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3,477,629 11/1969 Becht 227/130

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[54] **FASTENER DRIVING DEVICE OPERATING MEANS**
23 Claims, 11 Drawing Figs.

[52] U.S. Cl. 227/8,
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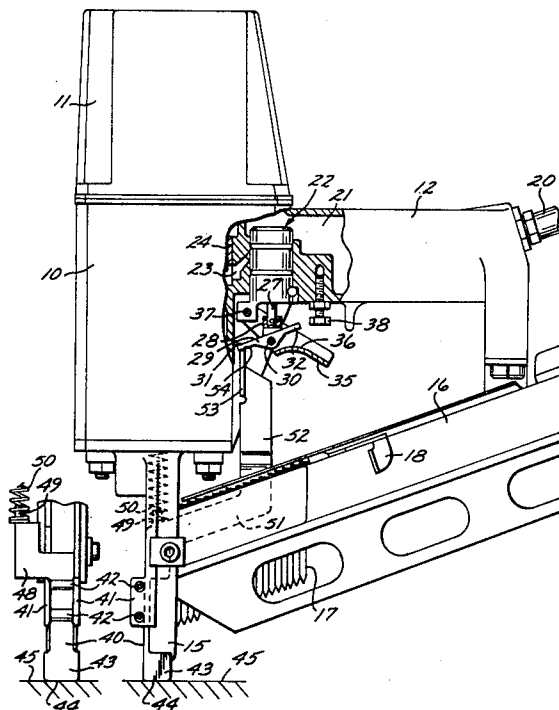
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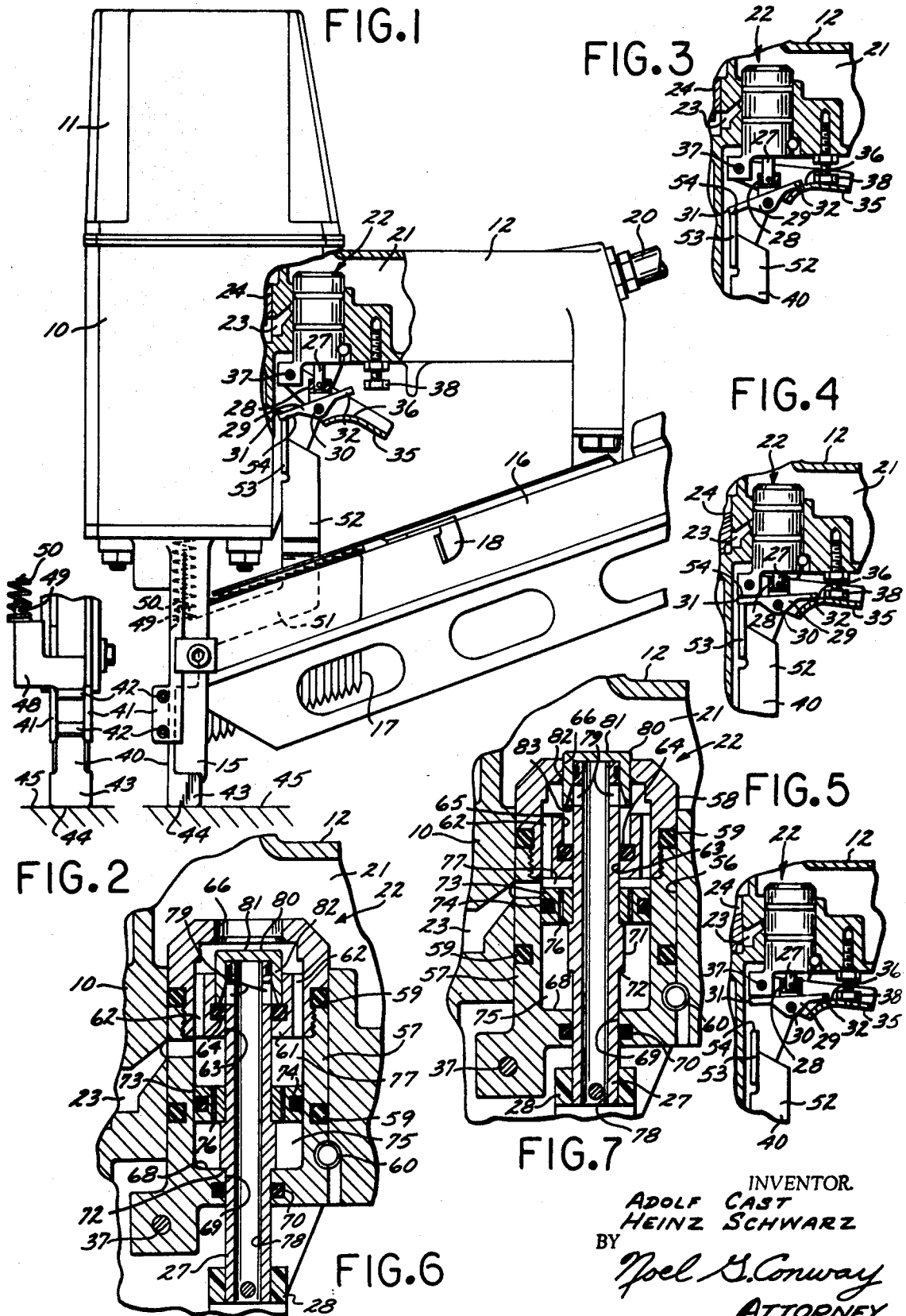
[50] Field of Search 227/7; 8,
 130

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ABSTRACT: A powered fastener driving device having a power control means for selectively supplying power to a driver blade which drives fasteners out of the device, which power control means includes a member movable between a first position where no power is supplied to the driver blade and a second position where power is supplied to cause the driver blade in the device to drive a fastener, said control means including a counterreturn chamber therein which prevents said movable member from returning from said second position until after a predetermined lapse of time after the member is moved to said second position from said first position, and a crossmember pivotally mounted at its midpoint on said movable member and arranged with a manually operated trigger and a slidable workpiece touch-member which extends slightly beyond the front end of the nose piece of the device to cause the movable member to said second position when the trigger is pulled and the touch-member is moved rearwardly by engaging said device nose piece to the workpiece.





