United States Patent

Lesner

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[54] PNEUMATIC NUTRUNNER WITH WORK MARKING MECHANISM

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[52] **U.S. Cl.** **81/52.5**

[51] **Int. Cl.** **B25b**

[58] **Field of Search** 81/52.4, 52.5; 192/150

[56] **References Cited**

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2,986,052	5/1961	Eckman et al.	81/52.4
3,298,481	1/1967	Schaedler et al.	192/150
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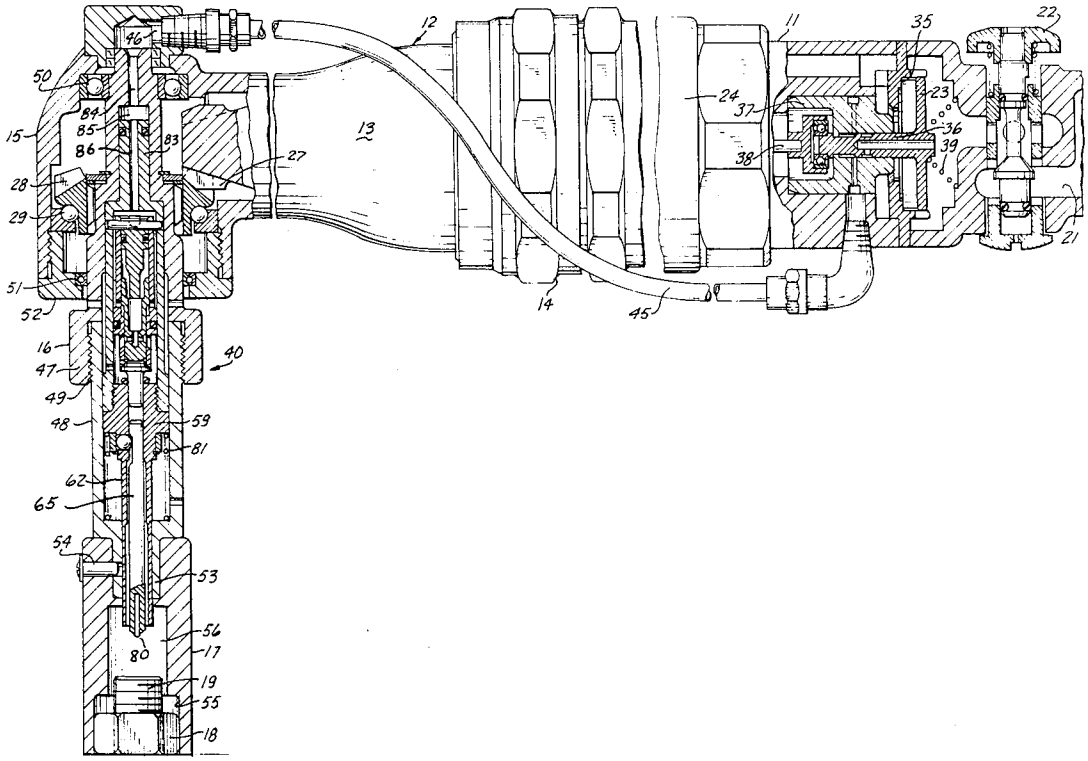
[57] **ABSTRACT**

A pneumatically powered nutrunner provided with marking mechanism which is pneumatically operable automatically in response to delivery of a preset torque to the work, such as a bolt head or stud, to apply a series of visible marks to the work. The marks serve to indicate that the required torque has been delivered. In one embodiment, the marking mechanism is combined with a nutrunner; and in another embodiment, it is a separate unit.

