Feb. 8, 1955 W. J. GIBNEY ET AL 2,701,715

CLOTH FOLDING DEVICE

Filed Feb. 14, 1951 5 Sheets-Sheet 1

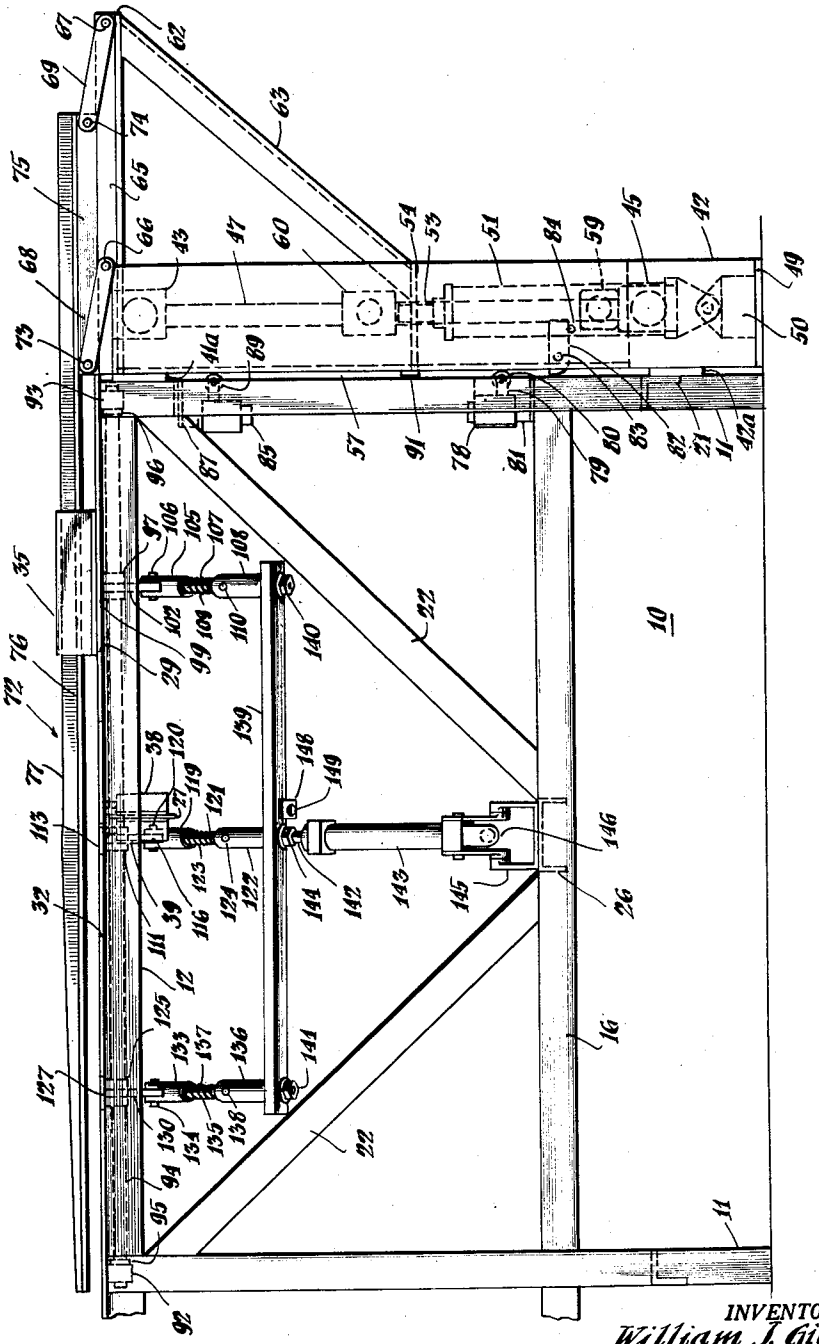

Fig. 1

INVENTORS
William J. Gibney
James C. Ryder
BY John P. McElhaney
ATTORNEY

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CLOTH FOLDING DEVICE

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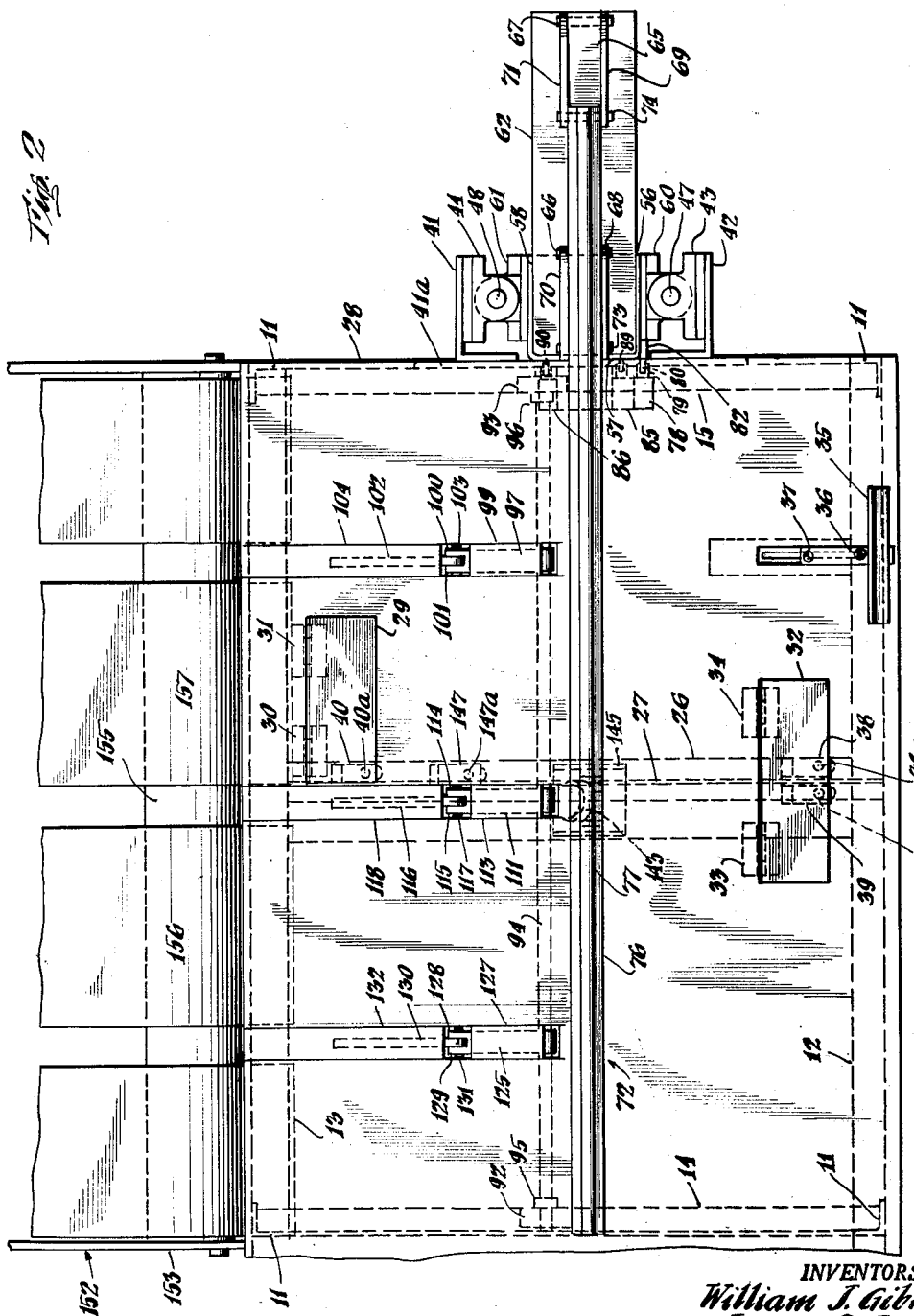
Fig. 2



