June 15, 1937. M. H. WARD 2,083,763

METHOD OF AND APPARATUS FOR SHAPING METAL

Filed Aug. 12, 1929 3 Sheets-Sheet 1

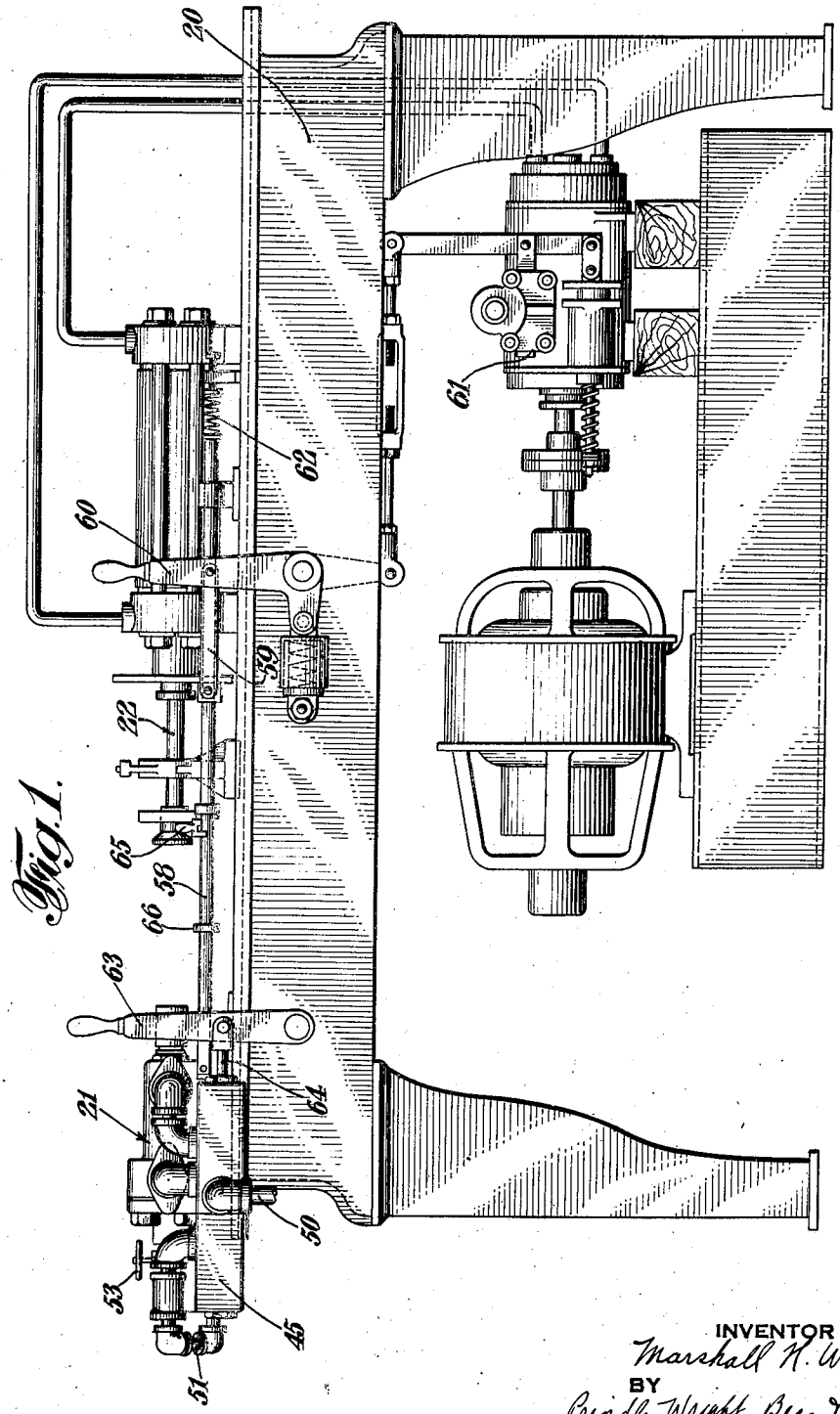


Fig. 1.

