THE ROLLS-ROYCE SILVER CLOUD II V8 ENGINE

By David Chaundy

Rolls-Royce had originally intended the Silver Cloud to have an all new power unit at the earliest design stages. Work on the design of the "L" engine as it became known began in early 1951 along with the rest of the car. The chassis and magnificent new body were ready for production long before the new engine was considered sufficiently developed to be allowed into the hands of the general public. Prompted by waning demand for the beautifully proportioned Silver Dawn and Bentley R type, Rolls-Royce decided to launch the new car with an enlarged and further refined version of their well proven in line six cylinder engines. The result was to take the six to its practical limit of development, without loss of silence and smoothness. The Silver Cloud I engine proved to be wonderfully silent and silky smooth. In other words, it was typically Rolls-Royce. Mated to the by then standard four speed Hydromantic automatic transmission, (built by Rolls-Royce under license from General Motors) it was to power the Silver Cloud 1 and Bentley S1 in standard form from 1955 to 1959. Even greater power was extracted for the Bentley continental chassis, using a modified cylinder head and raised compression ratio. Refined, capable and smooth it certainly was, however the Silver Cloud was a considerably larger and heavier car than the Silver Dawn it was to replace. The aging six cylinder engine would have to work harder than ever before. When the Silver Cloud I was launched it had adequate performance, but it lacked sparkle. By 1959 demands for ever more power to drive ever increasing levels of equipment, linked to the need not only to maintain performance, but to increase it led to the end of the road for the famous six cylinder unit. The writing was on the wall, the time was right for a change.

At the outset of the Silver Cloud design project, the engine design team headed by Jack Phillips had been given a tall order by the management. What the board required was an engine of the same weight or lighter, that cost no more to build, that needed no further bonnet space, which was as silent and refined, which produced significantly more power (at least 50% more power over the first 10 years of development). On top of these constraints the engine had to use the same radiator as the 4.9 litre straight six cylinder engine, and be narrow enough to fit into the Silver Cloud's narrow and high sided engine compartment. The new engine would also have to be a suitable platform for at least 25 years future development, due to the very considerable costs involved in developing it, and tooling up for its manufacture. In all, a very tall order, but it was an order that was fulfilled and even exceeded.

The new lightly stressed all aluminium V8 engine was lighter than its iron six cylinder predecessor. It produced more than 25% more power than the six. It fitted snugly under the bonnet of the existing range of cars and was as quiet and refined. Little did anyone know at the time, this was the birth of what was to become the most prolific motor car power unit in Rolls-Royce's history. It is a testament to the rightness of the original design that all be it in a highly developed form, the basis of the original 1959 design is still powering the Bentley Arnage in 2005. Some 46 years of development potential was provided by the design team back in 1959, quite an engineering feat!

I have heard the Rolls-Royce V8 referred to as a copy of a Buick design. Personally I would disagree with that opinion. Whilst it is no secret, Rolls-Royce examined and evaluated several American V8 engines, when they were deciding on the most suitable layout for the Silver Cloud engine. It appears to me they did not copy any one particular engine. The Rolls-Royce unit was to be made in aluminium which necessitates a wholly different approach to engine construction than if using cast iron. The Rolls-Royce engine also had to be substantially narrower than its American competitors, and had to be as quiet as the quietest cast iron units then available. The fact Rolls-Royce achieved such a high standard of smoothness and silence with the acoustic properties of aluminium seems to me very impressive. Even today, some 46 years after the introduction of the Rolls-Royce V8. A well cared for Silver Cloud II or III can prove to be amazingly silent running. American ideas were certainly incorporated into the Rolls-Royce design, hydraulic tappets being a

case in point. It should also be remembered Rolls-Royce were not famous for introducing cutting edge technology, but taking the best proven designs and refining them as far as possible. I would therefore suggest that the Rolls-Royce V8 is a conglomeration of the best designs around in the 1950's and not a copy of any one particular engine. The engine design team put several American V8 engines through severe tests, of one which was a full throttle test until the engine expired. In an article written by Jack Phillips in the mid 1990's he quoted they never got more than 100 hours full throttle running out of any of the American V8's that they tested to destruction. The "L" engine however, was tested to 450 hours full throttle running in order to satisfy Harry Grylls of the soundness of the design of the main bearing caps.