INVENTORS
William J. Gibney
James C. Ryder
BY John P. McGann
ATTORNEY

Feb. 8, 1955 W. J. GIBNEY ET AL 2,701,715

CLOTH FOLDING DEVICE

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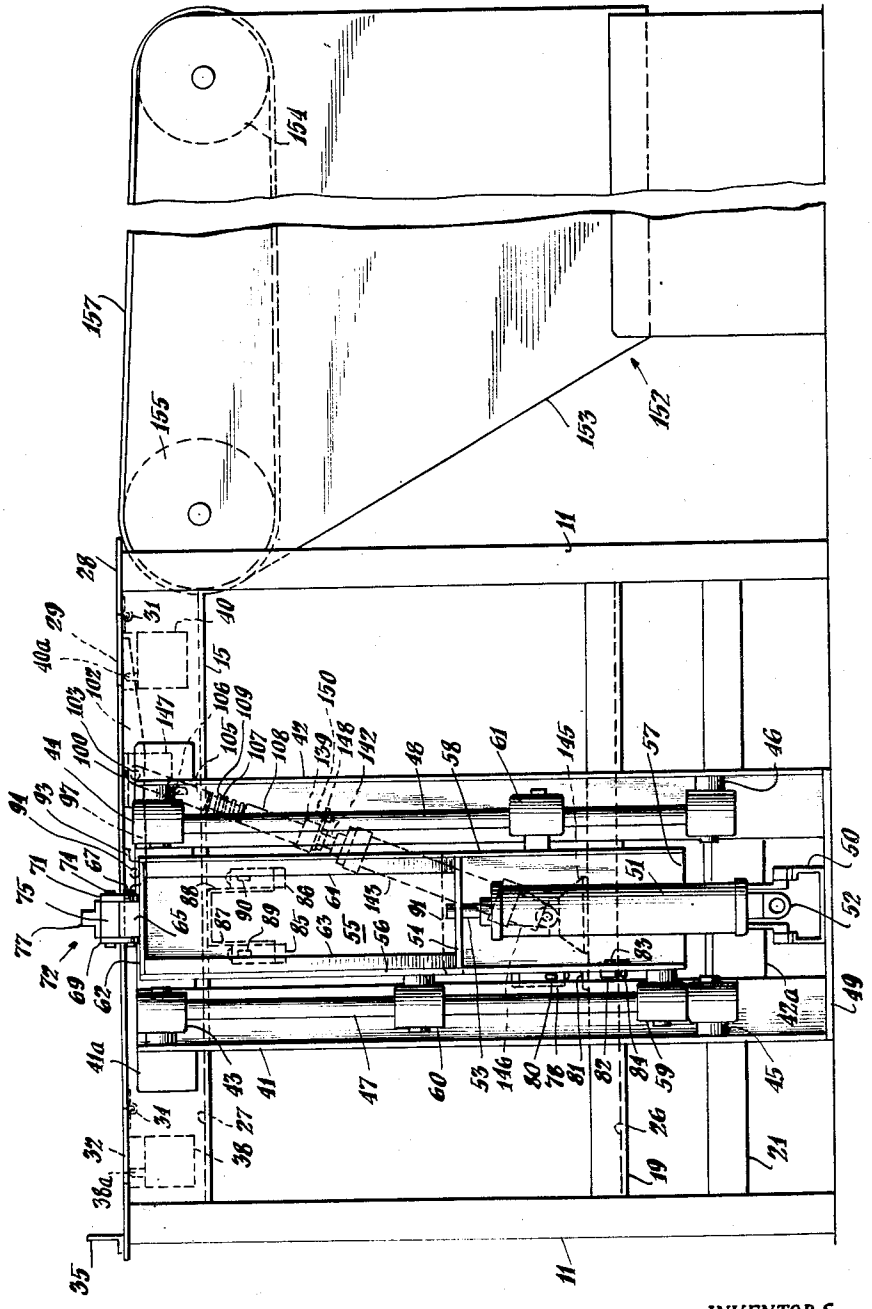
Fig. 3



INVENTORS
William J. Gibney
James C. Ryder
BY John A. McGann
ATTORNEY

Feb. 8, 1955 W. J. GIBNEY ET AL 2,701,715

CLOTH FOLDING DEVICE

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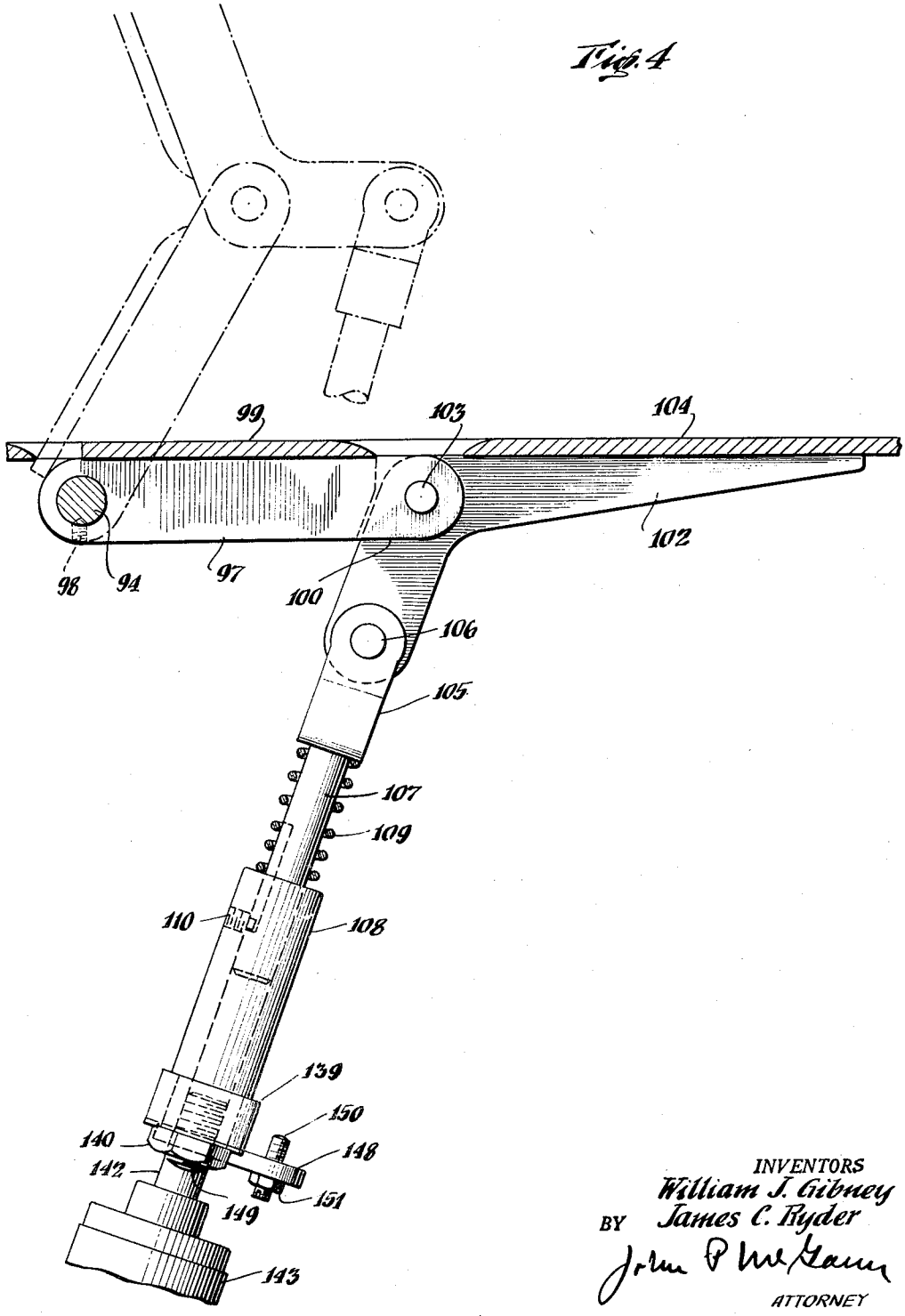
Fig. 4



