March 31, 1964 E. HAJOS 3,126,657

FOLDING AND STACKING MACHINE FOR ARTICLES OF LINEN

Filed May 12, 1953 14 Sheets-Sheet 1

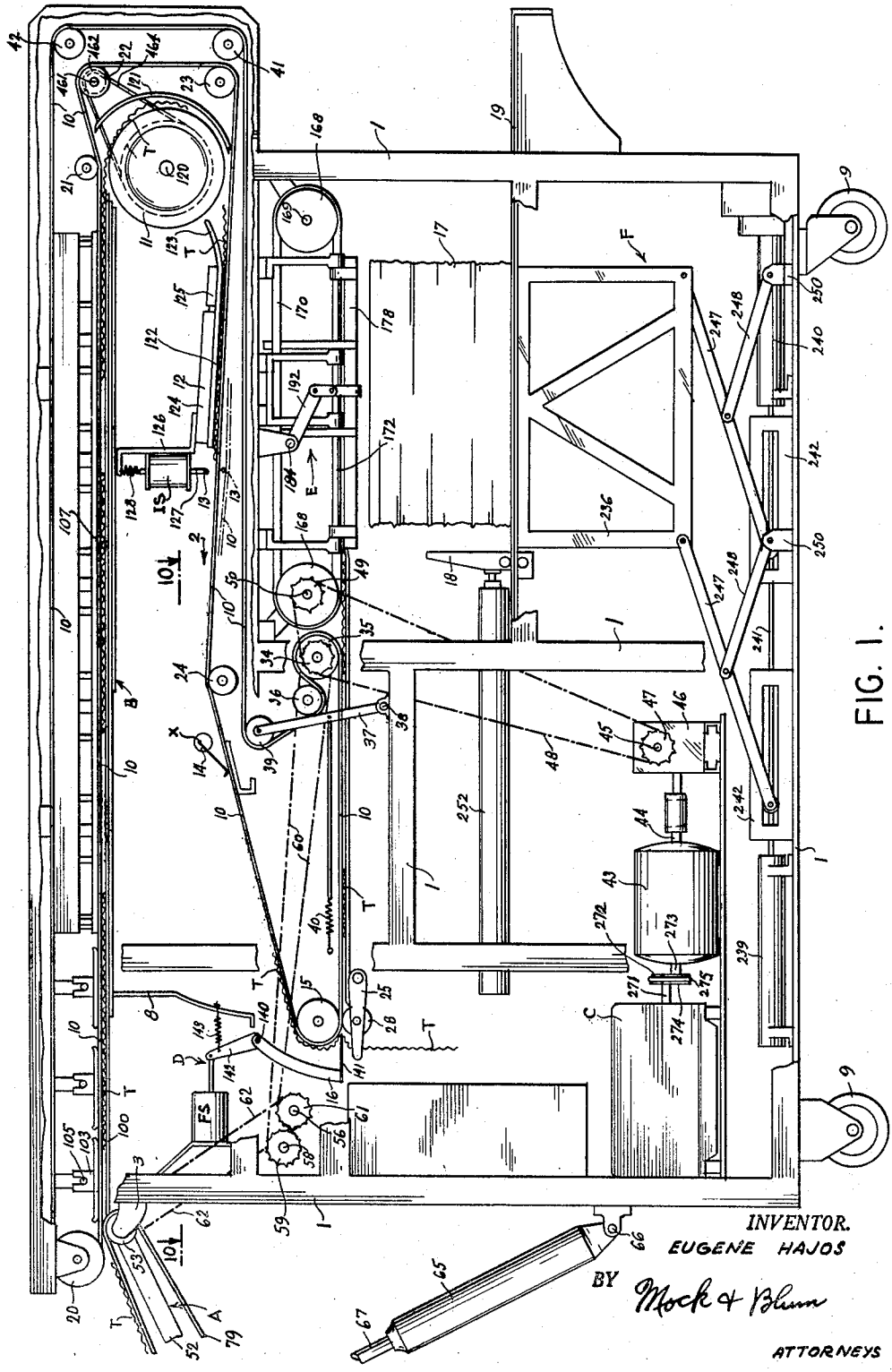


FIG. 1.

INVENTOR.
EUGENE HAJOS
BY Mock & Blum
ATTORNEYS

March 31, 1964 E. HAJOS 3,126,657

FOLDING AND STACKING MACHINE FOR ARTICLES OF LINEN

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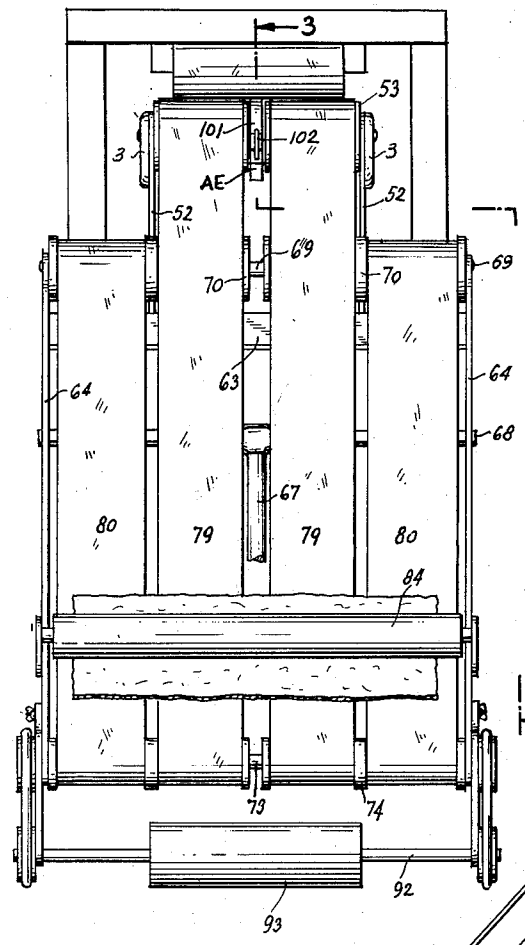
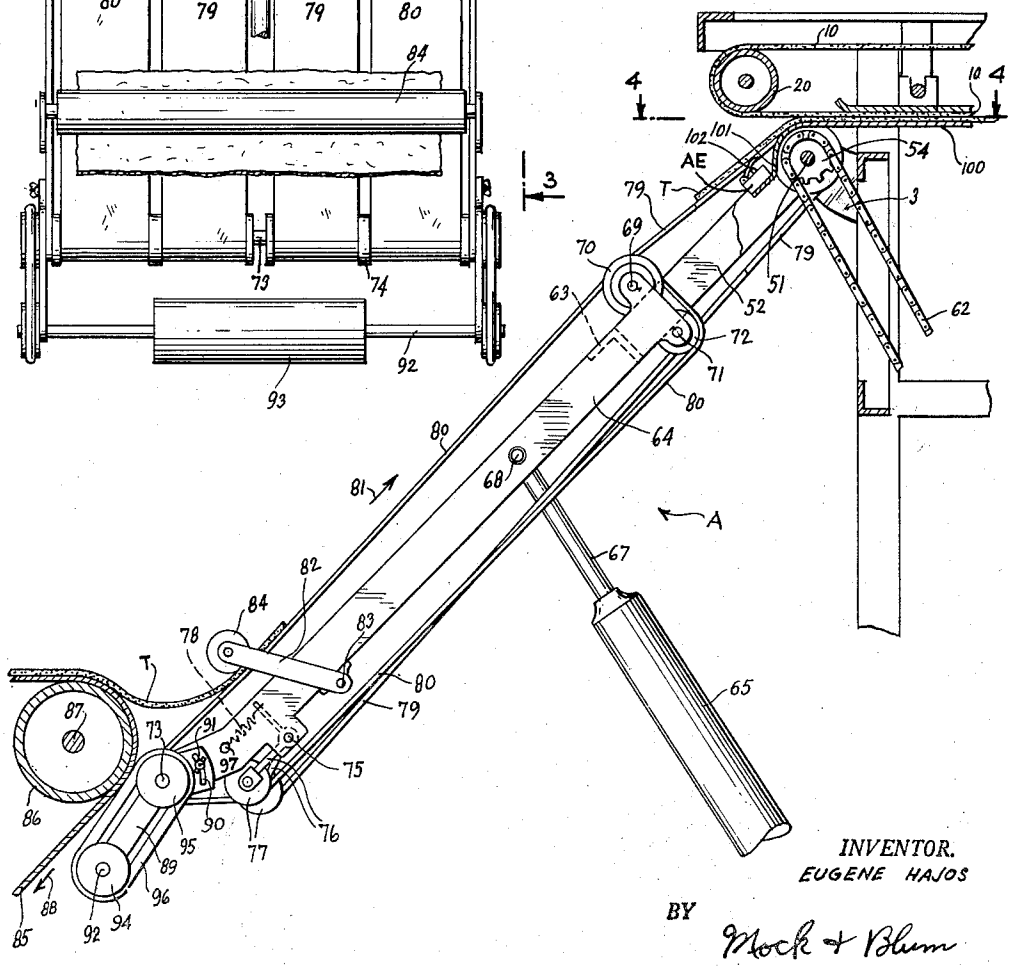


FIG. 2.

FIG. 3.



INVENTOR.
EUGENE HAJOS

BY Mock & Blum

ATTORNEYS

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FOLDING AND STACKING MACHINE FOR ARTICLES OF LINEN

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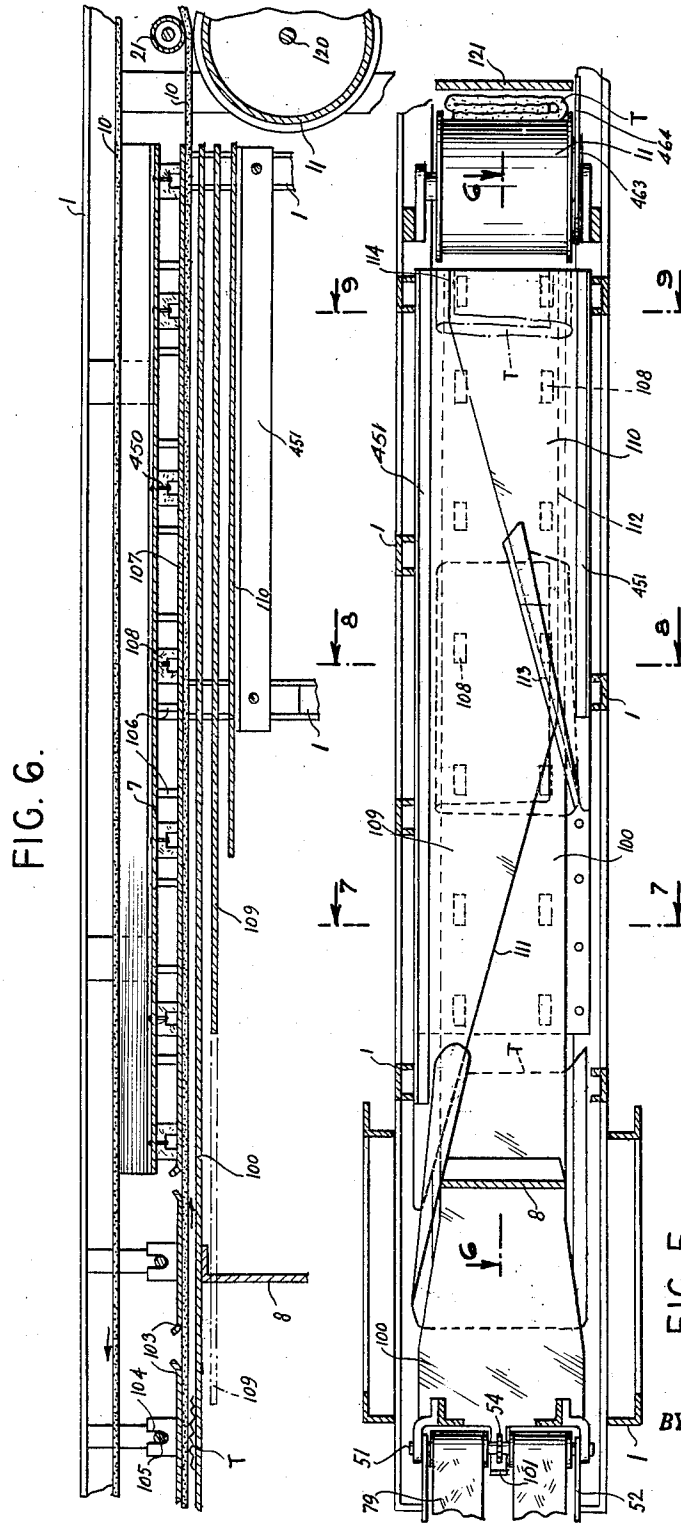


FIG. 6.

FIG. 5.

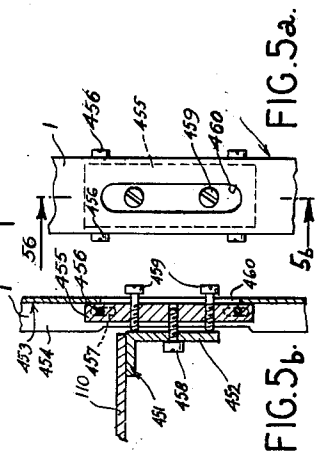


FIG. 5a.

FIG. 5b.

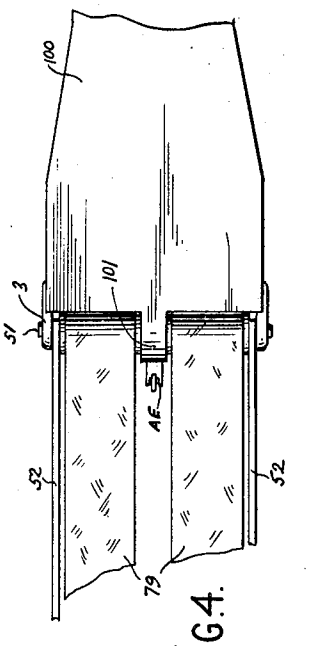


FIG. 4.

INVENTOR.
EUGENE HAJOS
BY Mock & Blum
ATTORNEYS

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FOLDING AND STACKING MACHINE FOR ARTICLES OF LINEN

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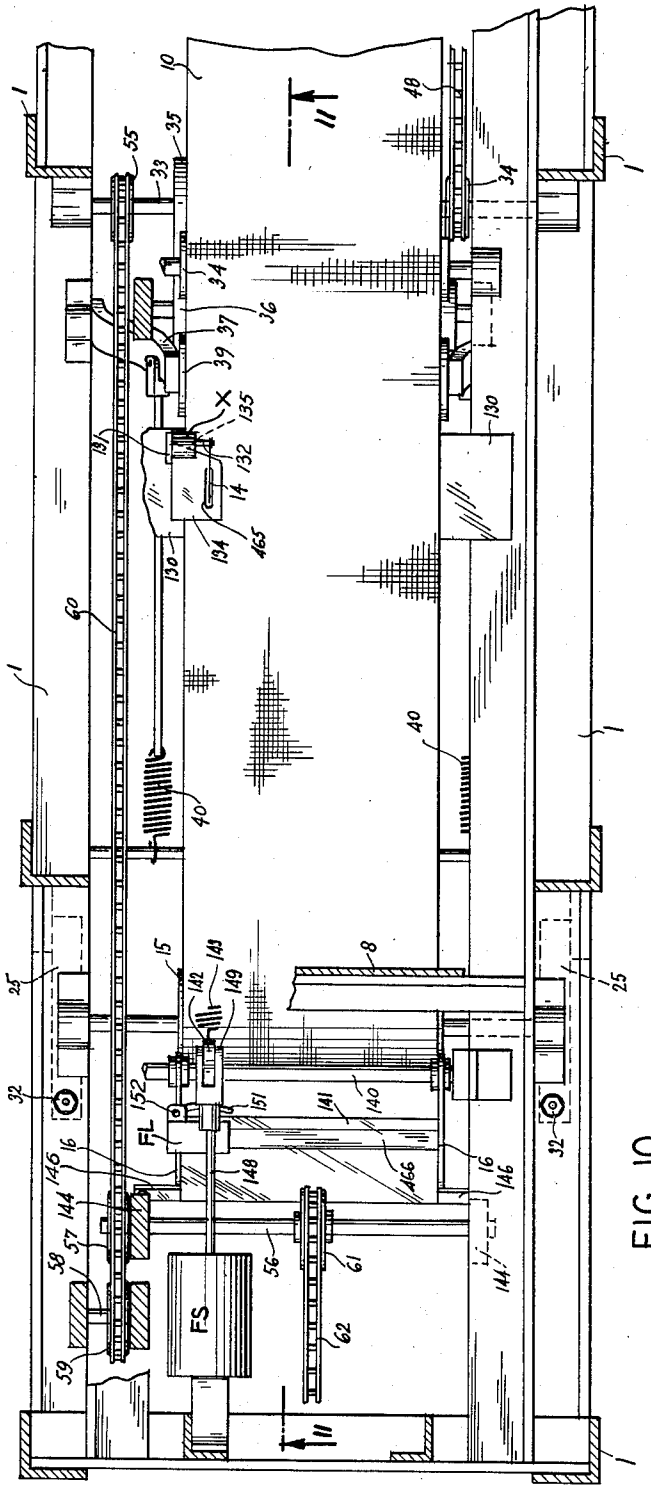


FIG. 10.

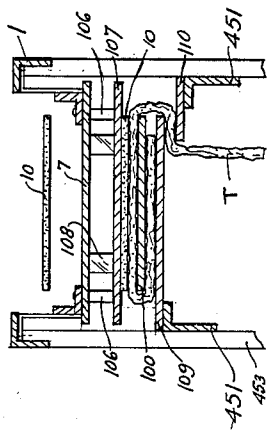


FIG. 8

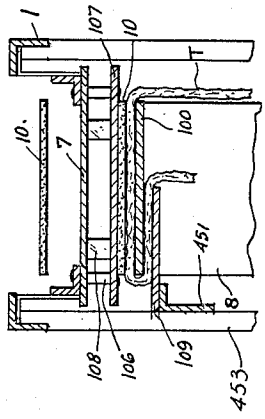


FIG. 7.

INVENTOR.
EUGENE HAJOS
BY Mock & Blum
ATTORNEYS

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FOLDING AND STACKING MACHINE FOR ARTICLES OF LINEN

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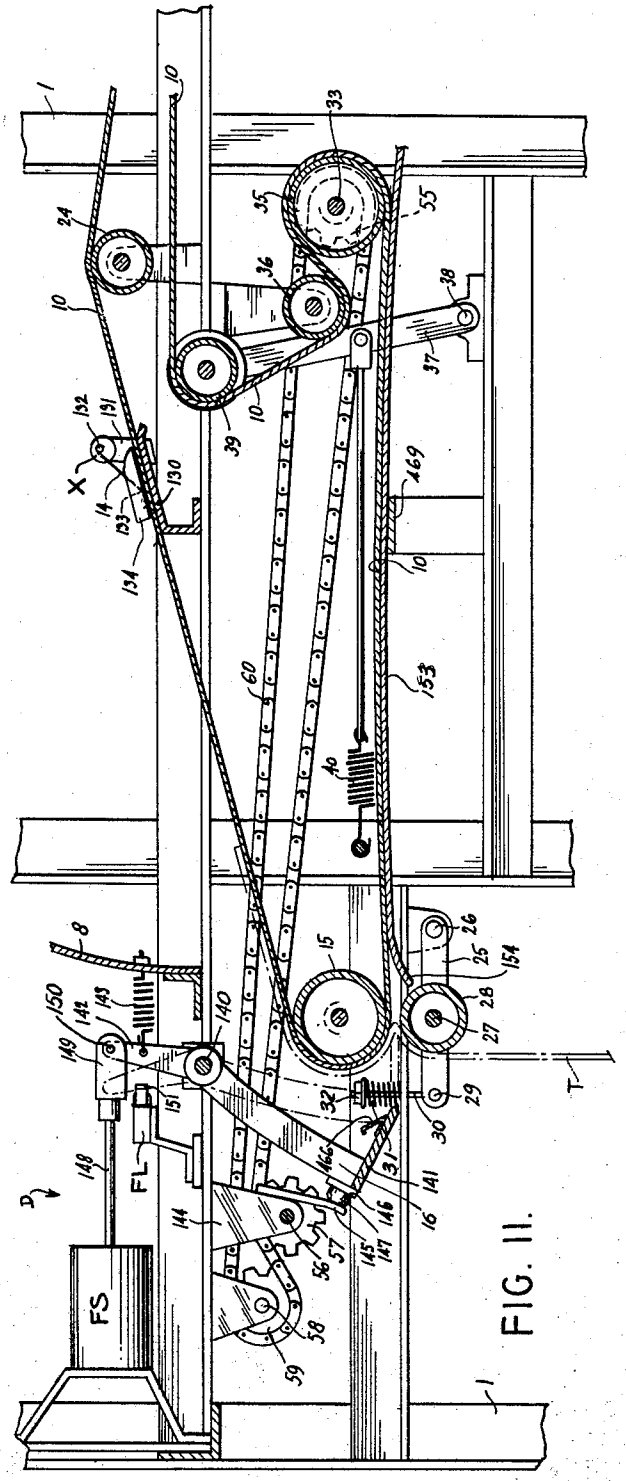


FIG. 11.

