

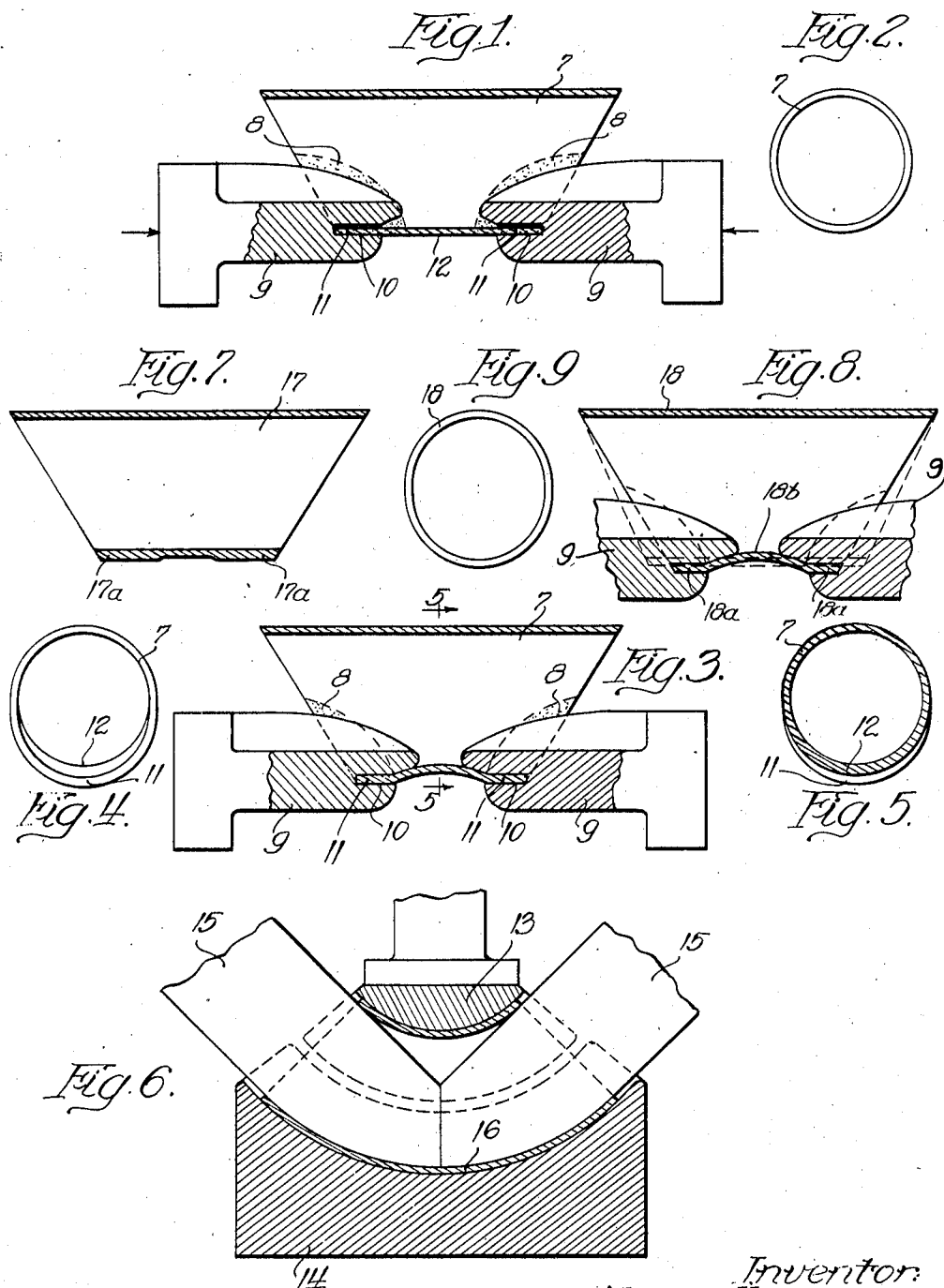
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TUBING FOR AND METHOD OF MAKING BENDS

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TUBING FOR AND METHOD OF MAKING
BENDS

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This invention relates to the making of pipe elbows and other pipe bends, and has to do more particularly with a method for producing bends from suitable lengths of wrought metal tubing, and with tubing intended for use in the production of pipe bends.