INVENTORS
William J. Gibney
James C. Ryder
BY John P. McGann
ATTORNEY

Feb. 8, 1955 W. J. GIBNEY ET AL 2,701,715

CLOTH FOLDING DEVICE

Filed Feb. 14, 1951 5 Sheets-Sheet 5

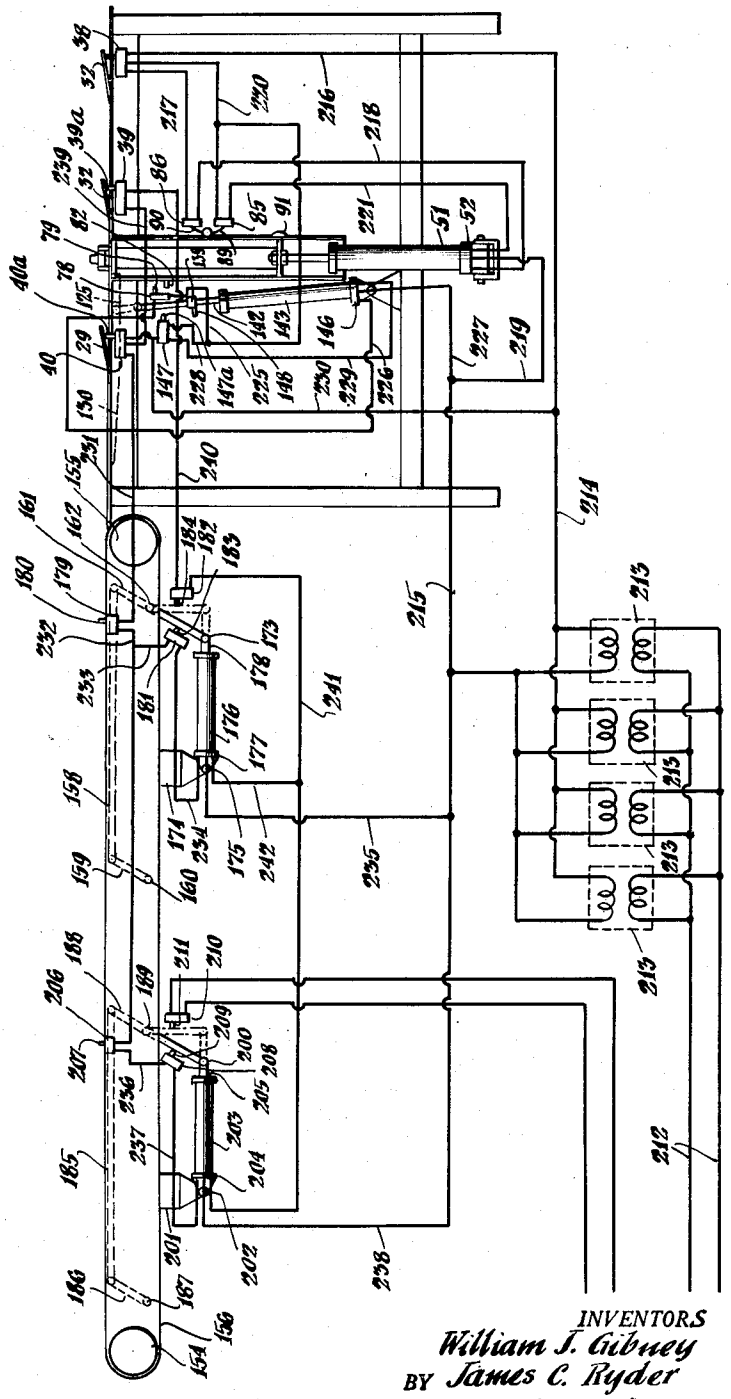


Fig. 5

INVENTORS
William J. Gibney
BY James C. Ryder
John P. McGann
ATTORNEY

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2,701,715

CLOTH FOLDING DEVICE

William J. Gibney, Somerset, and James C. Ryder, Fairhaven, Mass., assignors to United Merchants and Manufacturers, Inc., New York, N. Y., a corporation of Delaware

Application February 14, 1951, Serial No. 210,822

8 Claims. (Cl. 270—80)

This invention relates to a means for folding sheet material, or more particularly, to a machine for making a fold therein.

The device is particularly adapted to make a final fold in finished pieces of cloth or other sheet material after such pieces have been laid down in laps or folds by a folding machine such as a hooker.

One object of the invention is to eliminate the costly hand operation of folding for shipment. Another object is to decrease the time required to prepare individual cuts for delivery to customers. Still another object is to provide a machine for making a "put-up" fold in cloth. A still further object is to improve the effectiveness of clothroom operatives who put up goods for shipment. Still another object is to provide a machine for automatically making a fold in a series of layers or laps of sheet material. A further object is to decrease the time required in preparing individual cuts for shipment, and so reduce the unit cost.

With the above and other objects in view, as will be apparent, this invention consists in the construction, combination and arrangement of parts, all as hereinafter more fully described, claimed, and illustrated in the accompanying drawings, wherein:

Fig. 1 is a side elevation of an embodiment of the apparatus of the invention as applied to a table for folding finished cloth;

Fig. 2 is a plan view of the same device;

Fig. 3 is an end view of the device;

Fig. 4 is a view showing the cloth lift in detail; and

Fig. 5 is a schematic wiring diagram showing the circuits of the apparatus.

Ordinarily, finished textile goods are prepared for shipment by first running them over a cloth folding machine or hooker which permits inspection, and which lays down the cloth in a series of laps or folds which may be of varying extent, but which are usually one yard long.

From the hooker the cloth is passed to the folding table where an operator first evens the edges of the folds and then makes one or two folds of the complete piece to form the package. The present invention contemplates a device by means of which the operation of evening the edges of the laps is virtually eliminated and the process of folding the piece for packaging becomes almost mechanical.

According to the invention, goods folded by the hooker or otherwise may be transported by conveyor to a folding table. The goods are preferably placed on the conveyor so that the length of the goods is parallel to the direction of travel. As a result, the folds lie crosswise of the conveyor. The conveyor may deliver the goods to the folding table at one side and adjacent one end thereof. Projecting over the table and parallel to its length, is a bar capable of vertical motion under the influence of an air cylinder. There may also be provided a series of slats in the surface of the table, which may be parallel to the axis of the conveyor. The slats may be hinged at one end of each to the center of the table, and may be raised and lowered under the influence of a second air cylinder. A vertical guide may be provided adjacent one side of the table, to aid in placing the goods. The operator stands at this side of the table, looking across it toward the conveyor.

The operation of the device is simple and almost completely automatic. As the goods approach from the conveyor, the horizontal bar may be in its raised position.

The operator may reach over, draw the goods under the bar, and line them up against the guide. The weight of the cloth may be employed to activate a precision switch provided in the table top, which in turn may operate a solenoid valve to release the air in the air cylinder and lower the bar. When the holding bar arrives at the proper position, it may automatically activate the second air cylinder which lifts the series of slats provided to raise the back half of the fabric. When the slats approach the end of their stroke, the operator grasps the back edges (or edge) of the fabric and brings them (or it) forward to the guide, completing the fold. The slats return automatically to table level after each stroke. After completing the fold the operator may slide the goods down the length of the table, away from the holding bar. Moving the goods down the table releases the precision switch, causing the holding bar to be raised, thereby completing the cycle. Thus the device eliminates almost all of the manual labor involved in cloth folding, and enables the output of operatives to be multiplied several times.

