Nov. 28, 1939. J. H. TAYLOR 2,181,384

MANDREL FOR MAKING PIPE BENDS

Filed Jan. 15, 1938

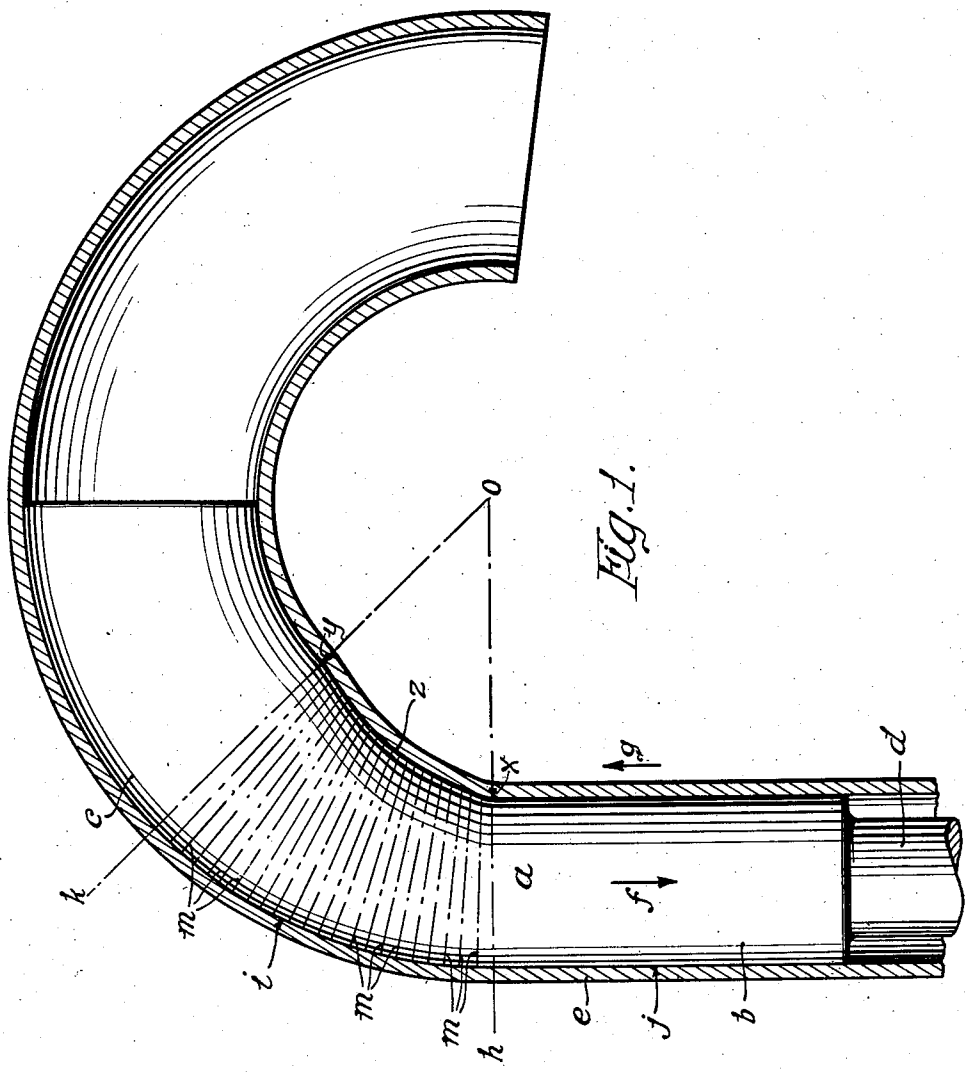

Fig. 1.

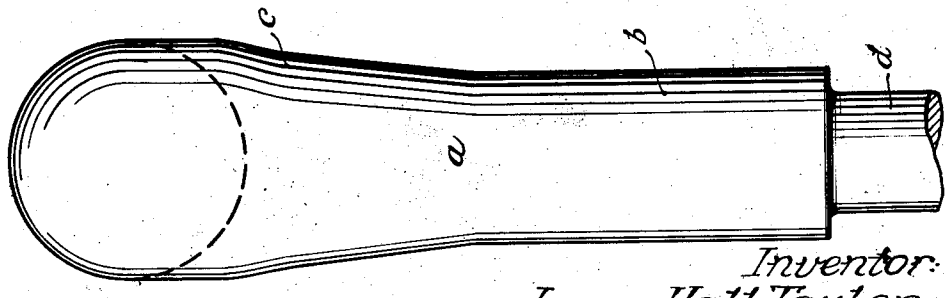

Fig. 2.

