May 17, 1932. S. SOKOLOW ET AL 1,858,565

FOLDING MACHINE AND METHOD

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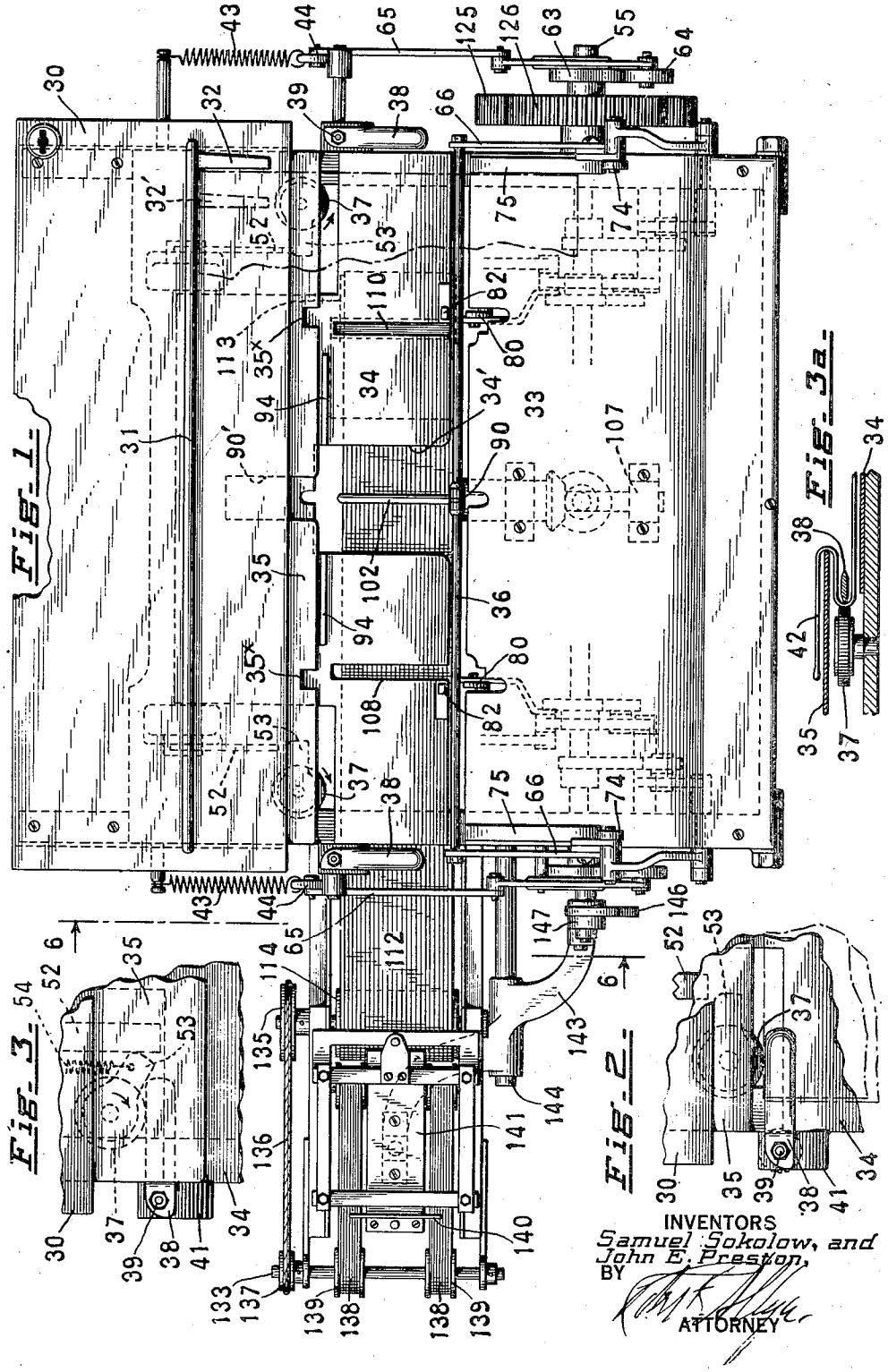


Fig. 1.

Fig. 3a.

Fig. 3.

Fig. 2.

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Fig. 4a.

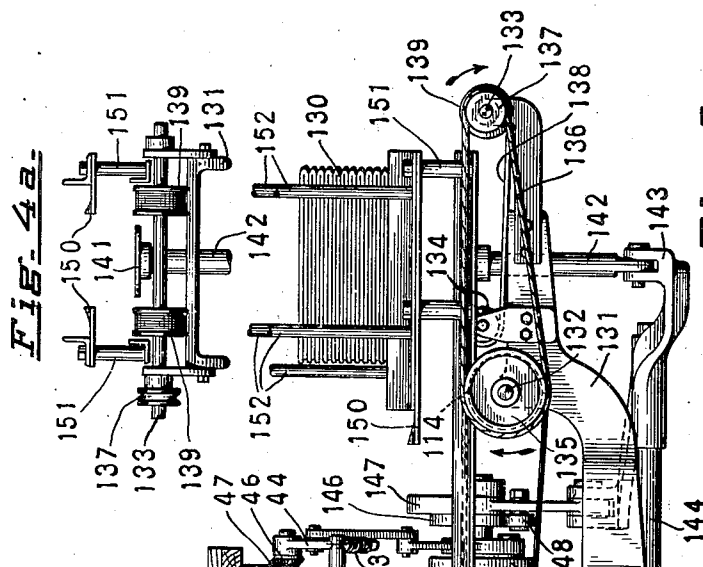


Fig. 5.