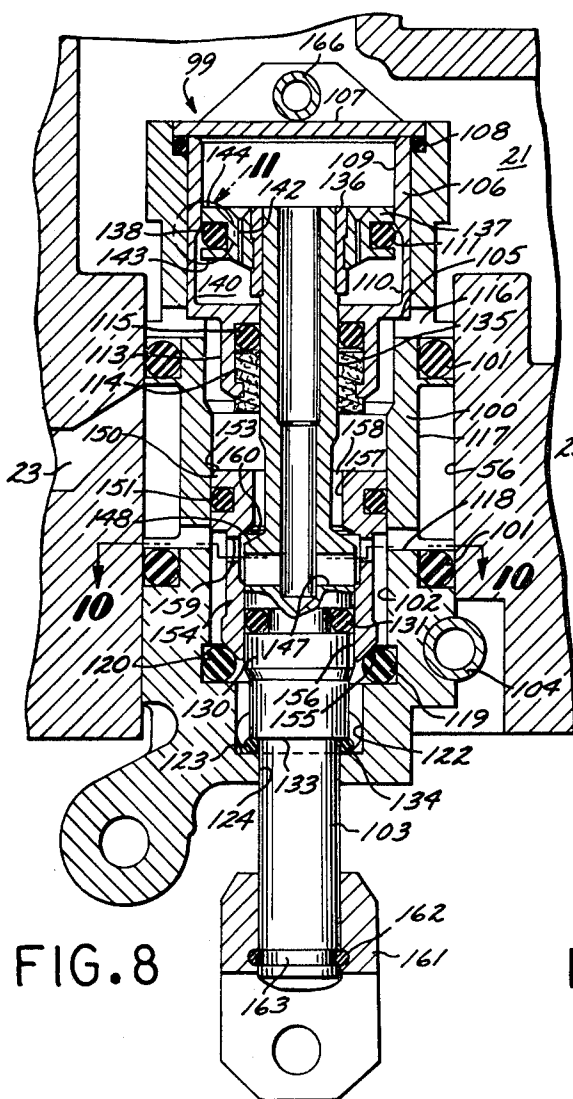


FIG. 8

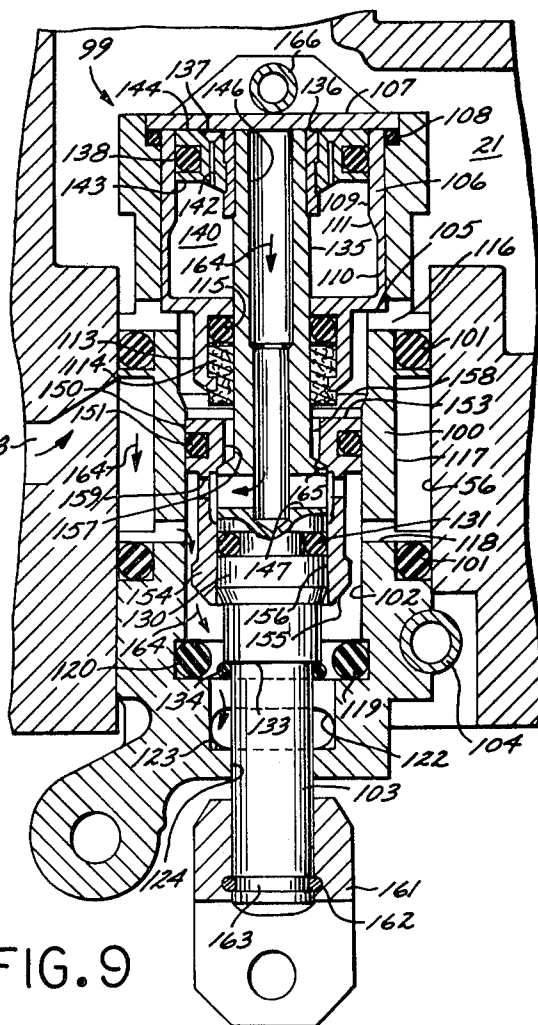


FIG. 9

FIG. 10

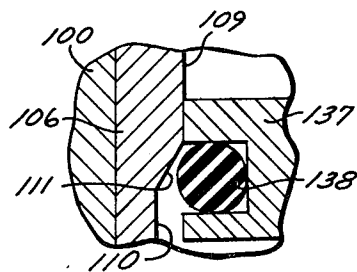
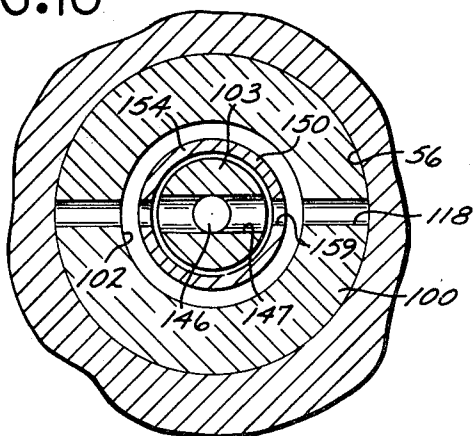


FIG. 11

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FASTENER DRIVING DEVICE OPERATING MEANS

This invention relates to fastener driving device operating means and more particularly to such means which will prevent a fastener driving device from erroneously double acting.

A principal use of the present invention is in fastener driving devices having operating means which include a manually positionable trigger and a workpiece touch-member. In such devices, the workpiece touch-member is slidably mounted on the device and projects slightly beyond the nose piece of the device. The device also includes a manually positionable trigger which cooperates with the means for controlling the power to drive the driver blade such that—when the trigger is moved to its operative position—the device is actuated by moving the workpiece touch-member rearwardly by touching the front end of the nose piece of the device to the workpiece. Such devices have been provided in the past, however, the following problem has been present. The operator will press the fastener driving device against the workpiece and the recoil of driving the fastener will “kick” the device slightly away from the workpiece. This recoil is sufficient that the workpiece touch-member will return to its original position. Then, the continued pressure of the operator will cause the driving device to move back against the workpiece and recycle at the same spot on the workpiece.

Such double action, or recycling of the fastener driving device has the disadvantage that two fasteners are placed where it is only desired to place one fastener. In pneumatically powered fastener driving devices, there is the additional problem that there may not be sufficient power to drive the second fastener all the way into the workpiece.

One aspect of the present invention is that it includes an arrangement wherein the workpiece touch-member can only operate in one way on the means which controls the power to the driver blade. More particularly, the touch-member can only operate to cause to be actuated the means controlling the power to the driver blade, however, the touch-member cannot exert any force tending to return the power control means to its unactuated condition.

Another aspect of the present invention is that the power control means includes means which prevents the power control means from recycling for a predetermined lapse of time after the power control means is actuated. The operation of this aspect of the power control means is further augmented by another aspect of the present invention which provides that the trigger and the touch-member are not physically connected to the power control means such that they cannot reduce or effect the above mentioned lapse of time.

A further aspect of the present invention is that the power control means includes structure which will cause the means to tend to snap from one position to the other. This causes the device to operate in a more regular fashion. This last mentioned aspect of the present invention is augmented by an aspect of the present invention which provides for large forces to cause the power control means to return to its unactuated position, and yet those forces will effectively diminish before the time that it is desired to recycle the device.

With the foregoing in mind it is a major object of this invention to provide an improved fastener driving device operating means.

Another object of this invention is to provide a fastener driving device operating means which can be selectively operated through the use of a workpiece touch-member.

