

Nov. 12, 1968

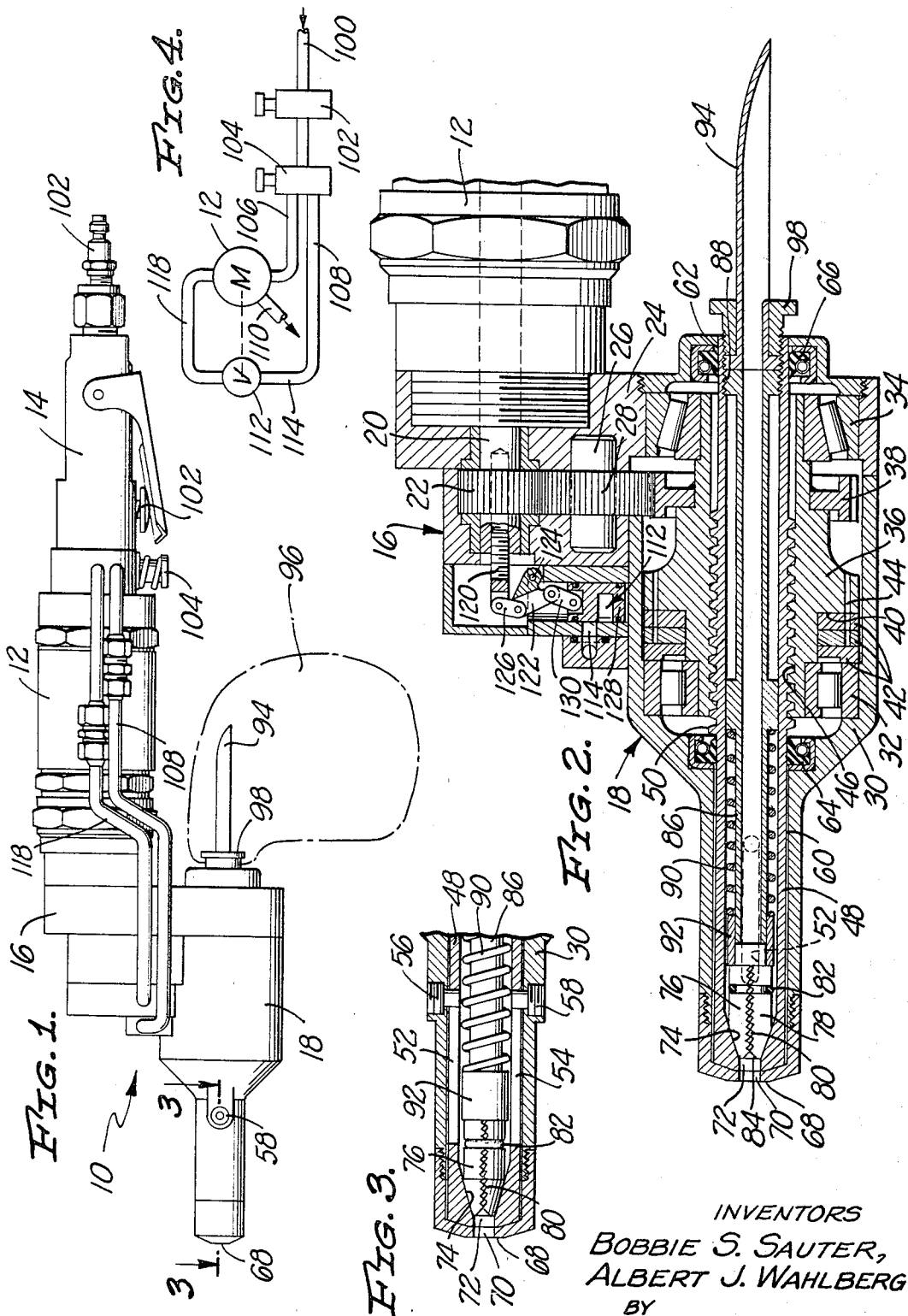
B. S. SAUTER ET AL

3,410,128

PULL GUN

Filed Oct. 13, 1966

2 Sheets-Sheet 1



INVENTORS
BOBBIE S. SAUTER,
ALBERT J. WAHLBERG
BY
EDWARD D. O'BRIAN
ATTORNEY

Nov. 12, 1968

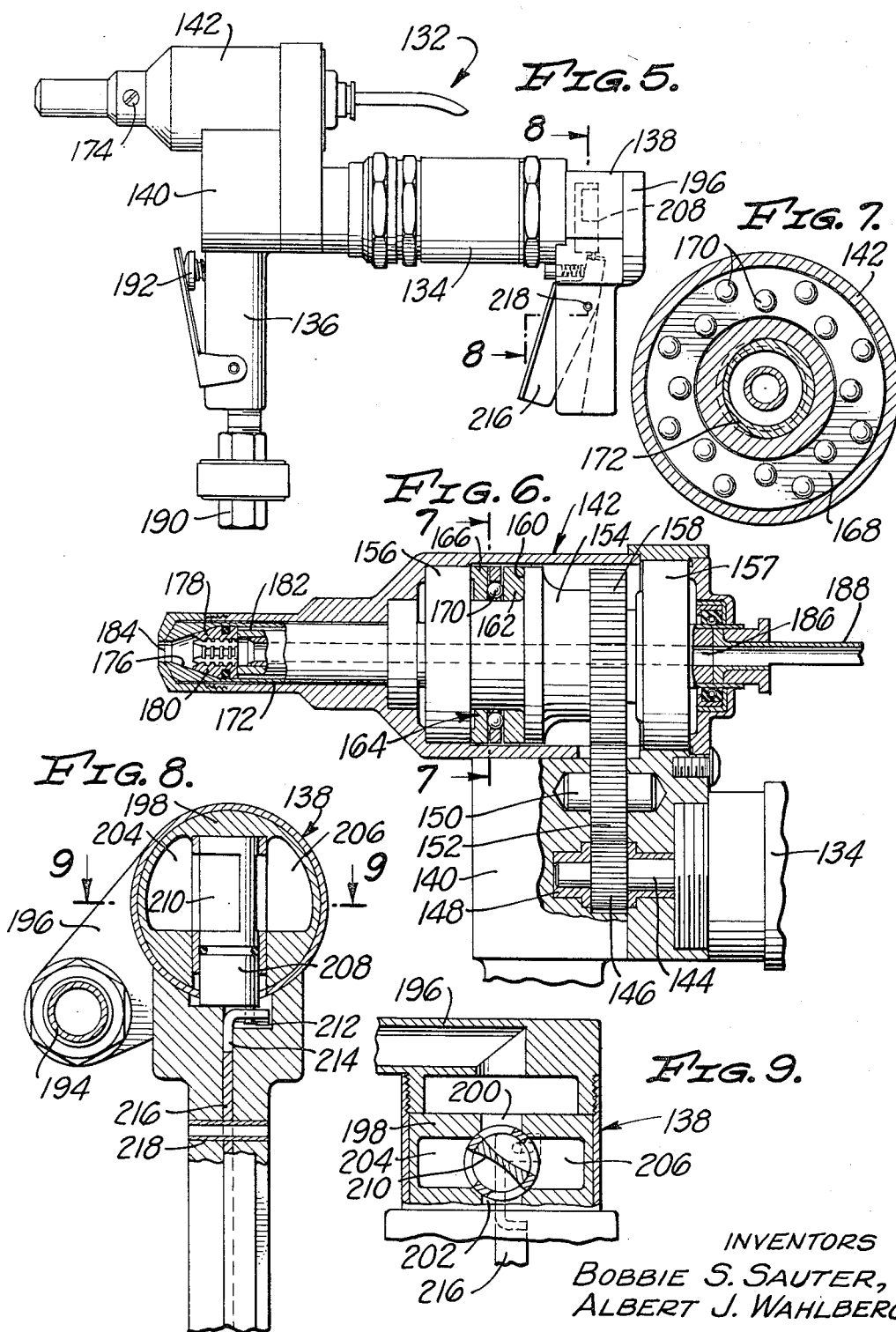
B. S. SAUTER ET AL

3,410,128

PULL GUN

Filed Oct. 13, 1966

2 Sheets-Sheet 2



INVENTORS
BOBBIE S. SAUTER,
ALBERT J. WAHLBERG
BY
EDWARD D. O'BRIAN
ATTORNEY

1

3,410,128

PULL GUN

Bobbie S. Sauter, Newport Beach, and Albert J. Wahlberg, Santa Ana, Calif., assignors to Standard Pressed Steel Co., Santa Ana, Calif., a corporation of California
 Filed Oct. 13, 1966, Ser. No. 586,444
 10 Claims. (Cl. 72-391)

ABSTRACT OF THE DISCLOSURE

A pull gun which is suited for the pulling of pullable stems or pin tails on fasteners which are secured by this means. The pull gun comprises a relatively fixed body housing and an axially movable set of pulling jaws. The puller carries screw threads on its exterior. A nut engages upon the screw threads and is rotatably mounted with respect to the housing. A motor is connected to rotate the nut. In the preferred structure, the motor is a fluid driven rotary motor. The motor has a drive shaft, which drives an analog nut and screw in proportion to the rotation of the main pulling nut and thus the amount of axial transport of the pulling stem. The analog nut and screw is connected to control means to limit the maximum rotation of the motor and thus the maximum transport of the pulling stem.