10 Claims, 5 Drawing Figures



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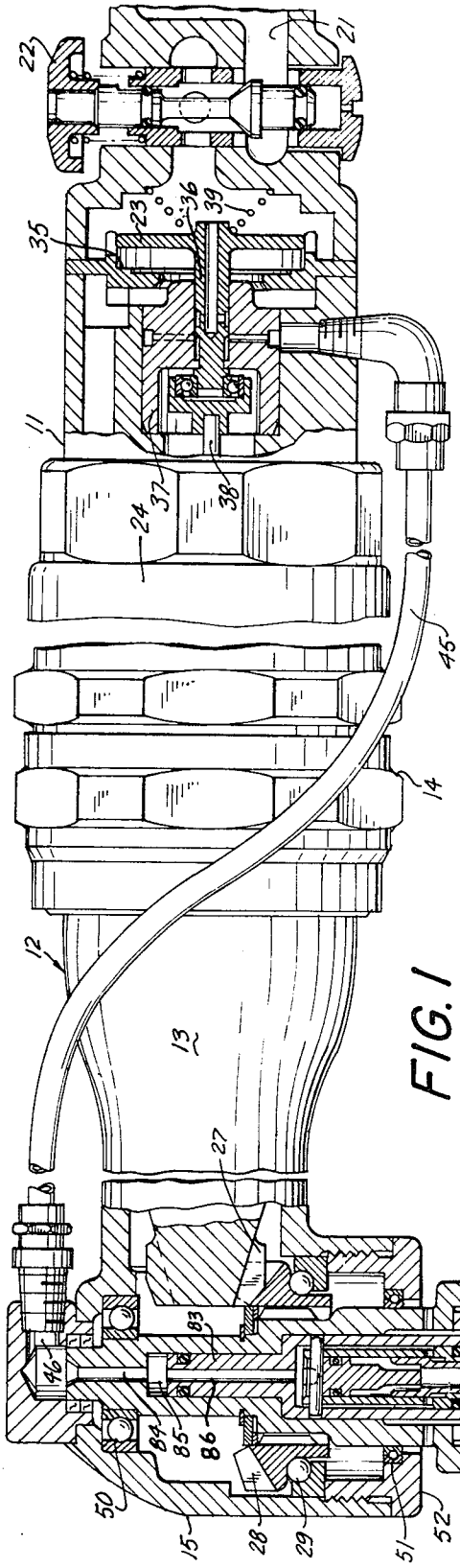

