United States Patent [19]

Martin

[11] **3,854,314**

[45] **Dec. 17, 1974**

[54] **STEP CONTROLLED TUBE EXPANDER**

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[73] Assignee: **Dresser Industries, Inc.,** Dallas, Tex.

[22] Filed: **July 25, 1973**

[21] Appl. No.: **382,413**

[52] **U.S. Cl.** ..... **72/122,** 72/125, 29/202 D

[51] **Int. Cl.** **B21d 39/06**

[58] **Field of Search** ..... 72/20, 122, 125; 29/202 D

[56] **References Cited**

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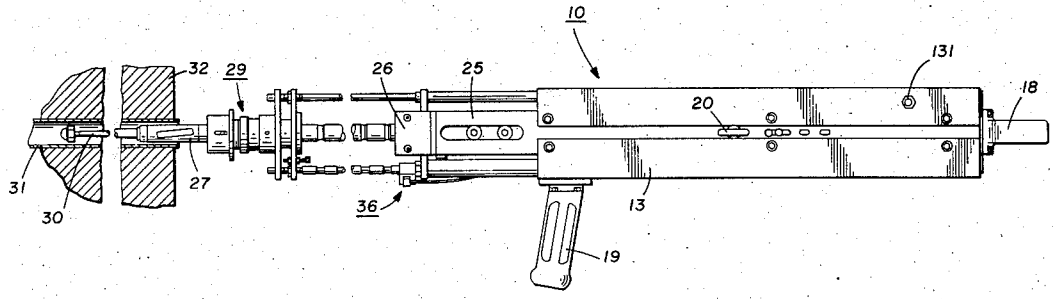
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Primary Examiner—Lowell A Larson
Attorney, Agent, or Firm—Daniel Rubin

[57] **ABSTRACT**

A power operated tube expander apparatus having automatic step control for deep hole rolling of a tube to a header sheet. A stop collar in the form of a thrust assembly is supported on the cage behind the expander rollers to prevent movement of the cage inward of the tube during the expansion operation. After rolling a longitudinal segment of tube, controls are operable to displaceably step the collar a predetermined incremental distance longitudinally away from the expander end. This allows an additional segment of tube to be subsequently rolled. Stepping of the collar continues until completing total joinder of the tube to the header.

