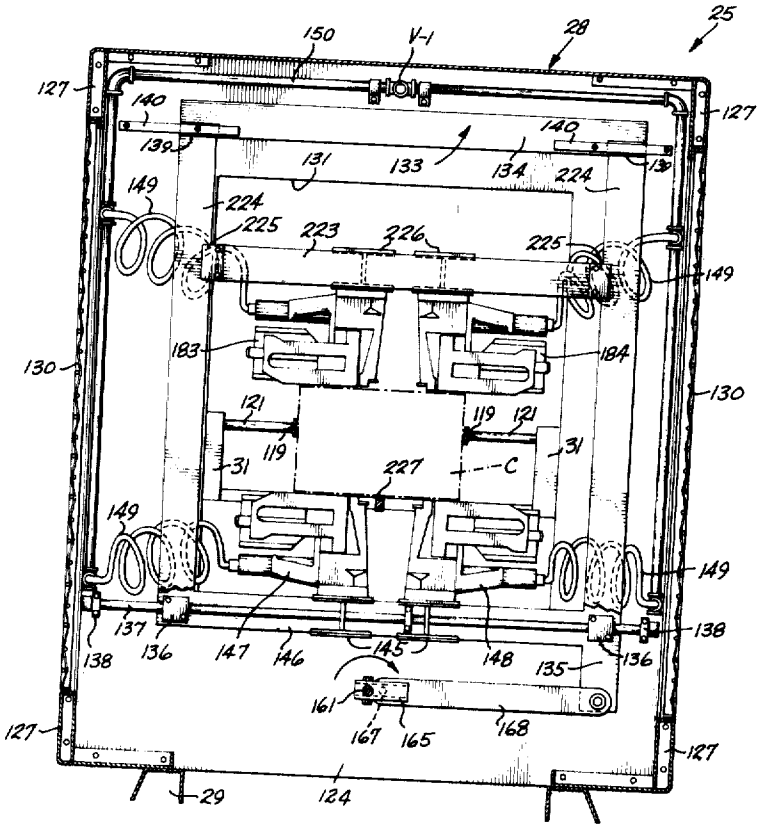


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[21] Appl. No. **726,644**
[22] Filed **Apr. 30, 1968**
[45] Patented **Nov. 16, 1971**
[73] Assignee
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Primary Examiner—Theron E. Condon
Assistant Examiner—Neil Abrams
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[54] **AUTOMATIC CARTON STAPLING MACHINE**
20 Claims, 26 Drawing Figs.
[52] U.S. Cl. **227/101,**
53/138
[51] Int. Cl. **B2717/06,**
B65b 51/05
[50] **Field of Search** **53/75, 76,**
138; 227/5, 6, 7, 99, 100, 101
[56] **References Cited**
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ABSTRACT: A power driven carton feed unit, a carton discharge unit and a thin stapling unit sandwiched therebetween; the carton being power delivered into the stapling unit which delivery triggers the firing of staples into the carton from two upper and two lower stapling heads, said heads being carried on a frame which is then automatically shifted laterally to a secondary position in which staples are again automatically fired from said heads into said carton. The frame remains in said secondary position for the first firing of staples in the next succeeding carton entering the staple unit and automatically returns to its primary position for the automatic second firing of staples into said succeeding carton.



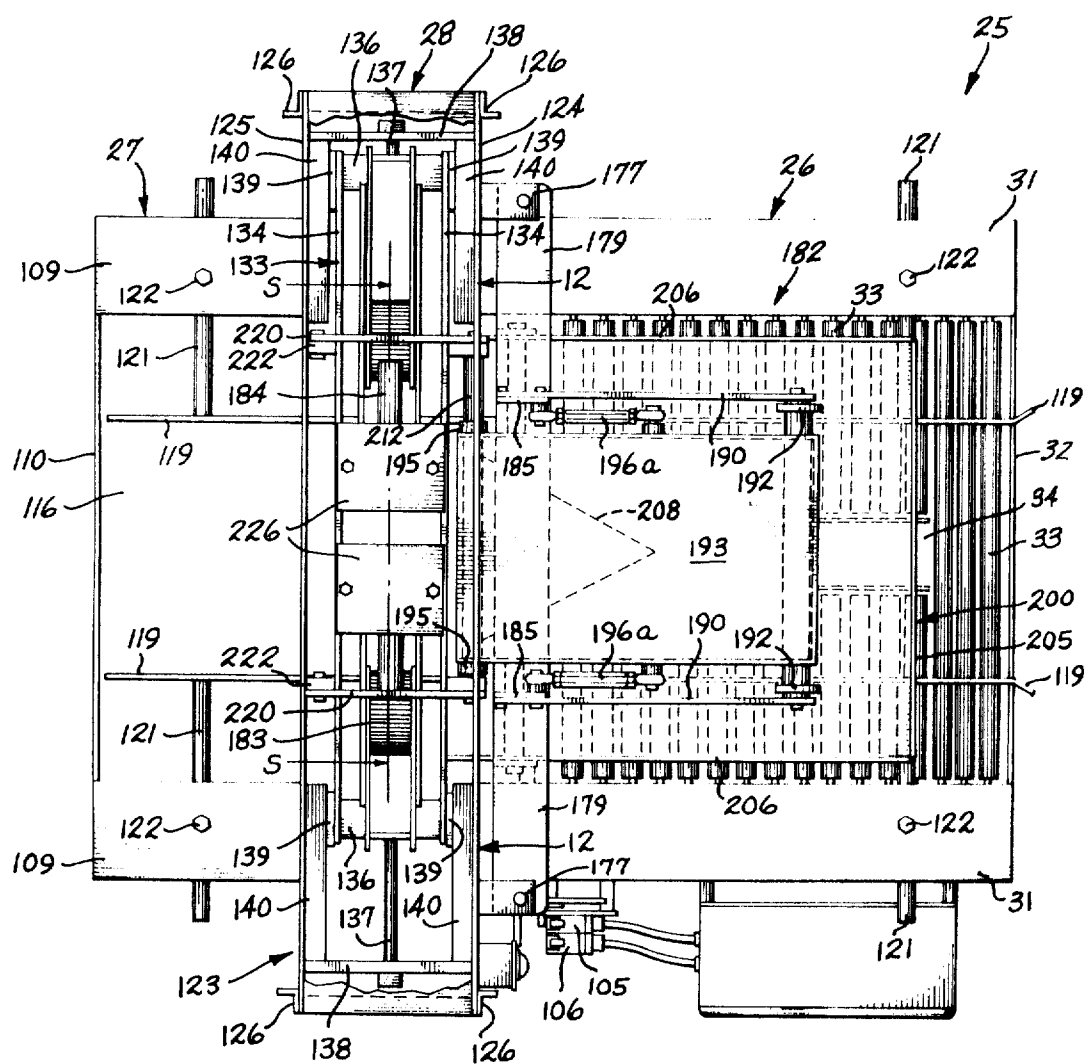


Fig. 1.

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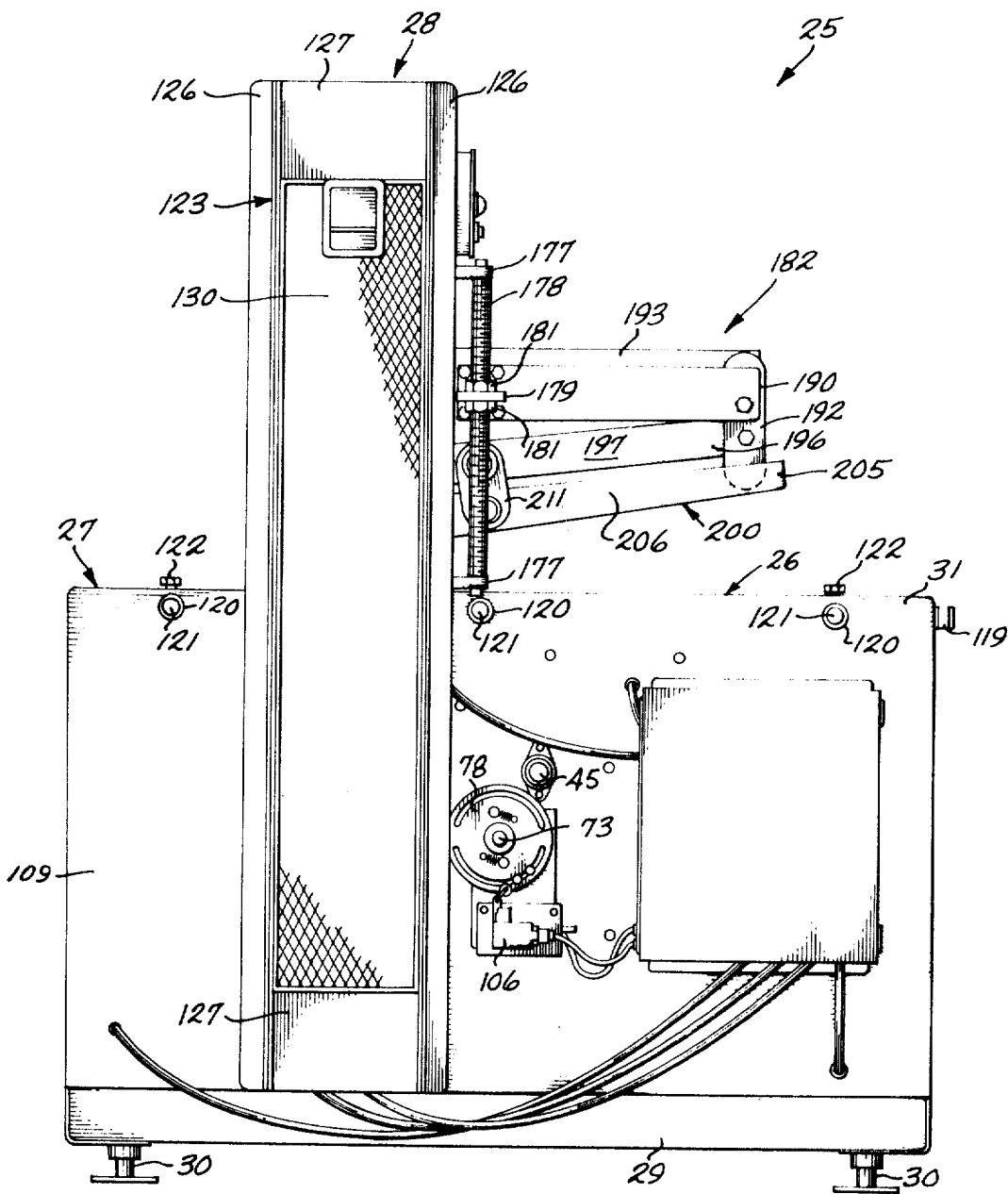
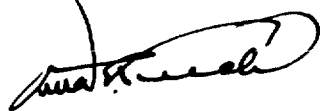


Fig. 2.

