

March 15, 1949.

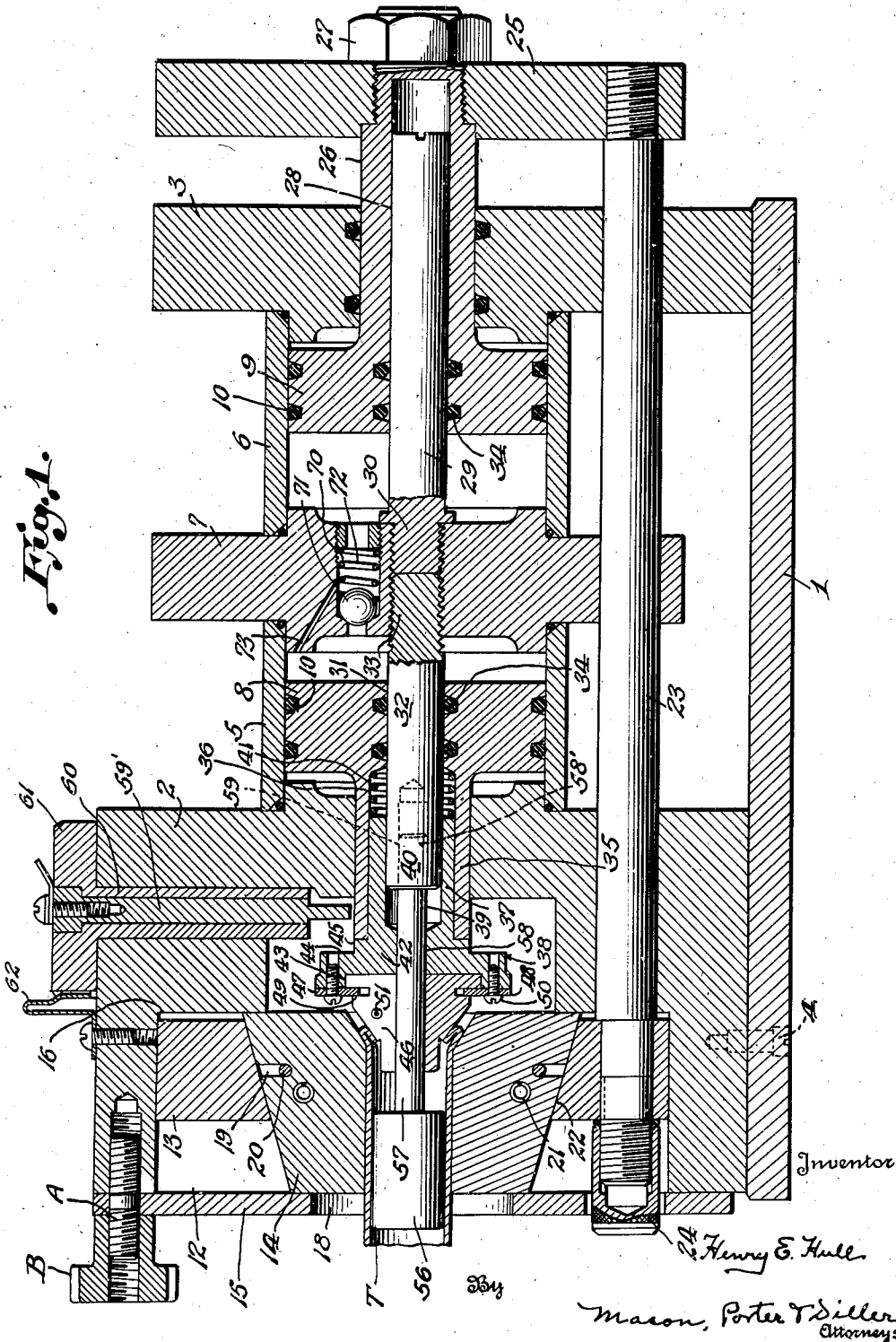
H. E. HULL

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TUBE FLARING MACHINE

Filed Jan. 10, 1945

