LAUNDRY FOLDING MACHINE

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References Cited
UNITED STATES PATENTS
2,374,779 5/1945 Preston 270/81
3,154,726 10/1964 McClain 270/81 X
3,162,765 12/1964 Cran 270/83 X
3,589,709 6/1971 Hey et al. 270/80

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ABSTRACT

In a folding machine of the general type disclosed in U.S. Pat. No. 3,154,726 having longitudinally spaced flatwork piece position sensing means which control the speed of operation of a timer means at relatively slow and fast rates depending upon the sequence in which the flatwork piece position sensing means are operated, the improvement wherein the initial speed of operation of the timer means is controlled by rotatable means positioned to be rotated by movement of a flatwork piece into the measuring area independently of the actual speed of movement of the conveyor means supporting the flatwork piece, the rotatable means being positioned substantially beyond the first article position sensing means in the direction of the second article position sensing means.

3 Claims, 1 Drawing Figure
LAUNDRY FOLDING MACHINE

BACKGROUND OF THE INVENTION

This invention relates to apparatus for controlling folding machines such as those employed by commercial laundries where each machine must handle flatwork pieces of widely varying lengths. More particularly, the present invention is directed to apparatus and means for actuating an article folding means at the proper time in relation to the variable length of the flatwork piece being folded and to its speed. While some aspects of the invention may have a broader application, the invention primarily is an improvement over the flatwork laundry piece folding machines described in U.S. Pat. No. 3,154,726 granted Oct. 27, 1964.

The construction and principles of operation of commercial folding machines are well-known and require little elaboration here. A typical folding machine employs an endless conveyor belt, generally having the form of a plurality of laterally spaced parallel ribbons or tapes which moves the flatwork piece to be folded across a length measuring station and thence across a first folding means at a folding station located beyond the measuring station a distance at least one half the longest flatwork piece to be fed through the machine. The folding means may comprise a folding blade or an air blast means. On the basis of information received from the flatwork piece length measuring station, folding machine control means actuates the folding means when the midlength of the flatwork piece moves into alignment therewith. The folding means then directs the flatwork piece, at its midlength, into gripping engagement with a set of first folding rolls to effect a first fold in the flatwork piece. If it is desired to fold the flatwork piece a second time, this process is repeated again on the once-folded flatwork piece by means of a second folding means and second folding rolls located farther along a second conveyor belt.

The successful operation of laundry folding machines of the class described depends to a very great extent on the ability of the control device to locate accurately the midlength of flatwork pieces of greatly different lengths. To achieve this objective, numerous types of control apparatus have been suggested by the prior art including rather complex assemblies of mechanical elements such as moving measuring stations, dual speed folding machine driving motors interlocked with a timing means, and the like.

One type of control apparatus currently in use comprises a dual speed timer and a single flatwork piece length measuring station, e.g., a feeder switch or light and photocell unit disposed a fixed distance in advance of the first folding station. When the leading edge of the flatwork piece contacts the feeder switch or interrupts a light beam, the timer commences a slow speed timing interval, and when the trailing edge of the flatwork piece subsequently passes beyond the feeder switch or light beam, the timer shifts over into a high speed timing interval. The slow and high speed timing intervals of the timer are so related to the speed of the conveyor means moving the flatwork piece involved and the distance between the feeder switch or light and photocell unit and the folding station that the high speed timing interval runs out when the midlength of the flatwork piece has arrived at a point opposite the folding station. The end of the high speed timing interval initiates actuation of the folding means. A second dual speed timer may be employed to actuate a second folding means to effect a second fold of the flatwork piece. A laundry folding machine with such a controller is disclosed in U.S. Pat. No. 3,162,765, granted Dec. 22, 1964.