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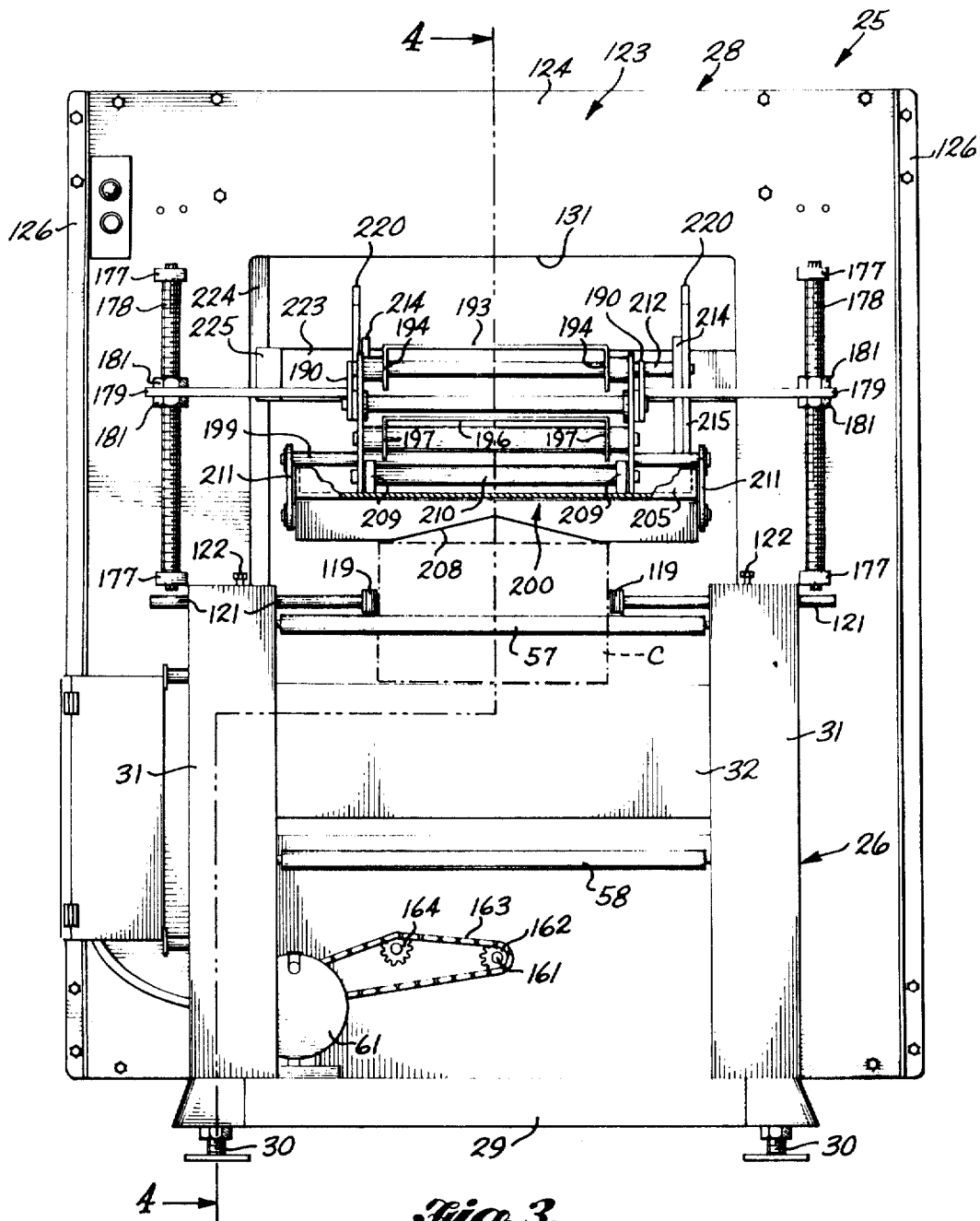


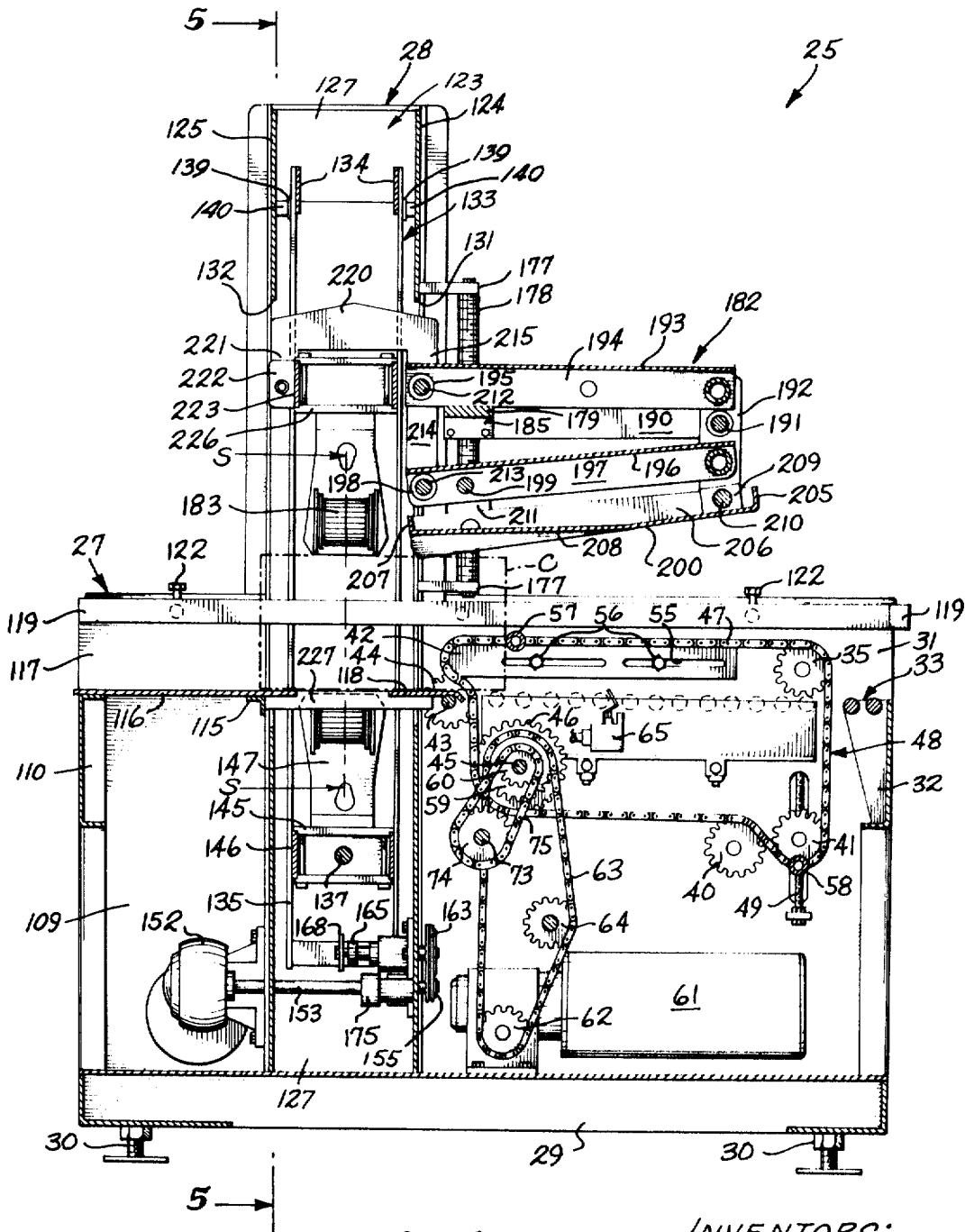
Fig. 3.

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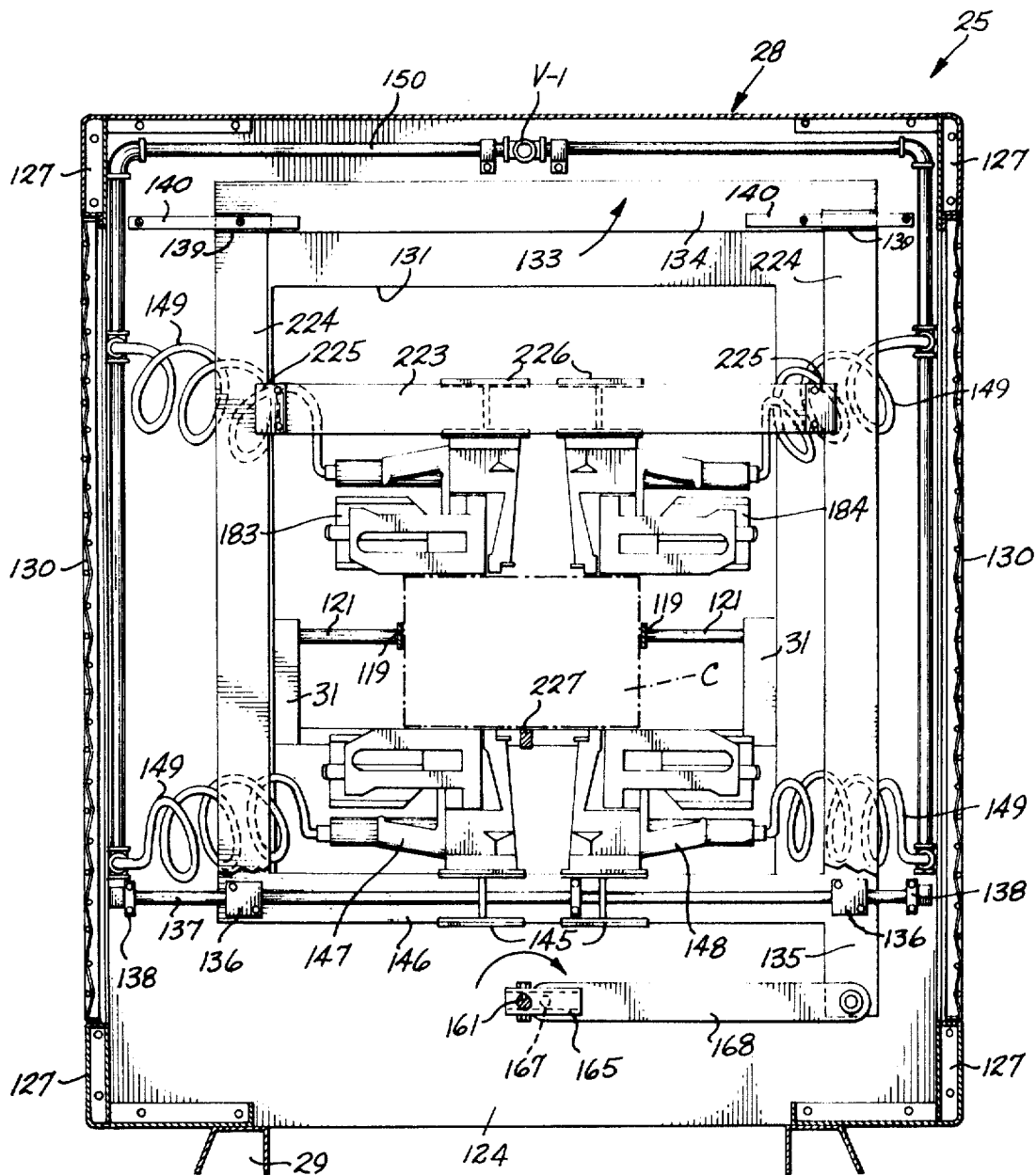


Fig. 5.