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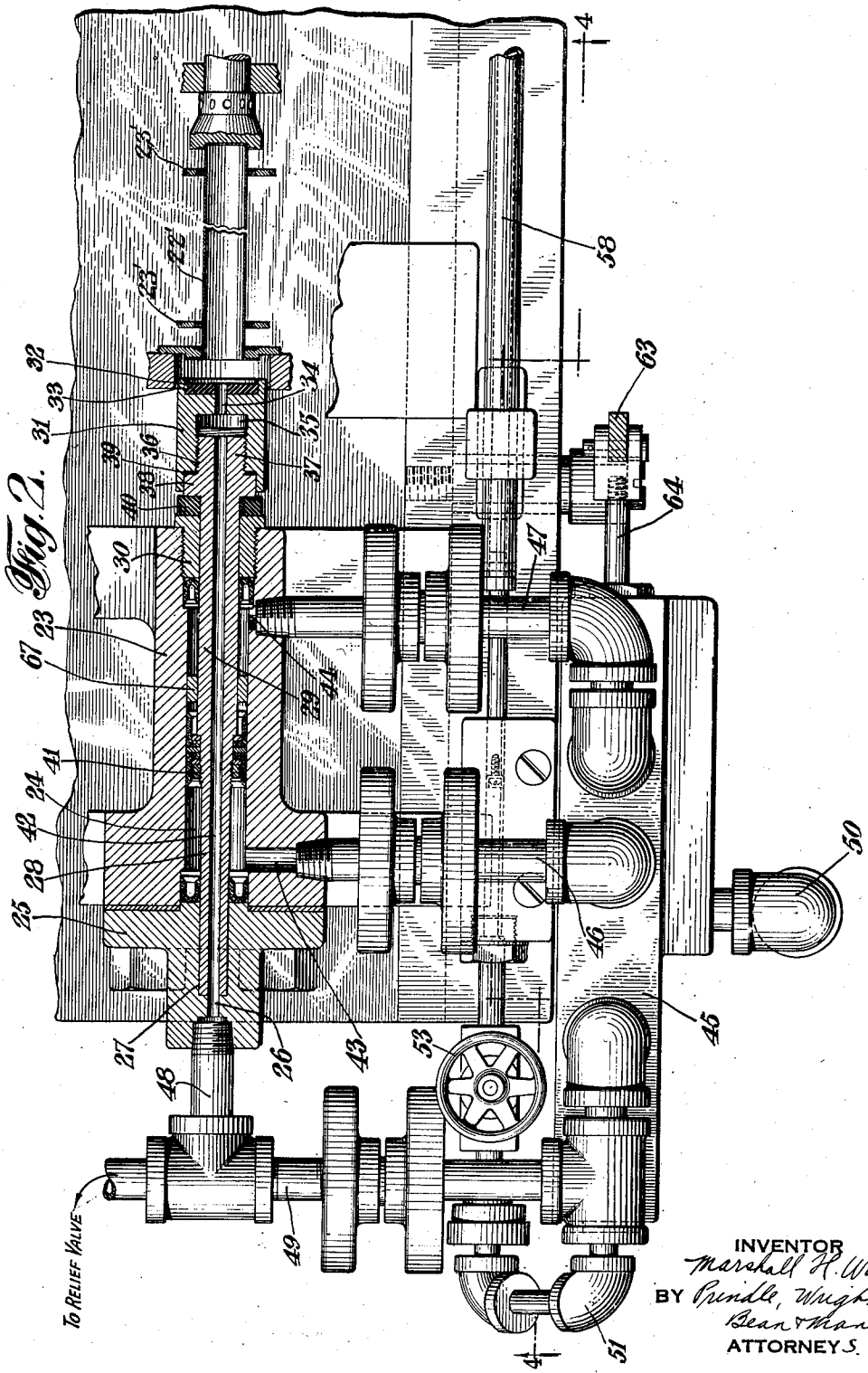


Fig. 2.

