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MEANS FOR CORRUGATING METAL TUBING

Filed March 7, 1932

3 Sheets-Sheet 1

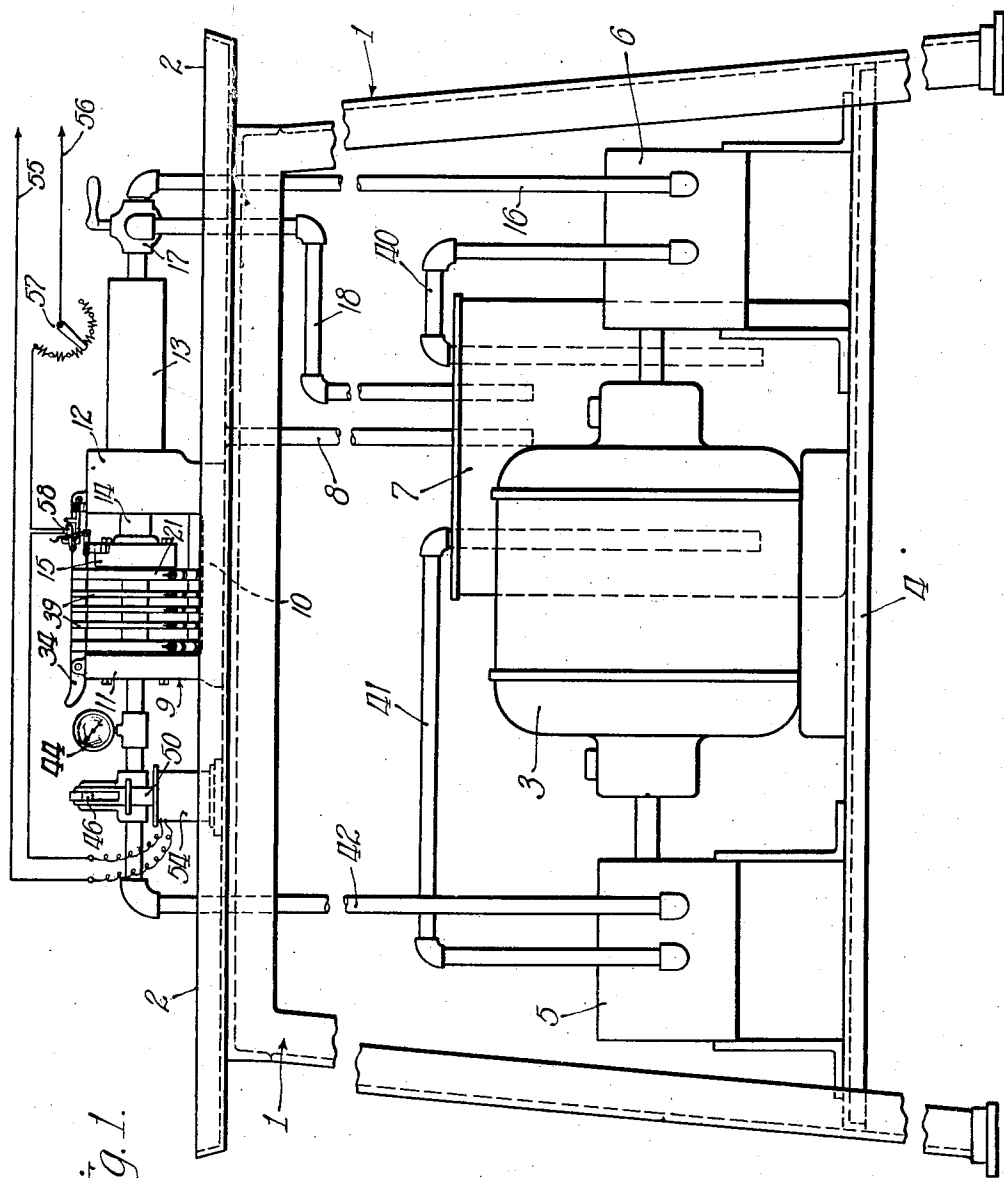


Fig. 1.

