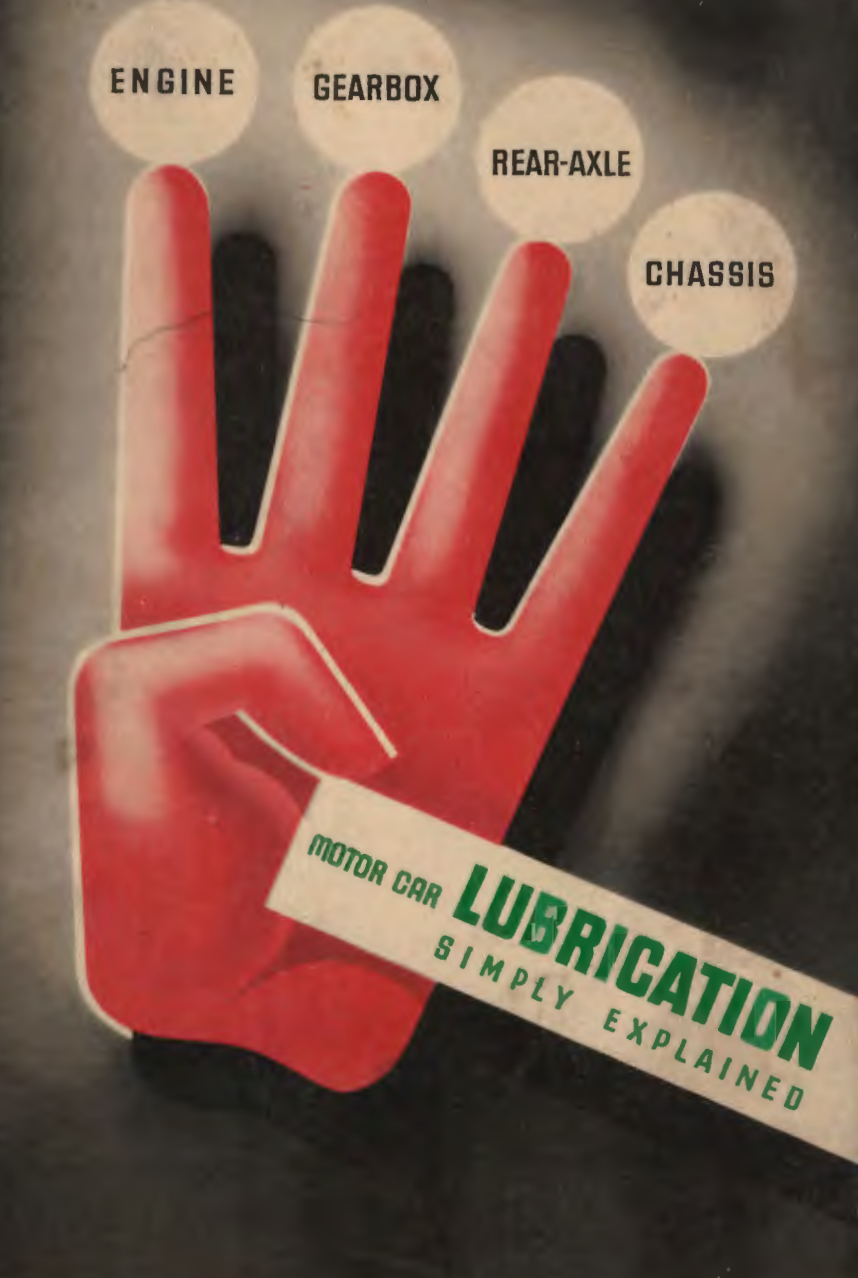

ENGINE
GEARBOX
REAR-AXLE
CHASSIS
MOTOR CAR LUBRICATION
SIMPLY EXPLAINED

WARNING

WHEN you ask for "XL" or "AA" you imagine you are getting Patent CASTROL XL or Patent CASTROL AA (or whatever is the grade specified). But this is not always the case. Possibly you are served with an inferior oil—an oil that will do your engine incalculable harm, and in addition, you are very often charged the Patent CASTROL price for it.

To be sure of getting the genuine Patent CASTROL, say Patent CASTROL first, then the grade letters, and see that it is drawn from a container bearing the trademark.

PATENT CASTROL will mix!

THERE are still some motorists who believe that Patent CASTROL will not mix with other makes of lubricating oil. There is no foundation for such a belief. Although an oil of peerless quality, Patent CASTROL mixes readily with any other brand of oil; naturally, also, one grade of Patent CASTROL will mix with another.

Patent CASTROL "R" (Racing) alone is excepted and should not be mixed with any other oil or any other grade of Patent CASTROL.

The full benefits of Patent CASTROL will not, of course, be experienced unless 100% Patent CASTROL is in use. Therefore, the sump should be drained and refilled with Patent CASTROL to obtain immediate results.

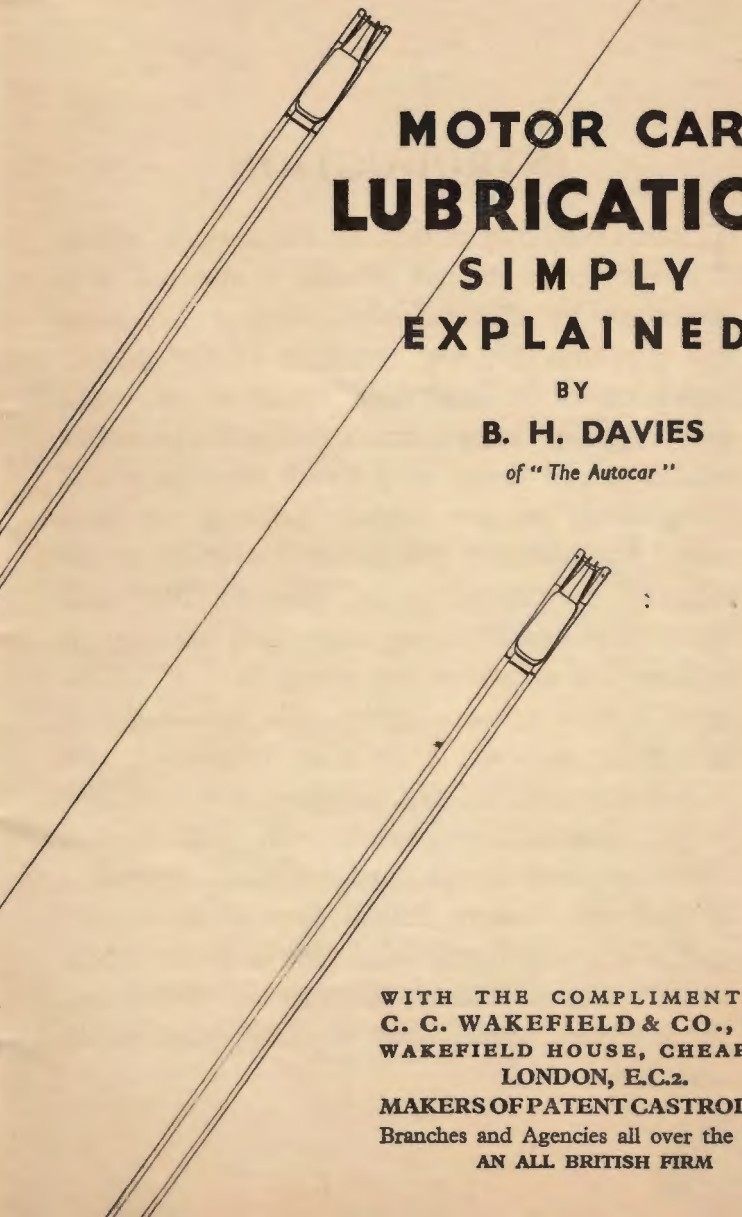
WAKEFIELD
PATENT
Castrol

MOTOR CAR LUBRICATION SIMPLY EXPLAINED

BY

B. H. DAVIES

of "The Autocar"



INTRODUCTION

FRICTION may be described as a sponge which soaks up power. If friction is reduced to a minimum by efficient lubrication, a motor-car can run smoothly and maintain its full power. Small errors in lubrication render a car weak, and sluggish. Larger errors produce rapid wear, whilst serious errors may wreck such expensive components as the engine, gearbox, or back axle. Furthermore, proper lubrication of certain items of the chassis has an intimate effect both upon comfortable riding, and upon silence. It follows that no owner can afford to treat his car as if it were a boot-scraper. He should devote half an hour to the study of its lubrication, and ever afterwards see that it is kept supplied with correct quantities of a suitable oil. This booklet is written from the standpoint of C. C. Wakefield & Co., the leading British firm of lubrication specialists, who supply lubricants to almost all the world's record holders, whether on motor-cars, motor-cycles, speed boats or long range racing aeroplanes.

CONTENTS

MOTOR-CAR LUBRICATION SIMPLY EXPLAINED

THE COMPONENTS OF A MOTOR-CAR

The Engine

Is the source of power. It is at once the most expensive and the most complicated component of a chassis. Its condition makes or mars your motoring. Lubricated accurately with good oil, it will preserve its pristine economy, power, silence, smoothness and performance for thousands of miles. Neglected, or lubricated with an inferior oil, it may be wrecked in ten minutes.

The Clutch

Couples the engine to the back wheels, and disconnects them when the driver wishes to stop. The velvet covering of a gramophone turntable transmits motion to the record and a motor-car clutch is very similar, though it utilises heavy pressure between the two discs owing to the high power which is passed from one to the other. If a clutch slips, the car becomes unuseable. If a clutch bites too fiercely, the car is unpleasant to drive. Here again accurate lubrication is essential.

The Gearbox

The gearbox is simply a kind of lever formed by cogged wheels. If the lid of a packing case cannot be prised off with a short tool, the operator will use a longer tool to obtain extra leverage. Similarly, the gearbox supplies the engine with varying leverage to suit the work in hand—acceleration from rest, speed on the flat, the climbing of steep hills Great pressure on the teeth and shafts generates intense friction unless the lubrication is efficient.

Universal Joints

The gearbox is coupled to the back axle by the propeller shaft. Since the back axle is continuously bouncing as the springs open and close over inequalities in the road this propeller shaft must be free to bend while it transmits the drive. For this reason it incorporates one or more universal joints, which are perpetually flexing, and must be safeguarded against wear by accurate lubrication.

Back Axle

Simple and solid as this component looks, it houses very complicated mechanism. At its centre the drive is transmitted from a bevel pinion to a crown wheel; their curved teeth run at right angles under a very heavy load. Inside the crown wheel is the differential, a clever device which divides the power equally between the two back wheels, even when the outside wheel is running faster than the inside wheel round a corner. Here too, accurate lubrication is the only preventive of intense friction.

Chassis

The chassis as a whole is insulated from bumps in the road by leaf springs. These are attached to shackle pins, and the leaves slide over each other. Discomfort and noise must arise from neglect of their lubrication.