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Filed Aug. 12, 1929 3 Sheets-Sheet 3

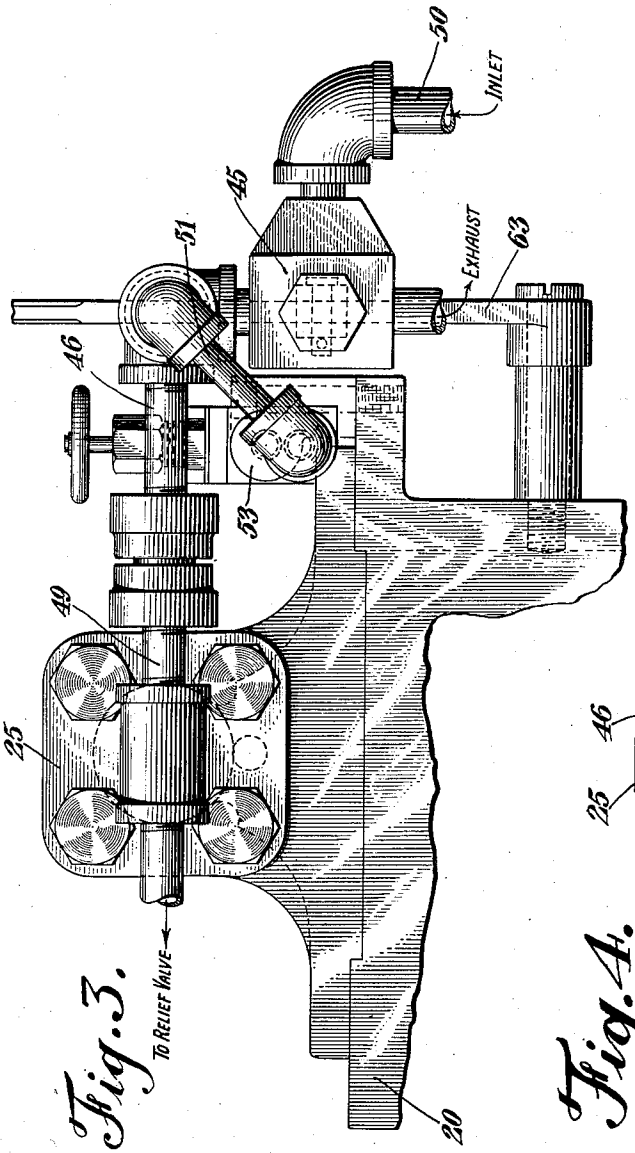


Fig. 3.

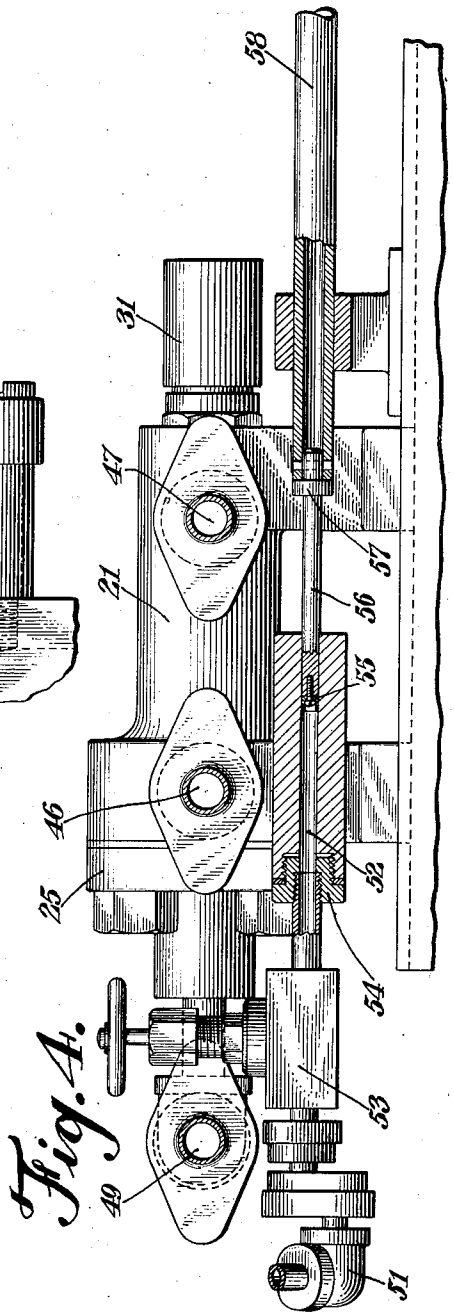


Fig. 4.

