

Dec. 12, 1950

E. S. MOORE
MANUALLY APPLIED POWER DRIVEN MACHINE
FOR AUTOMATICALLY DELIVERING AND
DRIVING A FASTENER

2,534,140

Filed Feb. 14, 1948

5 Sheets-Sheet 1

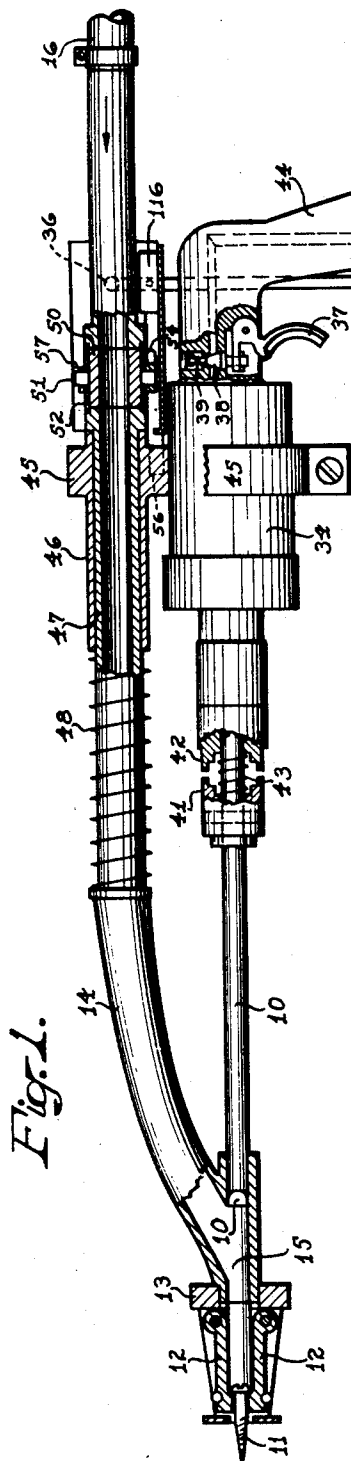


Fig. 1.

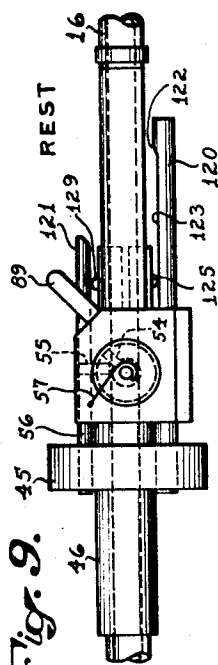


Fig. 9.

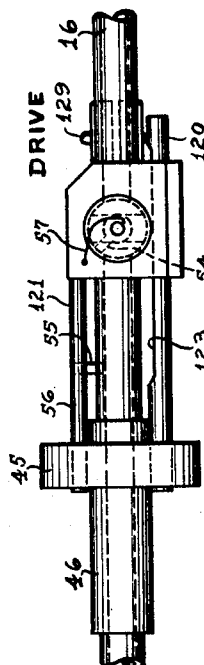


Fig. 10.

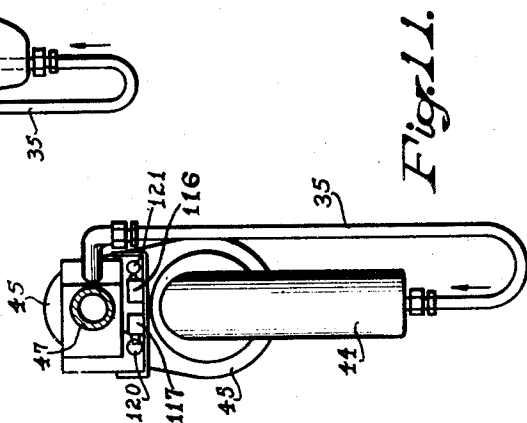


Fig. 11.