A further object of this invention is to provide a fastener driving device operating means which automatically prevents undesired recycling of the driving device.

It is still another object of this invention to provide a fastener driving device operating means which can be manufactured at a low cost and operated with low maintenance.

Still another object of this invention is to provide fastener driving device operating means which will prevent recycling of the device for a predetermined time and then will rapidly reset said means for a new operation.

Other and further objects of this invention will become apparent in the detailed description below in conjunction with the attached drawings wherein:

FIG. 1 is a partially cutaway side view of a fastener driving device incorporating a preferred form of the present invention;

FIG. 2 is a fragmentary view of the nose piece portion of the fastener driving device shown in FIG. 1 as seen from the left in FIG. 1;

FIG. 3 is a fragmentary cross-sectional view disclosing the arrangement of the power control means when trigger means is in the actuated position and the workpiece touch-member is still in the forward position;

FIG. 4 is a fragmentary cross-sectional view of the power control means shown in FIG. 3 but with the workpiece touch-member in the rearward position assumed when the fastener driving device is brought into contact with the workpiece;

FIG. 5 is a fragmentary cross-sectional view of the power control means shown in FIG. 3 with the workpiece touch-member returned to its original position but before the movable member in the control means has returned to its first position;

FIG. 6 is an enlarged fragmentary cross-sectional view of the first preferred power control means with the movable member thereof in the first position wherein the driving device driver blade would not be actuated;

FIG. 7 is an enlarged fragmentary cross-sectional view of the power control means shown in FIG. 6, but with the movable member therein in the second position where the driver blade of the fastener driving device would be actuated;

FIG. 8 is an enlarged fragmentary cross-sectional view of a second preferred power control means the movable member thereof in the first position wherein the driving device driver blade would not be actuated;

FIG. 9 is an enlarged fragmentary cross-sectional view of the power means shown in FIG. 8, but with the movable member therein in the second position where the driver blade of the fastener driving device would be actuated;

FIG. 10 is a cross-sectional view of the power control means shown in FIG. 8 taken along line 10-10 in FIG. 8; and,

FIG. 11 is an enlarged fragmentary cross-sectional view of a portion of the power control means taken along line 11 in FIG. 8.

Fastener driving devices of the type to be described are used in many positions, e.g., when nailing horizontal floors, or when nailing vertical walls. Therefore, although the invention is shown in the relation disclosed in the drawings, i.e., with the driving device pointed down, the invention will not generally be described in that frame of reference. Rather, the invention will be described on the basis that the nose piece of the driving device is at the forward end of the device as the fasteners are driven out of the forward end of the device. Therefore, generally speaking, the terms “forward” and “rearward” will be used herein to establish a frame of reference to relate the various components together.

In FIG. 1 there is disclosed a preferred embodiment of the present invention incorporated in a pneumatically powered fastener driving device. The particular fastener driving device disclosed is that driver device disclosed in detail in U.S. Pat. No. 3,351,257. Accordingly, reference is made to said patent for any disclosure of the fastener driving device not specifically illustrated or described herein.

In said FIG. 1, it can be seen that the fastener driving device has a main body 10 which includes an air chamber cap 11 and a hollow handle 12. At the front end of the main body 10 there is provided a nose piece 15. A magazine 16 is secured to the nose piece 15 and to the handle 12, which magazine has a stick, or strip, of nails 17 therein which are urged toward a barrel (not shown) in the nose piece 15 by a spring driven follower 18. As the particular driving device shown is operated by air pressure, there is an air hose fitting 20 provided in order to communicate air pressure into air chamber 21 in the handle 12 and the air chamber in the cap 11.

Indicated generally by the arrow 22, there is provided a power control means which communicates the air in the chamber 21 with passage 23. This passage 23 communicates with one side of a cylindrical slide valve 24 which is the main

valve of the driving device. Further details of the driving device are shown in the above mentioned patent. For the purposes herein, it is sufficient to state that, when the main valve is in the position shown in the FIGS. 1 and 3, the area on the rear side of the piston of the driver blade assembly will be vented to atmosphere. When the main valve 24 is in the position shown in FIGS. 4 and 5, the supply of pressurized air in the chamber 21 and the cap 11 will be supplied to the rear side of the piston of said driver blade assembly. In this latter case, the driver blade assembly will be driven forward to drive any fastener in the barrel of the nose piece 15 into a workpiece.

The power control means 22 has a movable member 27 therein. When the movable member 27 is in its first, or unactuated, position (the lower position as shown in FIGS. 1 and 3) air pressure is communicated from the chamber 21 through the passage 23 to the one side of the main valve 24. When the movable member 27 is in its second, or actuated, position (the upper position as shown in FIGS. 4 and 5) the passageway 23 is vented to atmosphere by structure to be described. Before going on to the details in which this is accomplished, the manner in which the movable member 27 is moved between its first and second positions will now be described.

At its outer, or forward, end the movable member 27 has a clevis 28 secured thereto by means such as a pin. This clevis 28 has a cross arm 29 pivotally mounted thereto through the use of a pin 30. Preferably, the cross arm is pivotally mounted at its midpoint thereof with first end 31 of the cross arm 29 located adjacent the main body 10 while second end 32 of the cross arm is located away from said main body.

Swingably secured to said body there is provided a trigger 35 having an engagement portion 36 thereon for a purpose to be described. The trigger 35 is bifurcated at its left end (as seen in FIGS. 1, 3, 4, and 5) in order to be swingably secured to the device through the use of a pin 37. The trigger 35 can be moved between its inoperative position shown in FIG. 1 and its operative position shown in FIGS. 3-5. An adjustable stop 38 is provided in order to adjust the operative position of the trigger 35.

A workpiece touch-member 40 is slidably mounted to the device by means such as guide plates 41 which are secured to the nose piece 15. These guide plates 41 combine with bolts 42 to hold the touch-member 40 in its desired position. As can be seen, the touch-member 40 has a U-shaped front end 43 with a U-shaped front edge 44. This touch-member 40 can be moved between its forward position shown in FIG. 1 and a rear position where the front edge 44 is substantially flush with the front end of the nose piece 15 by pressing the device against workpiece 45.

Just above the guide plates 41, the touch-member 40 has a step section 48 in order to get the touch-member to the side of the nose piece 15. At said step portion 48, there is provided an upstanding stub post 49 which is used to index compression spring 50. This compression spring resiliently biases the touch-member 40 toward its forward position. As shown in dashed lines in FIG. 1, the touch-member 40 has an offset section 51 in order that the touch-member may extend around the main body 10. From the offset section 51, rear section 52 extends rearwardly (upwardly as seen in FIG. 1) toward the power control means 22. The rear section 52 has a rear plate 53 with a rear edge 54 thereon. As can be seen, the rear edge 54 is directly in line with the first end 31 of the crossmember 29.