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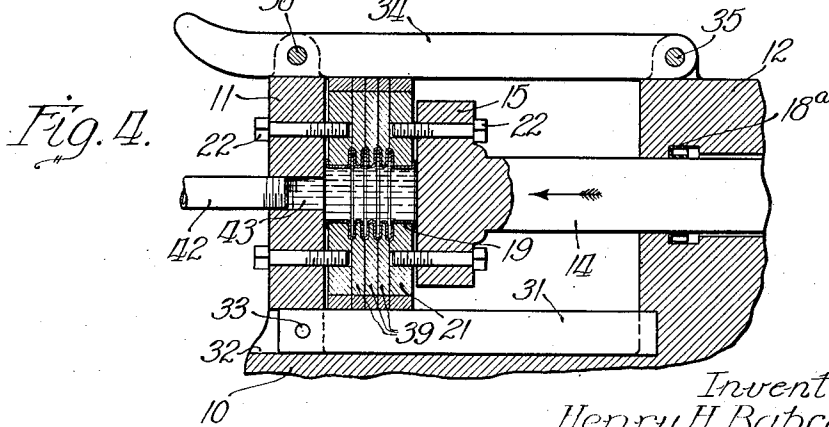
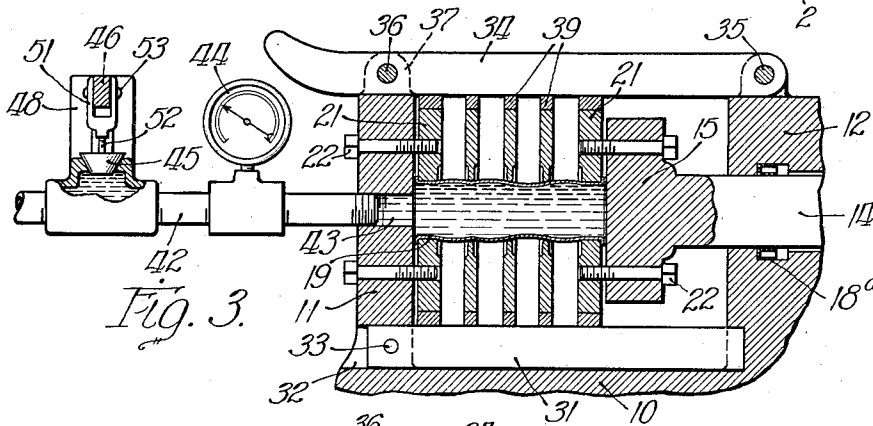
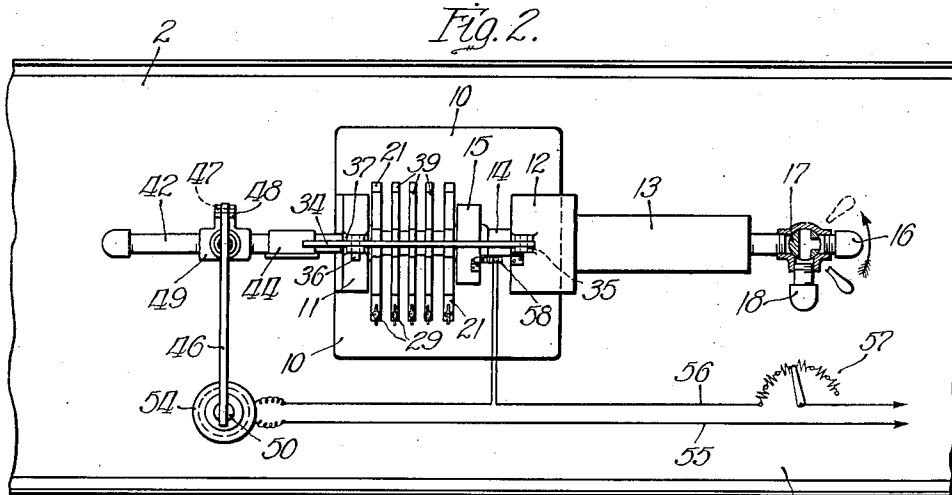
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3 Sheets-Sheet 2



