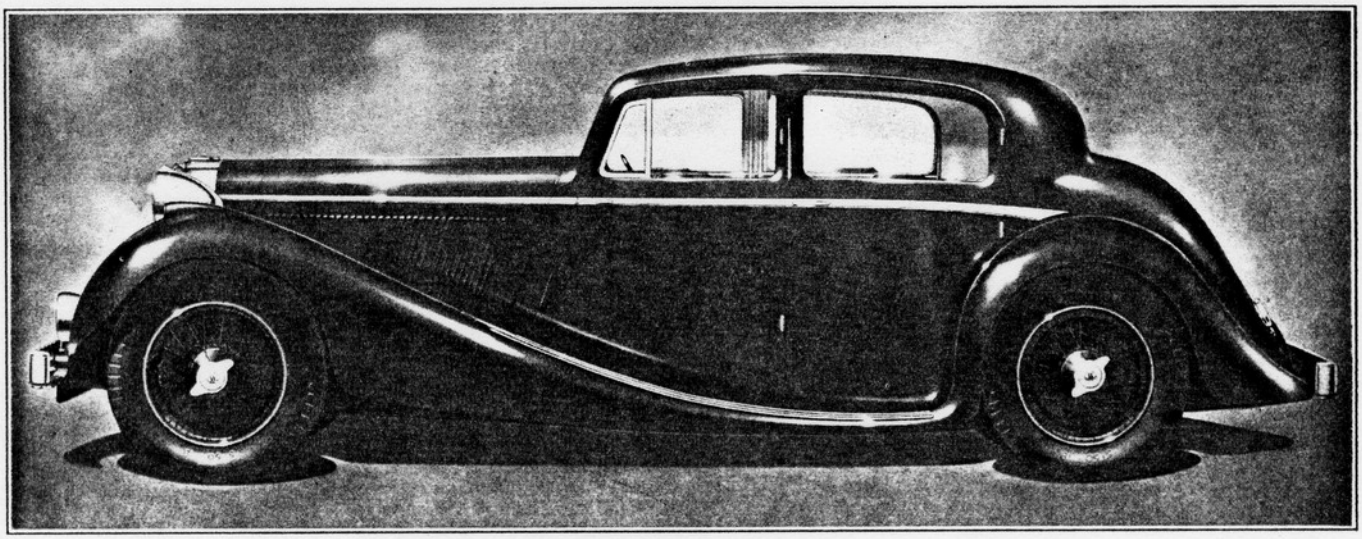
S.S. 2½-LITRE "JAGUAR."

A Quiet High-performance Sports Saloon.

OCCASIONALLY some quite outstanding vehicle makes its appearance in the industry and amongst such designs the chassis under consideration in these notes certainly merits a place. To some degree this applies also to the smaller car of 1½-litre, but principal attention undoubtedly centres on the 2½-litre model by virtue of its performance. Genuine 90 mile per hour cars are still rare and to attain such a standard on a production or repetition basis with an engine of 2½ litres for a full-sized car and at a moderate price is an achievement. It is, of course, no easy matter to produce a reliable high-performance sports car, quiet and of sound road behaviour, even when price is not a governing factor. The Jaguar chassis embodies not only a performance, but a bodywork style, together with a quality finish and general equipment that bears comparison with the best. Attributes such as these have hitherto been confined to cars in a very much higher price class. On a general summary of performance, appearance and value for money there is nothing comparable with it either in this country or elsewhere. Nevertheless, the chassis is completely ordinary in every detail, and this in large measure will account for its reliability. Nothing whatsoever is embodied that is in any way novel and therefore untried. A six-cylinder overhead valve engine transmits to a Borg and Beck clutch, thence through a four-speed synchromesh gear box by open Hardy-Spicer shaft to a spiral bevel rear axle. The steering is Burman Douglas and brakes are Girling.

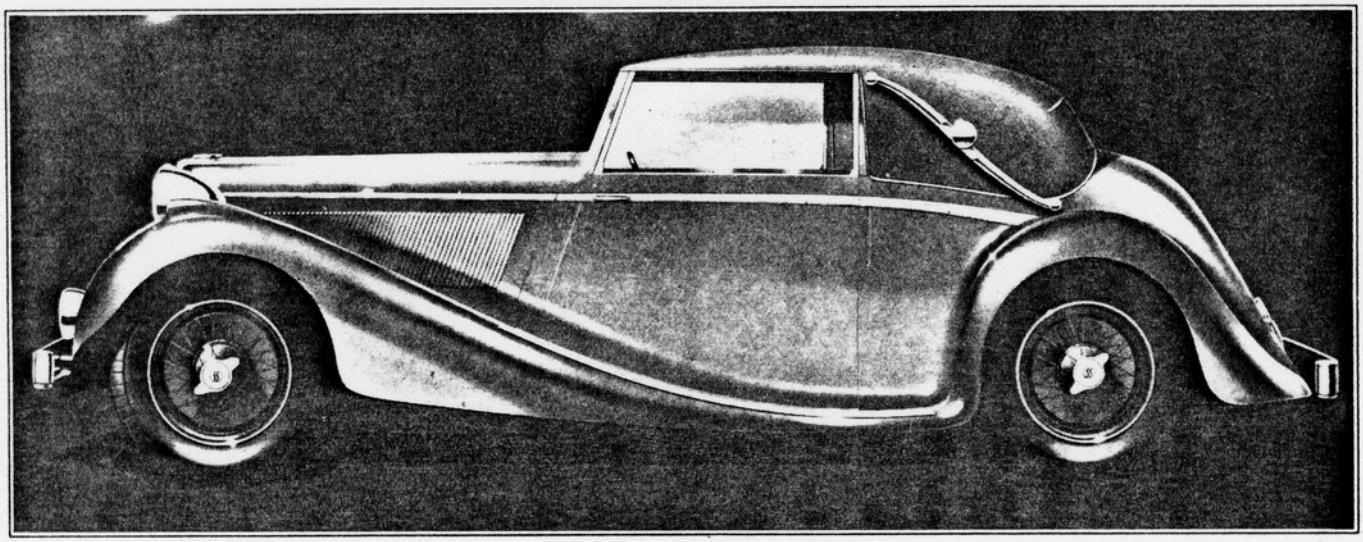


The five-seater saloon.

