United States Patent

Miller et al.

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[54] **INSTALLATION TOOL FOR FASTENERS REQUIRING ROTARY AND AXIAL MOVEMENTS**

[72] Inventors: **Delmar S. Miller,** 918 Balboa, Newport Beach, Calif. 92662; **Kenneth V. Cushman,** 2138 Salta St., Santa Ana, Calif. 92704

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Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 749,677, Aug. 2, 1968.

[52] **U.S. Cl.** **72/114,** 72/391
[51] **Int. Cl.** **B21d 9/05**
[58] **Field of Search** 72/114, 391, 454

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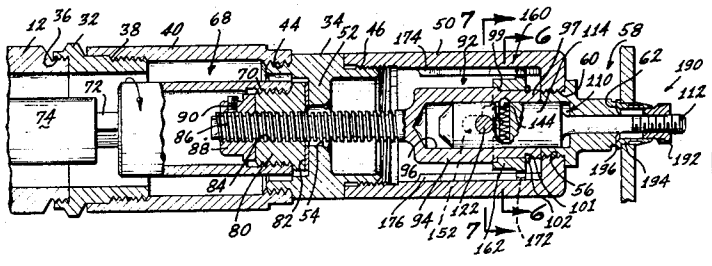
Primary Examiner—Charles W. Lanham
Assistant Examiner—Gene P. Crosby
Attorney—Albert M. Herzig et al.

[57] **ABSTRACT**

An installation tool for fasteners of the type wherein a nut part which is internally threaded is pulled axially to expand and/or clamp an extending sleeve part of the fastener to set it with respect to the material in which it is being used. The tool is power driven and imparts rotary motion initially to thread the nut part of the fastener into a threaded sleeve, and then to abruptly stop rotary motion and exert a strong axial pull for setting the fastener.

12 Claims, 15 Drawing Figures



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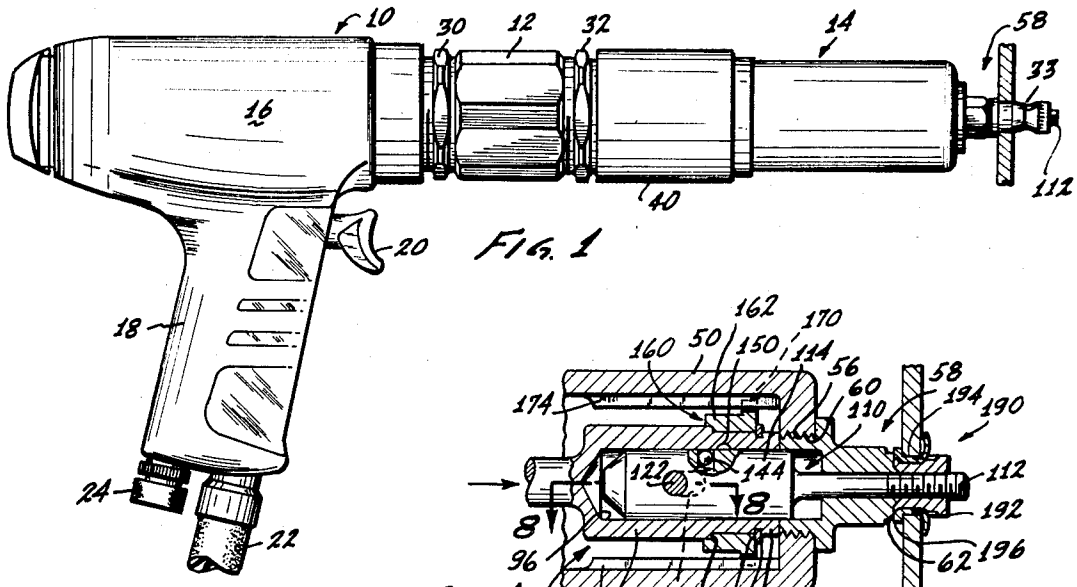