FIG. 1

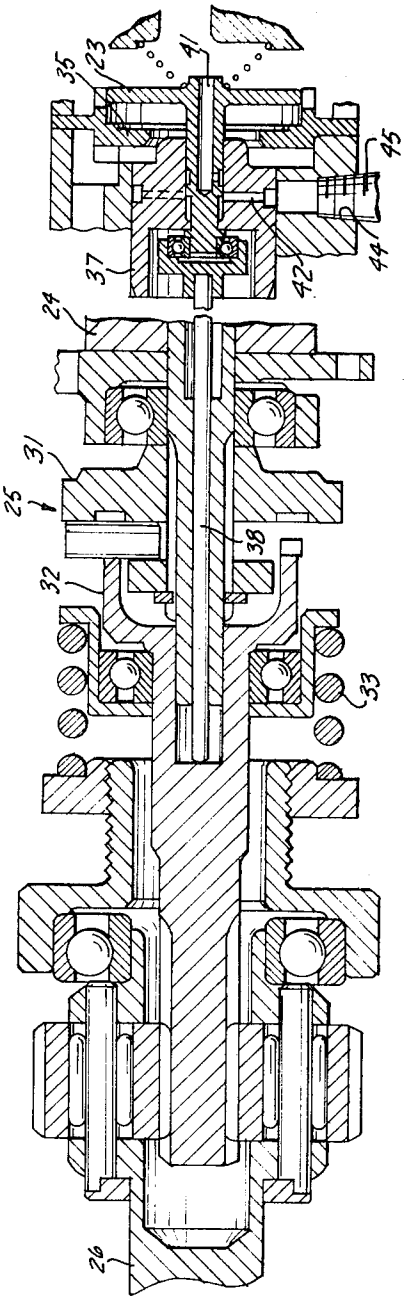

FIG. 2

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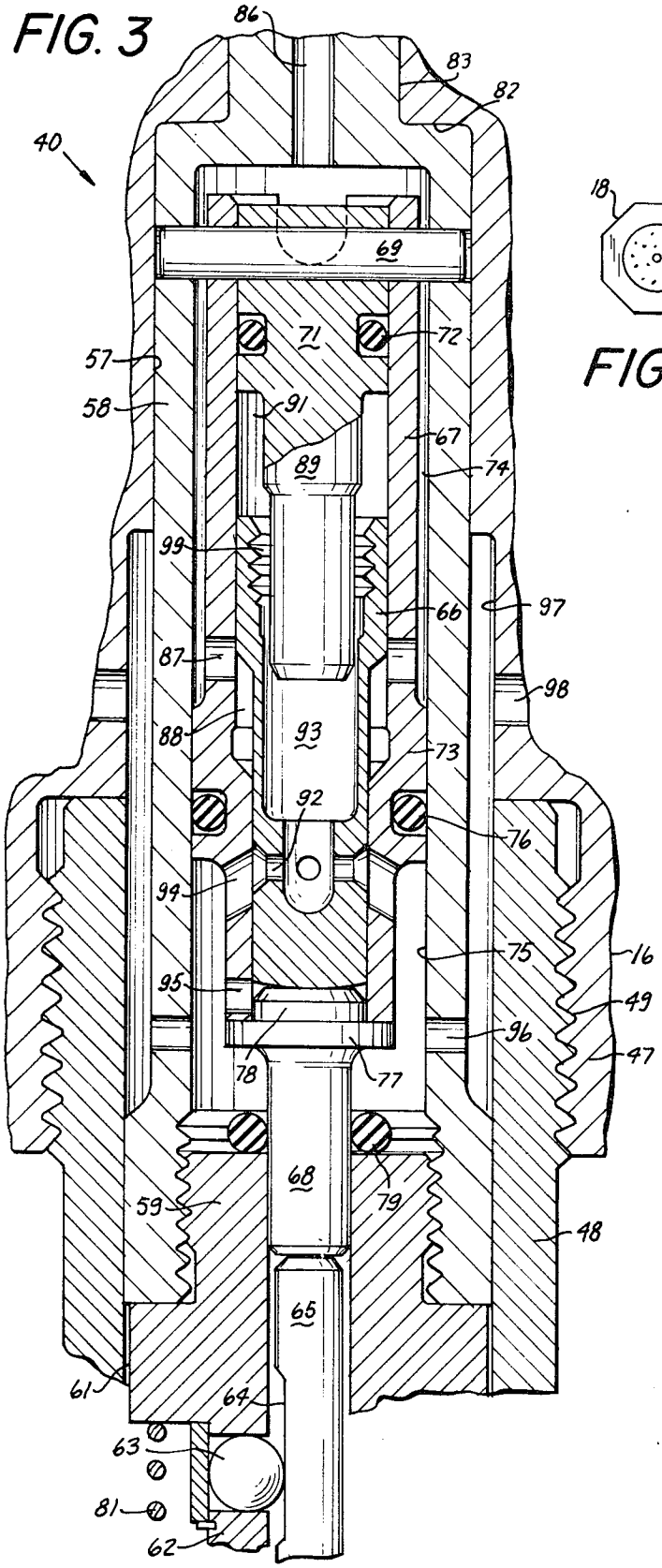
FIG. 3



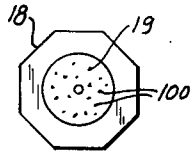
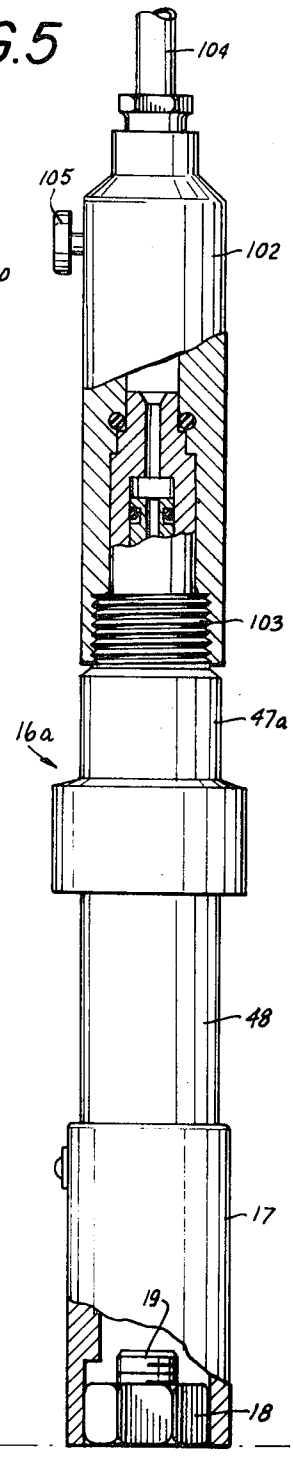


FIG. 4

FIG. 5



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PNEUMATIC NUTRUNNER WITH WORK MARKING MECHANISM

BACKGROUND OF THE INVENTION

This invention is directed to a pneumatically powered nutrunner provided with pneumatically operable work marking mechanism.

