TEE-ONE TOPICS

Number 35 May, 2004

IN YER BOOT MATE!

More old photos.. This time a very nice Silver Dawn with that extraordinary number plate window. The box behind the window would not take any Australian State plates which therefore had to be quite illegally cut down. When the 'R' type arrived it sported a universal mounting bracket that would carry any plate. Keen eyes will note the 'colonial bumpers'. Apparently we latter day convicts used our bumpers in a rather aggressive manner which discouraged new owners from ordering the pretty 'Home' version. God knows what the engineers of yore would think of today's fibreglass offerings.

But what is most interesting in this pic is the button immediately above the number plate box. This was dreamt up by the RTA of the day which required the driver to physically dismount, turn on the tail lights then return to the driver's seat and proceed. All cars had to have them and apparently as best I can find out, the idea was to stop Constable Plod who was following close behind you from losing you when you turned the tail lights off! The reverse situation prevailed however because people got in their cars switched on the lights and headed off forgetting the units at the back!

I have often wondered what went on in the board room in those heady days of the fifties. That Rolls-Royce ever considered that quaint little French car the Renault which in 1948 had not only a steering column lock but had flashing turn indicators. Probably ‘Bloody vulgar flashing things – not in the image you know!’. Instead they persevered with those idiotic trafficators until the ‘R’ type. The pic above shows one way of signalling by adding a pair of lights either side of the number plate. The Factory modification involved using the stop lamps and parking lights to signal. A very complicated relay box was installed on the right hand valance which cut off power to the stop lamp filaments should you have your foot on the brake and power in a pulsating form then was fed to the same bulbs to signal to the hapless driver behind you. I should add that the first signalling systems on the Australian Holden used the same idea.

You will also notice in the pic a neat pair of bicycle reflectors mounted immediately above the bumper bar. Even then bicycles had to have reflectors, why not cars. The tail light lenses of those days were glass and not plastic in Rolls-Royces and to produce the necessary prisms in the lens, plastic has to be the moulding material. Again it was not until the arrival of the Cloud that reflectors were installed. One wonders whether this fanglement was resisted by Board members having been pushed by various safety bodies around the world. My cynicism is not misplaced methinks when I read that the reason the ridiculous if stylish drop down boot lid seen above and on the pre-E type Silver Dawns was prolonged because one of the Board members liked to drop the lid down to load his son’s trunk thereon when he was returned to boarding school!

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An Australian travel writer touring Canada was checking out of the Spokane Hilton, and as he paid his bill said to the manager, asked, "By the way, what's with the Indian chief sitting in the lobby? He's been there ever since I arrived."

"Oh that's 'Big Chief Forget-me Not'," said the manager. "The hotel is built on an Indian reservation, and part of the agreement is to allow the chief free use of the premises for the rest of his life. He is known as 'Big Chief Forget-me Not' because of his phenomenal memory. He is 92 and can remember the slightest detail of his life."

The travel writer took this in, and as he was waiting for his cab decided to put the chief's memory to the test.

"'ello, mate!" said the Aussie, receiving only a slight nod in return. "What did you have for breakfast on your 21st birthday?"

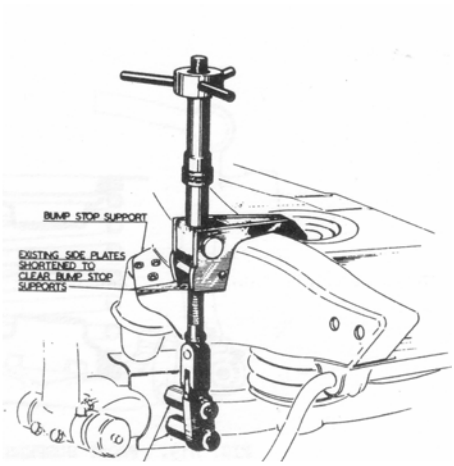
"Eggs," was the chief's instant reply, without even looking up, and indeed the Aussie was impressed.

He went off on his travel writing itinerary, right across to the east coast and back, telling others of Big Chief Forget-me-Not's great memory. (One local noted to him that 'How' was a more appropriate greeting for an Indian chief than "ello mate.') On his return to the Spokane Hilton six months later, he was surprised to see 'Big Chief Forget-me-Not' still sitting in the lobby, fully occupied with whittling away on a stick.

"How?" said the Aussie.

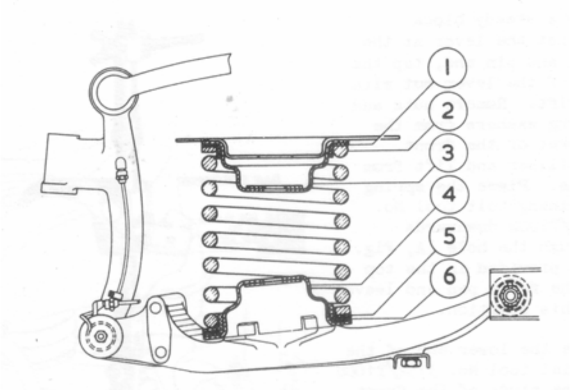
"Scrambled," said the Chief.

DECAPITATION BY A MARK VI

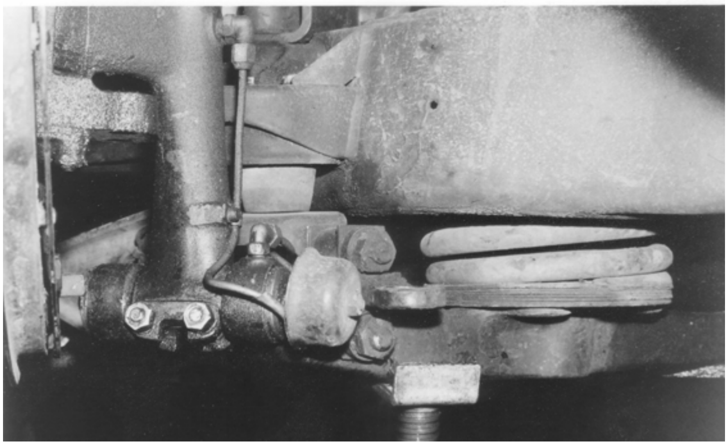


I was rummaging through a factory handbook on the Mark VI and associated models and was amused to see this diagram showing the removal of the front springs.. This has been the subject for later models but here we have a car nearly 60 years old and the manual is quoting a special tool 3752/T1008 which has never been available to the likes of us. But years ago I had to remove my first springs from a Silver Dawn and thought you might be interested to know how I did it and survived.

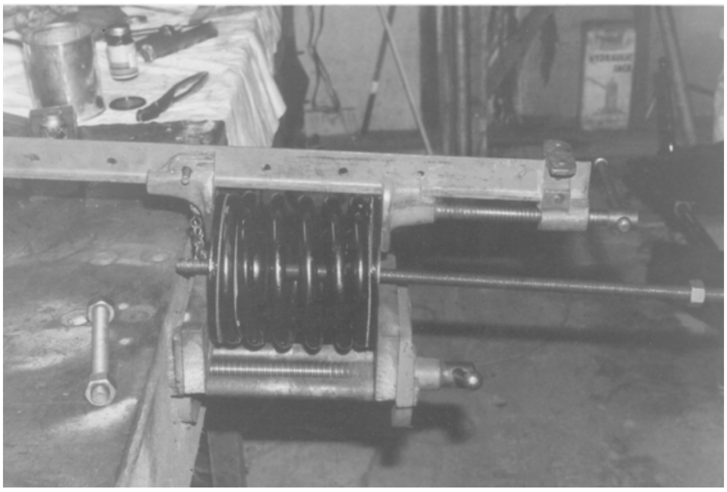
The springs as will be seen in the second diagram are seated and capped by a dished plate with a large hole drilled through it. The top of the top plate can be seen through a hole in the front cross member and there is a corresponding hole in the lower wish bone which carries the spring. The approach is to compress the spring with its plates to a tight bundle, then place a substantial bolt through the two and loosely screw on nuts to hold them together.