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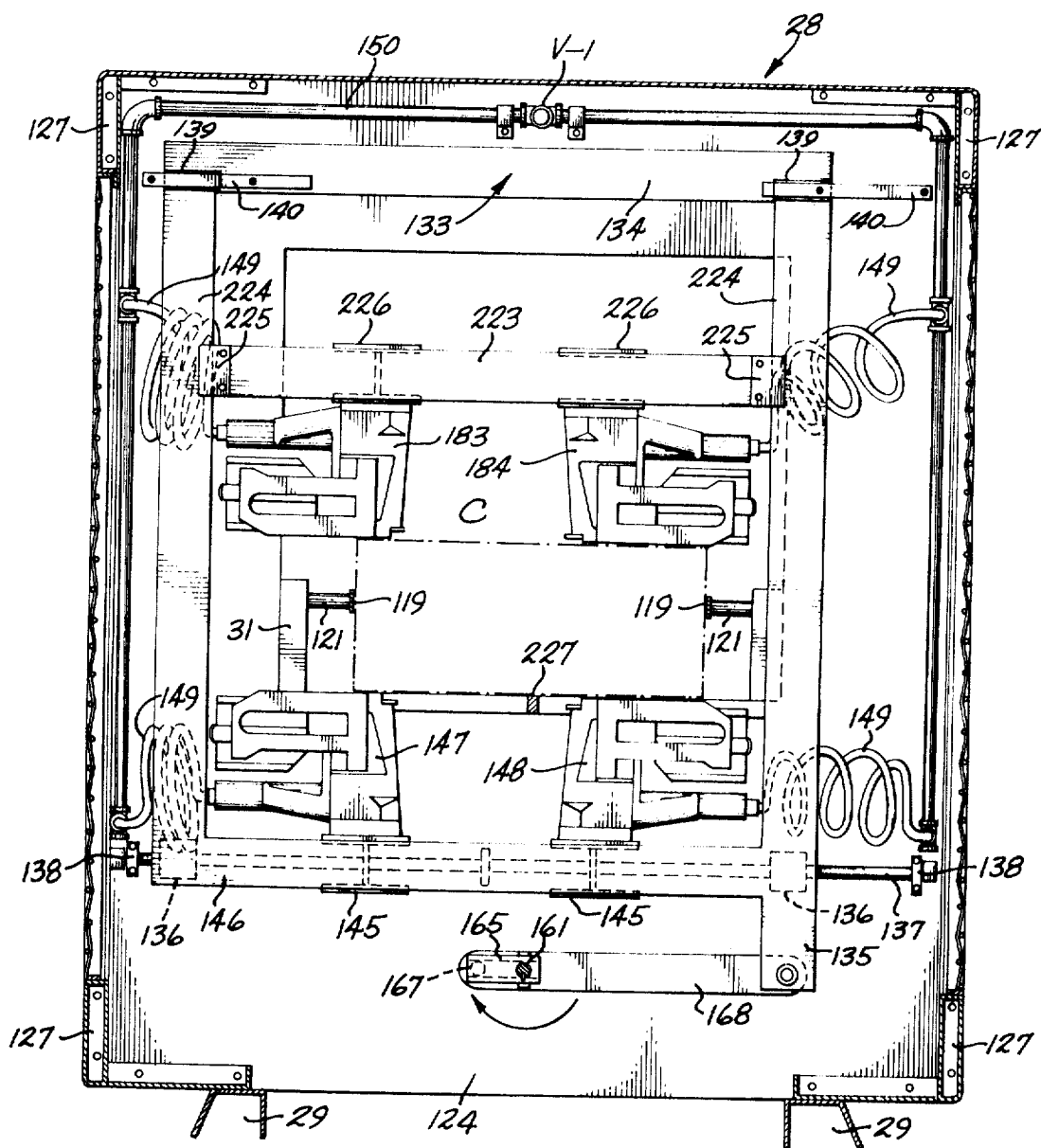


Fig. 6.

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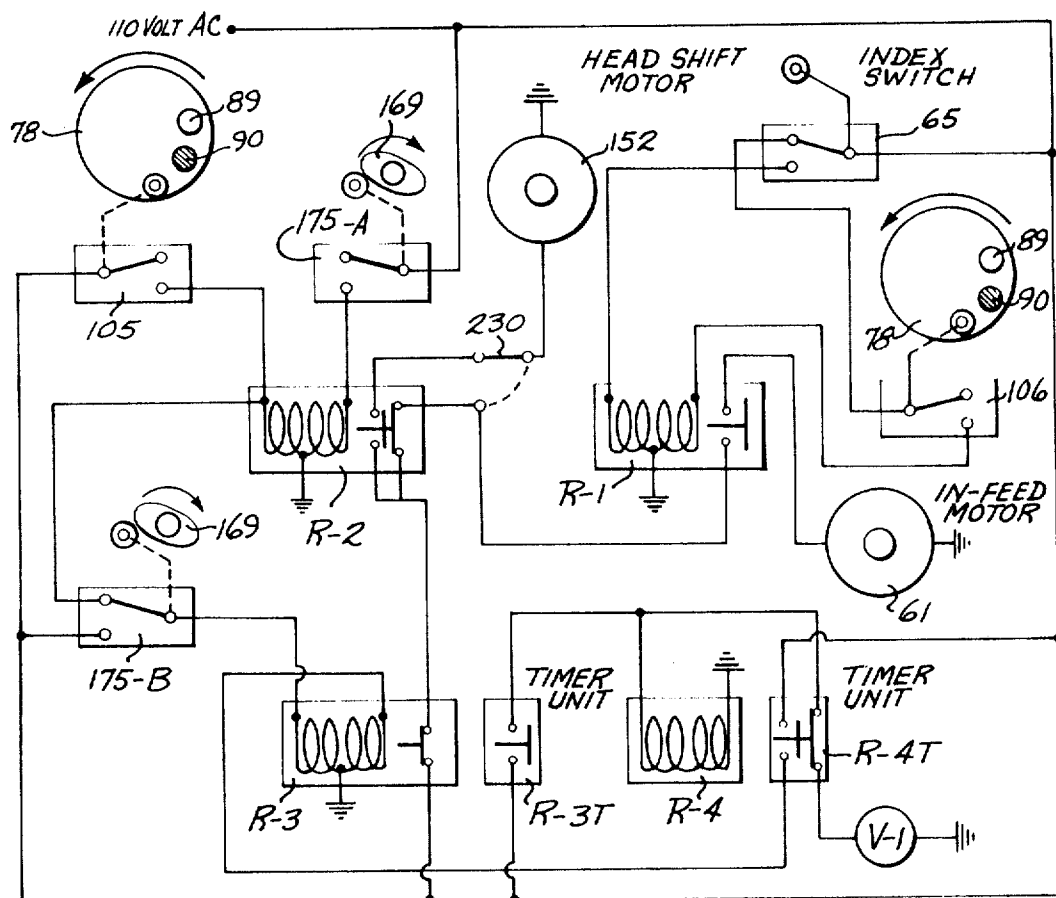
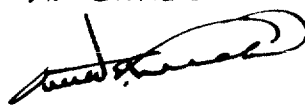


Fig. 1.

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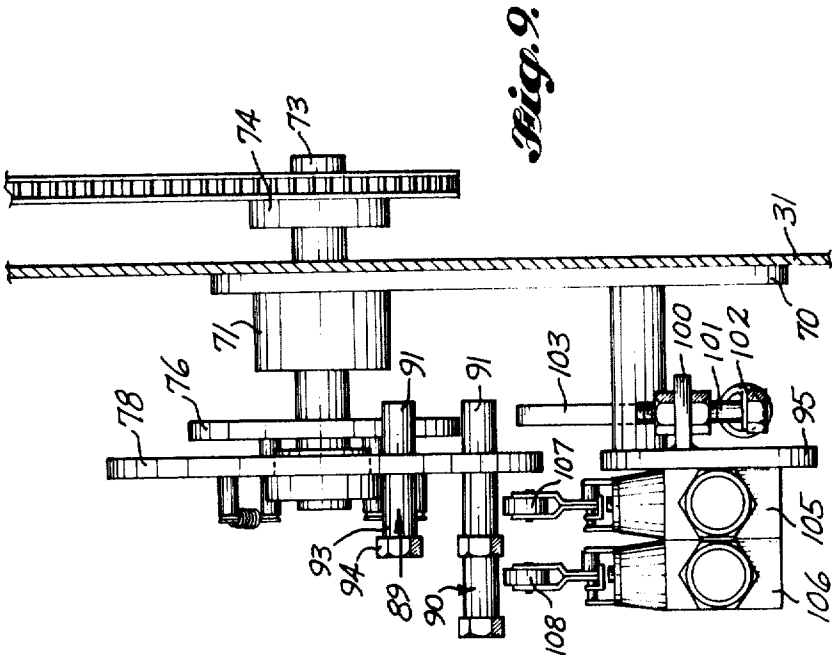


Fig. 9.

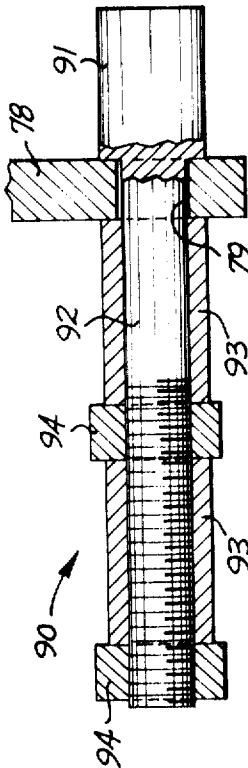


Fig. 10.

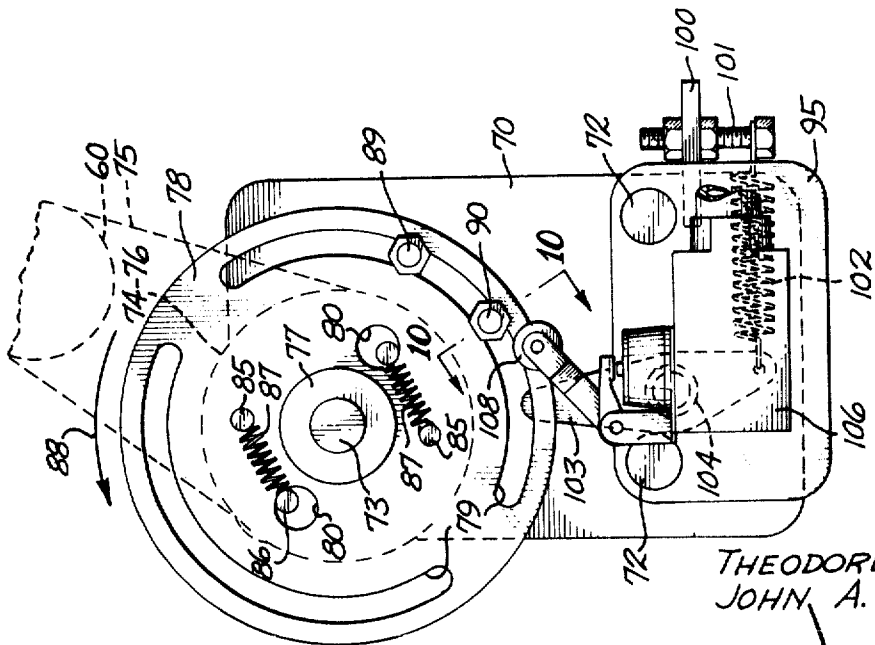


Fig. 8.

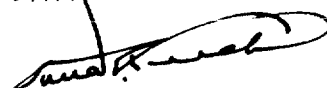
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Fig. 11.