Engine.

The engine, which remotely is a development from an earlier model, has a bore and stroke of 73 mm. × 106 mm. respectively, giving a swept volume of 2,663.7 c.c., the tax being £15. Little, if anything, however, now remains of the original side-valve design, the present engine being an overhead-valve layout. A new arrangement of head and induction system, with new pistons, a counterbalanced seven-bearing crankshaft, a new engine body, an extra large sump, new connecting rods, etc., evidently leave very little of the original power unit. It is virtually therefore a new design throughout and was specially evolved for the Jaguar chassis.

A perfectly orthodox layout has been adopted as regards the arrangement of the valves, but the porting system, or what may be described as the breathing of the engine, has received specialist attention. A rocker shaft of the usual form is arranged along the top of the cylinder head carrying the rockers with spring distance



The drophead Coupé.

S.S. 2½-litre "Jaguar"—contd.

pieces between. This shaft, upon the rigidity of which silence so much depends with valve gear of this type, is of good proportions and is strongly supported in six robust brackets attached by studs to the cylinder head. An aluminium cover encloses the gear, with the oil filler cap for the engine on top. On the near side of the engine are the push rods, which are, of course, hollow and have the cups at the top and the ball end at the bottom so that gravity ensures both joints operate in an oil bath.

Actually all the accessories, with the exception of the starter, are on the near side of the engine, giving a rather closely packed arrangement. Any work on the engine would necessarily be done from this side. On this account the spare wheel, which is bracketed off the near-side frame-member, would perhaps be more conveniently located on the off side. Here there is only the exhaust pipe, the dip-stick, and sparking plugs, so that there is less need for accessibility. On the near-side, then, there is the water outlet pipe to the radiator, the two S.U. carburettors, the distributor, the drive to the revolution counter, coil, dynamo, oil filter, oil pressure release valve, fuel pump, fuse box, cut-out, and crankcase vent. On the off side, as previously mentioned, there is only the exhaust branch, starter motor, sparking plugs, engine oil level dip-stick and, up on the dash, the screen wiper motor. The batteries also are carried on the dash.

As previously mentioned, the head, ports and induction system have been specially planned for maximum output. Two carburettors bolt direct to the head, slight bias towards the exhaust valve roughly midway between the two valves on the opposite side of the engine.

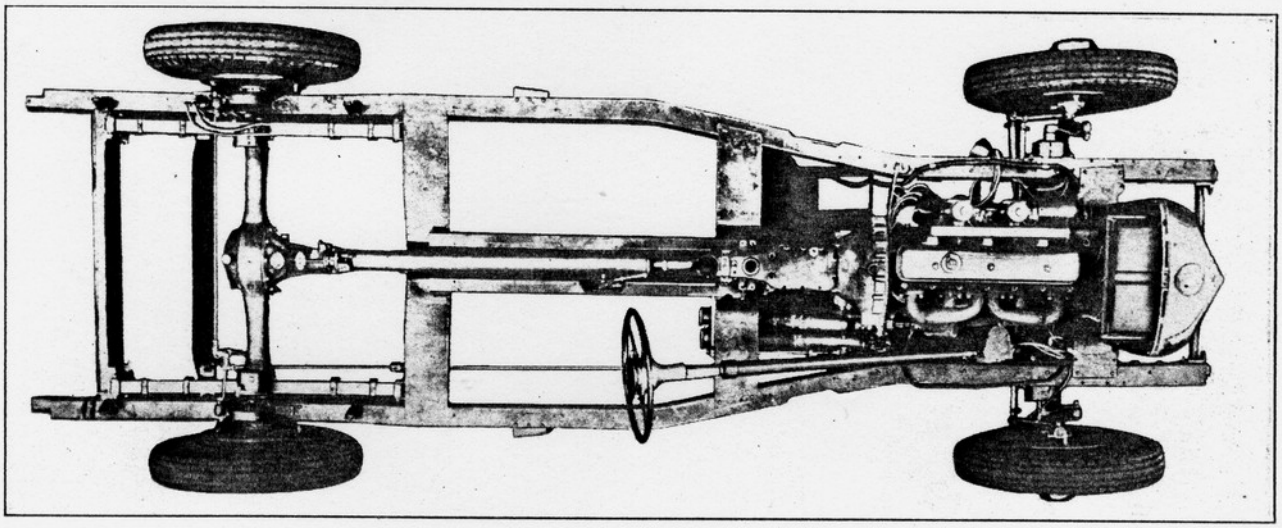
Aluminium alloy pistons are standard, together with light alloy connecting rods, the floating gudgeon pin being arranged direct in the metal, both in the piston and the connecting rod. Duralumin connecting rods are employed with a steel oil-feed pipe from the big end to the gudgeon pins. It lies between two webs running the length of the rod, which are paned over the full length of the pipe. Manganese Molybdenum alloy steel is used for the seven-bearing counterbalanced crankshaft, and the camshaft is located alongside, being driven by roller chain from a pinion at the front end of the engine. Both the distributor and the oil pump are skew gear driven from the crankshaft in the usual way.

An extension of the crankshaft at the front end of the engine carries a pulley for the triangulated vee-belt drive for the dynamo and combined fan and pump. There is an oil feed to the valve rocker shaft for supplying the rocker bearings; the rockers are drilled to supply oil to the cups in the top of the push-rods which overflow down the push-rods into the cups on the tappet heads and finally back to the sump. The arm of the rocker operating the valve is also drilled and packed with a wick to allow a limited supply of lubricant to find its way to the valve stem end.

The tappets are of simple hollow mushroom type in guides that are attached in sets of four by setscrew to a web running alongside the cylinders in the engine body. The tappet carriers are drilled and supplied with oil under pressure from the

performance that is given for a vehicle of its weight. Any consideration of compression ratio alone, however, must always be of doubtful value and its effect can only be evaluated in due relation to other factors such as valve and port design, opening diagram and breathing capacity at various speeds and throttle openings.