It is known in the art to produce elbows and the like by bending lengths of tubing in dies or other means. In bending a straight piece of tubing to produce an elbow, the side of the tubing corresponding to the shorter or inner side of the elbow is, in effect, drawn about a curved forming surface, for instance as disclosed in my Patent No. 1,598,893, dated September 7, 1926. This causes thinning of the wall at the inner side of the elbow, which thinning is objectionable as reducing the strength of the elbow at the portion thereof which is subjected to greatest stress while also interfering with proper welding of the ends of the elbow to pipes or tubes connected thereby. I have found that this objectionable thinning of the elbow at the inner side thereof can be avoided by properly pre-shaping the inner side portion of the tubing corresponding to the inner side of the elbow, and then imparting the desired final curvature to the tubing to produce the elbow.

One of the main objects of my invention is to provide a method whereby thinning of the inner side of the elbow is avoided. A further object is to provide a method in which standard size tubing, corresponding in diameter to the diameter of the elbow to be produced, may be used in the production of pipe elbows and bends without thinning of the wall at the inner side of the elbow. A further object is to provide a method in which the inner side of the tubing is pre-shaped and the ends of such inner side are upset or thickened slightly, preliminary to the bending of the tubing into its final form to produce the elbow, the pre-shaping of the inner side of the tubing and the thickening of the ends thereof being so related that thinning of the inner side of the tubing in the final shaping of the elbow is avoided. It is also an object of my invention to produce lengths of tubing particularly adapted for forming into pipe bends and so shaped as to avoid objectionable thinning of the walls at the ends of the inner side or curve of the bend produced. Further objects and advantages of my invention will appear from the detailed description.

In the drawing:—

Figure 1 is a sectional view through a length

of tubing disposed between a pair of opposed dies, illustrating the first step of my method;

Figure 2 is an end view of the tubing;

Figure 3 is a view similar to Figure 1, illustrating the second step of my method;

Figure 4 is an end view of the tubing after the inner side thereof has been pre-shaped as in Figure 3;

Figure 5 is a section through the tubing taken substantially on line 5—5 of Figure 3;

Figure 6 is a sectional view through an elbow produced from the tubing of Figure 3, and through the dies for producing such elbow, parts being shown in elevation.

Figure 7 is a sectional view taken lengthwise through the tubing, illustrating an alternative method of preforming the tubing;

Figure 8 is a view similar to Figure 3 but illustrating a second alternative method of preforming the tubing;

Figure 9 is an end view of the tubing used in the method of Figure 8.

In Figure 1 I have illustrated a length of tubing 7 of wrought metal, this length of tubing having its ends cut on planes converging toward the shorter side of the tubing. This tubing may be considered as constituting a blank from which an elbow is to be produced. The longer or upper (as considered in Figure 1) side of the tubing corresponds to the outer side of the elbow to be produced and the shorter side of the tubing corresponds to the inner side of the elbow. For convenience in description, therefore, the longer side of the tubing will be referred to as the outer side and the shorter side as the inner side.