The picture below shoes my method of compression using the car jack. What is not shown is a length of 4”x 2” timber placed beside the engine resting on the front of the chassis and jammed against the roof of the garage. Since the spring did not have enough tension to lift the roof and the car it gave up and allowed itself to be compressed. The outer upper wishbone is then unbolted and the jack lowered. It will also be necessary to disconnect the anti-roll bar to allow the suspension to drop down far enough to remove the compressed spring.

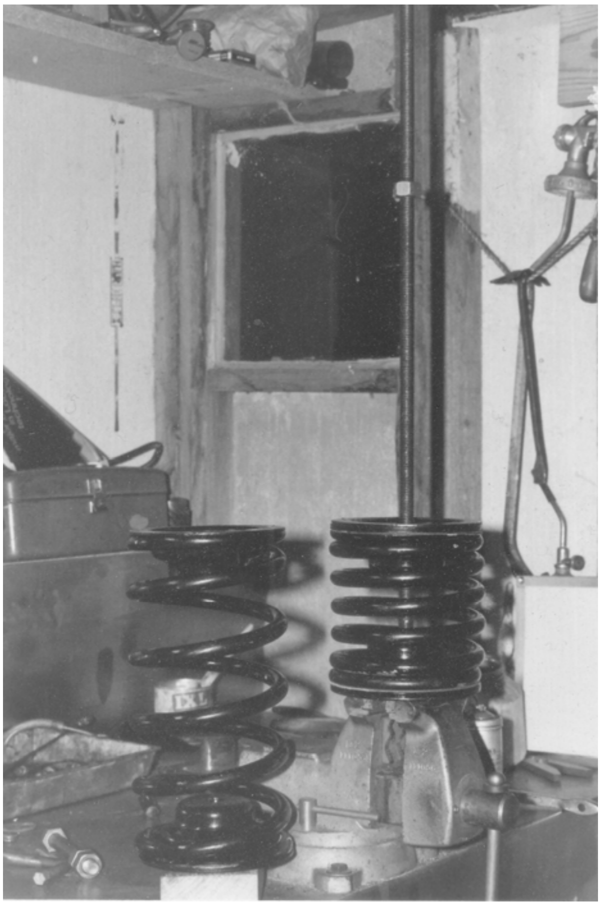


The next picture shows the spring clamped in a large woodwork vice and a couple of carpenters’ ‘G’ clamps. The bolt that held the plates together is on the bench. Having clamped the spring very securely and compressed it slightly the holding bolt could be removed and removed with a length of threaded rod, the nuts screwed up and the whole thing gradually allowed to open up for cleaning sand blasting and painting. At this point I placed two heavy steel washers well doused with grease to minimise the friction. I also greased the threaded rod and had a couple of safety nuts further up the rod to calm my trembling heart. Lest all our budding attorneys are reaching for their handbooks, I hope my description conveys the hazard of this operation. The Factory system was similar, they used an elaborate centre bolt and to release the tension the whole spring was placed in a tube, one end of which was bolted down the other welded. The holding down end bolts



were slowly undone releasing the spring. Were I to remove these again I would have such a box made up but in my more stupid days money or the lack of it seemed to loom large.

The replacement is the reverse process. Apart from exercising very great care the only obvious hazard is not clamping the compressed spring sufficiently while changing the centre bolt. Coil springs can belly to one side and escape their clamps. To avoid this, use at least three clamps. Concentrate on minimising the strain at any point, hence the washers and grease. Given the tension of the threads while you are unscrewing the nuts, the possibility of them giving away and stripping the rod is something I do not wish to contemplate.



The last picture shows my primitive method of compressing the spring for reassembly. Note the difference in height between the uncompressed one and the squashed one.

Although the Factory clearly wanted to cover its nether regions, it gave rather wise advice that even their beautifully made tools used for this task were to be changed at frequent intervals. Threads do wear!!!

When refitting any coil springs in any of our cars have a good look at the condition of the spring insulators those truncated top-hat-like inserts that the spring seats in. The older impregnated canvas-like ones which did a good job seem to last forever unlike the last iteration of soft rubber which finally disintegrate.

With any coil spring, unless it is very new (< 20 years) and nice and black, have them sand blasted and coat them well with a good enamel. Apparently this does a lot for the spring molecular structure particularly on the surface. Although it is rare, coil springs do break so a little TLC doesn't go astray.

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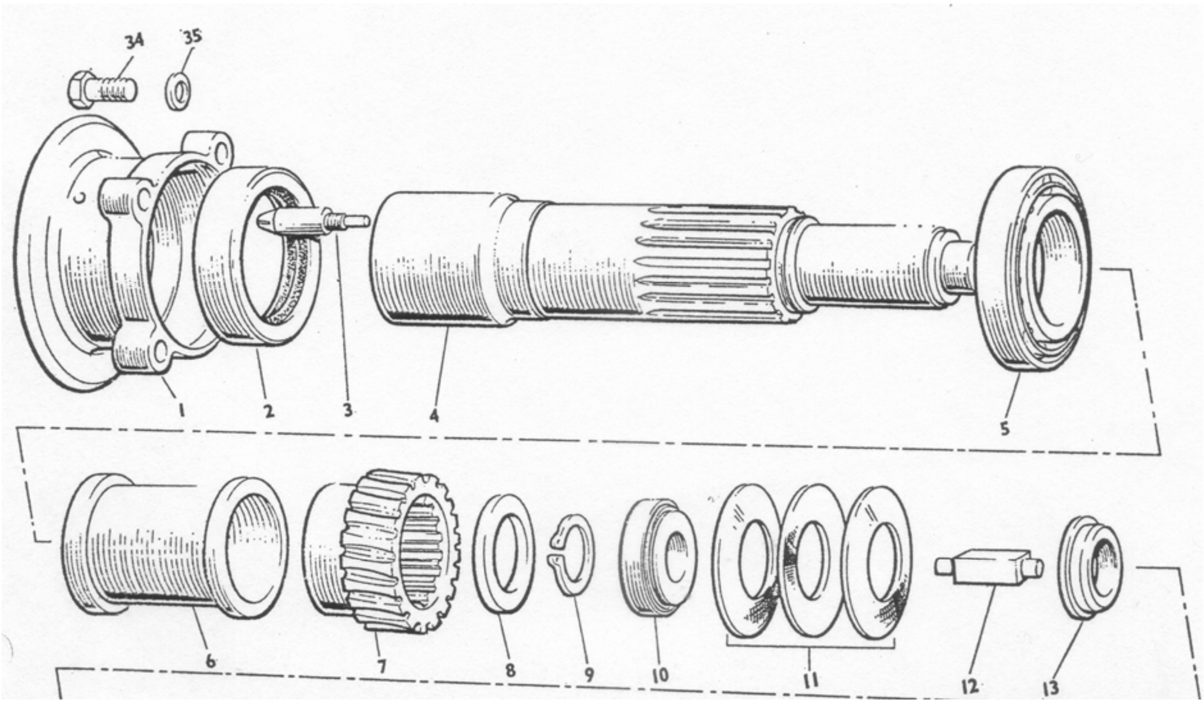
HAVE YOU CHECKED YOUR ACCUMULATORS LATELY???

