United States Patent

[11] 3,587,683

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[54] **AUTOMATIC SCREWDRIVER**
14 Claims, 11 Drawing Figs.

[52] **U.S. Cl.** **144/32,** 206/56
[51] **Int. Cl.** **B27b 17/00**
[50] **Field of Search** ..... 144/32; 206/56 (DF)

[56] **References Cited**

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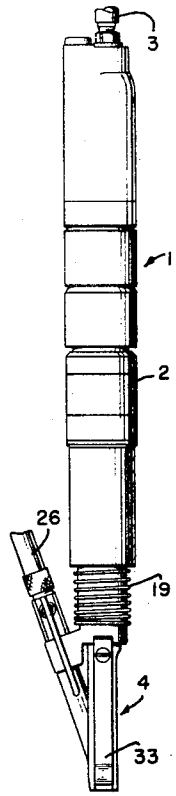
ABSTRACT: An automatic screwdriver having a head with a movable section which is normally retracted so that the screwdriver blade is resiliently urged against a screw located in the screwdriver and having means for moving the movable section forward to allow the feeding of a screw into the head and thereafter retracting the movable section. Urging the screwdriver blade resiliently against the head of the screw prevents the screw from backing up in the head when it is applied to a workpiece. Pneumatic pressure is used to move the movable section of the head forward.



