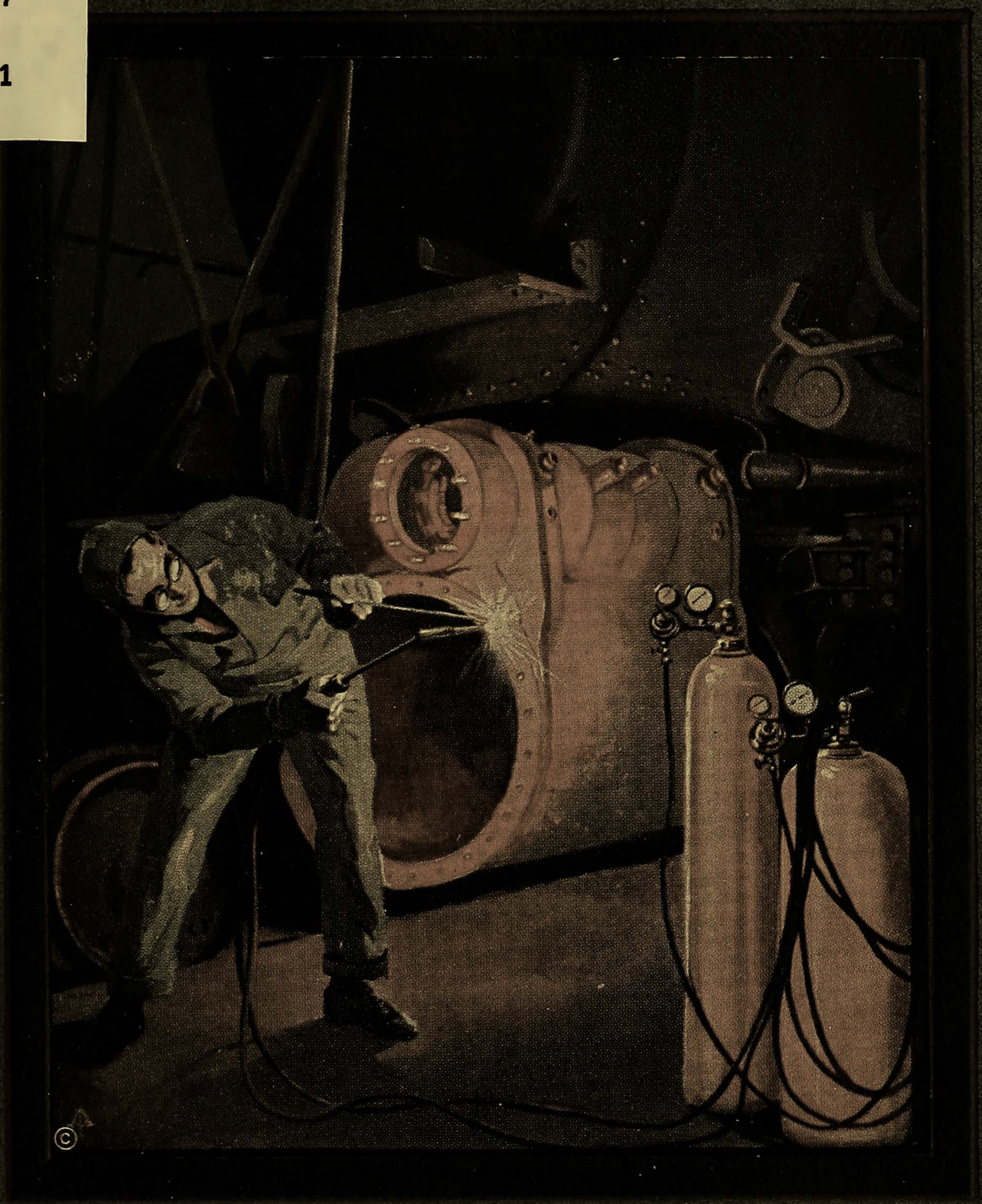


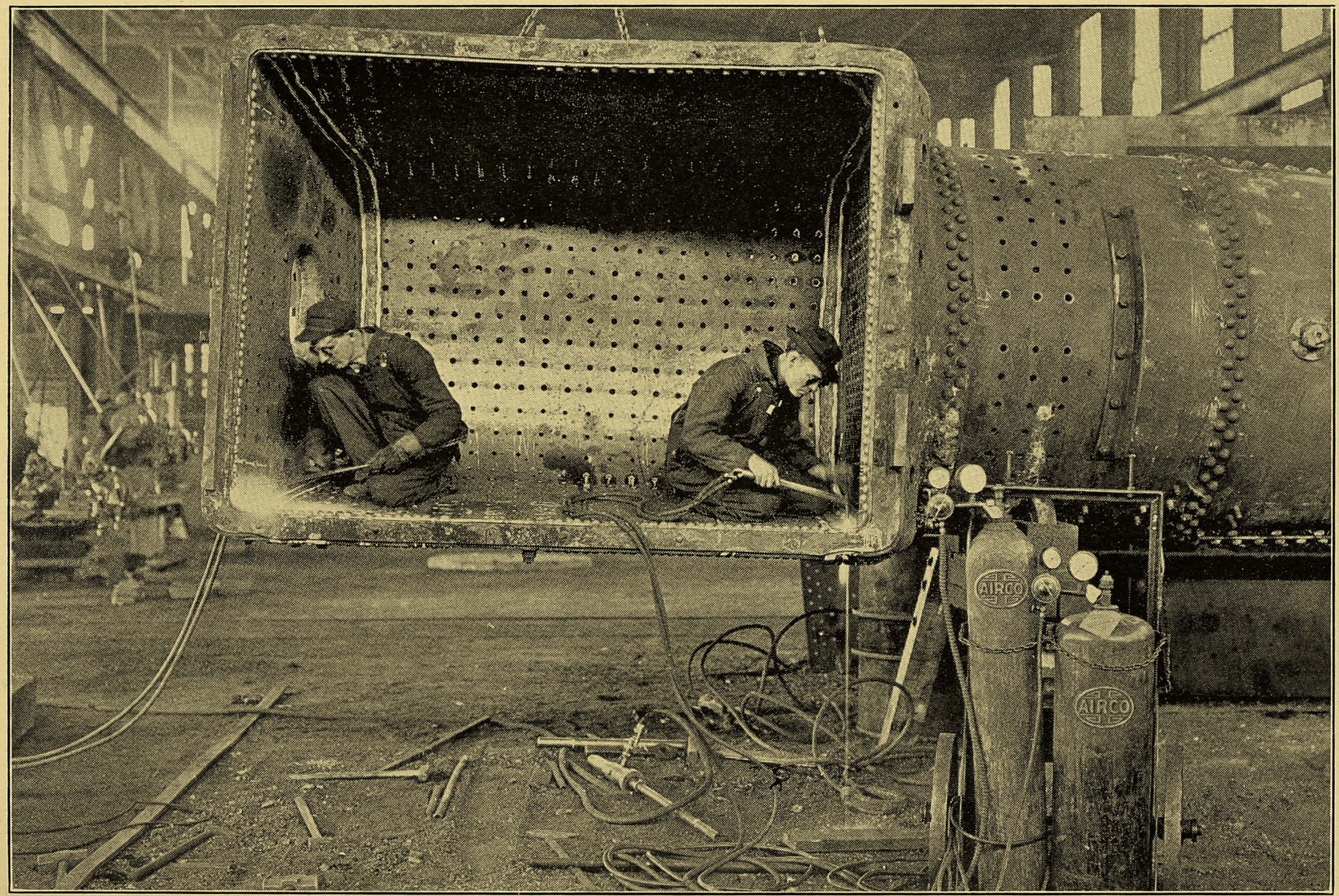
Airco Welding
Locomotive Fireboxes

BOOKLET NUMBER FOUR

AIRCO WELDING *of* LOCOMOTIVE FIREBOXES

AIR REDUCTION SALES COMPANY
NEW YORK

PRICE ONE DOLLAR



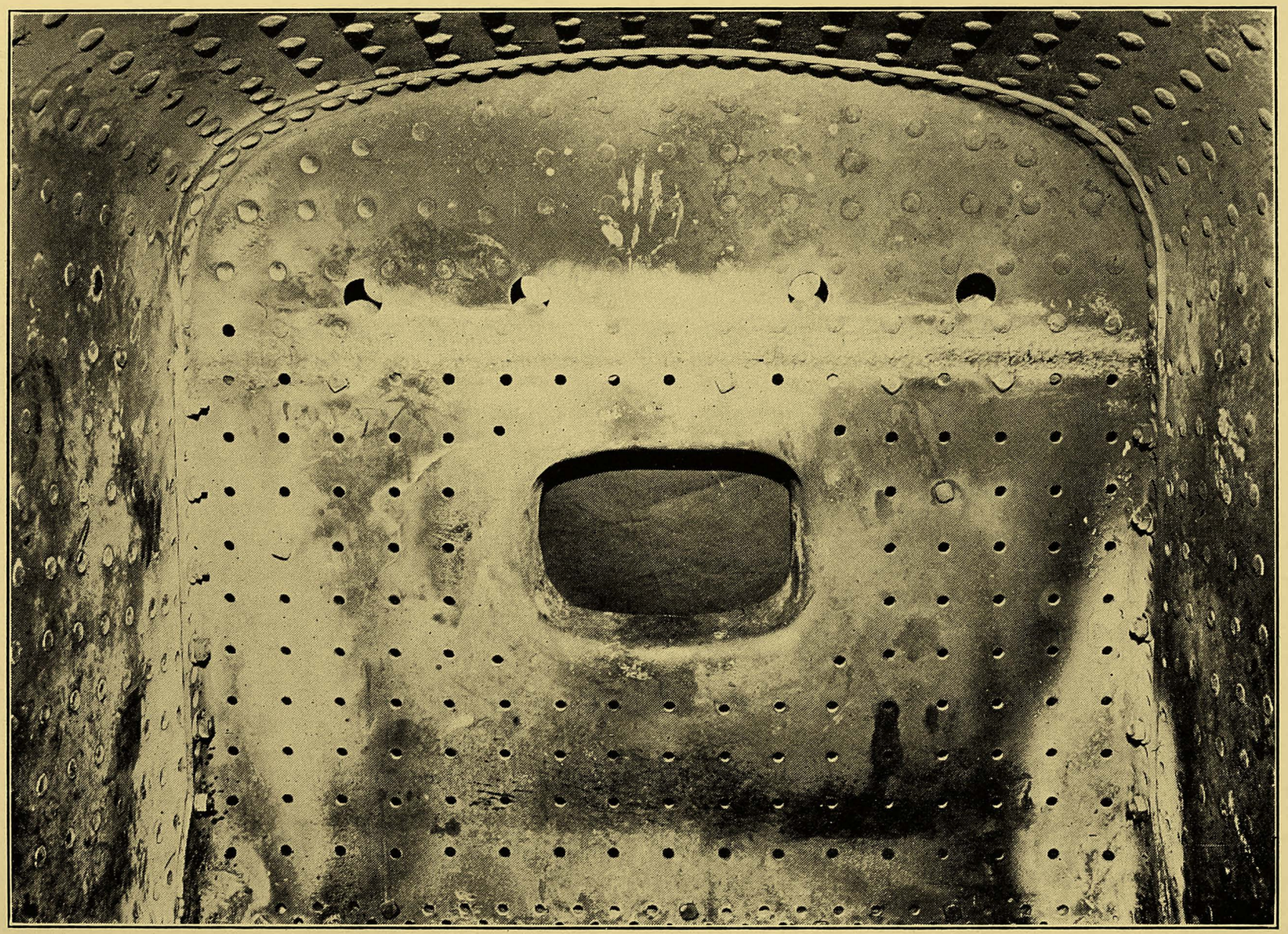
Airco Welding of a Locomotive Firebox at Seaboard Air Line Shops, Portsmouth, Va.

FOREWORD

THIS booklet treats of one of the most valuable applications of the oxyacetylene process to railroad shop repairs—that of the *welding* of locomotive fireboxes. The abnormal heat strains to which such fireboxes are subjected are the cause of frequent leaks at the rivetted joints, and the consequent laying-up of the locomotive for repairs becomes a matter of first importance to the motive power department. The Airco process has been producing most gratifying results in the correction of these weaknesses, and it is now a matter of record in many railroad shops that the former lengthy periods for repairs of locomotives have been greatly reduced by the substitution of the oxyacetylene weld for the rivetted seam as well as for other firebox repairs.

The efficiency of such work is shown by the increased strength of joint, its tightness, its added expansive characteristics, and the facility and speed with which the repairs may be made. The cost of the work is less than that of rivetting, depending on the skill of the welder.

The methods of welding described in the booklet have been devised with the assistance of Messrs. George L. Walker, and R. T. Peabody of the Airco Engineering Service Department.



