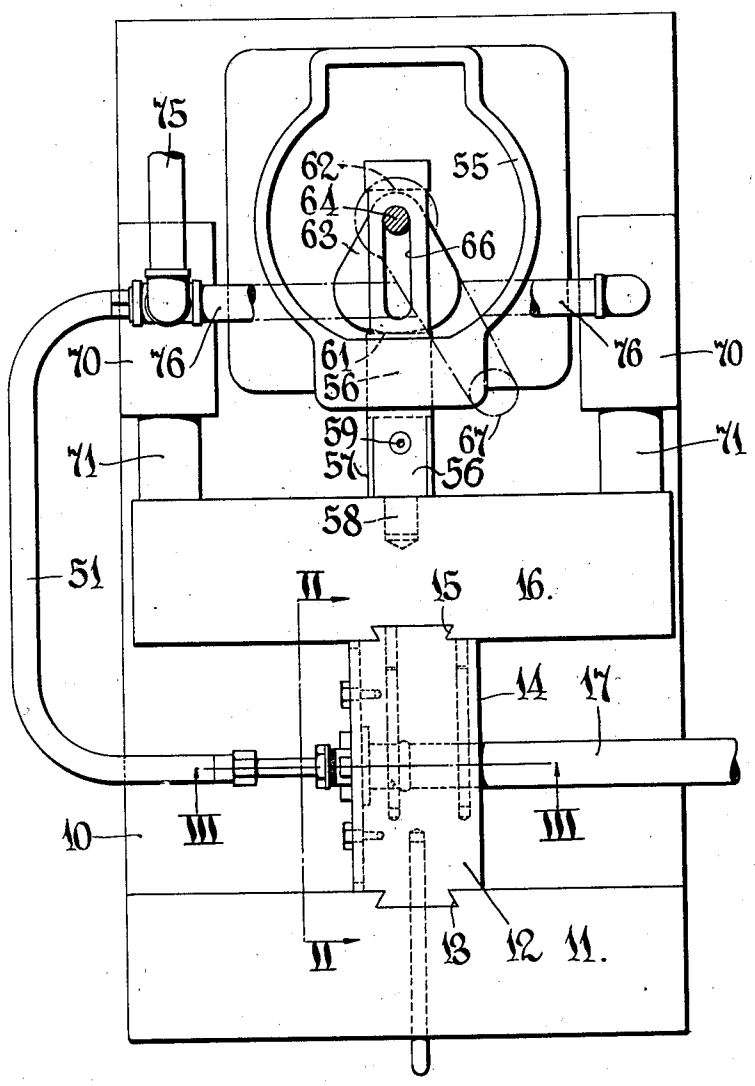
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HYDRAULIC TUBE BEADER

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Fig. 1.



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Fig. 2.

