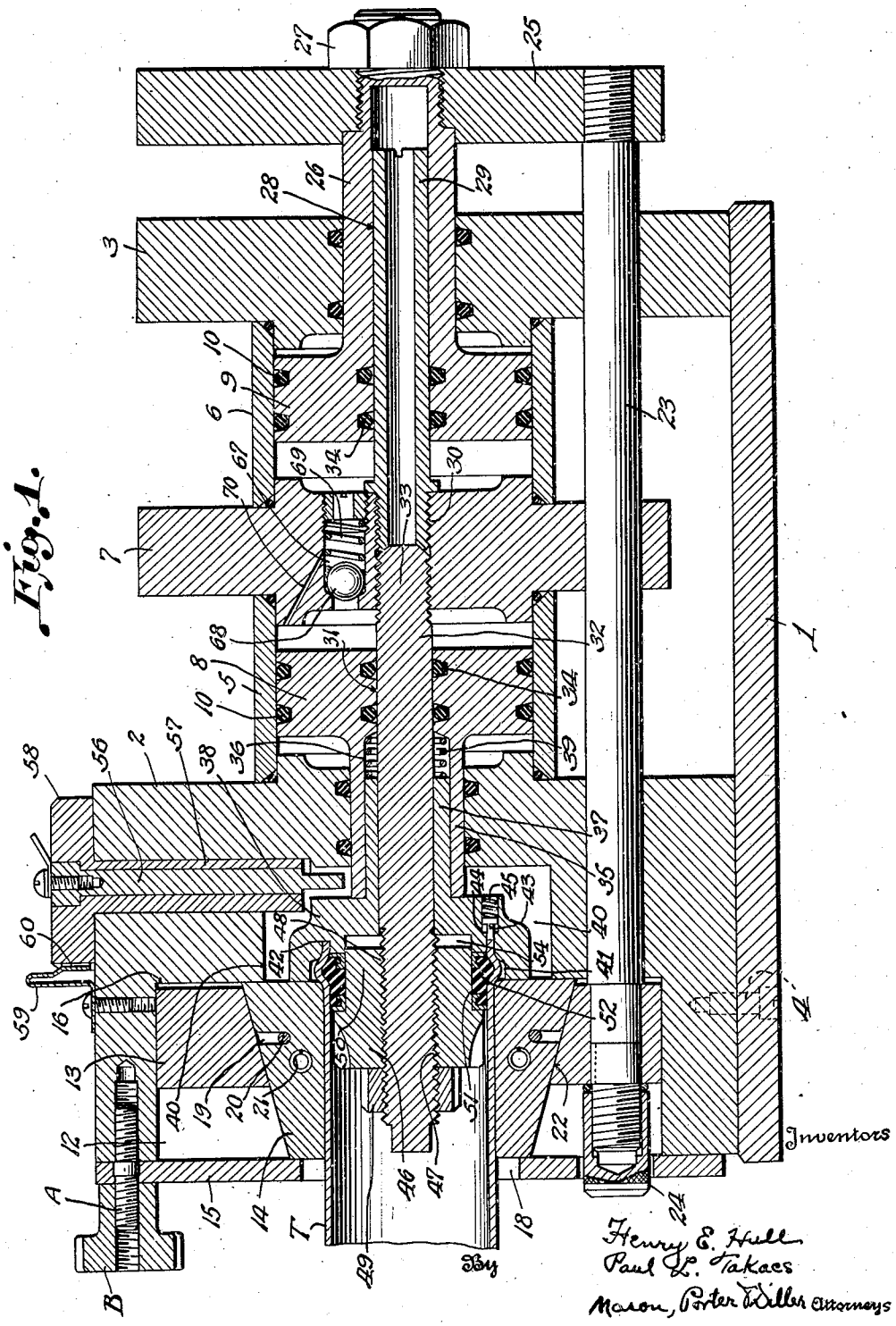
Jan. 11, 1949. H. E. HULL ET AL 2,458,854

MACHINE FOR BEADING TUBES BY RADIAL EXPANSION FOLLOWED BY AXIAL PRESSURE

Filed Jan. 10, 1945 4 Sheets-Sheet 1

Fig. 1.