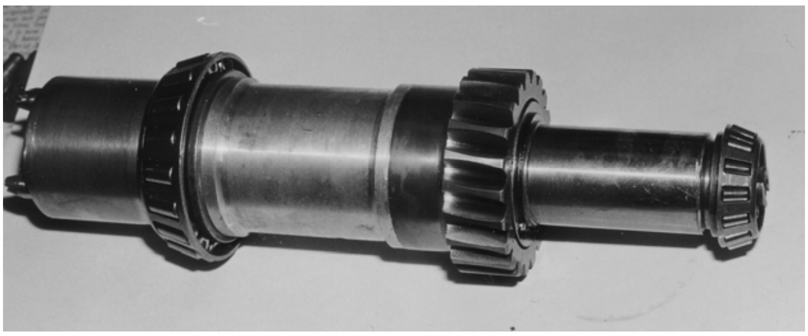
Shadow and Spirit owners still come round all wide eyed that there are too many lights coming on the dashboard. Let me tell you mateys when those brake lights start a' blinkin' its time to make peace with your Lord.. Once a month when you get home switch off the engine, then turn on the ignition. Start pumping those brakes and count the number until the lights start a blinking. For a Shadow I (sic) something less than 20, a II say 15 and a Spirit or mineral oil Shadow less than 10 calls for deep religiosity so do something about it!!!!

WHAT'S STOPPING YOU?

Right you all know what is below!? Well it's an exploded view pinched out of the spares manual and it's the shaft that runs cross wise on all Rolls-Royce fitted Hydromantic 4 speed boxes. The shaft which is driven by a bronze gear (#7 in the diagram) turns at 1/5th of the speed of the output shaft which drives the back axle. The shaft (#4) has the brake servo attached to it and it is the mechanism that stands between you and wearing the Flying Lady as a mouth guard!

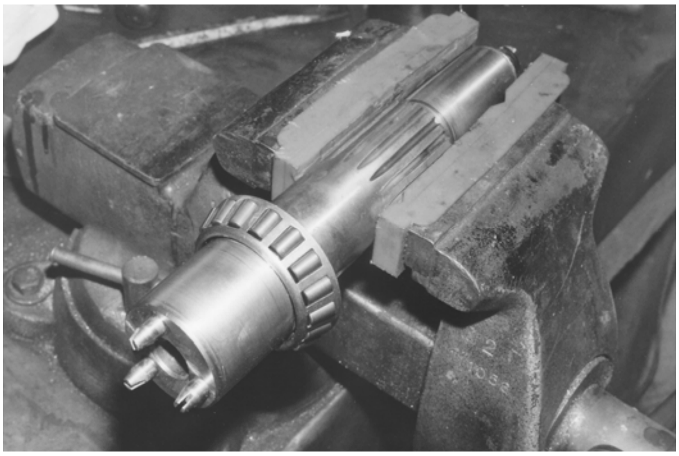


That is of course assuming you are driving a chassis from 1954 through to immediate pre Shadow. This braking system which Rolls-Royce pinched from Hispano Suiza in the early nineteen hundreds relies on dry friction linings in the servo motor on the side of the gearbox, correct adjustment of the various linkages and of course a correctly operating hydraulic system and good brake linings. These writings will concentrate on getting the servo to work properly.



I am so old I remember when these cars were new and one of the frequent complaints were under-chassis groans, clunks and various other sound effects. Most if not all these were traced to the servo motor as it was called and related to the servo lining, its condition and its mounting.

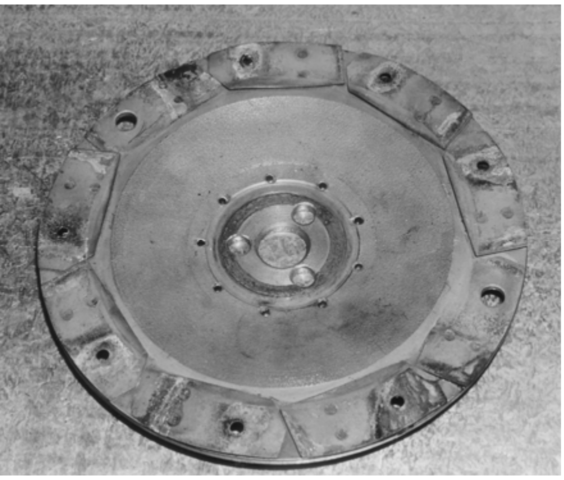
Initially the lining of the servo as you will note from the diagram below is not riveted directly to the driven disc but in lieu is riveted to spring plates. This gives a pleasant feel to the brake pedal rather than slamming the pedal up against a brick wall. These spring plates occasionally break and need to be replaced. Some operators remove them all and rivet the lining direct to the plate and you get the brick wall effect. It is simply a matter of drilling out rivets, replacing the broken plates (probably by now they all should be replaced and riveting on a new lining.



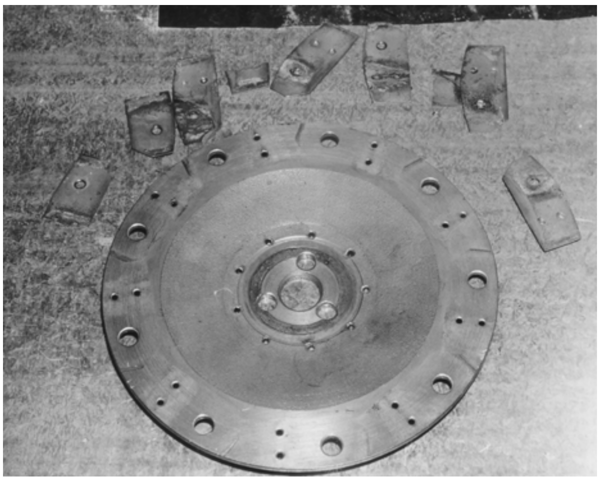
Having got that far it is a nice touch to rub the finished lining down on medium sandpaper on a sheet of glass (best flat surface usually available) to remove the glaze and ensure any distortions induced by the riveting are smoothed out. But before you start putting that plate and associated bits back together it is essential that you ensure that oil is not getting past the seal (#2 in the diagram above). If that occurs you may as well leave the car at home. Replace whatever is there with a double lip seal available at any good seal shop and have a good look at the drive shaft. If there is any evidence of scoring either replace it or more practically get a Redi-Sleeve to go over it. That way you should not have any more leakage before the car becomes a basket case. The pic below shows a very faint ring (if the printer reproduces it just to the left of the bearing. This 'score' does not like lip seals and it is here that the leaks occur.

Lastly have a good look at the bronze drive gear (#7 in the above diagram). If it is showing more than superficial wear replace it lest it wears right through and you suddenly find you have no servo action at all.

