March 10, 1953 J. E. TOTH 2,630,853

RETRACTIVE ROLLER EXPANDER

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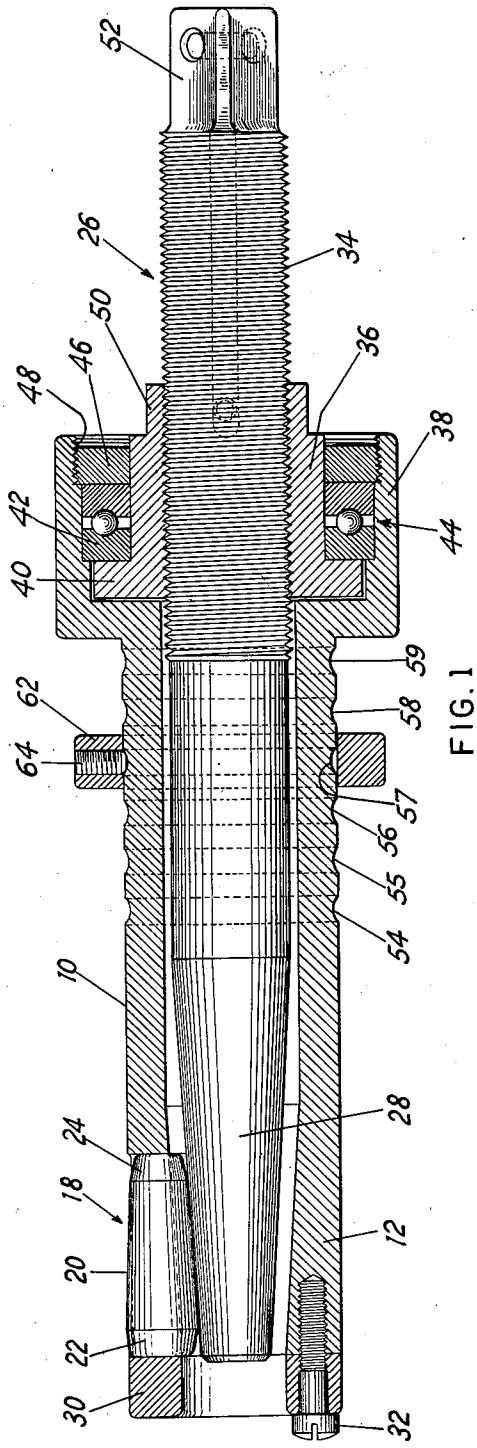


FIG. 1

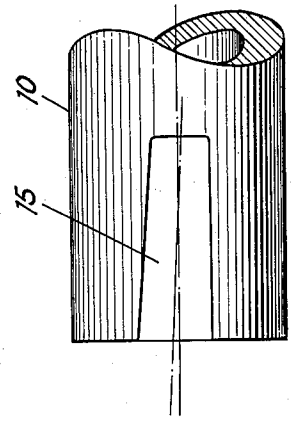


FIG. 4

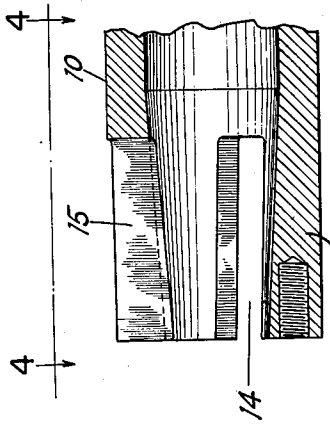


FIG. 3

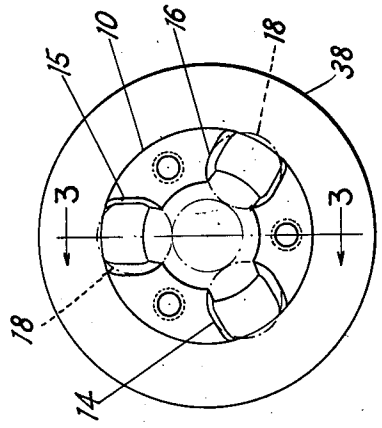


FIG. 2

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RETRACTIVE ROLLER EXPANDER

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2 Claims. (Cl. 153—82)

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This invention relates to a retractive roller expander adapted for use in expanding tubes to make a pressure-tight tube and tube seat connection, as for example between a water tube of a high pressure steam generator and the tube seat formed in a wall of a pressure vessel of the generator.

