

Aug. 31, 1954

A. G. JUILFS
STAPLING MACHINE

2,687,522

Filed March 30, 1953

4 Sheets-Sheet 1

FIG. 1.

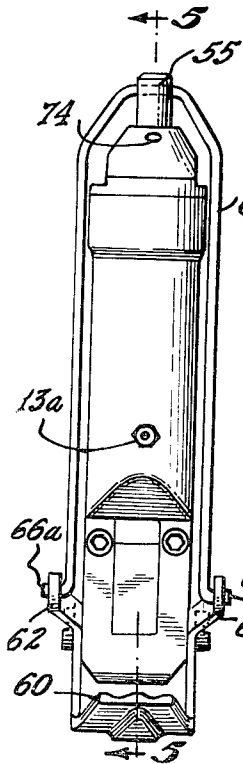
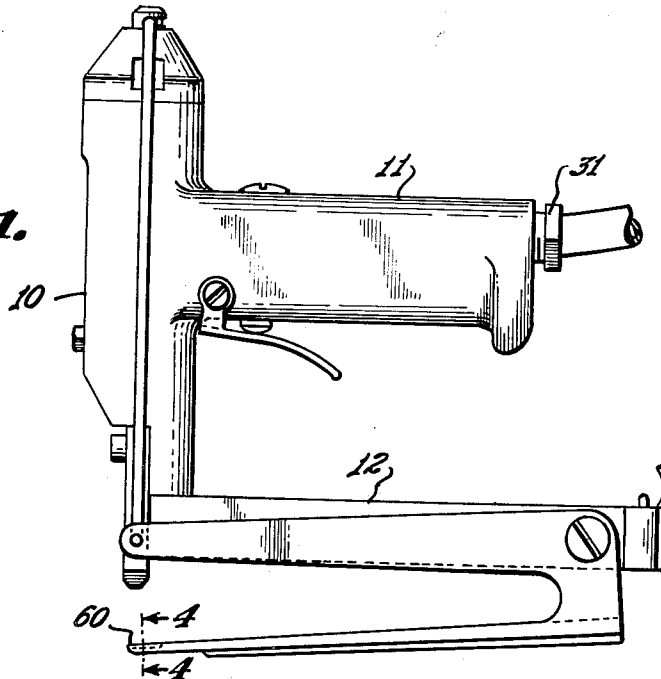


FIG. 3.

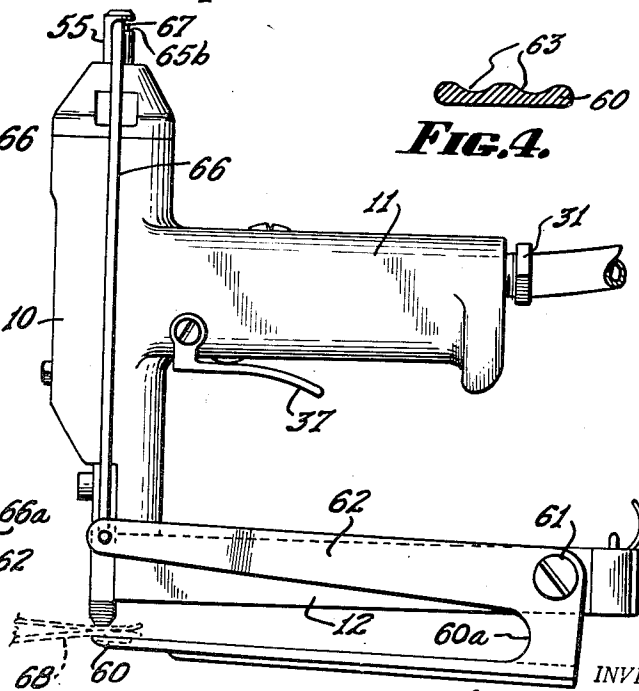


FIG. 2.



FIG. 4.

INVENTOR.
ALBERT G. JUILFS,
BY
Allen & Allen
ATTORNEYS.

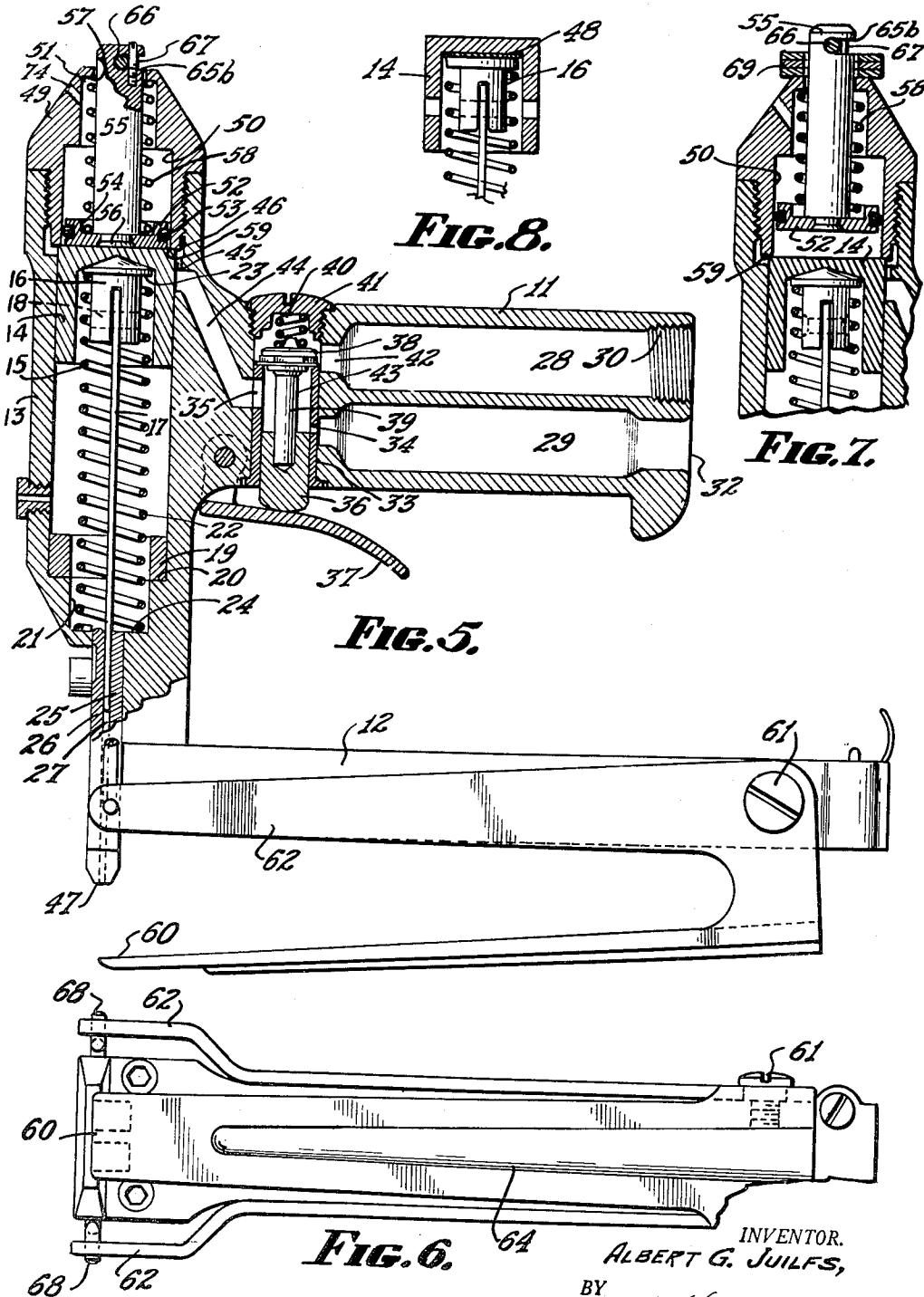
Aug. 31, 1954

A. G. JUILFS
STAPLING MACHINE

2,687,522

Filed March 30, 1953

4 Sheets-Sheet 2



INVENTOR.
ALBERT G. JUILFS,
BY *Allen & Allen*
ATTORNEYS.