Airco Welded Firebox Door Sheet

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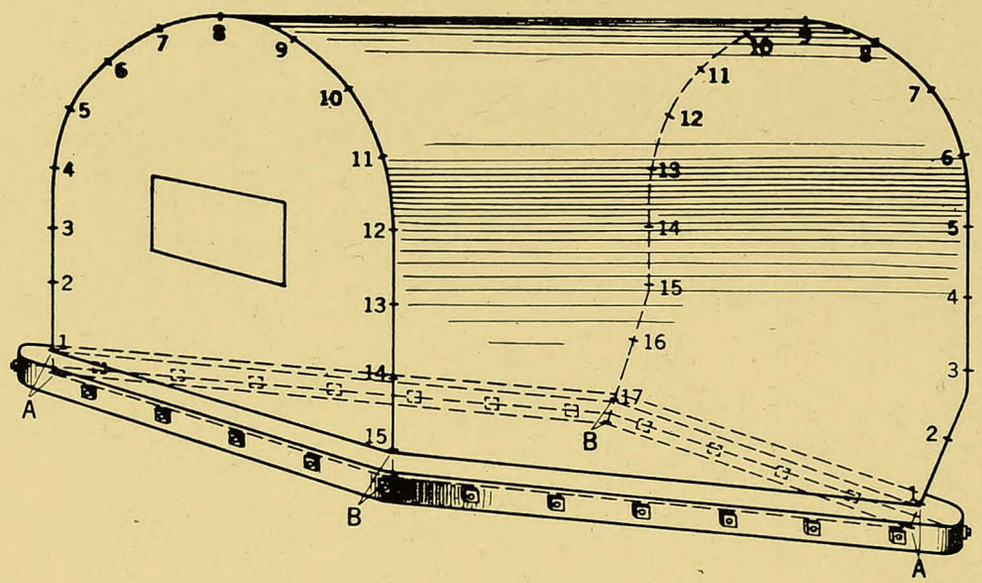


Fig. 1

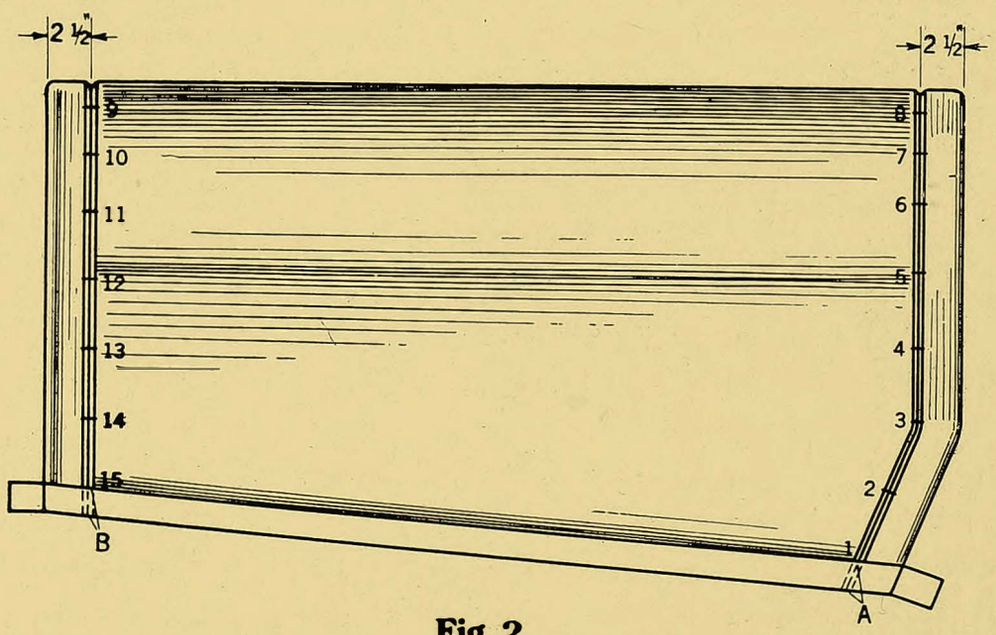


Fig. 2

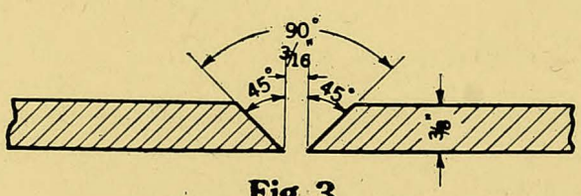


Fig. 3

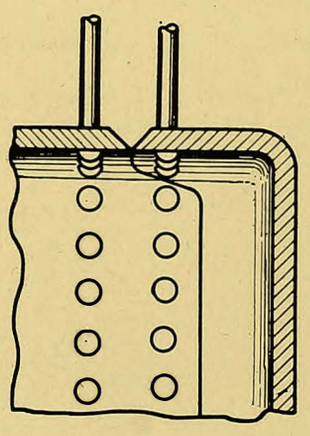


Fig. 4

AIRCO WELDING OF FULL-WELDED FIREBOXES

A FULL-WELDED FIREBOX is one which has all of its joints welded instead of rivetted. The welded joint is stronger, more economical, will not leak, and has more durable expansion and contraction properties than the rivetted seam. The welding should be performed as follows:

OPERATION 1. Place the firebox upon the mudring A B A B, Figure 1, and bolt it fast.

OPERATION 2. Prepare to weld the outside, or water side, of say the flanged flue sheet to the firebox, as shown at Figure 2, by cutting a bevel of about 45 degrees all the way along its edge from mudring to mudring. Now bevel the matched edge of the firebox in like manner. The beveling should be done with an Airco cutting torch set with a No. 1 tip. The best practice is to make the flange of the flue and door sheets so as to include a row of radial staybolts. See Figure 4.

OPERATION 3. Set the firebox so that the weld joint remains open at its bottom, about 3/16", Figure 3, to allow for expansion, to clinch the welding metal and insure a perfect weld through the vee. Start the joint by welding it for about an inch just above the mudring, say at 1, Figure 1, using 3/16" or ¼" Airco welding rod, and an Airco welding torch with a No. 8 tip. From a point about 10" up from the mudring weld downward from 2 to 1. Then, continuing the method, weld from 3 to 2, from 4 to 3 and so on. This practice will prevent the spreading of the joint from unequal expansion. Add enough welding rod to raise the surface of the weld about ⅛" above the original metal. If practicable, a second welder should follow the outside welder and smooth-flow the joint on the inside while it is red hot. This will be certain to make the joint tight.

OPERATION 4. Working from the inside, weld the firebox to the mudring at the corners A and B, Figure 1.

OPERATION 5. Weld on the door sheet the same as the flue sheet.

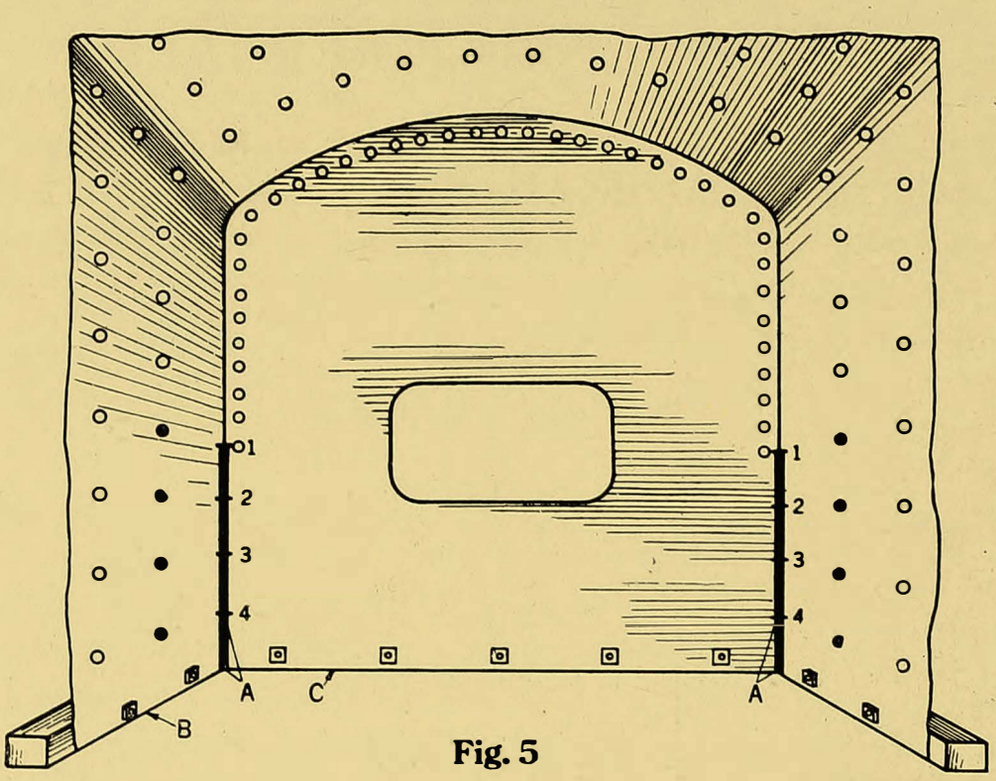


Fig. 5

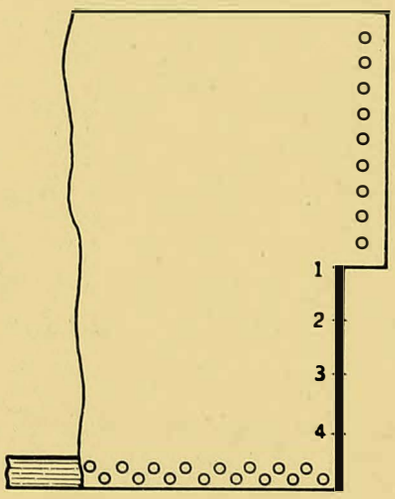


Fig. 6

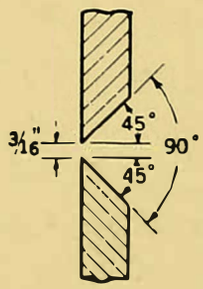


Fig. 8

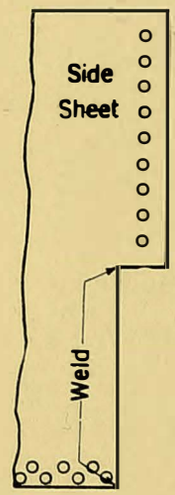


Fig. 9

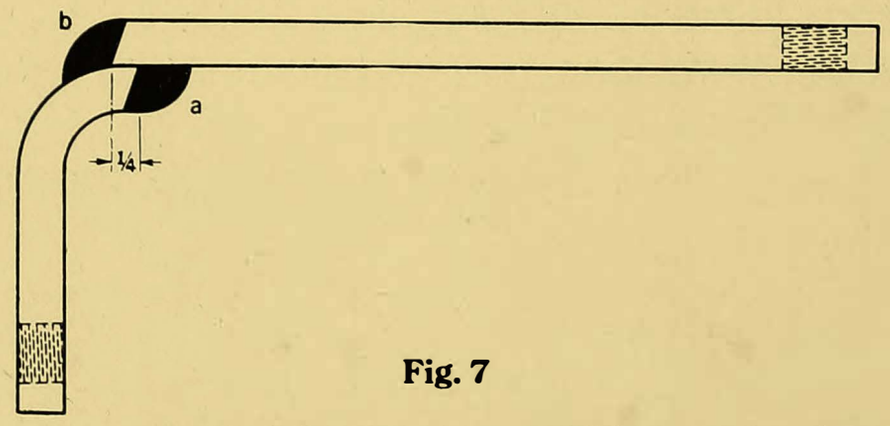


Fig. 7

AIRCO WELDING OF SEMI-WELDED FIREBOXES

A SEMI-WELDED FIREBOX is one in which welding is substituted for rivetting along the lower vertical joints of the flue and door sheets with the side sheets. This practice is followed where it is desired to avoid rivetted joints in the fire zone, and some shops also weld the bottom horizontal joint of the firebox and the mudring for about 12 inches both ways from each corner. The chief advantage of this welding is the elimination of leakage. The work should be done as follows:

OPERATION 1. Bolt the firebox to the mudring, and rivet the flue and door sheets to the side sheets down to within about 36″ from the mudring. Omit the rivet holes along the corner joints to be welded from 1 to A, Figure 5. Also leave out temporarily the rivets next to the top of the joint at 1.

OPERATION 2. Prepare the side sheets as shown in Figures 6 and 9, by cutting into the flange about ⅝″ so that it can be set down flush. Butt the joints and bevel both edges at about 45° on the outside of the firebox, using an Airco cutting torch with a No. 1 tip. Leave a 3/16″ opening at the bottom of the vee. Some welders have used a lap weld like that of Figure 7, but it does not make a strong, tight joint. The butt weld as shown in Figure 8 is the best for this work.

OPERATION 3. Tack-weld the flange at 1, Figure 5, using an Airco welding torch with a No. 8 tip, and 3/16″ or ¼″ Airco welding rod.

OPERATION 4. Starting on the outside at about 10″ below 1, weld from 2 to 1. Then from 3 to 2 and 4 to 3. Complete the joint by welding on the inside from A to 4. Weld the other three corners in like manner.

OPERATION 5. If a second welder is available, the weld should be flowed on the inside while being made.

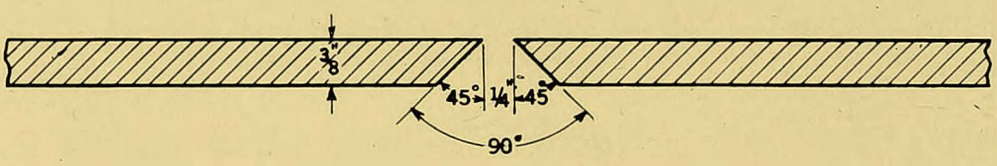
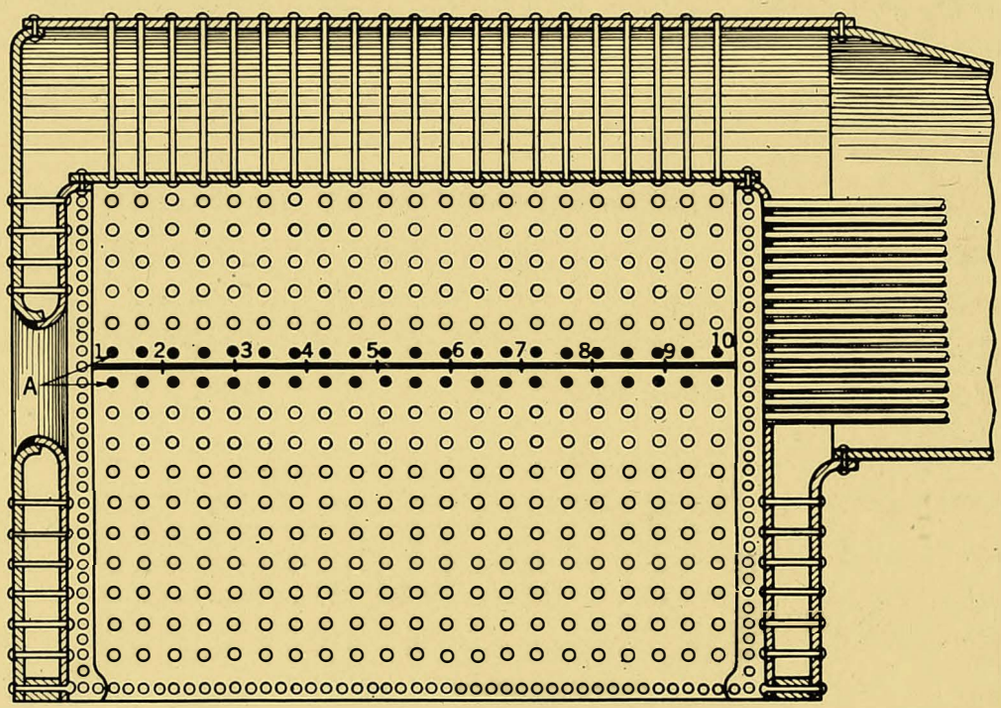


Fig. 10



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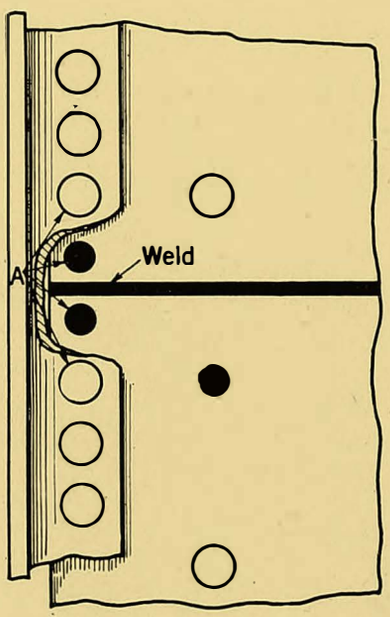


Fig. 12

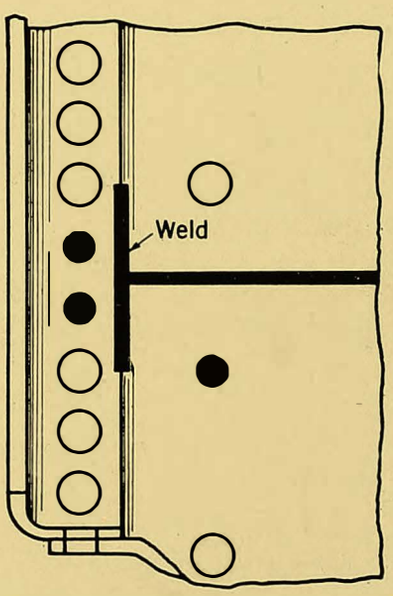


Fig. 13

AIRCO WELDING OF SEMI-WELDED HALF SIDE SHEETS

SEMI-WELDED HALF SIDE SHEETS are those which are welded along the horizontal joints to the crown sheets, and are rivetted to the mudring at the bottom and to the door and flue sheets at the ends.