The invention involves improvements in a multiple roller tube expander which performs a tube expanding operation in a retractive manner. In the use of such an expander the expander body with its rollers is inserted in a tube which has been fitted within a tube seat in a metallic wall. The expander is then operated to move the expander rollers radially to their outward or operative positons wherein they will cause a degree of actual expanding of the tube. Thereupon, the mandrel engaging the rollers is rotated so that its movement, combined with the lead angle of the rollers with respect to the mandrel, will cause the expansion of the tube incrementally or progressively toward the adjacent or nearest end of the tube into which the expander has been inserted. Prior art expanders operating in this manner have had tapered portions so arranged that the portion of the mandrel of smallest diameter was located between the point of application of the power to the mandrel and the load. This resulted in mandrel breakage. The present invention involves a construction which eliminates the type of mandrel with its weakest section between its ends, and thereby reduces maintenance and erection costs relative to the erection and maintenance of high pressure fluid heat exchange installations.

The illustrative expander also involves a construction whereby the tube engaging stop on the mandrel body is securely held in one of a number of operative positions. This result is secured by the formation of the mandrel body with a plurality of annular grooves at the positions of adjustment.

The illustrative retractive expander involves a hollow cylindrical expander body with a thickened tube entering end, tube engaging rollers circumferentially arranged and mounted within the roller holding recesses in the thickened end of the body, a tube end engaging stop adjustably mounted on the body at a position remote from the rollers, a tapered mandrel disposed within the body with the small end of the mandrel at a leading position relative to the entry of the expander into a tube, and a thrust member screw-threaded upon the mandrel and rotatably mounted relative to the portion of the expander body at its end opposite its roller receiving end.

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The illustrative expander will be described with reference to the accompanying drawings and objects of the invention will appear as the description proceeds.

In the drawings:

Fig. 1 is mainly a longitudinal section through the expander showing the mandrel and a tube engaging roller in elevation;

Fig. 2 is an end elevation looking toward the end of the mandrel with the tube engaging rollers and the retaining ring removed;

Fig. 3 is a partial vertical section on the line 3—3 of Fig. 2, and

Fig. 4 is a partial plan view of that part of the structure shown on Fig. 3. This figure is taken at the position indicated at 4—4 of Fig. 3.

The expander includes the hollow tubular body 10 having a thickened end portion 12 formed with three equally circumferentially spaced roller holding recesses 14–16 contracted at their outer edges as indicated by the shoulder portions 14', 15', and 16' for preventing the rollers from moving radially completely outwardly of the recesses. In each of these recesses there is mounted a roller similar to that indicated at 18 and each recess is so formed that its roller will be held in the recess. Each roller has a tapered main section 20 and end portions 22 and 24 of different taper. The rollers are arranged with their longitudinal axes disposed at a lead angle of about 2 degrees with the longitudinal axis of the mandrel generally indicated at 26, and each roller has its main section so tapered as to properly engage the tapered section 28 of the mandrel and to provide for gradual contact with the tube metal from the part of the main section 20 of each roller adjacent its tapered end 24 toward that part of the roller adjacent the tapered end 22 which performs the heaviest part of the work upon the tube metal.

The rollers are held in their operative positions by a steel retaining ring 30 secured to the thickened end portion 12 of the hollow body 10 by one or more cap screws such as 32. The leading end of the mandrel is free to move within this ring as the mandrel is turned to move the rollers outwardly to their operative positions after the insertion of the entire expander within the tube.

