petrol tap (remove and clean) or blocked vent hole in tank filler cap (a strand of wire can be used to clear this).
	5	Petrol supply satisfactory, spark satisfactory, but engine will not start or runs erratically. Proceed to STAGE FIVE.
5	1	Earlier tests carried out with negative result. Look for:—
	2	Loss of compression. Could be a blown gasket, allowing the compressed mixture to escape. This will need replacing. Could be faulty tappet adjustment on a four-stroke—check and re-set if necessary. Could be broken valve spring or sticking valve on four-stroke—no roadside cure. Could be broken or stuck piston rings on either two or four-strokes—again, no roadside cure.
	3	Slipped ignition timing. This can be caused by a contact-breaker unit becoming loose, which can be remedied at the roadside; a magneto sprocket coming loose, which can again be remedied; or a flywheel magneto coming loose, which is difficult to remedy outside a workshop as a special hammer-tight spanner is required. A rough check for ignition timing is to use a pencil inserted through plug hole to measure position of piston. If contact-breaker points are just opening when piston is ¼ inch before the top of its travel (on firing stroke, both valves closed, on a four-stroke) engine should be timed sufficiently accurately to provide get-you-home running.
	4	If the engine starts but lacks power a blocked silencer could be the cause. This fault is most often found on small engines and particularly two-strokes.
	5	Having carried out all these checks and still failed to start the engine, thank your lucky stars you joined the AA or the RAC and call out a patrol to your assistance!

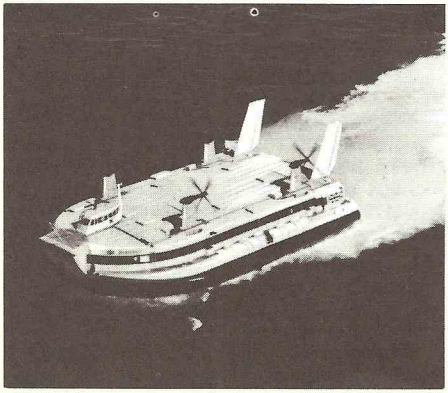
20 what Castrol means to you

DEVELOPMENT FOR THE FUTURE

Castrol's research and development facilities are centred in a brand new plant at Bracknell, Berkshire. With all the very latest laboratory and test equipment at their finger tips, Castrol scientists are able to reproduce the likely motoring conditions of tomorrow and to prepare new blends of lubricating oil that can match them effectively. The modern trend in two-wheeler design, for instance, is for engines and other components to be more highly stressed. This throws an extra heavy burden on the lubricating oil, but Castrol has already shown, with its introduction of the unique 'Liquid Tungsten' additive, that it has the tougher requirements of the immediate future under control. Other spectacular developments can certainly be expected to match the even tougher conditions of the years ahead, such is Castrol's unparalleled knowledge of the highly specialised subject of lubrication.

WORLD-WIDE EXPERIENCE

Castrol Limited was founded in 1899 by Charles (later, Lord) Wakefield, and entered the motor market in 1909. It is now a major international concern with branches throughout the world. Castrol lubricants are in constant use in all operating conditions, and comprehensive research data of a varied nature is continually provided to ensure that Castrol consistently sets the pace in lubrication development. Added to this, Castrol plays a leading part in the demanding worlds of racing and record-breaking. Quite apart from demonstrating the quality of Castrol oil these achievements boost the scientific know-how that eventually benefits you, the owner of a two-wheeler. Castrol's wide experience in other fields also assists you. There is a continual investigation of problems in applications ranging from atomic power stations to jet aircraft. All this helps to make Castrol the 'leaders in lubrication'.



21 Castrol products for two-wheelers

CASTROL ENGINE OILS

CASTROL GTX

An ultra high performance SAE 20W/50 motor oil, which exceeds the latest API MS requirements and manufacturers' specifications. Castrol GTX with liquid tungsten *, generously protects engines at the extreme limits of performance, combines both good cold starting with oil consumption control. Approved by leading motor cycle manufacturers for both engine and gearbox applications.

CASTROL XL (20W/50)

Contains liquid tungsten *, suitable for most single and twin cylinder 4-stroke motor cycle engines, it is recommended for a majority of 2-stroke engines as an alternative to Castrol Two-Stroke Self-Mixing Oil.

CASTROLITE (10W/30)

The lightest multigrade oil of the Castrol motor oil family, containing liquid tungsten *. It is recommended for certain motor cycle engines and primary chain cases, and as a hydraulic oil in certain motor cycle telescopic front forks. With its special features, Castrolite gives maximum engine protection.

CASTROL GRAND PRIX (50)

An engine oil, the heaviest in the range, recommended for summer use in certain twin and single cylinder motor cycle engines.

CASTROL TWO-STROKE SELF-MIXING

An oil developed to meet the special requirements of two-stroke engines. It mixes automatically with any grade of petrol.

CASTROL R20, 30, 40

Primarily designed and developed for highly stressed racing engines. Castrol R should not be mixed with any other grade of oil or any other grade of Castrol.

**An oil soluble long chain tertiary alkyl primary amine tungstate covered by British Patent No. 882,295*

CASTROL GEAR OILS

CASTROL HYPOY (90 EP)

A light-bodied powerful extreme pressure gear oil for many motor cycle gearboxes.

CASTROL ST (90)

A light-bodied gear oil with fortifying additives, recommended for some scooter gearboxes.

CASTROL D (140)

A heavy full-bodied gear oil with fortifying additives. Recommended for certain motor cycle gearboxes.

CASTROL HI-PRESS (140 EP)

A heavy-bodied extreme pressure gear oil for use in some scooter gearboxes.

CASTROL GREASES

(formerly Castrolease)

CASTROL LM

A multi-purpose high melting point lithium based grease suitable for most applications, including frame and wheel-bearing lubrication.

CASTROL CL

A semi-fluid calcium based grease for frame lubrication which is both waterproof and adhesive.

CASTROL MEDIUM

A medium consistency calcium based grease for frame lubrication and for motor cycle gearboxes which require a grease.

CASTROL HEAVY

A heavy consistency calcium based grease for wheel bearings.

CASTROL GRAPHITED GREASE

A graphited grease for the lubrication of transmission chains.

NOTE:

It is important to ask for the correct Castrol grade by name, and to see that it is dispensed from a Castrol container. Castrol is marketed as a finished product and contains carefully balanced additives in precise quantities. The addition of other additives or diluents cannot improve it and in some cases can prove harmful. While Castrol grades (except Castrol R) will mix with other mineral oils, full benefit cannot be derived unless the correct Castrol grade is used by itself.

To ascertain the correct grades for any two-wheeler please consult the Castrol Wall Index at your local dealer. For those interested in obtaining lubrication charts for their machines, these are available for certain models of these makes: A.J.S., Ariel, B.S.A., Honda, Lambretta, Matchless, Norton, N.S.U., Royal Enfield, Triumph, Vespa and Zundapp. Please write to the Castrol Chart Library, stating make, model and year.

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