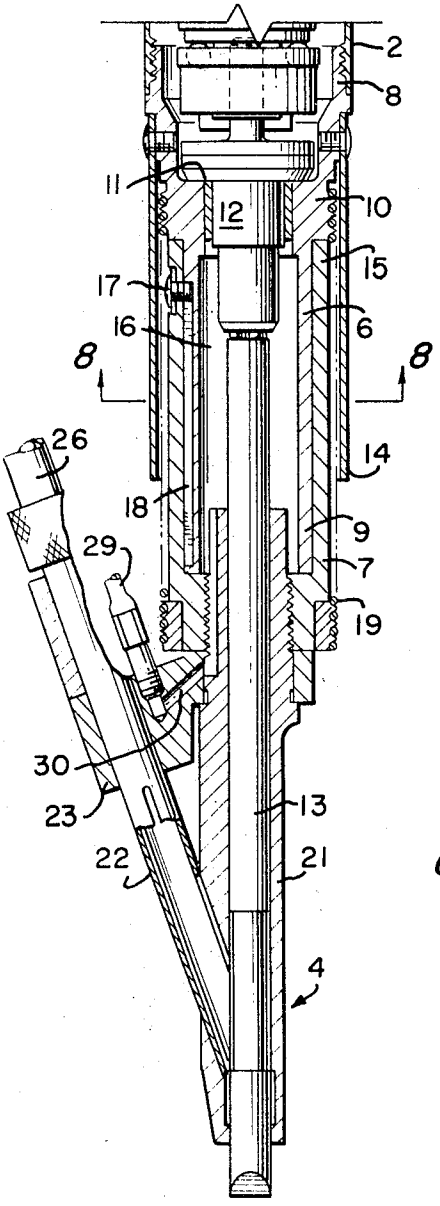


FIG. 2

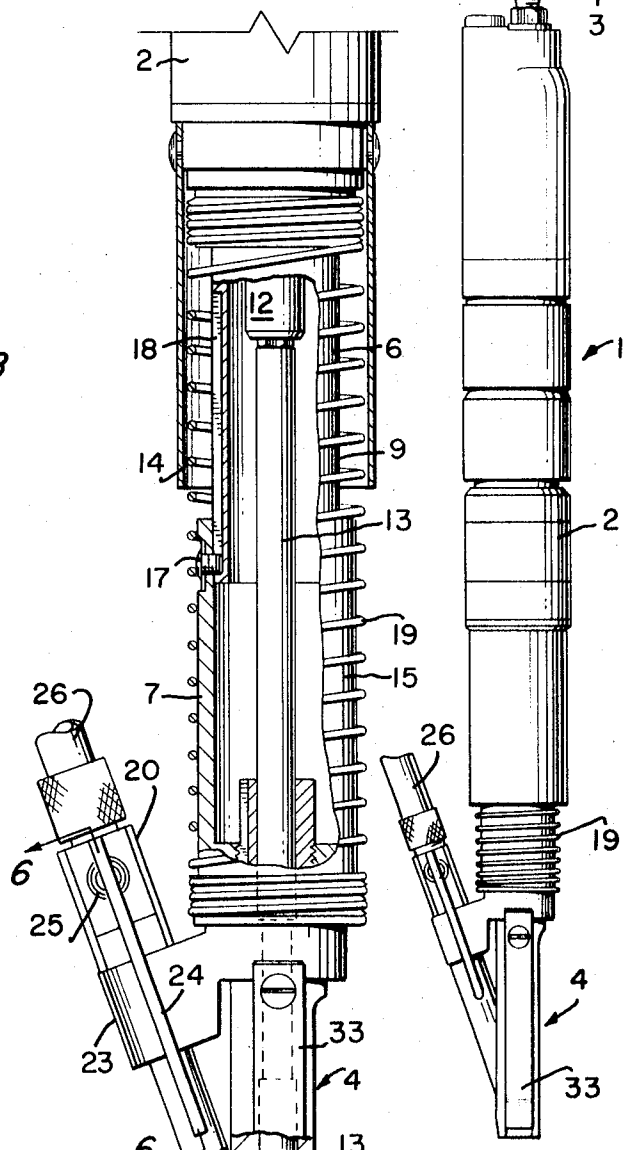


FIG. 1

FIG. 3

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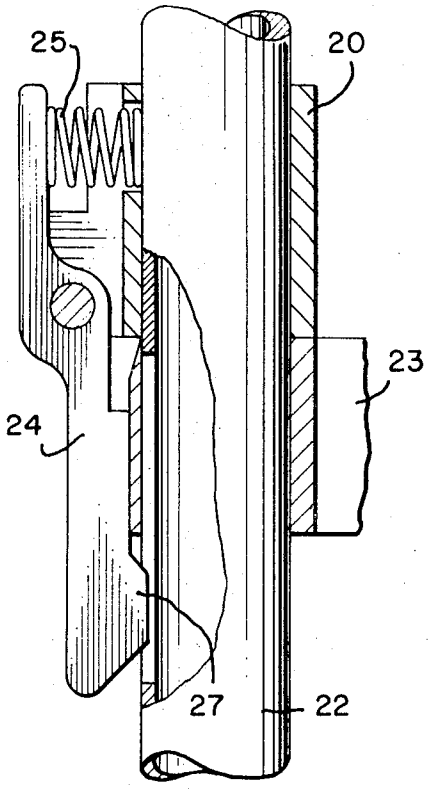

