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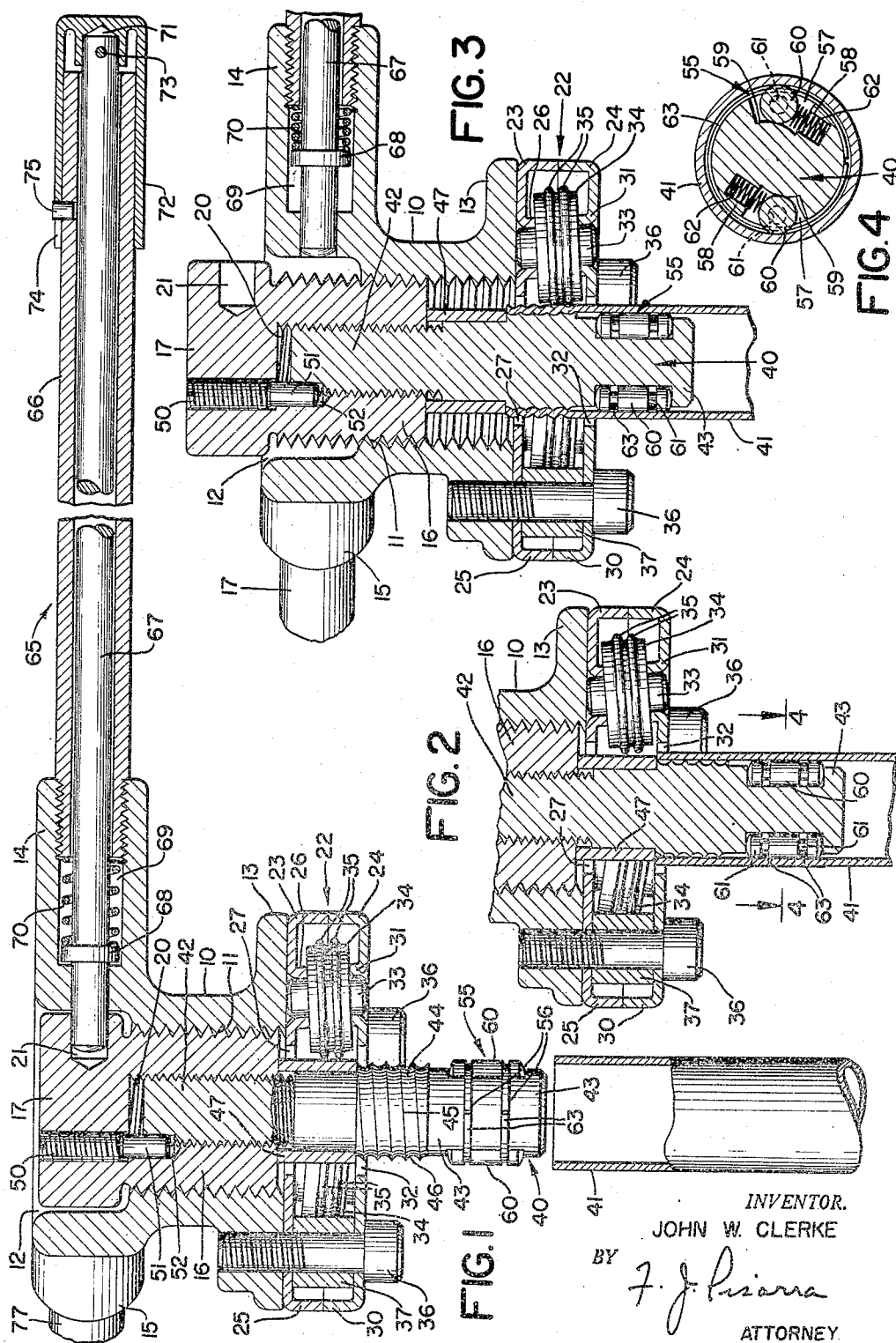
J. W. CLERKE

2,684,102

THREAD-ROLLING APPARATUS

Filed April 28, 1950

2 Sheets-Sheet 1



INVENTOR.

JOHN W. CLERKE

BY

J. J. Pizarra

ATTORNEY.

