July 4, 1933. J. H. TAYLOR 1,916,645

METHOD OF AND MEANS FOR MAKING CURVED PIPE FITTINGS

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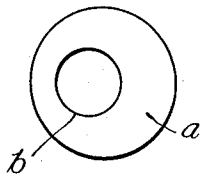
Fig. 2.



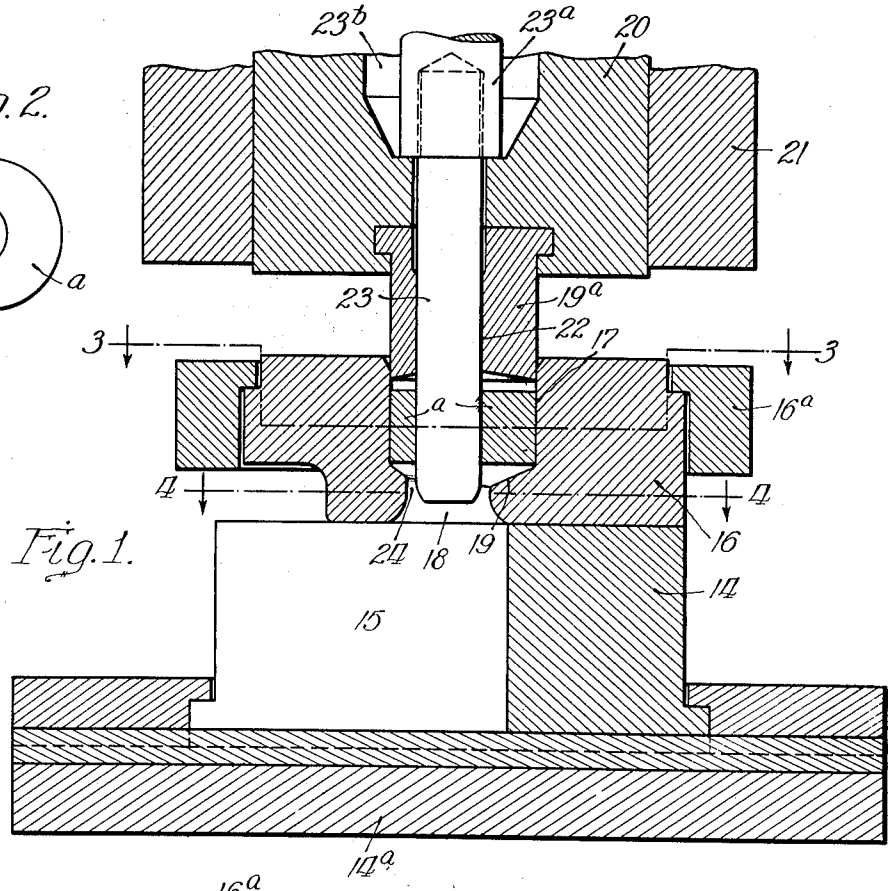


Fig. 1.

Fig. 3.

