Sept. 5, 1944. J. BENSON 2,357,447

METHOD OF AND APPARATUS FOR SHAPING TUBING

Filed June 16, 1942 2 Sheets-Sheet 1

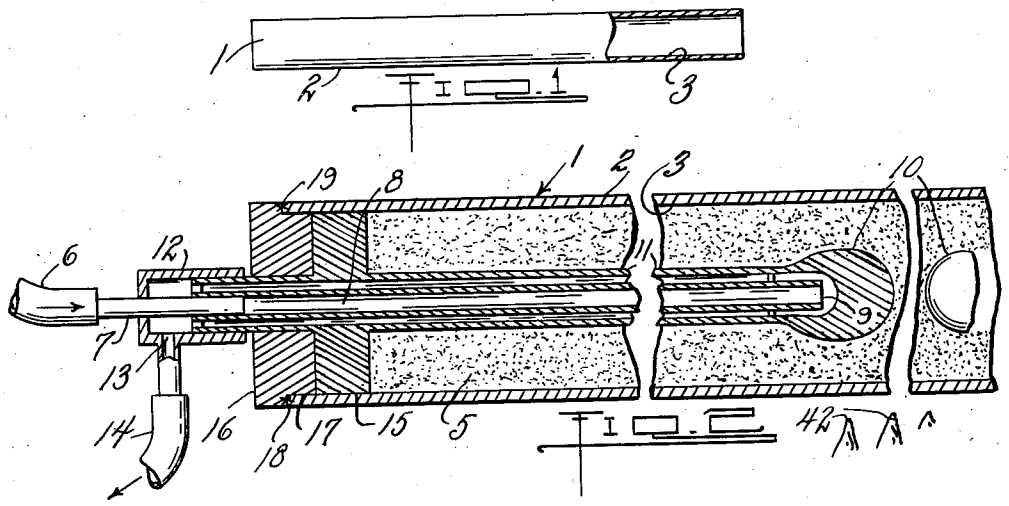


FIG. 1

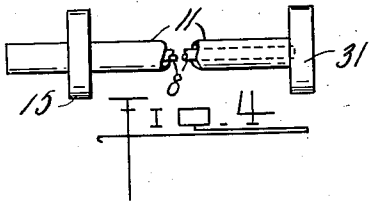


FIG. 4

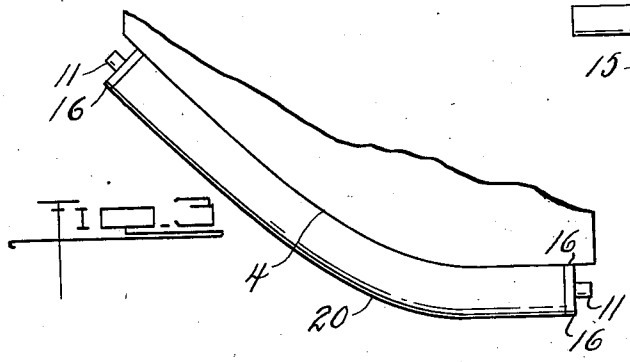


FIG. 3

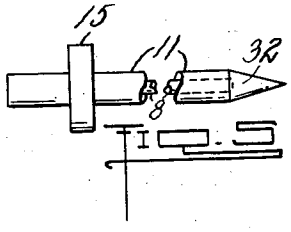


FIG. 5

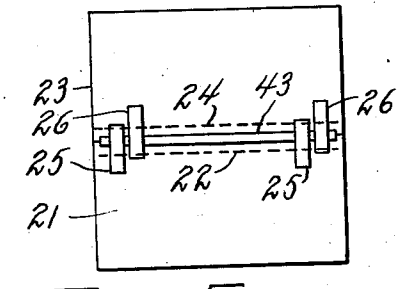


FIG. 6

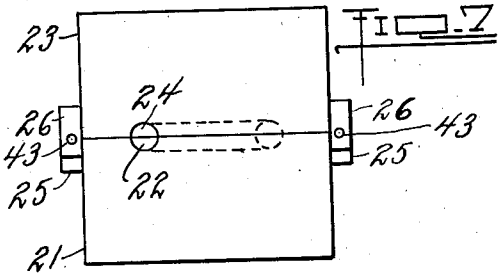


FIG. 7

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METHOD OF AND APPARATUS FOR SHAPING TUBING

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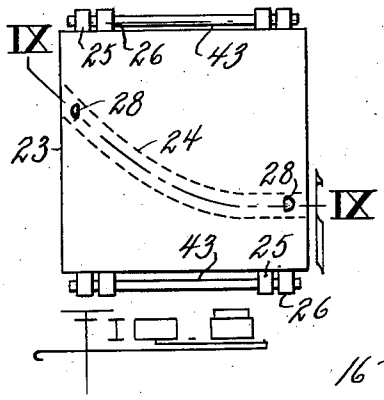