In practicing my method, the inner side of the tubing is heated in a suitable manner to a flowing heat, that is, a heat at which the metal will readily flow when subjected to pressure. The area over which the tubing is heated, indicated at 8, is of approximately semi-elliptical shape and extends an appreciable distance upwardly, or toward the outer side of the tubing, from the inner side thereof. The tubing, heated in this manner, is placed between opposed dies 9 having recesses 10 therein of slightly greater vertical height or thickness than the initial thickness of the wall of the tubing 7, and the dies are moved toward each other so that the end portions of the inner side of the tubing are disposed in the recesses 10. This is illustrated in Figure 1. Continued movement of the dies toward each other subjects the inner portion of the tubing to endwise pressure exerted simultaneously upon the heated ends or areas 8 with the result that such ends are bent

outwardly of the tubing, the tubing, as a whole, moving upwardly or outwardly away from the dies and the ends of the tubing being stretched so as to assume a more or less elliptical shape, this stretching of the ends of the tubing corresponding to the outward bending of the ends 11. The central area 12 of the inner portion of the tubing is not disturbed or distorted to any material extent, the diameter of the tubing at the central plane thereof remaining unchanged. In addition to bending the ends 11 of the inner portion of the tubing outwardly, the dies exert an upsetting action upon ends 11 so as to increase the thickness of the wall thereof. The outward bending of ends 11 is such that the central portion of the inner side of the tubing, that is, the area between the ends 11, is of arcuate shape and conforms in general to approximately the desired final curvature of the inner side of the tubing.

After the tubing has been preformed at the inner side thereof, in the manner described, it is then shaped by suitable means to produce the desired elbow. I have illustrated, by way of example, die means suitable for producing an elbow from the tubing of Figure 3. This means is disclosed in detail in the co-pending application of Jorge Maroto, for Method and means for forming pipe elbows, Serial No. 496,615, filed November 19, 1930. It is not necessary to describe in detail the die mechanism, and a brief description thereof will suffice. Referring to Figure 6, I provide opposed exterior dies 13 and 14 having relative movement toward and away from each other. The die 13 is provided with a suitable cavity defining a forming surface corresponding in curvature to the desired curvature of the inner side of the elbow. This die, therefore, is termed the inner die. Die 14 is provided with a suitable cavity defining a forming surface corresponding to the curvature of the outer side of the elbow and is, accordingly, termed the outer die. Horn dies 15, having converging and diverging movement toward and away from each other, operate between the dies 13 and 14 in synchronism therewith, the outer sides of dies 15 being curved to conform to the desired curvature of the outer side of the elbow. After the tubing has been pre-formed as in Fig. 3, it is placed in outer die 14 in symmetrical relation thereto, which outer die may be considered as the movable die for purposes of description. As die 14 moves toward die 13, the horn dies 15 are projected into the ends of the tubing and serve to progressively bend the tubing lengthwise. As dies 13 and 14 approach their full closed position, die 14 forms the outer side of the tubing accurately about the horn dies 15, and the horn dies act to shape the inner side of the tubing about the forming surface of die 13. The length of tubing is thus shaped to final curvature to produce the completed elbow 16. In this final shaping of the tubing, the end portions thereof are compressed radially by the action of the dies so as to be reduced in cross area to the original cross area of the tubing. Since the ends 11 of the inner side of the tubing are bent outwardly of the tubing by the dies 9, the horn dies 15 act to swing these ends 11 outwardly of the tubing about the lines of juncture between the ends 11 and the central area 12 of the inner side of the tubing, and the inner side of the tubing is shaped accurately about the forming surface of die 13 without any appreciable thinning thereof, particularly at the ends, and in the finished elbow the wall at each end of the inner side of the

elbow is at least as thick as, and in most instances thicker than, the initial thickness of the wall of the tubing before bending thereof. In this manner, thinning of the inner side of the elbow is avoided, and I render it possible to use standard tubing of the same diameter as the desired diameter of the elbow to be produced. By bending the ends of the inner side of the tubing outwardly, in the preforming thereof, the shaping of the inner side of the tubing about the forming surface of the inner die 13, in the production of the elbow, is facilitated and thinning of the wall of the inner side is prevented, the upsetting or thickening of the ends 11 providing an additional safeguard against thinning of the inner side of the elbow, particularly at the ends thereof. While my method is particularly adapted for the production of elbows, in its broader aspects it is applicable to bends of various types.