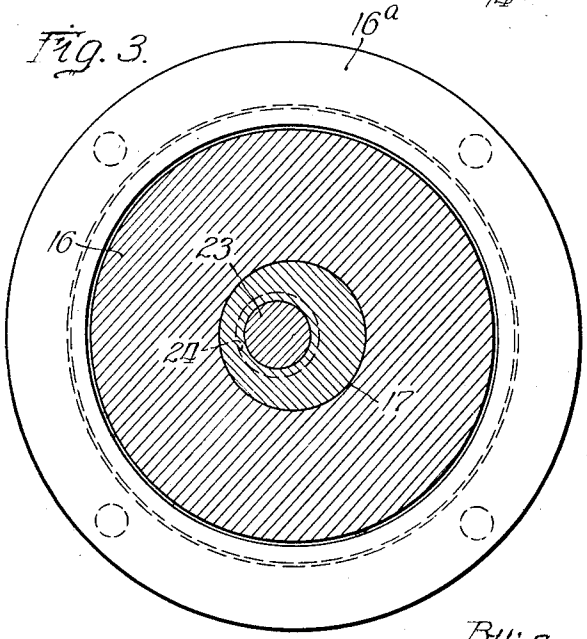
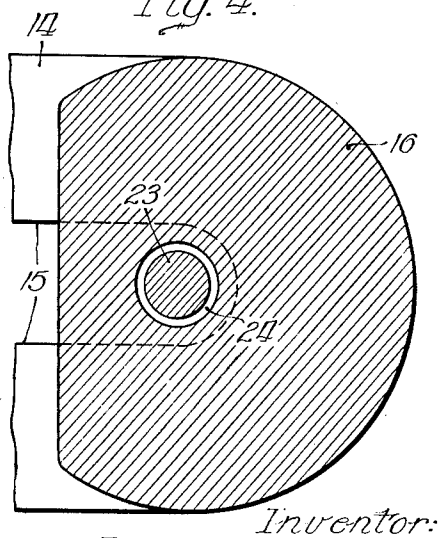


Fig. 4.



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METHOD OF AND MEANS FOR MAKING CURVED PIPE FITTINGS

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Fig. 5.

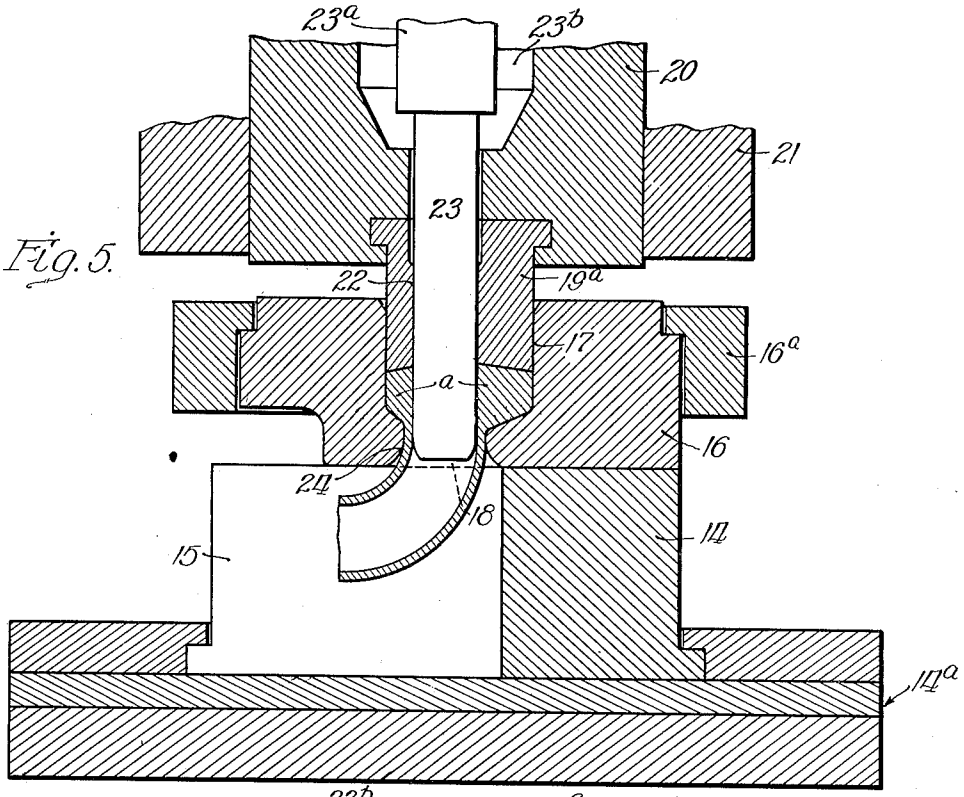
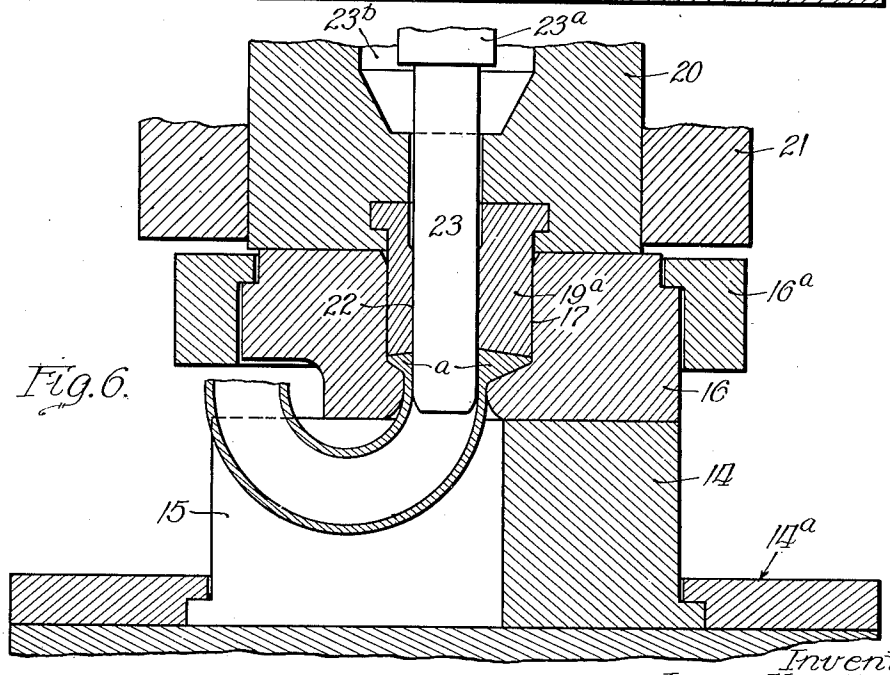


