

GETTING YOUR PEDAL UP!

The story has been told many times but it seems worthwhile to give it another airing! Having dispensed with the Hispano inspired mechanical servo to apply our brakes – a system last seen on the Cloud and for a little while later on the Phantom VI, the Factory plugged for the comparatively radical Citroën system of hydraulics to stop our cars and keep them on the level. Conceptually this simply involves a plunger pump driven off the camshaft which forces brake fluid into a sphere containing pressurised nitrogen behind a stout diaphragm, until a rather handsome pressure is realised. When you want to stop the car you simply open a valve and let some of this accumulated pressure into the brake lines and the car stops!



This is a forlorn master cylinder extracted from one of the iconic Corniches, well overdue for an overhaul or replacement. The external crud is from the continuous shower of brake fluid that drips from the brake actuation valves and blown back by the air stream. The master cylinder was fitted to all cars until mid '76 when they were replaced with a rubber cushion that pedal action forced into a suitable cup to give 'feel' to the pedal. The hydraulic line however was not wasted but incorporated into the high pressure system.

As most would know when Citroën produced this system on its magnificent 'Goddess' model they decided to go for broke and dispense with the customary brake pedal. This was replaced with a button a little larger than a dipper switch which when pressed released the 'pressure' into the brake lines and applied the brakes! So many Citroën customers balked at this practice that the company sighed and reluctantly supplied a conventional pedal. That, however was not enough. Half a century of pedal pushing had conditioned every driver to expect a solid resistance under their foot (other than the floor boards) particularly when braking hard. The psychological requirement was very real indeed. When Rolls-Royce adopted the system they noted this need and popped a conventional small master cylinder in the pedal linkage which gave all the conventional drivers an immediate feel that here they have a pedal on which to stand, with effect, when stopping is required.

And so the famous 'rattrap' was born. On first sight these early assemblies are mind boggling, having numerous levers and strange looking valves, but also one fairly clear attachment, the master cylinder. The latter was connected to one set of pistons in the double piston callipers on the back wheels. When the brake pedal is pushed, through all the various levers and linkages, the first thing to be actuated was this little master cylinder. A bit of a push and the driver was happy, he had something to get his boot into!



The crud seen here when the entry to the master cylinder is exposed comes from fluid leaking back through the piston seal when the pedal is not pressed. To check the veracity of similar seals in the wheels simply prise the rubber outer boots aside and inspect for fluid or viscous paste which is fluid 'condensed'.

While all this euphoria was being experienced the linkages in the rattrap were working to carefully open the valves that let the accumulator pressure

into the remaining brake lines. It should be mentioned that while the Factory actually suggested that the little master cylinder and its rear single calliper pistons constituted a third braking system, reliance on this as a stopper is not to be encouraged! Furthermore if the master cylinder fails, the brake pedal will go straight to the floor creating an immediate commitment in the laundry department for the uninitiated!

Recently a nice Corniche edged its way into the local community of cars. The car, the new owner advised appeared to have brakes but they were definitely optional and their availability was subject to the vagaries of seized pistons, rotten seals, a desultory brake pump and one



that didn't work at all. Mind you the paint job was superb! Somehow the car survived without collision until it could be careened for overhaul.

Here the push rod with its boot, the piston and the valving have been extracted. The hole at the end is the feed from the reservoir. This cylinder as always must be perfect. If it is not, have it sleeved in stainless steel and it should outlast you!

First job was to remove both pumps and accumulators and control valves and sort them out.

Apart from some curious archaeological concepts in past maintenance, overhaul was completed and the system re-started. Those cranky little lights which kept telling the driver he was about to die, remained extinguished (and not through wire disconnections or bulb removal either!) and after a massive cleanout and flush of the whole system, we had brakes. Magnificent brakes but no pedal. Hit the latter whilst moving, the pedal would go straight to

the floor and you would go over the top of the windscreen! Clearly the master cylinder was not working.