The general objective of a tool of this nature is to apply a visible mark to the work, such as the head of a bolt or stud, to indicate to those concerned that the work has been tightened to a predetermined degree of tightness. This provides a desirable advantage in that it facilitates inspection procedures in determining whether the work has received the proper torque. While a marking tool as a unit separate from the nutrunner may be provided for application to the work after delivery of a final torque, it is desired that the marking mechanism be a component of the nutrunner and so associated with it as to operate automatically in response to the delivery of a final torque to the work.

A feature of the invention is a locating plunger which is operable to bring a marking rod into contact with the work regardless of the extent to which the work extends axially into the work socket.

Another feature lies in the provision of a reciprocating piston hammer adapted to repeatedly pound the marking rod in an arrangement in which the marking rod is adapted under such action to oscillate from side to side and simultaneously turn on its axis so as to impart a group of clearly visible marks to the head of the work.

Another feature lies in the manner of the association of the marking mechanism with the nutrunner whereby the air used in operating the nutrunner is caused to be diverted to operate the marking mechanism.

The marking mechanism is illustrated in one form in which it is incorporated in the housing of a nutrunner. In this form, it is adapted to be operated automatically following final torque delivery. It is also illustrated in a modified form as a unit separate from the nutrunner. In this latter form, it is hand operated and may be selectively applied by the operator to the work. As a separate unit, the marking mechanism may be located externally of the nutrunner; it may also be associated with other machines.

Wrenches with which marking mechanism have been combined are known from U.S. Pats. Nos. 3,009,371; 3,472,102 and 3,389,623. However, these do not have the advantages of the present invention. The first two are hand powered; and the third one is a motor driven wrench of the impact type, the marking mechanism of which operates concurrently with the motor and while final torquing is in progress.

In the accompanying drawing:

FIG. 1 is an elevational view, partly in section, of a pneumatic nutrunner embodying the marking mechanism of the present invention;

FIG. 2 is a schematic showing of the relation of the shut-off valve to the cam release clutch;

FIG. 3 is a detail section of the marking mechanism, drawn to an enlarged scale for added clarity;

FIG. 4 is a plan view of the head of a threaded fastener which has been subjected to the marking action of the marking mechanism; and

FIG. 5 is a modified form of the marking mechanism, designed as a separate unit for use apart from the nutrunner.

DESCRIPTION OF A PREFERRED EMBODIMENT

Reference is now directed to FIGS. 1–4 of the drawing in which is shown a pneumatic nutrunner having a general housing 11 defined by a succession of sections connected to one another in end-to-end relation. An angle head housing section 12 is detachably coupled at the end of its long arm 13 to the general housing of the tool, as at 14. A shorter arm 15 of the angle head extends at an angle to the general housing; it supports a drive shaft 16 carrying a work socket 17 adapted for driving engagement with a threaded fastener, such as the nut 18 which is to be threadedly tightened upon the stud 19.

An inlet 21 at the rear of the tool is connectible to a source of pressure air. Operation of a throttle valve 22 in the tool allows flow of inlet air through a normally open shut-off valve 23 to drive a rotary air motor at 24 of a conventional slidable vane type. The motor is drivingly connected in conventional manner through a torque release cam clutch 25 (FIG. 2) with an output spindle 26. The latter extends into the long arm 13 of the angle head; and is drivingly connected by means of a bevel gear 27 with a gear 28 splined to shaft 16. Gear 28 is supported in a bearing 29.

The clutch includes a driving member 31 with which an axially disengageable clutch member 32 is normally held engaged under the force of a clutch return spring 33. The shut-off valve 23 is in the form of a disc which is guided to and from a valve seat 35 by means of a valve stem 36, the latter being slidable in a bore of a guide bushing 37. A slide rod 38, having one end abutting the disengageable clutch member and having its other end abutting the valve stem, normally holds the shut-off valve in an open condition, as in FIGS. 1 and 2, during the time that the clutch is engaged.

When the nut 18 has been tightened upon the stud 19 to a preset degree, clutch member 32 is forced by the torque reaction axially away from the driving clutch member 31 against the force of the clutch spring 33. The slide rod 38, under force of inlet air supplemented by the force of a spring 39 acting upon the head of the shut-off valve, follows the disengaging clutch member until the valve closes upon its seat. The inlet air is thus shut off from the motor, causing the latter to stop. The clutch, however, remains held by the rod in its disengaged condition under pressure of inlet air acting over the seated shut-off valve. This condition will continue until the operator releases the throttle valve 22 to closed condition. A nutrunning tool of the foregoing general construction and mode of operation is described in detail in U.S. Pats. Nos. 3,298,481 and 3,187,860.

