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Fehrs

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[54] **SAFETY DEVICE ON A COMPRESSED AIR-OPERATED DRIVE-IN APPARATUS TO DRIVE-IN FASTENERS**

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[52] **U.S. Cl.** **227/8**, 227/130

[51] **Int. Cl.** **B25c 1/04**

[58] **Field of Search** 227/7, 8, 130

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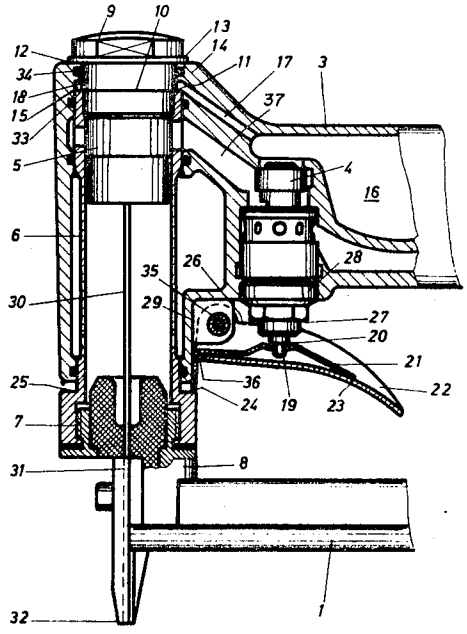
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[57] **ABSTRACT**

This apparatus comprises a housing, a cylinder having limited movement relative to the housing and a magazine for fasteners, attached to the cylinder and having a foot to engage a work piece and through which fasteners from the magazine are driven into the work piece. A piston in the cylinder has a plunger to drive fasteners through said foot. A valve means controls supply of compressed air to the cylinder to move the piston for driving a fastener. Manually actuable means, and means dependent on both movement of the cylinder when the foot is placed on the work piece, and on manual actuation of said manually actuated means, to actuate said valve means to supply compressed air to the cylinder to move said piston to drive a fastener.