10 Claims, 13 Drawing Figures



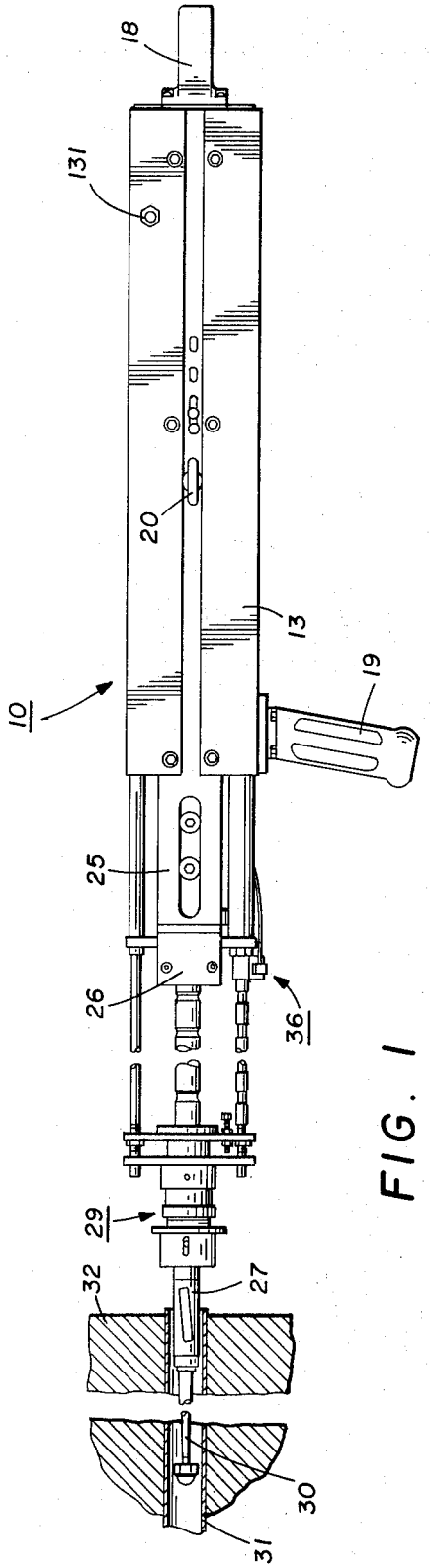

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FIG. 1

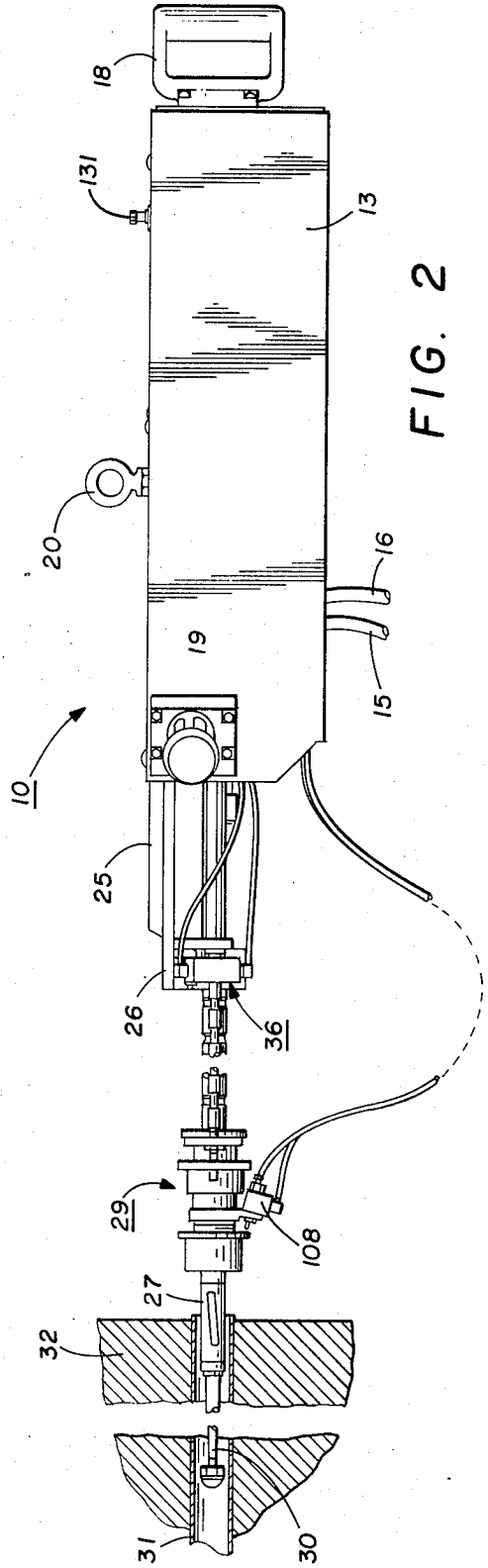

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FIG. 2

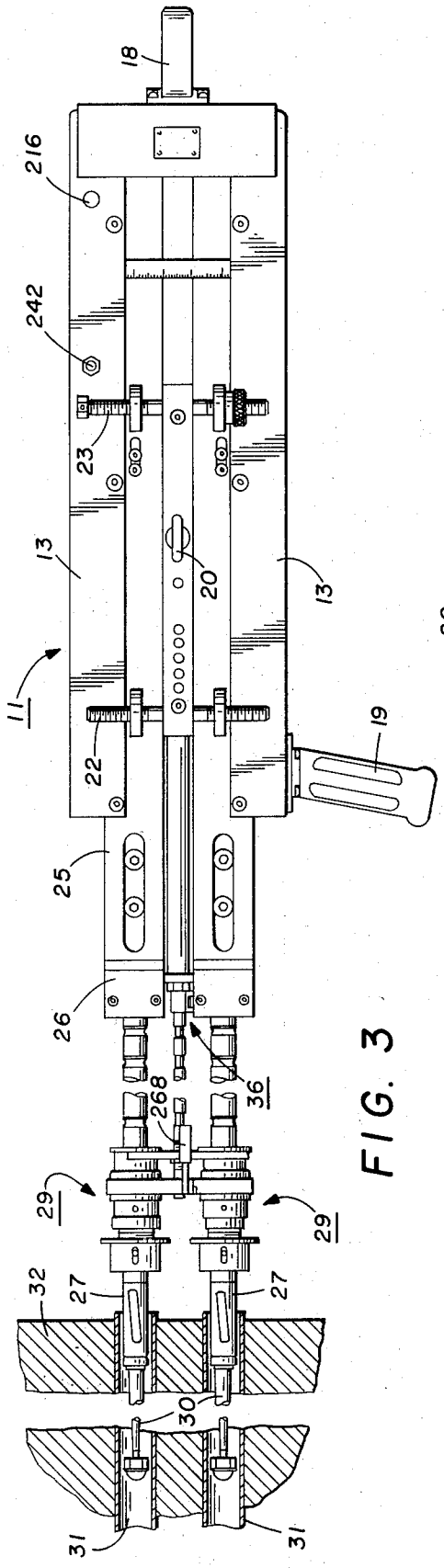

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FIG. 3

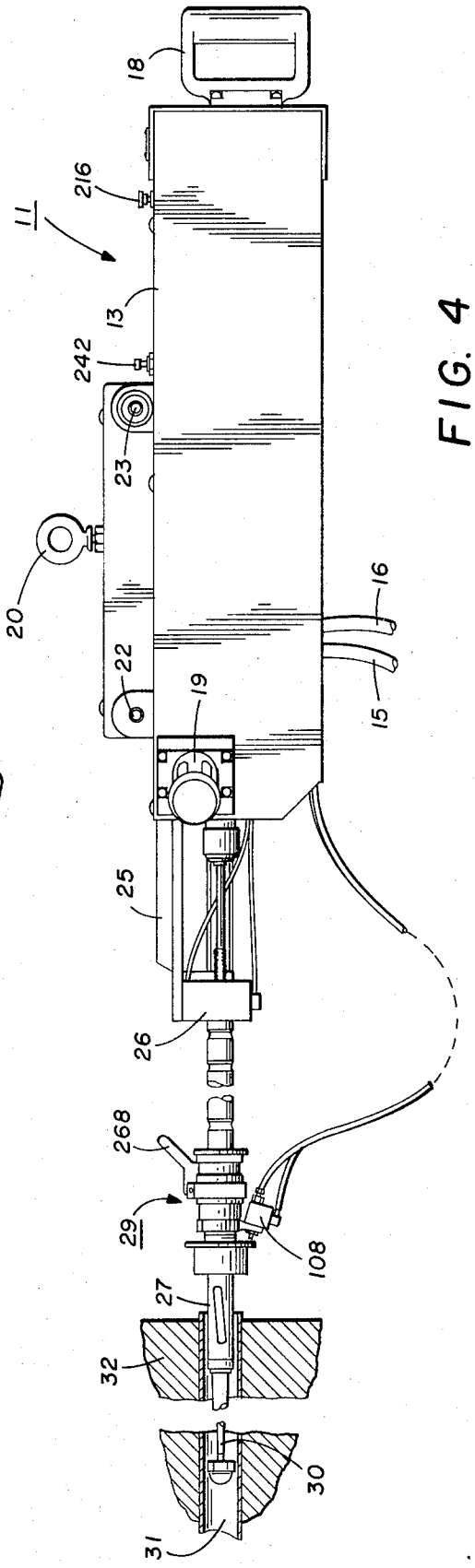

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FIG. 4

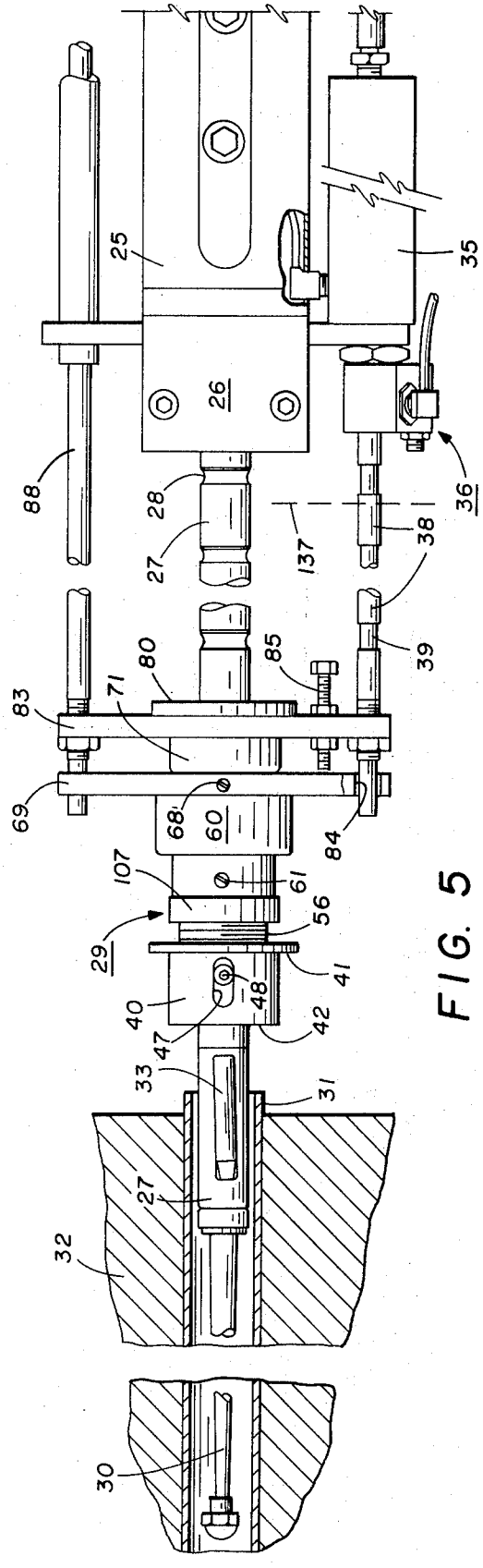

