THE 30-98 VAUXHALL

Contemporary Owners manual OE Type
Attributed to John Stanford

ENGINE

This is a straightforward four-cylinder, push-rod-operated overhead-valve engine, with detatchable head. The bore and stroke is 98 by 140 mm, which gives a capacity of 4,224 cc. The pistons are of die-cast aluminium, so designed that heat is transmitted from the piston head by two paths. Connecting rods are of H-section, made in duralumin. Heat generated in the big-end is very rapidly conducted away, it being very difficult even under the most severe tests to melt big-end bearings. It is interesting that the Vauxhall Motor Company advise you, in the event of a big-end failure due to lack of lubrication, to fill the sump up to a maximum of 2 gallons of oil (the normal level being achieved with 1¼ gallons), and the big-ends will then get the necessary lubrication by way of splash-feed.

The crankshaft, which is not counter-balanced on the earlier models, is carried in five substantial white-metal bearings. I it is hoped to up the speed over 3,600 rpm, fit the counterbalanced crankshaft. These can be occasionally obtained through such well-known people as the Higher Road Garage, Urmston. The oil pump is of the valveless rocking-plunger type, driven off the rear end of the crankshaft and supplies oil under pressure to every plain bearing in the engine. This pump is most efficient; I have never heard of any trouble being experienced with it. Oil pressure should never register less than 5 lb/sq. inch at 20 mph, and although Vauxhalls originally specified Castrol “R”, I have always used “XL” which fills the bill without the smell. The overhead rockers, which are of conventional design, are also lubricated by the mechanical pump, the supply of oil being controlled by a reducing valve in the rocker cover. Oil consumption on these cars should be around 2,000 to 3,000 miles per gallon, even after considerable mileage has been covered There are two oil filters in the system, one around the sump drain-plug which serves to filter the oil before the pump sucks it into the lubricating channels, and the other in the form of a tray, which runs the full length of the engine, just below the lowest point of the big-end throw; this tray can very easily be removed by undoing the four ¼ inch bolts located at the front end of the sump and withdrawing it by pulling on the small finger-grip provided.

The valves are of the normal mushroom type, placed vertically in the combustion chambers. Exhaust valve seats and stems, also the sparking plugs, are entirely surrounded by water, which is circulated by a belt-driven impellor set in the front of the engine block. Double valve springs are a standard fitment, and though the valve clearance is stated on the side of all engines, I give a more details on this point a little further on.

Any old sparking plugs seem to fill the requirements of this engine, although my own preference is for Champion R 3: plug-gap clearance should be from .012 inches to .015 inches.

The water impellor also drives the fan and it seems that most engines have a habit of developing a lot of slack in this shaft. In my own case the whole was dismantled and a distance-piece was inserted ahead of the actual impellor, which served to set back the whole shaft and so bring the driven pulley once again in line with the driving pulley on the end of the crankshaft. The whole design of this unit is definitely not of the best and occasionally attention to its running is well worthwhile. A thermostat is also included as standard equipment, and although I removed mine as being unnecessary, I soon found that in the autumn and winter months it was most valuable. The thermostat has, therefore, been replaced, and I would strongly recommend other drivers who suffer from that wretched “spit-back” which periodically occurs, even when running with a hot engine, to leave theirs in.

In the winter months, I have found that blanking off a good half of the radiator maintains the required inlet-manifold temperature, without any tendency for boiling to occur. For a long while I was bothered with “spitting-back” when the engine was run over 2,500 rpm, and, after a great deal of time had been spent on carburettor, plugs and magneto, to no avail, the trouble was immediately cured by reducing the cooling area.

The camshaft, placed low on the near-side, is driven by a multiple “Morse” chain from the front end of the crankshaft, which chain also drives the magneto, and is supported like the crankshaft, in five white-metal bearings. The actual cam profile has, no doubt, a large bearing on the power output of these engines. The magneto sits in a cradle, which together with its driving sprocket, serves as a chain tensioner. To check the tension on the chain, remove the plug at the bottom of the timing case (through this hole the chain can just be felt) and having previously eased off the bolts which hold the magneto cradle and which pass through elongated holes, pull the magneto in a clockwise direction, seen from the front. This will tighten the chain without upsetting the timing. Before commencing to do this, make quite certain that the slack in the chain is between the magneto sprocket and crankshaft, and not between the magneto and the camshaft, otherwise one may think all the slack has been removed, with the result that when the chain does pull into the correct driving position, the timing will be slightly affected. Don’t forget to replace the plug in the bottom of the timing case, or the contents of the sump will be lost as soon as the engine has been running for a few minutes.

