PULLING HEAD FOR INSTALLING FASTENERS WITH STEMS
AND LOCKING THE STEM THEREIN

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This invention relates to a pulling head for installing fasteners with stems and locking the stem therein.

The primary object of this invention is to provide a pulling head for the installation of fasteners which have a spindle or stem which is pulled for setting the fasteners, and which tool is capable to exert a pulling reaction for drawing sheets of material together and which is capable of transferring the pulling reaction load to a fastener head so as to swage and lock the stem in place, the pulling head is particularly adapted to form a notch or recess in the head of the fastener, while it restrains outward expansion of the head so that the material displaced by the notch near the stem is forced to flow inwardly to locking grooves on the stem.

Another object of the invention is to provide an installing and locking tool for fasteners, such as blind rivets, wherein a stem projects through the head of the fastener to be engaged by the pulling head while the pulling head exerts reaction pressure on the head, so as to clinch the work and set the fastener, restraining the expansion of the head outwardly, and then shifting pressure to a swaging anvil or notching tool so as to drive the latter into the top of the head around the stem whereby to force material from the head to flow into locking grooves on the stem for locking the latter.

Another object of the invention is to provide an installing and locking tool or pulling head which may be attached to a power tool directly or which may be attached through an adapter or converter device to a drill motor for installing and locking rivets or other fasteners having a stem to be pulled for setting the fastener.

I am aware that some changes may be made in the general arrangements and combinations of the several devices and parts, as well as in the details of the construction thereof without departing from the scope of the present invention as set forth in the following specification, and as defined in the following claims; hence I do not limit my invention to the exact arrangements and combinations of the said device and parts as described in the said specification, nor do I confine myself to the exact details of the construction of the said parts as illustrated in the accompanying drawings.

With the foregoing and other objects in view, which will be made manifest in the following detailed description for the illustrative embodiment of the invention, wherein:

FIG. 1 is a sectional view of the pulling head in the initial position of the blind rivet.

FIG. 2 is a sectional view of the pulling head in position of setting the rivet.

FIG. 3 is a sectional view of the pulling head in position where the rivet ist set and the anvil is applied.

FIG. 4 is a sectional view of the pulling head in position where the stem is broken.

The primary pressure applying and head restraining part of this device is the outer sleeve 1, with a nose 2, which has a recess 3 therein fitting around and over the outer periphery of a fastener head 4. In this illustration the head 4 is on a tubular blind rivet 6. A stem 7 extends through the tubular blind rivet 6 and through the head 4. A tail former 8 is on the tail end of the stem 7 to form a blind head on the blind rivet and clinch the work, such as plates or sheets together, when the stem 7 is pulled through the head 4.

The pulling device in this tool is a drawbolt 11 to which is threadedly secured a jawholder 12. The nose 13 of the jawholder 12 has a hole 14 therethrough to admit the stem 7 and has inclined sides 16 on its inner periphery frusto-conically tapering toward said hole 14. In the jawholder are held a plurality of suitable complemental jaw sections 17 separable at their forward ends 18 but held together by an "O" ring 19 at their base so as to pivot about said "O" ring. The separable jaw ends 18 are inclined to converge at an angle generally corresponding to the frusto-conical side 16 of the jawholder nose 13 and to be pressed together by the latter as shown in FIG. 1, to grip the stem 7. The jaw sections 17 are urged into the jawholder nose 13 by a coil spring 21 which latter is nested at its forward end in a follower cup 22 bearing against the base of said jaw sections 17 and is further held in recess 23 in the drawbolt 11. Thus when the stem 7 presses against the jaw end 18 the jaw sections 17 are pushed away from the jawholder nose 13 and the jaw ends 18 are pried open and admit the stem 7. As the drawbolt 11 and the jawholder 12 are pulled away from the pressure nose 2 the gripped stem 7 pulls the closed jaw ends 18 into the frusto-conical side 16 of the jawholder nose 13 and the pulling grip on the stem 7 is thereby tightened.

The device for depressing the top of the rivet head 4 around the stem 7 for locking the stem in place includes a tubular anvil 24 slidable through a hole 26 in the nose 2 of the sleeve 1. The forward notch end of the anvil 24 has a tapered inner periphery tapering to a sharp cutting edge 27. An anvil head 28 on the anvil 24 is normally spaced from the nose 2 and is slidable in the sleeve 1. An anvil sleeve 29 extends from the anvil head 28 slidable between the drawbolt 11 and the outer sleeve 1.