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UNITED STATES PATENT OFFICE

2,083,763

METHOD OF AND APPARATUS FOR SHAPING METAL

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Application August 12, 1929, Serial No. 385,451

23 Claims. (Cl. 153—73)

This invention relates to improvements in method of and apparatus for shaping metal, such as disclosed in my application Serial No. 334,454 filed January 23, 1929 now Patent No. 1,951,381, dated March 20, 1934.

The principal object of this invention is the provision of means whereby a continuous operation is accomplished, that is, the blank is placed in position, then sealed, then fluid pressure admitted thereinto and the movement of the movable head or ram begins before the internal fluid pressure in the blank reaches its maximum; this is all accomplished as practically one operation, without pause or interval.

Another object of this invention is the provision of means for controlling the movement of the movable head or ram in synchronism with the admission of fluid under pressure into the interior of the hollow blank so that this internal pressure may be restricted to a minimum prior to the beginning of the forming movement of the movable head.

A further object of this invention is the provision of controlling means for definitely regulating the retracting movement of the movable head and for causing the cessation thereof at the proper point.

Further objects of this invention include improvements in details of construction and arrangement whereby an apparatus of this character may be efficiently operated by unskilled labor at a maximum capacity with a minimum amount of spoilage or injury to the blanks being used therein.

To the accomplishment of the foregoing and such other objects as may hereinafter appear, this invention consists in the method and the construction, combination and arrangement of parts hereinafter described and then sought to be defined in the appended claims, reference being had to the accompanying drawings forming a part hereof and which show, merely for the purpose of illustrative disclosure, a preferred embodiment of my invention, it being expressly understood, however, that various changes may be made in practice within the scope of the claims without digressing from my inventive idea.

In the drawings—

Figure 1 represents a side elevation of a machine constructed in accordance with one embodiment of my invention, parts being shown in neutral or non-operative position;

Figure 2 is a view partly in plan and partly in horizontal longitudinal cross-section illustrating the fluid control feature;

Figure 3 is an end elevation of the construction shown in Figure 2 looking from the left-hand end of the same; and

Figure 4 is a vertical cross-section taken substantially on line 4—4 of Figure 2.

As this invention relates to an improvement on the disclosure of my above mentioned Patent No. 1,951,381, and as the major portions of these machines are alike, the general features of construction which are similar will only be referred to more or less casually and for the purpose of locating the parts which specifically relate to this invention, and which enter into the combination, and so as to understand the operation.

The numeral 20 designates a suitable bed or table upon which the apparatus is mounted. The stationary head designated generally as 21 is positioned to the left in Figure 1 and a movable head designated generally as 22 is positioned to the right thereof. The stationary head includes the main body 23 suitably supported upon the bed or table and bored so as to form the cylinder 24. One end of this cylinder is closed by the cap or plate 25, which is bored to provide the fluid passage or conduit 26 and also the wider bore 27 to slidably receive the piston stem 28 of the elongated piston 29. The other end of this piston extends through the nut or gland 30 which closes the other end of cylinder 24. The sealing end or head 31 is secured to the outer end of piston 29 and is movable therewith. This head 31 is formed with a flanged recess 32 in which washer 33 is seated. It is also provided with bore or passage 34 leading to a socket 35, which forms the fluid receiving chamber or compartment and is also internally screw-threaded for a portion of its depth as at 36 to provide means for attachment to the screw-threaded end 37 of the piston 29. This chamber receives internal pressure from a fluid pressure source to apply internal pressure to the tube. The piston is provided with the shoulder or flange 38 against one side of which said head 31 abuts, with a washer 39 interposed therebetween. The other side of the flange or shoulder 38 abuts against the cushion or washer 40 positioned against the gland or nut 30 when in retracted position. Within the cylinder 24 the piston 29 is provided with a double head 41 so that fluid pressure admitted to one side or the other of the piston head will cause movement of the piston in one or the other direction. The piston stem 28 and the piston 29 are formed