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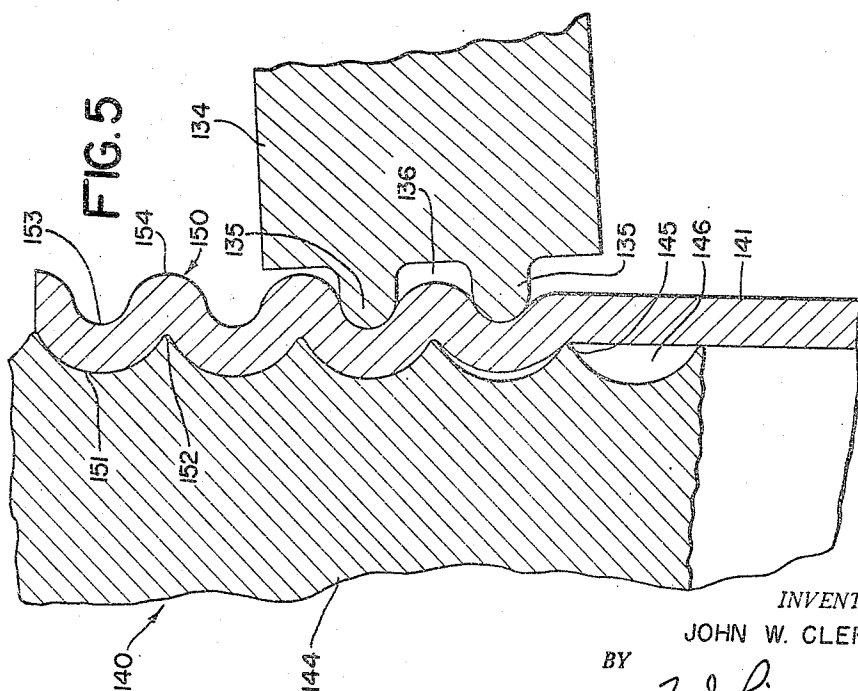
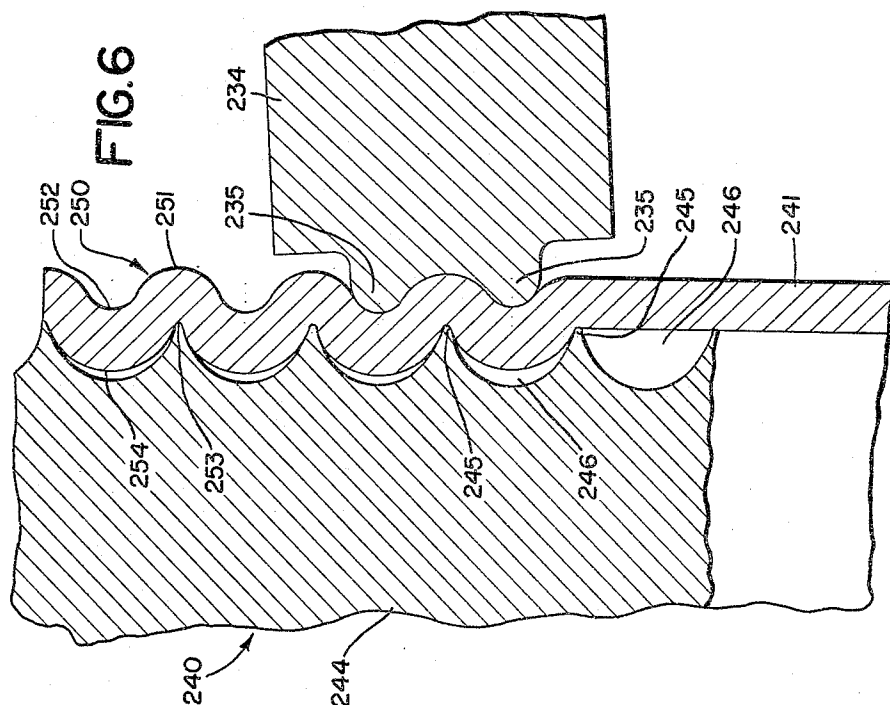
J. W. CLERKE

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INVENTOR.
JOHN W. CLERKE

BY

7. J. Pisarra
ATTORNEY.

ATTORNEY.

UNITED STATES PATENT OFFICE

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THREAD-ROLLING APPARATUS

John W. Clerke, Little Falls, N. J.

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3 Claims. (Cl. 153—71)

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This invention relates to thread-forming apparatus and, in one of its more specific aspects, to apparatus for rolling threads in an end portion of a section of tubing that may be made of any suitable material, such as stainless steel or the like.