In another type of control apparatus exemplified by the type disclosed in said first mentioned U.S. Pat. No. 3,154,726, the control apparatus employs dual-speed timing means and a pair of position sensing means, the first of which may be a feeder switch or light and photocell unit located at a first article position sensing point along the conveyor belt in advance of the folding station a distance generally somewhat greater than one-half the length of the longest article to be handled by the folding machine, and a second position sensing means (or equivalent signalling means) preferably positioned contiguous to the folding station which is activated to produce a signal when the leading edge of a flatwork piece involved reaches a second point preferably contiguous to the folding station. Gating means initiate a relatively slow speed timing interval of a timing means which has a characteristic which progressively increases in value in response to initial generation of a first signal by the first position sensing means as the leading edge of the flatwork piece reaches the same and the subsequent occurrence of either of two events, namely (a) the deactivation of the first position sensing means as the trailing edge of an article passes by the same which generates a second signal, and (b) the generation of said signal by said signalling means as the leading edge of the flatwork piece reaches said second reference point. Gating means is provided which initiates a relatively fast speed timing interval in responsive conjectionly to the initial activation of the first position sensing means and the subsequent occurrence of both the deactivation of the first position sensing means and the generation of said signal indicating that the leading edge of the flatwork piece has reached said second point. Control means is provided in the folding system being described which responds to a given predetermined control value of the variable characteristic of the timing means selected so that the midpoint of a flatwork piece will be folded by the folding means at the folding station independently of the length of the flatwork piece involved. The timing means can be adjusted to fold a flatwork piece at any given proportion of the length thereof, depending upon the particular selected control value of the variable of the timing means at which the folding operation is to be carried out. Since laundry folding operations are generally fold-in-half operation, the specific example of the invention described in the latter patent now being described (and in the exemplary embodiment of the present invention) will be one which folds a flatwork piece in half.

The dual sensor controlled folding machine just disclosed has a number of advantages over a folding machine having a single sensor as in the case of the folding machine described in the aforesaid U.S. Pat. No. 3,162,765. One of these advantages is that the dual sensor controlled folding machine described can accommodate articles having lengths ranging from slightly greater than zero up to twice the distance between the aforementioned first and second position sensing points. The single sensor controlled folding machine cannot accommodate flatwork pieces which have a length less than the spacing between the single position sensing means and the folding station. Additionally, a dual sensor folding machine as described can have
much shorter overall length to accommodate flatwork pieces of a given maximum length, is inherently more accurate and can be reliably operated with a smaller spacing between successive flatwork pieces for the reasons explained in said U.S. Pat. No. 3,154,726.

In the laundry folding machine disclosed in the latter patent, the relatively slow speed interval of operation of the timing means was initiated at a point in time when the flatwork piece involved was moving at the same speed as the conveyor belt carrying the same because in the particular embodiment of the invention disclosed therein, any relative difference in the speed of the article and the conveyor belt would introduce an error in the length measurement of the timing means. As is usually the case, an article is fed upon the conveyor belt of the folding machine at a speed initially slower than the speed of movement of the conveyor belt because the ironer from which the laundry pieces are fed into the folding machine commonly operates at a slower speed than the conveyor belt of the folding machine, and the trailing end of the flatwork piece in the ironer may be held thereby against acceleration by the folding machine conveyor belt and must be accelerated by this conveyor belt to the speed thereof when it is free to be accelerated. Obviously, therefore, it takes some finite time for the flatwork piece finally to reach the speed of the conveyor belt. In order to shorten the spacing between the point at which a laundry flatwork piece leaves engagement with the ironer and the location of the first position sensing means of the above described dual sensor folding machine, it would be desirable to be able to initiate the slow speed timing interval of the timing means before the speed of movement of the article has reached that of the folding machine conveyor belt.

