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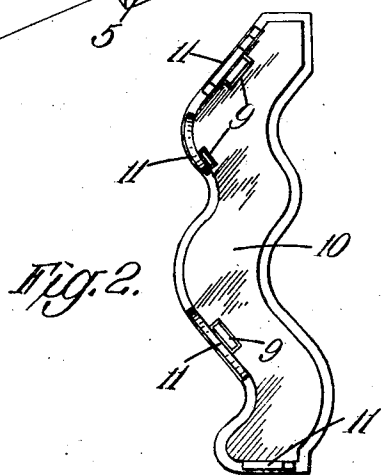
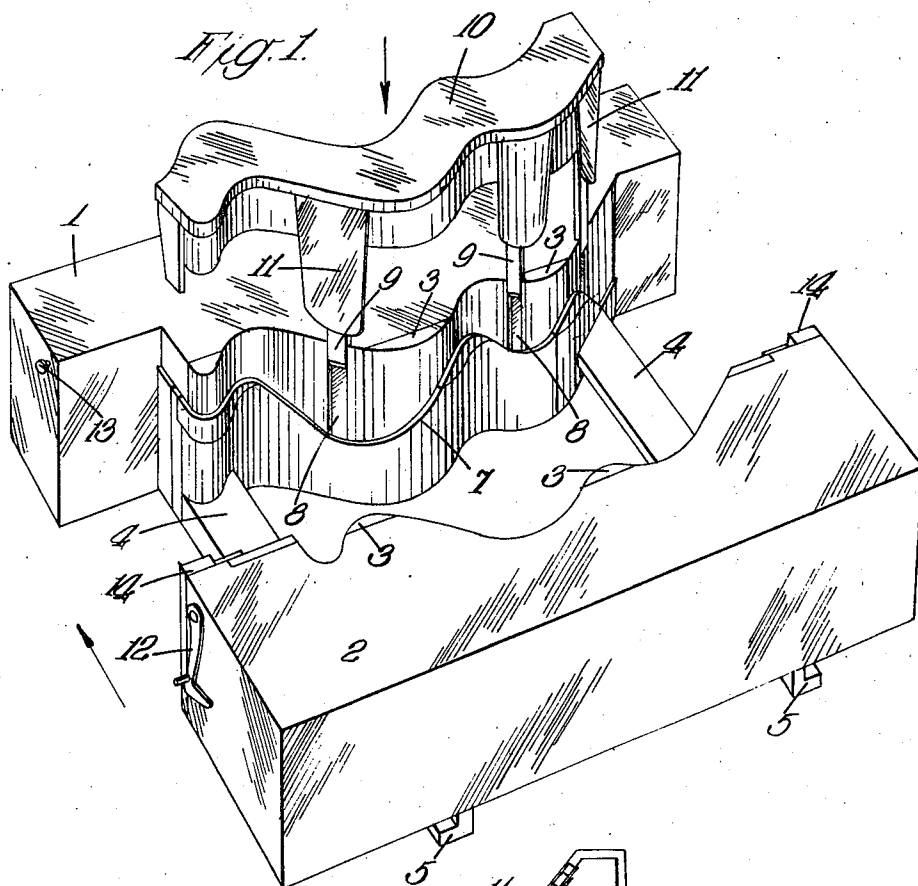
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2,357,605