Referring now to FIGS. 6 and 7, the details of the power control means 22 will be described. The handle 12 has a bore 56 on the forward side thereof which receives a generally cylindrical valve housing body 57 with valve housing cap 58 threaded therein. O-rings 59 function to seal the exterior of the valve housing resulting from the combination of the body 57 and the cap 58. Pin 60 functions to hold the body 57 and cap 58 in the bore 56.

Within the valve housing provided by the body 57 and the cap 58, there is provided a cross plate 61 (which can be made as an integral part of the valve housing cap as shown). This cross plate 61 has a plurality of air passages 62 therethrough

concentrically disposed around axial bore 63 which slidably receives therethrough the movable member 27. O-ring 64 is provided to seal between the cross plate 61 and the movable member 27, and counterbore 65 is provided in the cross plate for a purpose which will be described.

The structure of the cap 58 is further defined by an axial bore 66 which communicates the interior of the cap with the chamber 21. Through front end 68 of the valve housing body 57 there is provided an axial bore 69 through which the movable member 27 is received. O-ring 70 functions to seal the area.

It will be noted that there is an enlargement 71 near the midsection of the movable member 27. This enlargement 71 has a forwardly facing annular forward edge 72 at its forward end. At the rear end of the enlargement 71, there is provided a first piston 73 which is preferably secured to the movable member 27 by frictional engagement. This piston 73 is sealed to the wall of the valve body 57 by means of O-ring 74. Thereby, a counterreturn chamber 75 is provided on one side of the piston 73 between said piston and the front end 68 of the valve housing body 57.

The manner in which the counterreturn chamber 75 operates will be described further below. As will be described, it is necessary that air pressure within the chamber 75 be allowed to bleed out of the same. To this end, there are provided two bleed passages 76 in the first piston 73, the size of which passages is determined by the size of the counterreturn chamber 75 and the length of time it is desired to prevent recycling. Thereby, air within the chamber 75 can communicate with chamber, or space, 77 on the opposite side of the piston 73.

The movable member 27 is cylindrical with the centrally disposed exhaust vent passage 78 extending the length thereof. Through a pair of lateral vent ports 79, the vent passage 78 may communicate at selected times with the interior of the valve housing cap 58. Frictionally secured to the rear end of the movable member 27 (the upper end as seen in FIGS. 6 and 7), there is secured a cap 80 which functions as an inlet piston having an operating face 81 with a cylindrical skirt 82. It will be noted that the cap 80 has a rearwardly tapered inner surface 83.

The apparatus works in the following manner. When the fastening device is at rest, the compression spring 50 will bias the touch-member 40 to the forward position shown in FIGS. 1 and 2. When air pressure is supplied through the fitting 20 into the chamber 21, said air pressure will move the movable member 27 to the forward position shown in FIGS. 1, 2, and 6. The air pressure would initially operate on the operating face 81, and then the rear side of the first piston 73 (the upper side as shown in FIG. 6) biasing the movable member 27 forwardly (downwardly as shown in FIGS. 6 and 7). Even after the air pressure bleeds through the passages 76 so that the air pressure is the same on both sides of the piston 73, there would still be a net resultant force forcing the movable member 27 toward the forward position—which force is equal to the product of the air supply pressure times the cross-sectional area of the bore 69.

When the operator does not have the trigger 35 pulled to its operative position against the stop 38, the driving device will not actuate should the touch-member 40 be accidentally moved to its rearward position. As best seen in FIG. 1, the crossmember 29 would merely pivot about the pin 30. However, such would not be the case if the trigger 35 were moved to its operative position.

In FIG. 3, there is shown the device with the trigger 35 moved to its operative position resting against the stop 38. In this position, the movable member 27 is still in its first, or forward, position with the first end 31 of the crossmember 29 resting against the rear edge 54 of the touch-member 40 and the second end 32 lightly engaging the engagement portion 36 of the trigger 35. Substantially all of the force of the air pressure on the movable member 27 is transferred directly from the edge 72 to the front end 68 of the valve housing.

At this time, the power control means 22 is in the relationship shown in FIG. 6. As can be seen, air pressure in the chamber 21 may communicate to the main valve 24 through the inlet bore 66, the passages 62, and the passage 23. As explained in the above mentioned patent, this will cause the valve member to move to its rearward position (the upper position as shown in FIG. 3) which causes the area on the rear side of the driver blade assembly will be in its rearward position. Upon said connection of the air pressure, and said movable member 27 moving into the position shown in FIG. 6, air will bleed through the bleed passages 76 to cause the counterreturn chamber 75 to be charged with the supply pressure.

In operation, the operator will merely move the trigger 35 to the operative position. Then, he will go along sequentially hitting the front end of the nose piece 15 of the fastener driving device against the workpiece at the various positions that it is desired to insert a fastener. This will move the touch-member 40 to its rearward position causing the driving apparatus to operate as follows.

Referring to FIG. 4, it can be seen that rearward movement of the touch-member 40 will cause the upper edge 54 of the touch-member to move the first end 31 of the crossmember 29 rearwardly (upwardly as shown in FIG. 4). Since the engagement portion 36 of the trigger 35 prevents the second end 32 of the crossmember 29 from moving forward, the movable member 27 is caused to be moved rearwardly to the position shown in FIG. 4. When the movable member 27 is in the position shown in FIG. 4, the power control means 22 is in the relation shown in FIG. 7. At that time, air in the passage 23 can be vented through the passages 62, and thence through the lateral ports 79, and out through exhaust vent passage 78—causing the area on the forward side of the main valve 24 to reduce to atmosphere. As explained in the above mentioned patent, this will cause the main valve 24 to move to the forward position—causing the driver blade to be driven forward for the driving operation.

When the touch-member 40 causes the movable member 27 to move to the second, or rearward, position, the inlet piston 80 will move into and substantially seal off the inlet bore 66 (see FIG. 7 in particular). Additionally, the seal between the front edge of the skirt 82 and the O-ring 64 will be eliminated and air in the passage 23 is very rapidly vented through the passages 62, and thence through the lateral ports 79 and the exhaust vent passage 78. At the instant of this venting, there is set up an imbalance of air pressure forces on said movable member. More particularly, the counterreturn chamber 75 is still very nearly at the supply pressure (the pressure having been reduced only by the enlargement of the counterreturn chamber as the movable member is moved from the position shown in FIG. 6 to the position shown in FIG. 7). And, the effective face on the one side of the first piston 73 facing the chamber 75 is sufficiently larger than the area of the operating face 81 on the inlet piston 80 that the movable member 27 will remain in the position shown in FIG. 7 even if the touch-member 40 were returned to its original forward position. Therefore, in FIG. 5, the power control means 22 is illustrated with the movable member 27 remaining in its rearward position even though the touch-member 40 has returned to its forward position.

As can be seen, the main valve 24 remains in its actuated position. Therefore, if the touch-member 40 were immediately returned back to its rearward position, the driving device would not be recycled.