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FIG. 5

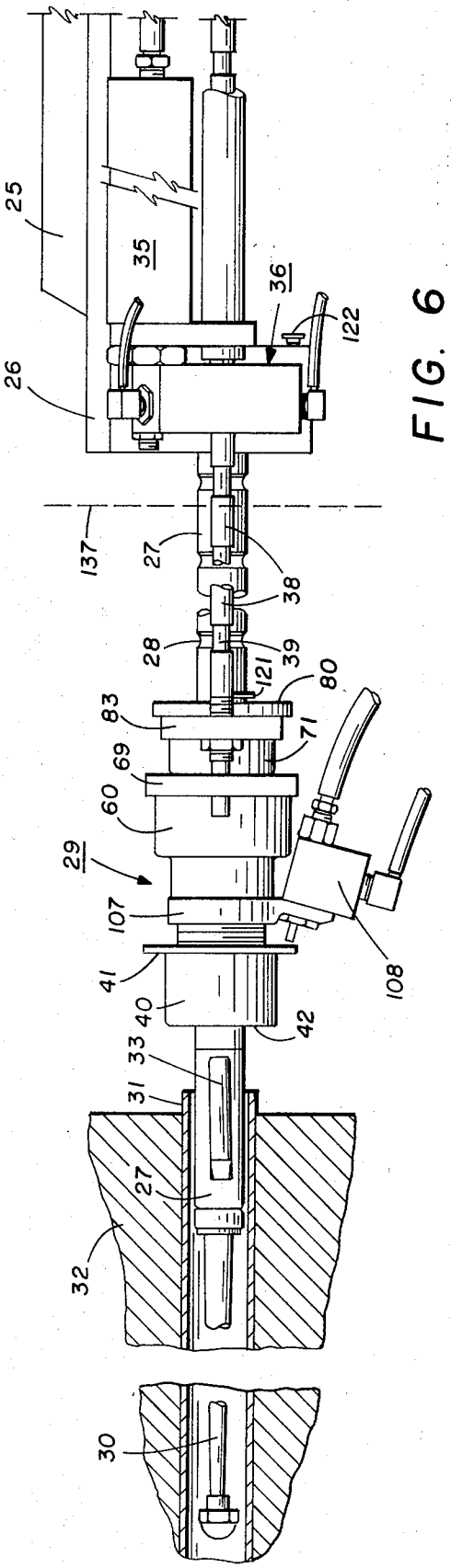

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FIG. 6

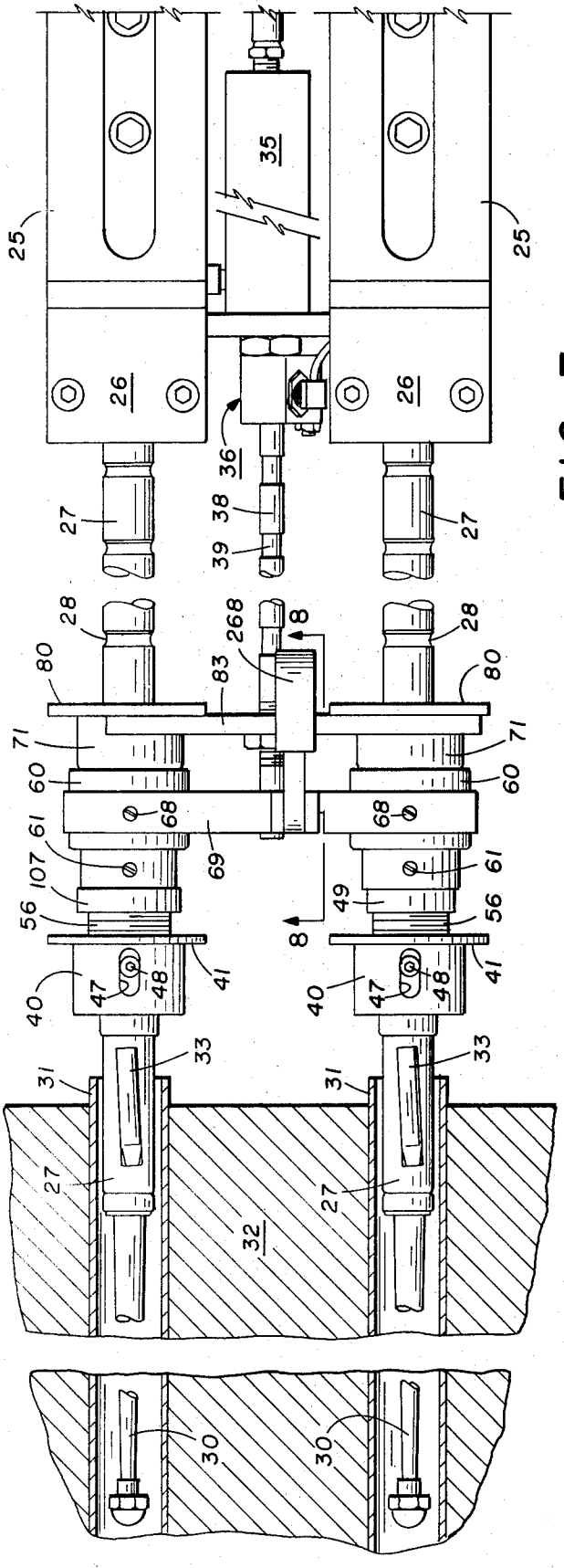

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FIG. 7

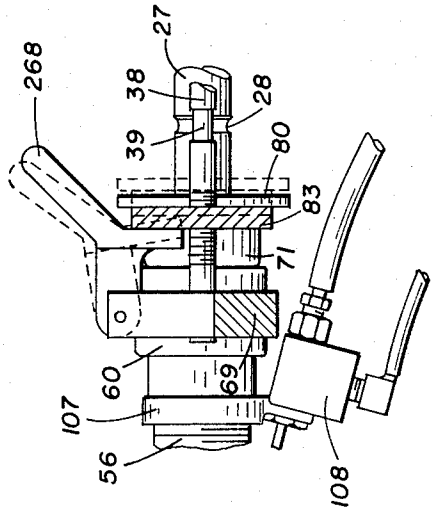

268
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FIG. 8

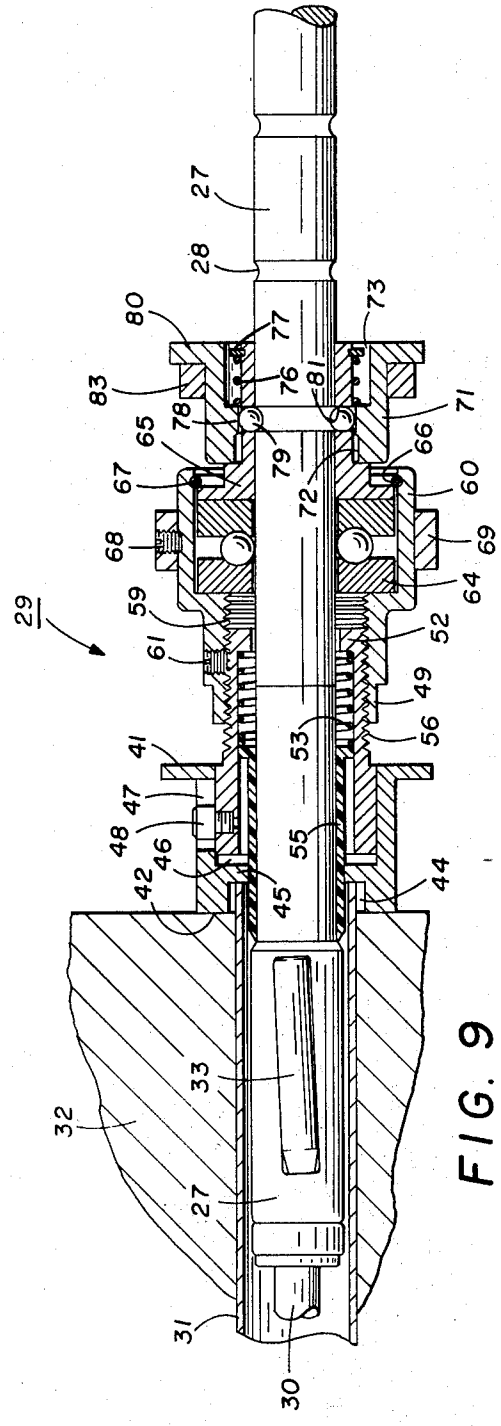


FIG. 9

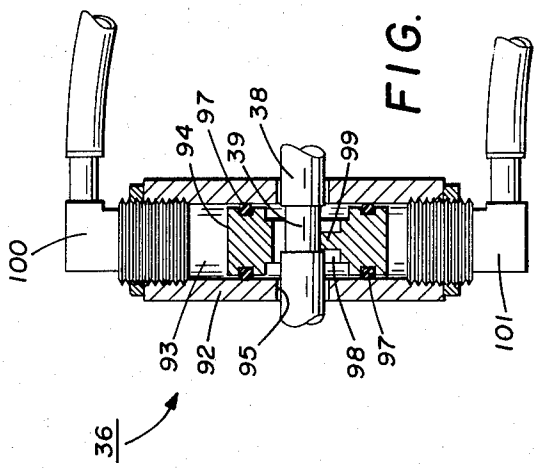


FIG. 11

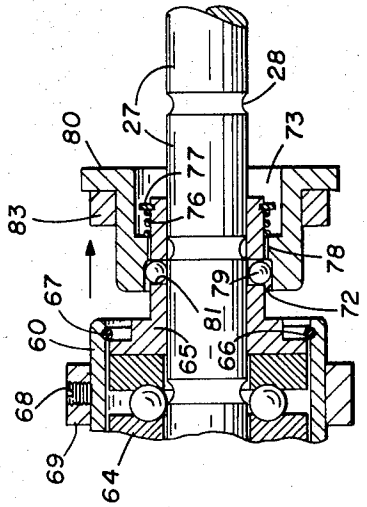


FIG. 10