Inventor
Edgar S. Moore
By Clayton L. Jenks
Attorney

Dec. 12, 1950

E. S. MOORE
MANUALLY APPLIED POWER DRIVEN MACHINE
FOR AUTOMATICALLY DELIVERING AND
DRIVING A FASTENER

2,534,140

Filed Feb. 14, 1948

5 Sheets-Sheet 2

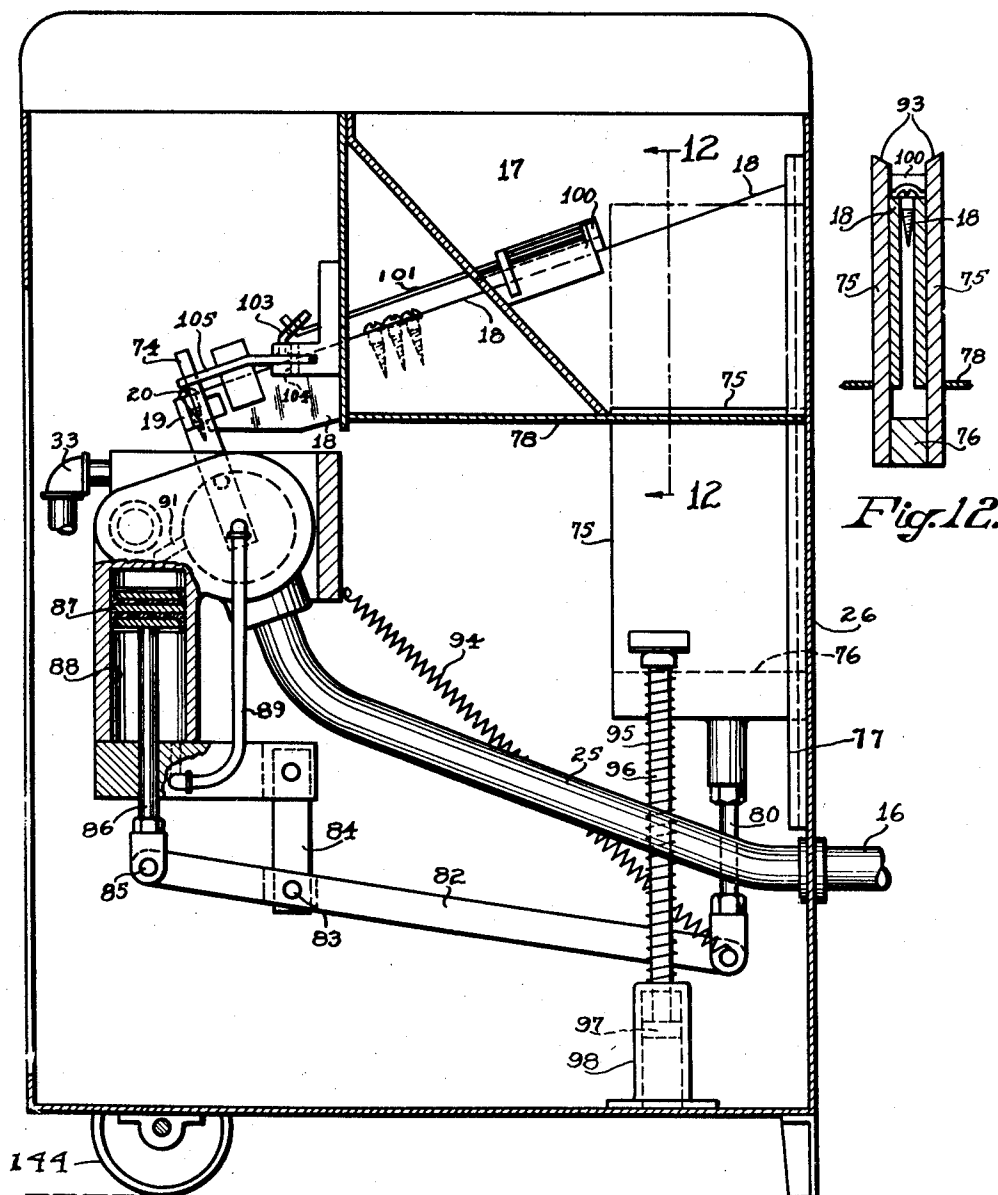


Fig. 2.

Inventor

Edgar S. Moore

88 Clayton L. Jenkins

Attorney

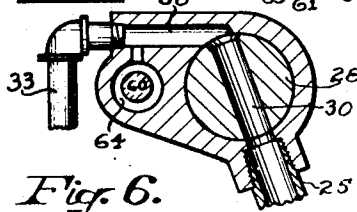
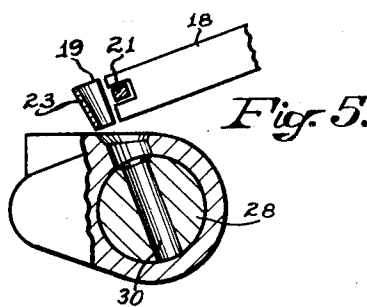
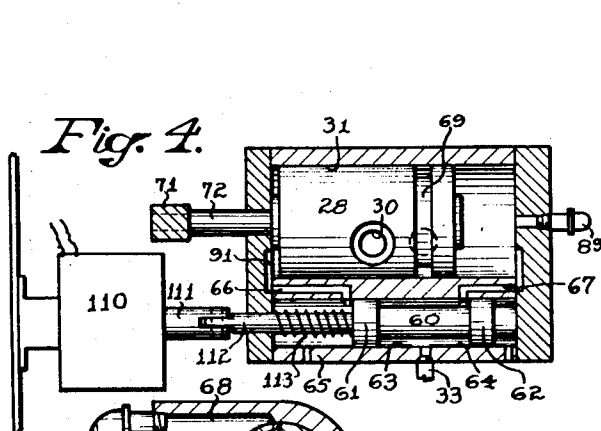
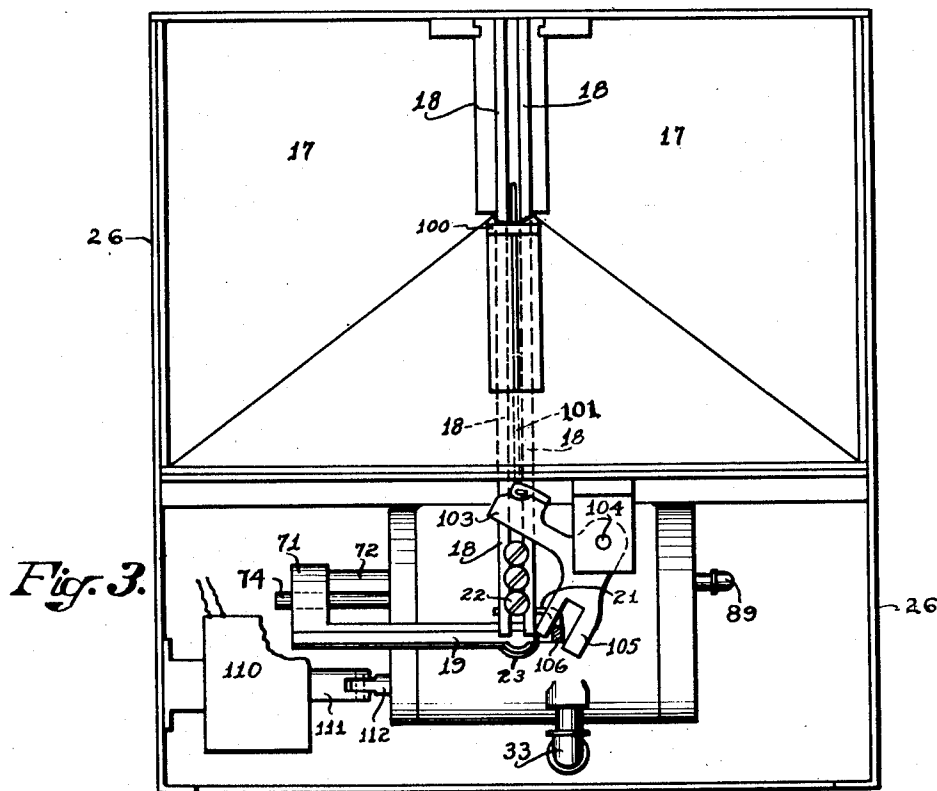
Dec. 12, 1950

