

Oct. 17, 1933.

J. H. TAYLOR

1,931,306

METHOD OF MAKING PIPE ELBOWS

Filed Jan. 9, 1931

2 Sheets-Sheet 1

Fig. 2.

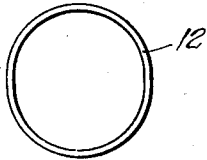


Fig. 1.

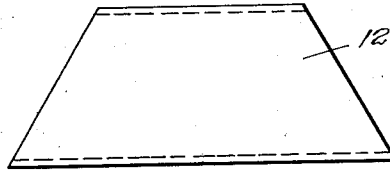


Fig. 4.

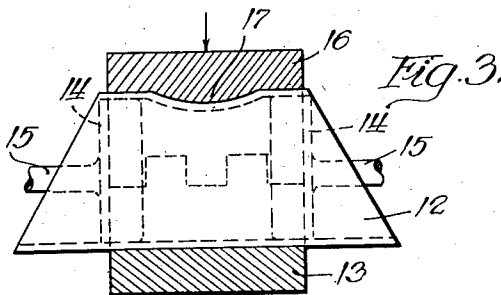
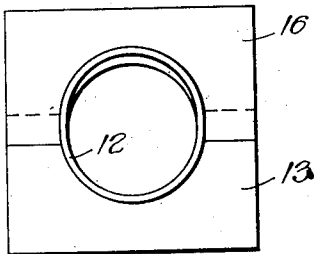


Fig. 5.

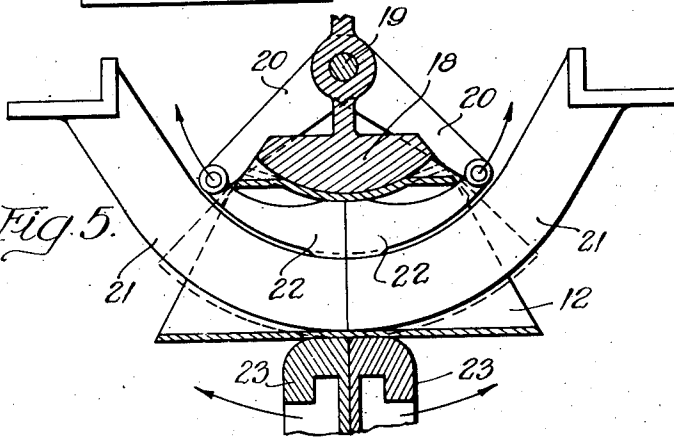


Fig. 7.

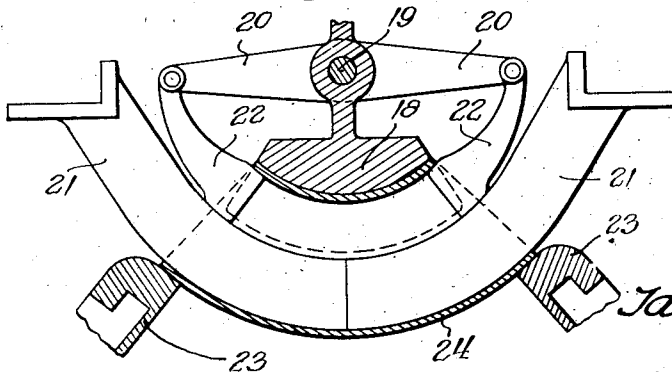
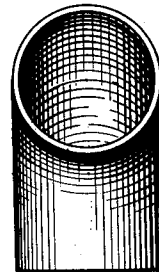


Fig. 6.