The welding of the long seams should proceed as follows when the door and flue sheets have not yet been set:

OPERATION 1. Bevel the edge of the half side sheets and the corresponding edge of the crown sheet, as shown in Figure 10. Use an Airco cutting torch with a No. 1 tip.

OPERATION 2. Screw in the second row of staybolts, and bolt the sheet to the mudring before starting to weld. To avoid delay, however, all of the staybolts except the rows adjacent to the weld, may be screwed in and set, and the side sheets rivetted to the mudring before the welding is done.

OPERATION 3. Weld about 2″ of the joint at 1, Figure 11. Then, beginning at 2, about 10″ from 1, weld back to 1, from 3 to 2 and so on to the end of the joint. Use an Airco welding torch with a No. 8 tip, and 3/16″ or ¼″ Airco welding rod.

OPERATION 4. The door and flue sheets should now be rivetted in.

Note a: If the side sheets are to be put in after the door and flue sheets have been set, the flanges of the door and flue sheet should be heated and raised, as shown in Figure 12, in order to allow the part of the joint under the flange to be bevelled.

b: When new door and flue sheets are put on, the adjacent rivets A, Figure 12, should be left out until the welding is done.

c: Figure 13 shows the practice of welding the end of the long seam when it is desired to change an old rivetted joint to a welded one. The vertical weld should be carried to the second rivet each way.

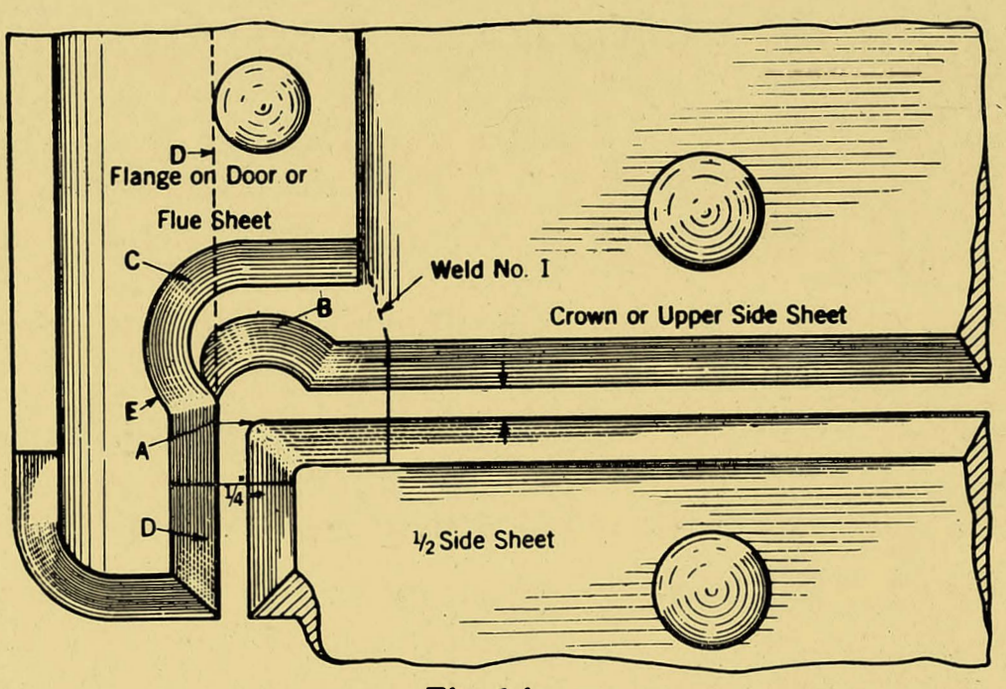


Fig. 14

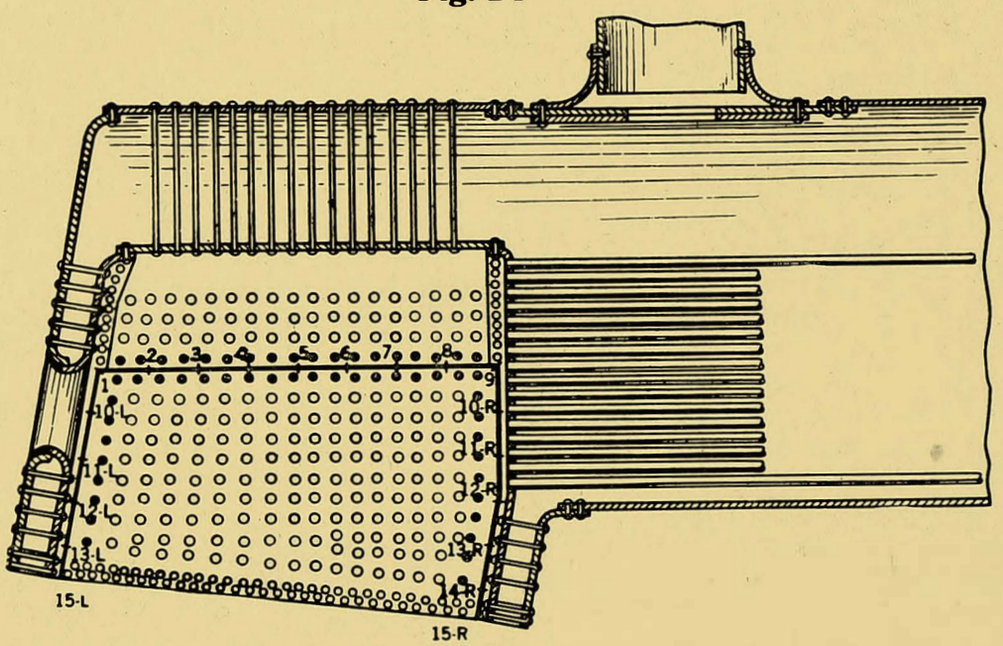


Fig. 15

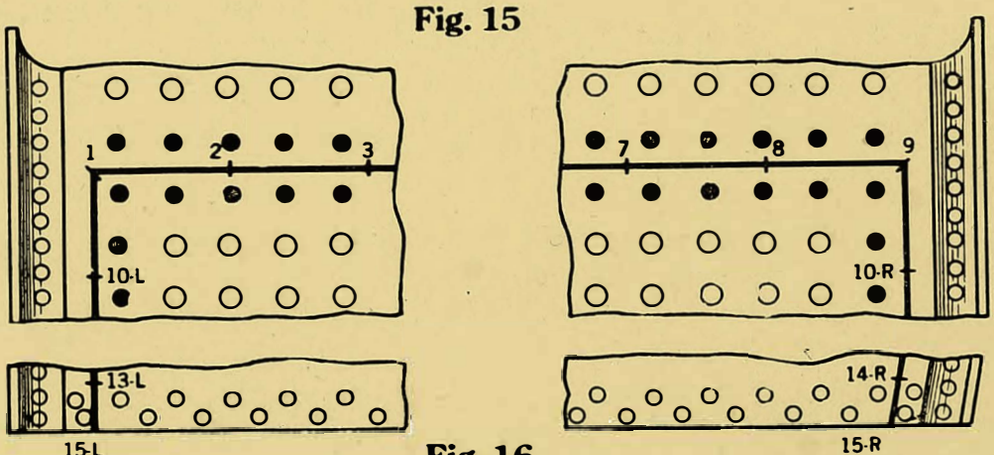


Fig. 16

AIRCO WELDING OF FULL-WELDED HALF SIDE SHEET

A FULL-WELDED HALF SIDE SHEET has no rivetted joints at the top or sides, all three edges being welded. The work should be performed as follows:

OPERATION 1. Cut out the flange of the door or flue sheet next to the joint of the crown and half side sheets, as shown at A and D, Figure 14. Then bevel the flange, including rivet hole C, and set it flush with the half side sheet. Use an Airco cutting torch with a No. 1 tip.

OPERATION 2. Bevel the crown sheet, including the rivet hole B.

OPERATION 3. Set the side sheet so that a ¼" space is left at its top and sides, and then bevel those edges. If this sheet is not rivetted to the mudring, bolt it fast.

OPERATION 4. Screw in and set all staybolts except those next to the welds.

OPERATION 5. Now weld the horizontal seam for about 1" at 1, Figure 15. Then from point 2, about 10" from 1, weld back to 1, and from 3 to 2, continuing until the joint is completed. Use an Airco welding torch with a No. 8 tip and 3/16" or ¼" Airco welding rod.

OPERATION 6. Start about 10" down the vertical joint of, say, the door sheet at 10L and weld up to 1, Figure 15. Then from 10" below 10L at 11L weld back to 10L, from 12L to 11L, and so on to within a few inches of the mudring.

OPERATION 7. Weld the flue sheet joint the same way as the door sheet, from 10R to 9, Figure 15, from 11R to 10R down nearly to the mudring. Weld the bottom of the joints to the mudring at 15L and 15R last.

Note: When the flanged joints of the door and flue sheets are in good condition, but the rest of the plate needs renewing, a good job may be performed by setting in the half side sheet, as shown in Figure 16. It should be tacked at 1. Then weld from 2 to 1, 3 to 2, and so on, following the practice described above.

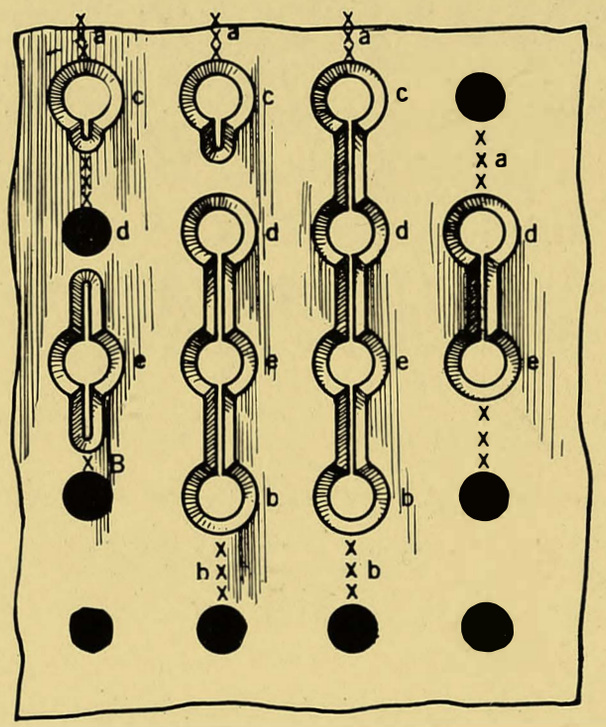


Fig. 17

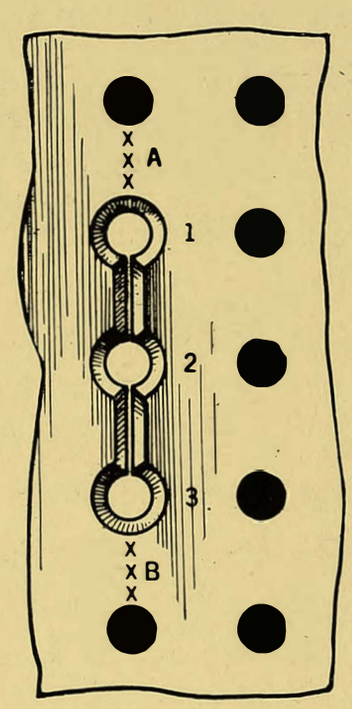


Fig. 18

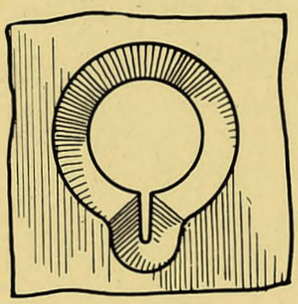


Fig. 19

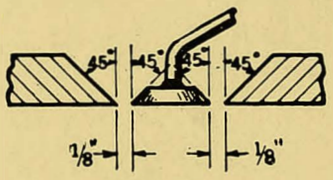


Fig. 20

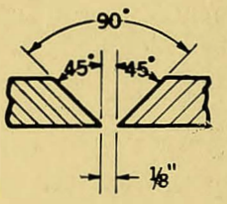


Fig. 21

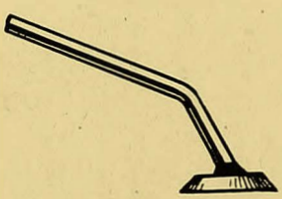


Fig. 22

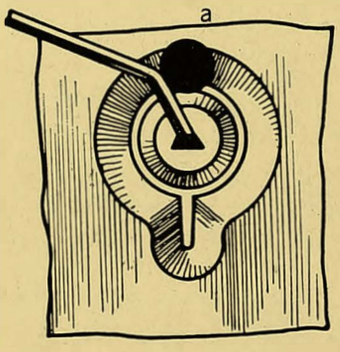


Fig. 23

Fig. 24

AIRCO WELDING OF CRACKS IN SIDE SHEETS

CRACKS IN SIDE SHEETS between staybolt holes are not easily welded, because of the difficulty of making proper allowances for expansion of the metal. In fact, if a side sheet has many cracks like those shown in Figure 17, it would be better to put in a new sheet rather than resort to welding. Much welding of side sheets is being done, however, and the following method may be successfully used when the staybolt holes are to be closed:

OPERATION 1. To weld a crack like that of Figure 18, bevel the sides of the hole and crack, as shown in Figure 19, using an Airco cutting torch set with a No. 1 tip.

