The adjusting nut should not be screwed up more than one serration—that is, $\frac{1}{25}$ of a turn—without testing the servo adjustment.

To test the servo adjustment the pedal should be depressed lightly by hand sufficiently to engage the servo and compress the buffer springs **Z1**, but just short of moving the lever **A2** rotationally.

The pedal travel should then be not less than $\frac{1}{2}''$ measured at the top of the pedal towards the dash.

It must be realised that this movement is entirely due to operation of the servo, and does not alter the rear brake clearances. Hence, lever **A2** is not moved rotationally, as mentioned.

After adjustment, the servo clearance should always be checked again by measuring the pedal movement as explained.

Emphasis is laid on this point, as obviously a dragging servo, due to abuse of the adjustment provided, would result in dragging of the brakes on all wheels.

Lubrication. The centralised chassis lubrication system described in Chapter I. and illustrated in Fig. 2, deals with the lubrication of the brake cam and actuating shafts on both axles, the rear brake countershafts, the front, rear, and hand brake equalisers and their shafts, the pedal shaft, the "T"-shaped balancing lever, the pneumatic damper and the fulcrum of the hand brake lever.

The outer bearings of the servo are arranged for lubrication with the oil can, a spring lid lubricator being provided. As directed on page 131, only one or two drops of engine oil should be injected every 5,000 miles. Excess of oil at this point must be carefully avoided.

Spouts are arranged on the brake covers just below the rear axle, as shown at **X** in Fig. 19, in order, as far as possible, to drain away oil which might otherwise reach the brake surfaces. These spouts should be inspected frequently and kept clear of any obstruction. In the case of the front brakes, a drain hole will be found in the covers beneath each brake cam shaft, which must also be kept clear.

In addition, there is a number of joints and links of the rods and levers which must be oiled with the oil can every 2,000 miles or four weeks, as instructed on page 129.

Oil on Brakes. If, owing to overfilling of the axle casing, or choking up of the oil drain channels referred to, the brakes become oiled up and ineffective, it will be necessary to remove the hubs, in which event application should be made to Rolls-Royce Ltd.

Use and Abuse of the Brakes. Although in the layout of the brake system every care has been taken to ensure, for a given pedal pressure, a constant retarding effect on the wheels distributed in a constant ratio between the front and rear wheels, a factor which remains very far from constant and outside the control of automobile designers is the adhesion between the tyres and the road.

As is well known, this factor varies greatly, being best on dry, firm roads, and worst on wet or loose-surfaced roads.

It is therefore very necessary for a driver to use his brakes with due regard to the conditions of the road, especially when rounding a curve or corner.

Violent braking under such circumstances—whether only the rear wheels are braked or all four—is far more likely to produce a skid than when the car is proceeding along a straight road.

This is due to the fact that a locked wheel ceases to have any tendency to proceed in its normal direction of rolling, and may be comparatively easily induced to move sideways. Further, a wheel which is braked almost to the limit of its adhesion to the road, that is to say, which is on the point of skidding, is much more easily deflected from its normal course.

When rounding a corner heavy side stresses are set up due to centrifugal force, and the conditions then present, if the rear wheels are locked or heavily braked, all favour a serious rear skid.

Such a skid, with a little skilful driving, may usually be corrected.

A front wheel skid, however, is incomparably more dangerous, as it is insidious and difficult to detect at the outset, and cannot be corrected so long as the front wheels are locked, there being then no steerage-way on the car.

The first intimation which a driver usually has that the front

wheels are locked is the fact that the car will not respond to movement of the steering wheel but continues straight ahead.

In fact, on a greasy road a driver may not realise that the front wheels are locked until he attempts to steer the car.

The only course then is to release the foot brake, when steerageway will usually be recovered.

It requires some presence of mind to do this, the first impulse being to put more pressure on the pedal.

Drivers should cultivate the habit of always releasing the brakes when actually turning a corner. The power of retardation provided is so great that there is no necessity for the full power of the brakes to be used on a turn.

Therefore, it is necessary to use the brakes with the greatest discretion when the car is rounding a curve, and with due consideration for the state of the road.

Experienced drivers will know that this applies to any form of braking, but with four-wheel brakes—with their increased powers of retardation—it will be obvious that still more care is necessary.

Also, one should remember that following traffic may not possess the rapid retarding powers of the Rolls-Royce with four-wheel brakes. Therefore drivers should continually keep themselves aware of the presence of any overtaking vehicle in order that the latter may be warned in time to prevent a rear collision if the Rolls-Royce car has to be heavily braked.