At left is a rear view of the servo drive plate. Around the centre drive pin holes is a ring of rivets. These can be drilled out to reduce the large Bellville washer and release the inertia ring beneath it.



This is the business side of the servo showing the spring plates riveted to the drive plate. These were Dispensed with after the Silver Cloud I (sic) and the lining was riveted direct to the drive plate.



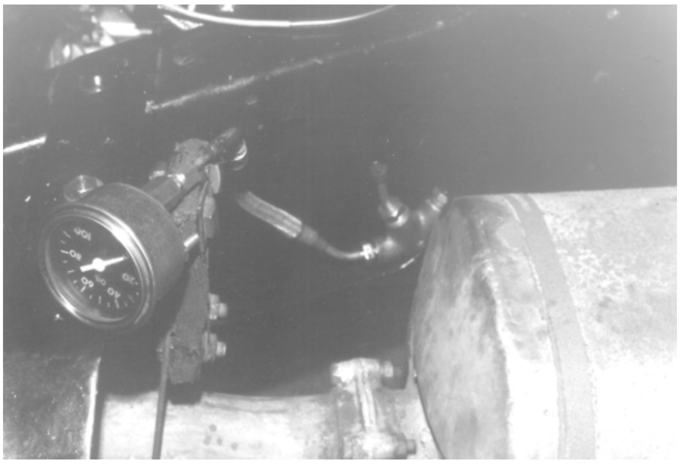
Down to the bare bones. This is the drive plate from a Silver Dawn with the spring plates unrivetted. When riveting the lining be very careful they are brittle and can easily be cracked.

KEEPING YOUR TAIL DOWN

The idea of controlling the ride of your car from the driver's seat is still a feature wondered at by passengers and drivers alike. Our Lexus LX470 has a ride and height control which is not only very effective but obvious as well. The coal face end of the system is the shock damper or as the uneducated such as myself would call it, the shock absorber. How these things stand the hammering they do beats me. The damper as we had better call it, assuaging the sensibilities of some of our more devout devotees, is simply a piston in a cylinder. The top of the cylinder is fastened to the body of the car the piston to the axle. The whole thing is filled with oil. With this set up the damper would be just one solid structure and a ride down even the smoothest road would induce corns where they were not meant to grow.

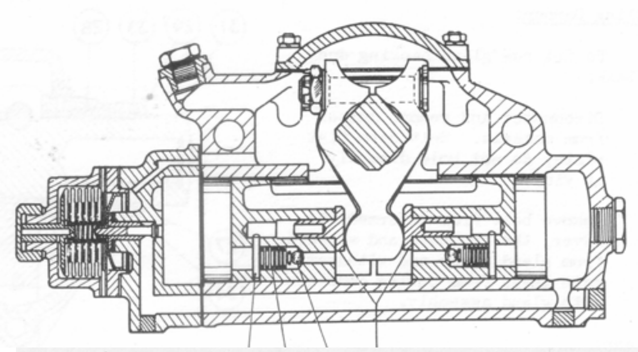
The 'damping' effect is actually achieved by drilling holes through the piston so that when it moves the oil can pass from one side of the piston to the other. Obviously there is a lot of resistance to this. The smaller the holes the more resistance and vice versa. And so as hard as the wheel may be pushing to ram the axle through the car the damper resists it and allows movement in a more sedate manner. The reverse action applies since having eventually shoved the axle up, the spring which does not favour compression is desperately trying to shove the wheel down. Again the oil has to be pushed through those little holes. And so the damper effect is applied to the wheel when travelling in both directions – hence the term double acting shock absorbers.

T'was not always so. Single acting shock absorbers in the absence of anything else were a great step forward in the infancy of the car in the last century. But back to this one, the size of the holes obviously dictates the type of ride and please, I am being simplistic here. Imagine being able to vary the size of the holes and change the ride. Well only twenty years ago dampers were sold which could be adjusted. All you had to do was crawl under the car, grasp the body of the tubular damper and give it a twist. But this was a little awkward in the middle of Macquarie Street or whilst tearing down Brown Mountain or at 125K on the Hume highway when you suddenly hit a patch of yet-to-be-repaired road!

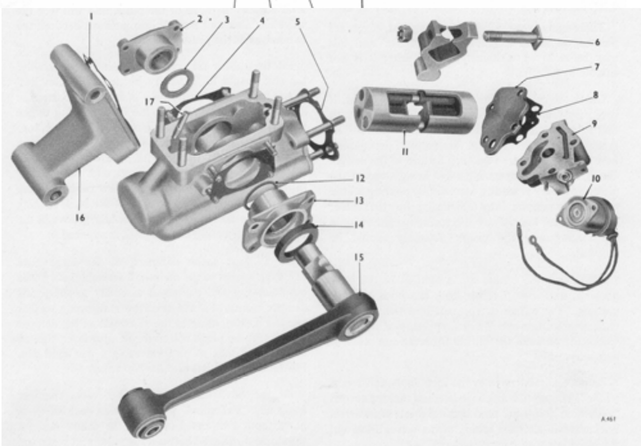


Rolls-Royce many years ago did just this although in a limited way. They changed the size of the holes but only for the rebound stroke. This required something to move and they did it by moving a small plunger in a valve in the rear shock dampers. To move it they initially pushed the plunger hydraulically by pumping oil from the gearbox back to the shock damper. To the left is a glimpse of the line that ran from the pump in the gearbox which was driven by the other end of the brake servo shaft. The brass junction has a tapping into which can be screwed a pressure gauge to check the efficiency of the pump. The other quaint procedure one had to follow was to bleed the pressure lines since any air in them could be compressed and the plunger wouldn't be plunged. There was a small bleed screw on the rear dampers that allowed you to do this. It is well to keep an eye on the flexible line from the gearbox to the chassis as these have been known to leak badly enough to drain the gearbox – an event calling for self immolation! The gearbox oil of course did not get into the damper proper but filled a bellows which pushed the plunger. The effect on the ride particularly if the car was heavily loaded, was to stop the rear leaping up and down on an undulating road. To control the plunger the driver moved a lever in a quadrant on the steering wheel boss. Rabid owners would demonstrate how the setting would make a radical difference to the ride of the car, moving the control one tiny notch one way or another 'See' they would squeal, 'Feel how much firmer that is!'. I who suffered these demonstrations in my younger days finally decided that the effectiveness of the ride control bore a close relationship to the drinking habits of the driver. As far as I know no attempt was made to hydraulically control the front dampers.

When the Cloud and its derivatives appeared, lo, the hydraulics had disappeared, replaced by a modern solenoid. These contraptions are simply switches that can move things, in this case our plunger. But unlike our hydraulic system which could be varied, the solenoid was either on or off and the ride was either hard or normal. Generally the effect is minimal for any car. With the Cloud however as it was not much trouble to run a wire so the Factory fitted solenoids to the front dampers as well as the rear and that setup was fairly noticeable when switched on. The fitting was certainly not universal but was a feature on a number of Australian delivered cars.



This is a side elevation of the rear damper. The piston in the middle moves back and forth, pushed by the lever in the middle. The oil is forced through valves the adjustable one with bellows is seen on the left hand end.