Two horizontal S.U. carburettors are fitted, fed by an S.U. electric pump. With the rearward carburettor is embodied the new S.U. automatic auxiliary starting carburettor. This system, which was pioneered by the S.S. Co. last year, is governed by the temperature of the water in the outlet pipe from the head to the radiator. The auxiliary carburettor is either in or completely out of action, according to whether the water is at a certain predetermined temperature or not. The arrangement is obviously entirely automatic and it provides an unfailing cold start. No co-operation, intelligent or otherwise, is demanded of the driver. There is nothing to push, pull or twist, the device comes into action when currrent is turned on in the ordinary process of switching on. To start the engine the starter button, of course, has to be actuated. After this it is possible to drive straightaway, the engine giving a perfectly normal performance. A bi-metallic strip thermostat in the water pipe actuates a switch controlling a solenoid on the carburettor, the solenoid opening and closing the pipe that carries the starting mixture to the engine. As soon as the temperature of the water rises to 35 deg. F. the thermostat switches off the solenoid, which shuts the auxiliary carburettor off.



Plan view of chassis.

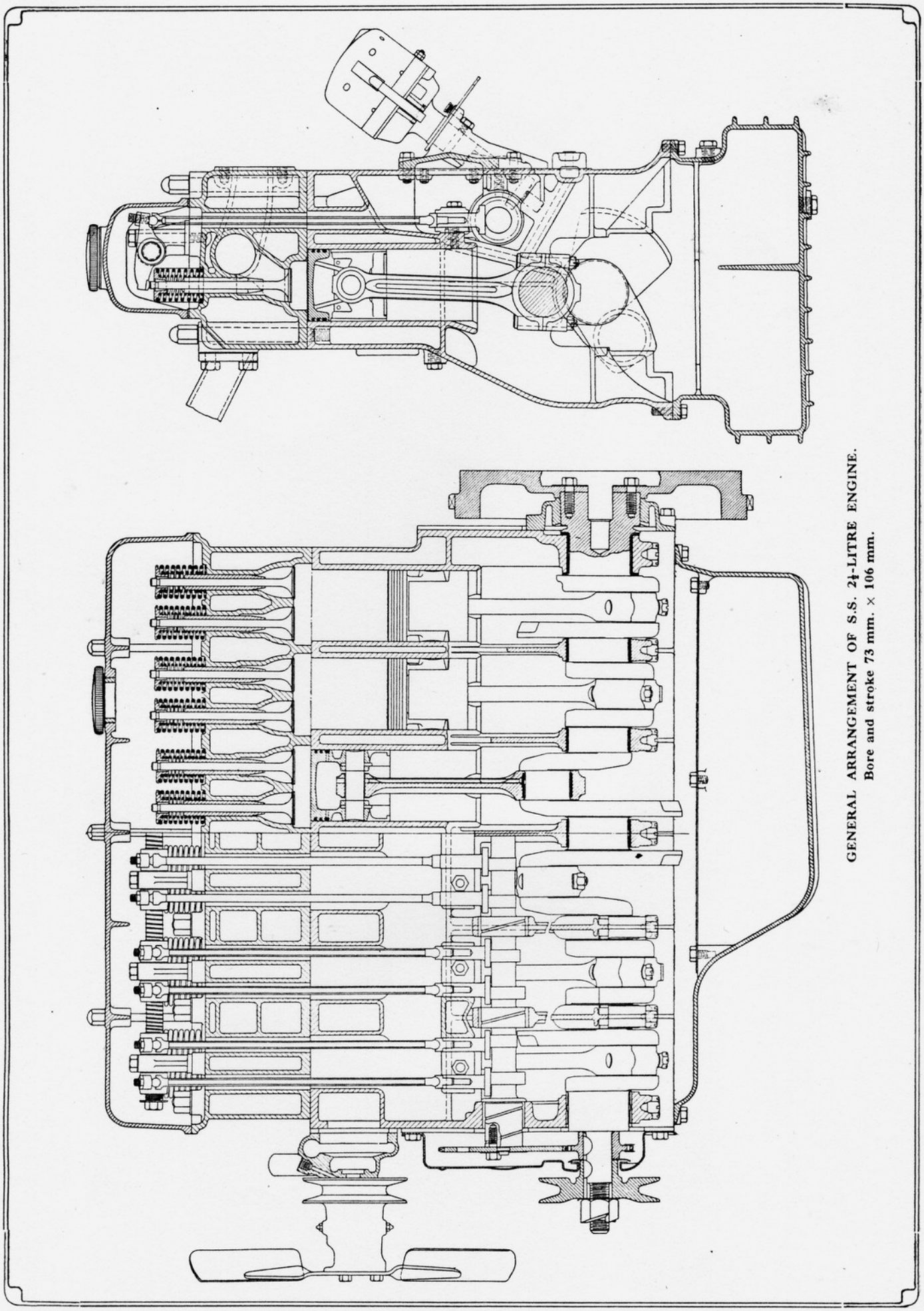
and deliver to a gallery or distribution pipe that runs down through the centre of the head and is, of course, water jacketed. At the middle of the pipe is a venturi held in position by one of the cylinder head studs, which forms a balance between the two carburettors. It is almost directly above the inlet ports and combustion chambers. Vertical valves with detachable valve guides are fitted and the valves have dual springs. Tappet adjustment is by the usual ball-ended screw that engages with the cup on the top of the tubular push-rod. The plugs are located with a

main oiling system. A light alloy sump is fitted holding two and a half gallons of oil, and it is well ribbed underneath and on both sides for cooling. It carries the usual oil strainer and gear type pump which discharges via the Tecalemit oil filter to a gallery cast along the inside of the engine body. From this there is a large diameter oil feed to each main journal bearing of the crankshaft.