The Silver Cloud II and Bentley SII launched in 1959 were the bestselling of all the Cloud / S type range. With the advent of the new engine the cars came of age and finally got the level of performance that they always deserved. As with most new engines teething problems soon showed themselves. Inevitably it took several months for the company to realise they had problems. The drawback with very expensive cars made quite slowly in small numbers is the comparatively small amount of data returning to the manufacturer from the service department. Data on problems in service collected by the service department can only be acted on when several cars display similar faults. No doubt Rolls-Royce rectified the problems as soon as they could, however several hundred cars were affected by these initial teething problems. These problems together with other aspects of the engine's design have left the Silver Cloud II and Bentley SII with an unfortunate reputation in the minds of some. The most maligned aspect of the engine is the rather inaccessible spark plug location. Hidden beneath the Exhaust manifolds the spark plugs are difficult to access from above. They are relatively easy to access when the wheel arch access panels are removed however.

One of the first causes of concern to the service engineers was the valve gear in the new engine. It was noted dramatic wear was taking place in the rocker shaft bearings. Valve guides were also wearing at alarming rates. Rectification took the form of adding a further drilling to the end of the camshaft. This increased the low pressure oil supply to the cylinder heads by a third. Very soon afterward it was decided to add a fourth drilling to effectively double the original volume of oil to the cylinder heads in order to counteract the wear problems. An owner with an unmodified early engine would do well to upgrade to the latest camshaft, thus avoiding premature wear to his rocker gear after an engine re-build. The added volume of oil spraying around inside the rocker chambers did reduce wear. However, it also created another problem, excessive oil consumption. The original design had relied on the restricted flow of oil to the rockers, along with long inlet valve guides with neoprene seals bonded to the valve retaining collets. The sealed collets were supposed to prevent oil from running down the valve stem and being drawn down the valve guide by the vacuum in the induction manifold. When the oil volume to the rocker gear was effectively doubled, it was soon found necessary to provide a more effective way of controlling how much oil entered the valve guides. The modifications adopted were inlet guides of reduced length, with both inlet and exhaust guides machined with a cup face to accept a gland seal similar to those used on the six cylinder engines. These seals were made of asbestos string coated in Russian Tallow. They were retained by a spring loaded cup assembly which was retained by and sat inside a modified valve spring base washer. The valve stems were also slightly modified to suit the new seals. This arrangement cured the excessive oil consumption. It has to be said at this point, that the string seals have a life of approximately 35,000 miles before oil consumption starts to rise. An owner would do well to bear this in mind.

Several early cars were subsequently fitted with exchange cylinder heads and camshafts, following complaints from their owners. Unfortunately, all the cars were not recalled and modified as a matter of course. Today, owners of early Silver Cloud II,s and their derivatives are likely to experience problems with their valve gear and or excessive oil consumption if their cars are unmodified. I am one such owner, my car a 1960 Silver Cloud II (Chassis No. SWC 322) had escaped modification. When I investigated what I hoped were worn or gummed up tappets on my 78,000 mile car I opened a can of worms! In the following

paragraphs I describe the engine overhaul I carried out. In the hope the information may assist other owners in similar circumstances.

Picture 1

Picture 2

When I removed the rocker assemblies to my horror I found every rocker had excessively worn tips and bearings (see pictures 1 & 2). The rocker shafts themselves were deeply ridged (see picture 3). Both rocker assemblies were clearly scrap. Upon deeper investigation I found all the hydraulic tappets were showing holes in their hardening and some camshaft lobes looked sick too. Having removed the cylinder heads I discovered all the valves and guides were worn beyond use. It was clear the car had suffered at the hands of a gorilla, who had fitted some rather odd looking "O" rings to the valve stems, the purpose of which I am not quite sure about. If they were to prevent oil being drawn down the guides the gorilla need not have bothered, they were useless. Having seen the state of the upper engine I decided on taking the engine out for a complete re-build.

