

Aug. 4, 1959

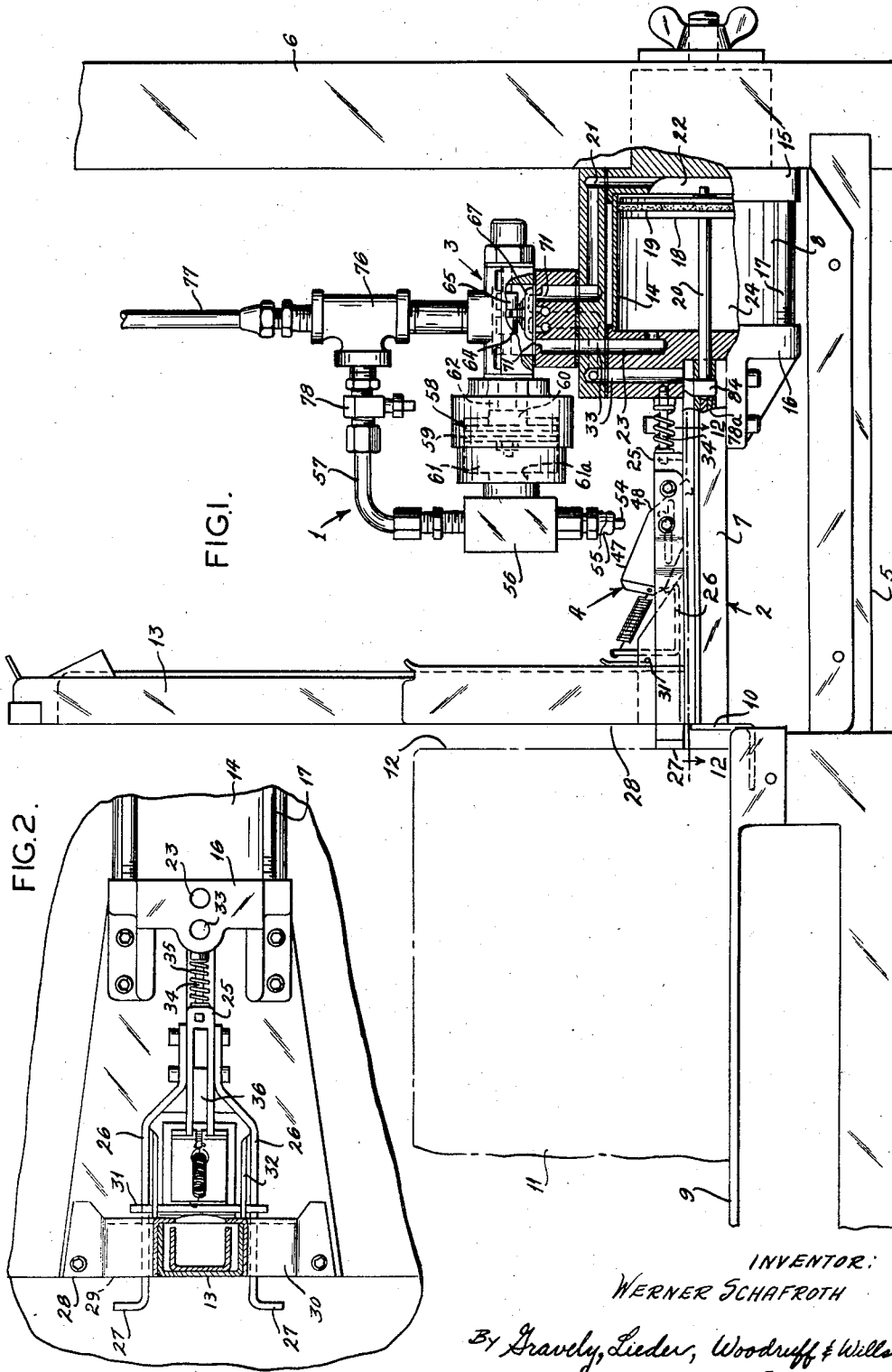
W. SCHAFROTH

2,897,503

AIR OPERATED CONTROL MEANS FOR STAPLING MACHINES

Filed March 26, 1956

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Aug. 4, 1959

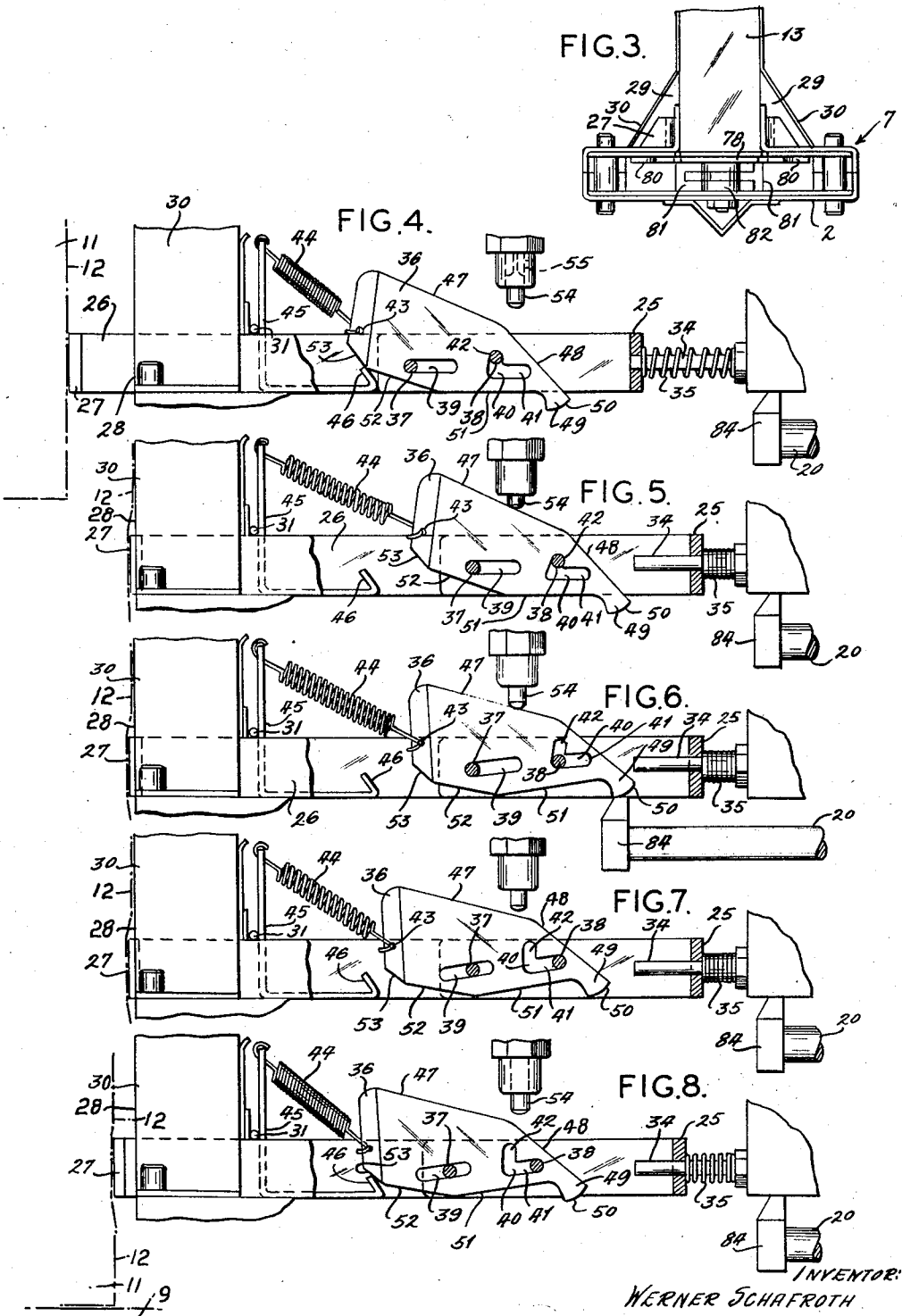
W. SCHAFROTH

2,897,503

AIR OPERATED CONTROL MEANS FOR STAPLING MACHINES

