MAINTENANCE WELDING

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INTRODUCTION

Maintenance Methods always cannot be the same as Erection / Manufacturing processes. In Erection / Manufacturing the processes methodical steps are preplanned and work is organised in a conducive atmosphere with well-laid out procedures, whereas in maintenance works time available to do the work will be limited and there may be constraints in space availability etc. coupled with unfriendly surroundings. Hence improved methods may have to be adopted to gain easy accessibility and to carry out the work quickly with minimum down time of the equipment. A typical example of the above viz. the window type welding technique adopted in welding of certain inaccessible areas is narrated in the paper.

PROCEDURE DESCRIPTION

On several occassions during maintenance of high pressure systems, the defective portion of welding of tubes/pipes may not be easily accessible. For example, the porosity or crack in the bottom of the tube on pipe laying on the ground, defect towards furnace side of water wall of a Boiler etc. cannot be approached unless certain time consuming preliminary works are carried out. To minimize the down time of any process unit for attending to such defects, window type welding technique can be resorted to.

The technique involves (a) cutting a window piece in a damaged pipe/ tube under repair on the opposite side of the defect, (b) removing off defective portions like pin hole, crack etc. by grinding upto the root, (c) welding it from top/outside thro' the window opening and (d) closing back the window by a suitable piece of similar pipe.

APPLICATIONS

a) Defects in pipe lines lying on the ground

A weld defect in the bottom portion of a pipe line lying on the ground can be attended to without much efforts on lifting and supporting the pipe. **Fig.1(a).**