OPERATION 2. Prepare for each hole a soft steel disc about 3/16" thick and of, say, ¼" smaller diameter than the hole. Bevel the edges of the disc, as shown in Figures 20 and 21. Melt a piece of welding rod to the disc, to serve as a holder, hot-bending the rod, as shown in Figure 22.

OPERATION 3. Set a No. 7 tip in the Airco welding torch and use 3/16" or ¼" Airco welding rod. Place the disc in the hole and melt down the upper edge *a,* Figure 23, to tack the disc in position. Preheat the metal between the two holes at *xxxA,* Figure 18, and keep it red hot. Melt off the rod and complete the welding of the disc into the hole. Now allow the hot section *xxxA* to cool with the weld at 1. This provides for uniform shrinkage.

OPERATION 4. Weld hole 2, Figure 18, in the same way, and then weld the crack from 2 to 1. Preheat the section *xxxB* when welding the last hole of that line. The weld should be reinforced, as shown in Figure 24.

Note: In some cases where it is not practicable to replace a badly cracked side sheet by a new one, or to put on a patch, the welding may be done as follows:

OPERATION 5. Referring to Figure 17, preheat the top of the left row of holes at *xxxa.* Then weld in hole *c* of this row. Preheat the area *xxx* down to *d,* as well as that at *xB.* Weld the crack at the bottom of the hole *e* of the first row, then the staybolt hole *e,* the crack at the top of this hole, and finally weld the joint around the head of the staybolt *d,* which is assumed to be in good condition. Reheat the area *xxxa* to relieve the shrinkage strains, and let the job cool down before proceeding with the other rows.

OPERATION 6. Weld the last row on the right next by preheating at *xxxa,* filling the holes at *d* and *e,* and then the crack between them. Reheat the lower part of the row at *xxx,* and allow the whole job to cool uniformly.

OPERATION 7. Now weld the second row from the left in the usual way, and allow the sheet to cool again.

OPERATION 8. Weld the third row from the left last, which is done in this case because it is the longest continuous crack.

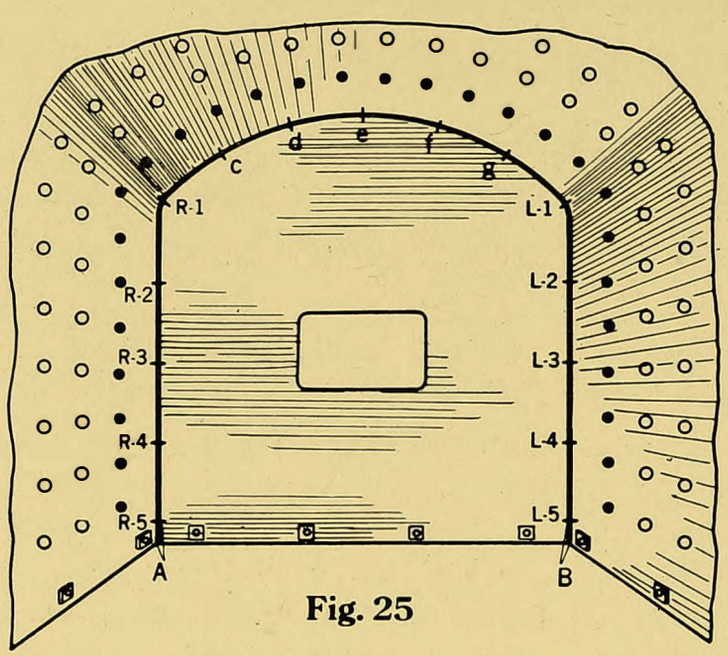


Fig. 25

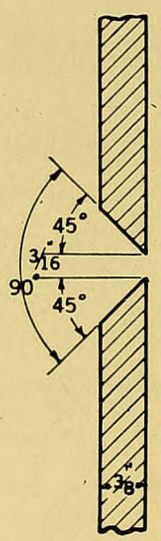


Fig. 26

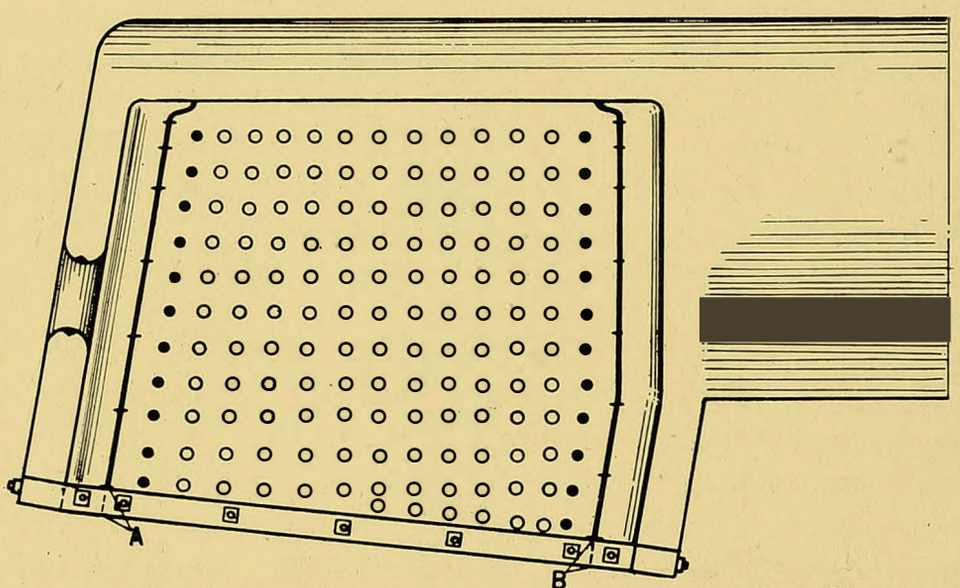


Fig. 27

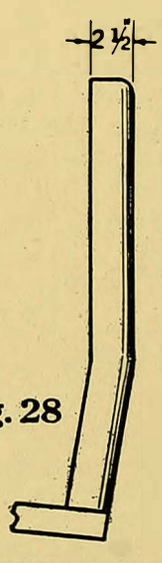


Fig. 28

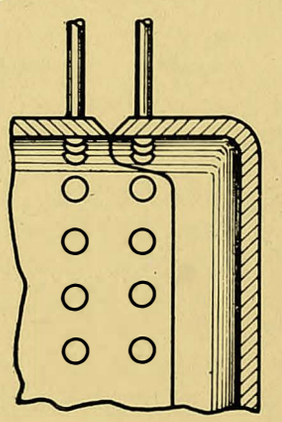


Fig. 29

AIRCO WELDING OF FULL-WELDED DOOR AND FLUE SHEETS

THE method to be followed in preparing to weld door and flue sheets is similar to that described for full-welded fireboxes, as shown in Figure 25. In the full-welding of door and flue sheets, however, the work is done on the inside at all the joints except the one with the crown sheet. That part of the welding is to be done on the water side, unless the radial staybolts are in the door sheet, when the welding must be completed from the inside.

OPERATION 1. Fit and bolt the door or flue sheet to the mudring.

OPERATION 2. Bevel both edges of the vertical joints on the inside, leaving a 3/16″ opening at the bottom of the vee. See Figure 26. Use an Airco cutting torch with a No. 1 tip. Now bevel the joint with the crown sheet on the outside. The door and flue sheets should be flanged, as shown in Figures 27, 28 and 29.

OPERATION 3. Tack weld the joint for an inch at R1, Figure 25. Then drop down about 10″ and weld from R2 up to R1, from R3 to R2, so continuing to R5 and welding last at A on the mudring. Use an Airco welding torch with a No. 8 tip, and 3/16″ or ¼″ Airco welding rod.

OPERATION 4. Assuming that the radial staybolts are not in the door sheet, both the door sheet and the flue sheet should be welded on the water side to the crown sheet, starting at c, about 10″ from R1, Figure 25, and welding back to R1, from *d* to *c*, *e* to *d*, on over to L1 and then welding on the inside of the firebox from L2 up to L1, thus welding along until the sheet is finally completed at B on the mudring.

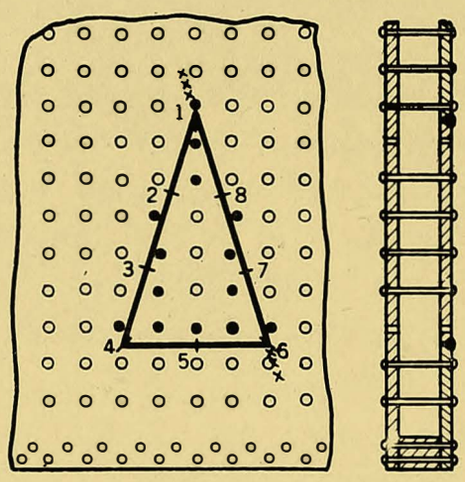


Fig. 30

Cross-Section of Fig. 30

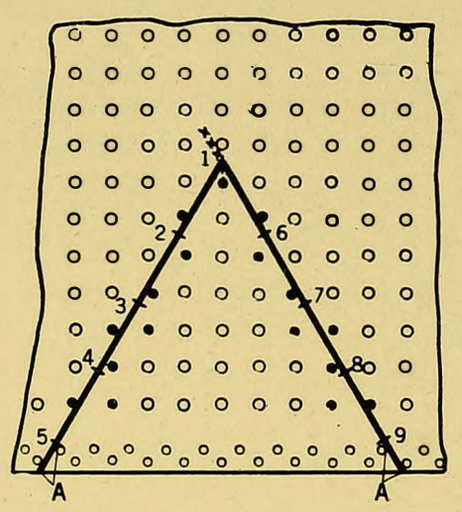


Fig. 31

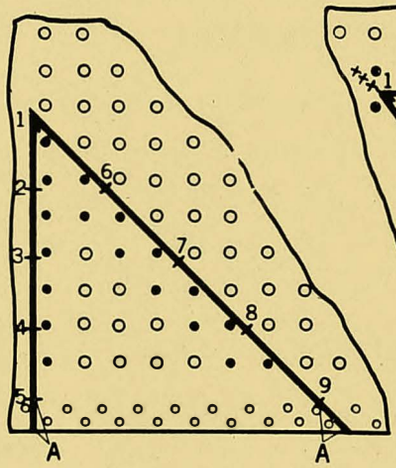


Fig. 32

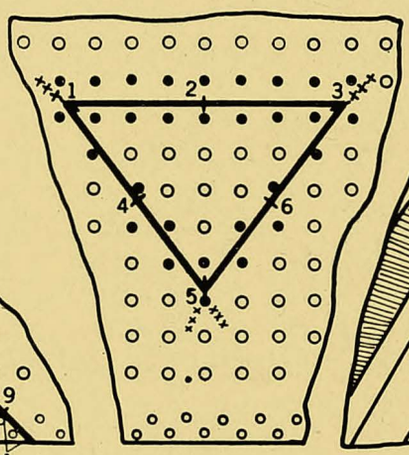


Fig. 33

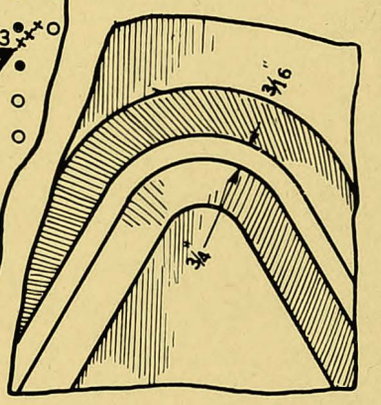


Fig. 34

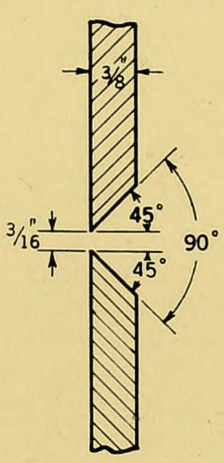


Fig. 35

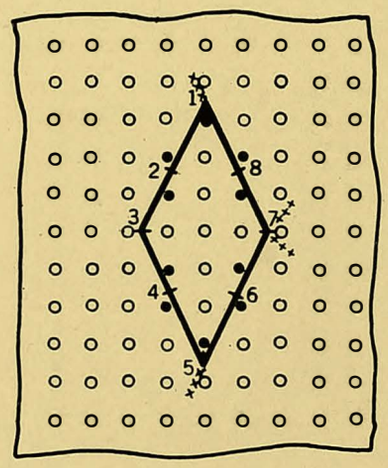


Fig. 36

AIRCO WELDING OF PATCHES ON FIREBOX SHEETS

PATCHES FOR FIREBOX SHEETS should be triangular in shape whenever possible, the reason being that the sides of the triangular patch do not run parallel with the rows of holes, and weaken the joint, as would a rectangular patch.

WELDING ON PATCH OF FIGURE 30:

OPERATION 1. Bevel the edges with an Airco cutting torch and a No. 1 tip. Tack weld at 1. Then, beginning about 10″ from 1 at 2, weld up to 1, from 3 to 2, and from 4 to 3. Use an Airco welding torch with a No. 8 tip and 3/16″ or ¼″ Airco welding rod.

OPERATION 2. Let the joint become cold. Then weld from 5 to 4, and 6 to 5.

OPERATION 3. Preheat as shown at *xxx1,* to allow for expansion. Weld from 8 to 1, 7 to 8, and 6 to 7, and complete the job by preheating at *xxx6*.

WELDING ON PATCHES OF FIGURES 31 AND 32:

OPERATION 4. Bolt the plate to the mudring. After bevelling the edges, tack weld at 1. Then weld from 2 to 1, 3 to 2 on down to the mudring at 5. *A* should be done last.

OPERATION 5. When the weld is cold, preheat at *xxx1,* and weld from 6 to 1, 7 to 6 on down to the mudring at *A*.

WELDING ON PATCH OF FIGURE 33:

OPERATION 6. Preheat along *xxx1*. Then tack at 1 and weld over about 10″ from 2 to 1 and 3 to 2. Let the plate get cold.

