

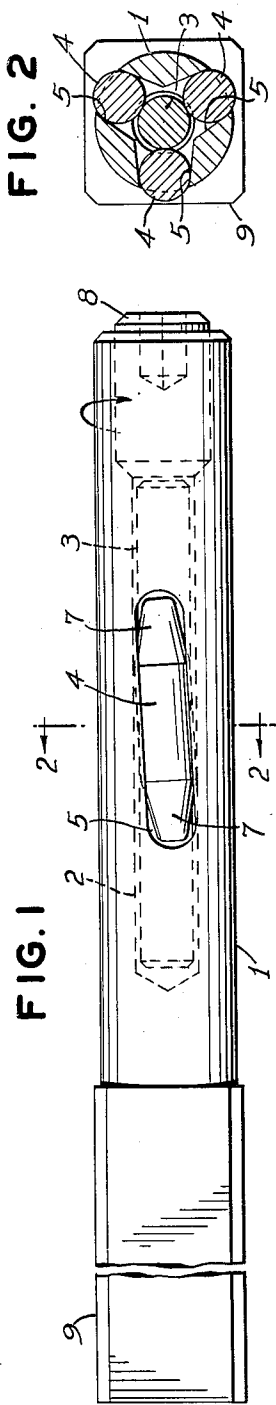
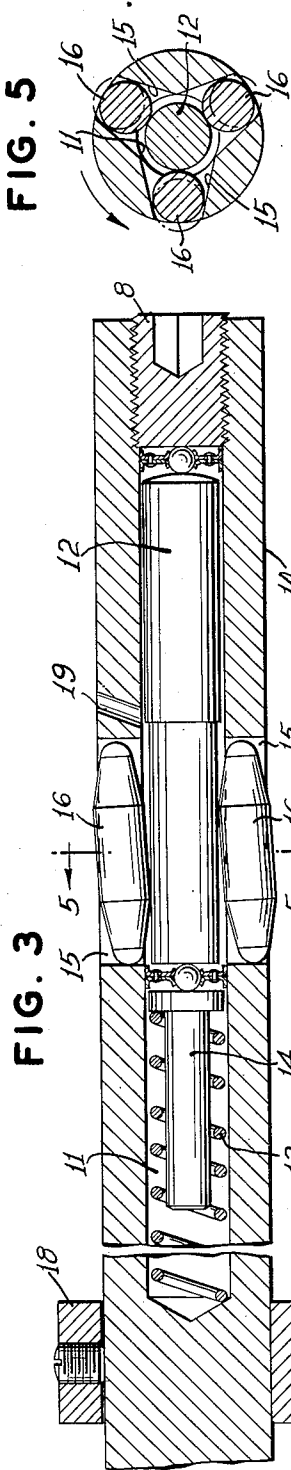
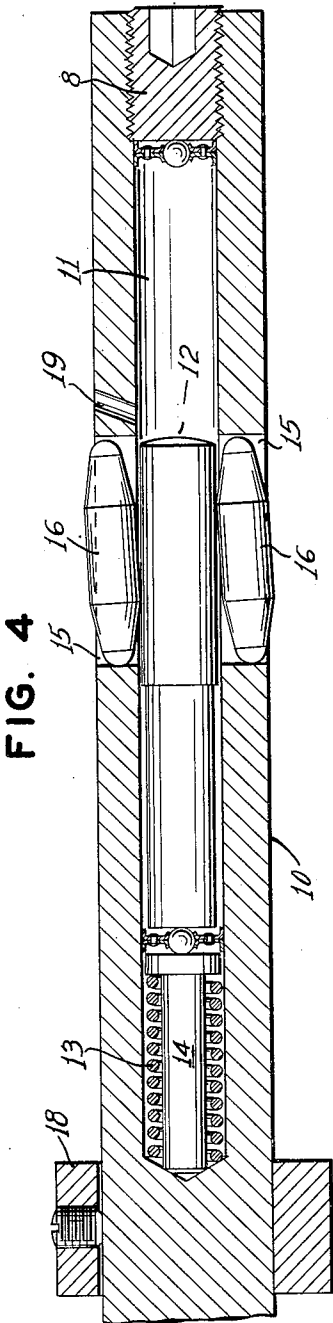
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TUBE EXPANDER

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TUBE EXPANDER

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My invention relates to a tube expander particularly designed for expanding tubes of small diameter in tube sheets in the fabrication of shell and tube apparatus or for other purposes.

The object of my invention is to provide a tube expander of simple construction and few parts and wherein the parts are so designed that those which are necessarily of small size because of the small sized tubes with which they are intended to operate, are subjected to only compression stresses whereby the liability to breakage and distortion of the parts is greatly reduced.