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4 Sheets-Sheet 2



INVENTOR:
WERNER SCHAFROTH

By *Gravelly, Lieder, Woodruff & Wills*
ATTORNEYS.

Aug. 4, 1959

W. SCHAFROTH

2,897,503

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4 Sheets-Sheet 3

FIG. 9.

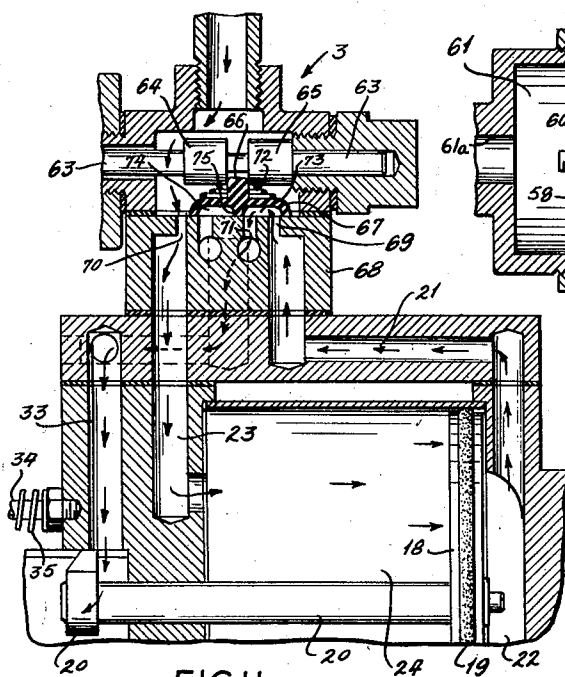


FIG. 10.