That has been done in a single sensor folding machine by controlling the rate of operation of the slow speed timing interval of the timing means by a roller which engages the flatwork piece as it enters the length measuring portion of the folding machine. Such a roller is positioned immediately behind the single sensor in the folding machine disclosed in said U.S. Pat. No. 3,162,765. However, no serious consideration was given to incorporating such a roller in the dual sensor folding machine of said U.S. Pat. No. 3,154,726 probably because to do so in the manner described in U.S. Pat. No. 3,162,765 (that is at the inlet to the measuring portion of the folding machine) would eliminate some of the main advantages of this folding machine, namely that it is usable with flatwork pieces which vary in length down to a minimum length which is only a small fraction of the spacing between the first and second reference points described above, and which can be relatively closely spaced thereon. Thus, the use of a timer controlling roller as described puts severe limitations on the minimum spacing between successive articles where a very short flatwork piece is followed by a very long flatwork piece. In such case, the spacing between a very short flatwork piece and a long flatwork piece following the same must be greater than the spacing between the aforesaid first and second position sensing points because the initial slow speed timing interval of the timing means under the control of the roller referred to does not terminate until a flatwork piece which is shorter than the spacing between the aforesaid first and second position sensing points reaches the second point. Therefore, where such a short flatwork piece is to be followed by a long flatwork piece, the long flatwork piece cannot be fed into the measuring area of the folding machine until the short flatwork piece reaches the second position sensing point, or else the movement of the long flatwork piece under the roller at the inlet end of the length measuring portion of the folding machine can slow the roller to create errors in the measuring operation. Consequently, the utilization of a roller in the manner described would defeat one of the important advantages of the dual sensor measuring system described, which is to reduce the spacing between successive flatwork pieces handled by the machine.

**SUMMARY OF THE INVENTION**

In accordance with the present invention, in a dual sensor controller described, the speed at which the timing means is operated is placed under the control of a roller which engages the article moving in the measuring end of the folding machine, but the roller instead of being positioned at the inlet end of the measuring area is positioned preferably as far away from said inlet area as possible, such as at a point just behind the second position sensing point. With such a unique use of the roller, all of the aforesaid advantages of the dual sensor folding machine remain, since a long article can be permitted to closely follow a short flatwork piece without any difficulties because the slow timing interval of the timing means ends almost immediately after the short flatwork piece passes by the roller which is near the point where the second position sensing means is located. Consequently, a long flatwork piece closely following the short flatwork piece will not slow the roller down while it is controlling the speed at which the timing means is operating to determine the folding point of the short flatwork piece.

The dual sensor measuring system described in U.S. Pat. No. 3,154,726 encompasses equivalent variations of the specific dual sensor system disclosed therein to which the present invention is also applicable. Thus, instead of providing a position sensing means at the second position sensing point to determine when the leading edge of the flatwork piece has reached such a point, there could be provided a second timing means also controlled by the actual speed of movement of the flatwork piece and which is adjusted to start a timing operation as the leading edge of the flatwork piece reaches the first position sensing means and generates a signal when the variable of the second timing means reaches a predetermined value indicating that the leading edge of the flatwork piece reaches the latter point. This and other variations of the dual sensor system disclosed in the latter patent, the provision of a roller which engages the flatwork piece at a point substantially removed from the first position sensing point (and most advantageously near the aforesaid second position sensing point) and controls the rate at which the timing means operates during its initial cycle of operation has the advantages of permitting a closer spacing between the flatwork pieces.

**DESCRIPTION OF THE DRAWINGS**

The drawing illustrates a diagrammatic elevational view of a typical laundry folding machine, an ironer which delivers ironed flatwork pieces to the folding machine, the various basic components of the present flatwork piece folding control system of the invention and
the manner of connection of these components to one another and to a pair of article position sensing means and a timer operating roller in the path of movement of articles through the folding machine.

DESCRIPTION OF THE PREFERRED EMBODIMENT OF THE INVENTION

In the drawings, part of a conventional laundry folding machine 2 is shown, the laundry machine having an inlet end 2a positioned opposite the discharge end 5a of an ironer 5. The ironer 5 and laundry folding machine 2 are shown in considerably simplified form and only so much of the details thereof are presented as will aid in a clear understanding of the control apparatus of the invention. A feed conveyor comprising laterally spaced ribbons 4 moves the flatwork pieces like 6 from an outlet conveyor 5b or the like of the ironer 5 first to a position sensing station or point A along the conveyor ribbons 4, then to a second sensing station or point B located contiguous to a folding station C shown located slightly beyond the second position sensing station or point B. The distance between the first and second position sensing stations or reference points A and B is identified by dimension D.