It is not essential in all cases, that the end portions of the tubing be moved outwardly thereof as in Figure 3. I find that it is sufficient, in certain cases, if the end portions of the inner side of the tubing be thickened slightly. This result can readily be accomplished by stopping the movement of the dies 9 toward each other before outward bending of the end portions of the inner side of the tubing occurs. In Figure 7 I have illustrated a piece of tubing 17 treated in this manner. The end portions 17^a have been slightly upset or thickened by the straight line pressure exerted thereon by the dies, thus rendering available additional metal at the inner side of the tubing and in sufficient quantity to compensate for any tendency toward thinning of such inner side in the shaping of the tubing into the elbow. The piece of tubing, preformed in this manner, is then bent to form the elbow in a suitable manner, as by the die means of Figure 6.

In Figures 8 and 9 I have illustrated a further variation of my method. In this form of my method, I provide a piece of tubing 18 of elliptical cross section, the shorter axis of the cross section of which corresponds approximately to the diameter of the desired elbow. The inner or shorter side of this tubing is subjected to endwise pressure, as in Figure 3, in proper amount to bend the end portions 18^a outwardly of the tubing and also cause inward movement of the center portion 18^b to such an extent as to reduce the cross sectional area of the center of the tubing to approximately that of the desired elbow. The tubing is then bent to form the elbow as before. Instead of using tubing of elliptical cross section, I may use tubing of circular cross section but of greater diameter than the desired elbow.

While the recesses of the dies 9 are preferably somewhat thicker than the initial thickness of the wall of the tubing, this is not always necessary. It is practicable, in certain cases, to have the die recesses such that no appreciable upsetting or thickening occurs at the ends of the inner side of the tubing. With such dies, upon movement of the dies toward each other, the end portions of the inner side of the tubing are bent outwardly of the tubing, as in Figure 3, but are not thickened. This results in stretching of the ends of the tubing, and causes a redistribution of metal in such manner as to render available, at the inner side of the tubing, additional metal to compensate for any tendency toward thinning of such inner side in the bending of the tubing to form the elbow. It is not essential that the initial thickness of the ends of the inner side of the tubing be main-

tained, it being sufficient if the displacement and redistribution of metal is such as to accomplish the desired result. This preformed tubing is then shaped to the desired final size and curvature in a

5 In the forming of the elbow, the ends of the tubing are reduced in cross area, and the displaced metal flows to the inner side of the elbow, particularly at the ends thereof, and effectively prevents any objectionable thinning thereof.

10 In all of the possible variations of my method disclosed, metal at the ends of the tubing is displaced and redistributed in such manner as to render available at the inner side of the tubing, additional metal. This additional metal is redistributed, in the final forming of the elbow, in such manner as to effectively prevent objectionable thinning of the inner side of the elbow, particularly at the ends thereof. In its broader aspects, therefore, my invention is not limited to the particular method herein disclosed, but comprehends any suitable method whereby the metal of the tubing is redistributed in the manner and for the purpose above set forth.

25 What I claim is:—

1. The method of producing pipe elbows and the like, which consists in providing a straight piece of metal tubing of proper length to form an elbow, then upsetting the metal at the ends of the side of the tubing corresponding to the inner side of the elbow to be produced and shortening said side of the tubing to render available at the ends of the tubing additional metal for assuring proper thickness of metal at the inner side of the formed elbow, and then bending the tubing to final size and curvature.

2. The method of producing pipe elbows and the like, which consists in providing a straight piece of metal tubing of proper length to form an elbow and with its ends cut on oppositely inclined planes converging toward one side of the tubing, then applying endwise pressure to the shorter side of the tubing to thicken the end portions of said shorter side and move the same outwardly of the tubing, and then bending the tubing to final size and curvature with the shorter side thereof at the inner side of the bend.

