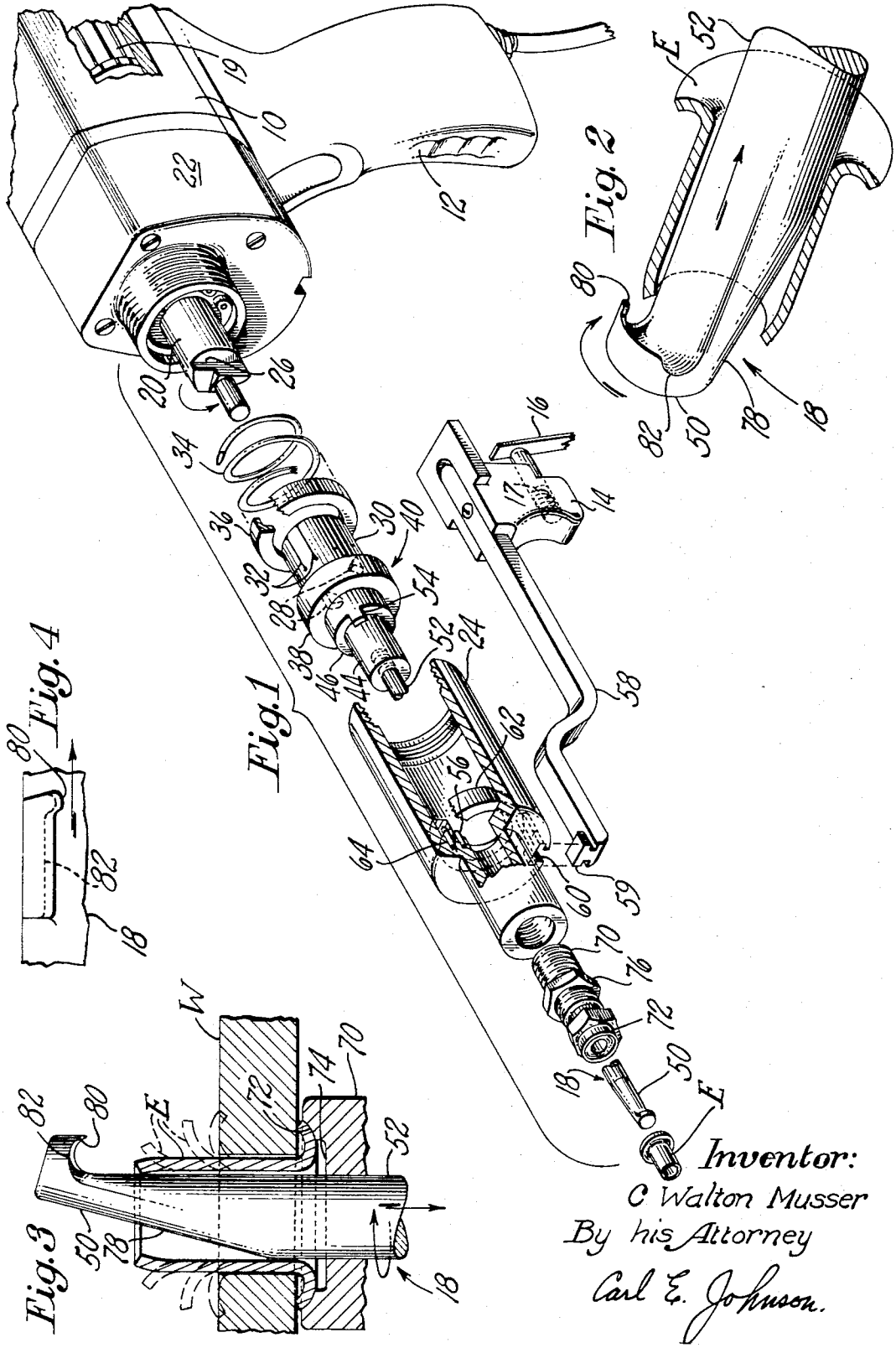
Oct. 22, 1968 C. W. MUSSER 3,406,556

SPIN FASTENER INSERTERS

Filed March 15, 1966 2 Sheets-Sheet 1



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SPIN FASTENER INSERTERS

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Fig. 5

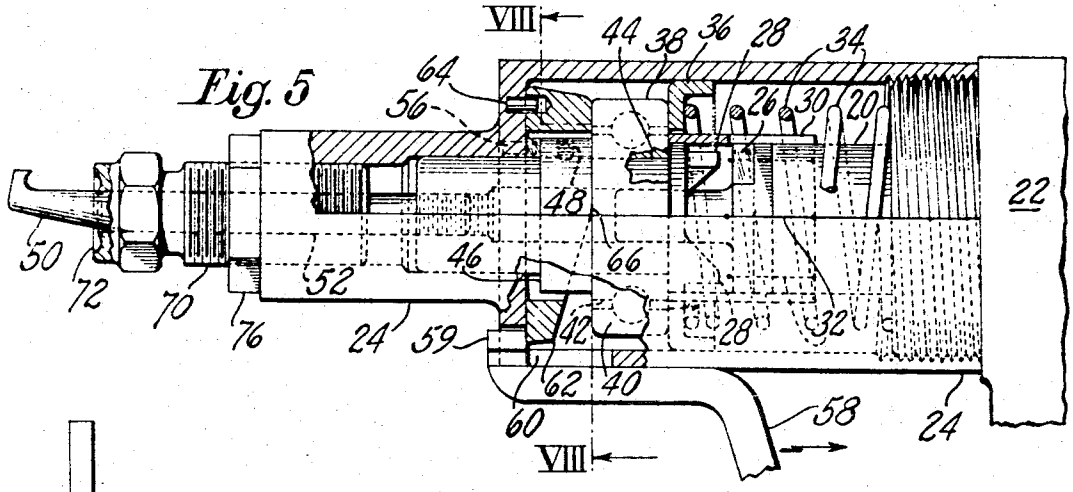


Fig. 6

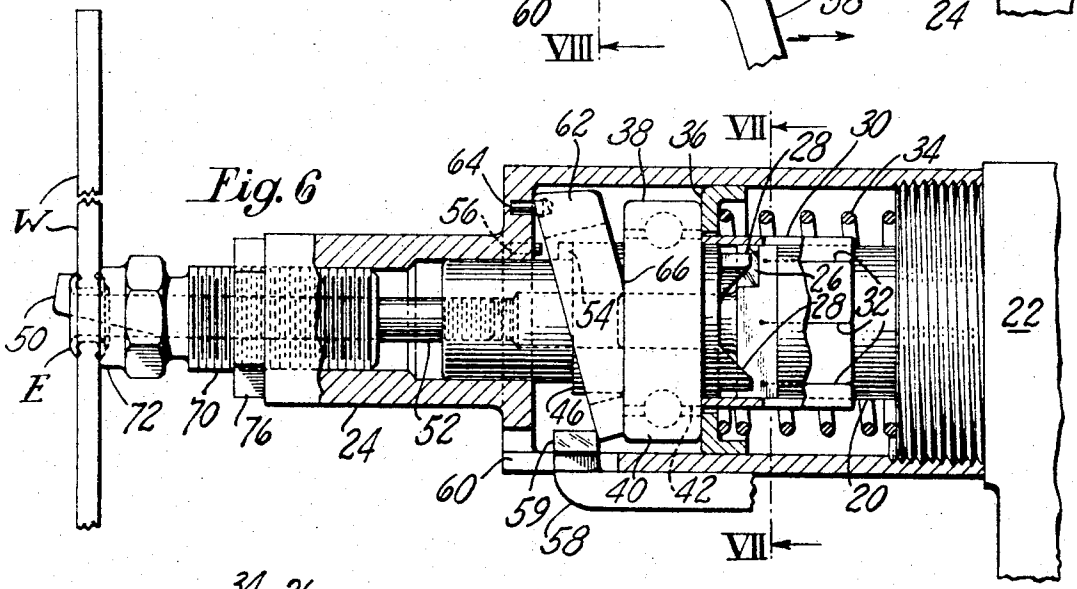


Fig. 7

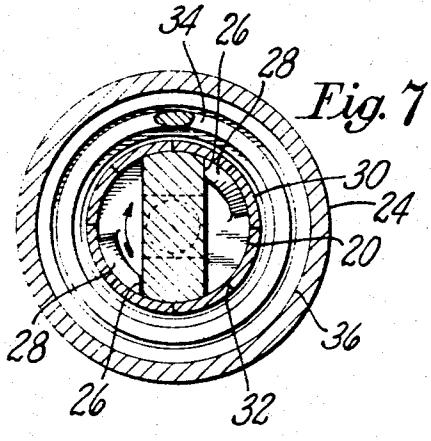
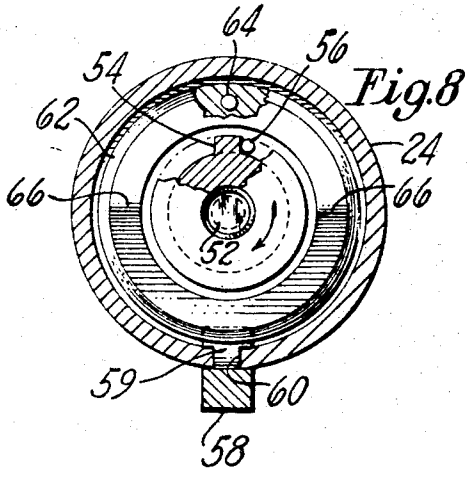


Fig. 8



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SPIN FASTENER INSERTERS

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ABSTRACT OF THE DISCLOSURE

A hand-held power tool for installing a tubular fastener by spinning and axially retracting a progressive forming mandrel. The arrangement shown employs a trigger which energizes a motor to rotate the mandrel through a clutch, the trigger being further operative through force multiplier means to control retraction of the mandrel as it spins to set a blind end of the fastener.

This invention relates to devices for installing and securing tubular articles in work pieces. More particularly the invention pertains to an improved tool for inserting hollow fasteners, especially blind rivets or eyelets, by means of a rotary, retractable