PRODUCTION OF BENT TUBES

Filed March 28, 1942

4 Sheets-Sheet 1



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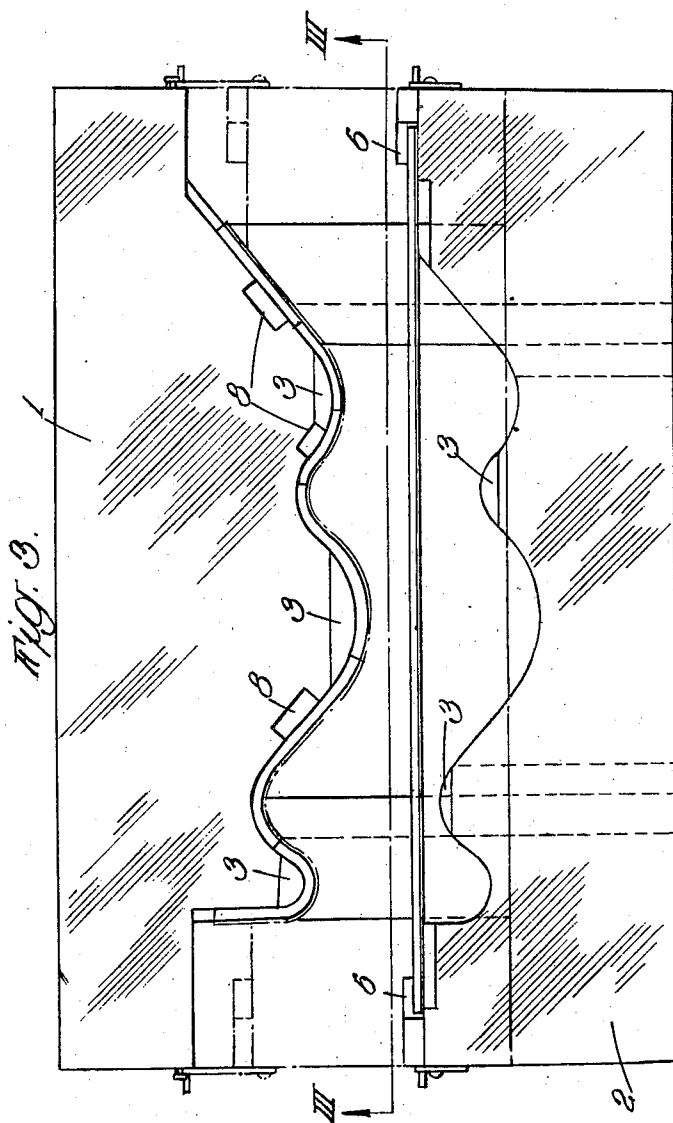
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4 Sheets-Sheet 2



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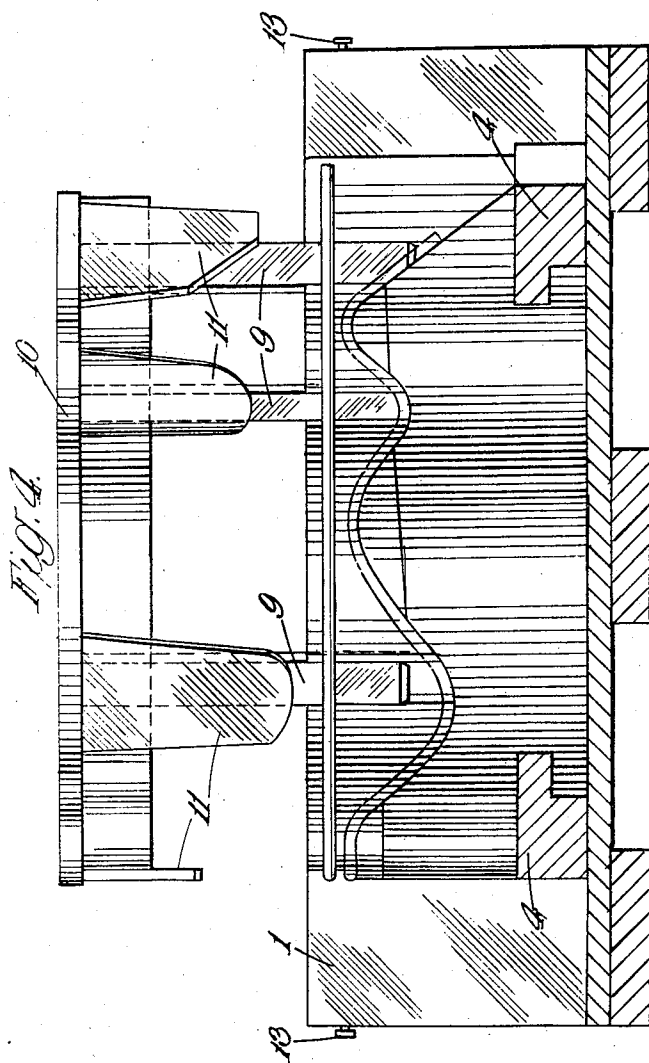
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PRODUCTION OF BENT TUBES

