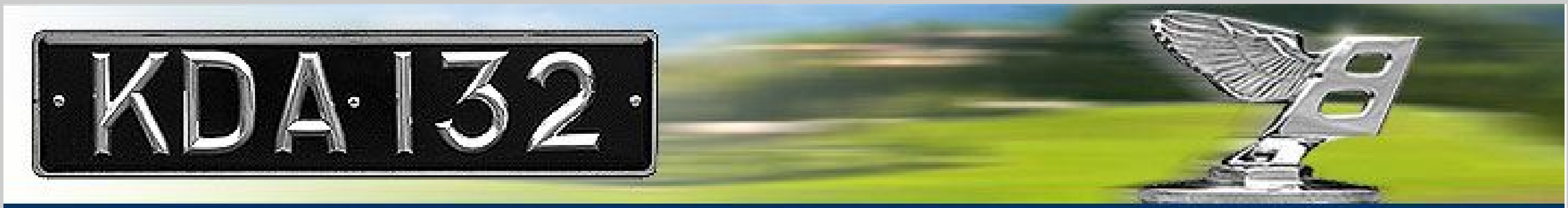

Cylinder Blocks and a few deviations

R-R Silver Dawn, Silver Wraith. Bentley MKVI, R type and S1 cars

N.W.Geeson I. Eng MSOE. MIRTE

The problem with the RREC Hunt House HQ is that so much data is available that one would need to be well over 100 years old to have read it all and spent the entire time at that location. This, for the purist, is not mathematically worked out, but a guess. I would be completely open to any higher assessments.

The problem with the staff, from the top down, is that they are too helpful and will insist on directing you to mountains of information when you ask for that small, detailed request. Anyone not familiar with the location, or the staff, should be warned to take at least three meals and plenty of coffee whilst researching that small problem. If more than one search is envisaged an overnight bag can become a required accessory. An absolute mountain of data is available and one should be warned of the certain possibility of being side tracked and going off at a tangent from the target for the day's research. One advantage, if you are an automotive engineer, is the thought that this could be heaven in a different guise. One of my encounters at Hunt House involved research of automatic transmissions for the post war cars, this extended from about two full days to seven days and I have still not finished.

I did have an excuse for getting side tracked. During that time I was mindful of eventually needing to overhaul the engine, in my own R type chassis B87 UL, a 1953 automatic. Someone had just bored it, and fitted pistons, before I purchased the car. I decided that it was most likely to still have half liners fitted and eventually it would require attention again, probably rather quickly. I am very much aware that the cooling system is a weak link and I was determined that once the engine had been overhauled correctly, it should be given the best chance to outlast at least the owner's life cycle.

Some of the research into R Type automatics involved listing gearbox numbers and inevitably becoming engrossed and reading every chassis card in full. Most noticeable at the time were the chassis cards of cars destined for Australia and Switzerland. They told a story in which I was most interested, with my impending engine overhaul and interest in the cooling system. The details of these chassis cards are related later.

The object of this article is to highlight some of the potential problem areas arising from, and also causing, interference of heat transfer and the inevitable differential expansions that occur. Hopefully it may be of interest to the enthusiast contemplating an engine overhaul and also provide some food for thought as to how and why the cooling arrangements may be modified. All measurements throughout are in inches unless specified.

Some cooling related problems.

Prior to the early 1960's antifreeze inhibitors were not effective and the Ford Motor Company was one of the first to instigate standards to address the situation, whereupon the rest of the industry followed. The ineffectiveness of early inhibitors was the cause of heavy deposits of silt in the cooling systems. Some of the cars have had engine and cooling system overhauls since the introduction of better quality antifreezes. Silting on these overhauled units should be all but eliminated effectively by flushing and antifreeze changing at least every two years. There are still a number of cars that have drastic cooling system blockages and, worse still, owners who do not realise the potential damage that this causes, particularly in this side exhaust valve design. They would be well advised to attend one of the RREC seminars on the post war six-cylinder cars where their knowledge of the engines would be supplemented and their bank balance saved from going into potential dive mode.

The cooling system is based on a thermosyphon system assisted by the water pump flow. Pump output is directed along a removable cooling tube in the top of the cylinder block and discharged through rectangular ports at 90 degs directly to the underside of the exhaust valve seats. After cooling the valve seats the coolant is directed against the top part of cylinder barrels, on the exhaust side of the engine. The joining together or siamesed cylinder barrels in the later engines effectively obstructs the lateral flow of coolant across the cylinder block. Even the very early blocks, with slight gaps between the barrels, inevitably silt up the passages causing the piston thrust side of the barrels to be in the shade regarding water flow.