member which acts through the barrel of the fastener to dilate and clinch it. While, as herein shown, the invention is especially well adapted for use in an electrically driven, one-hand controlled portable tool for setting eyelet type fasteners, it will be appreciated that the invention in certain respects is not necessarily thus limited.

The usual eyelet setting machine is stationary and of considerable weight to provide stability and requisite clinching power. In many instances it would be desirable to have a portable device for conveniently installing blind or non-blind tubular fasteners. Although the art of spinning to set eyelets in structure having only one side accessible has been known for many years, it does not appear to have ever succeeded commercially to any extent. This may have been largely due to the relative complexity and cumbersomeness of earlier spinning devices wherein the source of power, in addition to providing the axial clinching force, was required simultaneously to rotate the flange forming member, or it may have been due to the fact that prior spin setting tools have been inconvenient to use since their operation has normally required the use of both hands of an operator.

In view of the foregoing, it is a primary object of this invention to provide an improved blind fastener inserting tool of the spin-to-set type which shall be light weight, easily maneuverable, and of simple construction.

Another object of this invention is to provide a highly productive blind fastener setting tool operable even in restricted areas and controllable by the use of just one hand.

In accordance with these objects and as herein shown, a feature of the invention resides in the provision, in a hand-held fastener setting tool having an anvil for abutting the accessible end of a tubular fastener to be set, of a rotary mandrel extending beyond the anvil and trigger-retractable axially during its rotation to form and set the fastener. The illustrated fastener inserter preferably comprises a pistol-grip type body housing a small electric motor with suitable speed reducer means, clutch means connectable to the motor for spinning the mandrel about its axis when it is aligned with that of the initially inserted fastener, and a trigger coupled to the mandrel to retract it progressively in setting engagement with the remote end of the fastener, the arrangement being such that the coupling of the trigger obtains an actual mechanical advantage and its actuation is effective to render the clutch means operative.