10 Claims, 6 Drawing Figures



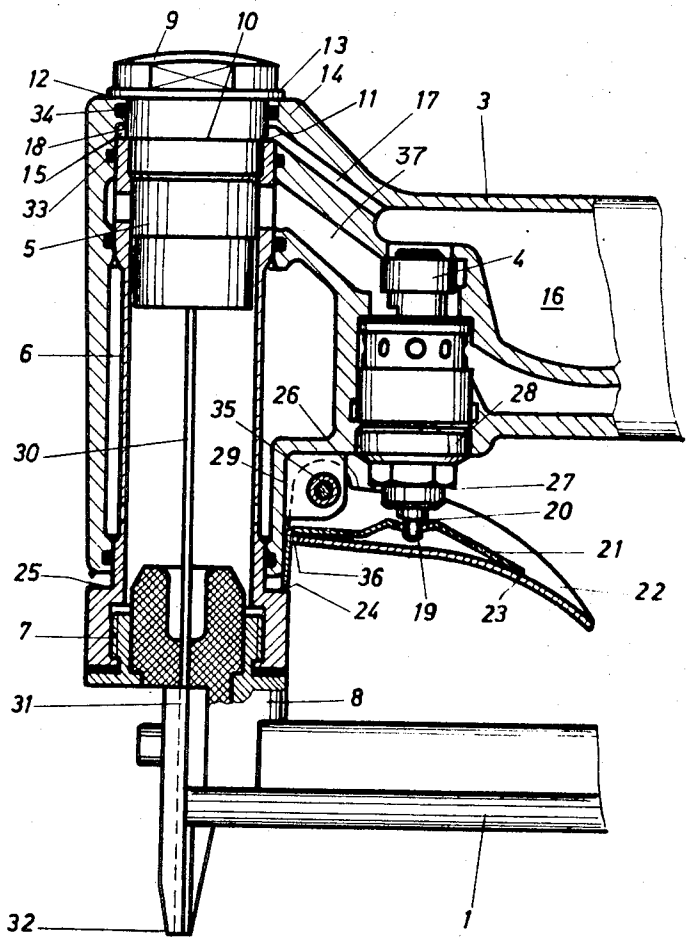


Fig. 1

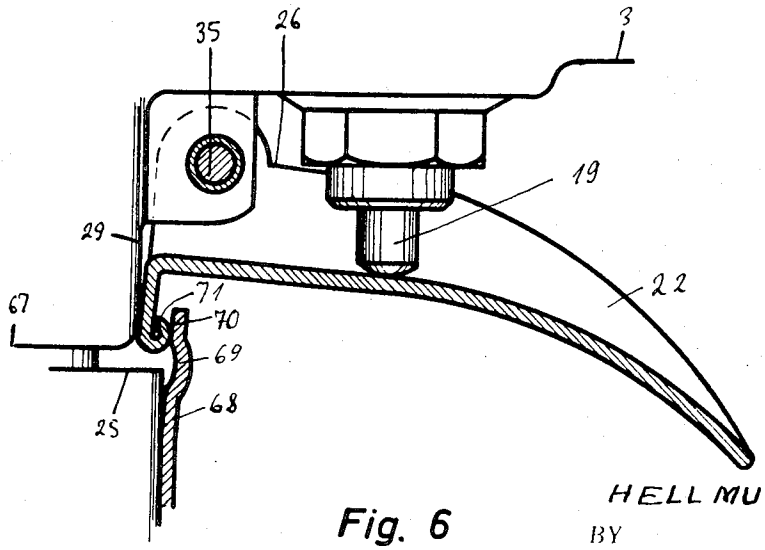


Fig. 6

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Fig. 2

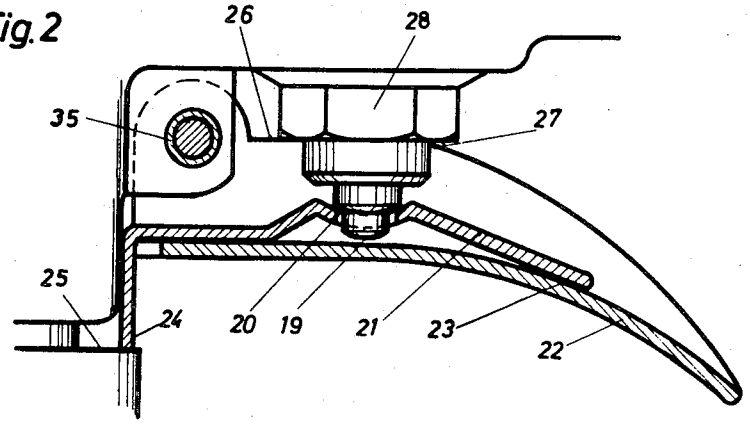


Fig. 3

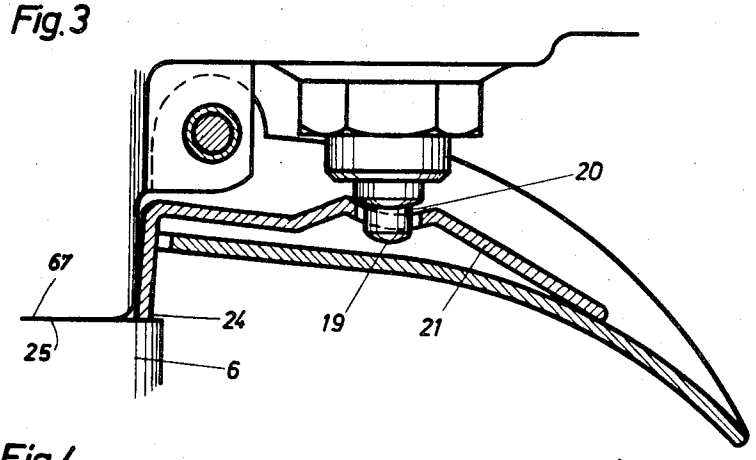
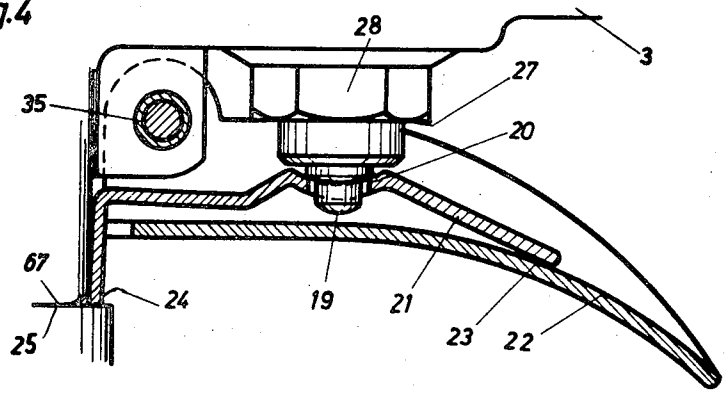
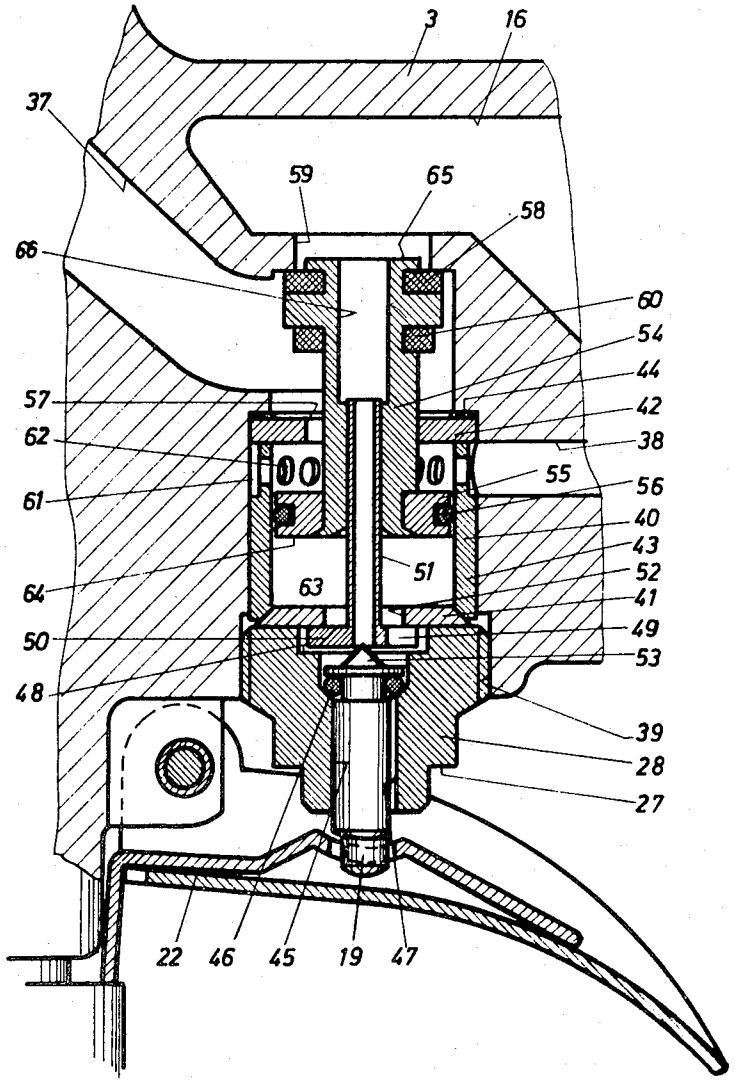


Fig. 4



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Fig. 5



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SAFETY DEVICE ON A COMPRESSED AIR-OPERATED DRIVE-IN APPARATUS TO DRIVE-IN FASTENERS

The invention relates to a safety device on a compressed air-operated drive-in apparatus to drive-in fasteners such as staples, nails or the like, into a work piece by means of a piston driving a propelling means, said piston being arranged in a cylinder and releasing a shot or a sequence of shots but not until a release level has been actuated manually and a foot portion of the drive-in apparatus surrounding the mouth of the shooting channel has been placed onto the work piece.

