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METHOD OF EXPANDING TUBES

Filed Oct. 24, 1932

FIG. 1

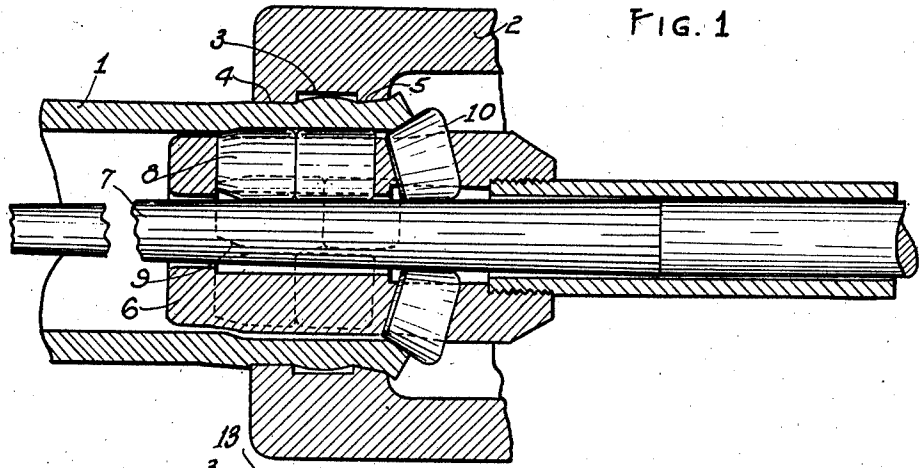


FIG. 2

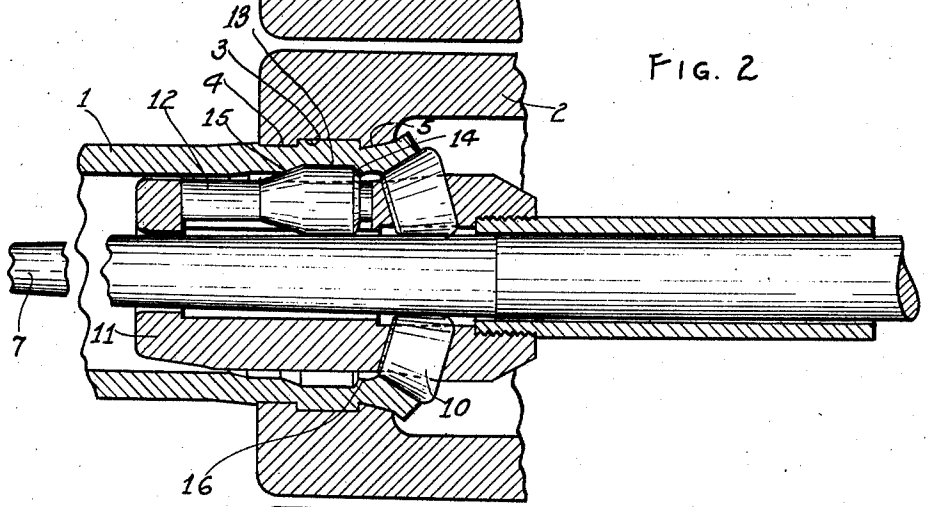
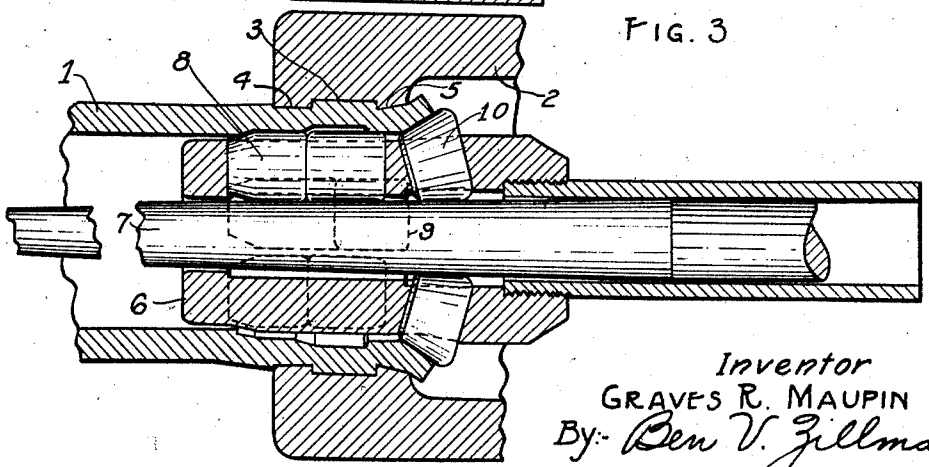


FIG. 3



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METHOD OF EXPANDING TUBES

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4 Claims. (Cl. 29—157.5)

My invention relates to improvements in a tube-expanding method, whereby a tube may be firmly and securely seated, substantially throughout its contacting area, within an annular opening having a rectangular groove or recess therein.

