

Nov. 4, 1969

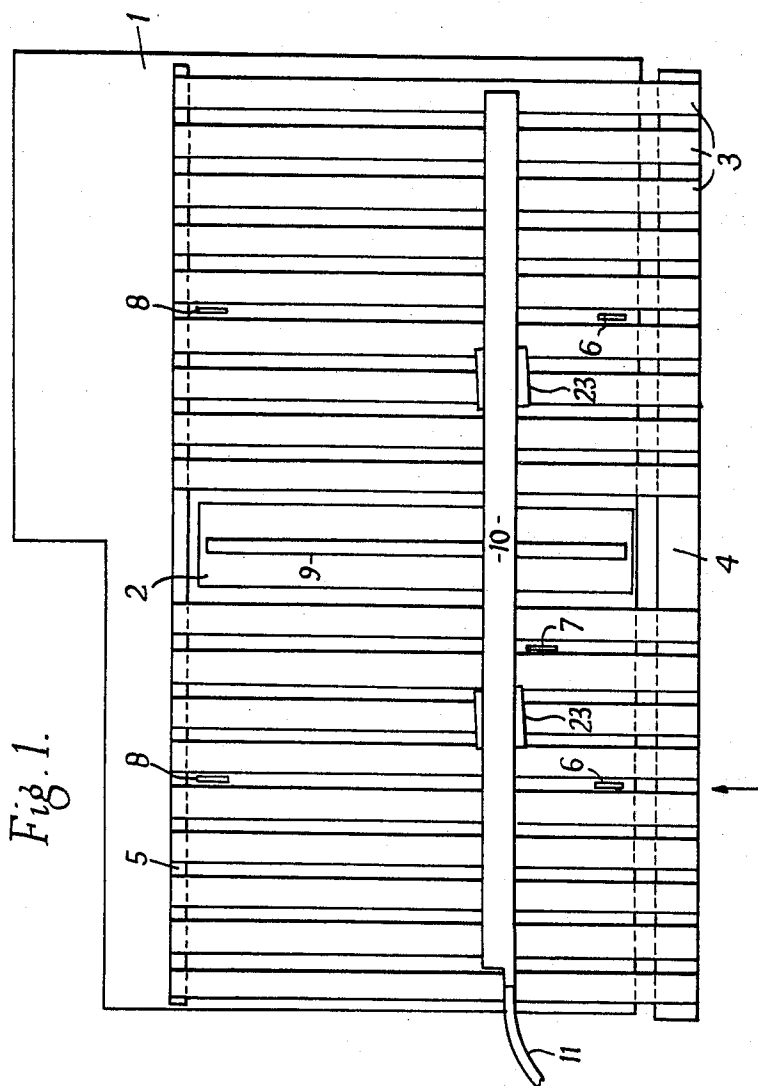
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3,476,379

LAUNDRY FOLDING DEVICES

Filed Jan. 27, 1967

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

Fig. 2.

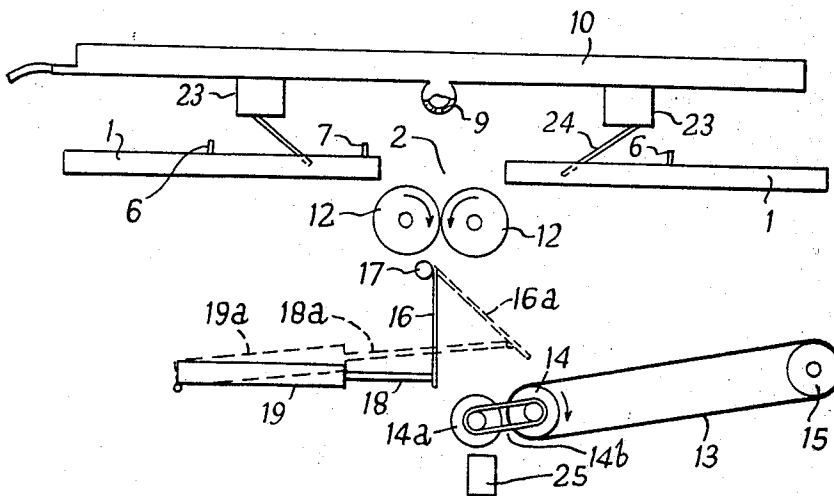


Fig. 3.