FIG. 6

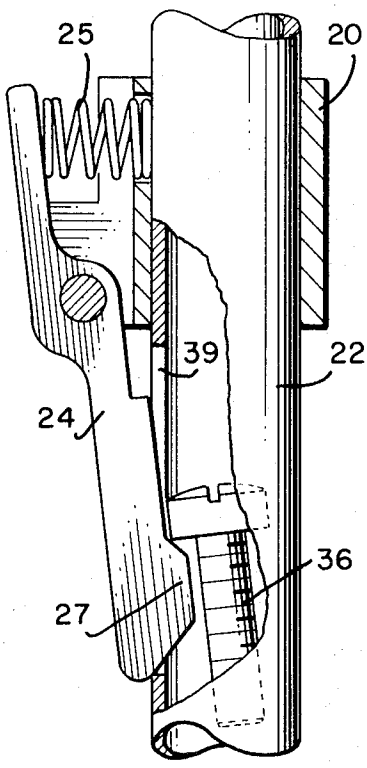

FIG. 7

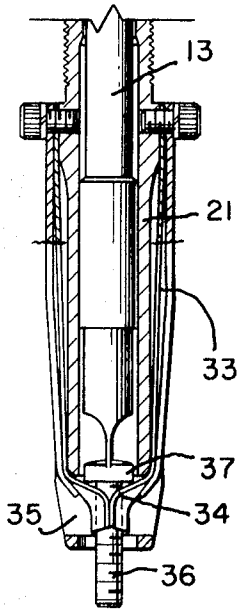

FIG. 5

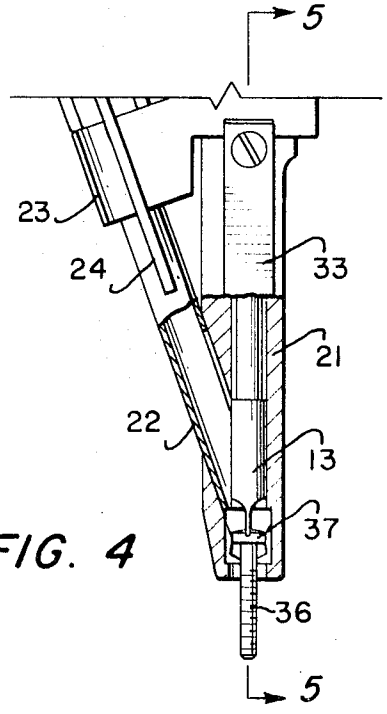

FIG. 4

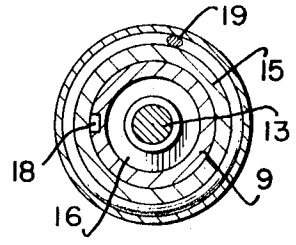

FIG. 8

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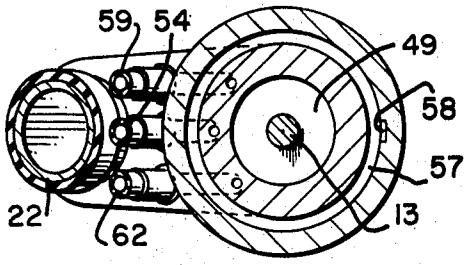