Steering

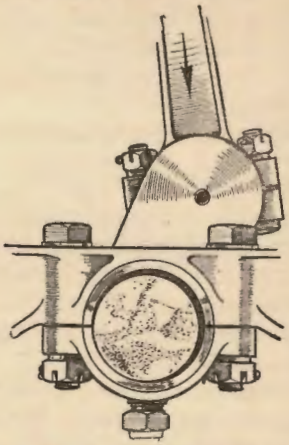
The front wheels are directed left or right through a system of jointed rods operated by a gearbox. This control is in continuous use and cannot operate accurately and lightly unless it is well lubricated.

A myriad other details might be added to the list, but this brief synopsis indicates that proper lubrication is a vital requirement of the entire car. We will, therefore, examine the needs of each component in turn, in order to master the essential few minutes of attention—the " stitch in time which saves nine."

MOTOR ENGINE OILS

Contrary to popular belief, there is a " best " type of oil for each individual engine on the road. A first-class motor engine oil must answer a host of requirements. First and foremost, it is exposed about 15 times in every second to a flame so searing that the exhaust valve may run continuously cherry-red. In the opposite direction, the oil must not be sensitive to cold, or it will congeal during the winter months and make the engine difficult to start. Yet it

OIL IN A BEARING



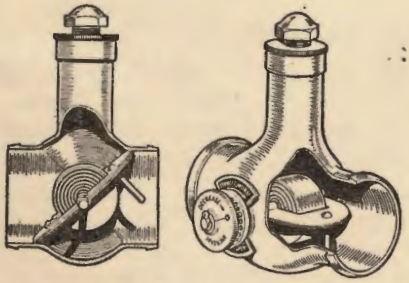
The oil film (shown solid black) which keeps bearing surfaces apart is here shown in an exaggerated form. It can also be seen how the pressure exerted by the explosion, acting through the piston and connecting rod, forces the shaft to one side in the bearing. If the pressure exerted is high enough, and the oil not of good quality, the oil film will rupture and the metallic surfaces will come into contact, causing friction, heat and finally seizure or a " run " bearing.

cannot be very thick, or it could not penetrate the hairlike clearances allowed in modern bearings. It must further resist dilution by any liquid elements in the fuel which may leak past the piston while the engine is still cold. Again, though some burning is inevitable, it must not deposit any appreciable amount of carbon in the explosion chamber. Nor must it surrender to the oxidising process created by passing hot oil over hot metal. Finally, it must refuse to be churned into an emulsion devoid of lubricating qualities, a failing common to inferior oils when lashed to a froth in a whirl of moving metal, just as a cook whips eggs with a whisk. Different engines create these tendencies in widely varying degrees, and the Wakefield experts labour incessantly to evolve the ideal and perfect oil for each engine on the world's markets.

TEMPERATURE

Somewhat rapid wear is experienced in the cylinder bores of many modern engines. It is known that this is not a result simply of friction but is caused by corrosion of the metal by acids which deposit on the cylinder walls, particularly when the engine is cold.

For this reason many car manufacturers fit a thermostat

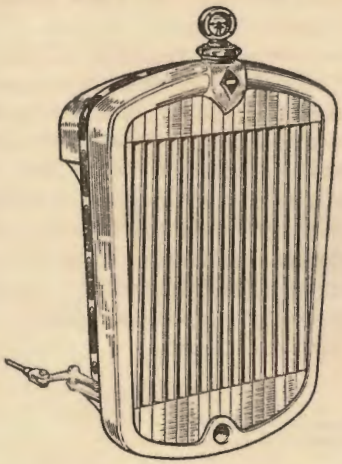


The Smith R.P. Thermostat.

THERMOSTAT VALVE

Placed in the upper hose between engine and radiator, this valve restricts the water circulation, until the heated water, acting upon the coil, causes it to expand and open the diaphragm thus permitting normal circulation to take place.

RADIATOR SHUTTERS



These serve the same purposes as a thermostat valve, but function by shutting off the cooling air instead of restricting water circulation. They may be operated by hand, or automatically by a thermostat.

which interrupts the water circulation and enables the engine to get warm without delay. If radiator shutters are fitted, they should be kept closed till the water nears boiling point. When the car is parked, shutters or rugs or a muff should be used in summer no less than in winter, to retain as much heat as possible both in the metal and in the water. On the other hand, a temperature exceeding boiling point is also deleterious, as water may be lost, and the circulation may cease. Most modern cars are equipped with dash-board thermometers, which assist the driver in keeping the temperature of the water as near boiling point as possible, without ever exceeding it.

CYLINDER LUBRICATION

Corrosion of the cylinders has been the subject of prolonged research by the oil chemists who designed Patent Castrol. This latest lubricant utilises the active constituent of stainless steel, chromium, in a microscopic soluble form in order to protect the metal surfaces against corrosion. This unique feature is not available in any other brand of oil.

Having protected the working parts of the engine, the chemists were not content; they wished to protect the oil

itself against deterioration in use. When churned up in a hot engine, oil absorbs oxygen, thickens and finally forms sludge which chokes oil pipes and filters.

After a thousand experiments it was found that a " tin-derived inhibitor " had the remarkable property of retarding the combination of oxygen with the oil in use. This inhibitor forms the second distinctive feature of the Patent Castrol range of engine oils.

LUBRICATION SYSTEMS

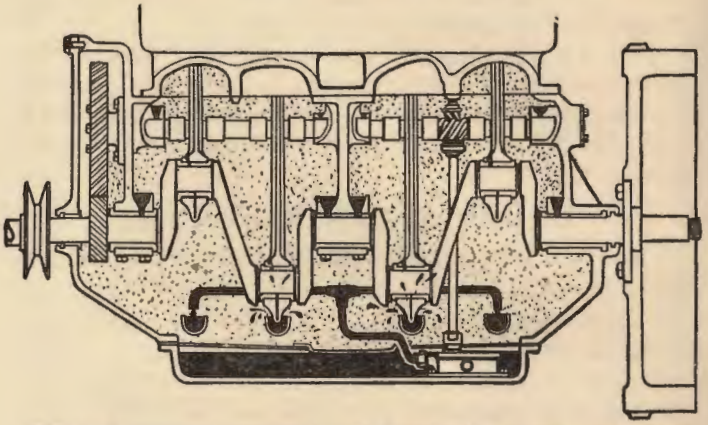
There are four main systems of engine lubrication, as follows :—

1. **The "splash" system.** Oil is pumped to small troughs located under the connecting rods. The big ends are fitted with dipper scoops which fling oil all over the engine. The oil then drains back through a perforated false bottom into the sump. This system is obsolescent, as pressure is required for modern engines incurring high stresses. It demands a light oil, capable of penetrating into all bearings with no pressure be hind it. But if the engine has ball or roller bearings, they do not require oil under pressure, so this system keeps recurring on certain quite expensive power units.

2. **Combined forced feed and splash.**—Similar to the above, except that the pump is further used to drive oil through ducts to the more heavily stressed bearings, e.g., crankshaft and camshaft.

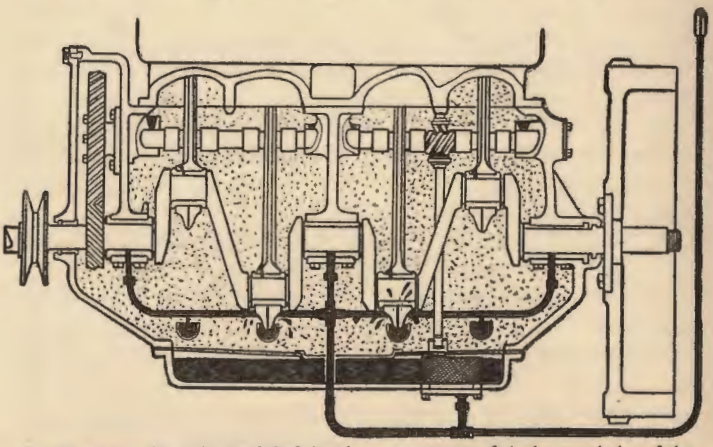
3. **Full forced feed with "wet" sump.**—No troughs and dippers are used. The pump forces oil through drilled shafts and other ducts to all parts except the cylinder walls and the little end of the connecting rods. These are lubricated by oil escaping from the big ends, which is whirled about the interior of the engine. In a few engines, tiny ducts supply the little ends of the connecting rods, leaving no parts except the cylinder walls to be oiled by " mist " or " splash."

A SPLASH LUBRICATION SYSTEM



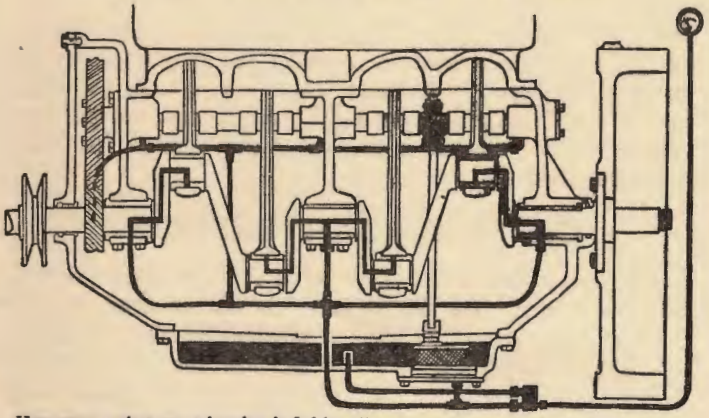
Oil is circulated by pump to troughs beneath the big ends, from whence it is splashed to all parts requiring lubrication, the surplus draining back through a strainer to the sump.

A FORCED FEED AND SPLASH SYSTEM



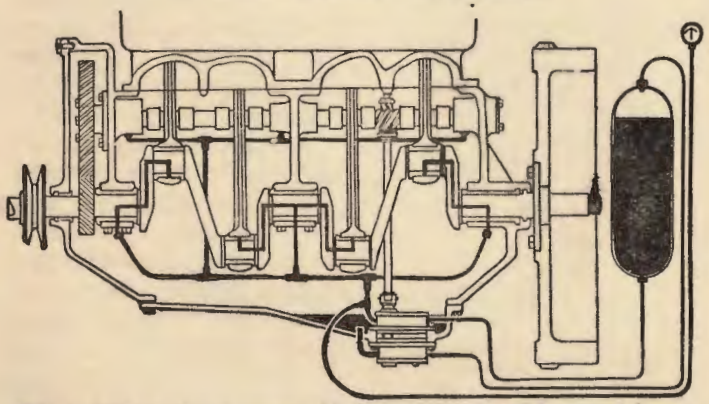
In this system the main crankshaft bearings are pressure fed, the remainder of the engine parts being lubricated as in the simple splash system.

FULL FORCE FEED SYSTEM



Here we see that every bearing is fed by oil under pressure, the big ends receiving their quota through passages drilled through the crankshaft, the oil entering these passages at the main crankshaft bearings. The surplus flung from the big end bearings lubricates the cylinder walls and little ends of the connecting rods, and then drains back to the sump.