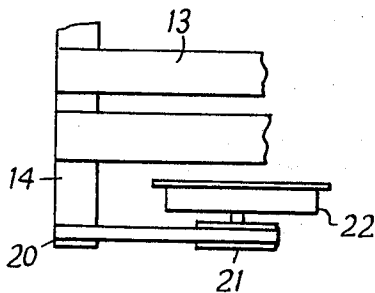
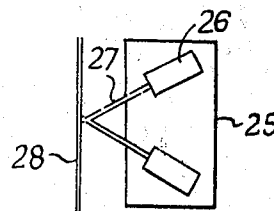


Fig. 4.



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LAUNDRY FOLDING DEVICES

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5 Claims

ABSTRACT OF THE DISCLOSURE

A laundry article cross-folder, particularly for pre-folded articles, in which the article to be folded is draped in front of a moving conveyor and projected onto the conveyor by means (folding blade, air jet or the like) which act on the sheet along a proposed horizontal fold line.

The invention relates to laundry folding devices and in particular devices for folding laundry flat work articles such as sheets, towels and the like. The principal application of the invention is to the folding of sheets and the term "sheet" will be used hereinafter in referring to the articles to be folded, although it is to be understood that this term is not limiting in this respect.

It is customary when processing a sheet to iron it in, for example, a calender ironer, pass it on a conveyor through a folder which makes one or more folds about lines transverse to the direction of travel of the sheet and then pass the sheet to a cross folder which makes one or more folds transverse to the former folds.

Folding devices as known at present operate in one of two ways on sheets which are passed through them. In the first way the leading edge of the sheet may be clamped between a pair of jaws, either before or after it reaches the conveyor and the jaws are raised to allow the remainder of the sheet to be carried forward on the conveyor. The jaws are then opened to drop the held edge so it falls, usually, on the trailing edge of the sheet which is thereby folded in half. The second way of folding is by tucking the sheet across its width at a predetermined line (half-way along the sheet for folding in half) and inserting the tuck between two adjacent and contra-rotating rollers which draw the sheet between them.

Each of these methods has disadvantages which are particularly onerous when the sheet has already been folded so that its thickness is appreciable. The more folds which have previously been made in the sheet the worse do these disadvantages become. At the cross-folding stage, in particular, it is usually required to fold in half a sheet which has previously been folded three times and thus has an overall thickness of eight sheet thicknesses. When the sheets have overall thicknesses of this order the first above mentioned method has the disadvantage that the clamps have difficulty in adequately grasping the leading edge because it is so thick and furthermore the folding is difficult to time accurately since compensation has to be made for the appreciable length occupied by the curve which the sheet assumes at the fold. Therefore it is found that the final folds of the sheet if made by this method are inaccurate. If an attempt is made to fold a sheet having an overall thickness of four, or eight, or even sixteen thicknesses of sheet by the second above mentioned method it is found that the pressure of the contra-rotating rollers causes creasing of the sheet at the inside of the fold. In a folding device of this kind the sheet is drawn through the rollers by the pressure between them and therefore this pressure cannot be reduced beyond a certain limit.

It is an object of the present invention to provide an

improved folding device which is particularly suitable for, but not necessarily limited to, folding sheets when they have already been folded a number of times.

According to the invention a folding device comprises a conveyor having an essentially horizontal roller or guide and a belt arranged to be driven around the roller or guide so that an upper run thereof recedes from the roller or guide, the belt being so arranged that a sheet may be laid on the upper run and conveyed thereby without contact from above, there being a clearance above the upper run which allows the sheet to be so laid and so conveyed without such contact; means for hanging a sheet to be folded in front of, parallel and adjacent the belt where it passes over the roller or guide; and means for acting upon a hanging sheet along a proposed horizontal fold line to lay the sheet on the upper run so that it is conveyed therealong with the fold line leading. With this arrangement the fold is effected without grasping the edge of the sheet and without exerting pressure on the folded sheet.