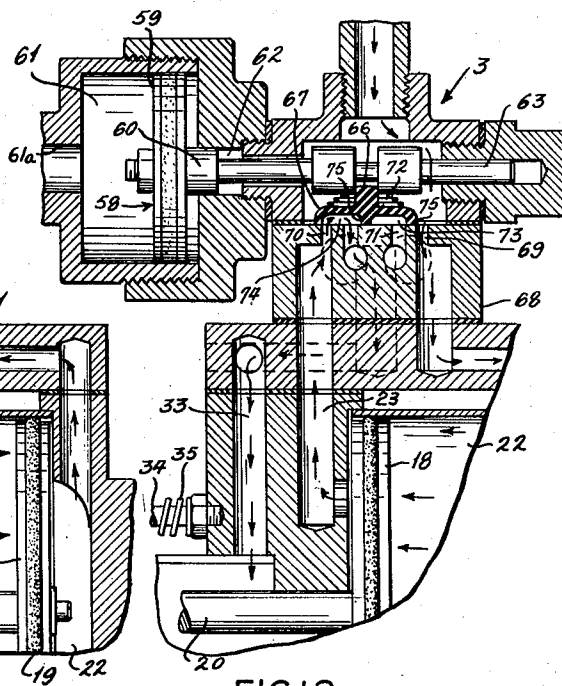


FIG. 11.

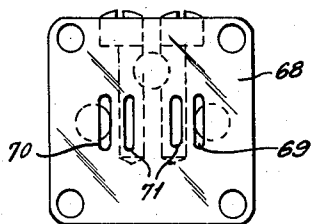


FIG. 12.

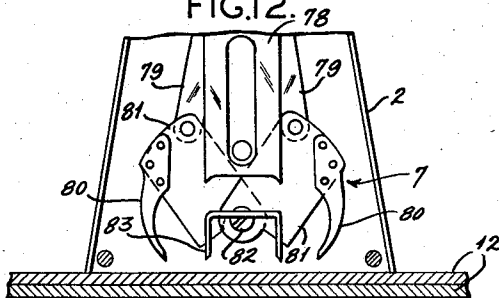


FIG. 13.

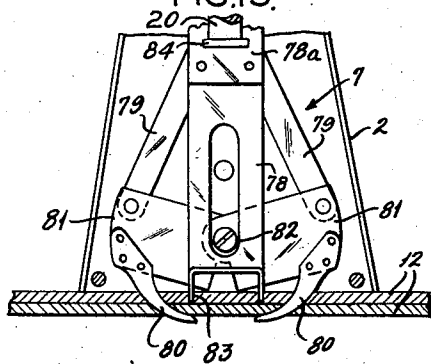
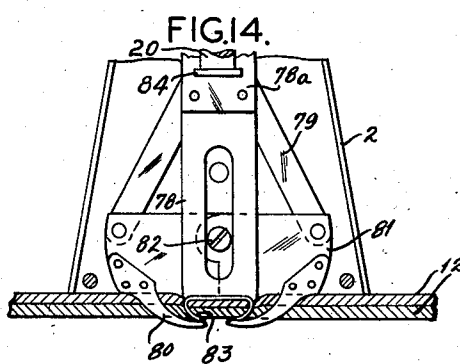


FIG. 14.



INVENTOR
WERNER SCHAFROTH
By *Travely, Lieder, Woodruff & Willis*
ATTORNEYS.

Aug. 4, 1959

W. SCHAFFROTH^r

2,897,503

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4 Sheets-Sheet 4

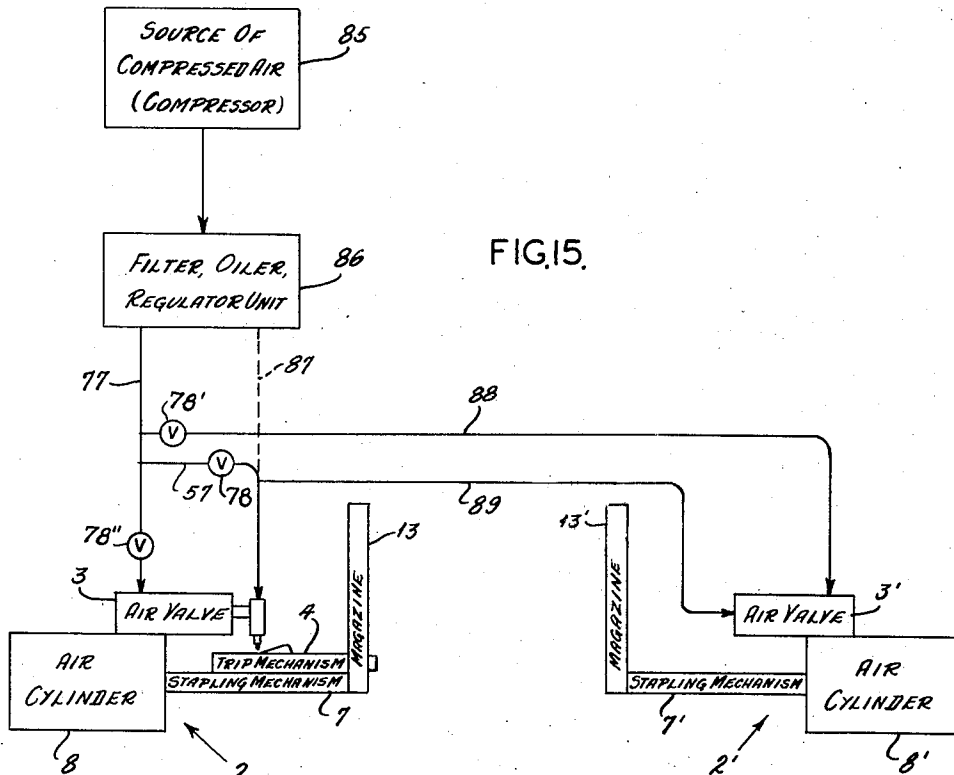


FIG.15.