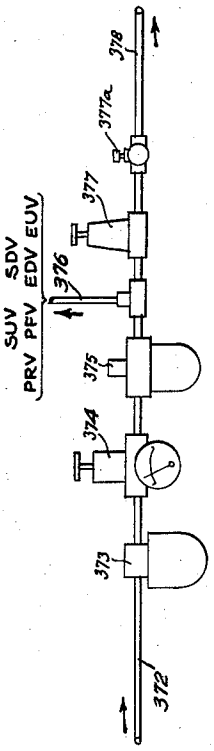


FIG. 18.

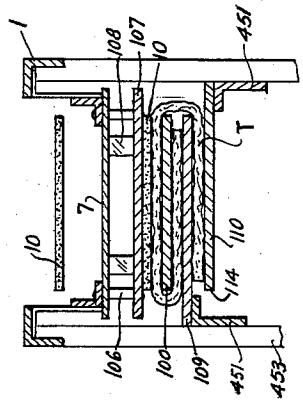


FIG. 9.

INVENTOR.
EUGENE HAJOS
BY Mock & Blum
ATTORNEYS

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FOLDING AND STACKING MACHINE FOR ARTICLES OF LINEN

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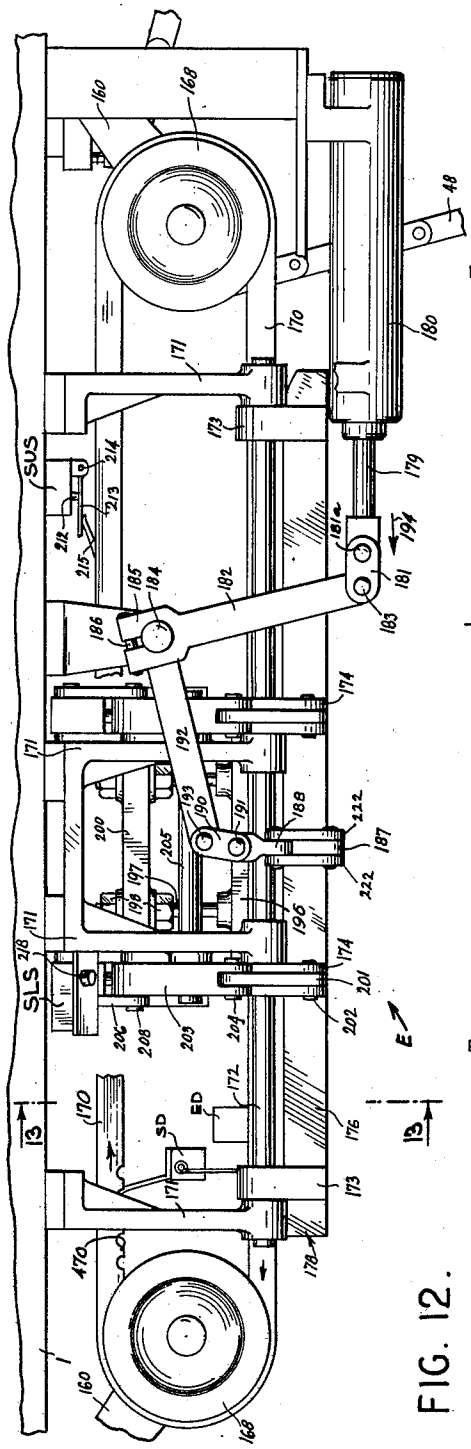


FIG. 12.

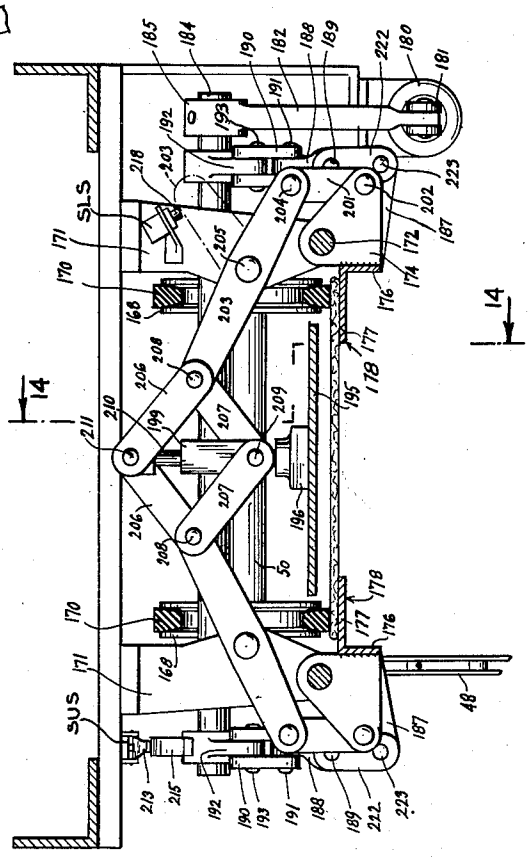


FIG. 13.

INVENTOR.
EUGENE HAJOS
BY Mock & Blum
ATTORNEYS

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FOLDING AND STACKING MACHINE FOR ARTICLES OF LINEN

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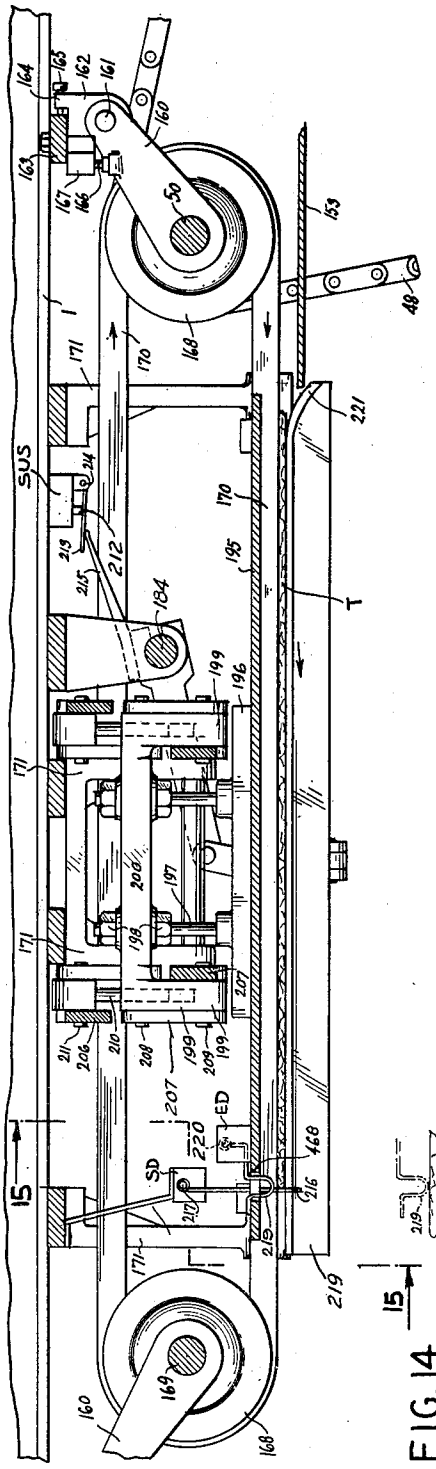


FIG. 14.

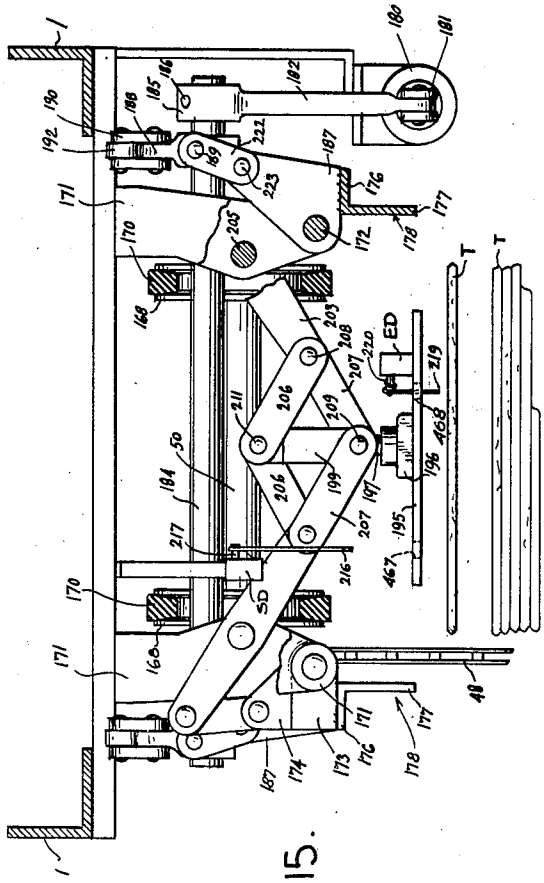


FIG. 15.

INVENTOR.
EUGENE HAJOS
BY Mock & Blum
ATTORNEYS

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FOLDING AND STACKING MACHINE FOR ARTICLES OF LINEN

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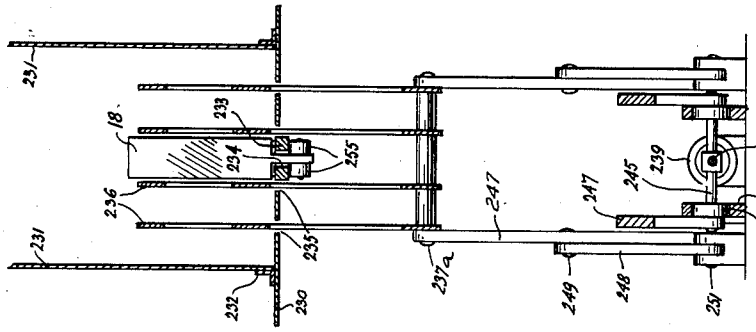


FIG. 17.

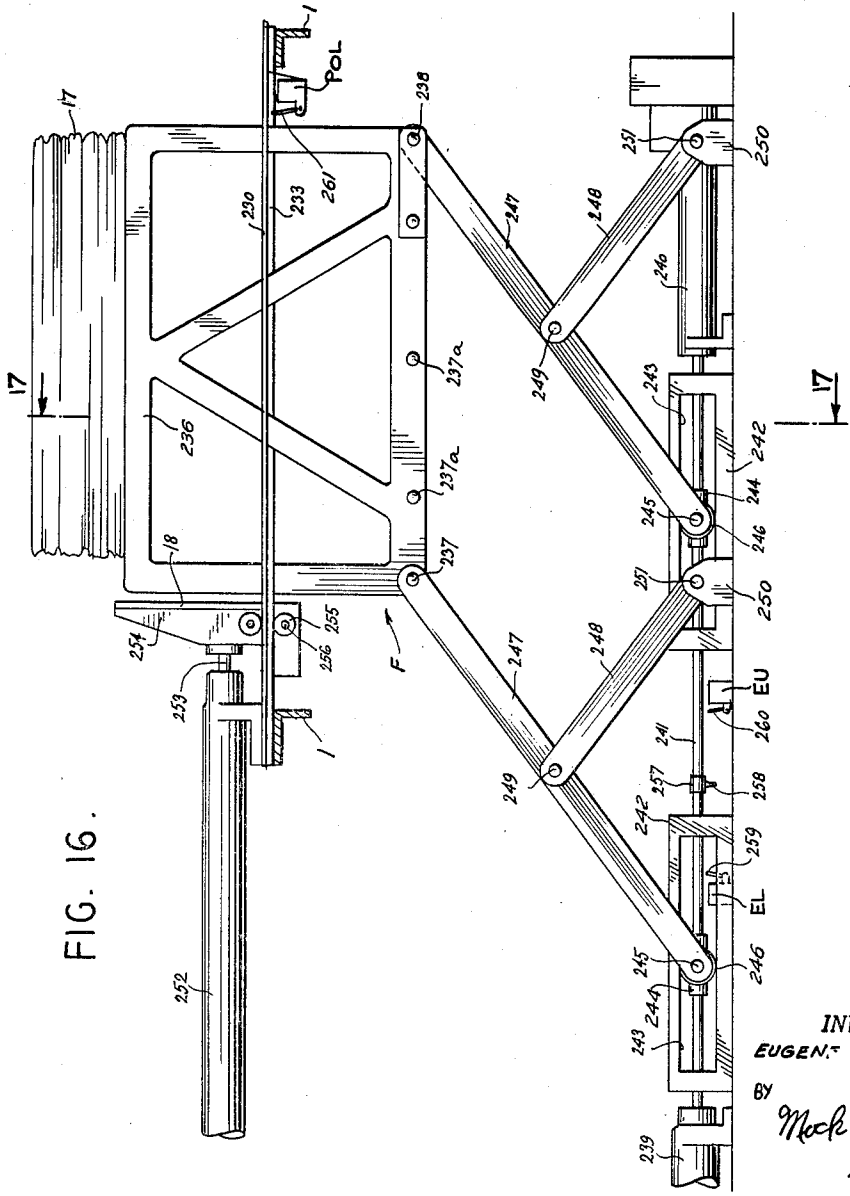


FIG. 16.

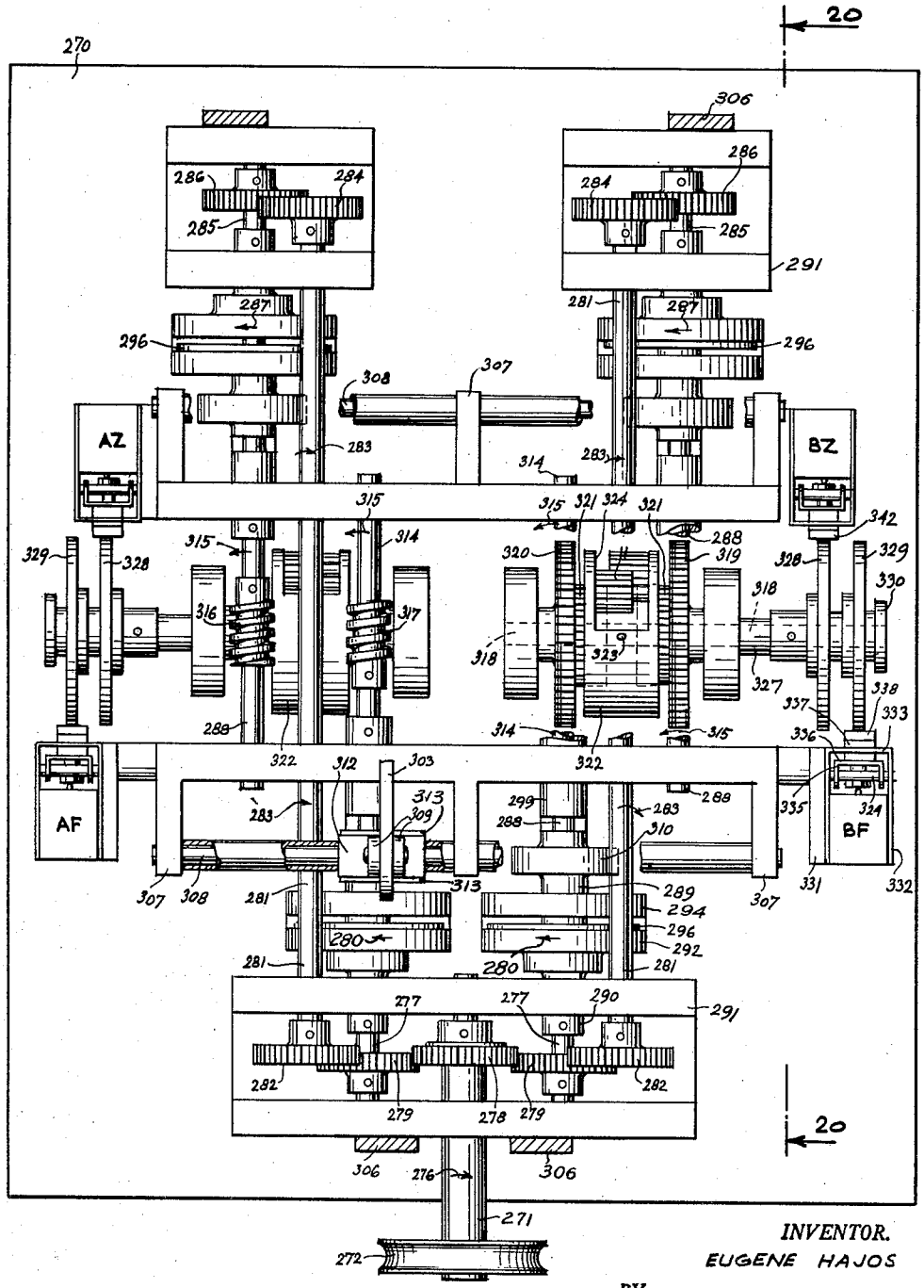
INVENTOR.
EUGENE HAJOS
BY
Mock & Blum
ATTORNEYS

March 31, 1964 E. HAJOS 3,126,657

FOLDING AND STACKING MACHINE FOR ARTICLES OF LINEN

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FIG. 19.



INVENTOR.
EUGENE HAJOS

BY Mock & Blum

ATTORNEYS

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FOLDING AND STACKING MACHINE FOR ARTICLES OF LINEN

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FIG. 20.

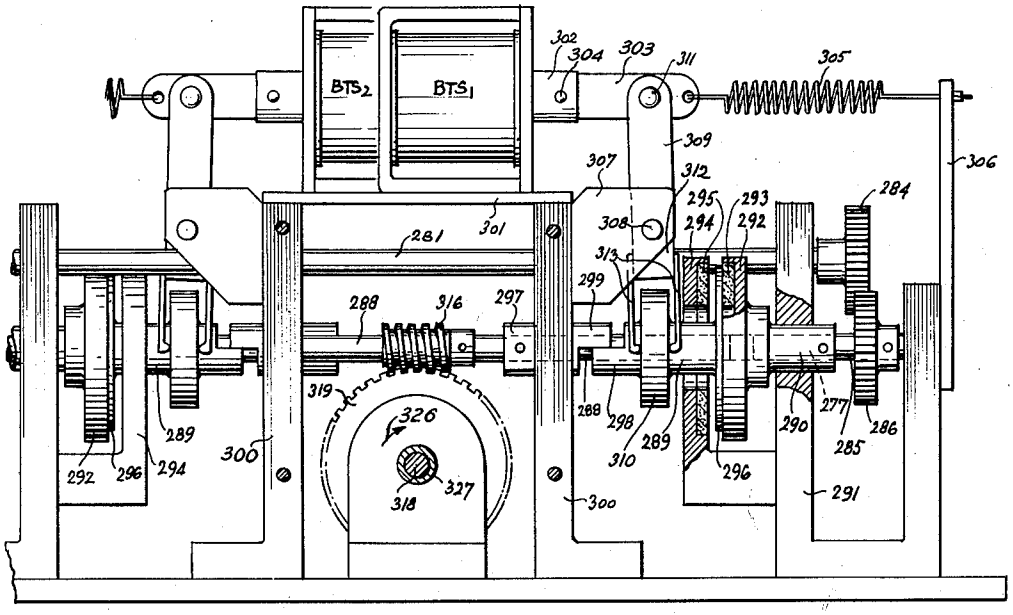


FIG. 22.

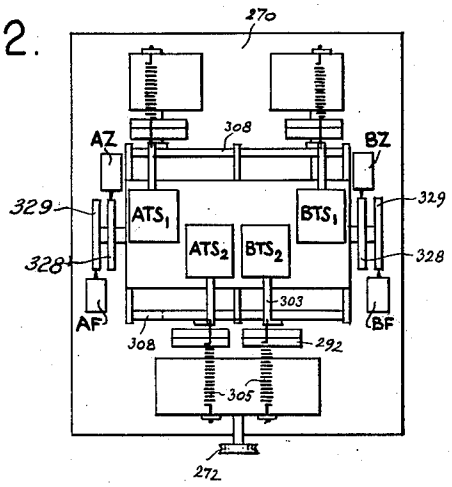
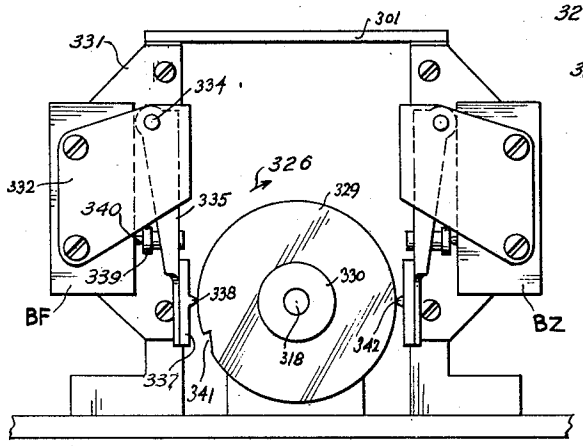


FIG. 21.