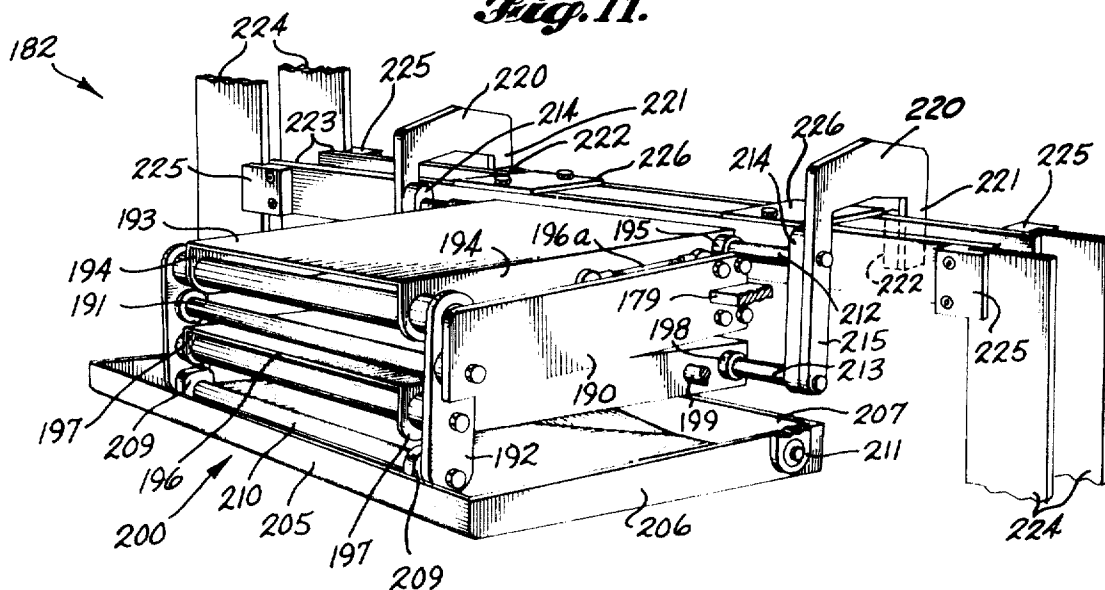


Fig. 12.

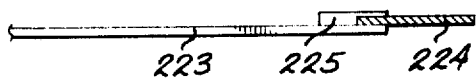
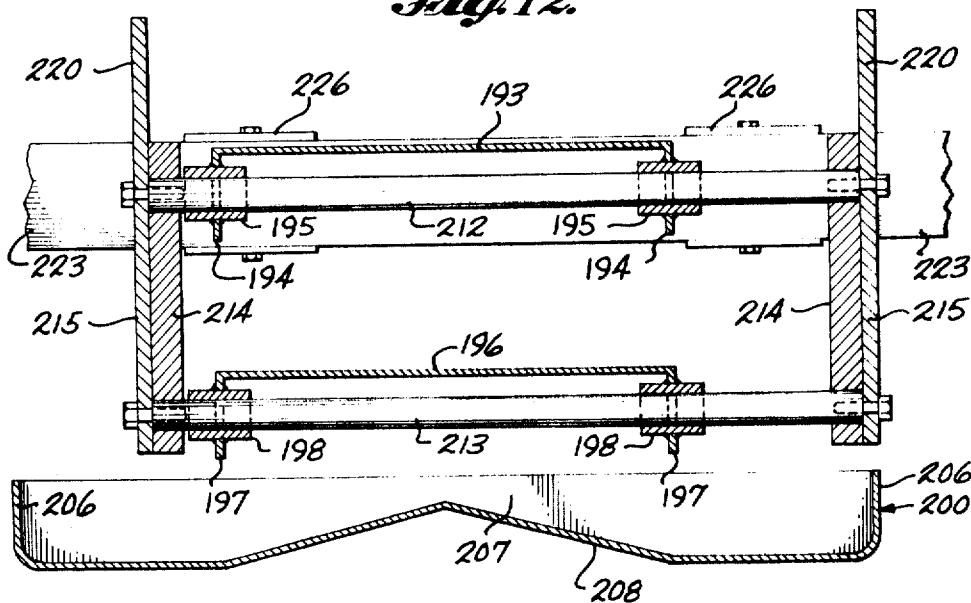
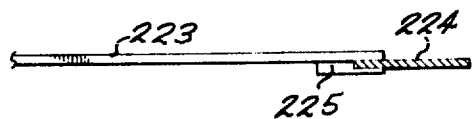
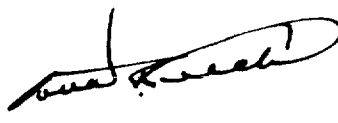


Fig. 13.



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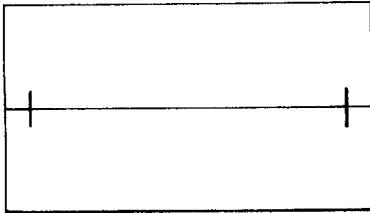


Fig. 14.
NO SHIFT
1-STATION

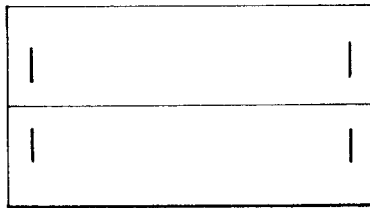


Fig. 15.
NO SHIFT
2-STATIONS

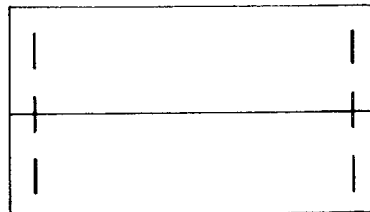


Fig. 16.
NO SHIFT
3-STATIONS

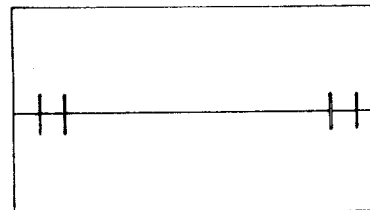


Fig. 17.
1-SHIFT
1-STATION

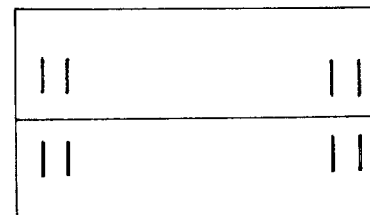


Fig. 18.
2-SHIFTS
2-STATIONS

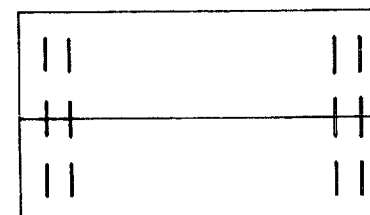


Fig. 19.
3-SHIFTS
3-STATIONS

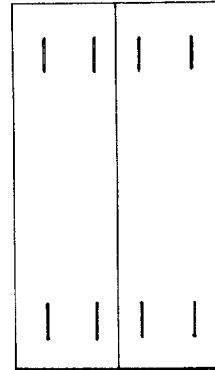


Fig. 20.
2-SHIFTS
2-STATIONS

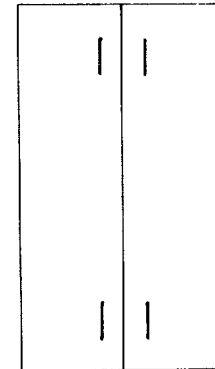


Fig. 21.
NO SHIFT
2-STATIONS

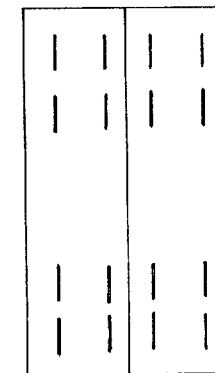


Fig. 22.
4-SHIFTS
4-STATIONS

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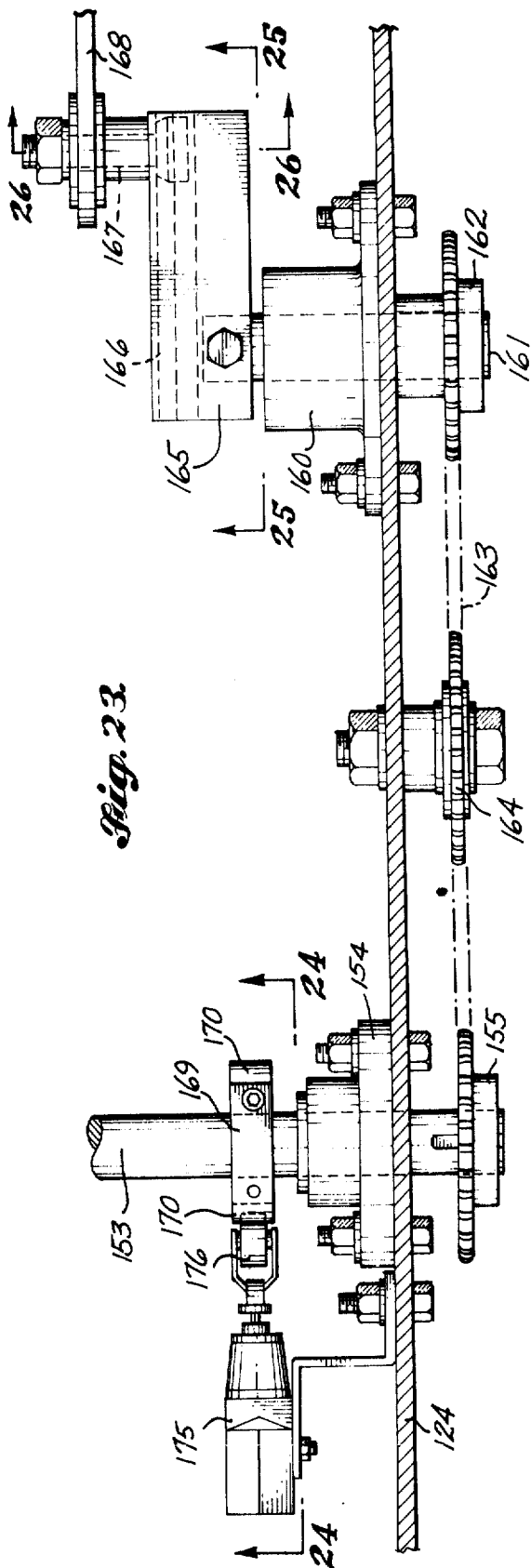


Fig. 23.

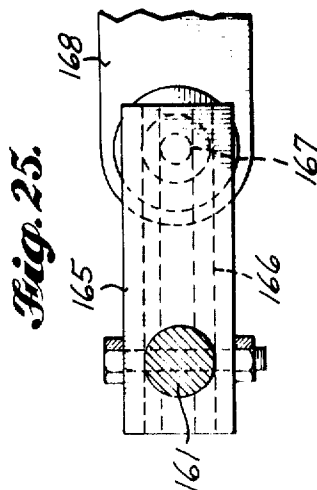


Fig. 25.

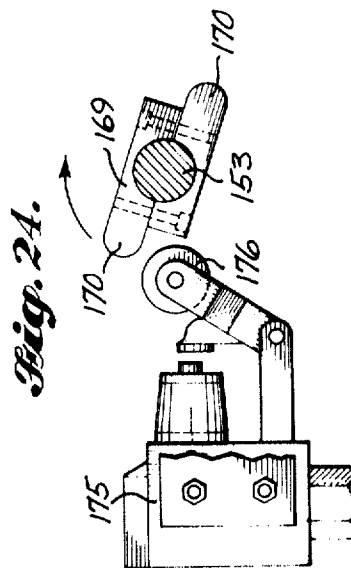


Fig. 24.

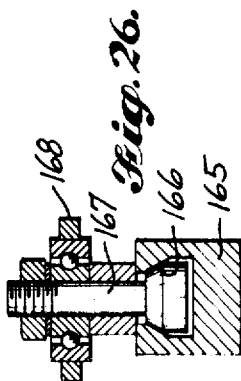
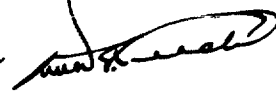


Fig. 26.

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AUTOMATIC CARTON STAPLING MACHINE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The development of machines for completing the packaging of a product in fiberboard cartons by simultaneously stapling the top and bottom side flaps to the top and bottom end flaps of the carton.

