Feb. 11, 1969

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3,426,565

TUBE EXPANDER

Filed March 11, 1966

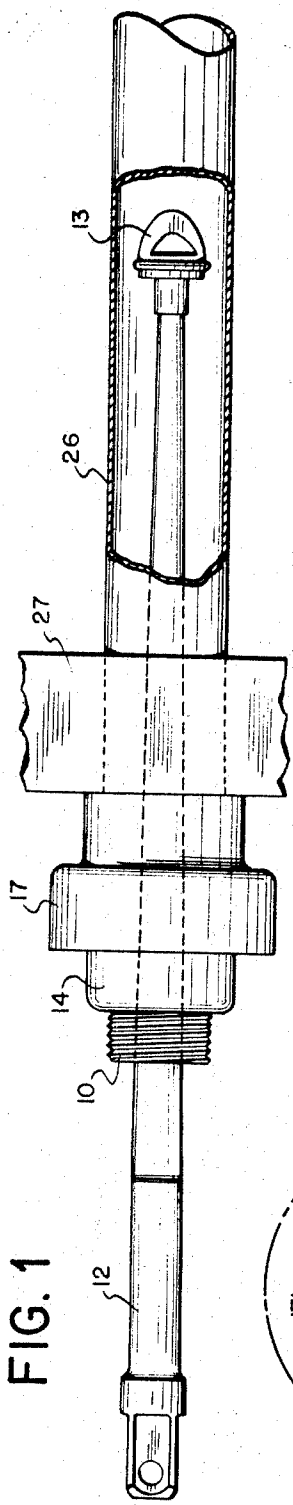

FIG. 1

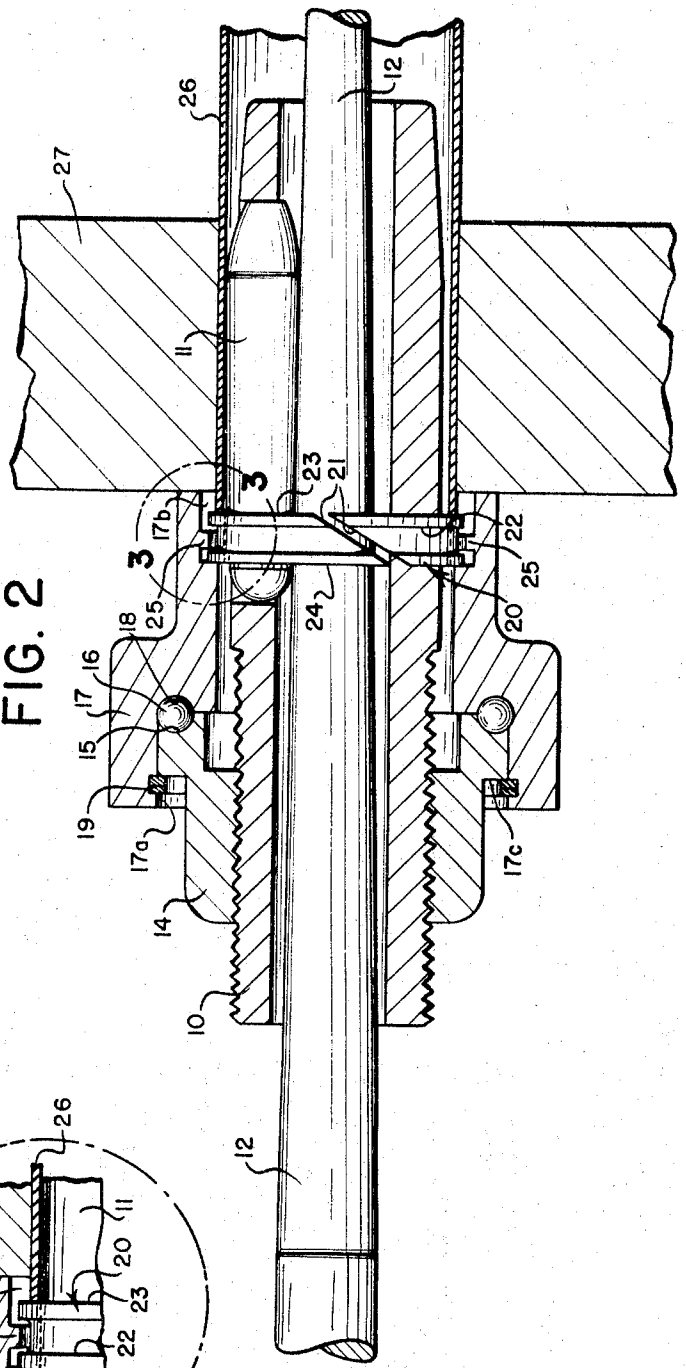

FIG. 2

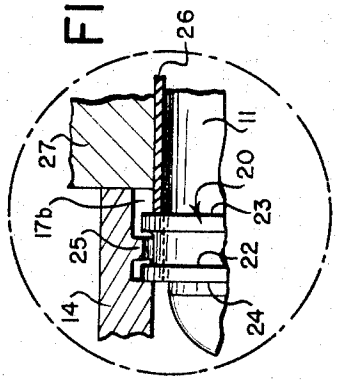

FIG. 3

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United States Patent Office 3,426,565
Patented Feb. 11, 1969

3,426,565

TUBE EXPANDER

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Filed Mar. 11, 1966, Ser. No. 533,553
U.S. Cl. 72—122 4 Claims
Int. Cl. B21d 3/02, 1/02, 39/10

ABSTRACT OF THE DISCLOSURE

A tube expander of the roller and mandrel type for expanding tubes within tube sheets is provided with a stop collar for restricting movement of the rollers into the tube. Outward movement of the tube is arrested by a radially expansible thrust ring which is mounted in a recess at the forward end of the collar and is capable of encircling and bearing tightly against the rollers.

This invention relates to tube expanders of the roller and mandrel type snch as are used in expanding tubes in tube sheets in the construction of heat exchangers and like apparatus. More particularly, the invention is concerned with a novel tube expander which may be employed to especial advantage in the expanding of thin-walled tubes, in that it performs its function without marking the tube sheet or deforming or otherwise damaging the end of the tube projecting beyond the sheet.

In the expanding in tube sheets of thin-walled tubes having a wall thickness of 18 gauge or thinner, it has been common to employ an expander which includes a tubular cage with slots containing rollers lying at an oblique angle to the axis of the cage and a tapered mandrel extending through the cage in contact with the rollers.. When such an expander is inserted into a tube and the mandrel is advanced and forces the rollers into contact with the tube, the rotation of the mandrel causes the cage to rotate and to move into the tube. This movement of the cage is arrested by engagement with the tube sheet of a collar mounted on the cage to rotate therewith and having an internal radial shoulder opposed to the end of the tube. During further rotation of the cage to complete the expansion of the tube, while movement of the cage into the tube is prevented, the rollers act to pull the tube outward through the sheet and into contact with the shoulder in the collar. Continued rotation of the cage then causes the rotating collar to mar the outer surface of the tube sheet around the end of the tube and to deform, curl, or otherwise damage the end of the tube.