The piston and valving. The piston is the short dark coloured section on the left, the valve to shut off the feed from the reservoir is on the right. On the end of the piston can be seen the flared seal that retains the fluid in the cylinder the valve is necessary otherwise when the brakes were applied the piston would just push the fluid back to the reservoir and not along the brake lines to the wheels. When the brake pedal is released the spring seen above pushes the piston back to its stops and the rod through its centre releases the sealing valve in the coloured cap on the right. This allows the fluid in the lines to flow back into the master cylinder and back to the reservoir. If the push rod (not shown here) cannot come right back, the end valve partially keeps the fluid in the lines. Gradually there is a build up of fluid resulting in involuntary application of the rear brake pads.

The obvious malady of a master cylinder is failing seals but then I discovered that the whole unit had been replaced with a new one albeit made in India! So the answer had to be air in the brake lines between the master cylinder and the pistons in the rear calliper! Bleeding these lines is vaguely in the realm of Voodoo but with perseverance, success will be the reward. In this case it wasn't. Still no pedal.

Thoughts of buckets of petrol and matches loomed until I enquired of the owner whether, when the master cylinder was replaced, were the associated linkages adjusted to suit? Blank look, so into the rattrap. A few minutes fiddling and we had pedal, stoppers that would do justice to a Jumbo Jet and all was suddenly right with the world. Let me dwell on master cylinders generally. Hydraulics depend on the basic principal that liquids are to all practical purposes incompressible (DOT5 otherwise known as silicon fluid is slightly compressible). 'Master' cylinders are simply finely machined vessels opened one end to admit a closely fitting piston fitted with a seal. Filling the cylinder with liquid, in this case brake fluid, and inserting the piston should result in a solid mass, the fluid can't escape either out of the walls of the cylinder nor past the seal.

The seal is usually designed along the lines of an umbrella with the lips facing the fluid. This means that the harder the piston is forced into the cylinder the harder the lips are forced against the walls because of the hydraulic action of the fluid. To establish your braking system then all you need do is connect up the closed end of the cylinder to a line to the wheel cylinders and push the piston. Alas as with all simple systems it ain't that simple. The first problem is that as brake linings, be they drum or rotor, wear, the piston will have to push further to get the same stopping effect. Eventually the piston will be at the bottom of the cylinder and all the fluid will be in the lines but there will not be enough stopping! The second problem is that brake fluid being a fluid expands considerably when it is hot. If there was not some way for the fluid to escape, the expanding fluid would apply the brakes without any application of the pedal.

Now to the rattrap. The levers operating the high pressure brake valves are connected also to the levers operating the master cylinder on the early Shadows. The only real adjustment in

the whole assembly is the length of the push rod operating the master cylinder. If it is too short you can bleed the thing until you die but still not finish up with a decent height pedal. If it is too long you will get a very nice pedal but after a few applications you may notice that the pedal is getting very high indeed. And then you will notice a pungent smell of very hot brake linings.



The latter situation often confuses owners who have just had a 'brake job'. They go on a drive and not uncommonly finish up with red hot rear brake rotors. If you look through section G of the workshop manual you will find various methods of adjusting the rattrap to give you a 'good' pedal. The variety comes about because of changes in design in the assembly.

Here is a closer view of the business end of the piston with its valve. The orange plastic piece is actually a spacer in which the valve moves.

The basic approach however is to bleed the low pressure system first then when all air has been removed adjust the length of the push rod to give a reasonable low pedal – say an under-pedal to floor dimension of about an inch and a half.



Take the car for a drive – some miles, using the brakes frequently whether needed or not. If you notice the pedal gets higher and higher the master cylinder rod is too long because the fluid cannot get back to the reservoir when the pedal is released since the inlet valve is still jammed up against the end of the master cylinder. If this is a chronic problem it can be instantly albeit temporarily corrected by opening one of the low pressure bleed valves. At left is the assembled master cylinder complete with threaded push rod and minus the protective rubber boot.

In summary having got the thing installed and bled give the car a good road test. When the whole system is well heated lengthen the rod in its clevis to get more pedal until you can feel the pedal building itself up with each application. At this point shorten the rod by say half a turn until frequent use does not create a 'rising' pedal. At that point lock the locknut and go and have a stiff drink!