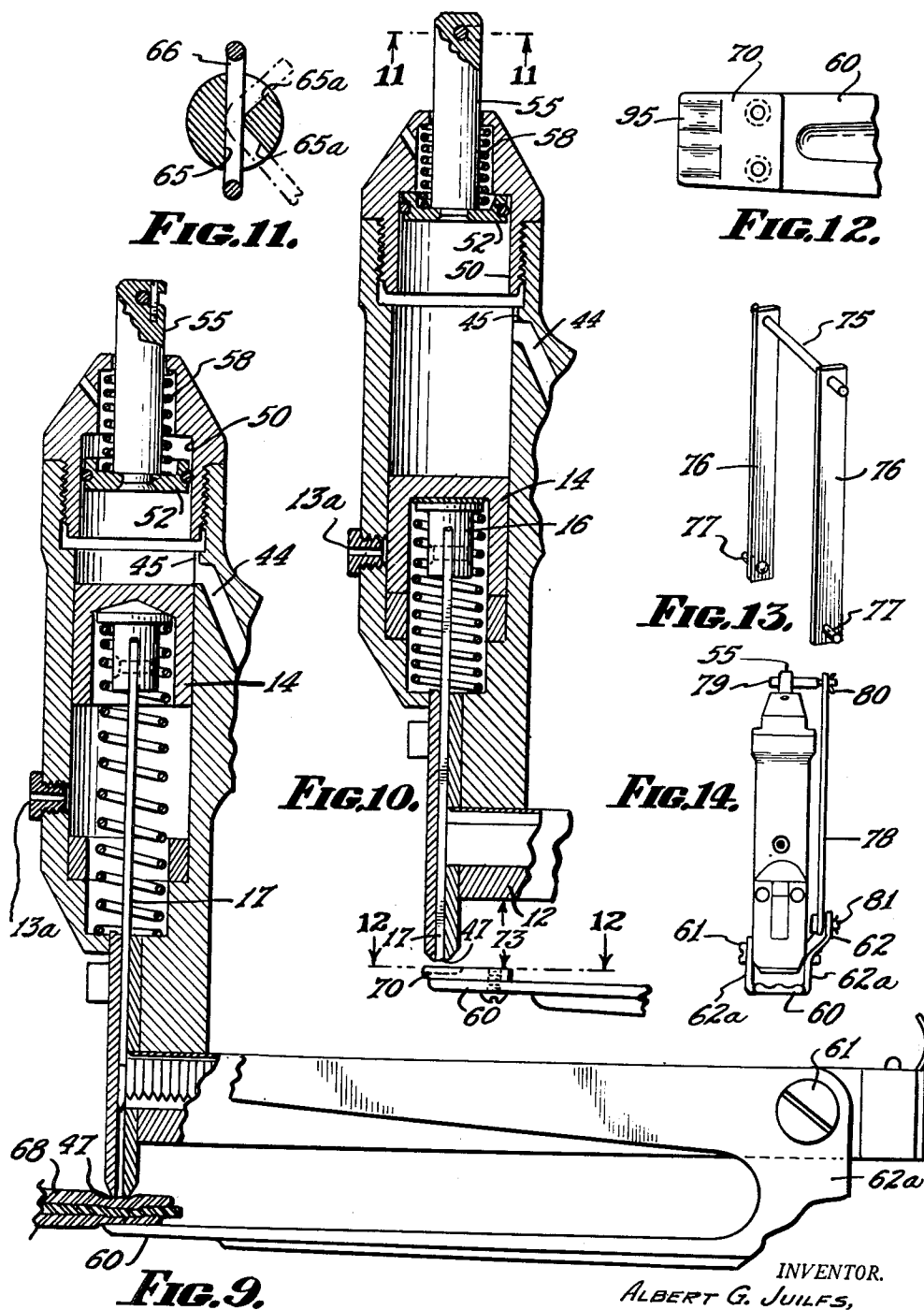
Aug. 31, 1954

A. G. JUILFS
STAPLING MACHINE

2,687,522

Filed March 30, 1953

4 Sheets-Sheet 3



INVENTOR.
ALBERT G. JUILFS,
BY *Allen & Allen*
ATTORNEYS.

Aug. 31, 1954

A. G. JUILFS
STAPLING MACHINE

2,687,522

Filed March 30, 1953

4 Sheets-Sheet 4

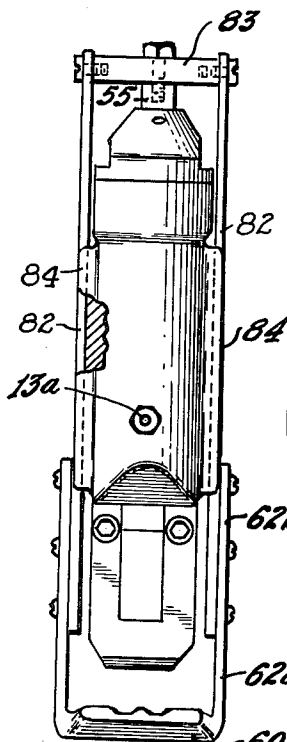


FIG. 16.

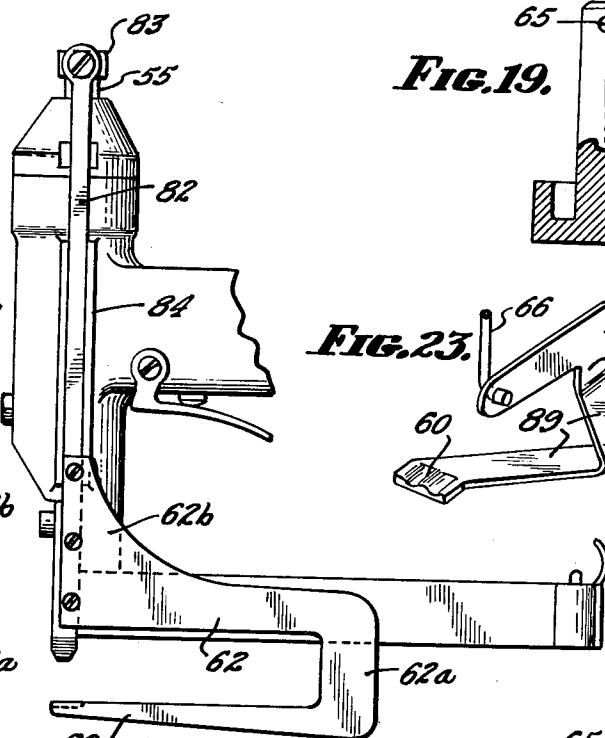


FIG. 15.