Fig. 6.



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METHOD OF AND MEANS FOR MAKING CURVED PIPE FITTINGS

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Fig. 7.

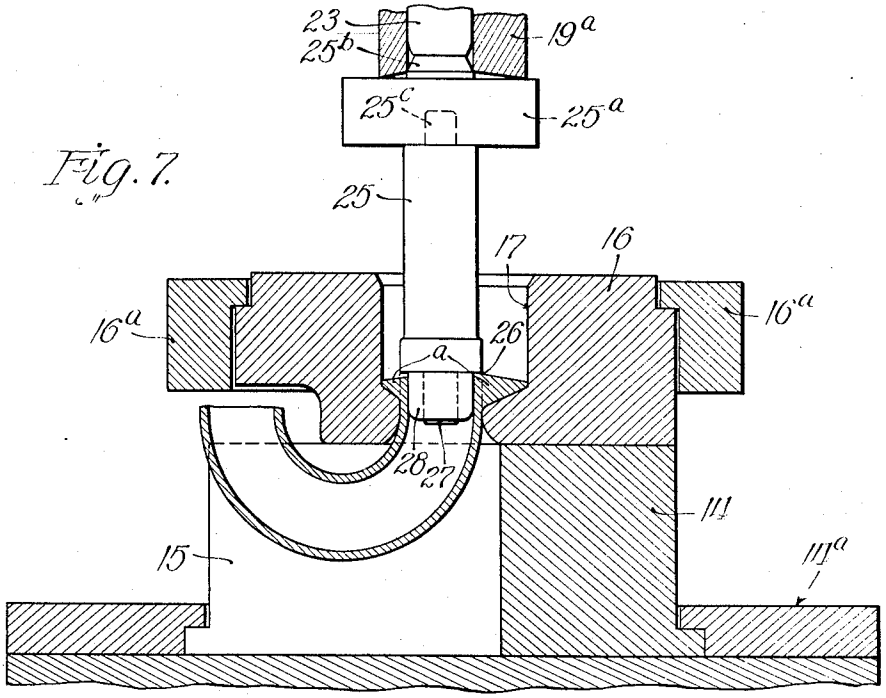


Fig. 8.