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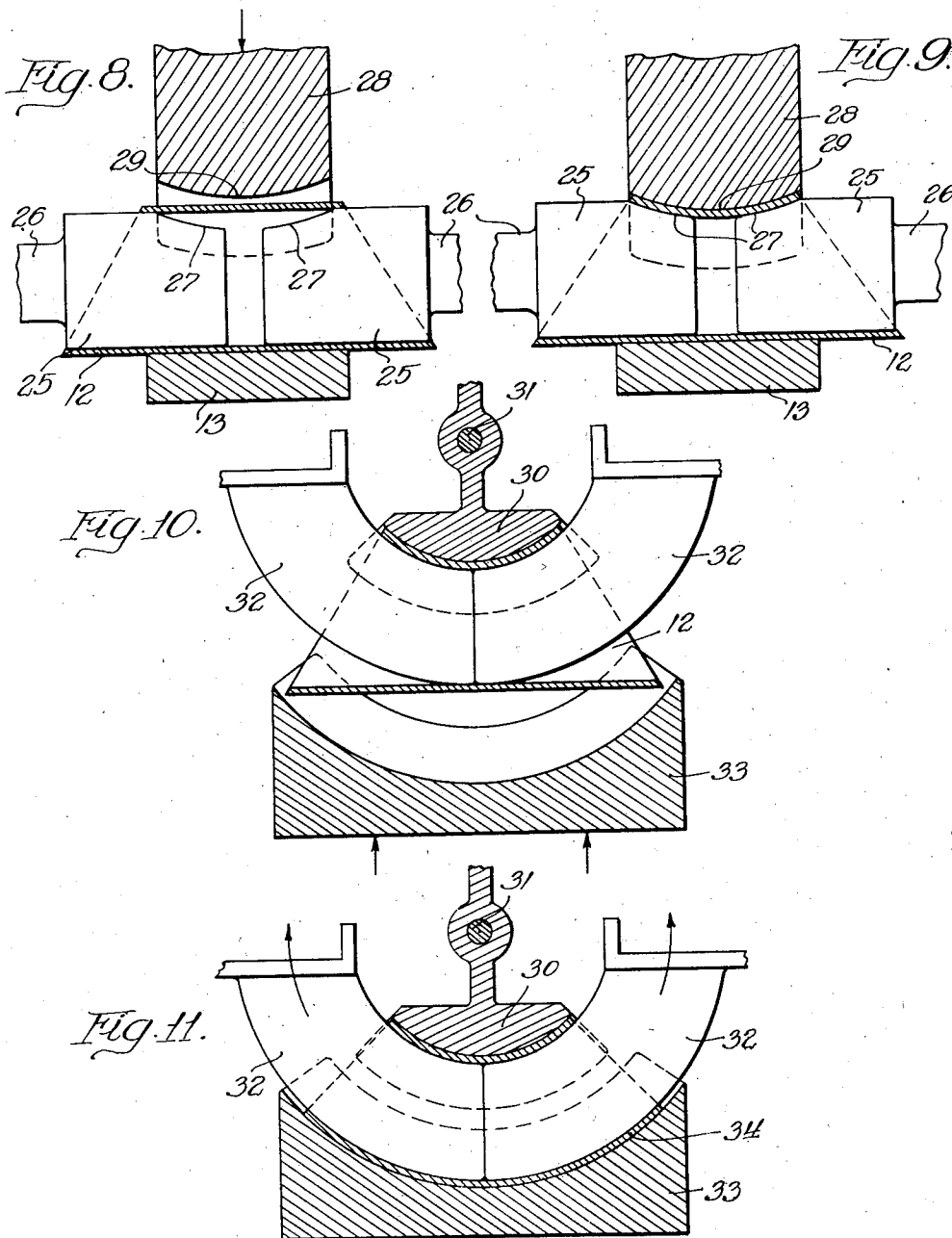
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UNITED STATES PATENT OFFICE

1,931,306

METHOD OF MAKING PIPE ELBOWS

James Hall Taylor, Oak Park, Ill.

Application January 9, 1931. Serial No. 507,654

5 Claims. (Cl. 29—157)

This invention relates to a method for making pipe bends, and has to do more particularly with a method for producing pipe elbows.

It is known to bend suitable lengths of tubing into elbows, return bends, and the like. In bending a straight piece of tubing about a curved surface to produce an elbow or other bend, by the method disclosed in my patent for Method of and means for forming pipe elbows, issued September 10 7, 1926, No. 1,598,893, the tubing at the inner side of the bend is, in effect, drawn about a curved surface with the result that the wall of the tubing at the inner side of the bend is reduced in thickness, particularly at the ends of the tubing. This is objectionable as weakening the elbow at the portion thereof which, in use, is subjected to the greatest stresses, and the thinning of the wall at the ends of the inner side of the elbow is also objectionable as interfering with proper welding of the elbow to pipes connected thereby. I have found that this objectionable thinning of the inner side of the elbow or other bend can be avoided by initially providing a length of tubing of greater cross area than that of the desired elbow, this tubing being compressed radially to approximately the desired cross area of the elbow, thus rendering available sufficient metal to compensate for the tendency to thinning of the inner side of the elbow in the bending thereof.

