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Press

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[54] EXPANDING TOOL

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[52] **U.S. Cl.** **72/122,** 72/120, 72/393

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[58] **Field of Search**.....72/117, 120, 122, 123, 393; 29/523

[56] **References Cited**

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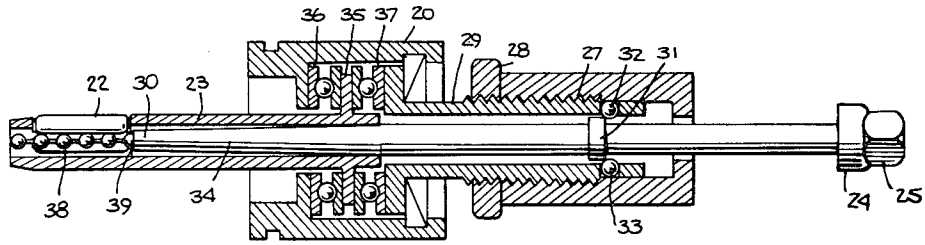
[57] **ABSTRACT**

A nonrigid portion is attached to the end of the tapered rigid mandrel of an epicyclic motion roller-type tube expander unit to enable tube bends to be located closer to the end fitting to which the tube is being attached.

3 Claims, 4 Drawing Figures



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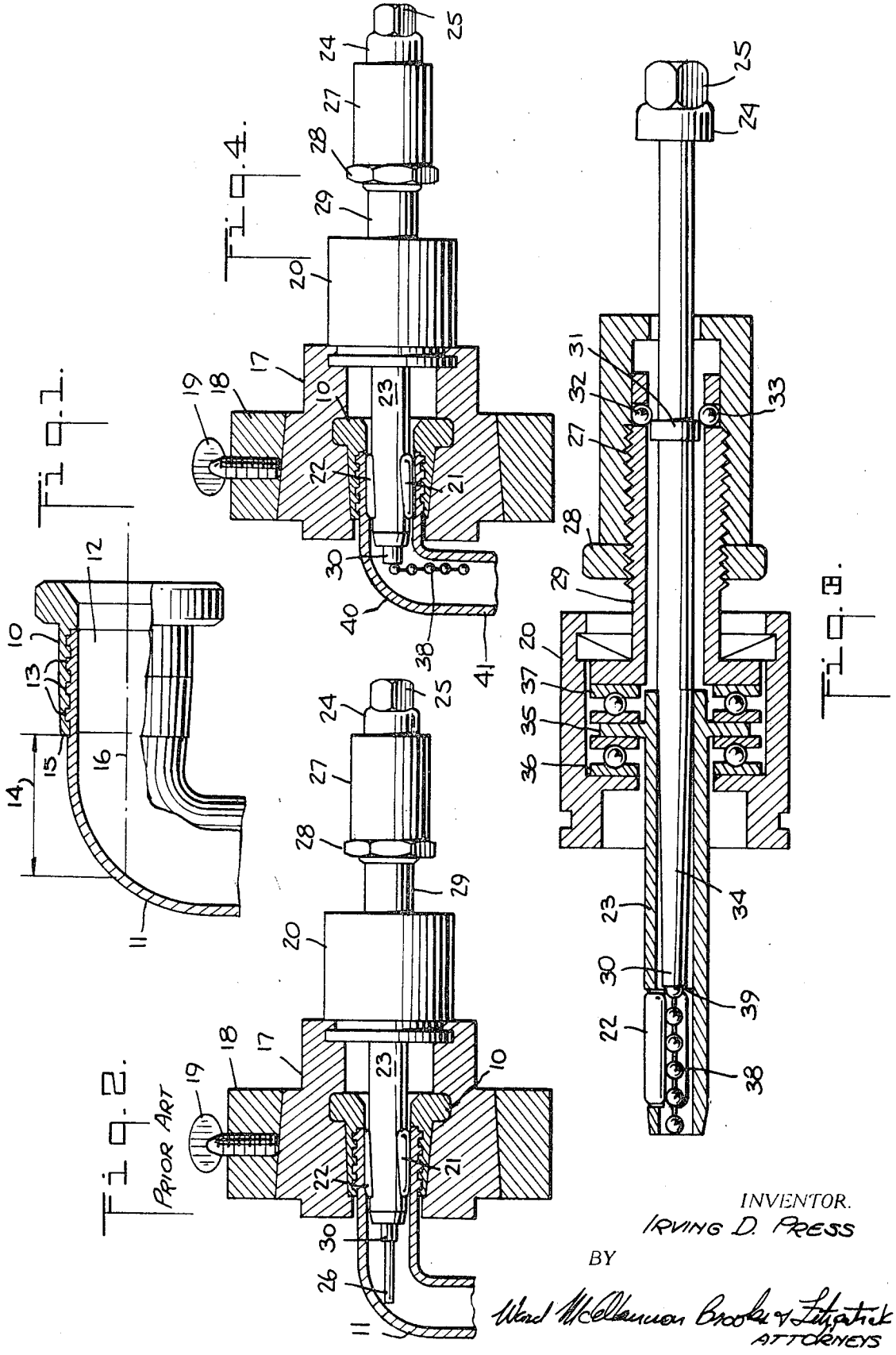