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Filed Jan. 10, 1945 4 Sheets-Sheet 2

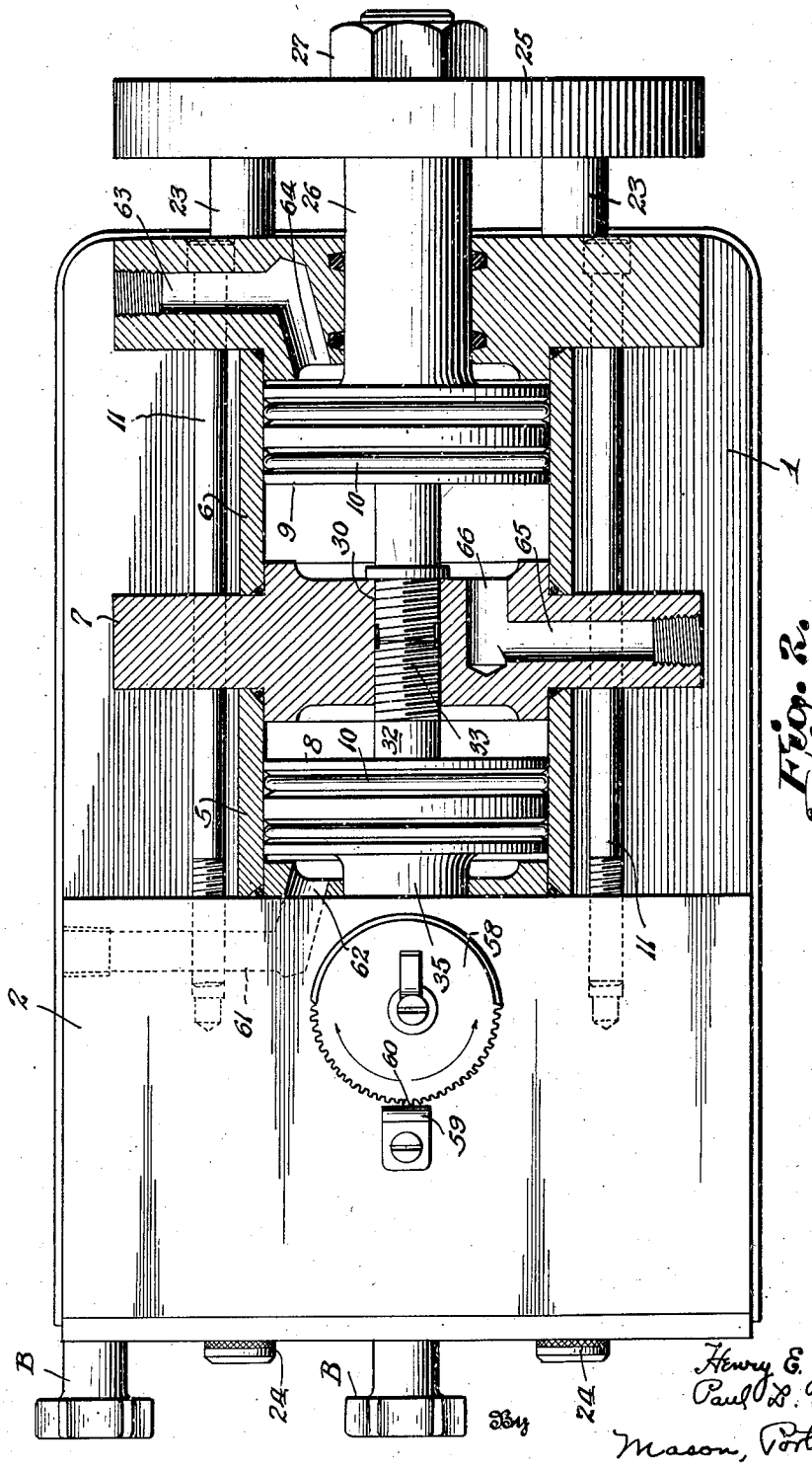


Fig. 2.

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MACHINE FOR BEADING TUBES BY RADIAL EXPANSION FOLLOWED BY AXIAL PRESSURE