EZYOUTS



I mentioned this little tool in the last issue and here is one in a holder ready to extract the rivet from the bottom of the 'G' valve. They come in different sizes are as old as the hills and are principally designed to remove broken off screws and bolts. If you look closely you will notice the coarse 'thread' is 'left handed'. The idea is to drill a hole in the broken bolt that the ezyout can be screwed into until it jams. Continuous turning should unscrew the broken bit.





SEALING THE SPHERES

For those not familiar with their accumulators the picture is the inside of the bottom half of one of the hydraulic accumulators, having been cleaned and polished and ready to be reassembled. The hole in the bottom is the one through which nitrogen gas is forced until there is a pressure of 1000 psi. While few owners would bother to kit up to do this job it should be of interest to know some of the steps involved. In this case having reached the required pressure which has to be read with a high pressure regulator

screwed to a cylinder of dry nitrogen, there is always the concern that the valve in the bottom of the sphere will hold and not let gas escape before you can get the sealing cap on.

The original arrangement involved a steel ball sitting on a conical seat at the bottom of the charging hole, held in place by a small spring, a centring retainer to hold the top end of the spring and a tiny circlip to hold the lot in the hole. One of life's little vicissitudes is pulling the charging tube off the accumulator and before you can get the cap on you are greeted by a steady hiss as nitrogen streams out of your newly overhauled accumulator.

NBS Services in Queensland has devised a simple but very effective insurance against this happening by designing a self sealing plunger to be inserted in lieu of the steel ball.



And here it is.

Unfortunately I forgot to lay the comparative penny against the line up to give some idea of the scale.

Working from top down,

the circlip fits into a grooved hole in the accumulator about 1/4" in diameter. That is followed in the picture by the centring washer, then the spring then the plunger. The last bit, the plunger, has a small 'O' ring slipped over the shank and that is jammed tightly into the valve seat by the pressure of the gas.

When as with most owners you send your accumulators to have them overhauled and re-gassed, when you get them back do check them for leaks in a bucket of water!



'In the event of a sudden loss of cabin pressure, masks will descend from the ceiling. Stop screaming, grab the mask, and pull it over your face. If you have a small child travelling with you, secure your mask before assisting with theirs. If you are travelling with more than one small child, pick your favourite.'



PUMP SEALS

Many owners are quite incredulous when you point out that one or both of their hydraulic pumps are leaking. The usual cry is 'but I only had them fixed last year!' The pictures show a pump with its clothes on and the other naked! Note the outer casing on the left complete with its little 'O' ring. This is where the brake



fluid/mineral oil goes in fed by gravity. The casing simply slides over the pump and is secured by a large circlip which can be seen at the top of the casing. The only bits keeping the fluid in the casing are the two large 'O' rings seen in the stripped pump on the right. The fluid gets into the pump through the hole drilled around the inner body.

It is thought that every time the pump's plunger is pushed up by the cam shaft push rods et al, there is a monetary increase in pressure in the casing and of course against the large 'O' rings. The later are therefore continually flexing and rubbing on the inner surface of the outer casing. Eventually with the constant rubbing and the heat of the engine the 'O' rings shrink, the seal is broken and the pumps start to leak. Eventually especially with the very old cars it seems that the inner sealing surface machined into the outer sleeves in turn wears or distorts until no 'O' ring made will retain the fluid. The solution here is to have the casing sleeved – a process similar to sleeving brake cylinders.

Removal of the sleeve is quite simple. After releasing the pressure from the accumulators, the low pressure feed pipe is disconnected from the side of the pump after you have clamped off the rubber hose connecting the reservoir to the pump. The high pressure delivery pipe on the top of the pump is then disconnected. The circlip is removed and the outer casing carefully prised upwards and off. A dental pick is the best gadget to winkle the old 'O' ring out of its groove so than a small sharp knife can be forced down to cut it.

