United States Patent

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[54] **DEPTH MEASURING POWER WRENCH**
4 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** **81/54,** 81/52.4
[51] **Int. Cl.** **B25b 13/00,** B25b 21/02
[50] **Field of Search** 81/52.4, 52.5, 54; 173/11

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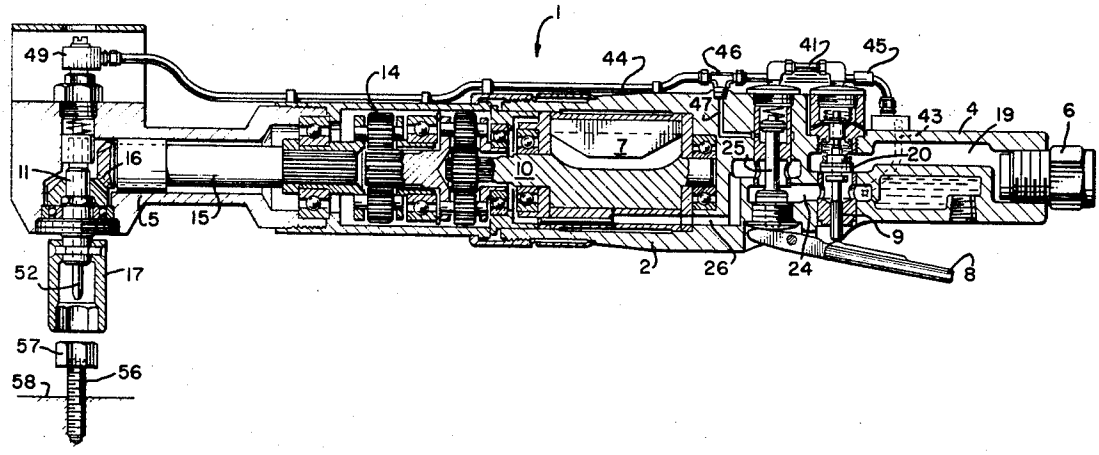
ABSTRACT: A power wrench including a motor driving a spindle mounted in an angle head and containing a device for measuring the depth of a fastener and creating a fluid signal upon arrival of the fastener at a predetermined depth. The wrench further contains a normally open valve operative to close in response to the signal thereby stopping the wrench motor when the fastener arrives at the predetermined depth.