A further feature of the invention relates to the provision, in an eyeletter of the type being described, of a mandrel having a straight main body adapted slidably to extend through an eyelet barrel and a projecting hook portion for curling the eyelet rim, the hook portion having a diameter less than that of the main body of the mandrel and a turning axis on the order of 12° to that of the main body to facilitate operation on a range of eyelet barrel diameters. Preferably, as shown herein, further to facilitate withdrawal of the hook type mandrel from an eyelet that has been set, novel means is provided in the tool for insuring that the mandrel ceases rotation at a predetermined angular position. An operator gripping the tool may accordingly always move it through the same small angle to permit its easy withdrawal from the work.

The foregoing and other features of the invention, together with novel details in construction and combinations of parts, will now be more particularly described in connection with an illustrative embodiment, and with reference to the accompanying drawings, in which

FIG. 1 is an exploded perspective view of a blind fastener inserting tool and an eyelet to be installed thereby, the tool body being shown in dash lines;

FIG. 2 is an enlarged perspective view of the forming end of a preferred mandrel shown in FIG. 1 and indicating its positional relation before retraction against the eyelet to be installed;

FIG. 3 is a detail in elevation of the mandrel forming end shown in FIG. 2 and indicating by dash lines the progressive setting performed;

FIG. 4 is a development of the mandrel forming lip to the same scale as shown in FIG. 3 and looking to the left therein;

FIG. 5 is a view in side elevation of a part of the tool shown in FIG. 1 when inoperative, large portions being broken away to reveal internal construction;

FIG. 6 is a view similar to FIG. 5 but with trigger means actuated until an eyelet has been set in a work piece;

FIG. 7 is a section taken on the line VII—VII in FIG. 6 and showing mandrel driving mechanism; and

FIG. 8 is a section taken on the line VIII—VIII in FIG. 5 and showing means for angularly positioning the mandrel to facilitate its withdrawal.

The illustrative tool comprises a motor housing **10** (FIG. 1) having an integral pistol type grip **12** in which there is slidably mounted a control trigger **14** arranged to be "squeezed," i.e., depressed to actuate a motor control switch a portion of which is shown at **16**. Such continued one-hand actuation of the trigger, permitted by its over travel spring **17** (FIG. 1), and positioning of the tool while seizing its grip **12** is, as will hereinafter be explained, essentially all that is required of an operator in order to cause a mandrel **18** (FIGS. 1–6) to set a blind tubular fastener, for example an eyelet E (FIGS. 1 to 3 and 6) in a work piece W (FIG. 3).

The housing **10** contains an electric motor **19** (which may be of the type commonly used in small electric hand drills) for rotating the mandrel **18** by means to be described including a shaft **20** driven through reduction gearing (not shown) within a cover **22** secured to the housing **10**. Threadedly secured to the cover **22** is a cylindrical housing **24** for trigger actuated mechanism controlling both the rotation of the mandrel about its axis and its axial movement. The shaft **20** is formed with jaw clutch faces **26** for driving engagement with lugs **28** (FIG. 7) respectively formed within a friction sleeve **30** (FIGS. 1–7) which is axially shiftable to the right for this purpose as will be explained. For a purpose mentioned later a right-hand portion of the sleeve **30**, which may be of brass, is formed with a plurality of axial slits **32** (FIGS.