4 Sheets-Sheet 1



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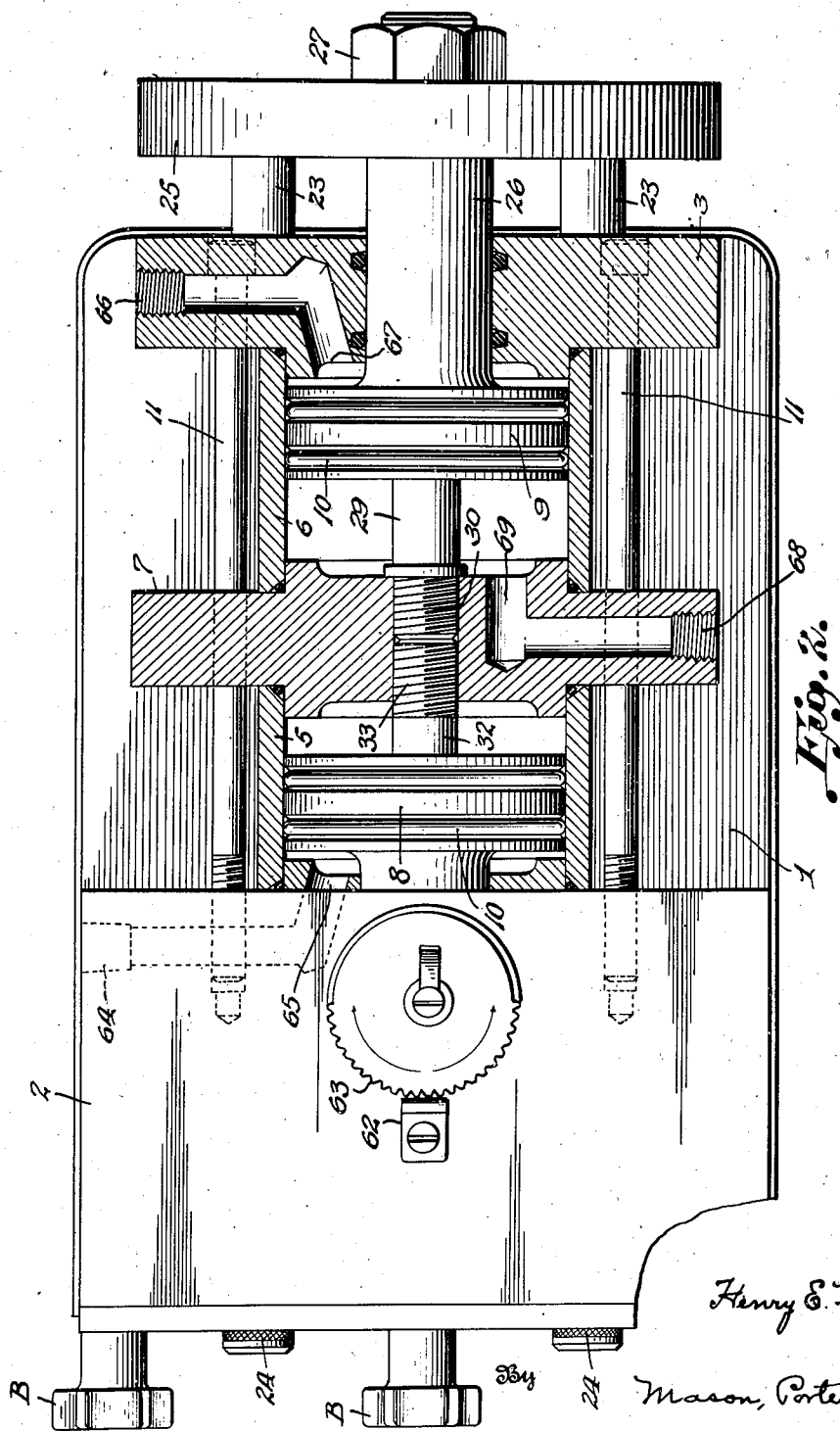
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Fig. 5.