Adjacent to the folding station C, there is provided a pivotally mounted folding blade 8 with one or more fingers adapted to extend between the conveyor ribbons 4, the folding blade 8 being movable by any suitable means, such as by an air piston unit 10 controlled by a solenoid operated valve 12 or the like. When the folding blade 8 is moved upwardly by momentary energization of the air piston unit 10, the fingers of the blade 8 will rise between the conveyor ribbons to push a flatwork piece 6 at the folding station between a pair of fold producing rollers 14-16 around which feed ribbons 15-17 extend and move in the direction shown by the arrows, to carry a fold produced between the fold producing rollers away from the folding station C in a conventional manner. The operation of the solenoid operated valve is controlled electrically in any suitable way by an electrical control means shown in block form. The electrical control means 14 may simply be a relay or transistor controlled circuit which, when energized, effects momentary operation of the solenoid operated valve 12.

At the first position sensing station A, there is located a first position sensing means S1 which may be a feeler switch as indicated (or a light-photocell unit) which is activated upon the passage of the flatwork piece 6 thereby. Upon the activation of the position sensing means S1, a first signal is produced on a control line 18 (which may be the presence or absence of a voltage), and as the flatwork piece 6 passes beyond the position sensing means S1 a second signal is produced on the control line 18 (which may be the absence or presence of the given voltage).

At the second position sensing station B there is shown a feeler switch S2 (which could also be a light-photocell unit) which, when the flatwork piece 6 reaches the same, generates a signal on a control line 20. The control lines 18 and 20 extend to a logic circuit 22 which produces at appropriate times gate opening signals on gate opening lines 22a and 22b and gate closing signals on gate closing line 22c to control the opening and closing of a slow timing interval control gate 24 and a fast timing interval control gate 26. Preferably, at a point contiguous to and slightly in advance of the second position sensing means S2, there is provided a timer operating roller 15 which rides on the upper section of the conveyor ribbons 4 when the flatwork piece is not beneath the same, and which rides upon the flatwork piece 6 when the same is carried by the conveyor ribbons 4 under the same.

The roller 15 controls the rate at which pulses are generated by a pulse generating circuit 28, which may take a variety of forms. As illustrated, roller 15 is geared to a cam 29 which has a projection 29a which engages a movable contact 30 to cause the same to make momentary contact with a stationary contact 32. The stationary contact 32 is connected to a resistor 34, in turn, connected to one terminal of a source 36 of direct current voltage whose opposite terminal is connected to the movable contact 30. The juncture between the resistor 34 and the voltage source 36 may be grounded at 38, to produce pulses at the ungrounded end of the resistor 34 each time the cam 29 is rotated one revolution. Pulses so generated are connected to a line 40 extending to the input of the slow timing interval control gate 24. The rate at which pulses are generated by the pulse generating circuit 28 is a function of the speed of rotation of the roller 15.

A high rate pulse source 42 is provided which provides pulses at a much higher rate (e.g., twice the rate) than the maximum pulse rate provided by the roller controlled pulse generating circuit 28.

The pulses fed to the control gates 24 and 26 when the gates are open are fed to an input 44 of a timing means 46 which may take a variety of forms. The timing means may include a capacitor charge circuit similar to that disclosed in said U.S. Pat. No. 3,154,726 where each pulse fed to the input thereof will charge the capacitor a given incremental amount. However, the timing means may be an electronic pulse counter. When the variable of the timing means (be it a voltage value or count) reaches a given control value, it generates a control signal or the like on a line 50 connected to an adjustable delay means 52 with a progressively operable control 52a which controls the degree of the delay in the appearance of the control pulse generated on the line 50 at the control means 14 which effects folding blade operation to correct for variations in the lag between the operation of control means 14 and the time a particular folding blade initially makes contact with the flatwork piece 6. The folding station C is positioned beyond the point at which the midpoint of the flatwork piece 6 is located when the timing means generates the control signal on line 50 so the folding blade can make contact with this midpoint (or a point adjacent to the same where a slight overlap of one margin of the flatwork piece is desired). This spacing is determined by the time lag between the energization of control means 14 and the instant the folding blade contacts the flatwork piece and the adjustable delay which can be effected by the delay means 52.