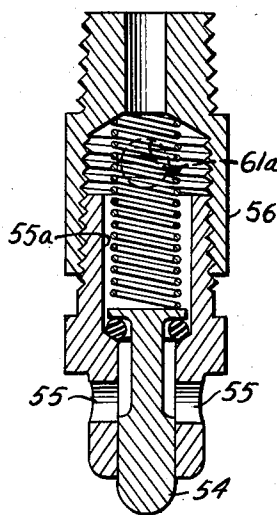


FIG.16.

INVENTOR:
WERNER SCHAFFROTH

By Gravelly, Lieder, Woodruff & Wills
ATTORNEYS,

2,897,503

AIR OPERATED CONTROL MEANS FOR STAPLING MACHINES

Werner Schafroth, Herrin, Ill.

Application March 26, 1956, Serial No. 573,796

6 Claims. (Cl. 1—101)

This invention relates generally to means for operating a power air cylinder and more particularly to an air valve and trip mechanism for operating one or more power cylinders of one or more stapling heads in a stapling machine.

Staples are commonly used for closing cartons or master shipping containers which are filled or loaded with goods. The stapling machines which are used are preferably of the retractable anvil type wherein anvils are projected from the bottom edge of the stapling machine itself and penetrate the material to be stapled so that the staple is clinched from the same side from which it is driven. Stapling machines of this type are shown in the Taylor and Sharpnack Patent No. 2,012,027, dated August 20, 1935, and in the Schafroth application Serial No. 340,443, filed March 5, 1953, and issued as U.S. Letters Patent No. 2,740,119 on April 3, 1956, and others.

For production purposes, these stapling machines are frequently mounted in tables or other suitable supporting structures and are power operated. The stapling machines or so-called stapling heads are mounted in the supporting structure so that the covers, the bottoms, or the side or end walls of a carton, or some combination thereof, can be stapled quickly and conveniently. Since the stapling machines are usually placed at the end of a conveyor line, they are usually power driven so that an operator need only actuate certain controls in order to perform the stapling operation after the carton has been properly positioned or oriented in the machine.

It is common practice to use a source of compressed air which is directed into a power or air cylinder on the stapling head for operating the staple driving blade and linkage which moves the retractable anvils to effect the clinching of a staple. In the past, it has been common practice to control the compressed air and the operation of the machine, including the movement of the movable stapling head, electrically by means of a lever or a foot switch which actuates a relay which energizes a solenoid which in turn actuates a switch on the stapling head to direct compressed air into the power cylinder to effect the clinching of a staple. This not only required the use of an electrical system and a source of electricity to the machine itself, but some of the individual units of the electrical system created still another problems because of their bulk and weight so that small motors and other compensating electrical means became necessary in turn added metal and weight to the machine and greatly increased the cost thereof. Completely mechanical means have also been used to direct compressed air into the power cylinder, but these require the use of greater force and cannot be used to operate a plurality of power cylinders in a single table stapling machine.

One of the principal objects of the present invention is to control the operation of a stapling machine by the same source of power which operates the stapling head,

Another object of the present invention is to provide a power driven stapling machine which eliminates all the expensive electrical control system and all of the individual electrical units therein such as switches, relays, solenoids, fuses, complicated electrical wiring and connections. Another object is to provide a stapling machine which is operated with fully pneumatic controls.

Another object is to use compressed air to quickly and positively supply air under pressure to the power cylinder to operate the stapling mechanism. Another object is to provide movable means on the movable stapling head which upon movement by a carton to be closed operates said pneumatic control to effect a stapling operation. Another object is to provide a control system which operates a plurality of stapling heads and which easily and inexpensively allows the operator to select which stapling heads will be operated when he actuates the master control means. Still another object is to provide an air valve and trip mechanism for automatically causing a staple to be driven after the stapling head has been brought to its proper position with respect to the carton to be closed.

These and other objects and advantages will become apparent hereinafter.

The present invention is embodied in a stapling machine whose stapling mechanism is actuated by an air cylinder, said machine having air operated control means for operating said air cylinder to drive and retract the stapling mechanism. The invention is also embodied in an air control system for stapling machines having a plurality of stapling heads therein.