One of the main objects of my invention is to provide a method in which the tendency to thinning of the inner side of the elbow is compensated for by metal displaced from selected portions of the tubing and redistributed in such manner as to render available at the inner side of the tubing increased thickness of metal. A further object is to provide a method in which the displacement and redistribution of the metal of the tubing occurs incident to the bending of the tubing to form the elbow. Further objects and advantages of my invention will appear from the detailed description.

In the drawings:

Figure 1 is a side view of a length of tubing from which an elbow is formed in accordance with my invention;

Figure 2 is an end view of the tubing of Figure 1;

Figure 3 is a semi-diagrammatic view of a pair of dies and associated parts illustrating the first step in my method, parts being shown in section;

Figure 4 is an end view of the dies and the tubing therein shown in Figure 3;

Figure 5 is a semi-diagrammatic view of forming dies and associated parts, in section, illustrating the tubing in position to be bent into its final curvature to produce the elbow, the tubing being also shown in section;

Figure 6 is a view similar to Figure 5, but showing the tubing bent into final curvature to produce the elbow;

Figure 7 is an end view of the completed elbow;

Figure 8 is a semi-diagrammatic view of a pair of dies and associated parts illustrating a modification of my method;

Figure 9 is a view similar to Figure 8 but illustrating the dies as closed and the inner side of the tubing bent or curved;

Figure 10 is a sectional and semi-diagrammatic view of a pair of dies and associated parts for bending the tubing to the desired final curvature to produce the elbow, the length of tubing being shown in position in the dies; and

Figure 11 is a view similar to Figure 10 but showing the dies closed and the tubing bent into final shape to produce the elbow.

In practicing my method I provide a suitable length of tubing 12, the ends of which are cut on converging planes, that is, on planes which converge toward the shorter or inner side of the tubing. This tubing constitutes the blank which is to be bent or shaped to produce a bend or elbow. As will be noted more clearly from Figure 2, the tubing 12 is initially of approximately elliptical cross section, the longer axis of the ellipse extending from the inner side to the outer side of the tubing and the shorter axis corresponding to the desired diameter of the elbow or bend. I position this tubing 12 in a lower fixed die 13, in symmetrical relation thereto.

Opposed heads 14, corresponding in shape to the interior of the tubing and suitably secured on rods 15, are moved into the ends of the tubing, in a suitable manner, as in Figure 3. The portion of the tubing between the heads 14 and at the upper or shorter side thereof, is then depressed by means of an upper movable die 16 opposed to die 13 and provided with a central projection 17 extending substantially half way around the tubing and tapering from the upper portion of the sides thereof. The dies 13 and 16 coact with each other and with the heads 14, to compress the intermediate portion of the tubing from the inner or shorter side thereof so that the tubing is of circular cross section at its central portion, as in Figure 4. The curvature thus imparted to this portion of the tubing preferably corresponds to the desired curvature of the inner side of the elbow to be formed. Since the projection 17 tapers from the center of the tubing toward each

end thereof, a certain amount of the metal at the upper portion of the tubing is displaced and redistributed in such manner that the wall of the shorter or inner side of the tubing is increased in thickness. This displacement and redistribution of the metal renders available, at the inner side of the tubing, sufficient additional metal to prevent thinning of the inner side of the tubing during the final shaping thereof to produce the elbow.