The device for shifting the pressure to the anvil 24 includes a housing 31 threadedly secured to the outer periphery of a housing or pressure boss 32 of a power applying tool. The forward end of the housing 31 has an inwardly projecting annular flange 33. An integral head 34 on the outer sleeve 1 is slidable in the housing 31 and abuts against said flange 33 in the initial position of the outer or pressure sleeve 1. A backup tube 36 is threadedly secured in said pressure boss 32 of the power tool and is thus held in fixed position relative to the housing 31. The forward end 35 of the backup tube 36 is tapered inwardly and toward sleeve head 34 and is initially spaced from the sleeve head 34 to accommodate a series of backup balls 37 bearing against the sleeve head 34. A locking tube 38 is slidable in the housing 31 and has a ring flange 39 with a convex curved ball engaging the balls 37 as to prevent the balls 37 from moving radially outwardly and into the space between the backup tube 36 and the housing 31. A coil spring 42 around the backup tube 36 between the pressure boss 32 and the ring flange 39 normally holds the locking tube 38 and its ring flange 39 in ball locking position.

The rear end of the anvil sleeve 29 extends into an enlarged bore 43 in the backup tube 36 and bears against the bottom 44 of the bore 43 so as to be held fixed relatively to the outer sleeve 1.

The drawbolt 11 is threadedly connected to a reciprocable shaft or rod 46 of a power tool.

This pulling head may be utilized on a power tool of the type shown in U.S. Patent No. 2,526,956, granted to H. W. Kugler, on October 24, 1950. The pulling head may be used also in connection with a converter of the type shown in U.S. Patent No. 2,941,687, granted to W. R. Simmons, on June 21, 1960, in which case the pressure
boss 32 would correspond to part 32 of said patent, and the shaft 46 would correspond to part 66 of said patent.

In operation the recess 3 of the sleeve nose 2 is pressed on the rivet head 4 so as to hold it against the plates 9 and restrain outward expansion of the rivet head 4. The sleeve 11 is held in such pressure position by the pressure exerted by the power tool through the pressure boss 32 and backup tube 36 and the backup balls 37. The stem 2 is gripped in jaw sections 18 and the anvil 24 is in its initial withdrawal position, while the drawbolt 11 is pulled by the power tool through the shaft or rod 46 for setting the rivet. After the work is clinched and the rivet is set, further pulling of the stem 2 sets up forces beyond those needed for setting the rivet. The taper of the tapered end 35, the tension of the coil spring 42, and the curvature of the convex locking face 41 predetermine the reaction force of the pressure at which the tension of the coil spring 42 is overcome and it yields so that the backup balls 39 push the locking tube 38 toward the pressure boss 32 and roll outwardly into and along the space between the backup tube 36 and the housing 31 thus the outer pressure sleeve 1 shifts relatively to the backup tube 36 and the anvil 24 and the pressure of the power tool is fully exerted to press the edge 27 of the anvil 24 into the top of the rivet to form a comparatively deep notch or groove in the top of the rivet head. Outward expansion of the rivet head 4 being restrained the displaced material swages inwardly to breakneck grooves 47 in the stem 2 and locks the stem 2 into said rivet head 4. Further pulling of the stem 2 breaks the stem at the outermost breakneck groove in the rivet head 4.

I claim:
1. In a pulling head for setting fasteners of the type wherein a stem is pulled through a fastener head for securing the fastener and wherein said stem has grooves in its periphery to receive locking material swaged from said head inwardly
   (a) an outer sleeve
   (b) a pressure nose on said outer sleeve engageable with said fastener head so as to restrain radial outward expansion of said head and having an axial hole therethrough
   (c) a tubular anvil in said axial hole to receive said stem therethrough
   (d) a cutting edge on said tubular anvil for pressing a groove into the top of said fastener head, said cutting edge being shaped to force material displaced thereby radially inwardly
   (e) pressure means to transmit pressure to said outer sleeve and said anvil, said anvil edge in its initial position being spaced inwardly of said axial hole in said pressure nose
   (f) a drawbolt slidable relatively to said sleeve
   (g) means in said drawbolt for gripping said stem and pulling it when said drawbolt is pulled
   (h) means to connect said drawbolt to a reciprocating element of a power tool to be pulled for setting said fastener
   (i) yieldable means interposed between said outer sleeve and said pressure means, the tension of said yieldable means being predetermined to yield only after the fastener is set thereby to transmit direct pressure to said anvil for pressing a groove radially inwardly into the top of said head thereby forcing head material into said grooves of said stem in said head.