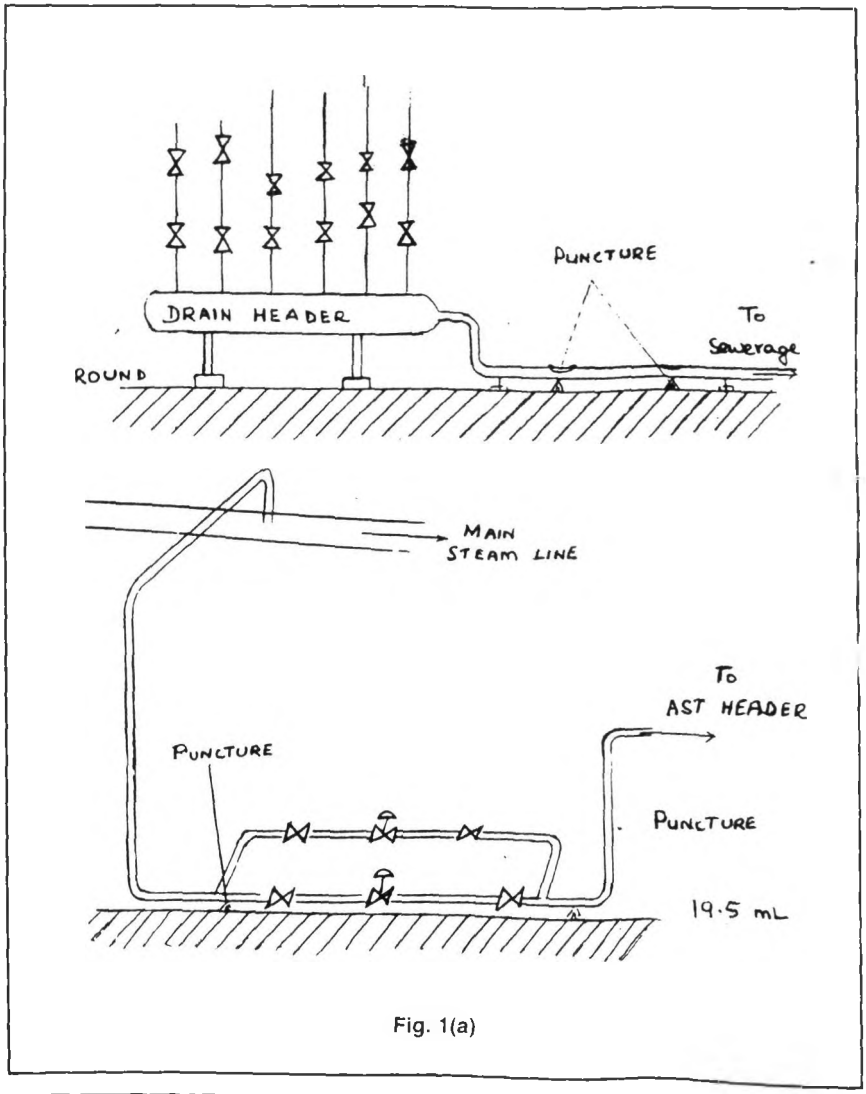


Fig. 1(a)

A sufficient size of opening will have to be cut in the pipeline above the point of defect and with the access available the defect is to be attended to. Then the window will have to be closed by a new piece cut from pipe of same size and materials. For high pressure application, use TIG welding for root run.

(b) Dents in Water Walls Fig.1(b) Due to falling of clinkers or some such reasons sometimes dents occur in the bottom hopper portion of the water wall tubes inside the furnace. This may affect the circulation in the particular tube and that may burst open due to overheating. So they are to be replaced. Alternatively if the unit is to be taken back to service immediately the window technique can be made use of for replacing the dented portion instead of the whole tube.