A DRY SUMP SYSTEM



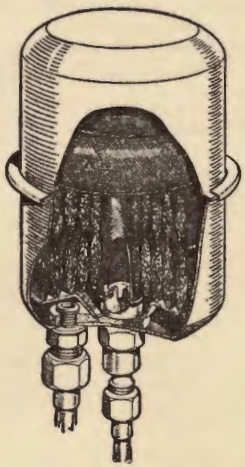
This is similar to the last system, with the exception that oil is pumped from a separate reservoir, and the sump is drained by a second pump, which returns the surplus oil to the reservoir. In this way a large body of oil is kept in circulation, which thus keeps cooler and remains cleaner for a longer period than a smaller quantity confined to the sump.

4. **Full forced feed with "dry" sump.**—This system employs two pumps. The smaller pump drives oil to all parts, and a more powerful pump returns the oil from the sump to a large container, possibly incorporating an oil cooler. Developed in racing practice, this system prevents the oil from becoming overheated. All forced systems can employ heavier oils, as it is mechanically driven into the fine clearances.

OIL FILTERS & PURIFIERS

The owner should see that the oil is clean when poured into the engine. He should keep his oil container tightly covered in his garage to prevent the entrance of grit, and use none but spotlessly clean funnels and cans for transferring oil to the engine. The car designer safeguards owners against carelessness by incorporating one or more filters. But dirt may enter an engine in various ways, notably through the air intake. The filters or purifiers should therefore be identified as soon as the car is bought, and cleaned regularly according to the instruction book. A single tiny fragment of grit may stop up an important oil-way if the owner is casual in such matters; and if

OIL FILTER



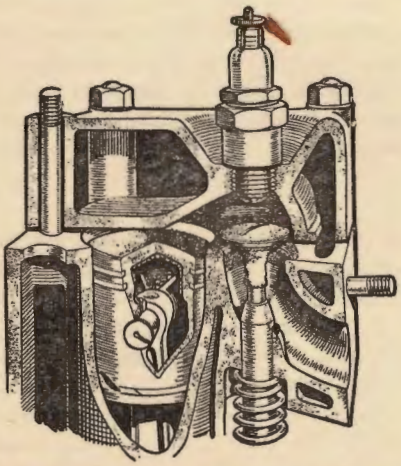
The illustration shows a popular type of oil filter. This is connected to the pressure lubrication system so that the oil is forced up through the centre pipe. Before finding its way to the pipe which returns it to circulation it must pass through the filtering mediums shown.

the car is driven with a choked oilway, expensive repairs may be needed. Air cleaners or filters are especially requisite if a car is used on dusty or sandy roads.

CARBON DEPOSIT

If an engine is found to be heavily carbonised after a short spell of work, the oil is not necessarily responsible, Heavy carbon deposits may certainly be due to the use of the wrong grade of a good oil, or to false economy in the use of cheap oils; but they are occasionally due to road dirt or to a bad mixture. Carbon deposits may be slowed down by (*a*) using the right grade of a first class oil; (*b*)

CARBON FORMATION



This illustration shows how in course of time carbon forms inside the combustion chamber, on the piston top, inside the piston, and on the valve head.

fitting an air cleaner; (*c*) Insuring correct adjustment of the carburettor.

OIL PRESSURE GAUGE

All modern cars bear oil pressure indicators on the dashboard, sometimes incorporated with a warning lamp. These gauges should be regarded as trouble indicators, and the owner should glance at their readings periodically, and doubly so if the engine runs hot or weakly, or emits any unusual metallic noises. The makers' booklet will inform him that the normal oil pressure is (for example) 40 lbs. per sq. in. at 30 miles an hour with the engine warm. The pressure will always be much higher than this when the engine is cold, and it will drop when the car is crawling in traffic. Its normal behaviour can be ascertained on the first drive. Any variations from normal behaviour demand instant attention. For example, a very low pressure or the absence of pressure suggests a shortage of oil in the sump, or a broken pipe, or pump trouble, or a damaged gauge, or a serious leakage. Very high pressure with a warm engine suggests a choked oil lead.

Unfortunately, very few oil indicators guarantee that oil is circulating properly throughout the entire lubrication system. For example, an oil gauge may be placed in front of a restricted passage supplying a reduced feed to the camshaft, and such a gauge may show the correct pressure when the camshaft lead is choked. Hence the driver should ascertain where the gauge is located in the circulation system; and should verify any oil supplies on the further side of the gauge when the engine loses power, or runs very hot, or emits strange noises.

Most engines are fitted with a pressure release valve, located between the oil pump and the bearings. Such a valve may have a spring-loaded ball, which lifts at a pre-determined high pressure, and prevents the oil gauge from being forced past its maximum when the engine is cold. Such release valves are adjustable, and are correctly set when the car is sent out. They are usually reliable, but any defect in such a valve may produce abnormally low or abnormally high readings on the gauge; and the possibility of trouble at this point should be considered if the readings are obstinately incorrect, either in a high or low direction.

DRAINING THE ENGINE

Every engine should be drained of its oil at regular intervals of from 1,000 to 2,000 miles. This is equally necessary, whether the consumption of oil be high or low. A first class engine may not demand the addition of any extra oil in 1,000 miles, the level remaining tolerably constant as tested by the dipstick. An inferior engine may require the insertion of a quart every 250 miles. In either case the sump should be drained regularly, because oil loses its virtue in use. It becomes defiled by impurities—by solid matter entering through the air intake, fragments of carbon from the combustion chamber, and metallic dust, and also by fluid contamination through wet fuel leaking past the rings, acids liberated in explosion, and so on. In addition it is oxidised by its contact with metal, and may be churned into an emulsion after adulteration by water leaking from the jacket, or liberated from the petrol in the course of combustion. The engine should never be flushed out with paraffin after draining,

as some of the paraffin will remain behind to adulterate the fresh oil. Special flushing oils can be procured for this purpose.

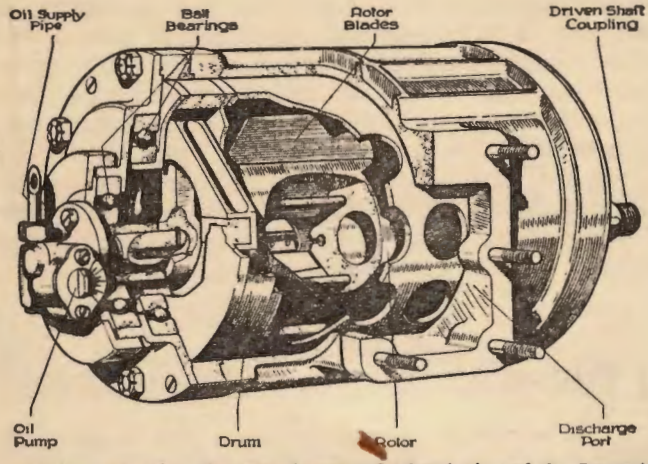
CHEAP OILS

Oil is the lifeblood of a fine engine, and it is false economy to use cheap oil. At the best the oil has many enemies to contend with, and inferior oil inevitably produces rapid wear, whilst a really bad oil may wreck the entire power unit. Competition in the oil world is so intense that profiteering is impossible; and reputable firms have long since scaled their prices down to minimum profits consistent with the supply of dependable lubricants.

A YEAR'S OIL COSTS

Assuming that an owner drives 10,000 miles per annum, and lubricates his engine with Patent Castrol, his lubrication expenses will be approximately £3 15s. 10d. for twelve months, viz., five gallons for " topping up " the sump at intervals on the road at 2/- a quart and say one five-gallon drum for replenishing the sump after periodic draining, at 7s. 2d. per gallon. For this expenditure he will obtain efficient lubrication, minimum wear, and minimum carbon deposit.

We venture to inform him quite frankly that he can buy oil at much less than 7s. 2d. per gallon. But such a cheap oil will be far more extravagant in use; he will probably use 20 gallons in 10,000 miles, as against 10 gallons of Patent Castrol. In addition his engine will evince more rapid wear, and carbonise more rapidly, even if he sustains no seizure or other serious breakdown.



Lubrication connections for superchargers. Sectioned view of the Powerplus Supercharger. (*Reproduced by courtesy of Powerplus (1927) Ltd.*)

EXCESSIVE OIL CONSUMPTION

This is normally due to wear. As soon as the piston rings and cylinder bores wear, splashed oil will pass them, and escape in smoke through the exhaust. As the engine bearings wear, leakage will occur at this point also, and make itself visible on the outside of the engine or even on the floor of the garage. The best remedy is to overhaul the bearings, cylinder bores and piston rings. The use of a thicker oil is unwise, as it may fail to penetrate into some of the finer clearances, and will in any case produce a dirty engine, and accelerate carbonisation.

SUPERCHARGERS

Quite a number of modern sports cars are fitted with superchargers or " blowers," which usually run even faster than the engine, and thus demand exceptional precision in

their lubrication. A small quantity of oil is metered to the vital parts of the blower, and it is important that only oil of the highest class, specially prepared for the purpose; should be used. In addition lubricant is often mixed with the petrol to insure the lubrication of the entire blower; here again selection is extremely important. Patent Castrol XL is supplied for this latter service, and the owner should adhere to the exact proportion advised by the maker of the blower—possibly a quart of Patent Castrol XL to 15 gallons of fuel.

UPPER CYLINDER LUBRICATION

Of late years it has been proved that it pays to add a little oil of a special type to the fuel. This oil lubricates the valve guides and cylinder walls, especially when an engine is started from cold, and the oil deposited on such parts during the last run may have drained away. A special Wakefield lubricant is sold for this purpose under the name "Castrollo." It is obtainable at all garages, one pennyworth sufficing for 2 gallons of fuel; and may also be bought for home use in tins of two different sizes, each equipped with a useful measure.

LUBRICATION OF OTHER PARTS OF THE CAR

MAGNETO, DYNAMO & STARTER

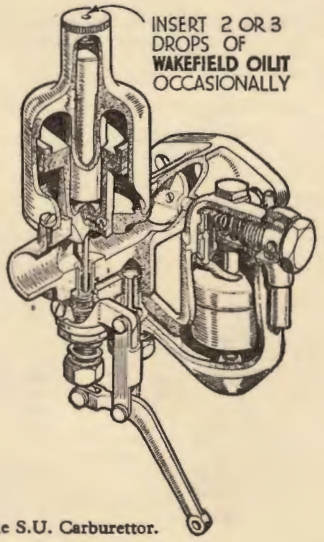
These components normally require a drop of Wakefield " Oilit " in their oilholes every 500 miles. Some magnetos possess no oilholes, as their ball bearings are packed with sufficient grease to last until the instrument requires overhaul. Care should be taken not to over-oil these components.

CARBURETTOR

Certain carburettors, notably the S.U. contain moving parts, and require a drop or two of Wakefield " Oilit " every 1,000 miles.