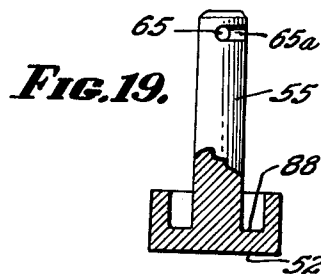


FIG. 19.

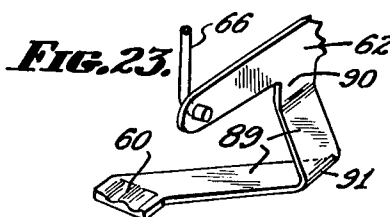


FIG. 23.

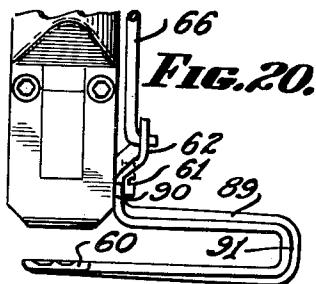


FIG. 20.

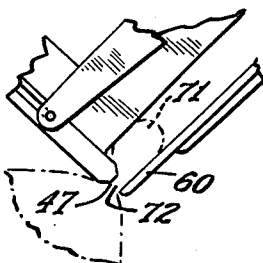


FIG. 18.

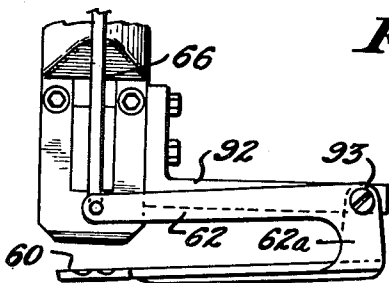


FIG. 21.

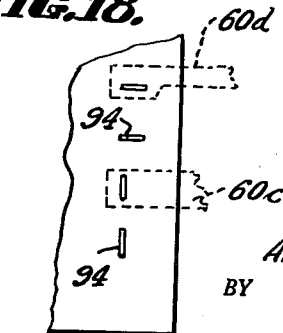


FIG. 22.

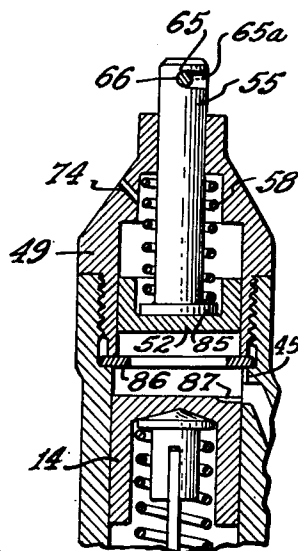


FIG. 17.

INVENTOR.
ALBERT G. JUILFS,
BY *Allen & Allen*
ATTORNEYS.

UNITED STATES PATENT OFFICE

2,687,522

STAPLING MACHINE

Albert G. Juilfs, Newtown, Ohio, assignor to
Senco Products, Inc., Cincinnati, Ohio, a cor-
poration of Ohio

Application March 30, 1953, Serial No. 345,489

32 Claims. (Cl. 1—44.4)

1

This invention has to do with the provision of a new and improved stapling machine, particularly of the type wherein the material to be stapled is clinched between an anvil and the nose of the machine.

A very important object of my invention is to provide a stapling machine wherein the anvil is moved towards the nose of the machine when a staple is to be set.

Another very important object of my invention is to provide a stapling machine with a movable anvil which is self-adjusting with respect to the thickness of the material being clinched and stapled together.

An object of this invention is to provide a stapling machine wherein the anvil is moved towards the nose of the machine and wherein the staple is driven through the material against the anvil, the movement of the anvil and of the staple driver being timed to provide a particular sequence of operations.

A further object of this invention is to provide a relationship between the means for moving the anvil and the means for actuating the staple driver so as to produce a particular cycle of operations.

Still another object of this invention is to provide an arrangement of the anvil and nose of the stapling machine which will enable stapling to be accomplished at areas other than just at the edge of material to be stapled.

It is also an object of my invention to provide a stapling machine in which the movable anvil may be so arranged as to permit stapling either parallel to a given line or at right angles thereto as is desired.

Yet another object of this invention is to provide a stapling machine having a movable anvil in which in addition to the self-adjusting feature, it is possible to vary the amounts the anvil will have to move in accordance with the thickness of materials to be stapled.

A further object of this invention is to provide a stapling machine which may be assembled easily and which may be taken apart with a minimum number of tools.

These and other objects of my invention will become apparent to one skilled in the art during the course of the following description and with reference to the accompanying drawings, in which drawings like numerals are employed to designate like parts throughout the same, and in which:

Figure 1 is a side elevation of the stapling machine of this invention,

Figure 2 is a view similar to Figure 1 but show-

2

ing the anvil in closed position for the actual stapling operation,

Figure 3 is an end view of the device of Figure 2,

Figure 4 is a section taken on the line 4—4 of Figure 1,

Figure 5 is a section taken on the line 5—5 of Figure 3,

Figure 6 is a bottom view of the device of Figure 5,

Figure 7 is a fragmentary section similar to Figure 5 but showing the arrangement utilized in those cases wherein thin materials are to be stapled together,

Figure 8 is a fragmentary section showing an alternative arrangement of the staple driver and its piston,

Figure 9 is a view, partly in section, showing the relative position of the various parts after the staple gun has been fired and before the staple has been set, this figure bringing out the fact that the anvil is moved to clinched position prior to the time that the staple driver picks up a staple, such figure also illustrating the self-adjusting feature above referred to,

Figure 10 is a view analogous to Figure 9, the guns differing somewhat in their construction in that the driver is rigid with the piston, but showing the position of parts which occurs when such a gun is fired empty and when both pistons have moved their full extent,

Figure 11 is a section taken on the line 11—11 of Figure 10,

Figure 12 is a plan view taken along the line 12—12 of Figure 10,

Figure 13 is a perspective view of a modified bail or stirrup that may be employed with my invention,

Figure 14 is an end view of a staple gun embodying the principles of my invention and showing another modification of the stirrup arrangement,

Figure 15 is a side elevation of a stapling machine embodying a variation of my invention wherein the anvil is not pivoted to the machine,

Figure 16 is an end elevation of the machine of Figure 15,

Figure 17 is a fragmentary sectional view showing a modification of my invention wherein the upper piston is free of the rod associated therewith,

Figure 18 is a fragmentary elevational view illustrating one of the advantages of a stapling machine or gun embodying my invention,

Figure 19 is a view, partly in section, of a modi-

fication of the upper piston and rod associated therewith.

Figure 20 is an end view showing a modified anvil that may be employed with my invention.

Figure 21 is an end view of still another modification of my invention.

Figure 22 is a diagrammatic view showing the different types of stapling that may be accomplished with a stapling machine embodying various of the modified anvils used therewith, and

Figure 23 is a perspective view showing in greater detail the anvil of Figure 20.