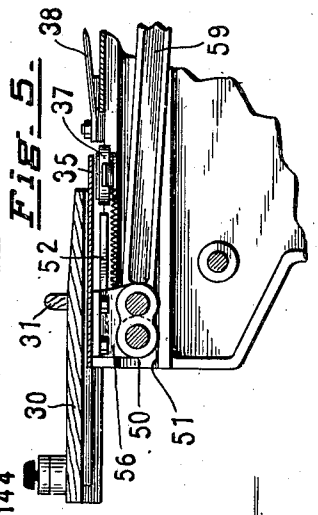
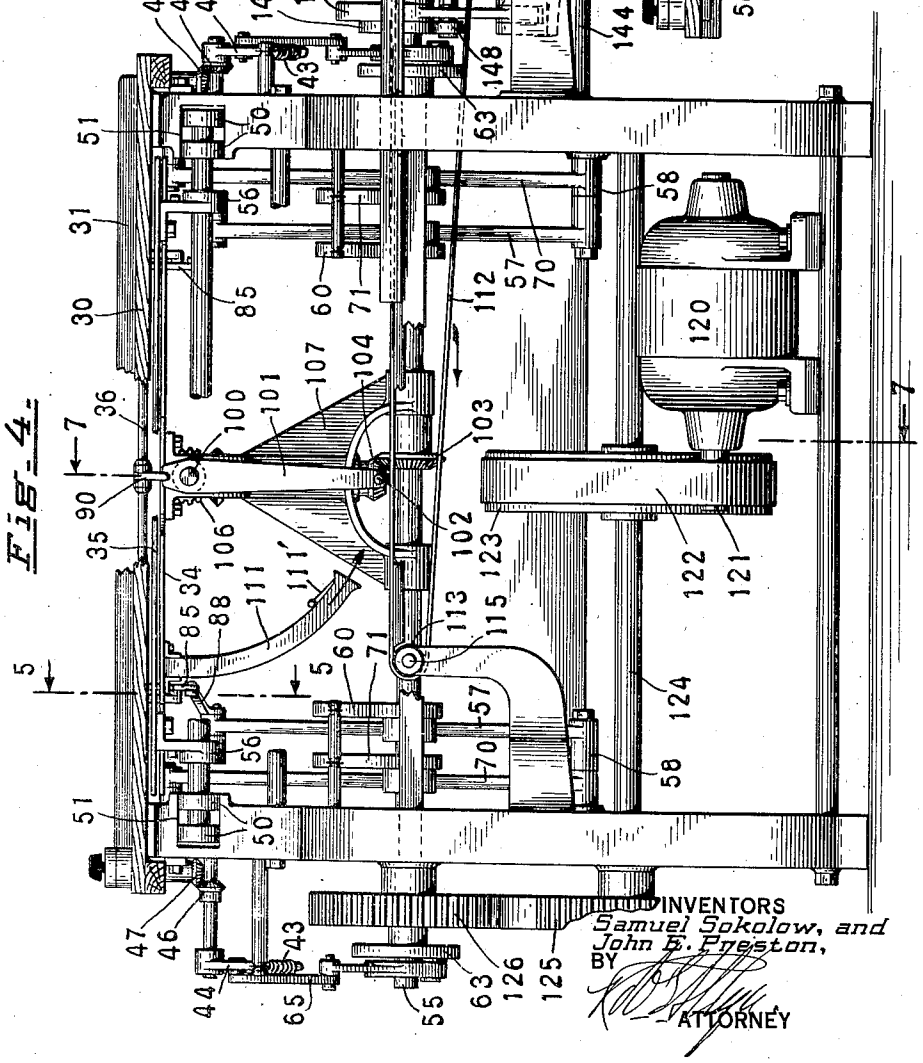


Fig. 4.



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Fig. 6.

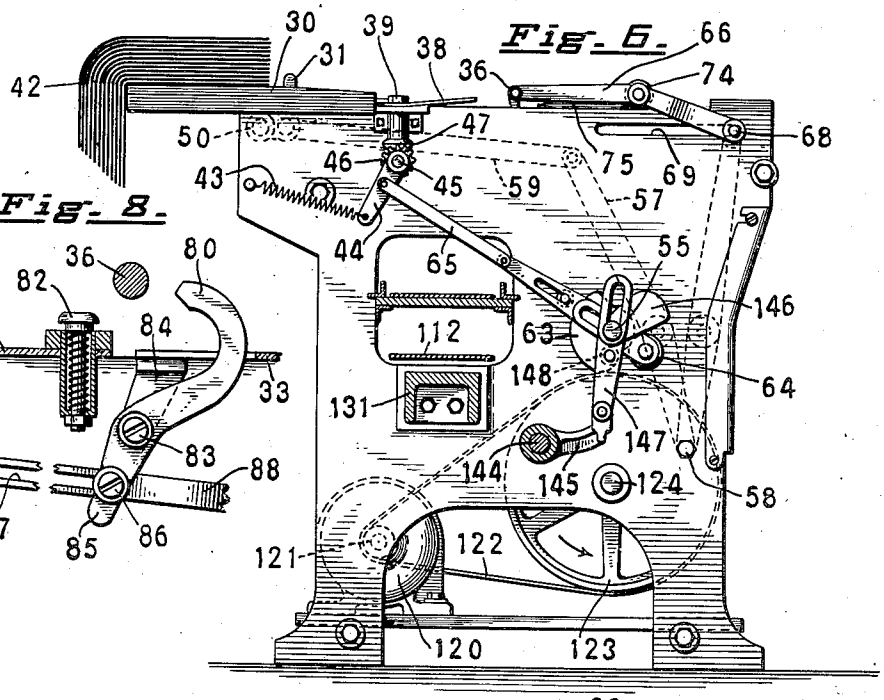


Fig. 8.

Fig. 7.

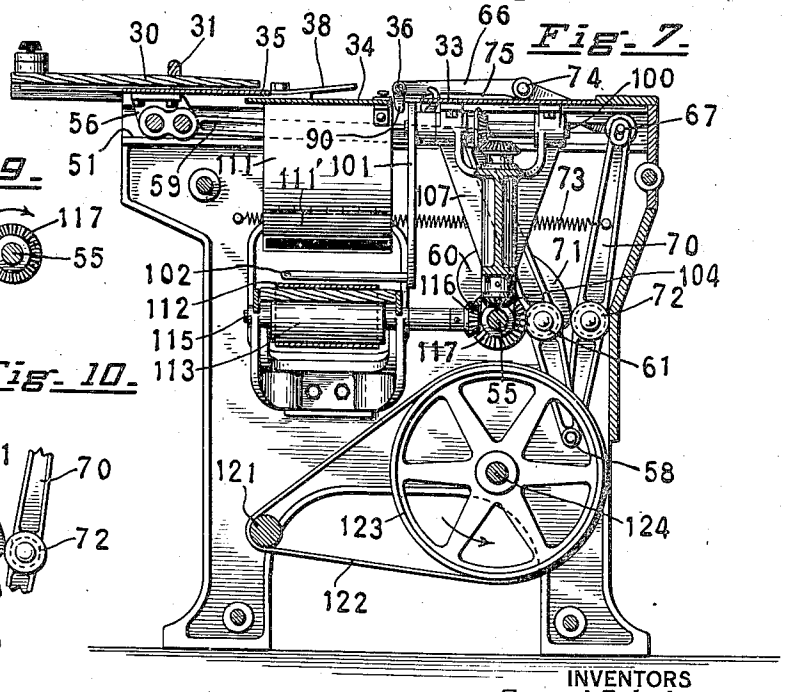


Fig. 9.

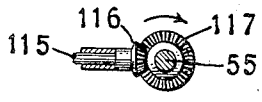
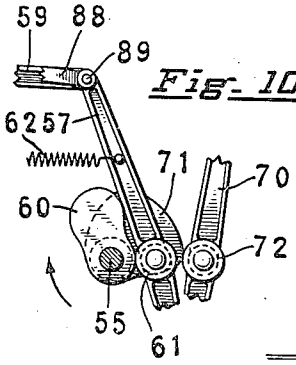


Fig. 10.



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Fig. 11.