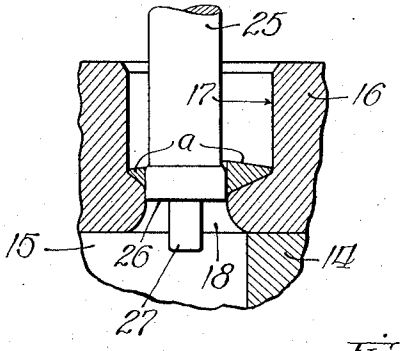


Fig. 9.

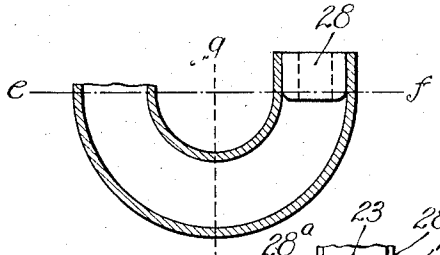


Fig. 10.

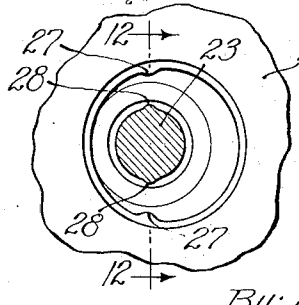
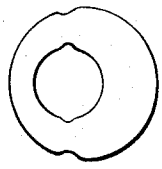


Fig. 11.



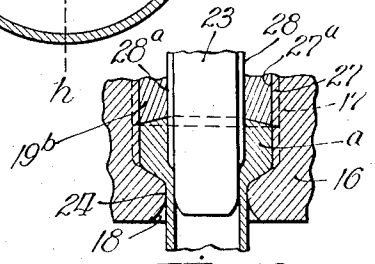


Fig. 12.

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METHOD OF AND MEANS FOR MAKING CURVED PIPE FITTINGS

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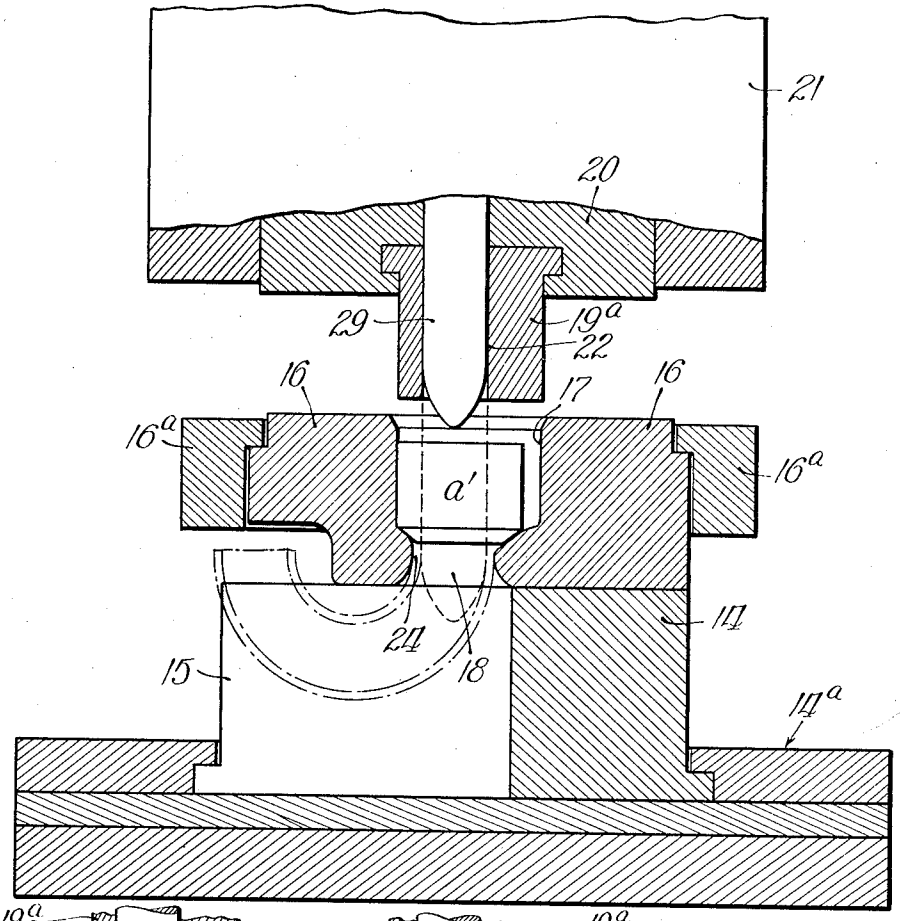
Fig. 13.