The tube expander of the invention is devoid of the objectionable features of the prior expanders and, although it is provided with a stop collar restricting the movement of the cage into the tube, the collar may be held stationary while the cage rotates, so that the collar cannot mar the tube sheet. The outward movement of the tube is then arrested by an element disposed within the recessed forward end of the collar and providing an abutment with which the entire end surface of the tube makes contact.

For a better understanding of the invention, reference may be made to the accompanying drawing, in which:

FIG. 1 is a view in elevation with parts broken away showing the tube expander of the invention in use;

FIG. 2 is a vertical longitudinal section through the expander disposed within a tube; and

FIG. 3 is a view on an enlarged scale of the area 3—3 of FIG. 2.

The tube expander of the invention in the form shown comprises a tubular cage **10** externally threaded at its rear end having a plurality of slots through its wall in

which are mounted rollers **11**. The rollers have a tapered central section with the large end at the forward end of the cage. A mandrel **12** extends through the cage and is tapered toward its leading end, on which is mounted a cap **13** serving to prevent accidental withdrawal of the mandrel from the cage. At its rear end, the mandrel is formed for connection to an air or electric motor.

A nut **14** is threaded on the cage and may be held in adjusted position lengthwise of the cage by means of a set screw not shown. The forward face of the nut is provided with a race **15**, in which are disposed a plurality of ball bearings **16**. A stop collar **17** having a recess **17***a* in its rear end and a recess **17***b* in its forward end is telescoped over the forward end of the nut and the recess **17***a* is formed with a race **18** entered by the ball bearings **16**. The collar is held against displacement from the nut by a snap ring **19** seated in an internal channel in the recess **17***a* in position to be engaged by a radial shoulder **17***c* on the forward section of the nut.