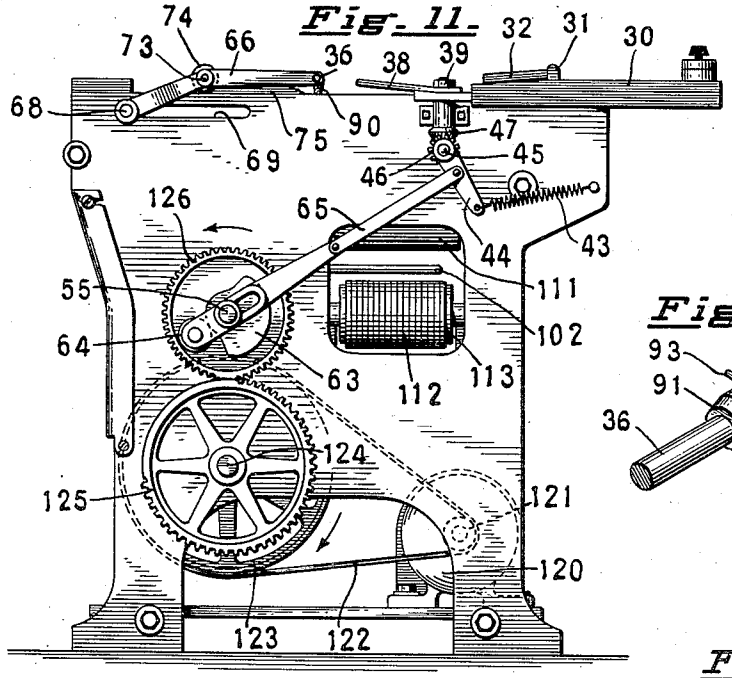


Fig. 12.

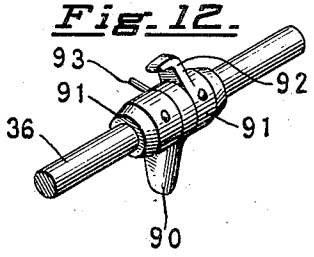


Fig. 13.

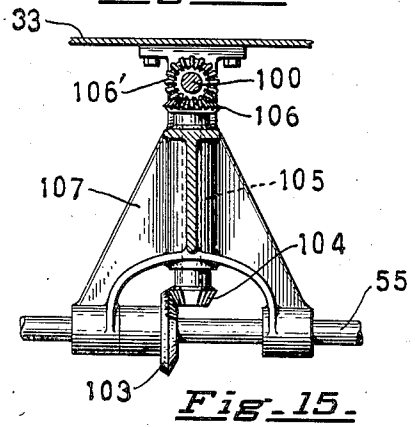


Fig. 14.

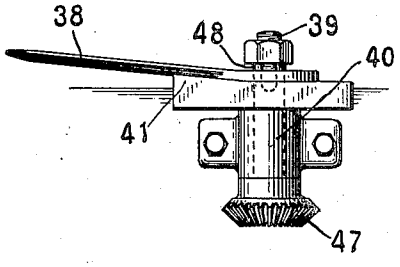


Fig. 15.

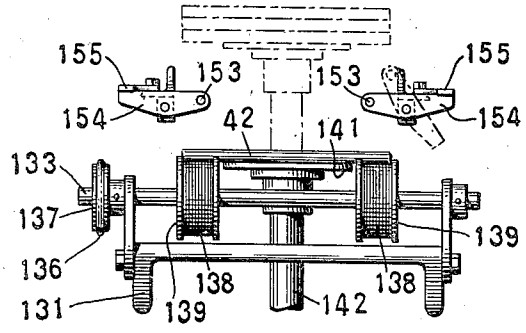
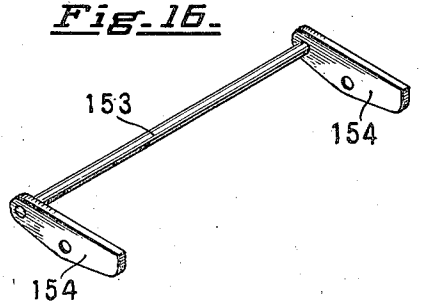


Fig. 16.



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Fig. 17.

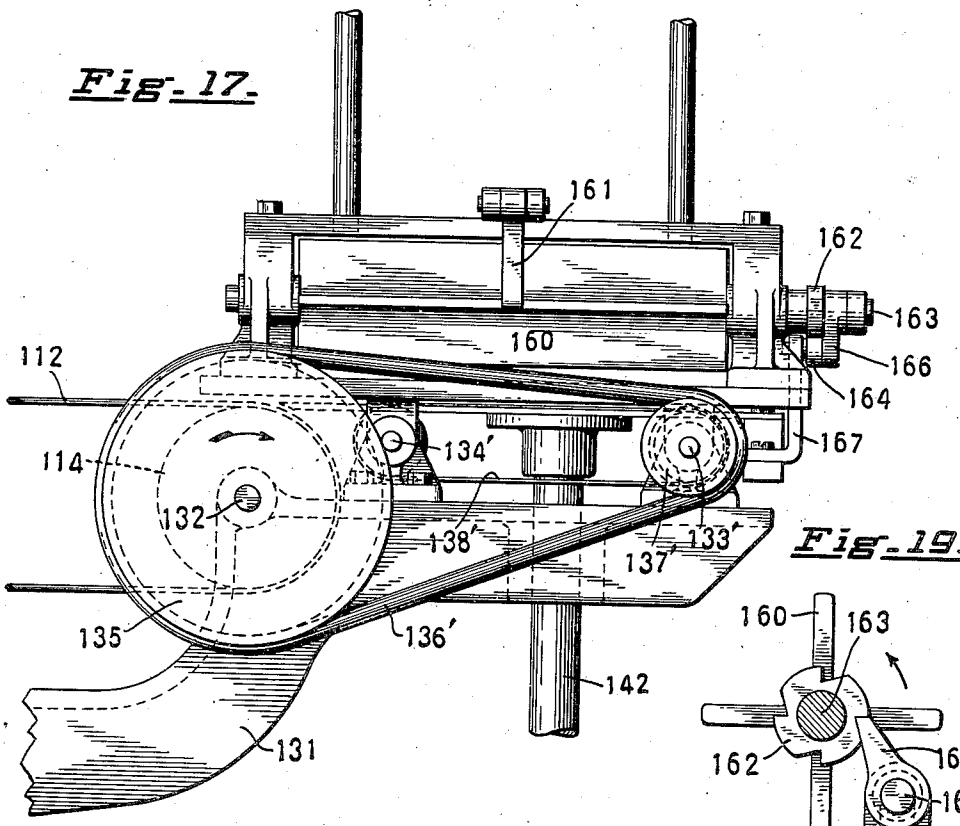
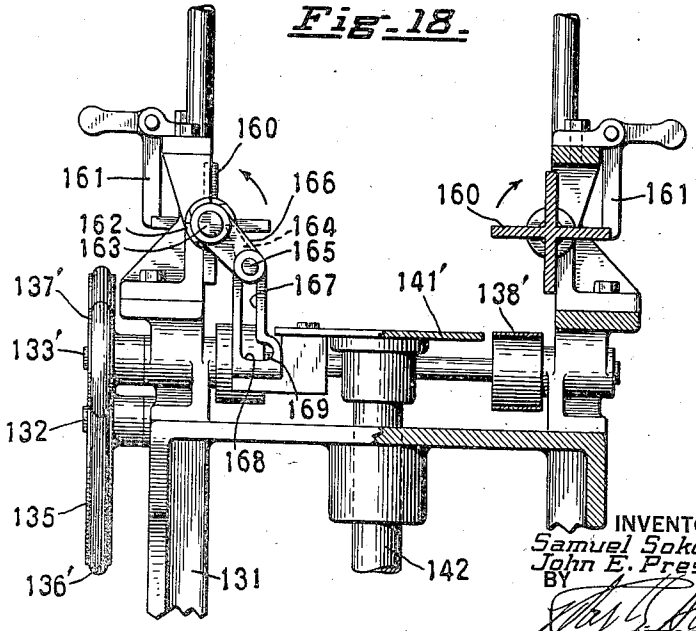


Fig. 19.