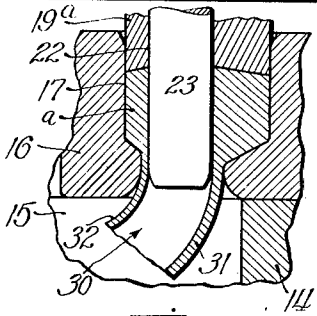


Fig. 14.

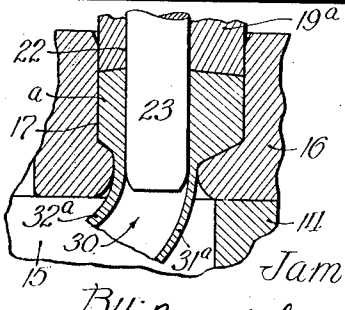


Fig. 15.

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Patented July 4, 1933

1,916,645

UNITED STATES PATENT OFFICE

JAMES HALL TAYLOR, OF OAK PARK, ILLINOIS

METHOD OF AND MEANS FOR MAKING CURVED PIPE FITTINGS

Application filed October 24, 1932. Serial No. 639,272.

My invention relates to the manufacture of curved pipe fittings, and contemplates a new and improved method of and means for making elbows and return bends.

My invention works a great economy in the manufacture of elbows and return bends, and it also results in elbows and return bends of inherently improved quality.

My invention is illustrated in the accompanying drawings, in which

Figure 1 is a vertical axial sectional view of the apparatus which is employed, so far as illustration is necessary for the purposes of this description;

Figure 2 is a plan view of a blank, which will be referred to;

Figure 3 is a horizontal sectional view, taken on the plane of the line 3—3 of Figure 1, looking downwardly;

Figure 4 is a horizontal sectional view taken on the plane of the line 4—4 of Figure 1, looking downwardly;

Figure 5 is a view similar to Figure 1, but showing the dies in a different relative position and showing the article in process of formation;

Figure 6 is another similar view showing the dies in another relative position, with the article further advanced in its making;

Figure 7 is a similar view, showing the substitution of a shearing member for one of the dies, and showing the beginning of the next step in the process;

Figure 8 is a similar view, limited however to a fragmentary showing, illustrating the action in this last named step of the process;

Figure 9 shows the article, as it is released from the apparatus, in longitudinal section;

Figures 10, 11 and 12 illustrate a modification which will be referred to;

Figure 13, a view similar to Figure 1, illustrates another modification;

Figure 14 is a view similar to Figure 5, limited however to a fragmentary showing, illustrating a third modification;

Figure 15 is a view similar to Figure 14, illustrating a fourth modification.

Referring first to Figure 1, a U-shaped supporting member 14 is suitably mounted upon a bed 14*a*. The space between the legs of the U is indicated at 15. Mounted upon the supporting member 14 is the die member 16, secured in position in a suitable manner, as by means of a clamp ring 16*a*. This die member 16 has the cylindrical cavity 17 from which a circular opening 18 leads at the bottom, the space of the cavity, indicated at 19, being inclined toward the opening 18, as illustrated.