It is a primary object of the invention to provide an improved tool or apparatus for rolling threads in an end portion of a section of relatively thin-walled tubing.

Another object of the invention is to provide a portable thread-rolling tool that includes a mandrel adapted to be introduced into an end of a section of tubing and means for preventing relative axial movement between the mandrel and the tubing in response to predetermined rotary movement of the mandrel with respect to the tubing in one direction only.

Another object of the invention is to provide apparatus of the character indicated that is adapted to be readily introduced in and locked to an end portion of a length of tubing, form rolled threads in such end portion of the tubing, and be subsequently withdrawn from the tubing.

Another object of the invention is to provide a mandrel having a part insertable in an end of a section of tubing with means for effecting sufficient frictional binding engagement with the inner surface of the tubing in response to rotational movement of the mandrel in one direction with respect to the tubing whereby to prevent relative axial movement between the mandrel and the tubing.

It is a further object of the invention to provide thread-rolling apparatus having parts so constructed and arranged as to permit deformation and "flow" of the material of relatively thin-walled tubing in which the threads are rolled. To this end, certain elements of the apparatus are so configured as to allow partial unrestricted movement of tubing material outwardly and/or inwardly with respect to the axis of the tubing in the course of rolling threads in the tubing.

A still further object of the invention is to provide apparatus of the type indicated that is adapted to perform its intended functions in an effective and trouble-free manner.

For the purpose of attaining the above-mentioned objects, a recommended and preferred form of apparatus constructed in accordance with the invention includes a first unit comprising a body and thread-rolling means carried by the body, and a second unit comprising a feed screw threadedly connected to the body and a unitary mandrel. The mandrel has a first part

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or shank threadedly connected to the feed screw, a second part or pilot adapted to be inserted into an end of a section of tubing, and a third part intermediate the first and second parts and grooved peripherally for coaction with the thread-rolling means in the formation of rolled threads in the tubing. The foregoing mandrel parts are coaxial. The mandrel shank is normally keyed to the feed screw to prevent relative movement therebetween.

Relative movement between the first and second units is prevented by a latch means that includes a rod carried by and slidable in the body and registering with an opening in the feed screw. This rod is normally urged in the direction of the feed screw by a spring which serves to maintain the rod in locking engagement with the feed screw. The rod is adapted to be moved in a reverse direction against the action of the spring by an arrangement of devices whereby to effect disengagement between the rod and the feed screw, as desired, and thereby permit relative movement between the body and the feed screw.

One of the principal features of the invention resides in a means for preventing relative axial movement between the mandrel and the tubing in response to predetermined rotary movement of the mandrel with respect to the tubing. This means preferably comprises a pair of rollers positioned in corresponding slots formed in diametrically opposite sides of the mandrel pilot part and having their longitudinal axes parallel with the longitudinal axis of the mandrel. Each roller is movable along a slot-forming camming surface that is preferably arcuate and eccentric to the longitudinal axis of the mandrel. The rollers are maintained in the mandrel slots by at least one split-retaining ring and are normally spring-urged in one direction along the paths defined by the camming surfaces.

Another feature of the invention resides in so configuring the mandrel intermediate part and/or the thread-rolling means as to permit partial unrestricted lateral flow of the material of the tubing in the course of forming threads in the tubing. As will be apparent to persons skilled in the art from a consideration of the detailed description that follows and the accompanying drawings, this feature facilitates the formation of rolled threads, reduces the cost of manufacture of parts of the tool, and prolongs the useful life of such parts.

With the enumerated and other objects in view, the invention comprises the devices, combinations and arrangements of parts set forth

in the following detailed description and illustrated in the annexed drawings of preferred embodiments of the invention, from which the several features of the invention, together with the advantages attainable thereby, will be readily understood by persons versed in the art.

In the drawings:

Figure 1 is a view in central cross section of a preferred arrangement of devices constructed in accordance with the invention, certain parts being broken away for better illustration. This figure shows a portion of a section of tubing axially aligned with the mandrel of the apparatus and prior to introducing the pilot part of the mandrel into the tubing;

Figure 2 corresponds to the lower portion of Figure 1 and shows the parts in another relative position, that is, with the mandrel inserted in the tubing but prior to starting the thread-rolling operation;

Figure 3 also corresponds to Figure 1 and shows the relative position of the parts at the completion of the thread-rolling operation;

Figure 4 is a view in enlargement taken along line 4—4 of Figure 2;

Figure 5 is an enlarged longitudinal cross-sectional view of portions of a mandrel and thread-rolling means constituting a modification of the form of the invention shown in Figures 1—4, the depicted portions of the mandrel and thread-rolling means being shown in association with a portion of a section of tubing in the course of rolling threads in the tubing; and

Figure 6 corresponds to Figure 5, and illustrates another modification of the invention.

