Welding Saved Foreign Exchange

By J. JAIN*

Repair welding is considered all over the world to be an important tool in prolonging the life of costly plant and equipment, effecting considerable savings and keeping down-times low. In developing countries like India, where a lot of machines and complicated equipment are imported ones, repair-welding assumes new dimensions. It can, under proper supervision and by proper selection of welding processes, welding machines, electrodes, proper weld preparation and welding techniques, go a long way in saving India considerable foreign exchange.

While taking up a repair job four factors are to be considered :—

1. *Comparative cost :* The total cost of the repairs and the replacements.

2. *Comparative life :* The ultimate life of the repaired job and the new one.

3. *Availability of new components/parts as spares* : Whether these are available indigenously or are to be imported. In case of imported spares, practical difficulties in procurement due to import procedures, regulations etc. are to be considered.

4. *Comparative commissioning time ;* Total estimated time required to carry out the repairs versus the total time required for procuring the spares.

   Cost and commissioning time generally favour repair-welding but, in some cases, the life of the repaired component cannot be predicted unless elaborate studies about the materials and the welding techniques and designs are taken up prior to the actual repair welding.

In India when some complicated imported parts are to be developed indigenously as replacements with a view to conserve foreign exchange, it would take considerable time. As such, down-time losses may run very high. Attempts, therefore, are generally made in such cases to repair immediately the damaged components with proper techniques to keep the machine running till it is indigenously developed. A situation like this arose twice during the last year in TELCO, Jamshedpur.

I. Repair of Forge Hammer

One Forge hammer has been working in the Forge Dirion of TELCO for the last 13 years. It had been imported from West Germany. It forges some complicated components of Tata-Trucks such as camshafts, coverbrake levers etc.

*Dr. Jain is with Tata Engineering and Locomotive Co. Ltd. Jamshedpur. This paper was presented at the seminar held in Jamshedpur in 1971.

The hammer is steam operated. It can impart a blow-energy of 10 mT. The working pressure is 100 psi. The piston along with its die holding head weighs about 8 T. The capacity of the forge hammer is about 200 camshafts per 8 hour shift.

The forging dies are held in the inverted piston head by means of solid taper keys (Fig. 1). The hammering of these keys into the dovetail causes uncontrolled impact loading on its sides. After about 12 years of service, cracks were detected at the dovetail corners. These cracks ran quite deep into the hammer.

The idea of importing a new one was rejected outright. For developing an indigenous one the matter was taken up with the Foundry Division of TELCO.

The composition of the cast steel hammer is 0.3% C, 0.5% Si, 0.9% Mn. The ultimate tensile strength is 55 kg mm². It was estimated that to plan and produce the casting of the required quality, it would take about 1½ to 2 years. To keep the production line of Trucks moving till such time, it was entrusted to welding department to repair the hammer immediately.

It was decided that the cracked portion would be machined out completely and a new block would be fitted there. The design of the new block was considered to be an important factor. The block has to withstand the impact of forging as well as the forces coming into play due to hammering-in of the keys for changing and setting the dies.

The block was designed in such a way that it is joined with the main body by (i) dovetailing, (ii) screwing and (iii) welding (Fig.2).

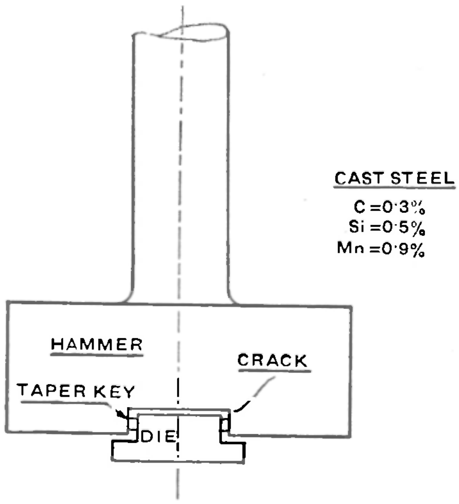

Fig –1

The block dimensions are 200×400×1000 mm.

1. For dovetailing, a liberal radius was given at the corner and the block slipped inside.
2. The block was drilled and tapped together with the hammer body. Six holes of varying depths were located in a zig-zag manner. Six nos. of reinforcing bolts of varying length were screwed into their respective holes. The heads were afterwards gouged out carefully as shown in the fig. All round the block, V-preparation with an opening of 70° and a depth of 50 mm was done by oxy-cutting and grinding.
   (a) Electric arc hand welding process was used for welding the studs and the block. On the basis of the chemical composition and the mechanical strength of the hammer low hydrogen electrodes were selected.
   (b) The studs were welded with the block. The head cavities were filled with the weld material. The block was then welded all around with the hammer.
   (c) Care was taken not to heat the hammer excessively. Deformations were not appreciable due to low heat input. Weld surfaces were finish ground afterwards. Special care was taken to avoid undercuts and to keep the surfaces free from stress concentration points. Testing of weldments was thought not to be necessary.
   (d) The whole repair work, i.e. making of block and bolts, dismantling, machining and erection took about twenty days.