with a continuous bore or passage 42, which communicates at one end with the fluid port or passage 26 and at the other end with the fluid compartment 35 provided in the sealing end or head 31.

Cylinder 24 is provided with ports or passages 43 and 44, one being located on each side of the double piston head 41. Port or passage 43 is placed in communication with valve 45 by means of conduit 46 and port 44 is placed in communication with the same valve by means of conduit 47. Conduit 48 connects the ports or passages 26 and 42 with the relief valve (not shown), and also with the conduit 49, which also communicates with said valve 45. This valve 45 is a five-way valve of standard construction and is adapted to be connected to a suitable source of fluid pressure through conduit 50.

Conduit 49 has a branch 51 which is adapted to place cylinder 52 in communication with the valve 45, control valve 53 being interposed in this conduit. As shown in Figure 4, cylinder 52 is in the form of an elongated member having at one end the gland or plug 54 which is bored to receive the end of conduit 51. In the cylinder 52 is slidably mounted piston 55 having the elongated piston rod 56, which is suitably connected or coupled as at 57 with a longitudinally-extending shaft 58. This shaft 58 at its other end (see Figure 1) has a link connection 59 with lever 60, which controls the operation of the control device 61, just as in said above-identified Patent No. 1,951,381. The right-hand end of shaft 58 is subject to the pressure of spring 62 which may be adjusted so that the pressure may be varied as desired.

The five-way valve 45 is operated by means of lever 63 and rod 64, which is connected to the plunger in the valve. When the lever 63 is in the vertical position, everything is shut off and the apparatus is at rest. As shown in Figure 1, the movable head 22 is shown in its retracted position. When in this position the machine is adapted to receive a tubular blank 22' within the partible die plates 23', which are then closed. The lever 63 is first moved to the right approximately 15°, whereby water or other fluid will be admitted through valve 45 and port or passage 43 into cylinder 24, forcing the piston 29 to the right until the head or end 31 engages the die plate and the end of the tubular blank and seals off the tube.

Further and continued movement of the lever 63 to the right (for approximately an additional 15°) maintains valve 45 open and also admits water or other fluid through conduits 49 and 48 into ports or passages 26, 42 and 34 into the tubular blank held in position within the dies. Water or other fluid under pressure is at the same time passed through conduit 51 into the cylinder 52 forcing piston 55 to the right. This movement of the piston 55 to the right moves shaft 58 in a similar direction and through the link connection 59 moves lever 60 to the right to cause fluid pressure to move the ram or movable head 22. This movement of the movable head 22 forms the corrugated diaphragm or bellows, as described in said above-mentioned patent, and after the forming operation is completed, the counterweighted handle or lever 65 is depressed or turned over on the shaft 58 so as to be positioned to the left of knock-off dog or lug 66, just as in the above-described application.

It is to be noted that in the first and second positions of the lever 63, conduit 47 and port or passage 44 are connected to the exhaust so as to permit the discharge of the fluid from the right-hand end of the cylinder 24 during the movement of the piston to the right. An abutment 67 is connected to the piston rod 29 within the cylinder 24 and positioned slightly to the right of the double piston 41. This abutment is adapted to partially cover the inlet to the port or passage 44 near the completion of the movement of the piston to the right so as to provide a dash-pot or similar construction to slow up the movement of the piston to the right during the last stages thereof.

Then the lever 63 is moved to the left through its vertical or non-operative position to approximately 15° beyond perpendicular. In this position port or passage 43 and conduit 46 are connected to the exhaust and water is admitted through conduit 47 and port or passage 44 to the other side of the double piston 41 moving the sealing end or head 31 to the left and breaking the seal with the formed blank.