Fig. 9

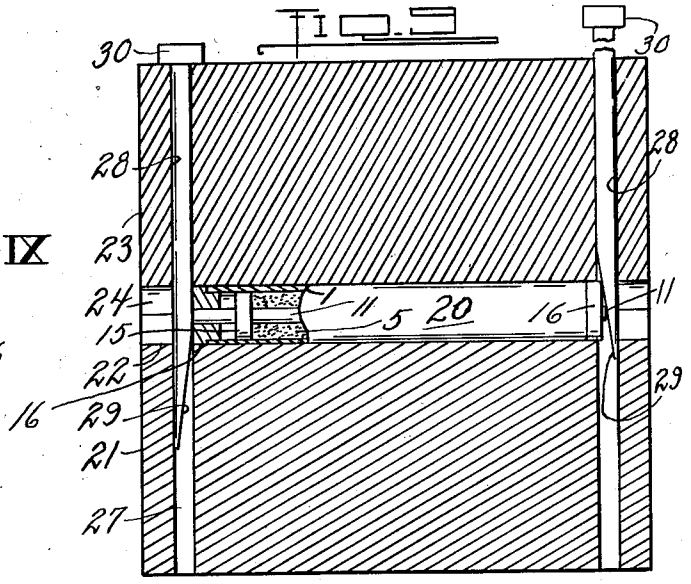


Fig. 10

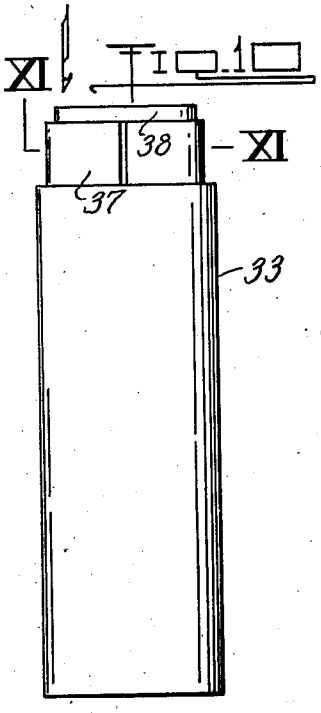


Fig. 11

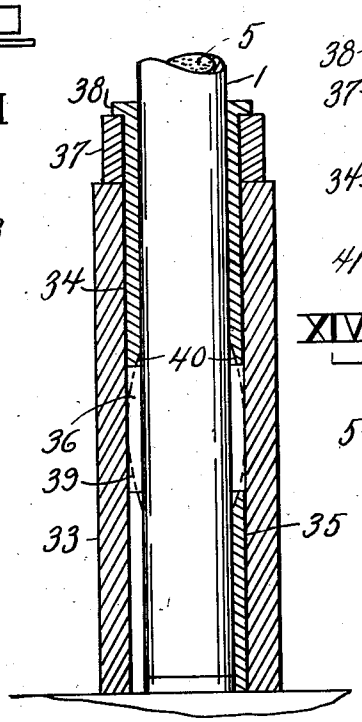


Fig. 12

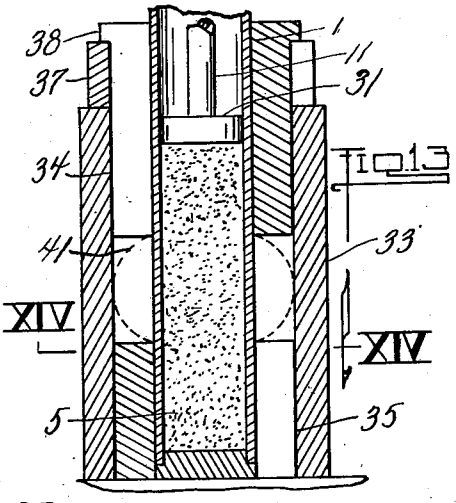


Fig. 13

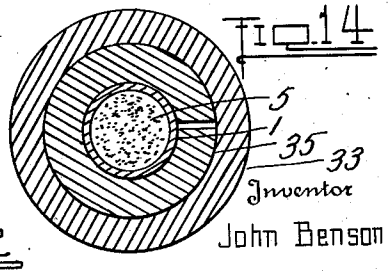


Fig. 14

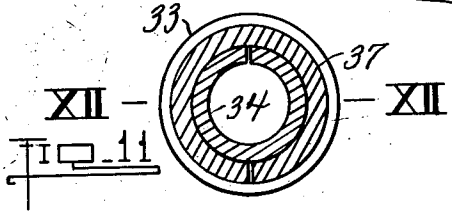


Fig. 11

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UNITED STATES PATENT OFFICE

2,357,447

METHOD OF AND APPARATUS FOR SHAPING TUBING

John Benson, Toledo, Ohio

Application June 16, 1942, Serial No. 447,309

3 Claims. (Cl. 153—2)

This invention relates to finishing hollow articles, more especially to conform to particular dimensions.