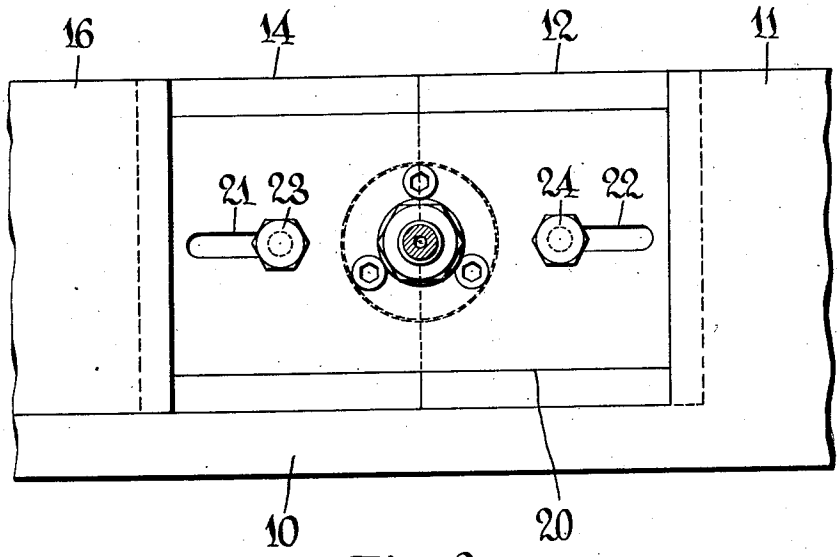
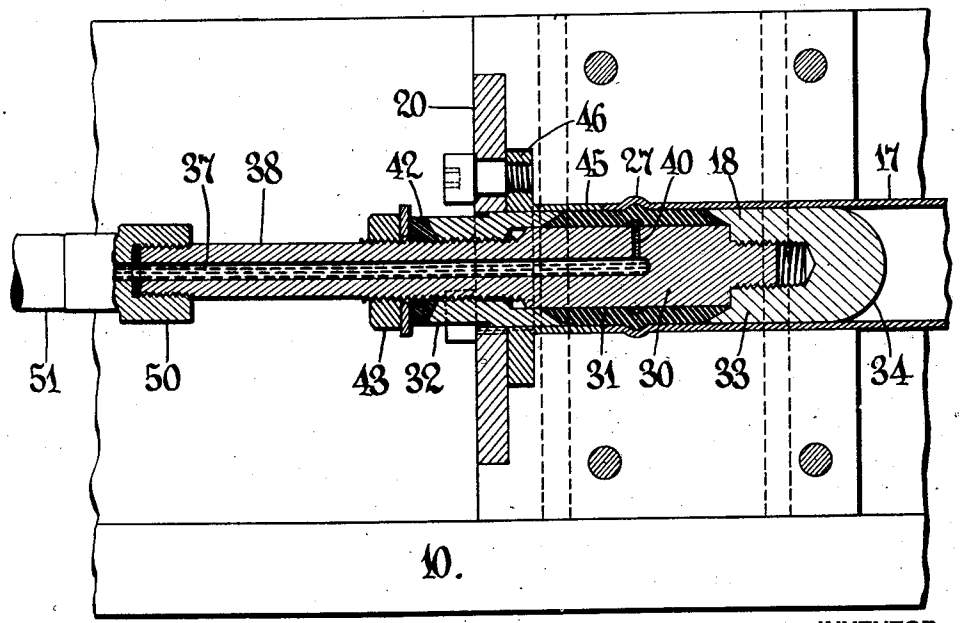


Fig. 3.



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HYDRAULIC TUBE BEADER

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Application April 14, 1942, Serial No. 438,913

4 Claims. (Cl. 113—44)

This invention relates to fluid means for forming sheet metal, and is shown herein as comprising novel hydraulic fluid means for forming an embossed bead upon a tube of metal or the like but it will be understood that the principles of the invention may be employed in other analagous manufacturing operations.

According to the present invention there are provided separable die or mold-forming elements adapted to receive a work piece, in combination with means for directing hydraulic pressure within the chamber or mold formed by the die elements to act upon and deform the work piece in a predetermined manner. The hydraulic means are so arranged as to exert a second force in addition to the metal deforming force within the die chamber or mold. This second force is arranged and directed to urge the separable die elements into closed mold-forming position with a total force which exceeds that of the metal deforming hydraulic force within the die chamber or mold. Thus, the possibility that the hydraulic metal deforming force acting within the work piece deforming chamber may separate the die elements while performing the metal forming operation is entirely eliminated.

In the embodiment which is set forth herein by way of example, mechanical means are provided for major movements of the die elements between open and closed position. In this way arrangement is made whereby the application of hydraulic force within the die chamber and upon the hydraulic force holding mechanism for keeping the separable die elements in closed forming position may be effected simultaneously and by use of a single valve. The apparatus of the invention is simple and economical in construction and extremely facile in use. Other objects and advantages attended upon a pursuance of the principles underlying the invention will appear from a consideration of the particular embodiment set forth herein by way of example.

In the drawings:

Fig. 1 is a top plan view of one form of the apparatus;

Fig. 2 is a cross sectional view taken as indicated by the line II—II, Fig. 1; and

Fig. 3 is a cross sectional view on an enlarged scale taken on the line III—III of Fig. 1.

Throughout the several figures of the drawings like characters of reference denote like parts and the numeral 10 designates base means in the form of a plate, or the like, having formed rigidly therewith an extending wall portion 11 for attachment thereto of a relatively immovable die element 12. The die element 12 is attached to the wall portion 11 by means of a dove-tail joint or the like as indicated at 13.

A second relatively movable die element is designated 14 and is likewise attached by means of a dove-tail joint 15 to a reciprocable die holder 16. By means of the dove-tail joints 13 and 15, the die elements 12 and 14 may be readily removed from assembly with the wall portion 11 and the die holder 16 for substitution of dies when working upon work pieces of other sizes or other desired conformation.