Referring now to the drawings, the cloth folding device of the present invention may be associated with a work table **10** of any suitable size, shape, and material. In practice, a rectangular table having a metal frame is preferred, although other materials, such as, for example, wood, may also be employed. Table **10** is supplied with four legs **11** of angle iron, which support horizontal members **12** and **13**, also of angle iron, and horizontal members **14** and **15** of channel iron. Horizontal members **16**, **17**, **18** and **19** of angle iron, mounted at about one-third the height of the table, serve to stiffen the frame thereof. Additional horizontal stiffeners **20** and **21** are provided at either end of the table. Four diagonal members **22**, brace the horizontal members **16** and **17**. A horizontal channel **26**, connecting the members **16** and **17**, and a horizontal strip **27**, connecting the horizontal members **12** and **13**, complete the frame of the table **10**. All of the above-mentioned parts may be firmly secured to the adjacent parts, as for example by bolting or welding.

A table top **28** of pressed wood, Masonite, or other suitable material is supported on the frame just described, and may be secured thereto, as by bolts with countersunk heads. The table top may project slightly beyond the frame on all sides, and be provided with three parallel spaced slots perpendicular to the rear edge and extending almost to the center of the table. A door **29** of the same material as the table top **28** supported from the rear by hinges **30** and **31** secured to table top **28**, is provided adjacent one of the said slots, spaced a short distance from the rear edge of the table top **28**. A second door **32** supported by hinges **33** and **34** at its rear edge, is located near the center of the portion of the table length bounded by the first and last of the three slots, and a short distance from the forward edge of the table top **28**.

A vertical cloth guide **35**, having its guide-edge parallel to the forward edge of the table, is fastened to the table by adjusting bolts **36** and **37** passing through table top **28** and/or the horizontal member **12**. Guide **35** is placed near the forward edge of the table at a point opposite either outer slot of the three above-mentioned slots in the rear of the table top.

Two precision switches **38** and **39** are secured to the horizontal member **27** at a point just below the door **32**. Switches **38** and **39** and the other precision switches mentioned hereinafter are of the single pole, double throw type, having a normally open circuit and a normally closed circuit, with a third terminal common to both. Shifting of a movable or spring contact, which normally coacts with one circuit, to the other circuit, is accomplished by means of a plunger type actuator which acts against the mechanical pressure of the spring.

Switches **38** and **39** are so placed beneath door **32** with their actuators **38***a* and **39***a* respectively directed upward, as to open the door slightly, i. e., tilt it upward. Thus the door **32** rests upon the actuators **38***a* and **39***a* of the two switches **38**, **39**. Whenever an object is placed upon the door **32**, the latter is forced down to table level and the actuators **38***a* and **39***a* shift the contacts of the switches **38**, **39** to their alternate positions.

A third precision switch **40** having an actuator **40***a*,

is secured to member 27 beneath the door 29 to coact therewith as described with respect to door 32 and switches 38 and 39.

At one end of the table 10, vertical angle members 41 and 42 are each secured along one face in vertical spaced relation, to rectangular spacers 41*a* and 42*a*, which are in turn secured to the frame of the table. Members 41 and 42 extend from the floor to a point just below the top of the table 10. Supports 43 and 44 at the respective tops and supports 45 and 46 near the respective bottoms are secured to vertical members 41 and 42.

Vertical rod 47 is fixed in a vertical position to the supports 43 and 45. In a like manner vertical rod 48 is supported by the supports 44 and 46.

A supporting plate 49, resting on the floor beneath the vertical angle members 41 and 42, is secured to them. At the center of the plate 49 is secured base 50, of an air cylinder 51 equipped with a solenoid valve 52, which controls advances and retractions of the cylinder piston. Valve 52 and the other solenoid valves mentioned hereinafter are conventional two position air valves equipped with two electrical circuits, one of which moves the valve to the position which allows the air pressure to advance the piston and the other circuit moves the valve to the position in which the air pressure is allowed to retract the piston. Each valve is provided with a terminal for each circuit and a third terminal common to both circuits.

Air cylinder 51 is mounted with its major axis vertical, and the shaft 53, to which the piston is attached, is directed vertically upward. A plate 54 is fixed to the end of shaft 53 and moves with it. The two ends and one side of the plate 54 are secured to vertical sides 56, 57, and 58 of an open box-like member 55. Member 55 has its major axis directed vertically and corresponds in length to the distance from the top of vertical angle member 41 to the support 45. Slidable bearings 59 and 60, through which rod 47 passes, are secured to vertical side 56 of the box-like member 55, in spaced relation, bearing 59 being at the lower extremity of the member 55 and bearing 60 being at or near the midpoint thereof. A similar slidable bearing 61 through which rod 48 passes, is secured to vertical side 58 of member 55, at a point opposite the midpoint of the distance between bearings 59 and 60. Thus the assembly including shaft 53, plate 54, member 55, and bearings 59, 60 and 61 move vertically upward or downward with each movement or retraction of shaft 53 in the air cylinder 51.

Member 55 is supplied with a rectangular top 62 which is secured to the tops of the respective vertical sides 56, 57, and 58, and which projects outward beyond the width of sides 56 and 58 for a distance more than twice their width. Top 62 is braced at its outer extremity by two diagonal braces 63 and 64, which extend diagonally downward toward the table and are secured respectively to sides 56 and 58 of member 55. Top 62 is provided with a rectangular centered raised portion 65 extending throughout its length. Raised portion 65 is provided with round holes at right angles to the major axis thereof, one at the outer end, and one at the center edge of member 55, passing through the raised portion and having their axes in the same horizontal plane. A pair of round shafts 66 and 67 are inserted in the holes, and protrude a short distance at each end. Shafts 66 and 67 support at their ends the four equal links 68, 69, 70, and 71 in rotatable relation.

A bar 72 which extends the full length of table top 28 and projects outward above the top 62 of member 55 for most of the length of said top 62, is connected to the links 68, 69, 70 and 71 by shafts 73 and 74, which pass through a projection 75 at one end of bar 72 which extends downward but is equivalent in cross section, to the raised portion 65 of top 62, and extends from a point opposite the edge of table 10 to the end of bar 72. Shafts 73 and 74 are both parallel to the shafts 66 and 67 and are spaced apart a distance equal to the spacing of shafts 66 and 67. Bar 72 is provided with a rectangular bottom or working surface 76, the projection 75, which extends downward from the latter and a rib 77 of a rectangular section which extends upward from the working surface at the center thereof and throughout the length of the bar 72. Rib 77 is tapered so that it diminishes in height toward the far end of table 10.

As a result of the foregoing, it follows that bar 72 is supported above the table 10, having its major axis always parallel to the length thereof and its working surface 76 always parallel to the surface of the table top 29. Bar 72 is capable of movement up and down in conjunction with movements of member 55 and its assembly. It is also capable of movement independent of the member 55 through rotation of links 68—71.

A precision switch 78, having a plunger-type actuator 79 carrying a roller 80 at its outer extremity, is secured to the horizontal member 19 by means of an angle bracket 81, with the axis of plunger 79 horizontal and the roller 80 protruding slightly beyond the end of the table. Switch 78 is placed opposite a point just in front of side 56 of member 55. A strip 82 which is rectangular in form except for the lower portion of one end, which latter is made in the form of a cam surface, is rotatably supported near the same end by the horizontal stud 83 which protrudes from side 56 of member 55 near the edge nearest the table and a short distance from the lower extremity thereof. A second stud or screw 84 protrudes from side 56 of member 55 at a point just below the lower edge of strip 82, when the major axis of the latter is horizontal. Thus strip 82 is held contiguous to side 56 and rotatably supported by stud 83, and ordinarily rests on screw 84, with its major axis horizontal. It follows that strip 82 is carried up and down with motion of the member 55. In so doing it coacts with the actuator 79 and roll 80 of switch 78 to acutate the switch on downward motion of member 55. On upward motion of member 55, the strip 82, after contacting roller 80, rotates about stud 83 and so passes roller 80 without actuating switch 78. Two more precision switches 85 and 86, located on the table frame opposite member 55 and having respective actuators 89 and 90 directed toward member 55, are supported from member 15 by means of brackets 87 and 88 respectively. A rectangular strip 91 is secured, with its major axis horizontal, to vertical side 57 of member 55. Strip 91 is so placed on side 57 of member 55 that when member 55 is at its highest point of movement, the strip 91 is in operative contact with actuators 89 and 90 of switches 85 and 86.