INVENTOR.
EUGENE HAJOS
BY Mack + Blum
ATTORNEYS

March 31, 1964 E. HAJOS 3,126,657

FOLDING AND STACKING MACHINE FOR ARTICLES OF LINEN

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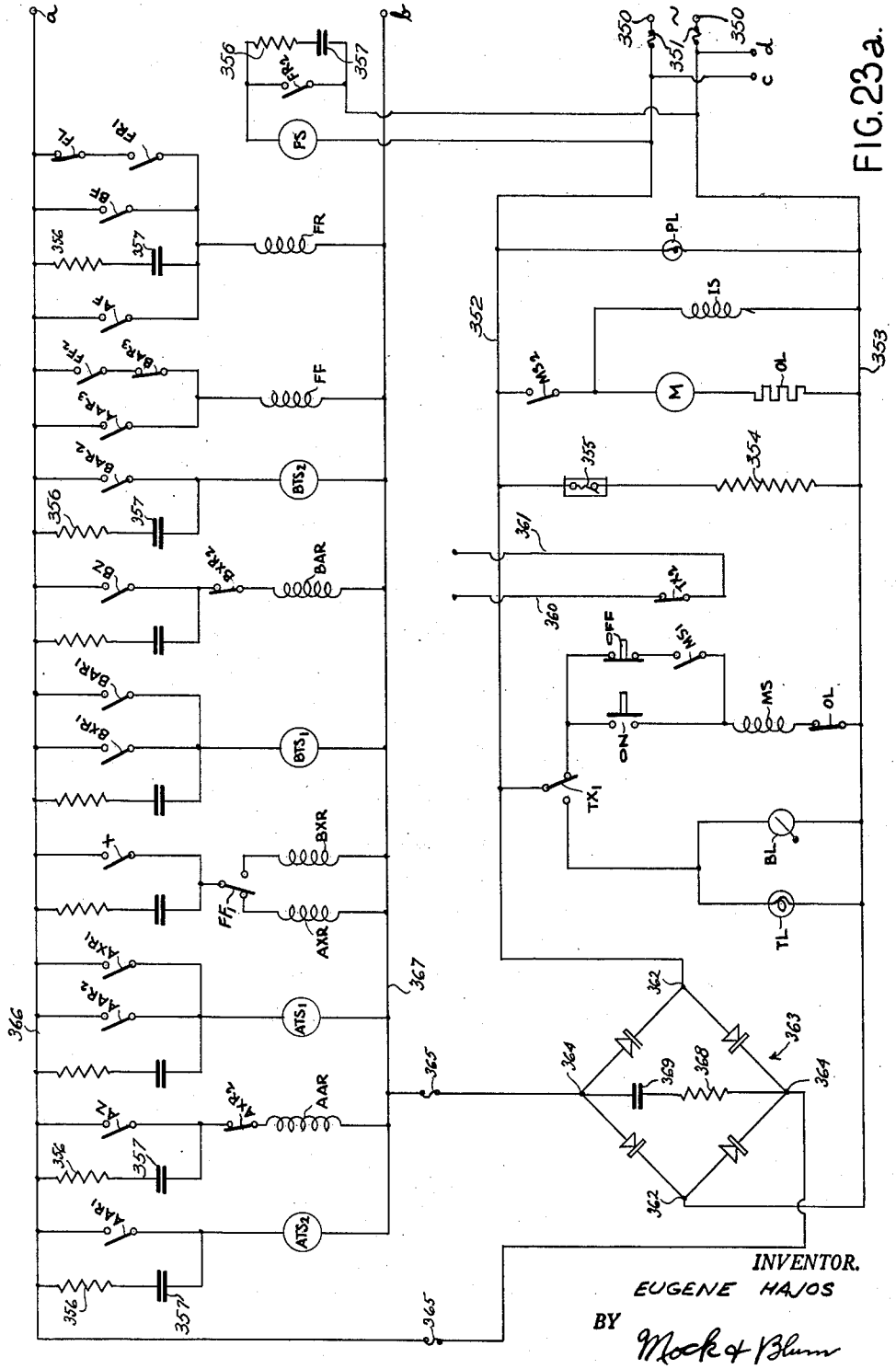


FIG. 23a.

INVENTOR.
EUGENE HAJOS
BY Mock & Blum
ATTORNEYS

March 31, 1964 E. HAJOS 3,126,657

FOLDING AND STACKING MACHINE FOR ARTICLES OF LINEN

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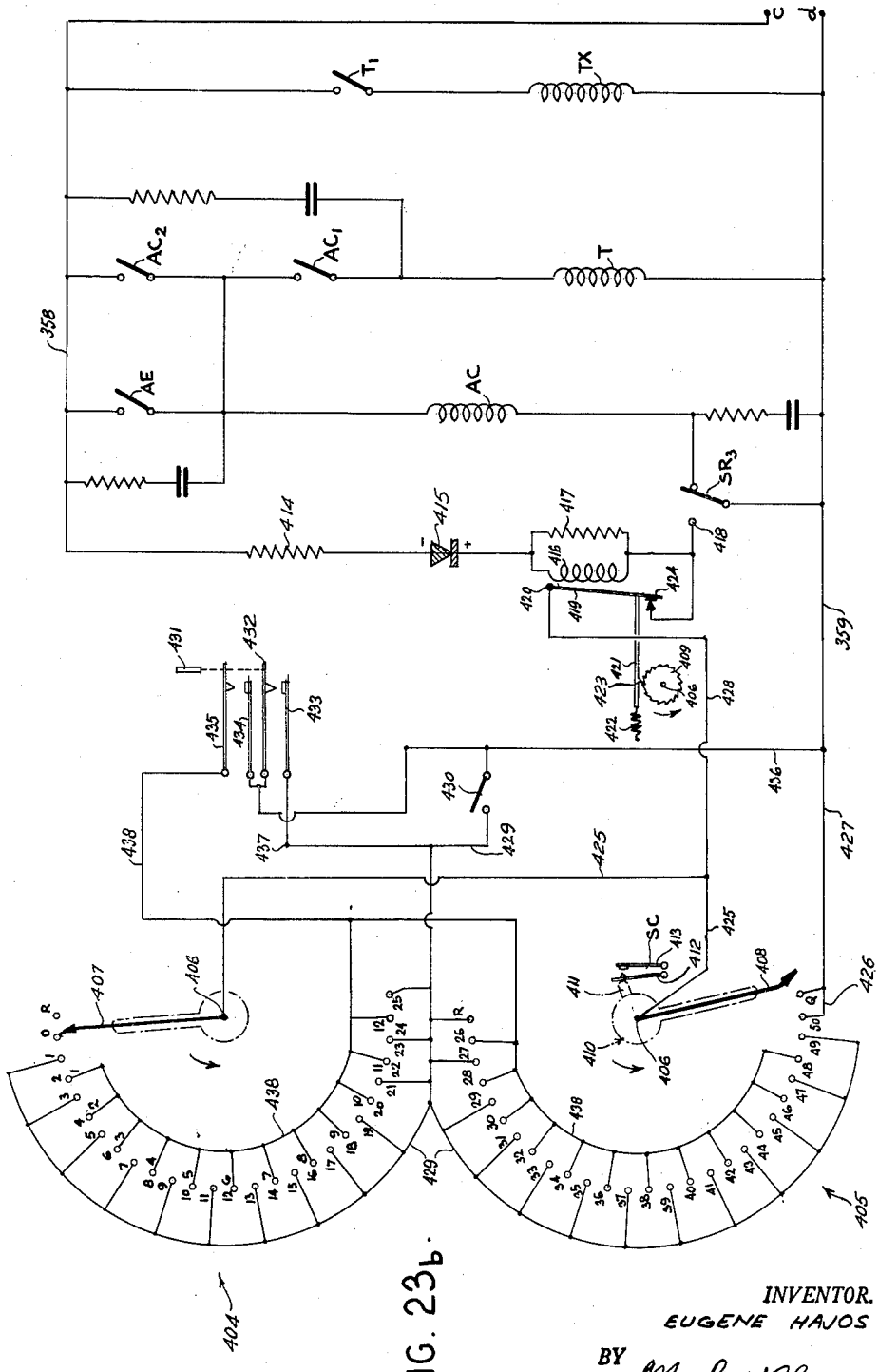


FIG. 23b.

INVENTOR.
EUGENE HAJOS

BY Mock & Blum

ATTORNEYS

March 31, 1964 E. HAJOS 3,126,657

FOLDING AND STACKING MACHINE FOR ARTICLES OF LINEN

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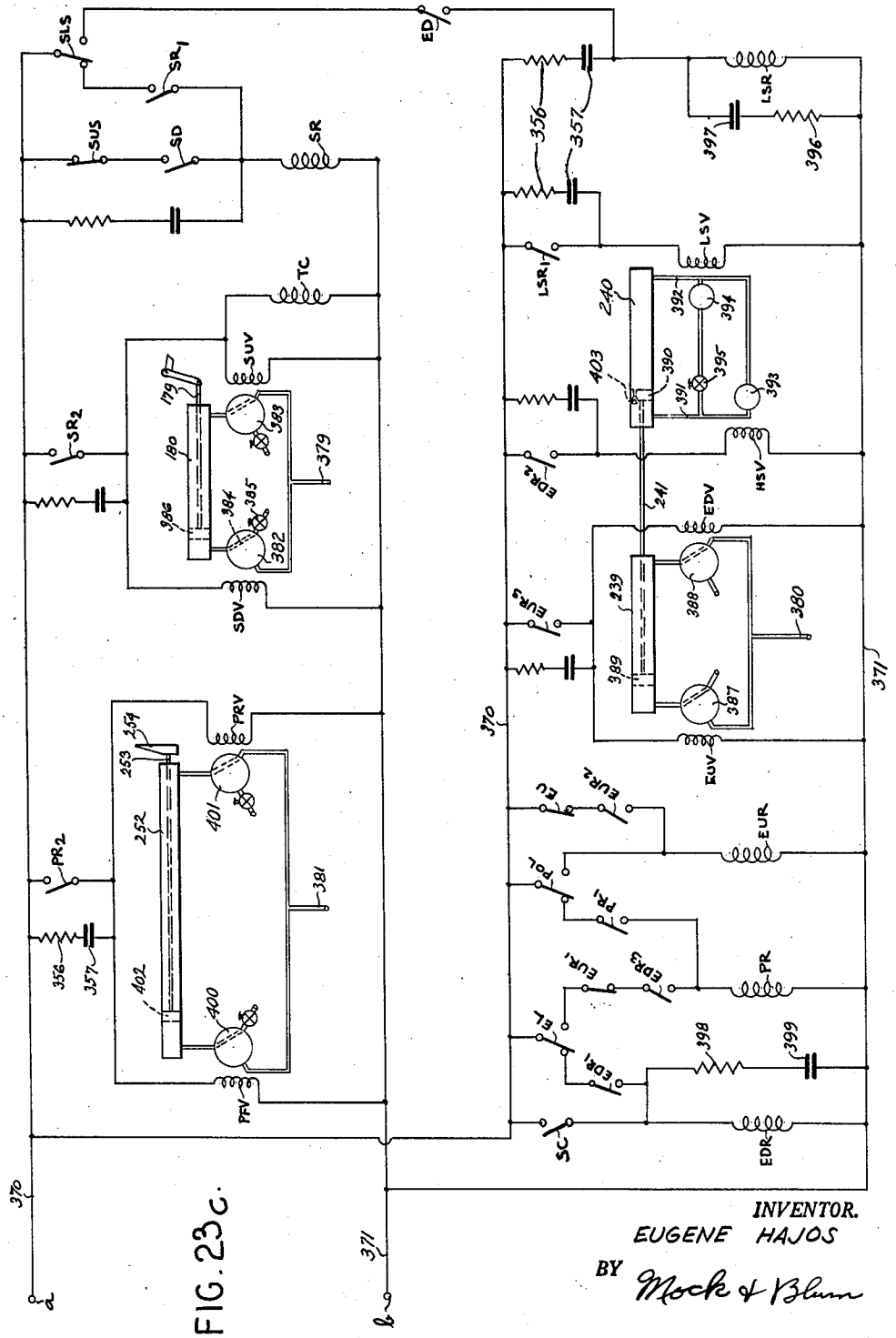


FIG. 23c.

INVENTOR.
EUGENE HAJOS
BY Mock & Blum
ATTORNEYS

March 31, 1964 E. HAJOS 3,126,657

FOLDING AND STACKING MACHINE FOR ARTICLES OF LINEN

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FIG. 24.

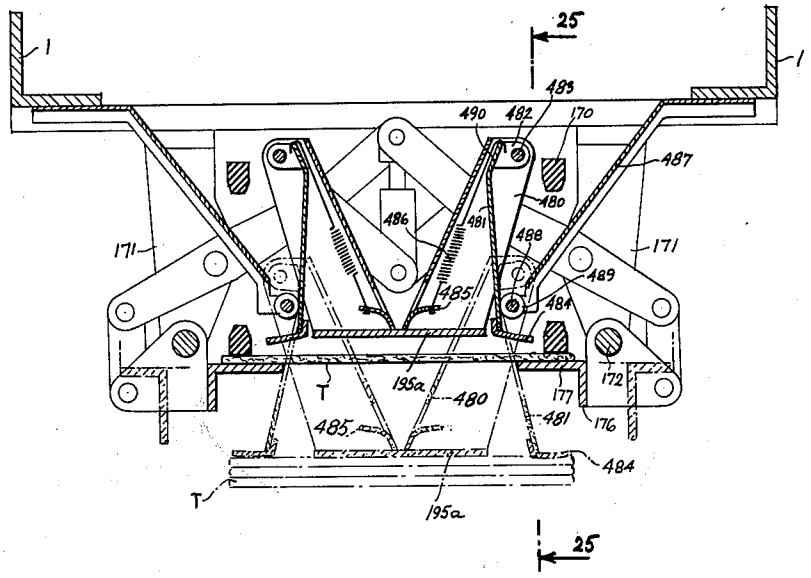
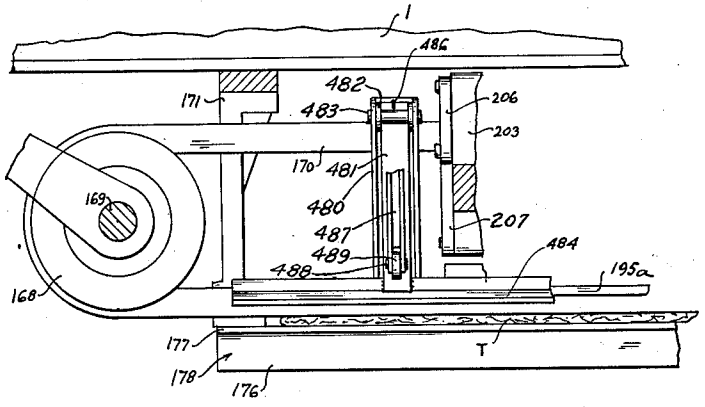


FIG. 25.



INVENTOR.
EUGENE HAJOS

BY
Mock + Blum
ATTORNEYS

United States Patent Office 3,126,657 Patented Mar. 31, 1964

3,126,657
FOLDING AND STACKING MACHINE FOR ARTICLES OF LINEN

Eugene Hajos, Fort Lee, N.J., assignor to Premier Laundry, Inc., New York, N.Y., a corporation of New York

Filed May 12, 1953, Ser. No. 354,510
22 Claims. (Cl. 38—2)

This invention relates to an improved machine for folding and stacking articles of linen automatically in discrete counted bundles.

An important object of this invention is to provide a machine which will receive ironed articles of linen successively and which will automatically fold these articles along their length into thirds, iron the partly folded articles, complete the folding of the articles by folding them centrally across their length, stack the completely folded articles and eject the articles in stacks containing preselected numbers of articles, ready for wrapping.

The commercial laundry industry has devoted a great deal of effort to the development of new methods and machines for performing the operations involved in the assembly-line laundering of so-called "flat" articles of linen and the like, such as towels, pillow cases and sheets. Some of these operations include washing the articles, drying the articles, ironing the articles, folding the articles, making stacks containing selected numbers of the articles and wrapping the stacks for delivery.

It is well known that the operation of ironing articles of linen has been solved by the development and use on a wide scale of automatic ironing machines. These machines, which are capable of high capacity and efficiency, are accordingly large, complex and costly. However, each ironing machine requires the use of a number of human operators who take the ironed articles and manually feed them to one or more small machines for folding the articles. The articles are stacked from below, and the counting of the stacked articles must be done manually.

The provision of high-speed machines in accordance with the present invention almost entirely eliminates the need for human operators for folding and stacking the articles, and results in more economical laundry operation.

One important feature of the invention resides in the provision of an improved longitudinal folder having a flexible and resilient main plate fixed to the machine frame at its input end and otherwise supported indirectly by magnets, so as to provide uniform driving traction for articles of linen carried on the lower face of the conveyor belt, and having folding plates located below the main plate.

Another important feature of the invention resides in the provision of a change-of-direction roller permitting an abrupt change in the direction of movement of the partly folded articles without wrinkling and thereby permitting compact construction of the machine as a whole.

Another important feature of the invention resides in the provision of an improved timing mechanism for insuring accurate central folding across their length of articles of varying length. The timing mechanism in accordance with this invention has two separate timers for timing the movement of two towels at a time, as a result of which it is possible for articles to follow each other closely upon the conveyor.

Another important feature of the invention resides in the provision of an improved device for stacking the completely folded articles and in an elevator for receiving the stacks. During stacking, the elevator is always positioned so as to maintain the stack just below the stacking

device. The elevator is lowered in a series of short drops as the stack grows. When a selected number of articles are stacked, as determined by an automatic counter, the elevator abruptly drops to its lowest position, and a pusher is actuated to eject the stack from the elevator.

Other objects, advantages and features of the invention will become apparent from the following description, in conjunction with the annexed drawings, in which a preferred embodiment is disclosed.

FIG. 1 is a side elevation of a folding and stacking machine according to my invention, the front of the machine being to the left in this view and the frame and input conveyor being partly broken away.

FIG. 2 is a front elevation of the input conveyor of the machine of FIG. 1.

FIG. 3 is a side elevation, partly in section, of the input conveyor of FIG. 2, taken on the line 3—3 of that view, showing it attached to the delivery end of an ironing machine.

FIG. 4 is a fragmentary plan view of the upper end of the conveyor associated with the front of the main frame of the machine, taken on the line 4—4 of FIG. 3.

FIG. 5 is a bottom plan view of the longitudinal folder of the machine of FIGS. 1–4.

FIG. 5*a* is a detail view in elevation showing the manner in which the folding plates are carried by the frame of the machine in an adjustable manner.

FIG. 5*b* is a corresponding view in section, taken at right angles to FIG. 5*a*, illustrating the mounting of the lower folding plate and taken on the line 5*b*–*b* of FIG. 5*a*.

FIG. 6 is a view in longitudinal section through the middle of the longitudinal folder of FIG. 5, taken on the line 6—6 of FIG. 5.

FIG. 7 is a view in vertical cross section through the folder of FIG. 5, taken on the line 7—7 of that figure, showing the upper folding plate making the first longitudinal fold.

FIG. 8 is a view similar to FIG. 7 on the line 8—8 of FIG. 5, showing the lower folding plate beginning the second longitudinal fold.

FIG. 9 is a similar view taken on the line 9—9 of FIG. 5, showing the second longitudinal fold completed.

FIG. 10 is a top plan view of the front part of the machine, taken on an elevation just below the folding plates on the line 10—10 of FIG. 1, showing some of the drive mechanism and part of the main conveyor belt mechanism.

FIG. 11 is a vertical longitudinal section through the transverse folding mechanism of the machine, taken on the line 11—11 of FIG. 10.

FIG. 12 is a longitudinal elevation from the rear of the machine as viewed in FIG. 1, showing part of the stacking mechanism for the folded towels located above the elevator.

FIG. 13 is a view transversely across the machine, taken on the line 13—13 of FIG. 12 and showing the mechanism of that figure, the angle irons of the stacking mechanism being shown in their normal or "up" position.

FIG. 14 is a longitudinal section through the middle of the machine from rear to front, reading from left to right, taken on the line 14–14 of FIG. 13.

FIG. 15 is a vertical view, partly in section, taken across the stacking mechanism of FIG. 14 on the line 15—15 of that figure, showing the angle irons in their stacking positions.

FIG. 16 is a view in side elevation from the right side of the machine, showing the elevator in an "up" or stacking position.

FIG. 17 is a view in vertical section through the elevator of FIG. 16, taken on the line 17—17 of that figure.

FIG. 18 is a diagram of a portion of the compressed air distribution system of the machine.

FIG. 19 is a plan view of the timing mechanism C for the transverse folder, certain parts being removed for clarity.

FIG. 20 is a sectional view in elevation of the timing mechanism of FIG. 19, viewed from the right of that figure on the line 20—20.

FIG. 21 is a view in elevation from the right of FIG. 19, showing the timer cams for the transverse folder switch and other switches.

FIG. 22 is a diagrammatic plan view of the complete timing mechanism of the machine.

FIGS. 23*a*, 23*b* and 23*c* are a schematic diagram of the electrical circuit of the machine.

FIG. 23*a* shows the circuit for the transverse folder and also shows the circuit for miscellaneous control devices.

FIG. 23*b* shows the circuit of the counter for determining the number of articles stacked.

FIG. 23*c* shows the circuits of the stacking mechanism, the elevator and the pusher for removing stacked towels from the machine.

FIG. 24 is a transverse section of the stacking mechanism, showing a modification thereof.

FIG. 25 is a fragmentary section on the line 25—25 of FIG. 24.

Upon reference to the drawings in detail, it will be noted that the machine is generally shown in its entirety in FIG. 1. In this and other views, articles of linen or the like are designated by the reference letter T. In general, except as specifically indicated below, the drawings are substantially to scale of a working model of the machine, and reference is made to the drawings to complete the disclosure. For convenience, the articles of linen T will be referred to as towels, although it will be apparent that other articles of linen may be folded in this machine. I will first describe the manipulation of the towels generally.