FIG. 1

FIG. 4

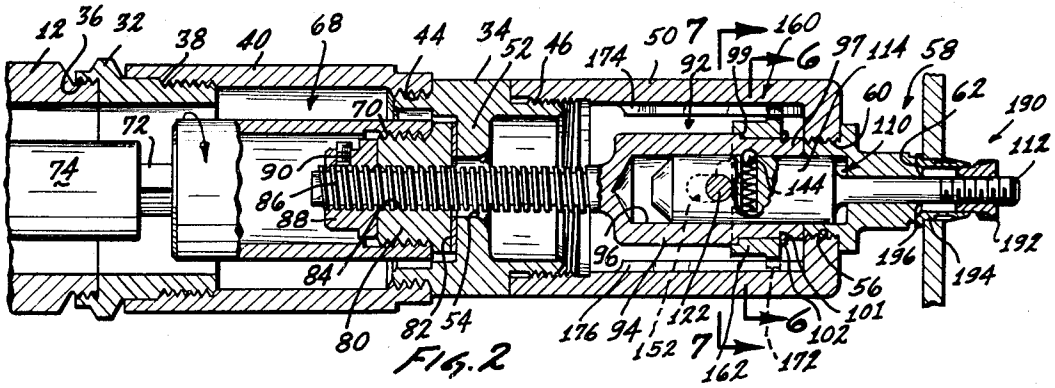


FIG. 2

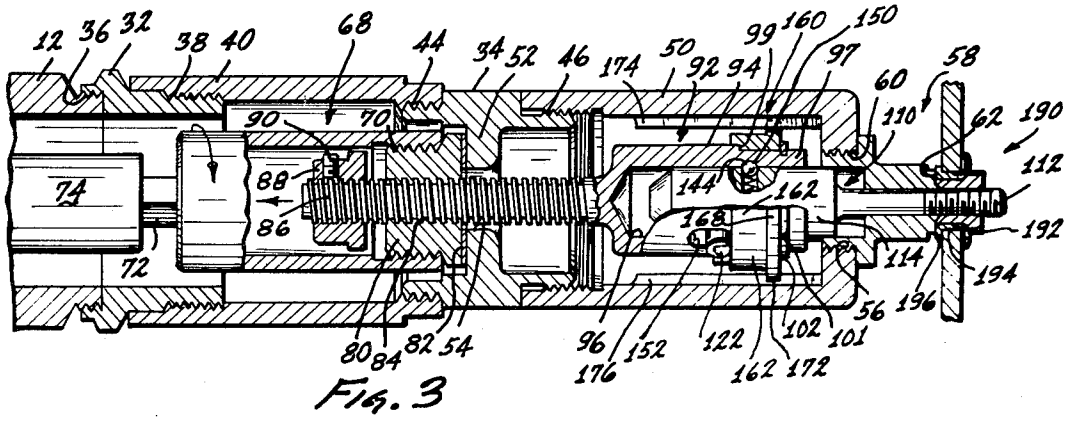
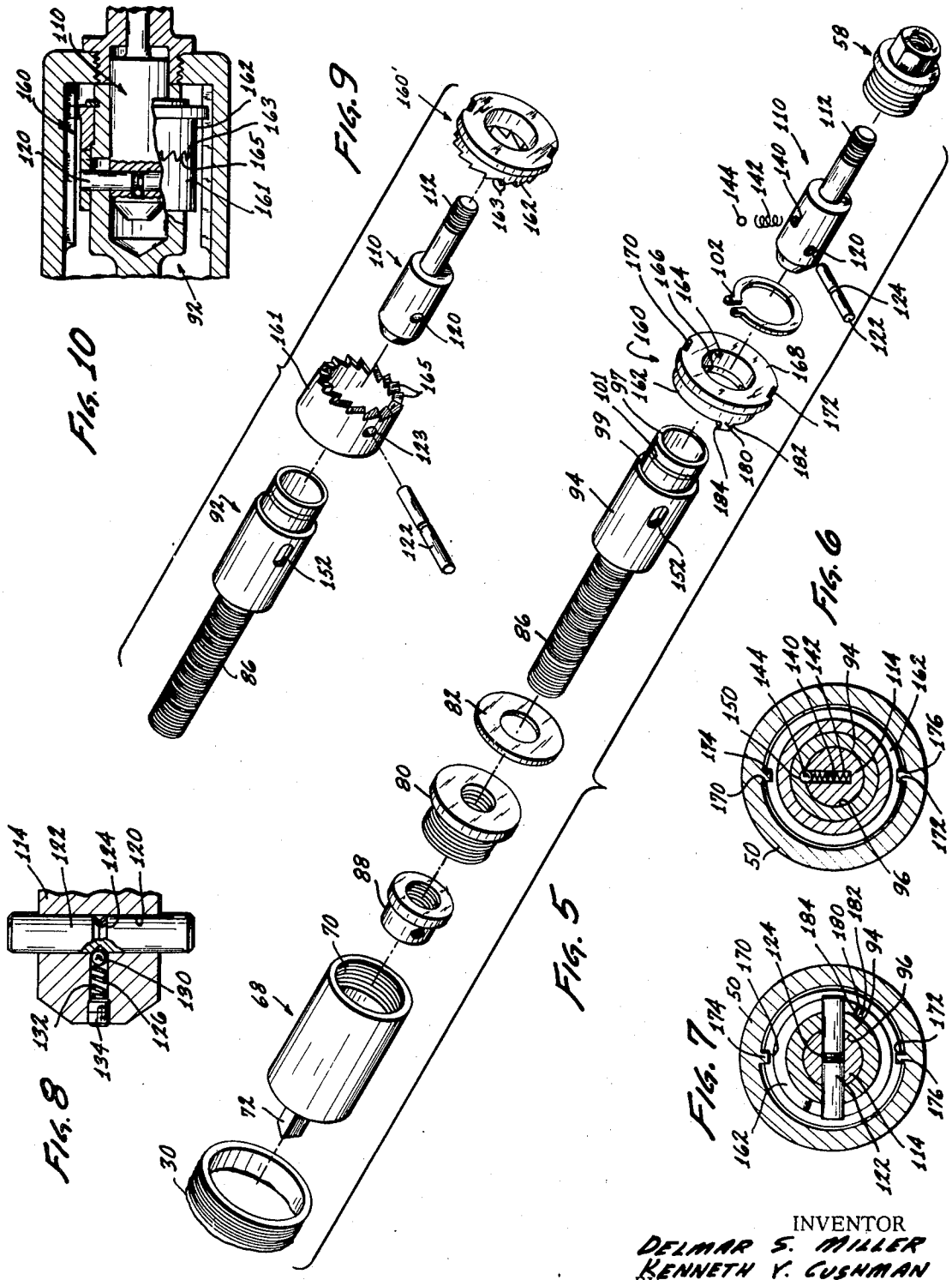