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4 Sheets-Sheet 3



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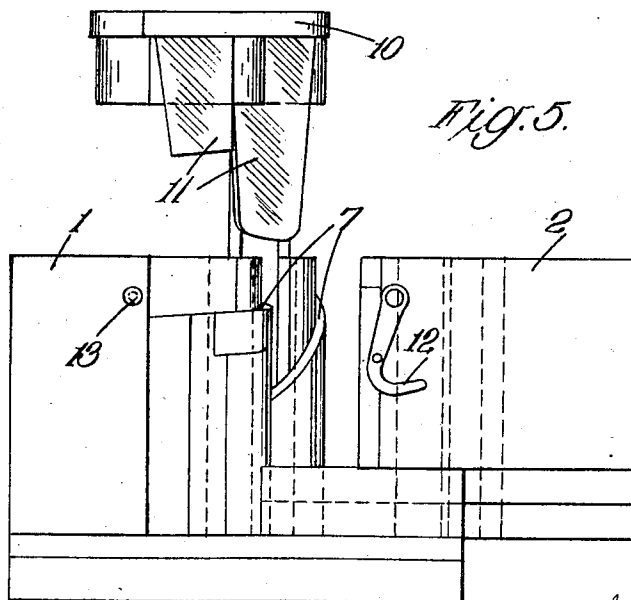
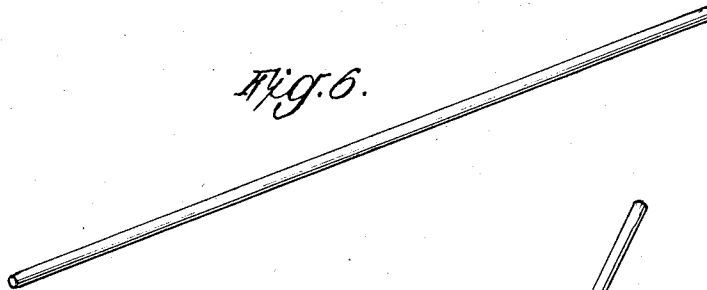
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4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

2,357,605

PRODUCTION OF BENT TUBES

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Application March 28, 1942, Serial No. 436,673
In Great Britain December 19, 1941

3 Claims. (Cl. 153—34)

The present invention relates to and is especially concerned with means for bending tubes which lend themselves to mass production whilst at the same time producing a finished article which is in no way inferior, and at least as to surface finish is even superior, to a product achieved as a result of normal hand- or machine-bending processes.

It is also worthy of mention that by employment of the means afforded by the present invention it is a simple matter to produce at a single operation a complicated bent formation which could be produced only with the greatest difficulty by hand or by the machines at present employed, with the further advantage that the bent tubes all have the same shape without the variations attendant on hand shaping.

The object therefore of the present invention is to provide a more simple apparatus for imparting complex bends to tubes.

According to the present invention a tube is first bent in one plane or direction either by relative movement with a shaping die or by pressure between a pair of shaping dies and is then bent in another plane or direction at an angle to the first by a shaping die moving relatively to the first employed shaping means.

Both the first and second stages in the bending operation are performed by a press acting on the shaping means and it is preferred to arrange that the distance between the top and bottom of the relatively movable parts in final position both in the first and second stages shall be the same so that the two operations may be carried by the same press without requiring to alter the setting of the means limiting the travel of the platens thereof.