Such drive-in apparatuses, in which a piston is accelerated by means of compressed air in order to obtain the necessary drive-in energy in the course of one stroke are known. To obtain optimum driving energies the most various control systems are employed to control the entry of air into the stroke cylinder. It is furthermore known to supply the fastening means in magazines as is the manner of transporting them from the magazine into the shooting channel. Owing to the constantly increasing requirements posed by industry, the drive-in energies of the drive-in apparatuses and the fastening means proper have both assumed values which call for more effective accident protection because accidents caused by fasteners shot in an uncontrolled manner have correspondingly increased both in numbers and as regards the seriousness of injuries. The clamps or nails anyway leave the shooting channel at an existing speed of the order of size of about 10 to 20 meters per second.

The known safety devices of this type above all suffer from the shortcoming that there is a sensor arranged in the region of the shooting channel mouth which is effective on the actuation trigger valves via a shifting linkage. The sensor and the shifting linkage detract from the handiness of the apparatus and also reduce its safety in operation.

Attempts have already been made to overcome this shortcoming by arranging the locking means in a manner to be pivotable in response to the magazine and to be released in response to a pivotal movement performed by the magazine. The pivotable arrangement of the magazine, however, makes the apparatus susceptible to trouble. The invention is concerned with the problem of providing a safety device which is free from any obstructing shifting linkage and, besides, does not add to the size of the region adjacent the shooting channel by the arrangement of a sensor.

With a safety device of the type as described above, this problem is solved in accordance with the invention in that the housing of the drive-in apparatus is arranged to be axially displaceable against a return force with respect to the foot portion and the cylinder accommodating the piston and in that the shot or the succession of shots may be fired in dependence upon the relative movement. In this manner, the arrangement of a special sensor in the region of the mouth of the shooting channel is rendered completely superfluous. Rather than providing a special shifting linkage, provision is made for the cylinder to be displaceable with respect to the housing which detracts neither from the handiness nor the safety of apparatus in operation.

In one embodiment of the invention, the manually operable release lever may be blocked in response to the relative movement between cylinder and housing in

such a manner that when the foot is not in its place, a blocking linkage connected with the cylinder will block the actuation of the release lever supported at the housing, said blocking being released when the foot is placed onto the workpiece.

With this embodiment, the sequence of actuation of the release valve is fixed in such a manner that the apparatus must first be placed on the workpiece in order to release the blocking of the release lever because it is only thereafter that the release lever may be actuated.

In the preferred embodiment of the invention, deviating from the above, there are provided a manually operated and a cylinder-actuated actuating lever of which the one, particularly the manually operated one, upon operation comes to lie against an abutment without actuating the release valve and the other one, particularly the cylinder-actuated release lever is supported against the first actuating lever and becomes effective on the release valve via a lost motion connection connection. With this embodiment of the invention, the sequence of actuation of the two actuating levers does not matter which is considered to be an advantage for many uses.

Preferably, in this arrangement the one actuating lever, the manually operated one, in particular, is designed as a rigid lever and is rotatably supported at the housing, while the other one, in particular, is supported on the cylinder by its one end and on the first actuating lever by its other end, while the center of this second actuating lever bears on the release valve via a lost motion connection. Here it is recommendable to design the one of the two actuating levers, preferably the cylinder-actuated one, as a leaf spring.

The return force which tends to drive the cylinder and housing away from each other may be constituted by a spring, for example. Most suitably, however, the return force is supplied by the compressed air for operation which is constantly effective on the operating faces provided at the cylinder and housing facing each other.