2. The pulling head defined in claim 1, said yieldable means including
   (j) a backup member in said pressure means
   (k) a plurality of backup balls between said backup member and said pressure sleeve being movable along said backup member
   (l) spring pressed locking means engaging and holding said balls in fixed pressure position
   (m) the angle of engagement of said balls by said backup member and by said locking means predetermining the pressure at which said locking means is pushed out of the way by said balls.

3. The pulling head defined in claim 1, said yieldable means including
   (j) a tubular backup member around said drawbolt, said backup member being stationary relatively to said drawbolt
   (k) a plurality of backup balls between said backup member and said pressure sleeve being movable along the outer periphery of said backup member
   (l) a tubular locking element movable along the outer periphery of said backup member
   (m) a coil spring around said backup member pressing said locking element against said balls so as to hold said balls in pressure transmitting position between said pressure sleeve and said backup member.

4. The pulling head defined in claim 3, and
   (n) a pressure flange on the end of said tubular locking element adjacent said balls
   (o) a convex pressure face on the said pressure flange inclined inwardly of the locking element for exerting radial pressure on said locking balls generally toward the axis of the backup member.

5. The pulling head defined in claim 3, and
   (n) a pressure flange on the end of said tubular locking element adjacent said balls
   (o) a convex pressure face on the said pressure flange inclined inwardly of the locking element for exerting radial pressure on said locking balls generally toward the axis of the backup member
   (p) a tapered end of said backup member adjacent said balls being inclined from the outer periphery of the backup member toward said balls so as to bear against the balls generally radially and partially outwardly with respect to the axis of said backup member.

6. The pulling head defined in claim 2, and
   (n) a tubular anvil sleeve extended from said anvil and directly connected to said pressure means so as to transmit pressure to the anvil when said yieldable means yield.

7. The pulling head defined in claim 2, and
   (n) a tubular anvil sleeve extended from said anvil to said backup member and unyieldably connected to said backup member whereby pressure is directly transmitted to said anvil when said locking means is pushed out of the way by said balls and said pressure sleeve.

8. In a pulling device for setting fasteners having a stem extending through a fastener head and breakneck grooves on said stem for interlocking said stem and head
   (a) an outer sleeve
   (b) a nose on the outer sleeve fitting over the fastener head for holding the head and to restrain outward expansion of the head
   (c) said sleeve nose having an axial hole therethrough
   (d) a tubular anvil slidable in said hole
   (e) the end of said tubular anvil having a tapered inner periphery to form an annular cutting edge for displacing material radially inwardly
   (f) an anvil head on said anvil normally spaced from said sleeve nose having a hole therethrough for the insertion of said fastener stem therethrough
   (g) an anvil sleeve extended from said anvil head slidably in said outer sleeve
   (h) a drawbolt slidable in said anvil sleeve
   (i) a drawbolt nose normally abutted by said anvil head
   (j) said drawbolt nose having a hole therethrough and having a frusto-conical inner periphery tapering toward said hole in said drawbolt nose
   (k) a jaw device in said drawbot coating with said frusto-conical inner periphery to grip said stem inserted through said holes for pulling the stem for setting the fastener.
(l) means to connect said drawbolt to a reciprocating element of a power tool for pulling said stem
(m) means to connect said outer sleeve to a pressure element of a power tool including
(n) a housing secured to said pressure element
(o) a tubular backup around said drawbolt secured to said pressure element concentric with and spaced from said housing
(p) said anvil sleeve engaging said backup
(q) a sleeve head on said outer sleeve slidably held in said housing
(r) a plurality of backup balls between said sleeve head and said backup
(s) a tapered end of said backup engaging said balls
(t) a locking member slideable in said housing
(u) a curved face of said locking member engaging said balls radially outside of said tapered end
(v) a locking spring around said backup urging said locking member against said balls at a predetermined pressure thereby to yield after said fastener is set and release said balls to the outside of said backup and release the direct pressure on said outer sleeve so that said outer sleeve is pushed back relative to said anvil for applying direct pressure to said anvil for cutting a groove in said fastener head and swaging displaced material radially inwardly into said breakneck grooves for locking said stem.

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