The invention also consists in the parts and in the arrangements and combinations of parts hereinafter described and claimed. In the accompanying drawings which form part of this specification and wherein like numerals and letters refer to like parts wherever they occur:

Fig. 1 is a vertical side elevational view, partly in cross section, showing an air operated control means mounted on a power driven stapling head of the retractable anvil type, said stapling head being mounted horizontally on a table to close the end flaps of a carton,

Fig. 2 is a fragmentary top plan view of the machine shown in Fig. 1 with the air valve removed so that the trip mechanism can be seen more clearly,

Fig. 3 is a fragmentary front elevational view of the stapling head showing the bottom of the stapling mechanism,

Figs. 4, 5, 6, 7 and 8 are diagrammatic views showing the trip block in its various positions during a stapling operation,

Fig. 9 is a vertical cross sectional view of the pilot air valve showing the position of the slider when compressed air is being directed into the air cylinder to retract the staple driving blade and staple mechanism,

Fig. 10 is a vertical cross sectional view of the pilot air valve showing the position of the slider when compressed air is being directed into the air cylinder to effect the driving of a staple,

Fig. 11 is a top plan view of the air valve block,

Figs. 12, 13 and 14 are fragmentary longitudinal cross sectional views along the lines 12—12 of Fig. 1 showing the stapling mechanism or the internal linkage and stapling driving blade in their normal or inoperative position, in their staple driving and piercing position, and in their final clinching position, respectively,

Fig. 15 is a diagrammatic view of the completely pneumatic system for automatically operating a plurality of stapling heads by a single trip mechanism mounted on one stapling head in a multiple head stapling machine, and

Fig. 16 is an enlarged cross-sectional view of the T-connection 56.

Referring now to the drawings in detail, it will be seen that the embodiment of the invention which has been illustrated comprises an air operated control means 1 for controlling the flow of pressure fluid to a pneumatically driven stapling head 2. The control means 1 comprises an air valve 3 and a trip mechanism 4 connected to the stapling machine or stapling head 2 horizontally mounted on a supporting structure 5. The supporting structure 5 is provided with a vertical mast 6 on which the stapling head 2 is adjustably mounted by means of a wing nut. The stapling head 2 contains a staple driving mechanism 7 which is actuated by a power cylinder 8 mounted on said stapling head 2. The air valve 3 is mounted on the power or air cylinder 8 in operative relation with said trip mechanism 4. The supporting structure 5 has a table 9 with a back bar 10 mounted thereon for supporting a carton 11 whose end flaps 12 are about to be stapled. However, it is to be understood that the foregoing stapling machine and pneumatic control means can be mounted in various positions on various types of supporting structures.

The stapling machine 2, or stapling head as it is called when suitably mounted on a supporting structure, is provided with a magazine 13 for receiving a supply of staples and a power cylinder or air cylinder 8 for driving and retracting the stapling mechanism 7. The air cylinder 8 comprises a cylindrical wall 14 suitably secured between an upper cylinder head 15 and a lower cylinder head 16, preferably by bolts 17. A piston 18 having a suitable seal 19 therearound is slidably mounted in the air cylinder 8. A piston rod 20 extends from the piston 18 through the lower cylinder head 16 and is fixedly connected to the stapling mechanism 7. The upper cylinder head 15 has a top passage 21 therein leading to the upper chamber 22 above said piston 18, and the lower cylinder head 16 has a lower passage 23 leading to the lower chamber 24 below the piston 18.

Secured to the stapling head 2 is the trip mechanism 4 comprising a yoke 25 having a pair of legs 26 with feet 27 thereon which extend beyond the bottom edge 28 of the stapler 2 through openings 29 formed by braces 30 between the magazine 13 and the stapling head 2. A pin 31 extends through a bracket 32 to keep the legs 26 against the face of the stapling head 2. The lower cylinder head 16 mounted on the top of the stapling head 2 is provided with an exhaust passage 33 and a return spring guide 34 which is circumscribed by a return spring 35. The return spring guide 34 projects through an opening in the yoke 25.

The trip mechanism 4 also includes a trip block 36 slidably and pivotally mounted in said yoke 25 on a forward pin 37 and a rearward pin 38. The trip block 36 is provided with a straightforward slot 39 and an L-shaped rear slot 40 having a longitudinal portion 41 parallel to the forward slot 39 and an angular portion 42. The trip block 36 has a small forward hole 43 for receiving one end of a spring 44 secured to a spring hook 45 mounted on said stapling head 2 and having a cam surface or lip 46 thereon. The trip block 36 is provided with an upper cam surface 47, a sloping rear portion 48, a downwardly projecting lug 49 and a lower rear cam surface 50 thereon and a straight bottom surface 51 with an inclined bottom surface 52 extending forwardly thereof and a forward cam surface 53 thereon.

The trip block 36 is mounted adjacent to a needle valve or an air valve plunger 54 having exhaust openings 55 associated therewith. A T-connection 56 is mounted between a conduit 57 and the air valve 3 having a double diametered piston 58 with a large head 59 and a small head 60 thereon with a large chamber 61 and a small chamber 62 respectively adjacent thereto. A passage 61a connects the large chamber 61 with a vertical pas-

sage 55a in the T-connection 56 leading to the exhaust opening 55. The piston 58 has a piston rod 63 therein which has two collars 64 and 65 thereon which straddle a projection 66 on a slider 67 slidably mounted on an air valve block 68 within the air valve 3.