The opposed faces of the die elements 12 and 14 have complementary semi-circular depressions whereby to receive and hold a work piece in the form of a tube 17 when the die elements are in abutment with each other. It is desired to dispose a mandrel designated generally 18 within the work piece 17 and means are accordingly provided for supporting the mandrel 18 in a central position with respect to the die elements 12 and 14. For ready disposition of a work piece 17 over the mandrel 18 it is further desired that the mandrel 18 be disposed centrally between the die elements 12 and 14 when the latter are in open or separated position, and to this end the mandrel 18 is supported in a manner which will now be described.

A mandrel-supporting plate is designated 20 and has a central opening for supporting the mandrel 18 in fixed relation with respect thereto. The plate 20 is formed with elongate slots 21 and 22, and corresponding screws 23 and 24 pass through the slots and threadedly engage the side walls of the die elements 14 and 12 respectively. The slots 21 and 22 are so formed and arranged (Fig. 2) that upon relative opening movement of the die element 14 with respect to the die element 12 to a distance approximately equal to the sum of the lengths of the slots 21 and 22 the mandrel 18 will be automatically disposed centrally with respect to the die elements; and in such condition of the apparatus the screws 23 and 24 will be engaged against the outer ends of the slots 21 and 22, respectively. In the illustrated instance the die elements 12 and 14 are provided with longitudinal recesses for receiving and guiding the plate 20.

It will be noted that the semi-circular depressions in the die elements 12 and 14 are provided for receiving and holding the work piece 17 while forming enlargements therein as indicated at 27. For this purpose the dies are recessed as shown for receiving a portion of the tube which is expanded by operation of the mandrel 18 for the

purpose of forming an encircling bead on the tubular work piece 17. The mandrel has heretofore been generally designated 18 and comprises more specifically a cylindrical body element 30 which has disposed thereabout a resilient sleeve 31 which may be of rubber or the like but is preferably of a suitable oil resisting synthetic rubber such as Neoprene or the like. The body element 30 is threaded at opposite ends of the resilient sleeve 31 to receive glandular retaining elements 32 and 33 which confine the flexible sleeve 31 axially. The outer end of the glandular element 33 may be rounded as at 34 to facilitate disposition of the tubular work piece 17 over the mandrel.

The body element 30 of the mandrel has an axial fluid passage 37 which emerges from the left hand end of the body element 30 as viewed in Fig. 3 in an extension 38 formed at its end of the body element. At its right hand end the fluid passage 37 terminates in the vicinity of the beading enlargement in the semi-circular die openings. At its terminus the passage 37 has a radial extension 40 emerging at the periphery of the body element 30 whereby a hydraulic medium may be directed under pressure against the inner periphery of the resilient sleeve 31 to deform the latter outwardly as illustrated in Fig. 3 to produce the annular bead in the tubular work piece at 27 as shown in that figure. Since the threaded opening in the glandular element 32 extends wholly therethrough, it is desirable to seal the outer end thereof against fluid leakage and accordingly the end of the gland is shaped to be inwardly conical and an annular packing element 42 is pressed thereagainst and secured in position by means of a nut 43.

A supporting sleeve 45 is disposed securely about a portion of the gland element 32 and, in the present instance, about a portion of the resilient sleeve 31. The supporting sleeve 45 has an outwardly directed annular flange 46 which is preferably secured directly and rigidly to the supporting plate 20, whereby central positioning of the mandrel assembly with respect to the die elements 12 and 14 is assured in both open and closed positions of the apparatus. The outer end of the extension 38 of the body element 30 of the mandrel is threaded to receive a nipple 50 which is associated with a hydraulic conduit 51.

Means for closing and opening the die apparatus preliminary and subsequent to the beading operation upon the work piece, as distinguished from the hydraulic die holding means which will subsequently be described, is shown as comprising a casing 55 which supports for longitudinal sliding movement a bar 56 which is rigidly associated with the die holder 16 in any conventional manner. In the present instance the bar 56 is shown as having a slotted outer end for receiving a flatted head 57 of a screw 58 which threadedly engages the die holder 16. A set screw or the like as at 59 is employed to secure the flatted head 57 to the bar 56.