At either end of the table 10, bearing blocks 92 and 93 are secured to the under side of the upper horizontal face of respective channel members 14 and 15 at points just to the rear of the midpoint of each channel member and opposite each other. A rod or axle 94 rotatably supported by bearing blocks 92 and 93 extends the length of the table and passes beneath the forward ends of the three slots in the tabletop mentioned previously. Collars 95 and 96, secured to axle 94, serve to prevent longitudinal motion thereof. An oblong crank 97, of rectilinear cross-section, having a hole at one end through which axle 94 passes, is secured to axle 94 by a set screw 98 at a point corresponding to the axis of one of the three slots previously mentioned at the rear of the table top. Crank 97 is of a width less than that of the slot and is supplied with a top plate 99 of a width almost equal to that of the slot and extending for most of the length of the crank 97, said top plate of such thickness that when horizontal its surface (except for the end toward the rear of the table which curves downward to the top of crank 97) lies in the plane of the upper surface of the table top. Crank 97 terminates at the end away from the axle 94 in two spaced identical bosses 100 and 101, which are pierced by identical hollow circular bearings, having their axes in the same straight line, which line is parallel to the axis of axle 94.

Bosses 100 and 101 are separated by a rectilinear slot centered with respect to the width of the crank 97. The inner end of the said slot is a bent surface formed by the intersection of two rectangular planes, the upper (when the crank is horizontal) of which is perpendicular to the axis of the crank 97 and the lower of which makes an acute angle with the said major axis and slopes downward toward the front of the table.

An angle lever 102, having the vertex of its angle inserted between the bosses 100 and 101, is pivotally supported on a shaft 103, which is in turn supported at either end by the bearings in the bosses 100 and 101. A top plate 104, corresponding in width and in thickness to plate 99, is secured to the top of the upper arm of angle lever 102, and extends beyond the end of the lever 102 to the rear edge of the table top 28. When horizontal, the upper surface of top plate 104, except for a short curved portion at the front, lies in the plane of the upper surface of the table top. As will be apparent, the upper arm of angle lever 102 may be tapered from the point of flexure toward the extremity of the lever as desired.

The end of the normally lower or inclined arm of lever 102 is inserted between two projections of a forked member 105. A shaft 106 parallel to axle 94 is supported at either end by the projections of the member 105, and in turn supports angle lever 102 in a rotatable manner. Member 105 is fixed to one end of a rod 107, which slides in a sleeve 108. A coil spring 109, resting on the end of the sleeve 108, encircles the shaft 107, and supports the member 105. A set screw 110, passing through the wall of sleeve 108 and projecting into the center portion, acts in a groove of limited extent provided in the shaft 107 to allow sliding motion of the shaft 107 while preventing axial rotation of it, and its withdrawal from sleeve 108.

A second structure identical with the one just described is located at approximately the midpoint of axle 94 and comprises crank 111, set screw 112, top plate 113, projections or bosses 114 and 115, angle lever 116, shaft 117, top plate 118, forked member 119, shaft 120, rod 121, sleeve 122, spring 123 and set screw 124.

A third structure, spaced along axle 94 beyond the second structure a distance equal to that between the first two, is identical thereto and comprises crank 125, set screw 126, top plate 127, projections or bosses 128 and 129, angle lever 130, shaft 131, top plate 132, forked member 133, shaft 134, rod 135, sleeve 136, spring 137, and set screw 138.

A connecting bar 139, having its major axis parallel to the length of the table, is fixed near one end to the base of sleeve 108. This may be accomplished by inserting the base of sleeve 108 into a hole provided in the bar 139 and then screwing a bolt 140 through the bar 139 into the base of sleeve 108. Sleeve 136 is fixed to bar 139 near the opposite end by bolt 141.

Sleeve 122 is fixed to the bar 139 in a manner similar to that in which the other two sleeves are secured, except that the sleeve 122 is screwed to the end of the piston rod 142 of an air cylinder 143 mounted on the frame of the table below the bar 139 and its appurtenances. A nut 144, also acting on threads provided on the end of the piston rod, locks the sleeve to the bar 139.

Cylinder 143 is provided with a support or base 145 about which it may rotate to a limited extent in a single plane. The base 145 is secured to channel member 26, near the midpoint thereof, such that the axis of the cylinder 143 is tilted slightly from the vertical in the direction of the rear of the table, and when plate 118 is horizontal the axis of the lower arm of angle lever 116, of fixed member 119, rod 121, sleeve 122, and cylinder 143 lie in the same straight line. The cylinder 143 is also provided with a solenoid valve 146 adapted to admit compressed air to the cylinder or to allow its escape therefrom in response to electrical control circuits.

A precision switch 147 having an actuator 147*a* is secured to member 27 on the side away from crank 111 at a point opposite shaft 114. Switch 147 is mounted with the actuator 147*a* directed vertically downward.

A short strip 148, which projects toward the rear of the table, is secured to bar 139 near the center thereof (and on the same side with reference to the center as the switch 147) by means of a bolt 149. A socket set screw 150 projects upward from the extremity of strip 148, and is locked in position by means of a nut 151. Thus, when piston rod 142 of cylinder 143 is extended, bar 139 and strip 148 move upward, and set screw 150 engages the actuator 147*a* of switch 147.

An endless belt conveyor 152 may be placed behind the table and arranged to deliver goods onto the table. Conveyor 152 may consist essentially of a frame 153 at either end of which are rotatably supported pulleys 154 and 155 on which are supported the endless belts 156 and 157 in parallel spaced relation. Pulley 154 or 155 or both may be driven by any suitable means, such as, for example, an electric motor (not shown).

A horizontal link member 158, having its major axis parallel to the major axis of the conveyor, operates in a slot in the upper surface of the frame 153, beside the outer edge of belt 156, a short distance from the delivery end of conveyor 152. Horizontal link member 158 is pivotally connected at one end thereof to one end of a link 159 which is in turn pivoted at the opposite end to the frame 153 at a point 160, which is located below the upper surface of the frame 153 a vertical distance somewhat less than the length of the link 159. The opposite end of link member 158 is pivotally connected to one end of a link 161 which is slightly more than twice the length of link 159. Link 161 is pivoted to the frame 153 at a point 162 which is spaced from the end of the link 161 a distance equal to the length of link 159, and which point 162 is located in the same horizontal plane as point 160 and spaced therefrom a distance equal to the length of the horizontal link member 158.

A second structure, essentially identical with the one just described, is located between the belts 156 and 157 opposite the previously described structure and comprises a horizontal link member 163, a link 164 pivoted to the frame 153 at a point 165, and a link 166 pivoted to the frame at a point 167.

Link 166 differs from link 161 in that its lower extremity is forked to permit the introduction of a rod-like member between the sides thereof.

A third structure, identical with the first just described, operates in a third slot in the frame located beside the outer edge of belt 157 opposite the two just described. Such third structure comprises horizontal link member 168, link 169 pivoted to the frame 153 at point 170, and link 171 pivoted to the frame at a point 172 in the same horizontal straight line as points 162 and 167.

A horizontal cross member 173 extending across the conveyor from link 161 to link 171 is rigidly connected to the lower end of links 161, 166, and 171. Thus the three structures move together as a single unit, and horizontal members 158, 163, and 168 always remain parallel and in the same horizontal plane.

A base 174 carrying a pivot 175 is secured to the under side of the frame 153 at a point centrally located with respect to the width of the conveyor 152 and beneath the horizontal members 158, 163, and 168. An air cylinder 176, having a solenoid valve 177 and a piston (not shown) with a piston rod 178 is supported beneath the frame of the conveyor 152 in an essentially horizontal position by the pivot 175 at one end and by the piston rod 178 at the other, which latter is inserted between the prongs of the forked end of link 166, and pivotally connected to horizontal cross member 173.

