

April 12, 1960

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2,932,030

PNEUMATIC FASTENER DRIVING AND LIKE TOOL

Filed Nov. 29, 1954

4 Sheets-Sheet 1

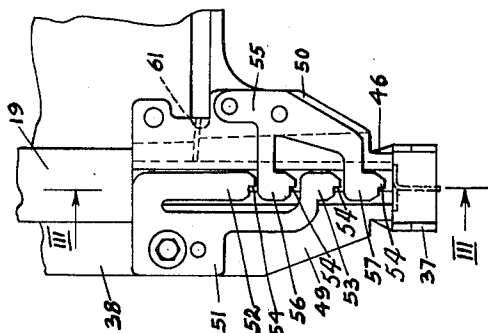


Fig. 2.

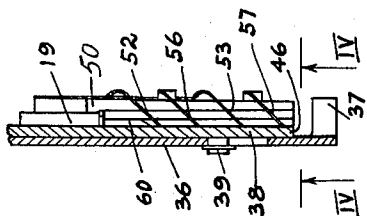


Fig. 3.

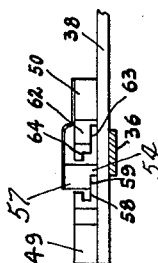


Fig. 4.

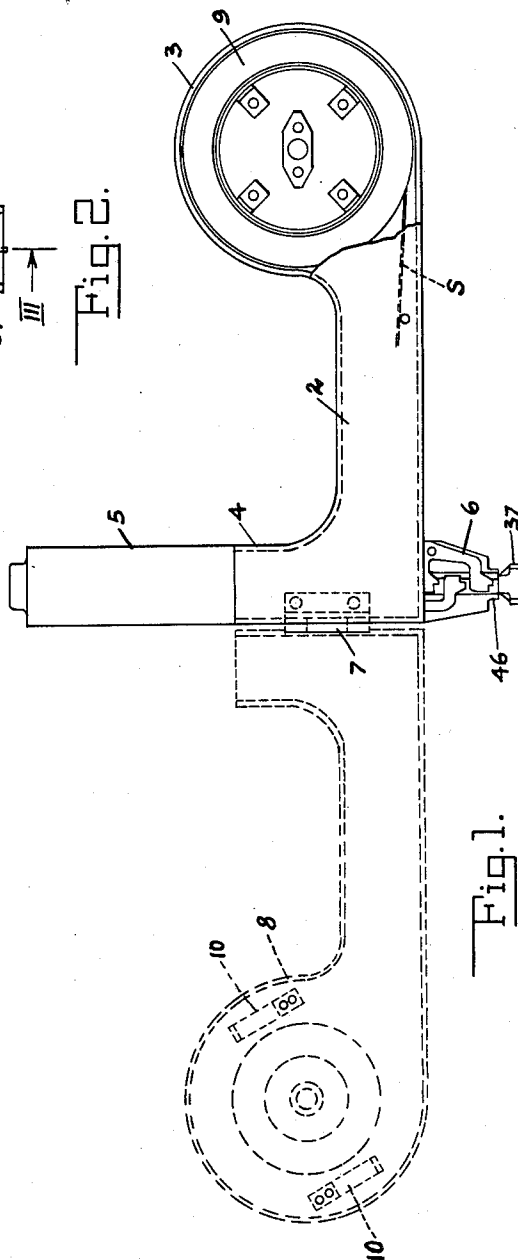


Fig. 1.

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4 Sheets-Sheet 2

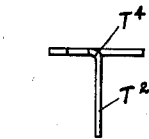
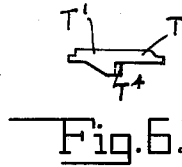


Fig. 6.

Fig. 7.

Fig. 8.

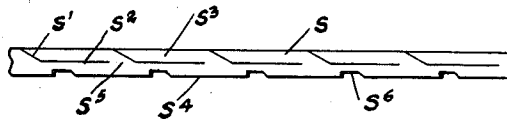


Fig. 8A.

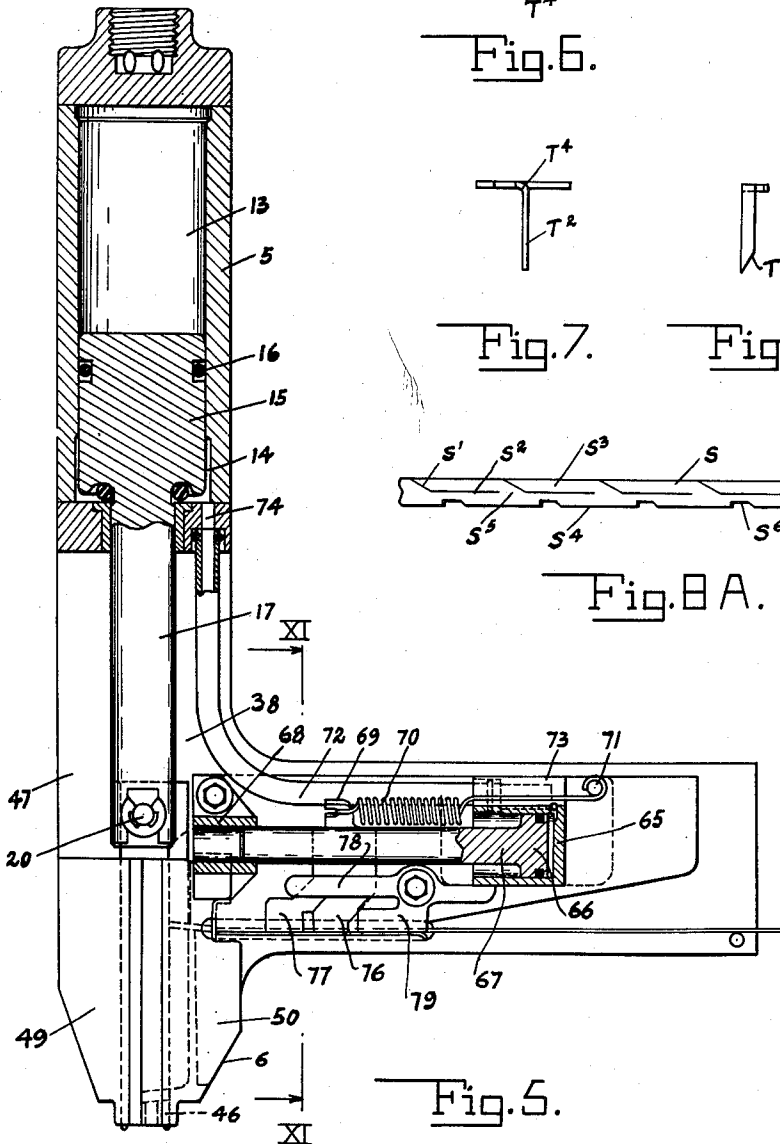


Fig. 5.