Having cleaned things up as best you can, lubricate the new rings and roll them down the pump. Fit the top one first and the lower one will roll over the upper one. Lube up the outer casing and carefully push it down over the 'O' rings which should have some lube also. It is usually a fairly tight fit. Circlip back on pipes back on and you are almost there. A tip on the low pressure feed pipe. Partially release the clamp on the feed hose while you are starting the nipple into the casing. This should ensure that fluid flowing into the casing will be free of air, otherwise it is not uncommon for there to be an airlock in the pipe and you find yourself

employing a special vocabulary to complement your frustration! Lastly you will need to bleed the system between the pump and the accumulator. This is easily done on the SZ cars where you simply open the bleed valve on the accumulator before you start the engine. When you feel that enough mineral oil has been pumped around to get any air out close the valve.

If you are repairing an SY car simply put a bleed tube on the relevant accumulator, open the bleed valve and start the engine. When the bubbles stop and then some close the bleed nipple. All this ignores the embuggerance of having to undo and lift the entire induction system forward so that you can get at the rear pump, or if your car is fuel injected, the pulling off of some bits again to get at the rear pump. And of course if you do not have the serrated/notched/castellated tube spanner, get one. They are available from the Factory and will pay for themselves in about 2½ changes of the pump seals just in labour alone!



HAM FISTING AND VARIOUS TROGLODYTES

This is one of those sights that reduce conscientious amateurs to quivering incoherency! You are lying on your back looking at the underside of the Corniche. This it appears has been serviced by those Denison of various caves and who operate apparently by feel. Their task here was to disconnect a flexible hose from one of the nipples. The hoses as you know are held in place by a large half nut which holds the hose end to a bracket also seen here. The bracket is perfectly capable of carrying out its functions but is NOT equipped to handle the force of a large spanner swinging on a frozen half nut. The result is as you see one of the hardened self tapping screws simply snapping off. The troglodyte operator solved the resulting problem by ignoring the break and the pipe. The latter then at some stage burst depositing the entire contents of the rear section of the main reservoir on the ground!



The solution is relatively simple albeit somewhat awkward. The latter because the area in this case is somewhat cluttered with sundry items of suspension etc. Not possessing a foot long drill to remove the broken stub of the self tapper I was able to use a small socket on a long extension, in turn chucked in a variable speed drill.

In the socket I placed one of the wonders of this age – a self drilling screw, in the little socket managed to get a direct poke at the broken one and simultaneously drilled out the stub and screwed in the new screw. I thought I was very clever to do that but some swine will come along and say they have been doing that since JC played full

back for the Arabs!