It will be understood that while I have shown my invention as applied to a stapling machine in which the staple driver is actuated in the manner taught in my co-pending application Serial No. 181,023 and in my patent number 2,585,941, it is also possible to apply the teachings of this invention to arrangements wherein the staple driver is actuated as taught in my patents 2,585,939; 2,585,940 and 2,585,942. Also, while I have shown my invention as utilizing a staple feed mechanism corresponding generally to those shown in my copending application No. 345,490 and in my Patents 2,585,939; 2,585,940 and 2,585,942, it will be apparent that the particular feed magazines do not constitute a limitation of this invention.

Similarly, it will be obvious to the person skilled in the art that many stapling machines now on the market may be modified to incorporate the teachings of this invention. Thus, this invention may be adapted in numerous stapling machines, which machines may differ in the specific manner in which the staple driver is actuated and which machines may also differ in the manner in which staples are brought into position before the driver so as to be driven thereby.

In general, my invention is applicable to stapling machines wherein a staple is brought to a position within a slot or drive track and wherein a staple driver moves through said track to push a said staple before it into the work to be stapled. This invention is particularly adapted for use in connection with stapling machines of this type wherein the staple driver is actuated by pneumatic means.

It is a specific feature of this invention that the same pneumatic means employed to actuate staple drivers found in machines already on the market may be employed to actuate the novel anvil added by this invention.

Referring now to the drawings, it will be apparent that my invention is shown as applied to a stapling machine having a body generally indicated at 10, a hand grip portion 11 and a staple feed magazine 12. The members 10, 11 and 12 are rigidly secured together. Referring particularly to Figure 5, I have shown the body portion 10 as comprising a cylinder 13. Within this cylinder 13 there is a piston 14 having a central bore 15. Within the bore 15 of the piston 14 there is a member 16 to which the staple driver 17 is pinned as indicated at 18. In the particular arrangement shown, the member 16 is not attached to the piston 14. This arrangement is taught in my co-pending application Serial No. 181,023.

Within the lower end of the cylinder 13 I provide a rather large bumper 19 which may be made of any suitable resilient material. This bumper 19 rests on a shoulder 20 formed within the cylinder 13. Below the shoulder 20, I have provided a bore 21 of smaller diameter than that provided in the cylinder 13, and it is within this

bore 21 that the spring 22 rests. The spring 22 also extends within the bore 15 of the piston 14 and it abuts at its upper end a shoulder 23 provided on the member 16 while it abuts at its lower end a portion 24 provided in the body of the stapling machine.

In the particular stapling machine shown in Figure 5, a pair of plates 25 and 26 are fastened to the forward part of the machine. These plates define a drive track or slot 27 in which the staple driver 17 is reciprocated. Preferably these plates are removably secured to the body of the stapling machine as taught in my Patent No. 2,585,939. It will be understood that the magazine 12 is designed so as to bring the succession of staples within the slot 27 before the driver 17. There are any number of staple magazines which may be employed to do this and, therefore, this feature does not constitute a limitation of the instant invention. The particular magazine shown, however, is of the type shown in my Patent No. 2,585,942 and in my copending application Serial No. 345,490.

Within the handle portion 11, I provide a pair of chambers 28 and 29. The connection to a source of pneumatic pressure may be made within the chamber 28 at the threaded portion 30 by means of a suitable coupling 31 generally shown in Figure 1. The chamber 29 is an exhaust chamber and is open as indicated at 32.

Associated with the chambers 28 and 29 is a valve mechanism. This valve mechanism may comprise a sleeve 33 having an exhaust opening 34 and an air inlet port 35 therein. Slidable within one end of the sleeve 33 is a member 36 which may be actuated by a trigger 37 which is pivoted to the body of the stapling machine.

A valve member having a head 38 and a stem 39 is provided. The stem 39 fits within a bore provided in the member 36 while the head 38 is adapted to close the upper end of the sleeve 33. A spring 40 which abuts a member 41 normally holds the valve head 38 against the end of the sleeve 33.

In operation, when the trigger 37 is pulled so as to force the member 36 within the sleeve 33 against the action of the spring 40, the member 36 blocks the port 34 and thereby prevents exhaust. At the same time, such action results in the head 38 moving away from the end of the sleeve 33 so that air within the chamber 28 may pass through the orifice 42, through the bore 43 of the sleeve 33, and through the port 35, into the channel 44, and thence through a small longitudinal groove 45 provided in the face of the cylinder portion 13 and into a recess 46. This recess 46 is located adjacent the end of the piston 14 when in its normal position as urged by the spring 22. Air gathering in the recess 46 drives the piston 14 towards the bumper 19. This in turn results in the staple driver 17 being moved through the drive track 27 so as to pick up a staple positioned therein by a feed mechanism 12. When the driver 17 is thus actuated a staple is driven from the drive track 27 and out the forward end of the nose or nozzle as indicated at 47 and as defined by the plates 25 and 26.

In the particular machine shown in Figure 5, the arrangement is such that when the piston 14 seats against the bumper 19, the member 16 is free to move under the influence of inertia. The shock of the piston meeting the bumper is eased by a cushion of air which builds up ahead of the piston after it passes the adjustable outlet vent 13a located towards the lower end of the

5

cylinder 13. Thus, in this arrangement, the driver 17 is free to project beyond the end of the nose 47 until stopped by the work being stapled and, of course, by actual contact of the member 16 with the bottom 24 of the stapling machine.

The features so far described, and their operations, are generally shown in my various patents and co-pending applications as above identified. For the purposes of this invention, nothing new is claimed in the foregoing material. I should point out, however, that in Figure 8 I have illustrated a possible variation wherein the member 16 is rigidly secured within the piston 14. This type of construction is believed novel with me. This concept, and various ways of effecting the rigid connection, constitute the subject matter of my co-pending application Serial No. 346,595. In the instant application, for purposes of illustration, I have indicated that this may be done by brazing or the like as shown at 48. In some instances it is desirable to sacrifice the free running driver 17 for the arrangement generally shown in Figure 8 (and described in detail in the said application Serial No. 346,595) so that the end of the driver 17 will not be free to pound against the anvil member which will be described shortly. It is believed that the foregoing description is necessary in order to make possible a complete understanding of the principles of my invention as will now be set forth.

Referring again to Figure 5, and also to Figures 2 and 3, it will be observed that in the upper portion of the body 10 or cylinder 13, I have provided a member 49 which serves as an extension of the body of the gun. This member 49 is bored as indicated at 50 and also at 51. Slidable within the bore 50 is a second piston 52 which is provided with a sealing ring 53. The piston 52 is recessed at 54 and a piston rod 55 is, in this particular embodiment, rigidly secured to the piston 52 as indicated at 56. The upper end of the member 49 provides a shoulder 57 and a spring 58 is placed between this shoulder and the piston 52, the spring being received in the recess 54.

It will be observed that the member 49 provides an abutment 59 against which the piston 14 is urged by the spring 22. This is perhaps best seen in Figure 7. It will be apparent that the spring 58 normally urges the piston 52 towards the piston 14. Any suitable resilient means may be used in place of the springs 22 and 58 if desired.