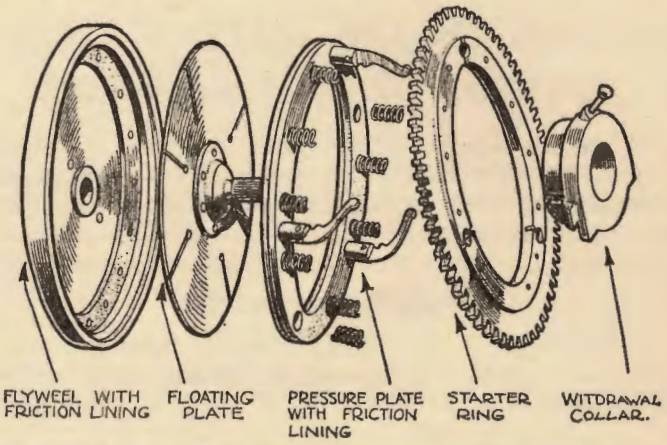
A POPULAR TYPE OF CARBURETTOR

The fuel enters the float chamber, causing float to rise, and at a predetermined level, close the needle valve and cut off the supply. The float chamber is connected by passages to the jet, in which the petrol thus stands at the level determined by the adjustment of float and needle. The other (and by far the largest) component of an explosive mixture is air. Air is drawn past the jet by the suction of the engine, and this same suction acts upon the petrol standing near the top of the jet and causes it to issue forth in the form of a fine spray, thus forming with the air an explosive mixture. The amount of mixture which passes and therefore the speed of the engine, is determined by the opening of the throttle.

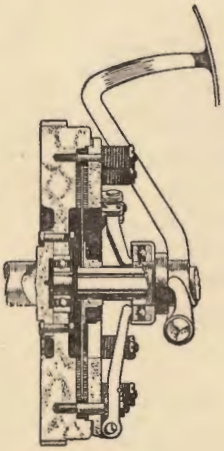


The S.U. Carburettor.

SINGLE & MULTIPLE PLATE CLUTCHES



An " exploded " view of the Components of a single plate clutch. (*By courtesy of " The Light Car and Cycle-car."*)

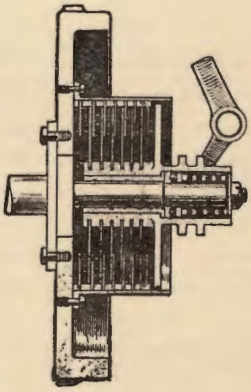


(left)

A popular single Plate clutch assembled.

(Right)

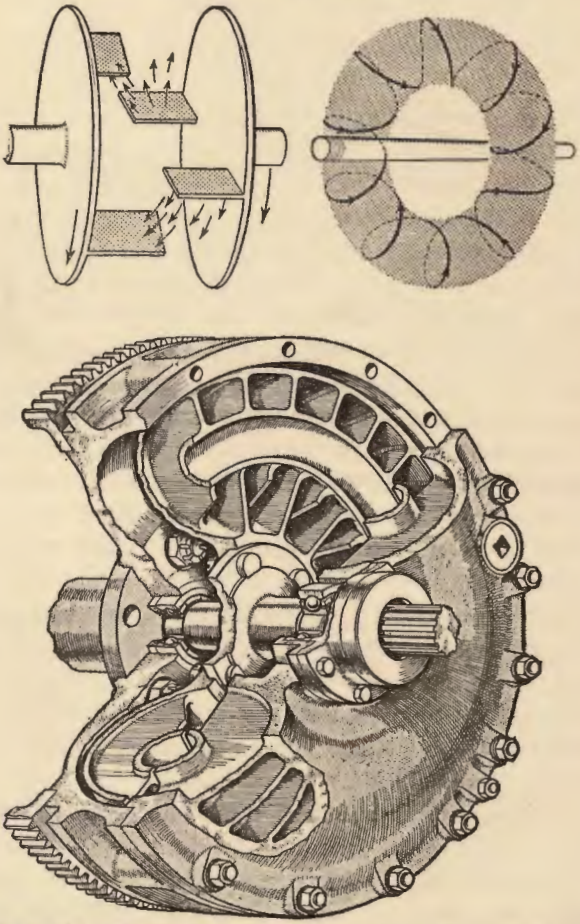
A multiple disc clutch.



CLUTCHES

No component is more sensitive to accurate lubrication than the clutch, on which the maker's instruction book should be carefully studied. The most popular type of clutch is the single plate, which normally runs dry, but the spigot bearing, thrust bearing and other control details should receive periodic attention, as directed in the maintenance pamphlet. The multiple disc type of clutch usually runs in oil, and is extremely sensitive to its lubricant, as too thick an oil may clog it, whereas excessive slip will soon destroy the virtue of a lubricant which cannot stand heat. The hydraulic type of clutch actually drives the car through a series of jets of oil. As shown in the diagram on page 22, its working principle consists of a spiral column of oil, some 4 in. in diameter, bent into a circle some 12 in. in diameter, and spinning in proportion to engine speed. This oil impinges on a series of webs fixed to the driven members. If the engine is running slowly, the oil hits the webs somewhat feebly, and slip occurs. If the engine is running fast, the column of oil hits the webs more violently, and the slip practically ceases. Since this clutch entirely depends for its action on the oil, the right oil must be used. When the car is trapped in a prolonged queue outside some famous sports resorts, great heat may be generated by constant slipping, and an oil of incorrect specification will become ineffective. Wakefield Patent Castrol XL or Patent Castrol C is correct for these " fluid flywheels."

THE "FLUID FLYWHEEL"



The diagram above illustrates the principle upon which the Hydraulic Clutch of "Fluid Flywheel" operates. Below is a sectional drawing of the actual mechanism showing the simplicity of its construction. (*By courtesy of "The Autocar."*)

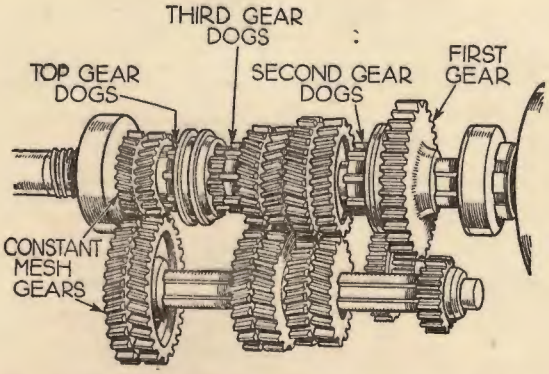
GEARBOX

During recent years the public have clamoured for easier gear-changing, and few cars any longer bear the old Panhard type of sliding gear, which has served motorists for so long The dominant types at the moment are :—

1. **Standard sliding gearbox with "silent" third.**—This employs two sets of constant mesh pinions.

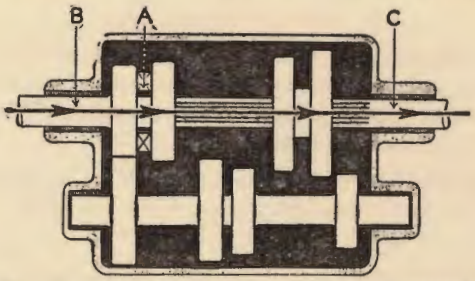
2. **Helical type.**—Spiral or helical gears are used for all the pinions in some gearboxes, and enable the gears to fit more closely into each other, with a marked reduction of gear noises. This design creates fresh problems in lubrication.

3. **Synchro-mesh.**—Silent gear-changing depends on two pinions running at approximately the same speed when the driver engages them. The synchro-mesh principle employs two cones, carried respectively by the driving and driven shafts, and connected with the pinions which the driver is

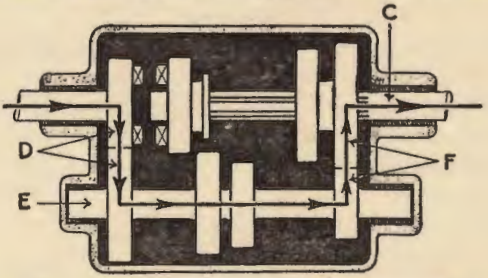


A type of gear box with three sets of constant mesh pinions, or "silent" third and second gears. In top gear, of course, the power is transmitted direct through the main shaft. (*By courtesy of "The Autocar."*)

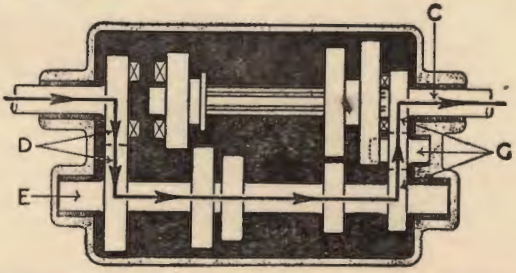
DIAGRAMS OF A FOUR-SPEED GEAR BOX



Fourth or Top Gear.—Drive follows arrows direct from engine through dog-clutch (a), connecting first (b) and second (c) motion shafts to rear axle.



First or Low Gear.—Drive follows arrows through constant mesh pinions (d) to layshaft (e), and back through low gear pinions (f) to second motion shaft (c).



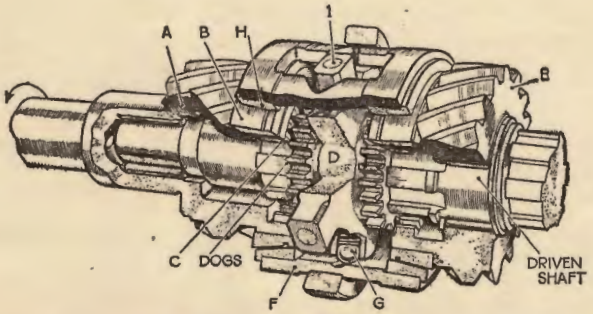
Reverse Gear.—Drive follows arrows through constant mesh pinions (d) to lay shaft (e) through reverse pinion set (g), the extra pinion thus reversing the direction of rotation of the second motion shaft (c). In the first two diagrams these reverse pinions have been omitted for the sake of simplicity.

seeking to engage. As the two cones touch with increasing pressure, they tend to synchronise the speeds of the two pinions before any positive engagement occurs; and thus they correct any small miscalculation on the part of the driver.

4. **Self-changing boxes.**—The best-known selfchanging or pre-selective box is that designed by Major W. G. Wilson, and now fitted to many leading makes of British car. This is of the planetary type, engaged by means of friction bands and coned rings, and is shown on page 26.

This brief survey indicates that gearboxes are much more complicated than they used to be a few years ago, and in turn are more sensitive to oil, since features like friction

SYNCHRO-MESH GEAR



This type of gear enables the speed of two dogs to be synchronised automatically as they are pressed into engagement by the gear lever.

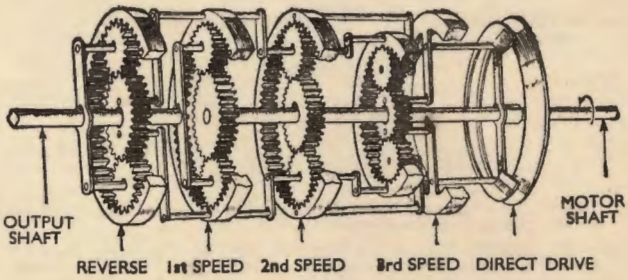
A and E are gear wheels. B is the cone clutch for A, and C is its internal teeth D is the sliding member between A and E. When engaged with A Top gear is in use and when with E third gear. F is the outer sleeve which slides to left or right with D owing to the spring loaded ball G. Not until the two cones H and B are synchronised can the extension 1 come out of the centre slot and travel its full movement to the left and so cause top gear to be engaged.

