Development of Welding for reconditioning Marine Diesel Engine Piston

By B. R. DAS*

The application of welding has become very wide in industry in general and repair work in particular. Welding technique has gone a long way in saving capital renewal costs by translating the concept of reconditioning into reality. This area is of particular importance to Indian industry where, apart from obviating the difficulty in obtaining imported spares, reconditioning results in substantial saving in foreign exchange.

With this concept in mind, in the year 1970 Hooghly Docking & Engineering Co., Ltd., where the author is engaged, undertook the project of developing suitable techniques for reconditioning marine diesel engine pistons which till then were only being reconditioned abroad involving expenditure of large sums of foreign exchange. The high cost and resultant delay were also affecting the operating costs of the ships.

This article presents the technique evolved which has since been found satisfactory and which, to the best of the author's knowledge, has not been tried elsewhere in India.

The piston heads of heavy duty marine diesel engines are water-cooled and are made of steel casting to specification equivalent to Din STG 52815. During operation, piston ring grooves are subjected to severe abrasion and high temperature resulting in worn out and burnt grooves after specified working hours. In addition, on surfaces and sub-surfaces of the piston ring grooves, thermal cracks develop extensively.

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The pistons rendered inoperative as mentioned above are reconditioned to restore the working properties for specified hours of service.

Fig. 1 shows a typical worn out piston prior to reconditioning :—

At the earlier stages of development of re-conditioning, attempts were made to repair the grooves by manual welding using low hydrogen electrodes. Pistons re-conditioned by this process gave service life of 2000-3000 hours only against 15,000—20,000 hours normally specified. This operation was also found to be uneconomical, the re-conditioning cost per service hour

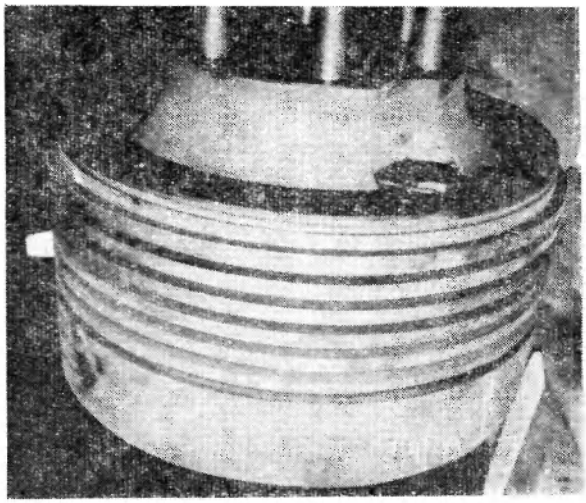

Fig. 1.

being high. Further investigation into the case of short service life of pistons repaired by manual welding indicated the following attributable reasons. :—

(i) Non-homogeneous deposit of weld metal.

(ii) Non-uniform hardness of welded surface (the actual requirement being 250 B.H.N. all over).

(iii) Difference between expansion properties of weld deposit and parent metal of piston.

(iv) Locked up stresses and sub-surface cracks.

In the light of this investigation, a technique was developed involving stress relieving operation, complete removal of ring grooves and re-building by submerged arc welding with subsequent machining and flame hardening of the working surfaces. The process is similar to the one adopted by M.A.N. at their Augsburg plant in West Germany. It is needless to mention that both the electrodes and flux used for the purpose are of indigenous origin.

The process for re-conditioning is detailed in the following paragraphs :—

(i) The piston head is annealed in an annealing furnace with the temperature being raised to 900°C slowly over six hours. The piston is allowed to cool slowly in the furnace after allowing a soaking period of 2/3 hours.

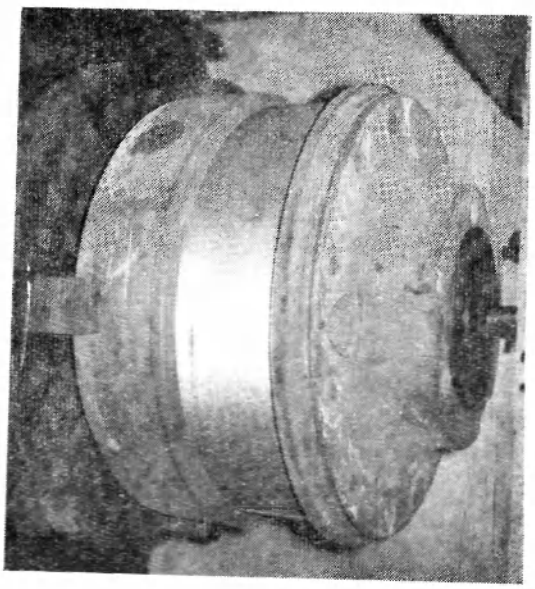

Fig. 2.