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Patented Nov. 28, 1939 2,181,384

UNITED STATES PATENT OFFICE

2,181,384

MANDREL FOR MAKING PIPE BENDS

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Application January 15, 1938, Serial No. 185,162

1 Claim. (Cl. 153—32)

My invention relates to the manufacture of pipe fittings and presents a new mandrel for the forming of pipe bends, such as elbows and U-turns.

The method of feeding straight pipe of given diameter to a curved enlarging mandrel, and drawing it over the same, forming a bend of greater diameter, is well known.

The object of my invention is to provide a mandrel whereby substantially uniform wall thickness is preserved and whereby the displacement of metal is reduced to a minimum. This object I attain by so calculating the mandrel that, constantly as the movement of pipe over the mandrel proceeds, the upsetting resulting from the curving thereof is substantially balanced by the stretching due to increase of diameter.

My invention is illustrated in the accompanying drawing, in which—

Figure 1 is an elevational view of the mandrel, with pipe, shown in section, being forced over it, and

Figure 2 is an elevational view of the mandrel normal to the elevation of Figure 1.

The mandrel, indicated at *a*, of circular cross-section, comprises the straight portion *b*, the curved portion *c*, and means *d*, at the free end of the straight portion *b* for the attachment of an operating rod. The pipe is shown at *e*, and it will be understood that the mandrel is pulled through the pipe in the direction of the arrow *f*, or the pipe is pushed over the mandrel in the direction of the arrow *g*, or both may be moved in such relative directions.

The straight pipe fed to the mandrel is of given wall thickness and diameter, and the straight portion of the mandrel fits snugly therein.

The mandrel begins to curve and enlarge at the transverse plane indicated by the dot-and-dash line *o—h*, and the point *o* is the point from which the outer curve *i* of the mandrel is subscribed, tangent to the straight line *j* on the surface of the straight portion of the mandrel, this curve representing the desired outer curve of the bend to be formed.

The mandrel enlarges from the plane *o—h* to the transverse plane indicated by the dot-and-dash line *o—k*, in which plane the pipe is of the internal diameter desired for the bend to be formed. Obviously, since the outer curve of the mandrel is already determined, the increasing diameter from the plane *o—h* to the plane *o—k* is reflected in a distorted inner curve *l*. My invention is concerned with the determination of this particular inner curve and the shape of the mandrel follows from that determination.

This inner curve *l* is determined as follows: The arc between planes *o—h* and *o—k* may be considered as divided into an infinite number of units of curvature and an infinite number of units of diameter increase. For practical purposes, the arc is divided into a multiplicity of equal parts, each representing a certain amount of curvature, which is reflected in longitudinal offsetting of metal in the pipe wall, and to each part is assigned diameter increase the ratio of which to the total diameter increase is the same as the ratio of each part to the total arc, such diameter increase reflecting itself in circumferential stretching of the metal in the pipe wall. For instance, the illustrated arc between the planes *o—h* and *o—k* is 46°; it is divided into twenty-three parts of 2° each, as indicated by the dot-and-dash lines *m, m*, representing planes interacting at the intersection of the planes *o—h* and *o—k*; if the radius indicated by the arrow-head *x* be taken as *x* and the radius indicated by the arrow-head *y* be taken as *y*, the increment in mandrel diameter for each plane to the next is

$$\frac{x-y}{23}$$

Accordingly, each unit of movement of the pipe over the mandrel results simultaneously in uniform longitudinal offsetting and uniform circumferential stretching. The outer curve of the pipe is as if it were simply bent about the outer curve of the mandrel, the offsetting graduating from zero at the outer curve to maximum at the inner curve, and the circumferential stretching being constantly in approximate balance with the longitudinal offsetting.

From the plane *o—k* to the free end of the curved portion of the mandrel, the diameter is uniform and is the desired internal diameter of the fitting to be formed, the inner curve being over the radius *y*.

As the pipe leaves the mandrel, elbows and U-turns are cut therefrom as desired, and the result is a superior fitting in the respects pointed out at the beginning of this specification.

I claim:

A mandrel for making pipe bends, comprising a body having a straight cylindrical portion of less diameter than the interior diameter of the desired bend, a curved portion of uniform diameter the same as the interior diameter of the desired bend, and an intermediate curved portion connecting said first-named and second-named

portions and increasing in diameter from said first-named portion to said second-named portion, the outer side of said intermediate and said second-named portions being of regular curvature and curved on an arc struck from a distant center and merging into the outer side of said first-named portion tangent thereto, the inner side of said intermediate portion being curved and of such curvature that the cross sectional areas of said intermediate portion in successive transverse planes equally spaced angularly about said center vary in diameter by substantially equal increments.

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