As far as possible the brakes should not be suddenly and violently applied. If they are, the rear wheels will certainly be locked and the power of the brakes thereby greatly reduced. Pressure should be applied to the pedal steadily, and so adjusted that the rear wheels are just short of skidding.

The maximum braking will then be available.

When stopping the car by means of the foot brake, this should be eased off when the car comes to rest, in order to avoid any shock or jerk to the passengers. It is found that this shock is most pronounced when the car is proceeding at quite slow speeds, and is then brought to a sudden standstill.

The hand brake should be used for holding the car when stationary.

Apart from the comfort of passengers and the safety and convenience of other road users, it must not be forgotten that the practice of braking heavily and frequently will inevitably make itself felt in the matter of tyre wear and cost of renewals.

The latter should not be greater with four-wheel brakes than with only rear wheel brakes.

If it is found to be so, then the fact can be taken as an indication that the driver is habitually taking too great an advantage of the retarding abilities which the brakes provide.

If chains are fitted to the rear wheels for driving on snow and ice, it is necessary also to equip the near side front wheel similarly. If this is not done, the front wheels will certainly be locked by application of the foot brakes due to the greater adhesion of the rear wheels.

No chains should be fitted to the off side front wheel. If only two sets of chains are available, these must be arranged on the off side rear and near side front wheels, respectively.

CHAPTER V.

Clutch, Gearbox, Propeller Shaft and Rear Axle.

Clutch Adjustments—Lubrication of Clutch Mechanism—Gearbox—Universal Joints—Rear Axle.

A part sectional elevation of the clutch is shown in Fig. 22.

It is of the single dry-plate type, the fabric, **O**, being secured to the flywheel, and clutch ring, **E**, respectively, thereby enabling the clutch plate, **P**, to be kept as light as possible.

Four levers, **R**, are provided for clutch withdrawal purposes, their ends being pressed inwards on operation of the clutch pedal by the sliding sleeve **D**, actuated through a ball thrust bearing and trunnion.

Owing to these and other features, operation of the clutch is very smooth and light, and gear-changing is greatly facilitated.

Clutch Adjustments. No attempt should be made to effect any adjustments to the clutch. Owing to the care taken in design, manufacture and testing, it is very unlikely that any adjustment will be necessary between general overhauls of the chassis.

Lubrication of Clutch Mechanism. The various joints and bearings of the clutch-operating mechanism should be lubricated periodically with an oil can, as directed on page 129.

There is a cup and oil-hole, **L**, in the clutch trunnion into which oil is fed by a spout, **L1**, from the chassis lubrication system to the ball thrust bearing.

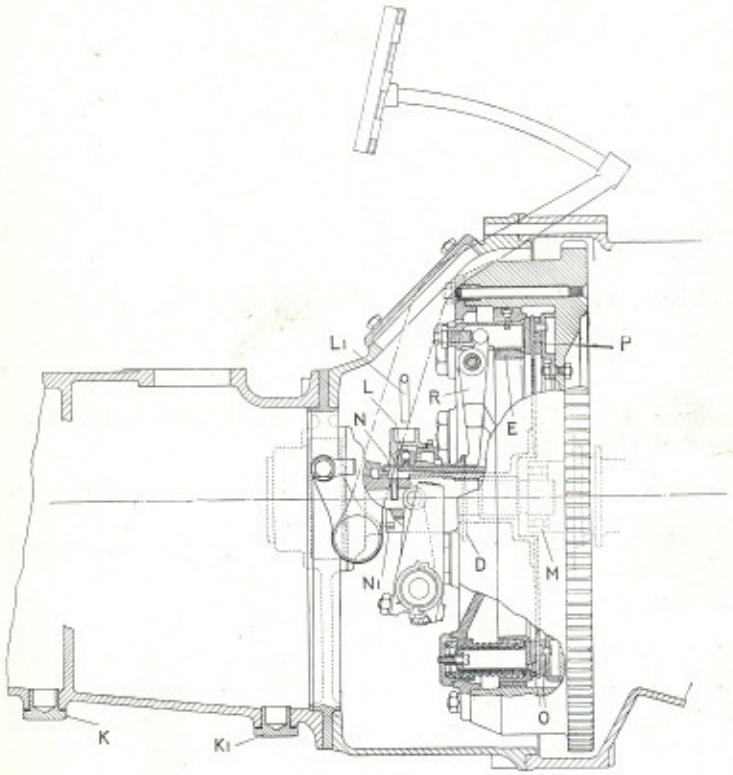

FIG. 22. PART SECTIONAL VIEW OF CLUTCH.