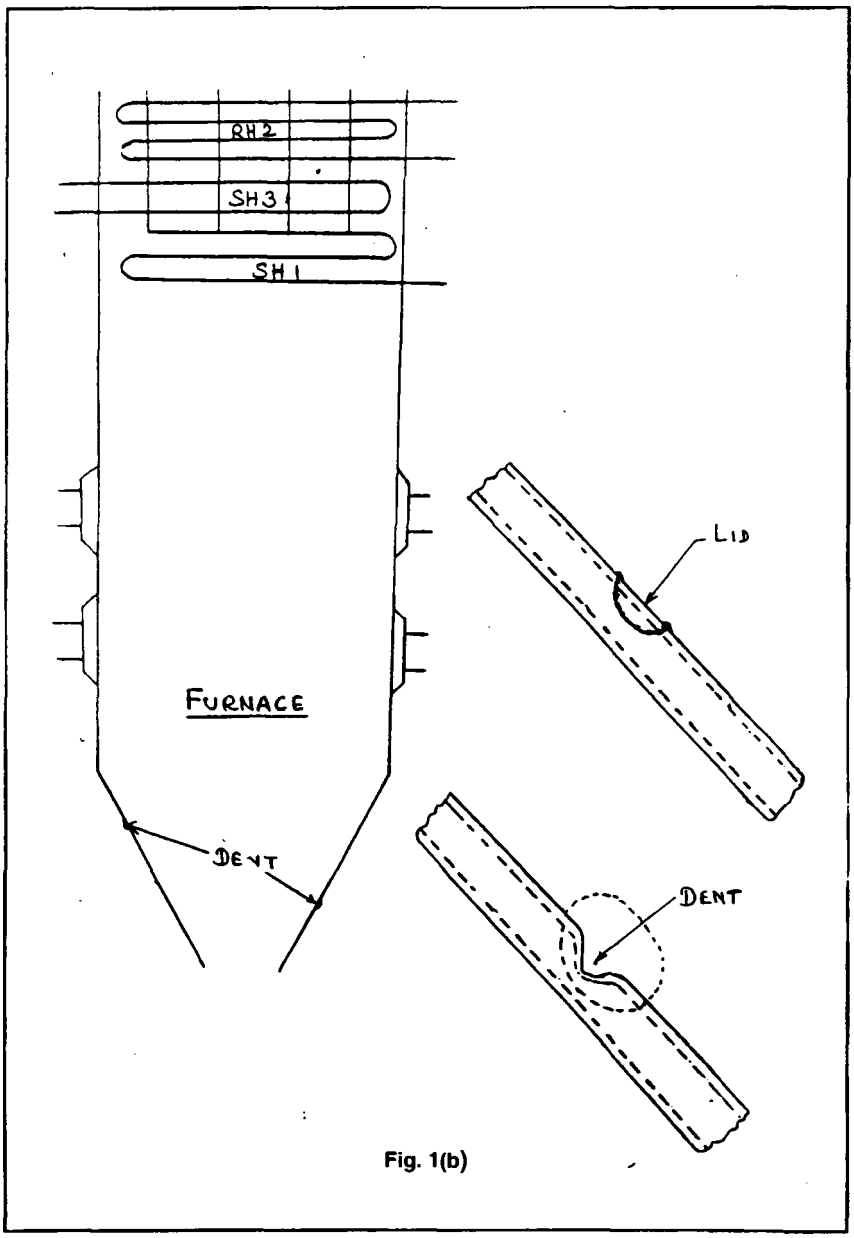


Fig. 1(b)

c) Water Wall punctures

Window welding technique has proved itself to be quite time saving and useful method in its applications while attending punctures in the water tubes inside the furnace. In case of punctures warranting water wall spool wall piece replacement, time consuming and elaborate procedures of some superheater/ reheater coil cleaning for safety purpose and erecting sky-climber are to be adopted for obtaining access to the inside of furnace. Alternatively following improvised procedure of window welding can be adopted.

While replacing the defective water wall tube in Boiler Furnace, the following steps shall be followed:

1. Erect a platform outside the furnace
2. After removal of insulation, locate the defective area by water and viewing thro' nearby man holes. Exactly mark on the water wall tube the portion to be removed and replaced. Flame cutting shall be nearer to the damaged tube so as to avoid flame impingement on unaffected tube.
3. Refer to **Fig.1(c).** Grind to square the top and lips.
4. Prepare a spool piece, taking into consideration the tolerance for shrinkage etc.
5. Now cut on spool piece as well as an existing tube to be jointed, a suitable configuration so that a window opening is available for root welding of the inner half of the tube.
6. Similarly, repeat it on the other joint also.
7. Refer to **Fig.1(d)** for weld joint preparation for inner half of the tube.

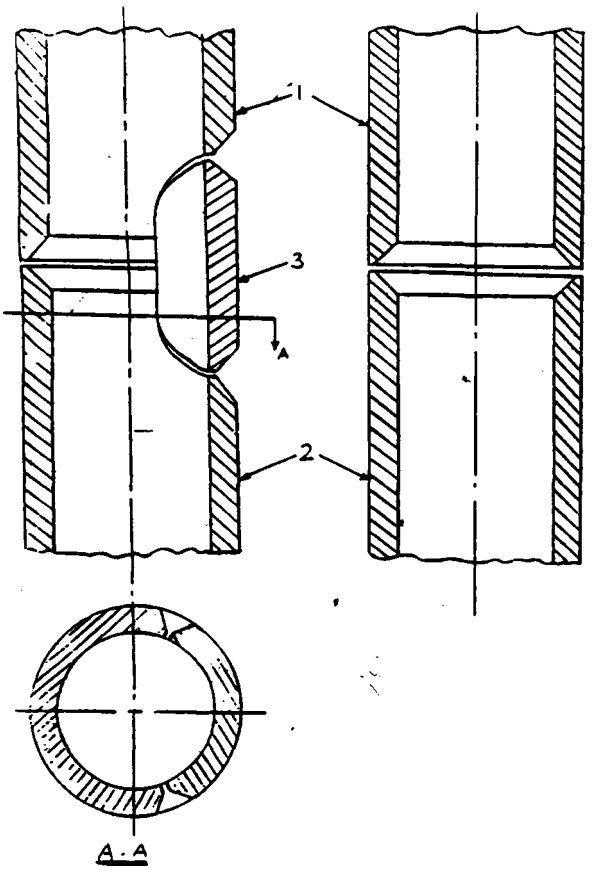
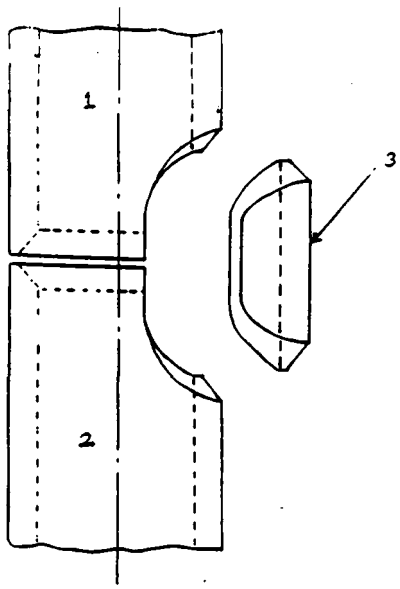