After the seal is broken the partible die plates 23' are opened and the formed corrugated member is removed. While the lever is in its position to the left of the vertical and the fluid is being exhausted from the left-hand end of cylinder 24, as previously described, fluid is also being exhausted through conduit 51 from cylinder 52. When this fluid pressure is released from the piston, spring 62 moves the shaft 58 to the left, thereby moving the lever 60 to the left and causing the operation of the ram in the opposite direction to withdraw the movable head 22. During this withdrawal movement, the counterweighted lever or handle 65, which moves with head 22, contacts with the knock-off dog or lug 66 and moves the rod 58 to the right. This causes the lever 60 to be moved to a neutral or non-operative position and stops the withdrawal of the ram to complete the cycle of operation, and place the parts in proper position for receiving and forming another blank.

This construction permits the inflow of fluid to the tubular blank through the ports or passages 26 and 42 and into the cylinder 52 and against the piston 55 to be synchronized so that the forward movement of the ram or movable head is begun before the maximum pressure is reached within the bellows tube. This synchronism may be further controlled by the manipulation of valve 53, which controls the inflow of fluid to the cylinder 52. By adjusting this valve the operation of the piston 55 and the consequent movement of the shaft 58 may be hastened or delayed.

The operation of forming the blank is a continuous one after the stationary head is brought into sealing engagement with the open end of the blank. All the operator has to do is to operate the lever 63 at proper intervals, as above described, which results in perfect control of the proper formation of the blank and its release from the mechanism.

While the description apparently divides the operation into steps or stages, this is for convenience only, as the forming operation is continuous from start to finish.

It is to be expressly noted, that the movable head or ram starts its movement before the fluid pressure within the blank reaches its maximum, and the parts are synchronized and adjusted to this end.

What I claim is:—

1. In combination in an apparatus of the char-

acter described for corrugating metal blanks, a movable head, a stationary head having a conduit to permit the passage of fluid under pressure therethrough, fluid pressure means for operating said movable head, control means for admitting fluid under pressure into the blank through the stationary head and causing the operation of the movable head before maximum pressure is reached within the blank.

2. In combination in an apparatus of the character described for corrugating metal blanks, a movable head, a stationary head having a conduit to permit the passage of fluid under pressure therethrough, fluid pressure means for operating said movable head, control means for admitting fluid under pressure into the blank through the stationary head and causing the operation of the movable head before maximum pressure is reached within the blank, said control means also having connections for causing the retracting movement of the movable head.

3. In combination in an apparatus of the character described for corrugating metal blanks, a movable head, a stationary head having a conduit to permit the passage of fluid under pressure therethrough, fluid pressure means for operating said movable head, control means for admitting fluid under pressure into the blank through the stationary head and causing the operation of the movable head before maximum pressure is reached within the blank, said control means also having connections for causing the retracting movement of the movable head, and means for automatically stopping said retracting movement.

4. In an apparatus of the character described for corrugating tubular metallic blanks, in combination with a plurality of die members for holding and shaping the tubular blank, a movable head and means for causing the forward movement thereof for forming the tubular blank and for causing a retracting movement thereof to an initial starting position, a stationary head having a movable sealing member adapted to engage the end of the tubular blank, said sealing member being provided with a conduit to admit fluid under pressure into the tubular blank and control means for causing the movement of said sealing member and then admitting fluid under pressure into the tubular blank, and causing the forming movement of the movable head before maximum fluid pressure is reached within the tubular blank.

5. In an apparatus of the character described for corrugating tubular metallic blanks, in combination with a plurality of die members for holding and shaping the tubular blank, a movable head and means for causing the forward movement thereof for forming the tubular blank and for causing a retracting movement thereof to an initial starting position, a stationary head having a movable sealing member adapted to engage the end of the tubular blank, said sealing member being provided with a conduit to admit fluid under pressure into the tubular blank and control means for causing the movement of said sealing member and then admitting fluid under pressure into the tubular blank, and causing the forming movement of the movable head before maximum fluid pressure is reached within the tubular blank, said control means also having connections for causing the retraction of the sealing member.