As the movable member 27 remains in the position in FIG. 7, the air in the counterreturn chamber 75 will be slowly bled through the bleed passages 76, relatively slowly (as compared to the speed at which the air is vented from the passage 23) venting the air from said counterreturn chamber. At some point, the pressure in the counterreturn chamber 75 will become sufficiently less than the supply pressure that the resultant force of the higher supply pressure over the smaller operating face 81 of the inlet piston 80 overcomes the resultant force of the pressure in the counterreturn chamber

75 over the larger area on the forward side of the piston 73. This will cause the movable member 27 to move forwardly until the operating face 81 of the inlet piston clears the forward edge of the bore 66. At that time, supply pressure will rush through the passages 62 and charge the chamber, or space, 77 with supply pressure, and will—through the passage 23—charge the forward side of the main valve member 24 to move it back to its original position shown in FIG. 1, 3, and 4.

It should be particularly noted how the structure gives a snap action to the return of the movable member 27. More particularly, when the supply pressure is supplied to the chamber, or space, 77 the supply pressure is not only operating on the operating face 81 but on the rear side of the first piston 73. Opposing this force which urges the movable member 27 forward toward its first position is only the rather low pressure (by this time) in the counterreturn chamber 75. This is because the bleed passages 76 prevent the chamber 75 from being charged as fast as the chamber, or space, 77. Very shortly after the movable member 27 is returned to its first position, the air will bleed through the passages 76 and return the counterreturn chamber to the supply pressure. At this time, the only imbalance of forces urging the movable member 27 toward its first position would be the resultant force of the supply pressure over the smaller operating face 81 of the inlet piston 80 (the pressure is on both sides of the piston 73 being the same). This smaller force can be easily overcome in the normal operation of the fastener driving device as above described.

It will also be noted that the skirt 82 of the piston 80 is received into the counterbore 65 before the operating face 81 clears the forward edge of the bore 66. This will substantially eliminate losses of supply air through the ports 79 and exhaust vent passage 78 during the time between when the operating face 81 clears the bore 66 and the front edge of the skirt 82 engages the O-ring 64.

As mentioned previously, the size of the bleed passages 76 is selected in order to accomplish the desired amount of delay between the time the movable member 27 is moved from its first position (shown in FIG. 6) to its second position (shown in FIG. 7). Preferably, the bleed passages are sized so that there is approximately 0.01 second delay before the return. A shorter or longer delay may be accomplished by providing that the bleed passages 76 are larger or smaller, respectively.

Referring now to FIGS. 8 to 11, a second preferred embodiment of the power control means will be shown and described. In said FIGS., there is shown a power control means, indicated generally by the arrow 99, received within the bore 56.

The power control means 99 includes a housing 100 which is sealed to the bore 56 by means of O-rings 101, which housing has a bore 102 therein which receives a movable member 103 for movement between a first position shown in FIG. 8 and a second position shown in FIG. 8 and a second position shown in FIG. 9. A pin 104 holds the housing 100 in the bore 56 in the same manner as the pin 60.

At its rear end (the upper end as seen in FIGS. 8 and 9) the housing bore 102 has been enlarged to provide an annular ledge 105 which functions to receive and hold a counterreturn chamber body 106 therein. A cap 107 is held by the pin 766 to the rear end of the housing 100 and an O-ring 108 serves to seal the joint between the cap and the body 106.

The counterreturn chamber body 106 has a first cylinder 109 at its rear end (the upper end as seen in FIGS. 8 and 9) with a second larger cylinder 110 therein joined by a rearwardly tapering surface 111 for a function to be described. The body 106 is further defined by a forwardly projecting portion 113 having an insert of Teflon or nylon to form a suitable annular recess to receive an O-ring 115.

By means of ports 116 supply air from the chamber 21 is continuously communicated with the bore 102 of the housing 100. The housing 100 is further defined at its midportion by an annular recess 117 which is in communication with the passage 23, and communicates with the bore 102 through ports 118. Near its forward end, the housing 100 has an O-ring

119 received in an internal annular recess 120, which O-ring operates in a manner to be described. The housing 100 is further defined by an exhaust port 122 adjacent front end 123 of the housing. A bore 124 in said front end 123 slidably receives the front end of movable member 103 and assists in guiding said front end of the movable member.

The movable member 103 has an enlargement 130 provided with a centrally disposed recess to receive an O-ring 131 and with a forwardly facing annular edge 133 (at the front end of the enlargement). In engagement with the annular edge 133, there is provided an O-ring 134 which has a normal diameter slightly smaller than the diameter of the movable member. When the movable member 103 moves to its first position, this O-ring 103 is engaged by front end 123 and cushions the stopping of the movable member.

Rearward of the enlargement 130, the movable member 103 is provided with a cylindrical portion 135 which is slidably received in sealing relation with the O-ring 115 of the counterreturn chamber body 106. Further, at its rear end 136 (the upper end as seen in FIGS. 8 and 9), the movable member 103 has a piston 137 secured by means such as a shrink fit. The piston 137 carries an O-ring 138, and serves to define a counterreturn chamber 140 in the area in front of the piston (below the piston as seen in FIGS. 8 and 9). (The manner in which the O-ring 138 cooperates with the walls of the cylinders 109 and 110 and the tapered surface 111 is described below.)

A pair of bleed passages 142 extend between front face 143 and rear face 144 of the piston 137, and function in the same manner as the bleed passages 76 in the first described embodiment. That is, they function to allow the counterreturn chamber 140 to prevent return of the movable member 103 to its first position for a predetermined time after the movable member is moved to its second position.

As in the first embodiment, air must be supplied to the counterreturn chamber 140. To this end, there is provided an axial passage 146 extending from the rear end 136 of the movable member 103 to the midportion of the movable member where the axial passage communicates with the exterior of the movable member through a plurality of ports 147. As can be seen, the ports 147 extend through the enlargement 130 at a position just below (as seen in FIGS. 8 and 9) rearwardly facing tapered sealing surface 148. Tapered sealing surface 148 functions in a manner which will be described below.

Encircling the movable member 103, there is provided a cylindrical inlet piston 150 of, e.g., nylon or Delrin which is slidably sealed to the bore 102 by means of O-ring 151. The inlet piston 150 has an operating face 153 on its rear side and as will be described further below, said operating face functions the same as the operating face 81 in the first embodiment. At its forward end, the piston 150 has a skirt portion 154 which terminates in a forwardly tapering outer surface 155. As can be seen in FIG. 8, the forwardly tapering surface 155 engages and seals with the O-ring 119 when the movable member 103 is in its first position.