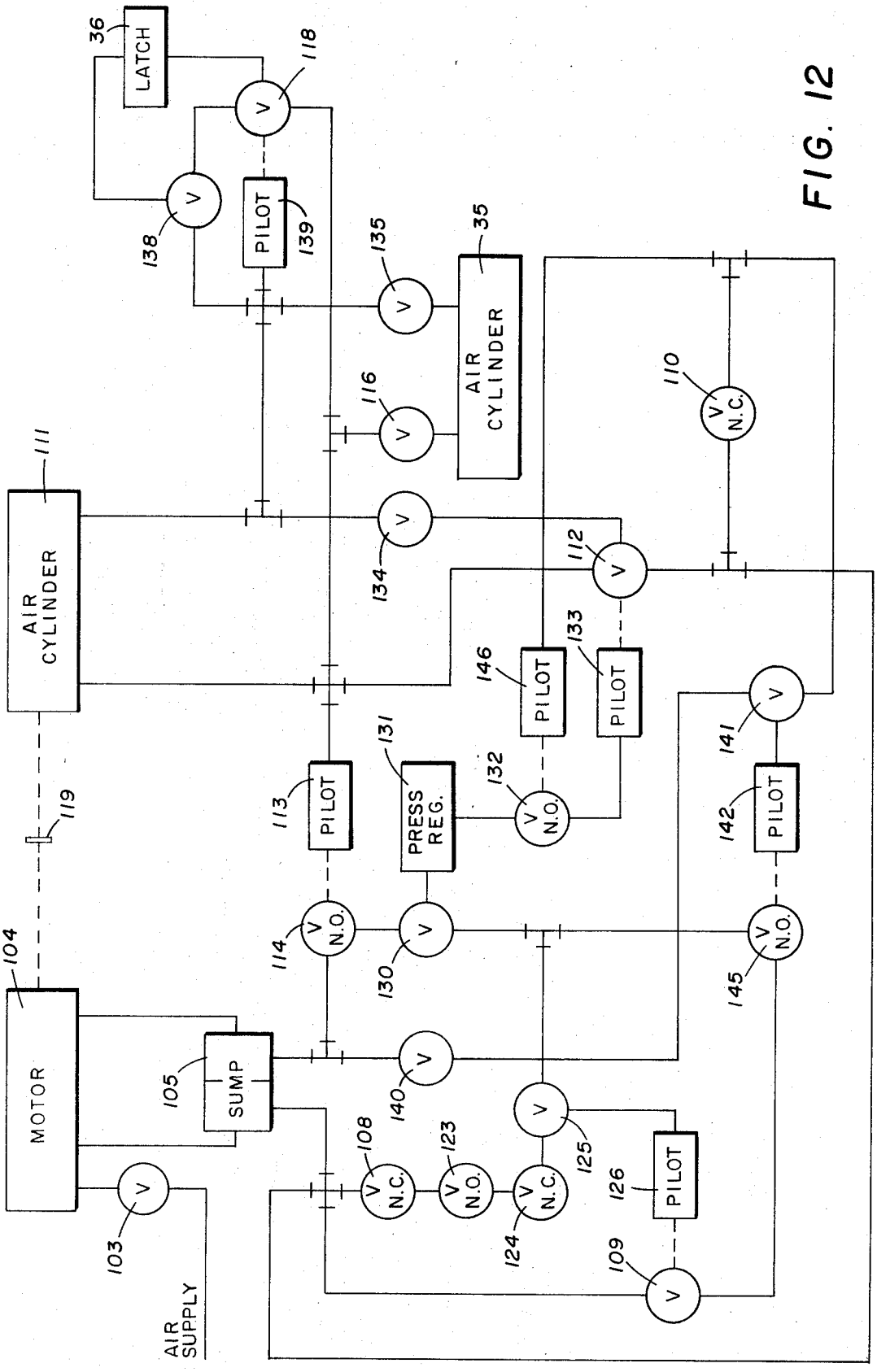

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LATCH
118
V
138
PILOT
139
135
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AIR CYLINDER
116
110
V N.C.
111
AIR CYLINDER
134
112
146
PILOT
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PILOT
131
113
PILOT
PRESS REG.
132
V N.O.
141
142
PILOT
119
104
MOTOR
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SUMP
114
V N.O.
130
140
145
V N.O.
108
V N.C.
123
V N.O.
124
V N.C.
125
126
PILOT
109
103
AIR SUPPLY