Referring now to the drawings wherein like reference numerals denote corresponding parts throughout the several views, a hollow body 10 is formed with a threaded longitudinal central opening 11 and a merging recess 12 at its upper end. Body 10 has at its lower end a flange 13 and at its upper end a plurality of angularly spaced, radially projecting tapped bosses, two of which are indicated at 14 and 15.

A feed screw 16, having an enlarged head 17 that registers with recess 12, engages threaded opening 11 in the body. The feed screw is provided with an axial tapped opening 20 and has a transverse blind bore 21 in its head.

A thread-rolling means or assembly 22, best shown in Figures 1—3, comprises a housing consisting of a pair of relatively inverted members 23 and 24. Member 23 includes a downwardly projecting flange 25, a plurality of downwardly projecting tubular extensions 26, and a central opening 27. Member 24 is complementary to member 23 and includes an upwardly projecting flange 30, a corresponding number of upwardly projecting tubular extensions 31, and a central opening 32. A shaft or trunnion 33 is press-fitted in each extension 26 and corresponding extension 31. Freely rotatable about each shaft 33 is a cylindrical thread roller 34 having integral, axially spaced, annular thread-rolling elements 35. The axis of each shaft 33 and, therefore, the common axis of each thread roller 34 and thread-forming elements 35 are inclined with respect to the axis of feed screw 16, whereby the thread-forming elements are adapted to cooperate with other devices, to be described further along herein, in the formation of helical threads. The thread-rolling assembly housing is attached to body flange 13 and maintained in the illustrated position with respect to the body through the medium of studs 36 and spacer sleeves 37.

A mandrel, generally indicated by numeral 40, is adapted to cooperate with the thread-rolling means in the formation of rolled threads in an end portion of a section of tubing 41. The mandrel comprises a shank or threaded upper part 42 that engages the threads of tapped opening 20 in the feed screw, a lower or pilot part 43, and an intermediate thread-forming part 44. Mandrel parts 42, 43 and 44 are integral and coaxial. Intermediate part 44 is formed with a generally helical ridge 45 that is substantially V-shaped in cross section and that defines the outer extremity of a generally helical groove 46.

The diameter of pilot part 43 is somewhat less than the internal diameter of tubing 41 to permit of ready insertion of the pilot part into the tubing. The diameter of intermediate mandrel part 44 is slightly less than the internal diameter of the tubing. A sleeve 47 is coaxial with the mandrel and bears at its upper end against the lower end of feed screw 16, and at its lower end against the upper end of intermediate mandrel part 44. The outer diameter of the sleeve is greater than the diameter of the intermediate mandrel part but smaller than the diameter of housing openings 27 and 32.

A screw 50 is machined to obtain a pin extension 51 which registers with an opening 52 defined by feed screw 16 and mandrel shank part 42. This screw serves to key the mandrel to the feed screw and prevent movement of the mandrel relative to the feed screw during the thread-rolling operation.

As was mentioned earlier herein, one of the features of the invention resides in the provision of a means for preventing relative axial movement between the mandrel and the tubing in response to predetermined rotary movement of the mandrel with respect to the tubing in one direction. This means is generally denoted by numeral 55 and will now be described, having reference particularly to Figures 1, 2 and 4. In this connection, mandrel pilot part 43 is provided with spaced peripheral grooves 56 that are transverse to the mandrel axis, a pair of diametrically opposed peripheral slots 57, and a pair of spring-retaining blind bores 58, each of which merges with a corresponding slot 57. Each slot 57 is defined in part by an arcuate eccentric camming surface 59. Positioned in each slot 57 and movable along the path defined by corresponding slot surface 59 is a roller 60 that projects beyond the peripheral surface of the mandrel pilot part. The longitudinal axis of each roller is parallel to the axis of the mandrel. Each roller has a pair of annular grooves 61 that are spaced apart the same distance as the axial spacing between grooves 56. Springs 62, registering with blind bores 58, normally and yieldingly urge corresponding rollers 60 along the paths of the camming surface. Resilient split-retaining rings 63 register with grooves 56 in the mandrel and a corresponding annular groove 64 of each roller to maintain the parts in the illustrated assembled relation.