Fig. 3.

(ii) After annealing, the damaged piston is turned on the lathe to remove the ring grooves completely. (Fig. 2)

(iii) The entire machined portion of the piston is built up by automatic submerged arc process by preheating the parent body. (Fig 3)

(iv) The piston is stress relieved subsequent to welding.

(v) The piston grooves are then machined leaving an allowance for grinding to be undertaken after flame hardening.

(vi) Both the faces of the ring grooves are flame hardened by oxy-acetylene flame to achieve a brinell hardness of 250/270 on the surfaces. The faces of the ring grooves were hardened upto a depth of 4 mm from the surface. The inner core is kept soft to restrict the thermal crack, likely to develop during operation, to the surface only.

(vii) The piston is next ground to ensure the required degree of finish on the ring faces. (Fig. 4)

(viii) Finally, the piston is hydraulically tested to a pressure of 300 lb. sq. in.

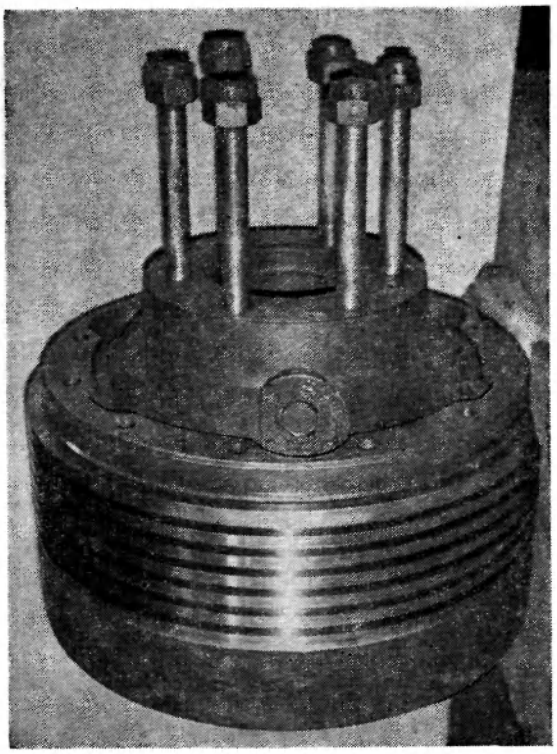

Fig. 4.

A total of twenty-five pistons have so far been reconditioned by this new process all of which have given satisfactory performance. A conservative estimate indicates annual saving of Rs. 50,00,000/- of foreign exchange on this account.

It will be evident from the above, that foreign exchange drained on account of welding services purchased from abroad can be effectively reduced by proper adaptation of methods using indigenous equipment. Doubtless, welding technologists throughout the country have come across similar or allied problems. The author will consider his purpose fulfilled if this article serves to solve some of their problems.

The author while dedicating this paper to the memory of Late G. Betze resident representative of M.A.N. in India in 1970 whose invaluable technical advice has made this project feasible, expresses his gratitude to Messrs. Lloyd's Register of Shipping and Messrs. Indian Steamship Co., Ltd., without whose keen interest and extensive assistance the development work would not have been initiated.

The author also takes this opportunity of thanking the management of the Hooghly Docking & Engineering Co., Ltd., for permitting publication of this paper.

BHPV Seminar on 'Rationalization of Materials'

Bharat Heavy Plates & Vessels Ltd Visakhapatnam had organised a seminar from the 23rd to the 25th April '75 which was attended by about 100 delegates from different public and private sector industries.

With technical know-how flowing in from a number of developed countries each following its own national standards and specifications, it has become difficult for fabricators in India to meet the great variety of material specifications. Rationalization is most essential and this was the subject of the seminar conducted by BHPV. Concrete proposals for variety reduction in items such as flanges, fasteners, pipe fittings, dished-ends and plates were made and discussed in the seminar.