Filed Jan. 10, 1945 4 Sheets-Sheet 3

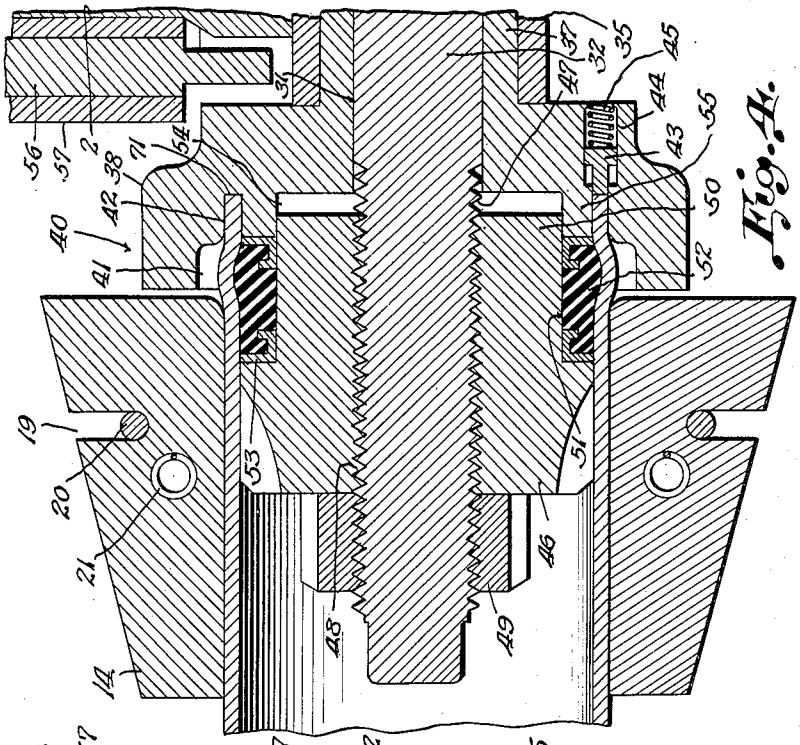


Fig. 4.

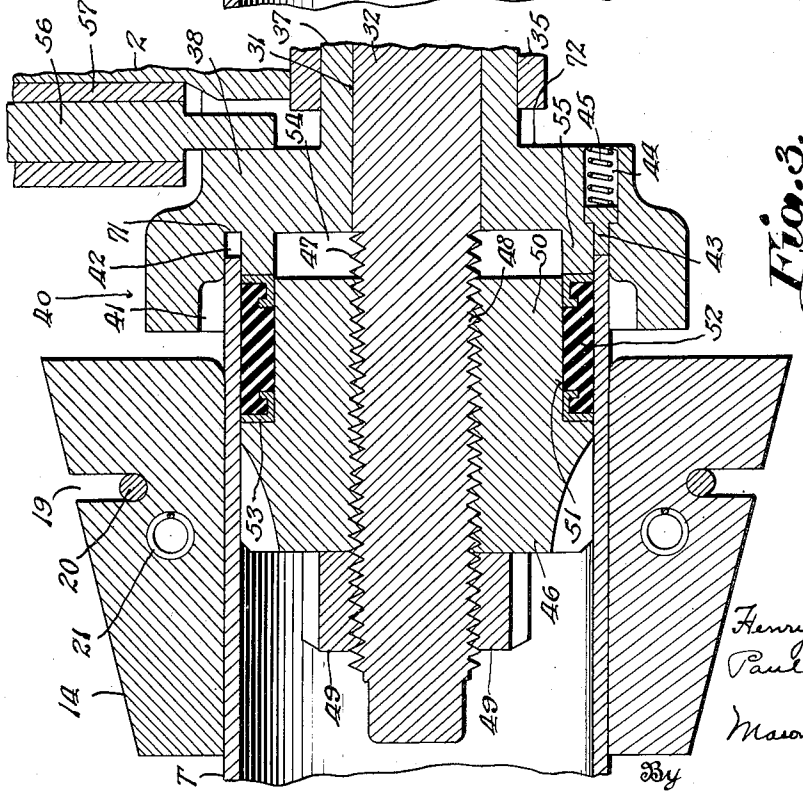


Fig. 3.

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MACHINE FOR BEADING TUBES BY RADIAL EXPANSION FOLLOWED BY AXIAL PRESSURE

Filed Jan. 10, 1945 4 Sheets-Sheet 4

Fig. 5.