The circular opening 18 is disposed eccentrically in relation to the cavity 17, as illustrated, and it is flared downwardly, being suitably rounded for reasons which will appear presently. It will be noted that the opening 18 leads into the space 15.

A plunger die 19*a* has movement relative to the die 16 and is adapted to fit snugly into the cavity 17. This die may be carried by a movable head 20 secured in a frame 21 suitably mounted on the head of a suitable press. The manner in which the dies have relative movement toward each other is of no concern here, and it suffices to say that appropriate movement, with sufficient pressure, is imparted to the head 20.

The plunger die 19*a* has an opening 22 therein, in axial alignment with the opening 18, this opening 22 in the plunger die 19*a* bearing to the plunger die the same eccentric relation that the opening 18 bears to the cavity 17.

A mandrel 23 fits slidably in the opening 22 and is provided with means whereby its downward travel may be limited. As illustrative of such means, the upper end of mandrel 23 may be secured in the lower end of a rod 23*a* extending into a bore 23*b* in block 20 and opening into the upper end of opening 22. Rod 23*a* contacts the bottom of bore 23*b* in the upward movement of head 20 for withdrawing mandrel 23, and this rod may have associated therewith suitable means for limiting downward movement thereof and thereby appropriately limiting downward travel of the mandrel. The diameter of the mandrel 23 is less than the diameter of the opening 18 so as to leave between the mandrel 23 and the die 16 an annular space 24. It will now be clear that this annular

space 24 communicates with and is eccentric in relation to the cavity 17.

According to my invention, I form the elbow or return bend from a relatively thick circular blank *a*, shown in plan in Figure 2. An opening is to be formed in this blank and, as will be seen, I contemplate both forming this opening in advance and forming it in the machine in which the further operations take place. The opening indicated at *b* in Figure 2, is eccentric in relation to the blank and, as will appear presently, the blank fits in the cavity 17 and the mandrel 23 fits in the opening *b*, all as illustrated in Figure 1. Let it be assumed that the opening *b* is formed in the blank *a*, either by punching or drilling, and that it is then placed in proper position in the cavity 17. The head 20 is lowered and the mandrel 23 passed through the opening *b* while the plunger die 19*a* enters the cavity 17.

The mandrel 23 now extends into the opening 18, forming the annular space 24. The metal of the blank *a* is now extruded through this annular space. The purpose of my invention is to extrude the metal through the annular orifice at a greater rate on one side than the other. This can be done in various ways, say either by having a die on one side moving more rapidly than a die on the other, or by moving the die at the same rate on both sides but against more metal on one side than on the other, or by any appropriate combination of these ways. The means which I have shown in Figure 1 is such that the plunger die 19*a* descends at the same rate on both sides, but, as will be understood from what has been said, there is more metal on one side of the mandrel 23 than on the other, the amount of metal per unit area gradually increasing from the minimum side to the maximum side both ways around the mandrel. Thus, when the plunger die 19*a* descends, it presses the metal through the orifice 24, at the lefthand side (Fig. 1) at a certain rate, and at an increasing rate from that point around both sides of the mandrel to the opposite side where the rate is at a maximum. This action is shown in Figure 5 and, from what has been said, it follows that a curved tube results. It will also be understood that the radius of the curve of the tube depends upon the relation between the minimum rate of flow of metal on the one side and the maximum rate on the other.

In Figure 5, the process has been illustrated advanced to the point where an elbow has been formed. If the amount of metal in the blank were originally calculated accordingly, and if the metal were then substantially exhausted from the cavity 17, the process might be regarded as ending at this point with the formation of an elbow. However, as will be seen, only about half of the metal of the blank has been forced through the orifice 24 and the further downward movement of the plunger die 19*a* therefore continues the operation which has been described to the extent of forming a complete return bend, as illustrated in Figure 6. Elbows may therefore be formed by limiting the amount of metal in the blank to substantially the amount of metal required for an elbow, or, as indicated in Figure 6, return bends may also be produced as a matter of practice and then cut in two to form elbows, as will be clear.