6. In an apparatus of the character described for forming corrugations in a tubular metallic blank by means of a plurality of die members, a movable head and fluid pressure means for causing the forming and retracting movements of said head, a stationary head including a sealing member movably mounted therein, and fluid pressure means for moving said sealing member against the end of the tubular blank to seal the same, said sealing member being provided with a conduit to admit fluid under pressure into the tubular blank, and fluid pressure control means for controlling the operation of said sealing member and the admission of fluid into the interior of the tubular blank, and having connections with the operating means for said movable head to control the operation thereof.

7. In an apparatus of the character described for forming corrugations in a tubular metallic blank by means of a plurality of die members, a movable head and fluid pressure means for causing the forming and retracting movements of said head, a stationary head including a sealing member movably mounted therein, and fluid pressure means for moving said sealing member against the end of the tubular blank to seal the same, said sealing member being provided with a conduit to admit fluid under pressure into the tubular blank, and fluid pressure control means for controlling the operation of said sealing member and the admission of fluid into the interior of the tubular blank, and having connections with the operating means for said movable head to control the operation thereof, said connections including a piston and actuating rod, said piston being subject to fluid under pressure to cause the movement of said rod in one direction.

8. In an apparatus of the character described for forming corrugations in a tubular metallic blank by means of a plurality of die members, a movable head and fluid pressure means for causing the forming and retracting movements of said head, a stationary head including a sealing member movably mounted therein, and fluid pressure means for moving said sealing member against the end of the tubular blank to seal the same, said sealing member being provided with a conduit to admit fluid under pressure into the tubular blank, and fluid pressure control means for controlling the operation of said sealing member and the admission of fluid into the interior of the tubular blank, and having connections with the operating means for said movable head to control the operation thereof, said connections including a piston and actuating rod, said piston being subject to fluid under pressure to cause the movement of said rod in one direction, and means for automatically moving said rod in the opposite direction when the fluid pressure against said piston is released.

9. In an apparatus of the character described for forming corrugations in a tubular metallic blank by means of a plurality of die members, a movable head and fluid pressure means for causing the forming and retracting movements of said head, a stationary head including a sealing member movably mounted therein, and fluid pressure means for moving said sealing member against the end of the tubular blank to seal the same, said sealing member being provided with a conduit to admit fluid under pressure into the tubular blank, and fluid pressure control means for controlling the operation of said sealing member and the admission of fluid into the interior of the tubular blank, and having connections with the operating means for said movable head to control the operation thereof, said connections including a piston and actuating rod, said piston

being subject to fluid under pressure to cause the movement of said rod in one direction, said control means being operable to first cause the sealing of the tubular blank and then the admission of fluid under pressure thereinto, and then the forming movement of the movable head before maximum pressure is attained within the tubular blank.

10. In combination in an apparatus of the character described, a movable head, fluid pressure means for moving said head in both directions, control means for controlling the operation of said fluid pressure means, a control valve, a piston and cylinder, said piston having connection with said control means, said control valve being operable to admit pressure against said piston to cause the movement of said control means in one direction, said valve also being operable to release the pressure within said cylinder, and automatic means for causing the movement of said control means in the opposite direction when said pressure is released.

11. In combination in an apparatus of the character described, a movable head, fluid pressure means for moving said head in both directions, control means for controlling the operation of said fluid pressure means, a control valve, a piston and cylinder, said piston having connection with said control means, said control valve being operable to admit pressure against said piston to cause the movement of said control means in one direction, said valve also being operable to release the pressure within said cylinder, and automatic means for causing the movement of said control means in the opposite direction when said pressure is released, and means associated with said movable head for moving said control means to a neutral position at the end of its retracting movement.