The clutch shaft, which is hollow, is spigotted at its forward end in the crankshaft on a ball bearing shown dotted at **M**.

Provision is made for the lubrication of this bearing by means of a small hole, **N**, through one side of the clutch shaft. To reach this hole, the sleeve, **D**, must be rotated with the fingers until a slot, **N1**, is at the top, and the engine then cranked until the hole is visible through this slot. A few drops only of oil should be inserted every 5,000 miles, as directed on page 131.

It is very important not to over-oil at this point, as excess of oil will find its way on to the clutch surfaces and cause trouble.

The bearings of the hollow clutch withdrawing shaft are lubricated from the chassis lubrication system. (See Fig. 2.)

The fulcrum pins of the levers **R** should also be lubricated every 5,000 miles, as directed on page 131.

Gearbox. The two main shafts of the gearbox are supported in three bearings each. The extra bearings contribute largely to the permanent silence of the gears, and, in the case of the third motion shaft, relieve the spigot bearing of much of its load.

On certain chassis a special device is incorporated to facilitate gear changing between third and fourth speeds and the change up from second to third.

Engine oil is inserted by unscrewing the filler plug, shown at **C**, Fig. 21, or in some cases located on a spout on the near side of the gearbox.

In the case of the former, oil should be poured in until the level reaches to the notch in the flat on the dip stick, **C1**, Fig. 21, and in the case of the latter, the oil level should reach the mouth of the filler spout.

It is very necessary that the oil should be well warmed before introduction, in order to reduce its viscosity. It is also important that the filling up should be done when the gearbox is warm after running, as otherwise a false level will be obtained.

The oil level should be inspected every 5,000 miles, as directed on page 131.

Every 20,000 miles all oil should be drained out by removing the two plugs, **K** and **K1** (Fig. 22), and fresh oil inserted, as directed on page 133.

A worm-driven connection is provided on the gearbox for the speedometer, the drive ratio being suited for the speedometer which is supplied.

Universal Joints. The propeller shaft universal joints are of a special type designed to be oil-retaining and having large bearing surfaces which are automatically flooded with oil by centrifugal force when the car is running.

The forward joint is shown in Fig. 23. Each is provided with an oil gun lubricator, **S**, and an air release plug, **T**, these being located diametrically opposite one another.

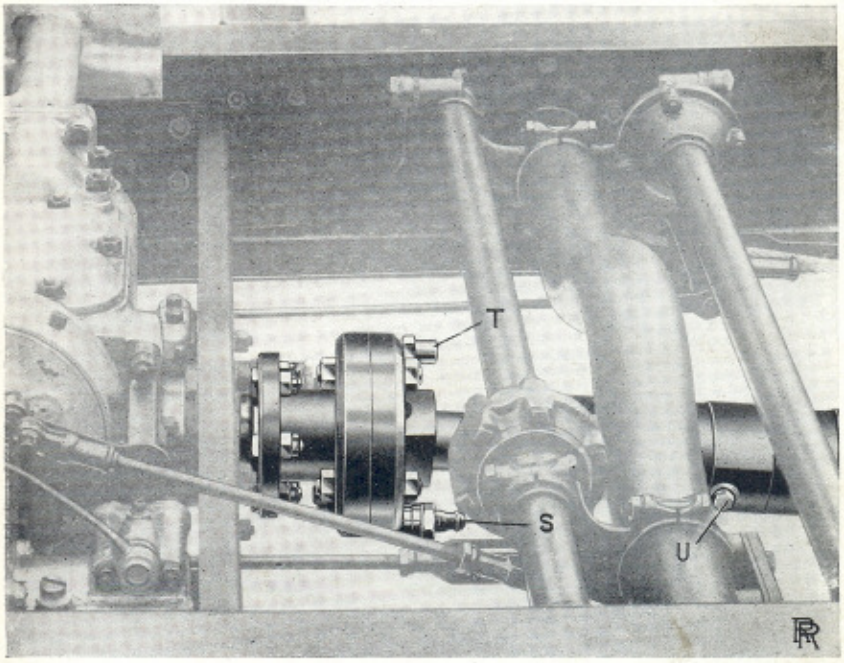

FIG. 23. FORWARD UNIVERSAL JOINT.