The apparatus for carrying out the invention is such that after performing the first stage in the operation, the apparatus used therein is turned through an appropriate angle and the second shaping die positioned with respect thereto ready to perform its function on the next stroke of the press.

The shaping dies may be constructed from any desired material, and may conveniently be constructed of wood when in order to reduce wear the surfaces contacting the tube may be formed of or be protected by a more hard wearing material.

To facilitate the operation of the shaping dies, they or the tube may be greased before the bending operation.

Where a tube is likely to be subjected in the bending operation to such pressure that it is likely to crinkle at a bend, or even collapse, the tube may be filled with some suitable medium which will prevent collapse but will not materially interfere with the bending operation.

In order that the invention may be clearly un-

derstood and readily carried into effect, it is hereinafter more fully described with reference to the accompanying drawings which show for purposes of illustration but not of limitation a construction of shaping dies for performing the two stages in the shaping of a tube.

In these drawings:

Fig. 1 is a perspective of the three constituent shaping dies in open position;

Fig. 2 is an under plan view of the secondary shaping die;

Fig. 3 is a plan view of the two main shaping dies showing the tube both before and after initial bending;

Fig. 4 is a sectional elevation on the line III—III of Fig. 3 showing one of the main shaping dies with the tube already bent in the first stage and the secondary shaping die in position to perform its operation;

Fig. 5 is a side elevation of the three shaping dies in open position; and

Figs. 6, 7 and 8 show in perspective the tube prior to bending, after the first stage of bending and after the second stage of bending.

Referring now to the said drawings which illustrate dies for forming the initial bending of a tube in one plane comprising a die member 1 and complementary die member 2. These two dies each have curved surfaces of matching contour which define the shape initially to be imparted to the tube. The point of maximum convex curvature of the shape in surfaces should preferably be made of hard wearing material or a more hard wearing material than the remainder of the die as by providing inserts 3. Each die is conveniently made of wood whilst the inserts 3 are conveniently made of tough fibrous material, e. g. such as is sold commercially under the registered trade mark "Tufnol."

The dies are provided with guide-ways comprising the mutually engaging elements 4 and 5 (see Fig. 1) to constrain the dies to follow a set path during relative movement thereof to bend a tube located between their shaping surfaces. The die 2 is provided with ledges 6 on which may be located the ends of a tube as may be seen in the lower portion of Fig. 3. The die 1 is provided with a ledge 7 which extends across the face of the shaping surface. The upper edge of the ledge 7 is curved to the shape desired to be imparted to the tube during the second stage in the bending operation. The die 1 is provided with guide-ways 8 in the form of slots adapted to receive guide rails 9 on a third die 10. The die 10 is provided with a plurality of shaping elements 11 which are shaped to match the portion of the face of the shaping surface of the die 1 against which they are arranged to slide. The ends of the shaping elements 11 depress the tube and force it to take a curvature defined by the ledge 7,

The dies 1 and 2 will be made for the particular diameter of tube intended to be bent thereby and the movement of the dies towards one another will be limited as by means of end pieces 14 or otherwise as may be convenient so that when closed together a gap is left between the shaping surfaces which is slightly larger than the diameter of the tube. The shaping elements 11 of the die 10 enter into this gap.

In the operation of the dies the dies 1 and 2 are separated and a length of straight tubing as shown in Fig. 6 is positioned with its ends resting on the ledges 6. The dies 1 and 2 are then moved towards one another between the platens of a press operating gradually at steady pressure. On completion of the relative movement between the dies 1 and 2 as indicated by chain run in Fig. 3 the tube is bent in the one direction to match the curvature of the shaping surfaces, as will be appreciated from an examination of Fig. 3 and from the perspective view of the bent tube shown in Fig. 7 which shows the tube as fashioned after the initial bending. The two dies 1 and 2 are now locked against separation as by means of hooks 12 engaging pins 13 or in any other suitable way. The dies 1 and 2 are turned through 90° and the guide rods on the die 10 are now introduced into the guide slots 8 in the die 1 with the shaping elements 11 in the gap between the dies 1 and 2 whereupon the platens of the press are caused to move the die 10 relatively to the dies 1 and 2 to cause the ends of the shaping elements 11 to bend the tube in the other direction to match the curvature defined by the ledge 7. After this operation the dies are separated and the finished tube will have a shape as shown in perspective in Fig. 8.