E. S. MOORE
MANUALLY APPLIED POWER DRIVEN MACHINE
FOR AUTOMATICALLY DELIVERING AND
DRIVING A FASTENER

2,534,140

Filed Feb. 14, 1948

5 Sheets--Sheet 3



Inventor
Edgar S. Moore
Clayton L. Jenkins
Attorney

Dec. 12, 1950

E. S. MOORE
MANUALLY APPLIED POWER DRIVEN MACHINE
FOR AUTOMATICALLY DELIVERING AND
DRIVING A FASTENER

2,534,140

Filed Feb. 14, 1948

5 Sheets-Sheet 4

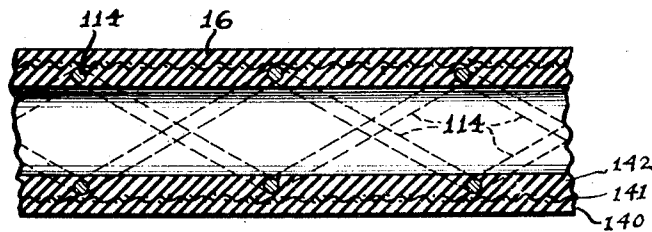
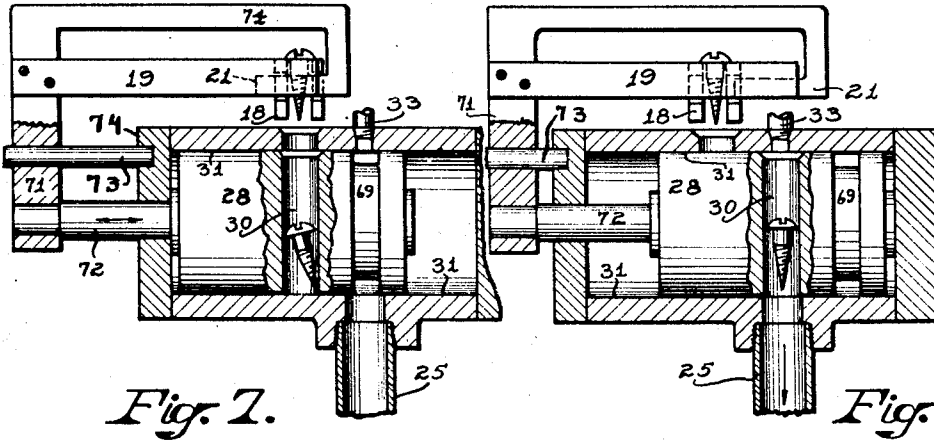


Fig. 16.

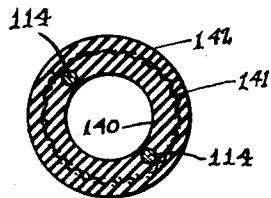


Fig. 17.

Inventor
Edgar S. Moore
By Clayton L. Jenkins
Attorney

Dec. 12, 1950

E. S. MOORE
MANUALLY APPLIED POWER DRIVEN MACHINE
FOR AUTOMATICALLY DELIVERING AND
DRIVING A FASTENER

2,534,140

Filed Feb. 14, 1948

5 Sheets-Sheet 5

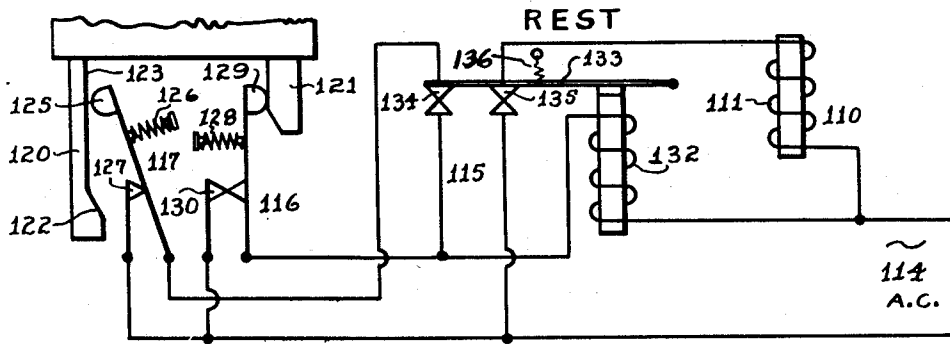


Fig. 13.

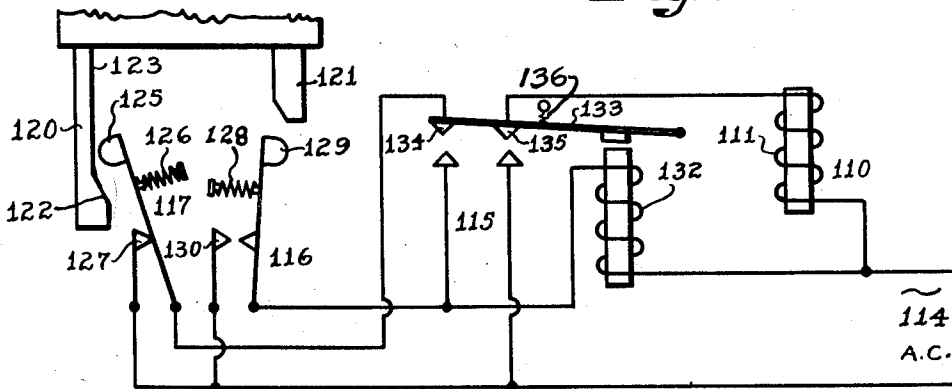


Fig. 14.

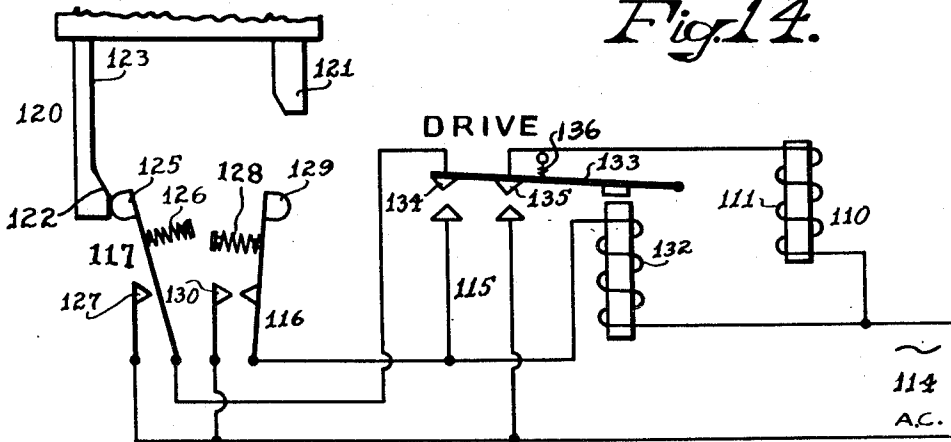


Fig. 15.

Inventor
Edgar S. Moore

By Clayton L. Jenkins
Attorney

UNITED STATES PATENT OFFICE

2,534,140

MANUALLY APPLIED POWER-DRIVEN MACHINE FOR AUTOMATICALLY DELIVERING AND DRIVING A FASTENER

Edgar S. Moore, Toronto, Ontario, Canada, assignor to Air-A-Feed Equipment, Inc., Worcester, Mass., a corporation of Massachusetts

Application February 14, 1948, Serial No. 8,355

17 Claims. (Cl. 144—32)

1

This invention relates to a manually controlled power driven machine for automatically delivering and driving a fastener, such as a screw, nail or rivet.