Fig. 18.



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FOLDING MACHINE AND METHOD

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Fig. 20.

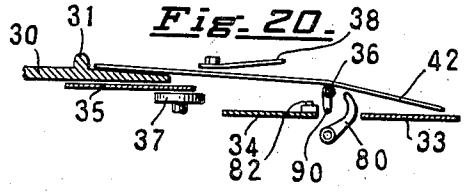


Fig. 21.

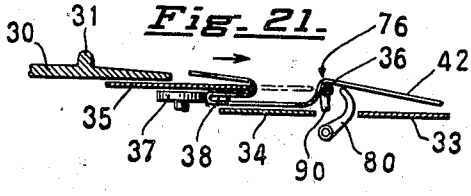


Fig. 22.

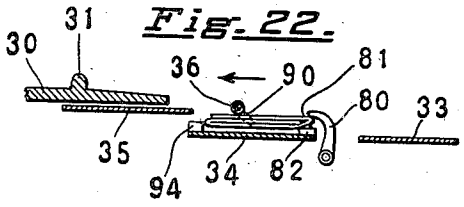


Fig. 23.

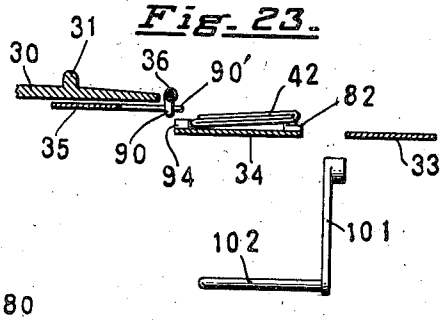


Fig. 24.

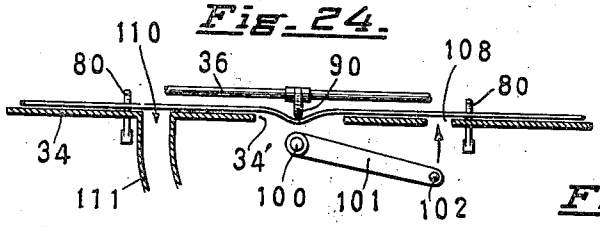


Fig. 26.

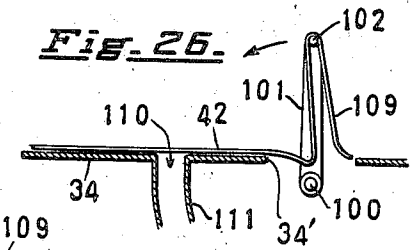


Fig. 25.

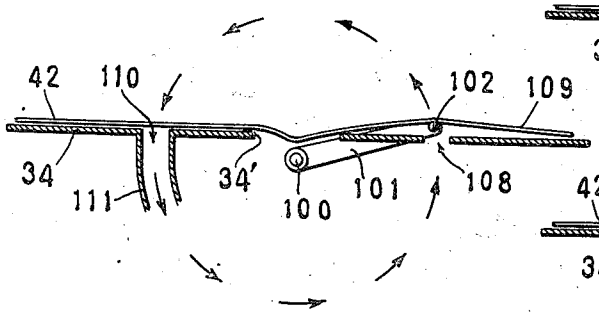


Fig. 27.

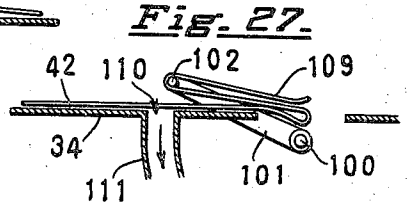


Fig. 29.

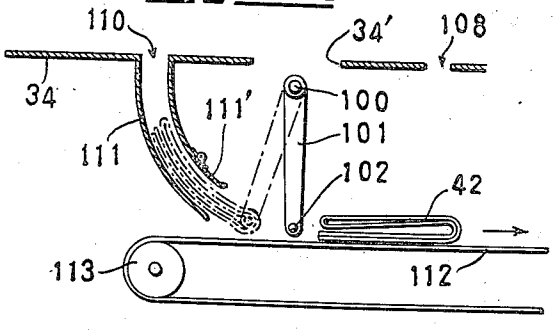
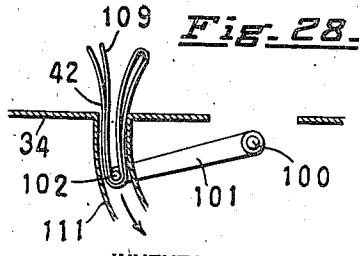


Fig. 28.



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Patented May 17, 1932 1,858,565

UNITED STATES PATENT OFFICE

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FOLDING MACHINE AND METHOD

Application filed December 30, 1930. Serial No. 505,520.

Our invention relates to methods and machines for folding fabrics such as towels and has particular utility in the towel supply industry and in laundries which handle miscellaneous articles.

Although towels are made according to more or less standard specifications, they vary considerably in size and in fact, due to shrinkage, the same towel varies accordingly in size, depending upon the number of trips it has had and the treatment it has received in the laundry.

One of the objects of our invention is to provide a method and machine for automatically folding towels of different sizes.

Another object is to provide a machine which will fold towels of different sizes into a standard dimension so that all of the miscellaneous sizes when folded will stack evenly.

Another object is to provide simple and reliable mechanism which can be operated at high speed.

Another object is to provide folding mechanism which is adapted to handle different weights or thicknesses of cloth without changes in adjustment.

Another object is to provide mechanism which will fold the towels smoothly and evenly.

Another object is to provide folding mechanism which facilitates inspection of both sides of the towel.

Another object is to provide folding mechanism which can be operated rapidly without injury to the fabric.

According to our invention we fold the towel twice along lines parallel to each other and longitudinally of the axis of the towel. These two primary folding operations are effected upon a table with the aid of overlapping slides.

The cloth is stretched and held tight during these folding operations. We then automatically fold the towel transversely—preferably into four folds—by means of a crank arm and slotted table. This crank arm then delivers the folded towel through a curved chute on to a traveling belt which strips the towel from the crank pin and delivers it to the bottom of a stack from which the folded towels can be readily removed. The details of the mechanism and method of operation will be understood from the accompanying drawings and the following specification:

Fig. 1 is a plan view of the machine embodying our invention, the parts being shown in the normal inactive position.

Fig. 2 is a fragmentary plan showing the parts of one of the gripping and stretching members with the parts in the position which they occupy when the lateral finger has gripped the fabric against the roller but before the roller has been revolved to stretch the towel.

Fig. 3 is a similar view showing the roller after it has started to rotate to stretch the towel.

Fig. 3*a* is a fragmentary vertical section of the parts shown in Fig. 3.

Fig. 4 is a front view of the machine, portions being broken away to disclose other portions of the mechanism.

Fig. 4*a* is an end view of the stacking mechanism shown in Fig. 4.

Fig. 5 is a fragmentary vertical section and side elevation on the plane of the line 5—5 of Fig. 4.

Fig. 6 is an end or side view and partial section on the plane of the line 6—6 of Fig. 1.

Fig. 7 is a vertical section on the plane of the line 7—7 of Fig. 4.

