United States Patent [19]

Conner, Jr.

[11] **3,765,672**

[45] **Oct. 16, 1973**

[54] **AUTOMATIC FEEDER FOR WORKPIECE OF FABRIC OR THE LIKE**

[75] Inventor: **William R. Conner, Jr.**, St. Louis, Mo.

[73] Assignee: **Stahl-Urban Company**, Brookhaven, Miss.

[22] Filed: **Dec. 20, 1971**

[21] Appl. No.: **209,821**

Related U.S. Application Data

[62] Division of Ser. No. 33,378, April 30, 1970, Pat. No. 3,670,674.

[52] **U.S. Cl.** **271/10,** 271/33, 271/55

[51] **Int. Cl.** **B65h 3/20,** B65h 5/10

[58] **Field of Search** ..... 271/33, 3–5, 271/27, 28, 18, 14, 11, 39, 10, 54, 55, 58, 59, 84; 112/211, 214, 121.29; 221/217; 214/85 H

[56] **References Cited**

UNITED STATES PATENTS

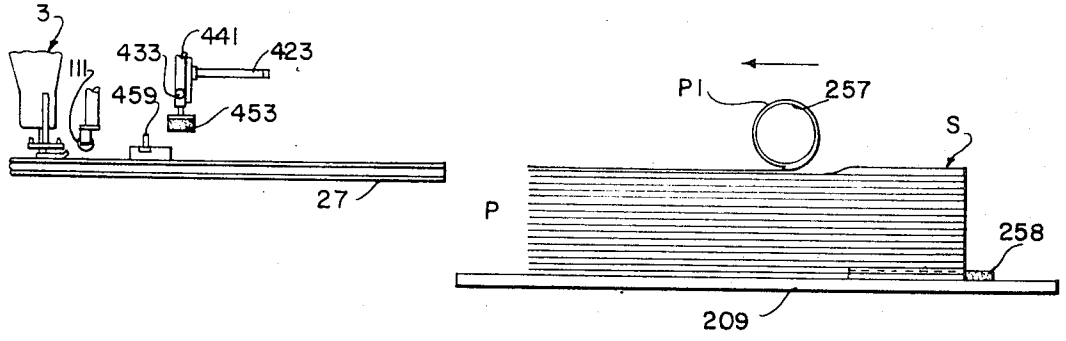
1,217,650	2/1917	Snyder	271/55 X
1,941,248	12/1936	Cottrell	271/59
3,032,006	5/1962	Kahn et al.	271/59 X
3,204,591	9/1965	Pickett	271/59 UX
3,463,482	8/1969	Baron et al.	271/59 X
3,544,098	12/1970	Hawley et al.	271/58 X

Primary Examiner—Evon C. Blunk
Assistant Examiner—Bruce H. Stoner, Jr.
Attorney—Koenig, Senniger, Powers & Leavitt

[57] **ABSTRACT**

Apparatus for automatically feeding workpieces of fabric or similar limp material one after another from a stack of workpieces and delivering each workpiece to a sewing machine for a sewing operation along an edge of the workpiece. The top workpiece of the stack is picked off by means of a roller which rolls up the top workpiece of the stack, advances it to a position spaced from the stack, and then retracts to unroll the workpiece, whereupon a feed device takes over to feed the workpiece into a sewing machine to start the sewing operation. The sewing machine then takes over, and the workpiece is fed through the sewing machine by the feed device of the sewing machine and stitched. In being fed through the sewing machine, the workpiece is automatically guided for contour stitching along an edge thereof. A stacker is provided on the exit side of the sewing machine for automatically stacking completed workpieces exiting from the sewing machine.

29 Claims, 26 Drawing Figures



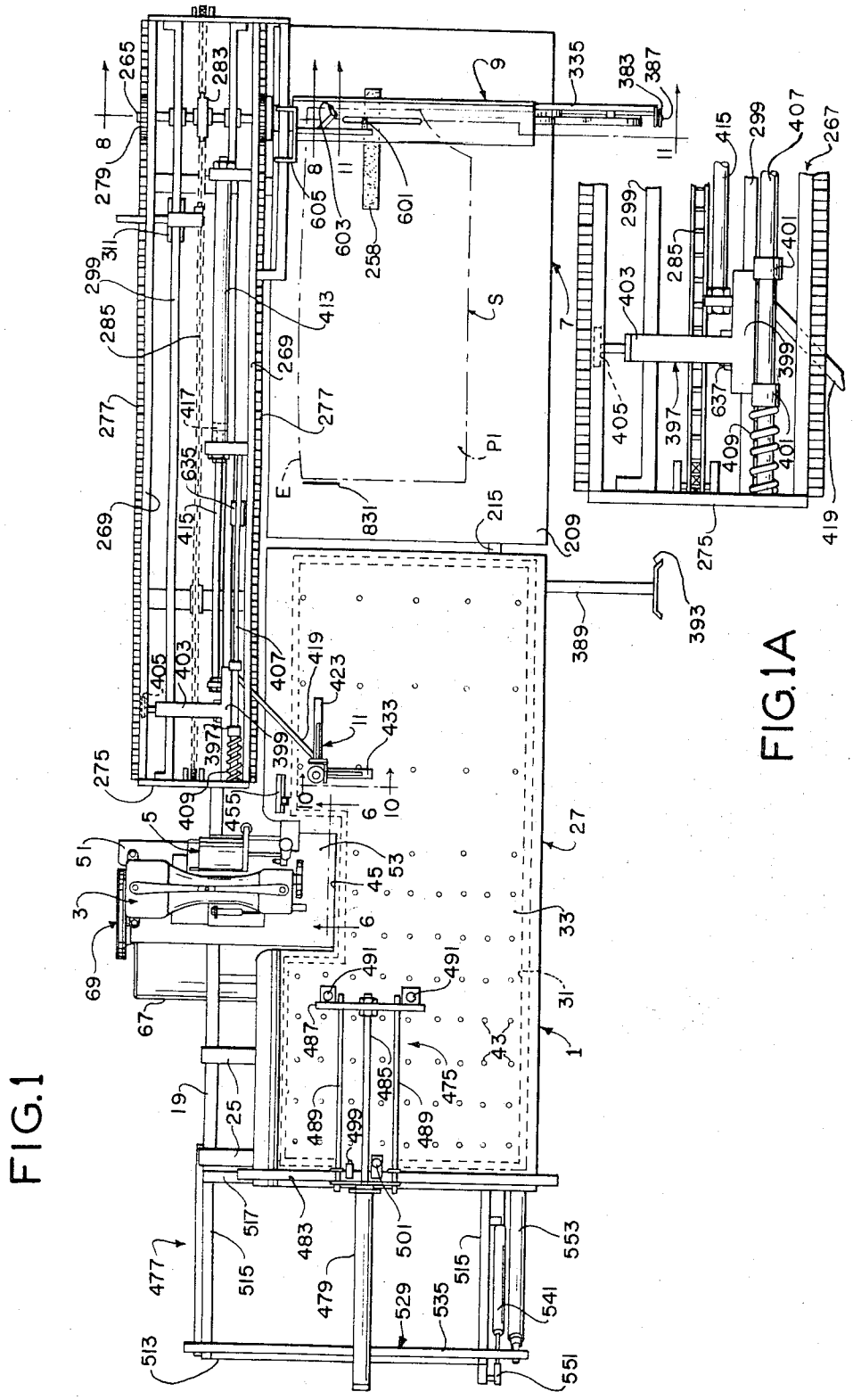


FIG.1

FIG.1A

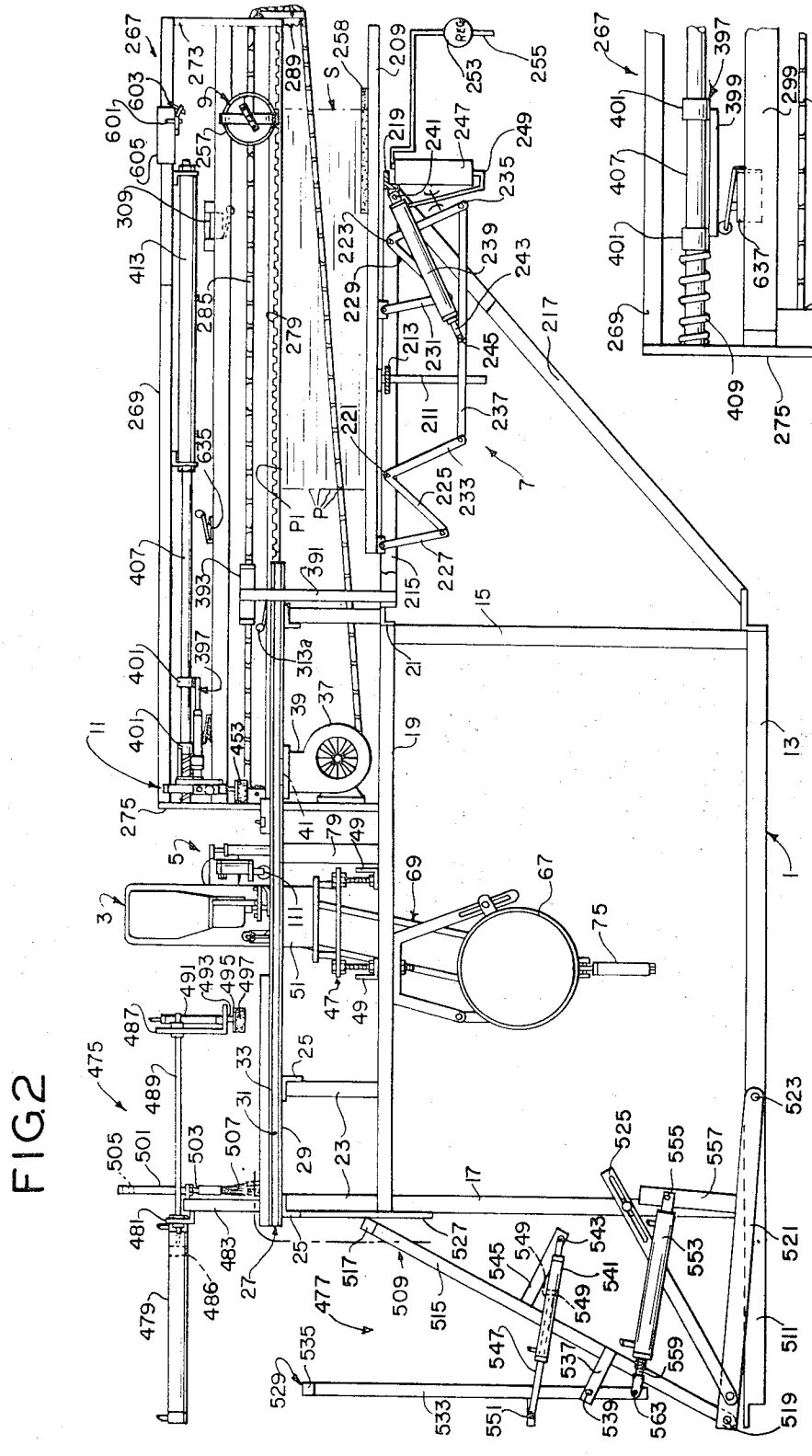


FIG2

FIG2A

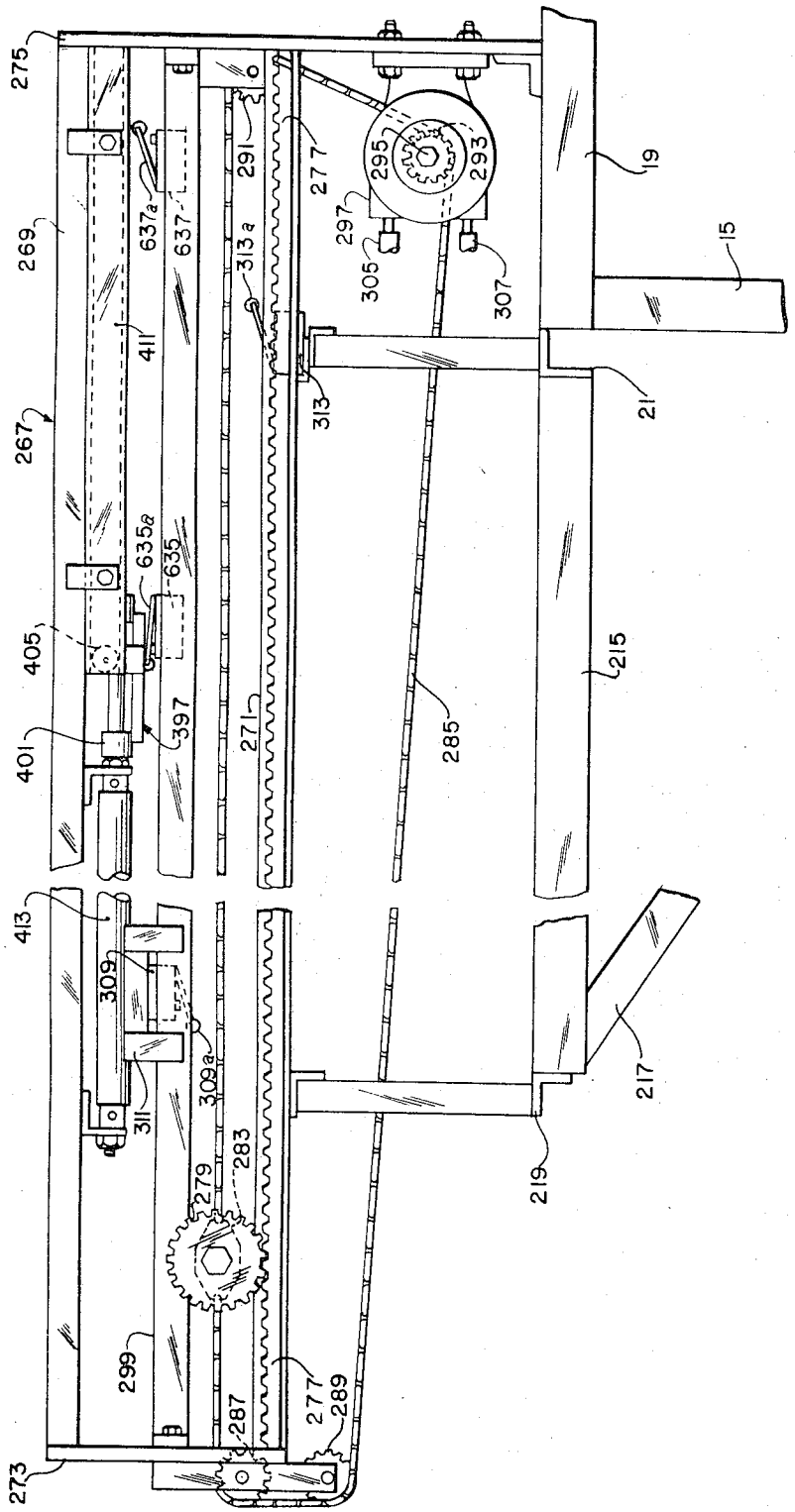

275
269
267
405
401
413
273
637a
637
291
313a
411
635a
635
397
271
277
295
293
297
305
307
313
19
15
21
285
215
309
309a
311
283
279
299
287
289
217
219