In my improved stapling machine an anvil 60 is movably mounted on the stapling machine. In the particular arrangement shown in Figures 1 through 9 I have indicated that this anvil 60 is pivoted to the feed magazine 12 as indicated at 61. It will be understood first that the anvil does not necessarily have to be pivoted at all, as will be discussed shortly, and second, that if pivoted, such pivot does not have to be on the feed magazine but can be on any portion of the stapling machine which will afford a rigid construction. Also, it is preferable that the pivot point be located some distance from the nose 47 so as to reduce anvil tilt or exaggerated circular movement thereof. This insures a good surface for the staples to strike. In addition I prefer to extend the anvil member 60 rearwardly as indicated at 60a (Figure 2) so that stapling may be accomplished at distances and areas reasonably far removed from the edges of the material to be stapled if this is desired.

The anvil member which I employ may constitute one leg of a generally U-shaped member, when viewed in side elevation, the other leg being

6

indicated at 62. In the particular arrangement shown in Figures 1 through 9 there are a pair of the legs 62 which straddle the feed magazine 12 and the nose of the gun as defined by the plates 25 and 26. As best seen in Figure 4, the anvil 60 is provided with particular configurations 63 which aid in the closing of the staple when it is driven through the work against this anvil. Also, I have provided the anvil member 60 with a reinforcing rib as indicated at 64.

It is quite important that the legs 62 and the anvil member 60 be rigidly secured together so as to form a unitary structure which, in the embodiment of Figures 1 through 9, may be pivoted to the machine so as to insure against lateral deflection of the anvil. It is important that the anvil properly register with the nose of the gun 47 both from a standpoint of lengthwise movement and also laterally thereof. The tolerance is small. If the anvil is misaligned with respect to the nose 47, the staple is apt to tilt and not be clinched properly. To this end, therefore, it is also important that the anvil member be pivoted to some structure which is rigidly associated with the stapling machine.

I have found the staple magazine to be a particularly good base for this pivot point. It may be, however, that in other structures there will be some other rigid part of the stapling machine to which the anvil member could be pivoted satisfactorily. Also, a separate arm may be provided for this purpose as will be described shortly.

The end of the piston rod 55 is drilled at 65, see Figures 10 and 11, so that it may receive a bail or stirrup 66. This bail is also a U-shaped member and its legs are each turned out at 66a (Figure 3) so as to engage within holes provided in the ends of the legs 62. In order to permit this bail or stirrup 66, the shape of which is best seen in Figure 3, to be connected to the rod 55 without the use of special tools, I mill the rod at either side of the hole 65 to form areas 65a which are at angles of approximately 45° with the centerline of the hole 65. This is best seen in Figure 11. The dotted lines in this figure illustrate how the stirrup 66 may be worked into or out of position. This is the preferred way of connecting the stirrup or bail with the rod but other ways are possible. Thus, for example, in Figures 1 through 9 I have shown the member 66 as maintained in a slot 65b by a pin 67.

This bail 66, therefore, connects the anvil 60, by means of the legs 62, with the piston 52, by means of the rod 55. Thus, when the rod 55 and piston 52 move upwardly within the extended portion 49 of the body of the stapling machine, the anvil 60 is brought towards the nose 47. In this way the material, generally indicated in dotted lines at 68 in Figure 2, is clinched between the nose 47 and the anvil 60. The staple driven through the material is clinched when it strikes the anvil 60.

In the preferred form of my invention I so arrange the parts that the following sequence takes place: First, the anvil 60 moves toward the nose 47 and clinches the material to be stapled therebetween; second, the staple driver drives a staple through the clinched material and against the anvil 60; third, the anvil 60 is retracted from the nose 47; and fourth, the staple driver returns.

In order to effect the cycle just set forth, I may arrange the parts so that the bore 50 is slightly smaller in diameter than the bore defined by the cylinder 13 and in which the piston 14 reciprocates. Air which is admitted to the recess 46

7
finds its way between the pistons 52 and 14. If desired, these pistons may have specially formed faces to insure that the air will get between them, such as, for example, a slight tit on one which will abut the other, but in actual practice this provision is really not necessary. This is true because it is practically impossible to machine surfaces so smooth that no air would be able to get between the pistons 52 and 14 if in abutment one against the other. In addition, in the embodiment of Figure 5, the bail 65 rests on the top of the gun and thus suspends the piston 52; the amount of space, if any, between the two pistons at rest can be controlled by varying the relationship among the bail, rod and piston.

Since the same volume of air is actuating both pistons and since the distance to be traveled by the piston 52 is shorter than that to be traveled by the piston 14, the result is that the piston 52 will complete its movement prior to the time the piston 14 will complete its movement. Since the piston 52 is connected to the bail 65 through the piston rod 55, this means that the anvil 60 is brought towards the nose 47 prior to the time a staple driver picks up a staple and drives it from this nose. In this way the anvil is positioned below the nose 47 so that the staple may be driven into it.

Upon release of the air pressure, the piston 52 will return to its home position as indicated in Figure 5 where it is suspended within the cylinder and prevented from falling through to the cylinder in which the piston 14 reciprocates by reason of the bail 65 striking the top of the gun as described above. The piston 52 will return to this position prior to the time that the piston 14 will return to its home position. This can be controlled not only by varying the distances each piston must move but also by regulating the relative strength of the springs 22 and 58.

In Figures 9 and 10 I have illustrated certain of the features just discussed. Figure 9 indicates the relative positions of the parts after the gun has been fired. It will be observed that the anvil has moved to clinched position and in so doing has clinched the work 68 between it and the nose of the gun. The driver and its piston have not yet completed their stroke. It will be observed, therefore, that the piston 52 moves the anvil 60 to clinched position prior to the time that the piston 14 moves the driver 17 enough to pick up a staple and drive it through the work.

Figure 9 also represents another distinct feature of this invention and such feature is the self-adjusting clinching action obtained. In Figure 9 it will be observed that the piston 52 has not moved completely to the end of the cylinder 50. This is because the work 68 between the nose 47 and anvil 60 prevents further movement of the anvil 60. If the work were thinner the piston 52 would more nearly approach the upper end of the cylinder 50 while if the work were thicker the piston 52 would not be so far up in the cylinder as indicated in Figure 9. In each case, however, the work 68 is being clinched between the nose 47 and anvil 60 by an equal amount of pressure. This is important for it means that the stapling machine does not have to be re-adjusted each time it is moved from a job in which it is stapling together material of a certain thickness to another job in which material having a different thickness is to be stapled.

In Figure 10 I have illustrated yet another feature of this invention. In this figure I have shown the stapling machine as employing a

driver and piston connection as best seen in Figure 8 wherein the member 16 is brazed within the piston 14. This figure shows the relationship among the parts when the gun has been fired empty following discharge of the last staple. It will be observed that the piston 52 has seated against the upper end of the cylinder 50. The relationship, however, among this piston, the rod 55, the bail 65 and the anvil 60 is such that the anvil will be just free of the tip 47 of the gun. Since the member 16 is shown as secured to the piston 14, the result is that the driver 17 will not bang against the anvil 60. This eliminates possible damage both to the anvil working surface and to the end of the driver.

