ROTATING AND IMPACT TOOL FOR INSTALLING A KEYED THREADED ELEMENT

Fig. 9

Fig. 10

Fig. 11

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ROTATING AND IMPACT TOOL FOR INSTALLING A KEYED THREADED ELEMENT

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This invention relates to an improved type of tool for installing a threaded element, typically an internally and externally threaded insert, within an opening in a carrier part. More particularly, a tool embodying the invention is in certain respects especially useful for installing inserts of the general type disclosed and claimed in Patent Number 2,855,970, issued October 14, 1958 to Robert Neuschotz on "Inventing Having Frictionally Retained Key Which Upsets Threads of Base Member."

The above identified patent covers a type of threaded element having one or more locking keys adapted to be driven axially after the insert has been screwed to a pre-determined ultimate position in a carrier part, with the keys being constructed to securely lock the threaded element in that position and against unscrewing movement from the carrier part after thus being driven to their locking condition. A major object of the present invention is to provide a tool which is capable of first screwing a threaded element of this general type into an installed position, and then with maximum facility and with the same tool driving the keys or other locking portions of the device to their locking positions. Preferably, the tool is driven by a conventional power operated rotary driving unit, and acts automatically to convert between two conditions for rotating the element and driving the keys respectively. Thus, a single continuous rotary driving motion acts to completely install and lock the threaded element in the carrier part in a minimum of time, and preferably without any manual operation being required for converting the unit from the initial screwing condition to the final key driving condition.

To attain the desired results, a tool embodying the invention includes a first structure which is rotatable about an axis and which cannot be screwed into the insert or other threaded element in a manner screwing it into the carrier part. In addition, the device includes a driving structure which is movable axially relative to the mentioned rotary first structure, and which acts upon such axial movement to drive the keys or other locking portion of the device to their locking conditions. For actuating both of these parts, there are provided rotary means which are turned by the power tool, together with two operative connections, the first of which acts to turn the rotary "first structure," and the second of which acts to effect relative axial movement of the key driving structure. Actuating means may be provided for automatically deactivating the first connection and activating the second connection upon arrival of the threaded element at essentially a predetermined desired ultimate setting within the carrier part. This automatic control apparatus may include a sensing element which engages the carrier part and is detachable thereby relative to the insert carrying first structure, in a relation breaking the first driving connection and rendering effective the second drive connection.

The above and other features and objects of the invention will be better understood from the following detailed description of the preferred embodiment illustrated in the accompanying drawings in which:

FIG. 1 is an elevational view of a tool embodying the invention, together with a rotary driving unit therefor, and an insert to be installed thereby;

FIG. 2 is an enlarged axial section through the tool of FIG. 1, showing the condition to which the parts of the tool return when the device is not in use;

FIG. 3 is an enlarged fragmentary partially sectional view showing the condition of certain portions of the tool during the initial stages of an installing operation;

FIG. 4 is a view similar to FIG. 2, but showing the tool after the insert has been screwed to its ultimate setting, but before driving of the keys;

FIG. 5 is a section similar to FIGS. 2 and 4, but showing the tool after the keys have been driven to their locking positions;

FIGS. 6, 7 and 8 are transverse sections taken on lines 6—6, 7—7 and 8—8 respectively of FIG. 4;

FIG. 9 is a perspective representation of the insert with which the tool is illustrated as being used;

FIG. 10 is a fragmentary end view of the insert, taken on line 10—10 of FIG. 9; and

FIG. 11 is a fragmentary view taken on line 11—11 of FIG. 2.