Further improvements and suitable developments of the invention are explained by way of the enclosed drawings showing two embodiments of the invention in a simplified manner.

In the drawings,

FIG. 1 shows a sectional view of a driving apparatus designed in accordance with the invention in its position of rest with those parts which are not necessary to describe the invention eliminated,

FIG. 2 shows a cutout from the representation of FIG. 1 on an enlarged scale with the manually actuated release lever however having been actuated and the apparatus not yet positioned on the workpiece,

FIG. 3 a partial cutout of the representation of FIG. 1 with the driving-in apparatus positioned on the workpiece but the manually operated release lever not yet actuated,

FIG. 4 a partial cutout from the representation of FIG. 1 with the driving-in apparatus positioned on the workpiece and the manually actuated release lever actuated; the release valve thus has been actuated in this representation and is in its position ready for shooting,

FIG. 5 shows on an enlarged scale a sectional view similar to that one of FIG. 1 and taken of an example of embodiment of a release valve in its closed position

serving to carry the invention into practice; the invention however is not restricted to this special design of the release valve,

FIG. 6 shows a partial sectional view of FIG. 1 taken of another embodiment of the invention with the manually actuated release lever adapted to be blocked in response to the relative movement between the cylinder and the housing.

The drive-in apparatus of FIG. 1 essentially consists of the housing 3, the magazine 1, the cylinder 6, the piston 5 arranged for to and fro movement in said cylinder, and the release valve 4. The magazine 1 is designed as a base-loader, for example, in accordance with the German Pat. letter 1 204 599 and is not shown nor described in any more detail because the invention does not relate to the design of the magazine.

FIG. 5 shows an embodiment of the release valve in more detail. But other release valves may be used as well to carry the invention into practice. It is also possible, in particular, to actuate the release valve direct rather than with the interpositin of a servo valve.

Piston 5 actuates a stem 30 which enters into a stem channel 31 and respectively drives-in a fastener supplied performing one single blow. It is also possible to operate the apparatus respectively in the well-known manner such that a continuous firing sequence results with a fastener driven-in here as well with every shot fired.

As a rule, however, it will be recommendable to actuate the release valve anew for the release of an individual shot. The cylinder 6 is rigidly connected with the head member 8 of the magazine via a thread 7. The top of cylinder 6 is closed by a cap 9 screwed therein with shoulder 10 or cap 9 abutting the end face 11 of cylinder 6.

The cap 9 is supported in web 14 of housing 3 for slidable movement. The web 14 is slightly smaller in its longitudinal extension in parallel with the cylinder axis than the distance between end face 11 of the cylinder 6 and the surface 12 of the flange 13 of the screw cap 9. This difference in length is equal to the stroke by which the housing 3 may be displaced with respect to the cylinder 6.

In the position of rest shown in FIG. 1 cylinder 6 is in its lower position in which it is pressed by means of a return force effective between cylinder 6 and housing 3. When the foot portion 32 is placed onto the workpiece, the cylinder 6 will be moved upwardly against this return force until the end face 11 of the cylinder 6 abuts against an end face 18 provided in the housing. The distance between these two surfaces corresponds to the path of the stroke by which the housing is displaced with respect to the cylinder when the apparatus is placed onto a workpiece.

This space 15 between the two faces 11 and 18 forms a pressure chamber closed by O-rings 33, 34 which is constantly filled with compressed air via a channel from chamber 16. The chamber 16 is connected with the source of compressed air for operation via a hose and in a manner not shown in more detail.

The compressed air here biases the end face 11 of the cylinder and the end face 18 of the housing thus exerting a return force which tends to keep the cylinder 6 and the housing 3 in the position in which they are driven apart as shown in FIG. 1. This force exerted on the housing and the cylinder must be overcome when the apparatus is placed on a workpiece in order to displace both parts towards each other.