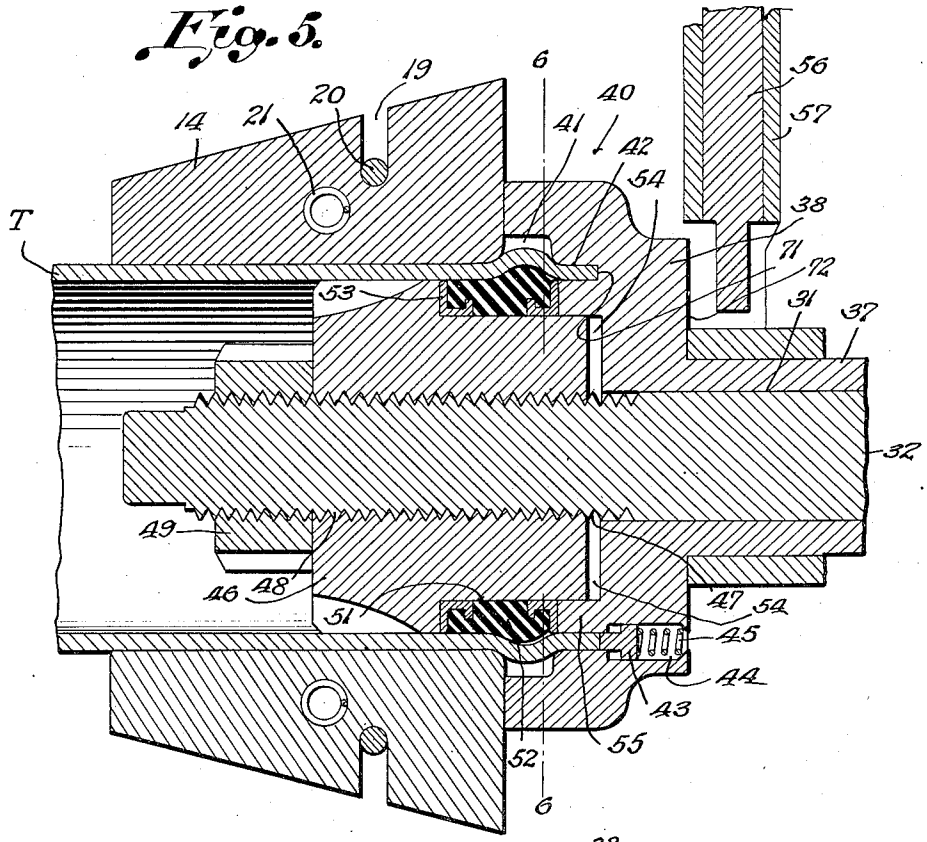
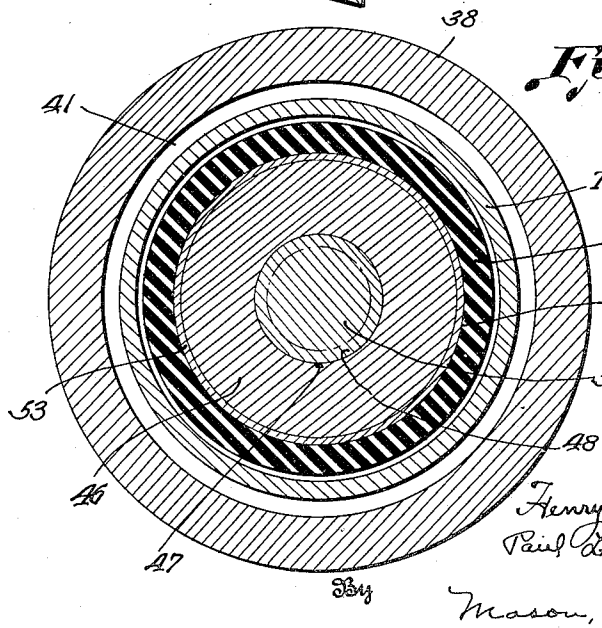


Fig. 6.



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UNITED STATES PATENT OFFICE

2,458,854

MACHINE FOR BEADING TUBES BY RADIAL EXPANSION FOLLOWED BY AXIAL PRESSURE

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Application January 10, 1945, Serial No. 572,147

8 Claims. (Cl. 153—73)

1

The present invention relates to new and useful improvements in machines for deforming the end portion of a tube outwardly, and more particularly to an apparatus for beading a tube adjacent its end portion.

An important object of the invention is to provide a machine of the above type embodying means for firmly clamping the tube end with means associated therewith for deforming the tube outwardly, the tube clamping means and the tube deforming means being shifted relative to one another to first expand the tube radially by means of a radial force and then complete the expansion by means of an axial force on the end of the tube.

Another object of the invention is to provide a machine of the above type wherein the means for first expanding the tube radially by means of a radial force comprises a ring shaped member of elastic deformable material, such as rubber, which is inserted within the tube and then compressed by the deforming means for radially expanding the tube.

A further object of the invention is to provide a machine of the above type wherein a shiftable beading head is associated with the ring shaped member for initially deforming said member to expand the tube radially and upon further movement of said head to complete the expansion by means of an axial force imparted on the end of the tube.

The above and other objects of the invention will in part be obvious and will be hereinafter more fully pointed out.