FIG. 1 shows a portion of an input conveyor A supported by machine frame **1** at the front or input end of the machine. Said input conveyor A is shown in detail in FIGS. 2–4. Towel T enters the machine at the upper part thereof, where it travels along the bottom face of main conveyor belt **10** through longitudinal folder B. Said longitudinal folder B is shown in detail in FIGS. 5–9. Longitudinal folder B folds towels T longitudinally into overlapping thirds.

At the rear of the machine, change-of-direction roller **11** is mounted on frame **1** with its axis extending laterally. Conveyor belt **10** passes over, in front of and below change-of-direction roller **11** and is spaced therefrom. Change-of-direction roller **11** is positioned to intercept towel T as it leaves longitudinal folder B and is adapted to reverse the direction of movement of towel T. Conveyor belt **10** again receives towel T as it leaves change-of-direction roller **11** and is adapted to carry towel T forwardly upon its upper face on a level below that of longitudinal folder B in the direction of the front of the machine.

In its forward movement the towel T passes operatively between belt **10** and an ironer **12** which is supported by frame **1** in normal operative engagement with belt **10**. A spring-controlled arm or rod **13** located just forward of the ironer **12** is adapted to move belt **10** out of operative engagement with ironer **12** when belt **10** stops moving, a solenoid IS holding rod **13** clear of belt **10** while the latter is moving.

Forwardly of ironer **12** and after passing rod **13**, towel T operatively engages a timer switch lever **14**, which controls the operation of timer mechanism C, said timer mechanism being shown in detail in FIGS. 19–22 and being mounted at the bottom front of frame **1**.

Forwardly of timer switch **14**, conveyor belt **10** passes over, in front and under idler roller **15** and then travels rearwardly. As towel T passes over roller **15**, it is folded across its width and pushed rearwardly by transverse folder lever **16** of transverse folder mechanism D. Timer mechanism C controls the operation of folder lever **16** so that it folds towel T centrally across its length. This transverse folder mechanism is shown in detail in FIGS. 10 and 11.

The now completely folded towel T is carried rearwardly against the bottom face of main conveyor belt **10** until it enters stacking mechanism E. Conveyor belt **10**, which is continuous, then follows a return path, in which it is idle, to the point where it receives towels T from input conveyor A. Stacking mechanism E is suitably actuated, when towel T is fully received therein, to drop towel T upon stack **17**. Stacking mechanism E is shown in detail in FIGS. 12–15.

The towel stack **17** is supported by an elevator F which extends above the bottom of frame **1** and which gradually drops downwardly as it receives towels T. When stack **17** contains a pre-determined number of towels, means are provided for rapidly dropping elevator F to its lowest position, shown in FIG. 1, and for driving a pusher **18** rearwardly to force stack **17** off elevator F and on to an outlet platform **19** mounted on the rear of frame **1**. Elevator F is shown in detail in FIGS. 16 and 17.

Main Conveyor Belt

The disposition of main conveyor belt **10** and the drive means therefor are clearly shown in FIGS. 1, 10 and 11. The direction of movement of belt **10** is shown by arrow **2** (FIG. 1).

Lateral idler roller **20**, which is mounted upon frame **1** at the top front thereof, will be taken for convenience as the starting and return point of the continuous belt **10**. A further lateral idler roller **21** is mounted upon frame **1** near the top rear thereof. There is a lateral idler roller **22** fixed on a laterally extending horizontal shaft **461** rotatably mounted upon frame **1** behind and on a level with roller **21**. Lateral idler roller **23** is mounted upon frame **1** somewhat below roller **22**. Belt **10** passes in front of and under roller **20**, under roller **21**, over and behind roller **22** and behind and under roller **23**.

There is a lateral idler roller **24** mounted upon frame **1** at about the longitudinal center thereof and on about the level of roller **23**. Lateral idler roller **15** is mounted upon frame **1** near the front thereof and below roller **24**. Belt **10** passes over roller **24** and over, in front of and under roller **15**.

A pair of approximately horizontal arms **25** are mounted at their rear ends upon frame **1** generally below and laterally of roller **15** by means of lateral pivots **26** (see FIG. 11). Lateral shaft **27** connects arms **25** intermediate their ends. Roller **28** is mounted upon shaft **27** directly below roller **15**. Lateral rod **29** connects the front ends of arms **25**. Rods **30** extend upwardly from rod **29** through suitable openings (not shown) in frame **1**. Spring **31** on each rod **30** bears between frame **1** and stop nut **32** on the upper end of rod **30**, so that the front ends of arms **25** are urged upwardly. As a result, roller **28** is held under tension against the part of belt **10** passing under roller **15**.

Lateral shaft **33** is turnably mounted upon frame **1** nearer the rear of the machine and on an approximate level with roller **15**. Sprocket gear **34** is fixed to an end of shaft **33**, and roller **35** is fixedly mounted upon shaft **33**. Lateral roller **36** is mounted upon frame **1** forwardly of and slightly above the level of roller **35**.

A pair of arms **37** are mounted upon frame **1** by means of lateral pivots **38** and extend upward and forwardly therefrom (see FIGS. 1 and 11). Lateral idler roller **39** is connected between the upper ends of arms **37**, and is located below the level of roller **24**. Springs **40** are connected between an intermediate point of each arm **37** and

a respective point on frame located forwardly of arm 37, and the springs urge roller 39 forwardly.

Belt 10 extends under, behind and over roller 35, under roller 36 and in front of and over roller 39. Vertically spaced lateral idler rollers 41 and 42 are mounted upon frame 1 rearwardly of rollers 23 and 22. Belt 10 extends rearwardly from roller 39, under and behind roller 41, behind and over roller 42 and back over the starting roller 20.

As will become fully apparent below, towel T operatively engages belt 10 from starting roller 20 until belt 10 travels under roller 35, with the exception that towel T is out of engagement with belt 10 after it passes under roller 21 and while it passes over rollers 22 and 23. During the return path of belt 10, from roller 35 back to roller 20, it is out of engagement with towel T. Belt 10 is maintained under tension by the action of spring 40 upon roller 39.

Electric motor 43 located near the bottom of the frame 1 of the machine serves as the drive means for main conveyor belt 10. Motor 43 has a longitudinally rearwardly extending driven shaft 44 which drives a lateral driven shaft 45 mounted in reduction gear box 46. Sprocket gear 47 is mounted upon shaft 45. Endless drive chain 48 meshes with sprockets 47 and 34 and also meshes with a sprocket gear 49 fixed to a lateral shaft 50 mounted upon frame 1 rearwardly of sprocket 34. Chain 48 drives sprocket 34, together with shaft 33 and drive roller 35, as well as sprocket 49. Roller 35 drives belt 10.

Input Conveyor

Input conveyor A is shown in detail in FIGS. 2–4. The drive means for input conveyor A is clearly shown in FIGS. 1 and 10.

Input conveyor A is supported by a pair of laterally spaced brackets 3 mounted upon the front of frame 1. Shaft 51 extends turnably between said brackets 3. A pair of input conveyor frame arms 52 are respectively turnably mounted on shaft 51 adjacent the respective brackets 3 and extend forwardly and downwardly therefrom. A pair of rollers 53 are fixed to shaft 51 intermediate arms 52. Rollers 53 are laterally spaced from each other.

Sprocket wheel 54, which is the drive sprocket for conveyor A, is fixed to shaft 51 between rollers 53.

There is a sprocket wheel 55 fixed to the opposite end of shaft 33 from sprocket 34 (see FIGS. 10 and 11). A lateral shaft 56 is turnably mounted at its ends upon blocks 144 which are respectively fixed to frames 1 near the front thereof and below sprocket 54. Sprocket wheel 57 is mounted on an end of shaft 56 in line with sprocket 55. Shaft 58 is turnably mounted upon frame 1 in front of shaft 56 and carries sprocket 59. Endless drive chain 60 extends meshingly behind and under sprocket 55, over sprocket 57, under, in front of and over sprocket 59, and over sprocket 55 and hence back to its starting point.

Sprocket wheel 61 is fixed to the central portion of shaft 56. Endless chain 62 meshes with sprocket 61 and sprocket 54 in the usual manner to drive the input conveyor.

From the foregoing, it will be apparent that motor 43 drives shaft 51 in a clockwise direction, as viewed in FIG. 3.

The front ends of arms 52 are connected to a cross-iron 63 which extends laterally outwardly beyond both arms 52. Frame arms 64 are connected to the respective ends of iron 63 and extend both forwardly and rearwardly thereof in substantially the same direction as arms 52.

One end of air cylinder 65 is connected to frame 1 by lateral pivot 66. Cylinder 65 extends upwardly and forwardly from pivot 66. Plunger 67 extends out of the upper end of cylinder 65 and is pivotally connected to lateral shaft 68, which extends between arms 64 forwardly of iron 63.

As will be further described below, compressed air is supplied to the interior of cylinder 65 to urge plunger 67 and hence the front end of conveyor A upwardly.

Arms 64 have upwardly extending ears at the higher end thereof, between which lateral shaft 69 extends. Four rollers 70 are mounted upon shaft 69. Arms 64 also have downwardly extending ears at the higher end thereof, between which lateral shaft 71 extends. A pair of rollers 72 are mounted upon shaft 71 adjacent the respective arms 64.

Lateral shaft 73 extends turnably between the front ends of arms 64 and also extends outwardly from them. Four rollers 74 are fixed to shaft 73 between arms 64 to work with the rollers 70 at the upper ends of the arms 64 as hereinafter described.

Arms 64 have depending portions near their lower ends, between which shaft 75 extends. Four individual bell crank levers 76 are turnably mounted at intermediate points thereof upon shaft 75. One end of each lever 76 extends forwardly of shaft 75 and has a lateral roller 77 turnably mounted thereon. The other end of each lever 76 is connected by spring 78 to a lateral rod 97 extending between arms 64, so as to urge roller 77 downwardly.

A pair of center belts 79 are provided. Each belt 79 extends around a roller 53 and a center roller 74 and also extends over a center roller 70 and under a spring-pressed roller 77. Belts 79 are driven by chain 62 and in turn drive rollers 74.

A pair of side belts 80 are provided. Each belt 80 extends around a side roller 70, a roller 72, a spring-pressed roller 77 and a side roller 74. Belts 80 are driven by rollers 74 through the belts 79 and shaft 73.

Belts 79 and 80 move in the direction of arrow 81 (FIG. 3). Each of these belts is individually tensioned by its associated roller 77. Conveyor A is wider than frame 1, except at its upper portion, where belts 79 extend above belts 80.

A pair of arms 82 are positioned outside the respective arms 64 and are connected to the lower part of these arms by lateral pivots 83. Said arms 82 extend forwardly of pivots 83. A relatively heavy idler roller 84 is connected between arms 82 and rests against the front faces of belts 79 and 80 above rollers 74.

Input conveyor A is adapted to be placed in position relative to a conveyor belt 85 (FIG. 3) to receive towels T carried by said belt 85. As an example, belt 85 may be the output conveyor belt of an ironer. Belt 85 is shown as moving in the direction of arrow 88 around a roller 86 mounted upon a lateral shaft 87. Said shaft 87 is fixed to the ironer frame (not shown). In order to position conveyor A properly relative to ironer belt 85, conveyor A is provided with a pair of arms 89 turnably mounted on the respective ends of shaft 73 outside arms 64. Each arm 89 extends forwardly and downwardly of shaft 73. The rear end portion of arm 89 has an arcuate slot 90 through which screw 91 extends. Screw 91 extends into a suitably threaded hole (not shown) in arm 64 and may be tightened to lock arm 89 in a selected turned position on shaft 73.

The front ends of arms 89 are joined by a lateral shaft 92 upon which idler roller 93 is mounted. Shaft 92 also extends outwardly of arms 89 and has pulleys 94 mounted on its outer ends. Pulleys 95 are mounted on the respective outer ends of shaft 73. Idler pulley belts 96 extend around the respective pairs of pulleys 94 and 95.

In the use of the machine, frame 1 is rolled upon casters 9 until idler belts 96 abut ironer conveyor belt 85 under roller 86, as clearly shown in FIG. 3. The air pressure in cylinder 65 upon plunger 67 holds conveyor A in position against belt 85. The length of belts 96 permits placing conveyor A in position against roller 86 located at varying heights above the floor. Preferably, roller 93 also abuts belt 85; but the provision of belts 96 extends

the range of contact when it is impractical for roller 93 to abut belt 85.

When conveyor A is thus positioned relative to belt 85 and roller 86, the leading end of a towel T carried on the upper face of belt 85 strikes the front faces of belts 79 and 80 and is carried thereby under roller 84 before the trailing end of towel T leaves belt 85. Preferably, towel T does not exceed in width the distance between the respective outer side edges of belts 80.

As towel T moves past the belts 80, the side portions of towel T drop down outside the respective side arms 52.

Longitudinal Folder

Longitudinal folder B is shown in detail in FIGS. 5–9. Because the plates thereof are very thin, being approximately one eighth of an inch thick, the thickness and spacing of the plates has been exaggerated in these views.

Longitudinal folder B includes a ferromagnetic main plate 100 which is positioned just below main conveyor belt 10 and which extends from a point just behind roller 20 to a point just in front of the point at which belt 10 passes between rollers 11 and 21. Near its front end, main plate 100 is supported from below by a laterally extending frame portion 8. The remainder of plate 100 is supported in a manner to be described below. The front end of plate 100 is positioned just behind the rear ends of belts 79.

Plate 100 has a central front-end extension 101 which passes over sprocket 54 and is curved downwardly in front of sprocket 54 (see FIGS. 2, 3 and 4). Plate extension 101 is located between belts 79. Plate extension 101 prevents towels T from striking sprocket 54. Also, plate extension 101 carries a switch AE whose switch lever 102 extends upwardly between belts 79 in a position to be depressed by a towel T carried by belts 79, whereby to close switch AE. As will become fully apparent below, the closing of switch AE by a towel actuates a timer which stops the operation of the machine if the towel does not emerge from the stacker within a specified time interval.

Upon leaving input conveyor belts 79, towel T travels between the lower face of main conveyor belt 10 and the upper face of main folder plate 100, as clearly shown in FIG. 3. Preferably, the front end portion of plate 100 is of approximately the same width as the rear part of conveyor A, plate 100 being of somewhat reduced width rearwardly thereof (FIG. 5). A plurality of longitudinally spaced weights 103 rest upon the upper face of belt 10 rearwardly of roller 20, so that belt 10 frictionally engages towel T. Each weight 103 has a slot 104 extending downwardly from its upper face and extending the width thereof. A lateral rod 105 is fixedly supported by frame 1 and rides in said slot 104. Said weights 103 are located forwardly and rearwardly of frame portion 8.

Rearwardly of weights 103, and below the uppermost return portion of belt 10, frame 1 has a longitudinally extending frame portion 7 (see FIGS. 6 to 9). A plurality of studs 106 depend from frame portion 7 and support a longitudinally extending, non-magnetic plate 107 spaced from said frame portion 7. Preferably, studs 106 are laterally disposed beyond the respective side edges of main plate 100, and are evenly spaced on both sides of plate 107 along the entire length thereof. Plate 107 extends almost as far rearwardly as main plate 100 (see FIG. 1).

A plurality of spaced magnets 108 are supported between frame portion 7 and the upper face of plate 107. Preferably, magnets 108 are disposed in two longitudinally extending rows located inwardly of the respective side edges of plate 107 (see FIG. 5).

Each magnet 108 is horseshoe-shaped, with its pole pieces extending downwardly from its cross-piece and longitudinally alined, and with its cross-piece fixed to frame portion 7 by bolt 450, or optionally by a strap.

Plate 100 is preferably only one-sixteenth of an inch thick and is flexible and resilient. Magnets 108 support that portion of plate 100 (most of the length thereof) which is not supported by frame portion 8 and hold plate 100 evenly in frictional abutment with the lower face of belt 10, so as to hold belt 10 in operative engagement with towel T.

Upper and lower non-magnetic, longitudinally extending folding plates 109 and 110 are provided. The front of upper folding plate 109 is preferably located forward of the front of plate 107. The left side of plate 109, as viewed in FIGS. 7–9, extends laterally outwardly of main plate 100 and is supported by angle iron 451. The right side of plate 110, as view in FIGS. 7–9, is similarly supported by another angle iron 451. Both angle irons are similarly mounted on the frame, that for plate 110 being shown in detail in FIGS. 5*a* and 5*b*.

Angle iron 451 extends longitudinally and has a horizontal arm fixed to plate 110 and a vertical arm 452 adjustably supported by frame 1. In order to support arm 452, a plurality of vertical channel irons are fixed to frame 1. Each said channel iron has a longitudinal cross-arm 453 and laterally inwardly extending end arms 454. Said channel iron is located outwardly of angle iron 451. Block 455 is positioned between arms 454 and is vertically adjustably secured to each arm 454 by means of respective screws 456 which extend through respective vertically elongated slots 457 in arm 454 and into respective thread holes (not shown) in the side of block 455.

Angle iron arm 452 is attached to each block 455 by means of a respective screw 458 which extends through arm 452 and into a threaded hole in block 455, the head of screw 458 abutting the inner wall of arm 452. Additional screws 459 extend through slot 460, in channel iron arm 453 and through respective threaded holes in block 455. Screws 459 are respectively located above and below screw 458, and the inner ends of screws 459 abut iron arm 452. It will be apparent that by adjustment of screws 459, plate 110 may be rocked to a selected inclination relative to the horizontal. The vertical position of plate 110 may be adjusted by means of screw 456.

The front portion 111 of the right edge of plate 109, as taken in FIGS. 7–9, meets the left edge thereof at the extreme front of plate 109 and diverges rearwardly therefrom. The rear portion 112 of the right edge of plate 109 is parallel to and preferably located in vertical alinement with the right edge of main plate 100.

The front of lower folding plate 110 is located rearwardly of the front of plate 109 and preferably slightly forward of plate edge portion 112. The right side of plate 110, as viewed in FIGS. 7–9, extends laterally outward beyond main plate 100 and is fixed to a second angle iron 451, which is supported entirely similarly to the first angle iron 451.

The front portion 113 of the left edge of lower folding plate 110, as taken in FIGS. 7–9, meets the right edge thereof at the extreme front of plate 110 and diverges rearwardly therefrom. The rear portion 114 of the left edge of plate 110 is parallel to and preferably located in vertical alinement with the left edge of main plate 100 (see FIG. 9).

Plates 109 and 110 extend rearwardly to approximately the same point as plate 100.

In operation, when towel T first enters folder B, it has a central portion resting upon main plate 100 and respective side portions extending below the side edges of plate 100. One of these side portions of towel T strikes the portion of upper folder plate edge portion 111 protruding laterally beyond plate 100 and rides along said edge portion 111 so that it is forced between plate 100 and plate 109. The second and third positions of the towel portions in FIG. 5, as well as FIGS. 7 and 8, clearly show this step. As shown in FIGS. 8 and 9, the leading edge 113 of the lower folding plate 110 makes the second longitudinal fold of the towel under the upper folding plate 109.

The width of plate 100 relative to standard towel width is optionally chosen so that towel T is folded approximately into thirds. However, in view of the further fold-

ing of towel T, to be described in detail below, it does not matter if the center portion of towel T is wider than the two side portions folded under said center portion. In fact, the center portion of towel T is usually wider than said folded side portions.

Change-of-Direction Roller

Change-of-direction roller **11** is clearly shown in FIG. 1. Roller **11** is fixedly supported by a lateral shaft **120** turnably mounted upon frame **1**. Pulley **462**, which is fixed to shaft **461**, and pulley **463**, which is fixed to shaft **120**, are coupled by pulley belt **464** so as to drive roller **11**. Preferably, the linear circumferential speed of roller **11** exceeds the linear speed of belt **10**.

A curved transversely and laterally extending plate **121** is supported by frame **1** behind roller **11** and in front of rollers **22** and **23**. The front face of the plate **121** is concave in vertical longitudinal section and is sufficiently spaced from the periphery of roller **11** to accommodate the partly folded towel T.

As the leading end of towel T leaves folder B at the rear end thereof, it falls upon the periphery of roller **11**. The trailing portion of towel T continues to be pushed rearwardly between belt **10** and plate **100**, so that towel T drops between roller **11** and plate **121**. The movement of towel T between roller **11** and plate **121** is also aided by gravity, by the driven turning of roller **11**, and by the frictional engagement of towel T between roller **11** and plate **121**. Towel T is carried forwardly upon belt **10** after leaving roller **11**.

Ironer

Ironer **12** is clearly shown in FIG. 1.

Ironer **12** is supported by plate **122** which extends laterally and longitudinally beyond it and which is supported by frame **1** is a suitable manner (not shown). Belt **10** is normally supported by rollers **23** and **24** so as to abut the lower face of plate **122** frictionally. The rear end portion **123** of plate **122** is curved upwardly away from belt **10**.

A front casing **124** containing heater elements and a rear casing **125** containing a thermostat are mounted on top of plate **122**. As will be explained in detail below, the thermostat and the heater elements are adapted to be connected in a suitable electric circuit in order to heat plate **122** to a selected temperature. Towel T passes under plate portion **123** and then moves frictionally between plate **122** and belt **10**, so that the heated plate creases the longitudinal folds in towel T. This is often necessary to prevent unfolding of towel T when the folded side portions are very narrow.