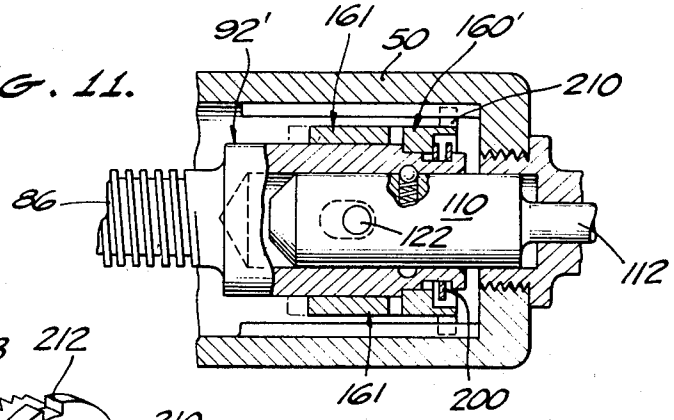
FIG. 3

INVENTOR
DELMAR S. MILLER
KENNETH V. CUSHMAN
BY
Herzig + Walsh
ATTORNEYS



INVENTOR
DELMAR S. MILLER
KENNETH Y. CUSHMAN
BY
Herzig + Walsh
ATTORNEYS

FIG. 11.



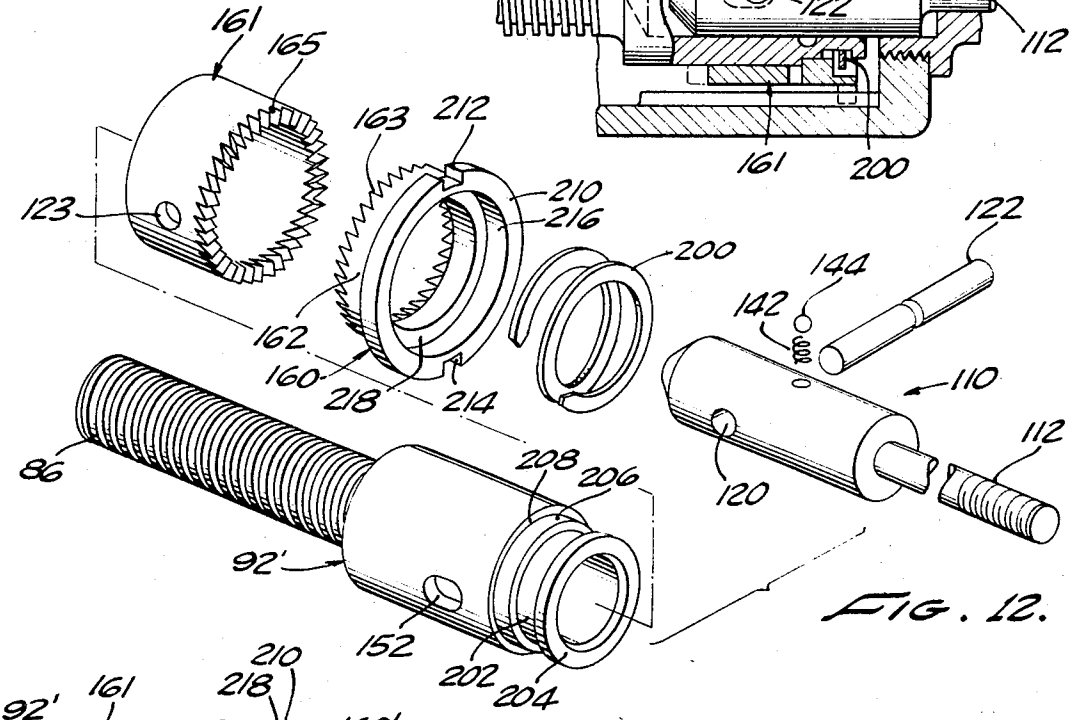


FIG. 12.