Preferably the means for hanging the sheet comprises means for progressively lowering the sheet past the end roller or guide and the means for acting on the sheet includes a timer arrangement for initiating the action when the proposed fold line is in the appropriate place. Usually, but not necessarily, the fold line will be half way along the sheet.

The means for acting on the sheet preferably includes a rectangular plate extending across the width of the conveyor and normally resting in a vertical plane closely adjacent the sheet when hanging and on the side thereof remote from the conveyor, being hinged along one horizontal edge and being swung about the hinge towards the conveyor when it is required to act upon the sheet. Preferably the plate is hinged at its upper edge and it is convenient in this case to move the plate by means of a pneumatic ram acting at its lower edge to deflect it at the appropriate time. Preferably the timing means comprises a timing arrangement as set forth in my Patent 3,266,794 which concerns a mechanical timing device in which timing elements are moved at speeds proportional to the speed of the article to be folded, movement of the elements being initiated in response to the operation of spaced switches which respond respectively to the passage of the leading and trailing edges of the sheet.

As was mentioned above, it is preferred that the device in accordance with the invention be used at least after the initial folds have been made in the sheet. Consequently, in accordance with a preferred embodiment of the invention the device is incorporated as part of a cross-folder. Preferably, the cross-folder comprises a table divided longitudinally, the folding device being arranged beneath the division in the table so as to accept a sheet passed down through the division. The sheet is projected onto the table so that its longitudinal centre line lies immediately above the division in the table and a preliminary cross fold is effected by nipping the sheet along this centre line between two contra-rotating rollers beneath the division. The sheet is then passed down between the contra-rotating rollers which constitute the means for hanging the sheet in accordance with the invention. The hinged folding plate is arranged beneath the rollers and the conveyor on which the sheet is to be laid is situated beneath the table and extends from the centre of the table out to one side thereof. Preferably, this conveyor is inclined slightly upwardly so as to deliver the folded sheets at a convenient height.

The cross-folder may be adapted for a plurality of parallel folding lanes, there being provided one or more further similar, folding devices, the table having a plurality of longitudinal divisions spaced across its width,

each at the centre of a respective lane. Preferably the conveyors of the different folding devices are arranged so that cross-folded sheets may be conveyed from one to another across the cross-folder to be delivered to a common delivery table.

In one embodiment of the invention the cross-folder has three folding devices arranged symmetrically across the table so as to accommodate alternatively one lane of sheets which may, before cross-folding, extend across up to the full width of the cross-folder or two lanes of sheets which may, before cross-folding, extend across up to half the width of the cross-folder, means being provided for selectively de-activating the outer folding devices for operation as a single lane machine or de-activating the central folding device for operation as a double lane machine.

The timing arrangement set forth in my Patent 3,266,794 requires two timing stations. In the above described arrangement according to the present invention utilizing such a timing arrangement it is preferred that one timing station be constituted by a microswitch arrangement suspended above the table and operated by the presence of a sheet on the table. As the trailing parts of the sheet are drawn by the contra-rotating rollers from the table this microswitch arrangement initiates the required timing action appropriate to the passage of the trailing edge of the sheet. The other timing station is preferably constituted by a photocell arrangement beneath the end roller or guide of the conveyor. The leading edge of the sheet is allowed to hang beneath the end roller or guide and thus affects the photocell which effects the necessary timing operation in the timing device. The mechanical drive for the timing device is taken directly or indirectly from the drive which rotates the contra-rotating rollers. Thus the mechanical drive for the timer is synchronized with the effective speed of the sheet.

The invention will further be described with reference to the accompanying drawings of which:

FIGURE 1 is a plan view of a cross-folder incorporating the invention;

FIGURE 2 is a sectional front elevation of the cross-folder of FIGURE 1;

FIGURE 3 is a plan view illustrating the drive to the timing device of the cross-folder of FIGURES 1 and 2;

FIGURE 4 is a plan view of the photocell arrangement used as the second timing station in the cross-folder;

FIGURE 5 is a view similar to FIGURE 2 and showing the first stage of cross-folding;

FIGURE 6 is a schematic front elevation showing the second stage of cross-folding; and

FIGURE 7 is a schematic front elevation of a multi-lane cross-folder incorporating the invention.