Picture 3

At this juncture I paid a visit to the RREC headquarters at the Hunt House. I pawed over various service bulletins and drawings, and plotted the modifications made to the engines of early Cloud II's, in an attempt to understand the problems shown up in service and how the factory rectified the faults when they arose. The Hunt House Archive and library is a marvellous resource. I can fully recommend a visit. The club officers showed me every courtesy, doing their level best to make sure I found all the information I required. I felt very fortunate to have access to such a goldmine of information. I could have spent days happily buried in the Hunt House Archives. Not many owners get the opportunity to study the original drawings from which their cars were made. From what I could see at the Hunt House, it appears to me they have a complete set of drawings for all parts of the Silver Cloud range and many others besides. Armed with my research I felt I at least understood some of the problems more fully and had ideas for rectifying my own engines problems.

Having mounted the engine in a suitable stand I continued dismantling. Surprisingly, the lower engine seemed in remarkably good condition. I could find no measurable wear in the crankshaft or any of the bearings. All the pistons were unmarked, so I began to feel a little better. When I measured the cylinder liners my heart sank. Several were showing ovality, they would have to come out.

Having read accounts of Rolls-Royce service agents having problems with early V8 crankcases I thought it best to proceed with great caution. Several recent stories of people ruining their crankcases filtered through the channel. It appeared that when people withdrew the cylinder liners the crankcase cracked or the lower liner retainer came away with the liner. Either situation would be disastrous to say nothing of costly to remedy. From my research I understand Rolls Royce re-designed the crankcase in 1961 to overcome this problem. What was I to do? I decided I would lower the entire crankcase into an old oil drum full of warm water, then heat the water until it boiled. The resultant expansion of the aluminium crankcase would allow more clearance for the liners to be withdrawn. A secondary advantage was the boiling water would partially soften any deposits on and around the liners.

When the day came to withdraw the liners I was in a nervous mood. As I waited for an hour and a half for the water to boil all the worst case scenarios ran through my mind. Fortunately with the aid of the correct Rolls-Royce tool the liners withdrew relatively easily and without damaging the crankcase.

I was amazed how much detritus filled every inch of what should have been water space. There was no way the engine could have possibly cooled itself with all that dirt inside. I decided to re-measure all the now withdrawn cylinder liners. To my amazement they were all perfectly round showing only a half thou wear on the two rearmost liners. I still find it hard to believe that such strong looking castings could be made to deform by the pressure of rust. I was delighted, the liners could be re-used with the original pistons, only new piston rings would be needed. Big sigh of relief!

Of course many owners are not so lucky. I have seen several cases of engines needing complete sets of new pistons and cylinder liners due to corrosion in the water jacket causing the liners to deform. The tell tail symptoms of impending disaster are a light knocking sound when the engine is running and water and or oil weeping out of the small drain holes in the flanks of the crankcase. Usually when an engine gets to the stage when it starts knocking, it is too late to save the pistons and liners. Corrosion pressure will have deformed the shape of the liners to such a degree the pistons become severely damaged. Cars driven in this condition have often suffered broken pistons and catastrophic internal damage. Piston rings break and in so doing, ruin the cylinder bores. In some cases the engine may even seize. All owners of Rolls-Royce V8 engine powered cars should understand how vital it is that they ensure their cooling systems are regularly flushed out and their cars have the recommended antifreeze mixture added at all times. In my opinion the cooling system should be drained and thoroughly flushed and new charge of correctly mixed inhibited coolant added annually, no matter what the theoretical life of the mixture should be. Furthermore I would suggest, any Silver Cloud II or III still running on an engine which has never had its cylinder liners withdrawn, is almost certain to need attention to prevent the kind of extensive damage I have described. It is false economy to wait until the engine develops a death rattle before any action is taken. Preventative measures could save thousands in the long run. When the V8 engine was introduced, Rolls-Royce understood how very important it was to maintain the level of corrosion inhibitor in the engine coolant. Without this vital ingredient the cast iron and cast aluminium components attack each other in a process known as electrolytic corrosion. Back in 1959 corrosion inhibited antifreeze mixture was only effective for a matter of months before degrading. New cars were therefore supplied with sachets of inhibitor crystals, so owners could maintain the necessary protection. Black stickers were also displayed in the car,s windscreens as a reminder to their owners of the importance of correctly inhibited coolant. If a car has received regular coolant changes and has always been diligently maintained it might just be ok, though I doubt it. Imagine the damage years of inactivity without maintenance can cause. I would urge any owner to take this issue very seriously before ignorance creates a major headache.