FIG. 11

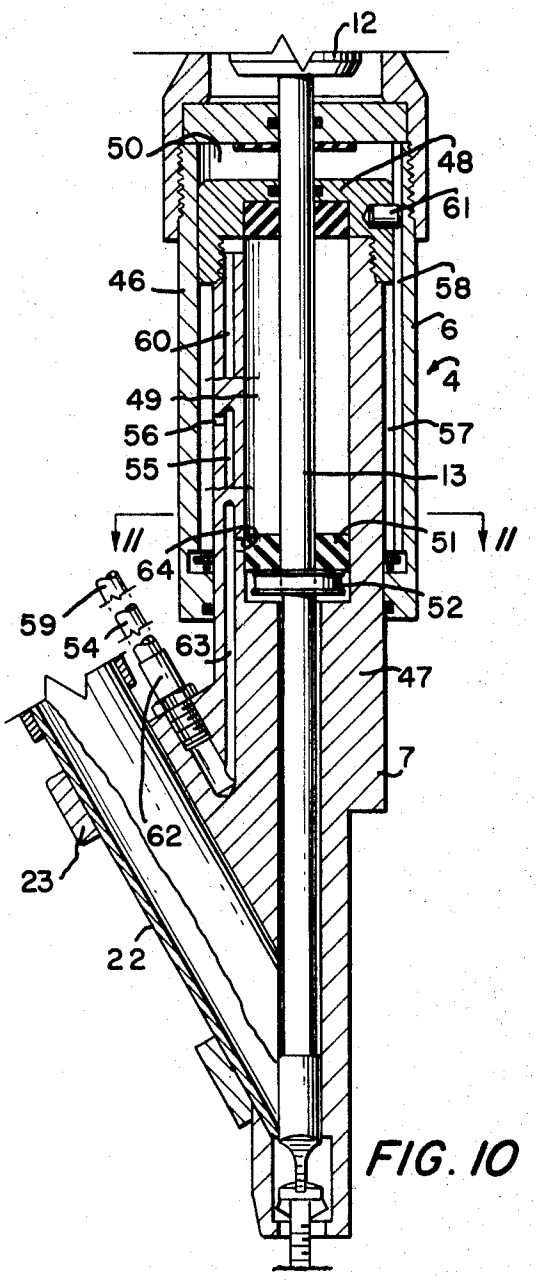

FIG. 10

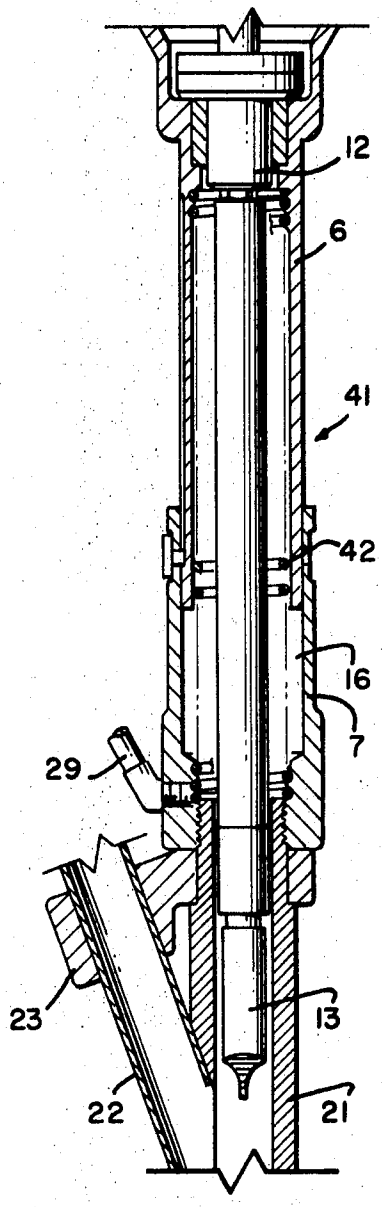

FIG. 9

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AUTOMATIC SCREWDRIVER

BACKGROUND OF INVENTION

This invention relates generally to power screwdrivers and more particularly to automatic screwdrivers wherein fasteners are individually and automatically fed to the screwdriver head as they are needed.

In general, automatic screwdrivers have a head with a Y-type connection to a fastener-feeding conduit or hose. Normally, the driver blade of the screwdriver is retracted or the head is resiliently extended, and a screw is fed into the head in position for being driven. Thereafter, the operator presses downwardly on the screwdriver to force the blade against the screw. If the screwdriver is of the portable type, the screw must engage the work before the screwdriver blade engages the head of the screw. As a result, the screw is urged rearwardly in the head of the screwdriver and means must be provided to prevent the screw from backing up. Otherwise, if the screw backs up into the head, it will jam further operation of the screwdriver.

SUMMARY OF INVENTION

The principal object of this invention is to provide an automatic screwdriver that eliminates the need for a separate means to prevent a fastener from backing up in the screwdriver head during the initial stages of driving of the fastener.

Other important objects are: to provide an automatic screwdriver which urges the screwdriver blade resiliently against a fastener resting in the screwdriver head; and to provide an automatic screwdriver having a movable head section which automatically moves apart from the screwdriver blade in order to feed a fastener to the screwdriver head.

In general, these objects are attained in an automatic screwdriver head including a front section that is reciprocably mounted in a rear section and having first resilient means urging the front section forwardly on the spindle of the fastener driving tool and second resilient means urging the front section rearwardly on the spindle. One of the foregoing resilient means is selectively operated by fluid pressure which is intermittently applied thereto to move the front section forwardly for feeding a fastener to it. After the fastener is fed to the head, the front section is released and allowed to return to its retracted position wherein the tool spindle rests against the head of the fastener to prevent its backing up when applied to a workpiece. The front section can be retracted by either a mechanical spring or by pneumatic pressure.

BRIEF DESCRIPTION OF DRAWINGS

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

FIG. 1 is an elevational view of an automatic screwdriver incorporating the invention;

FIG. 2 is an enlarged axial section of the screwdriver head with the head empty and retracted over the screwdriver blade;

FIG. 3 is a section similar to FIG. 2 showing the head extended with a screw deposited in the head;

FIG. 4 is a fragment of FIG. 3 showing the head returned to a retracted position with the blade resting on the screw;

FIG. 5 is an axial section taken on the line 5–5 in FIG. 4 and showing the spring fingers holding the screw;

FIG. 6 is an enlarged fragmentary section taken on the line 6–6 in FIG. 3 and showing the latch means for the screw feeding tube;

FIG. 7 is a view similar to FIG. 6 and showing the screw feeding tube removed from the head;

FIG. 8 is a cross section taken on the line 8–8 in FIG. 2;

FIG. 9 is a fragmentary axial section of the head of a second embodiment of the automatic screwdriver;

FIG. 10 is a fragmentary axial section of the head of a third embodiment; and

FIG. 11 is a cross section taken on the line 11–11 in FIG. 10.

DESCRIPTION OF PREFERRED EMBODIMENTS

The automatic screwdriver 1 shown in FIG. 1 comprises a casing 2 adapted at its rear end to be connected to a hose 3 for supplying compressed air to it for operating its motor (not shown). The screwdriver 1 is conventional. The front end of the casing 2 is attached to a screwdriver head 4 which is the subject of this invention.