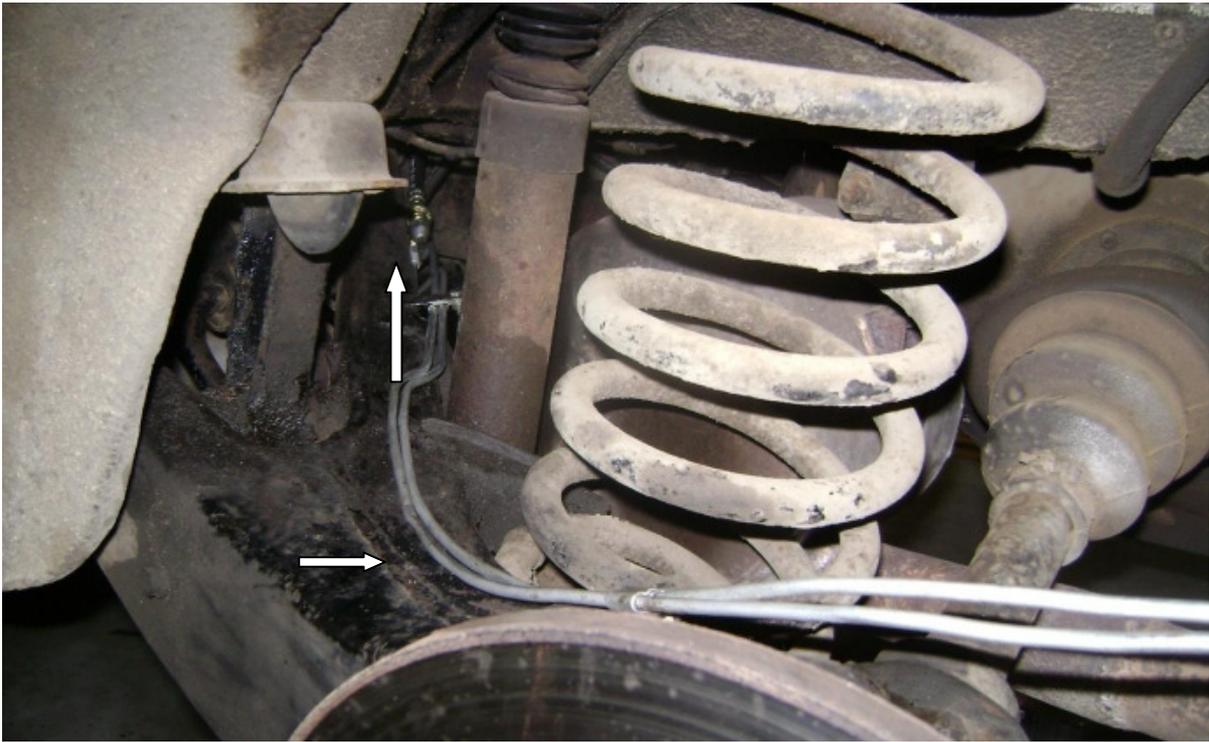
Next to exhaust work brakes would have to be one of the dirtier areas to work on for any car. Rolls-Royces are no exception. When these cars were made the body was immersed in a swimming pool filled with metal primer in the vain hope that it would fend off rust. Then there was the belief that if they sprayed on a bucketful of 'thixotropic' (their word) paint – we call it Proofcoat which has been around for at least 50 years again in the hope that stray rocks and sundry pedestrians would not damage the under-bits. This stuff is soluble in kerosene and very much more soluble in the higher complexity hydrocarbons. Perchlorethylene available in pressure packs as brake cleaner simply relishes the thixotropic paint. The results is half the staff dissolves the paint which is then deposited on you your tools and anybody else standing nearby! The more observant will notice that I fit not only new brake pipes but new half nuts as well. These are cheap, spin onto the pipe terminals with a flick of the finger and speed the whole job up. That they are anodised might give the purists dyspepsia being devotees of cadmium but then the same people I have noticed having delivered crushing observation on such detail drive off in their Crewe whatsis complete with rotten brake lines seals and often seriously worn brake pads!



These little darlings at left also demand the utmost in respect. After some 40 years the nipples screwed into these brass junction blocks are pretty well cemented in. Note that they are again mounted on a spacing bracket held by two screws. After liberal doses of WD40 some hours earlier the main bolt securing the junction piece to the bracket should unscrew. You will then be able to hold the former securely while you undo the nipples one by one.

Note also that the junction between the flat face of the hose and the junction block requires a soft copper washer to seal the joint.