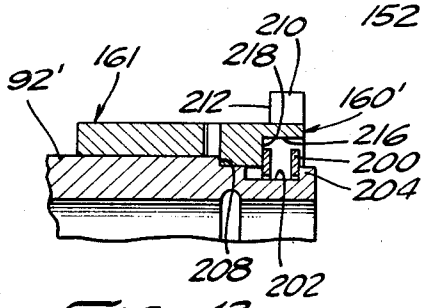


FIG. 13.

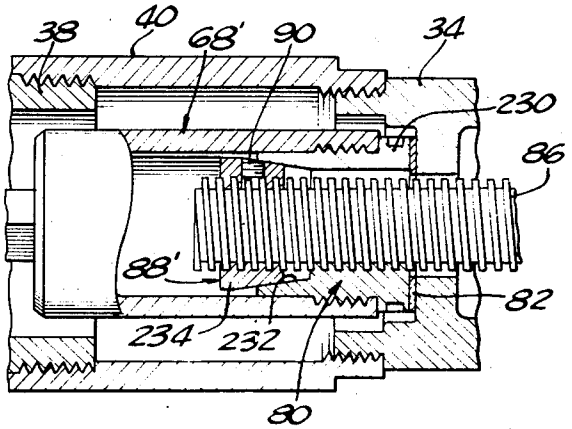


FIG. 14.

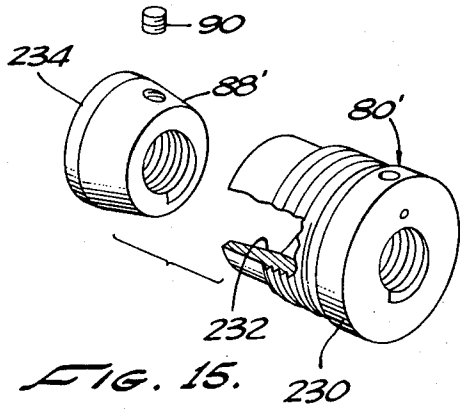


FIG. 15.

INVENTORS
DELMAR S. MILLER
KENNETH V. CUSHMAN
BY
Herzig & Walsh
ATTORNEYS

INSTALLATION TOOL FOR FASTENERS REQUIRING ROTARY AND AXIAL MOVEMENTS

This application is a continuation-in-part of application Ser. No. 749,677 filed Aug. 2, 1968.

SUMMARY OF THE INVENTION

The device of the invention is a tool particularly adapted for the setting of fasteners of the type which require that initially rotational movement be imparted to a mandrel and then a strong axial pull. Fasteners of the type in question generally embody a tubular sleeve-like part and a nut part that is drawn into the end of the other part for expanding and/or splitting it and clamping the split leaves against the material in which the fastener is being set. The fastener may initially be integral as between the two parts with the nut part shearing from the other part when the fastener is being set. The tool initially imparts rotation to the mandrel for threading into the nut part and then rotation is terminated and a strong axial pull is exerted to complete the setting of the fastener.

Tools of the general type referred to have been known in the prior art, but generally they have been subject to a particular deficiency. As pointed out, initially rotation is imparted to the mandrel for threading into the nut part of the tool. For actual setting of the fastener a strong axial pull is necessary without rotation. The deficiency attendant to tools of this type as previously known has been that the tool would continue to impart rotation to the fastener after the beginning of the axial pull. This is not acceptable in the setting of the fasteners for various reasons. The continued rotation tends to spiral the split leaves of the fastener sleeve that are being crimped and spoils the effectiveness and appearance of the fastener. Furthermore, this action results in the possibility of removing plating and scoring the top surface of the fastener.

In accordance with the foregoing the primary object of the invention is to provide a tool of the type described capable of producing the required axial pull without rotation after the initial period of the rotation of the mandrel.

Another object is to provide a tool of the type referred to embodying a clutch drive for the mandrel wherein relative axial movement of the mandrel is provided for to produce clutching and declutching.

Another object is to provide a tool of the type referred to embodying a clutch having toothed circular elements with biasing means to insure that the elements will engage without the teeth points meeting and jamming.