The piston 150 has a first internal bore 156 which is received around the enlargement 130 and seals with the O-ring 131 at all times when the inlet piston is moved between its first position relative to the movable member 103 (shown in FIG. 8) and its second position relative to the movable member (shown in FIG. 9). At its rear end, the inlet piston 150 has a second bore 157 which is somewhat smaller than the bore 156. However, as the movable member 103 is smaller in this area of the bore 157, there is provided an annular passage 158 which is able to be communicated selectively with ports 159 in the inlet piston.

At the forward end of the bore 157, there is provided an annular sealing surface 160. The tapered sealing surface 160 cooperates with the tapered sealing surface 148 to prevent the passage of air from the passage 158 to the ports 159 (and thence to either the passage 23 or the exhaust port 122) in the manner to be described below.

At the forward end of the movable member 103, there is located a clevis 161. This clevis functions the same as the clevis 28, i.e., it receives the crossmember 29 (not shown) by means of a cross pin (not shown). In this case, clevis 161 is secured to the forward end of the movable member 103 by means of a U-shaped pin 162 which is received in annular recess 163 on the movable member.

The operation of the power control means 99 is as follows. When the control means 99 is in the position shown in FIG. 8, air is supplied from the chamber 21, through the ports 116 and thence through the passage 158 and the ports 159 to the passage 23. This causes the driver blade of the fastener driving device to remain in the rear position as in the first preferred power control means 22.

In this condition, air is supplied through the ports 147 and the passage 146 to the area on the rear face 144 of the piston 137. From the area on the rear side of the piston 137, supply pressure air communicates with and charges the counterreturn chamber 140 through the bleed passages 142, and around the outer edge of the piston. (It will be noted that the O-ring 138 is not in sealing relation with the cylinder 110 when the movable member 103 is in its first position.)

Before going on with the description of the manner of operation of the power control means 99, it should be noted (see FIG. 8 in particular) that rearward movement of the movable member 103 causes the O-ring 138 to engage and seal with the cylinder 109 slightly before the annular sealing surface 148 engages the annular sealing surface 160. That is, the distance that the O-ring 138 must be moved (from the position shown in FIG. 8) in order to seal with the cylinder 109 is slightly less than the distance that the annular sealing surface 148 must be moved (from the position shown in FIG. 8) in order to engage the annular sealing surface 160. Accordingly, the counterreturn chamber 140 is sealed before control air is vented from the control means 99 in the manner to be described.

As the movable member is moved rearwardly, it will move to an intermediate position where the O-ring 138 seals with the cylinder 109 as just described. Then, slightly further rearward movement of the movable member 103 will move said member to an intermediate position where the tapered sealing surface 148 of the movable member engages the tapered sealing surface 160 of the inlet piston 150. Further rearward movement of the movable member 103 will cause the inlet piston 150 to move with the movable member. This action causes the forwardly tapered surface 155 of the inlet piston 150 to move away from the O-ring 119. At that time, air which is in the passage 23 (and therefore operating on the main valve 24) is exhausted through the recess 117, ports 118, bore 102, and exhaust port 122. This will cause the driving device to be actuated as in the first described embodiment. At this same time, air on the rear face 144 of the piston 137 is vented through the passage 146 and the ports 147. In FIG. 9, arrows 164 illustrate this venting action. It will be noted that the sealing relation between the surfaces 148 and 160 prevent supply air from replacing the vented air.

Although the air on the rear face 144 of the piston 137 is very rapidly vented, the air in the counterreturn chamber is not vented as rapidly—because of the restrictive nature of the bleed passages 142. Therefore, air in the counterreturn chamber 140 assists in the further movement of the movable member 103 to its second position (as is the first embodiment). While the movable member 103 is in its second position, air continues to bleed out of the chamber 140 through the bleed passages 142 causing the pressure in the chamber 140 to diminish. If the rearward force is removed from the movable member 103, the pressure in the chamber 140 will maintain the movable member 103 in its second position—as in the first embodiment.

It will be noted in FIG. 9 that—at all times that the tapered sealing surfaces 148 and 160 are in sealing position—there is a constant force of supply pressure urging the movable member 103 towards its first position. This is the force of the air on the

operating face 153 plus the exposed area of the tapered surface 148 indicated by brace 165 in FIG. 9. The area indicated by the brace 165 is the annular area between the diameter of cylindrical portion 135 of the movable member 103 and the diameter of bore 157.

However, it will be noted that the operating face of the forward face 143 of the piston 137 is substantially larger than the combined areas of the operating face 153 of the inlet piston 150 and the area indicated by the brace 165. Therefore, the movable member 103 is retained in its rearward position (and therefore, the driver device will remain actuated) until such time as the air has bled out of the counterreturn chamber 140 to a point where the rearward force of that pressure in the counterreturn chamber becomes less than the forward force on the operating face 153 and the area indicated by the brace 165. At such time, the movable member 103 will proceed to move forward.

As the movable member 103 moves forward, the tapered sealing surfaces 148 and 160 remain in their sealing position until the forwardly tapered surface 155 firmly engages the O-ring 119. Slightly further forward movement will open the seal between the surfaces 148 and 160. At this instant, supply air charges the passage 23 to return the main valve 24 to its unactuated position. Further, supply air passes through the ports 147 and the passage 146 to the area on the rear side of the piston 137.

This supply pressure on the face 144 of the piston 137 serves to accelerate the movable member 103 forward since the supply pressure is greater than the pressure in the counterreturn chamber 140. However, the imbalance of pressure is only for a brief instant since the continuing movement of the movable 103 moves the O-ring 138 to a position where it no longer seals with the cylinder 109. Once that seal of the O-ring 138 is broken, the counterreturn chamber 140 is very rapidly recharged with supply pressure.

It can be seen that the power control means 99 has certain advantages over the power control means 22. Primarily, the power control means 99 is able to recharge the counterreturn chamber 140 by air passing around the piston 137 rather than through the bleed passages 142. Therefore, the bleed passages 142 can be sized smaller in order to cause a longer delay before the movable member 103 returns to its first position without requiring a corresponding delay in the time necessary to recharge the counterreturn chamber 140. In the case of the power control means 22, the air in the counterreturn chamber 75 is both vented and charged through the bleed passages 76. Therefore, reducing the size of the bleed passages 76 (in order to cause a longer delay before the movable member 27 returns to its forward position) results in a corresponding increase in the amount of time needed to recharge the counterreturn cylinder 75. And, if the movable member 27 were moved from the first position to the second position before the counterreturn chamber 75 is properly recharged, the benefits of the counterreturn chamber would not be present.

A one way valve in the piston 137 would accomplish the desired results of the extending the delaying action of the counterreturn chamber without unduly extending the recharge time, however, the means provided is preferred.

While only a few embodiments of the present invention have been shown and described in detail, it will be apparent to those skilled in the art that such is by way of illustration only. And, numerous changes may be made to the structure illustrated without departing from the spirit of the present invention. Further, it can be seen that the present improved operating means could be used with an electric powered fastener driving device. In such case, the electrical switch for operating the electrically powered driving device would be connected to the movable member in some suitable manner so that the switch would be closed while the movable member remained in the actuated position (shown in FIGS. 7 or 9).