Petrol is fed to the engine through a Zenith visual-type filter and an Autovac. I have found this filter to be of very considerable use, as by the speed at which the bowl fills up a very good idea can be gained as to whether there are any air leaks in the vacuum circuit. If the bowl fills slowly, then either petrol is “out£ in the tank, or air is being sucked into the Autovac. From the Autovac the petrol falls by gravity to a Type 48 RA Zenith carburettor. The correct jets for normal running are 155 main and 165 compensating, with a 32 mm choke. (In the case of the E-type engine, these should be 165 main and 150 compensating, with a choke of the same size as for the OE carburettor). From the carburettor the inlet manifold is water-heated to the point where it passes through the head, after which it is similarly heated by the water passages in the head itself.

The exhaust manifold is fabricated from steel tube, probably for the sake of lightness, but this component is not sufficiently robust to stand up to many year’s work without breaking, and many owners have replaced it in favour of one in cast-iron.

There is no point in giving a lot of detail concerning the dismantling and re-erection of one of these engines, as no special tools or knowledge are required, it being on the whole quite a straight-forward engineering assembly.

Details of the valve and magneto timing may, however, be helpful. First, remember that the firing order is 1, 2, 4, 3, which is rather unorthodox, although there are a few other manufacturers whose cars fire in the same order.

Valve timing is as follows:-

Inlet opens: 1¼ inches before top dead centre or 9.5°

Inlet closes: 10 9⁄32 inches after bottom dead centre or 81°

Exhaust opens: 7^ inches before bottom dead centre or 60.2°

Exhaust closes: 2 inches after top dead centre or 15°

Where inch dimensions are given above, these are measured on the periphery of the flywheel, either before or after the indented line denoting “top dead centre” or “bottom dead centre.” Take care that the line referred to is actually at t.d.c., as there is always the possibility that the flywheel has been turned around for the benefit of the starter ring. It is advisable, in any case to check the actual position from the crown of the piston, which can just be reached through the sparking plug aperture. The gear wheel on the front end of the camshaft, to which reference was made earlier, is of vernier design and by removing the two bolts which clamp the actual wheel to the shaft, any desired relationship can be obtained between the crankshaft and camshaft. Before valve timing can be undertaken, it is necessary to remove the radiator and timing chain cover. The radiator can be freed by undoing the two] inch nuts just underneath, and located within the front channel cross-member of the chassis. From here on I have always found that the easiest manner by which to proceed is to draw out a timing diagram, glue this on to a piece of plywood and, having bored-out the centre to the same diameter as the front of the crankshaft, push it over the starting handle dog, making sure it is a tight fit, at the same time setting it in the relative position to tie up with top dead centre. If this diagram is about 8 inches across, a very accurate valve timing can be obtained, with patience. Time spent here is well worthwhile, these engines are very sensitive to timing.

If it is found that on the recommended tappet clearance only certain of the valves will give the correct opening or closing, then adjust the tappets until each gives the same result. Take a note of these tappet clearances for future setting. As an example, in my own engine the makers gave a clearance of 0.025 inches for all valves, but probably due to wear, the clearances have now become o.024 in., 0.021 in., 0.025 in., 0.027 in., 0.024 in., 0.025 in., 0.024 in., and 0.025 in.

The standard magneto is a Watford FO4, and magneto timing is quite simple with the magneto set at fully advanced, the points should just be breaking when the crankshaft , that is the flywheel periphery, is 4 inches before top dead centre. This can be increased up to as much as 6 inches, but is not advised, as starting will be difficult and accompanied by a violent kick-back, even when fully retarded. Even when the engine has been started unless very hot, on the slightest attempt to accelerate she will spit back through the carburettor, which frequently sets things alight. I think excess advance on many of these engines is the cause of the numerous fires one hears about, so if anyone is troubled by these occurrences, just measure the distance on the flywheel in the manner mentioned. Contact-breaker points should have a clearance of about 0.4 min.

The manufacturers state in their handbook that on a standard timing, which I have give, the ignition hand-lever should be set, for starting, about half-way up the rack, and when running at normal speeds, this should be further advanced to about two-thirds up the rack.