The mandrel is a cylindrical steel body having a screw-threaded section 34, threaded into a thrust nut 36. This member is mounted within the enlarged or cup shaped end 38, of the expander body and it has an annular thrust flange 40 engaging the thrust ring 42 of a ball bearing 44 mounted within 38. The roller bearing and the thrust nut are held in their operative positions by a retaining ring 46 which is screw-threaded

into the end of the cup 38 as indicated at 48.

The thrust member or thrust nut 36 has a wrench engaging end 50 so that the thrust washer may be held against rotation while the mandrel is turned by operative engagement of the squared end 52 with an operating motor.

The mandrel body is formed with a series of indentations herein shown as annular grooves such as 54–59 adapted for holding the tube engaging stop 62 in any one of the adjusted positions indicated by the grooves. The stop 62 is an annular steel ring having one or more set screws threaded radially therein as indicated at 64. The inner end of each set screw is seated within one of the annular grooves such as grooves 54–59.

The expander is adapted to be inserted within a tube while the tube engaging rollers 18 are in their retracted positions. The extent to which the expander is moved into the tube is controlled by the position of the stop 62 adjustably fixed to the body 10 of the expander for engagement with the tube end. After the expander is inserted within the tube to its operative position, the mandrel 26 is turned relative to the thrust member, or thrust nut 40, until a predetermined pressure of the rollers against the tube is attained. Thereupon, the rotation of the mandrel 26 is continued and the thrust nut 40 is permitted to rotate with the mandrel. The tube engaging rollers 18 have their longitudinal axes arranged so as to form a lead angle, such as 2 degrees, with the longitudinal axis of the mandrel. This arrangement causes the entire expander to move outwardly of the tube, upon continued rotation of the mandrel.

The illustrative expander has a mandrel which is tapered reversely as compared to other retractive roller expanders of the prior art such as the roller expander of Maxwell 2,375,235. This characteristic eliminates a disadvantage of the prior art expanders, wherein the weakest section of the mandrel was at a position between the application of power to the mandrel and the resistance to be overcome by that power. This arrangement caused breakage at the weakened section of the mandrels and materially decreased the operative life of the expander without major repair. By the use of a thickened portion of the expander body adjacent the tube recesses for the tube engaging rollers, the latter may be securely held in their operative positions, and a mandrel of maximum thickness and strength may be disposed and operated within the expander body, and a larger and stronger retaining ring is used for holding the tube engaging rollers in their operative positions, this retaining ring being secured to the thickened end portion of the expander body.

With the specific construction of expander body above described and the described arrangement and construction of the roller receiving recesses, it is clear that each recess is of tapered construction with its smaller transverse dimension at its end nearer the mid-portion of the length of the expander body.

It will also be clear from the above description and from an examination of the drawing that this invention provides a multiple roller retractive tube expander for forming a pressure tight connection between a tube and a tube seat at the end of the tube. This retractive tube expander includes a hollow cylindrical expander body 10 which has a thickened end portion 12. This thickened end portion is formed with roller holding recesses 14, 15, and 16 which are clearly indicated in Figs. 2, 3, and 4 of the drawings. These recesses are circumferentially spaced in the expander body. Fig. 4 clearly indicates that each of the recesses is of tapered construction, and this figure, in conjunction with Fig. 1, indicates that the smallest transverse dimension of each recess is at its end nearer the mid-portion of the length of the expander body 10. The drawing also clearly shows expander rollers such as 18 mounted within the recesses. These rollers are clearly shown as tapered.

The mandrel disclosed and described is clearly indicated as a metallic rod rotatably mounted within the expander body and having a reversely tapered end portion in operative engagement with the tapered expander roller. The end of the tapered section of the mandrel of smallest diameter is clearly shown as adjacent the thickened end portion 12.