The cylinder 176 is adapted to move the linkage structure, including the three horizontal link members 158, 163, and 168, into either of two positions. When the piston rod 178 is retracted, links 161, 166, and 171, and links 159, 164, and 169 make an acute angle with the vertical, and the horizontal link members 158, 163, and 168 are flush with the upper surface of the frame 153; when the piston rod 178 of air cylinder 176 is fully advanced, links 161, 166, 171, 159, 164, and 169 become vertical, and horizontal link members 159, 163, and 168 are raised a short distance above the surface of the belts 156 and 157.

For control of the operation of the air cylinder 176 and consequently the coacting linkage, a precision switch 179 is mounted on horizontal link member 158 with its actuator 180 protruding through a hole provided therefor in the upper surface of said member 158. Two more precision switches 181 and 182 may be mounted on the frame 153 at either end of the path of movement of the lower segment of link 161, with their actuators 183 and 184 adapted to coact therewith. Thus when the piston rod 178 is retracted and link 161 completes its movement switch 181 is activated; when piston rod 178 is advanced and link 161 completes its movement switch 182 is activated. A second linkage assembly identical with the first may be placed in spaced horizontal relation therefrom toward the receiving end of conveyor 152. Thus a horizontal link member 185 may be placed in a slot in the upper surface of frame 153 outside belt 156, connected at one end to a link 186, pivoted to the frame 153 at a point 187, and connected at the other end to a link 188, pivoted to the frame 153 at a point 189. A second horizontal link member 190 operates in a slot in frame 153 between belts 156 and 157, and is connected at one end to link 191 pivoted at a point 192 to the frame 153 and is connected at the other end to link 193 pivoted to the frame 153 at a point 194. Link 193 corresponds to link 166 and is supplied with a fork at its lower extremity. A third horizontal link member 195, operating in a slot in the frame 153 outside of the belt 157 completes the group, and is connected at one end to a link 196 pivoted to the frame at a point 197, and is connected at the other end to a link 198 pivoted to the frame 153 at a point 199.

A horizontal cross member 200, corresponding to

member 173, extends across the conveyor and is secured to the lower extremities of links 188, 193, and 198. A base 201 secured to the frame 153 below the link member 190 supports a pivot 202 which in turn supports one end of an air cylinder 203 having a solenoid valve 204 and a piston rod 205 which is inserted into the forked end of link 193 and pivotally connected to horizontal cross member 200. Precision switches 206 and 208 with actuators 207 and 209 correspond respectively to similar switches 179 and 181 on the first linkage assembly. A limit switch 210, having an actuator 211, is secured to the frame 153 at the end of the path movement of link 188 so that when piston rod 205 of cylinder 203 is advanced to its full extent and link 189 is vertical, the latter coacts with the actuator 211 of switch 210 to activate the switch.

Referring now to Fig. 5, switches 39, 85, 86, 78 and 147 have been shown herein in positions other than their actual ones as indicated in Figs. 1 to 3 in order that all may be clearly shown in a single figure together with all electrical connections. The actuators of switches 85, 86 and 147 have been made schematic, and strips 82 and 91 are shown in positions other than their true ones for the same purpose.

Leads 212 may represent any suitable A. C. supply of 110 volts which are connected to the primaries of four transformers 213, adapted to reduce the voltage to the desired amount for operation of the apparatus. Leads 214 and 215 are connected in parallel to the respective opposite sides of the secondaries of the four transformers 213.

A lead 216 connects lead 214 to the terminal of switch 38 which is common to both of its circuits. The normally closed circuit of the switch 38 is connected by means of a lead 217 to the common terminal of switch 86.

The normally closed circuit of switch 86 is connected to the advancing circuit terminal of solenoid valve 52 by means of a lead 218. The circuit is completed by a lead 219 which connects the common terminal of solenoid valve 52 to the lead 215 to complete the circuit.

A lead 220 connects the normally open circuit terminal of the switch 38 to the common circuit terminal of switch 85. The normally open circuit terminal of switch 85 is in turn connected to the retraction circuit terminal of valve 52 by means of a lead 221. The circuit is again completed through the common terminal of the valve 52 and leads 219 and 215.

The normally open circuit terminal of switch 38 is connected by means of lead 220 and another lead 225 to the common terminal of switch 78. The normally open circuit terminal of switch 78 is connected by means of a lead 226 to the advancing circuit terminal of solenoid valve 146. A lead 227 connects the common circuit terminal of valve 146 to the lead 215 to complete the circuit.

To control retractions of cylinder 143, the normally open circuit terminal of switch 38 is connected by means of leads 220, 225, and a lead 228 to the common circuit terminal of switch 147. The normally open circuit terminal of switch 147 is connected by means of a lead 229 to the retraction circuit terminal of solenoid valve 146. The circuit is again completed through the common terminal and leads 227 and 215.

Operation of cylinders 51 and 143 is controlled by the circuits just described. If, when the door 32 is tilted upward and switch 38 is in the normal position, the piston of cylinder 51 is in its lower or retracted position, then the circuit including the secondaries of transformers 213, leads 214 and 216, switch 38, lead 217, switch 86, lead 218, the advancing circuit of solenoid valve 52, lead 219, and lead 215 is completed, and if air pressure is applied to the valve 52, the piston of cylinder 51 is advanced. When the piston rod reaches the end of the stroke, strip 91 engages the actuator 90 of switch 86, opening the switch and consequently the circuit. If then the door 32 is pressed down, the normally closed circuit of switch 38 is opened and the normally open circuit thereof is closed, thereby closing the circuit including the transformer secondaries, leads 214 and 216, switch 38, lead 220, switch 85 (closed by strip 91 coacting with actuator 89), lead 221, the retraction circuit of solenoid valve 52, and leads 219 and 215. As a result the piston rod 53 is retracted, and member 55 carrying with it strip 91 moves downward allowing switch 85 to open and switch 86 to close. Thus, the circuit, including the retraction circuit of the solenoid valve 52, is opened by the retraction of piston rod 53.

As the piston rod 53 and the cooperating member 55 make their downward stroke strip 82 engages actuator 79 of switch 78, closing the switch. Closing of switch 78 completes the circuit, including transformers 213, leads 214 and 216, switch 38 (with door 32 down), leads 220 and 225, switch 78, lead 226, the advancing circuit of solenoid valve 146, and leads 227 and 215. Piston rod 142 of cylinder 143 is then advanced by air pressure carrying upward with it bar 139 and its assemblies, including cranks 97, 111 and 125, and angle levers 102, 116, and 130.

The action of the lever and crank assemblies and the shaft and sleeve assemblies may best be described in terms of the operation of one of each. Thus, as shown in Fig. 4, when the piston rod 142 advances, its motion is transmitted to the bar 139 and in turn to sleeve 108. Upward motion of sleeve 108 is transmitted through spring 109 to member 105 which is guided by the action of shaft 107 in sleeve 108. Motion of member 105 is, in turn, transmitted through shaft 106 to angle lever 102, shaft 103, and crank member 99. As the assembly rises, crank 99 and lever 102 pivot about shaft 96 together as a unit. After the mechanism has moved a short distance, however, lever 102 rotates about its pivot 103 and the lever consisting of the two members (crank 99 and lever 102) buckles as it were, giving a decided flip to the outer end of lever 102 and consequently in a greater degree to the extremity of top plate 104.

When the crank 97 reaches a point where it makes an angle of less than 45° with the vertical, the strip 99 comes into engagement with the table top. Any further motion of the piston rod 142 is absorbed by the spring 109 and movement of shaft 107 into the sleeve 108. The movements just described for crank 97, angle lever 102 and their appurtenances are duplicated at the same time and to the same degree by cranks 111 and 125, and angle levers 116 and 130, and their respective shafts, springs, and sleeves. Thus the three cranks 97, 111, and 125 and the three angle levers 102, 116, and 130 move together as a single articulated unit, wherein the respective members spaced along the table maintain an identical although changing relation with the table top.