OPERATION 7. Preheat again at *xxx1* and weld from 4 to 1. Then preheat at *xxx5* and weld from 5 to 4. Let the sheet get cold.

OPERATION 8. Preheat at *xxx3* and weld from 6 to 3. Again preheat at *xxx5* and weld from 5 to 6.

Note: Figure 34 shows the proper way to round the corners of the patches, using a radius of about ¾″. In preparing all of the joints, use a bevel of about 45° and leave the vee open about 3/16″ at the bottom, as shown in Figure 35.

In using the diamond patch of Figure 36, the welding should be done in the same way as that described for the triangular patches. Expansion must be provided for by the proper preheating and reheating at the ends of the line of weld.

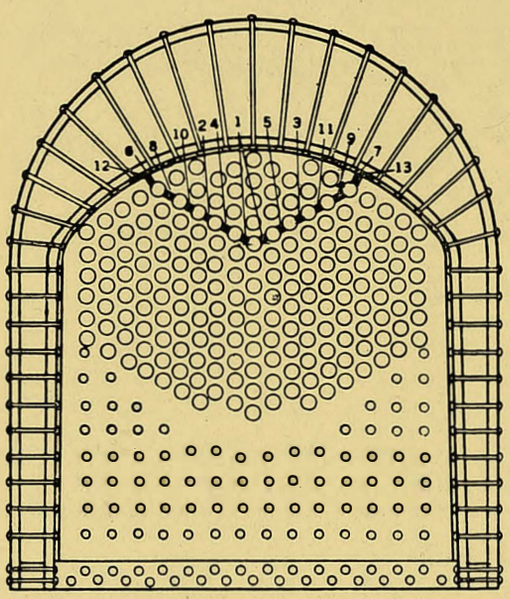


Fig. 37

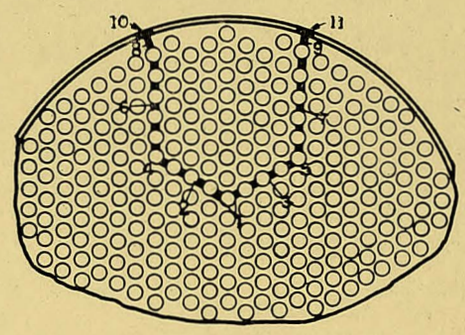


Fig. 38

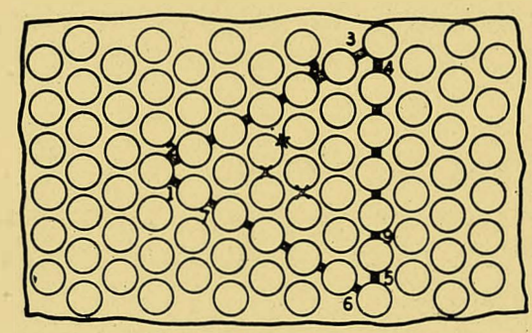


Fig. 39

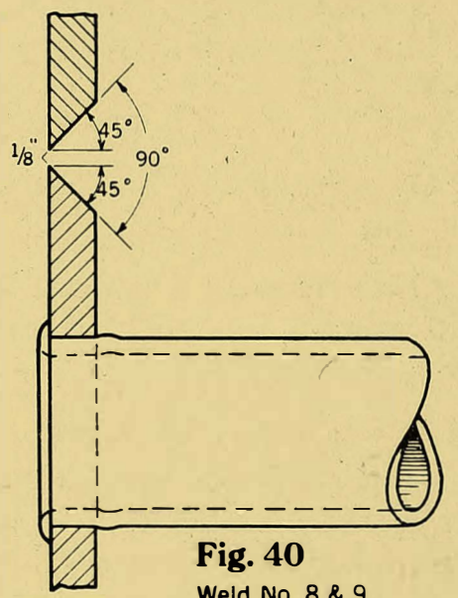


Fig. 40

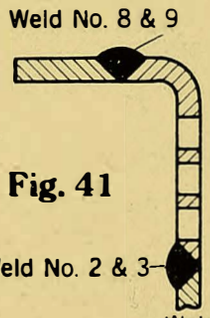


Fig. 41

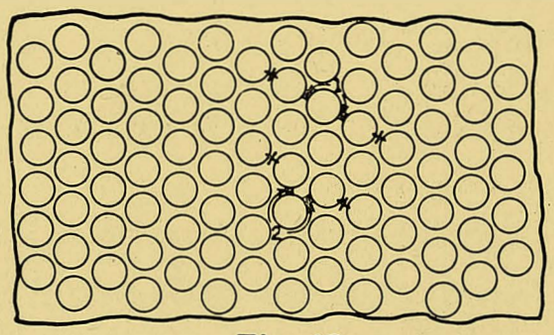


Fig. 42

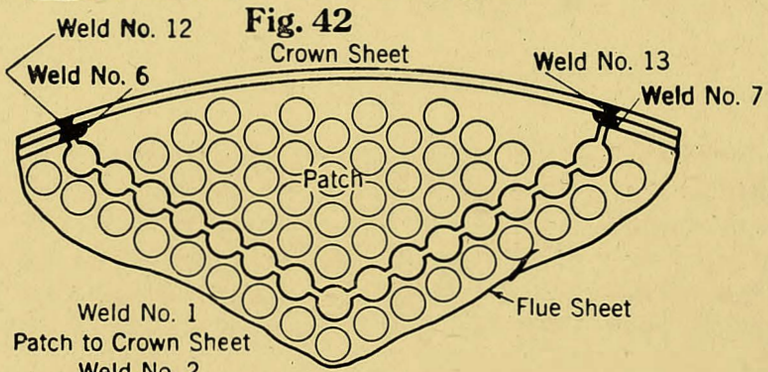


Fig. 43

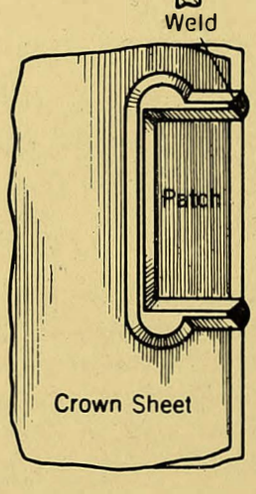


Fig. 44

AIRCO WELDING OF PATCHES ON FLUE SHEETS

THE TRIANGULAR SHAPED PATCH should be used for flue sheets wherever practicable. The method of applying the patches may be described as follows, the welding being done on the water side of the firebox:

WELDING ON PATCH OF FIGURE 37:

OPERATION 1. Cut the flue sheet as shown in the drawing, using an Airco cutting torch with a No. 1 tip.

OPERATION 2. Weld the bridges at 1, Figure 37. Then weld from 2 back to 1 and from 3 to 1. Use an Airco welding torch with a No. 8 tip and 3/16" or ¼" Airco welding rod.

Operation 3. Weld the knuckle at 6 and then from 10 to 6. Then weld the knuckle at 7 and from 11 to 7.

OPERATION 4. Complete the job by welding to the flange at 12 and 13.

WELDING ON PATCH OF FIGURE 38,

This is for a deep job and requires less welding to the flange:

OPERATION 5. Prepare the sheet as described for Figure 37. Weld the bridges at 1 and from 2 to 1. Then weld from 3 to 1, 4 to 2, 5 to 3 and so on until knuckles are welded at 8 and 9.

OPERATION 6. Weld the patch to the flange at 10 and 11.

WELDING ON PATCH OF FIGURE 39:

OPERATION 7. Weld successively bridges 1, 2, 3, 4, 5 and 6. Preheat at ends of rows, and weld bridges 7, 8, 9 and so on until all are welded. All welds should be butt-jointed as shown in Figure 40.

WELDING CRACKED BRIDGES OF FIGURE 42:

OPERATION 8. Preheat bridges marked *x* at 1 and 2. Weld at these points, and reheat at x.

WELDING ON PATCHES OF FIGURES 43 AND 44:

OPERATION 9. Weld patch to crown sheet. Then weld flue sheet to patch as shown at 2 and 3 of Figure 41.

OPERATION 10. Weld flue sheet to crown sheet at 6 and 7 of Figure 43, using butt joint 8 and 9, Figure 41.

OPERATION 11. Weld to the flange at 12 and 13.

OPERATION 12. A patch may be welded to the crown sheet as shown in Figure 44.

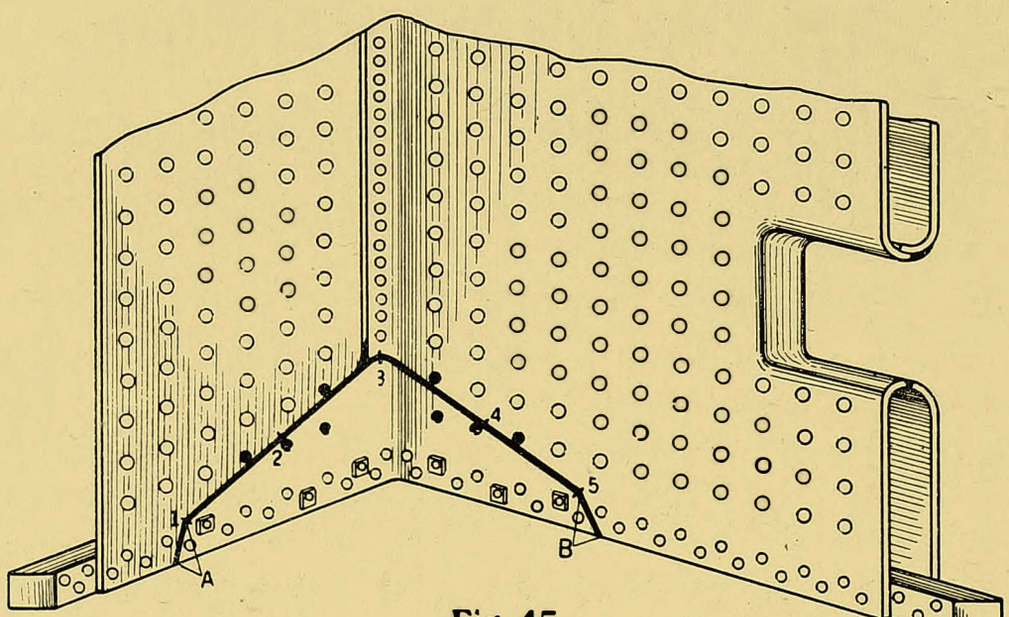


Fig. 45

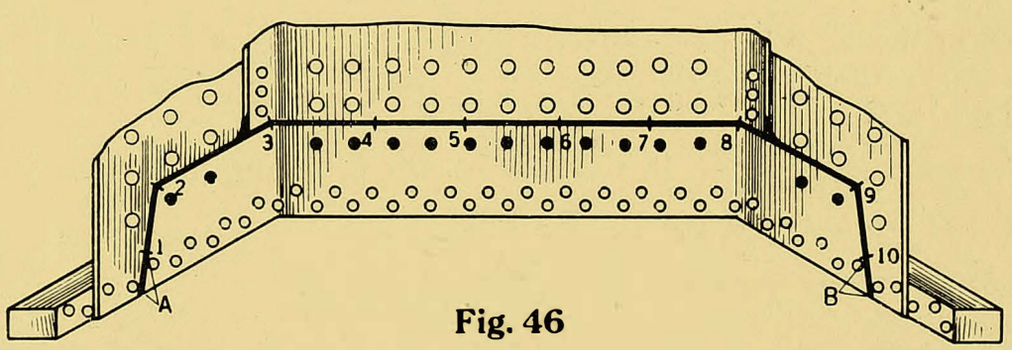


Fig. 46

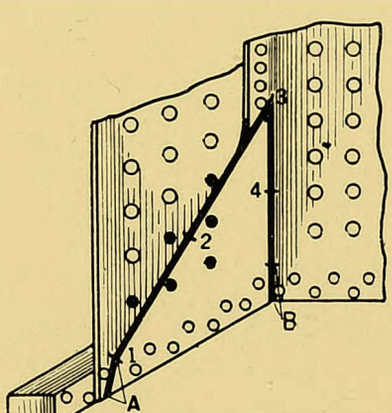


Fig. 47

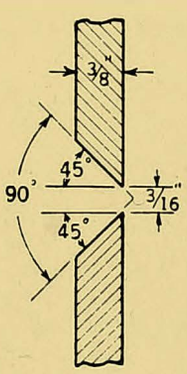


Fig. 48

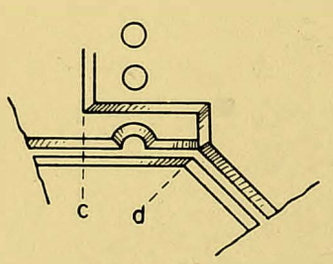


Fig. 49

AIRCO WELDING OF PATCHES ON MUDRING

THE FOLLOWING THREE methods of patching mudrings have proved to be the most serviceable. The beveling should be done with an Airco cutting torch set with a No. 1 tip and the welding with an Airco welding torch and No. 8 tip. Use 3/16″ or ¼″ Airco welding rod. Leave out rivets adjacent to the weld.

WELDING ON PATCH OF FIGURE 45:

OPERATION 1. Weld from A to 1. Then weld from 2 to 1, and from 3 to 2.

OPERATION 2. Weld patch to flange at 3, Figure 45, as shown in detail at c and d, Figure 49. Then weld from 4 to 3 and on to B.

WELDING ON PATCH OF FIGURE 46:

OPERATION 3. Weld from A to 1 on the mudring. Then back weld from 2 to 1, and allow weld to cool before welding from 3 to 2 and so along to 10. Complete the weld at B.

WELDING ON PATCH OF FIGURE 47:

OPERATION 4. Remove the rivets adjacent to the weld on the mud ring and side sheets, also remove the staybolts that would be affected by the heat. Start to weld at A. Then weld from 2 to 1, a distance of about 10″ apart, and let the metal cool. Weld from 3 to 2, also welding to flange near 3. Then from 4 to 3 and B last.

All weld joints should be beveled at 45° and opened 3/16″ at the bottom, as shown in Figure 48.