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EXPANDING TOOL

The present invention relates to a tool for expanding the inside diameter of the end of a metal tube, and more particularly, to a tool for accomplishing such expansion for the purpose of attaching an end fitting to the tube end.

End fittings are known which have a bore enterable from one end by the end of a metal tube with a sliding fit where the bore is provided with a plurality of axially spaced circumferential grooves into which the metal of the tube is caused to flow by radial expansion of the inside diameter of the tube. Heretofore, a tool has been used for accomplishing the assembly mentioned previously. Such tool includes a fixture die for surrounding and backing up the fitting and an expander unit. The expander unit has a plurality of rollers spaced circumferentially around its longitudinal axis and located within the confines of individual slots in a tubular cage with the axes of the rollers skewed slightly relative to the axis of the expander unit. The rollers are radially projected by interaction with the tapered surface of a rotatable hard metal mandrel when the latter translates axially relative to and between the rollers. Rotation of the mandrel imparts epicyclic motion to the rollers when they are in contact with a tube wall. The slots which confine the rollers have tapered sidewalls permitting the rollers to fall inwardly if otherwise unrestrained but preventing radially outward separation of the rollers from the cage. To prevent radially inward separation the mandrel is constrained to remain between the rollers at all times. However, because the rollers are adjacent an end of the tubular cage, the mandrel projects axially a substantial distance therefrom when the mandrel is fully advanced within the expander. As will be explained more fully hereinafter, the projection of the mandrel has placed a limitation on the proximity of a bend in the tubing as it leaves the end fitting.

With the foregoing in mind, it is an object of the present invention to provide an improved expander of the foregoing type which substantially eliminates the aforementioned limitation on proximity of a bend to the end fitting.

In accordance with the invention the end of the mandrel which remains between the rollers when the mandrel is fully retracted is made nonrigid while the remainder of the mandrel is rigid.

The invention will be better understood after reading the following detailed description of the presently preferred embodiment thereof with reference to the appended drawings in which:

FIG. 1 is an elevational view partly in section showing a typical assembly of an end fitting and a metal tube with a bend adjacent the fitting;

FIG. 2 is a longitudinal sectional view through the tool fixture and expander in association with the assembly of FIG. 1 at the completion of the expanding operation;

FIG. 3 is a longitudinal sectional view through an expander unit constructed in accordance with the present invention; and

FIG. 4 is a view similar to FIG. 2 showing the use of the tool of FIG. 3.

The same reference numerals are used throughout the drawings to designate the same or similar parts.

Referring now to FIG. 1, there is shown a typical assembly consisting of an end fitting 10 and a section of metal tubing 11 wherein the tubing is secured to the fitting 10 by radially expanding the inner surface 12 to displace metal into the axially spaced circumferential grooves 13. The arrow 14 designates the distance from the end 15 of the fitting 10 to the inner surface of the bend in the tube 11 as measured along the longitudinal axis 16 of the fitting. Heretofore, it has not been possible to reduce the distance 14 below a limiting minimum because of the nature of the expander tool as seen in FIG. 2 to which attention is now directed.

As shown in FIG. 2, the assembly of FIG. 1 is located within the fixture die 17, normally formed in two halves and held together by a die cage ring 18 and lock screw 19. The enclosure 20 for the expander tool bearing is secured by an interlocking groove and flange arrangement within the fixture 17.