Referring first to FIG. 1, I have represented at 10 an insert constructed generally in accordance with the above identified patent, and which is to be screwed into a mating threaded opening 11 in a carrier part 12. Insert 10 consists of a tubular body 13 having internal threads 14 and external threads 15 corresponding to the carrier part threads within opening 11 with which the device is to engage. The insert has at least one, preferably two, locking keys 16, having the configuration best brought out in FIGS. 9 and 10, which keys are received within axially extending grooves 17 extending along opposite sides of the outer surface of the insert. The keys themselves have a corresponding dovetail cross section, to be confined within the grooves or recesses 17 for only axial sliding movement, and are sufficiently tight fits within the grooves to initially be effectively frictionally held in the outwardly projecting positions of FIGS. 1, 4 and 9. Each key has an axially inner portion 18 of reduced radial thickness, adapted to be received within opening 11 of the carrier part without interference with the internal threads of that bore, and each key also has a radially thickened axially outer locking portion 19, which may contain a central axial groove 20 (FIG. 10), and which cannot be screwed into carrier part opening 11 beyond the position of FIG. 4 in which shoulder 21 defining the inner extremity of portion 19 engages countersink surface 22 formed in the carrier part at the axially outer end of opening 11. After reaching the FIG. 4 condition, keys 19 may be driven axially to cut into and deform the material of the carrier part, and thereby lock the insert against unscrewing rotation relative to the carrier part.

Referring again to FIG. 1, a tool embodying the invention for installing insert 10 within carrier part 12 is illustrated generally at 23, and is driven by a rotary driving unit or tool 24 of any conventional construction. This unit 24 may contain a rotary motor 25 which is reversible by a control lever or switch 26 to turn output shaft 27 rotatably about axis 59 in either a right hand insert advancing direction or a left hand withdrawing direction. Connected between motor 25 and output shaft 27, unit 24 contains a clutch typically preferred to be operated by lever 52 adapted to automatically break the drive connection between motor 25 and shaft 27 when the load imposed upon shaft 27 exceeds a predetermined torque, which torque is selected to be that which is attained by tool 23 when the insert has been fully installed and locked in place. As will be apparent, the driving unit 24 is normally of the hand held type, desirably of the conventional air operated or electrically operated gun type which is now well known in industry. As seen best in FIG. 6, shaft 27 is of a non-circular cross section, desir-
ably square, to fit within a correspondingly non-circular socket recess 30 formed in a drive element 31 carried with a second rotary member 33 in tool 23. A transverse pin 34 extends through registering apertures in parts 31 and 32 to effectively secure these parts together and transmit rotation therebetween.

The insert body 13 is screwed onto an externally threaded portion 35 of a shank or member 36 (FIG. 2), with threads 35 being designed to mate with and internal threads in the insert. The extent to which the insert is screwed onto threaded portion 35 of the shank is limited by engagement of an annular end surface 37 of the insert (FIG. 3) with a transverse annular shoulder 38. Cylindrical outer surface 39 beyond shoulder 38 is of a diameter to correspond approximately to the spacing between the enlarged axially outer locking portions 19 of keys 16 (FIGS. 3 and 4), so that the keys are received in close proximity to the outer surface 39. Beyond surface 39, shank 36 may have a slightly reduced diameter cylindrical outer surface 40, terminating in an externally threaded lead screw portion 41 which engages an internal thread 42 formed in part 33. As will be apparent, rotation of shank 33 relative to part 36 acts through the threaded connection 41–42 to cause relative axial advancement of the parts, which advancement is limited in one direction by engagement of an enlarged head 43 formed on an externally cylindrical extension 44 of shank 36 with a transverse shoulder 45 formed at the end of recess 46 in part 33. Extension 44 passes through and is slidable within a mating passage 47 in part 33.

For driving keys 16 axially, there is provided about shank 36 a tubular sleeve 48 having internal cylindrical surfaces 49 and 50 received about and slidable engaging surfaces 39 and 40 of shank 36. Externally, sleeve 48 has an out end of cylindrical surface 51, about which there is received in closely fitting but relatively axially movable relation a second sleeve 52 having an inner cylindrical surface 53 of a diameter corresponding approximately to outer surface 51 of sleeve 48. Sleeve 48 has a transverse flange 54 against which one end of a tapering coil spring 55 bears, to hold flange 54 against an annular thrust bearing 56, desirably of the ball type. The opposite end of thrust bearing 56 bears against a flange 57 on part 33.