An 'exploded' view of the same shock absorber this one on a Silver Cloud complete with solenoid (the bits on the right). The actuating shaft seen poking out of the operating arm The long black one, tends to get corroded. As far as I am aware the only way to repair this is to have it metal sprayed and re-finished this gives a perfect surface for the quaint Russian wax and hemp seal to run on. The front shock absorbers are identical in essence, simply different shafting. These must have been the last lever action shock absorbers used on a passenger car.

Lucas Electrical Theory

John Kilkenny

A very practical plain speaking site http://www.bayourovers.com/lucas.html dealing mainly with Land Rovers presented the following insight sent to us by John. Robert Chapman explained this theory to me some years ago but my mentation couldn't handle it. Now that I have it in writing it is becoming clearer. Perhaps Ken Saunders our resident electrical guru could elaborate!

Positive ground depends upon proper circuit functioning, which is the transmission of negative ions by retention of the visible spectral manifestation known as "smoke". Smoke is the thing that makes electrical circuits work; we know this to be true because every time one lets smoke out of the electrical system, it stops working. This can be verified repeatedly through empirical testing. When for example, the smoke escapes from an electrical component (like,say,a Lucas voltage regulator), it will be observed that the component stops working. The function of the wire harness is to carry smoke from one device to another, when the wire harness "springs a leak" and lets all the smoke out of the system, nothing works afterwards. Starter motors were frowned upon in British motorcycles for some time, largely because they consume large quantities of smoke, requiring very large wires. It has been noted that Lucas components are possibly more prone to electrical leakage than Bosch or generic Japanese electrics. Experts point out that this is because Lucas is British and all things British leak. British engines leak oil, shock absorbers and hydraulic forks and disc brakes leak fluid, British Tyres leak air, and the British defense establishment leaks secrets...so, naturally, British electrics leak smoke. From the basic concept of electrical transmission of energy in the form of smoke, a better understanding of the mysteries of electrical components--especially those of Lucas manufacture--is gained by the casual user.

COVERING THE WHEELS

I am often amazed at the beautifully intricate hubcaps that one sees littering the streets these days. Invariably they are plastic and off modern cars. They do their job, are cheap to produce inexpensive to replace and readily available. Wheel trims as the Factory refers to them, were never of plastic but with few exceptions always very smart. Pre-war spoked wheels were very much in favour presumably to reduce the unsprung weight. They were a swine to clean and needed the attention of one of the more assiduous chauffeurs. One way around this cleaning task was to fit covers to the wheels which were much easier to clean. The above assembly however is the solution for a late ‘R’Type Bentley. The outer ring is usually in aluminium and sat on rubber blocks fastened to the main wheel. The strip of rubber shown was pressed into the ring and the painted section pressed into the rubber. The centre nut seen at the very top of the picture had a fibre washer beneath it to minimise damage to the chrome finish on the mounting ring to its right. The split ring retained the nut. The whole assembly was screwed onto the hub and tightened with a monstrous ring spanner –supplied!

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The following paper presented by A J Phillips the designer of the still used vee eight engine found in so many of our cars presented this paper to the Institution of Mechanical Engineers in London at the end of 1961 when the newly powered Silver Wraith II had been in production for a couple of years. The content is rather esoteric but given that we are the inheritors of these amazing contraptions it behoves us to at least be aware of some detail. I apologise for the pictures – they were beyond my scanning abilities

THE DESIGN HISTORY OF A V8 ENGINE

By A. J. Phillips*

The author describes the design of a modern high-quality car engine and gives details of special problems encountered with the use of light alloys, and how they were successfully overcome. The principal engine components are described and illustrated and details of balancing calculations are given in the Appendix.

INTRODUCTION

THE successful evolution of a power unit is a process beginning with the rough project design, through the refinement of detail design and the preparation of detail drawings to the production of hardware upon which development testing and proving can be undertaken.

Opinions differ as to the relative importance of each contributor to the whole but this paper is confined to the design stage where the foundations are laid, for good or ill, of all engineering accomplishments.

A well-defined conception of requirement is essential to enable the designer to survey the many alternative arrangements of essentials in order to discard the impracticable and less desirable of the many variations on the original theme.

The refinement of the project design consumes many hours of concentrated effort by those who have the ability to picture mentally in three dimensions, two-dimensional presentation of ideas on the drawing board, and who in so doing avoid most, though it is to be regretted, not all, the less evident pitfalls of over-complication, difficulties of production and assembly.

The usually conflicting requirements of stylist, production engineer, planner and tool designer must at the same time, as far as possible, be met or reconciled.

It is proposed in this paper to show in as great a detail as space permits, how this refinement was conducted during the design of a V8 petrol engine and the decisions dictating its final form.

THE ASSESSMENT OF THE REQUIREMENT

The requirement was to produce a successor to a 4·9 litre in-line six-cylinder motor car engine which, at that time had almost twenty years of development behind it.

The MS. of this paper was received at the Institution on 22nd December 1961. A report of the meeting, in Derby, at which this paper was presented is on p. 358.

* *Rolls-Royce, Car Division, Crewe.*

The new engine was to possess the following characteristics:

(1) A power potential at least 50 per cent greater than the in-line six.

(2) No increase in weight.

(3) As little increase in cost as possible.

(4) A level of silence, smoothness and reliability at least as high as previously achieved.

(5) The engine should fit into the same bonnet space as that previously occupied by the in-line six-cylinder unit without resort to styling or structural alterations.

The first requirement dictated a potential cylinder capacity of at least six litres assuming that an increase of 20 per cent in specific power output could be achieved.

The second, that both a more compact design and a much lower specific weight should be attained—this dictated the extensive use of light alloys.

The third demanded close attention to production requirements and the elimination of complicated coring in the main castings, hence wet cylinder liners and co-planar faces whenever possible.

The fourth suggested the arrangement of as many as possible of the auxiliaries—potential noise producers—at the forward end of the engine and a short stiff configuration of engine structure.

As a natural coalescence of the first four requirements and the need for a small bulk/power ratio a vee form of engine was almost inevitable.

The project was therefore an 'all-aluminium' wet linered V8 of approximately 3·8 in. bore, 3·5 in. stroke (giving 5·2 litres but having cylinder spacing large enough to allow an increase in swept volume of up to 6 litres) 7·25/1 compression ratio; the short stroke being dictated as much by bonnet side clearances as the more technical reason of increased crankshaft rigidity.

The employment of the two-plane crankshaft with 90°

banks gives an inherently smooth unit because all noticeable torsional vices can be designed out and all primary forces, secondary forces and couples balanced out—(see the Appendix). Even firing intervals can be achieved but inlet manifolding is made difficult by uneven firing on each individual bank of cylinders. Alternatively a single plane (normal four-cylinder) crankshaft gives even firing on each bank and is comparatively easy to carburet but involves unacceptably large secondary vibrations.

The use of aluminium alloy is very much more open to criticism; it has the propensity, nay eagerness, to transmit noise freely which, coupled with a low modulus of elasticity and high notch sensitivity, makes it a difficult material to use for an automotive engine crankcase. A not unmixed blessing is its good heat-transfer coefficient.

In the search for silent and reliable operation a gear-driven camshaft is essential. This unfortunately meant push-rod-and-rocker valve operation with the attendant flexibility problems, even though the proposed maximum speed of the engine was only 4500 rev/min.

DESIGN

Perhaps it will be of interest to explain the designer's method of approach to the problem of starting with a blank sheet of paper and evolving the initial project design.