When the piston rod 142 of cylinder 143 reaches the end of its stroke, set screw 150, mounted on strip 148, comes into operative contact with the actuator 147*a* of switch 147 and closes the switch. Closure of switch 147 completes the circuit, including the transformer secondaries, leads 214 and 216, switch 38, leads 220, 225, and 228, switch 147, lead 229, the retraction circuit of solenoid valve 146 and leads 227 and 215. This causes the piston rod 142 to be retracted and the cycle is completed.

Operation of the cylinders 176 and 203 is controlled by switches 40 and 39 on the table, switches 179, 181, 182, 206 and 208 on the conveyor, and their coacting circuits. A lead 230 connects leads 214 to the common circuit terminal of switch 40. The normally open circuit of switch 40 is connected by means of a lead 231 to the common circuit terminal of switch 179. The normally open circuit of switch 179 is connected by means of leads 232 and 233 to the common circuit terminal of switch 181. The normally open circuit of switch 181 is in turn connected by means of a lead 234 to the advancing circuit of solenoid valve 177. The circuit is completed by lead 235 which connects the common circuit terminal of solenoid valve 177 to lead 215.

Lead 232 connects the normally open circuit of switch 179 to the common circuit terminal of switch 206. A lead 236 connects the normally open circuit of switch 206 to the common circuit terminal of switch 208. A further lead 237 connects the normally open circuit terminal of switch 208 to the advancing circuit terminal of solenoid valve 204. A lead 238 connecting the common circuit terminal of solenoid valve 204 to lead 215 completes the circuit. Thus when the door 29 is depressed it coacts with the actuator 40*a* of switch 40 to close the normally open circuit of the switch. If, while the door 29 is depressed, the actuator 180 of switch 179 is depressed, closing the normally open circuit of switch 179, and at the same time link 161 rests against actuator 183 of switch 181 keeping the normally open circuit closed, then the circuit including the advancing circuit of solenoid valve 177 is completed and the air pressure extends the piston rod 178, moving links 161, 166, and

171 about pivot points 162, 167, and 172 respectively and raising link members 158, 163, and 168; at the same time, link 161 moves away from contact with actuator 183 of switch 181 and the switch opens, interrupting the circuit.

If, while door 29 is depressed, closing the normally open circuit of switch 40, while actuator 180 of switch 179 is depressed closing the normally open circuit thereof, and while piston rod 205 of cylinder 203 is retracted, holding link 188 against the actuator 209 of switch 208, thereby closing the normally open circuit of the said switch 208, if then, the actuator 207 of the switch 206 is depressed, the circuit including the secondaries of the transformers 213, leads 214 and 230, switch 40, lead 231, switch 179, lead 232, switch 206, lead 236, switch 208, lead 237, the advancing circuit of solenoid valve 204, leads 238 and 215 is completed and the valve 204 moves into the advancing position allowing the air pressure to extend or advance the piston rod 205. Advancement of piston rod 205 causes levers 188, 193, and 198 to pivot about points 189, 194, and 199 respectively, thereby raising horizontal link members 185, 190 and 195. At the same time, motion of link 199 away from the actuator 209 of switch 208 allows the normally open circuit of the switch to open.

Retraction of cylinders 176 and 203 is controlled by the normally closed circuits of switches 40 and 39 acting together with switch 182. A lead 239 connects the normally closed circuit of switch 40 to the common circuit terminal of switch 39. A lead 240 connects the normally closed circuit of switch 39 to the common circuit terminal of switch 182. A lead 241 connects the normally open circuit of switch 182 to the retraction circuit of solenoid valve 204. And a lead 242 connects lead 241 (and through it the normally open circuit of switch 182) to the retraction circuit of solenoid valve 177. As a result of the above arrangement, when cylinder 176 or cylinders 176 and 203 are advanced, if thereafter door 29 rises under the influence of switch 40, thereby allowing switch 40 to return to its normally closed position (opening the normally open circuit and closing the normally closed circuit), and at the same time door 32 rises allowing switch 39 to return to its normally closed position, then the circuits including the secondaries of the transformers 213, and the respective retraction circuits of cylinders 176 and 203 are completed, the piston rods 178 and 205 are retracted and horizontal link members 158, 163, and 168, and 185, 190, and 195 are lowered.

Limit switch 210 is a conventional normally closed limit switch, which is kept normally closed, as by the action of a spring. It may be opened as by mechanical pressure applied to an actuator 211. Switch 210 is so placed on the frame 153 of conveyor 152 that when piston rod 205 is fully extended, link member 188 engages the actuator 211 and opens switch 210. The switch 210 is inserted into the electric power circuit for the motor which operates the conveyor so that when the switch is opened the motor and the conveyor stop.

In starting up the apparatus, electrical power is applied to the primaries of the four transformers, compressed air of a suitable pressure is applied to solenoid valves 52, 146, 177, and 204, and the motor of the conveyor is started. If the table top is clear, application of air pressure to valve 52 raises the member 55 together with bar 72, to its upper position. Cloth pieces or other sheet material in laps or layers are then delivered to the receiving end of the conveyor 152 at definite spaced intervals. This may be accomplished by hand or by another conveyor. In the case of cloth, the pieces are usually laid down in 36 inch laps or folds, as by a hooker, and then delivered to the conveyor. The operator stands facing the table at the front thereof directly opposite the conveyor. When the piece of goods is delivered to the rear of the table 10, he reaches across the table and draws it to him under the upraised bar 72 and lines it up against the guide 35. The weight of the cloth depresses door 32, shifting the switches 38 and 39 to their alternate positions. As previously explained, this lowers member 55 and bar 72.

When the bar 72 reaches the cloth on the table top, it comes to rest, but links 68, 69, 70, and 71 pivot about their supporting shafts and allow member 55 to complete its stroke while bar 72 adjusts itself to the height of the package. The device is thus adapted to receive packages of varying height or thickness—within, of course, predetermined limits.

As the assembly 55 descends, strip 82 coacts with actuator 80 of switch 78, which acts on the solenoid valve 146 of cylinder 143, causing the piston rod 142 to be extended and the three cranks 97, 111, and 125, together with levers 102, 116, and 130, to be raised. This raises the back half of the cloth package and bends it around the bar 72. As the levers raise the back of the package, the operator reaches over, grasps the back of the package, brings it forward to the guide to complete the fold, and evens it up to make an attractive appearance.

As previously described, the assembly including the piston rod 142, bar 139, and the coacting cranks and levers, returns to the table level automatically on completion of its stroke.

After completion of the fold, the operator slides the cloth package down the table to disengage it from the bar 72, and to move it on to tying and wrapping procedures.

Precision switches 39 and 40, together with switches 179 and 206, and the link systems including horizontal link member 158 and horizontal link member 185, prevent delivery of material to the table when another piece is already on the table. Material on conveyor 152, moving along the conveyor, closes switch 206 as it passes over it. Such material does the same with switch 179. If, at the time the material closes switch 179, door 29 is depressed, as by a piece of cloth resting on the table, with the resultant effect that the normally open circuit of switch 40 is closed, then piston rod 178 of cylinder 176 is advanced and the assembly, including horizontal link member 158 is raised, lifting the material with it from the conveyor belts. Forward motion of the piece of material is thus halted. If while switches 40 and 179 remain closed, a second piece of material moves up the conveyor 152 and closes switch 206, then piston rod 205 is extended and the assembly, including horizontal link member 185, is raised and the piece of material is raised with it from the conveyor. This prevents the piling up of material on the conveyor on account of its encountering horizontal link member 158 and appurtenances in their raised positions. To prevent piling up of material as it comes to the assembly including horizontal link member 181, when in the raised position, the limit switch 210 has been provided in the power circuit of the motor which drives the conveyor belts 156 and 157. When the assembly, including horizontal link member 185 is raised, link 184 coacts with actuator 211 of limit switch 210 to open the switch, thereby stopping the motor and consequently the conveyor belts.