Background

In the fastener art there are a number of fasteners which are pre-loaded and/or set by pulling a stem thereon. Hand tools are normally used for this pulling, and such hand tools must have large mechanical advantage to apply the necessary force to properly pull such fasteners, especially in the larger sizes. It is clear that in rapid installation of such fasteners a proper, powered pull gun is desirable. Furthermore, it is desirable that such a pull gun has adequate force and proper controls, as well as being of light weight, so that it can be easily managed, brought up to the fastener to be pulled, rapidly gripped thereon and accomplish the pull. Furthermore, it is desirable that such a pull gun has such internal controls that it will automatically return to the ready position. Such has not been previously available, despite the growing need.

Description

Accordingly, it is an object of this invention to provide a pull gun which is particularly suited for the pulling of fasteners having pullable stems or pin tails. It is another object of this invention to provide a pull gun which is easily manageable and readily controllable so that such fasteners can be economically and conveniently secured. It is a further object of this invention to provide a pull gun which is capable of high pulling force so that such fasteners of relatively large size may be properly and quickly secured. It is still another object of this invention to provide a pull gun for fasteners having a pullable stem which incorporates means for ejecting the pulled stem so that in repetitive use, the previous stem is removed from the pulling jaws without interfering with the insertion of the next stem to be pulled. It is a further object of this invention to provide a pull gun which has internal controls which limit the amount of stroke of the pulling jaws of the pull gun so that they stop in the position where they are ready for grasping on the pullable stem. Other objects and advantages of this invention will become apparent from a study of the following portions of this specification, the claims and the attached drawings.

FIG. 1 is a side elevational view of the preferred embodiment of the pull gun of this invention.

2

FIG. 2 is an enlarged partial longitudinal section therethrough.

FIG. 3 is an enlarged section taken generally along the line 3-3 of FIG. 1.

FIG. 4 is a schematic pneumatic control circuit for the pull gun of FIG. 1.

FIG. 5 is a side elevational view of a further embodiment of the pull gun of this invention.

FIG. 6 is an enlarged partial longitudinal sectional view thereof.

FIG. 7 is an enlarged section taken along the line 7-7 of FIG. 6.

FIG. 8 is an enlarged sectional view taken generally along the line 8-8 of FIG. 5.

FIG. 9 is a section taken generally along the line 9-9 of FIG. 8.

