MAINLY ABOUT CYLINDER HEADS

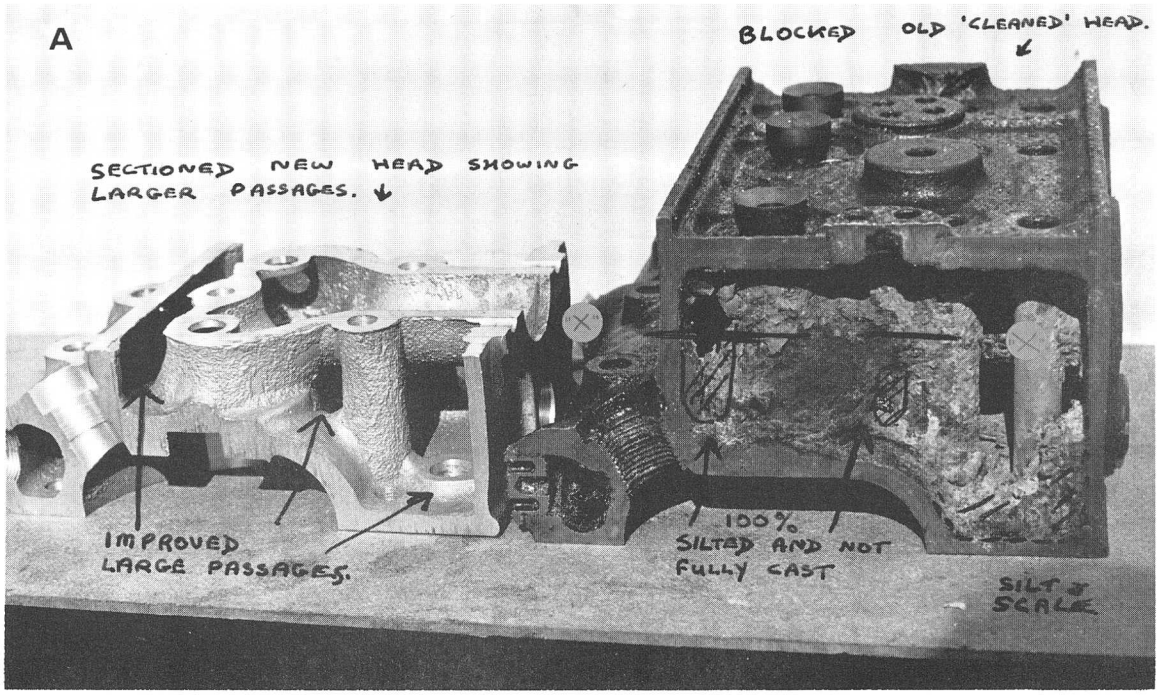
by Richard Shaw

THERE have recently appeared in the Bulletin several articles posing questions regarding overheating, especially with regard to the small capacity Rolls-Royce.

While this can be a common problem it is not difficult to cure and will not recur when the cause or causes have been found, as they are not the result of any design faults, merely the result of general wear and neglect over many years, aggravated by deposits from the cooling water.

It is essential that the radiator be reasonably clear of deposits and has a good flow, and this also applies to the block. The water pump rarely gives trouble, and if the car is actually running reasonably well, overheating is unlikely to be the result of poor carburation or ignition timing. The cylinder block can seriously obstruct water flow to the head due to lime and scale deposits, in which case the sideplates can be removed to facilitate the physical cleaning and removal of the deposits. If the engine is still overheating, then this is usually attributable directly to a faulty circulation of water in the cylinder head, compounded by poor heat transfer through the internal deposits. Either of these will put a stress on the casting and cause it to fail.