✘



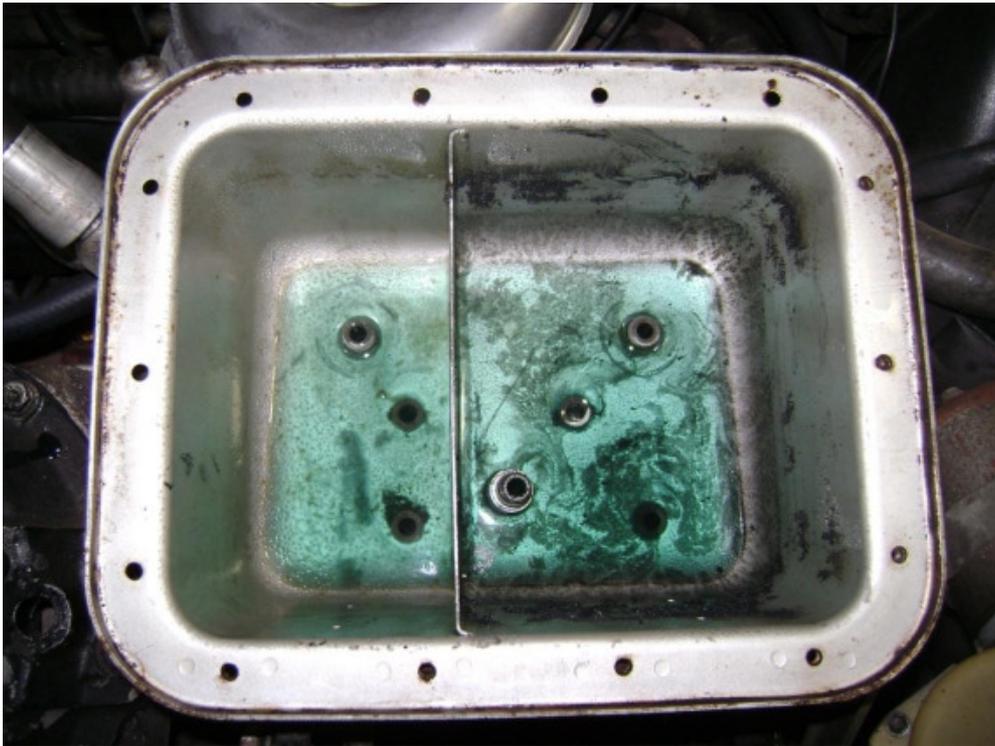
A SCENE FOR DISASTER

For those mere mortals they have not be allowed to view the private parts of a Corniche here is some detail of the rear suspension that is peculiar to the model. First up you will have noticed that there is no shock absorber nestling in the centre of the rear spring. Instead it is placed forward and more centrally. Its job is the same and the results are similar. This is necessary because there is simply not enough room for folded down roofs and associated mechanisms to accommodate the standard suspension rams and shock absorbers.

But my concern involves the pair of brake pipes snaking along the rear suspension arm. These pipes connect to flexible brake pipes well forward and which can be seen at the top of the picture. They then snake back to the rear calliper, one carrying high pressure fluid to the larger piston in the calliper and the other the low pressure fluid to the small piston. The latter providing the 'feel' to the brake pedal. The pipes are bracketed to the suspension arm in two places which again can be seen in the picture and above the calliper there should be another bracket that simply ties one pipe to the other for stability.

Somebody had for reasons unknown moved these pipes so that rather than lying close to the inner edge of the arm they were position almost centrally on the arm. As a result when the rear suspension was crushed up as far as it would go which involves the conical rubber buffer being jammed totally into the holding cup, the lip of the latter in this case just clipped the edge of the outer brake pipe. A little bit further in for the pipe and it would have been punctured. The pipes are all shipshape by the way because the low pressure line nipples on both sides had frozen solid in the callipers. Rather than smash a few more components, the calliper was dismantled in situ, the pipes unbracketted and the assembly pulled out of the chasm!





IT'S NOT THAT I AM NAGGING

The more observant among you will have picked up that the car of the month or so has been a Corniche. As happens with these valuable cars they are often bought by people who have far more money than brains and simply put somewhere for purposes I yet to understand. This car was no exception and while the new owner certainly succeeded in travelling a busy highway with little more than a headwind to slow progress he was quick to take up my suggestion that the the brake lines be flushed and most importantly the flexible hoses be replaced.

Step one was to find some pressure to feed the brakes. One of the brake pumps had a broken push rod and the other produced a mere trickle for all its efforts. Pumps and accumulators the latter with their valves were removed stripped cleaned overhauled re-assembled charged with nitrogen and the whole lot put back on the car. Standard brake fluid was loaded and an attempt made to bleed the system. All to no avail or at least a little. Open the bleed screws and but a mere ooze would emerge. There appeared to be enough to get through because the car would now stop albeit without any pedal height but it would stop.

Eventually all the callipers 'G' valve were removed cleaned and re-kitted. The system was again filled with standard DOT 4 fluid and bled this time very successfully. A few hundred miles later the reservoir was opened and the fluid siphoned out. What you see in the bottom of the picture is the rubber residue from the decaying pipes which was still circulating in the system. A good clean out and more flushing (some 15 litres) and the system is like brand new.

There is simply no excuse for not changing brake hoses at least every 8 years!