In the drawings,

Figure 1 is a vertical sectional view through one type of machine with which the beading arrangement can be used.

Figure 2 is a horizontal sectional view thereof with parts in top plan.

Figure 3 is an enlarged fragmentary sectional view illustrating the arrangement of the parts at the start of the beading operation.

Figure 4 is a similar view after the first step of the operation.

Figure 5 is a similar view illustrating the position of the parts after completion of the beading operation.

Figure 6 is a sectional view taken substantially on line 6—6 of Figure 5.

In the copending application of Henry E. Hull et al., filed December 26, 1944, Ser. No. 569,751, for a Tube end deforming machine, there is disclosed and claimed a portion of the machine shown in the present application. The copending application relates to a tube end deforming machine embodying means for clamping the end of the tube to be deformed, and hydraulic means associated therewith for actuating the clamping means. This application further discloses a tube end deforming element which is actuated by hydraulic means associated therewith. Both hydraulic means include a pair of pistons operable in individual cylinders, one of the pistons actuating the tube clamping means and the other piston actuating the tube deforming means.

2

The present application relates specifically to a novel means for forming a bead adjacent the end of the tube and the specific beading arrangement is not intended to be limited to use with the particular hydraulic machine herein shown. It is to be understood that the hydraulic mechanism disclosed in the present drawings is only illustrative of one type of mechanism that can be used in carrying out the beading operation. For sake of clarity and in order to present an operable structure, the machine for operating the beading head will be hereinafter specifically described.

Referring to the drawings for a more detailed description thereof, the new and improved beading head arrangement is shown in use with a machine which comprises a substantially rectangular shaped base 1, on which is mounted spaced upright numbers 2 and 3, said members being mounted at each end of the base plate and secured thereto by means of bolts or the like 4. Mounted between the uprights 2 and 3 is a pair of cylinders 5 and 6 maintained in spaced relation by means of the spacer member 7. The cylinders 5 and 6 carry pistons 8 and 9 respectively, said pistons being suitably packed by means 10 within the cylinders, and adapted to actuate the tube clamping and beading elements to be hereinafter more fully described. The uprights 2 and 3, cylinders 5 and 6 and spacer member 7 are linked together by means of tie bolts 11.

The front upright member 2 is formed with an annular recess 12 at its outer end for receiving a cam ring 13 and chuck 14, said chuck being held against longitudinal movement by means of the plate 15 which is held in position by means of studs A provided with scalloped thumb nuts B. The recess 12 is of a depth substantially equal to the length of the chuck 14 held against longitudinal movement between said plate and the rear wall 16 of the recess 12. The chuck 14 is adapted to grip the tube T as

the end of the latter is beaded, and the plate 15 is formed with a central bore 18 through which the tube is inserted.

The chuck 14 is of the type specifically illustrated and described in the above mentioned copending application and generally comprises four tapered segmental members, the outer periphery of which is formed with an annular groove 19 for receiving a snap ring 20. This snap ring maintains the segments in unitary relation at all times. The chuck further includes coiled springs 21 mounted in drilled holes in each segment for normally urging the segments outwardly for permitting the completed tube to be readily removed and a new one inserted therefor.

The segments of the chuck are urged into tube gripping engagement by means of the cam ring 13, said ring having a bore 22 tapering downwardly and outwardly and generally conforming to the outer periphery of the chuck 14. In Figure 1 of the drawings, the cam ring 13 has been shifted toward the right so as to actuate the chuck segments radially inward to grip the tube T for the beading operation. The cam ring 13 is adapted to be actuated by the piston 9 in the rear cylinder 6 and is connected to said piston by means of four draw bolts 23. The forward end of these bolts is provided with knurled nuts 24 which extend through the plate 15 and are held against the ring 13 as shown in Figure 1. The other end of the draw bolts screw threadedly engage a plate 25 which plate is mounted on the piston end 26, being locked thereon by means of lock nut 27. Piston 9 and its end extension 26 are formed with a central bore 28 in which is mounted a hollow tubular guide sleeve 29, whose end 30 is threaded within the spacer member 7. Thus it will be seen that as the piston 9 moves toward the right or left as viewed in Figure 1, it will be guided on the sleeve 29 and will carry with it the plate 25, draw bolts 23 and cam ring 13 since these parts are all interconnected. Movement of the cam ring 13 to the left as viewed in Figure 1 releases the chuck 14 so that the completed tube can be removed and a new one inserted therefor.