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4 Sheets-Sheet 3

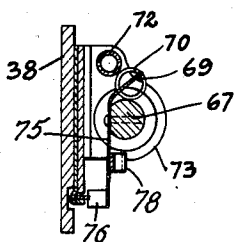
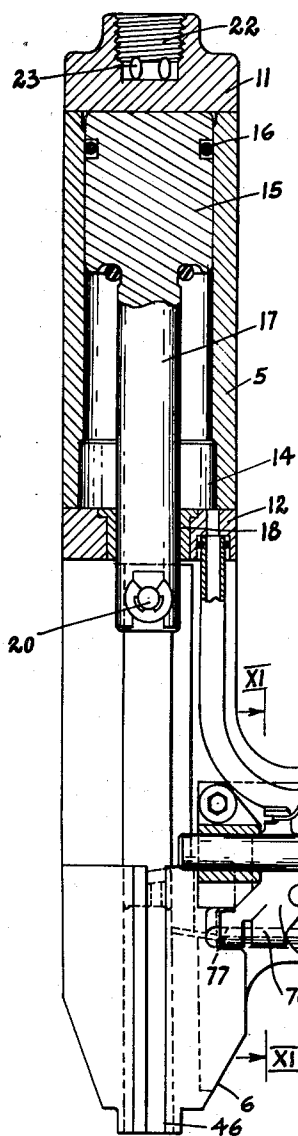


Fig. 11.

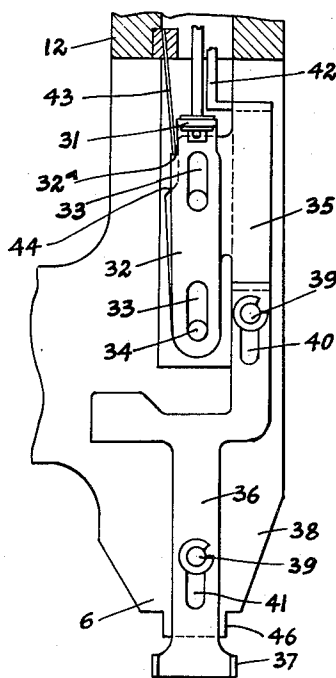


Fig. 12.

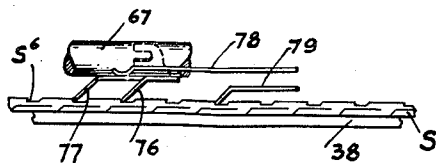


Fig. 10.

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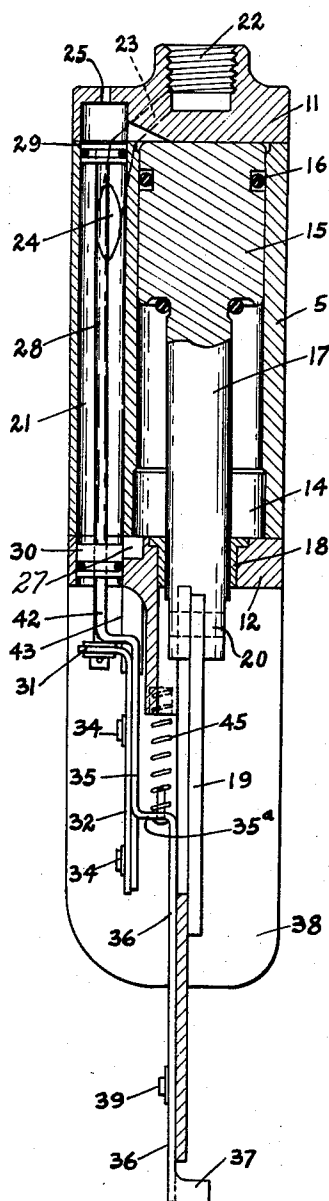


Fig. 13.

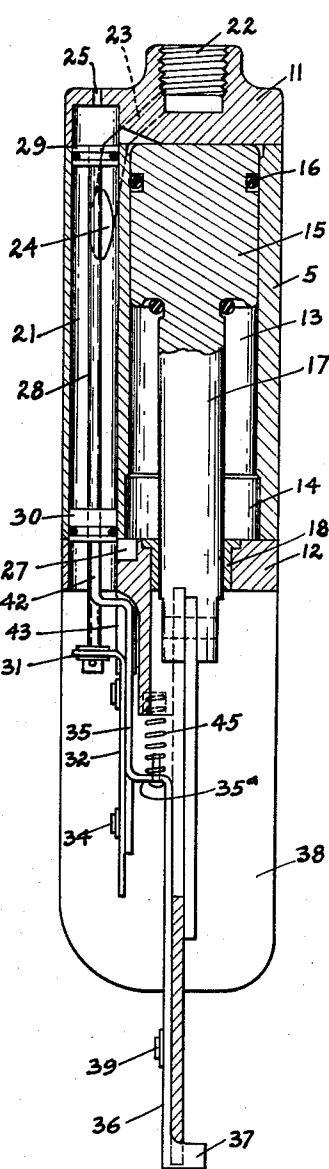


Fig. 14.

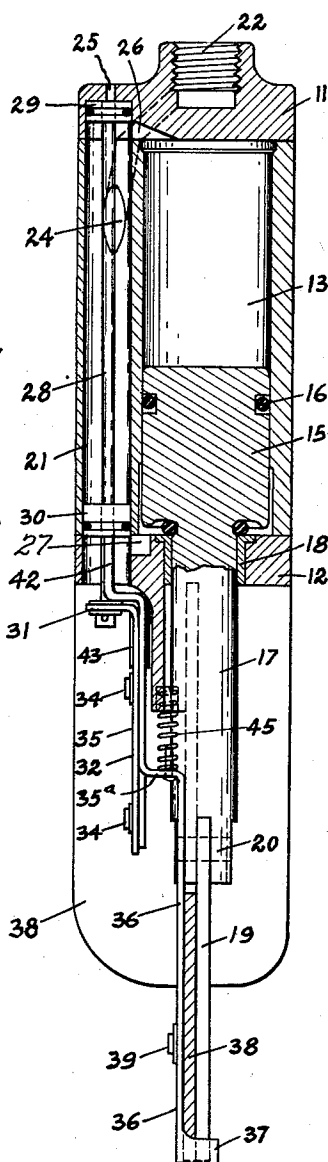


Fig. 15.