In the present embodiment, the drive shaft 16 has been improved to serve not only as a drive shaft for the nutrunner but also as a housing for metal marking mechanism 40 (FIGS. 1 and 3); and the shut-off valve 23 has been modified so that following shut-off of inlet air to the motor a restricted volume of inlet air will automatically be diverted to operate the marking mechanism. Inlet air pressure over the head of the shut off valve 23 remains adequate to hold the valve closed despite the restricted air volume being diverted to the marking mechanism.

As the shut-off valve is seated, a passage 41 in its stem connects with ports 42 in the guide bushing 37 so as to allow inlet air to pass through the valve stem to a housing port 44. The latter port connects by means of an external flexible hose line 45 with a port 46 leading into the marking mechanism. When the shut-off valve is in its open condition, as in FIG. 1, communication of the inlet 21 through the ports leading to the hose 45 is blocked.

The drive shaft 16 is shown here as extending at right angles to the longitudinal axis of the general housing of the tool. It comprises a pair of hollow cylindrical sections 47 and 48 which are threadedly coupled together, as at 49, in axial extension of one another. The upper shaft section 47 is rotatably supported in bearings 50 and 51 and extends through a cap 52 threadedly plugged in an open end of the angle head. A terminal stem 53 of the lower drive shaft section 48 is received axially in a rear opening of the socket 17 and is releasably retained therein by means of a spring loaded latch pin 54.

The socket has a multi-sided recess 55 in its end which is adapted to engage over the nut 18. Above the socket recess is an elongated space 56 into which an end of the stud 19 may progress as the nut is tightened.

The drive shaft 16 defines a housing for the marking mechanism. Its interior provides a chamber 57 in which a hollow plunger 58 of the marking mechanism is reciprocable. A head 59 of a marking rod holder 61 is threadedly plugged in an open front end of the plunger. A reduced tubular portion 62 depends axially from the head with a slide fit through the stem 53 of the drive shaft and projects part way into the socket

space 56 in axial alignment with the stud 19. Tube 62 is of lesser outer diameter than the stud. A spring loaded ball latch 63 cooperates with a flat 64 at the upper side of a cylindrical metal marking rod 65 to releasably retain the latter in the holder. The flat is longer in its longitudinal dimension than the diameter of the ball latch so as to permit limited axial movement or loss-motion of the marking rod relative to the holder. The transverse dimension of the flat corresponds substantially to that of the diameter of the ball latch. This arrangement, together with a slight looseness of the marking rod in the holder permits limited turning of the marking rod in the holder as well as limited side-to-side movement of the rod.

A piston 66 is pneumatically reciprocable in a piston cylinder 67 of the marking mechanism to repeatedly hammer an anvil 68 against the marking rod. Cylinder 67 is disposed within the interior of the plunger 58. A pin 69 anchored at its ends in the plunger extends, in order, through the upper end of cylinder 67 and through the head of a cylindrical guide rod 71 so that these connected elements move with the plunger as a unit. The guide rod 71 carries an O-ring seal 72 at its upper end. The cylinder has a peripheral land 73 between its ends which bears upon the inner wall of the plunger so as to define upper and lower annular clearances or chambers 74 and 75. An O-ring 76 in the land seals the clearances from one another.

The body of anvil 68 is slidable in the head 59 of the marking rod holder above the marking rod. In the raised position of the anvil, as in FIG. 3, an annular flange 77 at the base of its head 78 abuts against an open bottom end of the cylinder; and its head projects into the cylinder where it is subject to the pounding of the piston. An O-ring cushion 79 is provided for cushioning movement of the anvil. The marking rod has a dropped position wherein the upper shoulder of its flat 64 abuts the ball latch 63, and a pointed stylus end 80 of the marking rod projects slightly below the bottom of the holder tube 62, as appears in FIG. 1.

In the operation of the nutrunner, the socket 17 is applied to the nut 18 and the throttle valve 22 is depressed causing pneumatic operation of the motor 24. The torque of the motor is transmitted through the drive shaft 16 and the socket to tighten the nut upon the stud 19. At this time, inlet air is blocked by the open condition of the shutoff valve 23 and the unregistered condition of its ports from flowing through the hose line 45 to the marking mechanism 40. The marking mechanism at this time has, as in FIG. 1, an inactive condition wherein the plunger 58 is biased by its return spring 81 to an upper normal position in which a shoulder of the plunger abuts an internal shoulder 82 of the drive shaft, and its upper stem 83 is fully received in a complementary portion of the plunger chamber 57. In this inactive condition, the holding tube 62 and marking rod 65 are held by the plunger clear of the work.