FIG.3

FIG. 4

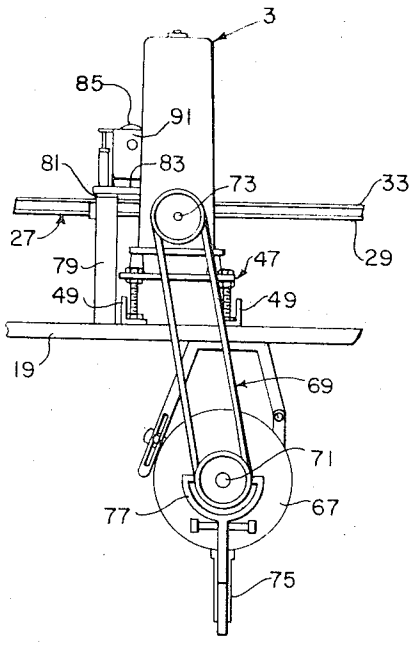

3
85
91
81
83
73
33
27
29
79
47
49
49
19
69
71
77
67
75

FIG. 5

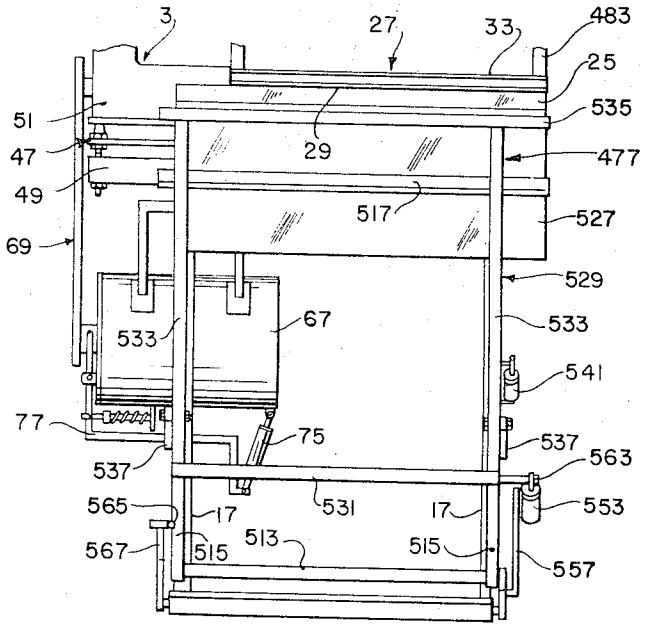

3
27
33
483
25
535
51
29
47
477
49
517
527
69
529
67
533
533
541
77
75
537
537
563
565
17
531
17
553
567
515
513
515
557

FIG. 6

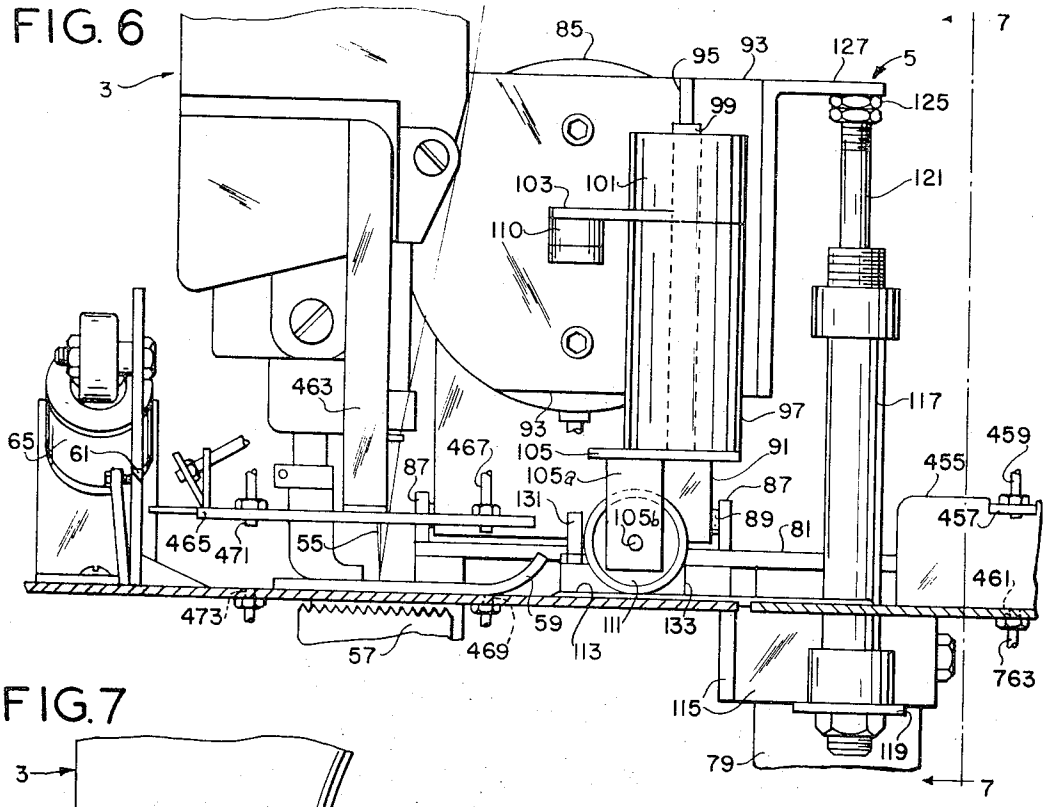

3
85
95
93
127
5
7
99
125
103
101
121
110
463
97
117
65
61
93
105
91
459
467
87
105a
87
455
131
105b
89
81
457
465
471
55
461
473
59
111
133
57
469
113
763
115
119
79

FIG. 7

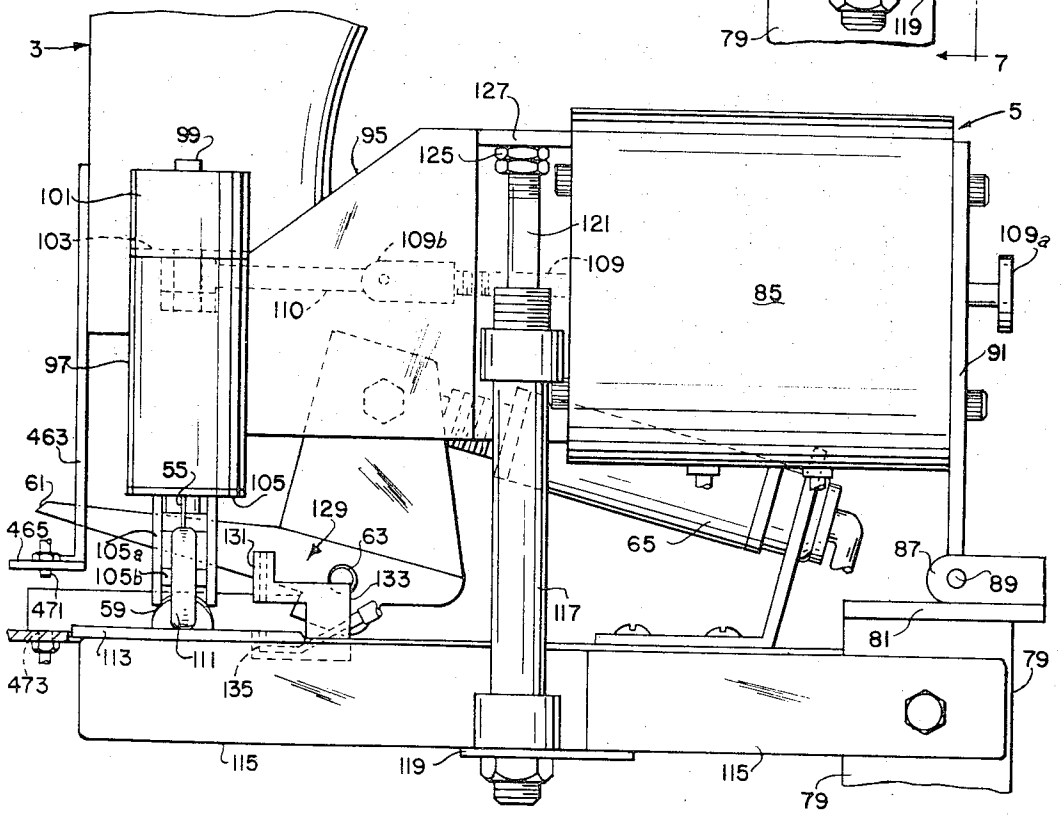
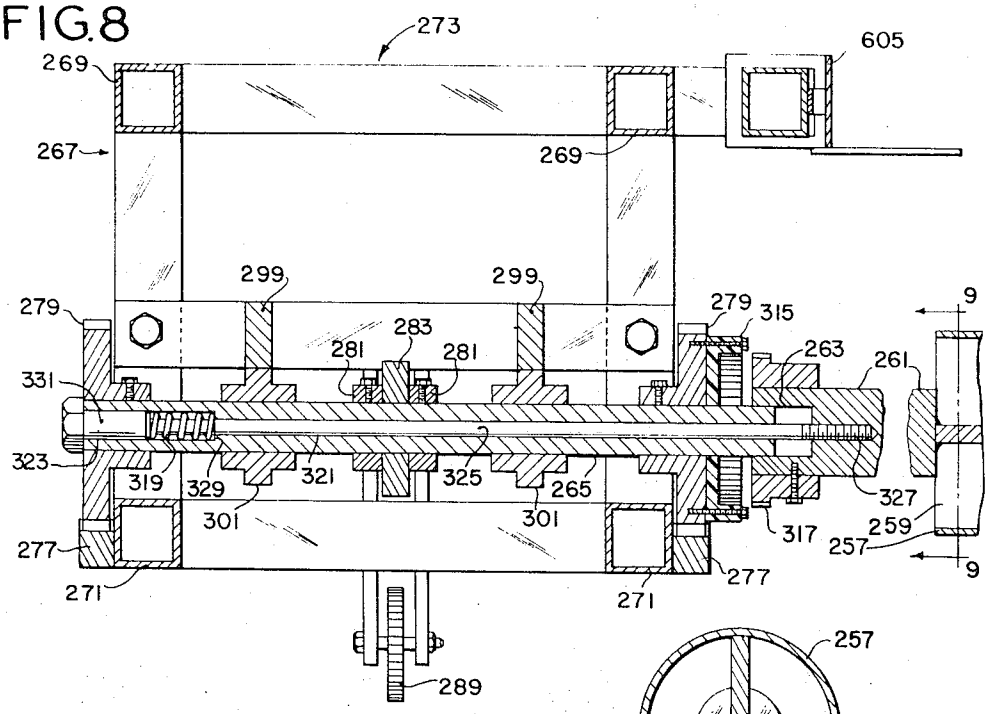

3
127
5
99
95
125
101
121
109a
103
109b
109
110
85
91
97
463
55
105
61
129
465
131
63
65
87
105a
105b
133
89
471
59
117
81
473
113
111
135
79
115
119
115
79

FIG.8



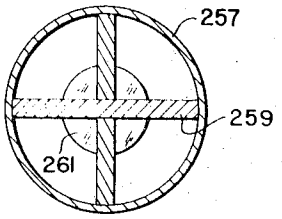
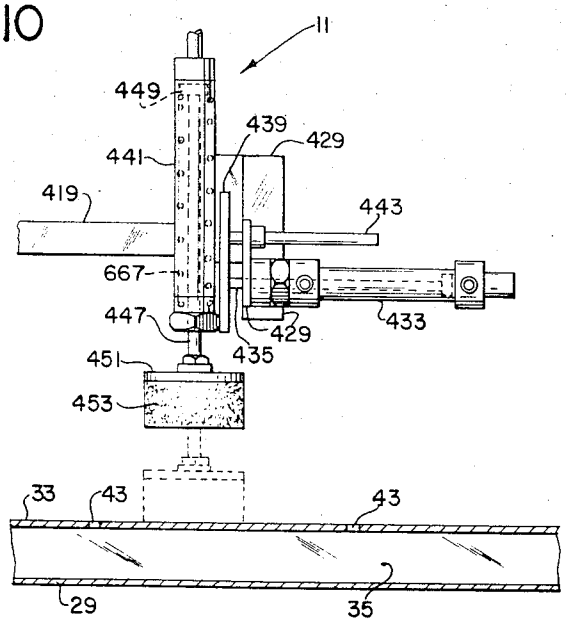