Return to operation of the conveyor is effected by operation of switches 40 and 39 acting with switches 182 and 210. Return of switch 40 to its normally closed position is required to effect retraction of cylinders 176 and 203. However, it will not effect retraction unless switch 39 is also in its normally closed position. Thus switch 40 may return to its normal position after the cloth has been lifted by the levers and folded over bar 72, but retraction of cylinders 176 and 203 cannot occur until removal of the cloth from the table has allowed switch 39 to return to its normally closed position. As a consequence of the retraction of cylinder 203, limit switch 210 closes, allowing the motor to start up and normal movement along the conveyor to proceed. Such stoppages and shutdowns are, however, relatively infrequent, it being a rather simple matter for the operator to adapt himself to the delivery rate of the conveyor, thereby allowing the goods to flow continuously without interruption.

Preparation of the goods thus becomes almost completely automatic, with the operator performing but three simple operations. He pulls the goods forward to guide 35, he catches the rear half of the goods as it is thrown forward by levers 102, 116, and 130 and brings it forward to the guide 35; and he slides the goods down the table to be tied and shipped. As a result, an operation requiring muscular effort and a special skill becomes easy and simple, with the machine performing most of the physical work involved and eliminating the need for specialized skill. In this way, operators are enabled to increase their production several times.

The specific embodiment of the invention has been described in detail. Manifestly, certain obvious changes may be made without departing from the principles of

the invention. As examples, the number of articulated levers could be increased or reduced from the three shown without impairing their function; the conveyor need not be horizontal but might be inclined slightly; or the assemblies on the conveyor for lifting the material from the conveyor belt might be replaced by a single assembly. Or the operation of the various parts need not be automatic, but might instead be controlled by the operator.

What is claimed is:

1. Cloth folding assembly comprising a cloth receiving table, a cloth folding bar suspended over the middle of the table, switch controlled means in back of the bar responsive to contact with the cloth for lowering and raising the folding bar, a crank in front of the bar constructed and arranged to lift the cloth toward the bar and out of the plane of the table's surface when the bar is lowered, and switch controlled means governed by movement of the crank for lowering the crank after it has been raised.

2. Cloth folding assembly comprising a table for receiving the cloth to be folded, a vertically movable bar suspended longitudinally across the table for holding the cloth while the fold is being made, an air cylinder under the table equipped with a coacting solenoid valve and piston rod for reciprocation of the bar in a vertical plane, a switch mounted underneath a normally open door hinged to the surface of the table in back of the bar, an electrical circuit connecting the switch to the solenoid valve for retracting the piston rod and the bar when the cloth being folded contacts the open door and closes it, at least one crank pivotally fixed to the front of the table in advance of the bar and the door for lifting cloth to be folded out of the plane of the table's surface and toward the folding bar before the folding bar is retracted, an air cylinder for controlling extension and retraction of the crank comprising a piston shaft connected at one end to the crank, and a solenoid valve, an electrical switch connected to the solenoid valve and adapted to be actuated by contact with the piston rod of the air cylinder controlling movement of the folding bar when the bar is retracted, thereby actuating the solenoid valve to extend the piston shaft of the air cylinder controlling the crank, an electrical switch controlled means for retracting the crank fixed to the under side of the table below the crank constructed and arranged to be actuated by the piston shaft of the air cylinder controlling the crank when the crank is completely extended, and an independent electrical switch connected to the solenoid valve controlling movement of the folding bar and adapted to energize the solenoid valve to raise the piston rod and the bar when the folded cloth is removed from the bar.

3. Cloth folding apparatus comprising in combination, a table to receive the cloth to be folded, a crank pivoted to the front of the table to lift the cloth up from the table at the beginning of the fold, a folding bar suspended across the middle of the table in back of the crank to hold the cloth while the fold is being completed, electrical switch controlled means in the rear of the table behind the folding bar for retracting the bar when the cloth being folded is in contact with the switch controlled means, and for raising the bar when the folded cloth is removed from the table, switch controlled means connecting the bar and the crank constructed and arranged to elevate the crank when the folding bar is retracted, and independent switch controlled means secured to the table under the crank for lowering the crank after it has been elevated.

4. Cloth folding apparatus comprising in combination, a stationary table for receiving the cloth to be folded, a movable crank pivotally secured to the forward part of the table for lifting the cloth toward the middle of the table, a fixed air cylinder comprising a movable piston shaft connected to the crank under the table for extending and retracting the movable crank, a vertically movable folding bar suspended across the width of the table to hold the cloth against movement while it is being folded after its removal from the forward crank, another fixed air cylinder having a movable piston rod connected to the folding bar under the table for raising and lowering the bar, switch controlled means incorporated in the rear part of the table and connected to the air cylinder having the piston rod controlling movement of the folding bar for lowering the bar toward the table when the cloth being folded reaches the back of the table, and for raising the bar away from the table when the folded cloth is removed from the folding bar, independent switch controlled means connected to the air cylinder comprising the piston shaft controlling movement of the pivoted crank constructed and arranged to lift the crank when the folding bar is lowered, and stop controlled means fixed to the under side of the table for returning the crank to its retracted position after completion of its stroke.

5. The combination in a cloth folding device of a stationary table, a movable link pivoted at one end to the table, a bellcrank centrally pivoted to the free end of the movable link, having one of its arms forming part of the table surface and having its other arm terminating below the table surface, an air cylinder comprising a solenoid valve and a coacting piston shaft connected at its upper end to the bellcrank arm below the table surface, and switch means adapted to actuate the solenoid valve thereby advancing the piston shaft of the air cylinder to raise both bellcrank arms above the plane of the table surface.

6. Assembly for folding cloth bundles or the like comprising in combination, a conveyor for delivering the bundles, a table for receiving the bundles from the conveyor, a transverse bar suspended over the table for making a fold in each individual bundle, a bellcrank centrally pivoted to the table for lifting each bundle individually toward the folding bar, switch controlled means in back of the folding bar responsive to the weight of the cloth bundle being folded to lower the bar, means incorporated in the table for suspending delivery of additional bundles from the conveyor to the table while one bundle is being folded on the table, independent switch controlled means for lowering the bellcrank and raising the folding bar, and means for resuming the delivery of cloth bundles to be folded from the conveyor to the table after the folded bundle has been removed from the folding table.

7. Cloth folding apparatus comprising the combination with a stationary table for receiving the cloth to be folded, of a movable folding bar suspended across the middle of the table, a crank pivoted to the table in front of the folding bar for lifting the cloth toward the bar above the plane of the table's surface, an air cylinder mounted below the level of the table top and comprising a piston rod for controlling vertical displacement of the folding bar, another air cylinder underneath the table and having a piston shaft for controlling rotation of the crank, and an assembly of switch controlled means for successively retracting the piston rod that controls vertical displacement of the folding bar, extending the piston shaft that controls rotation of the crank, retracting the same piston shaft to rotate the crank in the opposite direction, and extending the piston rod controlling vertical displacement of the folding bar.

8. Assembly for folding cloth bundles or the like comprising in combination, a conveyor for delivering the bundles to the cloth folder, a table for receiving the bundles from the conveyor, a folding bar suspended over the table for making a fold in each individual bundle after it is received on the table from the conveyor, a bellcrank for lifting each bundle individually from the table toward the folding bar, means responsive to the weight of the bundle being folded to lower the folding bar, means for suspending delivery of additional bundles from the conveyor to the table while the bundle is being folded, means for lowering the bellcrank, means for raising the folding bar, and means for resuming delivery of the cloth bundles to be folded from the conveyor to the table after each folded bundle has been removed from the folding table.

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