The quantity of oil in the joints should be checked every 2,000 miles, as directed on page 129. The only method of doing this is to turn the joint until the plug is at the top, remove the plug and inject oil by means of the oil gun through the lubricator until it commences to flow from the plug hole. This procedure will ensure that the casing is well filled with oil. Afterwards, the air release plugs must be carefully replaced.

It is of the utmost importance that no attempt should be made to inject oil with the gun without first removing the vent plugs as described. Such a course is likely seriously to damage the joint and impair its oil tightness.

The driven portion of the forward joint is provided with serrations which engage similar serrations within the propeller shaft to permit the necessary degree of telescoping movement. The serrated members are packed with grease during erection and need no attention between

overhauls of the chassis. In certain cases, however, a small plug, **U**, is provided, and this should be removed every 2,000 miles as directed on page 129, and about one tablespoonful of gear oil injected with the syringe.

Rear Axle. The rear axle is of the full floating type, the road wheels being mounted solely on extensions of the axle tubes.

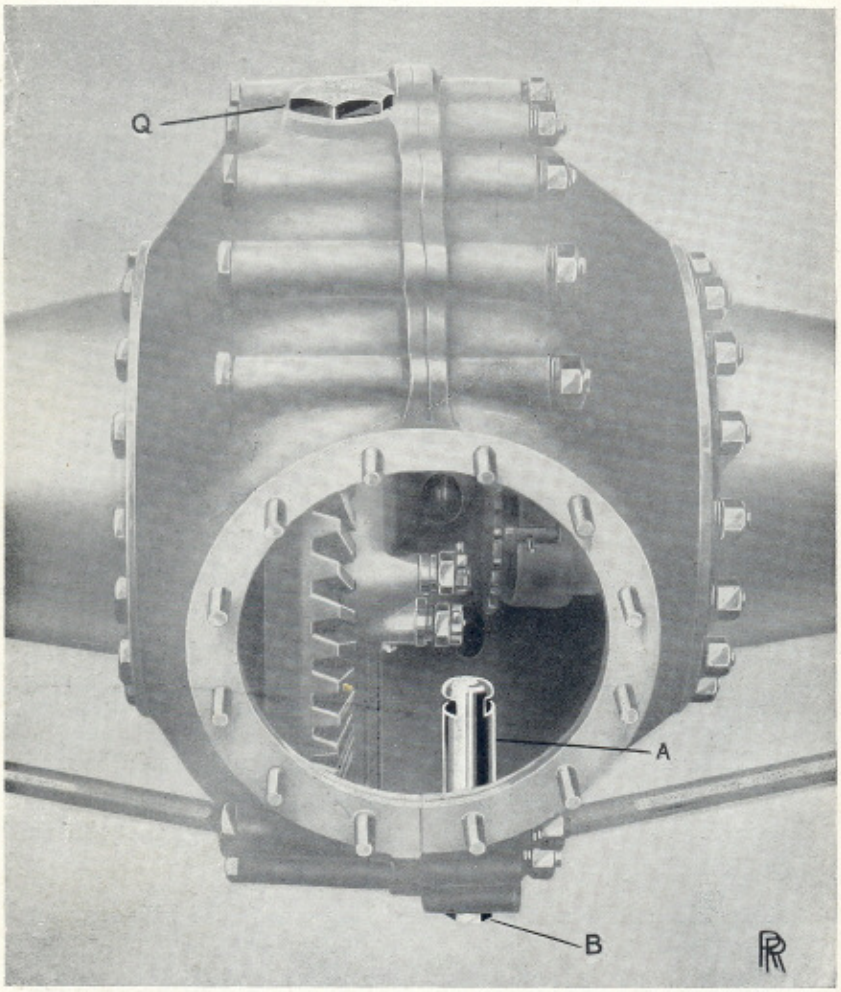

FIG. 24. OIL PLUGS IN REAR AXLE CASING.

The final drive is by spiral bevel gears.

In connection with lubrication of the axle, a point to be borne in mind when adding oil is that on certain chassis the oil level is determined by a stand pipe which projects the required height into the box and is normally closed at its bottom end by a plug.

The pipe is shown at **A** and the plug at **B** (Fig. 24). The latter should be removed during filling.