When the timing means 46 reaches its maximum desired voltage level, count or other variable value, it will reset itself to its initial value and will also effect closure of the fast timing interval control gate 26.

Before the flatwork piece 6 leaves the ironer 5, it continues to move at the speed at which the ironer conveys the flatwork piece therethrough, and so until most of the flatwork piece 6 leaves contact with the ironer conveyor 5b, the speed of the flatwork piece 6 does not necessarily match that of the conveyor ribbons 4 of the
folding machine 2. Generally, the flatwork piece 6 would be moving slower than it would in the folding machine 2, and so there will be some initial slippage between the flatwork piece 6 and the conveyor ribs 4 until the conveyor ribs can accelerate the usually initially slower moving flatwork piece 6 to the speed of the conveyor ribs 4.

It should be observed that with the placement of the roller 15 contiguous to the second position sensing station B, a flatwork piece which is shorter than the spacing between the roller 15 and the first position sensing station A will leave contact with the position sensing means S1 before the leading edge thereof will reach the roller 15. Such a short flatwork piece can be brought up to full speed by the conveyor ribs 4 before initiation of a measuring operation to be described. However, for flatwork pieces which are relatively long, that is much longer than the spacing between the first and second position sensing stations A and B, the flatwork pieces may not have had a chance to come up to the full speed of the conveyor ribs 4 by the time the leading edge thereof reaches the roller 15.

The logic circuit 22 responds to the signals appearing on the control lines 18 and 20 in the following manner: Flatwork pieces which have a length equal to or greater than the spacing D between the first and second position sensing means S1 and S2 cause in succession first the activation of the first position sensing means S1 followed by the activation of the second position sensing means S2. When the logic circuit 22 receives the resulting signals on the control lines 18 and 20 corresponding to this mode of operation, a control signal appears on the gate opening output line 22a which extends to a control input terminal on the slow timing interval control gate 24 to effect the opening thereof to permit the passage of the pulses from the pulses generating circuit 28 through the gate to the timing means 46. The rate of these pulses is determined by the speed of movement of the flatwork piece 6 independently of whether it is slower than or equal to the speed of movement of the conveyor ribs 4. When the trailing edge of the flatwork piece 6 leaves or deactivates the first position sensing means S1, the control signal on control line 18 fed to the logic circuit 22 results in the feeding of a control signal on the gate closing output line 22b of the logic circuit which is fed to the slow timing interval control gate 24 to close the same so that pulses do not pass therethrough to the timing means 46. At the same time, a signal appears at the gate opening output line 22a' of the logic circuit 22 which is fed to the control input terminal of the fast timing interval control gate 26 to open the same to permit passage therethrough of the output of fast count pulse source 42 which will then drive the timing means 46 at a fast predetermined rate. When the variable controlled by timing means 46 reaches the aforesaid control value, a pulse generated on the output line 50 thereof will, after a delay determined by the adjustable delay means S2, operate the control means 14 as described to effect a fold-in-half operation for the reasons described in U.S. Pat. No. 3,154,726.

When a flatwork piece having a length shorter than the distance D between the first and second position sensing means S1 and S2 moves into the folding machine, the first position sensing means S1 will be activated and then de-activated before the leading edge thereof reaches the second position sensing means S2.

When the sequence of control signals on the control line 18 corresponding to this mode of operation of the first position sensing means just described occurs, the logic circuit 22 will generate on the gate opening output line 22a thereof a control signal which opens the slow timing interval control gate 24 to permit the passage therethrough of the pulses from the pulse generating circuit 28, to thus drive the timing means 46 at the rate of these pulses. When the leading edge of such a short flatwork piece reaches the second position sensing means S2, the signal on the control line 20 fed to the logic circuit 22 results in the generation of a control signal on the gate opening output line 22a' thereof connected to the input of the fast timing interval control gate 26 which opens the same to pass the output of high rate pulse 42 to the timing means 46. When the timing means 46 ends its timing cycle, it operates in the same way previously described to effect the energization of the solenoid valve 12, the resetting of the timing means 46 and the closing of the fast timing interval control gate 26.