2. Description of the Prior Art

The closest patent of the prior art is U.S. Pat. No. 3,126,685 which issued Mar. 31, 1964 on Machine F or Simultaneously Closing Tops and Bottoms of Cardboard Cartons. The patented machine automatically centralizes the carton in the machine and, coincidentally with this motion, locates two lower and two upper stapling heads in opposed relation below and above end portions of the carton and causes said heads to automatically fire staples upwardly and downwardly respectively into said carton. Subsequent to this first firing of said four stapling heads, the upper pair of heads are raised, all four heads are shifted individually inwardly uniform distances and the upper air of heads is lowered into contact with the carton and all four heads are then again actuated to fire staples into the carton. The machine cycle concludes with the withdrawing of the carton centralizing means and the stapling heads to their starting positions, thus freeing the carton for discharge from the machine.

A considerable portion of the time consumed by a cycle of operation in the patented machine is devoted to centralizing the box in the machine, to shifting the upper pair of stapling heads downwardly and upwardly for each of the two stapling operations by these heads and then the final withdrawal of the carton centralizing means and their stapling heads to their individual starting positions.

SUMMARY OF THE INVENTION

It is the principal object of the present invention to shorten the total time period of the carton-closing cycle of the machine and thereby increase its production capacity. One of the features contributing to this result is the power feeding of the carton into a work station in the stapling unit along a guide path so that all that is required to properly position the carton for the starting of the initial stapling cycle is to halt the feed conveyor when the carton arrives in the work station. In the present invention, upper and lower pairs of stapling heads are rigidly fixed on a horizontally shiftable frame so that these stapling heads are already positioned in readiness for driving one pair of staples downwardly in the top of the carton and another pair of staples upwardly in the bottom of the carton when the carton arrives in the work station. Furthermore, the arrival of the carton in the work station and the halting of the feed conveyor to halt the feed movement of the carton with the latter in said station triggers all four stapling heads causing them to immediately fire staples into the top and bottom of the carton as above mentioned.

The stapling head-mounting frame has two positions, a primary stapling position and a secondary stapling position transversely offset from the first, and a separately powered means is provided, when properly triggered, to shift said frame from one of said positions to the other. A typical complete machine cycle on each carton fed thereto includes separate forward and reverse stapling cycles in the first of which said frame starts in one of said positions and in the second of which said frame starts in the other of said positions. The forward stapling cycle is automatically triggered by the halting of the conveyor to halt the carton upon arrival in the work station of the machine, and the completion of that stapling cycle triggers the means for advancing the carton either forward in the work station or out of the work station altogether. Following advancement of the carton performance of the second reverse stapling cycle occurs, for which the frame on which the stapling heads are mounted begins in the same position that it was in for the second stapling operation in the previous (forward) stapling cycle. The feed mechanism is then triggered by the comple-

tion of this second stapling cycle to propel another carton into said work station thereby expelling from the latter the carton which has just been subjected to a complete operation cycle of the machine.

The arrival of the new carton in the work station starts a new machine cycle which is just the same as the one above described with the qualification that regardless of the number of forward and reverse stapling cycles, the machine starts with the stapling head mounting frame in the position in which the last previous stapling operation had been performed, and the completion of this initial stapling operation triggers the frame-shifting means to return the frame to its other position and its arrival at the latter triggers the stapling heads to perform their second stapling operation of the machine cycle being currently described. The frame then again remains in its last-mentioned position while the carton feeder, triggered into action by the completion of the second stapling operation of the current machine cycle, propels another carton into the work station of the machine thus ejecting the carton which was subjected to the stapling operations of the machine cycle just ended.

The stapling heads have adjustable locations on their mounting frame by which the locations in which the staples are driven into a carton delivered to said work station may be varied. The carton feed device is also adjustable so as to vary the precise location of the work station in said machine in which the carton is halted during the stapling cycles of the machine cycle for stapling that carton, and to adapt the feeding means to cartons varying in size. The lower pair of stapling heads provided in the machine are mounted on the shiftable frame carrying these so that the upper faces of these heads are disposed just below the bottom of the carton when the latter is in said work station, and the upper pair of said stapling heads are generally disposed directly above said lower pair of heads with their lower faces just above the top of said carton and the means on the frame for supporting the upper heads is vertically adjustable to accommodate cartons varying in height.

The carton feed means includes horizontally adjustable side guides which are adjustable to properly form a guided path for cartons varying in width, the machine being adapted to receive cartons only of a given width for a given adjustment of said guides. The carton feed means also includes an overhead vertically adjustable shoe which is positioned to guide the top flaps of each carton downwardly as it is propelled into the work position so that these flaps will pass under the upper stapling heads in the machine.

Where the cartons are all of a given uniform height, said overhead shoe functions without being lifted from a given vertical position. Where the cartons vary in height as when closing cartons over packed with iced products, such as lettuce or carrots, the overhead shoe yieldable responds to engagement by the carton top and supports the upper stapling heads so that the shoe and upper heads are lifted by the carton as the latter is advanced to the work station so as to accommodate the carton in the space beneath the upper stapling heads. This maintains the latter in proper closely spaced relation with the top flaps of the carton so as to facilitate the driving of staples in the top of the carton when said heads are fired.

For any particular arrangement in setting the stapling heads on the horizontally shiftable head-mounting frame, the side guide bars defining the guided carton feed path may be readily reset in various locations to guide the carton to a work station disposing the carton in any desired transverse relation with the stapling heads for the initial stapling cycle. Likewise, by such an election in the adjusted locations of said carton guide bars, the choice may be made readily as to whether the carton (of any particular size) is to be fed to the carton closing station with the carton disposed lengthwise or broadside with respect to the path of delivery.

The invention functions to perform each machine cycle automatically from beginning to end. All that is required to cause it to automatically repeat this machine cycle indefinitely is to keep feeding a series of loaded cartons thereto at a rate

which will keep pace with the capacity of the machine to automatically close said cartons. The presence of a carton on the feed-in conveyor of the machine at the moment a machine cycle on a carton previously fed to the stapling unit is being concluded, automatically expels the latter carton and initiates another machine cycle by feeding the new carton into the initial work station.

In addition to the versatile characteristics of the invention above outlined, the electronic controls for the carton feed-in conveyor are readily adjustable to vary the point in the stapling unit at which the carton is halted in advancing it to what has been referred to above as "the work station." By this expedient, the transverse vertical plane in the machine in which staples are driven from all the heads, may, in the first stapling cycle, be considerably closer to the front end (or side) of the carton than it is to the rear end (or side) of the carton.

The electronic feed-in controls are further adjustable to introduce into each machine cycle the automatic actuation of the stapling heads on a single carton during intervals between successive advances of the latter by the feed-in conveyor in which intervals said carton is halted respectively in a series of progressively advanced positions in the work station of the machine.

This faculty permits the invention to be readily adapted, by a few simple adjustments, to automatically function rapidly and precisely during each machine cycle to drive three or four rows of four staples in each row, both in the top and in the bottom of the carton. These rows are parallel and distributed, in the direction the carton is fed through the stapling unit, over the top and bottom faces of the carton.

The versatility of the invention also extends to the rapid and precise performance of relatively simple stapling functions. For instance, the mere throwing of a manual switch temporarily disconnects the means which horizontally shifts the stapling heads, thereby converting the machine, with suitable adjustments of the feed-in conveyor, for automatically driving two staples near each end of a carton, both in the top and bottom thereof, on opposite sides of the longitudinal center line (where the side flaps meet) while this carton is fed longitudinally (lengthwise) through the machine, with momentary pauses for the stapling cycles.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view of a preferred embodiment of the invention.

FIG. 2 is a side elevational view of FIG. 1.

FIG. 3 is a front elevational view of FIG. 1.

FIG. 4 is a longitudinal section view taken on the line 4—4 of FIG. 3.

FIG. 5 is a transverse sectional view taken on the line 5—5 of FIG. 4 with the carton shown positioned in a given work station in the stapling unit of the machine with the head frame shifted to the right into what is referred to hereinafter as its primary stapling position.

FIG. 6 is a view similar to FIG. 5 with the machine adjusted to handle a carton fed broadside through the machine and with the stapling head mounting frame shown shifted to the left into what is referred to herein as the secondary stapling position of said frame.

FIG. 7 is a wiring diagram illustrating the functional electronic elements of the invention with their interconnecting circuits, as these appear at the start or end of a multiple work station machine cycle.

FIG. 8 is an enlarged elevational view of the feed-in conveyor switch control cam of the invention as it appears at the conclusion or start of a multiwork-station machine cycle.

FIG. 9 is an end view of FIG. 8.

FIG. 10 is an enlarged detailed fragmentary sectional view of the No. 2 switch actuating pin of said control cam.

FIG. 11 is a perspective view of the vertically yieldable stapler head supporting carton shoe of the invention.

FIG. 12 is an enlarged sectional detail taken on the line 12—12 of FIG. 11.

FIG. 13 is a detailed view of the vertically telescopic connection between the horizontal upper head support bars and the vertical end bars of the head-shifting frame.

FIGS. 14 to 22 illustrate various patterns of staple arrangements optional in closing cartons with the invention.

FIG. 23 is an enlarged detail of the adjustable crank and pitman mechanism by which the head-supporting frame of the invention is shifted between its primary and secondary stapling positions.

FIGS. 24—26 inclusive are vertical detail sectional views taken respectively on lines 24—24, 25—25 and 26—26, of FIG. 23.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring specifically to the drawings, and particularly to FIGS. 1 to 6 inclusive, the invention is shown therein as comprising an automatic carton stapling machine 25 including a power driven carton feed unit 26, a carton discharge unit 27, and a thin stapling unit 28 sandwiched therebetween. These units are secured to and supported on a sheet metal base 29 having four vertically adjustable feet 30.

The feed-in unit 26 has box formed sheet metal sidewalls 31 which are connected by a box-formed sheet metal spacer 32. Supported within unit 26 on sidewalls 31 thereof is an idle roller conveyor 33 having an open well 34 in the middle thereof. Mounted on suitable studs supported on and extending inwardly from sidewalls 31 are idle sprockets 35, 40 and 41 and chain guide plates 42 having rounded rear ends.

Mounted on inner faces of sidewalls 31 is a shaft 43 carrying sprockets 44. Also journaled in suitable bearings provided on sidewalls 31 is a conveyor drive shaft 45 on which is fixed a pair of large diameter drive sprockets 46. The sprockets and chain guide plates above described are arranged in duplicate in two groups in parallel vertical planes disposed just outside the idle roller conveyor 33, and endless chains 47 are trained about these two sprocket guide plate groups as shown in FIG. 4 to form an infeed carton conveyor 48. The idle sprockets 41 are vertically adjustable by adjusting mechanisms 49 to keep said chains 47 tight.

The chain guide plates 42 have slots 55 penetrated by bolts 56 which secure said plates to studs mounted on inner faces of sidewalls 31 so as to permit horizontal adjustment of plates 42, for a reason to be pointed out hereinafter. Fixed at their opposite ends to corresponding points in endless chains 47 and equally spaced in opposite directions along said chains from each other are carton propelling bars 57 and 58. Also fixed on shaft 45 are sprockets 59 and 60 which are progressively smaller in pitch diameter than the sprockets 46. Mounted on the base 29 within the carton feed unit 26 is a geared drive motor 61 having a drive pinion 62 which is connected by an endless chain 63 to driven sprocket 59 on shaft 45, this chain being kept taut by an idle sprocket 64.

Mounted centrally on the idle roller conveyor 33 in the well 34 thereof is an indexing switch 65, the functional significance of which is illustrated in FIG. 7. This switch is positioned relative to conveyor 33 so as to be depressed by a carton C when the latter is delivered onto conveyor 33 so as to override said switch.