On removing the plug, a little oil may run out, but it should not be inferred from this that there is sufficient oil in the casing, as such oil is probably only what has been trapped in the stand pipe.

On other chassis, the oil level is determined by means of an overflow plug in the rear off side of the casing, which should be removed to check the oil level.

Filling should only be done when the axle is warm after running.

Warm gear oil should be poured in through the plug hole **Q** until it just commences to flow out of lower plug hole or overflow hole, as the case may be.

The oil level should be checked every 5,000 miles, as directed on page 131.

The oils recommended for use in the rear axle are given on page 126.

Every 20,000 miles all the oil should be drained out and replaced with fresh oil as directed on page 133.

To do this on chassis fitted with the stand pipe, the latter, **A**, must be removed by unscrewing the serrated nut into which plug **B** is screwed. A locking washer is arranged with its tab bent into a serration of this nut. This tab must first be bent clear, when the nut can be unscrewed with the special tool provided. This has a threaded portion, which must be screwed into the stand pipe, the serrations being guided to engage with those of the standpipe flange. The tool can then be rotated by means of an ordinary jaw spanner to unscrew the stand pipe.

When replacing the stand pipe, a new locking washer must be used, and its tab bent into a serration.

Other chassis have a drain plug provided under the casing.

CHAPTER VI.

Steering, Shock Dampers, and Road Springs.

Steering Column and Box—Steering Arms and Joints—Steering Pivots—Hydraulic Shock Dampers—Shock Damper Connections—Road Springs.

Steering Column and Box. Steering is by worm and nut, a double ball thrust bearing being carried on the column a short distance below the steering wheel.

The cover of the worm-and-nut mechanism casing is provided with a filling plug.

Every 2,000 miles, or four weeks, as directed on page 129, this plug should be removed, preferably when the box is warm, and the level of oil inspected. If necessary, gear oil should be poured in until it is on the point of overflowing from the plug orifice.

Steering Arms and Joints. The steering gear should be examined regularly every 5,000 miles, or half-year, as directed on page 132, to see that all bolts are tight and joints well lubricated.

It should be noticed particularly that the steering arms are tight on the stub axles, and that all the nuts and bolts securing them are tight.

If any nuts are found loose, and only being retained by their split cotters, the latter should be removed, the nuts screwed up tightly, and new cotters fitted.

The ball joints of the cross steering tube and also those of the side steering tube are lubricated from the chassis oil pump, as described in Chapter I. and illustrated in Fig. 2.

The bearing pads of all four joints are spring loaded, being self-adjusting for wear. They should not normally require attention except when the car is undergoing a general overhaul.

Steering Pivots. The bearings of the steering pivots are lubricated from the centralised chassis lubrication system, as described in Chapter I. The two strainers situated on the front axle must be dismantled and the felt pads renewed every 20,000 miles, as directed on page 133. No other attention is necessary.

Hydraulic Shock Dampers. Hydraulic shock dampers of Rolls-Royce design and manufacture are fitted to both front and rear axles, as shown in Figs. 25 and 26.

Unless it is obvious that the effectiveness of the shock dampers has become reduced, or undue leakage of oil is apparent, no attention whatever will be necessary for 10,000 miles of running.

After 10,000 miles' running, it is necessary to inspect the oil level in the shock dampers as directed on page 133.

For this purpose a filling plug, **O**, is provided, arranged at such a height in the casing as to control the maximum oil level.

As it is of vital importance that only perfectly clean oil of the correct brand should be used, the following precautions must be observed :—

(a) Before attempting to remove the plug **O**, both the plug and the shock damper casing adjacent to it must be cleaned very carefully with a brush dipped in paraffin, in order to avoid the possibility of dirt entering the hole when the plug is removed.

(b) Only one of the recommended oils must be used (see page 126), and before inserting this, it should be strained through a fine gauze. Straining is greatly facilitated if the oil be first warmed to about 75° C.