A further object of the invention is to provide a tube expander wherein all the parts which operate under pressure have a free rolling contact one with the other to thereby reduce friction and prevent binding of the parts during the tube expanding operation.

A further object of the invention is to provide a tube expander of this type which automatically effects an expansion of the tube when thrust in one direction, while contracting when thrust in the other direction, so that after the end of the tube has been expanded in the tube sheet and the direction of the expander reversed, it will contract and release itself from the tube so as to be readily withdrawn. With this modified form of expander it is also possible to insert the expander with the parts in contracted relation into the tube and expand the tube by simultaneously rotating and pulling the expander out of the tube.

In the accompanying drawings I have illustrated my improved tube expander both in the simple form and also in the form wherein the expanding elements are contracted and expanded upon reverse movement of the expander in the tube.

Referring to the drawings:

Fig. 1 shows a side elevation of one form of my improved tube expander;

Fig. 2 is a cross section on line 2—2 of Fig. 1;

Fig. 3 is a longitudinal section of a modified form of my expander showing the parts in contracted position;

Fig. 4 is a similar view with the parts in tube-expanding position; and

Fig. 5 is a cross section on line 5—5 of Fig. 3.

Referring to the drawings, particularly to Figs. 1 and 2, my improved expander comprises a rod 1 of a diameter, throughout the greater portion of its length, slightly less than the internal diameter of the tube to be expanded. A cylindrical bore 2 extends into the rod 1 from one end and supported in the bore for free rotation therein is

a hardened roller 3. This roller serves as a backing roller for three tube expanding rollers 4 supported in slots cut in the wall of the rod 1 about midway the length of the bore 2 in which the bearing roller 3 is freely mounted. These slots 5 in which the expanding rollers 4 are mounted are at a slight angle to the longitudinal axis of the rod 2 and are tapered along their side walls to an extent such that the distance between the side walls at the inner edges of the slots is slightly greater than the diameter of the expanding rollers 4, while the outer edges of the slots are slightly less than the diameter of the expanding rollers to thereby permit radial movement of the rollers in the slots, while at the same time holding the rollers against falling out of the slots. The expanding rollers are hardened metal and are tapered at each end as shown at 7. The end of the bore 2 in which the backing roller 3 is mounted is closed with a set screw 8, as shown, and at the other end the rod 1 is provided with an enlarged portion 9 squared at the end for connection to a hand or power drive.

In operation the rod 1 is thrust into the end of the tube to be expanded until the tapered ends of the expanding rollers engage the metal of the tube, and while so held is turned in the direction indicated by the arrow in Fig. 1. The positioning of the expanding rollers with their axes at an angle to the axis of rotation of the supporting rod causes the expander to advance slightly into the tube as the expander is rotated, thus expanding the tube and rolling it into tight engagement with the wall of the tube sheet. When the expander is advanced the full thickness of the tube sheet, the direction of rotation is reversed and the angular position of the expanding rollers will then cause the expander to slowly move out of the end of the tubing.

An expander of the above design can be built to successfully expand tubes of less than one-quarter inch inside diameter and produce joints which will withstand fluid pressures of several thousand pounds per square inch. All the parts of the expander which are subjected to pressure, that is, the expanding rolls and the inner bearing roll, have free play within their guiding surfaces so that the tendency of the parts to bind and stick is virtually eliminated. Also, as the compression strains to which the parts are subjected are in the planes of their diameters, the parts, even though of very small size, can successfully withstand such strains.

In Figs. 3, 4 and 5 I have illustrated a modified form of my expander wherein the expanding

rollers are permitted to move inwardly to reduce the overall diameter of the expander when the expander moves in one direction, and are projected to their outward positions when the expander moves in the opposite longitudinal direction.

Referring to these figures, the expander comprises a rod 10 having an internal bore 11 at one end which is closed by a threaded plug after the insertion of a backing roller 12. As here shown, the backing roller is considerably shorter in length than the bore 11 and consists of two portions of different diameters. Mounted within the bore at its inner end is an expansion spring 13 carrying at its end a pin 14 whose head engages against the end of the reduced diameter portion of the backing roller 12. Under the action of the spring 13 the backing roller 12 is held with the end of its portion of larger diameter against the closing plug for the bore 11.

Slots 15 are formed in the walls of the rod at a point spaced from the end of the rod by a distance greater than the enlarged diameter portion of the backing roller. Each of these slots contains an expanding roller 16, the slots and rollers being of the same shape and relative dimensions as those provided in the previously described expander. Anti-friction thrust bearings 17 may be interposed between the ends of the backing roller 12 and the plug 8 and plunger 14 respectively.

The solid end of the rod 10 is provided with a square head, not shown, for attachment to the hand or power drive, and a stop collar 18 may be provided if desired which is adjustable for various thickness of tube sheets to limit the extent to which the expander will be projected into the tube. Also, if desired, an observation hole 19 may be drilled in the wall of the hollow portion of the rod 11 through which the position of the backing roller within the bore may be noted.