Fig. 1(c)



1. Tube 2. Tube 3. Lid

Fig. 1(d)

8. Use TIG Welding for completing the inner half root welding.

9. Grind the junction points and cheek for slag inclusion or porosity. If in doubt use DP testing.

10. Now close the window by a suitable pieces of same configuration.

11. Complete the Fin Welding.

INSPECTION AND TESTING

The following are to be carried out before putting the units in services:-

1. As Radiography of the joint could not be taken due to the inacessibility of the other side, junction points [See points 1, 2 in Fig.1[d] are to be ground and Dye penetrant Test is to be carried out before and after welding of the window lid [part no. 3 in Fig.1[d].

2. Hydraulic Testing to a pressure of 1.25 times the normal working pressure, is to be carried out.

WELDERS QUALIFICATION REQUIREMENT

Welding shall be carried out only by qualified and experienced welders to ensure reliability on this method.

Welders qualified as per I.B.R. 1950 and possessing valid qualification for carrying out welding on Carbon/Alloy steel with TIG Root, shall be considered. The welders having above qualification may also be given following simulated test to check this capability.

A test specimen of sizes as shown in **Fig.2(a)** shall be prepared and fixed vertical in 2 G Position. On either side of the test specimen, tubes of the same sizes and height shall be kept as close as possible as shown in Fig.2(a).

Welding shall be done from one side only (i.e. from front side)

Root Welding shall be by TIG only

Interpass grinding is allowed.

After completion of the test Radiographic examination shall be carried out and evaluated as per ASME Sec. IX-Q.W. 191.2.

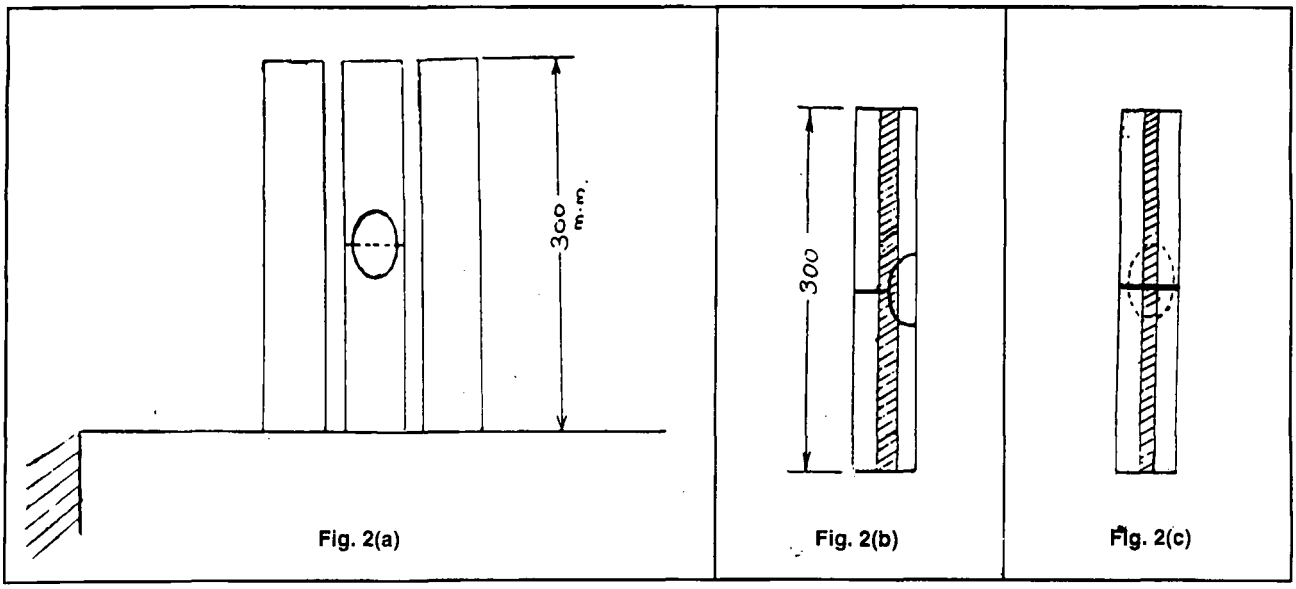
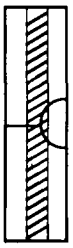