Referring to the drawings in more particularity, the preferred embodiment of the pull gun of this invention is generally indicated at 10. The pull gun 10 comprises a motor 12, which is preferably pneumatic. Valve assembly 14 is mechanically and pneumatically connected to the motor. The mechanical output of motor 12 is connected to gear case 16 which is in turn connected to thrust unit 18.

As is seen in FIG. 2, motor 12 has an output shaft 20, which is an integral part of the motor so that it rotates upon motor rotation. Drive gear 22 is secured to rotate with shaft 20. Housing 24 of gear case 16 carries pin 26 therein. Idler gear 28 is mounted for rotation on the pin. Idler gear 28 is in gear tooth engagement with drive gear 22.

Housing 30 of thrust unit 18 carries bearings 32 and 34 therein. These are anti-friction bearings which rotatably support nut 36. Nut 36 carries driven gear 38 which is in gear tooth engagement with idler gear 28. Through the use of the idler gear, nut 36 turns in the same direction as output shaft 20. Nut 36 is the pulling nut which draws upon the pulling stem of the pull gun. Nut 36 has a thrust face 40. Thrust washers 42 are stacked against thrust face 40 and bear against housing 30 through the outer race of bearing 32. Lubricant hole 44 permits the passage of lubricant to the faces of the thrust washers so as to maintain friction at a low level.

The interior of nut 36 is provided with threads 46. Pulling tube 48 has exterior threads 50 engaged in the threads of nut 36. As is seen in FIG. 3, pulling tube 48 is axially slotted with slots 52 and 54. Threaded pins 56 and 58 are respectively screwed into the housing 30 and extend into the slot so as to prevent rotation of pulling tube 48. By this construction, it can be seen that rotation of shaft 20 causes axial movement of pulling tube 48 with respect to housing 30. Pulling tube 48 has smooth exterior surfaces at 60 and 62 upon which are engaged seals 64 and 66. These seals maintain lubricant within the portion of housing 30 which is occupied by driven gear 38 and the several bearings.

Housing 30 extends forward to terminate in thrust face 68 which has opening 70 therein. Pulling tube 48 extends forward to a position fully forward against the interior of thrust face 68. The forward end of pulling tube 48 has an opening 72 which is aligned with opening 70. Interiorly of pulling tube 48, it is provided with conical surface 74 which acts as a closer for pulling jaws 76 and 78. There are preferably three or more such jaws, each provided with interior serrations 80 which are particularly arranged to engage upon the stem to be pulled. Resilient ring 82 is engaged around the jaws to urge them into the closed position. The front of the jaws facing opening 72 are arranged with an entrance cone 84 to guide a stem into the space between the jaws. When pull gun 10 is moved so that openings 70 and 72 accept a stem to be pulled, the stem engages upon the faces of the jaws moving them backward with respect to the conical surface 74 to thus

permit them to open to a sufficient extent to accept the stem. Resilient ring 82 resiliently maintains the jaws in the proper position with respect to each other.

Guide tube 86 is positioned within the interior of pulling tube 48 and is secured with respect thereto by means of threads 88. Spring 90 is positioned around guide tube 86 and engages thrust tube 92. Thrust tube 92 in turn engages the rear of the jaws 76 and 78 so as to urge them toward thrust face 68 and thus toward the closed position by actuation of conical surface 74. However, both the closing caused by resilient ring 82 and spring 90 are overcome by the inward thrust of a pull stem on the front of the jaws, to thus open them for acceptance and grasping of the pull stem.

In view of the fact that the pull stem on the fastener is torn loose as a part of the fastening operation, the pull stem must be disposed of. Guide tube 86 is in alignment with the jaws and is of sufficient size to pass these broken off stems. Furthermore, the deflection tube 94 is axially secured with respect to tube 86. Thus, broken off stems can pass through tube 86 and deflection tube 94 to be discharged from the rear of the thrust unit 18. Should it be undesirable to loosely discharge these broken parts, a receiving bag 96 can be secured over ring 98 on the rear of pulling tube 48.