12. In combination in an apparatus of the character described, a movable head, fluid pressure means for moving said head in both directions, control means for controlling the operation of said fluid pressure means, a control valve, a piston and cylinder, said piston having connection with said control means, said control valve being operable to admit pressure against said piston to cause the movement of said control means in one direction, said valve also being operable to release the pressure within said cylinder, and automatic means for causing the movement of said control means in the opposite direction when said pressure is released, said connection including an elongated rod or shaft having a knock-off dog thereon, and said movable head being provided with a movable lever adapted to be positioned over said shaft and to engage said knock-off dog during the retracting movement of the movable head and thereby cause the movement of said operating means to a neutral position.

13. The method of forming corrugated tubular elements from tubular metallic blanks which includes holding the blank within a set of movable dies, sealing the blank, admitting fluid pressure within the blank and subjecting the blank to axial pressure before the fluid pressure within the blank has reached its maximum while continuing the admission of fluid pressure to the blank.

14. In the method of making corrugated tubular elements from tubular metallic blanks, the steps of admitting fluid pressure within the blank and subjecting the blank to axial pressure before the pressure within the blank reaches its maximum while continuing the admission of fluid pressure to the blank.

15. In the method of making corrugated tubular elements from tubular metallic blanks by combined axial pressure and internal fluid pressure, the fluid pressure controlled synchronization of the admission of the fluid pressure within the blank and the application of the axial pressure thereto so that the blank is subjected to the axial pressure before the internal fluid pressure reaches its maximum.

16. In combination in an apparatus of the character described for making corrugated tubular elements from tubular metallic blanks, a stationary head having means to permit the admission of fluid under pressure into a blank, a movable head for subjecting the blank to axial pressure, and fluid pressure controlled synchronization means for admitting fluid under pressure into the blank and causing the movement of said movable head before the pressure within the blank reaches its maximum.

17. The method of making corrugated tubular elements from metallic blanks, which includes admitting fluid pressure into the blank sufficient to sustain the walls of the metallic blank, and then while admitting fluid pressure to the interior of the blank subjecting the blank to axial pressure before the pressure within the blank reaches a maximum.

18. The method of forming a plurality of corrugations simultaneously in a tubular metallic blank, which includes admitting fluid pressure into a blank sufficient to sustain the walls of the tubular blank and then while admitting fluid pressure to the interior of the blank subjecting the blank to axial pressure to start the collapsing of the blank before the fluid pressure within the blank reaches a maximum.

19. In combination in an apparatus of the character described for making corrugated tubular elements from tubular metallic blanks, a stationary head having means to permit the admission of fluid under pressure into a blank, a movable head for subjecting the blank to axial pressure, and synchronization means for admitting fluid under pressure into the blank and causing the movement of said movable head before the pressure within the blank reaches its maximum, and means for controlling said synchronization means for changing the relation between the movement of the movable head and the admission of fluid under pressure into the blank.

20. The method of corrugating metal tubing and the like, which comprises first compressing a tube axially to a predetermined extent, then automatically subjecting the tube to internal pressure of proper value to displace outwardly and radially of the tube the metal rendered available by the axial compression of the tube, and then continuing the axial compression of the tube.

21. The method of corrugating metal tubing and the like, which comprises first compressing a tube axially to a predetermined extent, then automatically subjecting the tube to internal pressure of proper value to displace outwardly and radially of the tube the metal rendered available by the axial compression of the tube, and then continuing the axial compression of the tube while maintaining such pressure within the tube.

22. The method of corrugating metal tubing and the like, which comprises first compressing a tube axially so as to displace the metal thereof, and then automatically subjecting the tube to

internal pressure during the axial compressing thereof and of proper value to redistribute the displaced metal of the tube outwardly and radially of the tube at a rate commensurate with the axial compression thereof.

23. The method of corrugating metal tubing and the like, which comprises compressing a tube axially to a predetermined extent, and continuing axial compression of the tube while subjecting it to a substantially constant internal pressure of proper value to displace outwardly and radially of the tube the metal rendered available by the axial compression of the tube while avoiding radial stretching of the tube wall.

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