We claim:

1. In combination with a fastener driving device having a main body with a nose piece at its forward end, which nose

piece has a forward end and a barrel through which fasteners are sequentially driven opening through said nose piece forward end, said device having therein a driver blade assembly with a driver blade movable between a rear position and a forward position where the driver blade has driven any fastener out of the barrel:

power control means for selectively communicating power to said driver blade assembly to drive it forward to said forward position, said power control means including:

a movable member movable between a first position where said means causes power to be held out of communication with said driver blade assembly and a second position where said power control means causes a communication of power to said driver blade assembly;

a crossmember having a first and a second point thereon, said crossmember being pivotally connected to said movable member at a third point on said crossmember, each of said first and second points having an operative position, said movable member being in said second position when both said first and second points are in said operative positions and in said first position when less than both of said first and second points are in said operative positions;

trigger means having an engagement portion mounted on said body for movement between an inoperative position where said engagement portion does not force said second point on said cross member into said second point operative position and an operative position where said engagement portion engages and forces said second point of said crossmember into said second point operative position;

and workpiece responsive means movably connected to said body for forcing said first point of said crossmember into said first point operative position when said front end of said nose piece is brought into proximity with a workpiece, whereby said trigger means may be held in said operative position and said device may be operated by bringing said nose piece into proximity with a workpiece.

2. The invention set forth in claim 1 wherein: said crossmember first and second points are first and second ends of said crossmember and said third point is a midpoint of said crossmember between said first and second ends.

3. The invention set forth in claim 1 wherein said workpiece responsive means includes: a workpiece touch-member slidably mounted on said body for movement between a forward position where a front end of said touch-member extends slightly beyond the front end of said nose piece and a rear position where said touch-member front end is substantially flush with the front end of said nose piece, said touch-member having a rear end in line with said first point on said crossmember, said touch-member rear end being capable of transmitting to said crossmember first point force in only a rearward direction, whereby said touch-member does not tend to force the crossmember forward when the touch-member moves from its rearward position to its forward position.

4. The invention set forth in claim 3 including:

return means connected to said touch-member for urging it to its forward position at a very rapid rate;

means in said power control means for urging said movable member from its second position toward its first position;

and means controlling the time needed to return said movable member to said first position so that it takes longer for said movable member to return from its second position to its first position than it takes said return means to return said touch-member from its rear position to its forward position.

5. The invention set forth in claim 1 including:

means operatively connected to said movable member for controlling the time needed for said movable member to return from said second position to said first position.

6. The invention set forth in claim 1 including:

means in said power control means for preventing said movable member from moving back toward said first position until after the lapse of a predetermined time after the movable member is moved to said second position from said first position;

and means in said power control means for causing said movable member to rapidly return to said first position after the lapse of said predetermined time.

7. The invention set forth in claim 6 including:

means in said power control means for causing a large force to rapidly accelerate said movable member toward said first position during said movable member toward said first position during said movement from said second position to said first position, said last-mentioned means causing said forces on said movable member to become substantially equal after the member has come to rest at said first position except for a substantially smaller constant force on the movable member urging said member toward said first position.

8. In combination with a fastener driving device having a main body with a nose piece at its forward end, which nose piece has a forward end and a barrel through which fasteners are sequentially driven opening through said nose piece forward end, said device having therein a driver blade assembly with a driver blade movable between a rear position and a forward position where it has driven any fastener out of the barrel:

power control means for selectively communicating the power to said driver blade assembly to drive it forward to said forward position, said power control means including:

a movable member movable between a first position where said power control means causes power to be held out of communication with said driver blade assembly and a second position where said power control means causes a communication of power to said driver blade assembly;

means for selectively moving said movable member to said second position;

and means operative to prevent said movable member from returning from its second position to said first position until the lapse of a predetermined time after the said member is moved from its first position to its second position.

9. The invention set forth in claim 8 wherein said device has a supply of pressurized fluid therein in communication with said power control means, said pressurized fluid exerting a constant force on said movable member when said member is in said second position urging said member toward said first position and said last-mentioned means includes:

a counterreturn chamber which is charged with said pressurized fluid when said movable member is in said first position and gradually loses fluid therefrom when said movable member is moved to said second position, said pressurized fluid in said counterreturn chamber urging said movable member toward said second position, whereby said movable member will move toward said first position when the pressure in the counterreturn chamber is reduced sufficiently by loss of fluid therefrom.

10. The invention set forth in claim 9 wherein said power control means includes:

a valve housing slidably receiving therein said movable member for sliding movement between said first and second positions;

a first piston carried by said movable member and sealing with said housing to form said counterreturn chamber on one side of the piston;

an inlet pressure piston carried by said movable member, said inlet pressure piston being in continuous communication with said supply of pressurized fluid, the force of said pressurized fluid on said inlet piston furnishing said constant force tending to urge said movable member toward said first position, said inlet piston having an

operating face which is substantially smaller than the operating face of said one side of said first piston;

and means for bleeding fluid out of said counterreturn chamber at a predetermined rate when said movable member is in said second position, whereby the fluid pressure in said counterreturn chamber will hold the movable member in said second position until the fluid pressure in said chamber is so low that the resultant force thereof on said one side of said first piston becomes less than the effective force of said constant fluid pressure on said operating face of said inlet piston.

11. The invention set forth in claim 10 wherein:

said housing has a bore therethrough which receives therein said inlet piston when said movable member is in said second position, said inlet piston effectively sealing said bore and preventing fluid from entering said housing until said member has moved a predetermined distance from said second position toward said first position;

and said first piston has a second side in said housing opposite said one side disposed such that pressure thereon will urge said movable member toward said first position, whereby after said movable member has moved said predetermined distance from said second position toward said first position fluid will enter the housing and cause force on said second side of said first piston which force will cause the movable member to rapidly return to said first position.

12. In combination with a fastener driving device having a main body with a pressurized fluid therein, said main body having a nose piece at its forward end, which nose piece has a forward end and a barrel through which fasteners are sequentially driven opening through said nose piece forward end, said device having therein a driver blade assembly with a driver blade and a piston movable by fluid pressure on the rear side of said piston from a rear position to forward position where the driver blade has driven any fastener out of the barrel:

a main valve movable between a first position where the area on the rear side of the piston of the driver blade assembly is vented to atmosphere and a second position where said last-mentioned area communicated with said pressurized fluid within the device, said main valve having a first side and moving to said first position when said first side is subject to said pressurized fluid within said device and moving to said second position when said first side is vented to atmosphere;

passage means communicating said pressurized fluid with said first side of said main valve member;

power control means in said passage means for selectively communicating said first side of said main valve member alternately between said pressurized fluid and atmosphere, said power control means comprising:

a movable member movable between a first position where said power control means causes power to be held out of communication with said driver blade assembly and a second position where said power control means causes a communication of power to said driver blade assembly;

means for selectively moving said movable member to said second position;

and means operative to prevent said movable member from returning from its second position to said first position until the lapse of a predetermined time after said member is moved from said first position to its second position.