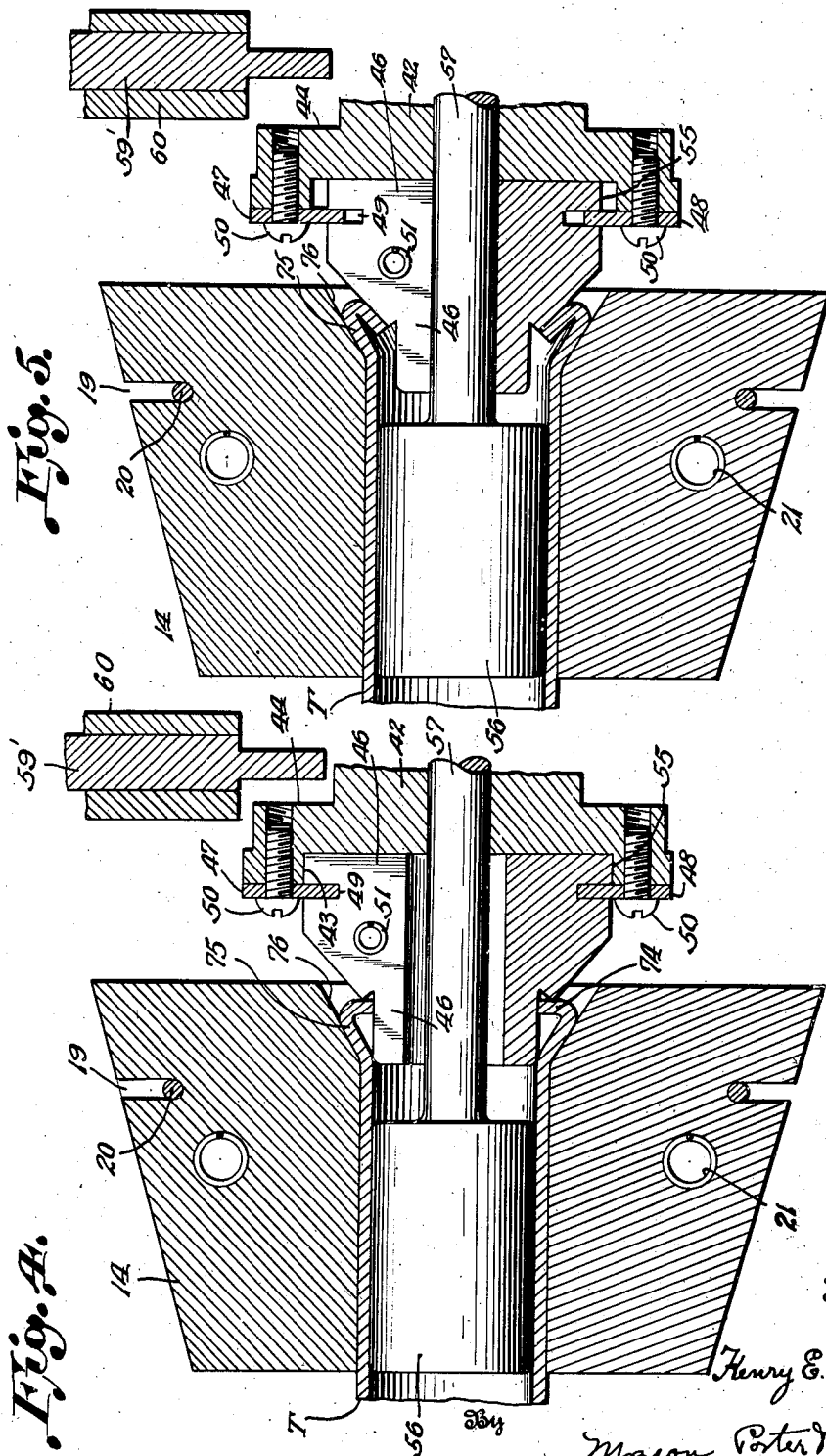


Fig. 4.