Fig. 8 is a detail side view and section of the folding bar and rear edge grippers.

Fig. 9 is a fragmentary detail showing part of the transmission gears for the feed belt drive.

Fig. 10 is a fragmentary view showing the cams for operating the slides.

Fig. 11 is an end view of the machine showing the driving mechanism.

Fig. 12 is a detail perspective view of a fragment of the folding rod and creasing finger.

Fig. 13 is a fragmentary detail view of the intermittent gear mechanism for driving the folding crank arm.

Fig. 14 is a detail side view of one of the front edge folding fingers and connected gear and cam.

Fig. 15 is an end view of another form of stacking mechanism.

Fig. 16 is a perspective view of a rocker arm of the stacker.

Figs. 17, 18 and 19 are detail views showing parts of another form of stacker to be used in connection with our invention.

Figs. 20 to 29 inclusive are diagrammatic views showing various stages in the folding action. Figs. 20 to 23 are transverse sections, Fig. 20 showing the parts in the position where the towel is laid on the table ready to be folded, Fig. 21 showing the action of the front grippers, the movement of the front slide and its relation to the rear slide, Fig. 22 showing the action of the rear gripping fingers and slide, and Fig. 23 showing the towel completely folded along longitudinal lines and the crank pin for folding the towel along transverse lines. Figs. 24 to 29 are diagrammatic sections taken on planes parallel to the front of the machine and showing in Fig. 24 the creasing of the towel and the crank pin just before it starts its folding action, Fig. 25 showing the crank pin at the beginning of its active cycle, Fig. 26 showing the crank pin with one-half of the towel folded, Fig. 27 showing the crank pin about to start the final folding action, Fig. 28 showing the folded towel entering the delivery chute, and Fig. 29 showing the folded towel stripped from the crank pin and on its way to the stack.

Tables

The machine shown is designed for hand feed although it will be understood that machine feed, for instance direct from a mangle or mangles, might be used. For the purpose of hand feed the machine has a receiving table 30 with a gage or positioning rib 31 for one edge of the towel and a gage 32 for one end. Opposite the receiving table 30 is a shelf-like portion 33 adapted to support the opposite edge of the towel and between these portions 30 and 33 is an intermediate shelf 34.

Longitudinal folding; first fold

The folding along the longitudinal lines or parallel to the length of the towel is effected by a front slide 35 and a rear slide rod 36 assisted by front and rear grippers. The front grippers consist of rollers 37 and fingers 38.

The fingers are mounted on studs 39 which are rotatably supported in bearing members 40. These fingers are provided with inclined surfaces which normally rest on the cam faces 41 so that in the position shown in Fig. 1 the tips of the fingers 38 are sufficiently above the level of the shelf 34 to clear the ends of the towel when the fingers are moved over the towel. The weight of the fingers, however, is sufficient to cause them to drop down as they are rotated over the towel and in this dropping action they reach the position shown in Fig. 3*a* where the edges of the fingers press the towel indicated by the number 42 against the roller 37, whose face is preferably made of a yielding material such as soft rubber.

The finger 38 is yieldingly pressed against the roller by a spring 43 connected to an arm 44 on the shaft 45. This shaft has the bevel pinion 46 meshing with the pinion 47 on the stud 39 of the arm 38. The stud 39 is flattened at 48 or otherwise provided with a loose connection with the arm 38 which causes the two to rotate together but permits the arm to tilt up and down for the purpose of engaging and disengaging the towel.

Stretching

The slide 35 is supported on rollers 50 in grooves 51 in opposite sides of the machine. On the bottom of the slide 35 is a rib 52 adapted to engage an arm 53 which is carried by and rotatable with the roller 37. As the slide 35 moves rearwardly the rib 52 engages the arm 53 and rotates the roller 37 outwardly so that the opposite ends of the towel are simultaneously grasped by the rotating rollers and the coacting fingers and stretched sufficiently to smooth the towel as the front edge of the slide 35 folds it over as shown in Fig. 21.

The spring 54 serves to return the roller 37 to its inactive position when released by the retraction of the slide 35 and its rib 52.

The action of the slide 35 and the gripping fingers 38 is controlled by a shaft 55. The rollers 50 are carried by a bracket 56 secured to the bottom of the plate 35.

The arm 57 hinged at 58 is connected by link 59 to the bracket 56. These arms and links are duplicated on the opposite sides of the machine and the shaft 55 has cams 60 for pressing against the rollers 61 on the arms 57 and for actuating the arms 57. The springs 62 press the rollers 61 against the cams 60. The cams 63 on the opposite ends of the shaft 55 coact with rollers 64 on links 65 which are connected to the arms 44 to return the gripping fingers 38 to their inactive position when each folding cycle is completed.

Second fold

The return fold is effected by a cross rod 36 carried by the arms 66. The rear end of each arm 66 has a roller 67 guided in a groove 51 in a side frame of the machine. This roller is carried by a pin 68 which extends through a slot 69. These same pins 68 are carried by the upper ends of arms 70 hinged at 58. The cam 71 coacts with roller 72 on arm 70 to move the arm 70 in one direction and a spring 73 moves the arm in the opposite direction. An intermediate portion of each of the arms 66 is supported by a roller 74 which is adapted

to travel on an incline 75 as the arms and folder rod 36 are moved forwardly so as to lift the rod 36 from its normally inactive position to the raised position shown in Fig. 21 where it carries the fold 76 up over the edge of the partially folded towel.

When the folding rod 36 has started its action it clears the gripping fingers 80 which are brought into action to grip the edge 81 of the folded towel as shown in Fig. 22. A resilient support 82 coacts with the hook-like tip of the finger 80. There are two of these sets of gripping members arranged on opposite sides of the center of the machine. Each hook is hinged at 83 to bracket 84 and provided with an extension or tail piece 85 which has a pin or screw 86 in a slot 87 of a link 88. This link 88 is connected at 89 to the upper end of the arm 57 previously described.

The parts are proportioned so as to time the operation of the gripping finger or hook 80 to come into action immediately following the start of the folding movement of the rod 36 which is at the end of the rearward stroke of the slide 35. To enable this to take place the edge of the slide 35 is cut away or notched at 35x to permit the gripping members 80 and 82 to act while the slide 35 is still at the rear end of its stroke so that the gripping fingers take hold of the towel while it is still stretched around the rear edge of the slide 35.

The pivotal centers of the hooks 80 are preferably arranged in rear of the resilient supports 82 so that as the sliding bar 36 operates to fold the rear edge of the towel over the center part it will tighten rather than loosen the grip of the hooks.

The bearings for the pivotal supports 83 of the hooks are preferably friction snug so that they will stay in the position shown in Fig. 8 while the links 88 are being returned rearwardly by the action of the cams 71 until the end of the slotted part 87 picks up the pins 86 and then forcibly move the hooks into the gripping position.

The hooks 80 hold the rear edge of the towel while the slide 36 completes the folding of the rear edge of the towel and while the slide 35 is being retracted from the folds of the towel.

The cams 63 are so timed as to retract the gripping fingers 38 from the rollers 37 before the slide 35 is retracted far enough for the rib 52 to release the arm 53 and allow the spring 54 to rotate the roller 37 backwardly.