FIG. 12

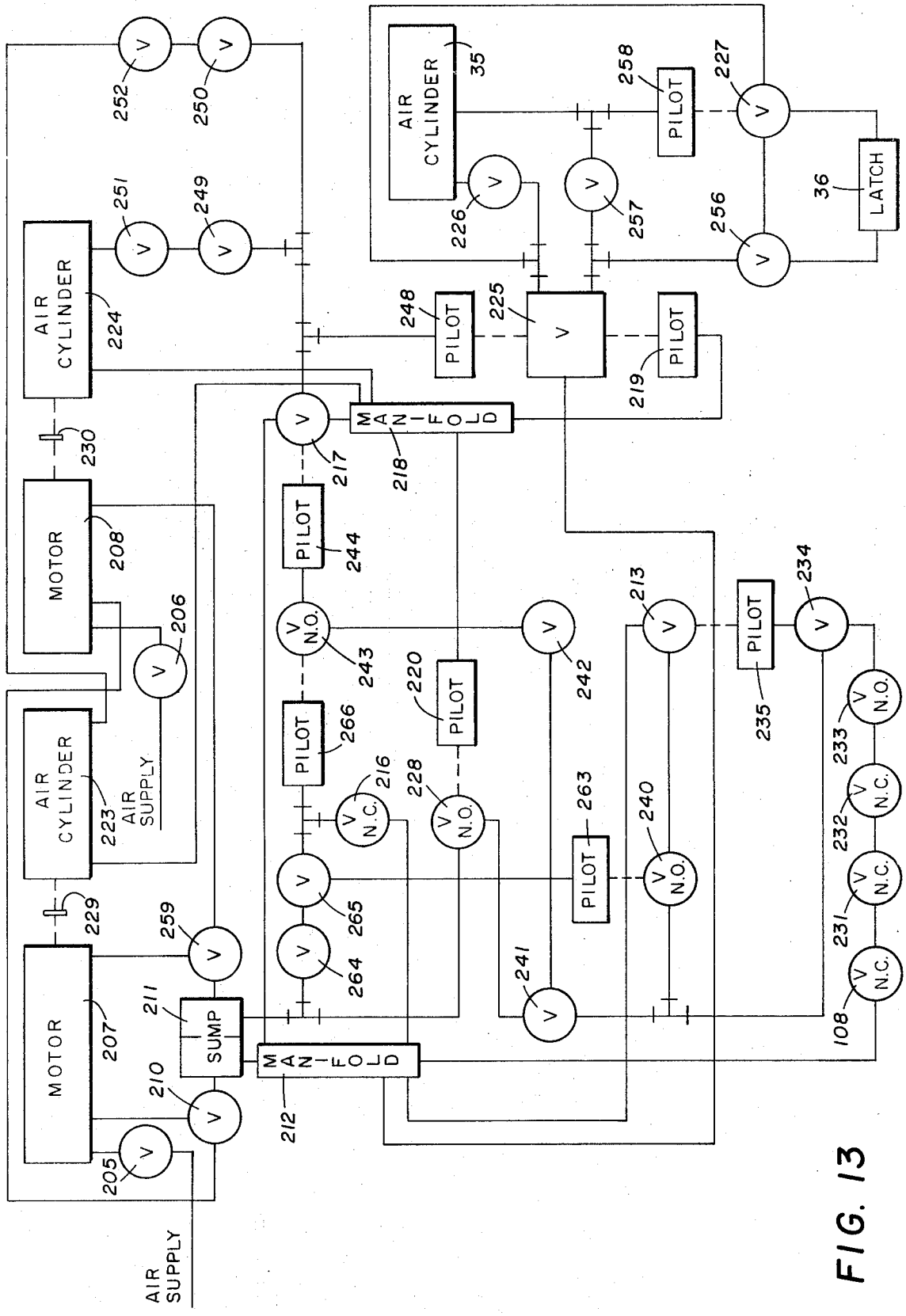

AIR CYLINDER
MOTOR
SUMP
MANIFOLD
PILOT
LATCH
AIR SUPPLY
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FIG. 13

STEP CONTROLLED TUBE EXPANDER

BACKGROUND OF THE INVENTION

1. The field of art to which the invention pertains generally comprises the art of metal deforming and more particularly to tube expanders of the roller and mandrel type for joining tubes into tube sheets.

2. Tube expanders are widely used by manufacturers of heat exchangers or the like for joining tube ends to headers and are available from a variety of commercial sources. In their usual construction, the roller and mandrel type tube expander is comprised of a tubular cage with slots in its periphery containing rollers lying at an oblique angle to the cage axis. A rotatable tapered mandrel extends axially through the cage in driving contact with the rollers for rotating the rollers while forcing them operably outward against a tube wall thereat to roll expand the tube against the header.

For certain applications such as in atomic steam generators, high pressure feed water heaters, etc., the tube sheet or header is frequently of very thick cross-section enabling it to withstand a tendency to bow under pressure. To insure proper joinder of the tube to the header for those applications, it has been found preferable to roll the tube the entire axial depth of the header sheet. Because of the large amount of metal to be deformed, deep hole rolling is usually performed in sequential steps along the tube length. Positioning the expander for each step or segment of tube is a thrust or stop collar engageable with the tube end or header face to prevent advance of the expander inward of the tube during the course of the rolling operation. As each segment is completed, the thrust collar is manually displaced further from the rollers for expanding the next subsequent incremental segment of tube. By this means, rolling uniformity has been reasonably obtained throughout the joined tube length.

The above procedure, as can be readily appreciated, contemplates a high degree of manual involvement for relocating the collar after each rolling cycle. At the same time, the tediousness and monotony of the procedure has frequently been found to cause a missed step that seriously detracts from the accuracy and reliability of joint formation sought to be achieved. Despite recognition of the foregoing, it has not been previously known how to automate the stepping procedure for controlled operation over the entire expandable length of tube.

SUMMARY OF THE INVENTION

The invention relates to tube expanders and more particularly to apparatus having automatic step rolling control for deep hole rolling of a tube to a header sheet. This is achieved in accordance herewith by means of apparatus that includes pneumatic control circuitry which is operative following completion of each rolling cycle to automatically relocate the thrust collar in preparation for the next rolling cycle.