The air valve block 68, best shown in Figs. 9-11, is provided with a top port 69 which leads to the top of the air cylinder 8, a bottom port 70 which leads to the bottom of the air cylinder 8, and a pair of exhaust ports 71 therebetween. The slider 67, which is biased toward the air valve block 68 by a weak spring 72, has two cavities 73 and 74 therein formed by the ribs 75. The cavity 73 connects the top port 69 and the cavity 74 connects the bottom port 70 with one of the exhaust ports 71 for exhausting the top or bottom of the air cylinder 8. A T-connection 76 connects the air valve 3 and the conduit 57 to a conduit 77 which receives compressed air from a source not shown. A valve 78 is provided in the conduit 57 in case it is desired to have a second stapling machine mounted on the supporting structure, said second machine having a similar air valve thereon with the line extending from the valve 78 being connected to the chamber adjacent to the large head of the double diametered piston in the air valve of the second stapling head.

Turning now to the operation of a stapling head 2 with a trip mechanism 4 thereon, as best shown in Fig. 1, compressed air from a source not shown is directed at all times into the conduit 77 so that compressed air is transmitted to the large and small chambers 61 and 62 on opposite sides of said double diametered piston 58. In this normal or inoperative position, as shown in Fig. 9, compressed air is prevented from reaching the top chamber 22 adjacent to the power piston 18. In fact, in the inoperative position the top chamber 22 is connected to atmosphere through the top passageway 21, the top port 69, the exhaust port 71, and the exhaust passage 33. In this inoperative position, compressed air is directed into the lower chamber 24 adjacent to the right side of the power piston 18 to keep it in its rightward position as shown in Figs. 1 and 9. The double diametered piston 58, having pressure on both sides thereof, remains in its rightward position so that the slider 67 normally is in the position shown in Fig. 9. The normal position of the stapling mechanism 7 is shown in Fig. 12, and the normal position of the trip mechanism 4 is shown in Figs. 1, 2, and 4.

In order to staple the end flaps 12 of a carton 11, the carton 11 is placed on the table 9 and pushed against the feet 27 at the place where the end flaps 12 are to be fastened until the carton 11 substantially abuts against the back bar 10. In so doing, the feet 27 and legs 26 and yoke 25 are moved as a unit, rightwardly as shown in the drawings, until the feet 27 are in substantially flush relation with the bottom edge 28 of the stapling head 2. The movement of the feet 27 effects a complete cycling of the parts. The movement of the yoke 25 causes the trip block 36 to move rightwardly until the upper cam surface 47 thereof contacts and moves the needle valve 54 upwardly thereby opening the exhaust passage 55 therein to exhaust air pressure from the large chamber 61 opposite to the large piston head 59. Actually, opening the needle valve 54 to exhaust pressure fluid reduces the pressure in the large chamber 61 on the left side of the double diametered piston 58 remote from said air valve 3 so that the air pressure within the small chamber 62 acting on the small piston head 60 forces the double diametered piston 58 to move leftwardly together with the piston rod 63 and collars 64 and 65 which move the slider 67 to the position shown in Fig. 10. In this position, the top port 69 in the air valve block 68 is opened to allow compressed air to flow to the right side of the power piston 18. At the same time, the pressure fluid on the left side of the power

5

piston 18 moves through the lower passage 23, the bottom port 70, the exhaust port 71, and is exhausted to atmosphere through the exhaust passage 33.

The compressed air drives the power piston 18 leftwardly together with the piston rod 20 which is connected to and which causes the staple driving mechanism 7 including the yoke 78a and the staple driving blade 78 to move leftwardly or toward the bottom edge 28 of the stapling head 2 together with the links 79 thereby causing the anvils 80 secured to the arms 81 pivotally mounted on a single pin 82 to pierce the end flaps 12 and assume their clinching position to clinch the staple 83. The operation of the stapling mechanism 7 is best shown in Figs. 12, 13, and 14 which show the inoperative position, the intermediate or staple driving position, and the final staple clinching position respectively. In practice, the bottom edge of the staple driving blade extends slightly beyond the bottom edge 28 of the head 2 in its final position.

The piston rod 20 is provided with a cam nut 84 which is secured in a slot in the yoke 78a and which during movement leftwardly or toward said bottom edge 28 contacts the cam surface 50 of the lug 49 thereby pivoting the rear portion of the trip block 36 upwardly so that the rear pin 38 is in alignment with the longitudinal portion 41 of the L-shaped rear slot 40 as best shown in Fig. 6. In this position, the spring 44 is free to pull the trip block 36 toward the spring hook 45 until the pins 37 and 38 are at the rear portions of the slots 39 and 40, as best shown in Fig. 7. The trip mechanism parts remain in this position until the carton 11 is removed, thereby allowing the return spring 35 to force the yoke 25 and legs 26 leftwardly whereupon the trip block 36 moves leftwardly with said yoke 25 with no movement relative therebetween until the forward cam surface 53 of the trip block 36 contacts the lip 46 and is forced upwardly, as best shown in Fig. 8, until the legs 26 and feet 27 assume their normal inoperative position as best shown in Fig. 4.