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TUBE FLARING MACHINE

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6 Claims. (Cl. 153-79)

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The present invention relates to tube deforming machines and more particularly to an apparatus for forming a two-ply flare on the tube adjacent its end portion.

The usual procedure in forming a two-ply flare on a tube end requires a two step method in which two separate tools are employed. One tool forms the first flare after which a second tool is positioned in a machine for forming the second flare, the second flare usually being formed by bending the first flare back upon itself.

In accordance with the present invention, these two separate tool and step methods have been combined in a single tool and method and the primary object of the invention, therefore, is to provide a single operation tool for forming a two-ply flare on a tube adjacent its end portion.

Another object of the invention is to provide a machine of the above character wherein means are provided for firmly clamping the tube end during the two-ply flaring operation.

A further object of the invention is to provide a machine of the above character wherein the deforming tool is formed with a shoulder for initially receiving the tube end so that when axial force is applied thereto a flare will be first formed at the end of the tube and upon imparting further movement to the deforming tool, the tube will be bent at an angle with respect to a plane perpendicular to the axis of the tube with the deforming tool entering the tube to cause the initially flared end to be formed with a perfect two-ply flare.

With the above and other objects in view that will hereinafter appear, the nature of the invention will be more clearly understood by reference to the following detailed description, and the several views illustrated in the accompanying drawings.

In the drawings,

Figure 1 is a vertical sectional view through one type of machine with which the single operation tool for double flaring the tube end is used.

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

Figure 3 is a fragmentary, vertical sectional view illustrating the arrangement of the parts at the start of the flaring operation.

Figure 4 is a similar view showing the position of the parts after formation of the first flare.

Figure 5 is a similar view illustrating the position of the parts after the two ply flaring operation has been completed.

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Figure 6 is an end elevational view of the two-ply flaring tool.

In the copending application of Henry E. Hull et al., Serial No. 569,751, filed December 26, 1944, for a tube end deforming machine, there is disclosed and claimed a portion of the machine shown in the present application. This 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 hydraulically operated 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.

The present invention relates specifically to a novel means in the form of a single operation tool for forming a two-ply flare on the end of the tube, and this specific tool 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 two-ply flaring operation. For sake of clarity, and in order to present an operable structure, an entire hydraulically operated machine for operating the two-ply flaring single operation tool will be hereinafter specifically described.

Referring to the drawings for a more detailed description thereof, the new and improved flaring tool arrangement is shown in use with a machine which comprises a substantially rectangular shaped base 1, on which is mounted spaced upright members 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 flaring 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 the

studs A provided with scalloped thumb nuts B. The recess 12 is of a depth substantially equal to the length of the chuck 14 and the latter is 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 flared 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 flaring 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 a lock nut 27. The piston 9 and its end extension 26 are formed with a central bore 28 in which is mounted a shaft 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 shaft 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 two ply flaring of the end of the tube T. This piston is formed with a central bore 31 in which is received a shaft 32, one end 33 of which threadedly engages the spacer member 7, and is held in abutting relation with the shaft end 30. Suitable packing 34 is provided for sealing the pistons 8 and 9 on the shafts 32 and 29 respectively. The piston 8 is formed with a reduced end 35 whose diameter is greater than the diameter of the shaft 32 forming a recess 36 in which is received the end 37 of the two-ply flaring tool generally designated by the reference numeral 38. It will be noted from an inspection of Figure 1 of the drawings that the reduced end 37 is formed with a bore 39 in which is positioned the other end 40 of the shaft 32. Thus the flaring tool 38 is slidable on the shaft 32 within the recess 36 as will hereinafter appear, and said tool is adapted to be actuated by the piston 8 for flaring the tube T. A coil spring 41 is positioned in the recess 36 in back of the reduced end 37 for normally

urging the tool toward the outer end of the machine.