The piston 8 is movable toward the left as viewed in Figure 1 for effecting the beading operation on the tube T. This piston is formed with a central bore 31 in which is received a tubular rod 32, one end 33 of which threadedly engages the spacer member 7 and is held in abutting relation with the sleeve end 30. Suitable packing 34 is provided for sealing the pistons 8 and 9 on the shaft 32 and sleeve 29, respectively. The piston 8 is formed with a reduced end 35 whose diameter is greater than the diameter of the rod 32 thereby forming a recess 36 in which is received the end 37 of the die member or beading head 38. A coil spring 39 is positioned in the recess 36 in back of the beading head end 37 for normally urging the beading head toward the outer end of the machine.

The beading head 38 is mounted for axial movement within the counterbore 40, formed in said front upright 2 which counterbore communicates with the annular recesses 12 and 36. The forward end of the beading head 38 is formed with a counterbore 41, and an annular recess 42 communicating therewith. Carried in the back end of the beading head 41 and projecting into the annular recess 42 is a series of, preferably three, plungers 43 adapted to move in individual bores 44. Each plunger 43 is backed by a coil spring 45 for normally urging the same into the annular recess 42. For reasons to hereinafter appear, the springs 45 are stiffer than the spring 39 and therefore create greater resistance to the tube T when it is initially positioned for deforming.

Carried on the end of the rod 32 and adapted to be inserted within the end of the tube T, there is a substantially cylindrical shaped abutment member 46. By referring to Figure 3 of the drawings, it will be noted that the end of the shaft 32 carrying the abutment member is exteriorly threaded as indicated at 47 while the abutment member is interiorly threaded as indicated at 48 for movement on the threads 47. Thus, the abutment member 46 is capable of adjustment on the rod 32 so as to be located at any desired position within the tube T. After the adjustment has been effected, the abutment member 46 is locked on the rod by means of a lock nut 49. The inner end 50 of the abutment member 46 is cut away as indicated at 51 and mounted on this cut away portion is a ring 52 of elastic deformable material, preferably rubber. This rubber ring 52 carries metal caps 53 at each end thereof which caps are vulcanized or otherwise secured thereto. The ring 52 being housed at each end through the metal caps 53, cannot expand axially nor can said ring expand inwardly due to its contact with the abutment member 46. However, when pressure is applied to the end of the ring through the beading head 38, the ring 52 will expand radially outwardly to bead the tube T in a manner to be presently described.

The beading head 38 is formed with a second counterbore 54 of a diameter smaller than the counterbore 41, the formation of which provides an annular flange 55 adapted to engage the innermost metal end cap 53 during the beading of the tube.

For adjusting the size of the bead B to be formed on the tube T, there is provided a pin 56, which is eccentrically mounted in a sleeve 57 positioned in the front upright member 2 so that when the sleeve is rotated the pin moves forward and backward as desired with respect to the chuck 14. The sleeve 57 is formed with a head 58 adapted to be engaged for imparting rotation to the sleeve and said head is yieldably held in any set position by a spring member 59 which engages notches 60 in the face of the head. Only 180 degrees of the face is notched since obviously 180 degrees turning of the sleeve will shift the pin 56 from its rearmost to its foremost position.

The machine herein illustrated is adapted to be hydraulically operated for actuating the beading head 38 into operating position. One means of supplying operating fluid to the machine is disclosed in Figure 2 of the drawings and it will be noted that the front upright member 2 has a fluid passage 61 therein terminating at 62 within the cylinder 5 and communicating with the left hand side of the piston 8. Likewise, the upright 3 has a fluid passage 63 therein terminating at 64 and communicating with the right hand side of the piston 9. The spacer member 7 has a passage 65 terminating at 66 and communicating with the left hand side of piston 9. The spacer member 7 is further formed with a passage 67 to afford communication between the cylinders 8 and 9 and mounted therein is a ball check valve 68 backed by a coil spring 69. A restricted passage 70 extends from the passage 67 into the cylinder 5 allowing the fluid to enter said cylinder for operating the piston 8.