The working parts of the tool 23 are contained within an outer tubular housing 58 which is centered about the same axis 59 as are the other parts heretofore discussed, and which serves also as an element for transmitting the rotation of the parts in one condition of the apparatus. At a location intermediate its ends, housing 58 contains and rigidly carries a ring 60, centered about axis 59, and which may be located by reception within an internally knurled slightly reduced diameter portion 61 of the housing. To lock ring 60 in the illustrated position, and to serve certain additional functions, we provide a threaded set screw and pin arrangement, typically including two screws 62 and 63 as shown in FIG. 2. Screw 63 is threadlessly connected into ring 60 and has an unthreaded cylindrical pin portion 64 projecting radially inwardly toward axis 59 for passage through an elongated axially extending slot 65 formed in sleeve 48, and reception within an elongated axially extending slot 66 formed in shank 36. The second screw 62 is threadlessly connected into both of the parts 58 and 60, to lock them against relative rotation, and also acts as a lock screw for frictionally retaining spring 67 against lost motion, between housing 58 and the two parts 56 and 48, while allowing substantial axial retracting movement (upwardly in FIG. 2) of housing 58 relative to parts 56 and 48.

58 axially away from the annular flange 54 of sleeve 48. At the opposite side of ring 60, this ring is engaged by a second rotary member 68 which engages annular flange 69 of sleeve 52 at its second side, to transmit axial forces to that flange and to a snap ring 70 engaged by flange 68 and received in fixed position within an annular groove 71 in housing 58.

The annular flange 57 of part 33 has parallel annular transverse surfaces 72 and 71, the latter of which bears circularly against thrust bearing 56, and the former of which is interrupted at only one point about its circular extent by a dog or lug element 73 engageable with a housing carried coating pin 74. Element 73 is elongated radially axially 59, and has the square cross section illustrated in FIG. 11, and is securely held within a passage 75 formed in part 33. Element 73 may for example be a tight friction fit within element 33, and element 73 has a portion which projects axially a short distance beyond surface 71 (left side of FIG. 2), to form a shoulder surface 76 at one side of element 73 which is engageable by pin 74 in the condition of FIG. 2 to transmit clockwise rotary motion (as viewed from the upper end of FIG. 2) from rotary member 33 to housing 58. Pin 74 is adjustable mounted within a ring 77 for axial adjusting movement relative to the ring by virtue of the threaded connection of the pin with the ring at 78. A set screw 79 extends through threaded passage 80 in housing 58 and ring 77, to lock ring 77 in a predetermined position relative to the housing, and to bear against pin 74 in a manner locking that screw in fixed position. Desirably, ring 77 is externally threaded, to screw into the housing at 81, and further assure effective location of ring 77 relative to the housing.

To assure optimum functioning of the tool in the final stages of an insert installing cycle, and particularly during screwing of the tool from the installed insert, we prefer to provide in conjunction with the apparatus thus far described a brake mechanism for yieldingly resisting left hand or unscrewing rotation of the outer housing 58 of the tool. This brake mechanism may take the form illustrated generally at 85 in FIG. 1, including an annular second housing 86 having a first cylindrical large diameter portion 87 received about and partially overlapping housing 58 in closely spaced relation thereto. At the upper end of portion 87, housing 86 may have a transverse annular portion 88 and a reduced diameter cylindrical portion 89 which is received about a non-rotating reduced portion 90 of the housing of drive unit 24. Portion 89 is split axially or interrupted, at one point about its periphery, in a manner enabling it to function as a clamp (or is provided with a clamp or is otherwise adapted to be tightly clamped to portion 90 of unit 24). The split portion 89 may be tightened against portion 90, and thereby retained against rotation, by tightening of a bolt represented at 91 which passes through a pair of clamping legs 92 provided on the tubular split portion 89.

Contained within stationary housing element 86, there is provided a coil spring 93, which is at all times maintained under substantial compression, and whose opposite ends bear against a pair of high friction braking rings 94 and 95 which frictionally engage transverse surfaces 96 and 97 axially on housing 85 respectively. Rings 94 and 95 may be formed of any conventional brake lining or clutch face composition, leather, rubber, or other friction material and may be suitably keyed to the engaged portions of spring 93, to hold these brake rings 94 and 95 against rotation relative to the spring, spring 67 movement. The rings with the two housing parts at 96 and 97 causes a substantial resistance to rotation of housing 58 relative to part 85 and the connected non-rotating housing of unit 24.