The release valve 4 which is described in more detail below by way of FIG. 5 is released via a switching pin 19. The switching pin 19 is provided with a flange 20 and is retained in its position of rest by means of a return force which is likewise supplied by the compressed air for operation, for example. Both the switching pin 19 and also the shaft of the flange 20 are formed cylindrically, the shaft being provided with longitudinal groove. Two levers serve to operate the switching pin 19–20. The one lever 22 which in the following is also called a valve lever, is rotatably supported about an axis 35 at the housing 3 and is of a rigid design. The cross sectional area of this valve lever 22 is in the form a U-shape and the switching pin 19 has its flange 20 extend between the two webs of said U-shaped lever.

The other actuating lever is designed as a leaf spring 21 the medium portion of which comprises a bore for the accommodation of the switching pin 19. The main portion of this leaf spring 21 extends within the U-shaped transverse position of the valve lever 22. The end 23 of the leaf spring 21 in this arrangement is supported on the valve lever 22. The other end 24 of the leaf spring 21 is bent on an angle of about 90° and is supported on an end face of the cylinder 6, said bent portion of the leaf spring passing through a corresponding opening 36 of a valve lever 22.

The actuating lever which is designed as a leaf spring 21 slidably surrounds the switching pin 19 leaving some play with a lost motion connection provided between the lever 21 and the end face which is formed by the flange 20.

The twistability of the valve lever 22 is limited on both sides. On the one hand, in the withdrawn position, the U-shaped legs 26 of the valve lever lie close to a flange 27 of the release valve 4. This flange 27 forms part of a bushing nut 28 of the release valve and accordingly is rigidly connected with the housing 3. On the other hand, the valve lever when in its position of rest, lies against the end face 29 of the housing 3. The valve lever is urged into this position of rest by means of a spring not shown. Here it is outside the reach of the switching pin 19, as is clearly shown in FIG. 1.

FIG. 2 shows the principal parts of the apparatus according to which the valve lever 22 is manually actuated and, accordingly, its two legs 26 come to lie close against the flange 27 of the bushing nut 28. Also in this position there is still a little clearance left between the center web of the valve lever 22 and the end face of the switching pin 19, so that the valve lever 22 cannot actuate the switching pin.

Owing to this pivotal movement of the switching lever 22 the end 23 of the leaf spring 21 has also been lifted thereby moving the medium part of the leaf spring to the flange 20 of the switching pin while that portion of the leaf spring which is bent through 90° is unchanged in its position and is supported on the end face 25 of the cylinder.

According to FIG. 3, the apparatus has been placed onto the workpiece by its foot portion 32 before the valve lever 22 was actuated manually. The cylinder 6 has thereby been moved upwards together with its end

face 25 by a distance corresponding to the path of the stroke as described above until the end face 25 of the cylinder comes to lie against the end face 67 of the housing. By this movement the end 24 of the leaf spring 21 has been lifted a distance equal to the stroke path by the shoulder of the cylinder 6. This movement only causes the medium portion of the leaf spring to move close to the flange 20 of the switching pin 19.

FIG. 4 shows the apparatus after both the valve lever 22 and the leaf spring 21 nave been operated. The release valve shown in this Fig. thus has been lifted by the switching pin having been moved upwards in FIG. 4 by the leaf spring 21. The valve lever 22 and the housing 3 are now in the position as shown in FIG. 2, while the cylinder has been moved upwards with respect to the housing. When the apparatus is operated from the FIG. 2 position, the left-hand portion of the leaf spring 21 which is supported on the end face 25 of the cylinder is moved upwards. Hereby the switching pin 19 is moved into its open position with the end 23 supported on the valve lever 22 being at rest. If, contrary to the above, the open position of FIG. 4 is to be reached from FIG. 3, the end 23 of the leaf spring 21 will be lifted by the valve lever 22 simultaneously moving thereby also the medium portion of the leaf spring which comes to lie already now close against the flange 20, and moving the switching 19 to its open position.