In the operation of the device, let it be assumed that the chuck 14 is open and that the pistons 8 and 9 are in engagement with the spacer member 7. At this time the beading head 38 is moved forward by the spring 39 to a point where the flat annular flange 55 has engaged the outer metal cap 53. The rubber ring 52 would not be compressed sufficiently by the pressure of the spring 39 so as to be expanded out of cylindrical form. The tube can then be readily placed over the abutment 46 and within the jaws of the chuck 14 and into the recess 42 of the beading head 38. At this time the end of the tube T will be in engagement with the end faces of the spring pressed plungers 43. Prior to starting the operation, the sleeve 57 has been rotated so as to move the pin 56 to the proper position for correct location of the tube relative to the chuck 14 for forming the desired size of bead (see Figure 3). Continued inward pressure of the tube T against the plungers 43 will move the beading head rearwardly until contact is made with the pin 56, at which time the operator will know that the tube has been properly positioned and located. The spring 39 will yield to permit the movement of the beading head into contact with the gauging pin. This movement of the beading head without altering the position of the plungers 43 is permitted since the springs 45 offer greater resistance than the spring 39 and thus the beading head can be shifted to the right with its reduced end 37 collapsing the spring 39 until contact is made with the pin 56. During this movement, the tube end will be held out of engagement with the bottom wall 71 of the recess 42. When the tube and parts are thus positioned, the hydraulic mechanism can be actuated whereby fluid will enter the cylinder 6 through the passage 65 to move the piston 9 toward the right on its sleeve 29 thereby moving the cam ring toward the right through the draw bolts 23 and plate 25 causing the segments of the chuck to be moved radially inward to grip the tube. After the chuck segments have closed to grip the tube, pressure will build up in the cylinder 6 so that fluid under pressure will travel through the passage 67 and restricted passage 70 into the cylinder 5 to move the piston 8 toward the left carrying with it the end 35 until said end contacts the rear wall 72 of the beading head 38. This contact of the end 35 with the beading head 38 will urge the latter toward the left with respect to the fixed abutment member 46 and the annular flange 55 of the beading head 38 will contact the innermost end cap 53, and the rubber ring 52 will be deformed to cause a slight expansion of the tube T as shown in Figure 4. This initial movement of the beading head will force the plungers 43 inwardly against the tension of their springs 44 until the end of the tube abuts the bottom wall 71 of the recess 42 as is also shown in Figure 4. Further movement of the piston 8 and beading head 38 toward the left operates directly against the end of the tube to complete the bead, expansion of the tube taking place within the counterbore 41. As shown in Figure 5 of the drawings, the extent to which the tube T can be beaded is limited by engagement of the beading head 38 with the chuck face, and expansion by means of the head occurs faster than the rubber ring 51 can be outwardly deformed.

In order to release the beaded tube from the apparatus so that a new tube can be substituted therefor, a valve, not shown, is actuated so as

to cause fluid to enter the cylinder 5 through the fluid passage 61 to move the piston 8 toward the right as viewed in Figure 1, withdrawing the end 35 out of contact with the rear wall 72 of the beading head 38. Simultaneously therewith, fluid will be admitted to the cylinder 6 through the passage 63 to shift the piston 9 toward the left as viewed in Figure 1. Fluid from within the cylinder 5 is exhausted through the ball check valve passage 67 and returned to the line through the passage 65. At the same time fluid being exhausted through the cylinder 6 is also being returned to the line through the passage 65. With the movement of the piston 9 to the left, the cam ring 13 will be moved out of engagement with the chuck 14, thereby releasing the end of the tube for its removal. A new tube is then ready to be inserted, and the operation repeated.

From the above description when taken in connection with the accompanying drawings, it will be noted that with the beading arrangement herein described, the rubber ring is first distorted to initially start the buckling column action and that the direct endwise push on the tube readily finishes the bead without requiring an exceedingly strong grip on the tube and without over stressing the rubber.

It will also be readily apparent that the beading arrangement including the metal confined rubber ring and beading head is not in any way limited to use with the particular hydraulic machine shown. The essential feature of the invention is that the tube be clamped and the clamp and beading head shifted relative to one another to first expand the tube radially by means of a radial force and then complete the expansion by means of an axial force on the end of the tube. Any means can be provided for moving the clamp or chuck into engagement with the tube and likewise any means can be provided for producing an axial force on the end of the tube.

It is to be clearly understood that various changes in the details and construction and arrangement of parts may be made without departing from the scope of the invention as set forth in the claims.

We claim:

1. A machine for forming a bead adjacent the end portion of a tube comprising a beading head having a counterbore and an annular recess communicating therewith for receiving the tube end, means for maintaining said tube end out of contact with the bottom wall of said annular recess when initially positioning said tube, an expansible head disposed within the tube and including a ring of elastic deformable material and metallic caps disposed one on each side of and engaging said ring, means for clamping the end of said tube to prevent longitudinal movement thereof, and means for shifting said clamping means and beading head relative to one another to first expand the tube radially into said counterbore by means of a radial force caused by radial expansion of said ring and then complete the expansion by an axial force on the end of said tube.

