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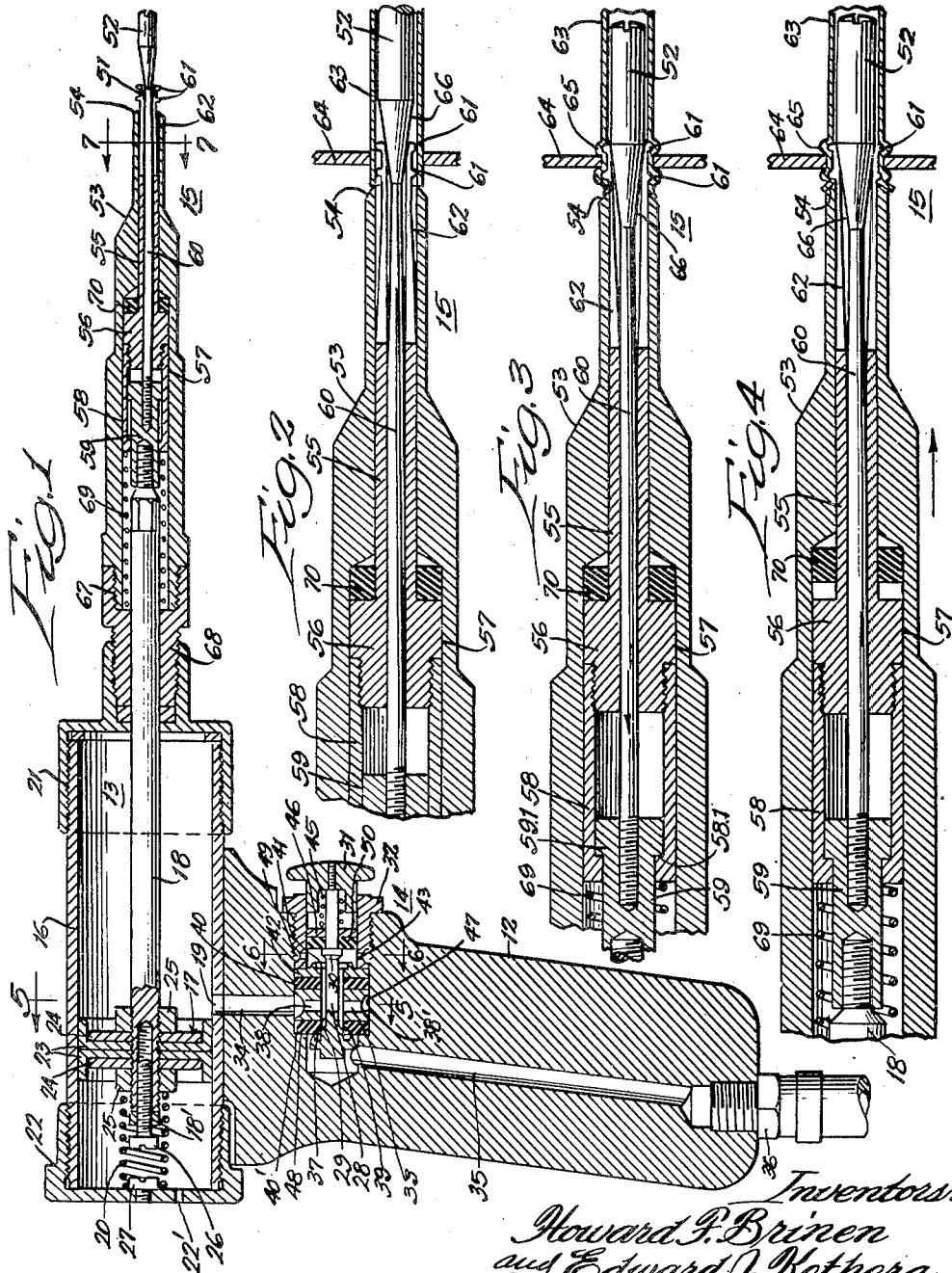
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TUBE BEADING TOOL