Referring to FIGS. 1 and 4, control of motor 12 is accomplished by suitable control valving. Air inlet 100 is arranged to accept air from a conventional factory compressed air source. Flow control valve 102 is a plain shutoff valve which can be infinitely variably controlled so as to control that amount of air flow and thus the rotational speed of motor 12. Reversing valve 104 is connected to receive air under pressure from flow control valve 102. Reversing valve 104 has tubes 106 and 108 connected thereto. Valve 104 is arranged so that when it is actuated, air under pressure is connected to tube 106 and tube 108 is closed. When reversing valve 104 is not actuated, the air under pressure is connected to tube 108 while tube 106 is closed. Motor 12 is a commercially available motor having exhaust 110 and internal valving arranged so that upon passage of air through tube 106, the motor rotates forward and exhausts air at 110. Upon pressurization of tube 118 the motor rotates in the reverse direction and exhausts air at 110.

Referring again to FIG. 2, the interior of shaft 20 is threaded to accept actuating rod 120. Actuating rod 120 is restrained from turning so that rotation of the motor causes the rod to move axially with respect to the shaft. This is an analog of the movement of pulling tube 48 with respect to housing 30. Rocker arm 122 is pivoted to the frame at 124 and is connected to actuating rod 120 by means of link 126 so that rocker arm 122 rocks as the motor rotates. Rocker arm 122 is connected to valve plunger 128 of valve 112 by means of link 130. Valve plunger 128 is arranged so that port 114 is closed in the position shown, when pulling tube 48 is all the way forward in housing 30. This stops fluid flow in the direction from tube 108 to tube 118 so that the pulling tube 48 is stopped when the pulling tube reaches its forward position. This prevents damage to the structure.

In operation, a fastener with a pullable stem is inserted through an opening in the member to be fastened. The pull gun 10 is moved up to the pullable stem and is thrust over the pullable stem so that the pullable stem moves the pulling jaw 76 and 78 backward toward an open position by overcoming resilient ring 82 and spring 90. These resilient means close the jaws around the usual serrations on the pullable stem. Thereupon, the operator actuates the valves 102 and 104 by wrapping his hand around valve assembly 14. Most fingers are engaged around the operating handle of valve 102, while the forefinger actuates valve 104 to the actuated, pulling position with air flow through tube 106, motor 12 and out exhaust 110. Air flow is controlled by valve 102 to motor 12 so that nut 36 turns at the desired speed. At the same time, ac-

tuating rod 120 axially moves in an analog to the axial movement of pulling tube 48. Rearward motion of the pulling tube, rightward in FIG. 2, causes pulling of the pullable stem on a fastener. At the same time, valve plunger 128 moves upward to open port 114. When the pullable stem is pulled loose, the operator releases his finger from reversing valve 104. Thereupon, the air flow to the motor is reversed with air flow passing through tube 108. Control valve 112, tube 118, motor 12 and exhaust 110. Upon reversal, pulling tube 48 moves forward and valve plunger 128 moves downward. When pulling tube 48 reaches its forwardmost position, valve plunger 128 cut off air flow to stop motor 12. The pull gun 10 is then ready for acceptance of the next pullable stem. When the next pullable stem is inserted into the jaws, the prior, broken off stem is thrust back through tube 86 to collect in receiving bag 96. This operation can be continually repeated as long as the pulling is required. In most cases, especially with larger fasteners, the forces and deflections involved are sufficient to fire the pulled stem through tube 86 and deflector 94.

Referring now to FIGS. 5 through 9, a further embodiment of the pull gun of this invention is generally indicated at 132. Pull gun 132 closely resembles the pull gun 10. It has a motor 134. Instead of a single valve assembly, it has two valve assemblies. Valve assembly 136 controls the amount of flow of pneumatic fluid while valve assembly 138 controls the direction of fluid flow to motor 134, and thus the direction of motor rotation. Motor 134 drives the gears in gear case 140 which in turn drives thrust unit 142. The general organization of pull gun 132 is the same as pull gun 10. The valve assemblies 136 and 138 are separately arranged for separate pistol grip holding and actuation, as compared to the single valve assembly 14, which is arranged in axial alignment with the motor 12.