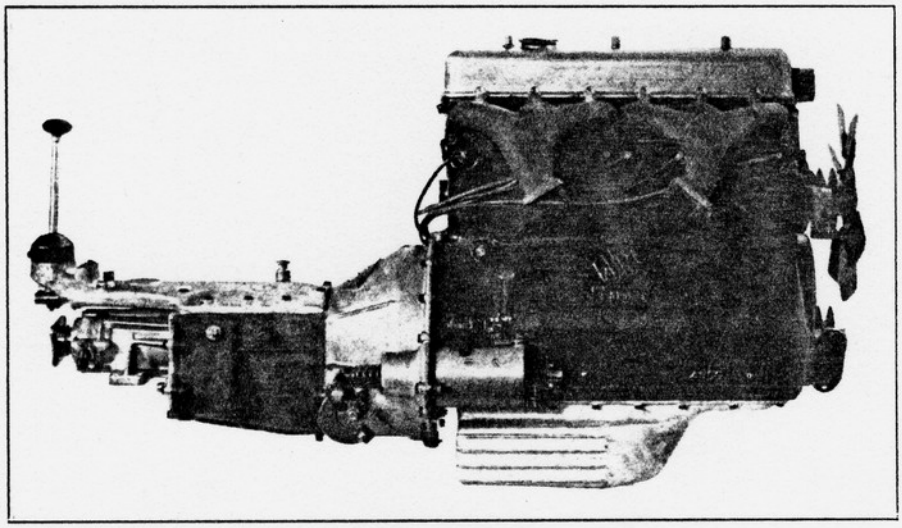
With a compression ratio of 7·6:1 a B.H.P. of over 100 is claimed. There is little doubt that an output of this order must, in fact, be secured, in view of the

Obviously such an arrangement fills the demand for complete automaticity or foolproof working that is so general to-day.

With the new S.U. scheme, jets adjustable from the dash are obviously no longer required. Basically, the original S.U. jet principle remains, but a fixed setting has been adopted. Alongside the float chamber of the carburettor that carries the auxiliary there is a taper needle set vertically in a tube that terminates in the auxiliary jet. This is fed from the float chamber, and just above there is a small annulus that permits air to be drawn up



GENERAL ARRANGEMENT OF S.S. 2½-LITRE ENGINE.
Bore and stroke 73 mm. × 106 mm.



Right-hand side of power unit.

with the fuel to form the usual starting emulsion. Normally the needle is held down in the jet by a spring above. The needle is fitted at the top with a disc, and in operation under engine suction, depression beneath this disc has the effect of drawing the needle downwards into its jet. In this way the extremely rich starting emulsion is only drawn to secure the first explosion, and as soon as the engine fires there is some weakening of the mixture. With the engine running, the air and fuel emulsion passes up round the stem of the needle, at the top of which it collects additional air, which passes in round the disc from holes at the top of its socket, the final mixture flowing to the delivery pipe to the engine.

It will be evident that the auxiliary needle operates in the opposite direction to the normal S.U. carburettor needle, which lifts under engine suction while the auxiliary needle descends. This does not imply an opposite effect with regard to mixture strength, because in the main carburettor, of course, the choke opens as well when the needle rises and consequently there is a greater volume of air flowing and more fuel is needed to charge it. The supply from the auxiliary carburettor is quite additional to that provided by the main carburettors and goes to the engine irrespective of the main throttles.

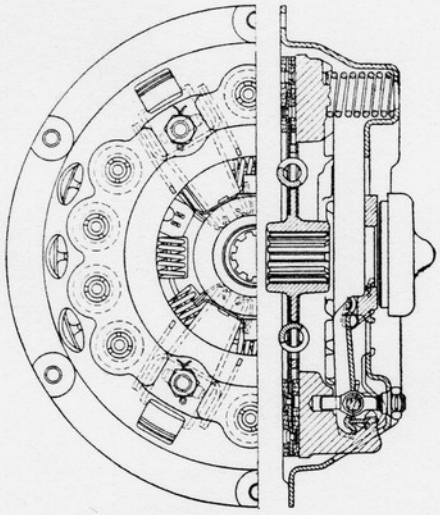
Opening and closing of the pipe from the auxiliary carburettor to the engine is, as previously mentioned, controlled by the solenoid, which is, in turn, operated by the switch that is actuated by the thermostat in the outlet water pipe. Normally, a disc valve that is flexibly attached by a light spring to the solenoid core, lies on its seating on top of the outlet pipe and so keeps the system closed off. This, in fact, is the position as soon as the outlet water from the engine reaches the predetermined temperature of 35 deg. F, at which satisfactory running is provided by the two main carburettors which can, therefore, have the fixed jet setting previously referred to. This setting is based on the normal requirements for an engine that is, as regards head and induction temperature, practically warmed up. Travel of the auxiliary jet can be varied by means of a small unit on top of the jet tube, so that a measure of adjustment is provided for the strength of the starting emulsion.

There are certain theoretical disabilities attaching to the system as there are with most mechanical contrivances which, after all, must be compromises. For one thing, the driver has no option but to let the auxiliary carburettor go on swallowing up fuel until it chooses to cut itself out. Failure of the thermostat, the switch, the solenoid, the shut-off valve, or any part of the auxiliary carburettor itself may render cold starting impossible. If the two main carburettors are correctly set for running a warmed-up engine, they will not be sufficiently rich to make a start from cold.

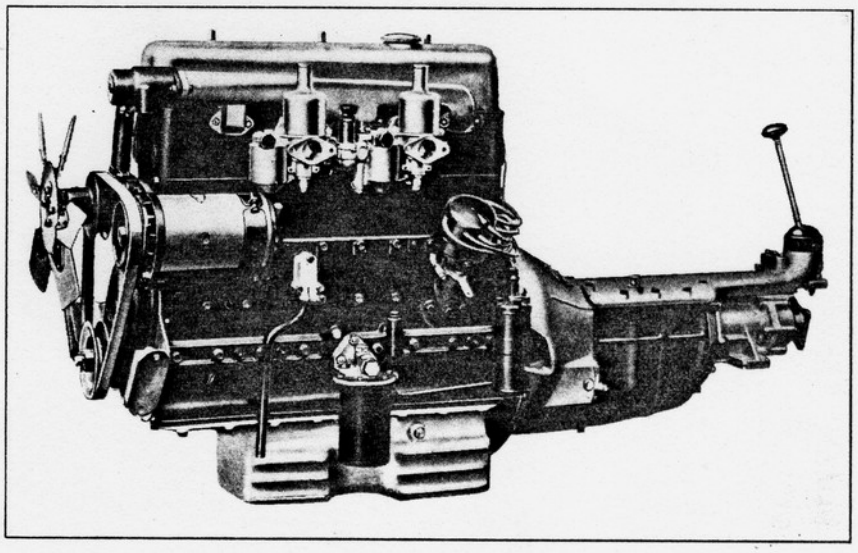
However, in practice the device works remarkably well and the remedy for the over-rich condition is to engage the starter with the throttle open to its very fullest extent. This will have the effect of reducing the depression all round, and so thinning out the mixture sufficiently to get a start. The over-lean condition is met by employing a fixed jet setting on the main carburettors just sufficiently rich to give a start even at an engine temperature as low as 35 deg. F. to get the eventuality of an involuntary stop before full warming up.