All of the functions performed by the logic circuit 22, the gates 24 and 26 and the timing means 46 may be carried by a control circuit like that shown in U.S. Pat. No. 3,154,726, modified to the extent that the charge capacitor thereof is charged by individual pulses rather than by the connection of a source of D.C. voltage thereto. In such case, the various elements described are integrated into one overall relay circuit similar to that shown in the latter patent. Also, it is obvious to a logic circuit designer that a combination of various basic "and," and "and/or" circuit elements produces the functions performed by the logic circuit just described can be readily obtained.

By the placement of the roller 15 at a point substantially removed from the first position sensing station A, preferably contiguous to the second position sensing station B, it can be appreciated that a very short flatwork piece can be folded closely by a very long flatwork piece without introducing any errors in the operation of the folding machine.

Also, as previously indicated, variations in the circuit illustrated may be made which are equivalent to the circuit described, in which the advantages of having the roller 15 positioned far removed from the first position sensing station A are obtained.

By varying the value of the variable of the timing means at which the folding function is carried out, one can fold a flatwork piece at any proportional point therein, although a midpoint folding operation is the most common type of folding operation performed by flatwork pieces, and so the midpoint folding mode of operation of the invention has been used as the exemplary form described herein.

It should be understood that various other modifications may be made in the exemplary form of the invention described without deviating from the broader aspects thereof.

I claim:
1. In flatwork piece folding apparatus for folding a flatwork piece at a given point behind the leading edge thereof a given proportion of the length of the flatwork piece carried by conveyor means moving the same past a folding station in a direction parallel to the length thereof, said folding station having folding means for forming a lateral fold in a portion of the flatwork piece located opposite thereto at the folding station, the con-
veyor means moving the flatwork piece through a length measuring area where the flatwork piece is moved first past a first position sensing point in advance of said folding station at a speed which initially at least may differ from the speed of said conveyor means, and then past a second point beyond said first point, there being first article position sensing means for providing a first signal when the leading edge of the article has reached said first position sensing point and a second signal when the trailing edge of the flatwork piece leaves said first position sensing point, and signalling means for providing a third signal when the leading edge of said article reaches said second point; and control means for controlling the point in time when said folding machine is operated, said control means including resettable timing means which when operated has a characteristic which progressively varies in value at a controlled variable rate, means responsive to said characteristic value reaching a given control value by effecting operation of said folding means, timing operating means initially responsive to respectively different combinations of said signals indicating the movement into said measuring area of a flatwork piece having a length greater or equal to the spacing between said first and second points, on the one hand, and a flatwork piece of a length less than the spacing between said first and second points, on the other hand, for initially operating said timing means at a given rate related to the actual speed of movement of said folding piece in said measuring area, and then responsive to signals generated by the passage of the trailing edge of a flatwork piece having a length equal to or greater than the spacing between said first and second points past said first point, on the one hand, and the movement of the leading edge of a flatwork piece to said second point, on the other hand, by operating said timing means at a substantially different rate also related to the actual speed of movement of said flatwork piece in said measuring area, and means for resetting said timing means after said characteristic has reached said control value, the improvement wherein said timer operating means includes rotatable means for controlling at least initially the speed of operation of said timing means so said characteristic of said timing means progressively varies in proportion to the speed of rotation imparted to said rotatable means by the passage of a flatwork piece therebeneath, the rotatable means being positioned to be rotated by the movement of a flatwork piece in said measuring area independently of the actual speed of movement of said conveyor means, the rotatable means being located between said first position sensing point and said second point so as to be located closer to said second point than to said first point.

2. The apparatus of claim 1 wherein said rotatable means is located immediately at or contiguous to said second point.

3. The apparatus of claim 1 wherein said characteristic of said timing means when operated by said timer operating means progressively increases in value when operated at relatively low and high speeds, and said characteristic responsive means being responsive to said first signal and the subsequent first occurrence of either of two events, namely (a) the generation of said second signal and (b) the generation of said third signal, by initiating a relatively slow speed operation of the timing means under control of said rotatable means, and responsive conjunctively to said first signal and the subsequent occurrence of both the generation of said second and third signals by initiating operation of said timing means at said relatively high speed.