The flaring tool 38 comprises a head 42 formed with a counterbore 43 in one face thereof, the other face being shaped to provide shoulder portions 44 and 45. The end 35 of the piston 8 is adapted to engage the shoulder 45 for urging the flaring tool toward the left as viewed in Figure 1 and it will be noted that the depth of said shoulder is substantially equal to the thickness of the reduced end 35. Mounted within the counterbore 43 is the shaping tool which comprises three segmental shaped members 46 which members are held in said counterbore by means of the pair of semi-circular annular plates 47 and 48 carried in annular grooves 49 formed in said segments and attached to said head by screws or the like 50. The plates 47 and 48 securely retain the segments against longitudinal movement but permit radial movement and when squeezed radially into engagement with one another are of perfect circular cross section. For urging the segments out of engagement with one another there are provided coil springs 51 mounted in drilled holes in the segments, the tension of the springs being sufficient to urge the segments radially outward upon the release of pressure thereon. Each segment is formed with a tapered surface 52 and circular shaped reduced end 53, the reduced end 53 and tapered surface 52 forming at their juncture, a shoulder 54. As shown in Figure 3 of the drawings, a portion of each segment 46 is of annular formation as indicated at 55 fitting within the counterbore 43, the surface 52 tapering downwardly from said annular surface.

In order to form a two-ply flare on the end of a tube with a single operation tool, a very firm grip is required on the tube, and while the chuck 13 firmly engages the outer surface of the tube, additional means should be provided for cooperating with said chuck from within the tube. In order to provide this firm grip there is provided a mandrel 56 of a diameter substantially equal to the inner diameter of the tube T. This mandrel 56 is carried on a rod 57 which extends through a central bore 58 formed in the head 42 and whose end 58' threadedly engages a bore 59 formed in the shaft 32. The tube T when initially positioned for flaring is slipped over the mandrel 56 between the segments of the chuck 14 and said mandrel will provide sufficient resistance from within the tube to permit the chuck segments to firmly grip the exterior of the tube so that the two-ply flaring of the end thereof can be performed without fear of the tube moving in any direction.

As in the above mentioned copending application, a means has been provided for properly locating the tube T with respect to the flaring head 38 and chuck 14. This means comprises a pin 59' which is eccentrically mounted in a sleeve 60 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 60 is formed with a head 61 adapted to be engaged for imparting rotation to the sleeve, and the said head is yieldably held in any set position by a spring member 62 which engages notches 63 in the periphery of the head. Only 180 degrees of the periphery is notched since obviously 180 degrees turning of the sleeve will shift the pin 59' from its rearmost to its foremost position. The pin 59' has a projecting portion which is engaged by the head 42 carrying the expansible head for deforming the

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tube. When the tube is inserted it will contact with the shoulder on the expansible head and move the head 42 carrying the same into contact with the pin 59'. This is what positions the tube in the chuck preparatory to the shaping of the end of the tube to provide a two-ply flare thereon.

The machine herein illustrated is adapted to be hydraulically operated for actuating the flaring 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 64 therein terminating at 65 within the cylinder 5 and communicating with the left hand side of the piston 8. Likewise, the upright 3 has a fluid passage 66 therein terminating at 67 and communicating with the right hand side of the piston 9. The spacer member 7 has a passage 68 terminating at 69 and communicating with the left hand side of the piston 9. The spaced member 7 is further formed with a passage 70 to afford communication between the cylinders 8 and 9 and mounted therein is a ball check valve 71 backed by a coil spring 72. A restricted passage 73 extends from the passage 70 into the cylinder 5 allowing the fluid under pressure to enter said cylinder for operating the piston 8.