To now describe the manner of use of the tool 23, assume that this tool is connected to driving unit 24, with the internal parts of the tool in the normal condition of FIG. 2. The first step may then be to manually screw
insert onto threads 35 of shank 36 to the position of FIG. 3. With the insert thus carried, the tool is located over the shaft 37, and the tool 24 is energized to commence clockwise rotation of rotary member 33. By virtue of the interengagement of shoulder 76 and pin 74, this clockwise rotation (as viewed from the upper end of FIG. 2) acts to turn housing 58 and the connected ring 60, which in turn acts through pin 64, which transmits movement of sleeve 48 to shank 36. Thus, the entire tool 23 is in the position rotated by and with shaft 27, and the insert 10 is thus screwed into thread opening 11 of the carrier part.

This advancement of the insert continues until the insert reaches the fully installed position of FIG. 4, at which shoulders 21 of keys 16 engage tapering countersink surface 22 in the carrier part to prevent further screwing of the insert, and thereby accurately locate the insert with its upper end surface 37 slightly beneath a flush condition with respect to the outer surface 81 of the carrier part. It is noted from FIG. 2 that, in the initial condition of the tool, the annular transverse end surface 82 of sleeve 52 lies in a transverse plane which is slightly axially beyond the plane of shoulder 38 of shank 36. As a result, just prior to the time that the insert reaches the FIG. 4 position, end surface 82 of sleeve 52 engages the outer surface 81′ of the carrier part, to halt advancement of sleeve 52 as the insert and shank 36 continue the advancement operation. The retention of sleeve 52 against further advancement acts through bearing 67 and ring 60 to prevent further axial advancement of housing 58 and its carried ring 77 and pin 74, whereas member 33 and its dogs 75 continue to advance axially (against the tendency of spring 59) so that when the FIG. 4 condition is reached, dog 75 moves out of driving engagement with pin 74, and the rotation of the housing therefore ceases. As the rotation of the housing ceases, the driving connection through pin 64 ceases to turn sleeve 48 and shank 36, so that the rotation of insert 10 stops at precisely the desired FIG. 5 setting. The bearing 67 between flange 68 and ring 60 allows part 52 to cease rotation as soon as it engages the carrier part, while ring 60 and the housing continue for a short interval beyond that time to rotate, until shoulder 76 and pin 74 move out of interengagement.

As opening, and a second operation of the FIG. 6 condition, the continued rotation of rotary member 33 by drive unit 24 acts through the threaded connection 41-42 to cause member 33 to commence axial advancement relative to shank 36. This axial advancement is transmitted through thrust bearing 56 to part 48, which thus advances axially relative to shank 36 and to the ultimate position of FIG. 5, to thereby drive or force keys 16 axially to their locking positions of FIG. 5 in which they engage the material of the carrier part in a manner locking the insert against unscrewing movement. In order to assure against radial outward deflection of the keys during this driving motion, it is found desirable to provide sleeve 48 with an annular end surface 83 which is slightly conical rather than directly transverse, and in a direction tending to cam the keys radially inwardly against shank surface 39, rather than radially outwardly. When the apparatus reaches the ultimate condition of FIG. 5, further rotation of motor 25 generates a gripper arm force, to cause the slip clutch 29 within driving gun 25 to slip and thereby prevent damage to the insert, workpiece, or tool as motor 25 continues to turn. The operator then actuates control lever or switch 26, to reverse the direction of rotation of motor 25, and cause unscrewing rotation of motor 27 which results in counterclockwise rotation from the condition of FIG. 5, initially carries member 33 to screw upwardly along the threaded portion 41 of shank 36, until head 43 engages shoulder 45 to limit such motion, following which shank 36 is required to turn with member 33 to unscrew its threaded portion 35 from the insert in preparation for the next successive insert installing operation. The resistance to unscrewing rotation of the part 58 occurs as a result of the presence of brake unit 85, and additional frictional resistance which may be developed in the device to upward retracting or unscrewing movement of part 33 relative to screw 41, to assure that part 33 will in fact, upon each operation of the device, screw upwardly to its FIG. 2 repositioned position relative to part 41 before shank 36 is unscrewed from the insert. Thus, the brake makes certain that the entire unit is completely rotated to its desired normal condition after each operation, in preparation for the next successive operation. We claim:

1. A tool for installing within an opening in a carrier part a threaded element having a locking portion adapted to be driven relative to said element to a position for locking the element in said opening, said tool including a rotatable first structure adapted to engage said element and rotate the element about an axis to screw it into said opening, a driving structure mounted for movement axially relative to said first structure at a location to drive said locking portion of the element to said locking position, rotary means adapted to be driven rotatably by a powered unit, a first operative connection operable by said rotary means to rotate said first structure and thereby screw the element into said opening, and a second operative connection operable by said rotary means to then actuate said driving structure axially relative to said first structure and said element and thereby drive said locking portion to said locking position.

2. A tool for installing within an opening in a carrier part a threaded element having a locking portion adapted to be driven relative to said element to a position for locking the element in said opening, said tool including a rotatable first structure forming a shank with an externally threaded portion adapted to engage internal threads within said element and rotate the element about an axis to screw it into said opening, a driving structure mounted for movement axially relative to said first structure at a location to drive said locking portion of the element to said locking position, rotary means adapted to be driven rotatably by a powered unit, a first operative connection operable by said rotary means to rotate said first structure and thereby screw the element into said opening, and a second operative connection operable by said rotary means to then actuate said driving structure axially relative to said first structure and said element and thereby drive said locking portion to said locking position.

3. A tool for installing within an opening in a carrier part a threaded element having a locking portion adapted to be driven relative to said element to a position for locking the element in said opening, said tool including a rotatable first structure having threads adapted to engage mating threads of said element and rotate the element about an axis to screw it into said opening, a driving structure forming an essentially tubular sleeve about said first structure mounted for movement axially relative to said first structure at a location to drive said locking portion of the element to said locking position, rotary means adapted to be driven rotatably by a powered unit, a first operative connection operable by said rotary means to rotate said first structure and thereby screw the element into said opening, and a second operative connection operable by said rotary means to then actuate said driving structure axially relative to said first structure and said element and thereby drive said locking portion to said locking position.

4. A tool for installing within an opening in a carrier part a threaded element having a locking portion adapted to be driven relative to said element to a position for locking the element in said opening, said tool including a rotatable first structure forming a shank with an externally threaded portion adapted to engage internal threads within said element and rotate the element about
an axis to screw it into said opening, said shank having a shoulder engageable with an end of said element to limit the extent to which the latter may be screwed into said opening, a driving structure forming an essentially tubular sleeve about said first structure mounted for movement axially relative to said first structure at a location to drive said locking portion of the element to said locking position, rotary means adapted to be driven rotatably by a powered unit for movement axially relative to said first structure and thereby screw the element into said opening, and a second operative connection operable by said rotary means to then actuate said driving structure axially relative to said first structure and said element and thereby drive said locking portion to said locking position.

5. A tool for installing within an opening in a carrier part a threaded element having a locking portion adapted to be driven relative to said element to a position for locking the element in said opening, said tool including a rotatable first structure adapted to engage said element and rotate the element about an axis to screw it into said opening, a driving structure mounted for movement axially relative to said first structure at a location to drive said locking portion of the element to said locking position, rotary means adapted to be driven rotatably by a powered unit, a first operative connection operable by said rotary means to rotate said first structure and thereby screw the element into said opening, and a second operative connection operable by said rotary means to then actuate said driving structure axially relative to said first structure and said element and thereby drive said locking portion to said locking position, and automatic control means responsive to arrival of said element at essentially a fully installed position in said carrier part to automatically deactivate said first connection and thereby cease rotation of said driving structure to then effect engagement of said second connection.