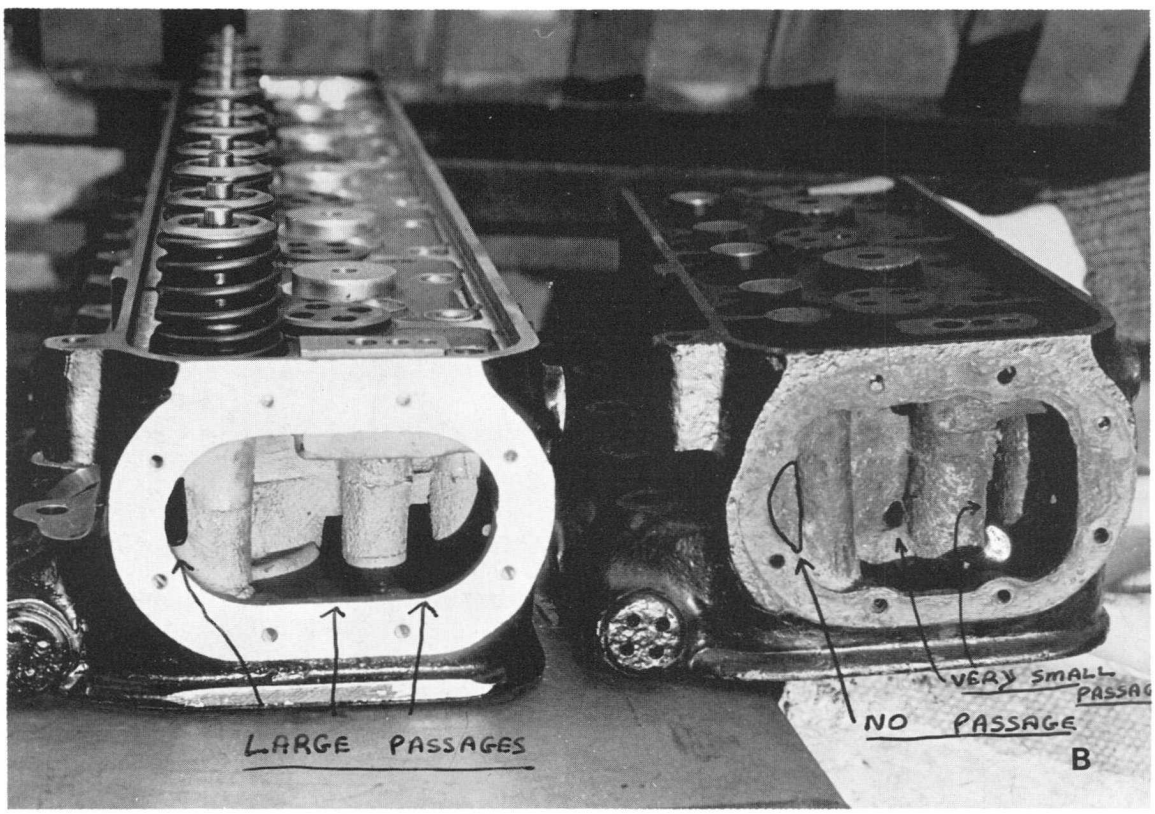
The original castings were a most elegant design, and typically Royce insofar as no regard was paid to production costs. They were very difficult to produce and, especially in the early years, up to 85% of the early batches of castings were rejected. At the labour rates at that time that was relatively unimportant, the cost today would be prohibitive, especially should a fault be discovered when the machining was almost complete. Moreover, even when the new cars were delivered, heads could and did fail — though the customer would be unaware of this fact, the overheating or water loss being