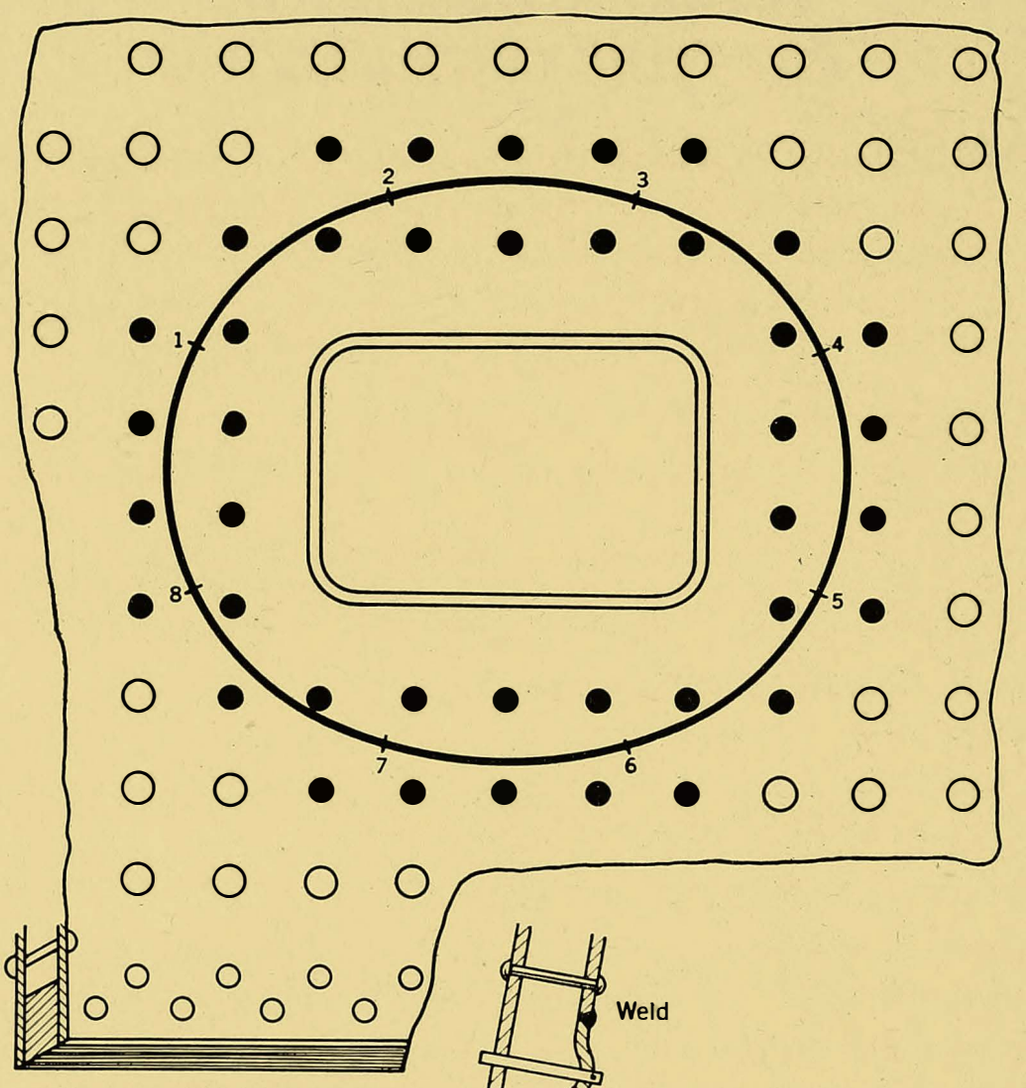


Fig. 50

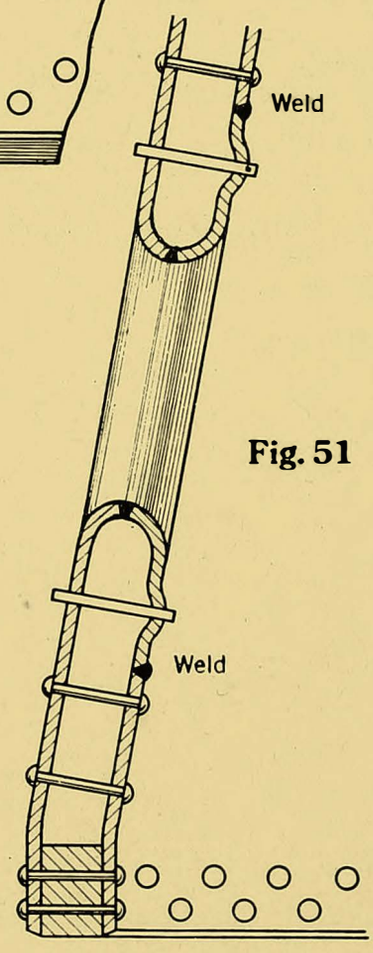


Fig. 51

AIRCO WELDING OF DOOR COLLARS

IN WELDING LOCOMOTIVE door collars the door sheet should be made large enough to include a row of staybolts within its area, as shown in Figure 50.

OPERATION 1. Bolt the patch in place by screwing in some of the staybolts.

OPERATION 2. Bevel the edges of the weld joint at 45° on the inside of the firebox, using an Airco cutting torch with a No. 1 tip.

OPERATION 3. Tack weld for about an inch at 1 and 5, Figure 50, using an Airco welding torch with a No. 8 tip, and 3/16″ or ¼″ Airco welding rod. Advance about 10″ to 2 and back weld to 1. Weld from 3 to 2, 4 to 3 and 5 to 4.

OPERATION 4. Now weld from 8 to 1, 7 to 8, 6 to 7 and 5 to 6.

Figure 51 gives an end sectional view of the welded joint of a door collar.

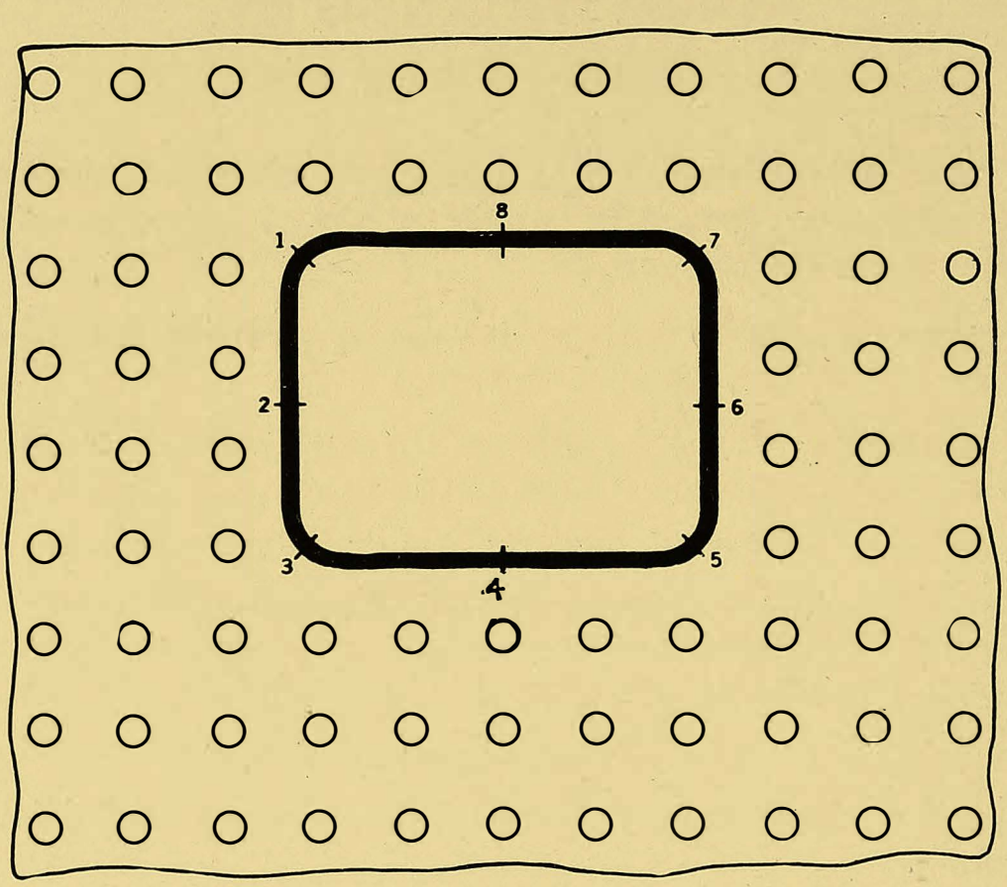
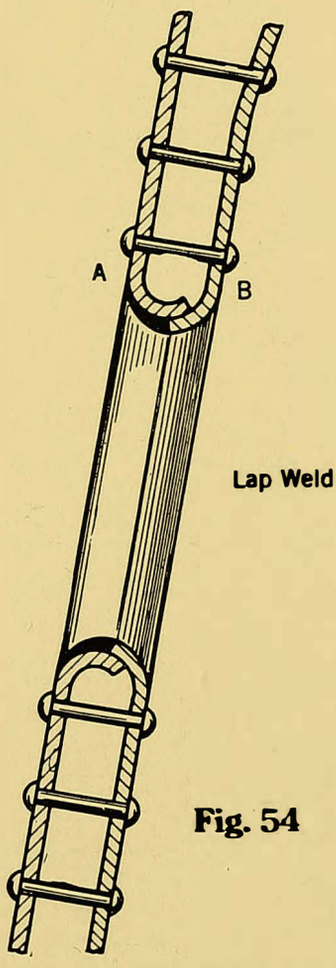
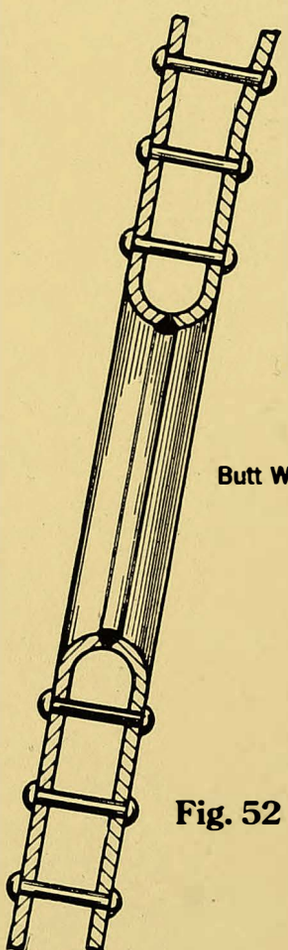


Fig. 53



Lap Weld

Fig. 54



Butt Weld

Fig. 52

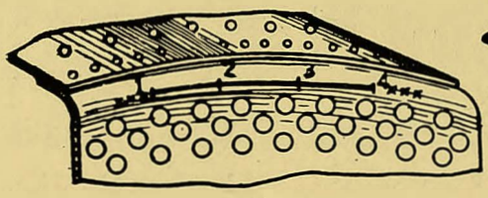
AIRCO WELDING OF DOOR HOLES

IN THE WELDING of door holes for locomotive fireboxes the butt weld of Figure 52 should be used. The work should be done as follows:

OPERATION 1. Bevel the edges to 45° with an Airco Cutting torch and a No. 1 tip, and leave bottom of weld open about 3/16 inch.

OPERATION 2. Tack at 1, Figure 53; weld from 2 to 1, 3 to 2 and so on to 5, using an Airco welding torch with a No. 8 tip, and 3/16″ or ¼″ Airco welding rod. Then weld from 8 to 1, 7 to 8, 6 to 7 and 5 to 6.

A lap weld like that of Figure 54 is sometimes used for welding door holes, but it should not be resorted to if the butt weld of Figure 52 can be made.



Flue Sheet Knuckle Patch

Fig. 55

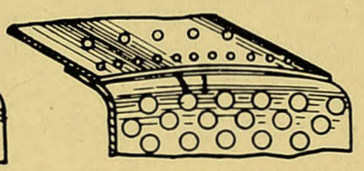


Fig. 56

Fig. 57

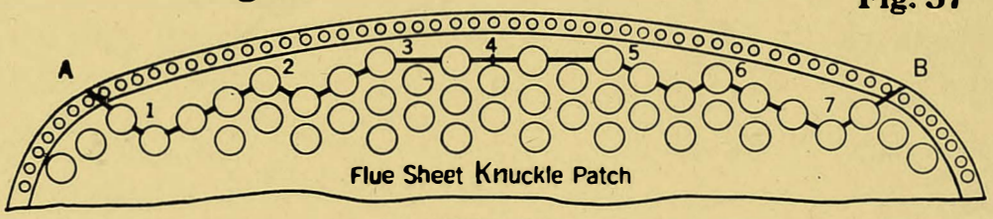


Fig. 58

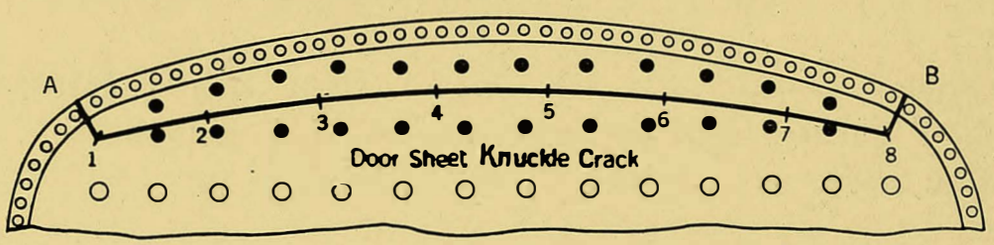


Fig. 59

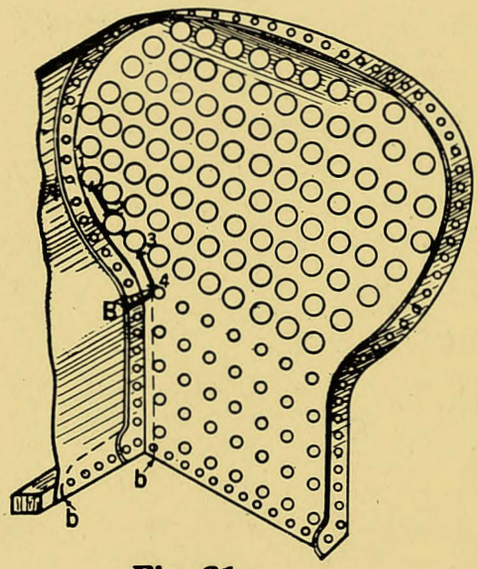
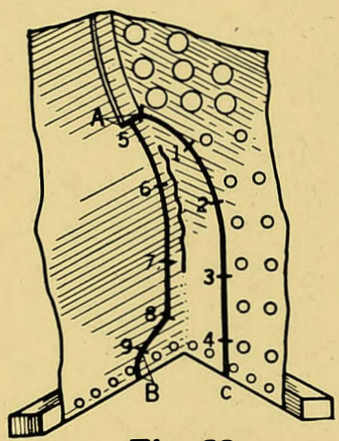


Fig. 61



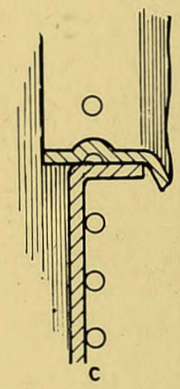


Fig. 62

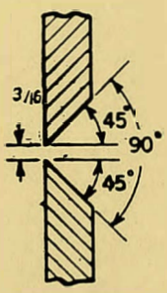


Fig. 60

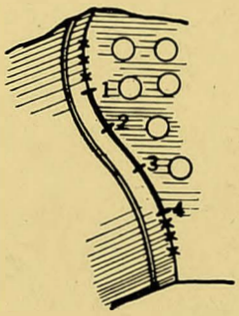


Fig. 63

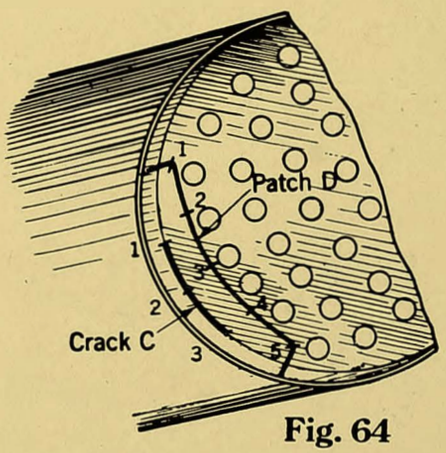


Fig. 64

AIRCO WELDING OF KNUCKLE CRACKS AND PATCHES IN DOOR AND FLUE SHEETS

IN THE FOLLOWING work the welding should be done on the water side of the firebox wherever possible. The bevels should be cut with an Airco cutting torch and a No. 1 tip, and the welding done with an Airco welding torch set with a No. 6 tip. Use Airco 3/16″ or ¼″ welding rod.