FIG. 9

FIG.10



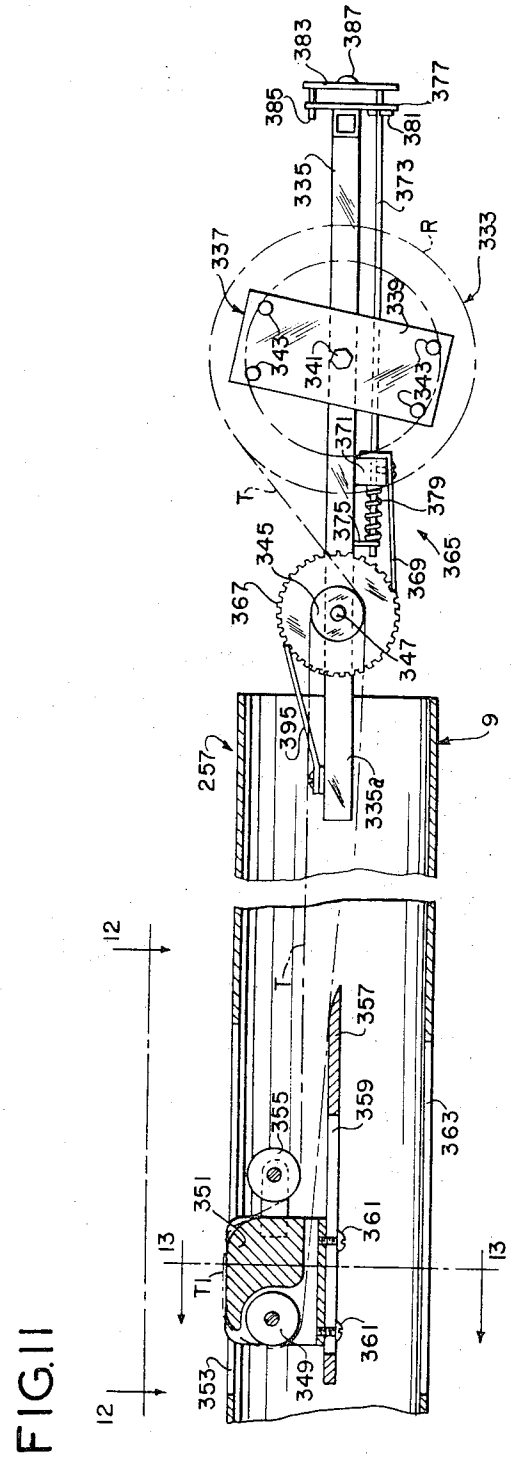


FIG.11

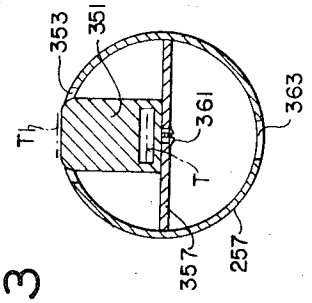


FIG.13

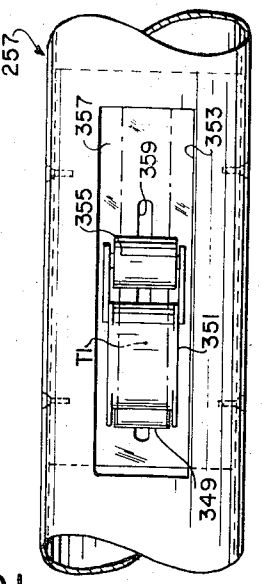


FIG.12

FIG. 14

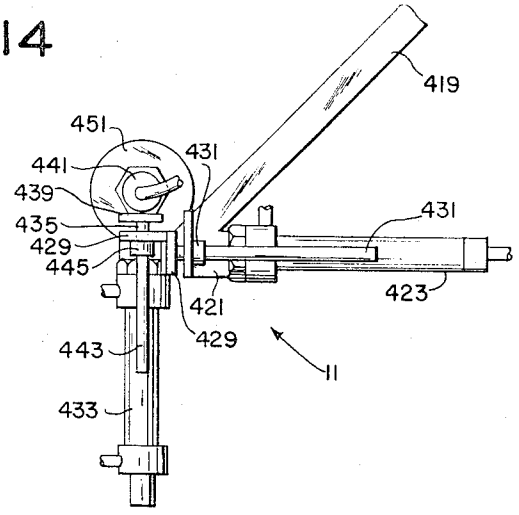

419
451
431
441
439
435
429
445
431
423
421
429
443
11
433

FIG. 15

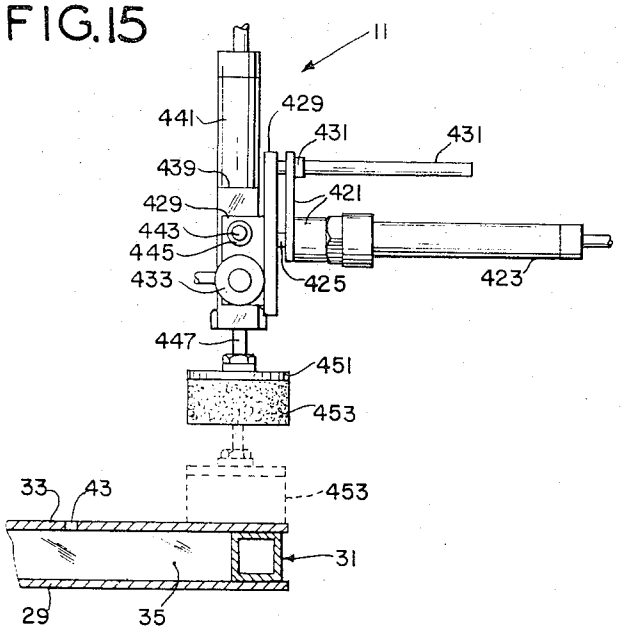

11
441
429
431
431
439
421
429
443
445
433
425
423
447
451
453
33
43
453
31
29
35

FIG.16

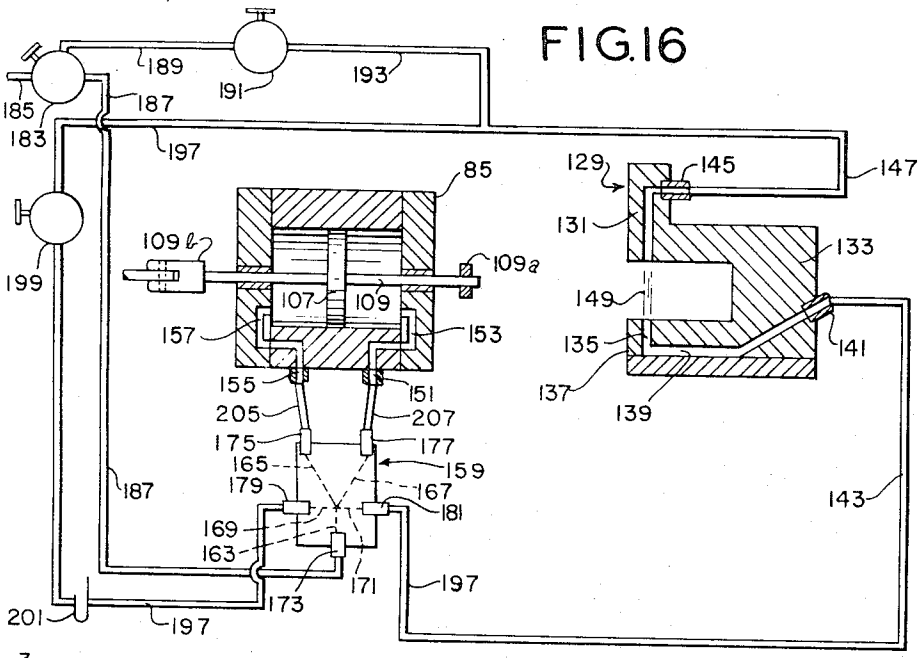


FIG.17

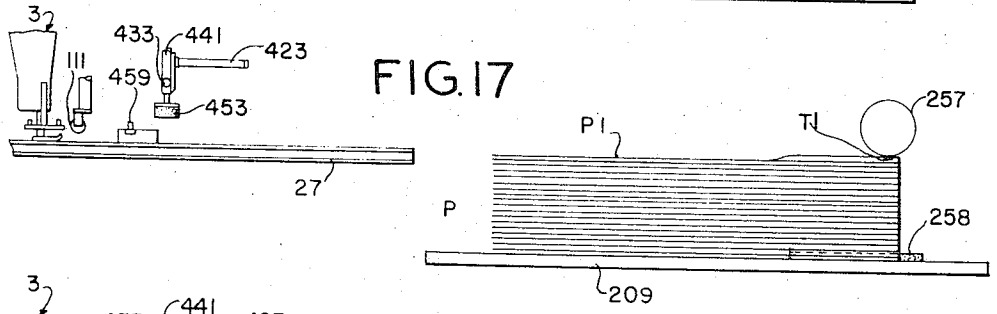


FIG.18

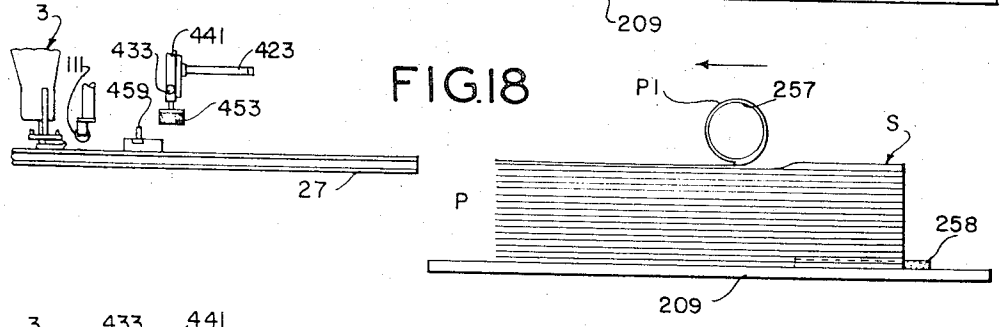


FIG.19

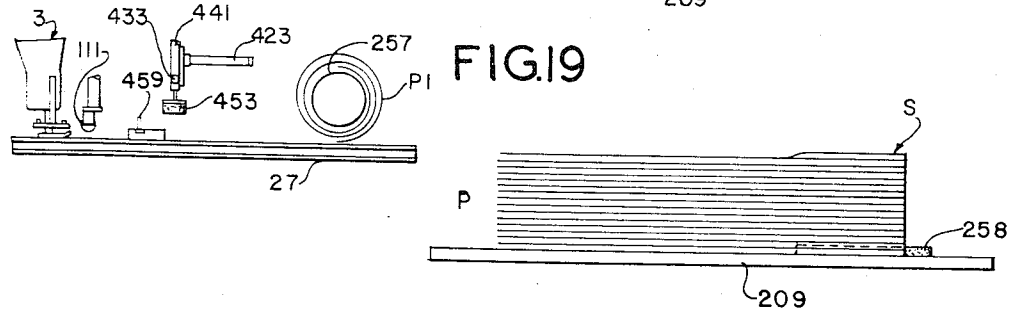


FIG.20

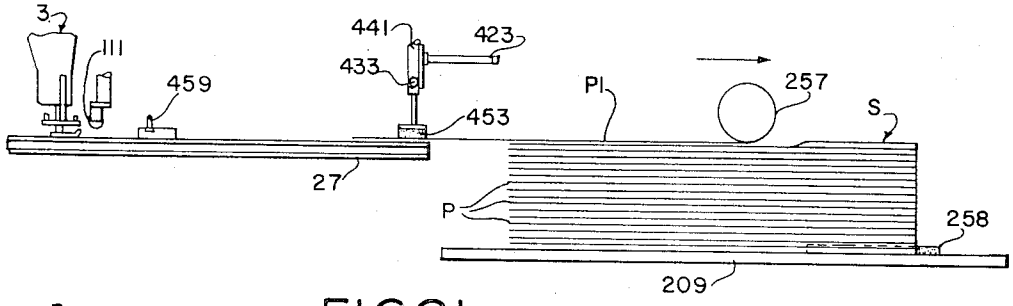


FIG.21

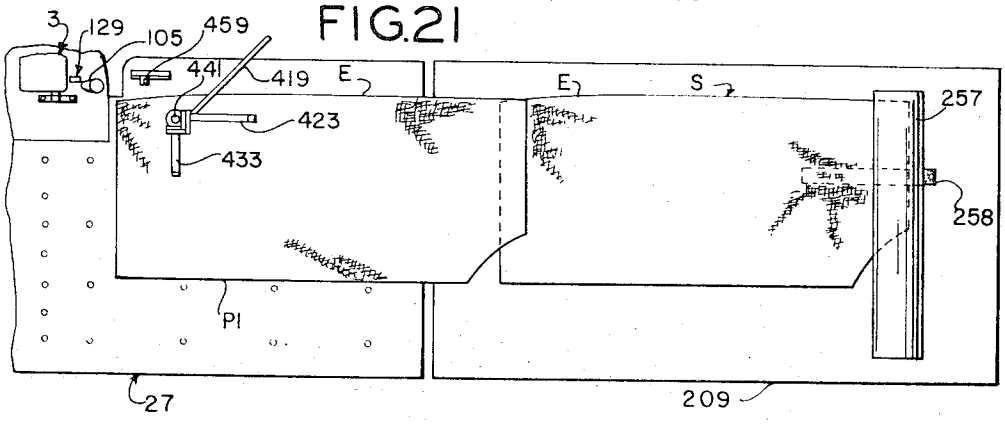


FIG.22

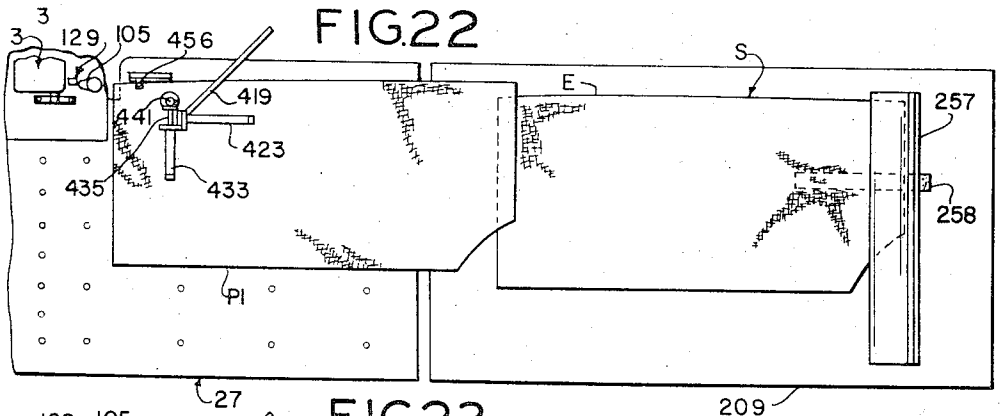
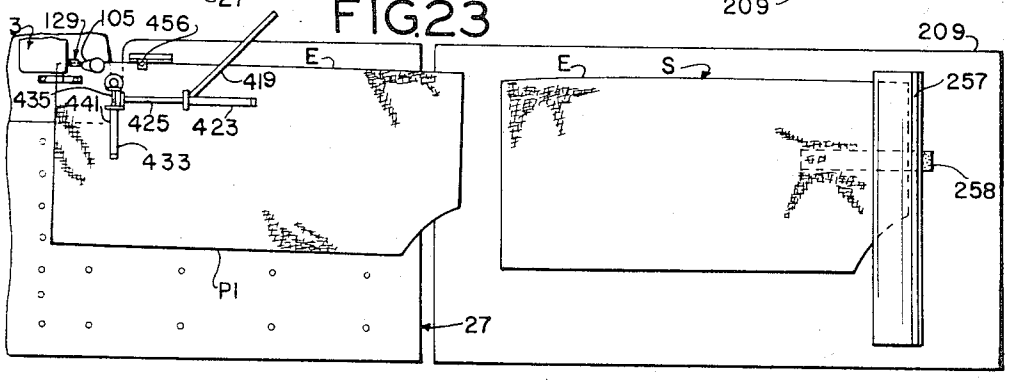