The expander unit includes a plurality of rollers of which two, 21 and 22, are seen in FIG. 2, spaced circumferentially around the longitudinal axis of the unit located within the confines of individual slots in the tubular cage 23. The axes of the rollers are skewed slightly relative to the axis of the expander unit. The mandrel 24 has one end provided with the wrench flats at 25 and the other end at 26 provided with a reduced diameter portion for retaining the rollers when the mandrel is fully retracted. As shown in FIG. 2, the mandrel is in its fully forward position. The fully forward position may be regulated by adjustment of the stop sleeve or collar 27 which is locked in place by a lock nut 28. The stop sleeve 27 and lock nut 28 are mounted on a tubular guide 29 through which the mandrel passes. The guide 29 is journaled in the enclosure 20. FIG. 2 shows the expander unit in the fully forward position after completion of an expanding operation. At the beginning of the operation the mandrel would be fully retracted to the right as viewed in the drawing. In order to accomplish the expanding operation a wrench is applied to the flats 25 and the mandrel is rotated in a clockwise direction as viewed from the wrenching end. As the mandrel is rotated, it imparts epicyclic motion to the rollers 21 and 22 which, in turn, tend to feed the tapered mandrel axially forward toward the position shown in FIGS. 2. The forward end of the tapered section of the mandrel is shown just protruding at 30 from the end of the cage member 23. It should, therefore, be apparent that the bend in the tube 11 cannot be located any closer to the fitting than that shown in FIG. 2 due to the projection of the end 26 of the mandrel 24. Unfortunately, this places an objectionable limitation upon the usefulness of this type of assembly.

Referring now to FIG. 3, there is shown in greater detail the construction of the expander unit as modified in accordance with the present invention. The mandrel 24 has a central collar or shoulder 31 which cooperates with the balls 32 and 33 to prevent further retraction of the mandrel beyond the position shown in FIG. 3. The end of the mandrel at 34 is provided with a gradual taper which cooperates with the rollers such as 22 to cause radially outward projection thereof as the mandrel advances longitudinally. The cage 23 is provided with a flange 35 which cooperates with the thrust bearings 36 and 37 within the enclosure 20. In order to prevent the rollers from moving radially inwardly so as to fall out of the cage 23 a length of bead chain 38 is joined to the end 39 of the mandrel 24. The length of the bead chain section 38 is just sufficient to extend to the far end of the rollers.

Now referring to FIG. 4, the advantage achieved by use of the expander unit of FIG. 3 will be readily apparent. As seen therein, the mandrel 24 is in its fully forward position with the bead chain 38 pushed out beyond the cage 23 and depending limply from the end 30 of the mandrel. Thus, the bend 40 in the tube 41 can be located right up against the end of the fitting being limited only by the clearance required for the fixture dies 17.

While a length of bead chain is shown in FIGS. 3 and 4, it will be understood that any nonrigid flexible strand or comparable element may be joined to the end of the rigid mandrel section and provide the necessary retention of the rollers when the mandrel is fully retracted. WIth the smaller diameter expander units, it may be found that a length of wire is preferable in view of the difficulty in obtaining a bead chain of sufficiently small bead diameter. Any convenient method may be employed for attaching the nonrigid portion to the rigid portion of the mandrel.

Having described the presently preferred embodiment of the invention, it will be understood by those skilled in the art that various changes in construction may be made without departing from the true spirit of the invention as defined in the appended claims.

What is claimed is:

1. A tool for expanding the inside diameter of the end of a tube wherein a plurality of rollers, which are circumferentially spaced around the longitudinal axes of the tool within the confines of slots in a tubular cage with the axes of the rollers

skewed slightly relative to the tool axes, are radially projected by interaction with the tapered surface of a rotatable mandrel when the latter translates axially relative to and between the rollers, and wherein rotation of the mandrel imparts epicyclic motion to the rollers when in contact with a tube wall; characterized in that the end of the mandrel which remains between the rollers to prevent them from falling radially inwardly out of the slots in the cage when the mandrel is fully retracted is nonrigid while the remainder of the mandrel is rigid.

2. A tool according to claim 1, wherein said nonrigid end of the mandrel comprises a length of bead chain attached to the adjacent end of the rigid remainder of the mandrel.

3. A tool according to claim 1, wherein said nonrigid end of the mandrel comprises a flexible strand extending from the adjacent end of the rigid remainder of the mandrel.

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