WELDING THE FLUE SHEET KNUCKLE CRACK OF FIGURE 55:

OPERATION 1. Preheat at *xxx1,* and tack weld at 1. Then start at 2 and back weld to 1, from 3 to 2, and 4 to 3. Reheat at *xxx4.*

WELDING THE FLUE SHEET KNUCKLE CRACK OF FIGURE 56:

OPERATION 2. Weld from flue sheet over knuckle to crown sheet on the water side of the firebox, and complete weld from the inside. This weld should be reinforced about ⅛″ and widened to about 2″ at the top of the vee, as shown in Figure 57.

WELDING THE FLUE SHEET KNUCKLE CRACK OF FIGURE 58:

OPERATION 3. Start to weld the flange at A, Figure 58, working on the inside of the firebox. Then weld on the water side from 1 to A, back weld from 2 to 1, 3 to 2 and so on to the flange at B.

WELDING THE DOOR SHEET KNUCKLE CRACK OF FIGURE 59:

OPERATION 4. Working from inside of firebox, weld from 1 to A, back weld from 2 to 1, 3 to 2 and on across to 8 and B. The distance between tack points of weld should be about 10″. Figure 60 gives the form of vee for the butt weld.

WELDING THE FLUE SHEET PATCH OF FIGURE 61:

OPERATION 5. Weld the flange at A. Then back weld from 2 to 1, and on to B.

WELDING THE FLUE AND SIDE SHEET PATCH OF FIGURE 62:

OPERATION 6. Cut the side sheet to outside of the rivet holes, as shown in drawing *c*. Weld the flange at A, and then back weld down to the flange at C. Now weld from 6 to 5, 7 to 6 and so on to B.

NOTE: The flue sheet weld of Figure 63 should be performed as described for Figure 55.

Crack C of Figure 64 should be welded the same as that of Figure 55, while Patch D may be welded in place by the method shown in Figure 61.

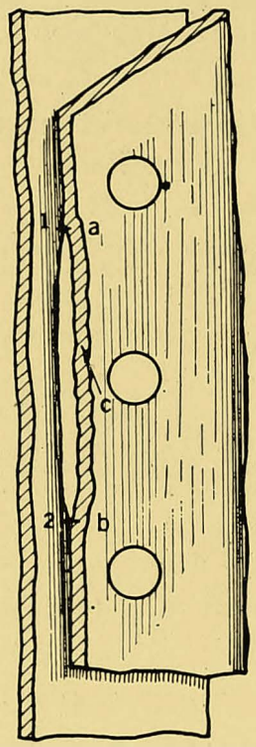


Fig. 65

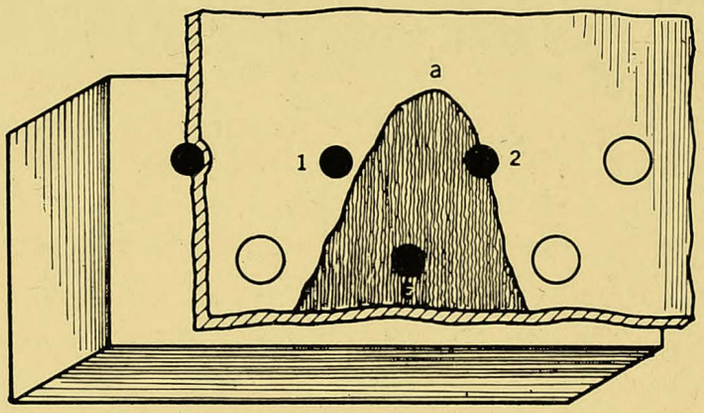


Fig. 66

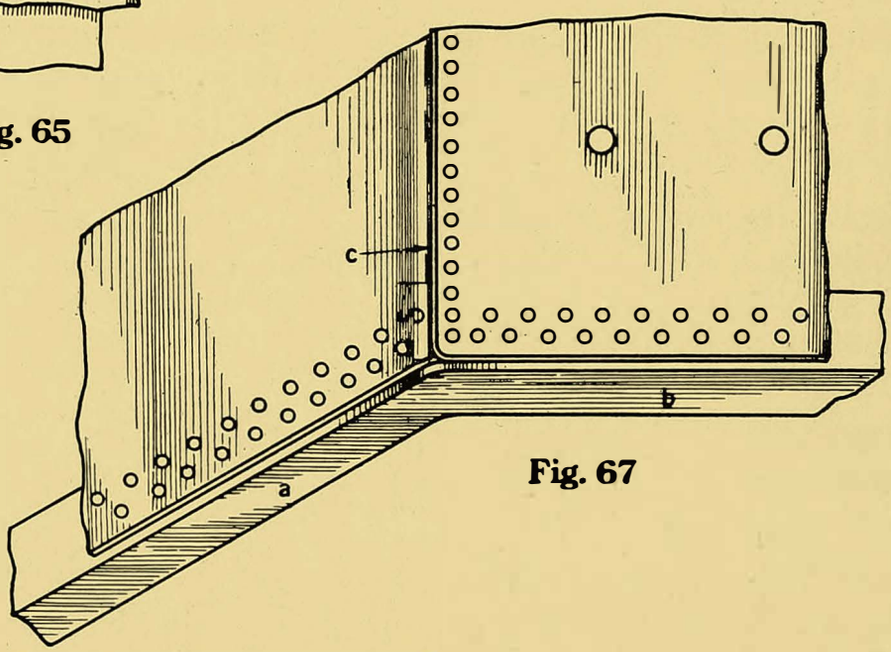


Fig. 67

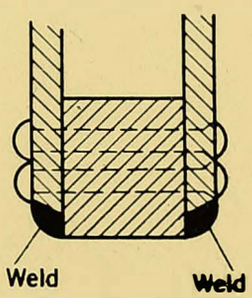


Fig. 68

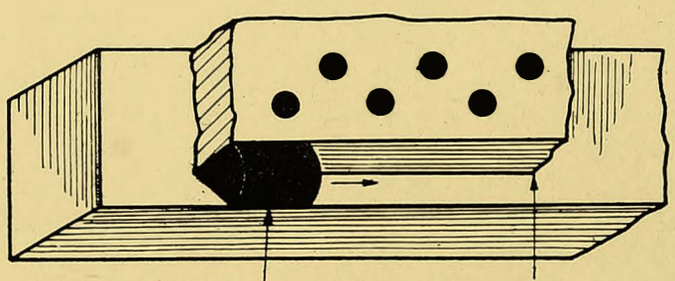


Fig. 69

AIRCO BUILDING-UP OF WORN EDGES OF FIREBOX

THE EDGES OF fireboxes become worn, and cause leaky joints, from excessive caulking, erosion from escaping steam and corrosion.

The restoration of these edges by building-up may be accomplished as follows, using an Airco cutting torch with No. 1 tip, an Airco welding torch with a No. 8 tip, and Airco 3/16″ or ¼″ welding rod.

OPERATION 1, FIGURE 65. Brush the rust off the edge of Figure 65 and build up from 1 to 2. Light hammering of the weld while red hot will improve the joint.

OPERATION 2. FIGURE 66. A piece rusted out as shown in this figure may be built up by first removing the rivets 1, 2 and 3, and then adding metal from *a* down to the bottom of the sheet to the mudring.

OPERATION 3, FIGURE 67. In welding sheets to a mudring build up the joint of the two sheets for about 5″ above the bottom. Bevel the bottom of the sheets as shown in Figures 68 and 69.

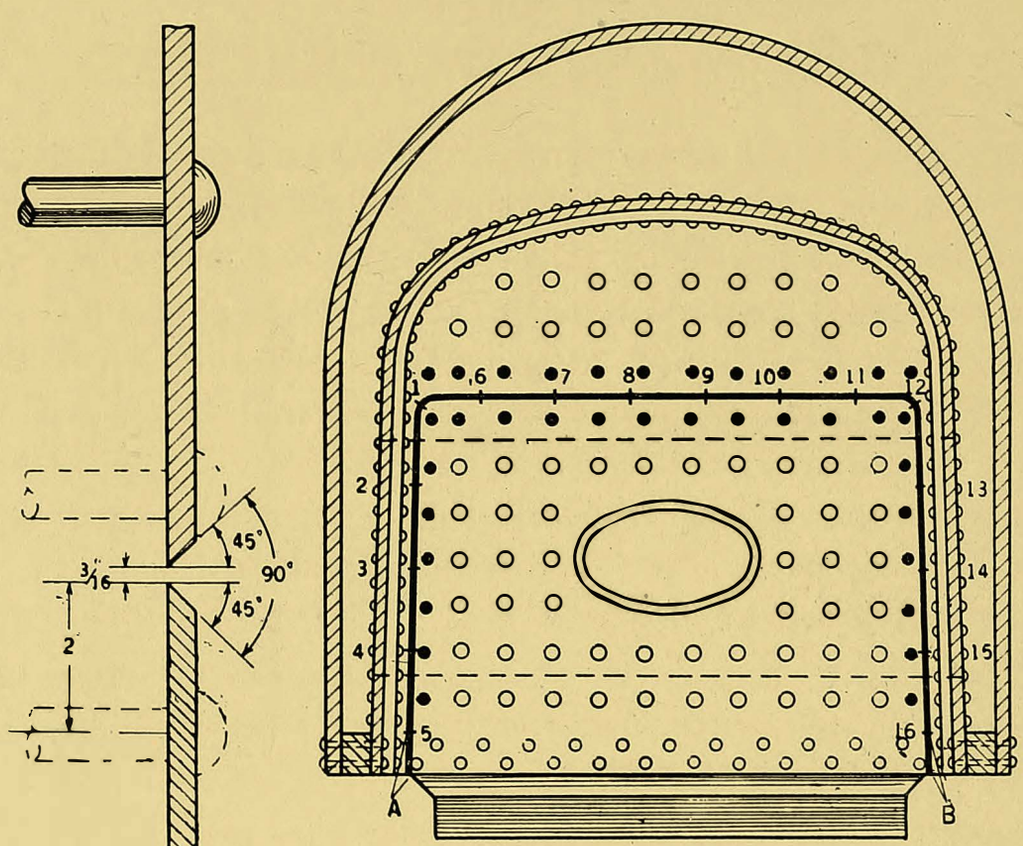


Fig. 70

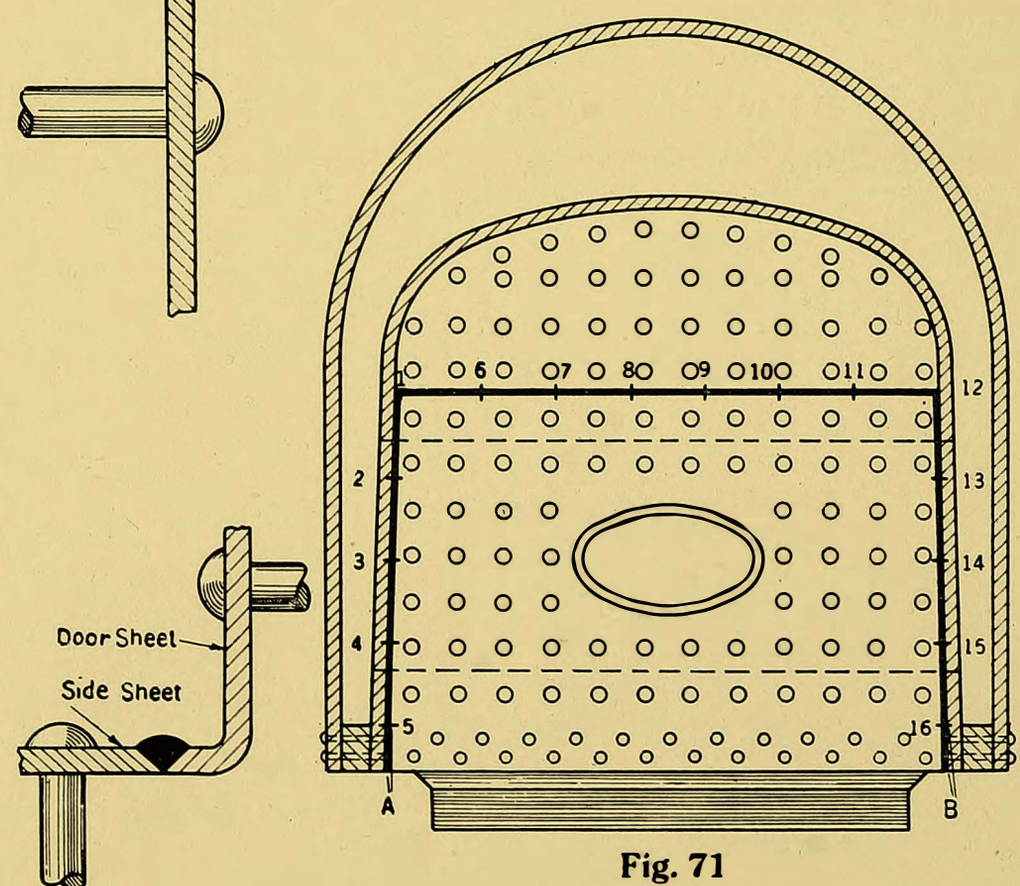


Fig. 71

AIRCO WELDING OF FULL-WELDED HALF DOOR SHEETS

THERE ARE TWO methods used to weld in half door sheets of fireboxes. That shown in Figure 70 is sometimes resorted to to save time. It is not the best way to do the work, however. This method leaves the old rivetted flange on the side sheets. The welding is done by starting at 1, back welding from 2 up to 1, and so on around, ending at B on the mudring.