A generally upstanding bracket **126** is mounted on top of casing **124** at the front thereof. Ironer solenoid IS is mounted upon the front face of bracket **126** and is spaced above belt **10**. Solenoid IS has a transverse plunger **127** extending therethrough and coupled at its upper end, above solenoid IS, to bracket **126** by means of compression spring **128**. The lower tip of plunger **127**, below solenoid IS, carries cross-rod **13**. Said cross-rod **13** is normally urged towards belt **10** by spring **128**. However, when belt **10** is moving, solenoid IS is energized by means to be described in detail below, and holds rod **13** spaced above belt **10**.

When belt **10** stops for any reason, solenoid IS is de-energized, and plunger **127** is forced downwardly by the action of spring **128**. As a result, rod **13** engages belt **10** and moves it to its broken-line position of FIG. 1, in which it is spaced from plate **122**. This prevents the residual heat of plate **122** from burning belt **10**.

Towel Length Switch

Towel length switch X is shown in detail in FIGS. 10 and 11.

Towel length switch X is supported by means of lateral plate **130**. Plate **130** is supported by frame **1** and bears frictionally against the lower face of belt **10** forwardly of roller **24**. Bracket **131** is attached to plate **130** beyond one side edge of belt **10** and extends above belt **10**. The casing of switch X is mounted on the inner face of bracket **131** and extends over belt **10** and is spaced therefrom. Said casing carries an inwardly extending, turnable shaft **132** to which one end of actuating lever **14** is fixed. Lever **14** is made of spring wire and extends downwardly and forwardly from shaft **132**. Lever **14** has a curved free end portion **133**.

Lever end portion **133** normally rests lightly upon belt **10**, in which position switch X is open. While the length of towel T is passing between belt **10** and lever end portion **133**, thereby raising the end portion, switch X remains closed with corresponding actuation of timer mechanism C to be explained in detail below.

In order to ensure positive movement of switch lever **14** from its closing position to its open position, obstruction member **134** is connected to plate **130** at the same side of belt **10** as bracket **131**. Obstruction member **134** extends upwardly past the side edge of belt **10** and protrudes inwardly thereof and has a longitudinal slot **465**. Normally, lever end portion **133** extends through slot **465** against belt **10**. Obstruction member **134** has a lower rear lateral knife edge **135** which is forwardly inclined from the outer edge of member **134**. The rear face of member **134** is forwardly inclined from edge **135**, which frictionally abuts belt **10**. A side portion of the front edge of the moving towel T strikes edge **135** and it rides over obstruction **134**. As a result, the side portion of towel T passes under switch lever **14** and raises its end portion **133** out of slot **465**, thereby causing a greater movement of lever **14** than the flattened partly folded towel T could cause. Switch X is closed when lever **14** is thus raised.

Transverse Folder

Transverse folder D is shown in detail in FIGS. 10 and 11.

Folder D includes a lateral shaft **140** turnably mounted upon frame **1** above roller **15**. Lever arms **16** are respectively fixedly mounted upon shaft **140** and extend forwardly therefrom. Arms **16** are respectively in approximate longitudinal alinement with the side edges of belt **10** as it passes over roller **15**.

Folder blade **141** is connected to the lower ends of arms **16** and extends between the two arms **16** and also rearwardly thereof. A further lever **142** is fixed to shaft **140** intermediate arms **16** and extends upwardly from shaft **140**. Lever **142** is located forward of frame portion **8** and is connected thereto by spring **143**. Tension spring **143** urges lever **142** in a clockwise direction about the axis of shaft **140**, as viewed in FIG. 11, and thereby normally maintains blade **141** in its front, inactive position.

Blocks **144** are fixed to frame **1** outwardly from the respective arms **16**. Each block **144** carries on its rear face a spring blade **145** which extends below block **144**. Blade **141** has lateral projections with respective upstanding flanges **146** which bear rubber stops **147** on the respective front faces thereof. These stops **147** are respectively adapted to strike the respective rear faces of the lower end portions of blades **145**, whereby the forward movement of blade **141**, under the urging of spring **143**, is checked.

Folder solenoid FS is mounted upon frame **1** forwardly of lever **142**. Solenoid plunger **148** extends rearward out of the casing of solenoid FS and carries on its rear end a yoke **149**. The upper end of the lever **142** extends between the arms of yoke **149** and is attached thereto by lateral pivot **150**.

The action of solenoid FS is controlled by timer mechanism C, in a manner to be described in detail below. When solenoid FS is energized, plunger **148** is drawn forwardly, against the action of spring **143**, and blade **141** is moved rearwardly to its broken-line position of FIG. 11, in which it is substantially horizontal and its rear edge approaches the opening between rollers **15** and **28**.

Folder limit switch FL is mounted upon frame 1 below plunger 148 and in front of lever 142. Laterally extending folder limit switch lever 151 is attached to the rear of the casing of switch FL by transverse pivot 152. When lever 142 is drawn rearwardly by plunger 148, lever 142 strikes lever 151 and opens the normally closed switch FL. As will be fully explained below, this results in the immediate interruption of the circuit of solenoid FS, so that spring 143 returns blade 141 to its normal position. The movement of folder blade 141 between its two positions is extremely rapid.

Longitudinally extending, metal plate 153 is centrally supported by frame portion 469 rearwardly of rollers 15 and 28. Plate 153 extends rearwardly just below and past roller 35 and also past sprocket 49. Belt 10 frictionally engages the upper face of plate 153. Plate 153 has a downwardly inclined front extension 154 which is positioned proximate to the opening between rollers 15 and 28. Plate 153 is downwardly bowed in longitudinal section and is so formed that its ends are upwardly springable. As a result, plate 153 exerts uniform tension on belt 10 along its length.

Blade 141 is timed to move rearwardly to strike the central lateral line of towel T after it has passed switch X. Blade 141 folds towel T on that line, and the two resulting towel portions on either side of the fold line are pushed by blade 141 between belt 10 and roller 28. Spring 31 urges roller 28 upwardly to catch towel T frictionally between roller 28 and the portion of belt 10 carried under roller 15. As a result, belt 10 carries the folded towel rearwardly over plate extension 154 and hence between belt 10 and plate 153. Towel T is carried rearwardly between belt 10 and plate 153 toward stacking mechanism E.

The lower face of blade 141 is substantially horizontal at the instant towel T is folded. The upper face 466 of blade 141 is then upwardly forwardly inclined. As a result, towel T is frictionally engaged between blade face 466 and belt 10 before it is frictionally engaged between belt 10 and roller 28. This makes it possible to limit rearward movement of blade 141 (by means of the usual limit stop within solenoid FS for rod 148) slightly forwardly of the point to which blade 141 would otherwise have to move, thereby minimizing the danger of blade 141 becoming jammed between the rollers. Also, the thick wedge-shape of blade 141 helps to prevent disturbance of the fold caused by movement of the upper folded portion relative to the lower folded portion resulting from contact of the upper folded portion with belt 10. Roller 28 is preferably covered with rubber for greater frictional engagement with the lower folded portion of towel T to aid in even movement thereof.

Stacking Mechanism

Stacking mechanism E is shown in detail in FIGS 12–15. It will be noted that FIG. 12 shows the opposite side of the machine from the side shown in FIG. 1

Stacking mechanism E includes a conveyor belt system which frictionally engages the upper surface of a towel T and draws it onto a pair of stacker members or rails having smooth operating faces, here shown as angle irons 178, until the towel T lies above the desired stack location. Then the stacker members are moved from their normal support position to a retracted position in which the towel T is free to drop.

The stacker conveyor system includes the previously mentioned lateral shaft 50 whose sprocket 49 is driven by chain 48 (FIG. 1). It was previously stated that shaft 50 is supported by frame 1. The manner in which shaft 50 is supported will now be explained more fully.

Intermediate the ends of shaft 50, one or more levers 160 are fixed thereto. This lever 160 extends upwardly and forwardly from shaft 50 and is connected at its upper end by lateral pivot 161 to block 162. Block 162 abuts the lower face of a cross-arm 163 of frame 1 and has an upstanding flange 164 located in front of arm 163. Adjusting screw 165 extends through flange 164 and into arm 163 and helps to hold block 162 to arm 163. The setting of screw 165 may be varied to adjust the longitudinal position of shaft 50.

Intermediate its ends, lever 160 is connected by adjusting screw 166 and block 167 to the lower face of arm 163, to permit vertical adjustment of shaft 50.

A pair of laterally spaced pulleys 168 are fixed to shaft 50.

A further lateral shaft 169 is located rearwardly of shaft 50 and carries two further pulleys 168 in respective longitudinal alinement with the front pulleys 168. One or more further levers 160 are fixed to shaft 169 and extend upwardly and rearwardly therefrom and are optionally adjustably attached to frame 1 similarly to the first-mentioned lever 160.

A pair of pulley V-belts 170 extend around the respective longitudinal pairs of pulleys 168 and serve as conveyor belts for towel T. Plate 153 extends rearwardly under and past the front pulleys 168, so that the leading edge of towel T moving between plate 153 and main conveyor belt 10 and passing out of engagement with belt 10 passes into the space between belts 170 and plate 153 before the trailing edge of towel T passes belt 10 (see FIGS. 1 and 14).

The angle irons 178 of stacking mechanism E are supported by means of two sets of columns 171 which depend from frame 1 laterally outwardly of pulley belts 170 and which extend below said belts 170. Said columns 171 are also located longitudinally between the front and rear pulleys 168, and the columns of each set are longitudinally alined.

The bottom portions of the columns 171 of each set are formed to provide suitable bearings through which a longitudinal shaft 172 extends turnably. A pair of end arms 173 and a pair of intermediate arms 174 are mounted upon shaft 172.

At their other ends, the arms 173 and 174 associated with each shaft 172 are fixed to the outer face, as viewed in FIG. 13, of the transversely and longitudinally extending arm 176 of one of the angle irons 178 of stacking mechanism E. In the normal position of FIGS. 12–14, the other arm 177 of angle iron 178 is integral with the upper edge of arm 176 and extends horizontally inwardly thereof.

In order to regulate the turned positions of angle irons 178, the angle iron arms 176 are coupled to the plunger 179 of an air cylinder 180. Said air cylinder 180 is fixed to frame 1 laterally outwardly from one of the angle irons 178 and at the front part of stacking mechanism E. Plunger 179 extends out of the rear end of cylinder 180. Links 181 are secured to the rear end of plunger 179 by lateral pivot 181*a*. One end of arm 182 is positioned between the links 181 and connected thereto by lateral pivot 183. Arm 182 extends upwardly from links 181.

Lateral shaft 184 is turnably mounted upon frame 1 and extends above and laterally outwardly from angle irons 178. The upper end of arm 182 is divided to provide fork arms 185 between which an outer end of shaft 184 is located. Arms 185 are held together above shaft 184 by means 186 in order to fix arm 182 to shaft 184.

Brackets 187 are respectively fixed to the outer faces of the respective angle iron arms 176 between the arms 174 respectively associated therewith. Links 222 are connected to respective faces of brackets 187 by longitudinal pivots 223. The lower end of coupling link 188 is connected between respective links 222 by means of longitudinal pivot 189. The upper end of link 188 is connected between the lower ends of a pair of link plates 190 by means of lateral pivot 191. Lever arm 192 is connected at one end thereof between the upper ends of the link plates 190 by means of pivot 193. The other end of lever arm 192 is fixed to shaft 184.

Plunger 179 is shown in its normal position in FIG. 12.

When air is admitted to cylinder **180**, plunger **179** is pushed rearwardly in the direction of arrow **194**. As a result, shaft **184** is turned in a clockwise direction, as viewed in FIG. 12, link plates **190** are raised, and angle irons **178** are turned from their positions of FIG. 13 to their positions of FIG. 15. In FIG. 13, angle iron arms **177** extend horizontally and are positioned below the respective pulley belts **170**. In FIG. 15, said arms **177** extend vertically and are positioned laterally outwardly from pulley belts **170**.

There is a horizontal pusher plate **195** normally positioned between pulley belts **170** and above angle iron arms **177**. It is coupled to angle iron arms **176** for downward movement when angle irons **178** move to their stacking positions of FIG. 15. Plate **195** is substantially coextensive longitudinally with angle irons **178**.

Plate **195** is supported at the central portion of its upper face by a thin block **196**. The upper face of block **196** carries a pair of longitudinally spaced and alined posts **197**. Those posts **197** are supported, by means of adjusting nuts **198**, by a longitudinally extending arm **200** which is spaced above block **196** and which extends longitudinally beyond the posts **197**. Legs **199** depend from arm **200** at the ends thereof. The front leg **199** is laterally alined with and coupled to the respective front arms **174**. The rear leg **199** is laterally alined with and coupled to the respective rear arms **174**.

In order to couple each leg **199** to its associated arms **174**, each arm **174** has a split portion within which the lower end of link **201** (as viewed in FIGS. 12–14) is connected by means of longitudinal pivot **202**. The upper end of link **201** is connected within a forked end portion of lever **203** by means of longitudinal pivot **204**. Lever **203** extends upwardly and inwardly from pivot **204**. The central portions of the respective longitudinally associated levers **203** are connected to each other by longitudinal pivot shafts **205**, each shaft **205** extending through suitable holes in a pair of longitudinally alined columns **171**.

The upper ends of the laterally associated levers **203** respectively have respective upwardly extending links **206** and downwardly extending links **207** connected thereto by longitudinal pivots **208**. The lower ends of the links **207** respectively extend forward and rearward from their associated leg **199** and are connected thereto by longitudinal pivot **209**. Rod **210** is located slidably in an axial bore of leg **199** and extends above leg **199**. The upper ends of links **206** respectively extend forwardly and rearwardly of rod **210** and are connected thereto by longitudinal pivot **211**.

It will be apparent that when angle irons **178** are turned from their normal positions of FIG. 13 to their stacking positions of FIG. 15, arms **174** are turned ninety degrees about the axes of the respective shafts **172**. Levers **203** are thereby turned so as to force plate **195** to make a substantial downward thrust. In FIG. 15, plate **195** is positioned substantially below pulley belts **170**. During the movement of plate **195**, rod **210** slides within the bore of leg **199** to accommodate the changes in the distance between pivots **209** and **211**. It will be apparent that plate **195** is always horizontal and moves only vertically.

The positions and functions of stacker upper limit switch SUS, stacker down switch SD, stacker lower limit switch SLS and elevator down switch ED will now be briefly discussed. The electric circuits controlled by these switches will be fully described below (see FIGS. 12, 13, 14 and 23*c*).

Switch SUS is supported by frame **1** and has a depending switch button **212** and a depending bracket to which one end of switch lever **213** is connected by lateral pivot **214** (see FIGS. 12 and 14). The upper face of one of the levers **192** carries a forwardly extending arm **215** which is positioned and adapted to bear upwardly against the free end of switch lever **213** and hold button **212** in its upward position, closing switch SUS, while stacking mechanism E is in its normal or "up" position. As soon as stacking mechanism E begins to move towards its stacking position of FIG. 15, switch SUS is opened.

Switch SD is mounted upon frame **1** above plate **195** and has a switch lever **216** secured thereto by lateral pivot **217** (see FIG. 14). Lever **216** extends between and below angle irons **178** and movably through a rear slot **467** of plate **195** (see FIG. 15), and its free end portion is in the path of movement of towel T. Switch SD is normally open. When a towel T strikes switch lever **216** and moves it rearwardly, switch SD is closed. With both switches SUS and SD closed, air is instantly supplied to cylinder **180** and stacking mechanism E is moved to its stacking position, opening switch SUS. Towel T moves downwardly and clears switch SD which also opens.

Because of the softness of towel T, it has been found preferable in practice to make switch SD and its lever **216** highly sensitive. As a result, it is possible that while stacking mechanism E is returning to its "up" position, lever **216** may vibrate to switch-closing position. However, with switch SUS still open, the stacking mechanism cannot be prevented from returning to its "up" position. Switch SUS, therefore, acts as a relatively insensitive safety switch for switch SD.

The stacker lower limit switch SLS is mounted upon a column **171** and has a depending switch button **218**. Switch SLS is a two-position switch. When stacking mechanism E moves to its stacking position of FIG. 15, the outer end of one of the levers **203** (shown in broken lines in FIG. 13) strikes button **218** and moves switch SLS from its normal first position to its second position. Stacking mechanism E can only move downwardly while switch SLS is in its first position. When switch SLS is moved to its second position, the action of plunger **179** is reversed, and the stacking mechanism returns to its normal position.

The elevator down switch ED is mounted upon the upper face of plate **195** at the rear thereof and has an external lateral switch arm **220** (see FIGS. 14 and 15). Switch lever **219** is made of spring wire and is coiled at one end thereof around arm **220** and fixed thereto. Lever **219** extends rearwardly from arm **220** and has a depending U-shaped bight which extends through and below slot **468** in plate **195**. Switch ED is normally open. When stacking mechanism E is in its position of FIG. 15, whereby switch SLS is in its second position, and when switch ED is closed (by means to be described in detail below), the operation of elevator F is affected.

In operation, towel T is carried along plate **153** until it rides upwardly on the downwardly inclined front guide portions **221** of angle iron arms **177**. The side portions of towel T are then operatively engaged between the respective pulley belt **170** and arms **177** of angle irons **178**. Towel T moves rearwardly until it strikes switch lever **216**. Arms **177** are then moved outwardly, and towel T drops downwardly. Plate **195** is forced downwardly more rapidly than towel T drops and forces towel T downwardly upon the stack supported by elevator mechanism F. Upon actuation of switch SLS, the parts of stacker mechanism E return to their original positions.

Optionally, pulley belts **170** are cog belts, as shown illustratively at **470**, the cogs **470** meshing with corresponding cogs (not shown) in pulleys **16B**, so as to synchronize the drive of belts **170** with the drive of belt **10**.

Elevator Mechanism and Pusher

Elevator mechanism F is shown in detail in FIGS. 16 and 17.

Elevator mechanism F includes a longitudinally extending table **230** fixed to frame **1** below stacking mechanism E and positioned to receive towels T released by said stacking mechanism E. Optionally, longitudinally and upwardly extending side plates **231** are fixed to the

top of table 230 by means of angle irons 232. Plates 231 are not shown in FIG. 16. Said table 230 has a thickened longitudinal center portion 233 which has a longitudinal slot 234. Table 230 also has pairs of longitudinal slots 235 respectively disposed between center portion 233 and the respective side plates 231.

Vertical and longitudinal plates 236 extend slidably through the respective slots 235. As clearly shown in FIG. 16, each plate 236 is substantially rectangular and has cut-out portions to reduce its weight. Plates 236 are supported from below and by the sides of slots 235 so as to be substantially parallel and in lateral registration and so as to have horizontal upper edges.

Plates 236 are connected to each other by respective front and rear lateral rods 237 and 238 and optionally by intermediate lateral rods 237a. Rods 237 and 238 are adjustably supported from below.

In order to support rods 237 and 238, a front longitudinal compressed air cylinder 239 and a rear longitudinal hydraulic cylinder 240 are fixed to frame 1 below elevator plates 236. Said cylinders 239 and 240 are longitudinally alined with each other and transversely alined with table center portion 233 and have a common plunger rod 241. Rod 241 extends out of the rear of cylinder 239 and out of the front of cylinder 240.

A pair of vertical and longitudinal plates 242 are mounted upon frame 1 on opposite sides of rod 241 and longitudinally forwardly of rod 238. A second pair of plates 242 are similarly mounted upon frame 1 longitudinally forwardly of shaft 237. Each plate 242 has a longitudinal slot 243 extending between the respective side faces thereof.

Rod 241 is divided into sections which are joined by sleeve blocks 244. Two such blocks 244 are provided, each being located between a respective pair of plates 242. Each sleeve 244 has a lateral rod 245 extending therethrough and extending outwardly through respective slots 243. A roller 246 is frictionally and turnably located between the upper and lower edges of each slot 243 and is turnably mounted upon a respective end of rod 245.

Rods 245 extend laterally outward from their associated plates 242. Linking arms 247 are respectively turnably mounted at their lower ends upon the respective outer ends of said rods 245 and extend upwardly and rearwardly therefrom. The rear ends of the rear arms 247 are turnably connected to the ends of rod 238. The rear ends of the front arms 247 are turnably connected to the ends of rod 237. The distance between the front rods 245 and the rear rods 245 is equal to the distance between rods 237 and 238.

Further linking arms 248 are respectively connected to the respective arms 247 by means of lateral pivots 249. Arms 248 extend downwardly and rearwardly from their respective pivots 249. Frame 1 is provided with a plurality of brackets 250 to which the lower ends of arms 248 are respectively connected by means of lateral pivots 251. Each pivot 249 is equi-distant from its associated pivots 245, 238 (or 237) and 251. All of the pivots 245 and 251 are located in a common horizontal plane.

It will be apparent from the above construction that when rod 241 moves forward, elevator plates 236 are lowered in unison, and that when rod 241 moves rearward, elevator plates 236 are raised in unison. FIG. 1 shows plates 236 in their lowest position in which their upper edges are located just below the upper face of table 230, although still retained within slots 235. FIGS. 16 and 17 show plates 236 in a position intermediate their highest positions and their lowest positions. It will also be apparent that the upper edges of plates 236 are always horizontal, and that plates 236 move only vertically and not longitudinally.