Fig. 2(a) Fig. 2(b) Fig. 2(c)

TABLE I
Test results of window Technique weld specimen

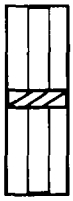
Sl. No.	Location of sample	Yield Tensile stress N/mm²	Ultimate Tensile stress N/mm²	Percentage of Elongation
1		445.2	526.0	12.1
2		387.9	648.0	15.3
3		458.0	647.4	12.7
4		424.4	593.0	16.2
Average		428.9	593.6	14.1
5	Parentmetal	275	485	26% for Thickness 5.6 mm
6		376.4	517.0	21.0
7		417.0	528.5	21.0
Avarage		396.7	522.7	21.0

Also two specimen from the position shown in **Fig.2(b)** [each on other side] and one specimen as per **Fig.2(c)** shall be cut and bend tested. In all Bend Testing, angle of bend shall be 90 and the root under tension. If all the above requirements are satisfied a welder is fully qualified for performing the window type welding.

ECONOMICS OF THIS METHOD

Failure in Boiler tube is one of the major causes of forced outage of steam power plans. A single tube failure in a large coal fired unit can result in an energy loss to the tune of lakhs of rupees even if the shut-down period lasts for a few days. One hour idle of a 200 MW itself will cost nearly a lakh of rupees and this one hour loss of power production would lead industrial losses to about 70 to 100%. So it is the paramount responsibility of the field engineer to reduce the down time of Boiler when tube failures are encountered. Among the tube failure of power Boiler, failures of water wall tubes are more predominant. So down time reduction in attending to

TABLE II
Test Results of Normal Butt Weld Specimen

Sl. No.	Location of sample	Yield Tensile stress N/mm²	Ultimate Tensile stress N/mm²	Percentage of Elongation
5	Parentmetal	275	485	26% for Thickness 5.6 mm
8		446.5	547.3	16.0
9		367.5	521.5	18.0
10		416.8	545.8	20.0
Average		419.2	538.2	18.0

water punctures will considerably increase productivity.

In tower type boilers with fouled furnace conditions, replacement of the tube will involve following sequences. Cooling the furnace to ambient temperature, cleaning of radiant super heaters and water walls near failure, erection of sky climber, replacement of tube, and dismantling sky climber. This may take around 5 to 6 days time but when window type welding is resorted only two days be sufficient to put back the unit on bars. One can imagine the cost effectiveness of this technique.

TEST RESULTS & ANALYSIS

On experimental basis several test pieces have been welded using this technique with different qualified welders. The tensile test specimens have been cut at most vulnerable places and then tested. The results are shown in **Table I**.

In all the tests the values of Tensile strength is found to be not less than that of the parent metal (which is also given in Table I). **Table II** shows the results of normal butt joint of the same size and material.

However the ductility is less in tricorner points (See Sl. No. 1 to 4 in Table I) which is due to the extended heat affected zones. Better ductility can be obtained by slight pre-heating and adopting interpass cooling during welding.

CONCLUSION

The above narrated window welding technique is not a qualified procedure and may also not be permanent solution. The defective tube/pipe where such technique has been adopted will have to be eventually replaced at a convenient time such as next major overhaul/annual maintenance.

ACKNOWLEDGEMENT

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