Fig. 1 also discloses an end thrust member or thrust nut 40 having internal threads in engagement with a threaded portion of the mandrel remote from the tapered portion of the mandrel 28. The drawing taken in conjunction with the description clearly discloses means including a thrust bearing 42 fixed relative to the expander body 10 opposite the end of the expander body having the roller recesses. This thrust member is shown as having a part in operative thrust relation to the thrust bearing. Under some conditions of operation, this part is the retaining ring 46.

It is also clear from the drawing and the description that there is disclosed an annular stop 62 adjustably disposed around the body of the expander.

The drawing clearly discloses a cup-shaped portion 38 of the expander body formed at the end of that body opposite the thickened end portion 12. Within this cup-shaped portion, the thrust bearing 42 is fixed in such position as to contact the thrust flange 40 of the thrust member 36.

The mandrel of the illustrative expander is also clearly shown and described as a cylindrical metallic body rotatably mounted within the expander body.

The stop 62 is clearly indicated in the preceding description as operative to engage a tube end. It is an annular stop. It is a tube end engaging stop, and it is clearly disclosed as being disposed around the body of the expander. Associated with this stop is a set screw 64 clearly indicated in Fig. 1 as being threaded through the stop and adapted to enter into any one of the indentations formed by the annular grooves 54–59 to hold the stop in an adjusted position.

While the invention has been described with reference to a specific embodiment, it is to be appreciated that the invention is not limited to all of the details thereof. The invention is rather to be taken as of a scope indicated by the subjoined claims.

What is claimed is:

1. In a multiple roller retractive and incremental tube expander for forming a pressure tight connection between a tube and a tube seat at the end of the tube, a hollow cylindrical expander body having a thickened end portion of a wall thickness increasing toward the roller receiving end of the body, said thickened end portion being formed with roller holding recesses circumferentially spaced in the expander body, each of said recesses being of tapered construction with its smallest transverse dimension at its

end nearer the mid-portion of the length of the expander body, tapered expander rollers mounted within said recesses, the rollers increasing in diameter toward the roller receiving end of the expander body, a mandrel in the form of a metallic rod rotatably mounted within the expander body and having a tapered end portion in operative engagement with the tapered expander rollers and decreasing in diameter toward its roller engaging end, the end of said tapered portion of smallest diameter being adjacent said thickened end portion of the expander body, at least one of said rollers having its longitudinal axis disposed at a small lead angle with respect to the horizontal axis of the mandrel, a thrust member having internal threads in engagement with a threaded portion of the mandrel remote from its tapered portion, means including a thrust bearing fixed relative to end of the expander body opposite its end having the roller recesses, the thrust member having a part in operative thrust relation to the thrust bearing, and an annular stop adjustably disposed around the body of the expander.

2. In a multiple roller retractive and incremental tube expander for forming a pressure tight connection between a tube and a tube seat at the end of the tube, a hollow cylindrical expander body having a thickened end portion and a cup-shaped portion at its opposite end, said thickened end portion increasing in wall thickness toward the roller receiving end of the body with the increase in thickeness being wholly radially inwardly of the body, said thickened end portion being formed with roller holding recesses circumferentially spaced in the expander body, each of said recesses being of tapered construction with its smallest transverse dimension at its end nearer the mid-portion of the length of the expander body, tapered expander rollers mounted within said recesses, the rollers increasing in diameter toward the roller receiving end of the expander body, a mandrel in the form of a cylindrical metallic body rotatably mounted within

the expander body and having a tapered end portion in operative engagement with the tapered expander rollers and decreasing in diameter toward its roller engaging end, the end of said tapered portion of smallest diameter being in position near the end portion of the expander body having the roller recesses therein, at least one of said rollers having its longitudinal axis disposed at a small lead angle with respect to the horizontal axis of the mandrel, a thrust member having internal threads in engagement with a threaded portion of the mandrel remote from its tapered portion, means including a thrust bearing fixed within the cup-shaped end of the expander body opposite its end having the roller recesses, the thrust member having a thrust flange in engagement with the thrust bearing and disposed within the cup-shaped end of the body, and an annular stop adjustably disposed around the body of the expander.

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