A stop collar in the form of a thrust assembly is supported on the expander cage and is operably connected to an elongated stepping bar. A latching mechanism is longitudinally movable over the stepping bar and in conjunction with a pneumatic stepping cylinder is operable concomitantly therewith in controlled sequence to displace the stepping bar and collar increasingly rearward after each rolling cycle. The extent of displacement corresponds to the next incremental segment of tube to be rolled. In this manner, stepping reliability is both assured and substantially simplified for obtaining high quality joint formation without the inaccuracies, unreliability and tedious procedures associated with such similar purpose devices of the prior art.

It is, therefore, an object of the invention to provide a novel step controlled tube expander for deep hole rolling of a tube to a header sheet.

It is a further object of the invention to effect the prior object in automatically controlled sequence for assuring high quality joint formation throughout the joined tube length.

It is a still further object of the invention to effect the aforementioned objects in a controlled manner with automatic circuitry enabling achievement thereof with a highly reliable yet relatively economical construction.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. **1** and **2** are a plan and side views, respectively, of a single spindle expander operative in accordance herewith;

FIGS. **3** and **4** are a plan and side views, respectively, of a multi-spindle expander operative in accordance herewith;

FIG. **5** is an enlarged plan view of the stop collar thrust assembly of the single spindle unit;

FIG. **6** is a side elevation of the thrust assembly of FIG. **5**;

FIG. **7** is an enlarged plan view of the stop collar thrust assembly of the multi-spindle unit;

FIG. **8** is a sectional elevation taken substantially along the lines **8—8** of FIG. **7**;

FIG. **9** is a sectional elevation through a typical stop collar thrust assembly in accordance herewith;

FIG. **10** is a fragmentary elevation of the encircled portion **10** of FIG. **9** illustrating component relationship during the course of displacing the stop collar;

FIG. **11** is a sectional elevation through the latching mechanism hereof; and

FIGS. **12** and **13** are diagrammatic circuit arrangements of pneumatic controls for the single spindle and multi-spindle units, respectively.

Referring now to the drawings and particularly to FIGS. **1–4**, there are illustrated both single and dual spindle power fed tube expander units designated **10** and **11** of a type generally available in the prior art and modified in accordance with the invention hereof. Each spindle unit is comprised of an outer casing **13** housing the various operating components to which pressurized air from a suitable source is furnished via a supply hose **15** and dissipated through an exhaust hose **16**. Gripping handles **18** and **19** on the back and side of casing **13**, respectively, enable operator manipulation of the tool while an eye hook **20** provides for receipt of a suitable balancer for balanced support of the tool in operative position. Associated with dual unit **11** are a pair of transversely extending adjustment screws **22** and **23** affording span spacing between units to be accurately pre-set in correspondence with tube spacing to be encountered. Forward of each unit is a frame **25** on the underside of which is secured a base **26** supporting the cantilevered expander end of the tool.

Extending forward through base **26** is the expander cage **27** for which reference is also made to FIGS. **5–7**

and 9. The cage is of elongated tubular construction formed with a plurality of semi-spherical recesses 28 periodically spaced along its longitudinal length. Supported on the cage is a stop collar thrust assembly 29 while extending internally through the cage is a tapered mandrel 30 adapted to be driven by an air motor not shown. At the forward or expander end of the cage are three or more cylindrical forming rollers 33 circumferentially displaced in the cage periphery and skewed obliquely to the axis thereof. The rollers are supported on mandrel 30 to be rotatably driven thereby in a well known manner for expanding a tube 31 radially outward against a header 32. Also supported from frame 25 are a step cylinder 35 and a latch assembly 36 to be described below and through which extends a stepping bar 38 secured at its outboard end to stop collar thrust assembly 29. The stepping bar is of elongated cylindrical section having longitudinal spaced apart recesses 39 in its periphery correlated to the stepping displacement of collar to be effected.

Comprising the stop collar thrust assembly, which is most completely shown in FIG. 9, are a plurality of tandem arranged components supported about the periphery of cage 27. At the front of the assembly is a start collar 40 having a front face 42 adapted for engagement against the face of a tube header 32 and an enlarged rear flange 41 adapted for operating a start valve 108 as will be understood. Internally rearward from front face 42 the collar is bored at 44 to form a radial flange 45 adapted to abut the end of tube 31. Immediately behind flange 45 the collar is counterbored at 46 for receiving an adjustable sleeve 49. Through a slot 47, an adjustment screw 48 connects to sleeve 49 which is threaded about its periphery at 56 whereby it can be adjustably positioned in internal thread 59 of thrust collar 60. A set screw 61 secures the position between sleeve 49 and collar 60. Sleeve 49 at its terminal end turns inwardly forming a radial flange 52 to enclose coil spring 53 compressed therein against the end flange of a nylon sleeve 55. Latter sleeve 55 surrounds cage 27 in extending to inward of tube 31 for preventing cage drag against the tube surface in the course of expansion as might otherwise occur.

Thrust collar 60 contains thrust bearing 64 secured by means of a nut 65 which in turn maintains the assembled relation of components via a retainer ring 66 positioned in collar groove 67. Secured to the thrust collar by means of a set screw 68 is a thrust bracket 69 extending transversely thereto. Positioned immediately behind the thrust collar is a relatively displaceable release collar 71. The release collar has at its forward end a counterbore 72 defining a controlled clearance about nut 65 and at its rearward end includes a counterbore 73 containing a coil spring 76 secured therein by a retainer ring 77. Intermediate the counterbores, the release collar includes a radially inward flange 78 operably engaging a plurality of loose balls 79 contained in circumferentially displaced nut apertures 81. Balls 79 are adapted to move radially between cage recess 28 and counterbore 72 for respectively coupling and uncoupling the cage and thrust assembly in a longitudinal direction. The coupled relation between these components is shown in FIG. 9 while the uncoupled relation is shown in FIG. 10.

For the purpose of uncoupling the components release collar 71 terminates at its rearward face in a radial outward flange 80 engageable by a transversely extending release bracket 83. Secured to and extending through the release bracket is the threaded outboard end of the stepping bars 38 which slideably terminate through an aperture 84 in parallel thrust bracket 69. With the single spindle units, a guide bar 88 is connected to release bracket 83 similarly as stepping bar 38 in order to balance and absorb the applied longitudinal and rotational forces. An adjustment screw 85 enables setting of proper spacing between brackets to maintain stepping bar position relative to the operation of latch assembly 36 as will be understood.

For withdrawing the stop collar thrust assembly following rolling completion of each incremental tube segment, there is provided control apparatus that includes a stepping cylinder 35 operative concomitantly and in conjunction with latching mechanism 36. The stepping cylinder is of a commercially available type, being a double acting Clippard model 75D–1 pneumatic cylinder. Comprising the latch mechanism, as can be understood with reference to FIG. 11, is an essentially elongated body 92 having a longitudinally central aperture 93 containing a double acting displaceable piston member 94. A transverse body aperture 95 accommodates stepping bar 38 extending therethrough. Piston 94 is double flanged at each end for supporting an intervening O-ring seal 97 and likewise accommodates stepping bar 38 by means of a central oval-like aperture 98 aligned generally superposed with body aperture 95. Formed internally at the underside of piston aperture 98 is a radial tongue or finger 99 for engagement with stepping bar recess 39 in controlled sequence to latch or release the bar. Pneumatic fittings 100 and 101 communicate with opposite ends of the piston for effecting its controlled operation.