3. The method of producing pipe elbows and the like, which consists in providing a piece of metal tubing of proper length to form an elbow and with its ends cut on oppositely inclined planes converging toward one side of the tubing, subjecting the end portions of the shorter side of the tubing to endwise pressure and thereby moving said end portions outwardly of the tubing while also moving the central portion of the shorter side inwardly of the tubing and shortening said shorter side, and then shaping the tubing to final size and curvature with the shorter side thereof at the inner side of the bend.

4. The method of producing pipe elbows and the like, which consists in providing a piece of metal tubing of proper length to form an elbow and with its ends cut on oppositely inclined planes converging toward one side of the tubing, subjecting the end portions of the shorter side of the tubing to endwise pressure and thereby upsetting said end portions and moving them outwardly of the tubing while also moving the central portion of the shorter side inwardly of the tubing and shortening said shorter side, and then shaping the tubing to final size and curvature with the shorter side thereof at the inner side of the bend.

5. The method of producing elbows and the like, which consists in providing a piece of metal

tubing of suitable length to form an elbow and of greater cross sectional area than that of the desired elbow, the ends of the tubing being cut on oppositely inclined planes converging toward one side of the tubing, subjecting the end portions of the shorter side of the tubing to endwise pressure and thereby shortening said shorter side and bending the central portion thereof inwardly of the tubing, and then bending the tubing to final size and curvature with the shorter side thereof at the inner side of the bend.

6. The method of producing pipe elbows and the like, which consists in providing a piece of metal tubing of proper length to form an elbow, then upsetting a portion of each end of the tubing and thereby increasing the thickness of the wall of the tubing at the ends thereof, and then bending the tubing to final curvature with the upset portions at the inner side of the bend.

7. The method of preforming a length of metal tubing for bending into elbows and the like, which consists in subjecting a selected portion of the tubing to endwise pressure and thereby simultaneously bending the ends of said portion outwardly of the tubing and thickening the same.

8. As a new article of manufacture, a length of tubing having inwardly converging areas at the ends bent outwardly of the tubing, the ends of the tubing being of greater cross sectional area than the center thereof.

9. As a new article of manufacture, a length of tubing having inwardly converging areas at the ends thereof bent outwardly of the tubing, the ends of the tubing being of greater cross sectional area than the center thereof and the wall of each of the outwardly bent areas being of increased thickness relative to the remainder of the wall of the tubing.

10. The method of producing pipe bends, which comprises first subjecting the wall at the short side of a piece of tubing with oblique converging ends to endwise pressure between die surfaces spaced to permit upsetting, and then bending said piece of tubing with said short side forming the inner curve of the bend.

11. The method of producing pipe bends, which comprises first subjecting the wall at the short side of a piece of tubing with oblique converging ends to endwise pressure between die surfaces spaced to permit upsetting, thus thickening said wall at said short side, and then bending said piece of tubing with said short side forming the inner curve, thereby restoring said wall at said short side to normal thickness.

12. The method of producing pipe bends, which comprises first upsetting and thereby thickening an inwardly converging area at each end of the wall at the short side of a piece of tubing with oblique converging ends, and then subjecting said piece of tubing to the action of complementary die surfaces corresponding to the outer and inner curves of the bend to be produced, whereby said piece of tubing is bent with said short side forming the inner curve.

13. The method of producing pipe bends, which comprises subjecting the wall at the short side of a piece of tubing with oblique converging ends to endwise pressure between die surfaces spaced to permit upsetting, and bending said piece of tubing with said short side forming the inner side of the bend.

14. The method of producing pipe bends, which comprises subjecting to endwise pressure the wall of a piece of tubing at the side thereof corresponding to the inner curve of the bend to

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be produced and thereby bulging said wall inwardly of the tubing, and bending the piece of tubing with said bulged side thereof forming the inner curve of the bend.

5 15. The method of producing pipe bends, which comprises subjecting the wall at the short side of a piece of tubing with oblique converging

ends to endwise pressure in the absence of endwise pressure at the long side of the tubing, thereby shortening and thickening said short side, and bending said piece of tubing with the short side thereof forming the inner curve of the bend. 80

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