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MEANS FOR CORRUGATING METAL TUBING

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3 Sheets-Sheet 3

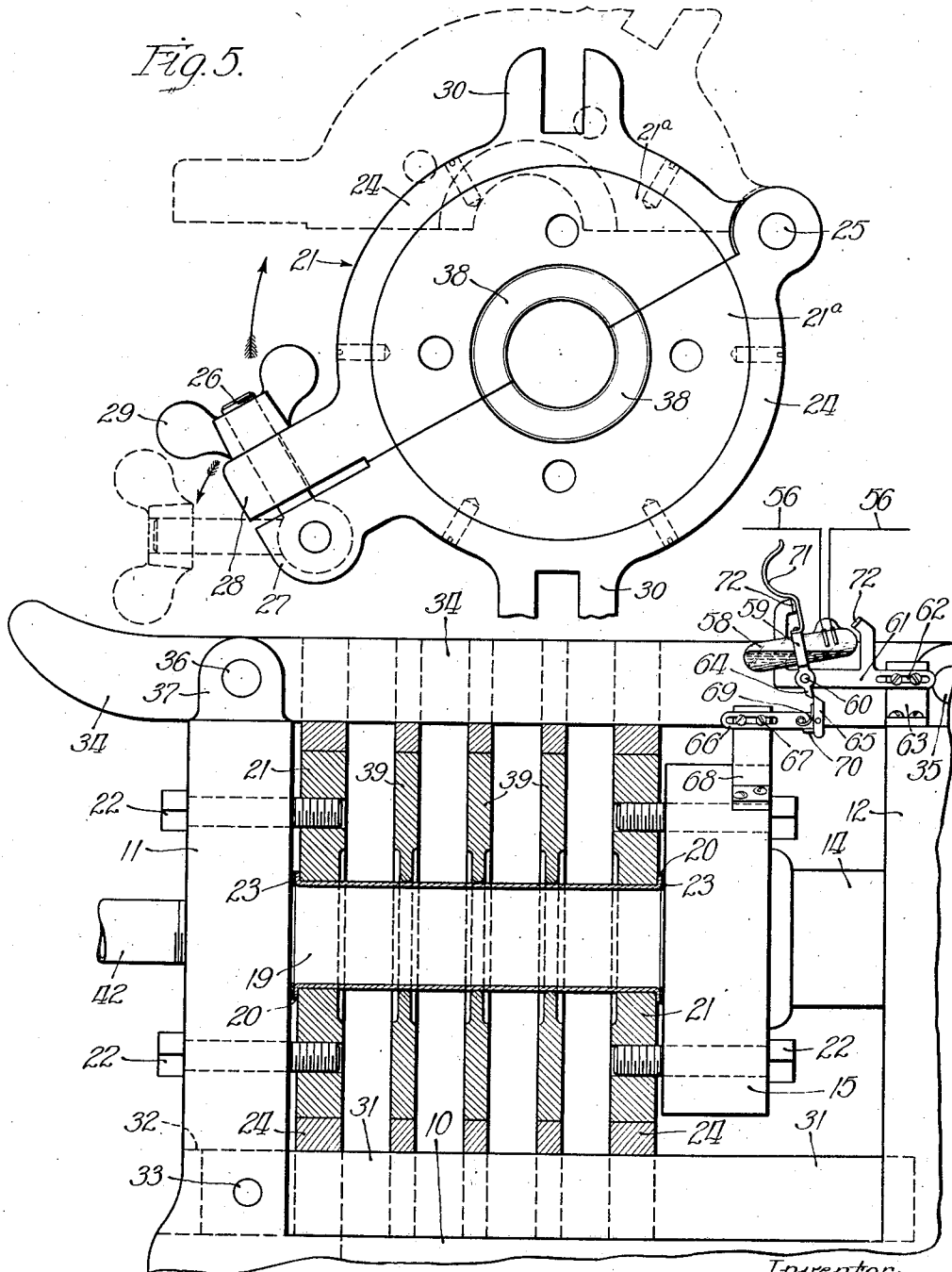


Fig. 6.