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2 Sheets-Sheet 1



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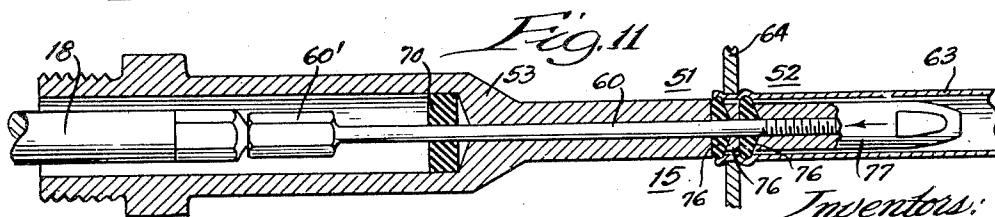
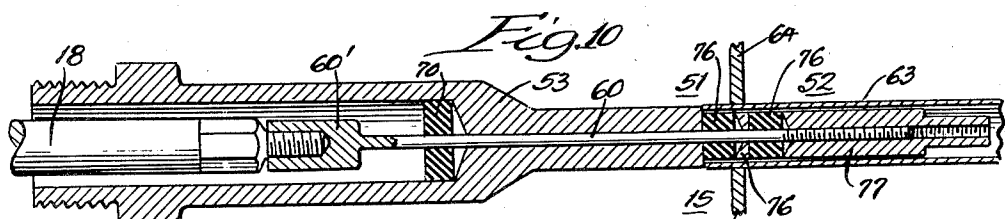
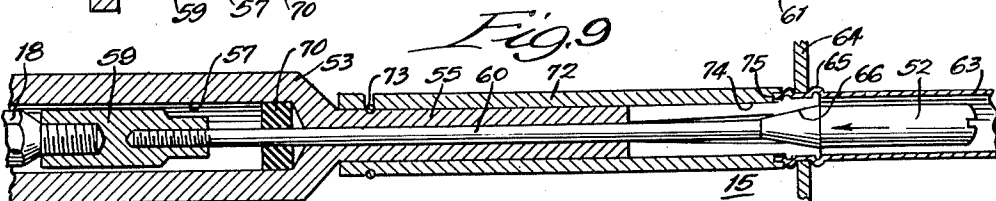
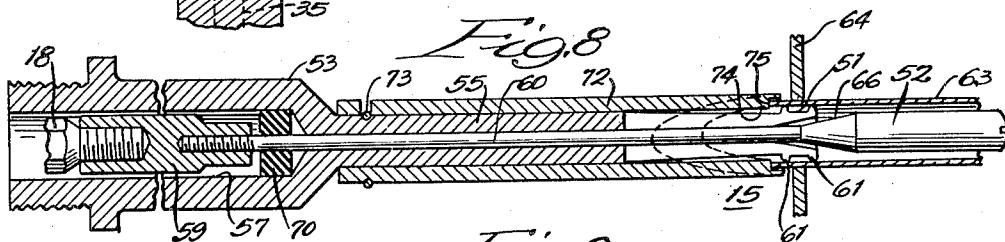
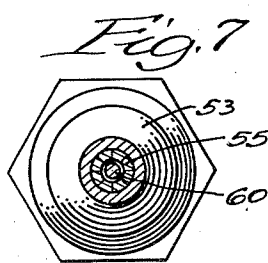
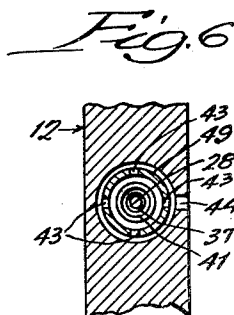
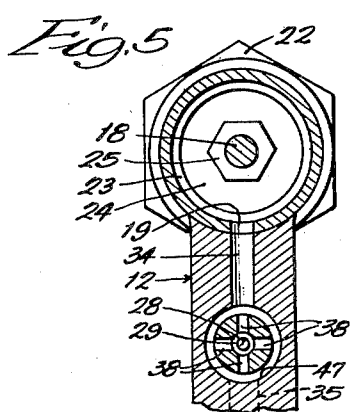
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TUBE BEADING TOOL