Referring to FIGURE 1 the cross-folder comprises a folding table 1 having two halves separated by a longitudinal division 2 at its centre. Running over the table in contact with its surface is a conveyor constituted by a number of individual belts 3. The belts 3 are moved over the table in the direction of the arrow by means of a driven roller 4. At the forward end of the table the belts 3 pass beneath the table surface through a transverse slot 5. The sheets to be folded are fed onto the table from the rear by the delivery conveyor of a preliminary folding machine (not shown) which folds the sheets twice across lines transverse to the direction of travel of the sheet. The folded sheets therefore arrive at the table with a width appreciably longer than their length.

As a sheet is delivered to the table it is carried forward thereover by the conveyor belts 3 which are at that time moving. The leading edge of the sheet engages first with a pair of microswitches having operating arms which protrude from beneath the table through slots at positions 6 and then with a microswitch having an operating arm which protrudes from beneath the table through a slot at position 7. The circuit arrangement for the drive to the roller 4 is such that the drive is continued while the

switch arms at 6 are operated by the presence of the sheet and is immediately stopped as soon as the trailing edge of the sheet leaves the slots at 6, provided that the sheet is still operating the switch arm at 7. Thus normally the sheet will be stopped with its trailing edge between positions 6 and 7. Provision is made for sheets of extra length since these cannot be accommodated by the folding mechanism to be described hereinafter. To this end two further microswitches are provided with operating arms at positions 8 at the front end of the table and if these microswitches are operated by the leading edge of the sheet before the trailing edge clears positions 6 then the folding mechanism is inhibited and the sheet may be removed from the table manually.

If the sheet is not too long for cross-folding, that is, if it is not longer than the division 2, the conveyor bands 3 are arrested as described above and the centre line of the sheet, which then lies directly above the division 2, is depressed downwardly by means of an air jet which issues from a pipe 9 arranged in line and directly above the division 2. Pipe 9 is perforated along its under side and is connected through a valve (not shown) to a compressed air reservoir 10 which is tubular and extends across the width of the table. Reservoir 10 is connected to a source of compressed air by means of a pipe 11.

As can best be seen from FIGURE 2 there are provided, beneath the division 2, a pair of contra-rotating rollers 12 into the nip of which the centre of the sheet is urged by the air blast from pipe 9. The rollers then draw the sheet downwards centre first. Spaced beneath the rollers 12 on one side of the centre line is a conveyor 13 which is constituted by a number of individual belts rotating around an end roller 14 at the inside and another end roller 15 at the outside. Above the upper run of conveyor 13 is a clearance which allows a sheet laid upon it in a manner to be described to be free of contact from above. The conveyor is inclined slightly upwardly so that the sheets shall be delivered at a convenient height, but it is ensured that the inclination and material of the conveyor are such that the sheets will be carried, being prevented from slipping on the upper run thereof by their own weight. An auxiliary feed roller 14a is provided for conveyor 13, being covered over its surface with a friction material to prevent the sheets from slipping and being geared to roller 14 by a 1:1 chain and sprocket gearing 14b. Roller 14a thus assists in feeding the sheets on to the conveyor, preventing them from slipping back. The speed of the conveyor 13 and the peripheral speed of roller 14a is the same as the peripheral speed of rollers 12.

Between rollers 12 and the conveyor 13 on the side of the centre line remote from the conveyor is provided a folding plate 16 which is rectangular and which extends for the full width of the conveyor, this being the same as the length of the division 2 to accommodate the maximum allowable sheet length. Plate 16 is hinged at its upper edge 17 and is coupled at its lower edge to the piston arm 18 of a pneumatic ram 19. The end of the ram 19 remote from the piston arm is hinged to the bed of the cross-folder about a horizontal axis. Energization of the control valve for the ram 19 is arranged to throw out the piston arm 18 and thereby deflect the plate 16 about its hinge to the position shown in broken line at 16a. This movement is initiated at such a time that the halfway line of the sheet as already folded by the rollers 12 is engaged by the lower edge of plate 16 and deposited on the conveyor 13. The conveyor thus draws the rest of the sheet along and the last fold is thereby effected. Plate 16 is retained in position 16a to guide the upper part of the sheet on to the conveyor. The signal to withdraw the plate to its rest position is given by a photocell arrangement 25 (to be described) when the lower part of the sheet clears arrangement 25 by being drawn upwards by the conveyor.