(*By courtesy of "The Autocar."*)

bands are by no means necessarily happy with an oil which might suit a gearbox containing nothing but pinions and bearings. Moreover, the pressure on gear teeth and gear-shaft bearings continues to rise every year as the performance of modern cars is improved. Some gearboxes form a unit with the clutch, or even with the clutch and the engine, each of which combinations confronts the oil expert with new problems. It follows that the selection of an ideal gear lubricant is far from simple, and users should be careful to select an oil of the correct type. These are indexed on p. 44.

In replenishing the gearbox the makers' instructions as to level should be scrupulously observed. Excess will soil the garage floor, the road, and friends' gardens, whilst a shortage may produce serious mechanical trouble. The gearboxes of new cars should be drained, flushed with thin oil, and replenished after 500 miles, as metallic dust usually develops during the running-in process.

SELF-CHANGING GEAR



The principle of the WILSON GEAR BOX. When the brake band closes on any one of the drums illustrated and prevents it rotating the Planet wheels must rotate inside the stationary drum and that gear is then in engagement.

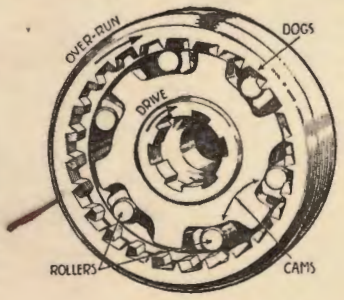
FREE WHEELS

To facilitate gear-changing and simplify coasting down hills, some modern cars are equipped with free-wheel mechanisms, analogous to those fitted to pedal-cycles. These freewheels bear heavy stresses, and demand accurate lubrication if annoyance is to be eliminated. Most of these devices act by pushing rollers up an inclined plane, the rollers being free in one position, and jamming the drive solid in the alternative position. If such a component is under lubricated, it may suffer from excessive wear, or even break up. If it is over-lubricated with an unsuitable oil, free action of the rollers and wedges cannot long endure. The right lubricants for free-wheel gearboxes are given in the index commencing on page 44. For independent free-wheels CASTROLEASE Heavy is generally suitable.

REAR AXLE

Externally, the rear axle seems to be a simple and solid piece of mechanism, but the R.A.C. statistics of roadside breakdowns indicate that axle failure is still far from uncommon, and in many such cases lubrication is the real culprit. Moreover, when no structural repairs are necessitated, axles often give trouble through lubricant

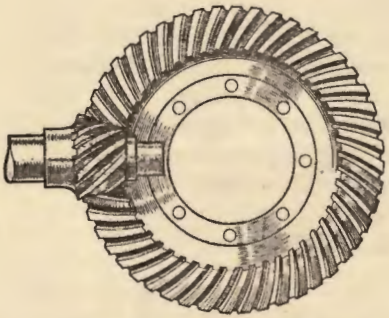
A COMMON TYPE OF FREE-WHEEL



When the drive shaft is rotated under power from the engine the rollers are jammed into the narrow sections of the cavities. On the overrun they roll freely in the wider section and the momentum of the car is not passed to the engine.
(*By courtesy of "The Motor."*)

leaking along the shafts into the brake drums, and weakening the brake action. Actually, the rear axle casing contains the final drive, the differential gear, and a host of load and thrust bearings, being indeed a box of tricks which few amateur motorists fully comprehend. Its lubrication is of the first importance, and embraces the following points :—

BEVEL DRIVE



Showing the popular helical or spiral bevel gear. This type of gearing is more silent than the straight bevel once in general use.

1. Use none but the correct grade of a recommended oil. (Wakefield back axle recommendations for all makes of car are given on p. 44.)

2. Fill the axle with the above oil to the precise level advised by the car manufacturer.

3. Drain and refill the axles of new cars after the first 500 miles.

4. Inspect the oil level in the axle at regular intervals.

WORM DRIVE

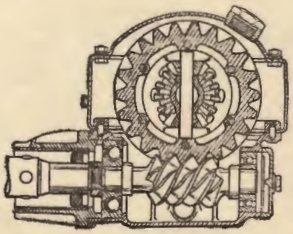
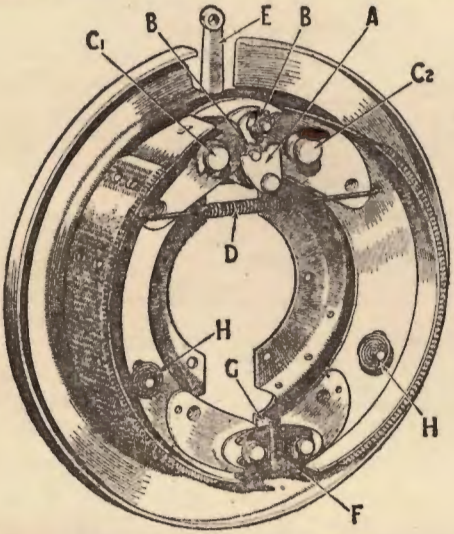


Diagram of a worm driven rear axle. The worm engages with bevel type teeth on the differential.
(*By courtesy of "The Autocar."*)

BRAKES

Oil should usually be excluded from the actual drums and shoes of a braking system; but the control gear in every case demands faithful lubrication. This applies to bearings, joints, compensator mechanism, etc., and these parts are usually serviced by means of a grease-gun and nipples, or by a "one-shot" installation, sometimes called

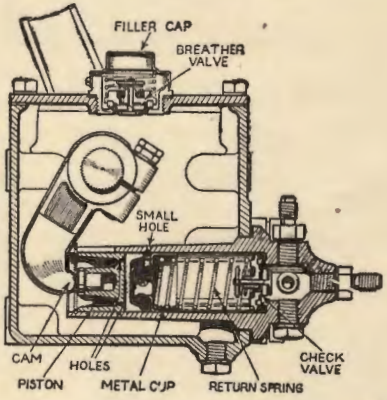
SELF-SERVO TYPE BRAKE-SHOES



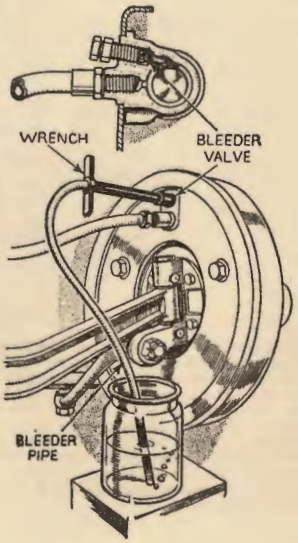
This illustration makes clear the operation of the Bendix-Perrot servo brake shoes The two shoes are free to move within certain defined limits on the pins C1 and C2. On rotation of the lever E the rollers B force the shoes apart, and against the brake drum. The revolving drum tends to force round the left-hand shoe, which through the connecting link F communicates its movement to the right-hand shoe. In this way the momentum of the car is utilised to slow down its own movement. It will readily be seen that the right-hand shoe is already being forced against the drum by one of the rollers B, so that with the rotating drum's further assistance additional braking effect is obtained. Friction washers A on fixed pins prevent play of the brake shoes when disengaged, and the spring D holds the shoes in perpetual contact with the rollers.

" central chassis lubrication." On many cars the brakes are actually operated by oil, which is utilised by means of a piston and a pipe line to transfer pressure from the driver's shoe to the brake levers. These hydraulic chambers should be recharged at the necessary intervals with Wakefield Castraulic.

HYDRAULIC BRAKING SYSTEM



The Lockheed Hydraulic brake system is operated by means of oil pipe lines through which oil is forced under high pressure. This operates valves at each brake cam thus applying the brakes.



(*Above.*) The Lockheed Master Cylinder in which pressure is generated on application of the foot brake pedal.

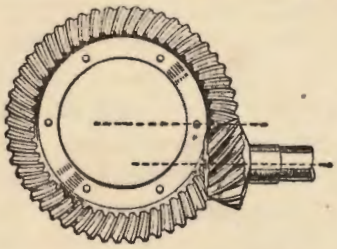
(*Right.*) Bleeding the Lockheed brake pipe line. This is necessary periodically to ensure that no air is present in the system.

(*By courtesy of "The Autocar."*)

EXTREME PRESSURE OILS

Most of the recent popular car models require a special gear oil in the rear axle—an oil capable of sustaining much heavier loads than an ordinary mineral oil, which breaks down when the pressure between the gear teeth exceeds 5,000 lbs. to the square inch. On page 49 is given a list of cars which require the extreme pressure lubricant Castrol HI-PRESS in the rear axle.

Another list on the same page sets out the cars fitted with " hypoid " final drive as shown in the diagram below. In this form of gearing, the small pinion meshes with the crown wheel at a level below the axis of the rear axle shafts, and thus enables the propeller shaft from the gearbox to be fitted at a lower level ; this gives a lower floor level inside the car. But these " hypoid " gears are more difficult to lubricate than the ordinary spiral bevel type. There is more " sliding " friction between the teeth compared with the spiral bevel " rolling " action. In order to prevent rapid wear of the expensive gear teeth a " powerful " type of extreme pressure oil must be used for hypoid rear axles, *i.e.*, Castrol HYPOY.



WARNING !

1. Do not mix Castrol HI-PRESS or Castrol HYPOY Gear Oils with any other kind of oil. The chemical compounds employed are quite safe in themselves, but may cause deposits if mixed with a different grade of lubricant.

2. Every 5,000 miles it is necessary to drain, flush and refill the axle when using extreme pressure oil.

3. Castrol HYPOY Gear Oil must *not* be used in gearboxes.

CHASSIS

The modern grease-gun has no screw connection, but is simply pressed against a nipple on the chassis ; the connection then telescopes into the gun, and lubricant is injected through the nipple under heavy pressure. The refilling of this type of gun is, however, a messy job, and is often neglected by the motorist. Under a more recent patent the Wakefield Ram Gun has no grease reservoir at all, but is simply screwed to an ordinary Wakefield canister, which serves as its reservoir. When this becomes exhausted the old container is thrown away and a new one affixed.

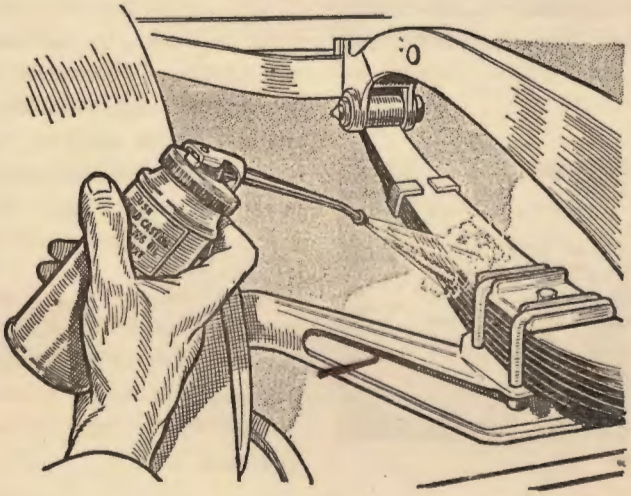
The one-shot system consists of a small tank containing lubricant, and connected by pipe lines to sundry parts of the chassis requiring oil. The oil is fed through the pipe lines either by a pump operated by the driver, or by capillary action through wicks, or by the slight vibration imparted through the motion of the car. It is folly to imagine that any sort of oil will satisfy even these simple conditions. Too heavy an oil may choke the system ; too light an oil would flow freely, but would not stand the pressure in some of the working parts of the chassis. Wakefield oils are available for every type of one-shot installation.