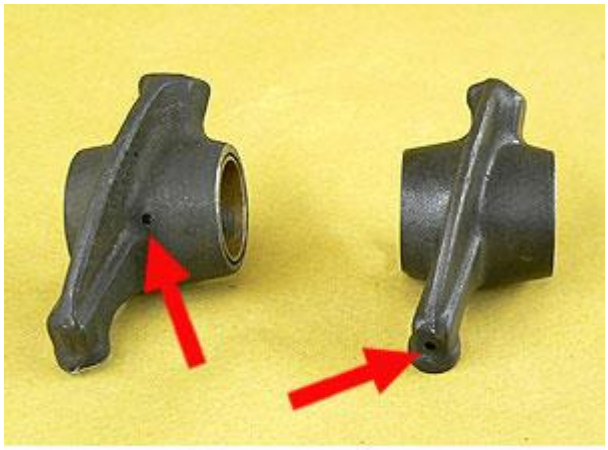
Two days were spent cleaning every inch of the crankcase to perfection. Whilst cleaning the main oil gallery that rises past the timing gears toward the camshaft front bearing. I discovered the reason for the advanced wear in the valve gear. A piece of broken stud had been left in the gallery. This was almost blocking the passage of oil resulting in insufficient oil reaching the cylinder heads, camshaft and hydraulic tappets. Someone had tried to extract the article, leaving tell tail scratches on it and in the gallery. It would appear they gave up and left it in. to cause the substantial damage I found. With the crankcase clean I dispatched it

along with the gearbox casing to be re-finished in polyurethane gold matched exactly to the shade of the original finish. (Early V8 crankcases were finished in a light metallic gold colour as was the gearbox casing. Later cars were left bare aluminium.) Polyurethane is superb for resisting oil and petrol especially when it is baked on.

The original liners were honed in a lathe, carefully cleaned and refitted with new sealing rings. Just to be sure, I rechecked the nip of each liner, (nip is the small protrusion of the liner above the crankcase to ensure a gas tight seal with the cylinder heads.) and re-checked the internal bore dimensions. These were all fine. After carefully fitting the crankshaft using new shell bearings the pistons followed.

A source of noise in many engines is a worn oil pump. I found it necessary to fit a new bronze bush to correct the small amount of wear present in the pump.

The camshaft had been sent to Leonard Reece & Co. to be re-profiled. It came back looking like new. I had no real choice in having it re-profiled. It is a very bad idea to fit new cam followers or in this case hydraulic tappets to a used camshaft or vice versa. The hardening is simply ripped off the new part resulting in the same job needing to be done again soon afterward. I had decided against using genuine Rolls Royce hydraulic tappets. Mainly because they are so very expensive, and secondly they are not very quiet immediately after starting the engine. I fitted American pattern replacements, a whole set of 16 for the cost of one genuine RR item! They have proved very satisfactory and faster than the RR tappets to quieten down after starting.



Picture 4

The cylinder heads were dispatched to a highly regarded engineering company to have the valve guides machine reamed to a slight oversize. At the same time I ordered a set of new inlet and exhaust valves to be made. The cost of genuine Rolls-Royce parts proved beyond all sense and reason. Especially when one may have a full set made as a one off batch exactly replicating the original components for one third of the cost of buying standard parts from Crewe. No doubt it is expensive to operate a spares service for a range of cars launched 50 years ago. However, I wonder at the logic behind the pricing structure, bearing in mind very few of today,s owners are in a similar financial position to that enjoyed by the first owners of the cars. New Valve springs were ordered along with a set of garter style seals for the valve stems.