Various mechanisms have been proposed heretofore for feeding and driving nails, rivets or screws in which the fastener is forced by air pressure through a tube to a driving head where, if the fastener is a nail, it is driven into position by a reciprocating hammer, or if a screw, it is rotated by a flexible shaft driven by air in a separate tube. The controls have been effected by a third power line separate from the tubes. The operation of such a machine is complicated by the multiplicity of tubes and flexible elements employed for the operating mechanism, since the operator may be hampered by the various lines getting tangled or the liability of air leakage and power trouble. Screws have been fed to the driving head by mechanical devices which present various problems in their manufacture and use. Also, the screw driver has been rotated by an electric motor, which must be stopped and started repeatedly. Such devices are not as efficient as one operated by compressed air; and the primary purpose of this invention is to provide a satisfactory construction which will serve for feeding and driving fasteners as required by the manual control of the device.

Another object of this invention is to provide a single hose line for conveying the fastener to the driving head and delivering air to operate the driver.

A further object is to combine with a pneumatic feeding mechanism an electrical power control which insures that the feeding and driving mechanisms are adequately coordinated.

Another object is to provide fastener feeding and driving mechanisms which are so operated and controlled that double triggering is prevented and which insures that only one fastener can be fed at a time and a second cannot be fed until after the first has been driven into position and the driver is inoperative and ready to receive the next fastener.

A further object is to provide a manually operated device which is completely automatic in its controls, so that a fastener is supplied and air pressure admitted to force the fastener to the driving head only when the driver has been returned to a rest position and so that any partial movement of the driver in either direction will not cause feeding of a second fastener.

A further object is to provide a control for a fastener feeding and driving mechanism in which

2

the starting and stopping of the controlled elements is positive and sharply defined as distinct from the slow movements incident to pneumatic devices requiring that the air pressure be built up to an operating point.

A further object is to provide a single air hose line in which the electric control wires are carried thereon or preferably concealed so as to provide a simple design of light weight which minimizes the fatigue of the operator and provides a construction that is readily handled and flexibly manipulated.

Further objects will be apparent to one skilled in the art in view of the following disclosure.

In the preferred form of my invention, I have provided a mechanism for automatically feeding a fastener to a driving head, such as a reciprocable hammer or a rotatable driver, by means of pneumatic pressure and then driving it into position by a power driven motor, and wherein the feeding mechanism is controlled in a timed sequence with the operation of the driving head. This control is effected by an electrical controlling mechanism operated by movement of the driving head which governs the automatic mechanism that feeds the fasteners from a hopper or other supply. This construction preferably employs a pneumatically operated feeder which delivers the fastener to an air pressure hose line, in which the movement of the feeder is automatically controlled by a valve controlled by a solenoid which in turn is governed by a switch controlled power line. The switch control is operated by manual movement of the driving head as required for driving the fastener, and the fastener feeding mechanism cannot be operated until the driving head has been brought back to a rest position after the previously fed fastener has been driven into place.

Referring to the drawings, which illustrate one embodiment of this invention as applied to driving screws:

Fig. 1 is an elevation partly in section of an air driven screw driver and the screw feed tube;

Fig. 2 is a vertical section through a casing, partly broken away, showing a feed hopper and a screw feeding mechanism which delivers a screw to a feed tube connected with the driving head of Fig. 1;

Fig. 3 is a top plan view of the hopper and feed mechanism of Fig. 2;

Fig. 4 is a detail largely in section of the solenoid controlled screw feeding mechanism;

Fig. 5 is a fragmentary sectional detail of the

screw feeding plunger in its left-hand screw retaining position;

Fig. 6 is a sectional detail of the plunger in its right-hand delivering position;

Fig. 7 is a sectional view of the screw feeding mechanism in the position of Fig. 5;

Fig. 8 is a similar sectional view of the feeder in the position of Fig. 6;

Fig. 9 is a top plan detail of part of Fig. 1 showing the cam controlled microswitches on the driver;

Fig. 10 is a similar view at right angles to Fig. 9;

Fig. 11 is an end view of the driver gun stock;

Fig. 12 is a detail on the line 12—12 of Fig. 2;

Figs. 13, 14 and 15 are diagrammatic wiring diagrams indicating the operation of the control switches; and

Figs. 16 and 17 are respectively longitudinal and transverse sections through the air hose line.

The construction illustrated comprises a power rotated screw driver 10 (Fig. 1) which is rotatably and slidably movable into driving engagement with the head of a screw 11 held within retaining pivoted jaws 12 that are carried by a head 13. The screw is fed into a driving position through a tube 14 which opens into an enlarged cavity 15 in the top portion of the driving head immediately below the screw engaging end of the screw driver. The screw is fed to the tube 14 through a flexible rubber pipe 16 which has a diameter somewhat larger than the head of the screw but yet small enough so that pneumatic pressure against the screw head will drive the screw forward.

The screw or other fastener to be driven is derived from a supply reservoir 17 (Figs. 2 and 3) arranged to carry a considerable supply thereof. These screws depend by their heads (Figs. 2 and 12) between a pair of spaced inclined tracks 18, and they slide automatically to a position where they are held by the straight flat portion of a reciprocable guard 19 shaped to engage or to release the end screw 20, as the guard is moved. When the guard is moved to release the end screw (Fig. 3), a reciprocable knife 21, mounted in a slot in each rail 18, is interpositioned to stop the next screw 22 and hold the remaining screws on the slide rails. The guard bar 19 has a recess 23 at its end shaped to permit a screw to escape from the rails when the curved recess is opposite the end screw, as shown in Figs. 3 and 5. When released, the screw falls into an opening in the carrier 28 of the feeding mechanism of Figs. 4 to 8 which is arranged to deliver the screw at the right time to an inclined tube 25 (Fig. 2) suitably mounted within the reservoir housing 26 and which connects with the feeding tube 16. The curved guard portion 23, when located (Figs. 3 and 5) opposite to the rails 18, directs the end screw 20 to a cylindrical opening 30 in the carrier, which is so arranged that it may be moved to deliver the screw to the top of the tube 25.

The screw feeding carrier 28 is a plunger or piston reciprocably mounted in a cylindrical chamber 31 in a casing. The passage 30 is a substantially vertical hole drilled radially through the piston. The lower end of the hole 30 is normally closed by the cylindrical casing 31 when the parts are in the inoperative position of Figs. 4 and 7. Reciprocation of the piston 28 towards the right brings the hole 30 over the upper end of the tube 25, so that a screw which has been pre-

viously delivered into that hole 30 will drop into the tube 25 (Fig. 8). Air under pressure is introduced from pipe 33 into the top of the pipe 25 to drive the screw to the operating head 13 of Fig. 1.