SHOCK ABSORBERS

In order to improve the riding comfort the majority of car manufacturers fit Shock Absorbers. Very little attention is necessary with the exception of periodical topping-up. The level of the fluid should be examined every 10,000 miles.

SPRINGS

If the road springs are maintained in perfect condition, the occupants of the car travel in far greater comfort, and the chance of skidding is reduced. The lubricant originally inserted by the car manufacturer does not last long. Naked springs soon grow stiff through rust; gaitered springs also stiffen if fresh oil is not introduced at regular intervals. The weight may be preferably taken off the springs during re-lubrication so that the oil is introduced into a pack of spring leaves which are "gaping," instead of being pressed firmly together by the weight which they support. Since many owners shrink from this labour, Wakefield's have introduced a special lubricant known as "Penetrating Oil," which has the property of creeping between two metal surfaces even while they are carrying a heavy load.



CASTROL LUBRICATION CHARTS

Many owners display sufficient energy and interest to lubricate their own cars. For such motorists Wakefield's have published Lubrication Wall Charts for over 600 different models. These are printed in colour on stout vellum paper for fixing to the walls of the garage. They depict in the simplest possible manner the parts of the chassis requiring lubrication, together with the type of lubricant best suited to each purpose, and the intervals (in road miles) at which a fresh supply is advised. If an owner of a 13 h.p. " Bugonda" obtains a Wakefield chart and secures it with drawing pins to his garage wall, it acts as a permanent aid to his memory, and supplies all necessary technical information. Each chart is approved by the designer of the car in question, and their huge popularity with owners is shown by the fact that scores of thousands of copies were supplied during the last twelve months. A list of the published charts is given on p. 52. No charge is made for the charts.

Owners who dispose of less energy, or confess that they are bored with the mechanical side of motoring, should consider the Castrol Lubre-quipment Service.

ENGINE TROUBLES

—their diagnosis and cure.

Engine troubles may broadly be divided into two classes—those that cause a complete stoppage, and the others that result in poor running. Generally speaking, the first are the easiest to trace.

It is obvious that (a) if a charge of the correct mixture of petrol and air reaches the cylinder; (b) it is properly compressed, and (c) a spark occurs at the correct moment, the engine must run.

The complete absence of any of these three desiderata will result in complete stoppage.

Efficient lubrication (d) is also necessary if the engine is to continue to run, but lubrication trouble usually gives so much preliminary warning that its worst and final state (seizure) is very seldom reached.

The factors (a), (b), (c), (d) essential to good running having been set down, we will now examine each in detail.

(a) Fuel System.

A gradual stoppage, perhaps preceded by a "spitting back" through the carburettor, intermittent running and "spitting back" or overheating, are the chief symptoms of a derangement of the fuel system.

(i) First see if the carburettor floods when needle valve is lifted. If it does not, ascertain that there is petrol in the main and also the vacuum tank if one is fitted.

(ii) If petrol is in the main tank but does not reach the vacuum tank, see that the vacuum tank air vent is clear,

connections to inlet manifold tight, and petrol pipe clear, with no air locks.

(iii) If petrol reaches the carburettor (but running is unsatisfactory), drain and clean out the float chamber, clean the jets, and also clean all the filters in the system. See that the carburettor is tightly bolted to the manifold, and check working of the controls.

(iv) If the carburettor floods continuously, see that the needle valve seats properly and is not bent, and shake the float; if punctured, petrol will be heard inside.

(b) Loss of Compression.

Poor starting, lack of power, and overheating may have their origin in lack of compression.

This is easily tested with the starting handle. All cylinders should be equally hard to turn over—although this is seldom exactly the case when an engine has seen much wear.

(i) Complete lack of compression in one cylinder is usually due to a broken valve or spring, or to a valve stuck up—in the latter case a squirt of Wakefield OILIT on the stem will cure it—or no tappet clearance—test for this when the engine is hot.

(ii) Partial loss of compression may be due to leaks round sparking plugs; test with a drop of paraffin when engine is running—no bubbles should appear.

(iii) Test cylinder head gasket—a bad leak is shown by a whistling, hissing sound when turning the starting handle, while a smaller leak can be detected by filling up the radiator to head of filler, and running the engine; the appearance of bubbles indicates a leaking gasket.

(iv) In an old engine it may be impossible to ensure perfect compression owing to wear of pistons, rings and cylinders. New rings (the engine maker will supply them oversize) may effect a partial cure, but the complete cure is to have the cylinder bores re-ground and new oversize pistons and rings fitted.

(v) Poor or the wrong grade of lubricant may cause poor compression, especially when hot. Use the Castrol grade recommended for your engine in the index at the back of this book.

(c) Ignition System

Sudden complete stoppage, refusal or difficulty in starting, or misfiring, perhaps accompanied by explosions in the silencer as well as " spitting back " through the carburettor, are all symptoms of possible ignition trouble.

(i) First make sure ignition switch is on, and that magneto is properly connected to its drive. Test for spark by holding the blade of a wooden-handled screw-driver in contact with a metal part of the engine, and within $\frac{1}{4}$ in. of plug terminals When engine is revolved, a spark should cross the gap at regular intervals. Test each plug similarly. If engine does not fire on all cylinders though a spark is shown at each plug terminal, "short " each plug in turn by bridging terminal and engine with a screw-driver blade. If shorting a particular plug makes little or no difference to running, then plug is defective.

(ii) Remove and clean it, setting gap between points to 1-50th inch; if still defective replace by a spare.

(iii) If screw-driver test shows no spark or a very weak one, see that points of contact-breaker are clean and even, and break 1-64th inch. The carbon brush and its track behind the contact-breaker should be clean and free from oil. Absence of a spark when attempting to start after engine has previously run well may be due to a stuck or stiff contact-breaker arm. Remove arm, polish pivot and drop a spot of OILIT in fibre brush; reamer bush out slightly with the tang of a file if OILIT does not make arm sufficiently free.

(iv) If there is still no spark, or a poor one, clean brushes and contacts of distributor, and also the slip-ring and its brush, which are usually at the driven end of the magneto. If still no spark is apparent, the magneto should be seen by a specialist.

(v) The previous remarks apply also in the main to battery ignition, but in addition all wiring and contacts should be checked, and also the condition of the accumulator. If there is sufficient charge to light the lamps even dimly the ignition should function.

(vi) If there is a good spark but the engine does not run, or runs powerlessly with a very deep note, perhaps the timing has slipped. The contact-breaker points should commence

to break (when fully advanced) when the piston in the same cylinder as the plug connected to the distributor segment in contact with the high tension brush is about 1-10th from the top of its stroke, and both valves are closed. This position, in regard to No. 1 cylinder, is usually marked on the flywheel.

(d) Lubrication

(i) First see that there is sufficient oil in sump. Check daily, and fill up to maximum mark with the grade of Wakefield Patent Castrol recommended for your engine in the Lubrication Index on pages 44 to 49. Never let lubricant get below minimum mark.

(ii) If there is no oil flow though sump is full, see that the pump is primed, and all external oilways free and connections tight. Clean oil filter. See that pump drive is in order, and if pump is of the spring return type, that spring is not broken.

(iii) A high pressure is usually shown when engine is cold. If this does not fall to normal when warm, see that relief valve is properly adjusted and oilways are clear.

(iv) Low pressure may be caused by worn bearings, or if accompanied by overheating and loss of power, it may be due to an engine overheated by causes not connected with the lubricant. If engine is clean and otherwise in order, see that you are using the correct grade of Patent CASTROL. Consult the Lubrication Index on pages 44 to 49.

WHAT IS PATENT CASTROL?

THE same famous Castrol engine oils have been improved since 1st January, 1935, and are now marketed under the name " Patent CASTROL." The same grade letters are retained to distinguish the grades suitable for each engine.

The Patents cover the use of certain new stabilisers including oil-dispersed compounds of chromium and tin, scientifically treated and processed with the oil.

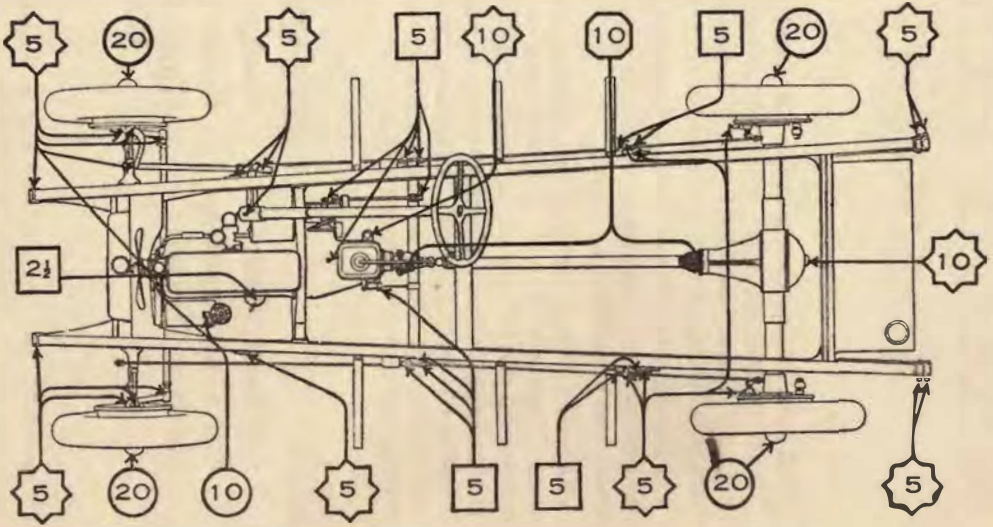
Chromium, in an invisible oil-dispersed film, forms an assured protection against corrosive wear to the cylinder and working parts of your engine, whilst a tin-derived inhibitor in microscopic soluble form stabilises the oil itself against the formation of sludge and gum. It has been proved by official tests of eminent authorities, motor manufacturers, and in everyday use that this patented process :

REDUCES	PREVENTS
Cylinder Wear	Sludge
Oil Consumption	Choked Filters
Carbon Deposit	Gummed Piston Rings

If you would like further information please ask us for Explanatory Booklet.

GENERAL LUBRICATION CHART

It must be understood clearly that these instructions and figures are given as a general guide and that the maker's own instructions should be followed in detail. The chassis drawing represents a typical car of up-to-date design, but is not intended to be of any particular make.



Explanation of the Chart

Periods at which attention is required.

Figures in the symbols indicate periods at which attention is required in 100's of miles, i.e., 2½ denotes 250 miles, 5—500, etc.