Reverting to the engine layout, to maintain the basic idea of full capacity "breathing" or flow of gas in and out of the engine, the exhaust branch has been designed with six separate outlets, giving easy bends and a ready escape for the gases. The six branches bolt separately, each by oval flange to the head, the joint faces being of ample proportions and the nuts accessible. The manifold portion itself is ribbed for cooling.

Automatic advance and retard is incorporated in the distributor head and the sparking plugs are on the off side of the engine. Despite its high performance, the engine is eminently simple in general planning and layout. There are no inaccessible nuts or corners, and in general all the machined faces are flat and square with one another, so that economical production can be secured. The fan, which is of the usual built-up sheet metal type, is combined with the centrifugal pump and bolts to the front of the cylinder head on much the usual lines. In the water outlet pipe on the near side head, a water thermostat is embodied. This is of a by-pass type, which restricts during the warm-



The clutch.



Left-hand side of power unit.

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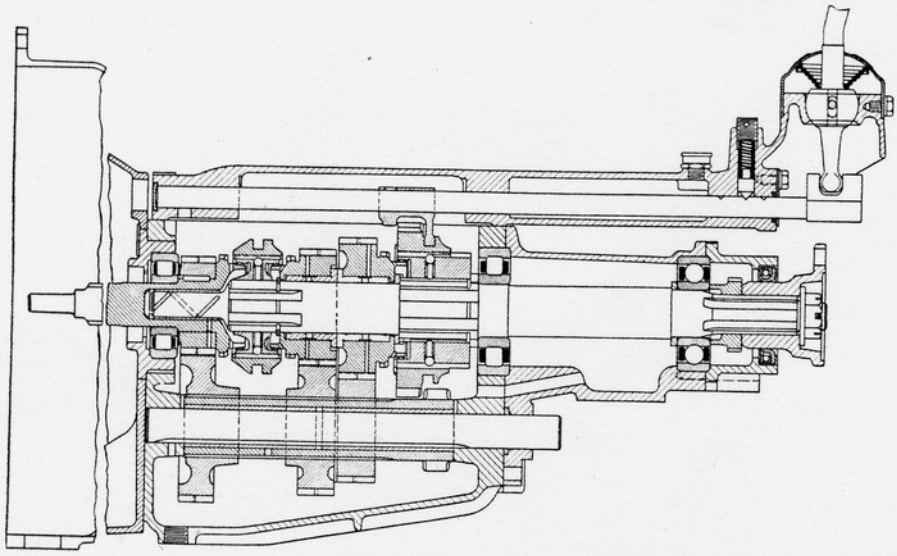
ing-up period the flow of hot water from the engine to the radiator block, by-passing it through a separate small water pipe back to the suction side of the water pump. At the front end, the crankshaft has the usual oil thrower, and the draw-up nut for the vee-belt pulley constitutes the starting dog. At the rear the shaft terminates in a large boss, to which the flywheel is setscrewed. Here the outside of the boss is threaded to form an oil retainer of the screw-thread type. At each end, the main crankshaft bearings are of extra length, as is also the centre, though this is slightly less than the two end ones. The intermediate bearings are, of course, shorter, their dimension being governed by the cylinder spacing.



Four-speed gear box.

Clutch.

The clutch is a standard single plate Borg and Beck with flexible centre. At the rear end, the crankshaft, as previously mentioned, terminates in a boss which is bored out for the clutch-shaft spigot which engages with a Hyatt-type bearing therein. The rear face of the flywheel is quite plain and constitutes the frictional surface for contacting with the clutch driven member. A heavy sheet metal pressing forms the outer clutch housing, which is attached to the clutch by studs, the registering of this casing being on the studs themselves. A light gauge pressing of special design forms the clutch driven member, which carries frictional fabric on both faces and is riveted to a central-splined boss. Nine springs provide the pressure, these being equally spaced in groups of three and recessed into the outer casing. In between each group is a fulcrum pin for the throw-out levers, making three in all. Attached by nuts to the outer casing, the inner ends of the fulcrum pins carry the presser plate, which is a heavy cast-iron casting. This centre pad, being carried on the fulcrum pins and the springs, is not fixed or registered in any other way. The throw-out ring also is clear of the shaft and suspended by spring clips which are flexibly attached to the throw-out levers. This ring contacts on its flat, rear face with a graphite block inserted in the centre of the throw-out bearing, which carries trunnions for engagement with the throw-out fork. All Borg and Beck clutches are very effective examples of highly efficient clutches reduced absolutely to their elements. They are of extreme simplicity in general layout, but embody many ingenious design details, making for satisfactory operation with minimum production cost.

Gear box.