2. A machine for forming a bead adjacent the end portion of a tube comprising a beading head having a counterbore and an annular recess communicating therewith for receiving the tube end, an expansible head disposed within the tube and including a ring of elastic deformable material and metallic caps disposed one on each side of and engaging said ring, means for clamping said tube to prevent longitudinal movement thereof,

and means for shifting said clamping means and beading head relative to one another to first expand the tube radially into said counterbore by means of a radial force caused by radial expansion of said ring and then complete the expansion by an axial force on the end of said tube by said beading head.

3. A machine for forming a bead adjacent the end portion of a tube comprising a beading head having a counterbore and an annular recess communicating therewith, said recess adapted to receive the end of the tube to be beaded, plungers carried by said beading head and projecting into said annular recess to provide an abutment for the tube end when initially positioning said tube, springs pressing on said plungers, spring means for normally urging said beading head toward the tube end, said spring pressed plungers adapted to overcome said spring means to urge the beading head rearwardly when initially positioning the tube, an expansible head disposed within the tube and including a ring of elastic deformable material and metallic caps disposed one on each side of and engaging said ring, means for clamping said tube, and means for shifting said clamping means and beading head relative to one another to first expand the tube radially into said counterbore by means of a radial force caused by radial expansion of said ring and then complete the expansion by an axial force on the end of said tube by said beading head.

4. A machine for forming a bead on the end portion of a tube comprising a beading head having an annular recess adapted to receive the end of the tube to be beaded, plungers carried by said beading head and projecting into said annular recess to provide an abutment for the tube end when initially positioning said tube, springs pressing on said plungers, an abutment member adjustably disposed within said tube end, a ring of elastic deformable material mounted on said abutment member, metal caps attached to each end of said ring, means for clamping said tube, means on said beading head adapted to engage the innermost of said metal caps upon movement of said beading head relative to said clamping means to radially expand said ring outwardly to first expand the tube by a radial force, and means whereby further movement of said beading head relative to said clamping means will displace said spring pressed plungers to allow said tube end to abut the wall of said annular recess to complete the expansion by means of an axial force created by said beading head on the end of said tube.

5. A machine for forming a bead on the end portion of a tube comprising a beading head having an annular recess adapted to receive the end of the tube to be beaded, plungers carried by said beading head and projecting into said annular recess serving as a tube end abutment when initially positioning said tube, springs pressing on said plungers, an abutment member adjustably disposed within said tube end, a ring of elastic deformable material mounted on said abutment member, metal caps attached to each end of said ring, means for clamping said tube, an annular flange on said beading head adapted to engage said ring upon movement of said head relative to said clamping means to radially expand said ring outwardly, the radial expansion of said ring causing said tube to be partially expanded by radial force, and means whereby further movement of said beading head relative to said clamping means will displace said spring pressed plungers to allow said tube end to abut the wall of said annular recess to complete the expansion by means of an axial force created by said beading head on the end of said tube.

6. A machine for forming an external bead in the end portion of a tube comprising means for clamping the tube against endwise movement, an expansible head disposed within the tube, a beading head disposed in axial alignment with the tube, means for reciprocating the beading head, said beading head having means adapted to engage the expansible head for expanding the same to initiate the formation of a bead in the wall of the tube, said beading head having means adapted to subsequently engage the end of the tube for completing the bead by an axial force applied to the end of the tube.

7. A machine for forming an external bead in the end portion of a tube comprising devices for clamping the tube, means for positioning the tube in the clamping devices, means for subsequently closing said devices for holding the tube from endwise movement, an expansible head disposed within the tube, a beading head disposed in axial alignment with the tube, means for reciprocating the beading head, said beading head having means adapted to engage the expansible head for expanding the same to initiate the formation of a bead in the wall of the tube, said beading head having means adapted to subsequently engage the end of the tube for completing the bead by an axial force applied to the end of the tube.

8. A machine for forming an external bead in the end portion of a tube comprising devices for clamping the tube, means for positioning the tube in the clamping devices, means for subsequently closing said devices for holding the tube from endwise movement, an expansible head disposed within the tube, a beading head disposed in axial alignment with the tube, means for reciprocating the beading head, said beading head having means adapted to engage the expansible head for expanding the same to initiate the formation of a bead in the wall of the tube, said beading head having means adapted to subsequently engage the end of the tube for completing the bead by an axial force applied to the end of the tube, and a stop engaged by said head for limiting the extent to which axial force is applied to the tube.

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