1 and 6) which enable it to frictionally engage and axially receive the circumference of the shaft **20**. As shown in FIG. 5 the sleeve is urged to the left to disengage the lugs **28** by means of a return spring **34** which at one end is seated in the cover **22** and at the other end bears on a washer or spring retainer **36**. The latter engages the outer race **38** of a ball bearing **40** the inner race **42** of which has a press fit on a hub **44**. A bearing retainer stop clutch **46** (FIGS. 1, 5 and 6) in the form of an annular washer is secured by a setscrew **48** (FIG. 5) to the hub **44** and engages the inner race **42** to determine the axial inoperative position of the ball bearing **40** and hence of the lugs **28**.

The mandrel **18**, which will have its hooked fastener forming end **50** (FIGS. 2–4) later described, has a main body portion **52** (FIGS. 5 and 6) coaxial with the axis of rotation and detachably threaded into the hub **44**. By reason of the frictional drive imparted to the sleeve **30** when the lugs **28** are disengaged, an ear **54** axially projecting on the clutch **46** will be rotated into abutment with a stop pin **56** in the housing **24** thus to establish a convenient fixed angular position wherein the mandrel forming end **50** may always be withdrawn from the work at the conclusion of a setting operation.

For shifting the lugs **28** axially into driving engagement with the clutch faces **26** and thereby rotating the mandrel thus to spin and set an article such as the fastener E, a slide link **58** (FIGS. 1, 5, 6 and 8) secured at one end to the trigger **14** has its other end formed as a T-shaped tang **59** to ride in a slot **60** in the housing **24** and engage the lower rim of a force multiplying means **62** (FIGS. 1, 5 and 6). The latter is herein shown as an annular lever pivotally supported at its upper end on a locating pin **64** fixed in the housing **24**. The lower right portion of the force multiplier **62** as seen in FIG. 5 is angularly slabbed off to provide diametric portions **66, 66** (FIG. 8) pivotal on the outer bearing race. It will accordingly be understood that retraction of the trigger **14** to move the link **58** to the right as indicated in FIG. 5 will produce several results. First, the motor **19** is energized and, the lever **62** being caused by the link to tilt counterclockwise as shown in FIG. 6, the clutch **46** is shifted axially to the right to clear the ear **54** from the stop pin **56** thereby freeing the mandrel **18** for rotation. Simultaneously the portions **66** bearing on the outer race **38** axially move the lugs **28** into driving relation to the clutch faces **26** against the resistance of the return spring **34** so that the mandrel **18** is now coupled to the operating motor.

In addition to rotatively connecting the mandrel to the motor as just explained, the trigger is coupled to the mandrel in a manner thereafter to effect its fastener forming retraction at the will of the operator and with actual mechanical advantage. This is to say that, as herein shown, the distance of the locating pin **64** from the T-shaped end **59** of the link **58** being about twice what it is from the portions **66, 66**, the axial force available to be exerted by the mandrel end **50** in curling over the eyelet is about twice the force applied to depress the trigger **14**. It will be understood that, if need be, greater mechanical advantage may be had by substituting other known force multiplier means; the 2:1 ratio has been found quite adequate for spinning a fairly broad range of ordinary sized eyelets with little or no special effort on the part of an operator.

For bearing on the preformed flange of different barrel lengths of eyelets E to be spun and set in an aperture of the work piece W, a hollow nose piece **70** is threaded into a reduced end portion of the housing **24**. The nose piece will be axially adjusted so that the distance between it and the working surface of the mandrel end **50** when the trigger is depressed will correspond to the desired barrel length of the set eyelet. An external anvil portion **72** of the nose piece is preferably centrally relieved as indicated at **74** in FIG. 3 in order to insure that tool pressure on the accessible end of the eyelet being spun prevents its rotation about the mandrel axis during setting. A lock nut **76** threaded on the nose piece can prevent its being shifted axially from a selected position.