There is a pusher plate 18 at the level of table 230 to remove the stack of towels from the elevator after the exact number of towels have been received. In order to support pusher plate 18, a longitudinal air cylinder 252 is mounted upon the upper face of table 230 forwardly of elevator plates 236. Plunger 253 extends out of the rear of cylinder 252. The front end of plunger 253 supports a longitudinally and vertically extending plate 254, to the rear of which the laterally and vertically extending plate 18 is secured. Plate 254 extends slidably through slot 234 and plate 18 is slidable along the top of table 230 between the center plates 236. Rollers 255 are mounted on both side faces of plate 254 above and below table center portion 233, by means of lateral pivots 256. Rollers 255 frictionally and turnably engage the upper and lower faces of said table portion 233.

When the top edges of plates 236 drop below the top face of table 230, depositing a stack of towels T upon table 230, and when plunger 253 is moved rearwardly, the stack is pushed rearwardly off table 230 and onto platform 19, which is fixed to the rear of frame 1 on the same level as table 230 (see FIG. 1).

The positions and functions of elevator upper limit switch EU, elevator lower limit switch EL and pusher "out" limit switch POL, in conjunction with the previously described elevator down switch ED, will now be briefly discussed. The electric circuits controlled by these switches will be fully described below.

A collar 257 is mounted upon rod 241 intermediate the sleeves 244 and has a depending switch-actuating lug 258.

Switch EL is mounted upon frame 1 forward of lug 258. Switch lever 259 is mounted upon the rear face of switch EL for movement about a lateral axis and is in the path of forward movement of lug 258. Switch EL is normally in a position in which it is possible for plunger rod 241 to be moved forward in order to lower plates 236. When plates 236 are lowered below the top face of table 230, lug 258 strikes lever 259 and moves switch EL to a second position permitting rearward movement of plate 18.

Switch POL is mounted upon the lower face of table 230 rearwardly of plates 236. Switch lever 261 is mounted on the front of switch POL for movement about a lateral axis. Switch POL is normally in a position permitting rearward movement of plate 18 when switch EL is momentarily placed in its second position. After plate 18 clears a stack of towels T from table 230, the lower part of plate 254 strikes lever 261 and moves switch POL to its second position, causing a return of plate 18 to its normal forward position and permitting forward movement of rod 241 to raise elevator plates 236.

Switch EU is mounted upon frame 1 rearwardly of lug 258. Switch lever 260 is mounted upon the front face of switch EU for movement about a lateral axis and is in the path of rearward movement of lug 258. Switch EU is normally in a closed position permitting rearward movement of rod 241 when switch POL is momentarily placed in its second position. Switch EU is opened when plates 236 are raised sufficiently so that lug 258 strikes lever 260, thereby preventing further raising of plates 236. Even when plates 236 are lowered from their highest positions, opening switch EU, the plates cannot be raised until switch POL is again moved momentarily to its second position.

In operation, with elevator plates 236 initially in their highest positions, towels dropped by stacking mechanism E are stacked upon the upper edges of said plates 236. Whenever the stack 17 becomes high enough so that the top towel thereon engages switch lever 219 as the stacking plate 195 reaches its lower position, and moves lever 219 sufficiently to close switch ED, cylinder 240 is actuated to permit a slight forward movement of rod 241 and thereby drop plates 236 slightly. These downward drops of plates 236 will occur on the average every two or three times that a towel T is stacked. The action of plate 195, together with the proximity thereto of stack 17, ensures stacking the towels in a neat, even stack and permits rapid stacking operation.

As will be explained in detail below, after a pre-

determined number of towels T have been stacked, plates 236 drop the remainder of the distance to their lowest positions. Pusher 18 is then actuated to transfer stack 17 to platform 19, after which pusher 18 returns to its normal position and plates 236 simultaneously rise to their highest positions.

Timing Mechanism

Timing mechanism C is shown in detail in FIGS. 19–22.

Timing mechanism C is mounted upon a frame 270 which is supported by frame 1 forwardly of motor 43. The cover of timing mechanism C, shown in FIG. 1, is omitted in FIGS. 19–22.

Timer drive shaft 271 is turnably supported by frame 270 at the rear thereof. Shaft 271 extends longitudinally and has cog wheel 272 mounted on the rear end thereof. Motor 43 has a driven shaft 273 extending longitudinally forward therefrom and carrying cog wheel 274. Pulleys 272 and 274 are preferably coupled to each other by cog belt 275 (see FIGS. 1 and 19), so that motor 43 drives timing mechanism C in synchronization with main conveyor belt 10. The direction of rotation of shaft 271 is indicated by arrow 276.

Relatively short longitudinal shafts 277 are respectively turnably mounted upon frame 270 on opposite sides of shaft 271. Shaft 271 carries a gear 278 which meshes with gears 279 respectively mounted upon the rear ends of shafts 277, so as to drive the latter. The direction of turning of shafts 277 is indicated by arrows 280.

Relatively long longitudinal shafts 281 are respectively turnably mounted upon frame 270 outwardly of shafts 277 and carry on their rear ends gears 282 which mesh with respective gears 279. As a result, shafts 281 are turnable in the direction of arrows 283. Gears 284 are respectively mounted on the front ends of shafts 281.

Relatively short longitudinal shafts 285 are respectively turnably mounted upon frame 270 outwardly of shafts 281 and carry gears 286 at their respective front ends. Gears 286 mesh with respective gears 284, so that shafts 285 are turnable in the direction of arrows 287.

The mechanism associated with the shaft 285 on the right side, as viewed in FIG. 19, is clearly shown in FIGS. 19, 20 and 22 and will now be described in detail.

Shaft 288 is turnably mounted upon frame 270 rearwardly of and in axial alinement with shaft 285. Shaft 288 is axially spaced from shaft 285.

Sleeve or collar 290 is fixed to shaft 285 and extends turnably through a transverse portion 291 of frame 270. Clutch plate 292 is fixed to the rear of collar 290 and extends rearwardly thereof. Annular friction disk 293 is mounted upon the rear face of plate 292 (see FIG. 20).

An annular, transverse braking plate 294 is fixed to frame portion 291 and is located rearwardly of clutch plate 292. Annular friction disk 295 is mounted upon the front face of braking plate 294 and is in longitudinal registration with friction disk 293.

Sleeve 289 is axially slidably mounted upon shaft 288. Shaft 288 and sleeve 289 extend through the openings of plate 294 and disk 295. The front portion of sleeve 289 carries a transverse annular clutch plate 296. In its extreme forward position, shown in FIG. 20, clutch plate 296 frictionally abuts friction disk 293, so that sleeve 289 turns in unison with shaft 285. Optionally, shaft 288 protrudes slightly forwardly of plate 296 and is adapted to be positioned within the opening of disk 293 in the forward position of plate 296. In the extreme rearward position of sleeve 289, plate 296 frictionally abuts braking disk 293, preventing sleeve 289 from turning.

A further sleeve 297 is fixed to shaft 288 behind sleeve 289, and extends turnably through transverse frame portion 300. Sleeve 289 has a rear semi-cylindrical extension 298. Sleeve 297 has a front semi-cylindrical extension 299. The respective longitudinal faces of these sleeve extensions 298 and 299 are in sliding abutment, as clearly shown in FIG. 20. As a result, shaft 288 turns in unison with shaft 285 when clutch plate 296 abuts friction disk 293 and is motionless when plate 296 abuts disk 295.

A second frame portion 300 is located behind and spaced from the first mentioned frame portion 300. The upper ends of these frame portions 300 support platform 301. Timer solenoid BTS_1 is mounted upon the upper face of platform 301, with its plunger 302 protruding longitudinally forwardly thereof. Forwardly extending arm 303 is attached to plunger 302 by means of lateral pivot 304. The front end of arm 303 is coupled by spring 305 to a support 306 fixed to frame 270.

Laterally spaced supports 307 extend outwardly from the front end of the front frame member 300, at the top thereof. Lateral shaft 308 extends through these supports 307. A lever 309 is turnably mounted intermediate their ends upon shaft 308 and is positioned above a collar 310 mounted upon sleeve 289 rearwardly of plate 294. The upper end of said lever 309 is forked and is connected to the respective side faces of arm 303 by means of lateral pivot 311.

A vertically and laterally extending block 312 is fixed to the lower ends of lever 309. Block 312 extends laterally outwardly of lever 309 and carries depending, preferably integral fingers 313. These fingers 313 extend on both sides of collar 289 and abut both faces of collar 310.

It will be apparent from the above description that when solenoid BTS_1 is not energized, spring 305 maintains plate 296 in abutment with disk 295, so that shaft 288 cannot turn. When solenoid BTS_1 is energized, plunger 302 moves rearwardly, against the action of spring 305, moving plate 296 into abutment with disk 293 so that shaft 288 turns.

It will be apparent without detailed description that shaft 277 is adapted to be clutch-coupled with shaft 314 (FIG. 19) in entirely the same manner as shaft 285 is adapted to be clutch-coupled with shaft 288, the action of the clutch for shafts 277 and 314 being controlled by timer solenoid BTS_2 (FIG. 22). Shafts 288 and 314 both turn in the direction of arrows 315 (FIG. 19).

Shaft 288 carries a worm gear 316 rearwardly of collar 297. Shaft 314 carries a corresponding worm gear 317 in lateral registration with and spaced from worm gear 316. (Worm gear 317 is not shown on the right side of timing mechanism C, as taken in FIG. 19; but the corresponding worm gear 317 on the left side is shown). Worm gears 316 and 317, which are adapted to turn in the same direction and at the same speed control the action of a differential gear mechanism which will now be described.

A lateral shaft 318 is turnably mounted upon frame 270 and extends below and laterally outwardly of worms 316 and 317. Optionally, bearing sleeve 327 is mounted upon shaft 318. Spaced gears 319 and 320 are turnably mounted upon shaft 318, and respectively mesh with the respective worm gears 316 and 317. Said gears 319 and 320 respectively have gears 321 of smaller diameter fixed to their proximate faces and also turnable upon shaft 318.

A cylinder collar 322 is fixed to shaft 318 between gears 321, by means of screw 323. Collar 322 is of greater diameter than gears 321 and has openings in the rsepective ends thereof into which gears 321 respectively turnably extend.

Collar 322 has a recess 324 extending inwardly from its peripheral surface. Gears 325 of relatively small diameter are mounted upon the respective end faces of recess 324 by means of respective lateral pivots (not shown). Each gear 325 meshes with a respective gear 321, and gears 325 also mesh with each other.

It will be apparent that when solenoids BTS_1 and BTS_2 are both de-energized, shaft 318 does not turn. When only solenoid BTS_1 is energized, so that worm 316 turns, shaft 318 turns in the direction of arrow 326 (FIG. 20) at a selected speed which is proportional to the linear speed of movement of belt 10. When both solenoids BTS_1

and BTS_2 are energized, so that both worms 316 and 317 turn, shaft 318 turns in the direction of arrow 326 at twice the speed occurring when only solenoid BTS_1 is energized.

Timer cam 328 is fixedly mounted upon shaft 318 outwardly of gear 319 and is adapted to control the action of zero switch BZ, which is fixed to frame 270. Timer cam 329 is mounted upon shaft 318 outwardly of cam 328 and is adapted to control the action of folder switch BF, which is fixed to frame 270. The turned position of cam 329 on shaft 318 relative to that of cam 328 may be regulated by means of adjusting screw 330. These parts are clearly shown in FIGS. 19 and 21.

The casing of switch BF is supported between the longitudinally extending arms of a generally U-shaped bracket 332, the cross-arm 333 of which is located in front of and spaced from the front of folder switch BF. Arm 333 extends laterally and transversely. Bracket 332 is fixed to the outer longitudinal face of support plate 331, which is in turn connected to the rear frame member 300 laterally outwardly thereof.

Lateral shaft 334 is connected between the side arms of bracket 332. The upper ends of the side arms of a generally U-shaped lever 335 are turnably mounted upon shaft 334, the cross-arm 336 of said lever 335 being positioned forwardly of shaft 334. Intermediate its upper and lower ends, arm 336 carries a longitudinal button 339 which extends rearwardly thereof. Lever button 339 is positioned and adapted to engage switch button 340, which protrudes out of the front of the casing of switch BF.

Lever arm 336 carries a nylon plate 337 on the front of its lower end portion, which plate 337 has a central nylon projection 338 on its front face. Projection 338 frictionally abuts and rides upon the periphery of cam 329, switch button 340 being thereby normally pressed rearwardly to hold folder switch BF open.

Cam 329 has a cam notch 341 extending across the peripheral edge thereof. Preferably, the leading face of notch 341 extends substantially radially, and the trailing face thereof extends at an incline from the inner edge of the leading face to the peripheral face of the cam, as clearly shown in FIG. 21. When projection 328 is located in notch 341, switch button 340 moves outwardly and switch BF closes.

It will be apparent without detailed description that zero switch BZ is coupled to cam 328 in substantially the same manner as switch BF is coupled to cam 329, the shape of cam 328 being the same as that of cam 329. The important difference is that zero switch BZ is closed at all times except when its associated lever projection 342 is located within the notch of cam 328. It may also be noted that switch BZ is mounted upon the front frame portion 300 and faces in the opposite direction from switch BF. Projections 338 and 342 are disposed one hundred eighty degrees apart with respect to the rotation of the two cams.

It will also be apparent without detailed description that the left side of timing mechanism C, as taken in FIG. 19, is substantially the same in construction as the right side. In fact, each side of timing mechanism C constitutes a separate timer. The operation of the left timer is controlled by solenoids ATS_1 and ATS_2 and switches AF and AZ (FIG. 22).

In briefly describing the operation of timing mechanism C, it will be assumed for the sake of convenience that the left or "A" timer is the first to be placed in operation. Initially, cam 328 is in its zero position, with lever projection 342 located in the notch of said cam 328, so that switch BZ is open. Initially, cam 329 is in a selected turned position relative to cam 328, projection 342 being out of notch 341 and folder switch BF being open.

When the leading edge of towel T closes towel length switch X (FIG. 1), solenoid ATS_1 is energized, by means to be described in detail below, and cams 328 and 329 turn at half of their full speed. Switch AZ is now closed. Solenoid ATS_1 remains energized throughout the time that towel T is passing under switch X. When towel T leaves switch X, both solenoids ATS_1 and ATS_2 are energized, by means which are now independent of switch X and which will be described in detail below, so that cams 328 and 329 turn at their full speed. At this time, in general notch 341 has not yet reached projection 338. At this time, also, the "B" timer comes under the control of switch X, by means to be described in detail below, so that the movement of the next towel T is timed by the "B" timer.

The cams 328 and 329 of the "A" timer now turn at full speed until projection 338 enters notch 341, whereby switch AF is closed. As will be explained in detail below, when switch AF is closed, folder solenoid FS is energized, whereby the transverse fold in towel T is made. Cams 328 and 329 continue to turn at full speed, projection 338 leaving notch 341 and re-opening switch AF, until cam 328 returns to its zero position, again closing switch AZ, whereby solenoids ATS_1 and ATS_2 are de-energized.

After the "B" timer has timed the folding of the next towel, the "A" timer again comes under the control of switch X, completing a cycle of operation of timing mechanism C.

In the preferred operation of timing mechanism C, the turned position of cam 329 relative to cam 328 is selected so that with cam 329 starting in its zero position, the time required for groove 341 of cam 328 to reach projection 338 so as to close switch AF with both cams turning at full speed, would be equal to the time required for the leading edge of towel T to be carried by belt 10 from the point at which switch X is first closed to the transverse folding point. Since cams 328 and 329 actually turn at only half of their full speed while the length of towel T is passing under switch X, it will be apparent that switch AF is not closed until half the length of towel T has passed beyond the transverse folding point. As a result, towel T is folded exactly at the center thereof. Since the longitudinal side folded portions of towel T face the folding levers, the finally folded towel is perfectly smooth and without protruding edges.

It will be apparent that towels T of varying length will each be transversely folded exactly at its center points. The turned position of cam 329 relative to that of cam 329 can be adjusted to compensate for fraction-of-a-second delays in solenoid operation and the like.

It will also be apparent that a second switch similar to towel length switch X, as well as a second transverse folding mechanism, can be provided. The two towel length switches can respectively actuate the respective timers "A" and "B," and the respective timers can respectively control the operation of the respective folding mechanisms. As a result, two transverse folds can be made in towel T.

The position of the transverse fold in towel T can be varied by varying the turned position of cam 329 relative to that of cam 328.

An important result of the use of the two timers "A" and "B" is that towels T can follow each other in close succession upon belt 10. This is because after a first towel leaves switch X, the further action of the timer controlling the folding of the towel is regulated by an auxiliary relay, so that the other timer is immediately available to time the folding of a second towel. Preferably, the cams of the first timer return to their zero positions before the second towel leaves switch X.

Control Devices

The description up to this point has concerned itself primarily with the mechanical operations performed by the various components of the machine. The control devices for the various components, which include electrical, mechanical, compressed air and hydraulic devices, will

now be described in detail, with particular reference to FIGS. 18 and 23*a*, 23*b* and 23*c*.

Upon reference first to FIG. 23*a*, it will be apparent that the electrical circuit includes a pair of terminals **350** which are adapted to be connected to a source of alternating voltage, preferably 115 volts, 60 cycles. These terminals **350** are respectively connected through fuses **351** to respective lines **352** and **353**. Pilot lamp PL is connected between said lines **352** and **353**. Ironer heater element **354** and thermostat **355** are connected in series between lines **352** and **353**.

In the drawings, relay coils are generally designated by reference letters without subscripts, and the switches or contacts operated by each relay coil are designated by the same reference letters as the relay coil, with the addition of numerical subscripts. All switches are shown in their normal positions.

In the drawings, a resistance **356** and capacity **357** are shown connected in series across the terminals of many of the switches or relay contacts. These circuit elements will not be referred to in the detailed description of the electric circuit. Their purpose is to suppress sparking during the opening of the switch contacts.

Auxiliary timer relay switch TX_1 (in the normal position thereof), the normally open On switch, motor starting relay MS, and overload switch OL_1 are connected in series between lines **352** and **353**. The normally closed Off switch and motor starting relay switch MS_1 are connected in series across the On switch. Motor starting relay switch MS_2, the motor circuit M of motor **43** and overload device OL are connected in series between lines **352** and **353**. Motor circuit M and overload device OL are together connected in parallel with ironer solenoid IS.

When the On button is momentarily held closed, relay MS is energized, closing switches MS_1 and MS_2. Even when the On button is released, relay MS remains energized. The closing of switch MS_2 causes operation of motor **43** to drive the machine and also causes operation of ironer solenoid IS to permit belt **10** to rise into operative contact with the ironer.

The motor circuit may be opened in three ways. First, the Off button may be pressed, breaking the circuit of relay MS. Secondly, the overload device OL, through excess current therein or other cause, may be actuated to open switch OL_1, which also breaks the circuit of relay MS. Thirdly, switch TX_1 may be moved from its normal position to its second position to open the circuit of relay MS.

The alarm circuit for opening switch TX_1 is shown in FIG. 23*b*. For convenience of illustration, lines **352** and **353** are shown in FIG. 23*a* as connected to respective terminals *c* and *d*. Terminals *c* and *d* are shown in FIG. 23*b* as connected to further respective alternating current lines **358** and **359**.

Alarm entrance switch AE, alarm setting relay AC and stacker relay switch SR_3 (in the normal position thereof) are connected in series between lines **358** and **359**. It will be recalled that whenever a towel T enters the machine, it closes switch AE. Timer relay T, alarm setting relay switch AC_1 and alarm setting relay switch AC_2 are also connected in series between lines **358** and **359**. Switch AC_2 is connected in parallel with switch AE. Timer auxiliary relay TX and timer relay switch T_1 are also connected in series between lines **358** and **359**.

The operation of the alarm circuit is as follows:

When switch AE is temporarily closed by an entering towel, relay AC is energized, closing switches AC_1 and AC_2. Even when switch AE is opened, relay AC remains energized as long as switch SR_3 is in its normal position. As a result of the closing of switch AC_1 and AC_2, device T is energized. If device T remains energized for a selected period of time, switch T_1 is closed and relay TX is energized.

Whenever a towel is stacked, switch SR_3 is moved to a second position (as will be explained in detail below), opening the alarm circuit. The alarm circuit is re-set when another towel passes switch AE, because device T resets instantaneously when its circuit is opened. If no towel is stacked for said selected period of time, as a result of a jamming of the conveyor or other cause, relay TX is energized.

When relay TX is energized, switch TX_1 moves to its second position, stopping the motor. In the second position of switch TX_1, trouble light TL and single stroke bell BL are connected across lines **352** and **353**.

When relay TX is energized, switch TX_2 is also opened. The terminals of the switch TX_2 may be connected by lines **360** and **361** to the motor circuit of a feeder conveyor for the machine (not shown), so as to stop the feeder conveyor when switch TX_2 is opened.

The input terminals **362** of full-wave rectifier **363** are respectively connected to lines **352** and **353** (FIG. 23*a*). The output terminals **364** of rectifier **363** are connected through fuses **365** to the respective direct current lines **366** and **367**. Resistance **368** and capacity **369** are connected in series between the terminals **364**. Lines **366** and **367** supply the current for the electric control devices for timing mechanism C.

In FIG. 23*a*, relays designated by a first reference letter "A" are part of the "A" timer, and relays designated by a first reference letter "B" are part of the "B" timer.

Towel-length switch X, flip-flop relay switch FF_1 (when flip-flop relay FF is not energized), and timer relay AXR are connected in series between lines **366** and **367**, so that relay AXR is energized while switch X is closed by towel T.