In FIG. 5, that portion of the apparatus housing is referenced 3 which in a manner known per se is arranged in front of the drive-in piston (not-shown) guided in a cylinder, and in which there are provided a passage 16 connected to the source of compressed air for operation, a passage 37 leading to the drive-in cylinder and a passage 38 constantly in communication with the atmosphere.

The bushing nut 28 is screwed into a threaded bore 39 at the underside of the housing 3 and via a plate 41 retains a cylinder jacket 40 and another plate 42 in a housing bore 43 close to an abutment surface 44 of the housing. In a bore 45 of the bushing 28 there is guided the switching pin 19 which is biased by the release lever 22 of the apparatus under spring pressure (spring not shown). The pin 19 has a sealing ring 46 lying in close contact with a seating surface in the bushing 28 and by flattenings or grooves of its jacket leaves free one or several channels 47 which lead into the open. An annular surface 48 in the upper surface of the bushing 28 supports a flange or plate 50 of a sleeve 51 leaving an axial and radial play, said plate being provided with a notch or recess 49, while the sleeve passes through a wide opening 52 of the plate 41 and has its lower opening disposed opposite a cone 53 of the pin 19. A sleeve shaft 54 is guided on the sleeve 51 for displacement in a longitudinal direction, said shaft carrying a piston 55 adapted to be displaced in the cylinder 40 while being sealed by a ring 56. Similar to pin 19, the correspondingly profiled shaft 54 too leaves a passage 57 in the bore of the plate. At its upper end the shaft 54 carries two sealing rings of which the upper ring 58 is adapted to seal an opening 59 to the channel 16 and the lower ring 60 is adapted to tightly close the passage 57. The cylinder 40 is grooved at the outer surface of its upper portion leaving an annular space 61 with respect to the housing bore 43, said annular space on the one hand communicating with the interior of the cylinder 40 through a circular arrangement of openings 62 and, on the other hand, communicating with the channel 38 leading into the open. The shaft 54 and the piston 55 form the master valve and the pin 19 forms the pilot valve of the control organ.

When the control organ is in its position of readiness before a drive-in stroke of the working piston is to be performed, the master valve and the pilot valve assume the position according to FIG. 5. The chamber 63 of the cylinder 40 is in communication with the line 16 via the bore 66 of the shaft 54, the sleeve 51 opened by the cone 53, the recess 49 of the plate 50, and the opening 52 of the plate 41 with the effect that the pressure of the compressed air prevails therein retaining the master valve 54 in its closing position blocking the line 37 from the line 16 carrying compressed air for operation, because the underside 64 of the valve piston 55 is greater than the upper surface 65 of the shaft 54 and the ring 58 which is likewise biased by the working pressure through the opening 59.

To initiate the drive stroke, the lever is tightened. The pin 19 lifted thereby will on the one hand block the supply of compressed air for operation by closing the sleeve 51 by means of the cone 53 and on the other hand will release the outlet path 52, 49, 47 for the compressed air into the atmosphere from the chamber 63 by lifting the sealing ring 46. The compressed air for operation which is effective on the valve surface 65 now presses the valve down into its open position without any resistance in which it allows it to pass to the passage 37 and to the drive-in piston and in which the sealing ring 60 closes the opening 57 of the disc 42. The operation is effective to cause the performance of the drive-In stroke. By releasing again the lever 22 the compressed air for operation can again reach the chamber 63 from the passage 16 on the way described above which is released by the cone 53, in order to return the master valve 54, 55 into its closing position according to FIG. 5. The amount of air expelled from the drive-in cylinder by the working piston on its return stroke which may effected by spring force or likewise by compressed air, flows through the passage 37, the opening 57, the openings 62 and the annular groove or channel 61 into the conduit 38 and thus into the open, with the openings 62 having a sound deadening effect.