During the leftward movement of the piston rod 20 the trip block 36 is pivoted as best shown in Fig. 6 so that the plunger 54 is released to its normal position thereby closing the exhaust passage 55 leading from the large piston chamber 61 and allowing compressed air to move the double diametered piston 58 rightwardly thereby moving the slider 67 rightwardly to exhaust the compressed air from the right side of the power piston 18, and at the same time, compressed air is free to flow into the left side or bottom chamber 24 of the air cylinder 8 to move the piston 18 rightwardly so as to retract the staple driving blade 78 and the anvils 80 to their position best shown in Fig. 12. Thus, the entire mechanism makes a complete cycle whenever the trip mechanism 4 is actuated. This includes a complete cycle of the staple driving mechanism 7 through the stages as shown in Figs. 12, 13, 14, 13, and 12 whenever the feet 27 are moved from the position shown in Fig. 4 to that shown in Fig. 5.

It is readily apparent that one or more stapling heads 2 may be provided in a single table stapling machine. One stapling head may be mounted horizontally or in a stationary but adjustable position as shown in Fig. 1 to staple the end flaps of a carton or, if desired, two stapling heads may be mounted in opposing spaced relationship so that both ends of the carton can be stapled at the same time. In such a machine, one head is stationary or fixed so that it does not move as a whole with respect to the machine and the other head is mounted to move toward and away from the stationary head. The movable head contains the air valve control means and trip mechanism and the stationary head is merely provided with an air valve and double diametered piston with conduits connected thereto so as to cause the double diametered piston and air valve of the remotely positioned stapling head to operate in the

6

same manner as the stapling head with the trip mechanism thereon. If desired, the stapling heads may be mounted in a vertical position to staple the cover flaps of a carton or a pair of stapling heads may be mounted in opposing spaced vertical relationship to simultaneously staple the cover and bottom flaps of cartons. Whenever several stapling heads are provided within a single staple machine for closing flaps on different walls, only one stapling head, preferably the moving stapling head, need be provided with a trip mechanism since the conduits for compressed air can be so arranged as to properly supply compressed air to a double diametered piston and air valve on each stapling head.

Fig. 15 shows a diagrammatic view of the pneumatic system for operating a table stapling machine having a plurality of stapling heads therein. Referring to Fig. 15, a compressor 85 supplies compressed air to a filter, oiler, and regulator unit 86 which is usually mounted on the table stapling machine itself. Compressed air is fed to the air valve 3 of one stapling head 2 through a conduit 77 having a short conduit 57 extending to the opposite side of said air valve so that the same pressure is directed into each end of the air valve 3. If desired, the short conduit 57 can be eliminated and replaced by a separate conduit 87 shown in the dotted lines, leading directly from the unit 86. A supply conduit 88 is connected to the conduit 77 so that the same air pressure is directed to the corresponding places of both air valves 3 and 3'. A second or another conduit 89 extends from the conduit 57 into the corresponding portion of the air valve 3' of the second stapling head 2'. In instances where the separate line 87 is not used, valves 78, 78' and 78'' may be included in the conduits 57, 88, and 77 respectively as shown in Fig. 15 to render the second stapler head 2' inoperative, or if preferred, the first stapling head 2 inoperative. The valve 78 is a needle valve, and the valves 78' and 78'' are manual shut off valves for the fixed head 2' and movable head 2.

Thus, it is apparent that only one trip mechanism 4 is necessary in each system since conduits can be taken from the lines leading to said first stapling head and inserted at corresponding places in the air valves of other staple heads.

The invention is intended to cover all changes and modifications of the example of the invention herein chosen for the purposes of the disclosure, which do not constitute departures from the spirit and scope of the invention.

What I claim is:

1. In a stapling machine whose stapling mechanism is actuated by an air cylinder having a piston therein, said stapling machine having clinching means normally retracted therein and a bottom edge beyond which staple clinching means are adapted to project, movable means normally extending beyond said bottom edge and adapted to be moved toward said bottom edge by a carton to be stapled, a trip mechanism connected to said movable means, said trip mechanism adapted to actuate an air valve for directing a source of air under pressure first to one side of the piston in said air cylinder to drive and clinch a staple and then to the opposite side of said piston to retract the stapling mechanism while said movable means are adjacent to said bottom edge.

2. In a stapling machine whose stapling mechanism is actuated by an air cylinder having a piston therein, movable means normally extending beyond the bottom edge of said stapling machine and adapted to be moved toward said bottom edge by a carton to be stapled, a trip mechanism connected to said movable means, an air valve connected to said air cylinder, said air valve having valvular means thereon, said trip mechanism adapted to move said valvular means to actuate said air valve thereby causing said piston in said air cylinder to move said stapling mechanism to clinch a staple, cam means

movable with said stapling mechanism for causing said trip mechanism to release said valvular means thereby actuating said air valve and reversing the movement of said stapling mechanism while said movable means are adjacent to said bottom edge.