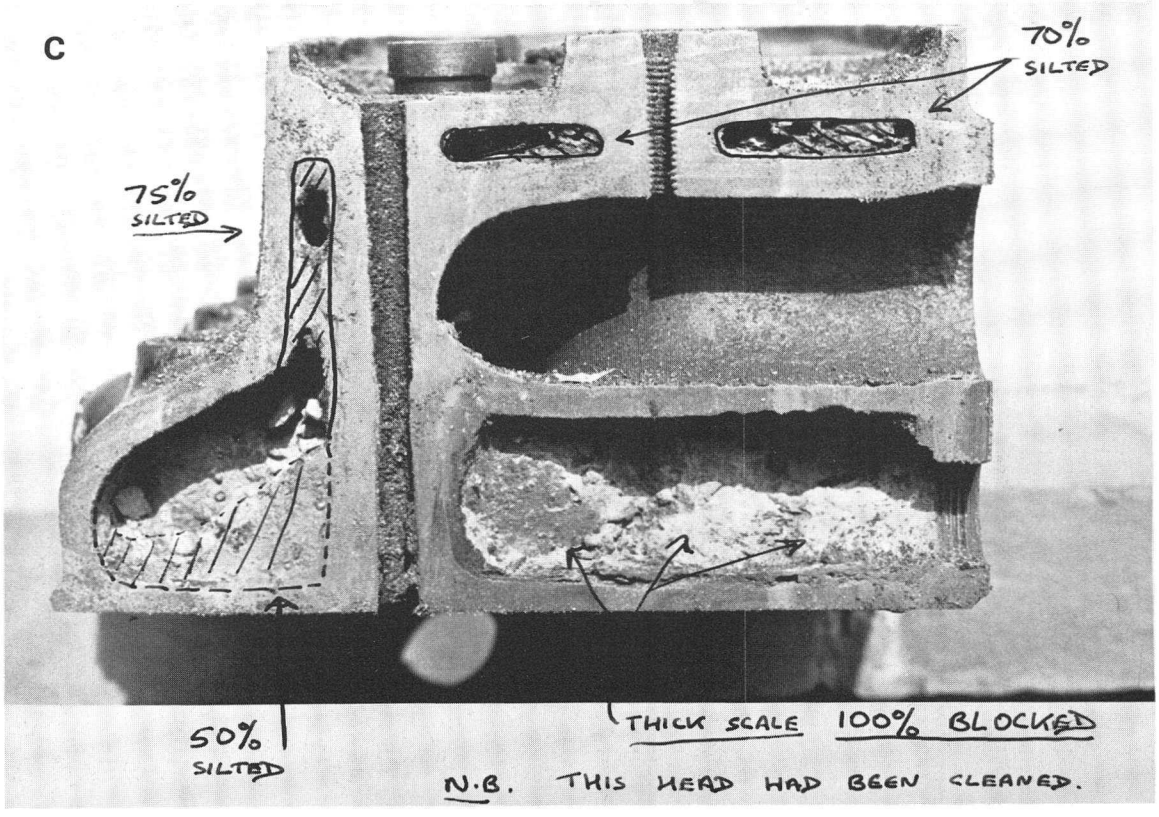


ascribed to another, more minor, fault. Many heads today have small dowels filling blowholes and other signs of early repairs. After all these years there is certainly no margin to cope with circulation problems.

The heads are superb examples of thin iron castings, but unfortunately in time and with perhaps neglect of a leak somewhere in the cooling system, they do silt up and also a very hard scale forms internally and this rapidly increases due to poor heat transfer, especially around the valves and combustion chamber. While iron is strong in compression, its tensile and fatigue strength is relatively poor. The local overheating caused by the silting rapidly results in weakness and then cracking. You will see from the section 'X-X' on photograph A, where a head was still 100% blocked, even after chemical cleaning. The 'X' on the left is exactly where the most common crack appears. This head had twice been expensively repaired and both times the repair had failed — it is hoped that this photograph clearly shows why. Cool water could only run in the upper part of the head, while the lower part became extremely hot due to the deposits insulating the combustion chamber from the water. There would be constant differential expansion rates between the cool upper and very hot lower parts of the casting.

It is important to appreciate that the cracks are the result of these continuing local stresses — and therefore if the cause of the stress (overheating due to internal blockage) is not removed the crack will recur either in the same place or in the form of a new crack close to the repair. Over half of the new heads sold are to people who have had heads repaired, often at great expense and with no guarantee, and subsequently the repair has failed.