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TUBE BEADING TOOL

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The main objects of this invention are, to provide an improved form of tool for expanding the ends of tubes into supporting header plates, particularly in that type of heat-exchange structure wherein the tubes are small and formed of light metal and closely spaced in the header plates; to provide a tube-end expanding-tool of this kind having an improved form and arrangement of a fluid-pressure and spring-motivated actuator for effecting the operation of the tube-end expanding-element; to provide improved means for controlling the admission and exhaust of fluid pressure to said actuator; to provide an improved construction of the actuator housing whereby tube-end expanding-elements of differing types may be operatively connected thereto; and to provide an improved tool of this kind so compact in form and design and so light in weight that it can be held in one hand and its operation controlled by a slight movement of the index finger of the holding hand.

In the drawings,

Fig. 1 is a vertical cross-sectional detail of the preferred form of an improved tube-end beading or expanding tool constructed in accordance with this invention;

Fig. 2 is an enlarged fragmentary longitudinal sectional view showing the positioning of the tube-end expanding attachment in the tube preparatory to its being actuated to expand the tube into a header plate;

Fig. 3 is a similar view showing the relative position of the parts after the beads have been formed in the tube end;

Fig. 4 is a similar view showing the relative position of the parts after a further relative shifting incident to flaring the tube end after the initial beading operation;

Fig. 5 is a vertical sectional detail of the fluid-controlled actuator for one attachment of this kind taken on the line 5—5 of Fig. 1;

Fig. 6 is a fragmentary cross-sectional view of a part of the valve mechanism for said actuator taken on the line 6—6 of Fig. 1;

Fig. 7 is an enlarged cross-sectional view of the tube-expanding attachment taken on the line 7—7 of Fig. 1;

Fig. 8 is an enlarged cross-sectional detail of a modified form of tube-end expanding attachment, the parts being shown in their relative positions after insertion in the tube end immediately prior to their actuation for expanding the tube end;

Fig. 9 is a similar view showing the relative po-

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sition of the parts after the tube-end expanding operation has been completed; and

Figs. 10 and 11 are similar cross-sectional views for a further modified form of tube-end expanding attachment.

An improved tube-end beading or expanding tool embodying this invention comprises a support 12 whereon is mounted a fluid-pressure-controlled actuator 13, the operation of which is effected by a fluid-pressure-controlled means 14, for actuating any one of several types of tube-end expanding attachments 15 which may be attached to the actuator 13.

The support 12 and actuator 13 are associated to simulate a pistol, the support 12 being shaped to rather comfortably fit the hand, as is the case with a pistol grip, and with the fluid-pressure-controlled means 14 being positioned for contact by the index finger of the hand grasping the support 12.

The actuator 13 comprises a cylinder 16 wherein is mounted a piston 17, attached to a rod 18, and retracted by air entering the orifice 19 against a compression spring 20.

The cylinder 16 is welded or otherwise secured to the support 12. End caps 21 and 22 provide closures for the cylinder. The cap 21 also provides a support for a tube-end expanding attachment 15. The cap 22 has an orifice 22' through which air passes when the piston 17 is shifted in the cylinder 16.

The piston 17 is of more or less conventional construction. A pair of flanged flexible washers 23 are clamped between a pair of plates 24 by means of nuts 25 threaded on the rod 18.

