March 2, 1965 C. MELTON, JR 3,171,646

FOLDING MACHINE FOR LIMP FLAT ARTICLES

Filed April 19, 1963 4 Sheets-Sheet 1

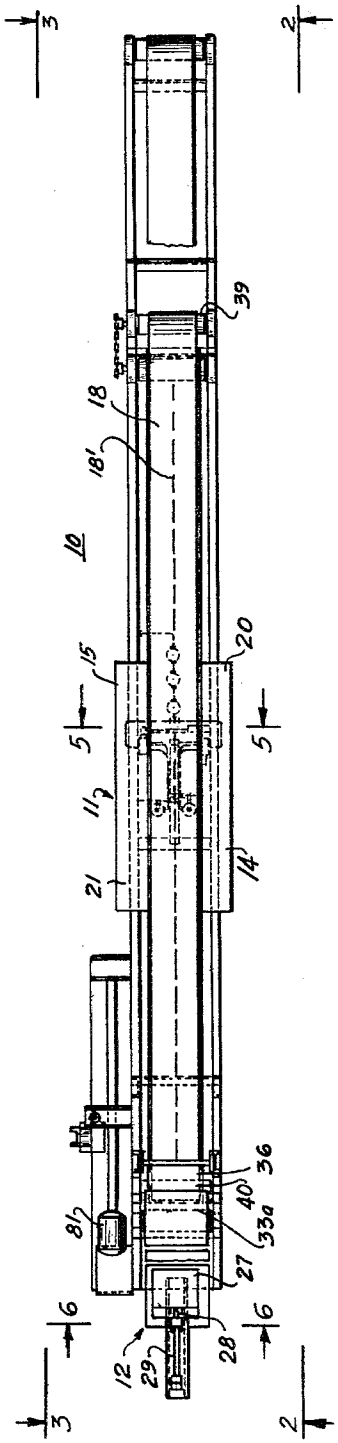


Fig-1

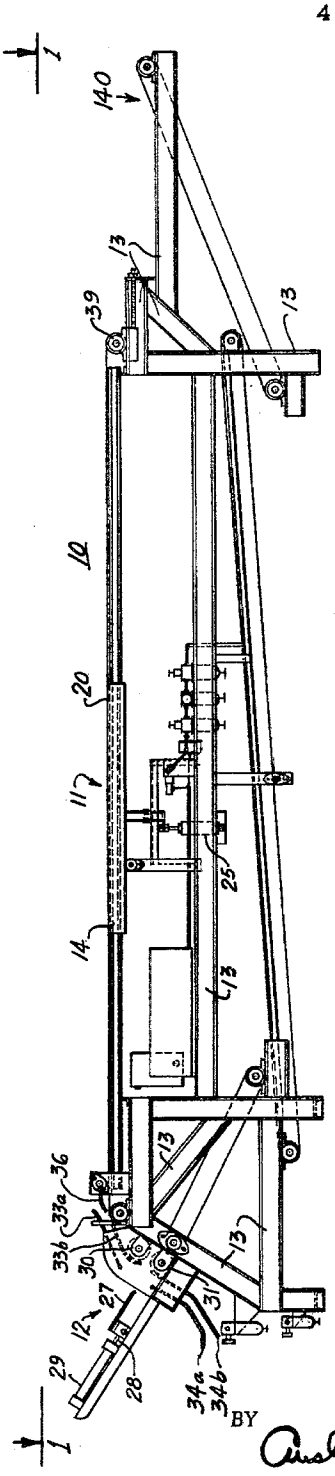


Fig-2

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March 2, 1965 C. MELTON, JR 3,171,646

FOLDING MACHINE FOR LIMP FLAT ARTICLES

Filed April 19, 1963 4 Sheets-Sheet 2

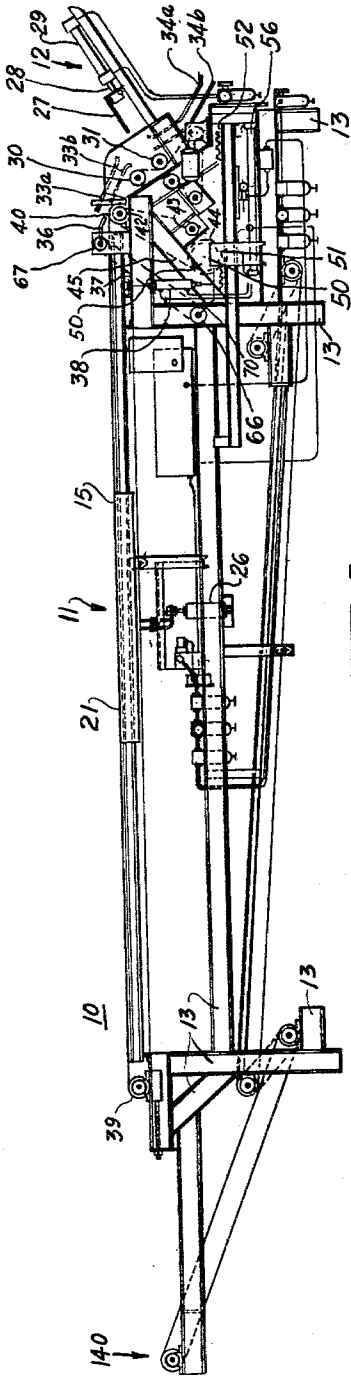


FIG-3

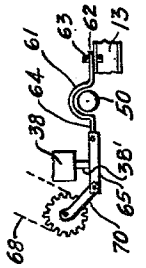


FIG-7

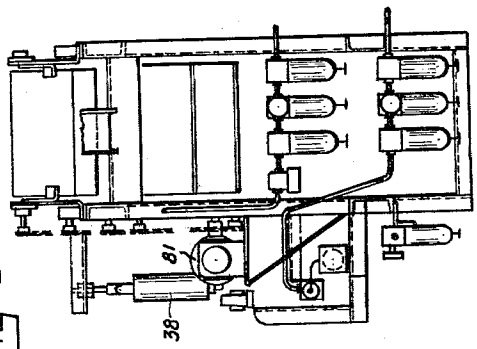


FIG-6

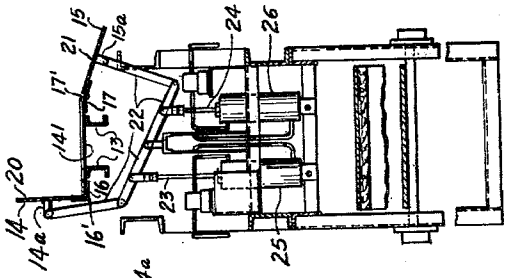


FIG-5

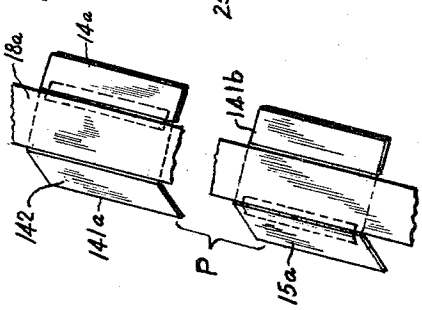


FIG-4

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FOLDING MACHINE FOR LIMP FLAT ARTICLES

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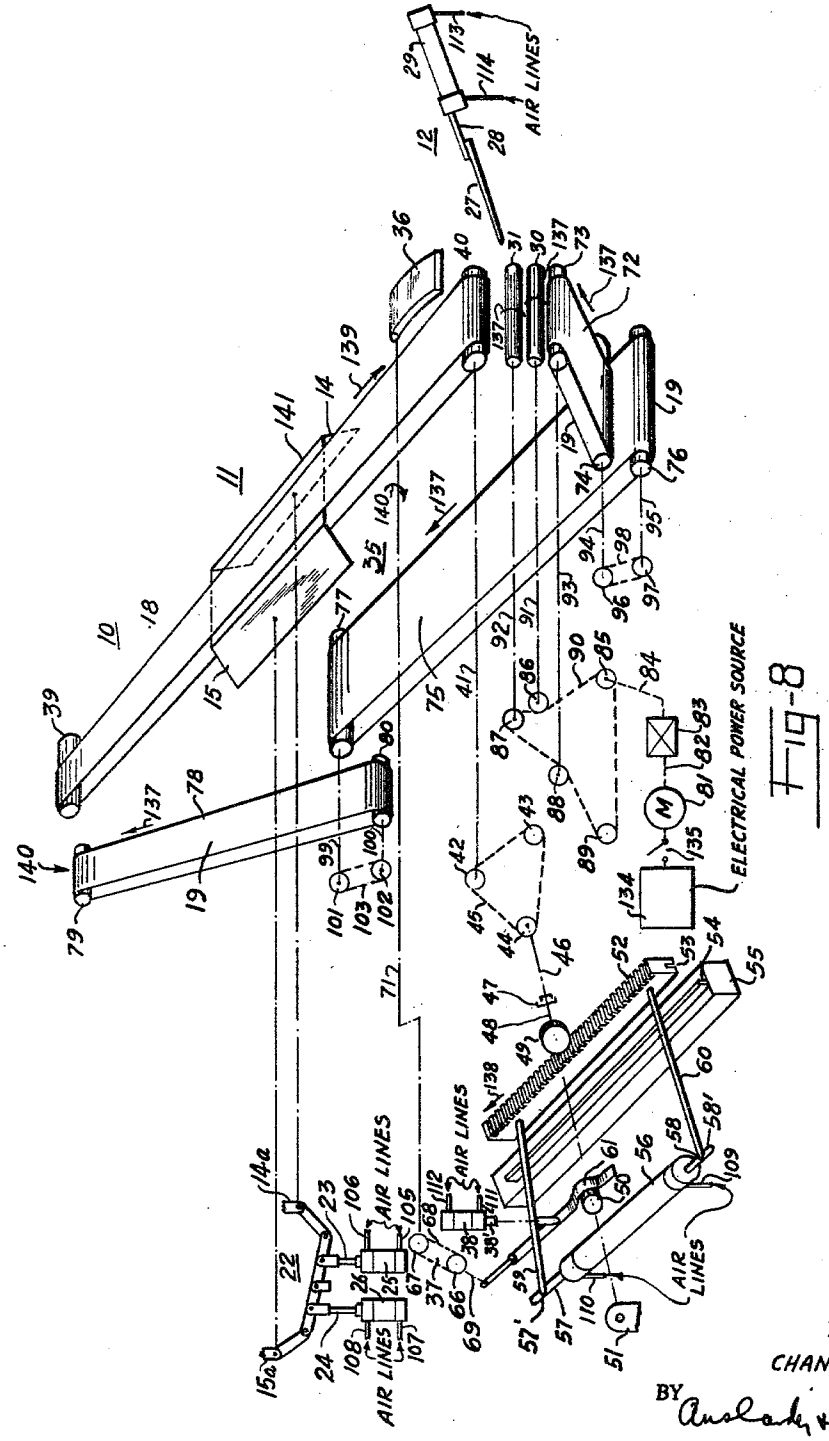


FIG-8

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FOLDING MACHINE FOR LIMP FLAT ARTICLES

Filed April 19, 1963 4 Sheets-Sheet 4

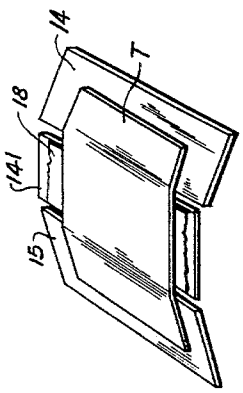


Fig-10a

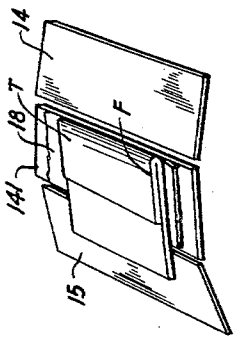


Fig-10b

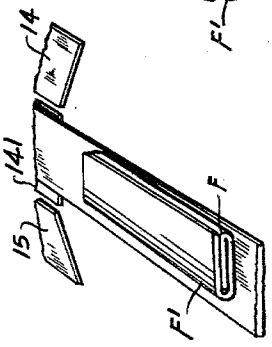


Fig-10c

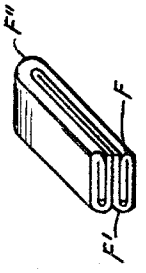


Fig-10d

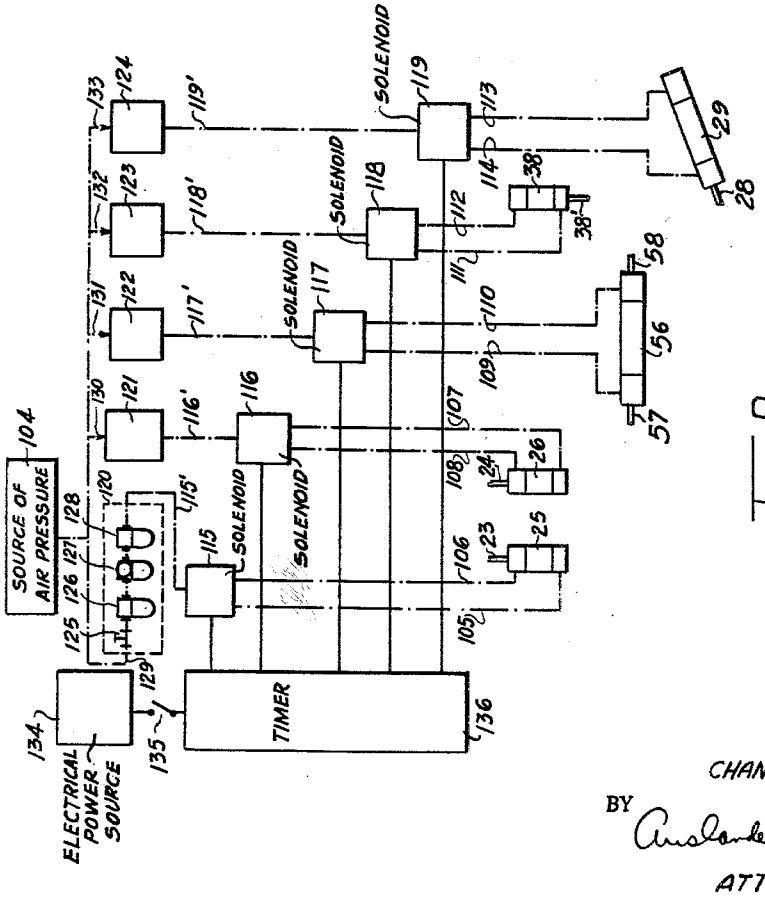


Fig-9

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United States Patent Office 3,171,646 Patented Mar. 2, 1965

3,171,646

FOLDING MACHINE FOR LIMP FLAT ARTICLES

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Filed Apr. 19, 1963, Ser. No. 274,216
1 Claim. (Cl. 270—66)

This invention relates to fiolding machines and more particularly to folding machines for limp flat articles and the like such as, for example, towels, linens, pillow cases, etc.

Prior art folding machines of this kind are known which generally utilize the motion of the article along a predetermined path for producing longitudinal folds therein For example, in one such prior art device, the flat moving article is fed between and coacts with two spaced stationary folding members having preshaped twisted forms which progressively changed from depending vertical positions at the receiving or front end to a horizontal disposition at the rear end so that the article when passing therethrough is folded upon itself in two longitudinal folds. Among the disadvantages of these prior art devices, are their complex structure, susceptibility to breakdown and/or ability to become inoperable when, for example, an article in a fouled condition is fed therethrough, etc., to name just a few.

An object of this invention is to provide a folding machine for limp, flat articles which provides longitudinal folds in the articles in a simple and reliable manner.

Still another object of this invention is to provide a folding machine for limp, flat articles as aforementioned which also provides a transverse fold in the longitudinal folded articles.

According to the broad aspects of this invention, the folding machine for limp, flat articles comprises, inter alia, at least one flat member which is adapted to pivot about a substantially horizontal pivotal axis. In addition, a conveyor belt system having a horizontal belt supporting surface with a longitudinal axis parallel to the pivotal axis is also provided. In operation, a stack of one or more of the flat articles is supported by the belt supporting surface and the upper surface of the flat member and the flat member is pivoted about the aforementioned pivotal axis, suitable means being provided for this purpose, to provide a longitudinal fold in the stack. A means to actuate the conveyor belt system is provided to move the longitudinally folded stack away from the proximity of the flat member.

As another aspect, the present invention further contemplates the utilization of a reciprocating blade assembly means to provide a transverse fold in the longitudinally folded stack.

Although such novel feature or features as are believed to be characteristic of the invention and are pointed out in the claim, the invention and the manner in which it may be carried out, may be further understood by reference to the description following and the accompanying drawings, in which:

FIG. 1 is a plan view of an embodiment of this invention;

FIG. 2 is a side view of the embodiment of FIG. 1 taken along the line 2—2;

FIG. 3 is the opposite side view of the embodiment of FIG. 1 taken along the line 3—3;

FIG. 4 is a perspective view illustrating partially another embodiment of this invention in which the longitudinal folding members are in a non-opposing alignment;

FIGS. 5 and 6 are sectional views of the embodiment of FIG. 1 taken along the lines 5—5, and 6—6, respectively;

FIG. 7 is a front view illustrating certain elements of FIG. 3 in greater detail;

FIG. 8 is an exploded perspective view schematically illustrated in part, of certain elements of the embodiment of FIG. 1;

FIG. 9 is a schematic view of the electrically controlled air pressure system utilized in the embodiment illustrated in FIG. 1; and

FIGS. 10*a*–10*d* are perspective views illustrating an article before and/or after certain operations have performed on it by the machine of this invention.

Referring now to the figures in greater detail, where like reference numbers denote like parts in the various figures.

In the drawings, the machine 10 for folding limp, flat articles is provided with a folding mechanism for providing the longitudinal fold or folds which is generally indicated by the reference numeral 11. As aforementioned, according to another aspect of the present invention, the machine 10 may also be and is preferred to be provided also with a folding mechanism for providing a transverse fold in the longitudinally folded article or articles which is of the reciprocating blade assembly type and which is indicated generally by the reference numeral 12.

Describing the machine 10 in greater detail, the folding mechanisms, 11, 12 are supported by a framework assembly generally indicated by the reference numerals 13. In the preferred embodiment illustrated in the drawings, the folding mechanism 11 is shown as comprising two flat members 14 and 15 which are preferably, but not necessarily, oppositely aligned. It is to be understood, however, as will become apparent hereinafter to those skilled in the art, that in certain applications only one flat member need be utilized or that additional flat members may be utilized depending upon the ultimate number of longitudinal folds desired to be placed in the article. The plates or members 14 and 15 are adapted to pivot, for example, by respective hinge means such as piano or continuous hinges 16, 17, FIG. 5, about respective parallel pivotal axes, which in the preferred example are illustrated as being horizontal. Thus, as is illustrated more clearly in FIG. 5, member 14 and 15 are pivotal about respective axes that are normal to the plane of the drawing of FIG. 5 at the hinge stud positions indicated by reference numerals 16′ and 17′, respectively. A conveyor belt supporting surface 18, which is part of a conveyor belt system 19, which is hereinafter sometimes referred to as the main conveyor belt system and described in greater detail, has a longitudinal axis indicated generally by the dash line 18′ that is parallel to the axes 16′ and 17′. It is to be understood that while surface 18 as well as the pivotal axis 16′, 17′ are preferably disposed in a horizontal relationship, that certain inclined relationships are also possible, as is apparent to those skilled in the art. Surface 18 and the respective upper surfaces 20, 21 of members 14, 15 are adapted to support a stack of one or more flat articles. Suitable means are provided for pivoting the members 14 and 15 about their respective pivotal axes and are illustrated in the drawing, by way of example only, as comprising a linkage assembly, indicated generally by the reference numeral 22, which is coupled to the members 14, 15 by brackets 14*a* and 14*b* and which is actuated by the respective piston rods 23, 24 of cylinders 25, 26, the latter being part of an electrically controlled air pressure system illustrated in FIG. 9 and hereinafter described in greater detail.

Folding mechanism 12 comprises a reciprocating blade assembly having, inter alia, a blade 27 that is affixed to the piston rod 28 of air cylinder 29, which may also comprise part of the aforementioned electrically controlled air pressure system. A pair of driven feed rollers 30, 31, whose rotational movement is integrated with an auxiliary conveyor belt system hereinafter described in greater detail, are provided in the proximity of the path of

the reciprocating blade 27. In practice the article or articles after being folded by mechanism 11 are adapted to be disposed between the upper and lower channel or guide member pairs 33*a*–33*b*, 34*a*–34*b*. Thereafter, the blade 27 is actuated and the leading edge contacts the article, causing it to be fed between rollers 30, 31. In this manner, the article or articles are provided with a transverse fold, and fed to the aforementioned auxiliary conveyor belt system, indicated generally by the reference numeral 35, FIG. 8, and described hereinafter in greater detail. To prevent the towel from slipping off prematurely from belt surface 18 before the blade 27 is actuated, a holding mechanism comprising pivotally inverted plate 36 is provided and actuated by the chain drive assembly means 37, the latter being driven by the piston rod 38' of air cylinder 38 in manner hereinafter described.

The main conveyor belt system, as best illustrated in FIG. 8, comprises by way of example, a pair of rollers 39, 40. Affixed to the axle, illustrated by the extended dash line 41, FIG. 8, for the sake of clarity, is the spur or sprocket gear 42 which is part of the schematically illustrated chain drive assembly comprising spur gears 43, 44 and sprocket chain 45. The axle, illustrated by the extended line 46 of FIG. 8, of sprocket gear 44 is coupled to a slip clutch 47. The drive shaft, illustrated in FIG. 8 as extended line 48, has affixed thereto pinion gear 49 and brake disc 50 and is adapted to rotate in axle bearing and bracket assembly 51 affixed to the framework 13. Pinion gear 49 is adapted to be rotated by slidable rack 52 which has an index or groove 53 adapted to fit about the track or tongue 54 of member 55 which is affixed to the framework 13. The movement of rack 52 is actuated by the two-way piston rod air cylinder 56, the ends 57', 58' of piston rods 57, 58 of which are coupled to the brackets 59, 60 that are affixed to rack 52. A brake assembly 59, 61 is provided, one end 62 of the brake band 61 of which is affixed to the framework 13, cf. FIG. 7, by suitable means such as bolt assembly 63, and the other end 64 is affixed to a bracket member 65 that is coupled to piston rod 38'. As aforementioned, the action of piston rod 38' controls the chain drive means assembly 37, the latter comprising spur gears 66, 67 and chain 63. The axle, shown as extended line 69 FIG. 8, of spur or sprocket gear 66 is connected to a link 70 which is pivotally connected to member 65. Spur gear 67 is connected to the axle, illustrated in FIG. 8 as extended dash line 71, which pivots plate 36 when rotated. Thus, when piston rod 38' moves into its downward position, the chain drive assembly 37 rotates the plate 36 into its holding position and when piston rod 38' moves into its upper position, the plate 36 is rotated back to its release position.

The aforementioned auxiliary conveyor belt system, indicated generally by the reference numerals 19, as illustrated by way of example and best shown in FIG. 8 comprises a series of three sub-systems. One sub-system comprises the belt 72 and rollers 73, 74. Another comprises the belt 75 and rollers 76 and 77 and the third sub-system comprises the belt 78 and rollers 79, 80. An electrically driven motor 81 is utilized to drive the three sub-systems as well as rollers 30, 31. Thus, as shown in FIG. 8, the shaft 82 of motor 81 is connected, via the gear box assembly 83 and shaft 84, to the driver spur gear 85 which in turn rotates, spur gears 86, 87, 88, 89, via the sprocket chain 90. Sprocket or spur gears 86, 87 are connected to the respective axles, illustrated in FIG. 8 as extended lines 91, 92 of rollers 30, 31, respectively. Spur gear 88 is connected to the axle, also shown in FIG. 8 for sake of clarity as extended line 93, of roller 73. Rollers 74 and 76 have affixed to their respective shafts, illustrated in FIG. 8 as extended lines 94, 95, spur gears 96 and 97, respectively, which are linked by the sprocket chain 98. Similarly, rollers 77 and 80 have affixed to their respective shafts, illustrated again in FIG. 8 as extended lines 99, 100, spur gears 101 and 102, respectively, which are linked by the chain 103.

The aforementioned electrically controlled air system will now be described with particular reference to the schematic of FIG. 9. To actuate the various piston rods 23, 24, 57–58, 38' and 28 of air cylinders 25, 26, 56, 38 and 29, respectively, a suitable source 104 of air pressure is provided. For the sake of clarity air lines will be generally indicated in FIG. 9 as dash-dot lines to distinguish them from electrical circuit lines, the latter being illustrated therein as solid lines. Thus, as shown in FIG. 9, each of the aforementioned air cylinders 23, 26, 56, 38 and 29 is connected to a pair of air lines 105–106, 107–108, 109–110, 111–112 and 113 and 114, respectively. Each of these pairs is coupled to respective control means such as, for example, electrically operated, oil immersed, air solenoids 115–119.

Each solenoid is preferably coupled via respective air lines 115'–119' to respective pressure regulating systems 120–124, which includes, inter alia, as shown, for example, in the system 120, a valve 125, a moisture trap 126, pressure and gage regulator 127 and an oil supply 128 for the associated solenoid. The air supply or source 104 is connected to the input of each of the regulating systems via respective air lines 129–133. Solenoids 115 are operated by a source 134 of electrical power via the switch 135 and the timer means 136. The latter may comprise, for example, a series of cam operated switches not shown, driven by an adjustable variable speed electrical motor, not shown, and which may also be adapted to be connected to the source 134, and is utilized to time the sequence of the respective air solenoids in the predetermined sequence as explained in the description following hereinafter of the operation of the embodiment of FIG. 1. The switch 135, if desired, may also be utilized to connect the motor 81, FIG. 8, to source 134.

Turning now to the operation of the embodiment of FIG. 1 and its other associated figures, and in particular FIGS. 8–9, the switch 135 is closed to connect source 134 to the aforementioned motor, not shown, of timer 136 and to the motor 81. Motor 81 causes the rollers 30, 31 and the various belts of auxiliary conveyor belt system 19 to operate in the directions indicated by the associated arrows 137. Timer 136's motor causes solenoids 115–119 to be sequentially actuated by source 134 in a predetermined time sequence as hereinafter described. In operation, a stack of one or more limp, flat articles, such as the towel T, cf. towel T of FIG. 10*a*, which are illustrated in FIGS. 10*a*–10*d* with an exaggerated thickness for sake of clarity, is adapted to be supported on the belt supporting surface 18 and in the preferred embodiment by the upper surfaces of both members 14 and 15. This step may be performed manually or automatically. In the first or manual case, the speed of the timer motor 136 is adjusted to the proficiency of the operator. In the second or automatic case, the feeding cycle of the automatic means is adapted to be compatible and/or integrated with the timing cycle of the timer 136, in a manner obvious to those skilled in the art. Furthermore, guide means, not shown, for example, such as guide lines, may be provided by way of example on one or more of the members 14, 15 and the towel disposed in relation thereto so that the towel may be folded in a symmetrical, as shown in FIGS. 10*a*–10*d*, or asymmetrical, not shown, manner. Timer 136 then causes one of the solenoids 115 or 116 to be actuated. For example, as illustrated in the drawing, solenoid 115 is actuated and the air cylinder 25 operated. As a consequence, the member 14 is pivoted, preferably in a fairly rapid motion, going from its depending or open position to a horizontally closed one above the surface 18' and thence back to its open position, due to the upward and downward movement of the piston rod 23 in a manner well known to those skilled in the art and thereby causing a longitudinal fold F, FIG. 10*b*, to be effected in the towel T. Then the other solenoid, which in the case illustrated in the drawings is solenoid 116,

is actuated by timer 136 causing the member 15, in a similar manner, to place a longitudinal fold F', FIG. 10*c* into towel T.

Timer 136 thereafter actuates solenoid 117, causing air cylinder 56 to be operated and the rack 52 to move in the direction of the arrow 138, FIG. 8. The movement of rack 52 drives pinion gear 49 in a direction which causes it to engage slip clutch 47 and thereby, via the chain drive assembly 42–45, initiates the movement of the conveyor belt system 18, 39, 40 in a direction away from folding mechanism 11 and towards folding mechanism 12 as indicated by the arrow 139.

The conveyor belt system 18 continues to move the towel T until it is disposed between the channel or guide members 33*a*–33*b* and 34*a*–34*b* where upon the timer actuates solenoid 118, causing air cylinder 38 to operate the brake band 61 to engage the brake disc 50. This action stops the rotation of pinion gear 48 and thus the movement of rack 52. Concurrently air cylinder 38 operated the holding mechanism 36 via chain drive assembly 37 and link 70 and the towel is held yieldingly in place between the channel or guide members at or near its trailing edge. The holding mechanism 36 is so adapted as to be able to coact with the trailing edge of the smallest longitudinal length of towel contemplated to be utilized by the machine of this invention such as, for example, by use of appropriate provided guide lines, not shown.

Solenoid 119 is thereupon actuated by timer 136 and the air cylinder 29 operated to reciprocate the blade 27. The leading edge of the blade 27 transversely contacts the longitudinally folded article T which is being held yieldingly in place between the channel or guide members 33*a*–33*b* and 34*a*–34*b*. The towel T is thus transversely folded and the forward motion of the reciprocating blade 27 is sufficient to cause the article T at the transverse fold F''', cf. FIG. 10*d*, to be placed between and gripped by the feed rollers 30, 31, whereupon the towel T is transported by conveyor belt system 19 to the delivery end of machine 10 and indicated generally by reference numeral 140 in the drawings.

Solenoid 118 is so actuated by timer 136 that the upward movement of piston rod 38' occurs when the blade 27 has been reciprocated by air cylinder 29, and solenoid 117 is so actuated by timer 136 that the piston rod 51–58 will cause the rack 52 to move in a direction which is opposite to the direction of arrow 138 when this occurs. As a result holding means 36 is released and the rack is returned back to its original position to be ready for the next cycle of the timer 136. When the rack is moved in the direction opposite to the arrow 138, the pinion gear 49 is disengaged, via slip clutch 47, from engagement with gear 44 and consequently the conveyor belt system 18, 39, 40 is stopped. Thereafter, another stack of one or more towels T is placed in the surfaces 18, 20, 21 and the timer cycle is repeated.

As shown in the embodiment of FIG. 5, it is preferred that a horizontal plate 141 be placed beneath the conveyor belt surface 18 and between the members 14 and 15 to improve the support for the towel and upper surface 18 especially during folding operations. It is also desirable that the members 14 and 15 be hinged to the plate 141.

As an alternative embodiment, the longitudinal members 14 and 15 need not be oppositely aligned, but may be staggered. Thus, as shown in FIG. 4 members 14*a* and 15*a* are staggered along the side of the conveyor belt surface 18*a* and the associated conveyor belt system thereof is adapted to move the article away from each member 14*a* and 15*a* after each performs its folding

operation. Auxiliary plates 141*a*, 141*b* may also be provided and the members 14*a*, 15*a* are preferably hinged, respectively, thereto. To guide the portion of the towel, not shown, which is opposite to the portion being folded by the folding member 14*a* and which extends over the side of the upper surface 18*a*, the member 141*a* is provided with a depending side 142 which is in close longitudinal proximity P, exaggerated in the drawing for sake of clarity, and aligned with the open position of member 15*a*. Thus, in this manner it is obvious that one or more longitudinal folding members may be provided in the machine of the present invention. Furthermore it is apparent to those skilled in the art, that the article or towel T need not be disposed so as to be supported by members 14, 15 or 14*a*, 15*a* in certain cases, but need only be so disposed as to one of the members as, for example, in those cases where only one longitudinal fold is desired.

The terms and expressions which are employed are used as terms of description, it is recognized, though, that various modifications are possible within the scope of the invention claimed.

I claim:

A machine for folding limp flat articles comprising, inter alia, first and second oppositely aligned downwardly depending flat members, a horizontal flat third member disposed between said first and second members, first and second hinges affixed to said first and second members, respectively, and to said third member, said first and second hinges having first and second pivotal axes, respectively, associated therewith, a first conveyor belt system having a conveyor belt adapted to pass between first and second members and above said third member, the upper surface of said first and second members and said belt being adapted to support a stack of a predetermined number of said flat articles, means for sequentially pivoting said first and second members about said first and second pivotal axes, respectively, to provide respective longitudinal folds on said stack, a reciprocating blade assembly having a reciprocating blade and a pair of feed rollers associated therewith, means for yieldably holding a longitudinal folded stack between said reciprocating blade and said feed rollers, means to actuate said reciprocating blade assembly whenever a longitudinally folded stack is being yieldingly held by said holding means to provide a transverse fold in said longitudinally folded stack, a second conveyor belt system to move said transversely folded stack away from said feed rollers, and timer means having a timing cycle comprising the steps of actuating said pivot means, actuating said first conveyor belt system to move said longitudinally folded stack away from said first and second members and into a predetermined engagement with said holding means, and actuating said reciprocating blade assembly whenever said holding means is in said predetermined engagement to feed said longitudinally folded stack between said feed rollers to provide said transverse fold therein and place said stack onto said second conveyor belt system.

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