In operation with the parts in the position shown in Fig. 3, the expander is thrust into the end of the tube until the tapered end of the rollers 16 engage the end of the tube. With the parts in the position shown, the rollers are in engagement with the portion of the backing rollers of smaller diameter so that the overall diameter of the expander at the point where the expanding rollers are located is only slightly greater than the internal diameter of the tubes.

The expander is inserted in the tube and rotated in a clockwise direction thereby, through engagement of the biased rollers with the surface of the tube, causing the expander to advance into the tube and expanding the tube lightly against its seat in the tube sheet. During the rotation in this direction the backing roller 12 is maintained in the position shown in Fig. 3, that is, with the portion of smaller diameter in engagement with the rollers 16. When the expander is advanced the desired distance, or until the collar 18 engages the tube sheet, the direction of rotation is reversed, thereby first causing the backing roller 12 to move from the position shown in Fig. 3 to the position shown in Fig. 4, where the portion of larger diameter is in engagement with the rollers 16, thereby forcing the rollers 16 outwardly to the necessary position to fully expand the tube. By continued rotation in a counterclockwise direction the expander moves out of the tube as the rollers 16 progressively expands the tube to form the finished union with the tube sheet.

It is particularly desirable to effect the final expansion of the tube during the outward movement of the expander when expanding the second end of a straight tube. As one end of the tube is now fixed in the tube sheet the tube will be under tension during the expansion of the second end of the tube if the expansion is effected during the outward movement of the expander, whereas, if the expansion is effected on the inward movement of the expander the metal of the tube will be placed under compression, thereby increasing the tendency to buckle when the tubes are subsequently heated in the operation of the apparatus in which they are installed.

While I have shown and described my improved tube expander in the forms which I have found most suitable, it is to be understood that the structures may be variously modified within the scope of the appended claims.

I claim:

1. A tube expander comprising a tubular member adapted to be inserted and rotated in a tube to be expanded the bore of said member being closed at both ends, a solid roller carried by the bore of said tubular member said roller being of slightly smaller diameter than said bore and freely rotatable therein, slots in the walls of said tubular member, said slots being at a slight angle to the axis of said tubular member, and tube-expanding rollers having tapered ends supported in said slots with their peripheries in rolling contact with the roller within the bore of said tube.

2. A tube expander comprising a tubular member adapted to be inserted and rotated in a tube to be expanded the bore of said member being closed at both ends, a solid roller carried by the bore of said tubular member said roller being of slightly smaller diameter than said bore and freely rotatable therein, slots in the walls of said tubular member, said slots being at a slight angle to the axis of said tubular member, and tube-expanding rollers having tapered ends supported in said slots with their peripheries in rolling contact with the roller within the bore of said tube, the walls of said slots converging at their outer edges to retain said rollers in said slots.

3. A tube expander comprising a tubular member adapted to be inserted and rotated in a tube to be expanded the bore of said member being closed at both ends, a solid backing roller carried by the bore of said tubular member said roller being of slightly smaller diameter than said bore and freely rotatable therein, slots in the walls of said tubular member, said slots being at a slight angle to the axis of said tubular member, and tube-expanding rollers having tapered ends supported in said slots with their peripheries in rolling contact with the roller within the bore of said tube, said first mentioned roller having two portions of different diameters and being mounted for movement in the bore of said tube-expanding member from a position where the portion of larger diameter engages said rollers to a position where the portion of smaller diameter engages said rollers.

4. A tube expander comprising a tubular member adapted to be inserted and rotated in a tube to be expanded the bore of said member being closed at both ends, a solid backing roller carried by the bore of said tubular member said roller being of slightly smaller diameter than said bore and freely rotatable therein, slots in the walls of said tubular member, said slots being at a slight angle to the axis of said tubular member,

and tube-expanding rollers having tapered ends supported in said slots with their peripheries in rolling contact with the roller within the bore of said tube, said first mentioned roller having two portions of different diameters and being mounted for movement in the bore of said tube-expanding member from a position where the portion of larger diameter engages said rollers to a position where the portion of smaller diameter engages said rollers, and a spring in said bore biased to move said backing roller to said last-named position.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
705,738	Davis -----	July 29, 1902
723,685	Lamplough -----	Mar. 24, 1903
1,506,988	Mirfield -----	Sept. 2, 1924
1,514,099	Pring -----	Nov. 4, 1924
1,601,329	Slesazeck -----	Sept. 28, 1926
1,752,408	Zein -----	Apr. 1, 1930
1,917,925	Cogsdill -----	July 11, 1933
2,040,440	Maupin -----	May 12, 1936
2,448,512	Brackett -----	Sept. 7, 1948