6. A tool for installing within an opening in a carrier part a threaded element having a locking portion adapted to be driven relative to said element to a position for locking the element in said opening, said tool including a rotatable first structure adapted to engage said element and rotate the element about an axis to screw it into said opening, a driving structure mounted for movement axially relative to said first structure at a location to drive said locking portion of the element to said locking position, rotary means adapted to be driven rotatably by a powered unit, a first operative connection operable by said rotary means to rotate said first structure and thereby screw the element into said opening, a second operative connection operable by said rotary means to then actuate said driving structure axially relative to said first structure and said element and thereby drive said locking portion to said locking position, and automatic control means responsive to arrival of said element at essentially a fully installed position in said carrier part to automatically deactivate said first connection and thereby cease rotation of said driving structure to then effect engagement of said second connection.
ture axially relative to said first structure and said element and thereby drive said locking portion to said locking position, rotary means adapted to be driven rotatably by a powered unit, a first operative connection operable by said rotary means to rotate said first structure and thereby screw the element into said opening, and a second operative connection operable by said rotary means to then actuate said driving structure axially relative to said first structure and said element and thereby drive said locking portion of the element to said locking position, rotary means engageable with said element to effect said relative shifting movement of said housing, means keying said housing to said first structure and said driving structure rotatively but allowing relative axial shifting movement thereof, and coating connector parts carried by said housing and said rotary means and movable out of said driving engagement by said relative shifting movement of the housing, said second connection including a screw thread connection between said rotary means and said first structure then operable to advance said driving structure axially relative to the first structure.

11. A tool for installing within an opening in a carrier part a threaded element having a locking portion adapted to be driven relative to said element to a position for locking the element in said opening, a driving structure mounted for movement axially relative to said first structure at a location to drive said locking portion of the element to said locking position, rotary means adapted to be driven rotatably by a powered unit, a first operative connection operable by said rotary means to rotate said element in said opening and deflectable axially relative to said first structure by engagement with a predetermined installed setting and operable by said relative deflection to automatically actuate said connections to halt the rotation of said first structure and commence said relative axial advancement of said driving structure.

12. A tool for installing within an opening in a carrier part a threaded element having a locking portion adapted to be driven relative to said element to a position for locking the element in said opening, said tool including a rotatable first structure adapted to engage said element and rotate the element about an axis to screw it into said opening, a driving structure mounted for movement axially relative to said first structure by engagement with said carrier part when said element reaches essentially a predetermined installed setting and operable by said relative deflection to automatically actuate said connections to halt the rotation of said first structure and commence said relative axial advancement of said driving structure, said first connection including driving lugs integrally engaged to transmit rotation from said rotary means to said first structure and relatively shiftable out of said driving engagement by said deflection of said control member relative to said first structure.

13. A tool as recited in claim 11, including a screw thread connection between said rotary means and said element for effecting axial advancement of said rotary member and said first structure relative to the said shank.

14. A tool as recited in claim 12, including a brake resisting rotation of said deflatable housing in a direction to unscrew said shank and including a second housing having a portion connectible to a non-rotating part of said rotary power operated tool, and a spring compressed in said second housing and applying forces in opposite directions to said two housings in a relation frictionally resisting relative rotation of said first structure.

15. A tool as recited in claim 13, including a brake resisting rotation of said deflatable housing in a direction to unscrew said shank and including a second housing and said rotary power operated tool, and a spring compressed in said second housing and applying forces in opposite directions to said two housings in a relation frictionally resisting relative rotation of said first structure.

16. A tool as recited in claim 14, including a brake resisting rotation of said deflatable housing in a direction to unscrew said shank and including a second housing and said rotary power operated tool, and a spring compressed in said second housing and applying forces in opposite directions to said two housings in a relation frictionally resisting relative rotation of said first structure.
said locking portion of the element to said locking position, rotary means adapted to be driven rotatably by a powered unit, a first operative connection operable by said rotary means to rotate said first structure and thereby screw the element into said opening, a second operative connection operable by said rotary means to then actuate said driving structure axially relative to said first structure and said element and thereby drive said locking portion to said locking position, said second connection including a screw threaded connection between said rotary means and said first structure operable to axially advance the rotary means and through it said driving structure relative to said first structure, and a brake frictionally resisting unscrewing rotary motion of said first structure.

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