The action above described folds the towel along two lines parallel to one edge which for convenience we will call the length of the towel although obviously the proportions of the towel are immaterial. In this position the towel lies freely on the shelf 34 without being held by any moving part or mechanism.

Creasing

During the folding by the rod 36 a central creasing action has been performed in a very simple manner by a depending finger 90 carried by the rod 36.

This finger is supported loosely between two collars 91 on the rod 36 so that it can swing through a limited angle. The finger 90 normally hangs downward by gravity and when the slide 36 is moved forwardly the finger 90 engages the center of the partially folded towel and creases it as indicated in Fig. 24. The collar has a lug or pin 92 adapted to be engaged by a pin 93 on the finger 90 so as to limit the upward lift of the finger and produce the effective creasing action. When the folding rod 36 completes its forward stroke, as shown in Fig. 23, the finger 90 drops down off the edge of the towel. To allow for the forward movement of the creaser 90 while the sliding plate 35 is in its rear position we cut out or notch the plate 35 at 90'.

As an additional precaution to hold the towel in place during the final forward movement of the rod 36 we provide stationary abutments 94 on the shelf 34 which act in effect as strippers or stops to hold the towel evenly in place. It will be seen that the width of the towel as thus folded is predetermined and fixed by the stroke of the slide 35 in one direction with respect to the location of the gripping surfaces of the fingers 38 and rollers 37 which are in line with the rear faces of the stops 94.

While the folding action thus decribed contemplates the movement of the opposite edges of a towel over the central portion of the towel so as to fold it in three layers, it will be obvious that the mechanism described would equally well fold the towel into four layers by a simple proper proportioning of the parts and the folding strokes with respect to the fabric. In other words, it will be merely necessary to fold the front edge completely to the rear edge in the first motion and then return the two edges to the central folded line. To effect this the center of the towel is located at the point to be grasped by the gripping and stretching members 37 and 38. It should also be understood that in case it is desired simply to fold a strip along the center the folding member 36 might be omitted entirely.

Transverse folding

Below the main plane or surface of the slides is mounted a shaft 100 having a crank arm 101 and a pin 102 which extends parallel to the sides of the machine and at right angles to the previously described longitudinal edges of the towel.

This shaft and crank pin are driven from the main shaft 55 through the gears 103,

104, shaft 105, and gears 106 and 106′, the latter being on shaft 100.

The ratio of the pitch diameters of the gears 103 and 104 is 2 to 1. Both these gears, however, have teeth omitted so as to provide for intermittent action of the crank shaft 100 while the shaft 55 rotates. This intermittent action may conveniently be produced by using gears 103 and 104 with tooth ratios of say 40 to 20 and omitting 22 teeth from the larger gear and 3 teeth from the smaller gear so that the larger gear and smaller gear will turn together while 17 teeth of the two gears are meshed, and during the balance of the revolution of gear 103 there is no rotation of gear 104, and in fact gear 104 is thereby held locked. This locked position is shown in Figs. 4 and 7 which is the position of the folding pin 102 while the slides 35 and 36 are operating.

The shaft 105 is carried by a yoke 107 which is partially supported by the shaft 55 and its upper end supports the shaft 100 and is secured to the top plate 33 as shown in Figs. 1, 7 and 13.

Just before the slide 35 finishes its stroke to the position shown in Fig. 23 the crank pin starts to move so that as soon as the partially folded towel is cleared by the rod 36 the pin 102 is ready to rise through the slot 108 in the table or shelf 34 as shown in Fig. 24.

As the crank pin 102 is rotated in the direction of the arrows in Fig. 25 the towel is picked up along a line at the approximate center of the right hand half of the towel. Gravity holds the tip 109 of the towel in the position shown in Fig. 26 as the crank pin continues its rotation to the position shown in Fig. 27. The left hand side of the machine has an opening or slot 110 through which the towel is drawn by the movement of the crank pin as shown in Fig. 28, which movement completes the folding of the towel.

Delivery

Beneath the opening 110 is a curved chute 111 arranged concentric with the shaft 100 through which the folded towel is delivered by the continuing movement of the crank pin. As the towel travels forwardly with the crank pin 102 the lower edge is pressed against the upper surface of a traveling canvas belt 112 as shown in Fig. 29, and this belt carries the folded towel along with it stripping it from the pin 102 which is now held stationary by the action of the mutilated gears previously described.

The belt 112 runs on the pulleys or drums 113 and 114. The pulley or drum 113 is on the shaft 115 and driven by bevel gear 116 which meshes with gear 117 on the shaft 55. (See Fig. 9.)

The holding of the upper edge of the folded towel in the chute 111, for instance by spring or gravity operated finger 111′, keeps the towel in a controlled position so that there is no danger of its accidentally falling onto the belt 112 until the belt is timed to pick it up and carry it smoothly to the stacker.

The creaser 90 above described provides a definite central line for the folding of the towel through the operations illustrated in Figs. 25, 26 and 27. This crease also brings the center of the towel closer to the axis of the crank shaft 100. To permit the center of the towel to sag down during this folding action the table or shelf 34 is cut away at 34′ as shown in Figs. 1 and 25.

It will be seen from the foregoing that the folding action produced by the shelf 34 and the rotating crank pin 102 produces a package or finished folded article of a definite and fixed length determined not by the size of the towel but by the distance between the centers of the slots 108 and 110 which is the approximate diameter of the cylinder described by the pin 102 as it rotates, and the length of the folded towel is approximately the radius of the crank arm 101.

It will be noted that the folding action performed by this rotating crank pin would be the same regardless of the number of layers of the fabric subjected to its folding action and the length of the folded package will be a standard length provided the towel does not exceed the maximum for which the table is designed and the towel is properly located by the gages 31 and 32.

Any shrinkage which may have taken place in the various laundry operations will be lost sight of because the shortage in the package will all appear in the length of the right hand end 109, see Figs. 25 and 26, which end it will be seen in Fig. 28 is folded inside of the package.

It will further be observed upon inspection of the action of the mechanism as portrayed in Figs. 25 to 29 that a considerably smaller towel even than the one above contemplated might be handled by this mechanism by simply adjusting the gage 32 toward the center of the machine, for instance as shown at 32′. If the towels are very short then the gages might be so adjusted as to bring the approximate center of the towel over the center of the slot 110 and the entrance to the chute 111. Obviously the crank pin in this case would have no function to perform as it rises through the passage 108 but it would fold the towel along the center of the passage 110 as it passed down the chute and the folded towel would, as in the previous case, be carried automatically to the conveyor belt 112.

It will also be obvious that the gripping members 37 and 38 and 81 and 82 might be adjustable to correspond with different lengths of towels and different widths of fold although such adjustments of course necessitate additional complications and detail

which are not necessary in the simpler types of machines.

We mention this because we understand as a fact efforts have been made to produce machines built on totally different lines which would handle various sizes of towels. Such machines, however, involve such complicated mechanisms that they have not thus far gone into practical use. The present invention, however, allows of a practical handling of fabrics such as towels regardless of their dimensions provided the variation in size is not extreme. The same machine, for instance, will readily handle a towel from 18 to 22 inches in one dimension by 30 to 40 inches in the other dimension, such variations requiring no adjustment in the machine. Such a leeway is highly desirable in the laundry machine art because of the miscellaneous character and size and the shrinkage from time to time of the towels.

The folded package, however, from a given dimension of machine will be of a standard size in both directions capable of being readily and neatly stacked, inspected and tied in bundles.

Driving mechanism

In the particular construction illustrated the machine is driven by an electric motor 120 with a small pulley 121 driving belt 122 and thence pulley 123 on shaft 124. Mutilated gear 125 on shaft 124 coacts with the multilated gear 126 on the shaft 55 so that the motor 120 may be allowed to run continuously and yet drive the shaft 55 intermittently. These gears and the various transmission elements are so timed that rotation of shaft 55 ceases once in each revolution.

This cessation of the mechanism of the machine per se allows time for the operator to place in position the next towel. While the folding mechanism is stationary the arm 101 occupies the dotted position show in Fig. 29 where the upper end of the folded towel is still held in the chute 111.

As soon as the shaft 55 starts to rotate the last tooth on gear 117 completes its disengagement from the gear 116 and rotates the arm 101 to the position shown in full lines in Fig. 29 at which the rear end of the towel drops down onto the belt 112 just after the belt has started to move and the belt picks up the towel, strips it from the pin 102 and carries it to the stacker.

The arm 101 stays in the position of Fig. 29 until the folding slides have almost completed their next action whereupon the crank arm again starts to rotate and goes through the cycle above described stopping at the position shown dotted in Fig. 29.

Stacking

As the towels are conveyed from the folding mechanism on the belt 112 they are automatically stacked as shown at 130 in Fig. 4. A bracket 131 supported from the main frame of the machine provides bearings for the shafts 132, 133 and 134. The shaft 132 is driven by the belt 112 and the drum 114 and carries a pulley 135 which drives the belt 136 and thence pulley 137 on shaft 133. Belts 138 travel on the pulleys 134 and 139, the latter being on shaft 133 so that as the folded towels leave the main conveyor belt 112 they are delivered onto the two spaced apart belts 138 until each towel as it arrives engages the stop 140 at the bottom of the stack.

Between the belts 138—138 is located a vertically movable plunger or lifter 141. This is carried on the upper end of a plunger 142 and actuated by a lever 143 supported on shaft 144. The lever 143 is oscillated on the stud shaft 144 by cam 146 on shaft 55. The slotted link 147 which is guided on the end of the shaft 55 has a roller 148 which coacts with the cam 146 and the lower end of the link is connected to the lever 143 so that for each rotation of the shaft 55 the lever 143 is oscillated and moves the plunger 142 and the lifter 141 up and down.

Above the level of the belts 138 are located two flanges 150 carried by the rods 151 and adapted to support the opposite edges of the folded towels. The action of the lifter 141 is so timed with respect to the traveling belt 112 and the belts 138 that the plunger is in the position shown in Figs. 4 and 4*a* when each folded towel is brought against the stop 140. The plunger and lifter then rise and force the towel up between the flanges 150—150 to a sufficient height so that the newly arrived towel lifts the entire stack far enough to permit the edges of the arriving towel to clear the edges of the flanges 150 whereupon the edges of the towel fly out into position to rest on the flanges as soon as the plunger descends far enough to permit it. Rods such as 152 may be provided to guard and steady the stack of folded towels. The folded towels may be readily removed from time to time from the stack in any quantity desired without in any way disturbing or interfering with the operation of the machine.

It will also be seen that the stacked towels can be readily counted automatically by the application of any suitable form of register operated for instance by each arriving towel as it goes into the bottom of the stack.

In the modifications illustrated in Figs. 15 and 16 the flanges 150 previously described are replaced by rods 153 carried by pivoted arms 154 which are weighted by the rods and held in position with their outer ends abutting against the stops 155. As the plunger 141 forces the towel upwardly the rocker arms tilt to permit the edges of the towel to pass, whereupon the newly arrived towel immediately becomes the bottom of the stack

which settles down onto the rods 153 which have fallen back into place as the plunger passed upwardly.

Obviously with such a construction a counter or register might readily be actuated by the oscillation of one of the rockers.

In the form of stackers shown in Figs. 17, 18 and 19 the mechanism operates on the same general principle as heretofore described, the towels being fed in by belts 138′ and lifted by a plunger 141′. The belts 138′ are driven by the usual pulleys on shafts 133′ and 134′ and belt 136′ on pulleys 135 and 137′ from the main conveyor 112 and the drum 114 and shaft 132. In this case the stacked towels are supported on flanges 160 of the rotating supports.

The latch 161 coacting with the successive wings of the support 160 prevents it from rotating backwardly. A ratchet 162 is mounted on the end of the shaft 163 of each of the supports and adapted to be actuated by a pawl 164. This pawl is supported on a pin 165 which is carried by a link 166 pivoted on the shaft 163. The pin 165 extends into the slotted link 167 which is carried by the plunger or lifter 141′.

As the plunger 141′ rises with a folded towel which has been delivered to it from the belts 138′ there is at first no action of the wing-like supports 160 but when the lower end 168 of the slotted link 167 engages the pin 165 the pawl 164 turns the ratchet 162 and the supporting member 160 just as the plunger 141′ presses the towel supported on it against the bottom towel in the stack. At this moment the supports 160 begin to rotate outwardly so as to apply lateral upward and outward tension or friction tending to stretch or smooth the towel as the next successive towel is applied to it from below. In this way each towel is smoothed so as to avoid any irregularity which might tend to wrinkle the towels or in fact produce an irregular stack.

It will be obvious that as each of the supporting wings finishes its smoothing action it is replaced by the succeeding wing which receives the edges of the stack as soon as the plunger 141′ descends. To accomplish this proper timing there are four of the wings 160 arranged ninety degrees to each other and four teeth on the ratchet 162 and the stroke of the slotted link 167 is arranged to provide a one quarter turn of the shaft 163 for each reciprocation of the plunger. It will be noted that the slot in the link 167 is widened at the bottom at 169 to permit the pin 165 to swing inwardly as the link rises when the shoulder 168 engages the pin.

Feeding

While such a machine can, of course, be fed automatically this particular machine is designed to be fed by hand and for that reason the various parts of the mechanism so far as possible are entirely enclosed as a safeguard against accident. In operation a bundle of towels would be laid up in a pile as shown at the left in Fig. 6 where the towels rest on the edge of the table 30 close to the operator. Because of the nature of the material being handled the towels will stick together and can therefore be laid over the edge of the table. This makes it possible for the operator to handle the towels with a minimum of effort and at the same time makes it possible to inspect each towel as it is taken from the pile and laid on the machine. By the simple expedient of turning each towel over as it is laid on the machine both sides can be inspected in a single movement of the operator.

Operation

As the towel is laid on the table with its corner positioned by the gages 31 and 32 the side fingers 38 are released by the action of the cam 63 and brought into position by the springs 43.

As the ends of the fingers slide down the cam surfaces 41 they press down on the opposite ends of the towel and grip the towel against the yielding surfaces of the rollers 37 in which action they carry a portion of the towel beneath the rear edge of the folding slide 35 which moves rearwardly as indicated in Fig. 21, folding the front edge of the towel over the center of the towel and at the same time the ribs 52 on the slide 35 engage the arms 53 of the rollers 37 and rotate the rollers sufficiently to stretch the towel lengthwise slightly along the line of the fold, thus ensuring a straight edge or fold line. The slide 35 continues rearwardly by the action of the cam 60, arm 57 and link 59 until at the rear end of its stroke the folding rod 36 is brought into action by the cam 71, arm 70 and links 66. As these members move forwardly the rollers 74 are raised on the incline 75 so that the rod 36 lifts the towel as shown in Fig. 21 up over the previously folded front section of the towel.

At the same time the hooks or fingers 80 are brought into action by the movement of the arm 57 and link 88 previously described so that the hooks 80 engage the newly folded rear edge of the towel as it is held over the rear edge of the plate 35.

The cams 60 and 71 are so timed that the slide 35 starts back under the action of the spring 62 very soon after the gripping hooks 80 have caught the rear folded edge and then the slide 35 and rod 36 travel in the same direction toward the front of the machine until they occupy the position shown in Fig. 23, whereupon the hooks 80 are disengaged by the forward movement of the link 88 and arm 70. The creasing action of the finger 90, of course, takes place automatically during the

forward movement of the folding rod 36 so that the center of the partially folded towel sags into the space 34' as shown in Fig. 24.

The folding of the towel transversely is then brought about automatically by the rotation of the shaft 100 and the crank pin 102, first upwardly through the slot 108 as shown in Figs. 25, 26 and 27 and then downwardly through the slot 110 and chute 111. The completely folded towel is then stripped from the pin 102 by the movement of the conveyor belt 112 which carries it to the stacker.

While the crank pin 102 is traveling down the chute 111 the cam 71 is engaging the roller 72 and forcing the arm 70 rearwardly with the rod 36 so that the rod 36 gets back to the position shown in Fig. 1 in time to permit the next towel to be laid on the table as soon as the previous towel has disappeared down the chute. There is thus no lost time in the movements of the machine, all movements of the machine being performed during a single rotation of the shaft 55.

The completed folded towels as they leave the folding pin 102 are carried successively to the stack at one side of the machine, each towel being moved from the belt 112 to the belts 138 till it engages the stop 140. It is then lifted by the plunger 141 which picks up a pile of towels and allows the bottom towel to be engaged by flanges such as 150 so that when the plunger descends it is ready to pick up the next towel as it arrives in position on the belts 138.

In order to allow sufficient time for the operator to lay down the next towel we have provided the mutilated gears 125 and 126 previously mentioned so that the shaft 55 rotates intermittently, remaining stationary just long enough for the operator to act.

It should be understood that while we have illustrated a complete machine for performing the various movements described some of the advantages of the invention might be utilized with portions of the machine or various combinations. It should also be understood that various changes might be made in the construction and adjustment in details or in the timing of the various movements. While we have referred to the article to be folded as a towel it should be understood that this term is used broadly to designate any article having the same general proportions and characteristics as towels and which it is desired to fold according to predetermined patterns.

The terms used in the claims are to be construed as broadly defining the structures necessary for performing the respective functions.

We claim:

1. In a folding machine, two pairs of members for gripping and stretching a fabric in one direction, and a sliding plate for folding one edge along the line of the gripping members.

2. In a folding machine, a supporting table, two pairs of gripping members for gripping and holding a fabric along a line parallel to one edge, a member movable over said gripping members for folding one edge of the fabric over the adjacent portion, and a movable member for folding the opposite edge of the fabric over said first movable member.

3. In a folding machine, two spaced abutments and a moving finger coacting with each abutment forming two pairs of gripping members to grip a fabric near its opposite ends, means for moving at least one of said gripping members to stretch the fabric and means for folding one portion of the fabric over another portion along the line of the gripping members.

4. In a folding machine, two sets of gripping members for engaging a towel along two spaced lines, and two sliding folding members movable one over the other and over the gripping members.

5. In a folding machine, a moving plate, a transverse member movable to fold one edge of a fabric over the edge of said plate and a pair of gripping members for engaging and holding a folded portion of the fabric while it is located on the edge of said plate.

6. In a folding machine a supporting shelf, a pair of resiliently supported members, grippers for grasping and holding a fabric, a folding member and means for moving it forward over said grippers.

7. In a folding machine, a supporting table, means for gripping the fold of a towel at points on opposite sides of its center, means for folding one edge of the towel over an adjacent portion and means for creasing the center of the towel.

8. In a folding machine, a supporting shelf, a member for creasing a towel or the like on the shelf, and a pin for folding the towel along two lines parallel to the line of said crease.

9. In a folding machine, a shelf having spaced slots, a member for folding one edge of a towel over said shelf, a second member for folding the opposite edge over the shelf and a member movable through said slots to fold the towel at right angles to the first folds.

10. In a folding machine, a supporting table having spaced slots, a rotating arm having a shaft and a projection at the end of the arm movable through one slot to pick up one end of a fabric and fold it over the other end of the fabric and carry the fabric through the other slot and thereby complete the folding operation.

11. A machine for folding towels and the like, means for grasping opposite ends of a towel and stretching it, a moving member

for folding one edge over the adjacent portion of the towel, a moving member for folding the opposite edge over the adjacent portion of the towel, a carrying member for engaging the partially folded towel at a point between its center and one end of it and carrying it upwardly and then downwardly to engage the towel on the opposite side of its center, a support having a slot through which the movement of said carrying member carries the completely folded towel and a conveyor for engaging the folded towel and removing it from the carrying member.

12. A combined folding and stacking machine comprising means for folding a towel and the like into a predetermined size, conveying means for receiving the folded towels successively from the folding means, a stack having lateral supports and a lifter for raising the towels from the conveying means and inserting them on the supports beneath the previously stacked towels and means for bringing the foregoing devices into successive action.

13. A machine for folding towels and the like comprising means for folding towels about lines parallel to their lengths to a definite width regardless of the widths of the towels and means for folding the partially folded towels about lines parallel to their widths to a definite length regardless of the lengths of the towels, and means for stacking the folded towels successively one beneath the other.

14. The method of folding towels which comprises spreading a towel horizontally, depressing a portion downwardly relative to the front edge along a line parallel to said edge, folding the front edge over the adjacent depressed portion, then folding the rear edge over the front edge, then downwardly creasing the central portion of the partially folded towel, then raising the central portion of one half of the partially folded towel while allowing the outer end to hang downwardly, carrying the raised portion over to the approximate center of the remaining horizontal half and then bringing the horizontal end adjacent the previously moved end.

15. In a folding machine, oppositely disposed movable fingers for depressing portions of the ends of an article downwardly from adjacent portions, means beneath the article for coacting with the said fingers to grip the article along a line parallel to the edge and means for then folding said edge over the adjacent depressed portion.

16. In a folding machine, a supporting table having two spaced slots, a swinging arm having a pin movable upwardly through one slot to pick up a portion of an article to fold it and then movable downwardly through the other slot to provide a second fold parallel to the first fold and means for moving said arm so as to move said pin successively upward and downward through a continuous orbit in one direction only.

17. A combined folding and stacking machine comprising means for folding articles in a predetermined manner, a stacker having means for supporting the lowest article of a column of stacked folded articles, a lifter for raising folded articles and inserting them successively above said supporting means beneath the previously stacked articles, means for conveying the folded articles from the folding means and delivering them successively on to the lifter and means for sequentially operating the folding and stacking means.

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