If the engine is in reasonably good condition, starting should be easy, either on the handle or by the electric starter. In this respect a Ki-gas primer is definitely an advantage. Once the pump itself is primed two or three pumps should be ample, and with the hand-throttle lever set two or three notches up the rack, if there is no slack in the linkage and assuming that , when fully home the engine will just tick over, she should start, if not first pull, most definitely at the second. (Four or five notches on the rack gives about 200 to 250 rpm). This procedure applies just the same summer as in winter and there is no choke fitted.

The above generally covers the specification of the OE engine, which can be summed up as follows:-

Number of cylinders	---	Four
Bore	---	98 mm. (3.9375 in.)
Stroke	---	140 mm. (5.59375 in.)
Maximum bhp	---	112
Maximum rpm	---	3,400
Compression ratio	---	5.2 to 1
Area of piston	---	12,177 sq. in.
Total swept volume	---	272 cu. in.
Torque at 3,400 rpm	---	175 lb. ft.
B.M.E.P.	---	95.8 ft./min. at 3,400 rpm
Max piston speed	---	3,170 ft./min. at 3,400 rpm
R.A.C. rating	---	23.8 horse-power

On the question of brake-horse-power, I have in my possession three graphs from the makers; one covers OE19 and is dated 5/2/23; the second is apparently that of the engine fitted to Major Coe’s car and is dated 30/4/24; and the third is of the “Super E” No. E1078, bore and stroke 98 by 140 mm., fitted with an S.U. carburettor Type J.3. This last named engine is also referred to as an OE type. Quite what the engine was, or what modifications had been undertaken, is not stated, but the bhp and torque figures are interesting. The comparative readings are as follows:-

R.P.M.	B.H.P. (OE 19)	B.H.P. (Major Coe)	B.H.P. (E1078)	Torque lb. ft. (E1078)
600	17	17	20	176
1,000	37	34	38	187.5
1,500	62	54	60	202 (peak 219)
2,000	86	74	82	216.5
2,500	104	94	101	214
3,000	103 (peak 2,700)	105	113	199.5
3,500	---	112	122	184.5
4,000	---	114 (peak 3,650)	130	170

All three graphs apparently refer to OE engines, though the figures given under the heading OE19 appear more consistent to the output of an E type slightly “hotted up.”
The figures in the second column are comparable to a standard OE engine in good condition, and those in the third column to a “hotted up” OE. On the other hand, it might be that the first OE engines gave a very different set of results from those made later, when power was sacrificed lower down in order to obtain more urge higher up.

CLUTCH --- The clutch, which is bolted direct to the flywheel in the customary manner, is of the Hele-Shaw multiple-disc type and should be lubricated by fine flake graphite only. Liquid graphite should never be used, unless one is prepared to dismantle the clutch after a thousand miles or so.

Generally speaking little trouble is experienced from this unit, which is most efficient considering its overall size and the torque it is called upon to transmit. There are, however, occasions when, after a long run, or after a lot of violent gear changes, when the whole assembly has become quite hot, it is found impossible to disengage the clutch. Sometimes it can be freed by allowing the assembly to cool down or by exerting extreme pressure on the pedal, but as the trouble is likely to occur again, and it can only be very disconcerting in traffic, it is far better to take the “bull by the horns” and strip it.

Before the clutch can be removed it is necessary to unbolt the gearbox, and, having removed the trunnions from the rear of the propeller-shaft, pull back the gearbox a few inches to allow the clutch room to come away, together with its subsidiary mechanism. There are, of course, other parts to be disconnected, such as the clutch and brake pedals, but no comments are necessary on these. Be careful when lifting away the clutch-operating cross-shaft, which carries the toggle arms, as there are two small spring-loaded carbon brushes which serve to combat any rattle or vibration which might occur between these toggles and the clutch-race withdrawal housing and are more than likely to fall out. Having disconnected the Hardy-Spicer flexible coupling (not, I believe, fitted to the E type, which has a metal coupling) and removed the bolts holding the clutch to the flywheel, the whole should come away. If difficulty is experienced a few clouts with a raw-hide hammer should serve to ease the small ball-bearing which locates the centre spline of the clutch in the flywheel.