In Figures 3, 4 and 5 of the drawings there is shown the several steps in the movement of the tool for two-ply flaring the tube T. 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. The tube T can then be readily moved into position over the mandrel 56 within the jaws of the chuck 14 with the end of the tube engaging the shoulder 54 of the tool 38. It is to be understood that the outer diameter of the reduced end 53 is substantially equal to the inner diameter of the tube T so that the end of the tube will snugly engage said reduced end when the segments 46 are in their relaxed position. This relaxed position is, of course, caused by expansion of the coil springs 51. Prior to starting the operation, the sleeve 60 has been rotated so as to move the pin 59 to the proper position for correct location of the tube relative to the flaring tool 38 and chuck 14. With the tube end engaging the shoulder 54 as in Figure 3 of the drawings, the tube and flaring tool 38 are moved rearwardly until the shoulder 44 contacts the pin 59 at which time the operator will know that the tube has been properly positioned and located. With the tube and flaring tool in the position shown in Figure 3 of the drawings, the hydraulic mechanism is actuated whereby fluid will enter the cylinder 6 through the passage 68 to move the piston 9 toward the right on its shaft 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 whereby fluid under pressure will travel through the passage 70 and restricted passage 73 into the cylinder 5 to move the piston 8 toward the left carrying with it the end 35 until said end contacts the shoulder 45 of the flaring tool 38. The tool 38 will then be urged toward the left to the position shown in Figure 4 forming a bead 74 at the end of the tube, and at the same time forming the single flare 75 which is caused by the tube end following the contour 76 of the chuck 14. Further movement of the tool toward the left starts

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to bend the beaded end 74 of the tube at an angle with respect to a plane perpendicular to the axis of the tube. At that time the tapered or conical surface of the segments 46 will engage the beaded end of the tube and be caused to enter said end with the result that the segments are collapsed radially inward to form a perfect conical shaped die to complete the bending of the tube for forming the two-ply flare as shown in Figure 5 of the drawings. Thus the tube end will not only be bent at an angle with respect to a plane perpendicular to the axis of the tube by reason of the flaring head 38 being moved toward the left, but the two-ply flared portion of the tube will be squeezed into tight engagement through the cooperating conical surfaces of the segments 46 and chuck 14.

In order to release the completed tube and permit the insertion of a new tube, the piston 8 will be moved toward the right through fluid entering the passage 64 and any fluid within the cylinder 5 will be exhausted through the check valve controlled passage 70 into the cylinder 6 where it returns to the line through the passage 68. Likewise, the piston 9 will be moved toward the left through fluid entering the passage 66 and as said piston moves toward the left it carries the cam ring 13 through the draw bolts 23 to move the cam ring 13 out of engagement with the chuck 14, thereby releasing the end of the tube. Fluid from within the cylinder 6 is exhausted through the passage 68 and returned to the line. The completed tube can then be removed and a new tube inserted and the operation repeated.

From the above description, when taken in connection with the accompanying drawings it will be readily apparent that there has been provided a single tool and a single operation for two-ply flaring the end of a tube which differs from prior procedure wherein one tool is required to form a bead while a second tool is required to turn the bead in to form the two-ply flare. While a specific type of hydraulically operated machine has been illustrated and described for operating this two-ply flaring tool, it is to be understood that this tool is not limited to use with the particular machine shown.

While one form of the invention has been shown for purposes of illustration, it is to be clearly understood that various changes in the details of construction and arrangement of parts may be made without departing from the spirit and scope of the invention.

I claim:

1. In a device of the character described, the combination of an external chuck movable to engage and clamp a tube, means on the inside of said tube cooperating with said external chuck to maintain said tube in a firmly clamped position, an expansible flanging tool movable with respect to said tube to engage and form a two-ply flare on the end thereof, said flanging tool comprising a head having a counterbored recess therein, a series of segmental members mounted in said counterbored recess, a pair of semi-circular shaped plates mounted on said head and engageable with said segmental members for locking said members against longitudinal movement while permitting radial movement thereof, each of said segmental members formed with a tapered surface and a cylindrical shaped reduced end forming a shoulder at their juncture, whereby said tube end will first abut said shoulder and upon continued movement of said tool relative

to said tube, said members will be caused to collapse radially inwardly to further enter the tube and form a two-ply flare on the end thereof.