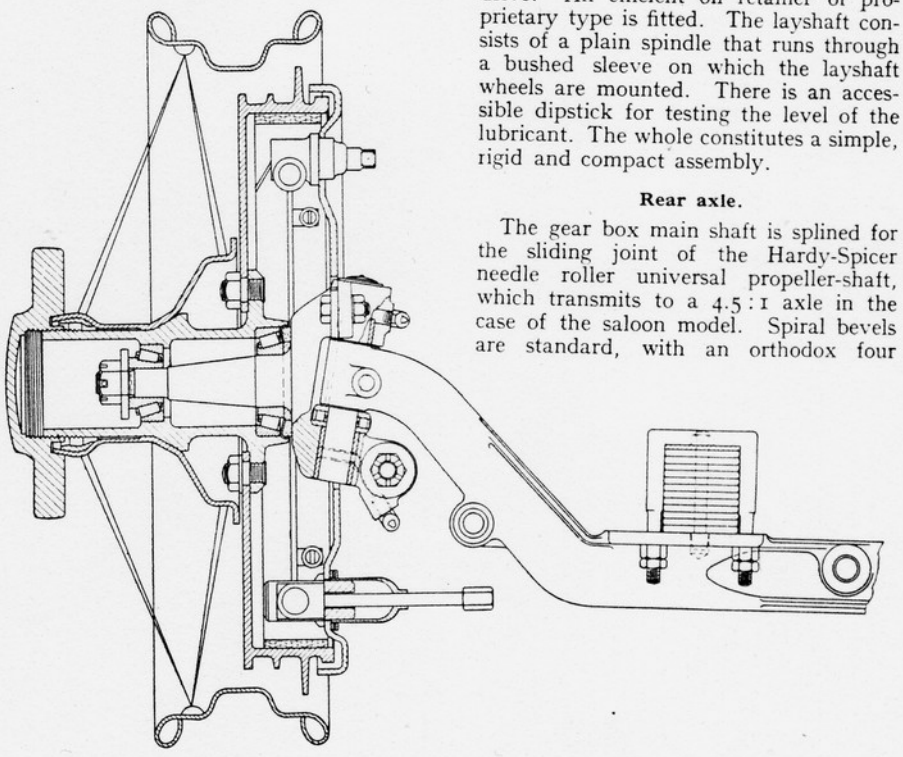
A four-speed box is fitted, with synchromesh to all speeds except first and reverse. In combination with the final bevel, the following ratios are given. First and reverse 16.2 : 1, second 9.51 : 1, third 6.18 : 1 and top 4.5 : 1. All gears, including constant mesh being double helical, the layout is actually a constant mesh design throughout as regards the working gears for the second, third and top speeds. The layshaft and reverse wheels are, as usual, below the main shaft, and the selector rods are extended back to a remote control in order to bring the change speed lever to a position accessible to the driver. The main shaft also is carried back in an extension nosepiece in order to bring the forward universal joint of the propeller-shaft sufficiently far back to clear the central cross-bracing of the frame. The gear box is of cast iron, the cover carrying the selector rods being aluminium alloy. This cover, which carries the change speed lever, is extended back in the usual manner to bring the lever to a convenient location.

All gears then being constantly in mesh, changes of gear are obtained by synchronised dog clutches of the internal, external tooth type. The internal toothed members slide on splines on the main shaft. These members are combined with internal cones for the synchromesh mechanism, the corresponding external cones and external dogs being on the gears. The clutch shaft or primary is carried on a large roller bearing and terminates in a constant-mesh pinion, in which is spigoted the main shaft in a plain bearing. The dog member for top and third gear is on splines adjacent to the constant-mesh pinion, the second and first speed dog member being, of course, on splines at the rear end of the main shaft, which is carried at this end on a substantial roller bearing in the main gear box casing.

The main shaft extension is in an aluminium housing bolted to the main casing and terminates in the splines for the universal joint spider. It is carried at this end in a substantial roller bearing and is fitted with the gear for the speedometer drive. An efficient oil retainer of proprietary type is fitted. The layshaft consists of a plain spindle that runs through a bushed sleeve on which the layshaft wheels are mounted. There is an accessible dipstick for testing the level of the lubricant. The whole constitutes a simple, rigid and compact assembly.

Rear axle.

The gear box main shaft is splined for the sliding joint of the Hardy-Spicer needle roller universal propeller-shaft, which transmits to a 4.5 : 1 axle in the case of the saloon model. Spiral bevels are standard, with an orthodox four



Front-axle swivel.

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pinion bevel differential. The axle is semi-floating, the differential drive being bolted as a unit to the front face on the axle casing. This drive unit is assembled in a single casting that carries the bevel pinion shaft and the bearings for the inner ends of the axle.

Built up of forged tube the casing has a domed cover-plate at the rear, which is welded solidly in position. This arrangement makes for a stiffer casing than by bolting, the whole constituting a light and strong assembly. There is, of course, no need for a detachable plate at the rear, as the differential and drive unit is assembled through an opening at the front of the casing. The differential housing carries at its front end the bevel pinion shaft, the housing being a steel casting well ribbed. Roller bearings are fitted at the pinion, with a two row, dual-purpose ball bearing at the other end of the shaft. The spider for the universal joint is machined on the outside for a felt oil retainer. Adjustment for the mesh of the pinion is provided by means of a deep ring nut which is accessible by a small cover-plate in the housing. The whole assembly is locked by another ring nut at the front which carries the groove for the felt oil retainer ring. The differential pinions are on splines on the axle shaft. Adjustable taper roller bearings are used on each side of the differential cage.

At the main drive pinion the bearing assembly is of much the usual order with a distance piece between the two bearings, the whole being pulled up on the shaft together with the universal spider by a castellated end nut.

At the wheel ends, the axle casing terminates in a flange to which is bolted a substantial circular pressing well dished and turned over on the outer edges. This plate forms the brake cover and carries the brake-shoe fulcrum at the front and the actuation at the rear. Bolted up with it on the opposite side is an extension housing carrying the single wheel bearing which is a taper roller. A proprietary oil retainer is fitted on both sides of the bearing. On the inner side, the oil seal is made direct on the axle and on the outer side on the machined surface of the hub itself. A taper and key fixing is used for attaching the hub to the axle shaft.

Bolted to a flange on the hub, the brake drum is of special chilled cast-iron, well ribbed and stiffened, there being one specially deep rib which, together with a turnover on the cover prevents the entry of water and dirt. A spline and cone hub for Rudge-Whitworth type knock-on wire wheels is the standard equipment. Grease gun points for the wheel bearings are provided on the hubs.

Girling brakes are well known, their essential characteristics being, of course, simplicity in general layout and actuation, and the fact that all the actuating rods are in tension. The wedge actuation for the shoes is also a feature, together with the floating type of fulcrum, giving accuracy of shoe bearing on the drum surface. One important point is the fact that all the brakes can be adjusted to a satisfactorily equalised condition, with the wheels on the ground, so dispensing with the trial-and-error methods and giving complete certainty as to the result.