Appropriate timing for the actuation of ram 19 is

effected by means of a timing arrangement of the kind disclosed in my Patent 3,266,794. Such a timing arrangement comprises a pair of mechanically driven engagement members which are controllably engageable with corresponding drive members, one engagement member travelling at twice the speed of the other when engaged. The mechanical drive to the timing device is linked to the drive which moves the sheet and timing is effected by two switching stations spaced apart in the direction of travel of the sheet. The equipment responds to two signals, one being generated by the passage of the trailing edge of the sheet past the first switch station and the other by passage of the leading edge past the second switch station. The engagement of the slow engagement member with its respective drive is initiated by the first occurring of these two signals and the engagement of the fast engagement member with its associated drive is effected by the second occurring of these two signals. Timing is completed when the fast engagement member makes contact at the end of its travel with a fixed switch and compensation for inherent delays in the equipment with which the timing device is associated may be made by adjustment of the effective overall length of travel of the fast member.

FIGURE 3 shows the way in which the drive is taken, in the embodiment of the present invention, for the timing device above described. The end roller 14 for conveyor 13 has an extension with a pulley 20 on the end thereof and a belt engaged thereby drives another pulley 21 which gives the mechanical input to the timing device, which is enclosed in a casing 22. Roller 14 is of the same diameter as rollers 12 and is engaged to rotate in synchronism therewith by a 1:1 gearing (not shown). Therefore, the drive to pulley 21 is in direct synchronism with the movement of the sheet downwardly from the rollers 12, this movement being governed by the speed of the rollers 12.

The first switch station of the timing arrangement described is constituted by two microswitches 23 (FIGURE 2) which are arranged equidistantly on either side of the center line of table and which are mounted on the reservoir tube 10 above the table. Microswitches 23 have operating arms 24 which depend from the body of the microswitch and project through slots provided in the table. The presence of the sheet on the table beneath the microswitches ensures that the arms 24 are resting on the sheet above the level of the table and the contacts of the associated microswitches are thereby disengaged. Microswitches 23 are connected in series and as soon as the trailing edges of the sheet are withdrawn by the action of rollers 12 past the arms 24 these arms are allowed to drop into their respective slots and when both arms have so dropped a circuit is made which initiates one of said two signals to the timing device.

The second of the switch stations, which is responsive to the passage of the leading edge of the sheet, is constituted by a photocell and lamp arrangement 25 immediately beneath the roller 14. FIGURE 4 is a plan view of this arrangement and it will be seen that it is a reflective arrangement. A lamp 26 normally directs a beam of light 27 outwardly and only when a sheet (illustrated at 28 in FIGURE 4) interrupts the beam is a portion of the light reflected back into a photocell 29. At this time the other of said two signals is generated and the timing arrangement is thereby able to determine the length of the sheet, as folded by the rollers 12, and initiate at the appropriate time, the action of pneumatic ram 19.

FIGURE 5 is a front elevation of the cross-folder showing a sheet 30 in the first stage of cross-folding. The sheet, having been tucked between rollers 12 by the air blast from tube 9, is being drawn downwards thereby past the front of roller 14a. FIGURE 6 shows the next stage of cross-folding in which plate 16 has been projected forwards at the appropriate time by the timing mechanism and has laid the centre 31 of the cross-folded sheet 30 onto the conveyor. The sheet is drawn along by the con-

veyor to be delivered onto a delivery table (not shown) at the side of the cross-folder. For the sake of convenience the sheet is illustrated as being of only one thickness before the first cross-fold whereas normally it will be of several thicknesses, as discussed above.