FIG.23



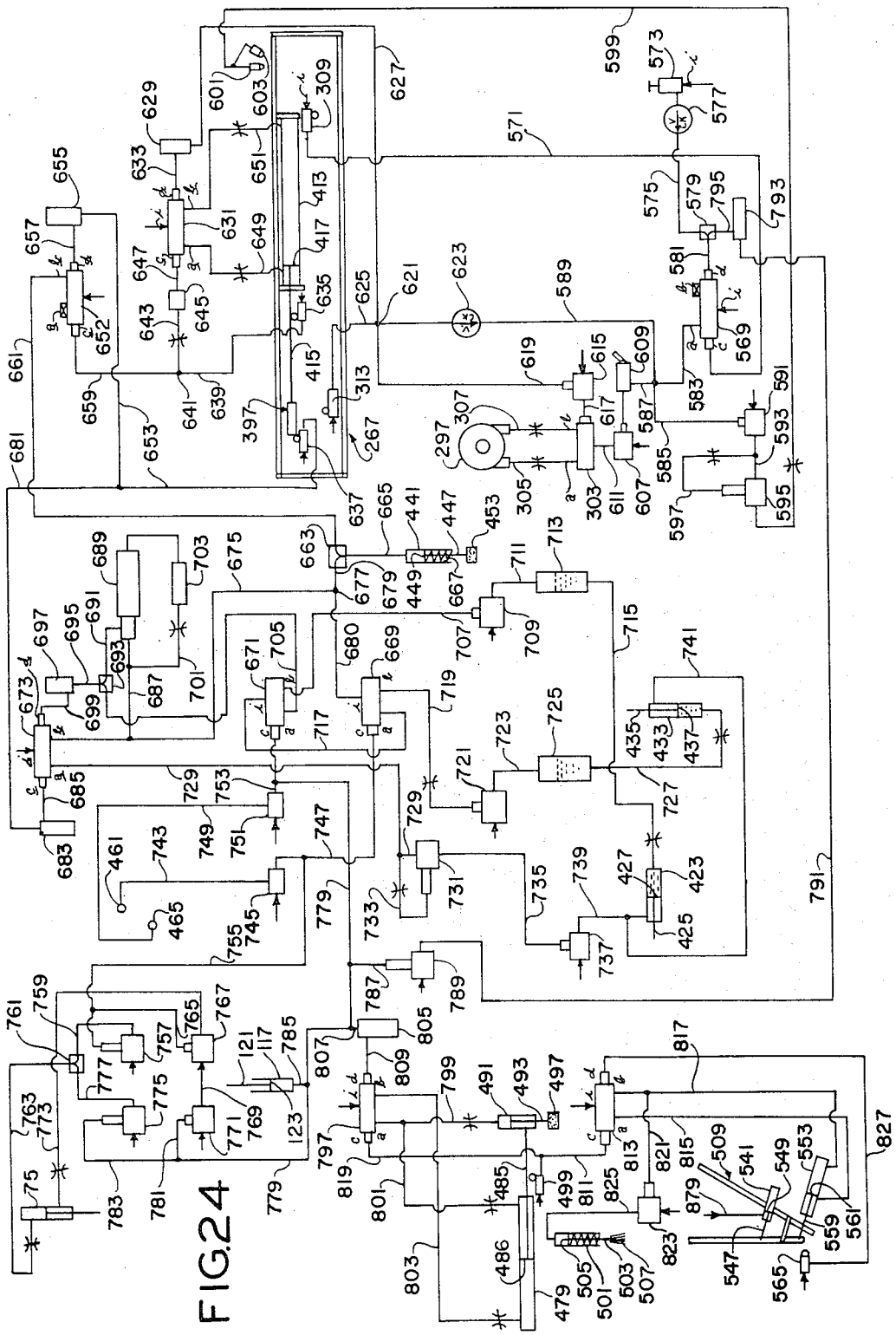


FIG24

AUTOMATIC FEEDER FOR WORKPIECE OF FABRIC OR THE LIKE

This is a division of application Ser. No. 33,378, filed Apr. 30, 1970, issued as U.S. Pat. No. 3,670,674, June 20, 1972.

BACKGROUND OF THE INVENTION

This invention relates to automatic feeders for workpieces of fabric or the like, and more particularly to apparatus for automatically feeding such workpieces one after another from a stack thereof to and through a sewing machine for a sewing operation along an edge of each workpiece.

This invention is particularly directed toward automating the sewing of workpieces of fabric or the like. Automation of sewing operations has involved problems in the separation and pick-up of a single fabric workpiece, referred to as a ply, from a stack of fabric plies, in the introduction of the ply into the sewing machine, in the control of the ply as it is fed through the sewing machine for contour stitching along an edge being sewn, and in the handling of the plies exiting from the sewing machine. Reference may be made to such U.S. Patents as Nos. 2,985,122, 3,083,961, 3,099,970, 3,168,307 and 3,168,308 for prior art of interest. Reference is also made to my prior copending U.S. Pat. application Ser. No. 738,036, filed June 18, 1968, relating to an Edge Contour Guidance Control for Pieces of Material, issued as U.S. Pat. No. 3,636,898, Jan. 25, 1972, which shows a control for contour stitching along an edge of the material being sewn utilized in conjunction with the present invention.

SUMMARY OF THE INVENTION

Among the several objects of this invention may be noted the provision of an automatic feeder for feeding workpieces of fabric or other limp material one after another from a stack thereof to and through a machine for carrying out an operation on each workpiece; the provision of such apparatus having improved means for separating and picking up the top ply of the stack (the top workpiece); the provision of such apparatus having means operable on the workpiece picked up from the stack to feed it forward to the machine in position for starting the operation of the machine on the workpiece; and the provision of apparatus such as described wherein the machine is a sewing machine for carrying out the operation of stitching along an edge of the workpiece and having means for guiding the workpiece through the machine for contour stitching along said edge.

In general, apparatus of this invention for automatically feeding workpieces of limp material one after another from a stack thereof to and through a machine, e.g., a sewing machine, for operating on the workpieces comprises a table over which workpieces may be fed to and through the machine. Means is provided adjacent the entrance end of the table for holding a stack of workpieces, and means is provided for separating and picking up the top workpiece of the stack and delivering it to the table. Further means is provided for feeding the workpiece over the table to the machine and entering it in the machine with the workpiece in position for being fed through the machine for operation thereon by the machine. The means for separating and picking up the top workpiece of the stack comprises a roller for rolling up the top workpiece, this roller being

mounted for rotation on its axis and also for translation at right angles to its axis to roll over the top workpiece, and having means for initial attachment thereto of the top workpiece so that it may be rolled up on the roller. Other objects and features will be in part apparent and in part pointed out hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan of an automatic feeder constructed in accordance with this invention;

FIG. 1A is an enlarged fragment of FIG. 1;

FIG. 2 is a front elevation of the feeder;

FIG. 2A is an enlarged fragment of FIG. 2;

FIG. 3 is a rear elevation of part of the feeder, on a larger scale than FIGS. 1 and 2, with parts broken away to reduce the length of the view, and showing a moved position of parts;

FIG. 4 is a rear elevation of another part of the feeder, on a larger scale than FIGS. 1 and 2;

FIG. 5 is a view in elevation of the left end of FIG. 1;

FIG. 6 is an enlarged vertical section on line 6 — 6 of FIG. 1;

FIG. 7 is an enlarged vertical section on line 7 — 7 of FIG. 6;

FIG. 8 is an enlarged vertical section on line 8 — 8 of FIG. 1;

FIG. 9 is a vertical section on line 9 — 9 of FIG. 8;

FIG. 10 is an enlarged view in elevation on line 10 — 10 of FIG. 1;

FIG. 11 is an enlarged section on line 11 — 11 of FIG. 1;

FIG. 12 is a view on line 12 — 12 of FIG. 11;

FIG. 13 is a section on line 13 — 13 of FIG. 11;

FIG. 14 is a plan of FIG. 10;

FIG. 15 is a front elevation of FIG. 14;

FIG. 16 is a diagrammatic view showing certain pneumatic circuitry;

FIGS. 17 – 20 are views in elevation showing certain steps in the operation of the apparatus;

FIGS. 21 – 23 are plan views showing certain steps in the operation of the apparatus; and

FIG. 24 is a pneumatic circuit diagram.

Corresponding reference characters indicate corresponding parts throughout the several views of the drawings.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings, first more particularly to FIGS. 1 and 2, apparatus made in accordance with this invention is shown to comprise a sewing machine table 1 over which a workpiece of fabric material P, which is sometimes referred to as a "ply", is to be fed to a sewing machine 3 and thence through the machine for contour stitching (e.g., overstitching or "serging") of the workpiece or ply P along one edge thereof, herein indicated as the long curved edge E of the piece of material. At 5 is generally indicated means for guiding a workpiece or ply P through the sewing machine in accordance with its edge contour to effect contour stitching of the edge, i.e., stitching along a line generally parallel to the edge. Adjacent one end of the sewing machine table 1, which may be referred to as its entry end (its right end as viewed in FIGS. 1 and 2), is means generally designated 7 for holding a pile or stack S of workpieces or plies P of fabric each of which is to be individ-

ually contour-stitched along its edge E, this means being adapted to maintain the top ply of the stack (this top ply being specially designated P1) generally in a predetermined plane as plies are separated from and picked up off the top of the stack, one-by-one. This plane is generally the plane of the top of the sewing machine table **1.** At **9** is generally indicated means for separating and picking up the top ply **P1** off the stack S and delivering it to the sewing machine table, and at **11** is generally indicated means for feeding the ply of material which has been delivered to the table **1** by means **9** over the table and entering its leading end at edge E into the sewing machine in position for contour stitching of said edge. Once entered into the sewing machine, the piece of material is fed forward through the machine by the conventional feed mechanism of the machine under the guidance control of means **5** for contour stitching of edge E.

The sewing machine table **1** comprises a base **13,** legs such as indicated at **15** extending up from the base at one end thereof constituting what may be referred to as its entrance end, and legs such as indicated at **17** extending up from the base adjacent its other end, which may be referred to as its exit end. Side rails such as indicated at **19** and end rails such as indicated at **21** extend between the upper ends of the legs. Extending up from the side rails **19** are additional short legs **23** spanned by transversely extending angle irons such as indicated at **25** supporting the table top, which is generally designated **27.** The table top is of hollow construction, comprising a generally rectangular bottom plate **29,** an open generally rectangular frame **31** extending around the margin of the bottom plate on the top thereof, and a generally rectangular top plate **33** on the frame spaced from the bottom plate so as to provide a plenum chamber **35** (see FIG. **10**) between the plates. A blower **37** is mounted below the table top, having its outlet **39** secured to the bottom plate **29** around an opening **41** in the bottom plate, so that it is adapted to blow air into the plenum **35.** The top plate **33** has a plurality of perforations, such as indicated at **43,** for exit of air from the plenum. In the operation of the apparatus, the blower **37** is continuously operated for blowing air upward through the perforations **43** to cause a workpiece or ply P being fed over the table top **27** in effect to "float" on the table top for easy low-friction movement over the table top.

The table top **27** has a generally rectangular cutout **45** in one side thereof which may be referred to as its rearward side. The sewing machine **3** is mounted as indicated at **47** on a pair of horizontal angle irons **49** which span the side rails **19** of the table **1** and which are cantilevered outward beyond the rear of the table from the rear side rail **19** with the front end of the bed **51** of the sewing machine received in the cutout **45** of the table and with the horizontal top surface of the bed **51** of the sewing machine generally flush with the top surface of the table top **27** (i.e., the table top plate **33**). The work plate of the sewing machine is indicated at **53;** the needle of the sewing machine is indicated at **55;** the feed device of the sewing machine is indicated at **57;** and the presser foot of the sewing machine is indicated at **59.** On the exit side of the needle is a cutter **61** (see FIG. **7**) pivoted at **63** on the bed of the machine and operable by an air cylinder **65.**

At **67** is indicated an electric motor for driving the sewing machine via a conventional clutch and brake mechanism (not shown) and a belt and pulley drive **69** between the output shaft **71** of the clutch and brake mechanism and the input shaft **73** of the sewing machine. In the operation of the apparatus, the electric motor operates continuously, and the clutch is engaged with attendant release of the brake to start the sewing machine for a sewing operation on a piece of fabric entered into the sewing machine, and the clutch is disengaged with attendant engagement of the brake to stop the sewing machine when the sewing operation has been completed. Actuation of the clutch and brake mechanism is via an air cylinder **75** operating a shifter fork **77.**

The means **5** for guiding a workpiece through the machine for contour stitching of the edge of the workpiece is similar to the edge contour guide system shown in my aforesaid copending U.S. application Ser. No. 738,036. It is located at the entrance side of the sewing machine **3** and comprises a post **79** extending up from the back side rail **19** of the table **1.** Extending back from the top of this post is a platform **81** on the rearward end of which is mounted a bracket **83** for pivotally supporting an air cylinder **85.**

The bracket includes a pair of arms **87** extending horizontally in the direction toward the front of the apparatus and having a pivot pin **89** extending horizontally between the arms at their front ends, this pin being generally at right angles to and slightly above the bed **51** of the sewing machine. A hinge plate **91** is hinged at its lower end on the pin **89.** The air cylinder **85** has its back end secured to the hinge plate **91** and extends therefrom in the direction toward the front of the apparatus.