Referring now to FIGS. 8, 9 and 10, a plate 70 is fixed to the outer face of one of the metal sidewalls 31 of carton feed unit 26, this plate having a bearing 71 provided thereon and a pair of studs 72 extending horizontally outwardly from said plate some distance below said bearing. Journaling in said bearing is a shaft 73 having a sprocket 74 fixed on its inner end which is driven by an endless chain 75 which is trained about this sprocket and about sprocket 60 (see FIG. 4). Fixed on the outwardly extending portion of shaft 73 is a disc 76 having a hub 77 on which a switch actuating cam disc 78 is freely rotatably mounted. The disc 78 is provided with a pair of accurate slots 69 near the periphery thereof, this disc also having holes 80 formed therein at diametrically opposite points and lying relatively close to the hub 77. Outwardly extending pins 85 are mounted on the disc 78 at circumferentially spaced

points from the holes 80. Fixed on disc 76 at diametrically opposite points therein and extending horizontally through holes 80 are pins 86. Extremities of pins 85 and 86 are grooved to retain loops provided at ends of tension springs 86 which are looped around end portions of these pins so that rotation of disc 76 by the rotation of shaft 73 is yieldably transmitted through coil springs 87 to the switch control cam disc 78. This rotation of shaft 73 is in the direction of arrow 88.

The cam disc 78 is provided with switch actuating pegs 89 and 90, the first of these pegs being referred to as the short peg and the latter as the long peg. These pegs are mounted in one of the arcuate slots 79 of the disc 78 as clearly shown in detail FIG. 10, which illustrates characteristics held in common by the pegs 89 and 90 as well as those characteristics which are peculiar to the long peg 90. As shown in FIG. 10, each of these pegs has a cylindrical butt end portion 91, which is larger in diameter than the radial width of one of the slots 79, and a threaded stem 92 which is formed coaxially from said butt end portion with an outside diameter fitting within said slot, and long enough to receive one or more sleeves 93 and nuts 94 to complete the peg. Peg 89 has only one sleeve 93 and one nut 94 as it is a short peg, while peg 90 has a stem which is long enough to receive two sleeves 93 and two nuts 94 as clearly shown in FIGS. 9 and 10. Pegs 89 and 90 are adjustable circumferentially on the cam disc 78 to any desired locations within the limits of arcuate slots 79 by merely tightening up on the nuts 94 to clamp the areas of the disc 78 bordering said slots which are located between the butt end portions 91 and the adjacent sleeves 93 of these pegs.

Fixed on the outer ends of studs 72 is a rectangular plate 95 which has welded thereto, near the right-hand end thereof, a lug 100 having a bolt 101 on which one end of a coil spring 102 is hooked. The opposite end of this spring is hooked into a hole formed in a downwardly extending end of a lever 103 which pivotally fulcrums on a stud 104 which extends inwardly from plate 95. Lever 103 is rotatably biased about stud 104 by coil spring 102 so as to engage an adjacent stub 72 whereby the upper end of lever 103 extends upwardly into the circular path followed by butt end portions 91 of pegs 89 and 90 as these pegs are caused to travel past the upper end of said lever by the rotation of cam disc 78.

Mounted on plate 95 are a pair of microswitches 105 and 106. These are mounted side by side in parallel relationship with their actuating levers angled upwardly so that the rollers 107 and 108 of said switches are disposed concentrically and in the path taken by the sleeves 93 of the pegs 89 and 90 on switch control cam disc 78. The roller 107 of switch 105 is located to be engaged by each of the pegs 89 and 90 when one of these passes said roller while the roller 108 of switch 106 is positioned to be engaged and actuated only by long peg 90.

When rotation of disc 76 and switch control cam disc 78 causes either one of the pegs 89 and 90 to engage the upper end of spring biased lever 103, this engagement temporarily halts rotation of control cam disc 78 to allow the coil springs 87 to be extended until the pins 86 engage the opposite sides of the holes 80 from the side said springs normally hold said pins against, whereupon, said pins positively transmit rotation from the disc 76 to the disc 78 thus swinging the lever 103 about its mounting stud 104 and stretching the spring 102 which brings the peg 89 or peg 90 (whichever is the case) into close proximity with one or both of the switch rollers 107 and 108. When the rotational travel of the peg which at this moment is engaging the upper tip end of lever 103 frees this peg from engagement with said lever, coil springs 87 produce a rapid rotational snap action of the disc 78 causing this particular peg to engage one or both of the rollers 107 and 108, as the case may be, thereby actuating one or both of the switches 105 and 106, depending upon whether the peg involved is the short peg 89 or the long peg 90. The snap rotational movement of the disc 78 just described causes the switch actuation to be accomplished rapidly so that the switch or switches involved are only actuated momentarily, and then released.

The carton discharge unit 27 (FIG. 4) includes box formed sheet metal sidewalls 109 which are joined together at the back end of the machine by box-formed sheet metal spacer 110. The sidewalls 109 are also joined by an angle iron 115 at the same level as the top of spacer 110 and a counterplate 116 with vertical end walls 117 rests on said spacer and angle iron. This counterplate lies at the same level as the upper carton-supporting surfaces of the conveyor 33 and the feed unit 26 has a delivery plate 118 at the delivery end of said conveyor which is on the same level as said counter plate.

To form a guide path along which cartons are guided in passing through the machine 25, carton feed unit 26 and discharge unit 27 provide means for supporting guide bars 119 for horizontal adjustment towards and away from each other independently so as to make said guide path of any desired width and position the center of this guide path at various transverse locations. The guide bar supporting means comprise horizontal sleeves 120 embodied in the sheet metal sidewalls 31 and 109 of said units for slideably receiving a series of parallel round bars 121 which are united with said guide bars (there being two of such bars in each sidewall 31 and one of these in each sidewall 109), and then providing set screws 122 for adjustably securing said bars in said sleeves. As shown in FIG. 4, the bars 119 extend the full length of the machine 25 and guide each carton C from the moment it is fed into the front of said machine until its discharge from the discharge unit 27.

The stapling unit 28 includes a box formed sheet metal wall 123 including a front plate 124, a backplate 125 which are reinforced at their outer edges by vertical angle irons 126 and joined together at top and bottom by narrow spacer plates 127. The lateral faces of wall 123 are occupied mainly by screen windows 130 mounted between the spacer plates 127. The wall 123 has a central passageway formed by matching openings 131 and 132 formed respectively in plates 124 and 125. Horizontally shiftable mounted within the hollow wall 123 is a rectangular frame 133 which carries the stapling heads of the invention horizontally between primary and secondary stapling positions for successive stapling cycles. The rectangular frame 133 is made up of a pair of rectangular frame plates 134 each of which has a downwardly extending arm 135 at the lower right-hand corner thereof as shown in FIGS. 5 and 6, these plates being secured together to opposite faces of bearing blocks 136 which have aligned cylindrical bores which slideably receive a shaft 137 opposite ends of which are fixed to mid points of crossbars 138, the ends of which are secured to wall plates 124 and 125. Opposite upper corners of the rectangular frame plates 134 are provided with slide bearing plates 139 which slideably bear against blocks 140 which are fixed to the inner faces of wall plates 124 and 125 opposite said bearing plates.

Secured by clamps 145 to bottom crossbars 146 of rectangular frame 133, are two stapling heads 147 and 148 which are mounted in transverse alignment, with their upturned faces (from which staples are driven) located just below the plane of the bottom of a carton C when the latter is propelled by the in-feed carton conveyor 48 into and through the stapling unit 28. These stapling heads are supplied with compressed air through an electronically controlled valve V-1 from which compressed air is delivered through coiled plastic tubes 149 to said stapling heads. The compressed air is delivered from valve V-1 to tubes 149 through pipes 150 mounted within vertical corner spaces and top corner spaces within hollow wall 123. This air is supplied to valve V-1 from a suitable air compressor (not shown).

Fixed to the outer face of backwall plate 125 near its lower end is head shift motor 152 (FIG. 4) which provides within itself a geared connection to a shaft 153 which extends horizontally through suitable apertures in wall plates 124 and 125 and a bearing 154 (FIG. 23) mounted on wall plate 124, said shaft having fixed on its extending end a drive sprocket 155. Fixed to the inner face of front wall plate 124 is a bearing 160 in which a crankshaft 161 journals, one end of the shaft extend-

ing forwardly through front plate 124 and having a sprocket 162 which is radially aligned with drive sprocket 155 and is connected thereto by an endless chain 163, the latter having an idle-tightening sprocket 164 for keeping this taut. Mounted on the inner end of crankshaft 161 is a crank arm 165 having a bayonet slot 166 provided radially in its outer face in which a crankpin 167 is adjustably mounted so as to vary the radius at which the axis of said crankpin is spaced from the rotational axis of said crankshaft. A pitman 168 has one end thereof pivotally connected to the crankpin 167 and the opposite end thereof is pivotally connected to lower ends of arms 135 which extend downwardly from reciprocating frame plates 134. Thus rotation of the crankshaft 161 causes a reciprocation horizontally of the rectangular frame 133 on shaft 137.

The sprockets 155 and 162 have the same number of teeth so that the crankshaft 161 and drive shaft 153 rotate at the same speed. Mounted on the drive shaft 153 is a cam 169 having two lobes 170 disposed 180° apart. Mounted on the inner face of front wall plate 124 is a head shift motor halting switch 175, the actuating roller 176 of which extends into the path of lobes 170 of cam 169 so that said switch is actuated with each one-half rotation of drive shaft 153. The cam 169 is oriented with respect to the position of crank arm 165 on crankshaft 161 so that each time switch 175 is actuated to halt the head shift motor 152, crank arm 165 is in one of the two positions in which it is shown in FIGS. 5 and 6. It is thus clear that each time head shift motor 152 is energized, crank arm 165 is in one of said positions, and the motor is only allowed to run until said crank arm has been rotated 180° to the other of said positions where said motor is halted by the actuation of switch 175 by one of the cam lobes 170.

Head shift motor 152 is provided with an electric brake which is automatically released when said motor is energized and applied when said motor is deenergized. The halting of the motor when the latter is deenergized is arranged to be delayed just long enough for the lobe 170, which actuated the switch 175 to accomplish the deenergizing of the motor, to rotate out of engagement with the switch roller 176.

Secured to the front face of front wall plate 124 on opposite sides of window opening 131 therein, are pairs of horizontal brackets 177 (FIGS. 1 to 4) which are in vertically aligned relation, these brackets supporting parallel threaded shafts 178, such shafts supporting a heavy bar 179, opposite ends of which have holes which fit around said shafts, by pairs of heavy nuts 181 which are screwed on said shafts from above and below said bar so as to lock the latter in a horizontal position, disposed at any desired level. Mounted on bar 179 is a mechanism 182 for automatically adjusting an upper pair of stapling heads 183 and 184 in proper superimposed relation with cartons C fed into the machine 25 where said cartons vary substantially in height. The mechanism 182 is designed in the illustrated embodiment of the invention to accommodate variations of as much as two inches in the height of these cartons.

This mechanism includes heavy plate lugs 185 which are welded to upper and lower faces of bar 179 to extend upwardly and downwardly therefrom in a pair of parallel planes, these lugs having bolted thereto bifurcated rear ends of heavy support plates or struts 190 which extend horizontally forwardly from bar 179 with the plates 190 disposed in vertical planes. Uniting the forward ends of plates 190 is a shaft 191 on which are pivotally mounted a pair of vertical levers 192. Disposed between upper ends of said levers and pivotally mounted thereon is the front end of an inverted sheet metal channel member 193 having side flanges 194 which, at their rear ends, are provided with slide bearings 195. Horizontal adjustable links 196a lie between upper portions of plates 190 and side flanges 194, said links having their forward ends pivotally connected to said flanges and their rear ends pivotally connected to lugs 185.