Before the advent of modern thin-shell bearings the areas of main and big-end bearings, coupled with torsional considerations, largely dictated the crankshaft design and hence the overall length of an engine. Nowadays allowable bearing loads have risen to an extent which makes cylinder centres the criterion of engine length—even when a two-bank arrangement with side-by-side big-end bearings is considered.

After the initial check of bearing areas and crankshaft torsional frequencies the cylinders are spaced as closely together as head studding will permit; Fig. 1 shows how closely the outer diameters of the liner flanges in the later large-bore versions of the engine are spaced.

This then is the heart of the matter and design progresses outwards from this centre.

THE 'WIDE' ENGINE

The crankcase

A fully heat-treated 4 per cent silicon–aluminium alloy (LM 8) is the material used for the cylinder block casting; in this condition a minimum Brinell hardness of 80 and an ultimate tensile strength of 15–17 ton/in^2 is attained and although reputedly it has only fair machining qualities, its excellent casting fluidity and good corrosion resistance make it one of the better light alloys for this purpose.

Upon the crankcase, together with the cylinder heads, depends the structural stiffness of the engine and, to a great extent, the ultimate smoothness of the power unit. The emphasis must be placed upon rigidity as a beam but beam stiffness is the product of the section modulus and the modulus of elasticity of the material. Since E is the unalterable factor, design effort must be confined to the attainment of the highest section modulus compatible with economic production.

To this end the skirt of the cylinder block extends 3¾ in. below the crankshaft centre line which, coupled with the extension of the front and rear walls to the full height of the cylinder banks and the tying together of the banks by intermediate ribs, largely contributes to the high beam stiffness achieved in the vertical plane.

In the horizontal plane also the skirt has been extended in width to provide additional rigidity.

This method of obtaining the requisite degree of crankcase rigidity has another advantage when the power unit, including the flywheel housing and gearbox, is considered.

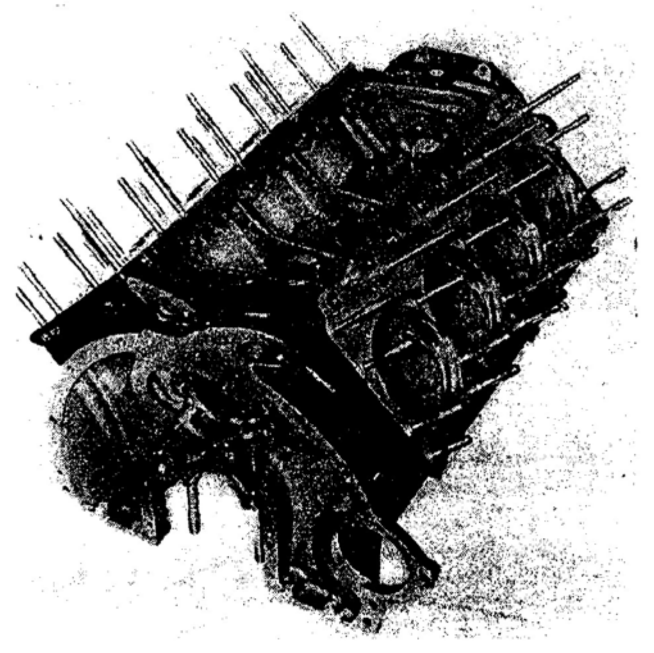


Fig. 1. Spacing of the cylinder liner bores

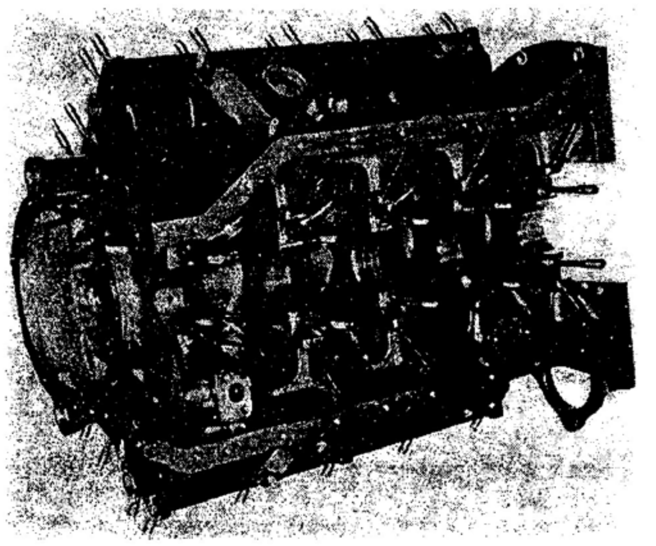


Fig. 2. Crankcase bottom face showing support buttresses

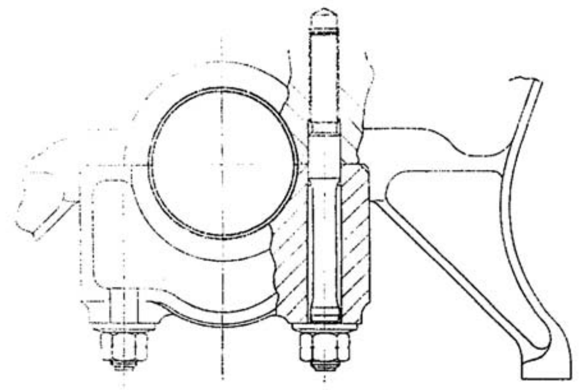


Fig. 3. Main bearing stud

The large abutment heel provided by the wide and deep rear face facilitates in turn the design of an almost conical shape of flywheel housing; thus a portion of the power unit assembly, where flexure is usually most evident, is provided with adequate stiffness at the cost of an insignificant weight penalty. Care must be taken to provide effective buttresses between the lower wings of the crankcase rear flange and the skirt if excessive deflection in this area is to be avoided and, as a corollary, the main load-carrying bolt bosses between the flywheel housing and the flange must be well supported in the carcases of the crankcase casting (Fig. 2).

All thread fixings, studs, setscrews and bolts are more difficult to engineer satisfactorily when securing light-alloy pieces than when ferrous materials are used. Interfaces where frettage is likely, such as main bearing caps and where a maximum freedom from distortion must be achieved, deserve special attention.

Consider a simple stud-fixing of a bearing cap as shown in Fig. 3. When the nut-tightening load is applied, it is well known that heavy stress concentration occurs in the threads, both male and female, nearest the interface. If the female thread is in light alloy excessive local distortion will occur; it is therefore prudent to counterbore all tapped holes to a considerable depth when dynamic loads are to be carried, thus avoiding large load variations across the mating faces.

Again at the nut end of the fixing a normal thin washer will distort excessively and indent the light alloy adjacent to the periphery of the hole to a stress beyond the limit of proportionality; the washer should therefore be made thicker and larger in diameter than usual to distribute the clamping load as evenly as possible over an area sufficient to keep the pressure to a reasonable figure; in this case a figure of about 6 ton/in^2 was chosen.

Even a conventional cast-iron cylinder block suffers bore distortion if the bolting stresses in the cylinder-head stud bosses are allowed to penetrate to the bore surface; how much more consideration must be given to head-studding when using light alloys! Only four load-bearing studs per cylinder were employed but these were designed to penetrate deeply into the structure and, in consequence, bore distortion was extremely small.