While differently shaped forming ends **50** may be employed, one which has been found very satisfactory since it is easily thrust through and removed from the barrels of eyelets, will now be more particularly described. As indicated in FIGS. 2 and 3, it has a tapering extremity formed by one side **78** disposed at an angle of about 12° to the axis of rotation. The untapered side radially projects to form a hook having a very smooth, concave inner work-engaging surface such as would be shaped by a ball-type cutter. The curl radius selected is usually about equal to that of a preformed flange on the eyelet E. Also, for good clinching, the outside radius of the hook about equals the radius of the eyelet being set. Accordingly, the shank of the hook preferably has a thickness one-half of that of the main body of the mandrel. Preferably a leading edge **80** (FIGS. 2–4) of the concave hook surface is rounded convexly and somewhat thickened, this active edge **80** progressively forming the eyelet as shown in FIG. 3 by its combined rotation and trigger-actuated axial pressure. Accordingly a trailing portion **82** of the concave hook surface is relieved to afford clearance with the eyelet rim being fashioned, thereby reducing the force required to turn outwardly and curl over the eyelet edge. The mandrel **18** is preferably of a tough, hardened steel. A series of mandrels in a range of sizes would normally accompany each tool to be interchangeably used therewith.

Operation of the tool to set an eyelet E from one side of the work W will now be briefly reviewed. Assuming the tool, which has been seized by its grip **12** with one hand, has previously been connected to a suitable source of electricity, an operator places the eyelet on the mandrel, the anvil portion **72** being adjacent to the preformed eyelet flange which is to remain on the accessible side of the structure W. Next the mandrel is inserted through this structure along with the barrel of the eyelet until its preformed flange is clamped between the structure and the portion **72**, the latter serving to bar or at least impede eyelet rotation. The trigger **14** is then depressed to energize the motor and to move the drive lugs **28** into engagement with the jaw clutch faces **26**, thus causing the mandrel **18** to rotate and then further depressed to have its spin setting edge **80** exert axial forming pressure on the blind end of the eyelet. Usually index finger pressure on the trigger is increased as setting progresses. The eyelet is ordinarily set in less than a second, its inner and newly formed flange clinching the work piece as shown in FIGS. 3 or 6. The operator may control the degree of axial forming pressure by his finger pressure applied to the trigger or, the eyelet may be set to the end of travel of the mandrel as determined by adjustment of the nose piece **70**. On releasing the trigger the spring **34** restores the parts from their relative operating positions shown in FIG. 6 to their inactive positions indicated in FIG. 5. The motor is deenergized, the drive lugs **28** are disengaged, and mandrel rotation proceeds to a stop with the forming end **50** always being angularly positioned in the same way with respect to the tool to facilitate its withdrawal from the spun eyelet. This angular position is accomplished by the continued frictional drive of the shaft **20** on the sleeve **30** until the stop pin **56** is engaged by the clutch ear **54**.

From the foregoing it will be apparent that the invention provides an easily manipulated and highly useful tool. Exclusive of its connecting power cable, for example, one model embodying the invention has a weight on the order of 26 oz. The slender nose portion of the tool is operative in restricted spaces which are to receive the fastener, and the one hand operation by which the tool is wholly controlled expedites successive insertions and repeat loading.

Having thus described my invention, what I claim as

new and desire to secure by Letters Patent of the United States is:

1. A portable tool adapted to be operated by one hand for radially deflecting the blind end of a preflanged tubular article to be installed in a work piece, comprising a housing having a nose piece adapted to abut the flanged portion of the article to restrain it from rotation when inserted in the work piece, a spin forming mandrel rotatably and axially projecting from within the nose piece and retractable in the article to apply axial deforming pressure on said blind end, a motor in the housing, a clutch means for imparting rotation of the motor to the mandrel, a control member movably mounted on a handle portion of the housing for energizing the motor and operatively connected to actuate the clutch means, and means responsive to actuation of the control member for retracting the mandrel during its spin forming operation.

2. A tool as set forth in claim 1 wherein the last-mentioned means includes force multiplier mechanism.

3. A tool as set forth in claim 1 wherein the mandrel has a tapered forming end terminating in a radially projecting, concave hook-like surface, the active leading edge of said surface being convexly rounded, and the remainder of said concave surface being relieved to afford clearance with the rim of said blind end of the article.