THE CESSPIT OF THE CHASSIS

One little feature of 'power steering' that few drivers realise is that it is almost impossible to steer a car when the power assistance has ceased. Some years back a lady in Canberra was negotiating a round-about in her '88 Spirit when the engine stopped. Fortunately the car was on the inside lane and realising that she could not steer and start the engine at the same time simply hung onto the wheel and let the car coast to a stop. In the process she blocked a line of traffic and attracted some original comment on women drivers in general! Why did the engine stop? Well unknown to most owners of older cars, this car is of the New World complete with an engine management system. Part of the latter involves, so help me God, an 'engine running sensor'! This gadget located behind the fuse panel is about the size of cigarette packet and is priced to match the value of a very nice tailored suit! It had failed and told anything that was interested that the engine had stopped even though it hadn't. But one recipient of the advice was the petrol pump, which ceased, and with fuel injection that immediately causes the engine to stop.

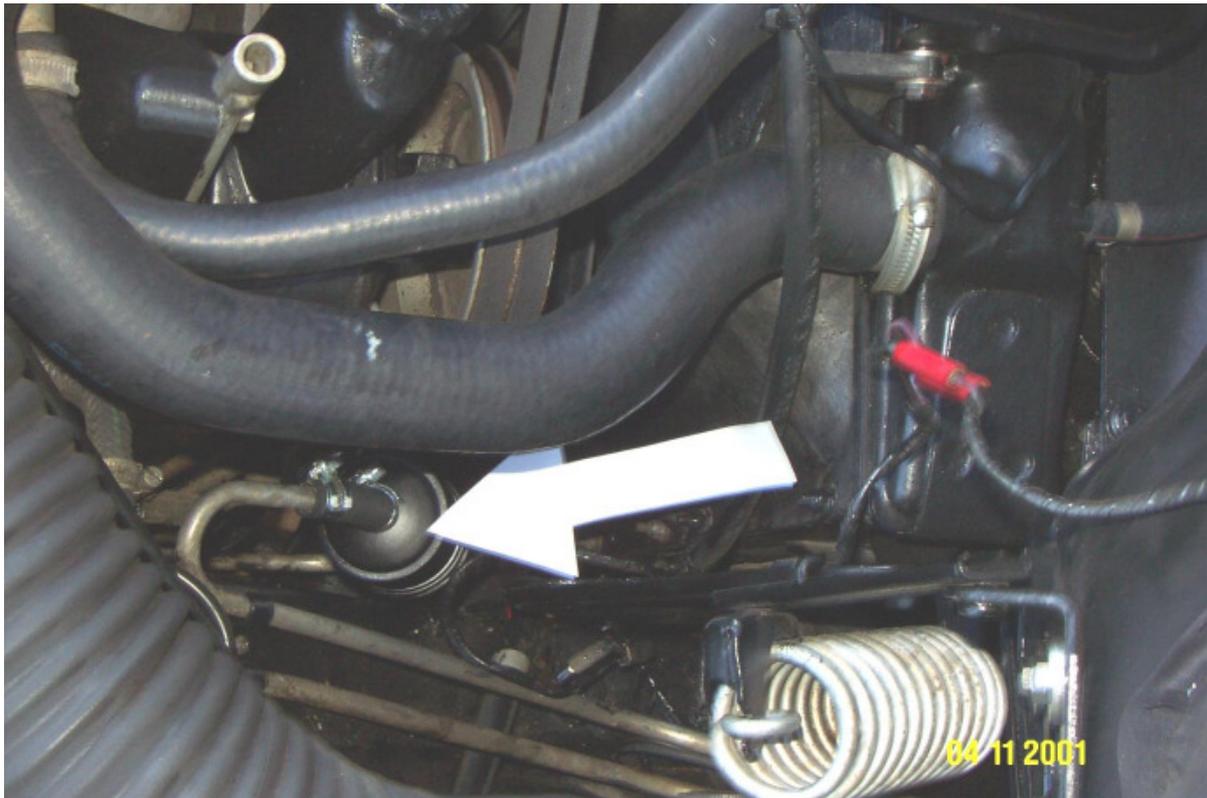


The Saginaw box of American design and manufacture fitted to the Shadow I's is remarkably resilient and reliable. Unavoidably it is at the bottom of the system so that any sludge, including metal fragments, settle in the main piston housing shown here protruding on the right of the casting.