In FIG. 6 like reference numerals have been used as in FIGS. 1 to 5 to designate like parts or parts corresponding to each other in these Figures.

The blocking device of the embodiment in accordance with FIG. 6 consists of a plate-shaped blocking member 68 fixed to the cylinder 6 and provided with a notch 69 and an upward projection 70. The valve lever 22 is provided with a projecting part 71 extend above said notch which, in the position of rest as shown, lies close against the projection 70 of the blocking member 68. In this position, the valve lever 22 thus cannot be operated.

By placing the drive-in apparatus onto the workpiece the cylinder 6 is moved upwards together with its end face 25 in accordance with FIGS. 3 and 4 until the end face 25 comes to lie against the end face 67 of the housing 3. In this position, the projection 71 of the valve lever 22 is in the region of the notch 69 of the blocking member 68, so that the valve lever may now be pivoted counterclockwise about its axis 35 actuating the

switching pin **19** of the release valve bringing it into the closed position. A spring for returning the valve lever **22** into its position of rest is not necessary. The switching pin **19** is moved into its position of rest by the compressed air also returns the valve lever **22** into its position of rest in which it lies close against the abutment surface **29** of the housing.

Passage **37** is a conduit to establish communication of the chamber **16** with the cylinder after opening of the valve means **4**. Then the air flows through passage **37** to the cylinder, and the pulse-like entrance of the pressurized air separates the piston from the cap **9**. In rest position the piston terminates at its upper end a slight distance above said passage **37**, however when the cylinder is moved relative to the housing, air from passage **37** is able to be applied to the upper face of the piston.

I claim:

1. Apparatus to drive fasteners, comprising a housing, a cylinder projecting into said housing and having limited movement relative to said housing, a magazine for fasteners fixed to said cylinder, a piston movable in said cylinder, means on said piston to drive a fastener from said magazine each time the piston is moved in one direction in said cylinder, valve means on the housing to control supply of compressed air to said cylinder, to move said piston in said direction, manually actuable means movably mounted on said housing, foot means fixed relative to said cylinder to engage a work piece and through which fasteners are driven from the magazine, and control means dependent upon both movement of said cylinder by engagement of said foot with said work piece and actuation of said manually actuable means, to actuate said valve means to supply compressed air to said cylinder to move said piston in said direction, and to prevent actuation of said valve means unless said manually actuable means is in actuated condition while said cylinder is in moved condition.

2. The combination of claim **1**, said valve means being actuable to supply compressed air to said cylinder, irrespective of whether the cylinder is moved before or after the manually actuable means is actuated.

3. The combination of claim **1**, said control means comprising means to prevent actuation of said manually actuable means before said cylinder has been moved and to allow actuation of said manually actuable means only after said cylinder has been moved by engagement of said foot with said work piece.

4. The combination of claim **1**, and conduit means to supply pressure air to return said cylinder upon the foot being disengaged from the work piece.

5. The combination of claim **1**, said manually actuable means comprising a trigger lever pivoted to said housing.

6. The combination of claim **5**, and means fixed relative to the housing to stop rotation of said lever in one direction through a predetermined angle from an initial angular position.

7. The combination of claim **6**, and means controlled by said cylinder to prevent rotation of said lever away from said initial position when said foot is not on the work piece, and to permit rotation of said lever away from said initial position through said predetermined angle, when said foot is on said work piece and the cylinder has moved.

8. The combination of claim **1**, said manual actuable means comprising a trigger lever pivoted to said housing, and a member having a portion engaging said cylinder and a portion engaging said lever, and a valve pin slidably mounted on said valve means, said member having means interposed between said portions thereof to move said pin.

9. The combination of claim **8**, means fixed relative to said housing to stop rotation of said lever in one direction through a predetermined angle from an initial position, said member having a lost motion arrangement relative to said pin when said lever is in its initial position and said foot is off the work piece.

10. The combination of claim **9**, said lever being substantially rigid and said member being made of resilient material.

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