Lubricants to Use.

The lubricants to use are represented on the diagram by the different symbols, thus :—

Wakefield Patent Castrol XL.
A medium-bodied engine oil of the highest quality.

CASTROL D Gear Oil.
A pure gear oil for lubrication of gear box and back axle. Also for application with the oil gun at the various chassis points.

Wakefield Castrolease Heavy.
A heavy grade grease specially suitable for wheel hubs.

Castrol Unijoynt Grease
A high speed non-separating grease for universal joint lubrication.

NOTE.—These are representative of CASTROL lubricants to the parts mentioned, C. C. Wakefield & Co., Ltd., have studied the requirements of each car and a full list of these together with recommended lubricants commences overleaf

Symbol on Diagram.	Parts Requiring Attention.	How to Lubricate.
2½	Engine.	Check oil level by means of dipstick and replenish.
5	Fan Bearing, Spring Pins and Shackles, Stub Axle Swivel Pin, Brake Cam Shafts, Steering Gear Box, and Connections.	Use oil gun at nipples provided.
5	Brake Control Gear Joints, and Linkage and Clutch Thrust Bearing.	Apply oil can generously.
10	Gear Box and Rear Axle.	Check oil and replenish to correct level.
10	Universal Joints.	Attach grease gun and fill ⅔ full.
10	Distributor and Water Pump.	Give screw-down grease cup 1 turn.
20	Wheel Hubs.	Remove Hub Cap and repack hub.

Magneto and Generator.—Every 1,000 miles place two or three drops of Wakefield OILIT in oilers provided.

DRAIN and REFILL.

Engine.—After first 500 miles and every subsequent 1,000 to 2,000 miles flush out with light oil, **NOT** paraffin, before refilling with fresh oil.

Gear Box and Rear Axle.—After first 500 miles and every subsequent 5,000.

The following list shows the most suitable grades of

WAKEFIELD PATENT CASTROL

These recommendations are equally applicable for use with Petrol, Benzole, or a mixture of both.

CORRECTED TO 1st NOVEMBER, 1937

CARS, LIGHT CARS and CYCLE CARS

NAME OF CAR.	Engine		Gear Box	Back Axle
	Summer	Winter		
A.C. (1935 & Previous) ...	XXL	XL	ST	D
A.C. (1936/8)	XL	AA	XL	D
A.J.S. (1931 and Previous)...	XL	XL	R	D
A.J.S.	XL	XL	XL	D
Adler	XL	AA	ST	ST
Alfa Romeo	XXL	XL	ST	ST
Alta	XXL	XXL	ST	ST
Alta (with self-change) ...	XXL	XXL	F	ST
Alvis (F.W.D. Supercharged)	R	R	XL	XL
Alvis (with self-change G.B.)	XL	XL	F	HP
Alvis (all 1935/7 models) ...	XL	XL	F	HP
Alvis (17 & 20 H.P. 1938)	XL	XL	AA	HYPOY
Alvis (other 1938 Models)...	XL	XL	AA	HP
Amilcar	XXL	XXL	XXL	ST
Ansaldo	XL	XL	ST	ST
Argyll	CW	CW	ST	ST
Armstrong Siddeley ...	XL	AA	ST	ST
Armstrong Siddeley (with self-change) ...	XL	AA	XL	ST
Aston Martin	XXL	XL	ST	ST
Aston Martin (1936/8) ...	XXL	XL	ST	HP
Auburn	XL	AA	D	HP
Austin (Standard Models) ...	XL	AA	XL	D
Austin 7 Sports	XXL	XXL	XXL	D
Austin (10 & 12/6 Sports) ...	XXL	XL	XXL	D
Austin (1937/8 Sports) ...	XXL	XL	XXL	HP
Austin (1937/8 other Models)	XL	AA	XL	HP
Austro-Daimler (Type ADR)	AA	CW	ST	ST
Austro-Daimler (Type Bergmeister & ADR.8) ...	C	C	ST	ST
Autovia	XL	AA	XL	R
B.M.W.	XL	AA	XL	HP
Ballot	XL	XL	R	D
Ballot (Sports)	R	R	R	R
Bentley (to 1931)	XL	XL	ST	R
Bentley	XL	CW	XL	HP
Benz	C	C	ST	ST
Berliet	XL	AA	ST	ST
Bianchi	XL	XL	R	R
British Salmson	XL	AA	ST	ST
Brough Superior	XL	CW	HP	HP
*B.S.A. (3 Wheeler) ...	XL	AA	D	D
B.S.A. (10 & 12 h.p.) ...	XL	AA	XL	D
B.S.A. (Scout)	XL	AA	D	D
Bugatti (Models 49/46) ...	XL	XL	ST	ST

* If fitted with 4-speed gearbox "XL."

NAME OF CAR	Engine		Gear Box	Back Axle
	Summer	Winter		
Bugatti (Models 50-55, 57 & 575)	R	R	ST	ST
Buick (1935 and Previous)	AA	CW	D	D
Buick (1936)	AA	CW	D	HP
Buick (1937/8)...	AA	CW	D	HYPOY
Buick (1938)	CW	CW	D	HYPOY
Cadillac	AA	AA	D	D
Cadillac (1936)	AA	AA	HP	HP
Cadillac (1937/8)	AA	AA	HP	HYPOY
Chenard Walcker	XL	AA	ST	ST
Chevrolet	AA	CW	ST	D
Chevrolet (1937/8)	AA	CW	ST	HYPOY
Chrysler (1931 & Previous)...	AA	AA	D	D
Chrysler	AA	AA	ST	ST
Chrysler (1936)	AA	AA	ST	HP
Chrysler (1937/8)	AA	CW	ST	HYPOY
Citroën	XL	AA	ST	ST
Clyno	XL	XL	D	D
Coventry Victor	XL	XL	ST	
Crossley Ten	XL	AA	D	D
Crossley Ten (with self-change G.B.)	XL	AA	F	D
Crossley (Golden & Super Six 1934)	XXL	XL	XXL	D
Crossley (other Models) ...	XXL	XL	F	D
Crossley (Streamline) ...	XXL	XL	F	HP
†Daimler (1935/8)	XL	AA	XL	D
†Daimler (1931/34) ...	C	AA	F	D
†Daimler (1930 & Previous)	C	AA	ST	D
Darracq	XL	XL	ST	ST
Delage	XL	AA	ST	ST
Delahaye (1937/8 self-change)	XL	AA	AA	HP
Delahaye (1937/8 other Models)	XL	AA	ST	HP
Derby	XXL	XXL	ST	ST
De Soto	AA	AA	D	D
Diatto	XXL	XXL	ST	ST
Dodge	AA	AA	ST	HP
Dodge (1937/8)	AA	AA	ST	HYPOY
Essex (1932 and Previous) ...	XL	CW	XL	D
Essex (1933 and 1934) ...	XL	CW	ST	D
Falcon Knight	CW	CW	LC	LC
Fiat	C	C	ST	ST
Fiat (6 h.p.)	AA	CW	ST	ST
F.N.	XXL	XXL	ST	ST
Ford (1928/1932 Models) ...	AA	CW	D	D
Ford (1933/34 Models) ...	AA	CW	ST	D
Ford (1935/8)	AA	CW	HP	HP
Franklin	XL	XL	D	D
Frazer Nash	XXL	XL	LC	LC
G.N.	XL	XL	LC	LC
Graham (1933 and Previous)	AA	CW	ST	ST
Graham (Overdrive) ...	AA	CW	XXL	HP

† Fluid flywheel—Engine Oil.

NAME OF CAR	Engine		Gear Box	Back Axle
	Summer	Winter		
Graham (other 1934/7 Models)	AA	CW	ST	HP
Hampton	AA	CW	ST	ST
H.E.	XXL	XXL	ST	ST
H.R.G.	XXL	XL	XXL	HP
Hillman	XL	AA	XL	D
Hillman (1936 6-cyl.) ...	XL	AA	XL	HP
Hillman (1937/8 Minx) ...	XL	CW	XL	D
Hillman (1937/8 6-cyl. Models)	XL	CW	XL	HP
Hispano-Suiza	XXL	XL	ST	ST
Hispano-Suiza (Sports) ...	R	R	ST	ST
Hotchkiss	XL	AA	ST	ST
Hudson (1932 and Previous)	XL	CW	D	D
Hudson (1933/34)	XL	CW	HP	HP
Hudson (1935)	XL	CW	HP	HP
Hudson (1936)	XL	CW	HP	HP
Hudson (1937)	AA	CW	HP	HP
Humber	XL	AA	*XL	D
Humber (1936 6-cyl.) ...	XL	AA	XL	HP
Humber (1937/8 Twelve) ...	XL	CW	XL	D
Humber (1937/8 6-cyl. Models)	XL	CW	XL	HP
Hupmobile (1933 & Previous)	AA	CW	D	D
Hupmobile (with T.O.) ...	AA	CW	XXL	HP
Hupmobile (other Models)...	AA	CW	ST	HP
Invicta	XL	XL	ST	D
Invicta (with self-change) ...	XL	XL	F	D
Isotta-Fraschini	XXL	XXL	D	D
Itala	AA	AA	ST	ST
J.M.B.	XL	AA	XL	
Jensen	AA	CW	HP	HP
Jowett (1932 and Previous)	XL	CW	D	D
Jowett (1933/6)	XL	CW	XL	D
Jowett (1937/8)	XL	CW	XL	XL
Lagonda (1936 & Previous)	XXL	XL	XXL	HP
Lagonda (with self-change)	XXL	XL	F	HP
Lagonda (1937/8)	XXL	XL	AA	HP
Lammas Graham	AA	CW	ST	HP
Lanchester (1932 & Previous)	XL	XL	XL	D
†Lanchester (1933/34) ...	XL	XL	F	D
Lanchester (1935/8) ...	XL	AA	XL	D
Lancia	XL	XL	D	D
La Salle	AA	AA	D	HP
La Salle (1937/8)	AA	AA	HP	HYPOY
Lea Francis (4 & 6-cyl.) ...	XXL	XL	D	D
Lea Francis (T.T. Models)	R	R	D	D
Lincoln (1933 and Previous)	AA	CW	ST	ST
Lincoln	AA	CW	ST	HP
Marmon	CW	CW	ST	ST
Marquette	AA	AA	D	D
Mathis	XL	CW	XL	D
Mercedes	XL	XL	HP	HP

† Fluid flywheel "XL."
* If De Normanville Gear Box CASTROL H.