Dismantling the clutch should be done as follows. Stand unit vertically, the top being the face which mates up to the flywheel, and undo the five or six small screws visible on the surface. Before actually removing those, rig up some sort of a lever capable of holding down the plate, which the screws serve to retain when fully driven home. The set-screws can then be removed safely without the plates becoming airborne. Gradually release the leverage until the spring has lost its tension and lift out all the plates, taking care that they are laid out in the sequence that they occupied prior to dismantling; the centre spline can then be lifted out. Thoroughly clean everything and examine the centre spline for grooves along the spline. As the majority of these cars have, today, covered large mileages it will be a fortunate owner who finds no grooves on those splines. This fault permits the plates to become lodged in set positions, whereas they should , of course, slide freely over this shaft when the pedal is depressed. There are two ways of overcoming this trouble; either file away the ridges until a smooth surface is again available, or get the shaft built up to its original dimensions. The latter course is definitely the better, because the former allows play between the plates and the shaft; however in my own case, filing only was done, and no further trouble was experienced afterwards.

Having attended to this part, turn your attention to the plates. These are of copper and steel, there being, I think, thirteer of one and fourteen of the other. Test each plate for flatness on a measuring table and, if warped, treat with a soft hammer until perfect flatness is obtained; also remove all burrs, which will be found particularly on the copper plates. Examine the splines within the housing; these do not usually suffer very badly but if they are notched, treat them the same way as mentioned above.

Re-assembly is quite straightforward, being merely a case of dropping all the plates back in the same order, compressing against the one spring situated at the rear of the clutch housing, and tightening down the small se screws. When assembled, fill with approximately half a pint of flake graphite through one of the plugs in the outer housing. I might mention that there is no necessity to undo the large ^ inch nut which appears to be the key to dismantling this unit. This serves only to hold the main spline to the driving shaft which protrudes through the rear of the housing.

If the clutch is care-for as described above, no sweeter clutch could be desired, given though it may be a little on the heavy side compared with modern standards. But for smooth get-away and easy gear-changing it is second to none. Normal maintenance is practically nil. Introduce about ¼ oz. Of graphite from time to time, keep the thrust race well lubricated, and keep all the withdrawal mechanism well oiled.

GEARBOX ---- It is not necessary to say much in respect of this unit, as the general principle is as with all other pre-synchromesh boxes. Troubles are practically unknown, although it must be admitted that these cars are heavy on the bearings. The only trouble I have experienced, and I mention it in case others suffer from the same annoying habit, was a periodic difficulty of not being able to select a particular gear, or when in gear, being unable to get either into neutral or any other gear.

I only remembered to look at the most obvious place, which is, of course, the selector arm, after much examination. This arm is clamped to the end of a shaft the other end of which carries the gear-lever, and is self-locking when a particular gear is selected, through the selectors which are housed in a small box of their own on the off-side of the gearbox. The bolt which locks the selector to the gearshift cross-shaft had worked loose (there is no locking device) and allowed it to move a little way to one side. Obviously misalignment occurred, and the selectors could not be moved. What was so misleading was that, every-so-often, this selector must have vibrated back into its correct position, when no further trouble would be experienced for a considerable while.

The gearbox, which like the engine is mounted on the chassis sub-frame, should be carefully shimmed up into position of alignment with the latter. This can be done by attaching a small pointer to the front flange, which for the purpose of this test would be disconnected from the flexible joint. Turn this in relation to the flywheel until the two are concentric.

To allow for the flex in the main chassis and the rigid mounting of the gearbox in the sub-frame, a ball joint is provided on the extreme end of the gear-shift cross-shaft; keep this well lubricated. It will make for easy gear-changing on rough roads. Also, keep the cross-shaft itself well lubricated, which can be done by feeding oil through the two small holes provide for the purpose in the steel tube surrounding the actual shaft.

The gearbox should be drained at intervals of 5,000 miles, and refilled with Wakefield Castrol gear oil to within 6 inches of the lid seating.. Gear-changing is easy, and comparatively light, except on winter mornings when the oil is particularly thick. Changes up and down can be effected without the us of the clutch, but in order to achieve this quietly a certain amount of brute force has to be employed. When changing gear in the more normal manner and using the very efficient clutch stop, the leather lining of which should be kept fairly well oiled, little pause is necessary in moving from one gear to another. The standard ratios provided are not the best for those who like high speeds on the indirects, perhaps because the car was essentially designed as a top-gear performer. With a 3.3 to 1 rear axle the ratios of the OE are:-