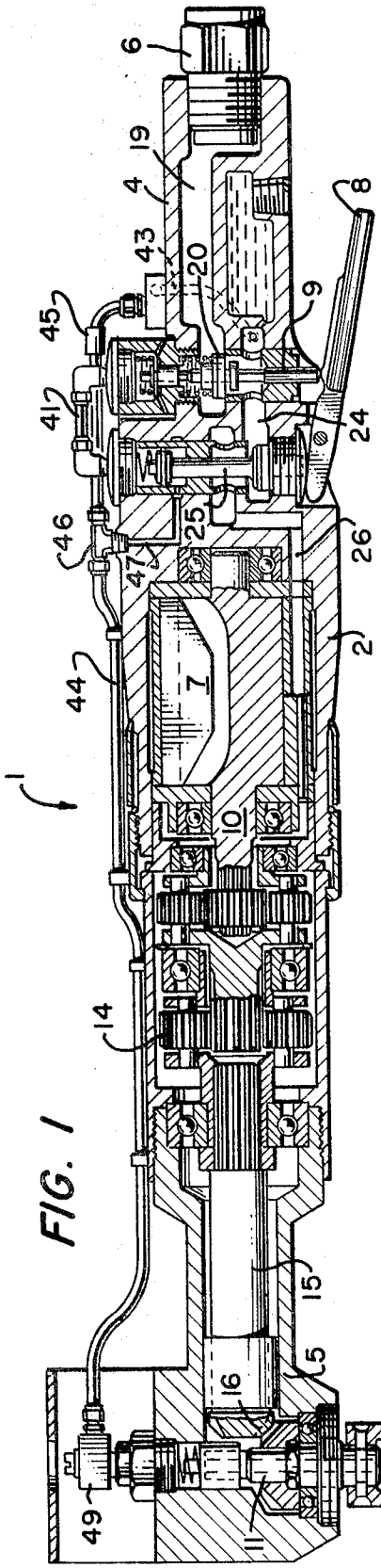


FIG. 1

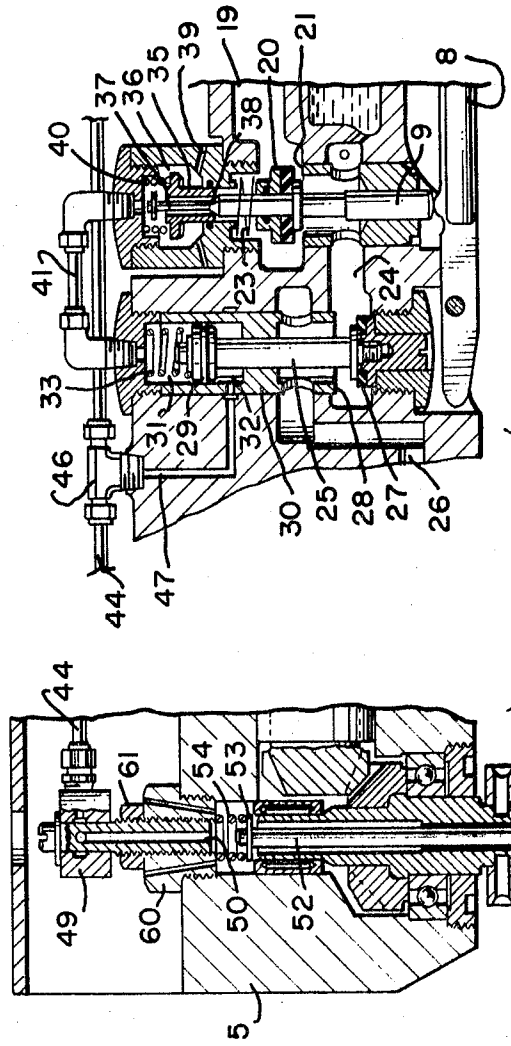


FIG. 2

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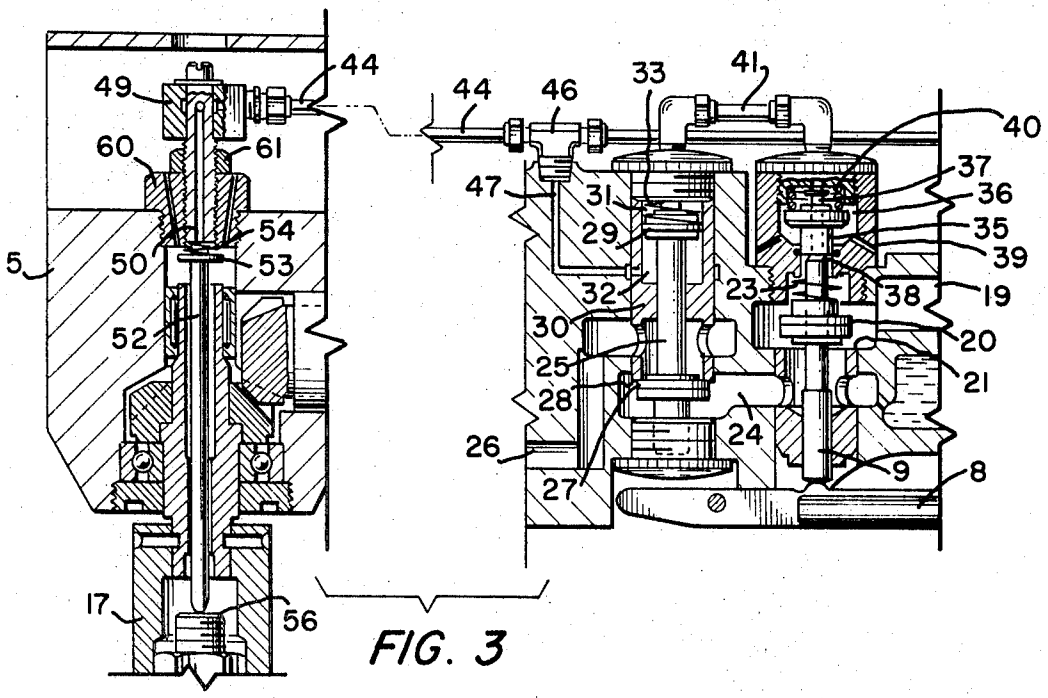