A split resilient thrust ring **20** encircles and bears against the rollers **11** and the ring is formed with ends **21** which extend at an oblique angle to a plane normal to the axis of the ring and overlap as shown at all times. The thrust ring is provided with an external circumferential channel **22** and its front and rear faces **23**, **24** lie parallel and normal to the axis of the ring and are of a width substantially greater than the wall thickness of any tube on which the expander is to be employed. The forward recess **17***b* in the stop collar is formed with an internal circumferential rib **25** which has an inner diameter less than the outer diameter of the ring in its relaxed condition. The inner diameter of the ring in its relaxed condition is less than the diameter of a circle fitting the rolls in their inmost positions in the slots in the cage.

In the use of the expander to expand a tube **26** into contact with a tube sheet **27**, the tube **26** is adjusted lengthwise in the opening through the sheet so that the first end of the tube to be expanded lies flush with the outside surface of the sheet or projects a slight amount beyond the sheet. The nut **14** is then adjusted along the cage to a position determined by the thickness of the tube sheet and is secured in position on the cage by the set screw. The cage with the mandrel in position is then inserted into the tube and the mandrel is rotated and moved forwardly. When the rollers are brought into contact with the inner surface of the tube, the rotation of the mandrel causes the rollers to roll on the tube surface and to rotate the cage. The skewing of the rollers causes the cage to be drawn into the tube and this movement continues until the forward end of the stop collar **17** comes into contact with the sheet. During the initial rotation of the cage, the collar **17** rotates with it but, as soon as the collar strikes the sheet, no further rotational movement of the collar occurs. Further rotation of the cage then tends to pull the tube outward through the sheet but such movement is arrested by engagement of the projecting end of the tube with the forward face of the thrust ring **20**. As the width of this face of the ring is wider than the wall thickness of the tube, the tube is fully supported at its end and, since the rollers cause no rotational movement of the thrust ring, there is no action tending to deform the exposed end of the tube when it is pulled into contact with the ring. When the expansion operation is complete, the mandrel is rotated in the reverse direction and the cage and mandrel are withdrawn from the tube.

In the expander shown, the recess **17***b* is of such depth in relation to the axial dimension of the thrust ring **20** that when the tube end is in contact with the ring and the latter is in contact with the bottom of the recess, the tube **26** projects beyond the face of the tube sheet **27**.

If desired, the recess may be made shallower, so that the face **23** of the ring makes contact with the tube sheet and the end of the expanded tube lies flush with the tube sheet.

A tube expander with a ball bearing stop collar which is capable of adjustment to a position encircling the rolls, cannot be satisfactorily used in expanding thin-walled tubing, because it is not possible to provide the collar with a shoulder opposed to the tube end which offers an abutment engageable by the entire end area of the tube. As a result, the tube tends to be drawn into the interior of the nut with consequent damage to the exposed end of the tube. The thrust ring of the expander of the invention provides an abutment for the tube giving the desired support to the end of the tube and, by forming it with the diagonal ends **21**, the opening between the ends cannot be entered by a roll in such a manner to cause the ring to rotate with the roll. The diagonal opening through the ring also avoids variations in the torque required for rotation of the cage and rollers.

I claim:

1. In a tube expander, the combination of a tubular cage having a plurality of openings through its wall, rollers mounted in the openings, a tapered mandrel extending through the cage in contact with the rollers, a collar encircling the cage and adjustable to and from a position in which it overlies the rollers, the collar having a recess in its forward end, a nut mounted on the cage for lengthwise adjustment, a bearing between the nut and the collar, and a radially expansible thrust ring within the recess in the forward end of the collar in contact with the bottom of the recess and capable of encircling and bearing tightly against the rollers, the ring having a forward radial face adapted to contact the end of a tube being expanded.

2. The combination of claim **1** in which the thrust ring has overlapping ends extending at an oblique angle to a plane normal to the axis of the ring.

3. The combination of claim **1**, in which the thrust ring and the collar have co-operating means preventing accidental displacement of the ring from the collar recess.

4. The combination of claim **3**, in which the cooperating parts on the thrust ring and collar comprise a circumferential channel on the outer surface of the ring and an internal circumferential rib on the collar entering the channel.

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U.S. Cl. X.R.

72—125, 126