A second inverted sheet metal channel member 196 having side flanges 197 lies with its front end located between vertical levers 192 just below shaft 191 and is pivotally connected to

said levers. Rear end portions of side flanges 197 are provided with bearings 198. Just forwardly of said slide bearings, side flanges 197 are provided with a transverse shaft 199 which extends laterally substantial distances from said channel member 196. Disposed beneath the lower ends of vertical levers 192 and inclined downwardly from its front end towards its rear end is a light sheet metal carton-contacting shoe 200 having an upwardly turned front flange 205, side flanges 206 and a rear flange 207. The bottom face of shoe 200 is flat excepting that a shallow V-shaped recess 208 is formed upwardly therein adjacent the rear edge of said shoe. The outline of this recess is shown in broken lines in FIG. 1 and a transverse profile thereof is shown in FIGS. 3 and 12. A pair of lugs 209 are fixed on shoe 200 between lower end portions of levers 192, these lugs being pivotally mounted on a shaft 210 which connects lower ends of said levers. Upper ends of a pair of plate links 211 are pivotally mounted on outer ends of shaft 199 and lower ends of these links are pivotally connected to side flanges 206 of shoe 200.

Horizontally slideable in slide bearings 195 and 198 are vertically superposed shafts 212 and 213. The opposite ends of these shafts are secured to heavy vertical bars 214 and to forward vertical elements 215 of inverted U-shaped plate yokes 220. These yokes have rear vertical elements 221 which are secured to vertical bars 222. Secured to rear edges of vertical bars 214 near their upper ends and to front edges of vertical bars 222 are transversely extending frame plates 223 which are vertically aligned with and lie in approximately the same planes with rectangular frame plates 134. The ends of frame plates 223 slightly overlap edges of side members 224 comprised in frame plates 134 of the rectangular frame 113, and are held in vertically slideable relation with said side members 224 by guide plates 225 secured to end portions of frame plates 223 (FIG. 13).

The frame plates 223 are thus supported on the inverted U-shaped plate yokes 220 which in turn are supported on slide shafts 212 and 213. These shafts are transversely slideable in slide bearings 195 and 198 so that frame plates 223 are all times supported through shafts 212 and 213 by the mechanism 182. This support is normally transmitted through the inverted sheet metal channel member 293 to the heavy transverse bar 179 because said member rests on said bar (FIG. 4). The upper stapling heads 183 and 184 are mounted between frame plates 223 in transversely aligned relation and are supported on said plates by clamps 226. The mechanism 182 is so designed that when said stapling heads are so supported, the lower faces of said heads from which staples are driven will lie just above the horizontal plane which is tangent with the lowermost carton engaging surface of the shoe 200 (FIG. 4). This means that where cartons C are being fed to the machine 25 as suggested in FIG. 4 (in which the cartons are uniformly confined within the profile indicated by the rectangular broken line in this view), the stapling operations employed in closing this carton will be performed without the necessity of upper stapling heads 183 and 184 being lifted from the positions in which they are shown in FIG. 4. Whenever cartons C are packed with a product which is generally referred to as an "overpack" such as iced packs of lettuce and carrots, and cartons of the size indicated by the broken rectangular line in FIG. 4 are thus bulged upwardly as much as 1 or 2 inches above the normal height of the carton, the feeding of such cartons into the machine 25 will bring the bulging top to the carton into engagement with the shoe 200 which will lift this and the upper stapling heads 183 and 184 so that the latter will be maintained in the proper vertical relation with the top of the carton during the downward driving of stapels from said heads into said carton, as clearly shown in FIGS. 4, 5 and 6, a carton bottom guide bar 227 is secured at its ends to bottom faces of counterplate 116 and delivery plate 118 and fits upwardly between said plates so that the upper edge of said bar is flush with the upper faces of said plates. The function of bar 227 is to support cartons C and smoothly guide these as they travel across the gap between plates 118 and 116.

The right-hand stapling heads 147 and 183 are turned 180° in their mountings on the reciprocating rectangular frame 133 relative to the left-hand stapling heads 148 and 184. Due to the fact that these heads are all aligned with frame 133, that is, the lengthwise central axes of said heads are parallel with that frame and coincide with the central axial plane of said frame, the staples driven from the heads on the right side of machine 25 and those driven from the heads on the left side of said machine are all driven symmetrically with said central axial plane of frame 133. The individual staples lie crosswise of that plane, half on one side and half on the other. Thus, it will be seen that the staples are also individually aligned, (lengthwise, that is) with the direction cartons travel along the conveyor 48. This clearly shown in FIGS. 14 to 22, inclusive, illustrating various patterns in which staples may be driven by the machine 25 in one particular size of carton.

For reference purposes, the central vertical axial plane of stapling head supporting frame 133, symmetrically with which all the staples are driven, may be designated as the staple firing plane S and this is indicated by the line s—S appearing in FIGS. 1 and 4.

OPERATION

As pointed out in the summary of the invention, this is extremely versatile in the many different stapling patterns which may be performed therewith. With slight adjustments the machine may be altered from a condition in which it will staple one of these patterns to where it will perform any particular one of the others. There are nine separate views in the drawings illustrating nine patterns of staples which can be applied in a single-machine cycle. The drawings for the most part shown the machine as set up for stapling the pattern shown in FIG. 18 which the carton is fed broadside into the machine or that shown in FIG. 20 in which the carton is fed lengthwise into the machine. With few exceptions, all of the views illustrate the machine as it appears at the beginning or ending of a machine cycle, the latter item being used to indicate all of the functions performed between the last stapling operation employed in the closing of a given carton and the last such operation performed in the closing of the next carton fed to the machine. Thus it is seen that each machine cycle ends while the carton which has just been closed still remains in the final work station in which it was operated on in the closing thereof, this carton being expelled from said work station by the start of the next machine cycle which begins with the feeding of a new carton into the initial work station in which the stapling of the carton starts. Referring to FIG. 8, it is to be noted that the switch control cam disc 78 is rotated in the direction of the arrow 88 while the feed-in conveyor 48 is operating. The operation of this conveyor starts with the energizing of the motor 61 and it halts with the deenergizing of this motor by the actuation of switch 105 when one of the pegs 89 or 90 is brought by the rotation of the disc 78 into engagement with the roller 107 of this switch. The drive ratio between the disc 78 and the chain 47 of the infeed carton conveyor 48 is such that this chain travels one-half its length during each revolution of the disc 78. When the motor 61 is energized therefore, (the manner of accomplishing which will be described later) the chain 47 travels (with the setting of the pegs 89 and 90 shown in FIG. 8) a little short of a full revolution before peg 89 will engage roller 107 of switch 105 and shutoff drive motor 61 and halt the travel of the conveyor chain 47. FIG. 4 is an exception to the general rule above stated as to the various elements of the machine being shown in the drawings as at the end of a given machine cycle. Instead, FIG. 4 shows the carton C in the position in which it is halted after the motor 61 has been energized at the beginning of a machine cycle and chain 47 has travelled slightly less than one-half its length and then been halted by the engagement of switch roller 108 by peg 90. The motor 61 has a magnetic brake which rapidly halts the travel of the conveyor 48 when said motor is thus deenergized. Carton C thus halts when the conveyor stops in the position in which this carton is shown by broken lines in FIG. 4. The carton is here disposed in the initial work station for this carton in this machine cycle.

At the start of the machine cycle, both motors 61 and 152 are deenergized. The index switch 65 which is positioned in the well 34 of the idle roller conveyor 33 is depressed by a carton delivered onto said conveyor, and this initiates an entire machine cycle of the machine 25 which is automatic from that point on until the cycle is concluded by the completing of a series of stapling operations in each of which staples are driven by the respective stapling heads of the machine downwardly and upwardly into the top and bottom of the carton and the same is thus completely closed ready to be discharged from the machine.

Besides the switches already described, the electrical system of the machine 25 includes relays R-1, R-2, R-3 and R-4. Of these relays, R-3 and R-4 are equipped with timer units R-3T and R-4T respectively. Each of these timer units is, in effect, a relay by itself and is actuated after a certain delay period which may be varied by rotation of a little thumb roller provided on the unit so that the switch or switches provided therein close or open to perform auxiliary functions in connection with the actuation of the relay with which the timer unit is associated. The relays used in this machine are of the type "NT" put out by the Allen-Bradley Co. of Milwaukee, Wisc.

The following explanation of the operation of the electronic units in the machine 25 will be clearly understood by reference to the wiring diagram of FIG. 7. The depression of switch 65 by moving a carton thereover energizes the left side of the coil of relay R-1 and closes the points in this relay thereby completing the circuit of feed-in motor 61 through the relays R-2 and R-3 which starts this motor. This drives the infeed carton conveyor 48 to cause the chains and bars 57 and 58 thereof to travel at a preferred rate of 24 inches a second, this travel continuing until roller 57 has been applied to the rear of the carton C (which was used to depress the switch 65) to propel this into the position shown by broken lines in FIG. 4 whereupon the conveyor 48 is halted and comes to a sudden stop leaving the carton C in its initial work station. The feed-in motor 61 is halted by peg 89 passing over roller 107 of switch 105 so as to close this switch and energize relays R-2 and R-3. As indicated in FIG. 7 this energizing of these relays is of the left-half of the coils thereof, the energizing of relay R-3 being through normally closed switch 175B. The energizing of relay R-2 breaks the circuit of the feed-in motor 61 thus causing this to halt and closes points in this relay in the circuit of the head shift motor 152 but prevents this starting by the points in this circuit in relay R-3 being open. The timer unit R-3T of relay R-3 closes with a delayed action permitting the feed-in motor 61 to come to a complete halt with the carton C in its first work station before functioning to actuate relay R-4 which operates through the timer unit R-4T to momentarily open compressed air valve V-1 and cause all of the stapling heads to fire staples into carton C. The timer unit R-4T, after a brief delay allowing the firing of said stapling heads, opens the circuit to valve V-1 and closes an auxiliary circuit which energizes the right-half of the coil in relay R-3 thus closing the points in said relay and starting the head shift motor 152. This causes shafts 153 and 161 to be given a one-half revolution which terminates in one of the lobes of the cam 169 momentarily actuating switches 175A and 175B. This actuation of switch 175A energizes the right-half of the coil in relay R-2 thus opening the points in the circuit of head shift motor 152 causing the same to halt. The energizing of relay R-3 also energizes timer unit R-3T which, after a suitable delay, functions through timer unit R-4T to open valve V-1 and cause all of the stapling heads of the machine to fire staples into the carton C. The staples fired at this time are in different positions than in the initial stapling operation with the carton C in the initial work station. In fact, as shown in FIGS. 18 and 20, the patterns of staples fired in these two initial stapling operations are transversely offset from and overlap each other so as to appear as shown in these two views, in one of which the carton is disposed broadside and in the other of which the carton is disposed lengthwise in the machine.