FIG. 3

FIG. 5

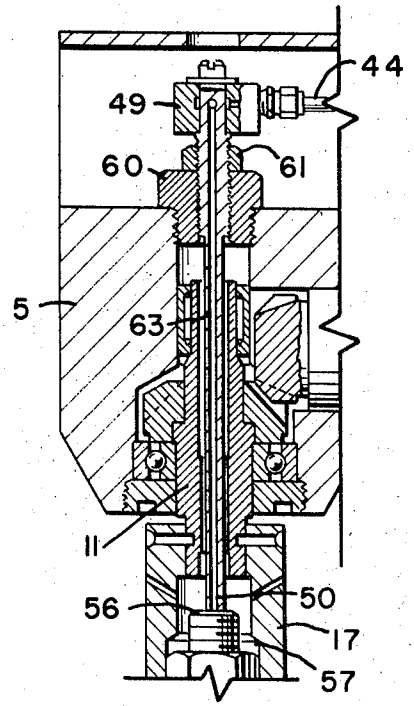
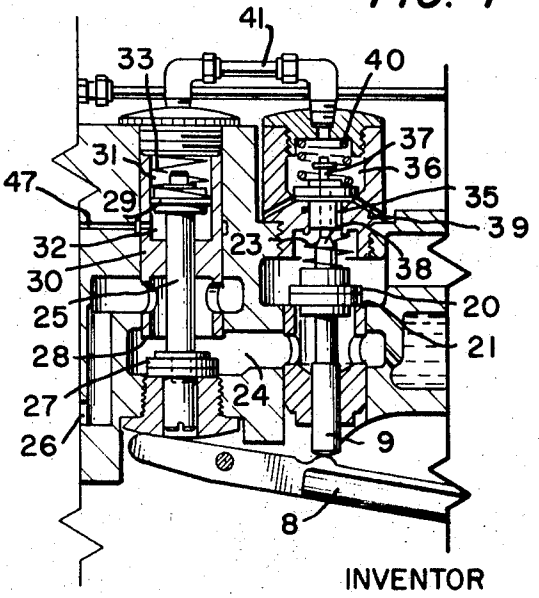


FIG. 4



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DEPTH MEASURING POWER WRENCH

BACKGROUND OF THE INVENTION

This invention relates generally to power wrenches and more specifically to a system for controlling and stopping a power wrench in response to a fastener reaching a predetermined depth.

Several power wrenches manufactured today stop their motors in response to a predetermined torque. This type of wrench is satisfactory for many fasteners but is not satisfactory for fasteners that have to be located at a predetermined distance from a selected surface, such as a work surface.

SUMMARY OF INVENTION

The principal object of this invention is to provide a power wrench which automatically stops its motor in response to a fastener reaching a precise location or position; to provide a system for sensing the depth of a fastener and stopping a wrench motor in response to the arrival of the fastener at a selected depth; and to provide a shutoff system for a power wrench responsive to the depth of a fastener.

In general, the foregoing objects are attained in a power wrench having a means for measuring the depth of a fastener being driven and operative to create a signal in response to the arrival of the fastener at a predetermined depth, and a means operative in response to the signal to shut off the wrench motor when the fastener arrives at the predetermined depth.

BRIEF DESCRIPTION OF DRAWINGS

The invention is explained in connection with the accompanying drawings wherein:

FIG. 1 is an axial section of a power wrench containing an embodiment of this invention;

FIG. 2 is an enlarged and fragmentary view of portions of FIG. 1 showing the throttle open and supplying operating fluid to the motor;

FIG. 3 is a fragmentary view similar to FIG. 2 and illustrating the position of the fluid valves after the wrench motor is shut off and prior to the opening of the hand throttle;

FIG. 4 is a fragmentary view of the valves showing them in their normal position with the wrench at rest;

FIG. 5 is a fragmentary view of a second embodiment containing a modified depth measuring means.

DESCRIPTION OF PREFERRED EMBODIMENTS

The power wrench 1 shown in FIG. 1 conventionally comprises a casing 2 including a midportion, also designated 2, a backhead 4 and a front end 5. The backhead 4 includes a nipple 6 adapted to be connected to an air line for feeding compressed air to the wrench motor 7 housed in the midportion 2. A hand-operated throttle lever 8 is pivoted on the casing 2 and operates a throttle valve 9 controlling the flow of compressed air to the motor 7. The motor 7 includes a drive shaft 10 driving a spindle 11 mounted in the front end 5 of the wrench 1 through a drive train comprising planetary gears 14, an output shaft 15 and a set of beveled gears 16. This spindle 11 carries a detachable wrench socket 17. All of the foregoing structure is conventional in power wrenches.