Another object is to provide a tool of the type described having improved constructional arrangements to facilitate changing of mandrels in the tool from one size to another.

Another object of the invention is to provide an assembly of the type referred to, in a tool of this type adapted for use with tool components that have different types of drives such as pneumatic or electric motor drive.

BRIEF DESCRIPTION OF THE DRAWINGS

Further objects and additional advantages of the invention will become apparent from the following detailed description and annexed drawings wherein:

FIG. 1 is a view of a typical installation gun embodying the improvements of the invention;

FIG. 2 is a cross-sectional view showing the improved construction in a position of the parts wherein the anvil of the gun has engaged the fastener and the clutch has operated to stop rotation of the mandrel to begin the axial pull;

FIG. 3 is a cross-sectional view similar to FIG. 2 illustrating the position of the parts wherein the axial pull stroke has been completed;

FIG. 4 is a partial sectional view illustrating the position of the parts upon a reversal of the tool for unthreading the mandrel after the fastener has been set;

FIG. 5 is an exploded perspective view of the tool in FIGS. 2 to 4;

FIG. 6 is a sectional view taken along the lines 6—6 of FIG. 2;

FIG. 7 is a sectional view taken along the lines 7—7 of FIG. 2;

FIG. 8 is a detailed sectional view showing the detent which positions the transverse stem of the clutch mechanism;

FIG. 9 is a partial exploded perspective view of a modified form of the clutch arrangement;

FIG. 10 is a sectional view of the clutch arrangement of FIG. 9;

FIGS. 11, 12, and 13 are views of a modified form of the invention;

FIGS. 14 and 15 are views of a modified form of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1 of the drawings illustrates a typical form of installation gun at 10 embodying the improved construction of the invention. The gun itself includes the part 12 which is a non-rotating member embodying a spring clutch and/or a gear adapter. The improvements of the invention are embodied in the assembly designated at 14. The gun embodies a generally cylindrical upper part 16; a pistol grip part 18 and a trigger 20. The gun shown is a pneumatically operated one having a flexible air connection as shown at 22 and a typical fitting as shown at 24. Other types of guns might be utilized such as electrically or hydraulically driven ones. The assembly 14 is arranged to be adapted to any different type of gun, it being understood that the unit 12 is also interchangeable depending on the type of gun used. The assembly 14 is adaptable to any of these arrangements.

Preferably, the part 12 contains a torque sensing device or clutch which may be of a known conventional construction, but which can be manually set to release at a desired degree of torque. Thus, when a fastener has become set, this torque sensing device will release and power will no longer be applied to it. This type of operation is preferably to merely stalling the drive motor when a fastener is set. A type of torque sensing device used may be a type manufactured by the Hank Thorn Company of Norwalk, Calif. and known as the PERF-A-TORQ. This arrangement is superior to attempting to control the applied torque by way of the air pressure. The operator may fail to adjust the pressure regulator, with the result that excessive pressure applied to the tool can break a mandrel or strip threads on a fastener.

As may be seen in the figures, the structure or unit indicated at **12** is coupled to the gun by way of a coupling nut **30** and to the assembly **14** by a similar coupling nut **32**. The coupling nuts and the unit **12** have side flats adapting them to rotation by way of a wrench. The fastener to be set is shown at **34** by way of example.

The assembly **14** comprises an adapter housing **40** which is cylindrical, being threaded onto the coupling nut **32** and being threaded at the other end onto a cylindrical fitting **34** of slightly smaller diameter. The coupling nut **32** is internally threaded at one end as shown at **36** and externally threaded at the other end as shown at **38**. The fitting **34** is externally threaded at both ends as shown at **44** and **46**. The housing **40** is internally threaded at both ends as shown.

Numeral **50** designates a cylindrical housing threaded onto the fitting **34** as shown. The fitting **34** has an internal web **52** having a central bore **54** as shown. The housing **50** has a threaded end bore **56** which receives the anvil member **58** which has a threaded end part **60** that threads into the bore **56** and it has a cylindrical body at the end of which is the anvil **62** as will be referred to more in detail presently.