After about one year of service the other side of the dovetail cracked. The cause of the failure was believed to be the fatigue of the hammer material.

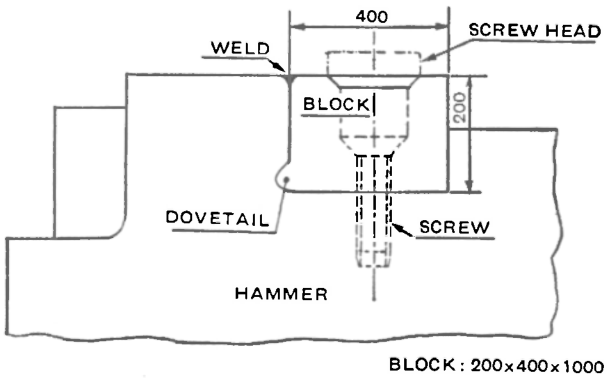

Fig –2

This side of the hammer was also repaired in the same way as the first side.

By such repair welding the hammer continued to function till the new casting was made available for erection. The casting, machining etc. of the new piece in Telco took about two years. But the role played by Welding sub-division in repairing the defective hammer by applying proper techniques and requisite technical know-how and guaranteeing a long working life so that foundries could complete their job was of vital importance.

Furthermore, it is estimated that importing of a spare hammer would have taken about 6 months' time. In addition to it, it would have cost the country a considerable amount of foreign exchange.

II. Repair of Rollers for Isothermal Annealing Furnace

The furnace was supplied to Telco's Forge Division by OFU, Ofenbau Union,, West Germany. It is used for heat treatment of forged components. The operating temperature is 1050°C. For continuous transport of the annealing components, it has got rollers of about 250 mm. (Fig. 3). The furnace has cost the Company about 4 million rupees in foreign exchange.

After about 6 months of service, it was found that 6 transporting rollers were damaged. Four of them showed longitudinal as well as circumferential cracks but the remaining two had burst due to explosion. The failure of these rollers could have been due to :

1. Wrong design
2. Wrong selection of material
3. Defective technique of production
4. Wrong application.

The chemical analysis of the material was found to be 0.51% C, 1.8% Si, 0.77% Mn, 20.8% Cr and 36.5% Ni. which conforms to the specifications given by the supplier.

These rollers are centrifugally cast. The damaged rollers showed two layers, the thickness of the outer layer being 9 mm and that of inner layer being 7 mm. The furnace, during its 6 months of operation, worked at below its operating temperature of 1050°C. The conveyor was also never reported stuck during the operations. The rollers were provided with gas-escaping holes, located on the charge carrying area. These were found to be blocked with scale and rust. A high pressure must have built up inside the rollers, resulting thereby in the rupture of the roller material.

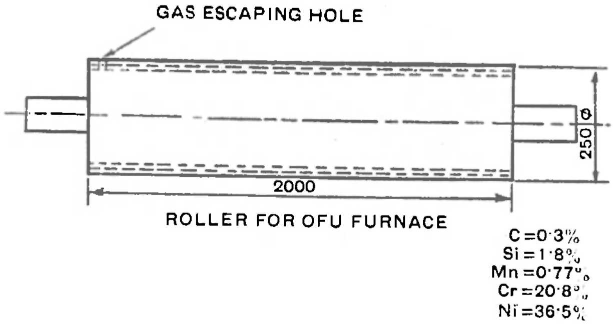

Fig.-3

The rollers were so badly damaged that it was impossible to repair them merely by crack rectification. New finished rollers were also not available indigenously for replacement. No Indian supplier could be located who could cast such rollers. To obtain replacement from Germany would cost foreign exchange. It had a long procurement cycle too.

Luckily, two spare rollers were available with the furnace. It was decided to replace the two broken rollers with these spare rollers. The badly deformed and damaged portions of the other four rollers were parted off by sawing and then replaced by the good portions taken out from the two broken rollers. These were joined by electric arc hand welding. Some imported electrodes of similar composition were also readily available. The deformation of rollers caused by bursting was taken into account and carefully corrected during the assembly. With proper welding sequence and care, the rollers were then welded.

The gas escaping holes were shifted from the charge-carrying area to the end supports under the brick wall to avoid their blocking due to scale and dust in future.

After welding the cut pieces to the rollers, they were heated to about 800°C and straightened mechanically. They were rolled under a heavy weight of a loco frame slab.

The whole repair work took about seven days. The furnace is now working satisfactorily for the last 9 months.

The attempts to develop the rollers indigenously has not succeeded as yet.

A right approach and a proper technique of repair welding saved Telco a lot of foreign exchange and kept the down-time losses very low.