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PNEUMATIC FASTENER DRIVING AND LIKE TOOL

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Application November 29, 1954, Serial No. 471,656

12 Claims. (Cl. 1—44.4)

This invention is for a pneumatic tool, and more particularly for a tool having a reciprocating driver or impact device.

The invention may be used for the driving of various fasteners such as staples and tacks, and will be hereinafter described particularly in reference to the driving of fasteners such as T-tacks disclosed in my Patent No. 2,580,444, dated January 1, 1952, but this is by way of illustration and not limitation.

Tools for the driving of tacks or other small fasteners are designed to be held in the hand and used in various positions. Consequently they should be well balanced, relatively light and easy to handle. Moreover, since speed of operation over hand-driven fasteners justifies their use, such devices must be capable of fast and sure operation. Another justification for the use of a power-operated driver in lieu of a hand-operated device is to assure of the fastener being fully driven, either into soft or hard wood, and without damaging or marring the wood finish.

Portable drivers of the class to which the present invention is particularly applicable generally employ a spring acting in opposition to pneumatic pressure to move the driver in one direction, and fluid pressure moves it in the reverse direction. For example, in my Patent No. 2,574,875, granted November 13, 1951, the driver is propelled on its working stroke by a spring, while pneumatic pressure is used to return the driver and cock or compress the spring. While this is satisfactory for many purposes, the force of the blow is limited to the strength of the spring and the rapidity of its expansion, and no increase of force can be secured with a given spring by changing the air pressure. Also the element of recoil is hard to control so that in driving a fastener into hard wood for example, the driver may bounce or spring away from the work instead of driving the fastener completely "home."

In other types of drivers a spring is compressed on the driving stroke of the impact element or driver, and the compressed spring serves to return the driver to starting position. This has the objection that the spring absorbs energy from the driver at the time it is most needed, and higher pressure or larger cylinders are required. Major objections to both types are the size, weight, weight disposition, complexity of manufacture, and rebound or recoil.

While air hammers are common in which pneumatic pressure operates to propel the impact element back and forth, their successful operation depends upon an automatic valve action that causes the hammer to operate rapidly back and forth so long as the air pressure is "turned on," and hence they are not adapted to controlled single blow operations where one operation of the trigger results in only one cycle of movement of the hammer. For the accurate positioning of fasteners in upholstery or like operations, single cycle operation is required; the tacker should not automatically continue to "shoot" tacks as long as the trigger is pressed.

My invention has for its object to provide a pneumatic

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tool which is triggered for single cycle operation and which requires a separate movement of the trigger for each tack driven, and in which the impact element is driven and returned by pneumatic pressure without spring pressure in either direction.

My invention further provides a pneumatic tool which operates without objectionable recoil; which will operate as rapidly as the trigger can be operated; which is well proportioned, light, well-balanced, compact and useable in various positions without adverse effect of gravity.

A further object of my invention is to provide a tool of this character in which the trigger is associated with and forms in effect a part of the driver in the sense that the trigger is so located with respect to the fastener guide that the tool is brought to position over the exact place where the fastener is to be driven, then pressed toward the work, and this operates the trigger. The act of pushing the trigger against the work conditions one's grip to resist any slight bounce or recoil that may occur.

A further object of my invention is to provide a unique and novel trigger and valve arrangement which makes it impossible to stop the cycle of operation after it has been initiated. This prevents the operator from jamming the machine by starting to drive the tack and then changing his mind, resulting in a partially driven fastener lodging in the machine.

Still another object is to provide in such a machine, means for feeding strip fastener blank material and cutting off lengths of the blank in the driving operation together with pneumatic means for operating the feed at the proper time, and power to operate the feed is not derived from the driver as has heretofore been customary.

These and many other objects and advantages are secured by my invention which may be more fully understood by reference to the accompanying drawings, in which:

Fig. 1 is a side elevation showing the assembled tool, part of the magazine cover being broken away to illustrate the interior of the magazine, and in this figure the dotted line position of the cover section of the housing shows how the machine may be opened;

Fig. 2 is an enlarged detail view showing the arrangement of guide fingers at the bottom of the tool for guiding the fasteners, and also showing the valve operating foot or trigger;

Fig. 3 is a transverse vertical section in the plane of line III—III of Fig. 2 showing the relation of the resilient guide fingers to the guide and showing the trigger;

Fig. 4 is a bottom plan view of the discharge end of the fastener guide or driving nose of the machine, the trigger mechanism being in section in the plane of line IV—IV of Fig. 3;

Fig. 5 is a side elevation on a larger scale of the driver portion of the tool, the driving cylinder being shown in section and part of the feed mechanism being shown in section with the feed piston retracted. Also in this view the trigger is omitted for clarity of illustration;

Fig. 6 is a plan view of a fastener formed to be driven;

Fig. 7 is a side elevation of the fastener;

Fig. 8 is a front elevation of the fastener;

Fig. 8A is a plan view of a portion of a strip of fastener blanks from which the fasteners are formed;

Fig. 9 is a view similar to Fig. 5, showing the feed mechanism at the feed advance position of its travel;

Fig. 10 is a fragmentary bottom view of the feed finger mechanism only;

Fig. 11 is a transverse section in the plane of line XI—XI of Fig. 5;

Fig. 12 is an enlarged side elevation of the air valve operating trigger mechanism;

Fig. 13 is a transverse vertical section in a plane at right angles to Figs. 1 and 9, showing the main cylinder,

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the valve cylinder, and the valve operating mechanism in the normal inactive position;

Fig. 14 is a similar view showing the position of the parts just before the piston starts its downward movement; and

Fig. 15 is a view similar to Fig. 13, showing the main piston at the bottom of its stroke.

The machine here specifically illustrated is designed to drive fasteners of the type which are frequently referred to as T-tacks, and which has a horizontal bar corresponding to the head of the T, forming the head of the tack, and which has a leg forming element that joins to the head intermediate its ends, and at one side edge thereof. Such a tack is disclosed in my prior United States Patent No. 2,580,444, above noted, and it is formed from a connected series of blanks made in strip form as shown in Fig. 8A. In Fig. 8A the strip designated S is slitted at regular intervals along one edge by diagonal slits S¹, and each diagonal slit terminates in a longitudinal slit S². This provides the single leg-forming element S³ of the blank. S⁴ designates the head-forming element of each blank, and it will be noted that each leg connects to the side of the head-forming portion through a connector portion S⁵. Each head-forming portion follows a ratchet-like notch S⁶ cut in the opposite edge of the strip from the diagonal cuts S¹, the notches S⁶ having one abrupt shoulder and one sloping shoulder as shown for co-operation with the feeding and indexing mechanism of the driver hereinafter described. This fastener strip which forms no part of the present invention is disclosed in my patent above referred to, and the strip is prepared in coils which may contain several hundred or several thousand fasteners, depending upon the size of the magazine of the driver intended to receive the strip.