3. In a stapling machine whose stapling mechanism is actuated by an air cylinder having a piston therein, said stapling machine having clinching means normally retracted therein and a bottom edge beyond which staple clinching means are adapted to project and retract, movable means normally extending beyond said bottom edge and adapted to be moved into substantially flush relation with said bottom edge by a carton to be stapled, a trip block slidably and pivotally connected to said movable means, said trip block adapted to cause a plunger operatively connected to an air valve to move in one direction, said air valve adapted to direct a source of air under pressure first to one side of said piston in said air cylinder to drive and clinch a staple and then upon release of said plunger by said trip block to the opposite side of said piston to retract the stapling mechanism independently of the movement of said movable means.

4. In a stapling machine whose stapling mechanism is actuated by an air cylinder having a piston therein, said stapling machine having clinching means normally retracted therein and a bottom edge beyond which staple clinching means are adapted to project and then retract, movable means normally extending beyond said bottom edge and adapted to be moved into substantially flush relation with said bottom edge by a carton to be stapled, a trip block slidably and pivotally connected to said movable means, an air valve operatively connected to said air cylinder with passages leading to the opposite sides of said piston, a source of air under pressure leading to said air valve, said air valve having means therein for selectively directing air under pressure to one side of said piston, said means being actuated by movable means connected thereto, said air under pressure being directed to both sides of said movable means, valvular means adapted to exhaust the air under pressure from one side of said movable means to cause movement of said means in said air valve, said valvular means adapted to be moved by said trip block to exhaust air under pressure from one side of said movable means, means on said stapling mechanism for pivoting the trip block to release said valvular means while said movable means is in substantially flush relation with the bottom edge of said stapling machine.

5. In a stapling machine whose stapling mechanism is actuated by an air cylinder having a piston therein, said stapling machine having clinching means normally retracted therein and a bottom edge beyond which a staple driving blade and a pair of anvils are adapted to project and then retract, movable means normally extending beyond said bottom edge and adapted to be moved into substantially flush relation with said bottom edge by a carton to be stapled, a trip block slidably and pivotally connected to said movable means, an air valve operatively connected to said air cylinder, passages connecting said air valve with opposite sides of said piston in said air cylinder, a slider in said air valve for selectively connecting a compressed air passage to one side of said piston and opening an exhaust passage on the other side of said piston, a rod adapted to move said slider, said rod having a piston thereon, a source of air under pressure directed to said air valve and to one side of said piston, said source of air being also directed to the side of said piston remote from said air valve, valve

means for exhausting the air on said remote side of said piston, said valve means adapted to be moved by said trip block as said movable means is moved by a carton to the bottom edge of said stapling machine to exhaust air from said remote side of said piston thereby causing said stapling mechanism to drive and clinch a staple, cam means on said stapling mechanism for pivoting said trip block and means for moving said trip block away from said valve means thereby retaining air under pressure on the remote side of said piston and causing said stapling mechanism to retract while said movable means are adjacent to said bottom edge, means on said stapling machine for causing said trip block to pivot to its normal position as said movable means moves away from said bottom edge to its normal position.

6. In a stapling machine whose stapling mechanism is actuated by an air cylinder having a piston therein, said stapling machine having clinching means normally retracted therein and a bottom edge beyond which a staple driving blade and a pair of anvils are adapted to project and then retract, movable means normally extending beyond said bottom edge and adapted to be moved into substantially flush relation with said bottom edge by a carton to be stapled, a trip block slidably and pivotally connected to said movable means, an air valve operatively connected to said air cylinder, compressed air inlet and exhaust passages connecting said air valve with opposite sides of said piston in said air cylinder, a slider in said air valve for selectively closing an inlet passage and opening an exhaust passage to one side of said piston and closing an exhaust passage and opening an inlet passage to the other side of said piston, a rod adapted to move said slider, said rod having a double diametered piston thereon, a source of air under pressure directed to said air valve and to one side of said double diametered piston, a conduit directing a source of air to the side of said double diametered piston remote from said air valve, valve means for exhausting the air on said remote side of said double diametered piston, said valve means adapted to be moved by said trip block as said movable means is moved by a carton toward the bottom edge of said stapling machine to exhaust air from said remote side of said double diametered piston thereby moving said slider and causing said piston in said air cylinder to move said driving blade and anvils beyond said bottom edge to drive and clinch a staple, cam means movable with said air cylinder piston for pivoting said trip block and means for moving said trip block away from valve means when said driving blade is in its most extended position beyond said bottom edge thereby closing said valve means and preventing the exhausting of air on the remote side of said piston so as to move said slider and direct air to the opposite side of said air cylinder piston to retract the stapling mechanism while said movable means are adjacent to said bottom edge, a spring for moving said trip block a limited distance with respect to said movable means and returning the trip block to its normal position as said movable means moves away from said bottom edge to its normal position.

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