Figures 10 and 12 also illustrate another embodiment of my invention wherein the actual working surface of the anvil comprises a separate and specially treated and formed plate 70 which may be fastened to the anvil 60 as indicated. This may make it possible to specially treat only the tip 70 rather than the whole anvil 60 as might otherwise be the case.

From the above it is apparent that the anvil will first clinch the work following which the driver will drive a staple through the work so that it may be clinched upon striking the anvil. In addition, upon release of the air, the piston 52 will return to its starting position prior to the time that the piston 14 will return to its starting position. This is desirable for if the reverse of this occurred, that is, if the piston 14 returned to its starting position ahead of the piston 52, the piston 14 would block the port 44 and make movement of the piston 52 even slower because the air between the pistons would then be able to flow out the channel 44 only by means of the small groove 45. The chief factor which produces that cycle wherein although the pistons 52 and 14 leave their starting positions together the piston 52 completes its travel prior to the time that the piston 14 completes its travel, whether upon application of air or release thereof, is the difference in length which each piston must travel.

Although I prefer the cycle just described, and the arrangement of parts necessary to produce it, it should be pointed out that the stapling machine will work on other cycles. Thus, in its broadest aspect, I do not intend to be limited to the particular cycle just described, except as particularly set forth in the claims.

Sometimes, when one is stapling relatively thin materials together, it is not necessary that the anvil 60 be so far from the nose 47 as, for example, is shown in Figure 5. Quicker action of the stapling process can be achieved by starting the operation with the anvil 60 in a normal position closer to the nose 47. This can be accomplished in the manner indicated in Figure 7. In this Figure I have illustrated a plurality of washers or the like 69 which are placed between the top of the member 49 and the bail 65. This has the effect of withdrawing the piston rod 55 so as to leave a gap between the piston 52 and the piston 14. When the rod 55 is moved upward in this manner it will be apparent that the anvil 60 is brought that much closer to the nose 47. This is supplemental to the self-adjusting feature just described; this simply provides a faster operating machine for use in stapling thin materials together. Such materials will be clinched with equal force.

In operation then, when the trigger 37 is pulled, air is admitted into the area adjacent the pistons 52 and 14. As noted, the air will be able to get

between these pistons by reason of the fact that it is not possible to so machine them as to get a contact close enough to prevent the air doing this. If desired, however, positive means could be provided to insure that the air would be able to get between the two pistons. Also, while I have shown an annular recess 46 disposed about the juncture of the two pistons, it will be understood that such a recess or its equivalent may be formed in a number of ways. An extra thread or so within the end of the cylinder 13 and adjacent the meeting of these two pistons would accomplish the trick.

When air is admitted between the pistons in the manner just described, the pistons are separated so that the piston 52 moves upward against the resistance of spring 58 while the piston 14 moves downward against the resistance of spring 22. Upward movement of the piston 52 causes the anvil 60, through the bail 66 and arms 62, to move toward the nose 47 of the stapling machine or gun. This serves to clinch any material 68 between the anvil and the nose. Downward movement of the piston 14 causes the driver 17 to contact a staple positioned in the drive track 27 and force it out the nose 47. This staple will be driven through the work against the anvil and thereby clinched.

Another feature of my invention resides in the relationship existing between the nose of the stapling machine as defined by the plates 25 and 26 and the anvil 60. In all other stapling machines known to me wherein an anvil is employed, that part of the machine which is opposite the working surface of the anvil lies in a plane substantially co-extensive with the anvil when in clinched position. This, for example, is the relationship which would obtain if the plates 25 and 26 did not extend beyond the lower surface of the magazine 12.

I accomplish two important things by having the nose 47 substantially removed from the adjacent parts of the stapling machine. First this arrangement insures proper application of the clinching pressure only at the specific point of stapling. Thus, if one is stapling a pair of sheets together at some little distance from the edges thereof it is necessary to apply pressure only in the immediate area of stapling and not along the surfaces between the edges of the sheet and the point of stapling. This differs from other arrangements known to me wherein the same operation would result in the sheets being pressed together along the whole plane between the anvil and the adjacent portion of the stapling machine.

Second, by having the nose 47 removed from the body of the stapling machine as indicated, I am able to accomplish stapling that could not be done by those machines presently known to me and including an anvil. This is best illustrated in Figure 18 where I have shown by stapling machine as applying staples to a mattress sisal or the like wherein it is necessary to staple over an enlarged portion 71 so that stapling may be accomplished at a thinner area 72. Because of the clearance 73, see Figure 10, which exists when the anvil 60 is moved to clinched position, the presence of the enlarged portion 71 does not prevent proper stapling. In all other stapling machines of this type known to me such an enlarged portion 71 would prevent proper stapling.

As above explained, I prefer that the anvil be moved to clinched position prior to the time a staple is set. It is to be understood, however, that although I prefer the particular sequence

outlined, other sequences will work. Thus, by rearranging the relative positions and sizes of the parts, it would be possible to first drive the staple and then bring the anvil to clinched position. This would result in the legs of the staple being bent and would effect stapling of a sort. Such a sequence of operations would be relatively slow but would probably be effective on thin materials.

When the operator releases the trigger 37 the spring 40 will force the valve head 38 to the position shown in Figure 5. This opens the port 34 to exhaust and the pistons will return to their home positions under the action of the springs 58 and 22.

The relative movement between the pistons 14 and 52 may be controlled by variations in the size of the respective bores in which the pistons operate, by variations in the relative strength of the springs 22 and 58, by variations in the amount of travel to which each piston is subjected, and variations in the air relief provided ahead of each piston. Quick action of the piston 52, for example may be insured by providing a vent 74, see Figures 3 and 5, so that air moved by advance of the piston 52 may escape readily. This is in contrast to the arrangement of the piston 14 wherein it is usually desired to prevent escape of the air so that a cushion of air may be built up to aid in stopping the piston and relieving the stapling machine from undue wear. This was described earlier in connection with the vent 13a of Figure 3.

Modifications in the basic teachings of my invention are possible and several of these have been illustrated in the figures. In Figure 13 I have shown an arrangement which may be substituted for the bail 66. Such arrangement comprises a pin or rod 75 which may be inserted within the hole 65 of the rod 55. A pair of flat metal straps 76 are fastened to either end of the rod 75. Short studs 77 in the lower ends of the strap 76 serve to engage the arms 62 by which the anvil is actuated.

In Figure 14 I have illustrated still another modification of the bail and its related means. In this modification I employ but a single strap 78 which may be fastened to a rod member 79 which is connected to the rod 55. The rod 79 has a turn down portion to which the strap 78 is fixed. A cotter pin or the like may be used to insure the connection and this is indicated at 80. At the lower end a stud 81 connects the strap 78 and an arm 62. It will be noted that in this embodiment of my invention only one arm 62 is necessary. I prefer, however, to arrange the parts so that there is a proper support on each side of the stapling machine for the pivot pin 61. This is best illustrated in Figure 14 at 62a.

Although the arrangement just described in connection with Figure 14 constitutes a possible modification of my basic teachings, this arrangement is not preferred for the reason that it leads to unequal wear of the operating parts. A stapling machine built as shown in Figure 14 is not apt to operate efficiently for a period so long as is the case with a stapling machine built according to the teachings of Figures 1 through 11.