2. A machine for forming a two-ply flare on the end of a tube comprising an external chuck for gripping and holding the tube, said chuck having an annular recess at its inner end providing a tapered wall conforming to the desired taper of the outer face of the two-ply flare, a head in alignment with said tube for forming a two-ply flare thereon, means for reciprocating said head, said head having a shoulder adapted to engage the end of the tube for buckling the same outward against the tapered wall of the recess in the chuck, said head having a tapered portion disposed in rear of said shoulder and adapted to move into the tube after it has been buckled against the wall of the recess for folding the extreme end portion of the tube against the inner face of the outwardly flared portion, thus completing the two-ply flare.

3. A machine for forming a two-ply flare on the end of a tube, comprising an external chuck for gripping and holding the tube, said chuck having an annular recess at its inner end providing a tapered wall conforming to the desired taper of the outer face of the two-ply flare, a head in alignment with said tube for forming a two-ply flare thereon, means for reciprocating said head, said head having a cylindrical portion at the outer end thereof adapted to enter the tube, a shoulder at the inner end of said cylindrical portion adapted to engage the end of the tube for buckling the same outwardly against the tapered wall of the chuck, and a tapered portion disposed in rear of said shoulder and adapted to move into the tube after it has been buckled against the wall of the chuck for folding the extreme end portion of the tube against the inner face of the outwardly flared portion, thus completing the two-ply flare.

4. A machine for forming a two-ply flare on the end of a tube, comprising an external chuck for gripping and holding the tube, said chuck having an annular recess at its inner end providing a tapered wall conforming to the desired taper of the outer face of the two-ply flare, an expansible head in alignment with said tube for forming a two-ply flare thereon, means for reciprocating said head, said head having a series of segments, yielding means for normally holding said head expanded, said segments having shoulders adapted to engage the end of the tube for buckling the same outwardly against the tapered wall of the chuck, and tapered portions disposed in rear of said shoulders and adapted to move into the tube for contracting the head for folding the extreme end portion of the tube against the inner face of the outwardly flared portion, thus completing the two-ply flare.

5. A machine for forming a two-ply flare on

the end of a tube, comprising an external chuck for gripping and holding the tube, said chuck having an annular recess at its inner end providing a tapered wall conforming to the desired taper of the outer face of the two-ply flare, an expansible head in alignment with said tube for forming a two-ply flare thereon, means for reciprocating said head, said head having a series of segments, yielding means for normally holding said head expanded, said segments having a cylindrical portion at the outer end thereof adapted to move into the tube, shoulders at the inner end of said cylindrical portions adapted to engage the end of the tube for buckling the same outwardly against the tapered wall of the chuck, and tapered portions disposed in rear of said shoulders and adapted to move into the tube for contracting the head for folding the extreme end portion of the tube against the inner face of the outwardly flared portion, thus completing the two-ply flare.

6. A machine for forming a two-ply flare on the end of a tube comprising an external chuck for gripping and holding the tube, means adapted to extend into a tube in the region of the external chuck against which said tube is clamped by the chuck, means for positioning the tube in the chuck prior to the clamping of the same, an expansible head in alignment with said tube for forming a two-ply flare thereon, means for reciprocating said head, said head having a series of segments, yielding means for normally holding said head expanded, said segments having shoulders adapted to engage the end of the tube for buckling the same outwardly against the tapered wall of the chuck, and tapered portions disposed in rear of said shoulders and adapted to move into the tube for contracting the head for folding the extreme end portion of the tube against the inner face of the outwardly flared portion, thus completing the two-ply flare.

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