FIGURE 7 shows schematically a multi-lane cross-folder according to the invention. The cross-folder has a folding table 32 which is similar in most respects to table 1 of FIGURES 1 and 2 but which has an operating width of ten feet and three longitudinal divisions 33. Beneath each division is a pair of contra-rotating rollers 34 and a conveyor 35, the arrangement being such that at each longitudinal division there is a cross-folding station of the kind described above. However, instead of an air jet for initiating the first cross-fold there is provided a tucking blade arrangement comprising, for each folding station, a tucking blade 36 pivoted at 37 so as to be capable of assuming a position 36a for tucking the sheet between rollers 34 and a pneumatic ram 38 for moving blade 36. Furthermore, at each folding station the second cross-fold is effected not by a hinged plate but by an air jet from a tube 39 extending across the width of the conveyor. The feed roller 14a for each conveyor is not provided in this embodiment. A set of timing switches and a timing device are provided for each folding station but are not shown.

The three conveyors 35 all run continuously at the same speed (the peripheral speed of rollers 34) and are so arranged that the gaps in the horizontal plane between adjacent conveyors at the folding stations are sufficient to allow a sheet to be draped between the conveyors but little more. With this arrangement a sheet folded onto conveyor 35c will be fed therefrom onto conveyor 35a, from there onto conveyor 35b and thence to the delivery table 40, the stiffness of the cross-folded sheet ensuring that it carries across the gaps between the conveyors.

The cross-folder may be used alternatively as a single lane machine capable of cross-folding an article up to ten feet wide or as a double lane machine capable of folding, in each of two independent lanes, articles up to five feet in width. In the former case the single lane is represented by A in FIGURE 7, for which the central folding station only is used. In the latter case the two lanes are represented by B and C, for which the left-hand and right-hand stations only are used respectively. A switch is arranged for selecting the mode of operation, being effective to de-activate the outer folding stations or the central folding station at will.

It is to be understood that the invention is not restricted to the details of the above described embodiments thereof. For example, it is envisaged that alternative means to the air blast or hinged fold plate described may be provided for deflecting the centre of the sheet to lay it on the conveyor. For example, a plate substantially parallel with the upper run of the conveyor 13 or a bar movable parallel therewith may be arranged to be projected forwardly at the appropriate time to effect the necessary fold. A stationary guide may be substituted for either of rollers 14 or 15 provided that the remaining roller is driven.

I claim:

1. A folding device, comprising feed means to suspend and progressively lower a sheet in a generally vertical manner, a conveyor spaced below the feed means adjacent the suspended sheet and having a generally horizontal upper run progressively moving away from the suspended sheet, a vertically oriented plate disposed below the feed means adjacent the suspended sheet on the opposite side thereof from the conveyor and operable to be moved laterally to engage its lower edge against the suspended sheet initially along a proposed horizontal fold line to project the sheet over the conveyor and to lay the sheet on the upper run with the fold line leading, said upper run being spaced sufficiently below the feed means and with overhead clearance to accommodate placement of the sheet

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thereon without contact of the sheet from above so that the portion of the sheet between the leading fold line on the conveyor and the feed means is freely suspended and is otherwise only influenced by the acting means, and means to actuate the acting means.

2. A folding device according to claim 1, wherein the plate is normally disposed in a generally vertical plane closely adjacent the suspended sheet and is pivoted about a horizontal axis to present a horizontal lower edge that engages the sheet at the proposed horizontal fold line and lays the sheet on the conveyor.

3. A folding device according to claim 1, wherein the feed means includes counter-rotating rollers, and wherein the sheet is passed between the rollers already folded to at least two thicknesses where the lowermost edge thereof as suspended from the rollers is on a second horizontal fold line spaced below the proposed horizontal fold line.

4. A folding device according to claim 3, wherein a table supports a sheet thereon over the feed means, wherein a table opening elongated in the direction of the feed means overlies the feed means, and wherein means above the sheet operate to direct the sheet on the table downwardly through the table opening into the feed means.

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5. A folding device according to any one of claims 1, 2, 3, or 4, wherein both the feed means and the conveyor advance at substantially identical rates.

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U.S. Cl. X.R.

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