Timer relay switch AXR_1 and timer solenoid ATS_1 are connected in series between lines **366** and **367**. Auxiliary relay switch AAR_2 is connected in parallel with switch AXR_1. Auxiliary relay AAR, normally closed timer relay switch AXR_2 and zero switch AZ are connected in series between lines **366** and **367**. Timer solenoid ATS_2 and auxiliary relay switch AAR_1 are also connected in series between lines **366** and **367**.

Flip-flop relay FF and auxiliary relay switch AAR_3 are connected in series between lines **366** and **367**. Flip-flop relay switch FF_2 and the normally closed "B" auxiliary relay switch BAR_3 are connected in series across switch AAR_3.

The operation of the "A" timer is as follows:

While towel T maintains switch X closed, relay AXR is energized. As a result, switch AXR_1 is closed and solenoid ATS_1 is energized. While switch AZ is closed as soon as the cams begin to turn, switch AXR_2 is open, so that relay AAR is not energized. As soon as towel T leaves switch X, relay AXR is de-energized. Switch AXR_2 closes and auxiliary relay AAR is energized.

With relay AAR energized, switches AAR_2 and AAR_1 close, so that solenoid ATS_1 remains energized and solenoid ATS_2 is also energized. Also, switch AAR_3 is closed, so that flip-flop relay FF is energized. Flip-flop switch FF_1 is now thrown to the position in which the "B" timer relay BXR and switch X are connected in series between lines **366** and **367**, relay AXR being now out of circuit. As will become apparent shortly, the "B" timer can now operate.

Relay AAR remains energized until the cams return to their zero positions and switch AZ opens, at which point the operation of the "A" timer ceases. When relay AAR is thus de-energized, switch AAR_3 opens. However, switch FF_2, which was closed as soon as relay FF was energized, and switch BAR_3 hold relay FF in circuit.

As soon as flip-flop relay FF is energized, the "B" timer is adapted to time the movement of a towel which closes switch X. The "B" timer circuit is quite similar to the "A" timer circuit. Solenoid BTS_1 and switch BXR_1 are connected in series between lines **366** and **367**, with switch BAR_1 in parallel with switch BXR_1. Relay BAR, switch BXR_2 and switch BZ are connected in series

between lines 366 and 367. Solenoid BTS_2 and switch BAR_2 are also connected in series between lines 366 and 367.

The operation of the "B" timer circuit should be apparent from the foregoing. When relay BAR is energized, after the re-opening of switch X, switch BAR_3 is opened, de-energizing flip-flop relay FF. The "A" timer is again available for timing the movement of a towel which closes switch X.

The control circuit for the transverse folder includes folder relay FR, as well as the previously mentioned timer cam folding switches AF and BF, folder solenoid FS and folder limit switch FL. These parts are shown in the diagram of FIG. 23*a*.

Folder relay FR and switch AF are connected in series between lines 366 and 367. Switch BF is in parallel with switch AF. Normally closed switch FL and folder relay switch FR_1 are connected in series across switch AF. Solenoid FS and folder relay switch FR_2 are connected in series between lines 352 and 353.

In operation, when either switch AF or BF is closed by the operating of timing mechanism C, folder relay FR is energized. Switch FR_1 is closed, so that relay FR remains energized even though said switch AF and BF is immediately opened again. Switch FR_2 is also closed, so that solenoid FS is energized, operating the folding mechanism. It will be apparent that when switch FL is opened, solenoid FS is de-energized, and the folding action ceases.

For convenience in illustration, the direct current lines 366 and 367 are shown as having respective terminals *a* and *b*. In FIG. 23*c*, these terminals *a* and *b* are shown as being respectively connected to further direct current lines 370 and 371. FIG. 23*c*, in conjunction with FIG. 18, shows the control devices for the stacking mechanism E and the elevator and pusher mechanism F.

FIG. 18 shows an air line 372 which is adapted to be connected to a source of compressed air, at a pressure of eighty pounds as an example. The incoming air travels through water and dirt trap 373, pressure regulating device 374 (at which the pressure is reduced to sixty pounds as an example) and then oil bath 375. At this point, some of the air enters branch line 376, and the remainder of the air passes through pressure device 377 and needle valve 377*a* into branch air line 378.

Branch air line 378 leads to air cylinder 65, whose plunger 67 helps to support input conveyor A. Pressure device 377 is of a type such that the pressure exerted upon the piston of plunger 67 is constant regardless of the position thereof within air cylinder 65. As a result, when the ironer conveyor (FIG. 3) is lowered at night, input conveyor A is automatically lowered without damage thereto. Furthermore, if the ironer conveyor is raised in the morning, conveyor A is automatically raised. Needle valve 377*a* prevents momentary pressure changes from affecting the position of plunger 67.

Air line 376 leads to further branch lines 379, 380 and 381 and hence to the various air cylinders previously referred to (FIG. 23*c*).

Air line 379 leads through respective solenoid-operated valves 382 and 383 to ports adjacent the respective ends of stacker air cylinder 180. Valve 382 is the stacker "down" valve and is operated by stacker down valve solenoid SDV. Valve 383 is the stacker "up" valve and is operated by stacker up valve solenoid SUV.

Each valve 382 and 383, as well as each of the other solenoid-operated air valves shown in FIG. 23*c*, is a two-position valve and is shown in its normal position in FIG. 23*c*. Each air valve has a conduit 384, one end of which always communicates with a respective port of its associated air cylinder and the other end of which communicates with its associated air line in one position of the valve and communicates through needle valve 385 with the atmosphere in the other position of the valve.

Valve 383 normally connects air line 379 to air cylinder 180 rearwardly of its plunger piston 386 and hence normally maintains plunger 179 in its forward position in which the stacker is up. The air in front of piston 386 is normally bled to the external atmosphere through valve 382. It will be apparent that when solenoids SDV and SUV are energized, air enters the front of cylinder 180 from line 379 through valve 382 and is exhausted from the rear of cylinder 180 through valve 383, so that the stacker moves to its "down" position.

Stacker relay SR, normally open stacker down switch SD and normally closed stacker upper limit switch SUS are connected in series between lines 370 and 371. Solenoids SUV and SDV are connected in parallel with each other and in series with stacker relay switch SR_2 between lines 370 and 371. Stacker relay switch SR_1 and stacker lower limit switch SLS (in the normal position thereof) are connected in series between line 370 and the end of relay SR which is remote from line 371.

In operation, when a towel T closes switch SD, relay SR is energized. Although switch SD re-opens immediately, switch SR_1 has first been closed, so that relay SR remains energized. Switch SR_2 is thereby held closed, energizing solenoids SDV and SUV so that towel T is stacked. When switch SLS is moved to its second position, relay SR is de-energized, and the stacker returns to its "up" position. In view of the fact that switch SUS is only closed while the stacker is in its "up" position, solenoid SR cannot be re-energized while the stacker is returning to its "up" position even if the sensitive switch SD accidentally closes.

Totalizing counter relay TC is connected in parallel with solenoids SDV and SUV and is thereby energized once for each stacking operation. Relay TC operates one or more counting devices (not shown) which indicate the total number of towels stacked.

Branch air line 380 leads through respective solenoid-operated valves 387 and 388 to ports adjacent the respective ends of elevator air cylinder 239. Valve 387 is the elevator "up" valve and is operated by elevator up valve solenoid EUV. Valve 388 is the elevator "down" valve and is operated by elevator down valve solenoid EDV.

Valve 388 normally connects air line 380 to air cylinder 239 rearward of its plunger piston 389 and hence normally tends to maintain plunger rod 241 in its forward position and thereby tends to make the elevator fall. The air in front of piston 389 is normally bled to the external atmosphere through valve 387 (see FIGS. 23*c* and 16).

The other elevator cylinder 240 is filled with hydraulic fluid and serves as a hydro-check for air cylinder and has the usual piston 390 connected to the rear end of rod 241. Hydraulic line 391 enters cylinder 240 forwardly of piston 390, and hydraulic line 392 enters cylinder 240 rearwardly of piston 390. Normally closed high speed valve 393, whose action is controlled by high speed valve solenoid HSV, is connected between lines 391 and 392. Normally closed valve 394 and constriction 395 are connected in series between lines 391 and 392. Valve 394 is a low speed valve, because of constriction 395, and its action is controlled by low speed valve solenoid LSV.

It will be apparent that the fluid in cylinder 240 prevents the compressed air in cylinder 239 from dropping the elevator unless valve 393 or valve 394 is opened.

Stacker limit switch SLS (in the second position thereof), elevator down switch ED and low speed valve relay LSR are connected in series between lines 370 and 371. Solenoid LSV and low speed relay switch LSR_1 are also connected in series between lines 370 and 371.

When the stacker is in its lowest position, so that switch SLS is in its second position, if the stack of towels is at that time sufficiently high so that switch ED is closed, relay LSR is energized. As a result, switch LSR_1 is closed and solenoid LSV is energized. Although switches SLS and ED are re-opened almost immediately, resist[or] 396 and capacity 397 are connected in series across r[elay] LSR and furnish sufficient time delay to maintain th[e]

lay energized for a short time after the switches are reopened.

While relay LSR is energized and solenoid LSV is thereby energized, low speed valve **394** is open, furnishing a path for the flow of a small amount of fluid from cylinder **240** through line **391** and line **392** and back to cylinder **240**. As a result, the compressed air in cylinder **239** from valve **388** and line **380** is active to force rod **241** a short distance forwardly, thereby lowering the elevator slightly. As a result, the elevator is lowered in a series of short steps just enough to provide vertical clearance for stacking towels thereon.

As will be explained in detail below, after a selected number of towels have been stacked, stepper counter switch SC is closed, thereby energizing elevator down relay EDR, which is connected in series with switch SC between lines **370** and **371**. The parts associated therewith will now be described.

Elevator limit switch EL (in the normal position thereof) and elevator down relay switch EDR_1 are connected in series across switch SC. Pusher relay PR, elevator down relay switch EDR_3, normally closed elevator up relay switch EUR_1 and switch EL (in the second position thereof) are connected in series between lines **370** and **371**. Relay PR is also connected in series with pusher relay switch PR_1 and pusher out limit switch POL (in the normal position thereof) between lines **370** and **371**. Elevator up relay EUR, elevator up relay switch EUR_2 and the normally closed elevator upper limit switch EU are connected in series between lines **370** and **371**. Relay EUR is also connected in series with switch POL (in the second position thereof) between lines **370** and **371**. Solenoids EUV and EDV are connected in parallel with each other and in series with elevator up relay switch EUR_3 between lines **370** and **371**. Solenoid HSV and elevator down relay switch EDR_2 are connected in series between lines **370** and **371**.

Resistance **398** and capacity **399** are connected in series across relay EDR to provide a time delay in the de-energizing of relay EDR after its current supply circuit is opened.

Branch air line **381** leads through respective solenoid-operated valves **400** and **401** to ports adjacent the respective ends of pusher air cylinder **252**. Valve **400** is the pusher "out" valve and is operated by pusher out valve solenoid PFV. Valve **401** is the pusher "return" valve and is operated by pusher return valve solenoid PRV.

Valve **401** normally connects air line **381** to air cylinder **252** rearwardly of its plunger piston **402** and hence normally tends to maintain plunger rod **253** in its forward position. The air in front of piston **402** is normally bled to the external atmosphere through valve **400**.

Solenoid PFV and solenoid PRV are connected in parallel with each other and in series with pusher relay switch PR_2 between lines **370** and **371**.

In operation, when switch SC is closed and relay EDR is thereby energized, switch EDR_2 is closed, thereby energizing solenoid HSV. Valve **393** is thereby opened, permitting a rapid flow of fluid from cylinder **240** through line **391** and line **392** and back to cylinder **240**. As a result, the compressed air in cylinder **239** moves piston **389** and rod **241** rapidly forward and drops the elevator rapidly to its lowest position. When relay EDR is first energized, switch EDR_1 is also closed. Although switch SC opens immediately, relay EDR remains energized while switch EL is in its normal position.

When the elevator reaches its lowest position, switch EL is moved to its second position. Relay EDR remains energized for an instant, because of the time delay caused by resistance **398** and capacity **399**, so that switch EDR_3 is held closed long enough for relay PR to be energized. Switch PR_1 is thereby closed, so that relay PR remains energized after switch EDR_3 is opened and until switch POL is moved to its other position.

While relay PR is energized, switch PR_2 is closed, energizing solenoids PFV and PRV. As a result, valves **400** and **401** are operated so that plunger rod **253** is driven rearwardly or outwardly, clearing the stack from the lowered elevator.

At the end of the rearward stroke of pusher plunger **253**, switch POL is moved to its second position, energizing relay EUR and de-energizing relay PR. As a result of the de-energizing of relay PR, pusher plunger rod **253** returns to its normal position. At the same time, switch EUR_3 is closed, energizing solenoids EUV and EDV, so that valves **387** and **388** are moved to positions wherein the compressed air from line **380** drives rod **241** rearwardly to raise the elevator. Piston **390** has a one-way check valve **403** which permits rearward movement of piston **390** through the fluid of cylinder **240**. It is noted that these movements of the elevator and of the pusher can be simultaneous, because the pusher is located laterally between the two center elevator plates **236**. This is a very important capability of my elevator in the time that is saved. By not having to wait for retraction of the pusher to start raising the elevator it is possible to have the elevator in its up position ready to receive the first towel of the next stack without halting the rest of the machine. This is true in spite of the high speed of the machine.

Although switch POL immediately returns to its normal position, switch EUR_2 has first been closed by relay EUR, so that relay EUR remains energized until switch EU is opened.

While relay EUR is energized, switch EUR_1 remains open. It is noted that switch EL remains closed during the outward pusher stroke. Without switch EUR_1, if relay EDR remained sufficiently energized to keep switch EDR_3 closed, relay PR could be energized even when switch POL was moved to its second position, with resultant pumping action of the pusher. However, as mentioned above, as soon as switch POL moves to its second position, switch EUR_1 is opened so that relay PR cannot be re-energized.

When the elevator returns to its highest position, switch EU is opened and relay EUR is de-energized.

As has been previously mentioned, step counter switch SC is adapted to be closed by a counting mechanism after a selected number of towels has been stacked. This counting mechanism is shown diagrammatically in FIG. 23*b*.

The mechanism comprises two contact plates **404** and **405** disposed in parallel registration with each other and fixed to a frame (not shown), each said plate being substandtially semi-circular and carrying twenty-seven contacts disposed about the periphery thereof. The number of contacts is illustrative only, and the number can be varried as will become apparent below. The first and last contacts are optionally and preferably diametrically opposed.

Said plates **404** and **405** extend transversely to a rotor **406**, which is turnably mounted upon the frame of the mechanism. Two contact arms **407** and **408**, cam **410** and ratchet-wheel **409** are mounted upon rotor **406** and are axially spaced from each other. Cam **410** carries a projection **411** which strikes the movable arm **412** of switch SC once during a revolution of rotor **406** and thereby moves arm **412** into switch-closing contact with the fixed arm **413** of switch SC, switch SC being otherwise open.

In order to turn ratchet **409** and hence rotor **406**, resistance **414**, rectifier **415** and solenoid **416** are connected in series between line **358** and terminal **418**. Resistance **417** is connected in parallel with solenoid **416**. Terminal **418** is connected by switch SR_3 (in the second, non-normal position thereof) to line **359**. Solenoid **416** is thereby energized when terminal switch SR_3 is in its second position.

Solenoid arm **419** is supported by the frame upon pivot **420**, which is parallel to rotor **406**. Arm **419** is connected intermediate its ends to one end of link **421**,

the other end of which is connected by spring 422 to the frame. Link 421 carries a detent 423 intermediate its ends. The lower end of arm 419 carries a movable contact of a switch 424, the other contact of which is fixed to the frame.

When solenoid 416 is energized, its arm 419 is drawn towards itself against the action of spring 422 and in a direction to open switch 424. When solenoid 416 is de-energized, arm 419 moves in the opposite direction so as to close switch 424 and so that detent 423 engages ratchet-wheel 409 and turns it sufficiently to move contact arms 407 and 408 the distance between successive contacts on the contact plates. Arms 407 and 408 turn in a counterclockwise direction, as taken in FIG. 23*b*.

For convenience, the contacts of plate 404 are designated in FIG. 23*c* by the reference characters R, 0, 1, 2, . . . 24, 25 and will be referred to in the description as C_R, C_0, C_1, C_2, . . . C_{24}, C_{25}. The contacts of plate 405 are designated by the reference characters R, 26, 27, . . . 49, 50, Q and will be referred to in the description as C_R, C_{26}, C_{27}, . . . C_{49}, C_{50}, C_Q:

In plate 404, contacts C_R and C_{25} are diametrically opposed. In plate 405, contacts C_R and C_Q are diametrically opposed. Also, contact arms 407 and 408 are disposed one hundred eighty degrees apart. Thus, when arm 407 makes contact with its associated contact C_R, arm 408 makes contact with contact C_Q. When arm 407 makes contact with any other contact of plate 404, arm 408 is out of contact with the contacts of plate 405.

Contact arms 407 and 408 are connected to each other by lines 425. Line 425 is connected by line 428 to arm 419. Contacts C_{50} and C_Q are connected to each other by line 426 and to line 359 by line 427.

In operation, when no towels have been stacked, rotor 406 is positioned so that contact arm 407 engages contact C_0. As previously mentioned, while the stacker is moving downwardly and until switch SLS is actuated, stacker relay SR is energized. As a result, switch SR_3 is held during this time in its position in which solenoid 416 is energized, and arm 419 is held in a position in which switch 424 is open and detent 423 is out of engagement with the teeth of ratchet wheel 409.

When the first towel is stacked and relay SR is de-energized, arm 419 is released and detent 423 turns ratchet wheel 409 so as to move arm 407 to contact C_1. Similarly, when the second towel is stacked, arm 407 moves to contact C_2, and so on. When the twenty-fifth towel is stacked, arm 407 moves to contact C_{25} and arm 408 moves to contact C_R of plate 405. When the twenty-sixth towel is stacked, arm 408 moves to contact C_{26}, and so on. After the fiftieth towel is stacked, and while contact arm 408 is moving from contact C_{49} to C_{50}, projection 411 brushes against switch arm 412 and momentarily closes switch SC, thereby actuating the mechanism to remove the stack from the elevator, as previously described.

When contact arm 408 makes contact with contact C_{50}, and although switch SR_3 is now in its normal position, an electric circuit is completed from line 358 through resistance 414, rectifier 415, solenoid 416, switch 424, arm 419, line 428, line 425, arm 408, line 426 and line 427 to line 359. As a result, solenoid 416 is energized, moving arm 419 to open switch 424, whereby arm 408 is moved to contact C_Q. The same circuit is again closed, and arm 407 is returned to contact C_0. The counting mechanism is now in position to count the next stack of towels.

It will be apparent that by tying other contacts to line 359, it is possible for other contacts to be skipped, so that the stack will be removed after a selected number of towels, other than fifty, has been stacked.

In particular, FIG. 23*b* shows a modifying circuit for stacking the towels in stacks of twenty-five. Contacts C_1, C_3 . . . C_{23}, C_{25}, C_{27}, C_{29} . . . C_{47}, C_{49} are all connected to line 429, which is connected through manually operable switch 430 (when closed) and line 436 to line 359. When either contact arm 407 or 408 strikes any one of these contacts, a circuit is completed from line 358 through resistance 414, rectifier 415, solenoid 416, switch 424, arm 419, line 428, line 425, the contact arm, the contact, line 429, switch 430 and line 436 to line 359, so that the contact arm is automatically moved to the next contact. Therefore, after twenty-four towels have been stacked, contact arm 408 is located at contact C_{48}. When the twenty-fifth towel is stacked, contact arm 408 moves to contact C_{49} and then automatically to contact C_{50} in the manner just described, closing switch SC. From contact C_{50}, arm 408 automatically moves two positions, as previously described, to return arm 407 to contact C_0.

A manual reset button 431 is provided for returning the counting mechanism to its zero position if it is desired to start a new stack before a complete stack of fifty (or twenty-five) towels has been made. When said button is depressed, it first closes a pair of switch contacts 432 and 433 and then closes a pair of switch contacts 434 and 435. Contacts 432 and 434 are both connected by line 436 to line 359. Contact 433 is connected by line 437 to line 429. Hence the closing of contacts 432 and 433 is equivalent to the closing of switch 430.

Contacts C_2, C_4, . . . C_{22}, C_{24}, C_{26}, C_{28} . . . C_{46}, C_{48} are all connected to line 438, which is connected to contact 435. Therefore, when contacts 435 and 434 are closed, and when either contact arm 407 or 408 strikes any one of these contacts, a circuit is completed from line 358 through resistance 414, rectifier 415, solenoid 416, switch 424, arm 419, line 428, line 425, the contact arm, the contact, line 438, contacts 435 and 434 and line 436 to line 359, so that the contact arm is automatically moved to a contact connected through lines 437 and 438 to line 358. As a result, arms 407 and 408 are automatically moved through all of these positions, closing switch SC, until arm 407 returns to contact C_0. This contact is not connected to the reset switches, so that arms 407 and 408 remain in their zero position until relay SR is energized and the first towel of a new stack is stacked.

Summary of Operation

The mode of operation of the various parts has been fully described in the course of the previous detailed description of the machine. At this point, therefore, the over-all operation of the machine will be only briefly described.