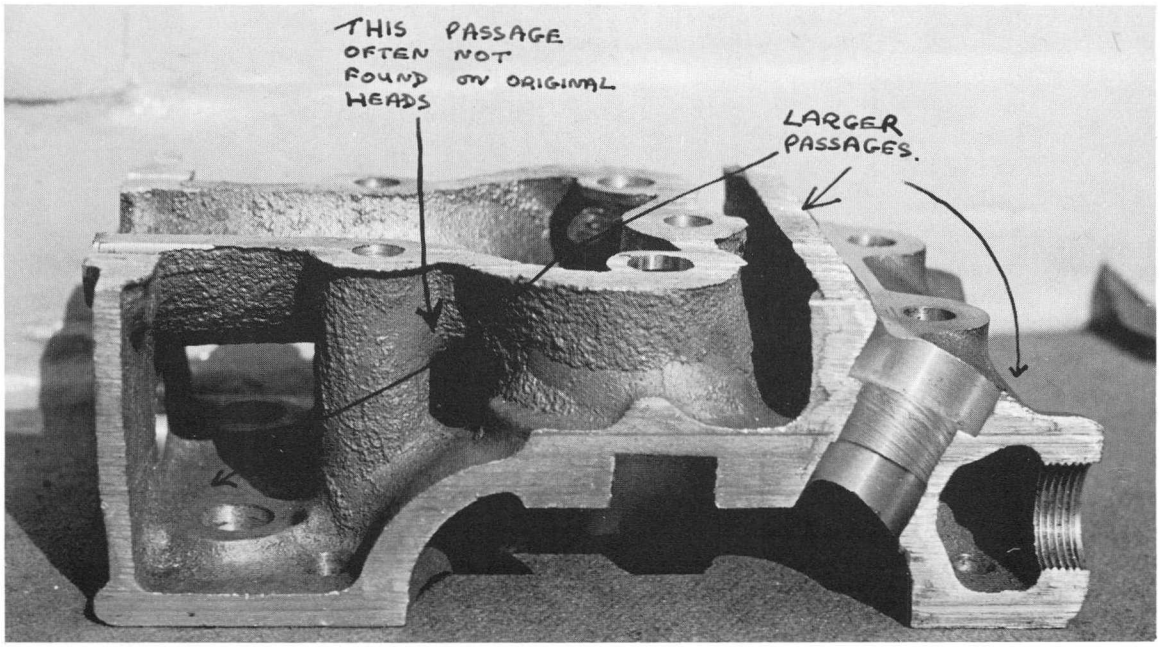




If a casting has failed due to a single non-recurrent physical force, such as a conrod breakage through a block, then a welded or Metalock repair may be effective, provided there is no new stress But, unfortunately, the typical cylinder head cracks are really only the final results of the chronic blockage stresses and, therefore, the repair will eventually fail as the source of the crack is still present. Indeed, welding can further block the head. The Metalock repair so confidently described recently by Dermot Bambride in Bulletin 131 likewise failed, and his engine is now fitted with a new head from us.

The photographs show the typical extent of the blockage and also how ineffective head cleaning chemically really is. When cleaning the cylinder block the sideplates must be removed so that with old hacksaw blades and similar weapons one can physically attack the scale and scrape it off, but this just cannot be done in the heads and the silting remains. The passages are small and narrow and are totally inaccessible inside the head. Moreover, as mentioned earlier, there were casting problems when the heads were new and the original castings do vary greatly. Even the original factory drawings only state 'endeavour to obtain' with regard to certain water passages, as a result of which the original heads varied from very good to acceptable when new — and inevitably do not have any margin after this period of time. This can be clearly seen on photograph B. The head on the left is a new one of the current series, the one on the right a cleaned original with a very small passage as originally cast in two places and no passage in another place. It was completely blocked due to deposits and had twice been repaired, but soon failed.

As a general indication of the state of health of your cooling system, a good cylinder head should on an average cool English day (say 15 degrees centigrade) run at an indicated temperature of 60-65 degrees, with the shutters fully open, either manually or by removing the calorstat link pin. It is always good practice to slow down gently before the end of a fast run to disperse the heat before a stop, as there can be a rise of 10-15 degrees while a very hot engine is just ticking over with little air and water movement. A good condition or new head has a reserve of capacity, but as an old head gradually becomes blocked this reserve is used up. The shutters open or are opened fully earlier without the owner really noticing, and the car then runs apparently normally at 80 degrees and



eventually even hotter. Severe stresses are being set up inside the head due to the uneven cooling and by the time the overheating is serious or the head cracks, it is usually too late. A repair would fail as the crack is only the end symptom.

For these reasons new heads became necessary, and when making them for the club we have endeavoured to provide larger passages and greatly increased strength in all the known problem areas. It was also necessary to consider ease of production and research carefully into the reasons for production failures, as otherwise the costs would have been prohibitive. We now have an 80% production success rate to final test. After final testing the heads are vacuum impregnated as a further measure to strengthen them and assist with heat transfer. It also stops internal scaling in any small casting voids.

The initial batch were cast in iron, but now we have standardised on aluminium alloy for the last two batches of twenty. It has better thermal conductivity, and much greater resistance to tensile stresses. Moreover, aluminium can simply and reliably be repaired by welding in contrast to the original iron heads. The appearance is identical and owners were given the choice but chose the aluminium alloy. It is substantially lighter, which is a useful extra benefit. The new heads are cast using a fine casting sand. This produces a smooth finish to assist water flow, reduce scaling and ensure accurate and consistent wall thicknesses. The combustion chambers and passages have a better gas flow for a smooth powerful engine performance.

It is essential that a good proprietary inhibitor be used in the engine all year round, suitable for aluminium and iron engines, and the writer has used Prestone for many years, but not in an unnecessarily strong concentration as this has a searching action and any small leaks would damage paintwork.

The small horsepower Rolls-Royce is a charming motor and most reliable and economical, with continuing maintenance no further problems should arise.

Footnote: Richard Shaw has run, with great success, the 20/25 cylinder head project. He has, in order to do so, researched the subject in great depth. — ED.