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UNITED STATES PATENT OFFICE

2,048,588

MEANS FOR CORRUGATING METAL TUBING

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9 Claims. (Cl. 153—73)

This invention relates to corrugating metal tubing, and has to do particularly with a means and method for subjecting metal tubing to combined axial and radial pressure, compressing the tubing axially while expanding it radially, so as to impart corrugations thereto.

This invention is in the nature of an improvement over the apparatus and method disclosed in the Hollerith & Metcalf Patent No. 349,718 for Apparatus for corrugating metal tubing, issued September 28, 1886.

The object of the present invention is to improve this apparatus and method, to the end of speed and uniformity for commercial purposes. Further objects and advantages of the instant invention will appear from the detailed description.

In the drawings:—

Figure 1 is an elevational view of a machine for practicing the method of the invention;

Figure 2 is a plan view of the machine;

Figure 3 is a vertical sectional view through the mold sections and the heads and associated parts of the machine showing the condition of the tube after it has been subjected to initial axial pressure, parts being shown in elevation;

Figure 4 is a view similar to Figure 3 after the completion of the corrugating operation;

Figure 5 is a face view of one of the mold sections and the holder therefor, on an enlarged scale;

Figure 6 is a vertical sectional view through a tube to be corrugated and the associated mold sections, before the tube has been subjected to initial endwise pressure, the movable head and associated parts being shown in elevation, this view also showing the switch for controlling the solenoid circuit.

The machine comprises a suitable stand 1 provided with a top 2 in the form of a drain pan. An electric motor 3 is mounted on a shelf 4 suitably supported at the lower portion of the stand, and has driving connection with pumps 5 and 6, of suitable type, these pumps also being suitably mounted upon shelf 4. A water tank 7 is mounted upon shelf 4 and water is discharged into this tank from top 2 by means of a suitable drain pipe 8.

A U-shaped frame 9 is mounted upon top 2. This frame includes a base 10, a fixed head 11 at one end of this base and an upright 12 at the other end of the base. A cylinder 13 extends from upright 12 and slidably receives a piston 14 which is provided, at its inner end, with a head 15.

Water is delivered from pump 6 to the cylinder

13, through a pipe 16 and a three-way valve 17 from the casing of which a return pipe 18 discharges into tank 7. With the valve 17 in the full line position of Figure 2, the water from pipe 16 is returned through pipe 18 to the tank 7 and the piston 14 is not actuated. By turning the valve into the dotted line position of Figure 2, pipe 16 is connected to cylinder 13 and piston 14 is actuated by hydraulic pressure derived from pump 16 for forcing head 15 toward the fixed head 11. A suitable packing 18a may be provided in upright 12 about piston 14.

A tube 19, to be corrugated, is disposed between the heads 11 and 15, as in Figure 3. Each end of this tube is flanged outwardly, at 20, and is clamped to the adjacent head by means of a mold section 21 which is secured to the head by bolts 22 and contacts the base of the flange away from the head. Preferably, packing gaskets 23 are disposed between the flanges and the heads to form a fluid tight and pressure resistant closure therebetween. Each of the mold sections comprises two members 21a adapted to fit closely about the tube 19, these members being suitably secured in a holder 24 which is formed in two sections hinged together at 25. A swing bolt 26 is pivoted to a lug 27 of one section of the holder and engages into a slotted lug 28 of the other section of the holder. A wing nut 29 screws upon the bolt 26 and cooperates with lug 28 for securing the two sections of the holder together. Each section of the holder is provided with a slotted lug 30. One of these lugs receives a guide bar 31 which rests upon base 10 and is insertable and removable through a slot 32 in head 11. One end of this guide bar rests in a corresponding recess in upright 12, and the other end of this bar is secured in head 11 by means of a pin 33, or in any other suitable manner. Lug 30 of the other section of the holder receives an upper guide bar 34 pivoted at 35 to upright 12, this bar being normally held in lowered position by a pin 36 passing through the bar and through spaced ears 37 projecting from head 11 and between which the guide bar fits. Each of the members 21a of the mold sections is provided with a recess 38 concentric with the tube 19 and corresponding to approximately one-half of the desired corrugation. Intermediate mold sections 39 are disposed about the tube 19 in spaced relation to each other and to the sections 21. These intermediate mold sections are mounted in suitable holders similar to that shown in Figure 5. The mold sections 39 are provided in the opposite faces thereof with recesses or cavities similar to the