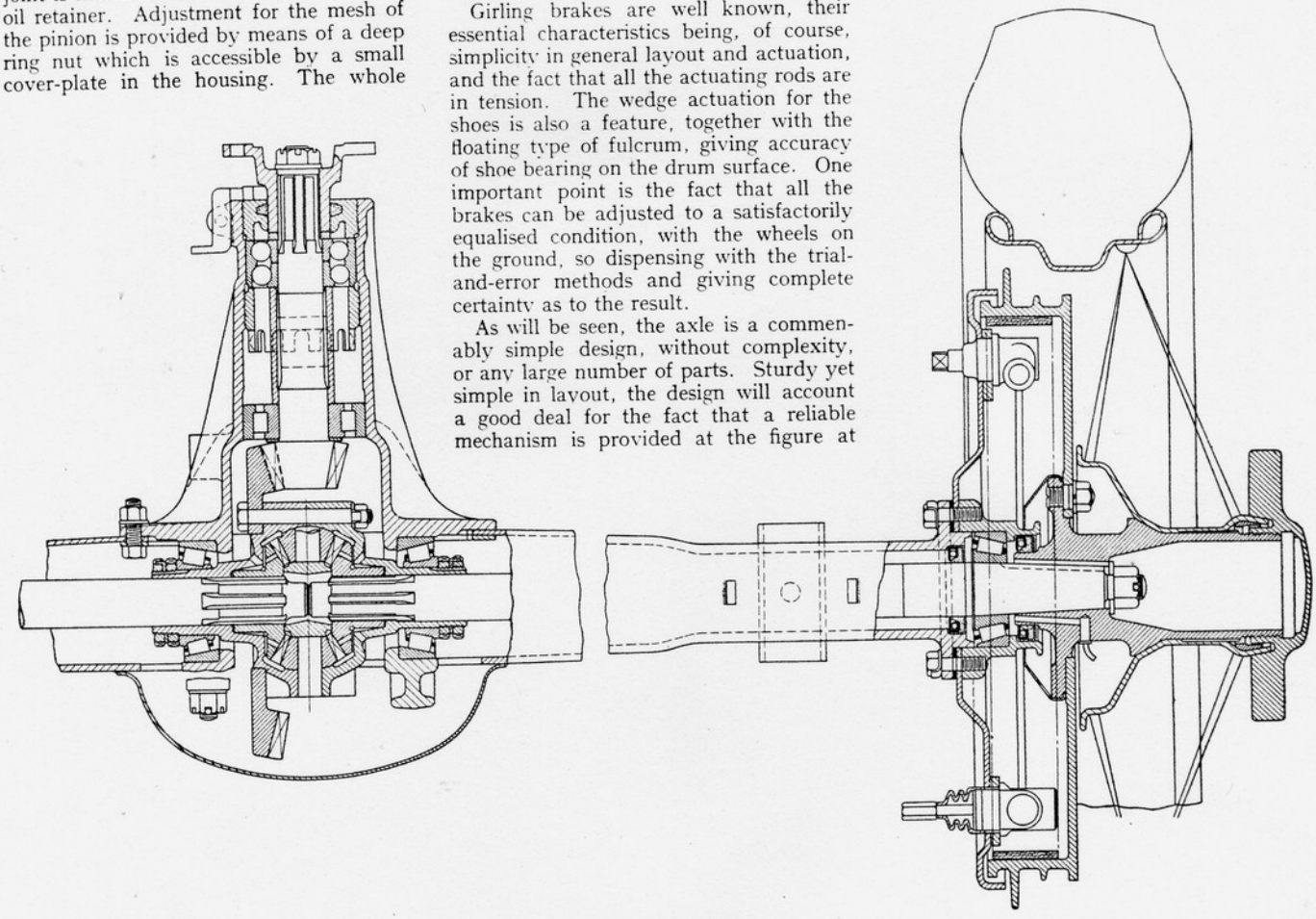
As will be seen, the axle is a commendably simple design, without complexity, or any large number of parts. Sturdy yet simple in layout, the design will account a good deal for the fact that a reliable mechanism is provided at the figure at which the vehicle has to be produced.

There is little doubt that the handling of this chassis at speed and the steadiness of the front end of the car is in no small measure due to the excellent design of the frame, which is a very rigid scientifically designed structure. The frame is composed entirely of box-section members of light gauge material, in each case built up of two members spot welded together to form a solid box-section. The frame is 30 per cent. stiffer in torsion than the previous cross-braced frame and yet shows a slight decrease in weight.

Two main box-section side-members run the full length of the car and have at either end the jack boxes welded in position. These are braced together by three large box-section cross-members, the first disposed over the front axle, the second at the rear of the gear box and the third at the front of the rear springs. Another smaller box-section cross-member ties the rear end of the frame together and carries the rear spring shackle brackets. At the front end a large diameter cross tube prevents any relative movement of the front dumb irons. All cross-members are securely welded to the side-members so that maximum use is made of their rigidity.

The frame is well dropped from the dash and runs practically in a straight line underneath the axle at the rear. From the front support of the rear springs the section is tapered back to the rear.

Orthodox semi-elliptic springs are fitted front and rear. They are lead coated, with the object of providing uniform interleaf friction and protection against rust. In this way even action is secured without the need for lubrication. As with modern type bodywork, the rear spring attachments are inaccessible. Silentbloc bushes are fitted throughout. At the front, with the object of securing a maximum lateral stability, the shackle has been eliminated and a slipper of robust proportions is fitted at the rear ends, the front of the springs being attached by bolt to the dumb iron in the usual way. Grease gun points are



General arrangement of rear axle.

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fitted at both attachments, the well flared front wings rendering these points readily accessible. In the rear boot there is a hinged panel to give access to the rear axle, and the only chassis points needing grease-gun attention are the front-axle swivels and the steering-rod connections.

The front axle is a completely orthodox design, a straight I-section beam forming the central portion, with oval section upswept arms at the sides. The swivel pin is well angled to give nearly centre-point contact between wheel and road, and the swivel loading is taken on a roller-thrust washer. Fixed in the axle by cotter in the usual manner, the swivel pin turns in bushes in the swivel, which is provided with grease-gun points for lubrication. Bolted to the hub from the front, the brake drum can be readily removed, and is interchangeable with the drum at the rear. A pair of taper roller bearings well spaced are employed at the hub, and a seal is made against the escape of lubricant into the brake by a felt pad against the face of the front-axle swivel. The brake shoes are fulcrumed at the top in the cover-plate which is bolted to the front-axle swivel, the actuation being at a point immediately below, whence the actuating rod is carried across to a bell crank bracketed off the front axle. A further rod from the bell crank is carried across the front of the axle to actuate the brake on the opposite side.