Compressed air flows through the nipple 6 into a supply chamber 19. When the throttle valve 9 is closed, it blocks the air in the supply chamber 19 from proceeding to the motor 7. The throttle valve 9 includes a poppet head 20 normally engaging a valve seat 21 which is fixed in the casing 2. A spring 23 urges the valve head 20 against its seat 21. When the throttle valve 9 is open, air flows from the supply chamber 19 into an inner a chamber 24 where it can flow through a normally open shutoff valve 25. After passing through the open shutoff valve 25, the compressed air flows through a motor passage 26 into the motor 7.

The normally open shutoff valve 25 includes a valve stem, also designated 25, a poppet-type valve head 27 fixed on the stem 25 and a valve seat 28 fixed in the casing 2. The end of the valve stem 25, remote from the valve head 27, carries an actuating piston 29 sliding in a cylinder 30. The differential pressures on the opposite faces of the piston 29 controls the position of the shutoff valve 25. The actuating piston 29 separates the cylinder 30 into two chambers including a valve-opening chamber 31 and a valve-closing chamber 32. A spring 33 is located in the valve-opening chamber 31 to lightly urge the valve 25 to its open position. The only reason for using the spring 33 is to prevent the valve 25 from closing by gravity after the throttle valve 9 is opened and before the valve 25 is closed by air pressure in the chamber 32. The only time this might happen is when the wrench is operated upside down. In some cases, the spring 33 can be eliminated, particularly, when the O-rings on the piston 29 offer sufficient drag to prevent the valve 25 from moving under mere gravitational force.

An air circuit is provided for opening the shutoff valve 25 after it is closed. This circuit is operative after the throttle valve 9 is closed. Looking at FIG. 2, the throttle valve stem 9 connects at its end, remote from the throttle lever 8, to a reset valve 35 sliding in the entrance to a reset chamber 36. The throttle valve stem 9 includes an extension 37 loosely mounted in an axial passage in the reset valve 35. When the throttle valve 9 is closed, the axial passage in the reset valve 35 is open allowing air to flow from the supply chamber 19 into the reset chamber 36.

When the throttle valve 9 is moved to an open position, the throttle valve stem 9 includes a beveled shoulder 38 adapted to seat in the axial bore of the reset valve 35 and plug it so that the compressed air in the supply chamber 19 is barred from entering the reset chamber 36. At the same time, the reset valve 35 is lifted off of several bleed vents 39 allowing the pressure in the reset chamber 36 to escape. The reset chamber 36 contains a spring 40 urging the reset valve 35 to its seated position wherein the vents 39 are closed.

The reset chamber 36 is connected by a pipe 41 to the valve-opening chamber 31 of the shutoff valve 25 so that the admission of pressure to the reset chamber 36 will urge the shutoff valve 25 to its open position as shown in FIG. 1. It will be understood that the reset chamber 36 is only pressurized when the wrench 1 is at rest and the throttle valve 9 is closed as shown in FIGS. 1 and 4. At all other times, the reset chamber 36 is exhausted.

The depth measuring system of the wrench 1 includes an air circuit which is fed from the inner chamber 23 through a passage 43. The passage 43 is connected by an external pipe 44 containing a fluid throttling orifice 45 and a tee coupling 46. The stem of the tee 46 is connected by a passage 47 to the valve-closing chamber 32 of the shutoff valve 25. The portion of the pipe 44 in front of the tee 46 runs forward to the front end 5 of the wrench where it is connected to a fitting 49 that includes an outlet 50. Normally, the outlet 50 is open and air passing though the pipe 44 and fitting 49 is exhausted to the atmosphere.