Operation of the single spindle unit in accordance herewith will now be described with reference also to the diagrammatic illustration of pneumatic control components shown in FIG. 12. Placing main valve 103 in the "ON" position supplies operating air to tube rolling motor 104 and through the motor to one chamber of a dual chamber sump 105. From the sump, air is supplied to start valve 108, four-way valve 109 (fourth port plugged) and to emergency stop valve 110. At the same time, four-way valve 112 is energized for supplying air to the left end of cylinder 111 and to pilot 113 which acts to close valve 114. A pin 119 on the operating rod of cylinder 111 operates valve 124 to open position. Concurrently, flow control valve 116 is energized for supplying air to the left end of stepping cylinder 35 maintaining it in retracted position and through four-way valve 118, latch assembly 36 is energized forcing piston 94 upward for tongue 99 to engage stepping bar recess 39 securing the bar in latched position. Depressing pushbutton 122 temporarily on four-way valve 118 transfers air pressure from latch fitting 101 to latch fitting 100. This releases stepping bar 38 from its latched relation permitting stop collar thrust assembly 29 to be positioned at the expander end ready to begin rolling operation for the first segment of tube.

To initiate the rolling cycle, the expander end is placed into the end of tube 31 until start collar contacts either the tube end or the header sheet 32 forcing the collar backward over sleeve 49 sufficient to operate start valve 108. (See also FIGS. 6 and 9). With start valve 108 in open position, air is supplied through valves 123 and 124 and through shuttle valve 125 to pilot 126. This establishes a self-holding circuit until

motor 104 is fully operative through shuttle valve 130 and regulator 131 for supplying reduced pressure air to valve 132 to pilot 133 and rendering four-way valve 112 operable. When the latter occurs, air is supplied to flow control valve 134 which simultaneously supplies air to the right end of cylinder 111 and through flow control valve 135 to the right end of stepping cylinder 35. Concomitantly, air is supplied through shuttle valve 138 to latch 36 placing it in unlatched relation enabling the energized stepping cylinder to relocate the latch assembly leftward the equivalent of a step on bar 38 to about line 137 (FIGS. 5–6).

While the latter is occurring, pilot 139 is energized to operate four-way valve 118 previously set manually. With valve 118 operating it allows an air bleed from the left end of cylinder 111 to atmosphere and from pilot 113 to open valve 114 while venting latch 36 and the left end of stepping cylinder 35. Air entering the right end of cylinder 111 induces push to be applied to the handle of motor 104 causing it to operate in the forward direction. With the motor operating, its right air line is pressurized via sump 105 and valve 114 through shuttle valve 130 and pressure regulator 131. Reduced pressure from the regulator is supplied through valve 132 to pilot 133 holding valve 112 in its operative position, while pressure regulating valve 140 through shuttle valve 141 and pilot 142 operates valve 145. Returning valve 145 to its normal relation effects a bleed of air pressure from pilot 126, etc., thereby eliminating the self holding circuit previously instituted. Air pressure will hold valve 112 operative until motor 104 completes the rolling operation, at which time the motor is de-energized by a torque control, not shown.

On encountering a predetermined torque level as set by the torque control, motor operation in a forward direction is discontinued, permitting pressure at the right end of motor 104 to decrease to near zero. This allows pilots 133 and 142, along with their respective valves 112 and 145, to assume their normal positions. Valve 112 is then enabled to exhaust air from the right end of stepping cylinder 35 and through various intermediate components from fitting 100 of latch mechanism 36. At the same time, air is supplied to pilot 113 for closing valve 114 and to the left end of cylinder 111 for pulling on the motor control handle and causing the motor to operate in a reverse direction for withdrawing mandrel 30. Likewise energized at that time are valve 118 and latch fitting 101 to move latch tongue 99 into its latch relation with stepping bar 38 while through flow valve 116, the left end of stepping cylinder 35 is energized. The effect of the latter is to draw stepping bar 38 backward forcing bracket 83 against release collar 71 to obtain release thereof by uncoupling it from cage 27 and allowing thrust assembly 29 to be moved back a distance corresponding to the separation spacing of cage recesses 28.

The foregoing continues repetitively until completing the final rolling step at which time valve 123 is operative by a pin 121 extending laterally from the stepping bar behind collar flange 83. This thereby prevents the start of additional rolling cycles until the thrust assembly has been forwardly repositioned to initiate a rolling operation for a subsequent tube. In the event of an emergency, manually pressing the button on valve 110 allows air to energize pilot 146 energizing pilots 146 and 142 to close their respective valves. This, in turn, bleeds air from pilot 133 allowing valve 112 to return to its normal position and with valve 145 in closed position, the self holding circuit is discontinued if not already discontinued as above. Valve 114 prevents false starts of air motor 104.

Operation of the dual unit will not be described with particular reference to FIG. 13. With main valves 205 and 206 in the "ON" position, air is supplied to each of the rolling motors 207 and 208, respectively. Air from the motors via shuttle valve 210 is supplied to one chamber of sump 211 to in turn supply manifold 212. This energizes start valve 108 and four-way valve 213, while at the same time air is being applied to emergency stop valve 216 and through four-way valve 217 and manifold 218 to energize the left end of air cylinders 223 and 224 and to pilots 219 and 220. This closes valve 228 while air is passed through four-way valve 225 and flow control valve 226 to the right end of stepping cylinder 35. Air is also passed through four-way valve 227 to the latch side of latching assembly 36 unless valve 227 has been manually operated. Depressing the manual pushbutton on valve 227 transfers air pressure for releasing the latch assembly whereby the stop thrust assembly can be positioned toward the expander in preparation for first step rolling in a pair of parallel tubes 31. Pins 229 and 230 on the operating rods of cylinder 223 and 224 operate valves 231 and 232 to open position.

Positioning the expanders inward of the tube ends as before and pushing forward on the unit triggers start valve 108. This serves to supply air through valves 231, 232 and 233 and shuttle valve 234 to pilot valve 235 for operating four-way valve 213. With the latter energized, air is passed through valve 240 and shuttle valve 234 back to pilot 235, thus forming a self-holding circuit enabling the motor to become fully operative. Air is thereby allowed to flow through shuttle valve 241 to pressure regulator 242 and through valve 243 to pilot 244. With pilot 244 energized, four-way valve 217 supplies air to pilot 248 and flow control valves 249 and 250 feeding toggle valves 251 and 252, respectively. These in turn supply the right end of air cylinders 223 and 224 while valve 217 effectively bleeds pilots 219 and 220 and the opposite end of the cylinders 223 and 224 through manifold 218. Pilot 248, being energized, will operate valve 225 allowing air to flow through shuttle valve 256 to place latch assembly 36 in unlatched position while also passing air through control valve 257 to pilot 258 for operating four-way valve 227 and to the left end of stepping cylinder 35. As before, this enables the energized stepping cylinder to relocate the latch assembly leftward over bar 38 to about line 137. At the same time, air is being bled through valve 225 to atmosphere from control valve 226 and the right end of stepping cylinder 35 and through the four-way valve 227 from the latching side of the latch assembly 36. With energizing the right end of air cylinders 223 and 224 control handles of air motors 207 and 208, respectively, are pushed causing the motors to run in a forward direction.