After the intermediate portion of the inner side of the tubing has been compressed in the manner stated, the tubing is then bent into final form to produce the elbow in a suitable manner. In my patent for Method of and means for forming pipe elbows, issued September 7, 1926, No. 1,598,893, I have disclosed dies and associated means suitable for bending lengths of tubing into elbows. I find the means of my patent well adapted for imparting the desired final curvature to the tubing after the preliminary bending and compressing thereof, and have illustrated such means, more or less diagrammatically, in Figures 5 and 6. The tubing 12 is disposed with the curved depression formed in the inner side thereof fitting snugly against the correspondingly curved forming surface of a fixed inner die 18. The forming face of this die is concentric with a pin 19 which serves to pivotally connect links 20 to the inner die structure. Horn dies 21, the outer sides of which are curved to conform to the desired curvature of the outer side of the elbow, are suitably mounted for movement concentrically with pin 19. These horn dies have associated therewith supplemental dies 22 pivoted to links 20. Two outer dies 23, movable toward and away from each other along the tubing, are suitably mounted for movement concentrically with pin 19, and are suitably shaped for forming the outer portion of the elbow over horn dies 21. After the tubing is disposed in the dies as in Figure 5, the outer dies 23 are moved from their central position away from each other and to the ends of the tubing. These dies form the outer portion of the tubing accurately over the horn dies 21. This forming of the outer portion of the tubing serves to move the end portions of the inner side of the tubing inwardly toward die 18 into substantially the dotted line position of Figure 5, so as to be disposed in close proximity thereto. The supplemental dies 22 are then moved outwardly through the ends of the tubing and during such movement are guided by the horn dies 21 so as to accurately shape the end portions of the inner side of the tubing about inner die 18. Since the wall of the inner side of the tubing is thickened and the greater portion of this wall is curved during the thickening thereof to conform to the final curvature of the inner side of the elbow, thinning of the wall at the inner side of the elbow is prevented. The supplemental dies 22 merely act to shape the wall of the inner side of the elbow accurately to the die 18 and do not exert any thinning effect upon this wall. The elbow, designated 24, is shown in its final form in Figure 6. In the final shaping operation, the dies 23 coact with the horn dies 21 and die 18 to compress the end portions of the tubing radially and to displace and redistribute the metal in such end portions in such manner that the wall at the outer side of the tubing is thickened to a certain extent and the ends of the elbow are of circular cross section, as shown in Figure 7, and of the same interior diameter as the center of the elbow. Since the cross sectional area of

the entire tubing is reduced during forming thereof to produce the elbow, with resulting increase in thickness of the wall of the tubing, particularly at the inner or shorter side thereof, the initial thickness of the wall of the tubing may be slightly less than the desired final thickness of the wall of the elbow.

Under ordinary conditions, however, I prefer to have the initial thickness of the wall of the tubing the same as the desired final thickness of the wall of the elbow, so as to assure ample thickness of the elbow wall, particularly at the inner side thereof.

Instead of radially compressing the intermediate portion only of the inner or shorter side of the tubing, I may compress the shorter side of the tubing for the whole length thereof in such manner as to reduce the central portion of the tubing to the desired final interior cross section while also imparting to the inner side of the tubing a full length curvature of somewhat greater radius than the desired final curvature. This is illustrated in Figures 8 and 9. In accordance with this form of my invention, the tubing 12 is disposed in a lower fixed die 13 in symmetrical relation thereto. Opposed heads 25, conforming in contour to the cross section of the interior of the dies, and carried by rods 26, are moved into the tubing from each end thereof. Each of these heads is provided, in its upper portion, with a depression 27 conforming in curvature to the lower or forming surface of an upper movable die 28. This die is provided with a projection 29 curved on a radius somewhat greater than the desired final curvature of the inner side of the elbow, this projection extending approximately half way around the tubing 12 and tapering from the center of die 28 to each side thereof. After the tubing has been properly positioned, the dies 13 and 28 are closed, die 28 serving to compress the tubing radially from the inner side thereof and in such manner that the tubing is of circular cross section and of the desired diameter at its central portion, the inner side of the tubing being curved by the die 28 to conform to the curvature of the projection 29, as in Figure 9.

After the inner side of the tubing has been compressed and shaped in the manner described, the tubing is bent into final shape to produce the elbow in a suitable manner. For this purpose, I preferably employ the means disclosed in my copending application for Method and means for forming pipe elbows, Serial No. 462,513, filed June 20, 1930. Such means is illustrated more or less diagrammatically in Figures 10 and 11 and includes a fixed inner die 30, the forming surface of which is concentric with axis 31 and corresponds in curvature to the desired final curvature of the inner side of the elbow. Opposed horn dies 32 are suitably mounted for movement about axis 31 into and out of the ends of the tubing 12. A lower movable die 33 coacts with dies 30 and 32 for imparting the desired final shape to the tubing to produce the elbow. This die 33 is provided, in the upper face thereof, with a trough-like depression having the same curvature lengthwise as the horn dies 32 and shaped transversely to conform to the desired transverse section of the outer portion of the elbow. With the tubing 12 disposed with its inner side seated against the forming surface of die 30, the horn dies 32 are moved into the ends of the tubing and shape the inner side thereof about die 30, as in Figure 10. Die 33 is then closed by moving it toward die 30, as indicated by the arrows, and

serves to shape the tubing accurately about the horn dies 32 so as to produce the elbow 34 of Figure 12. In the closing of die 33, the end portions of the tubing, at the outer side thereof, are compressed radially and the same circular cross section is imparted to the ends of the tubing as to the center thereof, the elbow being of substantially uniform circular cross section throughout its entire length. In practicing this form of my method, the die 28 serves to increase the thickness of the wall at the inner side of the tubing, by displacing and redistributing the metal in the same manner as in Figure 3, but to a greater extent, and this wall remains in its thickened condition since the desired final curvature is imparted to the inner side of the tubing by the dies 32 and further manipulation of this wall in the production of the elbow is not necessary.