When relay R-2 functioned to turn off head shift motor 152 it closed the points therein in the circuit of the feed-in motor 61 but the latter does not start because of the points in said circuit in relay R-3 being open. At the close of the functioning of the timer unit R-4T in producing the last-mentioned stapling operation, the points of this unit are reversed from the position in which they are shown in FIG. 7 so as to send an impulse to energize the right-half of the coil in relay R-3 thus closing the points in this relay in the feed-in motor circuit and starting the latter. Owing to the fact that peg 90 closely follows peg 89, the disc 78 is allowed to rotate only a relatively short distance before the peg 90 engages rollers 107 and 108 of switches 105 and 106 so as to close said switches momentarily. This causes a repetition of the functions which followed the momentary closing of switch 105 at the start of this machine cycle with the result that all stapling heads are caused to fire staples into the carton C with the latter in its new work station and with the stapling heads in their secondary firing position. At the same time, the momentary closing of switch 106 kicks out relay R-1 which is the signal of the end of the machine cycle. This end does not occur at once but this action of switch 106 is what ultimately causes the halting of the entire machine at the end of the machine cycle. The closing of switch 105 momentarily by the engagement of long peg 90 with switch roller 107 starts a repetition of the entire chain of automatic functions described hereinabove as following the first momentary closing of switch 105 with the result that the stapling heads are triggered to perform a stapling operation on the carton with the stapling heads in their secondary transverse position in the machine and with the carton in its second work station, following which, the head shift motor 152 is automatically energized to return the stapling heads to their primary or initial firing position and then automatically causes these heads to fire staples into the carton when said heads reach said position.

When the timer points of relay R-4 shift in the last firing of the stapler heads, the stapler valve V-1 is turned off and an impulse is sent back to relay R-3 which closes the points thereof so that the infeed motor is ready to turn on but it remains halted because the points of R-1 relay are now open. This concludes the machine cycle in which the stapling heads are caused to perform stapling operations on the carton C with the carton in its initial work station and with the stapling heads both in their primary and secondary positions in the machine and then automatically advances the carton C from its first work station to its second work station and, following this, automatically causes the stapling heads to perform a stapling operation with these in their secondary position in the machine after which they are automatically returned to their primary position in the machine where they are caused to automatically perform a final stapling operation in that position and then leave all parts of the machine halted pending the introduction of another carton onto the conveyor 33 so as to depress index switch 65.

Obviously whenever a continuous supply of cartons is provided so that during the performance of each machine cycle, another carton is rolled onto conveyor 33 so as to depress index switch 65, there is then no halt of the machine between subsequent machine cycles as the completion of one machine cycle occurs with index switch 65 depressed which causes the immediate initiation of the following machine cycle.

Provision is made for altering the electric wiring system illustrated in FIG. 7 so that the machine 25 may be operated to perform stapling operations on cartons which do not require a lateral shifting of the stapling heads as in the machine cycle above described. Patterns of staples requiring this change are shown in FIGS. 14, 15, 16 and 21. To accommodate the machine to this type of operation a switch 230 is provided in the line connecting relay R-2 to head shift motor 152. This switch, when thrown, breaks this line and connects the relay point normally leading to motor 152 to the relay point normally leading to relay R-1. This is a manually operated switch and when it is thrown from the position in which it is shown in full lines in FIG. 7 to the position in which it is shown in

broken lines in said figure, the head shift motor 152 does not function at all and the stapling heads of the machine remain wherever they are clamped in place in the machine throughout the entire machine cycle. In this case the machine cycle is also entirely automatic, and the carton is progressively advanced from one work station to another and the stapling heads caused to automatically perform stapling operations with the carton in each of these work stations. Only one stapling operation is however performed while the carton is in each position in the work station and the conclusion of this stapling cycle triggers the feed-in motor to advance the carton to the next position and the arrival of the carton in this position triggers the stapling heads to again perform a stapling operation with the carton in that position.

Where it is desired that stapling cycles be performed in each of two positions in the work station this can be accomplished by the use of the two pegs 89 and 90 and the various spacing of these pegs about the disc 78 in the slots 79 thereof will determine how far apart these positions are and just where they occur along the carton. If it is desired that more than two stapling cycles may be performed as the carton progresses past the stapling heads, additional short pegs 89 may be added to the timing disc 78 and the entire machine cycle is automatic, this cycle being closed by the engagement of the switch roller 108 by long peg 90 providing there is no new carton on the conveyor 33 depressing the switch 65 at the close of said machine cycle.

To modify the machine 25 for producing two stapling operations only in a given machine cycle and with the carton in a single position in the work station, the disc 78 is provided with only one peg, this being a long peg 90. This placed so as to position the carton to be stapled as shown in FIG. 17 where the carton is advanced broadside to bring the meeting line of the side flaps of the carton into coincidence with the transverse axis of the stapling heads.

In the machine cycle produced by the machine 25 thus altered, the stapling heads will remain in their secondary transverse positions at the close of the first machine operation. The initial stapling cycle of the next following machine cycle will occur with the heads in said secondary positions, and the heads will then be automatically returned to their primary transverse positions for performance of their second stapling operation in said second machine cycle.

We claim:

1. An automatic carton-stapling machine comprising:

1. means for advancing a carton along a guide path through a work station in said machine;

2. stapling head means supported in said work station for driving staples into said carton in a predetermined pattern spaced transversely across said carton;

3. stapling head-shifting means supporting said head means and operable to shift the same transversely of said path to staple in first and second transversely offset stapling positions; and

4. sequence control means coupled to the above-recited means and including

a. means for triggering said head means and shifting means to perform a forward stapling cycle consisting of stapling in the first position, shifting to the second position and stapling in the second position, while said carton is held stationary in said work station,

b. means for triggering said head means and shifting means to perform a reverse stapling cycle consisting of stapling in the second position, shifting to the first position and stapling in the first position, while said carton is held stationary in said work station, and

c. means for triggering said advancing means to advance said carton following each forward cycle and following each reverse cycle.

2. An automatic carton-stapling machine comprising:

1. means for advancing a carton along a guide path through a work station in said machine;

2. stapling head means supported in said work station for driving staples into said carton in a predetermined pattern spaced transversely across one side of said carton;
3. stapling head-shifting means supporting said head means and operable to shift the same transversely of said path to staple in first and second transversely offset stapling positions; and
4. sequence control means coupled to the above-recited means and including
 - a. means for triggering said head means and shifting means to perform a forward stapling cycle consisting of stapling in the first position, shifting to the second position and stapling in the second position, while said carton is held stationary in said work station,
 - b. means for triggering said head means and shifting means to perform a reverse stapling cycle consisting of stapling in the second position, shifting to the first position and stapling in the first position, while said carton is held stationary in said work station,
 - c. means for triggering said advancing means to advance said carton following each forward cycle and following each reverse cycle,
 - d. means for triggering performance of a reverse stapling cycle following advance after performance of a forward stapling cycle, and
 - e. means for triggering performance of a forward stapling cycle following advance after performance of a reverse stapling cycle.
3. An automatic carton-stapling machine comprising:
 1. a stationary housing defining a guide path leading to a work station in said machine;
 2. means for advancing a carton along said guide path and into said work station;
 3. stapling head means supported in said work station and operable to drive staples into a side of said carton lying substantially in a plane parallel to said guide path;
 4. means supporting said stapling head means in said work station for movement in a direction transverse to said carton side; and
 5. stapling head-positioning means including:
 - a. a strut member on said housing extending from said work station substantially in a direction opposite the direction of travel of said carton, and
 - b. a carton contact member positioned at an angle to the guide path for sliding contact with the forward edge of said carton side and having one end pivotally mounted on the end of said strut member opposite its mounting on the housing and having its other end connected to said stapling head supporting means to guide said stapling head means into sliding contact with said carton side during advance of the carton into said work station.
4. The machine defined in claim 1 wherein said stapling head means includes a head unit adapted to drive two staples at a time, and said shifting means shifts said unit through a distance whereby the pattern of staples driven in the first stapling position overlaps one side of the pattern of staples driven in the second stapling position.
5. The machine defined in claim 4 wherein said head unit includes first and second stapling devices; and said shifting means includes a frame supporting said stapling devices and adapted to shift the same together between said first and second stapling positions, and means on said frame for adjusting the relative positions of said devices thereon to vary said stapling pattern and the degree of overlap of the patterns for said first and second stapling positions.
6. The machine defined in claim 5 wherein said shifting means includes a shift power source and a drive coupling between said power source and said frame, said coupling including means for varying the distance through which said frame is shifted to further vary the degree of overlap of said staple patterns.
7. The machine defined in claim 1 wherein said sequence control means includes:

1. means responsive to entry of a carton into said guide path for actuating said advancing means;
2. means operative upon arrival of a carton in said work station for halting said advancing means and actuating said forward stapling cycle-triggering means;
3. means responsive to completion of said reverse stapling cycle for inhibiting actuation of said advancing means; and
4. means responsive to entry of a carton into said guide path for disabling said inhibiting means.
8. The machine defined in claim 1 further including means for disabling said shifting means and triggering said advancing means following each stapling operation of said stapling head means.
9. The machine defined in claim 1 further including variable means responsive to movement of said advancing means for setting the distance through which said carton is advanced following each of said cycles.
10. The machine defined in claim 9 wherein said sequence control means further includes means coupled to said advancing means and operative upon completion of the first stapling cycle performed upon a carton following its arrival in said work station, for halting said advancing means after advance of said carton through a distance less than its width in the direction of said guide path and triggering performance of the next stapling cycle, whereby a plurality of stapling cycles are performed on said carton.
11. The machine defined in claim 1 wherein said stapling head means comprises first and second head units on respectively opposite sides of said guide path; and said shifting means comprises a common frame supporting said first and second head units and adapted to shift the same together between first and second stapling positions.
12. The machine defined in claim 11 wherein said shifting means shifts said frame a predetermined distance whereby the pattern of staples driven in the first stapling position overlaps the pattern of staples driven in the second position on said opposite sides, respectively.
13. The machine defined in claim 12 wherein said head units are located above and below said guide path for stapling the top and bottom of said carton.
14. The machine defined in claim 1 further including sensing means sensitive to the position of a carton side into which staples are to be driven, said sensing means having a contact member positioned to be contacted by said carton side as the carton enters the work station, said contact member being connected to said stapling head means to guide the same into sliding contact with said carton side during advance of said carton into said work station.
15. The machine defined in claim 14 further including a housing defining said work station, a sensing means support frame mounted on said housing and extending substantially in the direction opposite the direction of travel of said carton, said contact member having one end pivotally mounted on the end of said support frame opposite its mounting on the housing and being positioned to contact the top of said carton, the other end of said contact member being connected to said stapling head means.
16. In a carton stapling machine having means for supporting and advancing a carton through a work station for stapling closure flaps of said carton, the combination comprising:
 1. stapling head means adapted to drive two staples at a time spaced in a predetermined pattern transversely of said guide path across a side of said carton,
 2. stapling head-shifting means supporting said head means and operable to shift the same transversely of said guide path to staple said pattern in first and second transversely offset stapling positions in which the pattern of staples for the first position overlaps one side of the pattern for the second position, and
 3. means for controlling stapling and advancement of said carton and shifting of said stapling head means to staple said carton in both said first and second position while said carton is held stationary between successive advancements thereof.

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17. The combination defined in claim 16 wherein said stapling head means includes first and second stapling devices; and said shifting means includes a frame supporting said stapling devices and adapted to shift the same together between said first and second stapling positions, and means on said frame for adjusting the relative positions of said devices thereon to vary said stapling pattern and the degree of overlap of the patterns for said first and second stapling positions.

18. The combination defined in claim 17 wherein said stapling head means includes separate sets of said first and second stapling devices, said sets being located on opposite sides of said guide path to staple opposite sides of said carton;

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and said shifting means includes a common frame supporting said sets of stapling devices and adapted to shift the same together between said first and second stapling positions.

19. The combination defined in claim 18 wherein said separate sets of stapling devices are located above and below said guide path for stapling the top and bottom of said carton.

20. The machine defined in claim 3 wherein said positioning means is located above said guide path, and further includes a vertically adjustable coupling between said housing and said strut member for auxiliary positioning of said sensing means.

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