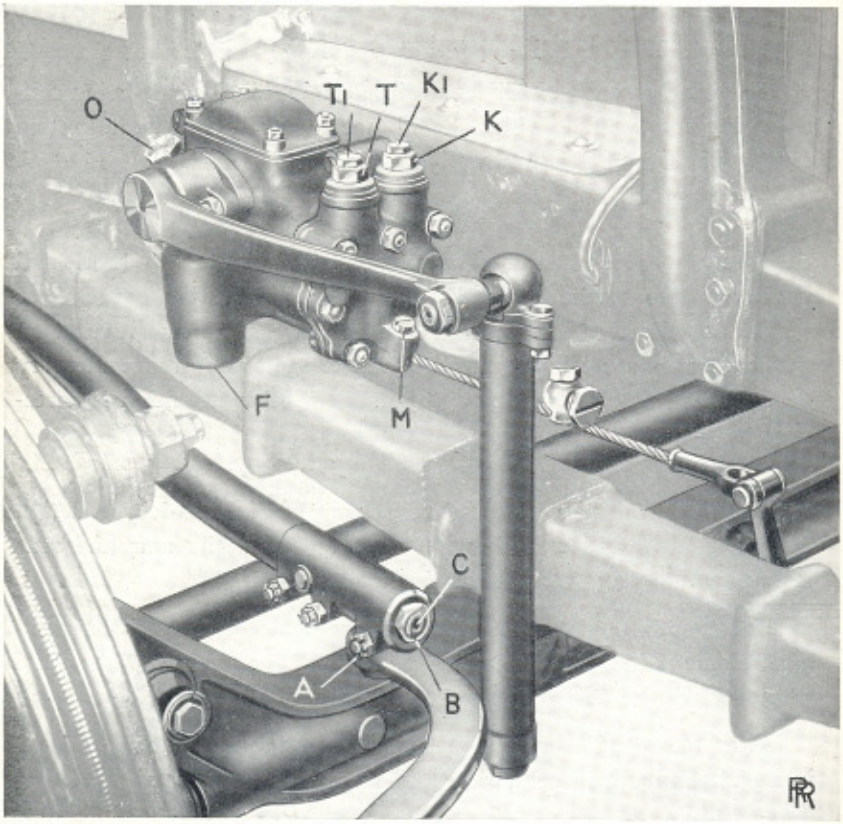

FIG. 25. FRONT HYDRAULIC SHOCK DAMPER.

The importance of such cleanliness cannot be over-emphasised. A very small particle of foreign matter in the oil may lodge under one of the valves and impair the effectiveness of the shock damper.

The plug **O** can then be removed with a box spanner, and the oil level restored, if necessary, to the bottom of the plug hole, the oil being poured in *very slowly* to avoid entrapping bubbles of air. When replacing the plug, care must be taken that its washer is in position.

Each shock damper consists of a piston operating in a cylinder which is maintained full of oil, the latter being displaced from one

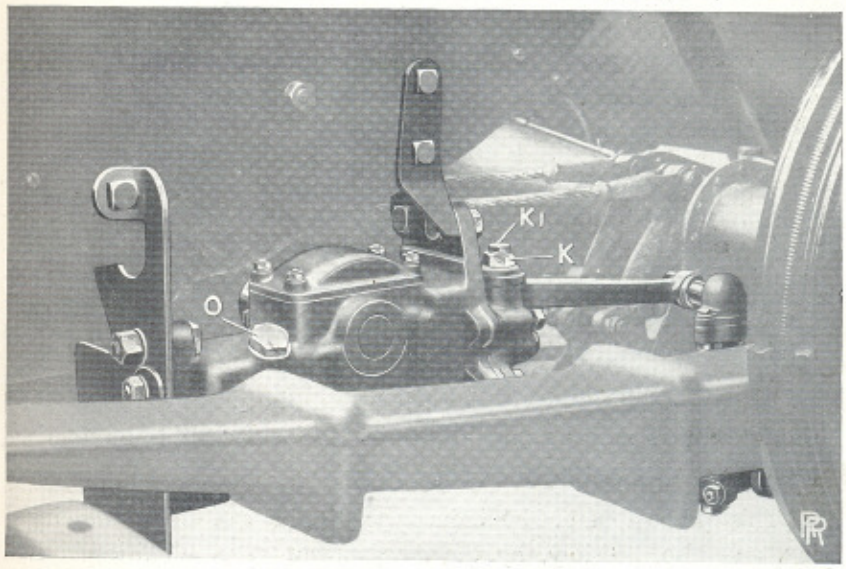

FIG. 26. REAR HYDRAULIC SHOCK DAMPER.

end of the cylinder to the other, past spring-loaded valves. The loading of the valves is such that greater resistance is offered to movement of the piston corresponding with downward movement of the axle relative to the frame than to upward movement of the axle.