cavities 38 of the mold sections 21 and when all of the mold sections are disposed in contact, the cavities thereof define spaces conforming to the desired corrugations of the tube.

5 The intake of pump 6 is connected to water tank 7 by a pipe 40 and the intake of pump 5 is connected to tank 7 by a pipe 41. The discharge of pump 5 is connected by a pipe 42, to a bore 43 (Figures 3 and 4) which opens through 10 head 11 into the tube 19. A suitable pressure gauge 44 is connected into pipe 42 and this pipe is provided with a relief valve 45. A valve lever 46 is pivoted at one end, at 47, to a bracket 48 carried by valve fitting 49. A weight 50 is pivoted 15 to the lever 46 adjacent the other end thereof and provides a load upon the valve 45 for normally holding the latter closed, this valve being appropriately connected to the lever as by means of a clevis 51 and valve stem 52, the clevis being 20 pivoted at 53 to the lever. The weight 50 depends from the lever into a solenoid 54 suitably mounted on table 2. Electrical energy may be supplied to this solenoid from any suitable source, by means of the conductors 55 and 56. Normally, 25 the circuit of the solenoid 54 is open and the weight 50 only is effective to load the valve. When the solenoid is energized, however, it exerts a considerable downward pull upon the weight 50, thereby materially increasing the loading of 30 valve 45. Conveniently, a rheostat 57 of suitable type is included in the solenoid circuit and provides means whereby the effective strength of the solenoid may be varied within considerable limits, thus rendering it possible to vary the 35 loading of the valve above normal to suit conditions.

A mercury tube switch 58, of known type, is interposed in conductor or lead 56. This switch is suitably mounted in a carrier 59 pivoted at 40 60 upon a frame 61 which is adjustably mounted, by slot and screw means 62, upon a bracket 63 secured to upright 12. Carrier 59 is provided with a depending finger 64 disposed to contact a trip finger 65 pivoted upon an arm 66 adjustably mounted, by slot and screw means 67, upon 45 a bracket 68 suitably secured to movable head 15. Finger 65 is normally held in upright position by a leaf spring 69 and a stop lug 70, the spring permitting rocking movement of finger 50 65 in counterclockwise direction as viewed in Figure 6. The switch 58 is normally in the position shown in Figure 6, in which position it is held by contact of a stop member 71, extending upwardly from carrier 59, with an appropriately 55 disposed stop finger 72 carried by frame 61. In this position of the switch 58, the circuit of the solenoid is opened.

With the tube 19 properly mounted between the heads 11 and 15, as in Figure 6, finger 64 60 is immediately in advance of the upper end of trip finger 65. With the three-way valve 17 in position to by-pass the water from pump 6 into the tank 7, the circuit of motor 3 is closed so as to drive both of the pumps. Pump 5 quickly fills 65 the tube with water and the pressure within the tube is built up to that allowed by the loaded valve 45, it being noted that this pressure is not sufficiently high to cause stretching and outward bulging of the tube between the mold sections, though it should be sufficiently high to 70 prevent objectionable inward collapsing or wrinkling of the tube when it is initially subjected to endwise or axial pressure. Valve 17 is then turned into position to admit water from pipe 6 75 into the cylinder 13, thus moving the head 15