In the subsequent use of the strip, the end of the strip is moved under a plunger or driver which, on one stroke, shears off a previously formed blank from the end of the strip and drives it, while the plunger at the same time turns down the leg-forming element of the next succeeding blank from the plane of the strip to the perpendicular position shown in Figs. 6, 7 and 8. In Figs. 6, 7 and 8 the tack itself designated as T, and it has a head portion T¹ corresponding to the portion of the original strip S⁴. It has a downwardly-turned leg T² corresponding to the leg-forming portion S³ of Fig. 8A, and the diagonal slit S¹ of Fig. 8A forms the point T³ of the tack. The bending line occurs transversely across the connecting portion S⁵, this bend being indicated at T⁴ in Figs. 6 and 7.

One form of driver for converting the T-tack strip into individual fasteners and driving them is disclosed in my prior United States Patent No. 2,580,444, above noted, and a feed mechanism for engaging in the notches S⁶ is also shown in said patent, and is also the subject of a co-pending application, Serial No. 264,294, filed December 31, 1951.

The present invention is for an improvement particularly in the application of pneumatic power to the driver, and the application of a pneumatic action to the feeder as well as to certain improvements and refinements in other portions of the driver. Also while being described primarily in connection with the driving of T-tacks, the mechanism is also applicable to drivers for other forms of fasteners, and to like impact-operated devices, but will be hereafter particularly described in connection with the driving of T-tacks.

In its general assembly, the device has the contour shown in Fig. 1, in which there is a horizontal bar portion designated generally as 2, and which constitutes the handle for the machine. At one end of the bar portion is a generally circular chamber constituting the magazine for the fastener strips, and at the opposite end of the bar 2 is the driver assembly and associated parts designated generally as 4. The driver includes a downwardly-projecting guide or nose portion hereinafter more fully described, the end of which is held flat against the work

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into which the tack is to be driven, and the length of this nose is sufficient to elevate the cross bar 2 just far enough away from the work so that one's fingers may pass under the cross bar when it is grasped in the hand, but the hand is still close enough to the work surface to enable the operator to readily position it on the work and keep it steady. This distance is greater than the length of the fastener which the machine drives, but less than the radius of the magazine. The magazine has its center above the axis of the handle, both to keep it from interfering with the tool being brought close to the work, and also to even the balance of the tool. The fastener strip is conducted from the magazine to the driver through the handle.

In Fig. 1 the driver has the power cylinder assembly 5 extending upwardly from the axis of the handle and a fastener guide or nose 6 that extends downwardly, as above explained. Below the cylinder assembly 5 the housing for the mechanism is divided into two parts, which are hinged connected through hinges located at 7 so that one part, indicated generally as 8, can be opened out to the dotted line position shown in Fig. 1 where it is 180° from the normal closed position. The purpose of having it thus open is to afford access to the magazine 3 for changing coils; access to the channel through which the strip feeds for threading the end of a new coil of blanks into the machine, and for giving access to the guideway through which the fastener is driven to facilitate the removal of a fastener should it become jammed in the machine, and the machine be unable to clear itself. As shown in Fig. 1, the straple strip S is mounted on a spool 9, which may be a throw-away spool, and which may contain several hundred, or even several thousand fastener blanks. It is preferable to use a coil which is not excessively large so that the weight of the machine does not become tiresome to the operator, and also to keep the proportions such that the tool will balance nicely when the hand is gripped around the handle portion 2. On the interior of the cover 8 (as shown in Fig. 1), there are spring friction fingers 10 in that portion that forms part of the magazine, designed to bear against the face of the spool when the cover is closed, and apply enough friction to the spool 8 to keep it from overrunning, or running too freely.

Considering first the pneumatic driver and its associated parts, the cylinder, assembly 5 has at its upper end a head 11 in which an internally threaded nipple 22 into which the end of an air hose may be screwed. The lower end of the cylinder is closed by a block or cylinder base 12, which is fastened thereto, and within the cylinder assembly is a cylinder or cylindrical chamber 13, the lower portion of which is slightly enlarged in diameter as indicated at 14.

Within the cylinder 13 is a piston 15, this piston having an annular groove between its ends to receive an O-ring 16. Projecting from the lower end of the piston is a solid metal extension 17 passing through a bushing 18 in the cylinder base 12, and this bushing serves as a guide for the cylindrical extension 17.

Since the driving force exerted by the driver is a function of the mass times the velocity squared according to the formula $E=MV^2$, it is to my advantage to make the piston and the projection 17 of solid metal in order to incorporate a relatively large mass into a relatively small space.

Attached to the lower end of the extension 17 of the piston is a driver 19 which, for the purpose of driving T-tacks, may have the shape of the driver shown in my Patent No. 2,580,444, dated January 1, 1952. 20 designates a pin by means of which the driver is detachably secured to the extension.

Extending alongside the cylinder is a valve chamber 21 (see Figs. 13-15). The cylinder and chamber 21 are here shown as an integral casting. The cap 11 at the upper end of the cylinder has a threaded recess 22

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above mentioned, to which an air hose may be connected, and from this socket 22 there is an air passage 23 that opens into the valve chamber 21 intermediate its ends at the port designated 24. The valve chamber is open at its bottom and has a vent port 25 at its top. There is a port 26 in the upper part of the valve chamber that leads from the valve chamber into the upper end of the cylinder 13, and there is a port 27 at the bottom of the cylinder that communicates with the lower end of the valve chamber.

As shown in Fig. 13, extending up through the valve chamber is a valve rod 28 having a piston-like valve element 29 at its upper end, this valve element 29 always being located in the space between the air inlet port 24 and the vent 25.

Slidable on the valve stem 28 is a second valve element 30 located near the lower end of the valve cylinder, and which is confined to the region between the lowermost end of the valve cylinder and a point above the port 27 as may be seen by comparing Figs. 13 and 14. The valve stem 28 (see Fig. 12) projects down through the open end of the bottom cylinder and is connected at its lower end to an ear 31 on a slide plate 32, which slide plate has slots 33 therein through which pass guide pins 34 these guide pins allowing a limited relative movement of the plate 32 relative to the guide pins.