A similar scheme is used on the rear axle. From these points direct pull rods are taken to the brake levers on the foot of the pedal, except in the case of the rear rod, where a relay lever is used in order to obtain the correct geometry for the rear brake rod and prevent roll on or roll off of the brakes in severe braking. The brake pedal lever at the foot of the pedal terminates in a single eye on to which is fitted a push-rod with a slotted jaw end. This push-rod operates on to two flat plates pinned at the top to the rear brake lever and at the bottom to the front brake operating rod, the push rod being so arranged in the plate that a leverage of 60 per cent. to the front and 40 per cent. to the rear brakes is obtained. A small pin through the push-rod, which is free to move in the clearance holes in the plates, provides a safety link which in case of failure of any part of the brake operating mechanism still retains braking by hand and foot on one axle. Here, again, it should be mentioned that by an ingenious linkage the hand brake operation is obtained on all four wheels instead of merely on rear wheels.

Extra large Luvax shock absorbers are fitted, the link to the axle being attached to bosses forged integrally with the upswept portion of the axle. The steering arms, which extend rearwards in the usual way, are pulled into the swivels by taper and key.

As previously mentioned, the steering gear is the proprietary Burman Douglas, which is a true worm and nut type, operating in an oil bath. The box is arranged in the horizontal plane so that the steering arm moves in an arc across the frame, the steering being effected by means of a transverse rod. In this way the side of the chassis is kept clear of the steering arm drag link, and certain of the complications attaching to steering and axle movement geometry are avoided.

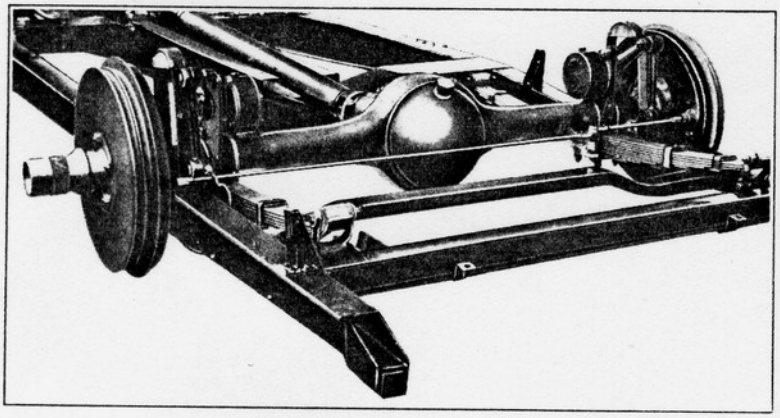
The box steering is provided with three feet, by which it is mounted directly on to the frame side-member, which is stiffened up at this point so that a maximum rigidity is obtained. The two holes in the feet at the front are slotted so that up-and-down adjustment can be obtained, while the back foot is attached to the frame by means of a single set pin with two locknuts, which allows for lateral adjustment.

The steering box itself is well forward towards the radiator, giving a nicely raked column, and the wheel is fitted with the Bluemel telescopic arrangement for adjusting the column length. On the steering wheel the controls consist of a lever for the self-cancelling trafficators, the dipping switch for the head lamps, and the spark control, the throttle setting being effected by screwed knob on the dashboard.

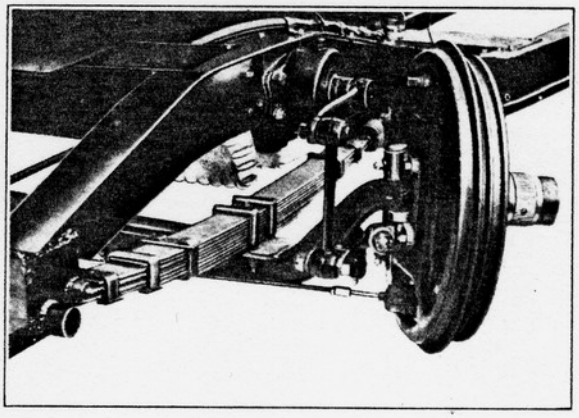
The wheelbase is 10ft., the track 4ft. 8in., and the weight 30 cwt. The overall length is 14ft. 10in., the width 5ft. 7in., and the height 5ft. 1in.; 5.50 × 18in. Dunlop "90" tyres are standard. The fuel tank has a capacity of 14 gallons. On the dashboard are a large-diameter revolution counter and speedometer, oil-pressure indicator, water temperature indicator, petrol gauge and ammeter, and electric cigarette lighter. A symmetrical layout of instruments in the walnut panel make an attractive layout. Interior lighting of the body by two corner lights is controlled by a switch from the instrument panel, and there is, of course, the usual switch for lighting the panel itself. There are two small cupboards with doors one on each side of the dashboard, and this, in addition to two small pockets in the rear doors, is the only carrying space within the body itself. There is, of course, a capacious luggage boot at the rear, in the lid of which the spare wheel is carried. In the surrounding space are the jack, pump, spanner and other items. Criticism may be levelled at this arrangement on the score that with heavy luggage in position the tools and spare wheel are inaccessible. The chances of a breakdown coinciding with one of the rare periods on which heavy luggage is carried do not seem to warrant abandoning the scheme which has so much to recommend it. All the tools are laid out before the eye, where they can be picked out readily. They are packed in such a way as to avoid rattle, any one missing is immediately detected, and they are, moreover, occupying space in the lid which would otherwise be wasted.

As previously mentioned, the appearance and finish of the car are excellent. The dashboard and interior garnish are in real walnut, and the standard specification includes Vaumal hide upholstery. A flush sunshine roof is fitted, and the Special Lucas de luxe electrical equipment also includes P.100 head lamps.

The address of the manufacturers of S.S. cars is Holbrook Lane, Coventry.



Rear axle.



Front axle.

ENGINE LUBRICATION.

A PRACTICE followed for five years of replenishing the oil in the crankcases of 20 Ford cars every 1,000 miles, keeping it to the level recommended by the manufacturer, instead of draining it, was discussed by Mr. E. W. Jahn in a recent S.A.E. paper. From chemical analysis of samples taken every 1,000 miles it was found that dilution remained between 5 and 10 per cent., sediment remained more or less constant after building up to 1 per cent., there was less sludge than was observed during operation with regular changes, and but few cases of bearings being attacked because of acidity were detected.

Among the results reported is that the saving effected by not changing the oil more than offsets an increase in oil consumption, as indicated by greatly reduced total oil cost. (286)