Within the housing **40** is the driver unit **68** which is cylindrical being internally threaded at one end as shown at **70** and having a square drive extension **72** at the other end which is received within an adapter fitting **74** in the unit **12**. Other forms of adapters could, of course, be utilized. Threaded into the end of the driver **68** is the drive nut **80**, the end part of which bears against a thrust bearing **82**. The drive nut **80** is internally threaded as shown at **84** with a square thread and extending through it is the threaded drive screw **86**. Numeral **88** designates a stop nut on the drive screw, the position of which can be set by set screw **90**, the stop nut being positionable against the end of the drive nut **80**. The drive screw **86** is on the end of a member or unit **92**, the right-hand part of which is of enlarged cylindrical form as shown at **94** having a bore **96**. The right hand of the member or unit **92** normally bears against the threaded end of the anvil member **58**. The end part of the unit **92** as designated at **97** is a slightly smaller diameter, there being a square shoulder **99** between these parts. Unit **92** is shown in more detail in FIG. **5**. In the end part **97** there is also an annular groove **101** which receives the snap ring **102**. Numeral **110** designates the mandrel member which comprises a threaded mandrel **112** extending from cylindrical body **114** that fits in bore **96**. Unit **110** has a transverse bore **120** that receives a pin **122**. See FIG. **5**. The pin **122** has a central annular groove **124** as may be seen more clearly in FIG. **8**. The unit **110** has an axial bore as shown at **126** in which is a detent ball **130** that detents in the annular groove **124** as shown. The ball **130** is urged in detenting direction by coil spring **132** in the bore **126**, the end of the bore being slightly enlarged and closed by set screw **134**. See FIG. **8**.

The unit **110** has another radial bore **140** in which is a coil spring **142** that bears against a detenting ball **144** that can be engaged in semi-spherical recess **150** in the inside, that is, in the wall of the bore **96** for purposes of holding the unit **110** in position as will be described hereinafter.

The member **94** has axial slots in its sidewalls, one of which may be seen at **152** to receive the end parts of the rod or pin **122**. Thus, it may be seen that the unit **110** has limited axial movement within the bore **96** of the drive member.

Fitting onto the drive member **92** is a clutch member **160**. The clutch member has a cylindrical body part **162** having a bore **164** with a short counterbore **166** at the opposite end forming a square shoulder which comes into engagement with the square shoulder **99** on the body **94**. The clutch part **160** has a flange **168** at one end and in this flange are diametrically opposed grooves or recesses **170** and **172**. These grooves engage or fit onto splines **174** and **176** which are diametrically opposed within the housing **50**. Thus, the clutch member **160** may have axial movement but is not free to rotate. It does not have freedom of axial movement on the member **92**, being restrained by the square shoulder **99** and the retaining ring **102**. The drive member **92** can rotate within the clutch member **160**. On the end face of the clutch member **160** are provided two cam shoulders one of which may be seen at **180** in FIG. **5**. These cam shoulders have a gradual rise **182** on one side and a square shoulder **184** on the other side.

The operation of the installation gun will next be described. As previously pointed out, an exemplary form of fastener is shown which is of the type wherein a mandrel is first threaded into a nut part; the nut part being drawn inwardly relative to a sleeve for splitting, curling back and crimping the split leaves of the sleeve so that the fastener becomes set, after which the mandrel is threaded out of the set fastener.

For purpose of description the fastener is designated generally at **190** comprising a nut part **192** which in the exemplary form is initially integral with a sleeve part **194** having an end flange **196**. At the outset the fastener is placed in the hole where it is to be set as may be seen in FIG. **1**. The threaded mandrel **112** of the tool is threaded into the fastener and this is done automatically by pulling the trigger **20** causing the parts within the tool to rotate to thread into the nut **192**. At this time the gun rotates the housing **68**, the drive screw **86**, the unit **92**, and the mandrel **112**. At this time the stop nut **88** is up against the drive nut **80**. For purposes of this description, this rotation may be clockwise. When the anvil **62** at the end of the anvil member **58** contacts the fastener, that is, the flange **196**, the forward movement of the tool is stopped; mandrel **112** is pulled out and the drive pin **122** is forced in a clockwise rotation axially forward, being guided in the slots as shown at **152**. The drive pin **122** now engages the shoulders such as shown at **180** on the clutch member **160** so that rotation of the mandrel member **112** immediately is stopped. Ball **144** now detents into recess **150**. This brings the square drive thread **86** into play. Since this threaded stem cannot now rotate, rotation of the drive nut **80** causes it to move axially, with the stop nut **88** moving away from the drive nut as may be seen in FIG. **3**. FIGS. **2**, **3**, and **4** illustrate the action on the fastener of the axial movement of the mandrel **112**. The nut part **192** shears from the sleeve part **194** and is drawn into it and the annular shoulder on the nut **192** splits the tapered end of the sleeve part into leaves and curls them back and crimps them against the material in which the fastener is being set. FIG. **2** illustrates the

position of the parts after axial pull has started and the nut **192** has begun to move into the sleeve **194**. FIG. **3** illustrates the position of the parts at the limit of axial pull on the mandrel **112** with the fastener completely set. FIG. **4** illustrates the position of the parts when the direction of rotation has been reversed for unthreading the mandrel **112** from the set fastener. Upon reversal of the rotation drive stem **86** moves axially in the opposite direction until stop nut **88** engages drive nut **80**, at which drive stem **86** turns and unit **92** turns; pin **122** engages the rises **182** on clutch member **160** to disengage the clutch allowing continuing rotation and unthreading of the mandrel, pin **122** moving in the slots such as shown at **152** into the position as in FIG. **4**.