Another object of my invention is to compact the material of the tube into close engagement with said groove and the wall opening to either side of the same, and remove objectionable burrs from the interior of the tube thereat, so as not to impede or interfere with the free flow of liquids or other fluids through said tube.

A still further object of my invention is to provide a method for seating a tube within an annular opening having a groove of the kind described, by initially expanding the tube at either side of the groove, into engagement with the opening, then expanding substantially only that portion of the tube in alignment with said groove to seat within the latter, and finally tightening up the fit between the previously expanded portions of the tube and opening to prevent any leakage therepast and to remove any irregularities or burrs from within the tube.

Many other objects and advantages of the construction herein shown and described, and the method employed, will be obvious to those skilled in the art to which this invention appertains, from the disclosures herein given.

To this end, my invention consists in the novel construction, arrangement, and combination of parts, herein shown and described, and the method employed, and more particularly pointed out in the claims.

In the drawing, wherein like reference characters indicate like or corresponding parts throughout the views,

Figure 1 is a longitudinal section view of the tool first employed for expanding a tube in place within an opening;

Figure 2 is a similar view, showing the next operation, with the second tool; and

Figure 3 is a similar view, showing the last step, with the tool first used.

Referring more particularly to the drawing, 1 indicates a tube of relatively thick metal, such as a boiler tube used for oil stills or other similar heavy duty, high-pressure service, 2 representing the header of such boiler, still or the like, and having any number of suitably spaced openings therethrough to receive said tubes.

Heretofore these tubes have been simply expanded into tight engagement with these apertures, with perhaps the end flared over to limit longitudinal movement between the headers and the tubes, but this means of securement has not been found sufficient in every instance, and therefore more positive interlocking of the parts must be had.

To accomplish this, I have provided a rectangular groove 3 in the peripheral wall of the annular opening, intermediate the side or end portions 4 and 5 of the same, the latter being preferably slightly tapered or flared as shown.

The tube is placed with one end within the annular opening in the header, and then initially expanded in place thereat with the tool shown in Fig. 1, the expanding pressure forcing the metal of the tube to tightly engage the opening at either side of the groove, and also flare over the end of the tube.

The tool shown for this purpose has been minutely described in my Patent No. 1,747,376, issued Feb. 18, 1930, and it will therefore be unnecessary to go into full details concerning the same. However, said tool comprises a rotatable cage 6 insertable through said opening within the header, and an operating mandrel 7 is insertable through said cage, this mandrel being movable longitudinally through said cage, and the cage and the mandrel being fed through the opening in any desired and suitable manner.

The cage has a plurality of radially extending openings or slots through the same, and into which are arranged groups of rollers 8—8 and 9—9, in multiples, the pairs of rollers 8—8 breaking joint out of alignment with the pairs of rollers 9—9 to thereby prevent the formation of burrs, ridges, or the like within the internal surface of the tube being expanded, as has been more clearly set forth in said patent.

Further, to the rear of said rollers 8—8 and 9—9, are rollers 10, whose rotational axes are not parallel with, but at an angle to those of the other rollers, and for the purpose of more sharply contacting with the free end of the tube and flare the same radially outwardly over the end or side wall of the annular opening, as shown.

After the tube has been placed within the opening, the tool shown in Fig. 1 is operated, being fed forwardly through the open end of the tube, and the rollers expanded to force the compacted or distorted metal of the same into close or interlocking engagement with the portions 4 and 5 of the wall of the annular opening, and the end of the tube flared to further interlock the parts and prevent any impedance of flow of material through the tube.

Although there may have been a slight distortion of the tube intermediate the portions 4 and

5, yet this is not sufficient to form a positive interlock of said intermediate portion with the rectangularly grooved portion of the opening. Therefore to better accomplish this, I have provided a second tool, for use after the foregoing operation has been performed.