At its forward end the piston rod 18 extends through the cap 21 for connection with one of the parts of a tube-end expanding attachment 15, as will appear more fully hereinafter. At its rear end the rod 18 has a machine screw 26 secured therein in opposed relationship to a similar screw 27 secured in the end cap 22. Between these screws is supported the spring 20 being held against displacement by said screws. The screw 26 is adjustable in the rod 18, and provided with the usual lock nut 18' so that its abutment against the screw 27 will determine the stroke of the piston rod 18 under the influence of air entering the cylinder orifice 19 as admitted by the air-flow control means 14, and consequently the amount of expansion effected by a tube-end expanding attachment 15.

The air-flow control means 14 comprises a valve stem 28 mounting a pair of opposed valves 29 and 30 and secured to a button 31, slidably

supported on a bushing 32, so as to control the flow of air through an orificed disk 33 connecting the branches 34 and 35 of a conduit extending through the support 12 from the cylinder orifice 19 to a hose connection 36.

The valve 29 is located at the end of the stem 28 opposite the button 31 whereas the valve 30 is located intermediate the valve 29 and the button 31. Intermediate these valves the stem 28 is of reduced diameter so as to provide a chamber 37 communicating with orifices 38 in the disk 33. In the periphery of the disk 33 is formed a groove 38' affording communication between all of the orifices 38 and the conduit branch 34.

The valve 29 coacts with a valve seat 39 in a washer 40 to control communication between the chamber 37 and the conduit branch 35.

The valve 30 coacts with a valve seat 41 formed on a disk 42 to control communication between the chamber 37 and orifices 43 in the bushing 32 leading to an orifice 44 in the support 12 (see Fig. 6). A spring 45 interposed between a disk 46 and the button 31 normally urges the button 31 to shift the valve stem 28 to close communication between the conduit branches 34 and 35 through the chamber 37 and open communication between the chamber 37 and the orifices 43 and 44 leading to the atmosphere. To that end the disk 46 has a press fit within the bushing 32 so as to resist movement when force is applied against the spring 45 by pressure on the button 31.

The bushing 32 is threaded into a transverse bore 47 in the support 12 and is set to press the disks 42 and 33 against the compression washers 40 and 40' interposed respectively between the disks 33 and 42 and between the disk 33 and an annular shoulder 48 formed in the bore 47. This firmly fixes the relation of the valve seats 39 and 41 with regard to the valves 29 and 30 respectively. A compression ring 50 is interposed between the valve 30 and the disk 46 against which the valve 30 is normally urged by the spring 45 to limit the relationship of the valves 29 and 30 and their respective seats 39 and 41.

A tube-end beading or expanding attachment 15 wherewith this air-controlled actuator 13 is suitable for use may take any one of several different forms. A preferred modification is shown in Figs. 1, 2, 3, and 4, and other modifications are shown in Figs. 8 and 9, and 10 and 11, respectively.

In any of the modifications the attachment comprises a die 51 and a mandrel 52. In the preferred form of attachment, shown in Figs. 1 to 4 inclusive, and the modification shown in Figs. 8 and 9, the die 51 and mandrel 52 are associated with a housing 53 which, in the preferred form, has its outer end shaped to form a tube-end flaring nose 54.

In the preferred form of tube-end expanding attachment 15, shown in Figs. 1 to 4 inclusive, the die 51 is formed on the forward extremity of an integral part of a tubular member 55 protruding beyond the housing 53. The inner end terminates in a hub or enlargement 56 slidable in the bore 57 of the housing 53 and connected to a sleeve 58 which supports a coupling 59 connecting the piston rod 18 to a rod 60, on the outer end of which is formed the mandrel 52. A head 59.1 on the coupling 59, and thereby in effect on the rod 60, abuts a shoulder 58.1 in the end of the sleeve 58, which constitutes on continuation of the member 55, and limits the relative movement of the rod 60 and the member 55.

When this head and coupling thus abut the member 55 is moved against the action of the spring 69 with any further retraction of the rod 60.