As best shown in Figs. 12, 13 and 14, the guide pins 34 are mounted on a metal stamping or plate 35, which plate has a downwardly-projecting extension 36 terminating in a bifurcated foot 37 that straddles the end of the staple guide to be hereinafter more fully described. The stamping 35 is slidably retained on the flat supporting plate 38 forming the main frame of the machine, and on which the cylinder is mounted, there being guide pins 39 on the plate 38 operating in slots 40 and 41, the slot 41 being in the extension portion 36 of the plate 35. The top of the plate 35 has an offset extension 42 that projects upwardly, and as shown in Fig. 12, terminates just inside the lower open end of the valve cylinder 21, Fig. 13 showing the parts in the normal position. The arrangement is such that when the end of the staple guide nose 6 is pressed against the work, the foot 37 will be pushed upwardly, and in the first portion of its travel the extension 42 will bear against the valve element 30 and lift this element above the port 27 to the position shown in Fig. 14.

As shown in Fig. 12, the slide plate 32 has a shoulder at 32a. A leaf spring 43 secured to the lower end of the valve and cylinder assembly projects over this shoulder when the parts are in normal position, and keeps the slide plate 32 from lifting. However when the presser foot 37 is moved upward relatively to the body of the machine, an inclined shoulder 44 on the slide plate 35 will hit the end of the spring 43 and cam it to the left as viewed in Fig. 12. At the time that this happens the plate 35 will have been lifted from the position shown in Fig. 12 so that the pins 34 will be in the upper portions of the slots 33 and the slide plate 32 can move up. With the release of the detent spring 43 as described, and with the valve 30 pushed up to the position shown in Fig. 14, the air pressure in the valve cylinder 21 will almost instantaneously move the valve 29 up past the port 26, whereupon air under pressure can enter the top of the main cylinder 13 and drive the piston 15 downwardly with great force. Since the valve 30 at such time has opened the port 27 at the bottom of the cylinder to atmosphere, air which may be in the cylinder under the piston can freely escape and will not impede the downward travel of the piston. When the piston moves down, no further operation can take place until the tool is lifted away from the work, but upon the tool being lifted away from the work, compression spring 45, confined between an abutment on the lower end of the cylinder and an offset 35a on the stamping 35 (see Figs. 13-15) will push the plate or stamping 35 down, returning it to the position shown in Fig. 13. The

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spring pressure required is very light because fluid pressure in the valve chamber pushing down on valve 30, bearing down on finger 42, equalizes the pressure acting upwardly on valve 29. As valve 30 moves down, air under pressure may enter the port 27 and again raise the piston to the position shown in this figure. Also as the plate 35 moves down the pins 34 will pull the slide plate 32 downwardly until the detent spring 43 catches over the shoulder 32a, and this downward movement of the plate 32 will pull the valve element 29 down against air pressure in the valve chamber to the position shown in Fig. 13 so that air from the valve chamber cannot get into the top of the cylinder 13, and at the same time the top of the cylinder will be vented through port 26 and air vent 25 to the atmosphere. Hence the air in the upper part of the cylinder will not impede the return or up stroke of the piston.

To follow through the operation of the piston, when the tool is connected to an air hose the parts immediately assume the position shown in Fig. 13. The air enters the valve chamber 21 and at this time the presser foot or triggering mechanism 37 is at the lowermost limit of its travel so that the valve 30 is held below the port 27 and the valve 29 is restrained from upward movement by the spring detent 43. Therefore the air pressure passes through the port 27 and raises the piston to the position shown in Fig. 13. When the operator presses the tool against the work at the point where the tack is to be driven and exerts a light pressure, the foot 37 will be pushed up relatively to the driver, moving the slide plate 35 upwardly, and the extension 42 will lift the valve 30 to the position shown in Fig. 14 where the port 27 will be opened to atmosphere, and as the plate 35 reaches the upper limit of its movement, the shoulder 44 will cam the detent 43 to the left as viewed in Fig. 12, whereupon air pressure acting against the under side of the valve 29 will instantly lift it, opening the port 26 from the valve chamber into the cylinder. It will be seen that by reason of the pin and slot connection of slots 33 and pins 34, plate 32 has a lost motion connection with member 35 on which it is carried and hence the opening of the port at the top of the cylinder occurs just an instant after valve 30 has opened the lower end of the cylinder to exhaust, and this is also an important reason for making the valve 30 relatively movable to valve 29 and stem 28 on which it is guided. When the air enters the cylinder, it will drive the piston down with great force, the air under the piston escaping to atmosphere through the port 27. When the cycle has been completed, the parts will be in the position shown in Fig. 15 and nothing more will happen until the operator lifts the tool away from the work. As soon as he does this, the spring 45 will push the slide plate 35 down, restoring it to the position shown in Fig. 13, and as the slide plate 35 moves down, the extension 42 is withdrawn from under the valve 30 so that the valve 30 is forced down by the air pressure in the valve chamber to the position shown in Fig. 13. As the plate 35 moves down, the pins 34 will transmit a downward movement to the valve stem 28, pulling the valve 29 back to the position shown in Fig. 13, and the machine will be completely ready for the next cycle of operation.

It will be seen that the piston cannot move on its driving stroke until the presser foot or trigger has been moved fully up relative to the tool to thereby release detent 43, and after this happens the full cycle of operation must follow, so that the driver cannot operate on part stroke and leave a partly driven fastener in the tool.

All of the valve operating mechanism described is positioned on one side of the plate 38 and is readily accessible for assembly or repair. As best seen in Figs. 9 and 12, the plate 38 is of substantially T shape with the cross-bar of the T vertical and the stem extending horizontally to the right as shown in Fig. 12. The driver 19 attached to the piston extension 17 is on the opposite

side of the plate 38 from the valve operating mechanism, as is most clearly seen in Fig. 9. The lower end of the plate 38 tapers in width forming the main part of the nose portion 6, and the lower-most end provides an extension or tip 46 of a width designed to operate between the bifurcations of the presser or trigger foot 37. The driver 19 slides or bears against the face of the plate 38, and is confined between two metal strips or blocks 49 and 50 respectively which form with the plate 38 channel-like tack guide or driver guide down which the tack or other fastener is moved in being driven. The driver is long enough and the stroke of the piston 15 is great enough to move the driver from the raised position shown in Fig. 9 to a position where its end is flush with the tip of the tack guide (see Fig. 15).

The details of construction of the tack guide are best shown in Figs. 2, 3 and 4. The block 49 has secured to it a stamping formed of sheet spring metal designated 51, and which has two inwardly-turned fingers 52 and 53 are over the center of the channel formed between the blocks 49 and 50 with the plate 38 forming the web or back of the channel. These spring fingers have shouldered ends 54 that are urged in against the bottom of the channel formed by the plate 38. On the plate 50 there is a somewhat similar but reversed stamping 55 having spring fingers 56 and 57, the terminal portions of the fingers 56 and 57 being the same as the terminal portions of the fingers 52 and 53, and finger 56 is located between fingers 52 and 53 (see Fig. 2) and finger 53 is located between fingers 56 and 57. This construction provides a succession of four resilient fingers as shown in Fig. 3, the tips of which fingers bear against the plate 38 (see Fig. 3), but the shoulders 54 of which are clear of the plate. The lowermost finger 57 is very close to the bottom end of the nose-like extension 46 of the plate 38 (see Fig. 2).