Reference is next had to Figures 1 and 3 for an understanding of a combined handle and latch means 65 for controlling relative movement between body 10 and feed screw 16. The latch means includes a tubular member 66 externally threaded at one end for connection with tapped boss 14. A rod 67 is rotatable and slidable in tubular member 66 and has a flange 68 that is positioned in a spring compartment 69 in boss 14. A helical compression spring 70 is coaxial with

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rod 67 and bears at its opposite ends against flange 68 and tubular member 66 to normally and yieldingly urge rod 67 toward the left, as viewed in Figures 1 and 3. The inner end of rod 67 registers with feed screw bore 21 and is maintained in such registry by spring 70.

The outer end of rod 67 registers with an opening 71 in a knurled cap 72, and is secured to the cap by a pin 73. The cap is notched as indicated at 74 to receive a pin 75 carried by tubular member 66.

To effect disengagement between rod 67 and feed screw 16, cap 72 is manually moved toward the right, as viewed in Figure 1, against the action of spring 70. This causes rod 67 to be withdrawn from bore 21 and notch 74 to be placed out of registry with pin 75. Cap 72 is then given about a quarter turn about its axis and released so that the open end of the cap bears against pin 75, which retains the cap and rod in retracted position.

Boss 15 is provided with a handle 77 that may be made of a solid rod or a tubular element externally threaded at its inner end for connection with the corresponding tap in that boss.

For the purpose of briefly outlining the mode of operation of the above-described embodiment of the invention, it is first assumed that the parts are assembled and in the relative position shown in Figure 1 so that the inner end of rod 67 registers with bore 21, thereby locking body 10 to feed screw 16, and the lower extremity of mandrel pilot part 43 is disposed above the upper end of tubing 41, which is held in a vise or the like (not shown). The mandrel pilot part is then introduced into the tubing and the entire apparatus is moved downwardly with respect to the tubing until the parts are in the relative position shown in Figure 2. At such time the lower end of sleeve 47 bears against the upper end of tubing 41, thus limiting downward movement of the mandrel with respect to the tubing. Also, rollers 60 are urged by springs 62 into frictional engagement with the inner surface of the tubing and corresponding camming surfaces 59 of the mandrel. Slight rotational movement of the mandrel in a clockwise direction, as viewed in Figure 4, causes corresponding relative movement between the mandrel and the rollers along the paths defined by the camming surfaces with the result that the rollers move outwardly with respect to the mandrel and effect firm binding engagement with the tubing. This prevents axial movement of the mandrel with respect to the tubing.

Cap 72 is next moved toward the right against the action of spring 70, as viewed in Figure 1, and given about a quarter turn about its axis. This retracts the inner end of rod 67 from bore 21 and places notch 74 out of registry with pin 75. The cap is then released and its open end will move against pin 75, maintaining rod 67 out of coupling engagement with the feed screw against the action of spring 70.

Handles 65 and 77 are then actuated to impart clockwise rotation to body 10. This causes body 10 to turn and move downwardly with respect to feed screw 16 and thread rollers 34 to cooperate with mandrel intermediate part 44 in the formation of rolled threads in tubing 41. In the course of rolling the threads in the tubing, parts of the apparatus move from the relative position shown in Figure 2 to that shown in Figure 3.

The tool may be readily withdrawn from tub-

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ing 41 by proceeding in a reverse manner from that outlined above. This permits the body to turn and move upwardly with respect to the feed screw until the body and the feed screw are in the relative position shown in Figure 1, and rod 67 to reenter bore 21. As will be apparent from a consideration of the drawings, the mandrel may then be unscrewed from the threads previously rolled in the tubing.