Looking at FIG. 2, the head 4 includes a rear stationary section 6 and a front movable section 7 telescoping on each other. The rear section 6 includes an externally threaded rear annular flange 8 threaded to the forward portion of the screwdriver casing 2, a forwardly extending tube 9 and an intermediate bearing portion 10. A screwdriver spindle 12 is journaled in the bearing portion 10 and is adapted to be driven by the motor (not shown) in the automatic screwdriver 1. The forward end of the spindle 12 carries an elongate screwdriving blade 13 which extends forwardly through the tube 9 and through the front section 7 of the head 4. The bearing portion 10 includes a rearwardly facing shoulder 11 adapted to engage a portion of the spindle 12 to limit the forward movement of the spindle 12.

The front section 7 includes a rearwardly opening sleeve 15 slidably telescoping over the tube 9 and cooperating with the tube 9 to form a closed chamber 16. The sleeve 15 contains a radially extending screw 17 near its rear end, projecting into a longitudinal slot 18 formed in the exterior of the tube 9 to act as a stop preventing the front section 7 from sliding entirely off of the tube 9. The front section 7 is resiliently urged rearwardly on the tube 9 of the rear section 6 by a coiled tension spring 19 which encircles the sleeve 15 and is attached between the front end of the sleeve 15 and the rear end of the tube 9, where the tube 9 joins the intermediate bearing portion 10 of the rear section 6. The spring 19 urges the front section 7 to the retracted position shown in FIG. 2 and resists any forward motion of the front section. The spring 19 is partly covered by a guard 14 attached to the rear section 6.

The forward section 7 of the head further includes an elongate tubular nose 21 extending forward from the sleeve 15 and slidably receiving the driver blade 13. The rear end of the elongate nose 21 is threaded into the front end of the sleeve 15. A screw feeding tube 22 is slidably connected to the interior of the nose 21 at an angle that is inclined outwardly and rearwardly from the nose 21. An offset bracket 23 is attached over the rear portion of the nose 21 and serves to provide additional support to the screw feeding tube 22.

As shown in FIG. 6, the tube 22 slides through the bracket 23 and is held in place by a latch structure including a pawl 24 pivoted on a frame 20 fixed on the tube 22 and biased to a locking position by a spring 25 mounted on the frame 20. The rear end of the tube 22 is attached to a screw feeding hose 26. The pawl 24 includes a leg, also designated 24, extending forward over the bracket 23 and having a tang 27 projecting inwardly over the front edge of the bracket 23.

Fluid-pressure means is provided for movably extending the front section 7 of the head 4 by injection of fluid pressure into the chamber 16 formed by the telescoping sleeve 15 over the tube 9. This fluid pressure means includes a hose 29 attached to the bracket 23 and communicating with an interior passage 30 extending through the bracket 23 and through the rear portion of the nose 21 into the chamber 16, as shown in FIG. 2. It can be readily seen that when fluid pressure such as compressed air is fed into the chamber 16, the front section 7 including the sleeve 15, will telescope forward against the spring 19 until the screw 17 arrives at the forward end of the groove 18. This position is the extended position of the screwdriver head 4, as shown in FIG. 3.

The nose 21 of the front section 7 further includes a pair of resilient fingers 33 attached diametrically opposite each other on the exterior of the nose 21 and extending forwardly to terminate in a pair of inwardly angled spring tips 34 extending through slots 35 formed in the nose 21, immediately behind the front surface of the nose 21. The spring tips 34 extend into the hollow interior of the nose 21 and are adapted to hold the

head of a screw 36 between them. The resilient spring tips 34 grasp the head 37 of the screw 36 as the screw is initially fed into the nose 21, thus, preventing the screw from continuing forward through the front end of the nose 21, and also hold the screw 36 in place during the initial stages of driving the screw.

In describing the operation of the screwdriver 1, it will be assumed that the operation starts with the head 4 empty as shown in FIG. 2. In this position the front section 7 of the head 4 is retracted rearwardly on the rear section 6 by spring 19, with the driver blade 13 projecting from the end of the nose 21. Automatic mechanism (not disclosed in this application) applies air pressure to the hose 29 to admit such air pressure to the chamber 16 causing the front section 7 to move rapidly forward on the rear section 6 and against the force of the spring 19. The forward movement continues until the front section 7 arrives in the position shown in FIG. 3, which is the extended position of the head 4. Thereafter, the automatic mechanism feeds a screw 36 through the screw feeding hose 26, the screw feeding tube 22 and into the nose 21 where it rests in the position shown in FIG. 3. In this position, the screw 36 is clasped between the pair of spring tips 34 of the fingers 33 attached to the sides of the nose 21. The fingers 33 prevent the screw 36 from continuing forward through the nose 21 as it is fed into position.