Whilst I awaited the return of the cylinder heads etc., I turned my attention to the ancillary components, a job which could fill several other articles. I also carefully cleaned every single nut bolt screw and washer. The process took weeks of work, with every single fastener being acid cleaned. I noticed a number of original fasteners had been replaced with more recent non Roll-Royce items, a situation I wanted to rectify. A very good friend who happens to be a highly skilled engineer was kind enough to replicate all of the missing fasteners, down to the smallest chamfered washers. Every single thread was re-cut, before every plated component was dispatched to be re- cadmium plated as they had been originally. Cadmium plating is now almost impossible to get done in the UK due to cadmium being a carcinogenic substance. It is very injurious to health, I am therefore careful only to handle it whilst wearing latex gloves. The finish of cadmium is very pleasing and unlike most other electro plating available, Cadmium is a sacrificial metal, it will destroy itself in order to protect the item it is plating. It is also ideal for use on high pressure threads. Re-finishing the cadmium plated components was VERY expensive, but it produced really superb results and replicated the factory appearance of the parts. Many people don,t realise all the threads in the aluminium engine castings are actually heli-coil inserts. These are like hard steel springs which are fitted using a special tool. Heli-coils are an excellent idea, not only are they much stronger and more durable than simple tapings into a casting, they may be relatively easily replaced without damaging the casting. I found it

necessary to replace a number of damaged heli-coils in several castings. With a couple of exceptions they were easily replaced.

With the parts returned, the next job was to machine the valve seats to 45 degrees. All the seats were in reasonable order and only required a light kiss from the tool to remove the small amount of burning present. In order to ensure there was no chance of pocketing the seats the 45 degree cut was crowned with a 32 degree cutter and careful attention was paid to blend the shape of the seats to ensure a smooth gas flow. The next job was to carefully prepare the cylinder heads and all the other gloss black finished parts for paint. All parts received at least three coats of stove enamel. It is a fairly drawn out business applying the enamel and baking it on, but the finished results are very pleasing. If I were to re-paint the black components again I think I would use a high quality acrylic two pack paint. The finish if anything is superior, and far less troublesome to apply.

When finally all the components were ready for assembly I took the opportunity to reassure myself everything was in order. Every valve was carefully measured with a micrometer. Every guide received similar attention with a bore gauge. All the valve springs had their poundage readings recorded. The protruding height of each valve was checked when fitted in the cylinder heads. Any discrepancy being taken up by shims under the valve spring base washers. This ensures all the valves are held against their seats with uniform pressures. The lift of each cam was carefully checked, and the dimensions of each new hydraulic tappet were also checked to make sure none of them would stick.

The cylinder heads were finally assembled using the non-Rolls-Royce garter seals on the valve guides, and a pair of overhauled Silver Shadow rocker assemblies. These fitted perfectly and look almost identical to the original assemblies. They were of course vastly superior. Rolls-Royce had found it advantageous to dispense with the separate bronze bearings in each rocker in favour of solid rockers, hardened all over, and running on hardened shafts. My one concern in using the Silver Shadow rocker assemblies was the altered position of the oiling holes. Originally the oil holes emerged adjacent to the rocker shaft, (see left hand rocker in picture 4) thereby avoiding the bulk of oil being deposited on the tips of the valves. The holes in the Silver Shadow rockers emerge at the tips and deposit oil on the valve tips (see the right hand rocker in picture 4). This position is an improvement, and prevents the rapid wear that was being found on the rocker tips when using when using the earlier design. When using Silver Shadow rocker gear on a Silver Cloud it becomes essential that valve stem oil seals are fitted. An early engine left unmodified without valve stem seals, will dramatically increase oil consumption and will probably start to misfire due to oil contamination of the spark plugs if fitted with Silver Shadow rocker gear.