toward the head 11. This subjects the tube 19 to axial pressure sufficient to cause a displacement of the metal of the tube. The metal thus displaced will bulge either inwardly or outwardly 5 between the mold sections. Due to the pressure maintained within the tube, the metal should, in the main, bulge outwardly between the mold sections, though it may bulge inwardly between certain of the sections, as shown in Figure 3, which 10 illustrates the first step, that is, the condition of the tube after it has been subjected to this initial axial pressure. This initial axial compression of the tube renders available metal for producing the desired corrugations without subjecting the tube to objectionable stretching or 15 thinning between the mold sections. Immediately after this initial axial compression of the tube has occurred, finger 65, which moves with the head 15, trips the mercury tube switch 58 and rocks it in a clockwise direction, as viewed 20 in Figure 6, into circuit closing position, in which position it is held by contact of stop 71 with stop finger 72 of frame 61. This closes the circuit of the solenoid which materially increases the load on valve 45, resulting in an immediate 25 and material increase in pressure within the tube 19. This increased pressure within the tube is not sufficiently great to cause undesirable stretching and thinning of the tube between the mold sections, but is of proper value to bulge the tube 30 outwardly between such sections. This applies particularly to such portions of the tube as may have been bulged inwardly by the initial axial compression of the tube. In this connection, it is to be noted that the increase in pressure within 35 the tube occurs before any small wrinkles, such as would be difficult to remove, have been formed in the tube by the axial compression thereof. The increased pressure within the tube is maintained during the continued movement of head 40 15 toward head 11, and the formation of the outward bulges of the tube between the die sections, in conjunction with the redistribution by the internal pressure of the metal displaced by the axial compression of the tube, serves to lock 45 the movable mold sections 39 to the tube so that, as the metal is bulged outwardly between these sections and the tube is compressed axially, mold section 21 carried by head 15 and the intermediate mold sections 39 are moved toward the head 50 11 until the mold sections are in contact, at which time the corrugating of the tube is completed, as in Figure 4. It is to be particularly noted that the metal for forming the initial outward bulges from which the corrugations are 55 formed, is rendered available by the initial axial compression of the tube, these bulges not being produced by stretching and thinning of the metal of the tube between the mold sections. In accordance with the method of the instant inven- 60 tion, the metal of the tube is displaced by subjecting the tube to axial compression, and this metal, as displaced, is redistributed by subjecting the tube to internal pressure and is formed between the mold sections into the desired cor- 65 rugations.

By providing automatic means for increasing the pressure within the tube, after the tube has been subjected to predetermined axial compression, proper forming of the desired corrugations 70 is assured and objectionable stretching and thinning of the wall of the tube, in the production of these corrugations, is avoided. Furthermore, this automatic increase of pressure within the tube eliminates the human factor and assures 75

the production of corrugated tubes having uniform characteristics. The initial pressure within the tube, as well as the value of the increased pressure, may vary considerably in accordance with the metal or alloy used, the wall thickness of the tube and the diameter thereof, and various other factors. The particular pressures best adapted for use with any particular tubing can readily be determined by experiment. The provision of the rheostat in the circuit of the solenoid provides convenient means whereby the loading effect of this solenoid can be varied to suit conditions.

What is claimed is:—

1. In combination in means for corrugating metal tubing and the like, means for compressing a tube axially, means for maintaining the tube under a constant and predetermined internal pressure during initial axial compression thereof, and means for automatically increasing the pressure within the tube after axial compression thereof has proceeded to a predetermined extent and for maintaining such increased pressure within the tube at a constant value during continued axial compression of the tube.

2. In combination in means for corrugating metal tubing and the like, two heads one of which is movable toward and away from the other, said heads being disposed to receive between them a tube to be corrugated, the heads closing the ends of the tube, means for imparting relative movement to the heads toward each other for compressing the tube axially, means for subjecting the tube to predetermined internal pressure during initial axial compression thereof, and means for automatically increasing the pressure within the tube after predetermined relative movement of the heads toward each other.