In order to save altering the setting on the press governing the extent of movement of movable platen towards the fixed platen, the overall measurement from the top and bottom of the dies 1 and 2 when together is made equal or substantially equal to the distance from the outer surface of the die 10 to the opposite surface of the dies 1 and 2 when pressed fully home.

Whilst the invention has been described in relation to a particular arrangement of dies showing a particular configuration to be imparted to the tube, it will be understood that the dies themselves may be varied in many respects as may also be the guiding means for constraining them to traverse a fixed path.

During the bending operation the tube will preferably be filled with some suitable medium which will prevent crinkling or even collapse of the walls thereof, and preferably the medium will be introduced into the tube and removed therefrom in a heated liquid state using material known in the art for that purpose. It is also useful during actual bending operation to grease the outer wall of the tube or the dies, or both the tube and the dies.

What I claim is:

1. An apparatus for bending tubes in two angularly related directions comprising a pair of relatively movable dies having opposed surfaces conforming to the desired curvature of the tube in one direction, means for guiding the dies during relative movement, means for limiting the extent of relative movement of the dies towards one another, means for maintaining the dies in said limit position, one of the dies of the pair having in its face a plurality of guide slots

and a ledge defining curvature in a second direction, and a third die introduceable between said pair of dies when said pair of dies are in said limit position, said third die having means thereon to engage the guide slots and separate, spaced shaping elements adapted to engage the tube and to force it into engagement with the ledge, the spaced shaping elements on said third die being opposite the places in the ledge of maximum displacement in said second direction when said third die is being introduced between said pair of dies.

2. Apparatus for bending tubes in two angularly related directions comprising a pair of relatively movable dies having opposed surfaces formed with outwardly concave and outwardly convex portions conforming to the desired curvature of the tube in one direction, the bodies of said dies being of wood, inserts of material having wearing properties greater than wood on the surfaces of said dies at the places of maximum outward convex curvature, means for guiding the dies during relative movement, means for limiting the extent of relative movement of the dies towards one another, means for maintaining the dies in said limit position, one of the dies of the pair having in its face a plurality of guide slots and a ledge defining curvature in a second direction, and a third die introduceable between said pair of dies when said dies are in said limit position, said third die having means thereon to engage the guide slots and separate, spaced shaping elements adapted to engage the tube and to force it into engagement with the ledge, the spaced shaping elements on said third die being opposite the places in the ledge of maximum displacement in said second direction when said third die is being introduced between said pair of dies.

3. Apparatus for bending tubes in two angularly related directions comprising a pair of relatively movable dies having opposed shaping surfaces defining the curvature to be imparted to the tube in one direction, means for guiding said dies during relative movement, means for limiting the extent of relative movement of the dies towards one another, cooperating means on said dies for locking them together, a third shaping die introduceable between said pair of dies when said pair of dies are locked in said limit position, a further shaping surface on at least one of said pair of dies which with said third die defines the curvature to be imparted to the tube in a second direction, and means for guiding the third shaping die during the movement thereof between said pair of dies, the overall dimension of said pair of dies in a direction normal to their curved surfaces, when said pair of dies are in their limit position, being substantially equal to the distance from the outer surface of said third die, when inserted between said pair of dies and pressed fully home, and the remote opposite surfaces of said pair of dies, so that when said dies are pressed together in a press having a single reciprocatory movement, the relative movement of the pressed parts may be the same when pressing said pair of dies together to impart a curvature to the tube in one direction as when said pair of dies are turned through an angle of 90° and said third die pressed fully home between said pair of dies to impart a curvature to the tube in a second direction.

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