Whether elbows or return bends, this step in the process is completed when the plunger die 19*a* has reached the bottom of the cavity 17, or substantially so.

After that point in the process has been reached, the head 20 is raised, and, with it, the mandrel 23 and plunger die 19*a*.

Next follows the operation shown in Figure 7. A shearing tool 25 is brought down by the head in order to shear off the remaining flange of metal within the cavity 17. This shearing tool is mounted upon the head so as to be coaxial with the opening 18, and the shearing edge 26 just fits within that opening. A cap plate 25*a* is suitably mounted upon the upper end of tool 25 for contact with plunger die 19*a* and transmits pressure from the latter to the tool in the downward movement of head 20. Plate 25*a* is provided, at its upper face, with a stud 25*b* which fits into the lower end of opening 22 of die plunger 19*a*, and has a bore extending from its under face and receiving a stud 25*c* at the upper end of tool 25. At its lower end the tool 25 carries a boss 27 upon which a ring 28 is held with friction fit. This ring 28 has an external diameter equal to the diameter of the mandrel 23 and when the shearing tool 25 is brought down it fits tightly within the end of the elbow or return bend still remaining within the cavity 17. Further movement, downwardly, of the shearing tool 25 has the action shown in Figure 8, i. e., the shearing of the flange from the elbow or return bend. The elbow or return bend drops down into the space 15 and it now has the form shown in Figure 9, i. e., with the ring 28 held therein. The ring 28 is then removed, in any suitable way, and the product of the process is then ready for final finishing. If it is a return bend, it may be used either as such, after being trimmed on the line *e—f* of Figure 9, or it may be cut in half, as indicated by the dotted line *g—h* in Figure 9, to make two elbows.

In Figure 10 I have illustrated a modification, wherein the inner wall of the cavity 17 is provided with vertical ridges 27, and the mandrel 23 is provided with vertical ridges 28, for the purpose of counteracting the flow of metal from one side to the other of the cavity, plunger die 19*b* being provided with grooves 27*a* and 28*a* which accommo-

date ridges 27 and 28, respectively. Figure 11 shows the blank which is formed correspondingly to fit in the cavity 17 of Figure 10. Figure 12 is a vertical axial sectional view taken on the plane of the line 12—12 of Figure 10, illustrating the ridges which have been referred to. I have demonstrated, in actual practice, that these ridges are not essential, but, depending upon dimensions and the nature of the metal, they may be desirable in order to compel the metal to be extruded through the annular orifice as calculated.

I have previously stated that the blank may have the opening formed therein before being placed in the cavity 17. Figure 13 shows a modification whereby a solid blank is placed in the cavity 17. In this instance, the mandrel 29 is formed at its lower end as a punch or piercing member, as illustrated. As shown, the blank a' does not fit the cavity 17, but has its area calculated so that when pierced, it will do so, or substantially so. This solid blank is disposed in the cavity, the head is brought down, the hole pierced by the mandrel, urging the metal outwardly. The result is a blank with an eccentric opening, as previously described. The further descent of the mandrel enables it to perform its function in forming the annular opening 24.

Under certain conditions it may be desirable to have the bend of greater wall thickness at one portion than at another. This may be accomplished by disposing the mandrel in eccentric relation to die opening 18 so that the orifice 24, instead of being of uniform width, is of greater width at one portion thereof than at another. In this case, the parts will be properly proportioned and the blank will be appropriately disposed to assure the desired curving of the bend during extrusion of the metal as well as thickening of the desired portion of the wall thereof.

In Figure 14 the mandrel 23 is disposed eccentric to die opening 18 and nearer the left side of this opening than the right side thereof. The orifice 24 is, therefore, of greater width at the right side thereof than at the left side and increases uniformly in width in both directions from the narrowest point at the left side thereof to the opposite point at the right side of the orifice. This means that the bend 30, produced by extrusion of the metal through the orifice, will be curved lengthwise, as in Figure 5, but the long or outer side 31 of this bend will be of greater wall thickness than the short or inner side 32 thereof, the wall of the bend increasing uniformly in thickness from the inner side to the outer side thereof. The difference in wall thickness of the bend at the different portions thereof will depend upon the eccentricity of the mandrel 23 to the die opening 18, which may be varied considerably within limits.