FIGS. **9** and **10** illustrate a modified form of the invention embodying a slightly different type of clutch, parts that are the same being identified by the same reference numerals. In this form of the invention the clutch member **160'** instead of having shoulders like the shoulders shown as **180**, has on the skirt or cylindrical part **162** continuous saw teeth **163** around the end face of the member. Additional clutch member **161** is provided which is cylindrical as shown with continuous notches or teeth in the end face as shown at **165**. The pin **122** goes through radial or transverse bores **123** in the member **161** as well as going through mandrel member **110**.

The operation of the form of the invention shown in FIGS. **9** and **10** is the same as, or very closely similar to the operation of the previous form of the invention. The sequence is the same as described in connection with FIGS. **1** to **8**. However, now when the anvil seats against the fastener, the member **110** and the clutch member **161** both move relatively to the right so that the clutch member **161** engages the clutch member **160'** stopping rotation as previously described and beginning the axial pull movement which is the same as described in the foregoing. Upon completion of axial pull and reversal of rotation for unthreading clutch member **161** by engagement of its teeth with the oppositely angulated teeth on clutch member **100'** to move itself and member **110** into disengaged position.

When it is necessary to change the mandrel **112** (unit disengaged **110**), the housing **50** is unthreaded exposing pin **122** which is disengaged by way of a light tap it normally being held in position as described in connection with FIG. **8**. Another mandrel unit is then simply substituted.

FIGS. **11** and **12** show another modified form of the invention which is similar to the form of the invention shown in FIGS. **9** and **10**. Similar or corresponding parts are identified by the same reference characters. The improvement in this form of the invention resides primarily in the helical biasing spring **200** which is associated with the clutch member **160'** to act on it. Without this improvement, it is possible for the teeth **163** on the clutch member **160'** and the teeth **165** on the clutch member **161** to be in the same phase relationship so that the tips of the teeth meet each other rather than engaging in clutching relationship. In these circumstances, the torque load is taken on the pin **122** at points on it spaced outwardly from its center and the load may be sufficient to bend or break this pin. The spring **200** overcomes this problem. The drive screw member or unit **92'** has an end part in which there is an annular square shouldered groove **202** adjacent to an end flange **204**. Inwardly from the annular groove is a part of reduced diameter **206** adjacent to a square shoulder **208**. The parts when assembled are as shown in FIG. **11**, the clutch member **160'** fitting on the end of the drive screw member or unit **92'** with the clutch member against the square shoulder **208**. The clutch member **160'** has a flange **210** with two diametrically opposed square notches in it as shown at **212** and **214**. The inside of the flanged part is of enlarged diameter as shown at **216** forming a square shoulder **218** adjacent to the internal diameter of the body part **162**. When the parts are assembled, they appear as shown in FIG. **11**. The spring **200** is received in the annular groove **202** in the drive screw unit **92'** in a position between the square shoulder formed by the counterbore **216** in the clutch member **160'** and the flange **204** on the end of the drive screw unit **92'**. As can be seen therefore, spring **200** exerts an axial biasing force biasing the clutch member **160'** toward the clutch member **161** and thereby eliminates the possibility of the ends of the teeth on the two clutch members meeting or matching each other and preventing engagement, and accordingly, the deficiency referred to in the foregoing is overcome.

FIGS. **14** and **15** show an improved and preferred form of drive nut **80'** and stop **88'**. The drive nut **80'** as in the previous embodiment is threaded into the end of the cylinder or drive unit **68'** and has an annular end flange that comes up against the end of the unit **68'** as designated at **230**. It drives against the thrust bearing **82** as in the previous embodiment. It threads on the drive screw **86**. At its left end is a tapered bore **232** which receives the stop nut **88'** and the stop nut has a taper as shown complementary to the taper **232** in the drive nut **80'**. At the end of the stop nut **88'**, it has a short axial surface **234**. It may be secured to the drive screw **86** by set screw **90** as in the previous embodiment. As may be seen, the tapered surfaces on the nuts comes into engagement to perform the clutching action rather than flat, radial surfaces. The operation is otherwise as in the previous embodiment.

From the foregoing, those skilled in the art will observe and understand the nature and construction of the invention, its operation and the manner in which it achieves and realizes all of the objects and advantages set forth in the foregoing, as well as the many additional advantages that are apparent from the detailed description.