Mounted on the front end of the air cylinder **85** is a bracket **93** having a leg **95** extending in the direction toward the front of the apparatus and carrying at its front end a vertical sleeve **97.** Rotatable in this sleeve is a shaft **99** having a collar **101** secured on its upper end at the top of the sleeve having a radial arm **103,** and a radial arm **105** constituting a wheel carrier secured on its lower end at the lower end of the sleeve. The cylinder has a piston **107** slidable therein having a piston rod **109** extending out through openings in the front end head of the cylinder and the rear end head of the cylinder. On the rear end of the piston rod is a collar **109*a*** serving as a stop with respect to frontward movement of the piston rod. On the front end of the piston rod is a clevis **109*b*** the rear end of which serves as a stop with respect to rearward movement of the piston rod, with a link **110** having a pin connection with the clevis and a pin connection with the radial crank arm **103** on the upper end of the shaft **99.** The wheel carrier arm **105** extends in the direction toward the sewing machine from the lower end of shaft **99** and has an inverted U-shaped yoke **105*a*** extending downward therefrom adjacent its foward end with a shaft **105*b*** extending between the lower ends of the sides of this yoke carrying a guide wheel **111.**

The cylinder **85,** carrying the bracket **93** and the wheel **111,** is adapted to swing down by gravity on the axis of pivot pin **89** to a lowered operative position determined by engagement of the wheel **111** with a horizontal bed plate **113** on the front end of an arm **115** which extends toward the front of the apparatus from the post **79.** The bed plate **113** is accommodated in the cutout **45** of the table top **27,** and is generally flush with the top plate **33** of the table top. The cylinder **85** is

adapted to be swung upward from its stated lowered position to lift the wheel 111 upward away from the bed plate 113 by a vertically extending air cylinder 117 having its lower end mounted as indicated at 119 on the arm 115. A piston rod 121 extends upward from a piston 123 in the cylinder and has a nut 125 adjustably threaded on its upper end engageable by an ear 127 at the top of the bracket 93, the arrangement being such that on upward movement of the piston rod 119 from its lowered retracted position of FIG. 7, the cylinder 85 is swung upward to lift the wheel 111 off the bed plate 113.

For operating the guide wheel 111 for automatic shifting of the fabric ply being fed through the sewing machine 3 in accordance with the contour of its edge E which is to be stitched, there is provided a pneumatic edge sensor for the ply, indicated generally at 129, and comprising an air nozzle 131 on a C-shaped bracket 133 on the work plate 53 of the sewing machine positioned to direct a continuous stream of air downward toward a vertical air inlet hole 135 in the base 137 of the C-shaped bracket. This hole intersects a hole 139 in the base and a nipple 141 is provided on the back of the base in communication with hole 139 for attachment of an air line 143. Nozzle 131 has a lateral nipple 145 for attachment of an air supply line 147. The lower end of the nozzle is spaced from the top surface of the base 137 of the bracket 133, the gap therebetween being indicated at 149. This gap is dimensioned for free passage therethrough of a piece of material being stitched by the sewing machine. The nozzle 131 (and the air inlet hole 135 aligned with the nozzle) are located closely adjacent the guide wheel 111 and in the region between the guide wheel and the needle of the sewing machine, and laterally offset toward the rear of the apparatus from the vertical longitudinal plane of the apparatus through the needle of the sewing machine a distance corresponding to the desired spacing for the stitching from edge E of the ply of material.

Air cylinder 85 operates in response to the edge sensor 129 to control the guide wheel 111 for guiding the ply of material being fed through the sewing machine by its feed means 57 in accordance with the contour of the edge E of the ply of material. Air cylinder 85 has a port 151 connected by passaging 153 to its rear end and a port 155 connected by passaging 157 to its front end. Supply of air to these ports is controlled by an air proportioning device 159 which is in turn under control of the edge sensor 129 (see FIG. 16). The air proportioning device 159 is of a type available from Corning Glass Works, of Corning, N.Y., essentially comprising a relatively thin generally rectangular body 161 having an air inlet passage 163, two air outlet passages 165 and 167, and two control passages 169 and 171. A nipple 173 is provided for connection of an air line to the inlet passage 163, nipples 175 and 177 are provided for connection of air lines to the outlet passages 165 and 167, and nipples 179 and 181 are provided for connection of air lines to the control passages 169 and 171. The passaging in the body is such that, with air under pressure supplied through the inlet passage 163, and with air at equal pressure supplied through the control passages 169 and 171, the air input is equally proportioned between outlet passages 165 and 167, so that the air output of each of the outlet passages 165 and 167 is equal. If pressure of air supplied through control passage 169 becomes higher than pressure of air supplied through control passage 171, then the device automatically functions to proportion the output according to the control pressures, i.e., to increase the pressure of air delivered through outlet passage 167 and decrease the pressure of air delivered through outlet passage 165. Conversely, if pressure of air supplied through control passage 171 becomes higher than pressure of air supplied through control passage 169, then the device functions automatically to increase the pressure of air supplied through outlet passage 165 and decrease the pressure of air supplied through outlet passage 167.

Referring to FIG. 16, there is indicated at 183 a pressure regulator to an inlet of which is connected an air line 185 leading from a source of compressed air (e.g., at 40 psi). Regulator 183 is adapted to drop the supply pressure to 5 psi, for example. An air supply line 187 extends from an outlet of regulator 183 to the inlet 173 of the air proportioning device 159. An air line 189 is shown as extending from another outlet of regulator to the inlet of another pressure regulator 191, which is adapted further to drop the pressure (e.g., to 2 ¼ psi). An air line 193 extends from the outlet of regulator 191, and has branch air line connections 147 and 197, respectively, with nozzle 131 and with nipple 179 for control passage 169 of the air proportioning device 159. Line 147 supplies air to nozzle 131. Line 197 has a flow regulator 199 and an air gap 201 therein. Air line 143 interconnects inlet 135 via nipple 141 with nipple 181 for control passage 171 of the air porportioning device 159. Line 197 maintains a control pressure (e.g., 1½ psi) in control passage 169 of device 159, the air gap 201 reducing surging in line 197. Pressure in control passage 171 varies in accordance with the extent of the opening or closing of the inlet 135 by the edge E of the ply of material, via line 143. Nipples 175 and 177 of air outlet passages 165 and 167 of device 159 are connected to ports 155 and 151 of cylinder 85 as indicated at 205 and 207.

The means 7 for holding the pile or stack S of plies P of material at the rearward end of the sewing machine table 1 comprises a vertically movable elevator platform 209 adapted to hold the stack, and biased to move relatively slowly upward as plies are picked up off the stack to maintain the top ply P1 of the stack generally in the plane of the top 27 of the sewing machine table 1. This elevator platform 209 is guided for vertical movement by means of a pair of guide rods such as indicated at 211 extending downward from the platform through guide holes in a crossbar 213 spanning a pair of fixed horizontal side rails 25 which extend rearward from the rearward end rail 21 of the sewing machine table 1. The rails 215 are supported at thier outer ends by a pair of inclined braces 217 joined at their rearward upper ends to a crossbar 219. Shafts 211 and 223 are journalled at their ends in the side rails 215. Shaft 221 has a pair of arms 225 extending radially therefrom having their outer ends connected by links 227 to the platform 209. Shaft 223 has a single arm 229 extending radially therefrom connected by a link 231 to the platform. Crank arms 233 and 235 extending from shafts 221 and 223, respectively, have their outer ends connected together by a link 237. A cylinder 239 is pivotally connected at its rearward end as indicated at 241 to the crossbar 219. A piston rod 243 extends from a piston in the cylinder through the foward end of the cylinder to a pin connection at 245 with the link 237. An oil reservoir 247 is mounted on the crossbar

219, the lowr end of this reservoir being in communication with the rearward end of cylinder 239 via an oil line 249 having a flow control therein for controlling the rate of flow of oil from the reservoir to the cylinder for controlling the rate of speed of rise of the platform. The upper end of the reservoir is supplied with compressed air from a suitable source (not shown) via a pressure regulator 253 and an air line 255. Compressed air under regulated pressure is maintained in the reservoir 247 on top of the oil therein to maintain the oil in the cylinder 239 under pressure for a constant upward bias of the platform 209 via the piston rod 243, link 237, crank arms 233 and 225, 235, and 229, and links 227 and 231. Upward movement of the platform is limited, as will appear, by engagement of the top of the stack S of plies of material on the platform with the bottom of a roller or reel 257 of the means 9 for separating and picking up the top ply P1 of material from the stack S. Extending lengthwise on top of the platform is a strip of foam rubber 258, forming a ridge for humping up the stack S at its trailing end.

The roller or reel 257 comprises an elongate hollow cylinder having one end thereof (its back end) secured on a spider 259 at the front end of a roller-supporting quill 261. The quil l has an axial bore 263 extending frontward from its back end receiving the front end of a quill-supporting shaft 265 with a sliding fit therebetween so that the quill 261 is axially slidable on the front end portion of shaft 265.

An auxiliary frame generally designated 257 (see FIGS. 1–3 and 8) extends longitudinally of the apparatus in back of the elevator platform 209 and partly in back of the sewing machine table 1 at level just above the top of table 1. This frame includes a pair of upper longitudinal bars each designated 269 and a pair of lower longitudinal bars 271 extending between frame ends indicated at 273 and 275. The lower bars 271 are located aproximately in the same horizontal plane as the table top 27, and each has secured on its outside face a rack 277. These racks extend generally the full length of the bars 269 with their teeth in a plane slightly above the plane of the top surface of the table top 27.

The shaft 265 (which supports the roller 257) has a pair of pinions each designated 279 keyed thereon meshing with and rolling on the racks 277. Shaft 276 has a pair of collars 281 secured thereon on opposite sides of a chain fastener member 283 mounted on the shaft 265, the shaft extending through and being rotatable in a central hole in this member. 283 at oppostie sides of the shaft 265 and extends A roller chain 285 has its ends connected to member 283 at opposite sides of the shaft 265 and extends around a pair of idler sprockets 287 and 289 at the outbaord end 273 of the frame 267, an idler sprocket 291 at the inboard end 275 of the frame 267, and a drive sprocket 293 on the output shaft 295 of a reversible air-operated rotary motor 297. The arrangement is such that, on operation of the air motor to rotate the shaft 295 in one direction which may be referred to as the forward or advance direction the chain 285 is moved in the direction for moving the shaft 265 forward, pinions 279 then rolling in counterclockwise direction as viewed from the front on the racks 277 and rotating the shaft 265, as it translates forward, in counterclockwise direction as viewed from the front. On operation of the air motor 297 to rotate the shaft 295 in reverse direction, the chain 295 is moved in reverse dirction thereby to move the shaft 265 back toward the outboard end 273 of the frame 267 with accompanying rotation of the pinions 279 and the shaft 265 in reverse direction (clockwise as viewed from the front of the apparatus). The pinsions 279 are held down in mesh with the racks by means of a pair of rails 299 extending longitudinally of the frame 267 above the shaft 265 on opposite sides of the chain fastener member 283, these rails engaging rollers 301 on the shaft 265.

An air-operated reversing valve for the air motor 297 is indicated at 303 (see FIG. 24). This is adapted to supply compressed air to motor 297 either via line 305 for operation of the motor in forward direction or via line 307 for operation of the motor in reverse direction. The valve is under control of a rearward pilot valve 309 carried by a bracket 311 adjustable mounted on the back rail 299 and a forward pilot valve 313 mounted in fixed position between the lower bars 271. These pilot valves have trip arms indicated at 309*a* and 313*a* engageable by the chain fastener member 283, with the arrangement such that when shaft 265 is moved forward by the chain 285 (i.e., in the direction toward the table 1), member 283 ultimately engages the trip arm 313*a* of pilot valve 313 to actuate this valve and hence to actuate reversing valve 303 to reverse the air motor 297 to cause the chain to reverse and return the shaft 265 rearward, and, as it returns, member 283 engages the trip arm 309*a* of pilot valve 309 to actuate this valve to stop the motor 297 with an overrun so that roller 257 reaches its retracted position. Valve 309 is a type which is tripped only on the rearward stroke of member 283, not on its forward stroke.

As previously mentioned, the quill 261 is axially slidable on the front end portion of shaft 265 which projects frontward beyond the front pinion 279. Secured on the front face of the front pinion 279 concentric therewith is an internal ring gear 315. The quill has a spur gear 317 on its back end, and the assembly of the quill and roller is biased in the direction toward the back of the apparatus to an operative position wherein the spur gear 317 is within and in mesh with the ring gear 315 by a compression spring 319. The shaft 265 has an axial bore 321 with an enlarged-diameter back end section 323. A rod 325 has its fron end threaded axially in the back end of the quill as indicated at 327 and extends back through the bore 321 in the shaft with a sliding fit therein. Spring 319 surrounds the rod 325 in the enlarged section 323 of the bore in the shaft 265 and reacts from the shoulder 329 at the inner end of section 323 against a head 331 on the back end of rod 325 to bias the quill/roller assembly in the direction toward the back of the apparatus.