In Figure 15 the mandrel 23 is disposed nearer the right side of the die opening 18 than the left side thereof. Consequently, the outer or long side 31a of the bend will be of less wall thickness than the short or inner side 32a, the wall of the bend decreasing uniformly in thickness from the inner side to the outer side of the bend.

It will be apparent from the above that the orifice 24 through which metal is extruded may be of either uniform or non-uniform width. The term "annular orifice" as used herein is, therefore, to be construed as including orifices which are of either uniform or non-uniform width. Furthermore, it is not essential in all cases that the extrusion orifice be of circular shape, and there may be instances where the use of a non-circular orifice is desirable. My invention comprehends, therefore, in its broader aspects, the use of an orifice of any suitable shape to accomplish the desired results.

I claim:—

1. The method of making a curved pipe fitting, which comprises confining an annular billet of metal with its internal periphery in substantially coaxial relation and its external periphery in eccentric relation to an annular orifice, and simultaneously subjecting the entire billet to endwise pressure toward said orifice to force different volumes of metal through said orifice at opposite sides thereof, and confining the flow through said orifice in respect of said different volumes of metal to produce greater linear speed of flow at said orifice at the side of the greater volume, thus causing curvature of the fitting as formed.

2. A machine for forming curved pipe fittings, comprising a die member having a cavity therein and an opening leading therefrom, the axis of said opening being offset from the axis of said cavity, and a plunger and a mandrel cooperating with said die member, said mandrel being arranged to extend eccentrically through said cavity to leave an annular cavity increasing in width in both directions from a point at one side to a point at the opposite side thereof and to extend into said opening to leave an annular orifice, the width of said annular cavity on its wider side divided by its width on its narrower side being greater than the width of said annular orifice on either of its sides divided by its width on its other side, and said plunger fitting said cavity and movable therein toward said annular orifice, whereby an annular metal blank disposed in said cavity may be forced by said plunger through said annular orifice to form a curved tube.

3. A machine for forming curved pipe fittings, comprising a die member having a cavity therein and an opening leading therefrom, the axis of said opening being offset from the axis of said cavity, and a plunger

and a mandrel cooperating with said die member, said mandrel being arranged to extend eccentrically through said cavity to leave an annular cavity increasing in width in both directions from a point at one side to a point at the opposite side thereof and to extend eccentrically into said opening to leave an annular orifice increasing in width in both directions from a point at one side to a point at the opposite side thereof, the width of said annular cavity on its wider side divided by its width on its narrower side being greater than the width of said annular orifice on either of its sides divided by its width on its other side, and said plunger fitting said cavity and movable therein toward said annular orifice, whereby an annular metal blank disposed in said cavity may be forced by said plunger through said annular orifice to form a curved tube with greater wall thickness on one side than on the other.

4. A machine for forming curved pipe fittings, comprising a die member having a cavity therein and an opening leading therefrom, the axis of said opening being offset from the axis of said cavity and said opening flaring immediately from its controlling restriction, and a plunger and a mandrel cooperating with said die member, said mandrel being arranged to extend eccentrically through said cavity to leave an annular cavity increasing in width in both directions from a point at one side to a point at the opposite side thereof and to extend into said opening to leave an annular orifice, the width of said annular cavity on its wider side divided by its width on its narrower side being greater than the width of said annular orifice on either of its sides divided by its width on its other side, and said plunger fitting said cavity and movable therein toward said annular orifice, whereby an annular metal blank disposed in said cavity may be forced by said plunger through said annular orifice to form a curved tube.

In witness whereof, I hereunto subscribe my name this 21st day of October, 1932.

JAMES HALL TAYLOR.