The object of the above tale is to point out that while you probably can hold the steering on course, changing direction is not really practical and in fact could probably damage components! The most likely of these incidentally is the 'collapse section' of the steering column. This, if you look at the exploded diagrams in the manual is a cage-like structure built into the steering column and designed to collapse when in a head on collision, your torso is hurled onto the steering wheel. It is this gadget incidentally that precludes you belting the puller used to extract the steering wheel. Do so and you will collapse the 'cage' and send you off to your local mortgage broker! I do remember a very perplexed owner fronting up, demanding to know why his steering wheel was suddenly 90° out from its normal position. This was caused by a collapsed cage probably due to someone heaving on

the wheel with the engine off and the car stationary! The cage was not fitted until the early seventies.

So I hope it follows that we should look after the power steering system despite there being no maintenance listed for this equipment other than keeping the oil topped up. It is well to mention at this point that a sure way to destroy the guts of the pump is to let it run dry. Except in an emergency do not use the patent sealers that are available to stop power steering systems leaking. They are designed to swell the 'rubber' seals which they do too effectively and can easily damage the steering box and the pump. Ideally if the system is working satisfactorily you should flush the whole circuit thoroughly.



One prophylactic measure is to provide a filter in the return line. These are standard accessories for transmissions and incorporate a magnet. The filter should be changed every year to avoid back pressure on the return. Interestingly filters were always provided in the systems used on the Cloud series of cars. Apparently there are a lot of owners who are unaware of these little items and they are left to eventually clog up!

After possibly forty years of service regardless of mileage it makes sense to have both the pump and the steering box overhauled. You may care to do this yourself although almost invariably internal components need to be repaired, usually by machining which is often beyond the average owner. Removal of the pump is simple, two bolts and two pipes and it's off after siphoning the reservoir dry but then the pump itself seems to have mega gallons of oil in it. Best get all your old dirty oil rags and pack them under the pump as you undo the pipes, they will soak up the mess.

The box however poses an interesting task since the transom that supports the engine uses the box for mounting on one side and the steering damper on the other. The solution is to lay a very stout beam across the front fenders with plenty of padding (a good fence post will do the job), undo the front engine mounting, jack up the engine and chain it to the beam.

Alternatively buy, steal or hire a proper engine support which makes the job even easier. The box is held onto the sub frame by three large bolts. Before these are undone you need to disconnect the steering column from the CV joint.

Be sure to paint an alignment mark to enable re-assembly. Remove the steel return pipe that runs across the top of the box. The latter is not necessary but is one less thing to get entangled! The transom can be removed after 4 large bolts and nuts are removed.



If you decide to flush the system this is a convenient method. Both lines behind the grille which normally feed the oil cooler were connected by plastic hose to a suitable container. The engine was started and while a steady stream of oil was poured into the reservoir the steering wheel was turned slowly from one side to the other. The oil will eventually run clean.

The two lower securing bolts on the box can be then removed and while a strong man supports the box from below the last securing bolt is unscrewed. The latter is accessed from under the front mudguard. The box is heavy – probably 20-25kg. Drain the box before despatch by cycling it from lock to lock. And before despatch secure the thing in a strong plastic bag as it will invariably dribble.



Here is a propriety stand that is readily available to the handyman. Legs on either side of the engine compartment fit into the water channels at the edge of the mudguards. The beam sits on these supports and the centre screw assembly which has a hook on it can be attached to a bracket on the front of the engine. The turn buckle is quite strong enough to lift the engine until the aircon compressor pulley is level with the header tank!

Reassembly is no trouble. When it is all together fill the system with oil and cycle the wheel from lock to lock, finally starting the engine and continuing the process until it will take no more oil and all air has been expelled. It is not a bad idea to have a wheel alignment when the thing has settled down.