In order to ensure that the working chambers shall be maintained full of oil, each end of the cylinder is provided with a ball valve controlling a passage which leads to an oil reservoir, the valves being located beneath screws **M**.

If there should be any shortage of oil in the working chambers, movement of the piston will cause one of these valves to lift and admit more oil from the reservoir, the oil passing through a gauze filter carried by the plug **F**.

As the presence of any air bubbles in the oil within the working chambers seriously impairs the effectiveness of the shock damper, special means are adopted to expel such air. Located at the highest point of the pressure system are very small holes, normally closed

by ball valves, which communicate with the upper part of the oil reservoir. The valves and holes are protected by gauze strainers. Any air present in the oil is easily expelled through the holes, but the size of the latter is too small to allow any appreciable quantity of oil to pass. The ball valves prevent air being drawn back into the working chambers.

These air leaks are arranged in the caps above the spring-loaded valves, being normally closed by the ball valves referred to. Referring to Figs. 25 and 26, K is the high pressure valve cap and T that over the low pressure valve, and K1 and T1 are nuts locking the adjustment for lift of the ball valves, or in some cases, plugs which retain the ball valves when no adjustment is provided.

In spite of these precautions, however, the effectiveness of the shock dampers may be impaired owing to insufficient oil or to the presence of dirt in the oil.

This will be apparent by an increased liveliness of the front springing, and also, possibly, by the development of peculiarities in the steering.

In such circumstances, and assuming ample oil is present in the reservoir, the ball-controlled air leaks should be inspected.

To do this it will be necessary to remove the caps K and T, but before doing so, great care must be taken to cleanse the caps and adjacent parts with a brush and paraffin, as in the case of plug O, to avoid the possibility of dirt getting into the shock damper. The caps K and T should first be unscrewed and then nuts or plugs K1 and T1, care being taken not to lose the small gauze strainers. A small slotted grub screw will be seen (where adjustment is provided), which can be removed to disclose the ball valve.

The small hole below the ball should be inspected to see that it is clear, the gauzes and other parts being carefully cleaned.

When replacing the caps K and T care must be taken to see that the springs just beneath them are seated properly on the valves, and that the gauze strainers are in position in the caps. Also, both caps and springs must be replaced in their original position and must not be interchanged.

Where adjustment is provided, it is very important that the lift of the ball valves should be carefully set to .010". This is done by first lightly screwing the grub screw right down on to the ball and afterwards releasing it one-quarter of a turn. Replacement of the nuts, K1 and T1, will lock this adjustment.

Washers are arranged beneath the parts K, K1, T and T1, and must be replaced.

As it is so very important that the shock dampers should be maintained always full of oil, evidence of any undue leakage should at once be reported to Rolls-Royce Ltd.

Shock Damper Connections. The connecting links of front and rear shock dampers are similar in design, therefore the notes which follow apply to both.

The ball and socket joints of these links are spring loaded by means of a coil spring, which exerts an equal pressure on the inner bearing pads of both the upper and the lower joint balls. The arrangement ensures that there shall be no slack in either joint, and renders the joints self-adjusting for wear. There is consequently no need for any adjustment between overhauls of the chassis.

Lubrication of the joints is effected automatically from the centralised chassis lubrication system, as described in Chapter I. and illustrated in Fig. 2. Oil is supplied to the lower ball of each link and conveyed through an internal conduit to the upper ball. Owing to the spring-loading there is no need for the interposition of a drip plug, therefore the supply is direct from the chassis system.

Road Springs. All spring pins and shackles are lubricated from the centralised chassis oiling system, as shown in Fig. 2.

The springs themselves are encased in leather gaiters, and, by means of a special arrangement of oil holes and grooves in the leaves, the ends of the three longest leaves of each spring are lubricated by surplus oil from the eye of the master leaf.

Owing to this arrangement, in combination with absorbent material inside the gaiter, the springs are entirely self-lubricating and remain free from squeaks.

It is advisable occasionally to inspect the " U " bolts which secure the springs to the axles to see that no nuts have worked loose.

When doing this it is not sufficient merely to satisfy oneself that the split cotters are still in position. The nuts should also be tested with a spanner. If any be found loose, the cotter must be removed before tightening.

In the case of the rear axle, such testing should be done when the car is jacked up with the head of the jack located between the two " U " bolts. This causes the latter to be relieved of tension due to the weight of the car, and the nuts can be re-tightened to better advantage.

After tightening, the nuts must be refitted with split cotters.