Associated with the roller 257 is a pressure-sensitive tape system generally designated 333 providing for removable attachment of the top ply of material P1 to the roller as the roller moves forward in translation and simultaneously rotates in wind-up direction (counterclockwise as viewed from the front of the apparatus) to cause the top ply of material to become rolled up on the roller. This pressure-sensitive tape system comprises a bar 335 extending out of the front end of the roller 257, having its inner end 335*a* secured to the inside of the annular wall of the roller. Mounted on this bar between the front end of the roller and the front end of the bar is a holder 337 for a roll R of pressure-sensitive adhesive tape T. The holder comprises a plate 339 rotatable on a pin 341 extending from the bar 335

having four pins 343 extending from the face of the plate for mounting the roll R thereon. A tape take-up roller 345 is rotatable on a pin 347 extending from the bar 335 between the front end of the roller 257 and the holder 337. The tape T extends from the supply roll R around the take-up roller 345 and into the roller 257, thence out and around a guide roll 349 and back over a shoe 351 which projects out slightly from the roller 257 through a slot 353 therein, thence in and around a guide roll 355 to the take-up roller. The shoe 351 is adjustable axially of the roller along a diametrical partition 357 in the roller 257, this partition having an axial slot 359 receiving screws 361 extending through the slot 359 and threaded in tapped holes in the base of the shoe 351. The screws 361 are accessible via a slot 326 in the roller 257 diamemtricaly opposite slot 353.

A pawl and ratchet mechanism for rotating the take-up roller is indicated generally at 365. This comprises a ratchet 367 on the end of the take-up roller 345 adjacent the bar 335 and a driving pawl 369 for this ratchet. Pawl 369 is a leaf spring member extending from a block 371 secured on a rod 373 mounted for sliding movement parallel to the bar 335 in inboard and outboard apertured guides 375 and 377 on the bar. A spring 379 reacting from the inboard guide 375 against the block 371 biases the rod 373 to slide outwardly to a retracted position determined by engagement of a cotter pin 381 in the rod with the outboard guide 377. A yoke 383 secured on the outer end of the rod has a guide pin 385 parallel to the rod extending through guide 377 at the end of bar 335. The yoke has a follower button 387 constituted by the head of a screw for cam actuation of the yoke and pawl-carrying rod 373. An arm 389 extending forward from the table structure 1 has a post 391 extending up from its outer end carrying a fixed cam 393 for actuating the button 387 on the yoke 383 to drive the rod 373 and the drive pawl 369 inward on forward movement of the roller 257 thereby to ratchet the take-up roller 345 one step forward to take up an increment of the tape T so as to advance a fresh part of the tape into position over the shoe 351. A holding pawl for the ratchet 367 is indicated at 395.

The means 11 for feeding the ply of material delivered to the table by the means 9 (which includes roller 257) comprises a carriage generally designated 397 slidable longitudinally in the frame 267. This carriage comprises a bar 399 extending longitudinally of the frame 267 having a pair of guide eyes 401 thereon at its ends and a bar 403 extending transversely back from bar 399 having a guide roller 405 at its back end. The guide eyes 401 receive and are slidable on a rod 407 extending longitudinally of the frame 267 under the upper front bar 269 of the frame. A coil compression spring 409 serving as a bumper is mounted on rod 407 at its forward end. Roller 405 rides in a channel track 411 on the bottom of an upper back bar 269 of the frame 267. The carriage 397 is adapted for reciprocation longitudinally of the frame 267 between the advanced position in which it appears in FIG. 1 and the rear retracted position in which it appears in FIG. 3 by a relatively long air cylinder 413 mounted in the frame having a piston rod 415 extending through the forward end of the cylinder from a piston 417 therein to a connection with the carriage 397.

An arm 419 extends forward from the carriage over the sewing machine table top 27 at an acute angle to the axis of the guide rod 407 for the carriage. At the free end (the forward end) of this arm is a bracket 421. An air cylinder 423 has one end (its forward end) secured to this bracket and extends horizontally rearward therefrom. A piston rod 425 extends forward from a piston 427 in this cylinder through the bracket 421 and has a vertical crosshead 429 on its forward end. A guide rod 431 extends rearward from the crosshead 429 through a guide 431 in the bracket 421 having a sliding fit therein. An air cylinder 433 has one end (its back end) secured to the crosshead 429 adjacent the lower end of the crosshead and extends horizontally toward the front of the apparatus therefrom. A piston rod 435 extends toward the back of the apparatus from a piston 437 in cylinder 433 and has a vertical crosshead 439 on its back end carrying a vertical air cylinder 441. A guide pin 443 extends toward the front from crosshead 439 through a guide 445 in crosshead 429, having a sliding fit therein. A piston rod 447 extends down from a piston 449 in cylinder 441 through the lower end of this cylinder and has a disk 451 on its lower end carrying a circular pad 453 of soft sponge material (e.g., sponge rubber) constituting a gripper. Cylinder 441 is a spring return cylinder.

On top of the sewing machine table 1 immediately rearward of the cutout 45 and adjacent the back side of the table is a bracket 455 having an upper ear 457 extending toward the front over the table, and mounted in this ear is a jet sensor nozzle 459 adapted to blow air downwardly toward an air inlet hole 461 in the top plate 33 of the table top 27 aligned with the nozzle. This nozzle 459 and the air inlet hole 461 constitute a sensor for sensing lateral movement of a ply of fabric over the table top in the direction toward the back of the apparatus to a position from which the ply is adapted to be fed forward into the sewing machine, and for effecting actuation of cylinder 75 to engage the clutch (and disengage the brake) of the sewing machine drive to start the sewing machine, also for effecting actuation of cylinder 413 as will appear.

A bracket 463 mounted at the front end of the sewing machine 3 has a horizontal flange 465 extending in the direction toward the front of the apparatus above the work plate 53 of the sewing machine. A jet sensor nozzle 467 is mounted in this flange adjacent its trailing end adapted to blow air downwardly toward an air inlet hole 469 in the work plate 53. This nozzle 467 and the air inlet hole 469 constitute a sensor for effecting deactuation of cylinder 117 to lower the guide wheel 111, deactuation of cylinders 423, 433, and 441 to retract the pad 453 (in three directions), deactuation of cylinder 75 to stop the sewing machine when a ply of fabric has been fed through the machine and stitched, and also controlling operation of a stacker. Another jet sensor nozzle 471 is mounted in flange 465 adjacent its leading end adapted to blow air downwardly toward another air inlet hole 473 in plate 53. This nozzle 471 and inlet hole 473 constitute a sensor for controlling operation of the cylinder 65 for operating the cutter 61. This operation is by means of a conventional pneumatic circuit adapted to operate the cylinder to drive the cutter through a cutting stroke when the trailing edge of a ply of fabric fed through the sewing machine exits from the machine, and then to retract the cutter.

Means indicated generally at 475 is provided at the exit end of the apparatus for feeding a ply of material which has been stitched by the sewing machine forward over the exit end of the top 27 of the sewing machine

table 1 to present it to a stacking means indicated generally at **477.** The feeding means **475** and the stacking means are fully described in the aforesaid U.S. Pat. No. 3,670,674, and the same reference numerals as used in said patent for parts of these means appear in the drawings of this application.

Referring to FIG. **24,** there is indicated at **569** a valve having an inlet *i* supplied with compressed air from a suitable source as indicated by the arrow and having two ports *a* and *b* and two air-operated actuators *c* and *d*. Port *b* is blocked. When actuator *c* is actuated by air, it shifts the valve to direct air from inlet *i* to port *b*, which is blocked. When actuator *d* is actuated by air, it shifts the valve to direct air from inlet *i* through port *a*. Pilot valve **309** is a normally closed valve having an inlet *i* supplied with compressed air, from the soruce as indicated by the arrow, with a line **571** interconnecting its outlet and actuator *c* of valve **569.** A normally closed manual on-off start valve **573** has its inlet *i* supplied with compressed air from the source and its outlet connected by a line **575** including a check valve **577** to one inlet of a shuttle valve **579.** A line **581** connects the outlet of the shuttle valve to actuator *d* of valve **569.** A line **583** interconnects outlet *a* of valve **569** with lines **585, 587** and **589.** Line **585** is connected to the air-operated actuator of a normally closed air-operated valve **591.** The inlet of this valve **591** is supplied with compressed air from the source as indicated by the arrow, and its outlet is connected by line **593** to the inlet of a normally open air-operated valve **595.** A line **597** including a flow control interconnects line **593** and the air-operated actuator of valve **595.** A line **599** including a flow control extends from the outlet of valve **595** and supplies air to two jets **601** and **603** carried by a bracket **605** adjustable along the front bar **269.** Jet **601** is positioned to direct air down on top of roller **257** when the latter is in its retracted (rearward) position, and jet **603** is positioned to direct air down at an angle behind the roller **257** when the latter is in its retracted position.

Line **587** is interconnected with the air-operated actuator of a normally closed air-operated valve **607** and includes an on-off toggle valve **609** which is maintained on for full automatic operation. The inlet of valve **607** is supplied with compressed air from the source as indicated by the arrow and its outlet is connected by a line **611** to the inlet of the aforesaid air-operated reversing valve **303** for the air motor **297.** The valve **303** has ports *a* and *b* connected by the lines **305** and **307** (each including a flow control) to the motor **297.** At **615** is indicated a normally closed air-operated valve having its inlet supplied with compressed air from the source as indicated by the arrow and its outlet connected by line **617** to the air-operated actuator of valve **303.** The arrangement is such that when valve **615** is closed (as is normal), valve **303** is set to operate motor **297** in forward direction, and when valve **615** is open, valve **303** is set to operate motor **297** in reverse direction. A line **619** is interconnected between the air-operated actuator of valve **615** and a junction **621.** Line **589,** which includes a check valve **623,** extends to this junction. Pilot valve **313** has an inlet supplied with compressed air from the source as indicated by the arrow, and has its outlet connected to junction **621** by a line **625.**

A line **627** is interconnected between junction **621** and the inlet of a pulse valve **629** (i.e., a valve which delivers a pulse of air on being actuated by air, and then shuts off). At **631** is indicated a valve having an inlet *i* supplied with compressed air from the source as indicated by the arrow, two ports *a* and *b*, and two air-operated actuators *c* and *d*. When *c* is actuated, air is delivered through *b* and *a* is vented, and when *d* is actuated air is delivered through *a* and *b* is vented. A line **633** connects the pulse outlet of valve **629** and actuator *d* of valve **631.** At **635** is indicated a pilot valve having an operating arm **635***a* engageable by the rear end of carriage **397** upon retraction thereof, and at **637** is indicated a pilot valve having an operating arm engageable by carriage **397** at the forward end of its stroke (see FIGS. **2** and **3** as well as FIG. **24**). Valve **635** has an inlet supplied with compressed air from the source as indicated by the arrow in FIG. **24** and has its outlet connected by a line **639** to a junction at **641.** A line **643** including a flow control extends from this junction to the inlet of a delay device **645** (e.g., a chamber) and a line **647** connects the outlet of this delay device and the actuator *c* of valve **631.** A line **649** including a flow control connects port *a* of valve **631** to the forward end of cylinder **413** and a line **651** including a flow control connects port *b* of valve **631** to the rear end of cylinder **413.**

At **652** is indicated a valve having an inlet *i* supplied with compressed air from the source as indicated by the arrow, two ports *a* and *b*, and two air-operated actuators *c* and *d*. ports *a* is blocked. When *d* is actuated, *b* is vented. When *c* is actuated, air is delivered through *b*. A line **653** connects the outlet of pilot valve **637** to the inlet of a pulse valve **655.** A line **657** connects the outlet of this pulse valve to actuator *d* of valve **652.** A line **659** extends from junction **641** to actuator *c* of valve **652.** A line **661** extends from port *b* of valve **652** to one inlet of a shuttle valve **663.** A line **665** extends from the outlet of this shuttle valve to the upper end of cylinder **441,** which is a spring-return cylinder having a spring **667** biasing its piston **449** upward.

At **669** and **671** are indicated valves each having an inlet *i*, two outlets *a* and *b*, and a single air-operated actuator *c*. At **673** is indicated a valve having an inlet *i* supplied with compressed air from the source as indicated by the arrow, two ports *a* and *b* and two air-operated actuators *c* and *d*. As to each of valves **669** and **671,** when *c* is deactuated, air is supplied from *i* to *a*. When *c* is actuated air is supplied from *i* to *b*. As to valve **673,** when *c* is actuated, air is supplied from *i* to *b* and *a* is vented, and when *d* is actuated air is supplied from *i* to *a* and *b* is vented. A line **675** extends from outlet *b* of valve **673** to a junction **677,** and a line **679** extends from this junction to the other inlet of shuttle valve **663.** A line **680** extends from junction **677** to the inlet *i* of valve **669.** A line **681** extends from line **653** to the inlet of a pulse valve **683** and a line **685** extends from the outlet of this pulse valve to the actuator *c* of valve **673.** A line **687** extends from line **675** to the inlet of an air-actuated snap-acting valve **689,** and a line **691** extends from the outlet of valve **689** to one inlet of a shuttle valve **693.** Valve **689** is adapted to snap open when pressure builds up therein to a predetermined valve and supply air through **691.** The outlet of shuttle valve **693** is connected by a line **695** to the inlet of a pulse valve **697,** the outlet of which is connected by line **699** to actuator *d* of valve **673.** A line **701** around valve **689** includes a flow control and a tank **703.**

A line **705** connects outlet *a* of valve **671** and the other inlet of shuttle valve **693.** A line **707** connects

outlet *b* of valve **671** to the air actuator of a normally closed air-operated valve **709.** The latter has an inlet supplied with compressed air from the source as indicated by the arrow and has its outlet connected by a line **711** to the top of an oil reservoir **713.** An oil line **715** including a flow control extends from the bottom of this reservoir to the rear end of cylinder **423.** A line **717** extends from outlet *a* of valve **669** to inlet *i* of valve **671.** A pilot line **719** including a flow control extends from outlet *b* of valve **669** to the actuator of a normally closed air-operated valve **721,** the inlet of which is supplied with compressed air from the source as indicated by the arrow. A line **723** extends from the outlet of valve **721** to the top of an oil reservoir **725.** An oil line **727** including A flow control extends from the bottom of this reservoir to the lower end of cylinder **433.** A line **729** extends from outlet *a* of valve **673** to the inlet of a normally open air-operated valve **731** and is connected by line **733** including a flow control to the actuator of this valve **731.** A line **735** extends from the outlet of valve **731** to the actuator of a normally closed air-operated valve **737,** the inlet of which is supplied with compressed air from the source as indicated by the arrow. A line **739** extends from the outlet of valve **737** to the forward end of cylinder **423,** and a line **741** interconnects line **739** and the upper end of cylinder **433.**