The On button is pressed to start the motor. Towel T moves from ironer conveyor belt 85 to input conveyor belts 79 and 80. The latter belts preferably travel much faster than belt 85, but sufficient friction is applied by roller 84 so that towel T is pulled up the incline of input conveyor A by the belts thereof.

From input conveyor A, towel T travels into the main machine between belt 10 and plate 100 and into longitudinal folder B, at the same time depressing alarm entrance switch AE. If a towel is not stacked by stacking mechanism E in fifteen seconds, for example, the alarm mechanism is actuated and the machine stops.

In longitudinal folder B, one side portion of towel T is folded under main plate 100 by folding plate 109, and the other side portion of towel T is folded under plate 109 by the second folding plate 110. Towel T, therefore, leaves longitudinal folder B folded longitudinally roughly into thirds. While the folded-under portions of towels T may vary in width, the central portions are all of the same width, which is governed by the width of plate 100.

Towel T then passes around change-of-direction roller 11 and then rides on the upper face of belt 10. Towel T passes under and in operative contact with inner plate 122, ironer solenoid IS having been energized to raise rod 13 when the motor was started).

Towel T then reaches switch lever 14 and holds towel-length switch X closed during the time that it passes be-

tween belt **10** and lever **14**. If it be assumed that the flip-flop relay FF is not energized, so that the "A" timer is in operation, relay AXR is energized while switch X is closed, as a result of which solenoid ATS_1 is energized and cams **328** and **329** turn from their zero positions at half their full speed (the time required for cam **328**, turning at full speed, to move from its zero position to the point of closure of towel folding switch AF being equal to the time required for a point on belt **10** to move from switch X to the transverse folding position). After towel T leaves switch X, auxiliary relay AAR is energized, both solenoids ATS_1 and ATS_2 are energized and cams **328** and **329** turn at full speed. Relay AXR is de-energized and flip-flop relay F is energized, making it possible for the "B" timer to time the movement of the next towel. Cams **328** and **329** continue to turn until switch AF is closed, at which time the center of towel T is at the transverse folding point, and then continue to turn until they return to their zero positions.

When switch AF is closed, folding solenoid FS is energized and operates folding mechanism D to fold towel T transversely and to force towel T between roller **15** and tension roller **28**, against the lower face of belt **10**. When the moving mechanism closes folder limit switch FL, solenoid FS is de-energized and the mechanism returns to its normal position.

Towel T is next carried between belt **10** and plate **153** to stacking mechanism E, where the towel is supported by angle irons **178** and is moved frictionally by pulley belts **170**. When towel T strikes stacker down switch SD, stacker solenoids SDV and SUV are energized, operating air valves **382** and **383** to admit compressed air to air cylinder **180** in a direction such as to drive plunger **179** outwardly to move irons **178** out of the downward path of towel T. Simultaneously, tamping plate **195** is pushed downwardly against towel T to force it onto stack **17**. When the stacker actuates stacker lower limit switch SLS, the solenoids SDV and SUV are de-energized, so that the action of valves **382** and **383** is reversed and the stacker returns to its normal position. The stack **17** is supported by elevator plates **236**, which are in their highest position at the start of the stack. The movement of plates **236** depends upon the movement of rod **241**, which serves as the common plunger rod for air cylinder **239** and hydraulic cylinder **240**. Normally, the air valves **387** and **388** for cylinder **239** are positioned to admit compressed air into cylinder **239** in a direction so as to tend to move rod **241** to lower plates **236**. This action is normally resisted by the pressure of the hydraulic fluid of cylinder **240** upon plunger rod piston **390**.

When elevator down switch ED of the downwardly moving stacker plate **195** strikes the top towel of the stack (the stack having risen too high), low speed valve relay LSR is energized. As a result, hydraulic valve **394** is opened to permit a small flow of fluid between the ends of cylinder **240**, making it possible for rod **241** to move slightly and lower plates **236** slightly.

Every time that a towel is stacked, the step counting mechanism is turned one step. After fifty towels have been stacked, the step counting mechanism is automatically turned back to its starting position. In moving from the forty-ninth to the fiftieth step, the step counting mechanism closes switch SC. High speed valve solenoid HSV is thereby energized, opening valve **393** and permitting a rapid flow of fluid between the ends of cylinder **240** so that the elevator drops rapidly to its lowest position. At this point, elevator lower limit switch EL is actuated, and pusher relay PR is thereby energized. Pusher plate **18** is forced in a direction to clear the stack from the elevator and to close pusher outer limit switch POL. Relay PR is de-energized, so that the pusher returns to its initial position; and solenoids EUV and EDV are energized to turn valves **387** and **388** to positions resulting in movement of rod **241** to return the elevator to its highest position. At this point, elevator upper limit switch EU is opened and solenoids EUV and EDV are de-energized.

Modification of Stacker Mechanism

In the stacker mechanism, as shown in detail in FIGS. 12–15, tamping plate **195** extends laterally between pulley belts **170**. It will be recalled that when angle irons **178** are turned downwardly and outwardly, releasing towel T, plate **195** is driven downwardly against towel T to force it upon stack **17**. When the stack rises high enough, plate **195**, in driving a towel downwardly, tamps the stack against the top edges of elevator plates **236** (at the same time closing switch ED).

Of necessity, plate **195** is narrower than towel T, as shown in FIGS. 13 and 15, so that only the longitudinal center portion of stack **17** is tamped. This sometimes results in curling of the sides of the stack and even in overturning of an untamped towel side portion.

Accordingly, a modified mechanism is shown in FIGS. 24 and 25.

FIGS. 24 and 25 show a plate **195***a* which is similar to and operates in the same manner as plate **195**. However, plate **195***a* is narrower than plate **195**.

Brackets **480** are fixed to plate **195***a* and extend above and laterally outwardly thereof, said brackets **480** being located on each side of plate **195***a* and forwardly of the front levers **203** and rearwardly of the rear levers **203**. Each bracket **480** is channel-shaped and has lateral end plates extending outwardly of a longitudinal connecting plate.

A transverse lever **481** is positioned between the lateral arms of each bracket **480**, said lever **481** having a pair of ears **482** which are turnably mounted on a longitudinal pivot shaft **483** supported by said lateral bracket arms. The lower ends of the levers **481** on each side of plate **195***a* are respectively connected to a longitudinal plate **484** which is longitudinally co-extensive with plate **195***a*. Plates **484** extend laterally outwardly of levers **481**. Each bracket **480** has a projection **485** at its lower end which is connected by spring **486** to the top of lever **481**, so that plates **484** are urged laterally outwardly.

Brackets **487** are mounted upon frame **1** laterally outward from and in lateral alinement with the respective levers **481**. Each bracket **487** has an idler cam roller **489** mounted on its lower end by means of longitudinal pivot **488**. Said cam roller **489** rides upon the outer face of lever **481**.

In the "up" position of the stacker, levers **481** respectively extend substantially vertically upwardly from points on an approximate level with and laterally just outside plate **195***a*, said levers **481** having upper end portions **490** which diverge upwardly and outwardly to the respective pivots **483**. Preferably, plates **484** slope slightly downwardly from their inner ends. The outer ends of plates **484** are located inwardly from pulley belts **170** and outward from and above the inner ends of angle iron arms **177**, with the inner ends of plates **484** close to plate **195***a*.

While the stacker is moving to its "down" position, cam rollers **489** ride upon levers **481**, which drop substantially vertically, angle iron arms **177** being moved out of the path of descent of plates **484**. Just before plate **195***a* reaches its lowest position, cams **489** ride upon lever portions **490**, permitting plates **484** to swing outwardly to their broken line positions of FIG. 24. Plates **484** are now approximately in the same plane as plate **195***a* and remote from plate **195***a* and extend outwardly substantially to the side edges of towel T. Therefore, when stack **17** is tamped, it is tamped at its center and also at its sides.

While I have disclosed a preferred embodiment of my invention and have indicated various changes, omissions and additions which may be made therein, it will be apparent that various other changes, omissions and additions may be made without departing from the scope and spirit of the invention.

I claim:

1. A stacking device for articles of linen and the like comprising a frame, a pair of rails having smooth operating faces, means mounting said rails laterally spaced on said frame above the desired stack location for movement about respective longitudinal pivots by said means from a normal position with their operating faces substantially located in a common horizontal plane and inward from said pivots to a downturned position in which articles of linen are free to drop between the rails at the stack location, in combination with conveyor means located close above the rails, parallel thereto, adapted to engage the articles of linen frictionally between the rails and the conveyor means substantially throughout the length of the rails and to draw the articles onto the rails above the stack location, said conveyor means comprising a pair of synchronized continuously moving belts each located above one of the stacker rails, and an actuating switch for the rails adapted to be operated by an article when drawn by the belts above the stack location.

2. A stacking device for articles of linen and the like comprising a frame, a pair of rails having operating faces, means mounting said rails laterally spaced on the frame for movement about respective longitudinal pivots by said means from a normal position with their operating faces substantially located in a common horizontal plane and inward from said pivots to a downturned position in which articles of linen are free to drop between the rails, upper and lower limit switches mounted on the frame, the upper switch being adapted to be held closed by the said mounting means only when the rails are in their normal position, the lower limit switch being adapted to be actuated to a return condition when the rails are in their downturned position, and actuating means for pivoting said rails including an actuating switch adapted to be operated by an article of linen moving on the rails and thereby cause the rails to turn from their normal position, said actuating means also being adapted to return the rails toward their normal position after the lower limit switch is actuated to its return condition in combination with means including the upper limit switch active during the return of the rails to the normal position thereof for preventing accidental closing of the actuating switch from causing movement of the rails downward, and conveyor means on the frame above the operating faces of the rails adapted to frictionally engage the articles along their upper faces and draw them into position on the operating faces of the rails, thereby causing operation of the actuating switch.

3. A stacking device for articles of linen and the like comprising a frame, a pair of rails having operating faces, means mounting said rails laterally spaced on said frame for movement about respective longitudinal pivots from a normal position with their operating faces substantially located in a common horizontal plane and inward from said pivots to a downturned position in which the articles of linen are free to drop between the rails, and conveyor means on the frame above the operating faces of the rails adapted to frictionally engage the articles along their upper faces throughout the length of the rails and to position them on the operating faces of the rails, in combination with tamping means located above the operating faces of said rails when they are in their normal position, said tamping means being adapted to be moved downward below the normal plane of the operating faces of the rails and between them when they are in their downturned position and to strike and force downward an article released by the rails and falling by gravity.

4. A stacking device according to claim 3 in which the tamping means have a tamper and lever means connected to the rails adapted to give the tamper a rapid downward movement simultaneously with the movement of the rails to the downturned position thereof.

5. A stacking device for articles of linen and the like according to claim 3 in which the tamping means comprises a main tamping plate and a pair of longitudinally extending side tamping plates, in combination with means mounted on the main tamping plate and supporting the side tamping plates so that the latter are movable laterally with respect to the main plate, said means being adapted to make them movable with respect to the main plate but positioned outwardly from the sides of the main plate in approximately the same plane and normally urged outward therefrom, and cam means fixed to the frame and engaging said side plate supporting means, the side plates being held proximate to the main plate by the cam means when the rails are in their normal position, the side plate supporting means being cooperatively positioned and shaped in such manner that the side plates move downward with the main plate and laterally outward with respect thereto when the operating faces of the rails swing downward and outward, the outward movement of the side plates occurring after they have passed between the rails and locating the sides plates outward of the positions of the inner edges of the operating faces of the rails when normally positioned; whereby the main tamping plate strikes the center portion of the article of linen and the side tamping plates smooth the edges of an article after it is on the elevator stack.

6. A stacking machine for articles of linen and the like comprising an elevator adapted to receive articles on its upper face for stacking, and stacking mechanism thereabove having means for releasing and forcing individual articles downward onto the elevator, means to drop the elevator downward from an upward position and means normally resisting operation of the elevator dropping means, in combination with a switch mounted upon said stacking mechanism and means to move said switch downward a limited distance while an article is stacked, said switch being adapted to operate by contact with the top of the stack if the stack is too high relative to the stacking mechanism, and means controlled by said switch for lowering said elevator successive short distances upon corresponding successive actuations of the switch to thereby maintain the top of the stack within a short distance of a predetermined level.

7. A stacking machine for articles of linen and the like comprising an elevator adapted to receive articles on its upper face for vertical stacking, a stacking mechanism thereabove in which there is a pair of rails having operating faces laterally spaced, means to move said rail faces about respective longitudinal pivots from a normal position with their operating faces substantially located in a common horizontal plane and inward from said pivots to a downward position in which the articles of linen are free to drop between the rails, and tamping means located above the operating faces of said rails when they are in their normal position, means for moving said tamping means downwardly below the normal plane of the operating faces of the rails and between the rails to strike and force downward an article released by the rails; means to move the elevator to drop the elevator downward from an upper position, means normally resisting operation of said elevator dropping means, a switch mounted upon the tamping means of the stacking mechanism, means to move the switch downward thereby while an article is being stacked, to touch and be closed by the top of the stack if the stack has risen too high relative to the stacking mechanism, and means controlled by said switch for actuating said elevator dropping means to lower the elevator successive short distances upon corresponding successive actuations of the switch to thereby maintain the top of the stack within a short distance of a predetermined level.

8. A stacking machine for articles of linen and the like in which there is an elevator below a stacking mechanism positioned to receive articles of linen dropped on it by the stacking mechanism, means in the elevator to drop it downward from an upper position and means resisting operation of said dropping means, a normally

open switch, means to move the switch downward while an article is being stacked, to contact and be closed by the top of the stack if the stack is too high relative to the switch, means controlled by said switch for lowering said elevator in slight steps as articles of linen are stacked thereon so that the top of the stack on said elevator will always be slightly below the stacking mechanism, and means for lowering the elevator to a lower discharge position for discharge of the stack after the stacking of a selected number of articles, and means operable upon the lowering of the elevator to said lower discharge position and removal of the stack to return it to its upper position.

9. A stacking machine for articles of linen and the like in accordance with claim 8 in which there is a pusher, means positioning said pusher relative to said elevator so that said pusher is positioned above the top face of said elevator in the lower position thereof and is movable across the top face of said elevator to eject stacked articles therefrom, and means coupling said pusher and said elevator and operable upon the fall of said elevator to its lower position for moving said pusher across said top face of said elevator and for then returning said pusher to its previous position.

10. A stacking machine having an elevator for receiving articles of linen or the like stacked thereon from the top comprising a substantially horizontal table having a plurality of parallel slots, in combination with vertical plates slidable vertically in the slots, means for maintaining the plates with upper edges substantially in a horizontal plane to receive articles to be stacked and for moving the plates vertically between a top position above and a bottom position below the table, and a horizontal pusher fitting between the vertical plates at the table level adapted to eject a stack from the elevator when the stack is lowered to bottom position and thereafter retract; said means being adapted to raise the plates after ejection of a stack while the pusher is still forward of its fully retracted position.

11. A stacking machine in accordance with claim 10, said means for moving said vertical plates comprising an air cylinder and a hydraulic cylinder disposed in axial alinement and having a common plunger rod extending out of the front of the hydraulic cylinder and into the rear of the air cylinder, said rod carrying pistons respectively slidably located in said air cylinder and in said hydraulic cylinder, means coupling said plunger rod and said vertical plates whereby forward movement of said rod causes lowering of said plates and rearward movement of said rod causes raising of said plates, said air cylinder being adapted to receive compressed air reversibly at opposite ends thereof so as respectively to tend to cause forward movement and rearward movement of said plunger rod, said hydraulic cylinder containing hydraulic fluid under pressure whereby normally to resist movement of said plunger rod under the influence of said compressed air, a normally closed high resistance external bypass connecting the ends of said hydraulic cylinder, a normally closed low resistance external bypass connecting the ends of said hydraulic cylinder, means for simultaneously directing compressed air into said air cylinder so as to tend to cause forward movement of said plunger rod and at the same time intermittently opening said low resistance bypass for short periods of time so as to lower said vertical plates from their top position in a series of short steps and for then opening said high resistance bypass so as to lower said vertical plates in a single step the rest of the distance to their bottom positions, said hydraulic cylinder piston having a one-way check valve which permits a flow of fluid therethrough in a direction to permit the vertical plates to return to the top position thereof when compressed air is admitted into the air cylinder in the direction so as to tend to move the plunger rod rearwardly, and means for admitting compressed air into said air cylinder so as to tend to move the plunger rod rearwardly.

12. A folded towel stacking device to form a stack of folded towels comprising an elevator to receive the folded towels to be stacked, a pair of rails positioned above the elevator and between which the towels are deposited upon the elevator, means to fold and feed the towels to the elevator and between the rails, means to position the top of the stack directly below the rails so that the folded towels will only be dropped a short distance without becoming unfolded or offset, a feeler device to feel the top of the stack and determine its position, means actuated by said feeler to actuate said positioning means and means to eject the stack when the stacking is complete.

13. The device of claim 12, tamping means being provided to move downwardly between the rails and tamp folded towels downwardly upon the stack as they are fed thereto.

14. A folded towel stacking device of the type wherein means are provided to fold the towel longitudinally and then transversely, said device comprising guide means having supporting angle arms, a conveyer to move the folded towel onto said arms, a control switch contacted by the moving towel when it moves onto said arms, means actuated by said switch to move said arms to release and drop the towel, an elevator mechanism to receive the dropped towel and form a stack including a vertically reciprocating means, and means to lower said vertically reciprocating means as towels are stacked thereon so that the top of the stack will be always just slightly below said angle arms.

15. The device of claim 14, including a table having a plurality of slots therein, said vertically reciprocating means comprising a plurality of vertical and longitudinally extending plates slidably extending through said slots.

16. A method of stacking folded articles of linen upon a stack comprising the steps of feeding the folded articles successively to an elevated position, dropping the articles onto the stack and simultaneously tamping them, and continually maintaining the top of the stack at approximately a predetermined distance below said elevated position by using the tamping movement to measure and to lower the top of the stack relative to the elevated position whenever above said predetermined distance.

17. A method of stacking folded articles of linen upon a stack comprising the steps of feeding the folded articles successively to an elevated position, dropping a folded article and simultaneously tamping the article from above as it falls so as to drive it toward the stack, and lowering the stack successively as folded articles accumulate thereon so that the top of the stack will always be at approximately a constant short distance below the elevated position.

18. A stacking device for articles of linen and the like comprising a frame, a pair of rails having operating faces, means mounting said rails laterally spaced on the frame above the desired stack location for movement about respective longitudinal pivots by said means from a normal position with their operating faces substantially located in a common horizontal plane and inward from said pivots to a downturned position in which the articles of linen are free to drop between the rails, pivoting means for pivoting the rails to said downturned position, and a pair of synchronized belts each located close above one of the rails, parallel thereto, and adapted to engage the articles of linen frictionally between the rails and the said belts substantially throughout the length of the rails and to draw them onto the rails above the stack location, in combination with an actuating switch on the frame for operating said pivoting means adapted to be operated by an article when so drawn by the belts, and a lower limit switch adapted to be operated when the rails are in their downturned position; said pivoting means

being adapted to return the rails toward their normal position when the limit switch is operated.

19. A stacking device for articles of linen and the like comprising a frame, a pair of stacker members having smooth operating faces, means mounting said stacker members on said frame for movement between a normal support position in which the operating faces thereof are substantially located in a common horizontal plane above the desired stack location to support said articles thereon and a retracted position in which said articles are free to drop between the stacker members at the stack location, conveyor belt means located close above the stacker members and adapted to frictionally engage the upper surfaces of said articles and draw the articles along said smooth operating surfaces of the stacker members to a position above said stack location, and means responsive to the positioning of a said article above said stack location for actuating said stacker members to said retracted position.

20. A stacking device in accordance with claim 19 including tamping means for tamping the top of a stack of articles, and means for successively actuating said tamping means as articles are successively added to the stack.

21. A stacking device for articles of linen and the like comprising a frame, a pair of stacker members having smooth operating faces, means mounting said stacker members on said frame for movement between a normal support position in which the operating faces thereof are substantially located in a common horizontal plane above the desired stack location to support said articles thereon and a retracted position in which said articles are free to drop between the stacker members, conveyor belt means located close above said operating faces of the stacker members in the normal support position thereof and adapted to frictionally engage the upper surfaces of said articles and draw the articles along said operating faces to a position above said stack location, means responsive to the positioning of a said article above said stack location for actuating said stacker members to the retracted position thereof, tamping means located above the operating faces of the stacker members in the normal support position thereof, said tamping means being mounted and adapted for downward movement between the stacker members in the retracted position thereof, and means for actuating said tamping means to tamp articles released by the retraction of the stacker members to form a stack.

22. A stacking device in accordance with claim 19 including an elevator positioned at said stack location to receive from above the articles released by the retraction of said stacker members, sensing means for determining when the top of the stack rises above a predetermined level below the plane of the operating faces of the stacker members when in the normal support position thereof, and means responsive to said sensing means for lowering said elevator successive short distances upon corresponding successive actuations of said sensing means to thereby maintain the top of the stack within a short distance of said predetermined level.

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Disclaimer

3,126,657.—*Eugene Hajos*, Fort Lee, N.J. FOLDING AND STACKING MACHINE FOR ARTICLES OF LINEN. Patent dated Mar. 31, 1964. Disclaimer filed Jan. 28, 1965, by the inventor and assignee, *Premier Laundry, Inc.*

Hereby enters this disclaimer to claims 1, 18 and 19 of said patent.

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