NAME OF CAR	Engine		Gear Box	Back Axle
	Summer	Winter		
Mercedes (super-charged) ...	R	R	HP	HP
M.G. (1935 and Previous) ...	XXL	XL	ST	ST
M.G. (1936/8)	XL	XL	ST	HP
M.G. (with self-change) ...	XXL	XL	F	HP
Minerva	AA	CW	ST	ST
Moon	AA	AA	D	D
Morgan (1931 and Previous)	XL	XL	GE	—
Morgan (1932/33)	XL	XL	D	—
‡Morgan (1934/38) ...	XL	XL	D	—
‡Morgan (4-cyl.)	XL	AA	D	—
Morris (1933 and Previous)	XL	AA	D	D
Morris (1934/1938) ...	XL	AA	ST	HP
Moveo	XXL	XXL	XXL	D
Nash (Transmission Overdrive)	AA	CW	XXL	HP
Nash (Normal)	AA	CW	HP	HP
Oldsmobile (1932 & previous)	AA	AA	D	D
Oldsmobile (1933/36) ...	AA	AA	D	HP
Oldsmobile (1937/8) ...	AA	CW	D	HYPOY
O.M.	XL	XL	ST	ST
Opel (1937)	AA	CW	ST	HP
Opel (1938 Olympia and Cadet)	AA	CW	ST	HYPOY
Opel (1938—2½ Litre) ...	AA	CW	ST	HP
Overland (13.9, 6-cyl. and Whippet)	CW	CW	LC	LC
Packard	CW	CW	ST	HP
Packard (1937/8)	CW	CW	ST	HYPOY
Panhard Levassor	CW	CW	CW	CW
Peugeot (Sleeve Valve) ...	AA	CW	D	D
Peugeot (other Models) ...	XL	AA	D	D
Peugeot (1937/8)	XL	CW	ST	HP
*Pontiac	AA	AA	D	D
*Pontiac (1937/8)	AA	CW	D	HYPOY
Railton (1935 & Previous) ...	XL	CW	ST	ST
Railton (1936/7)	XL	CW	HP	HP
Raleigh (3-wheeler) ...	XL	XL	XL	D
Rapier	XXL	XXL	F	HPH
Renault	XL	AA	ST	D
Renault (Vivasport) ...	XXL	XL	D	D
Reo	AA	CW	D	D
Rhode	XL	XL	D	D
†Riley (1932 and Previous) ...	XL	XL	XL	D
Riley (1933/4)	XL	AA	XL	D
Riley (1934 4-cyl. with self-change gearbox) ...	XL	AA	F	D
Riley (1934 6-cyl. self-change)	XL	AA	XL	D
Riley (Imp)	XL	AA	F	HPH
Riley (1935/7 other Models)	XL	AA	‡XL	HPH
Riley (1938—Sports Model)	XXL	XL	XXL	HPH

† During summer add 25% "D" to gearbox.
* Use Castrol Swanshot for gearbox in winter
‡ Use Patent Castrol AA for gearbox in winter.

NAME OF CAR	Engine		Gear Box	Back Axle
	Summer	Winter		
Riley (1938 other Models)	XL	AA	XL	HPH
Rolls-Royce (40/50 h.p.) ...	XL	XL	XXL	HP
Rolls-Royce (20/25 h.p., and 25/30, 1933/38) ...	XL	CW	XL	HP
Rolls-Royce (40/50 h.p., 1933/38)	XL	CW	XL	HP
Rover (8 h.p.)	C	C	D	D
Rover (9 h.p.)	XL	AA	XL	D
Rover (10/25 h.p., 12 h.p. & Light 20 1933 & Previous)	XL	AA	D	R
Rover (Meteor, 16 h.p.) ...	XL	AA	D	D
Rover (1933/37 Speed Models)	XXL	XL	XXL	XXL
Rover (1933/37 all other Models)	XL	AA	XXL	XXL
Rover (1938)	AA	CW	XXL	XXL
Schneider	XL	XL	XL	ST
Senechal	XL	XL	D	D
Singer	XL	AA	XL	D
Singer (Le Mans Models) ...	XXL	XL	XL	D
Squire	XL	CW	F	D
Standard (1933 & Previous)	XL	AA	ST	D
Standard	XL	CW	XL	D
Standard (1937)	XL	CW	XL	HP
Standard (1938)	AA	AA	AA	HP
Star	XL	XL	XL	ST
Stearns-Knight	CW	CW	D	D
Steyr (Types 50.45, 40 N and 40 O)	AA	CW	AA	HP
Steyr (other Models) ...	AA	CW	ST	HP
*Studebaker (1933 and Previous)	XL	XL	D	D
Studebaker (1934)	AA	CW	ST	ST
Studebaker (1935/6) ...	AA	AA	XXL	ST
Studebaker (1937/8) ...	AA	CW	XXL	HYPOY
Stutz	XXL	XL	ST	R
Sunbeam	XL	AA	ST	ST
Sunbeam (with self-change)	XL	AA	†	ST
Sunbeam (3 litre Sports) ...	R	R	ST	ST
Swift	XL	XL	D	D
S.S. (1933 and Previous) ...	XL	AA	ST	D
S.S. (1936 Jaguar and all 1937 Models) ...	XL	CW	XL	HP
S.S. (1934/6 other Models)	XL	CW	XL	D
S.S. (1938)	AA	AA	AA	HP
Talbot (1932 and Previous)...	XXL	XXL	XXL	D
Talbot (self-change) ...	XL	AA	†	HP
Talbot (synchro-mesh) ...	XL	AA	XL	HP
Talbot (10 h.p.)	XL	CW	XL	D
Talbot-Darracq	AA	AA	ST	ST
Terraplane (1934)	XL	CW	HP	HP
Terraplane (1935)	XL	CW	HP	HP

† Oil supplied from engine.
* If fitted with free wheel transmission "AA" for gearbox

NAME OF CAR	Engine		Gear Box	Back Axle
	Summer	Winter		
Terraplane (1936)	XL	CW	HP	HP
Terraplane (1937)	AA	CW	HP	HP
Triumph (1936 & Previous)	XL	AA	XXL	XXL
Triumph (1937/8)	XL	AA	XL	HP
Trojan (Chain Drive) ...	XL	AA	XL	HC
Trojan (Worm Drive) ...	XL	AA	XL	D
Vale Special	XXL	XL	R	R
Vauxhall (23.8 h.p.) ...	AA	CW	ST	ST
Vauxhall (30/98 h.p.) ...	R	R	ST	ST
Vauxhall (1936 and Previous)	AA	CW	ST	D
Vauxhall (1937)	CW	CW	ST	D
Vauxhall (10 h.p. 1938) ...	CW	CW	ST	HP
Vauxhall (other 1938 Models	CW	CW	ST	D
Voisin	CW	CW	ST	ST
Wolseley (1933 and Previous)	XL	XL	D	D
Wolseley (1934 & 1935) ...	XL	XL	ST	D
Wolseley (1936/8)	XL	AA	ST	HP

CASTROL HYPOY GEAR OIL

is recommended for the Hypoid Rear Axles of the following Cars:—

Alvis (17 & 20 h.p.—1938)
Buick (1937/8)
Cadillac (1937/8)
Chevrolet (1937/8)
Chrysler (1937/8)
Dodge (1937/8)
La Salle (1937/8)
Oldsmobile (1937/8)
Opel (1938)
Packard (1937/8)
Pontiac (1937/8)
Studebaker (1937/8)

CASTROL HI-PRESS GEAR OIL

is recommended for the following cars:—

Alvis (1935/8)
Aston-Martin (1936/8)
Auburn (1934/8)
Austin (all 1937/8 models)
Bentley (1934/8)
Buick (1936)
Cadillac (1936)
Chrysler (1936)
Dodge (1936)
Ford (1935/8)
Frazer-Nash—B.M.W.
Graham (1934/7)
Hillman (1936, 6-cyl.)
Hillman (all 1937/8 except Minx)
Hudson (1933/7)
Humber (1936, 6-cyl.)
Humber (1937/8, except 12 h.p.)
Hupmobile (1932/6)
Lagonda
Lammas Graham (1936/8)
Lincoln (1934/8)
M.G. (1936/8)
Mercedes (1937)
Morris (1934/8)
Nash
Oldsmobile (1935/6)
Opel (1937)
Peugeot (1937/8)
Packard (1936 and previous)
Railton (1936/8)
Rapier
Riley (1935/8) (Heavy Grade)
Rolls-Royce
S.S. (1936 Jaguar and all 1937/8 models)
Standard (all 1937/8 models)
Steyr
Talbot (1933/8)
Terraplane (1934/8)
Triumph (1937/8)
Wolseley (1936/8)

KEY TO RECOMMENDATIONS

MOTOR OILS.

Arranged in order of viscosity (or body).

CW	**Patent Castrol CW**	Practically carbonless. Fairly light-bodied, slightly less viscous than Patent CASTROL AA. Specially suitable for sleeve-valve engines, and some American cars in winter.
AA	**Patent Castrol AA**	A medium oil. Recommended for the winter lubrication of most popular English cars, and for use throughout the year in many American cars.
XL	**Patent Castrol XL**	The finest oil obtainable for many high-efficiency motor cycle and car engines. A fairly heavy-bodied oil especially suitable for use with aluminium pistons.
C	**Patent Castrol C**	A heavy oil for some motor cycles, cars and commercial vehicles.
R	**Patent Castrol R (Racing)**	Essentially an oil for high speed work. Used by leading car and motor cycle racing experts.
XXL	**Patent CastrolXXL**	Possesses all the characteristics of Patent CASTROL XL, but is of heavier body. Specially recommended for sports, high compression, and certain aero engines.
GP	**Patent Castrol GP.**	Heavier than any of the above grades.

GEAR OILS.

H	**Castrol H**	Possesses abnormal heat-resisting qualities. Specially prepared for use with De Normanville Gearboxes.
F	**Castrol F**	Specially suitable for self-changing gears.
ST	**Castrol Swanshot Gear Oil.**	This remarkable modern Gear Oil remains fluid even at 10° below freezing point. Ideal for chassis lubrication, many central and one-shot oiling systems, synchromesh gearboxes and for oil-tight rear axles.

D **Castrol D. Gear Oil.** A full-bodied Gear Oil.

D Heavy **Castrol D. Heavy Gear Oil.** Similar to Castrol D. but darker in colour and thicker at air temperatures.

No. 1. **Castrol No. 1 Gear Oil.** A heavy bodied dark Gear Oil.

HP **Castrol Hi-Press Gear Oil.** A "mild" extreme pressure lubricant.

HPH **Castrol Hi-Press Heavy Gear Oil.** A Heavier grade extreme pressure lubricant.

HYPOY **Castrol HYPOY Gear Oil.** A "Powerful" extreme pressure lubricant.

GREASES.

LC **Castrolease Light.** A semi-liquid Grease for some Motor-cycle gearboxes.

MC **Castrolease Medium.** A heavier grade for chassis lubrication by grease gun or cup, spring gaiters, and gearboxes which require a grease. Recommended by Burman & Sons, Ltd.

HC **Castrolease Heavy.** A heavier grade for chassis lubrication. Specially suitable for Ball and Roller Bearings.

XHC **Castrolease Extra Heavy.** A still heavier grade for chassis lubrication. Specially suitable for tropical climates.

G **Castrolease Graphited.** A Graphited Grease for transmission chains, overhead valve rocker bearings, valve cap threads, road springs, etc. Recommended by Messrs. Renold and Coventry Chain Co., Ltd.


WAKEFIELD
PATENT
Castrol
MOTOR OIL