In Figures 15 and 16 I have illustrated a modification of my invention wherein the pivot 61 has been eliminated. In order to accomplish this the anvil and the stirrup must be rigidly connected so as to constitute what amounts to a unitary structure. Specifically, I employ a pair of flat metal straps 82 which are screwed to the

11

ends of a rod 33 which may be fixed to the member 55. The body of the stapling machine is provided with grooves or channels defined by projections 84. Instead of the projections or wings 84 it may be possible simply to cut grooves in the body of the machine if there is material enough to permit this.

The anvil is again indicated at 60 and, as is the case with the basic stapling machine first mentioned, it is connected with a pair of arms 62 by means of the members 62a. In the arrangement of Figures 15 and 16 the arms 62 have enlarged portions 62b which are securely fastened to the straps 82.

When the piston 52 is actuated the strap 82 and the anvil 60 move as a unit. The wings 84 (or grooves as the case may be) insure vertical movement of the unit with the result that clinching is accomplished.

In Figure 17 I have illustrated yet another embodiment of my invention. In this embodiment I so arrange the piston 52 and piston rod 55 that they are not connected to one another. The piston 52 is provided with a recess in which the rod 55 fits and the rod 55 is provided with a flange 55 against which the spring 58 abuts. There is no connection between the flange 55 and the piston 52.

In order to keep the piston 52 from falling within the cylinder in which the piston 14 operates, I provide a shelf 86. It will be apparent that this shelf may serve a double function in that it acts also as the abutment for limiting a particular movement of the piston 14. The shelf 86 is provided with a centrally located opening to insure the passage of incoming air to a position between the pistons 52 and 14 to actuate them in the manner above described. As shown, the shelf 86 may simply be a washer or the like which is held in position by the part 49. Also, in order to insure that the air will pass through the centrally located opening of the shelf member 86, I provide a small groove or recess 87 in the piston 14 which extends from the small groove 45 to the central open portion of the shelf member 86.

In Figure 19 I have illustrated an alternative arrangement of the piston 52 and its rod 55. In the arrangement here shown the piston and rod may be formed as a single unit and provided with a recess 88 to receive the spring 58. In this embodiment, of course, the members 52 and 55 are connected together.

In Figures 20 through 23 I have illustrated two embodiments of my invention wherein the anvil is so formed and so positioned that stapling may be accomplished at an angle of 90° with respect to that at which the embodiment of Figures 1 through 11 is designed to operate. Specifically, in Figures 20 and 23 I disclose an arrangement wherein the anvil 60 is pivoted to the stapling machine at 61 as disclosed in the embodiment of Figures 1 through 11. As before there is an arm 62 extending from the pivot 61 to the forward part of the machine. This arrangement, however, differs in that the anvil 60 is supported from the arm 62 by means of an intermediate member 89 which first runs forwardly and outwardly from a point 90 on the arm 62 to a point 91 at which it then turns and runs inwardly and forwardly. In this way the pivot point 61 is maintained at the same position as is the case with the embodiment of Figures 1 through 11 while at the same time permitting the stapling machine to be turned at right angles to

the position which must be assumed by the machine of Figures 1 through 11.

It will be understood that the embodiment of Figure 20 may be employed with a bail 66 having a pair of arms or it may be actuated in the manner generally shown in Figure 14.

In Figure 21 I have illustrated a stapling machine arrangement which permits stapling in the same direction as that disclosed in connection with the showing of Figures 20 and 23. In this arrangement, however, a separate arm or suitable extension 92 is fixed to the stapling machine and the anvil is pivoted to this arm as indicated at 93. This arm 92 extends at right angles to the staple magazine 12 should such a magazine be employed. In Figure 21 I have again illustrated like parts with like numerals and it will be observed that there is an anvil 60 which is connected to an arm 52 by the member 62a, it being possible, of course, to construct the members 60, 62 and 62a as a single unit. Although there may be a pair of the members 62a, in this particular embodiment there will be only one arm 62 and, consequently, only one leg of the stirrup or bail 66.

The advantages of an arrangement such as shown in Figure 20 or in Figure 21 is diagrammatically illustrated in Figure 22. In some instances, such as in the box art, it is desirable to place a staple so that its crown is at right angles to the edge of the box rather than parallel therewith.

The anvil of the embodiment of Figures 1 through 11 is diagrammatically illustrated at 60c in Figure 22. The anvil of Figures 20 and 21 is diagrammatically illustrated at 60d in Figure 22. Because the anvil has in effect been moved through a quarter turn in going from the type and position shown in Figures 1 through 11 to the type and position shown in Figure 21, the stapling machine may be moved a corresponding amount with the result that the staples 94 may be set at right angles to the edge of the box rather than parallel therewith as is necessary with the arrangement of Figures 1 through 11.

Special anvils 60, generally similar to those employed with arrangements such as indicated in Figures 20 and 21, may be provided in order to accomplish particular types of stapling that cannot be performed with anvils of the ordinary type illustrated.

Referring again to Figure 18, it will be apparent that such stapling as there indicated might be performed on work in which the portion 71 is considerably larger, or smaller, by making the following changes. The removable nose pieces 25 and 26 may be replaced with longer or shorter ones as is desired and a different length bail or stirrup may be substituted for that shown. The interchangeable nose pieces and stirrup make possible a number of variations in the type of work that may be stapled together by the machine of this invention as will be obvious to the skilled worker.

Referring also to Figure 12, it will be apparent that the grooves 95, which serve to clinch the staple when it strikes the anvil, may be varied so as to spread the staple legs in or out as desired.

It is to be understood that modifications may be made in my invention without departing from the scope and spirit thereof. It is to be further understood that while I have shown my invention as embodied in a particular arrangement of specific structures, I do not intend to be limited

to such arrangement or structures except insofar as they are specifically set forth in the claims. Also, while I have disclosed a preferred arrangement and have outlined a preferred sequence of operations, I do not intend to be restricted to the preferred embodiments except insofar as such restrictions are specifically set forth in the subjoined claims.

Having thus described my invention, what I claim as new and what I desire to protect by United States Letters Patent is:

1. A stapling machine having a drive track terminating in a staple discharge nose, means to position a staple within said track, a staple driver slidable in said track, a pneumatic means to move said driver in said track against a said staple so as to discharge said staple from said nose, an anvil movable towards and away from said nose, and another pneumatic means to move said anvil towards said nose.

2. A stapling machine having a drive track terminating in a nose and having a body comprising a cylinder, a staple driver slidable in said track, means to position a staple in said track, a piston slidable in said cylinder to actuate said driver, an anvil movable towards and away from said nose, another piston slidable in said cylinder to actuate said anvil, and control means for actuating said pistons.

3. The stapling machine of claim 2 in which said control means includes means for introducing a volume of air between said pistons to spread them apart.

4. A clinch type pneumatic stapling machine having a nose and having an anvil mounted for movement toward and away from said nose, a staple driver, a cylinder and a main piston therein for actuating said staple driver, a supplemental piston in said cylinder and a linkage between said supplemental piston and said anvil, means associated with each of said pistons urging it to a position near the other of said pistons, means for placing a staple in position to be driven by said staple driver, and means for supplying air to said cylinder in the region of said pistons to drive them apart, whereby said anvil is caused to approach said nose and a staple is driven through said nose and clinched against said anvil.