With the engine re-assembled and back in the car. I was pleased to note a dramatic improvement in performance and very impressive silent running. I was not pleased to note oil smoke from the exhaust. The problem showed itself especially if the engine had been idling for a while. It appeared the garter style valve stem seals were not doing their job. Time for some more research!

I visited several engine re-conditioners and was given all kinds of conflicting advice. My options were to try a type of umbrella seal which located on the valve stem, and bobbed up and down with the valve shielding the guide from oil splashes. Or fit Silver Spirit seals which are a superior more robust version of the garter seal I had already tried. I seriously considered fitting Silver Spirit seals, I am sure they would be very effective in preventing oil entering the valve guides. My worry was they would be too effective! The Silver Spirit used valves and guides made from different materials to those in my Silver Cloud. Materials which in theory could tolerate dramatically reduced lubrication without causing accelerated wear or sticking valves. Unfortunately Silver Spirits suffer regularly with sticking valves caused by insufficient lubrication reaching the guides. They caused so much trouble in service, Rolls-Royce were forced to "modify" even these admirable seals! This time the modification was to drill a tiny hole in the seal. This was done in order to allow just enough oil into the valve guide to prevent the valve sticking.

I looked at the service bulletins published by Rolls-Royce, very little was written about Silver Cloud II valve stem seals, but I found some information on neoprene seals fitted to the Silver Cloud III. Subsequent investigations into this proposition led to nothing. The neoprene seal was eventually found to be unsatisfactory, and Rolls-Royce returned to recommending the use of the string and tallow seals. I considered all my options, and found I did not like most of them. It had certainly become apparent to me Rolls-Royce had experienced problems in this area over many years, and had tried several changes of materials and sealing arrangements to overcome the situation. By the look of it, it is only in recent years the problem been effectively cured, but only time will tell.

Having carefully weighed the pros and cons of each option, I decided what I wanted was the later Silver Cloud II arrangement. I decided I would modify the valve guides in situ in the cylinder heads to the later design and fit the string seal arrangement. Thereby saving the very considerable cost of buying new guides and valves.

THE FOLLOWING PARAGRAPHS AND PHOTOGRAPHS DESCRIBE THE PROCESS

Firstly having removed the cylinder heads, the valves were extracted. It is possible to see the non-Rolls-Royce garter style seals in situ. (see picture 5)

Picture 5

With the valves removed, it becomes obvious the non-Rolls-Royce garter seals had not been in the least effective. The inlet valves were all showing this sticky residue of carbonised oil on their back faces, this is a direct result of ineffective oil control. (see picture 6)

Picture 6

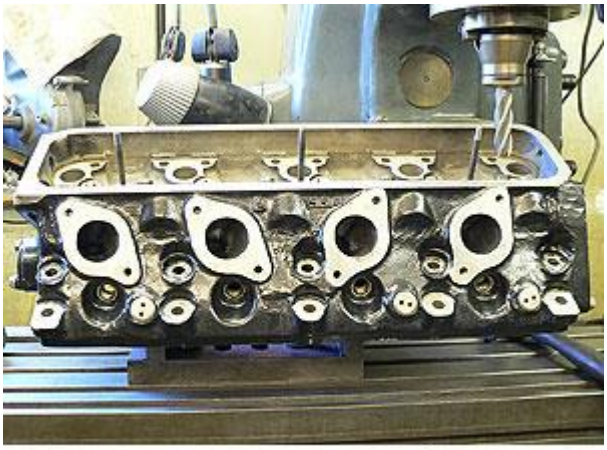
Picture 7

The exhaust valves similarly were excessively covered in carbon after only 2500 miles, a situation that was causing them to stick slightly. It is worth noting carbon deposits are able to climb further up the valve stem/guide if an engine is not fitted with valve stem oil seals. With such carbon build up combined with the

lack of Tetra Ethyl Lead in today,s fuel, the problem of sticking valves can occur. Both inlet and exhaust valves may be seen in (Picture 7) Lead additive certainly did more than just boost octane levels in 4 and 5 star fuel (which the Silver Cloud range were designed to run on). It provided a cushioning effect for the valve seats, which prolonged the life of the seats. In addition it acted as an upper cylinder lubricant, helping the smooth operation of the valves in their guides. It is worth considering adding an upper cylinder lubricant to modern fuels to lessen the risk of sticking valves when using unleaded fuels.