The long studs of both cylinder head and main bearing caps together combined to reduce the volume of crankcase material called upon to carry tensile loads and where material was in tension very generous sections were provided without increasing unduly the overall structure weight.

The cylinder liners, produced from centrifugally cast, high-phosphorus iron pots, were sealed by direct contact between the underside of the top flange and the cylinder-block counter bore, the 'nip' being controlled to approximately 0·002 in. Separate coolant and oil seals at the skirt end of the liner were provided by rubber rings located in grooves machined into the cylinder block. 'Tell-tale' drillings between the grooves were made to indicate any oil or coolant leakage past the rings but to the best of the author's knowledge not one case of leakage has ever occurred.

The bores were honed to a finish of approximately 30 micro-inches to provide an oil-retaining surface and the outer diameters of the liners were given a protective coating of lacquer on the surfaces exposed to coolant.

The cylinder head and valve gear

The cylinder heads, produced in LM 8 and to the same heat-treatment as the cylinder block, had a basically hemispherical combustion chamber modified to provide a squish ratio of 20 per cent and had a centrally disposed sparking plug.

A feature of the cylinder head was the very short exhaust elbows and a good deal of time was spent reducing the area of coolant over these ports in order to avoid the necessity for a larger radiator than that previously employed to cool the smaller 4·9 litre in-line engine. In fact the heat-to-coolant was reduced from 76 per cent of the power output in the case of the in-line engine to only 54 per cent in the V8.

The initial design employed only two rows of studs which were sufficient to carry explosion loads, coolant and oil transfer between block and heads being provided by

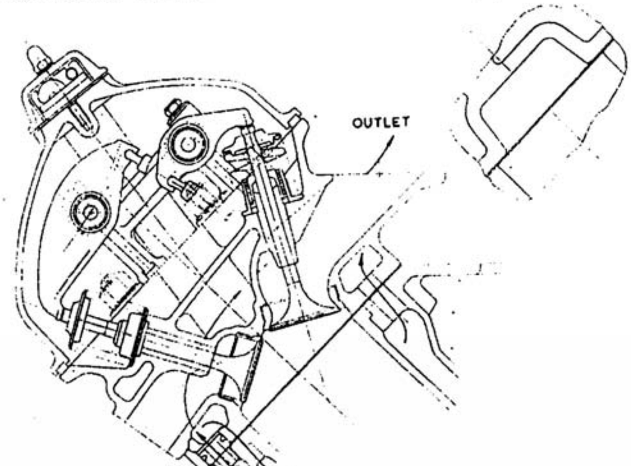


Fig. 4a. 'Wide' cylinder head and coolant circulation

bobbins with rubber O-rings but because the O-rings tended to adhere to the cylinder-head material, head removal was difficult and a further two rows of smaller diameter studs were later included with a nip-line outside the transfer area to overcome this trouble.

Later still in the 'narrow' cylinder-head design all studs were made the same diameter to avoid the necessity for different torque loadings during servicing.

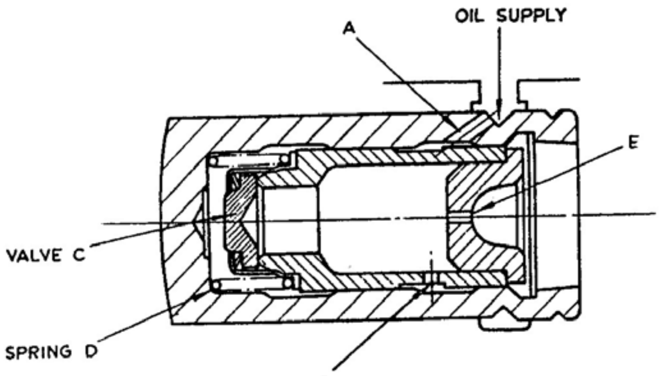
Contrary to contemporary American practice, the gear-driven camshaft was carried in four bearings and rotated in a trough formed as an integral part of the crankcase.

The objects of this departure from the more usual arrangement of five bearings and a camshaft exposed to crankcase oil-splash were twofold. Firstly, the reduction in total bearing length allowed more room for cams and tappets. Secondly, an oil-bath ensured better low-speed lubrication of the tappets when the peak Hertz stress was a maximum.

Tappet diameters were 0·875 in. having flat bottoms offset to provide positive rotation and a peak Hertz stress of 126 000 lb/in² based on a cam width of ½ in. The first designs employed 'solid' tappets running directly in the crankcase material but they would have been excessively noisy and a design change was made immediately to hydraulic tappets running in cast-iron tappet blocks. The separate tappet blocks would facilitate production and maintain a more constant diametral clearance under all running conditions.

The reasons for assuming that solid tappets would be noisy were largely due to the fact that in this aluminium engine, the differential expansion condition, with hot coolant and cold oil, could account for an increase of 0·020 in. valve train clearance. It was essential, therefore, that a 'lash adjuster' or hydraulic tappet should be employed, if we were to achieve our standard of mechanical silence, as an extended ramp on the cam form would have meant sacrificing the area under the lift curve and hence performance.

The hydraulic tappet (Fig. 4*b*), as with most tappets of this nature, receives its oil from the engine lubrication system, entering the inner chamber of the tappet through holes A and B.



A, B Oilholes.
C Valve.
D Spring.
E Hole for oil supply.

Fig. 4b. Hydraulic tappet

With the tappet running on the base of the cam, spring D takes up the clearance in the valve train and oil is transferred through valve C into the lower chamber of the tappet. As the tappet reaches the flank of the cam, valve C closes and the valve train is operated through the medium of the column of oil in the base of the tappet.

An intermittent supply of oil to the rocker-arm socket is effected through the tubular push-rod via hole E, and this takes place during the period when the tappet is in contact with the base of the cam.

The use of case-hardened steel cams and chill-cast tappets, whilst entirely satisfactory in the previous in-line engines, gave rise to catastrophic failures in the V8 but an alteration to chill-cast iron cams tapered at an angle of five minutes and running against hardenable iron tappets with a 50-inch base spherical radius largely cured the trouble.

The inlet valves had a head diameter of 1·750 in. and the Stellite faced and tipped exhaust valves 1·5 in. The same cam form was used for each, giving a valve lift of 0·345 in. and a maximum acceleration at change-over of 0·0006 in./degree². The mean gas velocity at 4500 rev/min was approximately 200 ft/sec. Inlet valve guides were of cast iron but to avoid valve-stem scuffing troubles the exhaust guides were made of phosphor-bronze.

Valve timing was I O 23° B.T.D.C. (before top dead centre), I C 100° A.B.D.C. (after bottom dead centre), E O 55° B.B.D.C. (before bottom dead centre), E C 26° A.T.D.C. (after top dead centre) at 10 and 15 thou. clearance respectively.

Off the ramps at 0·030 in. clearance the timing was I O 8° A.T.D.C., I C 39° A.B.D.C., E O 36° B.B.D.C. and E C 5½° B.T.D.C.

The comparatively small valve overlap chosen was necessary to reduce steady tick-over speed to a minimum, a feature essential to reduce the tendency of the car to 'creep' when the engine is to be used in conjunction with an hydraulic coupling.

The long exhaust rocker necessitated by this valve arrangement presented a major problem in stiffness per unit of polar moment of inertia. Studies were made to produce the best design of rocker, and the resulting form is shown in the drawing of the head, which also gives, in greater detail, other features, chiefly the coolant circulation within the engine (Fig. 4*a*).