While I have illustrated and described two forms of dies and associated parts for imparting the desired final shape and curvature to the tubing in the production of the elbow, I do not intend to in any way limit myself to the means employed for this purpose since the tubing may be bent in any suitable or preferred manner. In its broader aspects, my invention comprehends the prevention of thinning of the inner wall of a pipe elbow or bend in the production thereof by suitably displacing and redistributing metal of the tubing from which the bend or elbow is produced, and includes any suitable means for imparting the desired final shape and curvatures to the tubing.

What I claim is:

1. The method of producing pipe elbows and the like, which comprises reducing the mid-portion of a tubular blank and thereby thickening the intermediate portion of the wall at the side of the blank corresponding to the short side of the elbow while maintaining the original thickness of the wall at the side of the blank corresponding to the long side of the elbow, and shaping the blank to final size and curvature by reducing the ends of the blank and flowing the metal displaced at the ends toward the end portions of the wall at the short side of the elbow to compensate for any tendency toward thinning of said wall at said ends, whereby thinning of the wall at the ends of the short side of the elbow is prevented.

2. The method of producing pipe elbows and the like, which comprises reducing the mid-portion of a tubular blank and thereby thickening the intermediate portion of the wall at the side of the blank corresponding to the short side of the elbow while maintaining the original thickness of the wall at the side of the blank corresponding to the long side of the elbow, and shaping the blank to final size and curvature by reducing the ends of the blank and flowing a portion of the metal displaced at the ends toward the end portions of the wall at the short side of the elbow while also flowing a portion of the metal displaced at the ends of the blank toward the

long side of the elbow, whereby thinning of the walls at the ends of either side of the elbow is prevented.

3. The method of producing pipe elbows and the like, which comprises subjecting to radial pressure the mid-portion of the wall at the side of a tubular blank corresponding to the short side of the desired elbow and thereby reducing the mid-portion of the blank and shaping the mid-portion of said wall to the curvature of the short side of the elbow while thickening said mid-portion of the wall, shaping the wall at the opposite side of the blank over interior curved dies to the curvature of the long side of the elbow with the curved mid-portion of the wall corresponding to the short side of the elbow seated against a correspondingly curved exterior die and thereby reducing the end portions of the blank and flowing metal displaced therefrom toward the ends of the short side while also moving the end portions of the short side into close proximity to said exterior die, and shaping the short side of the blank to final curvature over the exterior die by supplementary interior dies moving from the center of the blank toward the ends thereof.

4. The method of producing pipe elbows and the like, which comprises subjecting to radial pressure the mid-portion of the wall at the side of a tubular blank corresponding to the short side of the desired elbow and thereby reducing the mid-portion of the blank and shaping said wall to approximately the curvature of the short side of the desired elbow while thickening the mid-portion of the wall, and shaping the blank to final size and curvature over curved interior dies and between opposed exterior dies with the wall at the short side seated against one of the exterior dies which conforms in curvature to the short side of the elbow, thereby reducing the end portions of the blank and flowing the displaced metal toward the ends of the short side of the elbow and thereby preventing thinning of the wall at the ends of the short side of the elbow.

5. The method of producing pipe elbows and the like, which comprises subjecting to radial pressure the mid-portion of the wall at the side of a tubular blank corresponding to the short side of the desired elbow and thereby reducing the mid-portion of the blank and shaping said wall to approximately the curvature of the short side of the desired elbow while thickening the mid-portion of the wall, and shaping the blank to final size and curvature over curved interior dies and between opposed exterior dies with the wall at the short side seated against one of the exterior dies which conforms in curvature to the short side of the elbow, thereby reducing the end portions of the blank and flowing the displaced metal toward the ends of the short side and the long side of the elbow and thereby preventing thinning of the wall at the ends of the elbow at either side thereof.

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