The block 49 as best shown in Fig. 4 has a ledge 58 thereon that extends under the shoulders 54 of the several spring fingers, and the clearance space for the point and leg of the staple being driven is designated 59 in Fig. 4, and is provided between the edge of the ledge 58, the face of the plate 38, the shoulders 54 of the spring fingers, and the tips of the spring fingers. The fingers are inclined as shown in Fig. 3 so that when the driver 19 slides from the raised position shown in Fig. 3 downwardly to the end of the nose 46, it will progressively cam the fingers 52, 56, 53, 57 outwardly or to the right as shown in Fig. 4 in the order named. Each spring finger will thus serve to confine the leg of the fastener as it travels down, and hold it against the edge of the ledge 58 and the face of the plate 38 to keep the tack from bending, but as the head of the tack is pushed down by the driver, each spring finger in turn is forced out of the way. In Fig. 2 one of the tacks is shown in dotted lines merely to show its location as it finally emerges, but it would never be in this relation with the presser foot 37 in the position shown.

The driver not only serves to drive the tack from the strip, but it serves to cut the tack off from the strip and at the same time bend down the leg-forming element of the next-succeeding blank on the strip. The top of the block 50 provides the die which cooperates with the driver for effecting these operations. As shown in Fig. 2 the block 50 has a transverse groove 61 formed therein through which the head-forming portion of the blank slides in moving to a position under the driver. As shown in Fig. 4 the block 50 has a portion 62 that overhangs the plate 38, leaving a clearance space 63 where the leg-forming element of the fastener is engaged by a part on the driver and moved from the plane of the strip down into a vertical plane. The block 50 has a shoulder at 64 providing clearance for the head of the tack as it is pushed down the guideway. The construction and arrangement of the leg-forming and shearing die are fully shown and described in my said Patent No. 2,580,444, and further detailed description with ref-

erence to them is not here required. It is sufficient to point out that when the blank reaches the position of the blank 60 in Fig. 3, the downward stroke of the driver shears the head portion of the blank from the continuous strip to which it is connected and drives the tack under the four resilient fingers with its leg guided in the manner described until the leg penetrates the material in which the tack is being driven, the tip 46 through the end of which the tack is discharged being held firmly against the work when the driving is taking place.

The said mechanism for advancing the tack strip on each operation of the driver is of the general type shown in my copending application Serial No. 264,294, filed December 31, 1951, but whereas the feed mechanisms heretofore employed have derived their power from the driver, the present invention provides a feed mechanism which is pneumatically operated.

As previously explained, the staple strip unwinding from the coil in the magazine moves horizontally through the lower portion of the handle portion 2 of the instrument, and in the left-hand end of the instrument as viewed in Fig. 5 there is a narrow channel through which the leg-forming elements of the strip are guided while the head-forming edge, which is seen edgewise in Fig. 5, is turned outwardly, exposing the indexing notches S⁶ described in connection with Fig. 8A. Located in the handle portion of the tool above the strip guide is a small air cylinder 65 in which is a piston 66 having a circular extension 67 which is guided at its outer end in a guide block or bearing 68 (see Figs. 5 and 9). On the rod-like extension 67 is a hook-like ear 69 to which is hooked one end of a tension spring 70, the other end of which spring is anchored to a stud 71 on a part of the frame back of the cylinder. The function of the spring is to urge the piston to the right as viewed in Fig. 5, or to retract it after it has been extended in its feeding stroke. A pipe 72 is received in a fitting 73 (see Figs. 5 and 9) formed along one side of the cylinder 65, and a port 74 establishes communication between the pipe 72 and inner end of the cylinder 65. The other end of the tube 72, as shown in Figs. 5 and 9, is fitted into the lower end closure piece 12 at the bottom of the cylinder 13. The piece 12 simply has a socket into which the end of the tube is inserted, and an O ring around the end of the tube forms the seal, a similar arrangement being used where the tube projects into the fitting 73.

A port 74 establishes communication between the upper end of the tube 72 and the inside of the bottom of the cylinder 13. The arrangement therefore is such that when air enters the cylinder 13 under the piston 15 to raise it, the pressure will also be transmitted through the port 74 into the tube 72 and enter the right-hand end of the cylinder 65 as viewed in Fig. 5, urging the piston to the left-hand position shown in Fig. 9. The enlargement 14 in the lower end of the cylinder assures of this taking place. Thus an impulse of air is delivered to the cylinder 65 each time the piston 15 is lifted. When the port 27 at the bottom of the cylinder is opened to atmosphere, the pressure in the pipe 72 and consequently in the cylinder 65 is released and the spring 70 can operate to retract the piston 66. It will thus be seen that the one valve mechanism controls both the drive cylinder and the feed cylinder since air can enter the feed cylinder only when it is also entering the bottom of the drive cylinder. This operation of the piston 66 is used to feed the fastener blank so as to advance the fastener strip one step each time the driver is operated. For transmitting movement from the piston 66 and its extension 67, the extension 67 is provided with a metal piece 75 secured thereto as by a rivet (see Fig. 7), this piece 75 having two fingers 76 and 77 that are turned inwardly (see Fig. 10) to engage in the notches S⁶ in the edge of the strip S, the one finger engaging in one notch, and one in the succeeding notch of the strip. A resilient metal spring finger 78 extends out over the metal piece 75 to create a resilient pressure urging the ends

of the fingers 76 and 77 yieldably down into engagement with the notches. The arrangement is such that when the piston moves to the left as viewed in Fig. 5, the ends of the fingers 76 and 77 being pressed into the notches S⁶ of Fig. 8A will move the strip forwardly to the left, traveling to the position shown in Fig. 9. When the piston is returned to its retracted position the ends of the fingers 76 and 77 slide up on the inclined edges of the notches S⁶, thus causing the extension 67 of the piston to be rotated very slightly as the fingers 76 and 77 are cammed out of the notches of the strip against the pressure of the spring 78, so that the fingers 76 and 77 move back to their starting position while the strip S remains stationary. The stroke of the piston 66 is just equal to the distance between one notch S⁶ and the next, so that in each cycle of movement, the strip is advanced the length of one blank. In order to prevent any retracting movement of the strip there is a second spring finger 79 (see Fig. 10) having a terminal portion that rides against the edge of the strip S, and which catches against one of the vertical shoulders of the strip, should the strip tend to move backward, but this finger will ride up on the sloped edge of the notch when the strip is being advanced. In other words, the spring finger 79 is a holding pawl cooperating with the notches, and the fingers 76 and 77 are feeding pawls cooperating with the notches, the notched strip constituting the ratchet. There are two fingers 76 and 77 just to effect a positive feed and avoid any possible failure of the device to feed, but one pawl alone would be sufficient. As stated, the fingers 76 and 77 are operatively positioned the distance between notches S⁶ on the fastener strip.