Upon delivery of final torque to the work and consequent moving of the shut-off valve 23 to closed condition, inlet air is shut-off from the motor and rotation of the drive shaft 16 stops. Inlet air is then diverted through the connected passages 41, 42 of the shut-off valve and valve bushing to the hose 45. The live air entering the angle head from hose 45 passes through a bore 84 in the drive shaft to a shallow inlet compartment 85 above the stem 83 of plunger 59. Live air entering compartment 85 acts upon the plunger to force it gently downward against the resistance of its spring 81 until the open end of the holding tube 62 limits upon the top of the stud 19. As the marking rod 65 descends with the holding tube, it eventually engages the top of the stud and is then slidably retracted in the holder to take up the loss-motion permitted by the ball latch 63 and flat 64. The retracted movement of the marking rod raises the anvil so as to seat its flange 77 against the open end of the piston cylinder 67. The weight of the tool prevents the socket 17 from being forced free of the work in this action. As the inlet air is forcing the plunger downward, it also is flowing through a passage 86 to the interior area of the plunger defined by the upper clearance 74. The air then flows from clearance 74 through side ports 87 to an annular chamber 88 defined about the piston. Build-up of air in chamber 88 acts upon the piston to force it upwardly away from the anvil. In this movement, the piston slides over an enlarged diameter portion 89 of the guide rod 71 causing static air trapped in the space 91 above the piston to be compressed. The piston moves upwardly in this action until side ports 92 therein register with chamber 88. Inlet air entering chamber 88 then flows through the side ports 92 to the recessed interior 93 of the piston and acts to drive the piston forcefully downward against the anvil 68. Any static air trapped below the piston is forced in this action through side ports 94 and 95 in the piston cylinder to clearance 75. From the latter it flows through side ports 96 in the plunger to an annulus 97 communicating with vents 98. The compressed air trapped in the space 91 aids in forcing the piston downward. In its downward movement, the piston moves clear of the larger diameter portion 89 of the guide rod to develop a clearance 99 between its inner wall and a reduced end portion of the piston guide rod. This clearance allows static air trapped above the piston to escape through the ports 92 and 94 to the vents 98. The reciprocating cycle of the piston is automatically repeated as inlet air in chamber 88 again acts upon the piston to drive it upwardly; and it continues automatically to cycle at a high frequency until the operator releases the throttle valve to closed condition.

The plunger continues to be held downward with its tube 62 in contact with stud 19 during the entire time that the piston is reciprocating.

The stylus tip 80 of the marking rod is formed of hard metal such as carbide steel. It repeatedly marks or dents the surface of the stud 19 under a rapid succession of impacts imparted to the stud by the anvil. It is desired that the markings will not be one upon the other in a single spot but that multiple markings will be produced. To this end, the marking rod 65 has a loose fit in the holding head 59 and in the holding tube 62. Since there is a slight circumferential looseness at the upper end of the marking rod in the holding head, the marking rod tends to oscillate sideways in the tube 62 and to turn on its axis as it is subjected to repeated hammering by the piston. The tube serves to curb the extent of side-to-side swinging of the marking rod. This oscillating action causes a group of marks to be indented in the top of the stud 19 in a general circular pattern, as indicated at 100 in FIG. 4. There is also a slight looseness between the opposed ends of the anvil and the marking rod which permits the marking rod to rebound slightly following impact.

It is to be noted (FIG. 1) that the socket space 56 above the work is adequate to accommodate variations in the vertical extension of the work into the socket. It is also to be noted that the locating plunger 58 has the capacity to carry its holding tube 62 downwardly against the resistance of spring 81 until the holding tube has limited upon the work, regardless of the extent to which the work extends into the socket 17.