The die 51 is in the form of a pair of annular enlargements 61 on the outer extremity of the member 55. Inwardly from the end of the sleeve extend a plurality of slots, forming a plurality of fingers 62. These fingers are normally biased toward each other by the resiliency of the material from which the member is formed whereby the outside diameter of the annular enlargements 61 normally is less than the inside diameter of a tube 63 which the tool is to be used to expand. This permits the enlargements 61 to slip into the end of the tube 63 preparatory to expanding it into a header plate 64. The inner faces of the fingers 62, at their outer extremities, are tapered as indicated at 65 to conform to the cam face 66 of the mandrel 52.

The mandrel 52 is an integral enlargement at the outer end of the mandrel rod 60 and has a cam face 66 which coacts with the tapers 65 on the fingers 62 to expand the die 51 and form beads on the tube 63 when the rod 60 is drawn inwardly along the member 55.

In this preferred form of attachment 15, the housing 53, at the end opposite the flaring nose 54, is formed with a threaded hub 67 whereby the housing is attached to a nipple 68 threaded into a hub on the cylinder cap 21.

A spring 69 interposed between the sleeve 58 and the nipple 68 normally presses against the sleeve 58 to cause a retraction of the mandrel 52 from the die 51 up to the limit of the abutting of the enlargement 56 against the washer 70 which in turn abuts against the end of the bore 57 of the housing 53.

In the modified form of tube-end expanding attachment 15 shown in Figs. 8 and 9 the housing 53 is integral with the member 55 on the outer extremity of which is formed the die 51 such as above described. As in the preferred form, the mandrel rod 60, in this modified form of attachment, is slidably sheathed in the tubular part 55 and has its rear end connected to the coupling 59 housed in the bore 57 and secured to the forward end of the piston rod 18. At the forward end of the bore 57 the washer 70 is so located as to serve as a stop to limit the forward movement of the member 55 under the action of the spring 69 and indirectly of the coupling 59 under the action of the actuator spring 20, therefore limiting the retraction of the mandrel 52 from the die 51.

In this modified form of attachment 15, a gauge sleeve 72 is mounted on the tubular member 55 and locked in position by a spring locking ring 73. The forward end of the sleeve 72 is cut away at opposite sides as shown at 74 so as to provide a pair of shouldered fingers 75 adapted to contact the end of the tube 63 and limit the insertion of the die member 51 into said tube.

In the second modified form of the tube-end expanding attachment 15, shown in Figs. 10 and 11, the die member 51 is in the form of a pair of resilient rings 76, preferably rubber, and the die member 52 comprises a disk interposed between the rings 76 and a fitting 77 screwed onto the end of the mandrel rod 60. In this modification the mandrel rod 60 at its inner end is formed with an enlargement 60' which is threaded so as to connect the mandrel rod 60 with the piston rod 18.

The operation of a tube-beading tool con-

structed in accordance with this invention is as follows:

Once a tube-end expanding attachment 15 is set in the end of the tube 63 a depression of the button 31 shifts the valves 29 and 30 so as to unseat and seat the respective valves with regard to their valve seats 39 and 41. This results in a closing of the forward end of the passage 37 and opening communication at the rear end thereof with the branch conduit 35. Thereupon air rushes into the cylinder 16 through the branch conduit 34 connecting the orifices 38 and 19. The piston 17 is forced rearwardly against the action of the spring 20, causing the piston rod 18, acting on the mandrel rod 60, to draw the mandrel 52 against the die 51, expanding it to form beads in the tube 63 as indicated in the figures. Upon releasing the button 31 the spring 45 shifts the valves 29 and 30 to close communication between the conduit branches 34 and 35. The spring 20 shifts the piston to retract the mandrel 52 from the die 51 and thereby disengage the head 59.1 of the coupling 59 from the shoulder 58.1 on the inner end of the sleeve 58, to restore these parts to their normally retracted positions permitting the expanding attachment 15 to be withdrawn from the tube 63. In such movement of the piston 17 air in the cylinder 16 is forced out through the conduit branch 34, the chamber 37, and the orifices 43 and 44.