As shown in Fig. 1, the lower portion of the tack guide may be exposed, while the portion of the guide which includes the dies and the feeding mechanism is enclosed under the hinged part of the housing so that when the housing is closed this part of the mechanism is concealed and protected, but upon opening the hinged part to the position shown in dotted lines in Fig. 1, all of this mechanism will be exposed. All of the mechanism is mounted on the flat plate 38 and the hinged part of the housing, designated 8, is in the form of a casting having a flange that fits over and encloses the mechanism when the housing is closed.

The mechanism thus described comprises a convenient, light, well-balanced form of tool. The operator grasps the bar portion 2 in his hand when he is using the tool and positions the nose 46 over the place where the tack is to be driven. He then presses down on the cross bar, causing the presser foot 37 to move up and initiate the step of driving and feeding as hereinbefore described. The pressure of his hand is exerted close to the point of driving, which is helpful in positioning the tool and holding it steady. All of the parts of the mechanism are readily available for assembly or for tension as they require it, and they are designed to be relatively light so that the tool is not tiring to the arm of the operator who may use it for long periods at a time. By having a driver which is operated entirely by air instead of by a spring in one direction and air in the other, the force with which the driver drives the tack may be varied by varying the air pressure. This is desirable because tacks may be driven one day into soft wood, and another day into hard wood, and if the same driving pressure is used both times, the head of the tack may be sunk too far into the wood in one case, or not sufficiently embedded in the wood in another. Moreover, there being no spring to absorb power from the driver, the full force of the blow is spent on the tack. Also since the feed is operated by air, there is no absorption of power from the driver to operate the feeding mechanism as is the case where the driver is provided with cams or linkages for moving the feeder. The tool is safe in that the driving of each tack requires a separate operation of the triggering foot 37, so that tacks cannot be driven unless the triggering foot is directly operated. The bifurcations

on the triggering foot form a guard which prevent the operator from getting his fingers under the driver during the driving operation, and since the tool must be pressed against the surface into which the tack is to be driven, there is little danger of personal injury, as may be the case where there is a finger-operated trigger and a fastener can be expelled or "shot" from the device merely by pressing the trigger while the instrument is in the open air. In other words, the trigger mechanism here provided does not permit the accidental discharge of any fasteners into the air, but a fastener can only be ejected when the triggering mechanism is pressed against a resistant surface. As stated, after the driving stroke has been started, it must go through to a point where the tack is entirely clear of the machine, and the tack guide cannot become jammed with partly driven fasteners, except perhaps in the case of an imperfect tack or improper feed adjustment, but never from the operator not triggering the device properly.

The simplicity of construction and assembly is a further feature of my invention. There is a single flat supporting plate 38, shaped to the general contour of the assembled tool, this plate having the horizontal bar between a disk-like terminal at one end forming one face of the magazine and a vertical cross bar providing the downwardly-extending tapered nose 46 and the upward extension on which the main cylinder 5 is secured. On one side of the vertical cross bar of the plate is mounted the valve and trigger mechanism where it is readily accessible. On the other side of the plate is mounted the driver and fastener guide, the feed mechanism and the spool holder. The cover is hinged to the supporting plate, two screws or rivets being required, as shown in Fig. 1, and the cover, having flanges about its edges, in its closed position, encloses the feed mechanism, magazine and upper part of the fastener guide. When the cover is open the driver, forming die, feed and magazine are all accessible. This is a convenient, economical and unique assembly.

While I have shown and described in detail one preferred embodiment of my invention, it will be understood that various modifications and changes may be made in the construction and arrangement of parts within the contemplation of my invention and under the scope of the following claims.

I claim:

1. A pneumatic fastener driver comprising a cylinder, a piston in the cylinder having an extension projecting beyond one end of the cylinder, a driver on said extension, a valve chamber adjacent the cylinder and having ports opening into opposite ends of the cylinder, means for introducing air into the valve chamber intermediate its ends, two relatively movable valve elements in the valve chamber, the first of which is movable between two positions to alternately shift from a position where the port at one end is open to the pressure in the valve chamber to a position where it is open to atmosphere, the second valve being similarly shiftable with respect to the port at the other end of the cylinder, a trigger mechanism for moving the first valve from a position where the port is in communication with the pressure in the valve chamber to a position where it is open to atmosphere, and upon movement of the first valve, releasing the second valve for movement under pressure of fluid in the valve chamber to a position where the port which it controls is open to fluid pressure in the valve chamber and closed to atmosphere.

2. A pneumatic impact tool comprising a cylinder, a piston reciprocable in the cylinder having a driver attached thereto, a port at each end of the cylinder, a valve chamber alongside the cylinder open at each end to atmosphere and connected between its ends to a source of air pressure, a valve at each end of the chamber movable to alternately expose the respective ports to atmosphere and pressure in the valve chamber, a

reciprocable trigger element having an extension for moving one valve upon initial movement of the trigger to a position where the port controlled by it is open to atmosphere, a detent for holding the other valve in position where the port controlled by it is open to atmosphere, means on the trigger for releasing said detent after the first valve has been moved by said extension whereby fluid pressure in the valve chamber moves the second valve to a position where the port it controls is open to pressure in the valve chamber, and means for returning the trigger to its starting position and moving both valves to the position where the port controlled by the first valve is open to pressure in the valve chamber and the port controlled by the second valve is open to atmosphere and for resetting said detent.

3. A pneumatic impact tool as defined in claim 2 wherein the second valve has an operating extension connected with the trigger through a lost motion connection, said detent comprising a resilient finger, the operating extension having an abutment thereon engaged by said finger.