Top: 3.3 to 1; Third; 5.1 to 1; Second; 7.8 to 1; and Bottom; 12.2 to 1. Assuming the maximum engine-speed to be 3,400 rpm and the car to be fitted with 20 inch by 5.50 inch tyre, allowing for various losses, speeds of 88 mph on Top, 60 mph on Third, 38 on Second, and about 20 mph in Bottom should be possible. There are available today, I believe, redesigned sets of gears which allow higher speeds on the indirects, although this is naturally quite likely to affect the acceleration a little. To my mind the best modification is to fit a side-valve< E type, rear axle, which is fitted with a 3.0 to 1 crown wheel and pinion.

TRANSMISSION --- The drive from the gearbox to the rear axle is transmitted by an open propeller-shaft with universal joints at either end. Immediately behind the gearbox is the transmission brake drum. The centre of the drum makes up part of the universal joint, which is of the metallic type, and through which two hardened and ground pins locate alternately in the propeller-shaft housing. This form of universal joint, though quite common on cars built during the twenties, has now been generally discarded in favour of the more popular flexible joint, as made by Hardy-Spicer, added to which, with the latter type of joint, lubrication is unnecessary. Generally speaking, little wear occurs with the forward end, and it is only necessary to dismantle this when one has cause to remove the propeller-shaft in its entirety. To do this, remove the rubber boot, which serves to retain lubricant, and undo the serrated collar which is then exposed, and which surrounds the propeller-shaft and screws into the outer casing of the universal joint. On the earlier cars the speedometer-belt pulley is an integral part of this assembly, but as these pulleys, which are made of cast-iron, break for no apparent reason at the flange, I scrapped mine and took my speedometer drive from a split pulley fitted round the actual prop-shaft, at the same time fitting a spring belt in place of the earlier flat rubber or leather drive in the same arrangement as fitted to the later cars . With this small alteration no further trouble was experienced through the belt coming off and becoming entangled in the works. It is important to keep this belt taught and the two pulleys absolutely in line.

The rear end of the propeller-shaft carries a Carden Joint which consists of a transverse pin, on which are located two bronze trunnions; these trunnions slide in two slots of a machined housing which forms part of the pinion assembly, the trunnions being kept into position by a cover which slides over the whole, and is secured by four small bolts. When driving these cars at low speeds in the higher gears, roughness or jerking in the transmission is frequently experienced, and this can usually be traced to the trunnions having become worn on their driving faces. If they have not previously been turned round this action will quite frequently cure the trouble, but more often than not this expedient has already been tried, in which case there is only one thing to do, scrap them and have new ones made. The head of these trunnions is of spherical design and this surface also suffers wear, but this can, up to a point, be rectified by placing shims underneath the blocks. The life of these trunnions is not long, and they will well repay very regular lubrication and replacement. To my mind one of the best improvements which can be made on these cars is the complete scrapping of the standard prop-shaft, replacing it by a modern-type Hardy-Spicer unit.

REAR AXLE ----- The rear axle is made up of two steel castings, bolted together round the periphery to form the pinion and differential housing, and into which are fed two steel tubes, these tubes leading through to the hubs. There is no doubt that this form of construction makes for extreme strength with the minimum of weight. On the E type cars the casing was also supported by a tie-bar underneath but this seems to have been discarded on the OE models. Keep this tie-bar well adjusted; there is provision at the ends. Unless for any reason it is necessary to remove the crown wheel and pinion, which are of the spiral-bevel type, there is no necessity to open up the two halves of this housing. There is, however, a frequent necessity to remove the hub assemblies, as wear often takes placeat these extremities. Perhaps the following few notes on dismantling these ends will be helpful to those who are not familiar with the layout. First, remove the hub-cap, split-pin and nut, and withdraw the brake drum and hub in one piece. There is a steel bush dowelled into the front of the hub, the inside of which is splined and slides over the splines on the extremity of the half-shaft. Should the female splines for any reason become damaged or worn it is only necessary to replace this bush, and not the whole hub. Having exposed the brake shoes, remove the thrust race which is also visible, the shoes, oil retainer and back-plate. The difficulty usually comes in removing the spring pad, which should be a floating fit on the axle tube, but which is more often than not seized solid through lack of grease.