So long as the motors operate forwardly, the air lines from their right ends are pressurized supplying shuttle valve 259, sump 211, valves 228 and 241, regulating valve 242 and valve 243 to pilot 244. The latter places four-way valve 217 in operative position while pilot 263 is energized through flow control valve 264 and shuttle valve 265 to close valve 240. Pilot 235 is then bled eliminating the self-holding circuit previously de-

scribed. This relation of active components continues until the preset torque level is encountered at which time the motors are de-energized by the torque control, not shown.

When the motors are stopped, air pressure at their right ends nears zero allowing pilots **244** and **263** and their respective operative valves **217** and **240** to resume their normal position. As the operative position of valve **217** is transferred, it will exhaust the right end of cylinders **223** and **224** and pilot valve **248** via the intervening toggle and control valves **249–252.** Transfer likewise applies air pressure through manifold **218** to pilots **219** and **220** for energizing the left side of air cylinders **223** and **224** to initiate reverse operation of motors **207** and **208.** Pilot **220** will cause valve **228** to close whereas the effect of pilot **219** is to switch valve **225** to an air bleed position through control valve **257** from the left end of stepping cylinder **35** and via pilot **258** and shuttle valve **256,** from the unlatching side of latching assembly **36.** Simultaneously with transfer, valve **225** will apply air pressure through valve **227** to the latching side of latch assembly **36** while air through valve **226** will apply air to the right side of stepping cylinder **35.** The effect of the latter is to draw stepping bar **38** backward forcing bracket **83** against release collar **71** to obtain release or uncoupling thereof and allowing stop thrust assembly **29** to be moved one step back on the expander cage as before.

The foregoing continues repetitively until completing the final rolling step at which time valve **233** is operated by pin **121** thereby preventing a start of additional cycles unitl after the thrust assemblies have been forwardly repositioned. Valves **231** and **232** are each operated by one of motors **207** or **208** when the motors are in their home position thereby likewise preventing any starting cycle until after the previous cycle has been completed. The unit is then ready to repeat the total cycle for another tube.

Valve **216** functions as an emergency stop which when manually depressed allows air to flow to pilot **266** for closing valves **243** and **240** which in turn bleed air from pilot **244** allowing valve **217** to return to its normal position. With valve **240** in closed relation, the self-holding circuit is dropped out if not already eliminated as above. Valve **228** functions as a safeguard against false starts of the air motors. Toggle valves **251** and **252** enable operation of one motor without the other. A finger latch **268** which when pivoted upwardly in the position shown in FIG. **8** permits manual reset of the thrust assembly after completion of the last operating cycle.

By the above description, there has been disclosed novel expander apparatus capable of controlled step rolling for deep hole rolling of a tube to a header sheet. A stop collar thrust assembly is supported behind the expander rollers in the direction of advance to inward of the tube and operation is initiated with the stop collar in the forwardmost position bearing against the tube end or header sheet. In this position pneumatic circuitry is triggered via start switch **108** for operating the motor in the forward mode. Simultaneously, latch assembly **36** is detached from stepping bar **38** while step cylinder **35** moves the latch assembly to a forward position about the bar. Upon completing each rolling cycle for each incremental segment of tube, the motor is automatically stopped by a torque control at which time the latch assembly **36** is operative to latch onto stepping bar **38.** In seriatim, the stepping cylinder **35** then draws the bar and thrust assembly backward as a unit a one step distance of the bar to prepare the tool for the next operating cycle.

To begin operation again, it is only necessary that the operator again force the stop collar against the tube or header to initiate the next rolling step. Alternatively, the entire tool can be biased toward the tube to eliminate operator intervention between steps. By this means, all rolling steps are insured and accidental step omission is precluded. After the last step has been rolled, the stepping bar actuates a cycle completion valve **233** thereby preventing the machine from re-rolling the last step. Other safety features have been provided although not specifically mentioned. The entire unit is thereby rendered self-contained and is readily adaptable to either a single or a multiple unit device for rolling one or more tubes simultaneously. By this means, the previous difficulties and psychological factors associated with deep hole rolling are diminished or eliminated as to substantially reduce the high labor costs previously associated therewith.

Since many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the drawings and specification shall be interpreted as illustrative and not in a limiting sense.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. Tube expander apparatus comprising in combination:

a. a rotatable expander for insertion into an end of a receiving tube to be expanded against a header sheet;

b. motor means for rotatably driving said expander within the receiving tube in rolling relation to a longitudinal wall segment thereof for effecting tube expansion of the segment against the header;

c. a stop collar supported on said expander at a location outward of the receiving tube end to prevent said expander from advancing inward of the tube beyond said segment while said rolling relation is being conducted; and

d. control means operable after said expansion is completed to displaceably step said collar to a support location a predetermined distance away from the tube end for said expander to subsequently conduct expansion on an additional wall segment of said tube.

2. Tube expander apparatus according to claim **1** in which said control means is pneumatically actuated.

3. Tube expander apparatus according to claim **2** including latch means and a stepping cylinder concomitantly operative for displaceably stepping said collar.

4. Tube expander apparatus according to claim **1** including coupling means operatively effective while said rolling relation is being conducted to longitudinally couple said collar to said expander and said control means includes release means effective when operable to release said coupling means for displaceably stepping said collar.

5. Tube expander apparatus according to claim **4** including a longitudinally movable stepping bar operably

connecting said collar to said control means, said stepping bar having a plurality of recesses defined longitudinally spaced apart in its periphery at incremental distances correlated to the stepping distances to be effected by said control means.

6. Tube expander apparatus according to claim **5** including latch means operable in controlled sequence by said control means to a latch or release relation with said stepping bar.

7. Tube expander apparatus according to claim **6** in which said expander comprises an elongated cylindrical cage having a plurality of annular recesses defined longitudinally spaced apart in its periphery at distances corresponding to the incremental recess distance of said stepping bar, said collar is supported on said cage and said coupling means is operatively cooperative with said recesses to longitudinally couple said collar to said expander.

8. Tube expander apparatus according to claim **6** including stepping means operable in controlled sequence by said control means to displace said latch means in a first direction relative to said stepping bar when the latch means is in a release relation therewith and to displace said latch means together with said stepping bar in an opposite direction when said latch means is in a latch relation therewith.

9. Tube expander apparatus according to claim **8** in which said stepping means comprises a stepping cylinder operative concomitantly with said latch means.

10. Tube expander apparatus according to claim **9** in which said control means is pneumatically actuated.

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