When the fastener has reached the driving head, the driver 10 is ready to be reciprocated or moved to drive the screw home. Rotation or reciprocation of the driver may be accomplished by standard constructions. For example, the screw driver may be rotated by means of an air motor or turbine, or other suitable motor (not shown), which is mounted in the casing 34 (Fig. 1). The air motor is operated by compressed air admitted through the air pipe 35 that connects with a side passage 36 in the tube 16. The air to this turbine may be suitably controlled by a trigger 37 operating a poppet valve 38 that is held by a spring 39 in a normally closed position but is lifted by means of the bell-shaped, pivoted trigger lever 37.

The screw driver 10 is releasably connected to the turbine through a suitable clutch made up of the clutch part 41 pinned to the screw driver shaft 10 and a further meshing clutch part 42 that is connected to the turbine. These clutching parts are normally held apart by means of a spring 43 until the screw driver 10 has been thrust downwardly against the screw 11 and the pressure forces the two parts of the clutch into interlocking engagement. Various suitable or standard constructions may be employed for the clutch and the driving mechanism that rotates the screw driver.

A primary feature of this invention involves so coordinating the various mechanisms that a screw is always presented in proper position for engagement by the screw driver, but improper operation of the screw driver will not cause or permit two screws to be jammed into the head at the same time or permit the mechanism to fail to deliver a screw when required. The control mechanism is such that the piston 28 (Figs. 4 to 8) is moved to deliver a screw to the pneumatic pipe lines 25, 16 only after the driver 10 has operated to drive the previous screw into position and the screw driver has been returned to an inoperative position. A further feature of this invention involves the use of a single pneumatic supply line for feeding the screw into driving position and for operating the screw driver.

The driver casing (Fig. 1) is slidably mounted relative to the pipe line 14, 16. That is, the casing 34, which carries the air motor and the gun handle 44, is mounted by means of a clamp 45 fixed on a sleeve 46 that surrounds and slides on the cylindrical tubular air conducting metal pipe casing 47 integral with the air line 14. A helical compression spring 48 surrounds and engages a shoulder on the pipe 14 and the end of the sliding sleeve 46, and so tends to hold the screw driver 10 and its supporting casing in the retracted position of Fig. 1.

Located between the inlet opening 36, which feeds air to the turbine, and the reciprocable sleeve 46 (Fig. 1), is a rotary cylindrical valve 50 having a radial hole therethrough, which normally connects the passage 16 with the tube 47 through which the screw is fed to the driving head. The valve member has pivots 51 on its ends carried in bearing holes in two opposed plates 52 that are pressed into position on a flat portion of the tube casing 47, thus rotatably supporting the rotary valve. One of the valve pivots has a lug 54 (Figs. 1, 9 and 10) which pro-

jects into the path of a striker pin 55 that projects from the side of the cam arm 56 mounted on the clamp casing 45 parallel with the axis of the air tube 47 and the direction in which the casing 45 slides. A hair spring 57 secured on the side of the casing serves to urge the valve 50 to the closed position of Fig. 10, when permitted by removal of the striker pin 55. The rest position of the gun is such that the valve 50 is open to the passage of a screw when the spring 48 has urged the clamp 45 and casing 34 to the extreme right which brings the parts into the positions shown in Fig. 9.

It will, therefore, be seen that a screw will pass normally through the rotary valve 50 when the screw driver is in the retracted position of Fig. 1; but when the gun handle 44 of the screw driver is pushed to the left to engage the driver 10 with the screw 11, this causes the pin 55 to move towards the left and release the valve lug 54 and let the valve 50 rotate to the closed position of Fig. 10, which is at 90° to the open position of Fig. 2. This shuts off the air from the pipe line 14 and permits the full pressure to go through pipe 35 into the turbine casing to rotate the turbine when the trigger is held open or moved to an open position. If desired, that pipe line may be connected always with the turbine. It is, however, preferable that the screw driver be not rotated until it has come into engagement with the screw head. When the manual pressure is released from the screw driver casing, then the spring 48 returns it to its inoperative or rest position, where the pin 55 engages the valve contact 54 and opens the valve 50 to the screw feeding position.

When the gun handle and screw driver move back to the rest position of Figs. 1 and 9, the fastener feeding piston 28 and associated parts (Figs. 4 to 8) are caused to move so as to deliver a fastener to the supply tubes leading to the driving head 12. This piston 28 is moved in opposite directions by air under pressure derived from a reciprocable valve 60, which controls the flow of air entering through the inlet pipe 33. This valve 60 comprises two spaced cylindrical pistons 61 and 62 that are slidably mounted within a cylindrical valve casing 63 into which the inlet pipe 33 opens. The piston rod has a portion of reduced diameter to provide an annular chamber 64 communicating always with the inlet pipe 33. The end chambers outside of the pistons open to the outside air through holes in the valve casing 65. A port 66 communicates with the piston chamber 31 at the left of the screw feeding piston or plunger 28 for delivering air to move the piston to the right when the valve piston 61 has been moved to the left to connect the space 64 with the port 66. Another port 67 connects the chamber 64 with the space at the right of the screw carrier 28 when the valve is moved to the right, and thus drives the screw delivering piston to the left, as shown in Fig. 4.

When the carrier piston 28 is in the left-hand position of Figs. 4 and 7, the hole 30 is located for receiving the end screw 20 delivered from the rails 18, and that screw is held in the compartment 30 until the piston is moved towards the right (Fig. 8) to deliver the screw to the pipe line 25. When the hole 30 comes into communication with the pipe line 25, air is at the same time admitted from the pressure chamber 64 through a port 68 (Fig. 6) to an annular space 69 formed by cutting a slot in the piston 28. This space communicates at that time with the top of pipe

25, and thus the screw is blown down the screw feeding pipe line to the head 12.

The release of the end screw 20 from the carrier rails 18 is controlled by movement of the carrier piston 28. The barrier or guard 19 (Fig. 3) is secured to an arm 71 affixed to the end of the piston rod 72 that slidably projects outwardly through the casing wall from the screw feeding piston 28. The arm 71 is slidably supported on a rod 73 secured to and projecting from the wall 74 of the piston casing. The guard 19 is so located and of such length that when the piston 28 is at its right-hand position (Fig. 8), the side of the guard 19 projects closely adjacent to the ends of the slide rails 18 and thus holds the end screw 20 in place. When the piston 28 is moved towards the left (Figs. 3 and 7), the guard 19 is withdrawn from its guarding position and the end screw 20 can drop off the rails. The knife 21 is at the same time interposed between screws 20 and 22 to keep the remaining screws on the rails. The knife 21 is carried by a curved arm 74 secured to the reciprocable member 71, and it has its forward knife edge so located that it is thrust between the screws 20 and 22 just before screw 20 can fall off the rails. Thus, only one screw can drop into the opening 30 of the piston 28 when the latter is in its left-hand position.

