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METHOD OF FORMING TUBE CONNECTIONS

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FIG. I.

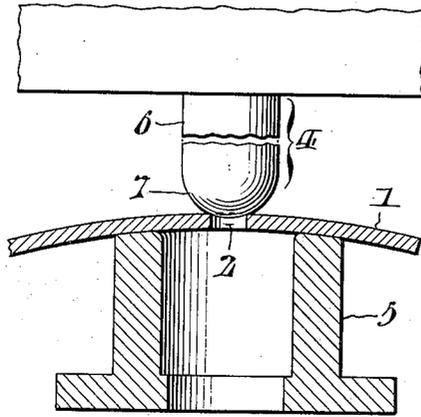


FIG. II.

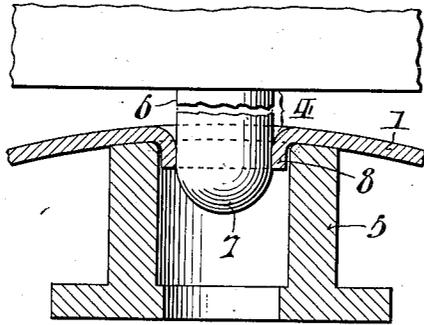
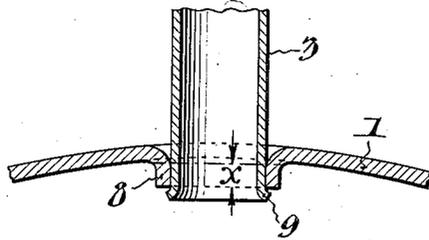


FIG. III.



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## UNITED STATES PATENT OFFICE

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## METHOD OF FORMING TUBE CONNECTIONS

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6 Claims. (Cl. 29—157.5)

This invention relates to tube connections and methods of forming the same, and, though applicable generally to the art of joining a tube to a relatively thin metal sheet, it is particularly useful as a method of connecting arch tubes of a locomotive boiler to the throat sheet thereof.

One object of the present invention is to increase the area of contact between the tube and sheet, and thus to establish a more firm connection between these elements. Another object of the invention as applied to a locomotive boiler is to provide increased exposure of the metal forming the connection between the arch tube and throat sheet at the water side of the sheet, and hence to provide reduced exposure of the metal of such connection at the fire side of the sheet, with the result that the joint will last longer. Still another object of the invention is to provide an annular flange surrounding the hole in the sheet in which the tube is inserted and serving to reinforce and materially strengthen the sheet, at the same time creating no interference with necessary expansion and contraction.

The tube connection of this invention avoids many of the difficulties formerly experienced with older methods of connecting arch tubes to throat sheets, and especially it eliminates cracking of the sheets at the holes.

Other objects and advantages characterizing my present invention will become more fully apparent from the description hereinafter set forth of one embodiment or example thereof as applied to a locomotive boiler, having reference to the accompanying drawing. Of the drawing:

Fig. I represents a portion of a boiler throat sheet, showing a die and plunger in association therewith preparatory to the formation of an annular flange at a hole in the sheet.

Fig. II is a view similar to Fig. I, showing the position of the parts when the plunger has entered the die to complete the formation of the annular flange; and

Fig. III represents in cross section the assembled boiler sheet and tube end when the joint has been completed.

In the drawing, there is represented an example of the invention as applied to the art of joining the arch tubes to the throat sheet of a locomotive boiler. The throat sheet is represented at 1, and the first step of the process consists in drilling holes 2 corresponding in number and location to the arch tubes 3 to be used, such holes being made of a diameter considerably smaller than the outside diameter of the arch tubes to be inserted therein.

When the throat sheet 1 has been thus perforated, it is placed in a power press having a plunger 4 and a bottom die 5, as represented in Figs. I and II. In accordance with the preferred practice, the plunger 4 is formed with a substantially cylindrical shank 6 and a hemispherical head 7, the diameter of the plunger corresponding closely to the exterior diameter of the arch tube 3. The complementary die 5 is of annular formation with an inside diameter larger than the diameter of the plunger 4.

In Fig. I, the parts are represented in the positions occupied preparatory to forcing the plunger 4 through the hole 2 in the throat sheet 1. Downward movement of the plunger 4 causes the hemispherical head 7 to be forced through the hole 2 with incidental pressing out of an annular flange 8 substantially at right angles to the sheet, as shown in Fig. II. After the flange 8 has thus been formed, the tube end 3 is inserted and is expanded to close fitting engagement with the flange. The final step in the process consists in rolling the extreme end 9 of the tube to form a bell overlapping the end of the flange 8.

It will be particularly observed that the flange 8 is so formed that a substantially large bearing area is provided between the inner wall of the flange and the outer wall of the arch tube 3. As shown in Fig. III, the tube end 3 is in contact with the flange 8 over a distance, represented at X, longitudinally of the tube which is greater than the thickness of the throat sheet 1. Furthermore, it will be noted that the flange 8 is formed at the water side, rather than at the fire side, of the throat sheet 1, thus reducing to a minimum the exposure of the parts of the tube connection to the extreme heat of the fire.

With a joint of the character described, the presence of the flange around the hole in the sheet acts as a reinforcement which materially strengthens the sheet, while at the same time creating no interference with expansion and contraction. Accordingly, the difficulties formerly experienced with joints of this character, and caused by the inadequate bearing areas between the sheet and tube, are eliminated. Particularly, the tendency of the throat sheet to crack at the joint is avoided.

While I have described one example of my invention, as applied to boiler practice, it will be apparent that various changes may be made in the steps and instrumentalities employed in forming a joint of the character described, all without departing from the spirit of my invention as defined in the annexed claims.

Having thus described my invention, I claim:

1. The method of joining a tube to a boiler sheet or the like which consists in making a round hole in the sheet, forcing a rounded plunger of larger diameter through said hole, thereby to produce an annular flange on said sheet, inserting the tube through said flange, and expanding the end of the tube against the end of the flange to form a joint therebetween.
2. The method of joining a tube to a boiler sheet or the like which consists in making a circular hole in the sheet, forcing through said hole a plunger having a spherical head of larger diameter than the hole, thereby to produce an annular flange on said sheet, inserting the tube through said flange, and expanding the end of the tube against the end of the flange to form a joint therebetween.
3. The method of joining a tube to a boiler sheet or the like which consists in making a round hole in the sheet, the walls of said hole being vertical to the plane of the hole, forcing a rounded plunger of larger diameter through said hole, thereby to produce an annular flange on said sheet, inserting the tube through said flange, and rolling the end of the tube over the end of the flange.
4. The method of joining a tube to a boiler sheet or the like which consists in making a circular hole in the sheet, forcing through said hole

a plunger having a spherical head of larger diameter than the hole, while applying a complementary die to the opposite side of the sheet from that at which the plunger enters the hole, thereby to produce an annular flange on said sheet, inserting the tube through said flange, and expanding the end of the flange to form a joint therebetween.

5. The method of joining a tube to a boiler sheet or the like which consists in making a circular hole in the sheet, forcing through said hole a plunger having a spherical head of larger diameter than the hole, while applying a complementary die to the opposite side of the sheet from that at which the plunger enters the hole, thereby to produce an annular flange on said sheet, inserting the tube through said flange, expanding the end of the tube, and rolling the edge thereof over the end of the flange.

6. The method of joining a tube to a boiler sheet or the like which consists in drilling in the sheet a circular hole whose walls are vertical to the plane of the hole, forming a flange by forcing a plunger with a rounded end through the hole, the diameter of the plunger being larger than that of the hole, inserting the tube through said hole and rolling the end of the tube over the edge of the flange.

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