This invention has utility in effecting departures such as direction and diameter.

Referring to the drawings:

Fig. 1 is a side elevation, with parts broken away, of a metal tube as a body to be treated hereunder;

Fig. 2 is a fragmentary view of the tube as charged with a granular filler and a circulating cooler for its interior and in condition for the initial shaping, say bending;

Fig. 3 shows the article as receiving the initial change of direction or bend;

Fig. 4 is a fragmentary view of a circulating cooler of somewhat different form from that shown in Fig. 2;

Fig. 5 is a fragmentary view of the point type of cooler instead of the piston type of Fig. 4 or the bulb type of Fig. 2;

Fig. 6 is a side elevation of a two part form or die to receive the initially bent tube, say of Fig. 3 after such has been not allowed to cool or has been reheated;

Fig. 7 is a view of the form or die pair of Fig. 6 from the right;

Fig. 8 is a plan view of the die form of Fig. 7;

Fig. 9 is a section on the line IX—IX, Fig. 8, with parts broken away to show the squeeze operation in the reshaping hereunder;

Fig. 10 is a side elevation of a straight die assembly hereunder;

Fig. 11 is a section on the line XI—XI, Fig. 10, showing the initial set or holding means to receive the tubing or hollow body to be re-formed;

Fig. 12 is a section on the line XII—XII, Fig. 11, showing the way for shaping a bulge in the wall of the tubing;

Fig. 13 is a view similar to Fig. 12 of a more wide departure or bell form of the tubing; and

Fig. 14 is a section on the line XIV—XIV, Fig. 13, showing the assembly of the filler in the tube or body.

Tube 1 (Fig. 1) has outer side or surface 2 and inner side or surface 3. In the carrying out of the invention herein, such tube 1 may be given a reshaping or forming, say by bend at tool 4 (Fig. 3). This may be by heating or otherwise lowering the resistance of the body to change its shape. As the body may be of metal, heating is a step in lowering its resistance to holding its shape and thereby adapting it more readily to conform to the change. However, with metal, whether steel, brass, or other tubing, there is experienced a tendency, following or incidental to the initial shaping for the stresses especially on cooling to disturb its initial condition. This may be termed warping or departure in uniform cross section.

To overcome this difficulty, there may be at this initial shaping or thereafter a charging of the tube 1 with free flowing granular filler material as sand 5 (Fig. 2). Additionally, as a means for opposing as great a rise in temperature in the inner side 3 as may be effected for the outer side 2 of the tubing, a circulating cooler may be installed. Herein such is shown as water supply hose 6 connected to duct 7 registering with inner duct 8 having discharge terminus 9 into heavy wall ball 10 with return therefrom by outer concentric member 11 to head 12 having outlet port 13 to which is connected exhaust or discharge hose 14. This water circulating cooler device has solid piston or centering member 15. As installed, this may be inward from plug 16 having registering diameter 17 within the tubing 1 and outer shoulder 18 thereagainst. This may be in instances positively anchored with this tubing 1 say by welds 19.

In this water circulating cooler for the inner side 3 of the tubing, the outer side 2 in its skin-like surface portion may be heated and the initial shaping or bend effected say for curve portion 20 (Fig. 3). This may be appropriate for the direction to be given a fuel intake for an internal combustion motor or for an exhaust pipe therefrom, as in aviation work. Lower form or die member 21 (Fig. 9) has way 22 conforming to the bend 20. Complementary die or form member 23 has opposing complementary way 24. With this bent tube 20 in position between the form holders 21, 23, such register one with the other through outer ears or lugs 25, 26 (Figs. 6, 7). As so located in the form, this reheated outer skin or still superficially hot bent tube 20 may be given a squeeze as to the interior or granular body 5. The end achieved by this rise in temperature local to the outer surface is to the extent of compensating for slight elongation on the outer or longer convex side and compression on the inner concave side; but with each of these skin surfaces having sufficient reinforcement maintained by the inner wall therefor that gage disturbance may not be serious. In fact with some thicknesses of stock, stock character and extent of arc, it may be in order to allow the diametrical warming by conduction or radiation, say for a stretch in the warmer longer side of the arc. This may develop elongation, emphasizing the importance of the endwise squeeze. This is effected for the reason