The screws in the hopper 17 are in a haphazard arrangement and may be below the level of the rails 18. In order to feed them to the slide rails, I provide a vertically reciprocable elevator comprising two spaced parallel plates 75, as shown in Figs. 2 and 12. These plates are suitably carried by a cross member 76 mounted between slide ways 77 on the side of the casing, and the plates are arranged to pass upwardly through a slot in the floor 78 of the hopper. The plates 75 are vertically reciprocated by means of a vertical pusher 80 pivotally connected to a horizontal lever 82 of the first degree. This lever is pivoted at 83 on a fixed arm 84 and connected through a pivot 85 with a vertically reciprocable piston rod 86. The piston rod 86 is connected to a piston 87 that is vertically reciprocated in a suitable piston casing 88. The chamber beneath the piston 87 receives air from the pipe line 89 which connects with the right-hand end of the piston chamber 31 (Fig. 4) so that the piston 87 moves up when the valve 60 causes the piston 28 to move towards the left.

Air is admitted to drive the piston 87 upwards when the valve compartment 64 is in the position of Fig. 4 and the plunger 28 is at the left and the screws are held stationary on the rails. A pipe 91 connects the left-hand compartment in the casing 31 with the chamber above the piston 87, so that when the plunger 28 is moving to the right, air is at the same time admitted to the top of the piston chamber above the piston 87. Thus the piston 87 serves to move the top of the elevator 75 to and from a position above the rails 18, and a number of the screws are moved upwardly by the inwardly beveled top faces 93 of the elevator plates 75 to positions where some of the screws will fall into position on the rails when the elevator descends. A tension spring 94 suitably secured to the lower end of the pusher 80 and a stationary part of the casing helps to support the weight of the elevator. A compression spring 95 surrounds a vertical piston rod 96 which carries at its lower end a piston 97 in an air cushioning compartment or dashpot 98. The rod 96 is suitably secured to the

7

elevator. This aids in taking up the shock incident to the movement of the elevator.

To prevent the screws from becoming jammed between the elevator plates and rails, I have mounted a pusher 100 on the rails, which is reciprocated by a pusher rod 101 (Fig. 2). The pusher is cut away centrally (Fig. 12) so as to move freely above the heads of screws properly depending between the rails, but it serves to knock off the rails any screws that are lying crossways thereon. The rod 101 has its lower end hooked into a bell crank lever 103 (Fig. 3) suitably pivoted at 104 on a stationary member. The other end 105 of the lever is shaped as a fork 105 within which is mounted a lug 106 projecting vertically from the arm 74 that terminates in the knife 21. Thus, the pusher 100 is given a momentary quick movement to kick away any screws that happen to be out of place whenever the piston 28 is reciprocated to the left for receiving another screw.

A positive control of the cycle of operations is effected by means of switches and a solenoid which moves the valve 60 of Figs. 3 and 4. This comprises a solenoid 110 of standard construction which has its core 111 pivotably connected to the stem 112 of the valve 60. A compression spring 113 serves to hold the valve 60 to the right. Energizing of the solenoid serves to pull the valve to the left against the pressure of the compression spring.

The solenoid and its valve are operated in a timed sequence by means of a suitable power circuit 114 (Figs. 13 to 15) controlled by a relay 115 which is in turn controlled by two microswitches 116 and 117 of standard construction. The microswitch 116 is of the normally open type, and the other switch 117 is normally closed, as shown in Fig. 14. These switches are operated by two cams 120 and 121. The cam 121 is a rod formed as a prolongation of the part 56 which carries the striker arm 55 and is mounted on the reciprocable casing 45 of the screw driver (Figs. 1, 9 and 10). The longer cam 120 has a short thickened end portion 122 and a cutaway portion 123. When the projecting button 125 of the normally closed microswitch 117 is opposite the cutaway portion 123, then the switch is closed. That is, the movable metal contact arm carrying the button 125 is suitably positioned by a compression spring 126 so that it is normally held in contact with the stationary contact 127 of the switch. The cam 122 serves to thrust the parts out of contact against the force of the spring 126. The other switch 116 is similarly constructed, but with its spring 128 holding it normally open, the parts being so arranged that the movable metal arm carrying the button 129 is held normally out of contact with the stationary member 130 of the switch. When the cam arm 121 strikes the button 129, the switch members are forced into contact, as shown in Fig. 13. It will be understood that various mechanisms may be employed for these microswitches and that the drawings and the above description are to be considered as diagrammatic of the switch operation.

The relay 115 is a double pole, single throw switch of suitable construction which comprises the solenoid 132 having a core that is adapted to pull down on the spring held arm 133 when energized and close the two sets of contacts 134 and 135. The tension spring 136 or the resilient nature of the contact arms holds the relay normally open. When the microswitches are in the normal

8

rest position of Fig. 13, current flows through the valve operating solenoid 10, since the microswitches are both closed. As shown in Figs. 9, 10 and 11, the two microswitches are mounted back to back on a stationary portion of the casing surrounding the valve 60, with the spring pressed buttons held normally distended where they may be struck by the parallel cam arms 120 and 121 which reciprocate with the clamp casing 45 that is attached to the gun stock of the screw driver.

The operation of the electrical control mechanism is best understood by reference to Figs. 13, 14 and 15. Assuming that a screw 11 is already in the driving head and that the screw driver is at rest, as shown in Figs. 1, 9 and 13, the microswitches are both closed and the solenoid 110 remains energized and holds the valve 60 at the left which causes the piston 28 to stand at the right where its screw passage 30 remains empty and out of a feeding relation with the rails 19. The operator places the screw driver in position for driving the screw 11 into the woodwork and then presses forward on the gun handle 44 (Fig. 1). This moves the screw driver casing carrying the cams 120 and 121 to the left against the compressional force of the spring 48 (Fig. 1). As the operator presses forward on the screw driver, the short cam 121 moves from the position of Fig. 13 to that of Fig. 14 where it releases its microswitch 116, and the switch arm 129 moves out of contact with the second switch part 130. This kills the relay circuit of switch 116, but the normally closed switch 117 remains closed and still energizes the relay, so that its contacts remain closed and the valve solenoid 110 does not move. But when the operator forces the screw driver to its final operating position where it engages the screw 11, the microswitches take the open positions of Fig. 15 where the normally closed switch 117 is opened and the normally open switch 116 remains open. This causes the valve solenoid 110 to be deenergized, with the result that the valve 60 is moved to the right (Fig. 4) by its spring 113 and the fluid pressure forces the screw piston 28 to the left so that it may receive another screw in its compartment 30. The screw 20 is released from the rails by movement of guard 19 to the left, and the screw drops into the pocket 30 in the piston 28. This screw cannot be delivered to the driving head until the operator lets up on the handle 44 since the relay and switch circuits are all open.