In FIG. 1, the marking mechanism is shown as combined with the angle head of a pneumatic nutrunner. In FIG. 5, the marking mechanism is shown as a separate unit, independent of the nutrunner. In this modified form, an inlet adapter section 102 has been threadedly coupled as at 103 to the upper section 47*a* of the unit's housing 16*a*. The lower section 48 of the housing carries the socket 17 which is adapted to receive the nut 18 and stud 19. The adapter 102 is provided with a throttle valve 105 and is connectible to a pressure air source by means of a feed line 104. In using this form, the socket is applied over work that has been previously torqued in order to center the work relative to the marking rod and holding tube; the throttle valve 105 is then actuated to effect operation of the marking mechanism and consequent repeated marking of the work.

In FIG. 1, the marking mechanism is shown as incorporated within the angle head section of the nut runner. However, as indicated in FIG. 5, the marking mechanism may be a separate unit provided with its own housing. As such, it may be mounted in suitable manner as by bolting or clamping to the

exterior surface of the nutrunner either at the rear of the angle head section or at some other selected area. When mounted as a separate unit, its inlet may be connected with the hose line **45**; or it may be connected by the hoseline **104** with an independent source of operating air. Where the inlet is connected with the hoseline **45** of the nutrunner, the throttle valve **105** may be omitted.

As a separate unit, the marking mechanism may also be associated with various types of automatic machines. When so applied, its housing would be mounted to a suitable work station and its mechanism caused to be operated at a precise time by means of suitable air flow controls operatively associated with the automatic machine. When so used, the socket element **17** may be used where the work is concerned with nutrunning; or the socket element may be omitted, when it is only required to mark the work, whatever it may be, to indicate that the work has passed through a final work stage.

It is understood where the marking mechanism is used as a separate unit that its housing may be designed, as needed, to facilitate its mounting or positioning.

What is claimed is:

1. A nutrunner comprising a rotary air driven motor, a hollow work shaft carrying a socket at its end adapted to fit over a nut threaded upon a stud, a spindle having a driving connection with the shaft, a torque disengageable clutch drivingly connecting the motor to the spindle adapted to disengage upon the nut being tightened to a predetermined torque value, pneumatically operable marking mechanism housed in the shaft for applying marks repeatedly in rapid succession to the stud, slidable valve means controlling flow of live air to both the motor and to the marking mechanism having a normal position allowing live air flow to the motor to operate it and blocking live air flow to the marking mechanism, the valve means having a second position blocking live air flow to the motor so as to cause the motor to stop and allowing live air flow to the marking mechanism so as to cause it to operate, and means having response to disengaging of the clutch for causing the valve to move to its second position and holding it in said position.

2. A nutrunner as in claim **1**, wherein the shaft is rotatably supported in an angle head housing section at an angle to the spindle.

3. A nutrunner as in claim **2**, wherein a conduit arranged externally of the nutrunner connects the valve means with an inlet to the marking mechanism.

4. A nutrunner as in claim **2**, wherein the marking mechanism includes a locating plunger carrying a marking rod, the plunger being pneumatically movable in one direction to carry the marking rod into abutment with a fastener engaged by the socket, and a spring is provided in the shaft for re-turning the plunger and marking rod away from the fastener to a normal inactive position.

5. A nutrunner as in claim **4**, wherein a pneumatically reciprocable piston is arranged within the plunger for applying repeated impacts to the marking rod.

6. A nutrunner as in claim **5**, wherein passage means communicates an air inlet of the marking mechanism with both the plunger and the piston.

7. A nutrunner as in claim **5**, wherein the marking rod has a loss-motion connection with the plunger permitting limited axial movement of the marking rod relative to the plunger, the loss-motion connection is at a rear end of the marking rod, the marking rod is cylindrical and has a loose fit in the plunger allowing limited relative turning of the marking rod as well as limited side-to-side swinging of the marking rod.

8. A nut runner as in claim **7**, wherein a tube carried by the plunger surrounds with a clearance the marking rod, and the marking rod projects at its front end slightly from a corresponding end of the tube when the plunger is in its normal position, the extent of projection of the marking rod being determined by the extent of axial loss-motion allowed to the marking rod, the tube providing a curb to the extent of side-to-side swinging of the marking rod.

9. In a pneumatically driven torque release wrench having a driving member connectible to a threaded fastener for tightening the same to a predetermined torque value; marking mechanism housed in said driving member for applying marks repeatedly in rapid succession to the fastener after said predetermined torque value has been obtained; and means having response to the application of said predetermined torque value to cause the driving member to stop operating and to cause the marking mechanism to operate.

10. In a power driven torque release wrench as in claim **9**, wherein means is provided for causing the marks to be applied in a circular random pattern.

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