that openings 27 (Fig. 9) in the lower form 21 register with segment shaped openings 28 in the upper form member 23. There is accordingly provided across the way 22, 24, and adjacent each terminus thereof, a continuous passage for wedge stem 29 having head 30 to be inserted in these respective openings 27, 28. As driven, these wedges 29 effect a longitudinal squeeze action and internally of the bent tube 20, which is a thrusting of the granular material 5 due to the shifting of the piston 15 away from the plug 16. The extent of this shifting may be according to the deformation or the formation which it is desired the tube 20 take. In this operation the squeeze is retained for a period of time for the temperature to drop sufficiently so that the more rigid holding of the tube 20 by the filler 5 and the form 21, 23, is effective. The experience had is that with this treatment there is reduced, if not fully eliminated, tendencies of the tube to warp or get out of shape, and there is thus established a uniformity in the product for application to the particular jobs for which designed.

The particular type of device for the cooling circuit, as well as the plunger for squeeze action, may be a departure from the bulb device of Fig. 2, say to head 31 (Fig. 4) or to point 32 (Fig. 5).

In lieu of the two part form 21, 23, especially in instances where the object is not one to have a direction change as a bend, but merely a diameter change for increasing or reduction, then there may be adopted form 33 (Fig. 10) as the outer member of the die having inner die portions 34, 35 (Fig. 12) with clearance region 36 therebetween for dimension change, say for enlarged diameter. In order to determine this clearance region 36 there may be introduction of split collar 37 at shoulder 38, thereby to hold this die member 34 of the form while the tubing 1 is inserted therein. This tubing 1 may have the cooling circuit means. The squeeze action may be effected say in a press. This adaptation for a developing swell or bulge 39 on the tube 1 may have bevel portion 40 at the die or form member 34, thereby to have the bell 39 less abrupt at the change of dimension. An instance of enlargement say to bell 41 (Fig. 13) may be effected with the piston 31.

In these operations, it is desirable to hold an ultimate shaping. To this end, there may be initial bend, and shaping or change in the initial tubing as to diameter (Figs. 12, 13). However, at the shape to which to be held it is desirable that the outer side 2 of the tubing have its temperature raised or the tube be less resistant at such region to holding its shape, while the inner side 3 is not so released, at least to as great extent, due to the filler 5 and the cooling circuit therein, and this cooling circuit is of such embodiment as to promote squeeze of the tubing body in the form, while the temperature of the outer side is such that the tube may readily be so re-formed. With the lower inner side temperature for the tube and the holding of the squeeze for the temperature still further to drop, there is the production of a symmetrical article in the operations hereunder.

The reheating may be effected by the action of flame 42 (Fig. 2). It is preferable to localize the reheating to the regions wherein shape disturbance may be minimized. With the bent tubing 20 in the form 21, 23, the assembly of these forms is maintained by pins 43 at the application of the squeeze pressure through the functioning of the drive pin wedges 29. Upon removal of these wedges 29 and the pins 43, the welds 18 may be broken for removal of the plugs 16 and the circulating cooler as well as the sand 5. The head 12 with its supply and discharge connections is removed from the unit to be squeezed before the pins 29 are driven to start the squeeze operation in pushing the sand to distend the tube into the form.

What is claimed and it is desired to secure by Letters Patent is:

1. In the reshaping of a tube, the step of charging the tube interior with a granular filler, the step of circulating a temperature control medium in the tube spaced by the filler from the tube interior side in thereby retarding temperature rise while simultaneously heating the outer side of the tube counter to the medium, the step of locating said tube in a form, and the step of squeezing the ends of the tube toward each other while the tube is held and subject to circulation of said medium.

2. Apparatus for reshaping a superficially heated tube embodying the combination of a rigid form of the contour for the reshaping, a granular filler for the tube, sealed plug ends for the tube, piston means in the tube between a plug end and the filler, and thrusting means for moving a piston means as to a plug end of the tube for acting upon the filler in reshaping the tube to the contour of the form.

3. A tube reshaper comprising a rigid form of the contour to be developed, sealed plug ends for the tube to be acted upon, duct communication thru the plug ends for circulating a cooling medium, piston means rigid with a duct portion, granular filler in the tube, and wedge means for shifting the piston means as to a plug end by moving the duct to compact the filler in the tube.

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