3. In combination in means for corrugating metal tubing and the like, two heads one of which is movable toward and away from the other, said heads being disposed to receive between them a tube to be corrugated with its ends closed by and in abutting relation to the heads, means for moving the movable head toward the other head and thereby compressing the tube axially, and means for subjecting the tube to predetermined internal pressure at the initiation of the axial compression thereof and for automatically increasing the pressure within the tube after axial compression of the latter to a predetermined extent.

4. In combination in means for corrugating metal tubing and the like, two heads one of which is movable toward and away from the other, said heads being disposed to receive between them a tube to be corrugated with its ends closed by and in abutting relation to the heads, means for moving the movable head toward the other head and thereby compressing the tube axially, means for subjecting the tube to predetermined internal pressure at the initiation of the axial compression thereof, and means responsive to travel of the movable head for automatically increasing the pressure within the tube in the travel of the movable head toward said other head.

5. In combination in means for corrugating metal tubing and the like, two heads one of which is movable toward and away from the other, said heads being disposed to receive between them a tube to be corrugated with its ends closed by and in abutting relation to the heads, means for moving the movable head toward the other head and thereby compressing the tube axially, pressure means for supplying fluid to the interior of the tube and thereby subjecting the latter to

internal pressure, a loaded relief valve for controlling the pressure within the tube and initially set to open at a pressure less than the maximum pressure of said pressure means, and means for automatically increasing the loading of the valve after the tube has been subjected to predetermined axial compression.

6. In combination in means for corrugating metal tubing and the like, two heads one of which is movable toward and away from the other, said heads being disposed to receive between them a tube to be corrugated with its ends closed by and in abutting relation to the heads, means for moving the movable head toward the other head and thereby compressing the tube axially, a constantly driven pump delivering liquid under pressure to the interior of the tube, a loaded relief valve between the pump and the tube, and initially set to open at a pressure less than the maximum pressure of said pump, and means for automatically increasing the loading of the valve after the tube has been subjected to predetermined axial compression.

7. In combination in means for corrugating metal tubing and the like, two heads one of which is movable toward and away from the other, said heads being disposed to receive between them a tube to be corrugated with its ends closed by and in abutting relation to the heads, means for moving the movable head toward the other head and thereby compressing the tube axially, a constantly driven pump delivering liquid to the interior of the tube, a relief valve between the pump and the tube, a lever connected to the valve, a weight on the lever for loading the valve, a solenoid, the weight being subjected to the magnetic field of the solenoid when the latter is energized, and means for automatically closing the circuit of the solenoid after the tube has been subjected to predetermined axial compression.

8. In combination in means for corrugating metal tubing and the like, two heads one of which is movable toward and away from the other, said heads being disposed to receive between them a tube to be corrugated with its ends closed by and in abutting relation to the heads, means for moving the movable head toward the other head and thereby compressing the tube axially, a constantly driven pump delivering liquid to the interior of the tube, a relief valve between the pump and the tube, a lever connected to the valve, a weight on the lever for loading the valve, a solenoid, the weight being subjected to the magnetic field of the solenoid when the latter is energized, and means actuated by the movable head for automatically closing the circuit of the solenoid after the tube has been subjected to predetermined axial compression.

9. In combination in means for corrugating metal tubing and the like, two heads one of which is movable toward and away from the other, said heads being disposed to receive between them a tube to be corrugated with its ends closed by and in abutting relation to the heads, means for moving the movable head toward the other head and thereby compressing the tube axially, a constantly driven pump delivering liquid to the interior of the tube, a relief valve between the pump and the tube, a lever connected to the valve, a solenoid, a weight on the lever for loading the valve and extending into the solenoid, and means for automatically closing the circuit of the solenoid after the tube has been subjected to predetermined axial compression.

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