With the cylinder heads clean they were mounted on a milling machine (see picture 8)

The protruding lengths of the valve guides can be seen here (see picture 9) Originally the inlet valve guides stood proud of the cylinder head. The exhaust guides were only slightly higher than those of the later specification at π‰ The correct protruding height of the modified valve guides should be 450‰ A height gauge was made to fit around the guides, this would turn when the cutter reached it making it easy to see when the correct height had been reached. Having set the machine with a pilot in each guide, the inlet guides were milled down to 450‰ gauge.



Picture 8

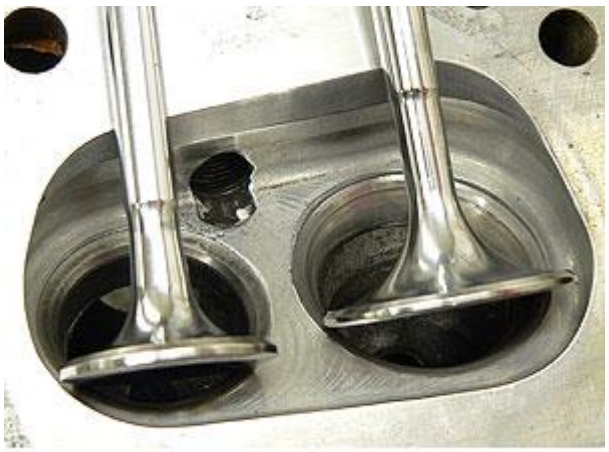
Picture 9

Having reduced the protrusion of the inlet guides, the cup face was added to both inlet and exhaust guides with milling cutter, ground to the correct profile (see picture 10)

Picture 10

The shortened and modified valve guides can be seen here, with swarf still around them. (see picture 11) After cleaning, all the internal bores of the guides were polished to reduce friction. Their internal dimensions were once again checked, and found to be text book perfect.

Picture 11



Picture 12

Picture 13

Next, all of the valves were polished all over. Both their stems and heads received attention. (see pictures 12 and 13). Polishing helps reduce friction and aid gas flow, at least for a while until carbon deposits build up and destroy the effect.

Picture 14

After polishing the valves were carefully lapped together with their mating seats in the cylinder head to ensure a gas tight seal. (Picture14) shows a fully polished and lapped exhaust valve. With the valves ready for assembly their stem diameters were measured to ensure that the correct running clearance was present in each case.

Picture 15

(Picture 15) shows the cylinder head components ready to be assembled. From left to right, the components are as follows; Inlet and Exhaust Valves, Valve springs including caps, Original Valve Springs Base Washers, Late Silver Cloud II valve spring base washers, the string and tallow seals, valve stem seal cups, and finally the valve retaining collets. I should point out at this point the original valve spring base washers are not used on modified cylinder heads.

Picture 16

A further modification I felt desirable is the addition of an oil drain hole to the late type valve spring base washer (see picture16). I was unconvinced these top hat section items once filled with oil would have drained effectively left in their original state. I didn,t want to risk the possibility of a pool of oil surrounding the string seal. Therefore the drilling was added to ensure effective drainage. As I was using Silver Shadow rocker gear sufficient oil is certain find its way down the valve stem to ensure correct lubrication, especially as all my valve retaining collets have lost their seals.

Picture 17

Picture 18

(Pictur
e 17) shows the string seal in place on the valve guide cup face.

(Picture 18) shows the string seal in its retaining cup which is in turn fitted with its retaining spring.

Picture 20

(Picture 20) shows the cylinder heads, one complete, the other awaiting assembly.

The Rolls-Royce V8 engine may look large and complicated. It is large and heavy and not the most easily accessible, it also demands the correct tooling and a mechanic/engineer willing and able to have his patience exercised! At heart it is a beautifully made, but fairly simple engine.