The second tool consists of the cage 11, somewhat similar to the cage 6 hereinbefore described, the same or a similar mandrel 7 being insertable therethrough and movable longitudinally therethrough to actuate the rollers, in a manner to be set forth. The tool has flaring rollers 10 similar to those of the previous tool, and similarly arranged, and for the purpose of maintaining, insofar as possible, the flared end of the tube in contact with the end of the annular opening. In addition to the flaring rollers, there is one or more expanding rollers 12 seated in slots within the cage and radially movable into or out of contact with the inner wall of the tube.

This roller 12 has a radially enlarged portion 13 of substantially the same length as the width of the groove 3, this radially enlarged portion being so spaced longitudinally from the rollers 10, to be in alignment with the groove 3 when the rollers 10 are in co-operative contact with the flared end of the tube, as shown in Fig. 2. This roller 13 is sharply tapered to normal diameter at its portion nearest the rollers 10, as at 14, but is more gradually reduced in diameter toward its other end, as at 15, that portion between 15 and the adjacent end of the roller 12 being of such diameter as to just about engage the interior of the tube when the roller 12 is in outermost operative position, and thereby center the roller and prevent wobbling of the same.

After the second tool has been inserted in place within the end of the tube 1, previously expanded to the shape shown in Fig. 1, the mandrel is fed longitudinally through the cage and rotated to rotate the cage and the rollers carried thereby. This, in turn, will cause the rollers 12 and 10 to ride along the interior of the tube surface, the latter substantially preventing longitudinal movement between the cage and the tube in one direction, namely, in the direction of movement of the mandrel.

The rollers 12 are rolled against the interior of the tube and pressed radially outwardly intermediate the ends of the previously expanded portions, substantially at that portion of the tube in alignment with the groove 3, so that continued operation will expand the material of the tube to cause the same to flow into and fill the groove and firmly seat at every portion thereof, as shown in Fig. 2.

In the operation of forming the seating of the tube at its intermediate portion to seat within the groove, a slight loosening or separation of the tube and the opening to either side of the groove may have occurred, as there is a tendency of the metal to flow sideways during this operation, and further, the ridge or burr 16 has been formed. In order to remove this burr, and to tighten up the fit between the tube and opening, the first tool is reinserted into the tube after withdrawing the second tool therefrom, and again operated.

This re-expanding of the tube at either side of the grooved portion will iron out the burr 16, as shown in Fig. 3, and press the tube again into a tight fit with the wall of the opening and thereby correct any looseness that may have occurred at these parts.

Having thus described my invention, it is obvious that various immaterial modifications may be made in the same without departing from the spirit of my invention; hence I do not wish to be understood as limiting my self to the exact form, arrangement, construction, and combination of parts herein shown or described, or the method mentioned, except as limited by the state of the art to which this invention appertains, or the claims hereunto appended.

What I claim as new and desire to secure by Letters Patent is:

1. The method of expanding a thick metal tube to seat in a rectangular groove in an annular opening, consisting of first expanding said tube into engagement with the annular wall of said opening at either side of said groove; and then expanding the intermediate portion of said tube to seat in said groove.

2. The method of expanding a thick tube into a rectangular groove in an annular opening, consisting of first expanding said tube into engagement with the annular wall of said opening to either side of said groove; then expanding only that portion of said tube which is in alignment with said groove so as to seat therein; and then re-expanding only those portions of said tube which are at either side of said groove into engagement with said annular wall.

3. The method of expanding a metal tube into an annular opening provided with a substantially rectangular annular groove therein intermediate the sides of said opening, consisting of first expanding said tube to seat against the wall of said opening at either side of said groove and flaring the end of said tube against one end of said opening; then expanding said intermediate portion of said tube into said groove to fill the latter while maintaining said flared end of the tube expanded against said end of the opening; and then re-expanding said tube at either side of said groove while re-flaring said end.

4. The method of expanding a thick metal tube to seat in a rectangular groove in an annular opening, consisting of first expanding said tube to seat in said opening at either side of said groove and flaring the end of the tube against one end of the opening wall; then expanding the intermediate portion of said tube that is aligned with said groove, so as to fill the latter while exerting pressure against said flared end of the tube; and then re-expanding said tube at either side of said groove and removing the internal burrs of the tube while flaring said end.

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