When the screw 11 has been driven into position, the operator lets up on the gun handle and the spring 48 (Fig. 1) forces the handle to the rest position. Then the microswitches are operated by the cams in the reverse order. That is, the part 125 of the normally closed switch 117 falls off the cam 122 on the long cam and it now closes, but this does not close the relay circuit since only the switch 116 can do it. The cam arm 121 is so short that switch 116 is not closed until the screw driver has nearly reached a rest position. Also, the passage through valve 60 is not opened by lug 55 (Fig. 9) until the screw driver has returned to rest. When the switch 116 closes at the rest position (Fig. 13), this serves to close the relay and energize the solenoid 110, which now pulls the valve 60 to the left and the screw feeding piston is moved to the right and delivers the screw 20 to the air tube 25 and it is blown down through tube 16 and the open passage of valve 60 to the driving head, where it is gripped and held by the spring pressed jaws 12. This screw, therefore, goes to the operating head

only when the device is at rest, and no partial movement in either direction of the gun can feed a new screw. The double cycle of movement of both switches prevents this. That is, switch 116 has to close before switch 117 is effective, and the latter holds the relay closed after switch 116 has opened. Hence, this series movement is one in which switch 117 is set in a closed position but cannot hold the relay closed until the short cam closes switch 116.

The electric control wires are preferably mounted on the air hose line 16 through which the fastener is fed; and in order that the wires may be out of the way and not subject to injury or entanglement with other parts or breakage, they are preferably wrapped closely around the air hose line or embedded in a rubberized fabric structure so as to be entirely concealed, as shown in Figs. 16 and 17. This construction comprises the two wires 114 arranged helically around a rubber tube portion 140 and held in position by a fabric layer 141 and further protected by an outer coating of rubber 142. This helical arrangement of the wire in a flexible hose pipe insures that the wire may be readily bent with the hose and without injury to the wire or interference with the electric circuit.

By means of this electric control, I have provided a positive acting mechanism which acts quickly and precisely in accordance with the movement of the gun stock and associated driver. If the operator should press the gun control trigger 37 at the wrong time, nothing detrimental can happen, since the fastener feeding mechanism is not operated from that trigger but solely by the position of the driver relative to a stationary casing carrying the hose line. Also, if the operator should move the driver gun stock back and forth through an incomplete cycle, nothing can happen, since the use of two switches and their controlling cams with the double pole relay makes it imperative that the driver be moved in an orderly manner through its complete cycle of pushing the fastener into place and then retreat to a position of rest.

The feed of the fastener from the hopper is also positive, in that the parts are fed serially and in an orderly manner to a position near the reciprocable piston 28, and they are released one at a time into the cavity 30 in the piston and there held in storage while the driver is being operated and so are ready to be moved quickly into position for delivery to the pneumatic pressure tube 25 the instant that the gun has been returned substantially to rest. There is no delay in this delivery of the fastener, and the operation is positive and compulsory. The timing is such that after the screw has passed through the valve and the driver is pushed forward manually, the lug 55 on the short cam arm releases the valve 50, and the valve then turns to deliver the maximum of air pressure to the rotary motor for rotating the screw driver when it reaches the head of the screw. It is immaterial as to whether the operator holds the trigger of the gun and opens the poppet valve, since the clutch is not engaged until the driver engages the screw and provides back pressure to move the clutch parts together.

As will be understood, a suitable source of pneumatic pressure is provided, such as a compressed air storage tank and a power actuated compressor automatically controlled to maintain a given pressure in the tank, and the air delivery tube 33 is suitably connected to the tank by a pipe line including a flexible hose that permits a substantially

free movement of the hopper or fastener supply magazine. The casing 26 may be mounted on wheels 144 (Fig. 2) for transportation around the plant. The wheeled casing is normally located convenient to the air supply line and the tube 16 is made long enough to reach from the casing 26 to the position of the work.

Various modifications will be readily suggested to one skilled in the art by the above disclosure. Hence, the drawings and specification are to be interpreted as disclosing the principles of my invention and a preferred embodiment thereof and not as imposing limitations on the appended claims.

I claim:

1. A fastener feeding and driving mechanism comprising a movable tool having a body, a manually applied and reciprocable fastener supporting and driving head slidably mounted on said body to move between driving and inoperative rest positions, a driver and associated power mechanism for driving a fastener in the head, a tube for delivering a fastener to the head, a relatively stationary fastener magazine which is remote from the tool, a fastener carrier arranged to receive and hold a fastener delivered from the magazine and which is movable to transport and deliver the fastener to said tube, means including a motor connected to move the carrier between the receiving and delivering positions, motor control mechanism rendered effective by movement of the head towards a driving position which automatically causes the motor to move the carrier to one position and remain there during driving of a fastener and to move to the other position when the head becomes inoperative, and mechanism operated in timed relation with the carrier movement which causes a single fastener to be delivered from the magazine to the carrier when the latter is in a receiving position.

2. A mechanism according to claim 1 in which the motor and its control mechanism comprises a fluid pressure operated motor and a control valve therefor which is biased to hold the motor operated carrier in a fastener delivering position and means rendered operative by movement of the driving head to a driving position which reverses the valve and causes the carrier to move to a fastener receiving position and to remain there until the driving head moves to an inoperative position.

3. A mechanism according to claim 1 in which the motor and its control mechanism comprises a motor having a fluid pressure actuated piston connected to reciprocate the carrier, a valve controlling the motor which is biased to hold the piston stationary and maintain the carrier in a fastener receiving position, a solenoid to move the valve and means controlled by manual movement of the driving head to a rest position which energizes the solenoid for shifting the valve and causing the carrier to move to deliver a fastener.

4. A mechanism according to claim 1 comprising a reciprocable agitator in the magazine and associated mechanism to select a single fastener and deliver it to the carrier, pneumatically operated motors to actuate the agitator, move the carrier and drive the fastener, compressed air conduits to said motors and valves therein controlled by movement of the driving head relative to the tool body which cause operation of the motors in a timed relationship.