Considering pull gun 132 in more detail, motor 134 has output shaft 144. Drive gear 146 is mounted on the shaft for rotation therewith. Gear case 140 carries bushing 148 which supports the outboard end of shaft 144. Furthermore, gear case 140 carries pin 150 on which idler gear 152 is rotatably mounted. Idler gear 152 is in gear tooth engagement with drive gear 146.

Thrust unit 142 has nut 154 rotatably mounted therein. Nut 154 is mounted on antifriction bearings 156 and 158 which are of conventional design, and are preferably the same as bearings 32 and 34. These bearings are carried in thrust unit housing 142. Nut 154 has driven gear 158 mounted thereon so that rotation of the gear causes rotation of the nut. Gear 158 is in gear tooth engagement with idler gear 152.

Nut 154 has a thrust face 160 which bears against race 162 of thrust bearing 164. Race 166 faces race 162 and bears against the stationary part of bearing 156. Retainer 168, see FIG. 7, is positioned between these races. Thrust balls 170 are positioned in suitable holes in retainer 168. Preferably, in order to carry greater thrust loads, the balls 170 are spaced upon at least two different pitch diameters. In any event, the size of balls 170 and their number is adequate to carry the thrust load encountered by nut 154.

Pulling tube 172 extends through nut 154. Pulling tube 172 has threads on its exterior which engage with threads on the interior of nut 154, so that when the nut rotates the pulling tube is axially moved. Rotation of pulling tube 172 is prevented by pins similar to pins 56 and 58. One of these pins is illustrated at 174 in FIG. 5. Pulling tube 172 extends forward and has a conical interior surface 176 which acts as a closer for jaws 178 and 180 positioned within the pulling tube. Similarly to the earlier described jaws, there are at least three jaws in the pull gun 132. Thrust tube 182 acts against these jaws, spring urged identically to thrust tube 92 to hold the jaws in position. Openings 184 are provided in the front end of pulling tube 172 and in the front end of housing 156 to

permit entry of a stem to be pulled into the jaws. Guide tube 186 extends into the rear of thrust unit 142 with deflection tube 188 extending therefrom for discharge of pulled stems.

Valve assembly 136 is secured to gear case 140 so that the valve assembly extends away from the gear case to provide a comfortable pistol grip manner of holding the pull gun 132. Air inlet 190 is connected to valve assembly 136 and is adapted to be connected to a conventional source of plant compressed air, or other motive fluid supply. Air inlet 190 is connected to valve 192, which simply provides an infinitely variable air flow control. The outlet from valve 192 is connected by means of a tube, not seen on the other side of FIG. 5, a portion of which is seen at 194 in FIG. 8, to valve assembly 138. Connector 196 is connected to the tube and to the valve assembly. Valve inlet 198 has an air inlet port 200 and a vent 202 to atmosphere. Valve 198 also has passages 204 and 206 which has dividing web 210 across its center. The web 210 is arranged so that upon 90° rotation of the valve plug about its axis, connections between the motor passages are reversed with respect to fluid supply and exhaust. Thus, 90° rotation of the web causes reversal of the motor.

Eccentric pin 212 extends downwardly from the valve plug and is engaged by fork 214 on operating handle 216. Operating handle 216 is pivoted at 218 and is arranged so that grasp around the pistol grip construction including operating handle 216 causes rotation of the valve plug. Thus, valve 192 controls motor speed and valve 198 controls motor direction. Two pistol grip handles are provided for convenient handling of the pull gun 132.