As soon as the screw 36 arrives in place in the nose 21, the fluid pressure in the chamber 16 is automatically exhausted, allowing the front section 7 to return to its retracted position wherein the screwdriver blade 13 will resiliently rest on the head 37 of the screw 36, as shown in FIG. 4. Thereafter, the operator moves the screwdriver 1 to press the screw 36 against the workpiece. Normally, the movement of pressing the screw against the workpiece will trigger the screwdriver 1 into operation. Alternately, the operator can initiate the operation of the screwdriver by a hand throttle. As the screw 36 is driven, the front end of the nose 21 eventually engages the surface of the work, preventing its further forward motion and the screwdriver blade 13 continues driving the head of the screw through the tips 34 of the fingers 33, until the screw 36 is driven "home."

By resiliently urging the screwdriver tip 13 against the head 37 of the screw 36, after the screw 36 is fed to the head 4, the screw 36 is prevented from backing up or shifting to an improper position when the screw is initially pressed against a work surface. This is a very important benefit because the prior art has the problem of holding the screw 36 against shifting in the head as the operator presses the screw against the work.

FIG. 7 illustrates a portion of the screw feeding tube 22 withdrawn from the bracket 23. In this position, the forward end of the pawl 24 is free to swing inwardly through an elongated slot 39 in the tube 22 and to block the interior of the tube, thereby barring the passage of a screw therethrough. This is a safety feature which prevents the accidental ejection of a screw from the end of the tube 22 when the tube is removed from the bracket 23. Without this safety feature, inadvertent operation of the screw feeding mechanism would result in screws being "shot" from the end of the tube 22 with sufficient force to injure surrounding personnel.

SECOND EMBODIMENT—FIG. 9

The second embodiment 41 shown in FIG. 9 is essentially the same as the first embodiment with the exception that a retraction spring 42 is contained within the chamber 16, rather than being located outside of the two head sections 6 and 7.

THIRD EMBODIMENT - FIGS. 10 and 11

The third embodiment 44 differs from the preceding embodiments by utilizing pneumatic pressure to move the front section 7 of the head in the extension and retraction directions. The two earlier embodiments utilize a spring to retract the front section.

The rear stationary section 6 of the head includes a sleeve 46 extending forwardly and slidably receiving, internally thereof, a tube 47 forming part of the front section 7. The tube 47 is closed at its rear end by a cap 48 to form a retraction chamber 49 located within the tube 47. The retraction chamber 49 is closed at its forward end by a sealing washer 51 attached on the driver blade 13 and seated on a flange 52 fixed on the driver blade 13. The cap 48 on the rear end of the tube 47 cooperates with the interior of the sleeve 46 to form an extension chamber 50.

It is readily seen that the application of pneumatic pressure to the extension chamber 50 will urge the front section 7 forwardly of the rear section 6. Conversely, the application of pneumatic pressure to the retraction chamber 49 will urge the front section 7 rearwardly within the rear section 6.

Pneumatic pressure is applied to the extension chamber 50 through a hose 54 which is attached to an extension passage 55 located in the bracket 23 and extending rearwardly through the tube 47. The extension passage 55 terminates in a port 56 which exits into an annular space 57 located between the tube 47 and the sleeve 46. The annular space communicates with the extension chamber 50 through a longitudinal slot 58 cut into the interior of the sleeve 46 to guide the key pin 61. The key pin 61 is similar to the stop screw 17 of the first embodiment, in that it keys the tube 47 to the sleeve 46.

Pnuematic pressure is fed to the retraction chamber 49 through a hose 59 which connects to a retraction passage 60. The retraction passage 60 extends through the bracket 23 and the tube 47 to exit into the rear end of the chamber 49.