5. A fastener feeding and driving mechanism

11

comprising a normally stationary magazine for fasteners, a manually movable tool having a body, a power motor thereon for driving a fastener and a fastener supporting head which is movable relative to the body from an inoperative to a driving position when pressed against the work, a single flexible tube for pneumatic pressure connected to the tool and which serves to deliver a fastener to the head, delivery mechanism for depositing in the tube a fastener selected from the magazine, a motor connected to actuate the delivery mechanism, means including an electrical device for controlling the delivery motor and a circuit therefor having a switch on the movable tool, switch actuating mechanism on the tool controlled by movement of the head when pressed against the work, and means including a valve governing the flow of air through the tube which is controlled by movement of the head for causing a fastener to be blown through the tube to the head when the latter is in an inoperative position.

6. A mechanism according to claim 5 in which the power motor on the tool for driving the fastener is operated by pneumatic pressure and comprising a short conduit carried by the tool which connects the single tube with the motor for driving the same and a valve operating device on the tool for closing the air passage to the head and causing the motor to operate when the tool is pressed against the work.

7. A fastener feeding and driving mechanism comprising a relatively movable tool body and a driving head for supporting a fastener in a driving position, a stationary fastener supply magazine remote from the head, a pneumatic tube for receiving a fastener from the magazine and delivering it to the head under air pressure, feeding mechanism having a carrier movable between two positions to receive a fastener from the magazine and deliver it to the tube, a manually applied power operated driver carried by and movable with the body between inoperative and driving positions, an electrical control device associated with the feeding mechanism and including a circuit rendered operative by relative movement of the tool body and head, and a power operated motor governed by the control device which moves the feeding mechanism from a receiving to a delivering position when the driver is inoperative and to a position of receiving and holding a fastener when the driver is moved towards and is in a driving position.

8. Apparatus according to claim 7 comprising a carrier reciprocable from a fastener receiving to a delivering position, a fluid pressure motor to move the carrier, a valve controlling the motor, a solenoid to move the valve, and an electrical circuit including a switch governed by movement of the driver towards an inoperative position which causes operation of the valve so as to feed a fastener to the head when the driver is inoperative.

9. Apparatus according to claim 7 in which the electrical control device comprises two switches operated in sequence, one of which renders the circuit operative only when the driver is inoperative, and the other serving to maintain the circuit effective during the driving stage and to hold the carrier in a delivering position until the companion switch operates to cause the carrier to move to a receiving position.

10. A screw feeding and driving mechanism comprising a manually movable tool body, a fastener supporting and driving head slidably mounted on the body, a relatively stationary fastener supply magazine remote from the head, a single flexible tube for compressed air from a supply source arranged to receive a fastener from the magazine and connected to deliver it to the head under pneumatic pressure, electrically controlled delivery mechanism which delivers a fastener from the magazine to the tube, an electric control for said delivery mechanism including a switch mounted to be operated by relative movement of the body and head which causes a fastener to be delivered to the tube only when the driving head is in an inoperative position and means including a pneumatically operated motor on the tool body driven by air from said tube which serves to drive the fastener in the head.

12

11. A mechanism according to claim 10 comprising an air conduit connecting the motor with the flexible tube, a valve controlling the air flow, and means operated by relative movement of the head and body which moves the valve to a position where it causes air under pressure in the tube to blow a fastener to the head while the head is in an inoperative position and to a second position where it closes the passage to the head and directs the air to the motor to drive the fastener.

12. A fastener feeding and driving mechanism comprising a driving head for supporting a fastener, a driver movable between driving and inoperative positions, a pneumatically operated motor to operate the driver, a single flexible tube for compressed air from a supply source which serves for supplying air to operate the motor and for delivering a fastener to the head under pneumatic pressure, a relatively stationary fastener supply magazine remote from the head, feed mechanism having a carrier movable to receive a fastener from the magazine and deliver it to the tube, a motor to move the carrier, an electrical device controlling the carrier motor, a circuit including said electrical device and a switch associated with and governed by movement of the driver to and from an inoperative position which causes the carrier motor to receive a fastener when the driver is applied to drive the work and to feed a fastener to the tube only when the driver moves towards an inoperative position, and means controlled by movement of the driver which causes air in said tube to blow a fastener to the driving head when the driver is inoperative and thereafter to operate the driving motor.

13. Apparatus according to claim 12 comprising electrical circuit wiring arranged on the flexible tube and bendable therewith which connects the switch and the carrier motor controlling device.

14. Apparatus according to claim 12 in which the electrical control circuit comprises a normally open switch, a normally closed switch and a relay governed by the switches, and associated cams mounted to operate the switches successively in response to movement of the driver in either direction which require that the driver move through a full cycle of driving a fastener and returning to rest before the fastener delivery mechanism can deliver another fastener.

15. Apparatus according to claim 12 in which the electrical device includes a solenoid biased to a non-energized position and the carrier motor includes a valve positioned by the solenoid, and a circuit including a switch controlled by movement of the driver which energizes the solenoid and holds the carrier in a delivering position while the driver is inoperative.

13

16. A screw feeding and driving mechanism comprising a manually applied and freely movable tool body, a fastener supporting and driving head on the body, a fastener driver which is slidably movable relative to the head to engage and drive a fastener therein, a motor on the body which operates the driver, means for controlling the motor, a relatively stationary fastener supply magazine remote from the tool body, a single flexible tube connected to the tool head which is arranged to receive a fastener from the magazine and deliver it to the head under pneumatic pressure, delivery mechanism which delivers a selected fastener from the magazine to the tube, an electrically governed motor for operating said delivery mechanism and an electrical control device governing said delivery mechanism including a circuit, a switch therein and means for actuating the switch which is mounted to be operated by relative movement of the head and driver, said control device insuring that a fastener is delivered to the head only when the driver is in a non-driving position.

17. A screw feeding and driving mechanism according to claim 16 comprising a pneumatic motor to operate the driver, a conduit for conducting air from the tube to the motor, a valve for con-

14

trolling the air flow in the tube and means operated by relative movement of the head and driver which causes the valve to divert the air to operate the motor when the head is pressed against the work and to direct the air through the tube to blow a fastener to the head when the pressure of the head against the work is released.

EDGAR S. MOORE.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,014,639	Colwell	Jan. 16, 1912
1,441,250	Smith	Jan. 9, 1923
1,499,887	Snyder et al.	July 1, 1924
1,618,367	Dick	Feb. 22, 1927
1,703,458	Ruff	Feb. 26, 1929
1,774,030	McLaughlin	Aug. 26, 1930
1,813,697	Dellaree	July 7, 1931
1,980,967	DeMooy	Nov. 13, 1934
2,255,827	Snyder	Sept. 16, 1941
2,261,134	Blair	Nov. 4, 1941
2,373,992	Billinghurst	Apr. 17, 1945
2,471,793	Stull	May 31, 1949