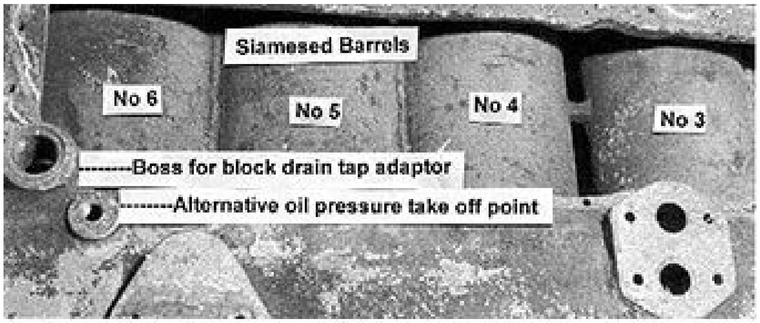

FIG1. Late type R type cylinder block RE 16217, with the side cut away.

Fig 1 shows very clearly the siamesed barrels in a late R type cylinder block, photographed from the carburettor side of the engine. Just out of view, on the left and above the outlet for the drain tap, is the coolant passage between No 6 cylinder barrel and the rear of the block. The small gap between No 4 and No 3 cylinders can clearly be seen, as can the link core adjoining the two barrels half way up the bores. Note how effectively No 5 cylinder barrel is sandwiched between the adjacent cylinders, this situation is also repeated with No2 cylinder. Clearly, the barrel cores restrict the water flow from the other side of the block. When heavy silt is allowed to accumulate, this side of the block can be full, up to 2 inches or even more above the top of the cylinder block tap drain outlet. The depth of the silt can give a false illusion that the cylinder block has been fully drained. In this view the holes around the block periphery are the result of a botched attempt to fit a side plate, in the mistaken belief that this would affect a cure for a cracked block.

Most of the water flow to the thrust or intake side of the block must take the torturous route through the centre between cylinders 3 and 4, or around the ends of cylinders 1 and 6. This situation is made worse if the cylinder block to cylinder head passageways are blocked or if a large amount of silt has been allowed to accumulate around cylinders 5 and 6. If that condition exists, any coolant flow around the rear end, generally the hottest part of the engine, becomes very restricted. If you are lucky and the cylinder block to cylinder head passages are actually free, some coolant may even find a way into the cylinder head. All this of course, even in a clean engine, depends, in the first instance, on whether or not adequate volumes of coolant actually reach the rear end of the cooling tube leading from the water pump. The pump, which normally runs at less than engine speed and with a large rotor to back plate clearance, must be struggling to attain adequate flow, particularly at idle speeds. Silt deposits naturally settle in the rear end of the block and at the bottom of the coolant jacket on the inlet side. My train of thought is that improved scouring and better heat dissipation can only be improved by more vigorous coolant circulation. Of course any minor silt deposits will not disappear and will need removing by regular flushing of the cooling system. Heavy silt deposits can only be removed by physically cleaning the cylinder block, with all the necessary access plates removed.

The radiator is also an effective filter of silt particles and needs clearing out and back flushing vigorously whenever cylinder block silting is found. Fine silt particles do eventually reach the bottom of the radiator. The water pump does not possess enough lifting capacity to bring all these heavier particles back into the cylinder block system, particularly when the pump outlet cooling tube is restricted. These heavier particles are drawn towards the bottom radiator hose outlet and collect in the area of the bottom hose radiator connection. A cooling flow restriction is then formed and if the blockage is severe, or the bottom hose is weak, the hose will collapse inwards under the influence of the water pump suction when the engine revolutions are raised. In this condition a very effective cooling system restriction is formed and the evidence of the hose collapsing is gone when the engine is inspected under idling conditions. Fitting a cooling system filter in the top hose will protect the radiator from excessive silt return, but it is important to frequently service the unit, particularly if the internal condition of the cylinder block is unknown.

Anyone studying the drawings of the pistons, liners and particularly the cylinder block cooling flow on these post war six-cylinder engines will quickly realise some potential problem areas. The engineering picture backs up practical experience in that these engines suffer from quite a degree of differential expansion, some quite uncommon, due to the side exhaust valve design. The peculiar heat transfer problems are confirmed by the wear pattern when these engines are examined internally. Although the company and the piston suppliers in particular, went to some length to circumnavigate the expected problems known to arise from differential expansion, they appeared to be only partially successful. The majority of original tests were conducted on engines that, prior to testing were in either new or very good condition. After many years of service, sometimes in conditions of neglect, like some of us, the cylinder blocks in particular, are showing the signs of stress.

These points however, should not be taken out of context; we all have some advantage over the original engineering and design staff, that of 50 or 60 years of hindsight. Further more, it should be remembered that these were, without doubt, the finest engines available at the time. It is a credit to the original engineering staff that the engines have a remarkable ability to keep running, long after other designs have long since died the death.