With the tube-end expanding attachment 15 of the type shown in Figs. 1 to 4 inclusive, after the mandrel 52 has been moved to expand the die 51 and cause the enlargements 61 to form beads in the tube 63 on opposite sides of the plate 64, the air pressure in the actuator 13 effects a relative movement of the housing 53 with respect to the expanded die 51 so as to complete the flaring of the tube end as shown in Fig. 4.

When a tube-end expanding attachment of either of the modified forms shown in Figs. 8 and 9, and 10 and 11, respectively, is connected with the actuator 13, there is of course no relative movement of the housing 53 and the expanded die member 51 to effect a tube end flare as is the case with the preferred form shown in Figs. 1 to 4.

Other variations and modifications in the details of structure and arrangement of the parts may be resorted to within the spirit and coverage of the appended claims.

We claim:

1. In a tube-beading and -flaring tool, the combination of a concentrically-arranged, relatively-shiftable housing, tubular member, and rod concentrically arranged for relative axial shifting, a tube flaring nose formed on the outer end of said housing to contact the end of a tube which is to be beaded and flared, said member having one end protruding beyond the end of said housing and whereon is formed an annular enlargement, said member having slits extending inwardly through said annular enlargement to form a plurality of fingers normally biased by the resiliency of said member toward each other so that the normal outside diameter of said enlargement is less than the inside diameter of said tube, a die-expanding mandrel formed on the end of said rod protruding beyond said member and adapted when shifted relative to said member to expand said annular enlargement to form a bead on said tube, a stop arranged in

the forward end of the bore of said housing, a hub on said member abutting said stop to limit the protrusion of said member from said housing, resilient means normally urging a relative axial movement of said member and housing to the limit permitted by the abutment of said hub against said stop, a head on said rod and a shoulder on said member coacting to limit the relative movement of said rod in the expansion of said enlargement by said mandrel, other resilient means normally urging a relative axial movement of said member and rod to disengage said head and shoulder, and manually-controlled means operatively connected to said housing and said rod to effect a successive relative movement of said rod and member and said member and housing so as to first form a bead on a tube and subsequently flare the end with said member remaining in fixed axial relationship to said tube during the formation of said flare.

2. In a tube-beading and -flaring tool, the combination of a concentrically-arranged relatively-shiftable housing, tubular member, and rod concentrically arranged for relative axial shifting, a tube flaring nose formed on the outer end of said housing to contact the end of a tube which is to be beaded and flared, an apertured cap removably attached to the opposite end of said housing, said member having one end protruding beyond the end of said housing and whereon is formed an annular enlargement, said member having slits extending inwardly through said annular enlargement to form a plurality of fingers normally biased by the resiliency of said member toward each other so that the normal outside diameter of said enlargement is less than the inside diameter of said tube, a die-expanding mandrel formed on the end of said rod protruding beyond said member and adapted when shifted relative to said member to expand said annular enlargement to form a bead on said tube, a stop arranged in the forward end of the bore of said housing, an extension on said rod protruding through said apertured cap beyond the opposite end of said housing, a hub on said member abutting said stop to limit the protrusion of said member from said housing, resilient means encased within said housing between the end of said member and said cap and normally urging a relative axial movement of said member and housing to the limit permitted by the abutment of said hub against said stop, a head on said rod and a shoulder on said member coacting to limit the relative movement of said rod in the expansion of said enlargement by said mandrel, other resilient means normally urging a relative axial movement of said member and rod to disengage said head and shoulder, and manually-controlled means located beyond said apertured cap with respect to the flared end of said member operatively connected to said housing and said rod extension to effect a successive relative movement of said rod and member and said member and housing so as to first form a bead on a tube and subsequently flare the end thereof with said member remaining in fixed axial relationship to said tube during the formation of said flare.

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