5. The stapling machine of claim 4 in which the same air supply means serves both pistons, whereby a single given volume of air actuates both pistons.

6. The stapling machine of claim 4 in which the portion of said cylinder in which said supplemental piston moves is of shorter length than the portion in which said main piston moves, whereby movement of said anvil is completed before a staple is driven through said nose.

7. The stapling machine of claim 4 in which said main piston is normally held against an abutment provided in said cylinder, and in which said supplemental piston normally is maintained near said main piston, air being supplied to said cylinder so as to come between said pistons.

8. The stapling machine of claim 4 in which there is a rod fixed to said supplemental piston, said linkage comprising a bail member connected to said rod.

9. The stapling machine of claim 4 in which said anvil comprises a relatively flat member constituting one of the legs of a rigid U-shaped member, the other of said legs being split to straddle said nose, said linkage being connected to said straddling portions, and said U-shaped member being pivotally mounted in said machine in the region of the bridge of the U.

10. The machine of claim 4 in which said supplemental piston is normally maintained out of abutting contact with said main piston whereby the stroke of said supplemental piston is shortened and the distance between said nose and said anvil at rest is shortened a like amount.

11. The machine of claim 4 in which said nose extends beyond the body of said machine so that there is a relatively large clearance between said anvil and the body of the machine when said anvil is adjacent said nose in clinched position, whereby pressure is applied to work being stapled only in the region of the setting of the staple.

12. The machine of claim 4 in which said supplemental piston urges said anvil towards said nose with equal force regardless of the thickness of the work being stapled.

13. The machine of claim 4 in which said linkage comprises a bail which is a single U-shaped piece of material, the bridge of the U having a connection with said supplemental piston and the legs of said U having a connection with said anvil.

14. The machine of claim 4 in which said linkage comprises a stirrup comprised of a cross pin and a pair of flat metal strips fastened thereto.

15. The machine of claim 4 in which said linkage comprises a cross pin and a single strap connected thereto and to said anvil.

16. The machine of claim 4 in which said anvil comprises a base plate with an anvil member mounted thereon so as to be positioned directly below said nose.

17. The machine of claim 4 in which said linkage comprises a pair of vertically movable straps held against lateral movement, said anvil being rigidly connected to said straps and otherwise free of said machine, whereby said anvil is reciprocated by reciprocation of said supplemental piston.

18. The machine of claim 4 in which said supplemental piston is recessed to receive a rod which is otherwise free thereof, and a shelf on which said supplemental piston normally rests.

19. The machine of claim 4 in which said supplemental piston has a centrally disposed rod extending therefrom and formed integral therewith.

20. A clinch type pneumatic stapling machine having a body, a nose at the lower end thereof, an anvil mounted for movement toward and away from said nose, a staple driver, a cylinder and a main piston therein for actuating said staple driver, a supplemental piston in said cylinder and a linkage between said supplemental piston and said anvil, means associated with each of said pistons urging it to a position near the other of said pistons, means for placing a staple in position to be driven by said staple driver, and means for supplying air to said cylinder in the region of said pistons to drive them apart, whereby said anvil is caused to approach said nose and a staple is driven through said nose and clinched against said anvil, and said anvil being pivotally mounted in said machine, whereby said anvil is oscillated by reciprocation of said supplemental piston.

21. The machine of claim 20 in which a rigid member extends from said body in the same vertical plane with the crown of a staple driven by said machine, said anvil being pivotally mounted to said rigid member.

22. The machine of claim 20 in which a rigid member extends from said body at right angles to the vertical plane passing through the crown

of a staple driven by said machine, said anvil being pivotally mounted to said rigid member.

23. The machine of claim 22 in which said rigid member is a staple feed magazine.

24. In a clinch type pneumatic stapling machine, a nose, an anvil mounted for movement towards and away from said nose, said anvil having a pair of members one on either side of said nose, said anvil and pair of members being rigidly secured together, a staple driver, a cylinder and a main piston therein for actuating said staple driver, means for placing a staple in position to be driven from said nose by said staple driver, a supplemental piston in said cylinder and a linkage between said supplemental piston and said pair of members, means associated with each of said pistons urging it to a position adjacent the other of said pistons, and means for supplying air to said cylinder in the region of said adjacent pistons to drive them apart, whereby said anvil is caused to approach said nose and a staple is driven through said nose and clinched against said anvil.

25. The machine of claim 24 in which said pair of members and said anvil are pivotally mounted in said machine at their ends removed from said nose, a rod engaging said supplemental piston, said linkage connecting said rod and the ends of said pair of members adjacent said nose, whereby movement of said supplemental piston rocks said anvil and said pair of members about their pivotal mounting.

26. The machine of claim 25 in which said linkage comprises a U-shaped bail the free ends of which are engaged in those ends of said pair of members which are adjacent said nose and the bridge of which is engaged in said rod, said bail straddling said nose.

27. The machine of claim 26 in which the staple placing means comprises a rigid magazine section fixed in said machine at right angles to said nose, said anvil underlying a major portion of said magazine section and said pair of members straddling said magazine section, said anvil and said pair of members being pivotally mounted to said magazine section.

28. The machine of claim 27 in which said cylinder comprises a main section and an auxiliary section removably secured in said machine, said auxiliary section forming a shoulder against which said main piston abuts, said main piston being disposed for movement in said main section

and said supplemental piston being disposed for movement in said auxiliary section.

29. The machine of claim 28 in which said main piston and said main cylinder section have a larger diameter than said supplemental piston and said auxiliary cylinder section.

30. In a clinch type pneumatic stapling machine, a nose, an anvil mounted for movement towards and away from said nose, said anvil having a pair of members one on either side of said nose, said anvil and pair of members being rigidly secured together, a staple driver, a cylinder and a main piston therein for actuating said staple driver, means for placing a staple in position to be driven from said nose by said staple driver, a supplemental piston in said cylinder and a linkage between said supplemental piston and said pair of members, means associated with each of said pistons urging it to a position adjacent the other of said pistons, and means for supplying air to said cylinder in the region of said adjacent pistons to drive them apart, whereby said anvil is caused to approach said nose and a staple is driven through said nozzle and clinched against said anvil, said linkage comprising a rod engaging said supplemental piston, and a U-shaped bail, said rod having a hole bored therethrough, each side of the rod having a portion cut away adjacent said hole and on the same side of said hole, said bail having a bearing in said rod in said hole.

31. A clinch type pneumatic stapling machine having a nose and having an anvil mounted for movement toward and away from said nose, a staple driver, means for placing a staple in position to be driven from said nose by said driver, a pneumatically operated piston for actuating said staple driver, another pneumatically operated piston for actuating said anvil, and trigger means to effect operation of said pistons.

32. The stapling machine of claim 31 including means to insure movement of said anvil towards said nose prior to the driving of a staple from said nose.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
2,006,530	Zervneith	July 2, 1935
2,101,660	Vogel	Dec. 7, 1937
2,488,940	Schofroth	Nov. 22, 1949