The modifications of the invention shown in Figures 5 and 6 contemplate configuring the mandrel intermediate part and/or the thread-rolling elements in a manner to permit of partial unrestricted lateral flow of the material of the tubing in the course of rolling threads in the tubing by the apparatus of this invention. The modification illustrated in Figure 5 comprises a mandrel 140 that includes an intermediate part 144 having a helical ridge 145 which defines a helical groove 146. Thread roller 134 has integral annular thread-rolling elements 135 spaced apart, as indicated at 136. The apparatus may otherwise be the same as that shown in Figures 1-4, and is adapted to roll threads 150 in a section of tubing 141. The depth of the inner crests 151 and inner roots 152 of threads 150 conforms to the configuration of groove 146 and ridge 145, respectively, of mandrel 140, and the outer roots 153 of threads 150 conform with the extremities of elements 135. The outer crests 154 of the rolled threads do not conform with the opening between elements 135 for the reason that space 136 between elements 135 is deeper than required to receive the outer crests 154. By providing a space of the character of space 136, the material of the tubing is allowed to flow outwardly in the formation of the rolled threads. Such flow is at least partially unrestricted by elements 135, and facilitates formation of the rolled threads. The configuration of groove 146, ridge 145, and the outer portion of each thread element 135 does, however, control and determine the configuration of outer thread crests 154.

A similar result may be obtained by configuring the groove in the mandrel and the thread-rolling elements so that the mandrel groove is deeper than required to receive the inner crests of threads formed in the tubing. This will be apparent from a consideration of Figure 6 which shows a mandrel 240 that includes an intermediate part 244 having a helical ridge 245 and a helical groove 246. A thread roller 234 has spaced annular thread-rolling elements 235. Threads 250, rolled in tubing 241 by apparatus of this invention having incorporated therein the modification of Figure 6, include outer crests 251 and outer roots 252 that respectively conform with the space between the thread roller elements and those elements; and inner roots 253 that conform with ridge 245. Inner crests 254 do not conform with groove 246 for the reason that this groove is deeper than required to receive the material of the tubing that forms the inner crests.

From the foregoing, it is believed that the construction, operation, and advantages of my present invention will be readily comprehended by persons skilled in the art. It is to be clearly understood, however, that various changes in the apparatus set forth above may be made without departing from the scope of the invention, it being intended that all matter contained in the description or shown in the drawings shall be interpreted as illustrative only and not in a limiting sense.

I claim:

1. In apparatus of the character described, a first unit comprising a body and thread-rolling means carried by the body, a second unit comprising a feed screw threadedly connected to the body and a mandrel including a first part or shank connected to the feed screw and a second part extending below the first part and adapted to be introduced into an end portion of a section of tubing, means carried by the second part and adapted to clamp and therefor prevent axial movement between the mandrel and the tubing in response to predetermined rotary movement of the mandrel with respect to the tubing, said means comprising at least one member carried by the second part and movable along a path eccentric to the longitudinal axis of the mandrel and resilient means normally and yieldingly urging the member in one direction along said path, latch means preventing relative movement between the units, said latch means comprising a rod carried by and movable with respect to one of the units and releasably engaging the other unit, whereby the second mentioned means is adapted to be actuated so as to clamp the mandrel to the tubing, and means for actuating the rod in a manner to effect disengagement between the rod and said other unit, whereby the first unit may thereupon be rotated relative to the second unit to effect formation of threads on the tubing by the thread rolling means.

2. In apparatus of the character described, a first unit comprising a body and thread-rolling means carried by the body, a second unit comprising a feed screw threadedly connected to the body and a mandrel including a first part or shank connected to the feed screw, a second part below the first part and adapted to be introduced into an end portion of a section of tubing, and a third part intermediate the first and second parts, said third part being grooved peripherally for coaction with the thread-rolling means in the formation of rolled threads in the tubing,

means adapted to clamp and therefor prevent axial movement between the mandrel and the tubing in response to predetermined rotary movement of the mandrel with respect to the tubing in one direction only, said means comprising at least one member carried by the second part and movable along a path eccentric to the longitudinal axis of the mandrel and resilient means normally and yieldingly urging the member in one direction along said path, latch means preventing relative movement between the units, said latch means comprising a rod carried by and movable with respect to the body and releasably engaging the feed screw, whereby the second mentioned means is adapted to be actuated so as to clamp the mandrel to the tubing, and means for actuating the rod in a manner to effect disengagement of the rod from the feed screw, whereby the first unit may thereupon be rotated relative to the second unit to effect formation of threads on the tubing by the thread rolling means and the third part of the mandrel.

3. Apparatus in accordance with claim 2 wherein the second mentioned means comprises a pair of rollers carried by the mandrel second part, said rollers being disposed to diametrically opposite sides of the mandrel, each roller having its longitudinal axis parallel to the longitudinal axis of the mandrel and being movable along a corresponding arcuate path that is eccentric to the longitudinal axis of the mandrel.

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