This spring block is an aluminium casting, into which is pressed a large bronze bush, this bush being located by a dowel pin which is the extension of the spring clamping bolt. The easiest way of removing this casting is to slacken-off the retaining ring (which can be found behind the spring pad and which serves to adjust this part), against the thrust bearing already referred to, knocking it up the axle tube four or five inches and then heating the whole with a blow-lamp, until it can be forced free. Having removed the block, the bush, if not too badly worn, should be scraped, and the axle tube cleaned down until the two once again mate properly. In view of the general design of the transmission of these cars, it is most important that a smooth and easy movement is achieved, so that the axle is allowed to move when riding rough roads or when accelerating violently. When re-assembling make sure the bush is fitted the right way up, that is, so that the dowel pin can locate in the hole made for it, and which will ensure the bush moving on the axle tube and not in the aluminium housing. One other point, the small oil-retainer pressing, which screws to the back-plate, has a hole drilled on one side. This hole must be at the bottom, to allow any surplus oil from an over-filled rear axle to escape. Re-assembly of the remainder is orthodox, finally tightening up the retaining ring until the spring pad is just free.

The rear axle should be filled with Wakefield Castrol gear oil, until the level comes up to the filler-cap orifice. There is no drain plug in these axles and to remove old oil it is necessary to unscrew the filler-aperture from the actual casing. Even this procedure will not entirely empty the axle of oil.

BRAKES ---- Undoubtedly one of the worst feature of these cars are the brakes, and there is no doubt that it is this which has prevented the “30-98” from becoming as popular as others in the same class.

The E type and the first 30 OE type cars were fitted with two-wheel brakes only and a transmission brake, the hand-brake working the rear wheels and the foot-brake on the transmission. The dimensions of the transmission drum made it impossible to dissipate heat generated when the foot-brake was applied hard at even moderate speed, and the lining wear was excessive. One car I owned had actually been fitted with \ inch copper linings; I do not know if this was common practice but to me it seemed most dangerous, due to the violence of the grab.

About August 1922, Vauxhalls, who were then building the OE, apparently decided it would be a very good thing for their cars to be shown at that year’s Motor Show equipped with four-wheel brakes. The time at their disposal was not very long and no doubt this contributed to the poorness of the brakes which Dan Oliver designed. Obviously something had to be devised which called for no great chassis modifications. The outcome was a compensating mechanism rigged up externally and enclosed within a kidney-shaped box ahead of the radiator. Apart from this , and the design of the actual brakes themselves, nothing else was done, except to hook the whole up to the pedal, which then applied both front wheel and transmission brakes, the hand-brake still operating on the rear wheels. This certainly provided a four-wheel-braked vehicle, but it is a great pity that in the next four and a half years no improvements were made, with the exception of increasing the drum diameters, which was done in 1927 when the hydraulic system from the S type was fitted. To all intents and purposes this system, on the face of it, should work reasonably well if the hand-brake is used at the same time, but it just doesn’t. To my mind the root cause of the trouble appears to be that the rear wheel and transmission brakes are cam-operated, whereas the front brakes are operated by a vertically-rising wedge, pulled upwards by cables operating through callipers and the kidney-box. From details that I have worked out the linkage required to operate the two separate brake systems to advantage from the pedal would have to be very much larger than it is reasonable to fit within the limit of space available and so, without making any alterations to design, the easiest way to overcome the brake problem is to entirely disconnect the front-wheel mechanism from the transmission brake. In my own case I scrapped the transmission brake in its entirety, it is unsatisfactory anyway, and tied up the foot brake to the front wheels only, leaving the rear wheel to be operated by the hand-brake. With the brakes in good condition, no further troubles were experienced and quite an efficient stop could be made by using the foot-brake , followed by an application of the hand-brake. By an efficient stop, I mean that it was quite possible to stop from 30 mph on a dry road in about 43mfeet, without experiencing any tendency to pull or skid. Many owners have attempted to hook up all the four wheels to the foot-brake, and connect the hand-brake to the transmission. I have already pointed out that I believe this to be unsatisfactory without major modifications, but it is always interesting to hear from anyone who has achieved a good four-wheel brake system by this means, and in this respect I refer to having a minimum of 60 per cent, braking on the front wheels.