The bar 56 is provided with a further slotted portion whose ends are designated 61 and 62 respectively in Fig. 1, and a flat cam 63 is disposed in this slot and is fixed to a carrying shaft 64 journaled in the casing 55. The bar 56 has a longitudinal slot 66 for receiving the shaft 64 to permit longitudinal movement of the bar 56 with respect to the shaft 64. Obviously, as viewed in Fig. 1, rotation of the shaft 64 and the cam 63 through approximately 180° will move the bar 56 to a position where the movable die element 14 is substantially separated from the stationary die element 12. Upon such movement the mandrel is automatically disposed approximately midway in the open space between the two die elements, as has heretofore been explained. Manipulation of the cam 63 by means of the rock shaft 64 for opening and closing the die apparatus is effected simply by the provision of a manual operating crank or handle indicated at 67.

For assuring maintenance of the separable die elements in tightly closed condition during the beading operation a pair of hydraulic rams having operating cylinders 70 and projecting plungers 71 are provided. The cylinders 70 are secured to the base 10 in such manner as to direct the plungers 71 against the outside of the die holder 16 in such manner as to urge the die 14 against the stationary die element 12 when hydraulic pressure is applied to the cylinders 70. In Fig. 1, a hydraulic pressure supply line designated 75 leads to one of the cylinders 70 and is provided with a branch conduit 76 leading to the other of the cylinders 70. A second branch of the supply conduit 75 constitutes the previously described conduit 51 for supplying fluid pressure within the resilient sleeve 31.

The effective fluid pressure responsive total area of the heads of the plungers 71 within the cylinders 70 is arranged to be such that the total force holding the die elements 12 and 14 in closed position is, under any fluid pressure condition, materially greater than any force generated within the mandrel tending to separate the die elements. Therefore, by virtue of this arrangement not even the slightest separation of the die elements during the tube expanding operation is permitted, either as a result of play in the clamping means or of a preponderant expanding force within the mandrel. Thus, the objectionable features of prior art devices of this type are avoided, and inaccuracies in the final product and/or production of fins thereon due to die separation are absolutely prevented.

Although only one form of the invention has been shown and described in detail, it will be apparent to those skilled in the art that the invention is not so limited but that various changes may be made without departing from the spirit of the invention or the scope of the appended claims.

I claim:

1. Tube forming apparatus comprising a pair of complementary tube encircling elements movable toward and away from each other, mandrel means between said tube encircling elements for disposition within a tubular work piece, said mandrel means comprising a flexible sleeve whereby hydraulic pressure within said mandrel urges said sleeve against the tube encircling elements to form the tubular work piece in conformity with the tube engaging surfaces of the tube encircling elements, and hydraulic means for urging said tube encircling elements against said tubular work piece, said hydraulic means being proportioned to exert a greater tube encircling force than the tube forming force within said mandrel, and means engaging said encircling elements and adapted to support said mandrel means therebetween, said supporting means being operative to dispose said mandrel means substantially midway between said encircling elements when the latter are in spaced, open position.

2. Metal forming apparatus comprising a pair of complementary mold-forming elements mov-

able toward and away from each other, means comprising a core within said mold, said core having a flexible wall portion and hydraulic means for expanding said wall portion, supporting means for said core adapted to dispose the same in medial exposed position when said mold-forming elements are moved away from each other, said hydraulic means being arranged to bear against one of said mold-forming elements when said flexible wall portion is being hydraulically expanded to urge the mold-forming elements toward each other.

3. Metal forming apparatus comprising a pair of complementary mold-forming elements, means comprising a core within said mold, said core having a flexible wall portion and hydraulic means for expanding said wall portion, one of said mold-forming elements being movable to expose said core for disposing a work piece thereagainst, a lost motion connection between said movable mold-forming element and said core whereby opening movement of said element removes it from said core and likewise automatically removes the latter from the other mold-forming element, said hydraulic means being arranged to bear against one of said mold-forming elements when said flexible wall portion is being hydraulically expanded to urge the mold-forming elements toward each other.

4. Metal forming apparatus comprising rigid die means and a hydraulically expansible jacket for urging metal into conformity with said rigid die, and means whereby the hydraulic medium of said jacket is simultaneously directed against said rigid die means to urge same into forcible engagement with said jacket, a portion of said rigid die means being movable with respect to the remainder thereof to expose said jacket and permit the introduction and removal of work pieces, a lost motion connection between the movable portion of said die means and said expansible jacket whereby movement of said portion to expose said jacket automatically moves said jacket out of the remaining portion of said die means, said hydraulic means being proportioned to direct a greater force for maintaining said die means and said jacket in operative engagement than the force exerted by said jacket tending to displace the latter relative to said die means.

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