The coolant circuit

Coolant issues from a double-volute pump into two cast galleries, on the upper and outer extremities of the cylinder banks. It does not at once enter the cylinder blocks but is directed immediately upward into the heads; coolant is then deflected to scour the valve seats and spark-plug bosses and leaves the heads to collect in water rails cast integrally with the induction pipe situated in the centre of the vee.

The coolant pump is designed to provide a flow of 40 gal/min at a pressure of 20 lb/in² and the cylinder-block flow has a characteristic of low flow rate at high pressure to reduce, somewhat, the likelihood of cavitation erosion

(To be continued)

A NEW EVENT!

Organised by the Morris Minor Club and largely motivated by the poorly organised 'Terribly British Day, I have spoken to the Citröen people and hopefully we can put on a joint display of our mutual hydraulic interests. As usual our aim is to educate the public (and probably ourselves) about Rolls-Royces always in the hope of entrapping new enthusiasts who can share the load of keeping these cars on the road.

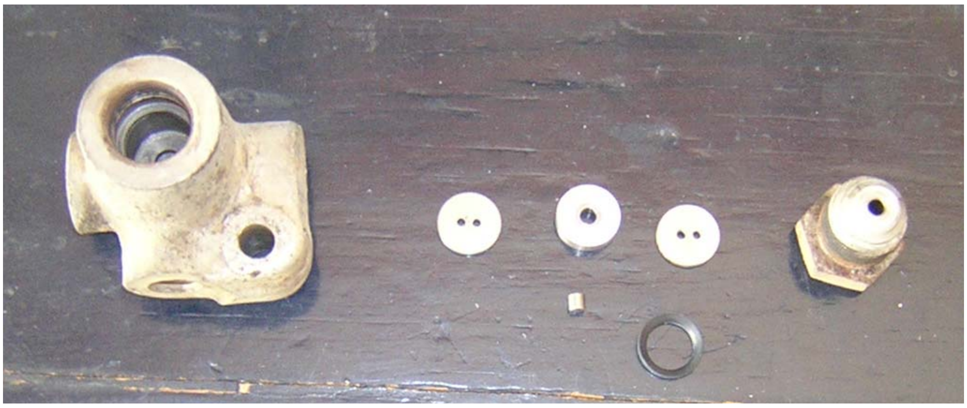
If you have any interesting bits bring them along and we can have a mutual 'you show me yours etc' and hopefully provide some material again for the public to inspect.

I also hope to produce information posters which can be stuck on the windows. It would be a help if you could be on site by about 9.00 AM to help get set up. See you there.

☸

RESTRICTED

This strange little object with the pipes protruding from it can be seen if you care to lie under your Shadow at the rear, is a hydraulic restrictor. It is one of two and among other functions

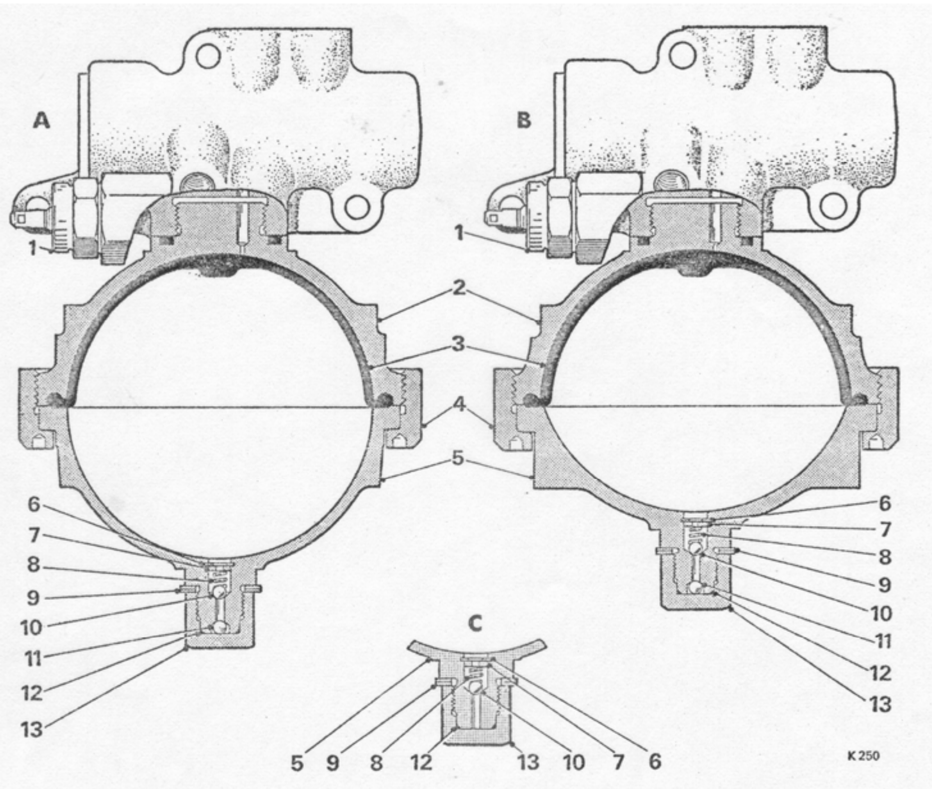


protects the levelling valves from the full onslaught of pressure from the accumulators. The picture below shows the restricted opened. It is very simple but if the slightest bit if dirt gets in there it can produce noises that no contemporary composer would contemplate. The system has to be exhausted before the pipes are undone and the system (number 2) bled afterwards. Note the tiny jiggle pin – something not to be lost!

☸

MORE ON INFLATING SHADOW ACCUMULATORS

A number of owners are intent on having the accumulators on their Shadows re-pressurised before they damage their diaphragms. Most would not bother or would want to afford the equipment to do this since it not only requires a cylinder of nitrogen but also a high pressure



regulator and gauges which today cost over $700! Nitrogen originally at 1000 psi is going to leech through the 'rubber' diaphragm no matter how well made it is. So it is no reflection of the car when the number of pumps you can get out of your brakes starts dropping. The diagrams below illustrate a fully charged sphere with the diaphragm jammed hard up against brake fluid entry point. The charging valve at the bottom consists of a steel ball and light spring retained by a washer and tiny circlip. When recharging these spheres the nitrogen must be piped in slowly lest the whole ball and spring assembly be blown out of their socket. If there is any resistance it is wise to pass a small drill but up the charging hole to ease the ball off its seat. Note also the plastic crush ball on the valve which has to be replaced each time the valve is opened. The sphere on the left was originally fitted to Shadow I's (sic) and the other to II's which explains why the latter has less capacity than the early cars. It is also common to find either or even both on some cars.

WEB SITES YOU SHOULD HAVE ON YOUR COMPUTER

http://www.rroc.org.au/
Rolls-Royce Owners' Club of Australia

http://web.rroc.org/
Rolls-Royce Owners' Club of America

http://www.swammelstein.nl/rolls.htm
A Dutch private web site with an excellent forum

All the above sites have free forums where you are welcome to share your knowledge and ask your questions. Or write to me - Bill Coburn Post Office Box 827 FYSHWICK ACT 2609 Australia or tuppercharles@bigpond.com.

If undeliverable please return to Post Office Box 827 FYSHWICK 2609 ACT AUSTRALIA