13. The invention set forth in claim 12 wherein:

said device has a supply of pressurized fluid therein in communication with said power means, said pressurized fluid exerting a constant force on said movable member when said member is in said second position urging said member toward said first position, and said last-mentioned power control means includes:

a counterreturn chamber which is charged with said pressurized fluid when said movable member is in said first

position and gradually loses fluid therefrom when said movable member is moved to said second position, said pressurized fluid in said counterreturn chamber urges said movable member toward said second position, whereby said movable member will move toward said first position when the pressure in said counterreturn chamber is reduced sufficiently by loss of fluid therefrom.

14. The invention set forth in claim 13 wherein said power control means includes:

a valve housing slidably receiving therein said movable member for sliding movement between said first and second position;

a first piston carried by said movable member and sealing with said housing to form said counterreturn chamber on one side of the piston;

an inlet pressure piston carried by said movable member, said inlet pressure piston being in continuous communication with said supply of pressurized fluid, the force of said pressurized fluid on said inlet piston furnishing said constant force tending to urge said movable member toward said first position, said inlet piston having an operating face which is substantially smaller than the operating face of said one side of said first position;

and means for bleeding fluid out of said counterreturn chamber at a predetermined rate when said movable member is in said second position, whereby the fluid pressure in said counterreturn chamber will hold the movable member in said second position until the fluid pressure in said chamber is so low that the resultant force thereof on said one side of said first piston becomes less than the effective force of said constant fluid pressure on said operating face of said inlet piston.

15. The invention set forth in claim 8 including:

a crossmember having a first and a second end thereon, said crossmember being pivotally connected to said movable member at the center of said crossmember, each of said first and second ends having an operative position, said movable member being in said second position when both said first and second ends are in said operative positions and in said first position when less than both of said first and second ends are in said operative positions;

trigger means having an engagement portion mounted on said body for movement between an inoperative position where said engagement portion does not force said second end of said crossmember into said second end operative position and an operative position where said engagement portion engages and forces said second end of said crossmember into said second end operative position;

and workpiece responsive means movably connected to said body for forcing said first end of said crossmember into said first end operative position when said front end of said nose piece is brought into proximity with a workpiece, whereby said trigger means may be operated by bringing the nose piece into proximity with the workpiece and the device will not erroneously recycle if said workpiece responsive means is very rapidly brought into proximity with a workpiece and then moved slightly away therefrom and then brought back into proximity with the workpiece.

16. The invention set forth in claim 15 wherein said workpiece responsive means includes:

a workpiece touch-member slidably mounted on said body for movement between a forward position where a front end of said touch-member extends slightly beyond the front end of said nose piece and a rear position where said touch-member front end is substantially flush with the front end of said nose piece, said touch-member having a rear end in line with said first end of said crossmember, said touch-member rear end being capable of transmitting to said crossmember first end force in only a rearward direction, whereby said touch-member does not tend to force the crossmember forward when the touch-member moves from its rearward position to its forward position.

17. The invention set forth in claim 9 including:

means in said last-mentioned means for charging said counterreturn chamber with pressurized fluid at a more rapid rate than the rate at which fluid is lost from said chamber.

18. The invention set forth in claim 9 wherein said last-mentioned means comprises:

a piston connected to said movable member;

a housing having a bore therein forming a first cylinder of predetermined diameter and a second cylinder of slightly larger diameter in axial alignment, said housing being positioned so that said piston is received in said first cylinder when said movable member is in said second position and said piston is in said second cylinder when said movable member is in said first position;

means cooperating with said piston for sealing with said first cylinder when said piston is in said first cylinder when said piston is in said second cylinder, whereby pressurized fluid may pass around the piston when it is in said second cylinder but not when it is in said first cylinder.

19. The invention set forth in claim 2 including:

means operatively connected to said movable member for controlling the time needed for said movable member to return from said second position to said first position.

20. The invention set forth in claim 3 including:

means operatively connected to said movable member for controlling the time needed for said movable member to return from said second position to said first position.

21. The invention set forth in claim 2 including:

means in said power control means for preventing said movable member from moving back toward said first position until after the lapse of a predetermined time after the movable member is moved to said second position from said first position; and

means in said power control means for causing said movable member to rapidly return to said first position after the lapse of said predetermined time.

22. The invention set forth in claim 3 including:

means in said power control means for preventing said movable member from moving back toward said first position until after the lapse of a predetermined time after the movable member is moved to said second position from said first position;

and means in said power control means for causing said movable member to rapidly return to said first position after the lapse of said predetermined time.

23. The invention set forth in claim 11 including:

a crossmember having a first and a second end thereon, said crossmember being pivotally connected to said movable member at the center of said crossmember, each of said first and second ends having an operative position, said movable member being in said second position when both said first and second ends are in said operative positions and in said first position when less than both of said first and second ends are in said operative positions;

trigger means having an engagement portion mounted on said body for movement between an inoperative position where said engagement portion does not force said second end of said crossmember into said second end operative position and an operative position where said engagement portion engages and forces said second end of said crossmember into said second end operative position; and

workpiece responsive means movably connected to said body for forcing said first end of said crossmember into said first end operative position when said front end of said nose piece is brought into proximity with a workpiece, whereby said trigger means may be operated by bringing the nose piece into proximity with the workpiece and the device will not erroneously recycle if said workpiece responsive means is very rapidly brought into proximity with a workpiece and then moved slightly away therefrom and then brought back into proximity with the workpiece.

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,580,455 Dated May 25, 1971
Inventor(s) Adolf Cast et al.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In Figure 9, movable member 103 should be shown to have a reduced cylindrical portion, corresponding to that shown in Figure 8, extending upwardly from annular sealing surface 148 to approximately the mid-point of the packing 114. Further, the brace 165 should indicate the area of sealing surface 148 between the diameter of said reduced cylindrical portion on movable member 103 and the diameter of bore 157.

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,580,455 Dated May 25, 1971

Inventor(s) Adolf Cast and Heinz Schwarz PAGE - 2

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 5, line 8, after "assembly" insert--to be vented to
atmosphere and said driver blade assembly--.

Column 6, line 40, remove "first" and insert--second--;

remove "6" and insert--7--;

remove "second" and insert--first--;

line 41, remove "7" and insert--6--.

line 53, remove "and a second position shown in
Fig. 8".

line 59, remove "766" and insert--166--.

Column 11, line 12, remove "movable member toward said".

line 13, remove "first position during said".

Signed and sealed this 27th day of May 1972.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents