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FOLDING MACHINE

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This invention relates to a machine for folding flat articles, such as sheets, table cloths and the like, and particularly to a machine for cross-folding such articles.

The invention contemplates providing a machine which passes a flat article, such as a sheet, along a conveyor, then guides the sheet around and over a unit consisting of rotatable rollers and tapes running over such rollers, and eventually cross-folds the sheet by means of a blade which passes up through a space dividing the unit centrally and transversely. The blade thrusts the elliptically rolled sheet between belts which flatten it and impart the cross fold. Closely spaced switches are provided which cause actuation of the cross-folding blade when the trailing end of the sheet has passed one such switch but not the other, thus measuring the sheet so that the fold will be accurately placed.

At the same time, the switches cause the sheet-moving means, other than the folding blade and the cross-folding belts, to stop automatically, such stopping being necessary while the folding blade is performing its function. Such a machine eliminates complicated timing mechanisms which have heretofore been thought necessary to impart a fold accurately positioned with respect to the dimensions of the article being folded.

In my copending application Serial No. 657,407, filed February 16, 1933, an apparatus is described for cross-folding flat articles of moderate size by deflecting the same from a conveyor into the form of a loose roll which can then be flattened by bringing a folding blade transversely against it and directing it between a pair of rollers. This means works very well with small articles but is not practicable with larger articles, such as sheets, due to the fact that the larger tube necessarily formed cannot be satisfactorily manipulated. Accordingly, it is an object of the present invention to provide a machine having supporting means for the rolled article, such as spaced drums with tapes extending around the same. The sheet is then deflected around the structure and adequately and effectively supported in the form of a flattened circle whereof half the perimeter is equivalent to one of the sides of the subsequently folded article.

In most folding machines adapted for folding a series of flat articles in succession without attention from the operator individually to each sheet, the operation of the blades at the proper time with regard to the dimensions of the sheet and the position thereof in the machine has been brought about by more or less complicated timing mechanisms which cause the folding blades to function at the right time so as to bring the blade against the center of the article. Such mechanisms are expensive to make and require constant attention in order to maintain their maximum operating efficiency. Another object of the present invention is to do away with such complicated timing mechanisms and provide in their place a machine having an arrangement of switches under which the trailing edge of the article to be folded passes. Both switches must be closed in order to actuate the folding blade and to affect other parts of the mechanism, but one switch is normally open when no article is passing thereunder and the other is open when an article lies under both switches. Consequently, both switches will be closed so as to complete a circuit actuating the operating mechanism only when the trailing edge of the sheet has passed by one switch, leaving it normally closed, and has not yet passed the other switch which it holds also in closed position. In this way, accurate measurement of the sheet for the purpose of imparting folds thereto is secured since the switches are closely spaced and are also positioned a predetermined distance from the unit about which the sheet is deflected prior to the cross-folding operation.

It is also an object of the invention to provide means for directing a blast of air over the article being folded around the drums, in order to prevent wrinkling and to cause the work to cling to the drum tapes during the rolling process, in order to produce a smoothly folded article.

Still other objects of the invention include means for simultaneously stopping moving parts which move the article therethrough when the cross-folding blade is functioning, and means for moving the work through the folding machine faster than it is fed to such machine in order to compensate for the delay occasioned by this intermittent cessation of forward movement.

As a further object, the invention includes the provision of means for lowering the deflectors, which direct the article over the forming drums and tapes, to an inoperative position and simultaneously preventing the functioning of the measuring switches mentioned in order that an improperly laundered article may be shunted through the machine without being folded.
Other objects of the invention will in part be obvious and will in part appear hereinafter.

One machine, by the use of which the aforementioned objects and advantages may be secured, is illustrated in the accompanying drawings, but it is to be understood that the same may be modified in various particulars, not affecting the principle of its operation; without departing from the scope of the invention.

In said annexed drawings: Fig. 1 is a longitudinal section taken on the line 1-1 of Fig. 2, through an ironing machine and a folding machine constructed in accordance with the invention; Fig. 2 is a transverse section taken along the line 2-2 of Fig. 3; Fig. 3 is a top plan view of the folding machine; Fig. 4 is a fragmentary plan view showing the drums and associated tapes about which the articles are wound prior to the folding operation; Fig. 5 is a fragmentary detail of a clutch operating means for automatically actuating the cross-fold blade and the stripping rollers and for declutching certain drive members, this view showing the clutch operating means in the disengaged position; Fig. 6 is a view similar to Fig. 5 but with the clutch operating means in engaged position; Fig. 7 is a detail partly in section taken along the line 1-1 of Fig. 5; Fig. 8 is a perspective view showing the various clutch operating levers illustrated in Figs. 5 and 6; Fig. 9 is a fragmentary detail of the secondary clutch means for automatically operating the cross-folding mechanism; Fig. 10 is a detail partly in section taken along the line 10-10 of Fig. 9; Fig. 11 is a fragmentary view, partly in section, showing the construction of the article-measuring switches; Fig. 12 is a fragmentary elevation of the article deflectors and associated means for rendering the switches inoperative when an article is to be passed through the machine without folding; Fig. 13 is a diagrammatic showing of the electrical circuit forming a part of the apparatus; Fig. 14 is a vertical section through a portion of the machine, showing the clutches and driving mechanism for the cross-fold blade and the conveyor tape drive rollers; Fig. 15 is a fragmentary section taken along the line 15-15 of Fig. 3, showing the sprockets and drive chains; and Fig. 16 is a similar view of the opposite side of the machine, the section being taken along the line 16-16 of Fig. 3.

Referring to the drawings, Fig. 1 shows an ironing machine 1, positioned to feed work through a folding machine 2. Work is conveyed between the ironing rolls 3 and the chest 4, thence back against the under side of the chests by means of the conveyor belt 5, between this conveyor belt and the lower conveyor tapes 6 of the folding machine 2. The spaced work-conveying tapes 6 are substituted for the customary conveyor apron and the upper laps thereof travel from right to left, as viewed in Fig. 1, around a driving roller 7 and idler rollers 8, 9, 10 and 11. The work is taken from the upper roll 6 by a plurality of spaced endless cords 12 passing around the roller 13 and the shaft 20 and is transferred to the work-conveying tapes 14 and 15 of the folding machine.

The work, upon leaving the ironing machine, passes between the face-covered roller 13, extending transversely of the frame 16 and journaled in the inner end rails of the frame, and a plurality of spaced narrow rollers 17, constructed preferably of wood, fiber or like material and securely mounted on the shaft 18.

The purpose of these rollers is to accelerate the speed of the work through the folding machine as compared to the speed with which the work is fed from the ironing machine, the increased speed being requisite to permit continuous feeding of work from the ironing machine to the folding machine, as will appear hereinafter.

The roller 17 is driven from the roller 13 through a gear 19 rigidly secured to a portion of the shaft 16 projecting outside the inner rail 10 of the machine frame and arranged in meshing relation with a gear 21, of similar ratio, which is securely mounted on an outwardly projecting portion of the roller shaft 13.

The work, thus accelerated by passage between the rollers 12 and 17, passes onto the conveyor tapes 14 and is carried under the laterally extending drums or cylinders 22, over which run spaced endless narrow tapes 23. The work is directed by a plurality of deflectors 24 around and upon the tapes 23 to form the article into a roll of flattened elliptical shape. The rolls 22 are carried by the side rails of the machine 16 and extend inwardly across the width of the machine, terminating in stationary members 25 in which they are rotatably mounted. A longitudinally extending space is thus left between the two halves of the unit constituted by the drums and enclosing tapes, through which is adapted to pass the cross-folding blade 26. This blade is moved upward by suitable mechanism at the proper time and pulls the flattened elliptical roll, into which the article has been formed, off the drums 22 and tapes 23 and thrusts it between cross-folding belts 27 and 28, this action being assisted and guided by stripper rollers 29 and 31. The article roll is thus simultaneously flattened and cross-folded by the cross-folding belts and can be delivered onto suitable conveyors for stacking or other disposition.

In the course of its travel through the machine, as above outlined, the work to be folded is first changed from the flat condition to the form of a flattened roll of predetermined size by the dimensions of the unit made up of the drums 22 and tapes 23, and by which one-half the circumference of the elliptical roll will be equivalent to the width of one of the sides of the finished folded article. The roll of work is next changed from the rolled form to the cross-folded condition by action of the folding blade which forces the roll between the cross-folding belts.

The drums 22 are, as stated, journaled in the end rails of the frame 16 and have outwardly extending end portions carrying sprocket gears 32, around which sprocket chains 33 and 34 pass for driving the drums. The rollers 35, which drive the conveyor tapes 15, are furnished with sprocket gears 36 securely fixed to their outwardly extending ends and are driven by the sprocket chains 33 and 34.

The deflectors 24, which direct the work in a flat state from the tapes 14 and 15 upwardly and around the tapes 23 of the drums 22 and form it into an elliptical roll, are mounted on a rotatable shaft 37 which extends transversely of the frame, as shown in Fig. 4, and is journaled in the end rails of the frame and in brackets 38 and 39. The deflectors consist of a series of arms formed on a circumference centering at, or approximately at, the centers of the rear pair of drums 22. These deflectors can be moved into and out of operating position rela-
The operation of the article-portioning roll of the apparatus, the tapes 14 and 15 are set in motion to pull work in the flat state from the feed end of the frame toward the opposite end, the drums or cylinders being rotated in a clockwise direction as viewed in Fig. 1. The crank 41 is operated to rotate the shaft 37 to swing the deflectors 24 from the inoperative position, shown in dotted lines in Figs. 1 and 12, wherein they are beneath the upper laps of the tapes 15, into the position shown in full lines wherein they are in deflecting position with respect to the tapes 15 and the drum 22 and drum tapes 28. In normal operation, the work is conveyed in the flat state through the apparatus by the tapes 14 and 15 until it strikes the deflectors and is curved upwardly around the aforementioned drums and associated tapes by continued motion of the work and the rotation of these drums and tapes. The work is finally rolled into the elliptical shape illustrated in dotted lines in Fig. 1.

While the apparatus is operating, an inspection operator is stationed at a point approximately at the rear of the ironing machine and the rear of the folding machine to observe the condition of each article being formed. Articles which have been properly washed are permitted to be folded, but those which have not been properly washed, those commonly termed "wash-overs" in the laundry, are shunted through the machine without being folded. This is brought about by manually operating the crank 41 to lower the deflectors below the upper laps of the feed aprons 15 so as to allow the articles to pass by the folding mechanism without being folded and into a receptacle 42 provided at the rear of the machine.

An article which has been given an elliptical shape on the drums and tapes must now be reduced to a flat folded condition. This is accomplished by the cross-fold blade 26 which, at the proper time, is moved upwardly between the inner support members 25 of the cylinders and between adjacent tapes to engage the cylinder of work at approximately its longitudinal center so as to pull the work off the drums or cylinders 22 and the conveyor tapes and thrust it upwardly between the stripper rollers 28 and 31 into the bite between a plurality of cross-folding belts 27 and 28. The work is then pulled upwardly between these cross-folding belts and is reduced to a flat, cross-folded condition.

The cross-fold blade 26 is moved up and down in guides 43 in which the rods 44, rigidly secured to the bottom of the cross-fold blade, are adapted to slide. A cross rod 45 is securely fixed to the vertical rods 44 at approximately their vertical center and links 46 are rotatably mounted on each cross rod. Cranks 41 are pivotally assembled to the links 46 by means of pins 48, the opposite ends of the cranks being securely pinned to a shaft 49 journaled in the brackets 51. This shaft 49 carries a bevel gear 52 meshing with another bevel gear 53 fixed to a drive shaft 36 mounted on the cross-fold blade. At its opposite end this shaft 54 is assembled to the driven member of a clutch mechanism. A spring 55 is secured to the frame of the machine and to the lower portion of the cross-fold blade so as to cause a quick return of the blade after it has performed its function of lifting the work between the cross-fold tapes 27 and 28.

As mentioned, the associated conveying means must be temporarily stopped when the cross-fold blade is brought into operating engagement with the work. An automatically operating control means has been devised for regulating the operation of the cross-fold blade and the stripper rollers 29 and 31, and for simultaneously rendering the driving mechanism for the conveyor tape drive rollers 20 and 35, the rollers 13 and 17, and the drums 22 inoperative. This control means is actuated by movement of the work through the apparatus and thus requires no manual intervention. The control includes mercury switches 55 and 57 having arms 53 and 59 which project downwardly between the upper laps of the tapes 14. An article travelling over the tapes beneath the switches operates the arms as its trailing edge passes them, with the result that an electrical circuit to a solenoid 61 is controlled. Energization of the solenoid actuates a lever 62 through a link 63 in a clockwise direction, as viewed in Fig. 5, to set the clutch operating mechanism on the shaft 64 for accomplishing the above mentioned objects.

Switches 65 and 67 are under the control of the mercury type, the switch 65, which is the first in the path of the article travelling through the machine, being so disposed as to be normally closed, while the other switch 67 is so disposed as to be normally open, such disposition being brought about by proper positioning of the contacts 55, 66 and 65' and 66', with respect to the pool of mercury in the switch. A flat article passing under the switches strikes the arms 58 and 59 and moves them in a clockwise direction, or to the dotted line position shown in Fig. 1, such movement opening the switch 65 and closing the switch 67, as will be apparent. The switches remain in this position, the circuit to the solenoid being still open since closing of both switches is necessary in order to close the circuit, until the trailing edge of the article passes from under the arm 68 of the first switch, permitting the arm to rotate in a counterclockwise direction and close the circuit since the arm 69 of the second switch is still being held up by the article which has not yet completely passed the second switch. The circuit is thus closed only while the trailing edge of the article is between the two switches or, more exactly, between the arms of the two switches, and the circuit thus established during this short period energizes the solenoid which actuates the main clutch for operating the various mechanisms. The switches will be placed close to the forward drum 22 so that only a small portion of the article falls to lie under the tapes 23. This small portion allows for the spreading of the rolled article when folded, so that the trailing edge may be aligned with the folds, if desired. Once the folding blade is actuated only when this trailing edge lies between the two switches, or the corresponding space between their respective arms, and since, moreover, the spacing of the switches may be made quite small, it will be seen that very accurate measurement of the sheet for folding purposes may be attained without recourse to complicated timing mechanisms.

The main clutch, actuated by these switches, is illustrated in Figs. 5, 6 and 7 and includes a sprocket gear 67 rigidly secured to the shaft 64, the gear having a plurality of axially extending
rollers 68 circumferentially spaced upon its inner face. The shaft also carries a cam 69 loosely mounted thereon and has a dog 71 on its inner face opposite to the inner face of the sprocket gear 61. This dog is adapted to be moved into contact with the rollers 68 on the gear by means of a spring 72 to connect the loosely mounted cam with the rigidly mounted sprocket gear. This is brought about when the solenoid 61 is energized to pull the trigger arm 62 into position shown in Fig. 6, where the dog has been released by the trigger arm and the spring 72 has pulled it into engagement with the rollers 68. The opposite action is secured when the solenoid is de-energized by the passing of the article from under the switch arms 56 and 59, whereupon the trigger arm 62, loosely mounted on the shaft 73, is moved in a counterclockwise direction by means of a spring 74 which returns the trigger arm to a position where it will contact with one end of the dog 71 when the rotation of the cam has brought the dog into abutment with the trigger arm. This forces the dog around its axis and swings the operating end thereof into a position where it will not contact with the roller 68 and thus disconnects the cam 69 from the sprocket 67. Thus, Fig. 5 illustrates the automatic control mechanism in the disconnected position and Fig. 6 illustrates the same in the connected position.

The cam 69 has an indentation 75 therein which is adapted to receive a roller 76 carried on the end of an arm 17 rotatably mounted on a shaft 78. The opposite end of this arm 71 is pivotally mounted on a shaft 79, this shaft, in turn, being rotatably mounted in slide members 81 and 82. The slide members are slidably assembled in guides located in the side rails of the frame 16 and have stripper rollers 29 and 31 rotatably assembled in their lower ends. A spring 83 is secured at one end to the shaft 84 and at the other end to the arm 17 in order to maintain the roller 76 in constant engagement with the periphery of the cam 69.

When the main clutch mechanism described above becomes engaged, as illustrated in Fig. 6, the cam 69 is rotated in a clockwise direction to cause the roller 76 to ride out of the indentation 75 and onto the higher portion of the cam periphery, thus causing the arm 71 to be rotated in a clockwise direction. This moves the slide members 81 and 82 downwardly and lowers the stripper rollers 29 and 31, carried on the lower ends of these slide members, to a position adjacent the drums 22 to approach the upwardly moving cross-fold blade 26. The stripper rollers will remain in this lower position until the cam has completed one rotation and the roller 76 has again come to rest in the cam indentation.

At the same time that the stripper rolls are thus being lowered, the cross-fold blade 26 is also being raised. This is brought about by the counterclockwise rotation of the arm 84, fixed to the shaft 73, which operates through the linkage consisting of rod 85, bell crank 86 and rod 87, to release clutch trigger arm 88. As may be seen in Fig. 5 of the drawings, arm 84, being rigidly attached to the shaft 73, turns, when the solenoid is energized, simultaneously with the turning of the arm 62 to release the dog 71 for the operation of the stripper rolls. Release of the clutch trigger arm 88, as may be seen in Figs. 9 and 10, permits the dog 89 to become engaged with one of a plurality of circumferentially spaced axially extending rollers 90 on a driving member 91 rigidly secured to a shaft 92. Upon release of the dog in this manner, a spring 93 is attached to the dog and to the shaft 92, so that the dog into engagement with one of the aforementioned rollers, thus turning the disk member 94 which is rigidly mounted on the shaft 95. Rotation of the shaft 94, in turn, rotates the bevel gear 95 and the bevel gear 92 meshing therewith, and the shaft 94, in turn, being made to rotate by the bevel gear 96, as shown in Fig. 1, is rotated to raise the cross-folding blade through crank 47, links 45, and the rods 44.

As the cranks 47 continue to rotate, the blade is again lowered, aided by the spring 85, and, at the same time, opening of the second switch 87, as the trailing edge of the article passes it, de-energizes the solenoid and permits the spring 74 to bring the lever 62 into position to lock the cam 69 out of engagement with the sprocket gear 61. This releases the pull on the rod 88 and permits a spring 95 to operate the bell crank lever 86 in a counterclockwise direction to lower the rod 87, as shown in Fig. 14. The rod forces the trigger arm 88 into engagement again with the dog 89 and locks the latter out of engagement with the rollers 90 so as to disconnect the driven member 94 from the driving member 91. This mechanism thus brings about controlled operation of the folding blade 26.

While the stripper rollers 29 and 31 are lowered and the folding blade 26 is raised in order to remove a rolled article from the rollers 22, it will be apparent that some means must be devised to prevent the continued operation of these rollers and of the feed means while the blade is functioning, otherwise interference with the smooth and secure operation of the machine will result. Simultaneously with the operation of the cross-folding parts, cessation of movement by associated conveying elements is brought about in the following manner: When the main clutch mechanism illustrated in Figs. 5 and 6 becomes engaged by the closing of the switches and consequent energizing of the solenoid 61, the cam 69 is rotated in a clockwise direction and causes, among other effects, a counterclockwise movement of the bell crank 96 by means of a lug 100 mounted on the outer face of the cam and contacting with the bell crank which is rigidly mounted on the shaft 94. The shaft is journalled in bearings in the frame and rear rails of the frame, as may be seen in Fig. 3. This counterclockwise movement of the bell crank operates on a clutch 97 through the rod 98 attached to the bell crank 96, the bell crank 95, rod 101 and the clutch operating member 102 to disengage the clutch. The female member of the clutch is slidable mounted on the shaft 103, being held against rotation by the key 104, and the male member is attached to the shaft 60. A spring 105 is attached to the frame and to the operating member 102 for the purpose of moving the clutch back into engaging position immediately upon return of the cam to its normal position wherein the roller 76 rests in the indentation 75, after the completion of one revolution.

Disengagement of the clutch 97 in this manner disconnects the drive from the conveyor tapes 14 and 15 and the tapes 23 during the time that the folding blade is being moved upwardly into engagement with the work, as will appear more fully hereinafter in connection with the description of the drive for the various parts. Following the drive back from the operating parts, the 75
cylinders 22 and tapes 23, as well as the drive rollers 20 and 35, are driven by sprocket chains 33 and 34, as shown in Figs. 15 and 16, one on each side of the machine. The sprocket chains engage sprockets 21, 107, 32 and 36 and drive the same, the chains being driven by the sprocket 108 fixed on one end of a shaft 109 suitably journaled in the frame. A sprocket pulley 111 is rigidly mounted on the opposite end of this shaft and is arranged to be driven by a series of V-belts 112 extending around a drive pulley 113 fixed to the shaft 105. The shaft 105, as mentioned above, has the main clutch 97 rigidly attached thereto. The drive for this shaft 105 is through the clutch which connects it with the aligned shaft 103, this latter shaft having mounted on one end the pulley 110 which is belted to a pulley on the shaft of the motor 114. The forming cylinders and tapes and the conveyor drive rollers and tapes are thus driven through the clutch 97 and are subject to intermittent stoppage according as the clutch is moved into or out of engaging position by the above described control mechanism.

The drive for the main chute-operating mechanism and for the cross-folding belts 27 and 28 includes the shaft 115 journaled, at one end, in the drive sprocket 108 and journaled at the opposite end in a suitable bearing 116 in the end rail of the frame, the shaft carrying sprocket pulley 117 mounted thereon. The pulley 117 is connected to the motor drive by means of belts 118 running over pulley 119 rigidly attached to shaft 103. Midway between the sprocket and frame, a bevel gear 121 is rigidly mounted on the shaft 116 in meshing relation with another bevel gear rigidly attached to a shaft 123. A sprocket pulley 124 is also rigidly attached to the shaft 123 and carries V-belts 125, as may be seen in Fig. 3, to drive the pulley fixed on a shaft 127. The shaft 127 has an outwardly extending portion which carries the sprocket pulley 128 driving V-belts 129 passing therethrough and driving sprocket pulley 131 fixed to the shaft 78. Referring to Fig. 3 a sprocket 132 is rigidly mounted on the shaft 78 at a point approximately midway of its length between the front and rear rails of the frame 16, and carries V-belts 133 for driving the driving member 97 of the main clutch mechanism shown in Figs. 5 and 6.

The rearwardly extending portion of the shaft 78 is provided with a sprocket pulley 134 rigidly mounted thereon and carrying the V-belts 135 which drive sprocket pulley 136. The sprocket pulley 135 is mounted rigidly on the conveyor tape drive shaft 137 together with a spur gear 138 which meshes with another spur gear 139, of equal ratio, rigidly mounted on one end of drive shaft 141. Since cross-folding belts 27 pass around shaft 141 and belts 28 pass around shaft 127, it will be seen that the two gears, of equal ratio, accomplish the drive for the belts. It will furthermore be noted that, since the drive for these belts as well as for the main clutch-operating mechanism, is not through the clutch 97 but directly from the shaft 118, the belts and main clutch-control mechanism operate continuously.

The drive for the cross-folding blade 26 is taken off the shaft 115 by means of V-belts 140 running over pulley 142 on the shaft 115 and pulley 143 on shaft 92. The rotation of shaft 92 is thus continuous but the shaft 54 is turned to operate the blade only when the clutch members 91 and 94 are connected by the rod 87 actuated by means of the main clutch operating mechanism. In brief, it may be said that the drive for the conveyor rollers 20 and 35 and for the article-forming cylinders 22 is taken from the shaft 105 through the clutch 97, the drive for the main clutch control mechanism and for the cross-folding belts is taken from the shaft 115 driven directly from the motor, without intervention of a clutch mechanism, and the drive for the cross-folding blade is taken from the shaft 52 through the clutch constituted by the members 91 and 94, all three shafts being parallel and driven through appropriate belting by the motor 114.

The electrical circuit for actuation of the solenoid 61 to control the main clutch mechanism for operating the various portions of the folding machine, is illustrated in Fig. 13, wherein line 144 leads from L2 to contact 65 of the first switch 56, and line 145 leads from the other contact 66 to contact 85 of the second switch 87. A line 146 leads from the other contact 58 of this switch to the solenoid 61, and a line 147 connects the solenoid to L1. It will be noted from the diagram that switch 56 is normally closed since its contactors are positioned at the bottom of the switch where they are both immersed in a pool of mercury while the switch 57 is normally opened since its contactors are positioned at one side where at least one of them will not be in contact with the pool of mercury. During the period when no article is passing under the arms 58 and 59, the second switch will be open and during the time that an article is under both arms, the first switch will be open, due to the raising of one or both of the contactors 65 and 66 out of the pool of mercury, so that, in either case, the circuit is broken and the solenoid is not energized. The only time when the circuit is complete is that occurring when the trailing edge of the article lies between the arms 58 and 59, the first switch being released to return to normally closed position and the second switch still being held in closed position by the article. The folding of the article is thus accurately timed automatically by the position of the article in the folding machine.

The switches are mounted on arms rigidly assembled in insulating blocks, of fibrous or other non-conductive material. These blocks are rigidly assembled in the free ends of shafts rotatably mounted in the machine frames 16. While the switch mechanisms are shown as being of the well-known mercury type, it will be obvious that other switch constructions may be used without departing from the inventive principle involved.

While means have been provided to direct a flat article from the tapes 14 and 15 around and over the tapes 23, such means being the deflectors 24, it is found that the operation is improved by directing a blast of air downwardly upon the article as it rests on the upper runs of the tapes 23 in order to prevent wrinkling and the like. This is accomplished by blowing air driven by a motor 148, the blower and motor therefor being securely mounted on a bracket 151. The blower is connected to a duct 152 which directs a blast of air at room temperature over the top surface of the article being folded. Blades 153 are located above the top cylinder tapes 23, extending the full length thereof and curving around the forward end of such tapes to confine the flow of air against the
work, these blades being fastened to the machine frame by means of brackets 154. A plurality of baffles 155 have also been provided to induce equal distribution of the air after it leaves the blower.

In the operation of the apparatus, an article of flatwork which has been ironed in the ironing machine is seized in the bite of the rollers 13 and 17 and is passed along over tapes 14 at a speed exceeding at which the article is delivered to the folding machine by the ironing machine. The work is carried toward the drums or cylinders 22 and the deflectors 24, the deflectors being in the operative position shown in full lines in Fig. 1. The deflectors direct the article upwardly around the rear drum and the tapes 23 carry it in the reverse direction to the forward drum 22, around which it is directed by the air blast which is confined against the work by the blades 153. The article is thus converted into a flattened elliptical shape of dimensions calculated to produce a folded article of the required size. When the article is fully wrapped around the drums, its trailing edge has passed beyond the switch arm 58 but has not yet freed the switch arm 59. This leaves both of the switches in the closed position and causes energizing of the main clutch mechanism. The main clutch mechanism then stops the movement of the tapes 14, 15 and 23 and simultaneously raises the cross-folding blade 26 between the inner drum-supported members 25 to lift the article from the drums. The action of the folding blade is aided by the stripper rollers 29 and 31 which are moved downward at the same time that the blade is moved upward to pull the article from the drums and guide the center thereof into the bite of the cross-fold belts 27 and 28.

The cross-fold belts not only cross-fold the article but also flatten the ellipse formed on the drums 22 to produce longitudinal folds in the article. The finished work is thus folded both transversely and longitudinally and passes upwardly between the cross-fold belts onto a stationary conveying means 156 which changes the direction of travel of the article and deposits it upon a wrapping table, not shown, located at the rear of the machine. The cross-fold belts and the shaft 64 are continuously driven while the folding machine is operating but the clutch 57 is rendered inoperative at the same time that the folding blade and stripper rollers are actuated in order that stationary conditions may prevail while the article is being lifted off the forming drums by the folding blade. This intermittent stoppage of the conveying means during the folding operation necessarily slows up the passage of articles therethrough and, since it is desired to feed such articles continuously in succession from the ironing machine, delay would be occasioned if the folding machine operated at the same speed as the ironing machine conveying belts. Accordingly, the speed of travel of the articles is accelerated as they pass between the rollers 13 and 17 in order to compensate for the time lost during the cross-folding step.

As previously stated, an operator is stationed by the machine for the purpose of inspecting work which passes therethrough and rejecting any improperly washed article, termed "a washover". The article to be rejected is passed directly through the folding machine without being wound about the drums or cylinders 22 by lowering the deflectors 24 below the tapes 16, as shown in dotted lines in Fig. 1. The article will then pass along the tapes 14 and over the deflectors 24 and will drop into a receptacle 42. Means are also provided for maintaining the control mechanism in the inoperative position and thus preventing actuation of the folding blade and other parts when such an article passes through, this means taking the form of a device for holding the arms 157 and 158 in raised position. Referring to Fig. 12, the arms 157 and 158 are adapted to move in a clockwise direction each time that the crank 41 is turned in a counterclockwise direction by hand. The movement of the arms 157 and 158 is effected through fingers 159 and 161, pivotally mounted on the side frame 16 at one end and pivotally connected to operating lever 162 at a point approximately midway of their pivotal points and free ends, as at 163. The operating lever is pivotally connected at the opposite end to an upwardly extending portion of the crank 41, as at 164. Throwing of the crank 41 to the position shown in dotted lines in Fig. 12 depresses the deflectors and simultaneously moves the fingers 159 and 161 counterclockwise against the switch arms 157 and 158 to raise the article-contacting arms 58 and 59 above the work. Such raising of the arms will, of course, leave one of the switches in the open position and prevent any actuation of the folding mechanism. The rejected article thus passes directly through the machine without any delay consequent on operation of the apparatus, so that folding is interrupted for a minimum period of time.

What I claim is:

1. In a folding machine, means for feeding a flat article therethrough, means for forming said article into a flattened elliptical shape, means for directing said article from said feeding means about said forming means, a blade adapted to remove the formed article from said forming means, and belts for cross-folding said formed article.

2. In a folding machine, means for feeding a flat article therethrough, means for forming the article into a roll, cross-folding means for removing said article from said forming means and folding the same, and means for actuating said cross-folding means including spaced electrical switches adapted to close an actuating circuit when the trailing edge of the article lies between said switches.

3. In a folding machine, means for feeding a flat article therethrough, means for forming the article into a roll, cross-folding means for removing said article from said forming means and folding the same, and article measuring means for timing the operation of said cross-folding means including spaced electrical switches adapted to close an actuating circuit only when the trailing edge of the article lies between said switches.

4. In a folding machine, means for feeding an article therethrough, means for forming the article into a roll, cross-folding means for removing said article from said forming means and folding the same, spaced switches intersecting the path of said article, one of said switches being normally open and the other normally closed and being adapted to reverse those positions successively when an article passes thereunder.

5. In a folding machine including means for conveying a flat article therethrough and means
for cross-folding the same, a measuring means for alternately actuating said conveying means and said cross-folding means, comprising spaced electrical switches in circuit with a solenoid, contact points in one of said switches normally electrically connected and contact points in the other of said switches normally disconnected, and arms on said switches adapted to be raised by the passage of an article along said conveyor to reverse the condition of said switches successively.

6. In a folding machine including means for forming an article therethrough, means for forming the article into a roll and cross-folding means for removing said article from said forming means and folding the same, the combination which comprises a drive for each of said means, and means for producing intermittent operation of said cross-folding means, said feeding means and said forming means being stationary during operation of said cross-folding means.

7. In a folding machine including means for feeding an article therethrough, means for forming the article into a roll and cross-folding means for removing said article from said forming means and folding the same, the combination which comprises a drive for each of said means, a clutch for each of said means and a main clutch-operating means for periodically connecting the clutch for said cross-folding means and simultaneously disconnecting the clutch for said feeding means and said forming means.

8. In a folding machine including means for feeding an article therethrough, means for forming the article into a roll and cross-folding means for removing said article from said forming means and folding the same, the combination which comprises a drive for said means, spaced switches intersecting the path of travel of said article to measure the same, a solenoid energized when the article is passing said switches, a clutch-operating mechanism adapted to be actuated by said solenoid, and clutches connecting said feeding, forming, and folding means to said drive and controlled by said clutch-operating mechanism.

9. In a folding machine, a device for rolling an article to be folded into a cylindrical shape, which comprises spaced rotatable drums and tapes running between and about said drums.

10. In a folding machine, means for feeding an article therethrough, spaced rotatable drums having tapes running thereover and positioned adjacent said feeding means, means for directing said article over said drums and tapes, and means for directing a blast of air against said article on said tapes.

11. In a folding machine, means for feeding an article therethrough, means for rolling said article into a flattened roll, deflectors for directing said article from said feeding means to said roll-forming means, and means for manually lowering said deflectors below said feeding means to shunt an article past said roll-forming means.

12. In a folding machine, means for feeding an article therethrough, means for rolling said article into a flattened roll, deflectors for directing said article from said feeding means to said roll-forming means, and means for manually lowering said deflectors below said feeding means to shunt a rejected article past said roll-forming means and for simultaneously preventing the operation of said roll-forming means and said cross-folding means.

13. In a folding machine, means for feeding an article to be folded therethrough, means for rolling said article into the form of a flattened roll, electric switch actuated means for operating said roll-forming means, deflectors for directing said article from said feeding means to said roll-forming means, and means for manually lowering said deflectors below said feeding means to shunt a rejected article past said roll-forming means and for simultaneously rendering said switches inoperative.

14. In a folding machine, means for conveying an article therethrough, means for forming said article into a roll, means for removing said article from said roll-forming means, means for flattening said roll and cross-folding the same, and means for receiving and guiding said article between said roll-forming means and said flattening means.

15. In a folding machine, means for conveying an article therethrough, means for forming said article into a roll, a reciprocable blade adapted to pass through said forming means and lift the roll off said roll-forming means, stripper rolls adapted to move downward as the blade moves upward to receive and guide said article, and belts adapted to receive the article from said stripper rolls and fold the same.

16. In combination, a flatwork ironer and a folding machine, means for feeding articles in close succession through said ironing machine to said folding machine, means for conveying said articles through said folding machine, means for cross-folding the same, means for stopping said conveying means while said cross-folding means operates, and means for driving said conveying means at a greater speed than said feeding means from said ironer to fold said articles continuously in close succession.

17. In a folding machine, means for forming a substantially flat article into generally flattened elliptical form, conveyor means for delivering such an article to said forming means, and means for cross-folding such elliptically formed article.

18. In a folding machine, means for forming a substantially flat article into generally flattened elliptical form transversely disposed relative to the direction of travel of said article, conveyor means for delivering such an article to said forming means, and means for cross-folding such elliptically formed article.

19. In a folding machine, means for forming a substantially flat article into generally flattened elliptical form and including two spaced parts, conveyor means for delivering such an article to said forming means, and means movable between the two spaced parts of said forming means for removing such elliptically formed article from said forming means.

20. In a folding machine, means for forming a substantially flat article into generally flattened elliptical form and including two spaced axially aligned roll members, conveyor means for feeding such an article to said forming means, and means movable between the axially aligned roll members of said forming means for removing the elliptically formed article therefrom.

21. In a folding machine, means for forming an article into generally roll form and including generally parallel roll members interconnected by travelling tape members, conveyor means for
delivering such an article thereto, deflector means for deflecting said article from said conveyor means to the tape members of said forming means, and means for removing a formed article from said forming means.

22. In a folding machine, means for forming a substantially flat article into generally roll form and including generally parallel roll members interconnected by travelling tape members, conveyor means for delivering such an article thereto, deflector means for deflecting said article from said feeding means to the tape members of said forming means, means for removing a formed article from said forming means, and means for cross-folding said removed formed article.

23. In a folding machine, an article conveyor, article forming means positioned thereabove and including spaced roll members interconnected by tape members, and deflector means for deflecting from said conveyor to said forming means the leading edge of an article to be formed by said forming means.

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