A third hose 62 is connected to a signal passage 63 which also extends rearwardly through the bracket 23 and the tube 47. The passage 63 is provided to initiate a pneumatic signal in the event the head is empty of screws when the front section 7 is retracted. In the event the front section 7 is retracted and does not contain a screw, the tube 47 moves rearwardly until the signal port 64 is uncovered by the seal washer 51. When this occurs, pneumatic pressure in the chamber 49 enters the signal passage 63 to create a pneumatic signal indicating the empty head. This signal may be utilized to recycle the screw feeding operation and to indicate trouble to the operator. The port 64 is not uncovered when a screw is in the front section 7. In addition, this signal can be used to recycle the tool at the end of driving a screw.

While several embodiments of the invention are described and illustrated in detail, this invention is not limited simply to the embodiments but contemplates other embodiments and variations which utilize the concepts and teachings of the invention.

We claim:

1. A power fastener driving tool of the portable type adapted to be held in the human hand and comprising:
   - a casing containing a rotary motor driving a fastener driving spindle extending from one end of said casing;
   - a head slidably mounted on said one end of said casing to reciprocate axially relative to said spindle and adapted to hold a fastener in position for driving by said spindle, said head having a forward end adapted to discharge individual fasteners as they are driven and having an inlet located rearwardly from said forward end for receiving individual fasteners preparatory to driving said fasteners;
   - first resilient means urging said head forwardly on said spindle;
   - second resilient means urging said head rearwardly on said spindle;
   - one of said resilient means being operated by pneumatic pressure which is intermittently applied to said head causing said head to be initially moved forward for feeding a fastener to it and thereafter moved rearwardly to resiliently urge the spindle against the fastener prior to driving the fastener.

2. The tool of claim 1 wherein: the other resilient means is a spring.

3. The tool of claim 1 wherein: the other resilient means uses pneumatic pressure.

4. The tool of claim 1 wherein:

said one resilient means applied intermittently to said head urges it forward to its fastener receiving position.

5. The tool of claim 1 wherein:

said head includes a front section slidably mounted on a rear section which is attached to said casing with said sections being arranged to cooperatively form an expansible chamber between them; and

means for introducing pneumatic pressure into said chamber.

6. The tool of claim 5 wherein:

said fluid chamber is arranged to move said front section forward on said rear section when expanded by pneumatic pressure.

7. The tool of claim 6 wherein: said sections telescope on each other.

8. The tool of claim 7 wherein:

said front section is resiliently urged rearwardly on said rear section by a spring connected between said sections.

9. The tool of claim 8 wherein:

said rear section includes a forwardly projecting tube surrounding said spindle with an annular space formed therebetween;

said front section includes a rearwardly projecting sleeve telescoping over said tube; and

stop means interconnected between said tube and said sleeve limiting the forward movement of said front section.

10. The tool of claim 9 wherein:

said tube and said sleeve are sealingly engaged with said spindle to substantially close said annular space and thereby form said fluid chamber.

11. The tool of claim 6 including:

a second fluid chamber formed by said front and rear sections and adapted to contain fluid pressure to urge said front section rearward.

12. A power fastener driving tool comprising:

a casing containing a rotary motor driving a spindle and a head surrounding said spindle;

said head having a forward end to discharge individual fasteners as they are driven and having an inlet located rearwardly from said forward end for receiving individual fasteners preparatory to driving said fasteners;

a fastener feeding tube slidably mounted in said inlet at an angle extending outwardly and rearwardly from said head;

latch means locking said tube in place in said head an manually releasable to detach said tube; and

said latch means being combined with an automatic means for blocking said tube when it is removed from said head to prevent it from accidentally shooting fasteners and including

a pawl pivoted on said tube and operative to project into said tube to block it when said tube is removed from said head and to move to a position clear of blocking the tube when the tube is attached to the head.

13. A power fastener driving tool of the portable type adapted to be held in the human hand and comprising:

a casing containing a rotary motor driving a fastener driving spindle extending from one end of said casing;

a head slidably mounted on said one end of said casing to reciprocate axially relative to said spindle and adapted to hold a fastener in position for driving by said spindle, said head having a forward and adapted to discharge individual fasteners as they are driven and having an inlet located rearwardly from said forward end for receiving individual fasteners preparatory to driving said fasteners; and

resilient means normally urging said head rearwardly on said spindle to hold a fastener against said spindle prior to driving the fastener.

14. The tool of claim 13 including:

means to periodically move the head and spindle relatively apart for delivering a fastener into said head.