The foregoing disclosure is representative of preferred forms of the invention and is to be interpreted in an illustrative rather than a limiting sense, the invention to be accorded the full scope of the claims appended hereto.

WHAT IS CLAIMED IS:

1. An installation tool of the type for setting fasteners of the type wherein the fastener comprises parts requiring an initial rotary action for threading into a part followed by a straight axial pull for finally setting the fastener, in combination, a tool embodying a drive means and a threaded mandrel adapted to engage a part of the fastener in threaded relationship and to be threaded into said part whereby to draw the threaded part along the rotating mandrel, said drive means for the mandrel embodying a clutch operable to be actu-

ated to prevent rotation of the mandrel, the said tool having a part engageable with the material being worked on by the tool whereby relative axial movement of the mandrel causes the clutch to operate to prevent further rotation of the mandrel, and said tool embodying means whereby upon operation of the clutch to discontinue rotation of the mandrel the drive means operates to exert a straight line axial force on the mandrel serving to complete the setting of the fastener, said mandrel being mounted to have axial movement relative to the drive means for engaging and disengaging the said clutch.

2. A tool as in claim 1, wherein said clutch has a part engaged with the body of the tool so as to not rotate with the mandrel, and the said mandrel having means engageable with the said clutch part to prevent rotation of the mandrel when the mandrel is moved axially relative to the clutch part.

3. A tool as in claim 2, wherein said clutch part has engagement with a tool body allowing axial movement thereof relative to the tool body whereby after rotational movement of the mandrel has been terminated axial movement may be imparted to the mandrel relative to the tool body.

4. A tool as in claim 1, wherein said drive means comprises a rotary member and a threaded stem connected to said mandrel associated with said rotary member, means whereby said rotary member is secured to said threaded stem for rotating the mandrel and for releasing from said threaded stem when rotation of the mandrel is prevented whereby the rotary member rotates relative to the threaded stem and by way of the thread transmits axial pull to it.

5. An installation tool of the type for setting fasteners of the type wherein the fastener comprises parts requiring an initial rotary action for threading into a part followed by a straight axial pull for finally setting the fastener, in combination, a tool embodying drive means and a threaded mandrel adapted to engage part of the fastener in threaded relationship and to be threaded into said part whereby to draw the threaded part along the rotating mandrel, said drive means comprising threaded stem means having a drive nut and a stopnut thereon, rotary drive means engaging the stem in threaded relationship, the threaded stem means having engagement with the mandrel whereby the drive means normally can rotate the threaded stem and mandrel, and means whereby after rotation of the mandrel continued rotation of the threaded stem and mandrel is prevented whereby the drive means rotates relatively to the threaded stem imparting axial movement to the threaded stem and mandrel, said stopnut being adjustably positionable on said threaded stem with the threaded stem in adjustable positions relative to the drive nut whereby the length of stroke imparted to the stem in an initial point is adjustable.

6. A tool as in claim 5, embodying a clutch device operable to terminate rotation of the threaded stem and mandrel in response to a relatively small axial movement of the mandrel.

7. A tool as in claim 6, wherein said means for terminating rotation of the threaded stem comprises a clutch having a part which is mounted in said tool so as to not be rotatable, a clutch member engageable and disengageable with said part, said clutch member being axially movable relative to the part by an axial movement of the threaded mandrel relative to the tool.

8. A tool as in claim 7 including releaseable detent means for holding said clutch part and said clutch member in engagement.

9. An installation tool of the type for setting fasteners of the type wherein a fastener comprises parts requiring an initial rotary action for threading into a part followed by a straight axial pull for finally setting the fastener, in combination, a tool embodying drive means and a threaded rotatable mandrel adapted to engage part of the fastener in threaded relationship and to be threaded into said part whereby to draw the threaded part along the rotating mandrel, said drive means comprising threaded stem means, a rotary drive means engaging the stem in threaded relationship, means whereby the drive means can either rotate the threaded stem or can impart a linear axial stroke to it which is adjustable in length, said last means comrpisng said drive means having a drive nut engaging said threaded stem and means comprising an adjustable stop nut adjustably positionable on said threaded stem with the threaded stem in adjustable positions relative to the drive nut whereby the length of stroke imparted to the stem from an initial point is adjustable.

10. An installation tool as in claim 5, wherein the drive means has a socket to receive the mandrel and means for holding the mandrel in position.

11. An installation tool as in claim 9, including an anvil member at the end of the tool through which the mandrel extends, said anvil member being threaded and being adjustable relative to the tool to adjust the position at which the anvil and fastener come into engagement.

12. An installation tool as in claim 1, wherein said clutch embodies clutch members and biasing means urging one member toward the other.

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