Similarly to the gun, 10, the pull gun 132 is brought up to the stem to be pulled and is inserted over the stem to be pulled so that the stem extends into jaws 178 and 180. Squeezing of operating handle 216 places valve plug 208 in such a position that the motor will be rotated in the pulling direction. Thereupon, operation of valve 192 introduces air to the motor and results in the pulling of pulling tube 172, the closing of jaws 178 and 180 around the stem to be pulled and the pulling of the stem. When stem pulling is complete, operating handle 216 is released and the pulling tube is returned to the forward position.

No control valve, such as the control valve 112 in pull gun 10, is shown with respect to pull gun 132. However, it will be apparent that such a control valve can be readily employed therein for the same purpose. In the present case however, the operator can readily hear from motor operation when the pulling tube has reached the ends of its stroke, and use this information to shut off the pull gun by closing valve 192 or reversing the pull gun by actuation of operating handle 216.

This invention having been described in its preferred embodiment, and an additional embodiment disclosed, it is clear that it is susceptible to numerous modifications and embodiments within the ability of those skilled in the art and without the exercise of the inventive faculty. Accordingly, the scope of this invention is defined by the scope of the following claims.

We claim:

1. A pull gun, said pull gun comprising a housing, a rotary motor mounted on said housing, a pulling tube mounted for nonrotative, axial motion with respect to said housing and positioned within said housing, screw threads on said pulling tube, a nut mounted for rotation in said housing, said nut embracing said pulling tube and in engagement with said threads of said pulling tube, said

rotary motor being connected to rotate said nut with respect to said housing so as to move said pulling tube axially with respect to said housing, and pulling jaws mounted with respect to said pulling tube, said pulling jaws being adapted to engage upon the pullable stem of a fastener.

2. The pull gun of claim 1 wherein said rotary motor is pneumatically powered, a flow control valve connected to said motor so as to control the amount of air flow to said motor to control the rotary speed of said motor, a reversing valve connected to said motor so as to control the direction of rotation of said motor.

3. The pull gun of claim 2 wherein said motor further has a stop valve connected thereto, said stop valve being positioned in accordance with the position of said pull tube with respect to said housing so as to stop motion of said pull tube with respect to said housing when said pull tube reaches a predetermined position with respect to said housing.

4. The pull gun of claim 3 wherein said stop valve is connected by connection means to be driven by said motor, said connection means comprising a screw thread connected to be driven by said motor, said screw thread being connected to move said valve so that said valve moves proportionally to said pull tube and said valve is closed when said pull tube reaches its terminal position.

5. The pull gun of claim 1 wherein said pull tube has front end and a rear end, said front end of said pull tube being open to permit entry of a stem to be pulled into said jaws within said pull tube, said rear end of said pull tube being open to permit the discharge of a pulled stem from the rear of said pull tube.

6. The pull gun of claim 5 wherein a guide tube is positioned within said pull tube, said guide tube being adapted to guide a pulled stem, said guide tube extending from adjacent said jaws within said pull tube and extending out of the rear end of said pull tube.

7. The pull gun of claim 6 wherein a deflection tube is positioned within said pull tube and around said guide tube, a spring around said guide tube, said spring engaging a thrust tube, said thrust tube engaging said jaws so as to thrust said jaws with respect to said pull tube to urge said jaws toward a closed position.

8. The pull gun of claim 1 wherein a key is mounted on one of said housing and said pulling tube, a slot on the other thereof, said key engaging said slot to constrain said pulling tube with respect to said housing for said nonrotative axial motion therebetween.

9. The pull gun of claim 8 wherein said slot has ends and the engagement of said key with said slot ends determines the axial limit of motion of said pulling tube with respect to said housing.

10. The pull gun of claim 9 wherein said key is a pin secured in said housing and said slot is in said tube.

References Cited

UNITED STATES PATENTS

2,342,089	2/1944	Rossmann	72-454
3,028,987	4/1962	Van Hecke	72-391
3,095,106	6/1963	Morrison	72-391
3,196,662	7/1965	Simmons	72-391

FOREIGN PATENTS

535,584 10/1931 Germany.

CHARLES W. LANHAM, *Primary Examiner*.

G. P. CROSBY, *Assistant Examiner*.