The spindle 11 is hollow and contains a elongated bar or probe 52 slidably mounted therein. The inner end of the probe 52 includes a fixed washer 53 preventing the probe 52 from dropping from the spindle 11 before the wrench 1 is placed on a fastener, and is urged outwardly of the spindle by a spring 54 interposed between the washer 53 and the fitting 49. The inner end of the probe 52 is adapted to block the outlet 50 when urged against the fitting 49. Normally, the spring 54 will maintain the probe 52 in its extended position as shown in FIG. 2, wherein the outlet is free and open. The length of the probe 52 is selected to engage the end of a stud 56 during the driving of a nut 57 on the stud 56 and to be moved rearwardly until it closes the outlet 50 when the nut 57 is driven to a predetermined depth. It is assumed that the outer end of the stud 56 has been previously driven to a predetermined depth in relationship to the work surface 58 so that the probe 52 is able to accurately measure the driven depth of the nut 57 in relationship to the work surface 58.

Assuming that the wrench is being operated to drive the nut **57** and the throttle valve **9** is open as shown in FIG. **2**, the motor **7** will be operating and the shutoff valve **25** will be in its open position. Air is flowing through the pipe **44**, fitting **49** and outlet **50** at a rate so that there is little or no pressure in the valve-closing chamber **32** of the shutoff valve **25**. This pressure can be varied by varying the size of the orifice **45**. In general, the outlet **50** is large enough so that air is exhausted from the outlet **50** faster than it can back up and create a pressure in the valve-closing chamber **32** of the shutoff valve **25**.

When the probe **52** is moved inwardly to block the outlet **50**, the pressure rapidly increases in the pipe **44** and in the valve-closing chamber **32** to urge the piston **29** in a valve-closing direction, thereby closing the shutoff valve **25**. At this moment, the motor stops and the operator known that the driving cycle of the wrench is finished. This will occur when the nut **57** has been driven to a predetermined depth as measured by the probe **52**. FIG. **3** illustrates the position of the valve elements of the wrench at this moment.

After the motor stops, the operator will lift the socket **17** from the nut **57** to allow the probe **52** to return to its extended position. Usually, the operator will release the throttle **8** as he lifts the wrench **1** from the nut **57**, causing the throttle valve **9** to close. The closing of the throttle valve **9** will cause the reset valve **35** to open so that pressure in the supply chamber **19** flows into the reset chamber **36** and thence into the valve-opening chamber **31**. The return of the probe **52** to its extended position uncovers the outlet **50** so that the previous buildup of pressure in the valve-closing chamber **32** is vented allowing the pressure in the valve-opening chamber **31** to return the shutoff valve **25** to its open position. At this time, the wrench **1** is ready for another cycle. It should be noted that the wrench cannot be recycled unless it is lifted from the nut and the throttle closed.

The fitting **49** is threaded into a large nut **60** fastened to the front end **5** so that it can be moved to different positions in the nut **60** to vary the depth at which the wrench **1** will shut off its motor. The fitting **49** includes a locknut **61** to lock the fitting at a selected depth in the larger nut **60**.

SECOND EMBODIMENT—FIG. 5

The embodiment shown in FIG. **5** differs from the first embodiment by the elimination of the slidable probe **52**. In place of the probe **52**, the fitting **49** includes an elongated extension **63** which extends forwardly through the hollow spindle **11** and is adapted to directly engage the end of the stud **56**. The engagement of the extension **63** with the end of the stud **57** closes the outlet **50** in the end of the extension **63** and causes the shutoff valve **25** to close in a manner identical to the operation of the first embodiment.

While two embodiments of the invention have been illustrated and described in detail, this invention is not limited simply to the described embodiments but contemplates other embodiments and variations which utilize the concepts and teachings of this invention as set forth in the accompanying claims.

I claim:

1. A power wrench including:

a casing containing a rotary motor connected to a spindle adapted to drive a fastener;

signal means to measure the depth of a fastener being driven by said wrench and operative to create a signal in response to the arrival of the fastener at a predetermined depth;

said signal means including a fluid signaling circuit including a normally open fluid outlet exhausting a continuous flow of fluid and means to close said outlet in response to a predetermined depth of the fastener; and

shutoff means operative in response to said signal to shut off said wrench motor when the fastener arrives at the predetermined depth.

2. The power wrench of claim **1** wherein:

said measuring means includes a probe extending axially through said spindle and adapted to engage the end of a stud or bolt holding said fastener.

3. The power wrench of claim **1** wherein:

said shutoff means includes a normally open shutoff valve controlling the flow of motor fluid to the motor of the power wrench and an actuator operative to close said shutoff valve in response to the closing of said outlet.

4. The power wrench of claim **3** wherein:

said shut off valve closes in response to a rise in fluid pressure in said signaling circuit.