Adjustment of these brakes is perfectly orthodox, though there is one small point which many are likely to overlook, and that is, that on the cable-operated front-wheel-brake models it is most essential to make quite sure that no slack exists between the ends of the cable coverings and the kidney-box itself. There are two slots, one at each end of this box, in which sit two bolts, which can be adjusted inwards or outwards. Make absolutely certain that these bolts are always in tight contact with the shrouds over the ends of the cable covering. It is very surprising indeed to try the brakes on one of these cars before and after the slack has been removed; a very great improvement can be obtained without interference with the normal thumb-screw adjustments behind the drum. The kidney-box itself encloses a compensating mechanism and should permit the two front brakes to equalise themselves when pressure is applied to the pedal. The manufacturers give the following notes on brakes and brake adjustment:-

1. Always use the hand-brake for normal stopping. Keep the foot-brake for emergency use only.
2. When adjusting hand-brake, wheel should just be turning by hand when the hand-lever is pulled on four or five notches.
3. When adjusting the front brakes (foot), jack up one wheel at a time bringing the shoe as near to the drum as possible without fouling otherwise the compensating mechanism will never give equal braking.
4. To adjust cables, slacken nuts on front cross-member and tap bracket holding cable ends along the cross-member.
5. The normal amount of play in the pedal action is about ½ inch at the extreme top of the pedal, when the brakes are in the full-off position.

All drums are of steel, with cast-iron liners riveted in, their overall diameter being 12[inches diameter, and the total brake-lining area, excluding the transmission brake is 160 sq. in.

The later OE cars, that is those made during 1927 , were equipped wit hydraulic brakes. I have had no experience with this design, but from those layouts I have examined it does seem to me that one of the biggest troubles is the use of the rigid copper pipe which carries the fluid to the operating cylinder within the drums. This pipe leads into the cylinder through the top of the king-pin and, as the whole assembly moves on steering the car, obvious difficulty is experienced in retaining the fluid. A definite improvement could be made in this respect by altering the layout to carry Bundy tubing, as used on the Lockheed system. The hydraulic brake air-pressure system should be maintained at 10 lb./ sq. in.

On the other hand, it seems that the older design of cable-operated brakes could quite easily be converted to hydraulic operation by fitting two small transverse cylinders vertically over the king-pins; these would serve to lift the wedges very much more satisfactorily than the cable mechanism. No difficulty would be experienced in installing the remainder of the hydraulics.

CHASSIS ---- The chassis is of perfectly straightforward design. Along roughly half of its length is a sub-frame carrying engine and gearbox. The rear end of this sub-frame is slung from a tubular cross-member which also acts as the bearing to which the rear axle torque stay is clamped. This cross-member is subjected to considerable strain and frequent attention should be paid to the rivets by which it is held to the frame side-members, and also to the bolts which support the sub-frame. It is advisable to replace all these bolts and rivets with modern high-tensile bolts on an elderly car. Keep the torque-shaft bearing well lubricated and eliminate any side-play. Immediately behind this member is the cross-shaft operating the rear rakes. On the outside of the frame will be found two grease nipples and regular attention to these will go a long way towards easy smooth brake operation.

At the extreme rear of the chassis is slung a 12-gallon fuel tank of lead coated steel, held in position by two quite frail steel straps with wood packing anchored to one of the rear tubular cross-members. These straps seem to receive all the splash from the rear wheels and are very liable to rust. On one occasion I had a full tank come adrift, so it is particularly advisable these days to examine them, as even twelve gallons of petrol cannot easily be replaced.

The chassis as a whole is very flexible, but seldom appears to fracture; the front end is possibly too flexible and it does help to insert an additional cross-tube between the dumb-irons on the two wheel-braked cars.

The springs are supported in the normal manner and give little trouble, the main point of wear being where the rear inverted shackles bear on the extremities of the rear cross-member. Replacing the bushes in the spring ends is not necessarily a cure and the only satisfactory way of putting these parts into good condition is to remove the cross-member and either build up the worn-away material or regrind the ends to suit the new bushes. To remove it, knock out the taper pins which pass through the dumb-iron ends (on the e type these ends were made of bronze), heat the dumb-irons, and then I am afraid it is a case of a heavy hammer.

The steering layout is quite conventional. All ball joints were originally enclosed in leather gaiters and this was no doubt responsible for such little wear being apparent on the cars that I have owned and dismantled. There is I decided toe-in on these cars and the track should be about \ inch less in front than between the same point measured at the rear of the front wheels (this being based on the car being fitted with 820 by 120 beaded edge tyres).