The object of test bed and road testing is to subject the engine to as much stress as necessary in order to highlight and eliminate any failings that may be expected to arise in service. Although testing cycles endeavour to parallel service conditions, it is very often the case that they fail to replicate faults that may occur after many temperature cyclic duties, or peculiar operating cycles, have taken place over years of service. In other cases, rather rare test bed failures occur, which are discounted as not likely to occur in service. Unfortunately these types of failure have a nasty habit of changing after years of service from rare to frequent. Test results have a remarkable ability to discount years of maintenance neglect and that specific animal, sometimes defined under the term driver, but more often better described as a motor mover.

At the risk of repeating myself, the importance of de-silting cylinder blocks and then regularly flushing cannot be emphasised enough. The hard silt in these blocks will not be removed just by inserting a pressure hose, the silt is so hard, almost like larva rock and requires very hard mechanical scraping. Owners are generally not inclined to remove the block side plates and apertures, but I am afraid there is no substitute. Running water through the block until it appears to egress clean has only removed the merest of silt traces and the dangerous hard silt, which is preventing good heat transfer to the coolant, will still be in place. It is unfortunate that owners are only too willing to convince themselves that they have flushed the offending silt away. In this respect a particular fact is clear. Once an owner has experienced the de-silting of a cylinder block and filled two or three large coffee jars with the offending matter, that owner does not require any further convincing.

Hardness

The components under discussion later, invariably had a hardness specification and before describing individual parts in detail, some description of hardness is required.

Hardness is best described as the resistance to penetration by other objects. One must therefore have some means of testing the component part surface resistance to penetration, or deformation, and compare the results.

Brinell hardness numbers or BHN, were usually used for the larger castings. The BHN number is found by indenting the part to be tested by a spherical surface, which is forced into the test piece by a known force. The hardness number in BHN is calculated by taking the total pressure applied and dividing it by the curved surface area of the depression made in the test part by the applied load. In practice this curved surface area is related back to the diameter of the impression and is measured by a scale across the lens of a microscope, specially used for the purpose. A comparison is then made of the depression diameter, using known tables.

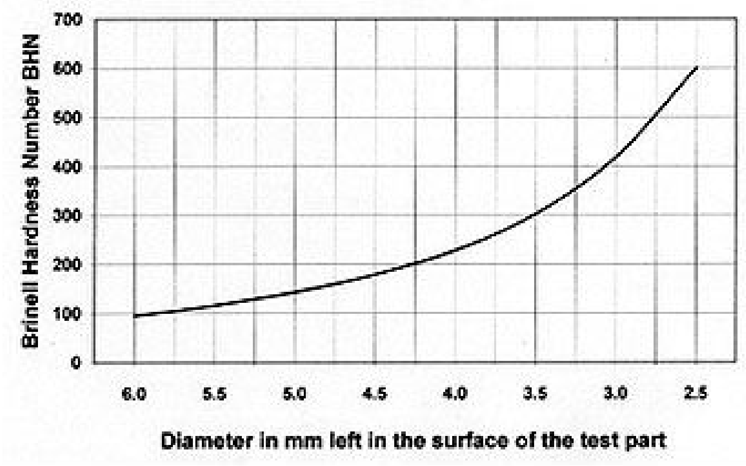

FIG2. Brinell Hardness number graph, showing BHN with a v3000 kgs load on a 10 mm ball.

Fig 2 shows a graph, which gives the BHN numbers when a 3000 Kgs load is applied to a 10 mm diameter ball and the resulting diameters of the depression. In very practical terms, if one took, say a fully loaded Phantom III and rested the entire weight on a 10mm ball resting on a piece of steel, if the resultant indentation on the steel was 4.00mm diameter, then the BHN number would be 228. This 228 BHN incidentally, is a very good hardness rating for a cylinder block but using a Phantom III is not a very practical way of measuring. Especially for smaller parts, quicker methods are used.

Usually either chromium or chromium and copper will be added to cast iron to improve its hardness, but other difficulties apply on large castings, such as keeping the temperature of the iron. The larger the casting the more difficult it can be to keep the temperature and very often chills or hard spots develop. A good example of hard spots can normally be found in the flywheel plates on the crankshaft dampers on these engines, where some of the surface is harder than the adjacent section.

The Vickers Pyramid Numeral system, VPN, and the Rockwell C method will occasionally be encountered. The VPN system uses a small pyramid diamond as the indenter and the test can be conducted on a Vickers machine without the use of outside power although modern machines use electrics and hydraulics for convenience. The different methods usually relate to the physical size of the part to be tested and the ease and speed of the test. An equivalent to Rockwell C49 – C55 would be a BHN of 472 – 547. Hardness at these high figures could be described as extremely hard as against, say, a hardness of BHN 300- 350, which would still be largely untouchable when using a file.

Page 2