The most serviceable way to do the work is as shown in Figure 71.

OPERATION 1. The side sheet should be cut to the inner edge of the rivet holes, fitting the door sheet to the edge of the side sheet. Use an Airco cutting torch with a No. 1 tip, and bevel the joints as shown in sketch at left of Figure 70.

OPERATION 2. Screw in the second row of staybolt holes, and bolt the door sheet to the mudring.

OPERATION 3. Using a No. 8 tip in the Airco welding torch and 3/16″ or ¼″ Airco welding rod, start to weld at 1, Figure 71. Then weld the door sheet to the side sheet by welding from a point about 10″ down at 2 up to 1, from 3 to 2 and ending at A on the mudring.

OPERATION 4. Back weld 10″ from 6 to 1, from 7 to 6 and on around to B at the mudring. The sketch at the left of Figure 71 shows the style of joint between the door sheet and the side sheet.

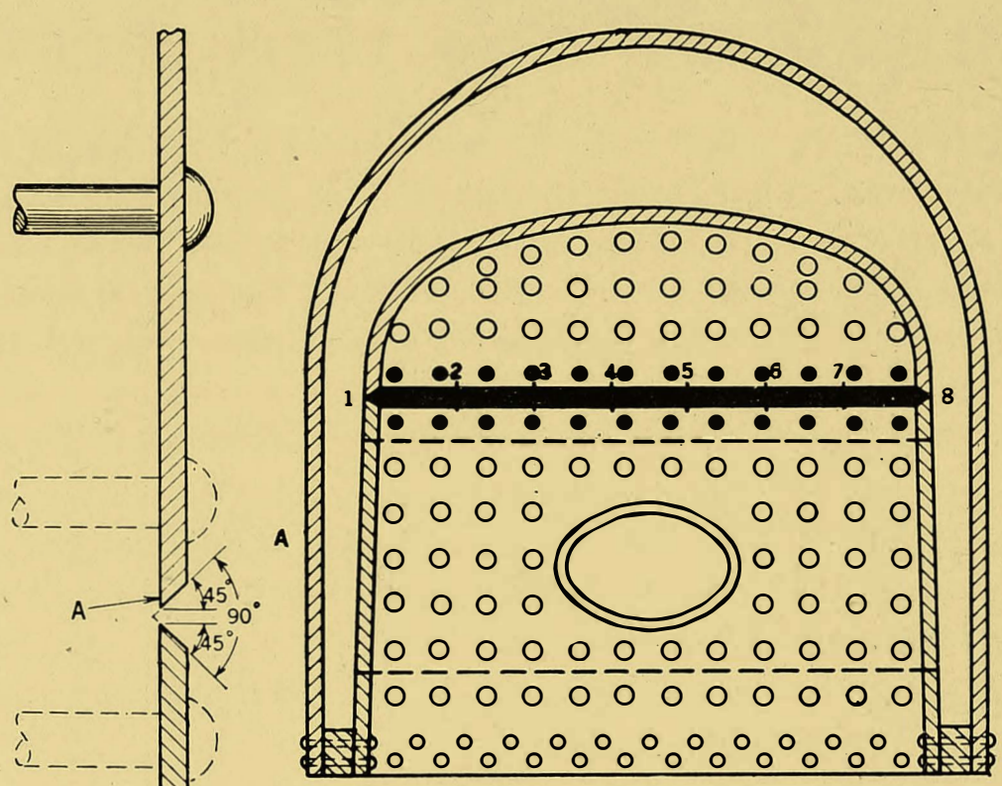


Fig. 72

Fig. 73

Fig. 74

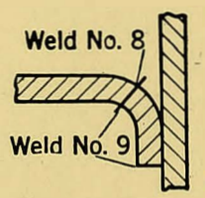


Fig. 75

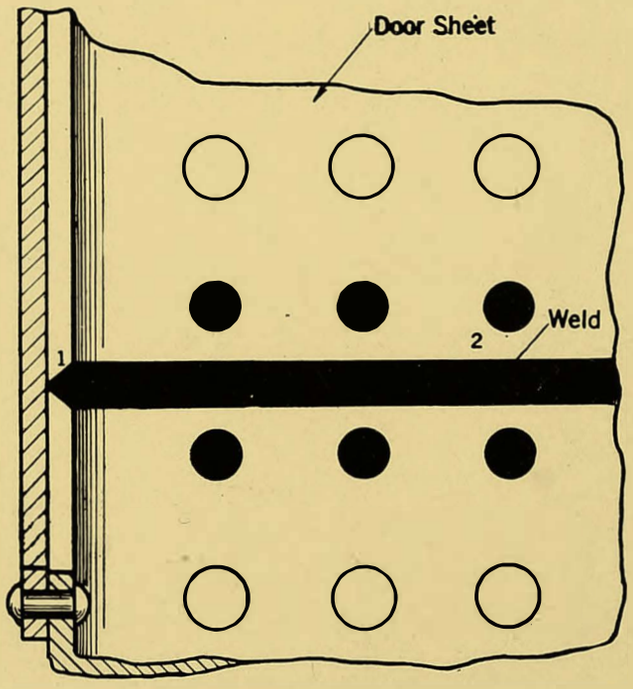


Fig. 72 A

AIRCO WELDING OF HALF DOOR SHEETS RIVETTED TO SIDE SHEETS

IN PREPARING TO weld half door sheets above or below the doorhole, the sheet should be cut not nearer the doorhole than between the first and second rows of staybolts as shown in Figures 72 and 72A. All the staybolts, except those adjacent to the weld, may be screwed in place. The door sheet should be rivetted to the side sheet and mudring before welding. The cutting should be done with an Airco cutting torch and No. 1 tip, the weld vee being formed as shown in Figure 73.

OPERATION 1. Weld the flange at 1, Figures 72 and 74, using an Airco welding torch with a No. 8 tip and 3/16″ or ¼″ Airco welding rod. Then at a distance of about 10″ from 1 back weld from 2 to 1, from 3 to 2 and continue to 8. Figure 75 gives details of the end of the weld.

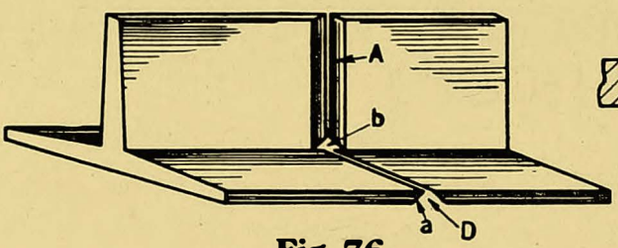


Fig. 76

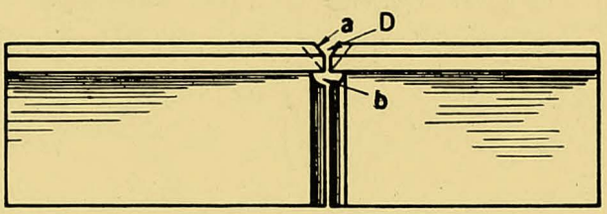


Fig. 77

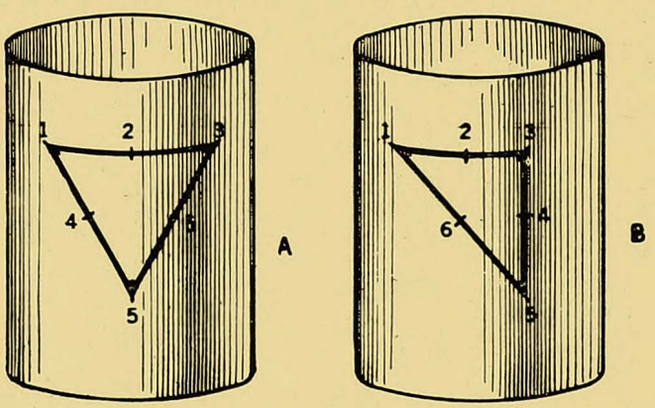


Fig. 80

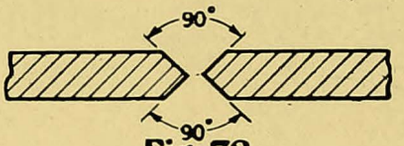


Fig. 78

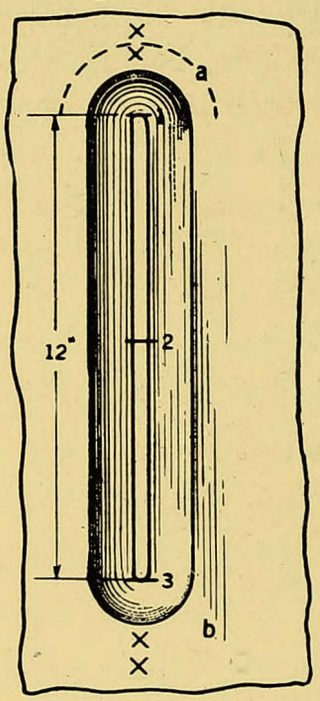
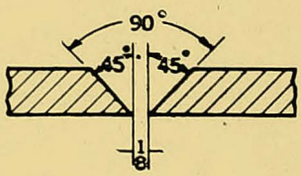


Fig. 79



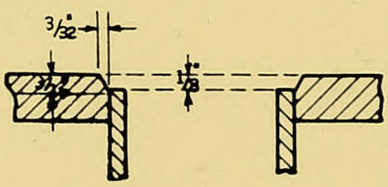


Fig. 81

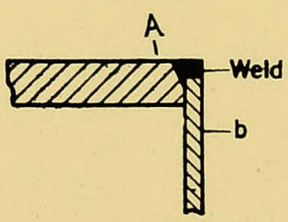


Fig. 82

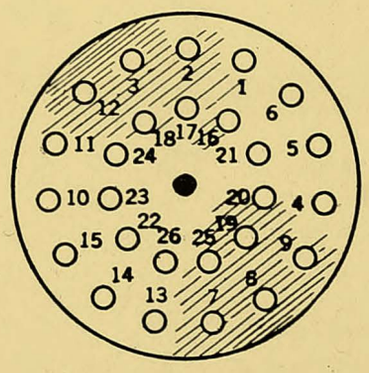


Fig. 83

SPECIAL AIRCO WELDING

STEEL BEAMS

IN WELDING STEEL beams, like those of Figures 76 and 77, bevel the web at 45° on one side if less than 1″ as shown at A, and the flange at D. If over 1″, use the double bevel of Figure 78. Make a hole at the junction of the flange and the web at *b*. This will make it possible to get a strong weld at this point.

Start to weld the flange at *a*, and weld the web last.

VARIOUS KINDS OF CRACKS

FIGURE SEVENTY-NINE SHOWS the method to use in welding cracks where expansion must be carefully considered. The best practice is to tack and back weld. The back weld jumps should be about 6″ for ¼″ plate, 10″ for ⅜″ plate and 12″ for ½″ plate. Bevel at 45°, and leave bottom of vee open about ⅛″. Preheat one end of the crack as shown at *xxa*. If the crack is in a vertical position tack weld at the top at 1, then back weld upward from 2 to 1, and 3 to 2. Complete the weld by reheating it red hot at *xxb*. The weld should be made about 2″ wide at the top, and be reinforced about ⅛″ thicker than the original metal.

PATCHES ON CYLINDRICAL SHELLS

SKETCHES A AND B of Figure 80 show how patches should be applied to cylindrical shells and tanks. The base of the triangular patch should run with the circumference of the shell.

A weld like that of Sketch A should be started at 1 and go to 3, and be allowed to cool. Then from 3 to 5 and cool. Finally from 5 to 1.

The weld of Sketch B should be run from 1 to 3, and allowed to cool. Then from 3 to 5 and cool, and from 5 to 1.

LOCOMOTIVE FLUES

TO WELD LOCOMOTIVE flues, first countersink the fluehole about 3/16″ deep, as shown in Figure 81. Extend the flue to within 1/8″ of the outer surface of the sheet and 1/16″ beyond the bottom of the countersinking. Leave out the copper ferrules, and expand the flues just enough to fill the flueholes.

Start to weld at the bottom of the hole, and weld around to the top on one side, and then the same way on the other half. Weld the fillet flush with the inside of the flue and the face of the flue sheet.

Figure 83 shows the order in which the flues should be welded so that unequal expansion may be allowed for. Weld the row of flues 1, 2, 3 and then 4, 5, 6, then 7, 8, 9 and so on to completion.

GENERAL AIRCO WELDING IN THE LOCOMOTIVE SHOP

WHILE the foregoing pages have been devoted to a description of the application of the Airco Process to locomotive firebox repairs, there are many other jobs in the locomotive shop on which the Airco Process can be used successfully, some of which are enumerated below:

CUTTING

Staybolts
Rivets
Miscellaneous sheet steel
Miscellaneous angle iron

WELDING

Firebox mudrings
Stationary boilers
Superheater tubes
Superheater units
Boiler flues
Ash pans
Petticoat pipes
Aprons
Oil tanks
Angle iron
Channel iron

AIRCO SERVICE

THE information contained in this booklet covers the welding of locomotive fireboxes. Should you, however, desire special information not dwelt upon here, or personal help, we would be glad if you would call upon the nearest branch of the Air Reduction Sales Company. Airco Service Stations are located in the following cities:

Atlanta, Ga.
Baltimore, Md.
Boston, Mass.
Bridgeport, Conn.
Bronx, N. Y.
Brooklyn, N. Y.
Buffalo, N. Y.
Camden, N. J.
Chicago, Ill.
Cincinnati, O.
Cleveland, O.
Coatesville, Pa.
Columbus, O.
Defiance, O.
Des Moines, Iowa.
Detroit, Mich.
Dorchester, Mass.
Duluth, Minn.
East St. Louis, Ill.
Emeryville, Calif.
Grand Rapids, Mich.
Jersey City, N. J.
Johnstown, Pa.
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