A line **743** connects the sensor inlet hole **461** to the control of an interface valve **745** (an amplifier) the inlet of which is supplied with compressed air from the source as indicated by the arrow. A line **747** connects the outlet of this valve to the actuator *c* of valve **669.** A line **749** connects the sensor inlet hole **465** to the control of an interface valve **751** similar to **745** the inlet of which is supplied with compressed air from the source as indicated by the arrow. A line **753** connects the outlet of this valve to actuator *c* of valve **671.** A line **755** extends from line **747** to the actuator of a normally open air-operated valve **757,** the inlet of which is supplied with compressed air from the source as indicated by the arrow. A line **759** extends from the outlet of valve **757** to one inlet of a shuttle valve **761.** The outlet of this shuttle valve is connected by a line **763** including a flow control to the upper end of cylinder **75.** A line **765** extends from line **755** to the actuator of a normally closed air-operated valve **767.** The inlet of this valve is adapted to be supplied with air via a line **769** from the outlet of a normally closed air-operated valve **771,** the inlet of which is supplied with compressed air from the source as indicated by the arrow. The outlet of valve **767** is connected by a line **773** including a flow control to the lower end of cylinder **75.** A normally open air-operated valve **775** having its inlet supplied with compressed air from the source as indicated by the arrow has its outlet connected by a line **777** to the other inlet of the shuttle valve **761.** A line **779** extending from line **753** has branch connections **781** and **783** to the actuators of valves **771** and **775.** The lower end of cylinder **117** is connected to line **779** as indicated at **785.** A line **787** connects line **779** to the actuator of a normally open air-operated valve **789** the inlet of which is supplied with compressed air as indicated by the arrow. The outlet of valve **789** is connected by a line **791** to the inlet of a pulse valve **793,** with a line **795** connecting the outlet of this pulse valve and the other inlet of shuttle valve **579** from line **575.**

The pneumatic circuitry for the feeding means **475** and the stacking means **477** (appearing at the lower left of FIG. **24**) is fully described in the aforesaid U.S. Pat. No. 3,670,674, and the same reference numerals as used in said patent for parts of said circuitry appear in FIG. **24** of this application.

Operation is as follows.

The apparatus as described above and shown in the drawings is adapted to operate automatically to process each ply or workpiece P through a cycle, with each successive cycle starting before the previous cycle is completed for rapid processing of the workpieces, involving separating and picking up of a workpiece (the top ply P1) from the stack S and delivering it to the table top **27,** feeding the workpiece over the table top **27** by means **11** for entry of the leading end of its edge E into the sewing machine **3,** feeding the workpiece through the sewing machine (by the feed device **57** of the sewing machine) and stitching along its edge E, with the workpiece guided for contour stitching along edge E by the edge contour guide means **5,** feeding the stitched workpiece exiting from the sewing machine by means **475** to the stacking means **477,** and, finally, stacking the workpiece by means **477.**

At the start of the cycle on each workpiece, the roller **257** is back in its retracted position of FIGS. **1 – 3** and **17** over and engaged by the trailing end portion of stack S, and the roller is in the angular position of rotation around its horizontal axis wherein the exposed reach T1 the pressure-sensitive tape T is facing downward, contacted by the humped-up trailing end portion of the top ply P1 of the stack. The retracted position of the roller **257** is determined by the position of the pilot valve **309,** which, as above noted, is adjustable longitudinally along the frame **267** to make the retracted position of the roller to correspond to the position of the trailing end portion of the stack S on the elevator platform **209.** Generally, the platform **209** will have a mark such as indicated at **831** thereon indicating the position for placement of the stack on the platform, and valve **308** is adjusted in accordance with the length of plies P in the stack so that the roller **257** retracts to a position above the trailing end portion of the stack. To place the roller **257** in its stated angular position wherein the exposed reach T1 of the tape T faces downward when the roller is in its retracted position, the roller is pulled axially toward the front of the apparatus (against the return bias of spring **319**) to disengage the spur gear **317** from the internal ring gear **315,** then the roller may be rotated on its axis to bring it into its stated angular position with the exposed reach T1 of the tape T facing downward, and finally the roller is returned axially toward the back of the apparatus for reengagement of gears **319** and **317.** The carriage **397** and cylinders **423, 433** and **441** carried thereby (constituting the feeding means **11**) are in the advanced or forward position of FIGS. **1, 2** and **17** with the piston rods of all three of these cylinders retracted, hence with pad **453** raised above table top **27.** Platform **209** is biased upward by the air-pressurized oil in cylinder **239** so that the humped-up trailing end portion of the top ply P1 of the stack S is in contact with (and adhered to) the exposed reach T1 of tape T on the roller **257.**

A cycle may be regarded as starting when the leading end of a workpiece (i.e., top ply P1) being fed forward by means **11** during the preceding cycle passes between the jet **467** and the inlet **465** and interrupts the flow of air through lines **749, 753, 779** and **787.** When this occurs, valve **789** is returned to its normally open posi-

tion, and supplies air via line **791** to pulse valve **793** which delivers a pulse of air via line **795**, shuttle valve **579** and line **581** to actuator *d* of valve **569**, thereby setting this valve to deliver air through its port *a* to lines **583, 585, 587** and **589**. This results in valve **303** being set to operate the air motor **297** in forward direction, and in air being delivered via line **599** to the jets **601** and **603**.

Upon operation of the air motor **297** in forward direction, chain **285** is driven in forward direction to pull member **283** forward, and this moves roller **257** forward in translation in direction normal to its axis. As roller **257** moves forward, it is caused to rotate by the rolling of pinions **279** on the racks **277** in counterclockwise direction as viewed from the front of the apparatus. The top ply **P1** of the stack S is in effect attached to the roller by its adherence to the exposed portion T1 of the pressure-sensitive adhesive tape T, and hence is rolled up around the roller as the roller moves forward as illustrated in FIGS. **18** and **19**. The humping up of the trailing or rearward end of the stack by the strip **258** of sponge rubber acts to minimize the tendency of the second ply of the stack S to cling to the top ply **P1**, and the top ply is efficiently and cleanly peeled off the stack away from the second ply of the stack. The jet **601** directs air down on the top of the roller **257** as the roller moves forward, and the jet **603** directs air at an angle down behind the roller **257** to peel the second ply away from the first ply if it should tend to cling to the top ply.

The roller **257** moves forward in translatory motion and rotates on its axis as it moves forward to continue winding up the top ply **P1**. It continues its forward motion and its rotation on its axis until it has rotated one complete revolution after leaving the leading (forward) end of the stack, as determined by the position of valve **313**. FIG. **19** shows the roller **257** with the wound-up ply P1 thereon as it completes this one-revolution motion; it will be observed that at this point the roller **257** has moved forward some distance over the table top **27**. The outer end of the ply P1 on the roller (which had been the leading end of the ply as it reposed at the top of stack S) is disposed on the table. Chain fastener member **383** engages arm **313***a* of valve **313** and actuates valve **313** at this point. Valve **313** thereupon delivers air via lines **625** and **619** to the actuator of valve **615** to set it to deliver air via line **617** to the actuator of valve **303**, thereby setting the latter to drive the air motor **297** in reverse direction. Chain **285** is thereupon driven in reverse direction to pull member **283** back, and this moves roller **257** back toward its retracted starting position. As roller **257** moves back, it is caused to rotate in unwinding direction (clockwise as viewed from the front of the apparatus) by rolling of pinions **279** on the racks **277**, and this results in unwinding of the ply P1 from the roller.

On being actuated by member **283**, valve **313** also delivers air via lines **625** and **627** to pulse valve **629** which delivers a pulse of air to actuator *d* of valve **631** to set this valve to deliver air via its outlet *a* and line **649** to the forward end of cylinder **413** (its left end as viewed in FIG. **24**) and to vent the rearward end of this cylinder via line **651** and port *b* of valve **631**. As a result, piston rod **415** is retracted to retract the carriage **397** rearward and this moves the cluster of cylinders **423, 433** and **441** rearward to the retracted position in which they appear in FIG. **20**, the cluster closely following the retreating roller **257**. The carriage **397** moves rearward until it engages the operating arm of valve **635** and actuates this valve to supply air via lines **639, 643**, delay means **645** and line **647** to actuator *c* of valve **631**. After a delay due to **645**, valve **631** is reversed to deliver air via line **651** to the rearward end of cylinder **413** and to vent the forward end of cylinder **413** via line **649** to return the carriage forward to its starting position. However, before the return of the carriage forward (i.e., during the delay imposed by **645**), valve **635** also supplies air via lines **639** and **659** to actuator *c* of valve **652**, setting it to deliver air via its port *b* and line **661**, shuttle valve **663** and line **665** to the top of cylinder **441** to drive the pad or gripper **453** downward (see the dotted line position shown for **453** in FIG. **10**, and also see FIG. **20**) to clamp the leading end of the workpiece (ply P1) down on the table top **21**. This keeps the workpiece from being pulled back by the retreating roller **257**, so that the workpiece remains in the position in which it has been delivered to the table by the roller **257**, as shown in FIG. **20**. The pad **453** holds its FIG. **20** position until the roller **257** has been completely retracted and portion T1 of tape T has disengaged from the workpiece.

When the roller **257**, in moving forward, passes off the forward end of the stack S, the platform **209** and stack are released for upward movement under the bias of the air-pressurized oil in cylinder **239**. However, the arrangement is such that the platform and stack move upward relatively slowly, and as the roller **257** moves back from its FIG. **19** advanced position it rolls over the top of the stack and, if necessary, pushes the stack and platform down.

As the roller **257** is moving forward and near the end of its forward stroke, the button **387** on the yoke **383** engages the cam **393**, and the yoke **383**, rod **373** and pawl **369** are driven inward with respect to roller **257** against the return bias of spring **379** to ratchet the take-up roller **345** one step forward and thereby take up an increment of tape T to effect bringing a fresh portion of tape into position T1 for the ensuing cycle.

As the carriage **397** is moved forward back to its starting position, the pad **453**, which is in its lowered position pressing the leading end of the workpiece down against table top **27** to grip the workpiece, feeds the workpiece forward over the table top **27** from the FIG. **20** position to the FIG. **21** advanced position wherein the leading end of the ply is somewhat forward of the sensor jet **459**. The carriage **397**, at the end of its forward stroke, actuates valve **637**, opening the latter to deliver air via line **653** to pulse valve **655** which delivers a pulse of air to actuator *d* of valve **652**. This sets valve **652** to vent port *b*, and line **661**, but cylinder **441** remains pressurized and pad **453** remains down due to valve **637** also supplying air via lines **653** and **681** to pulse valve **683** to deliver a pulse of air via line **685** to actuator *c* of valve **673** thereby to deliver air through port *b* of **685**, and lines **675** and **679**, and shuttle valve **663** and line **665** to the upper end of cylinder **441**. It also provides for delivery of air via line **680** to inlet *i* of valve **669**, which is set at this time to deliver air via its port *b* and line **719** to the actuator of valve **721**. The latter opens and delivers air via line **723** to the oil reservoir **725** to pressurize oil in this reservoir and in line **727** and the cylinder **433** to extend the piston rod **435** of cylinder **433** so as to move the pad **453** (which is down and still gripping the workpiece) later-

ally with respect to the table top **27** in the direction toward the sensor jet **459** and the related air inlet **461.** The pad **453,** still clamped down on the workpiece and gripping it moves it laterally of the table top **27** back in the direction toward the jet **459** (compare FIGS. **21** and **22**).

Piston rod **435** of cylinder **433** continues its movement, with continuing movement of the workpiece laterally with respect to the table top **27,** until the margin of the workpiece at its edge E intersects the sensor inlet port **461** and blocks the flow of air through line **743.** The result of this is to cut off flow of air through valve **745** and line **747** to actuator *c* of valve **669,** with the result that valve **669** is deactuated to deliver air via its port *a* and line **717** to inlet *i* of valve **671.** Valve **721** is thereby deactuated to vent the upper end of the oil reservoir **725,** and piston rod **435** stops, with the workpiece in a position of alignment with respect to the needle of the sewing machine, as determined by the location of jet **459** and air inlet **461** for entry of the workpiece into the sewing machine **3.** Valve **671** is set at this time to deliver air from its inlet *i* to its port *b*, hence air is delivered via line **707** to actuate valve **709** to deliver air to the top of oil reservoir **713.** The pressurized oil acts via line **715** to extend piston rod **425** of cylinder **423,** thereby moving cylinders **433** and **441** and pad **453** (which is still down and still gripping the workpiece) forward to feed the workpiece P1 further forward over the table top **27** to enter the workpiece into the sewing machine (see FIG. **23**).

The forward movement of piston rod **425** and pad **453** continues until the leading end of the workpiece P1 intersects the sensor inlet port **465.** This blocks the flow of air through line **749,** with the result that valve **751** shuts off the flow of air through line **753** to actuator *c* of valve **671.** Accordingly, valve **671** is shifted back to its deactuated position in which it vents its port *b*, and hence it vents line **707,** deactuates valve **709,** and vents line **711** and oil reservoir **713.** This stops the forward movement of piston rod **425** of cylinder **423.** Valve **671,** being deactuated, provides for delivery of air via line **705,** shuttle valve **693** and line **695** to pulse valve **697** to deliver a pulse of air via line **699** to actuator *d* of valve **673,** thereby shifting valve **673** back to its starting position. Valve **673** thereupon vents cylinder **441** via **679, 675** and its port *b* for retraction (raising) of the pad **453.** It also delivers air via line **729** to and through valve **731** to close it and line **735** to the actuator of valve **737,** actuating the latter to deliver air via lines **739** and **741** to cylinders **423** and **433** to retract the piston rods **425** and **435** of these cylinders (thus returning them to their starting position). The flow control in line **733** acts to delay actuation of valve **731** which when actuated cuts off the return air pressure for cylinders **423** and **433** so that they are not pressurized when off duty.