4. A pneumatic driver of the class described comprising a cylinder, a piston reciprocable in the cylinder, said cylinder having a port at each end thereof, a valve chamber alongside the cylinder open at each end to the atmosphere and having two movable valve elements therein, one of which moves from a position where the port at one end communicates with the valve chamber to a position where said port is open to atmosphere, the second valve being similarly movable with respect to the other port, means for admitting operating fluid to the chamber between said valves whereby the operating fluid exerts a pressure against both said valves urging each of them to the position where the respective ports are closed to atmosphere and open to the valve chamber, a valve stem on the first valve extending outside the valve chamber having a detent plate thereon with an abutment, a spring finger resiliently urged into a position engaging said abutment when the valve attached to said stem is in a position where the port which it controls is open to atmosphere, a trigger mechanism reciprocably movable with respect to said valves and having a lost motion connection with said stem, said trigger mechanism having an extension thereon positioned to engage the second valve member and move it against the pressure of fluid in the chamber to a position where the port which it governs is open to atmosphere, a cam on said trigger mechanism for releasing said detent only after the trigger mechanism is so moved to a position to shift said second valve member whereby fluid pressure in the valve chamber may upon release of said detent be effective to move the first valve to a position where the port controlled by it is in communication with the fluid pressure in the valve chamber to thereby actuate the piston toward that end of the cylinder, the port of which is open to atmosphere, and means for returning the trigger and moving the valves in the opposite direction whereby the piston is then moved to the opposite end of the cylinder and retained there by fluid pressure.

5. A pneumatic driver as defined in claim 4 in which there is a second cylinder having a piston therein and a spring for moving the piston in one direction, and a conduit connecting said second cylinder to that end of the first cylinder which has the port controlled by said second valve so that when said port is open to atmosphere, said second cylinder is vented to atmosphere, a driver attached to and operated by the piston in the first cylinder and a fastener feed mechanism attached to and operated by the piston in said second cylinder, the energizing of the feed cylinder thereby being effected only when the driver is being retracted.

6. A pneumatic driver as defined in claim 4 in which the trigger is manually operated in the first instance and a spring is provided for returning it.

7. A pneumatic driver as defined in claim 6 in which the trigger has a foot element designed to be pressed against a work piece to effect movement thereof.

8. A pneumatic impact tool comprising a cylinder, a piston reciprocable in the cylinder having a driver attached thereto, a port at each end of the cylinder, a valve chamber alongside the cylinder open at each end to atmosphere and connected between its ends to a source of air pressure, said ports leading to said valve chamber, a valve at each end of the chamber movable to alternately expose the respective ports to atmosphere and pressure in the valve chamber, said valves being movable relatively to each other, and a trigger mechanism for effecting relative movement of the valves, said trigger mechanism having an extension which abuts against and reciprocates one valve from a position where the port which it controls is open to fluid pressure in the valve chamber to a position where it is open to atmosphere and thereafter causing the movement of the other valve to be effective from a position where its port is open to atmosphere to a position where its port is in communication with the fluid pressure in the valve chamber, and means for resetting the trigger and withdrawing said extension from out of contact with the first valve whereby fluid pressure in the valve chamber returns it to a position where the port which it controls is open to pressure in the valve chamber and returning the second valve to a position where the port that it controls is open to atmosphere.

9. A pneumatic impact tool of the class described comprising a cylinder, a piston in the cylinder movable from a retracted position to an extended position, an operating extension on the cylinder projecting beyond one end thereof for transmitting an impact, a valve chamber having its opposite ends connected through ports with opposite ends of the cylinder, means for introducing fluid under pressure to the chamber intermediate its ends, a valve movable in the valve chamber from a position where the port at one end of the cylinder opens into the chamber and is closed to atmosphere to a position where it is open to atmosphere and closed to pressure in the chamber, a trigger for effecting such movement of said valve, pressure in the valve serving to move the valve in the reverse direction where the trigger is released, a second valve in the valve chamber movable from a position where the port at the other end of the cylinder is open to atmosphere and closed to pressure in said chamber to a position where it is open to the pressure in the chamber and closed to the atmosphere, said valve being movable in such direction by fluid pressure in the chamber, means controlled by the trigger for restraining such movement of the second valve until the first valve has opened its port to atmosphere, and a lost motion connection between the trigger and the second valve for resetting the second valve to a position where its port is open to atmosphere and closed to pressure in the valve chamber.

10. A feed mechanism for feeding a connected strip of fastener blanks to a driver wherein the strip of fastener blanks has ratchet-shaped notches in the edge thereof, said feeder comprising a piston, a cylinder in which the piston moves, a spring for moving the piston in one direction, a fluid pressure connection for applying fluid pressure to the cylinder to move the piston in the other direction, an operating extension in said piston, a pawl extending transversely from said extension and movable with the piston back and forth along the edge of the connected strip of blanks, a spring for urging the pawl into engagement with the notches in the strip when the piston moves in one direction, said piston and extension being rotatable about the longitudinal axis of said extension to enable said pawl to move into said notches under the influence of said second spring and out of the notches against the pressure of said second spring.

11. A pneumatic driver of the class described com-

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prising a cylinder, a piston movable back and forth in the cylinder, and in normal condition held in a retracted position in the upper end of the cylinder, by air pressure, a valve means for normally supplying air under pressure from a pressure source to the lower end of the cylinder to hold the piston in retracted position, said valve means having a relatively movable valve element that normally vents the upper end cylinder to atmosphere when the piston is held in retracted position, an operating mechanism manually movable in one direction for pushing said valve means from a normal to an actuated position where the lower end of the piston is open to atmosphere and closed to the source of operating air, a detent mechanism normally restraining the relatively movable valve element from operating, means actuated by said operating mechanism to release said detent whereupon said relatively movable valve element may move under air pressure to a position where the upper end of the cylinder is closed to atmosphere and in communication with the source of operating air pressure, a spring assisted by air from the source of operation for returning said operating means, valve means, valve element and associated parts to normal position, and a driver connected with and actuated by said piston.

12. A pneumatic mechanism of the class described comprising a cylinder, a piston in the cylinder having a projection at one end that extends through the cylinder for striking a blow, said piston being movable to extend and retract said projection, a valve cylinder alongside the first cylinder having an air pressure supply port intermediate its ends and opening to atmosphere at each end and also having a port at each end leading to the respective ends of the first cylinder, a valve element in each end of the valve cylinder movable from a position where the port which communicates to the first cylinder is open to atmosphere through the valve cylinder or open to the pressure within the valve cylinder, said valve being relatively movable and urged by pressure in the cylinder in opposite directions, a spring biased trigger for operating

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one valve to open the port at the end of the cylinder through which the projection on said piston extends to atmosphere, a detent for holding the other valve normally in position where the port at the other end is also open to atmosphere, means operated by movement of the trigger to release said detent only after said movement of the first valve has been effected whereby the second valve may then move by pressure in the valve cylinder to a position where air from the valve chamber may enter the first cylinder to propel the piston to its extended position, the spring bias of the trigger effecting movement of the first valve to a position where it closes the port which it contacts to atmosphere and opens it to pressure in the valve cylinder, and means operated by such movement of the first valve for restoring the second valve to normal position and resetting said detent to hold the second valve in normal position.

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