4. A tool as set forth in claim 1 wherein the clutch means includes a mandrel driving member shiftable between a first position in which it is in positive, direct driving relation to an element transmitting the output of said motor and a second position in which the member is in frictional driving relation to the element, and stop means is arranged to cooperate with the member in its second position to predetermine an angular position of the mandrel in the tool to facilitate its withdrawal from the installed article.

5. A tubular fastener inserting tool comprising a housing having an anvil portion for abutting one end of a fastener to be set, a mandrel rotatable about an axis and having a forming end axially movable through said anvil portion and the fastener to spin and set its other end, an electric motor in the housing, means for rotatably coupling the mandrel to the motor, a circuit for controlling the motor, switch actuating means on the housing and actuatable for energizing the motor controlling circuit, and mechanism responsive to further actuation of the switch actuating means for retracting the forming end of the mandrel toward said anvil portion.

6. In a hand tool for setting eyelets and the like, a pistol grip type housing for an electric motor and its rotary output member, a tubular extension on said housing having a nose piece adapted to engage an accessible end of an eyelet when its other end is inserted into a work piece, a rotary mandrel axially movable in the nose piece and having a projecting end adapted to set said other end of the eyelet, a trigger movably mounted on the grip of the housing to energize said motor, clutch means for interconnecting said rotary output member with the mandrel and operative by the trigger, and mechanism actuatable by the trigger for effecting the axial retraction of the mandrel with mechanical advantage during its rotation.

7. A tool as set forth in claim 6 wherein the mechanism for axially retracting the mandrel includes a link connected to the trigger, a bearing having one race coupled to the mandrel, and force multiplier means movably mounted on said tubular extension and interconnecting the link to a second race of the bearing.

8. In a spin eyeletter, a housing having one end provided with a piston grip and another end provided with a nose piece for abutting the accessible end of an eyelet to be inserted and set in a work piece, a mandrel axially and rotatably movable in the nose piece, power means in the housing for rotating the mandrel, clutch means connected to the mandrel and yieldingly movable axially in the housing from a non-mandrel driving position to a position wherein the mandrel is in driving relation with the power means, a finger actuated control member movably mounted in the pistol grip and having operative connection with the clutch means, and a circuit switch operable by the control member for energizing the power means, the arrangement being such that actuation of the control member sequentially initiates rotation of the mandrel and its eyelet forming retraction toward the nose piece.

9. An eyeletter as set forth in claim 8 further characterized in that a stop is fixed in said housing, and said clutch means includes axially spaced portions one of which is positively engageable with the power means and the other is frictionally engageable with the power means, the arrangement being such that release of the control member from its operative position de-energizes the power means, disengages the positively driven portion of the clutch means from the power means, and the power means operates frictionally to urge the clutch means into abutment with said stop to determine the angular position of said mandrel wherein it may be withdrawn from the installed eyelet.

10. An eyeletter as set forth in claim 8 wherein the mandrel is formed with a tapered end having a radially projecting hook, a leading active edge of the hook being concave when viewed normal to its general plane and convex when viewed at right angles thereto.

11. A hand tool for blind setting eyelets and the like comprising a housing having a handle portion and a nose piece portion spaced therefrom for abutting the preformed flange of an eyelet to be set, a mandrel axially and rotatably movable in the nose piece, an electric motor mounted in the housing adjacent to the handle portion and energizable to rotate an output member, clutch means in the housing connected to the mandrel and shiftable toward and from engaged driving relation with the output member, a trigger movably mounted in the handle portion for controlling energization of the motor, and mechanism interconnecting the trigger and the clutch means for shifting the latter into said driving relation while causing the mandrel to be retracted toward the nosepiece to spin and set the eyelet.

12. A tool as set forth in claim 11 wherein a return spring urges the clutch means out of engagement with the output member and into abutment with a stop in the housing for angularly predetermining a position for removal of the mandrel from the eyelet.

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