When flow of air through line **753** is shut off (by blocking of sensor inlet **465**), air is shut off from line **779.** This deactuates cylinder **117** so that the edge contour guide wheel **111,** which had been held up in raised position by piston rod **121** of cylinder **117** being extended upward, comes down on the workpiece P1 which has been fed under the wheel **111** by the pad **453** as it is moved forward by cylinder **423.** This downward movement is under the weight of cylinder **85,** bracket **95** etc.

As above noted, the workpiece is moved laterally from its FIG. **21** to its FIG. **22** position by pad **453** until the workpiece blocks sensor inlet **461,** which results in curtailing the flow of air through line **747.** It also curtails the flow of air through line **755,** with the result that valve **757** is deactuated and hence opened (and valve **767** is deactuated and hence closed). Valve **757** thereupon supplies air via **759, 761** and **763** to the upper end of cylinder **75.** The lower end of this cylinder is vented via line **773** and valve **767** (deactuated on account of curtailment of air flow in **755** and **765**). Accordingly, the piston rod of cylinder **75** is extended to start the sewing machine **3.** Thus, the sewing machine is running when the workpiece is fed forward by the forward movement of the piston rod **425** of cylinder **423** (FIG. **23**) and its leading end is entered in the sewing machine. The pad **453** is raised when the leading end of the workpiece enters the sewing machine, and the feeding device **57** of the sewing machine then takes over and feeds the workpiece through the machine for stitching of the workpiece along its edge E. As the workpiece is fed through the sewing machine, it is guided for contour stitching of its edge E by the wheel **111** under control of cylinder **85,** the air proportioning device **161** and jet sensor **129.**

During the time the workpiece is being fed through the sewing machine, sensor port **469** remains covered by the workpiece. When the workpiece has been almost completely fed through the machine, its trailing end passes by port **469,** which then again receives air from jet **467.** Air thereupon flows through line **753** to reset valve **671.** Air flows from line **753** through lines **779** and **785** to extend piston rod **121** of cylinder **117** (i.e., move it upward) so as to lift up the guide wheel **111** for entry of the next workpiece, air flow through **779** and **781** actuates valve **771** and air flow through line **783** actuates (closes) valve **775.** Valve **771** supplies air through line **769** to valve **767,** which is open, and thence through line **773** to the lower end of cylinder **75.** The upper end of the cylinder **75** is vented via line **763,** shuttle valve **761,** line **777** and valve **775.** Thus, the piston rod of cylinder **75** is retracted (moved upward) to stop the sewing machine. This is after a delay due to the flow control in line **763,** enabling the sewing machine to complete the feeding and stitching of the workpiece along its edge E.

Also, line **779** supplies air to effect operation of the feeding means **475** and stacking means **477,** all as fully described in the aforesaid U.S. Pat. No. 3,670,674.

Previous reference has been made to the return movement of the roller **257.** As it is moved in the return (rearward) direction by the chain **285,** the chain fastener member engages the operating arm **309***a* of valve **309** and thereby trips this valve to deliver air via line **571** to actuator *c* of valve **569.** Valve **569** thereupon is set to deliver air from its inlet *i* to port *b*, which is blocked, and to vent its port a, thus venting line **583** and lines **585, 587** and **589.** Valve **591** thereupon shuts off to stop flow of air to the jets **601** and **603.** Valve **607** also shuts off to stop the air motor **297.** Roller **257** continues to move rearward after motor **297** for about one-half a turn and comes to a stop in its retracted position above the trailing end of the stack ready for the next cycle, which starts when, during the instant cycle, the leading end of the workpiece intersects the jet sensor inlet **465.** It will thus be observed that successive cycles overlap, providing for rapid operation.

It will be observed that the pad **453**, constituting the gripper or gripping means, is mounted for movement between a raised retracted position above the table **1** and a lowered position in engagement with the top of a workpiece on the table and also for multi-directional movement over the table including movement in forward and lateral directions.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As various changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. In apparatus having a machine for operating on workpieces of limp material, means for automatically feeding such workpieces one after another from a stack thereof to and through saidmachine, comprising a table over which workpieces may be fed to and through said machine, means adjacent one end of the table for holding a stack of workpieces, means for separating and picking up the top workpiece of the stack and delivering it to said table, means for feeding the workpiece over the table to said machine and entering it in said machine with the work-piece in position for being fed through the machine for operation thereon by the machine comprising a gripper engageable with the top of a workpiece on the table, means for moving the gripper downwardly from a raised retracted position into engagement with the top of a workpiece delivered to the table and then moving it forwardly and laterally over the table from a rearward retracted position to slide the workpiece forwardly and laterally over the table, said means for separating and picking up the top workpiece of the stack and delivering it to the table comprising means for rolling up the top workpiece of the stack, delivering the rolled-up workpiece to the table, and then unrolling the workpiece, said rolling and unrolling means comprising a roller mounted for rotation on its axis and for translation in the horizontal plane of its axis to roll over the top workpiece of the stack toward and away from the table, said roller having means for initial attachment thereto of the top workpiece so that it is rolled up on the roller as the roller rolls over the top workpiece toward the table, said means for holding the stack being movable upward for engagement of the top workpiece with the roller, the roller being movable between a retracted position over the trailing end portion of the stack and an advanced position over the table, and a workpiece being rolled up on the roller as it moves forward to its advanced position and being unrolled from the roller as it returns to its said retracted position.

2. Apparatus as set forth in claim **1** wherein the roller rotates through approximately one revolution in moving from the forward end of the stack to its advanced position over the table.

3. Apparatus as set forth in claim **1** wherein said gripper is operable to clamp the forward end of the workpiece down against the table as the roller is retracted.

4. Apparatus as set forth in claim **1** wherein said means for attachment to the roller of the top workpiece comprises pressure-sensitive tape.

5. Apparatus as set forth in claim **4** wherein said roller carries means for holding a supply roll of the tape, a take-up roller for the tape, means guiding the tape from the supply roll internally of said roller to the take-up roller and presenting an exposed portion of the tape for adherence of the top workpiece, and means for intermittently rotating the take-up roller to take up a portion of the tape.

6. Apparatus for peeling off the top workpiece of a stack of workpieces of relatively limp material, such as cloth, and conveying it to a position spaced from the stack, comprising means for supporting a stack of said workpieces, a roller for rolling up the top workpiece of the stack, means mounting said roller for rotation on its axis and for translatory movement in a direction at right angles to its axis to roll over the top of the stack, said roller having means for initial attachment thereto of the top workpiece of the stack so that it is rolled up on the roller as the roller rolls in a forward direction over the top workpiece, said roller being movable in forward direction beyond the forward end of the stack to an advanced delivery position, and then being movable back in reverse direction to unroll the workpiece.

7. Apparatus as set forth in claim **6** wherein the roller has a retracted position over the rearward end of the stack.

8. Apparatus as set forth in claim **7** wherein said stack supporting means comprises an elevator platform and having means for biasing said platform upward for engagement of the top of the stack with the roller.

9. Apparatus as set forth in claim **8** wherein the platform carries a longitudinal ridge for humping the stack.

10. Apparatus as set forth in claim **9** having air jets directed toward the roller for peeling the second workpiece of the stack away from the first workpiece if the former should tend to cling to the latter.

11. Apparatus as set forth in claim **6** wherein said means for attachment to the roller of the top workpiece comprises pressure-sensitive tape.

12. Apparatus as set forth in claim **6** having means for holding the unwound forward end of the workpiece against rearward movement as the roller moves back in reverse direction.

13. In apparatus having a machine for operating on workpieces of limp material, apparatus for automatically feeding such workpieces one after another from a stack thereof to and through said machine, comprising a table over which workpieces may be fed to and through said machine, means adjacent one end of the table for holding a stack of workpieces, means for separating and picking up the top workpiece of the stack and delivering it to said table, and means for feeding the workpiece over the table to said machine and entering it in said machine with the workpiece in position for being fed through the machine for operation thereon by the machine, said means for separting and picking up the top workpiece of the stack and delivering it to the table comprising means for rolling up the top workpiece of the stack, delivering the rolled-up workpiece to the table, and then unrolling the workpiece, said rolling and unrolling means comprising a roller mounted for rotation on its axis and for translation in the horizontal plane of its axis to roll over the top workpiece of the stack toward and way from the table, said roller having means for initial attachment thereto of the top workpiece so that it is rolled up on the roller as the roller rolls over the top workpiece toward the table,

said means for holding the stack being movable upward for engagement of the top workpiece with the roller, the roller being movable between a retracted position over the trailing end portion of the stack and an advanced position over the table, a workpiece being rolled up on the roller as it moves forward to its advanced position and being unrolled from the roller as it returns to its said retracted position.

14. Apparatus as set forth in claim **13** whrein the roller rotates through aproximately one revolution in moving from the forward end of the stack to its advanced position over the table.

15. Apparatus as set forth in claim **13** having means for clamping the forward end of the workpiece down against the table as the roller is retracted.

16. Apparatus as set forth in claim **15** wherein said clamping means is part of the means for feeding the workpiece over the table to said machine.

17. Apparatus as set forth in claim **13** wherein said means for attachment to the roller of the top workpiece comprises pressure-sensitive tape.

18. Apparatus as set forth in claim **17** wherein said roller carries means for holding a supply roll of the tape, a take-up roller for the tape, means guiding the tape from the supply roll internally of said roller to the take-up roller and presenting an exposed portion of the tape for adherence of the top workpiece, and means for intermittently rotating the take-up roller to take up a portion of the tape.

19. In apparatus comprising a machine for operating on workpieces of limp material, said machine having means for feeding workpieces therethrough, means for automatically feeding such workpieces one after another from a stack thereof to said machine, comprising a table, means adjacent one end of the table for holding a stack of workpieces, means for separating and picking up the top workpiece of the stack and delivering it to the table, pneumatically operated means for feeding said workpiece forwardly and laterally over the table to a position for entry into the machine, and then feeding it forward for entry into the machine and subsequent feeding of the workpiece through the machine by the feeding means of the machine, said pneumatically operated means including an air jet sensor for sensing the arrival of the workpiece, when moved laterally, at the appropriate lateral position thereof for entry into the machine.

20. In apparatus comprising a machine for operating on workpieces of limp material, said machine having means for feeding workpieces therethrough, means for automatically feeding such workpieces one after another from a stack thereof to said machine, comprising a table, means adjacent one end of the table for holding a stack of workpieces, means for separating and picking up the top workpiece of the stack and delivering it to the table, pneumatically operated means for feeding the workpiece forward over the table to a first position wherein it is located longitudinally for entry into the machine but offset laterally from a second position for entry into the machine, then feeding the workpiece laterally to its said second position, and then feeding the workpiece forward from its said second position for entry into the machine and subsequent feeding of the workpiece through the machine by the feeding means of the machine, said pneumatically operated means including an air jet sensor for sensing the arrival of the workpiece at its said second position, the leading end of said workpiece, when it is fed to its said first position, being forward of said sensor.

21. In apparatus having a machine for operating on workpieces of limp material, a table over which workpieces may be fed to and through said machine, and means for feeding workpieces over the table to the machine entering it in said machine with the workpiece in position for being fed through the machine for operation thereon by the machine, said feeding means comprising gripping means engageable with the top of a workpiece on the table, means for lowering the gripping means from a raised retracted position into engagement with the top of a workpiece on the table, means for moving the gripping means when lowered and engaging a workpiece to move the workpiece over the table to enter it in the machine, and means controlled by the workpiece for sensing its position on the table and controlling said moving means to effect alignment of the workpiece relative to said machine.

22. In apparatus as set forth in claim **21,** second means controlled by the workpiece for sensing and terminating its entry into the machine.

23. In apparatus as set forth in claim **22,** means controlled by one of said sensing means for starting said machine.

24. In apparatus as set forth in claim **23,** said starting means being controlled by the first sensing means.

25. In aparatus as set forth in claim **24,** means controlled by said second sensing means for stopping said machine when the workpiece has been fed through the machine.

26. In apparatus as set forth in claim **26,** said means for moving the gripping means being operable to move it laterally to position it for entry in the machine, and then forwardly to enter it in the machine, said sensing means being responsive to the lateral feed of the workpiece to a position of alignment relative to the machine.

27. In apparatus as set forth in claim **21,** said means for moving the gripping means being pneumatically operated, and said sensing means comprising an air jet sensor.

28. In apparatus as set forth in claim **21,** means adjacent one end of the table for holding a stack of workpiecess, and means for separating and plicking up the top workpiece of the stack and delivering it to said table for delivery to said machine by said gripping means.

29. In apparatus as set forth in claim **28,** said means for moving the gripping means being operable to move it forward to a first position wherein it is located longitudinally for entry into the machine but offset laterally from a second position for entry into the machine, then feeding the workpiece laterally to its said second position, and then feeding the workpiece forward from its said second position for entry into the machine and subsequent feeding of the workpiece through the machine, said sensing means being responsive to the lateral feed of the workpiece to a position of alignment relative to the machine.

* * * * *

PO-1050
(5/69)

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,765,672 Dated October 16, 1973

Inventor(s) William R. Conner, Jr.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Front page, item [54], "WORKPIECE" should read -- WORKPIECES --; item [75], "St. Louis, Mo." should read -- Shelbyville, Tenn. --. Column 1, line 1, "WORKPIECE" should read -- WORKPIECES --. Column 6, line 52, "thier" should read -- their --. Column 7, line 1, "lowr" should read -- lower --; line 30, "257" should read -- 267 --; line 45, "276" should read -- 265 --; lines 49-50, "283 at oppostie sides of the shaft 265 and extends" should be omitted; line 53, "outbaord" should read -- outboard --; line 66, "chain 295" should read -- chain 285 --. Column 8, line 44, "fron" should read -- front --. Column 9, line 15, "326" should read -- 363 --. Column 11, line 16, "soruce" should read -- source --. Column 13, line 15, "A flow" should read -- a flow --. Column 14, line 39, "308" should read -- 309 --. Column 15, line 44, "383" should read -- 283 --. Column 16, line 17, "21" should read -- 27 --. Column 20, line 64, "and way" should read -- and away --. Column 22, line 31, "aparatus" should read -- apparatus --; line 35, "claim 26" should read -- claim 21 --.

Signed and sealed this 21st day of May 1974.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents