

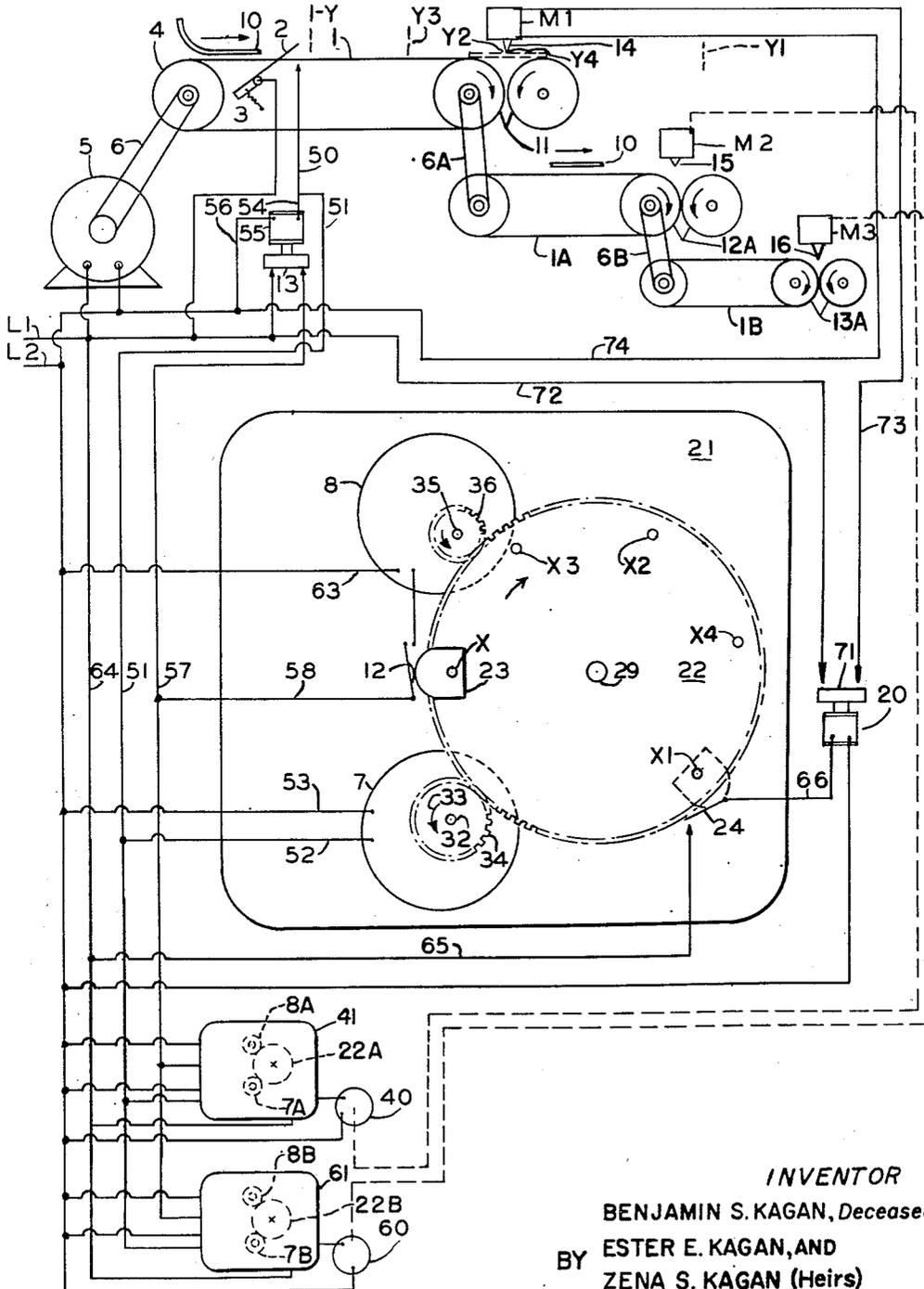
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TIMING MECHANISM TO DIVIDE SHEETS PROPORTIONATELY

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TIMING MECHANISM TO DIVIDE SHEETS PROPORTIONATELY

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The invention relates to novel means for dividing sheets of varying lengths into parts having the same proportion to each other regardless of the length of the sheet. The invention may be used in conjunction with machines designed to merely mark each piece, to shear it, to punch it, to fold it, or to act upon it in any other manner at points dividing the length of each piece in the same proportion.

The invention is concerned with means for automatically closing a circuit that will actuate a machine to do work on some point of each sheet. The circuit is to be closed when each sheet is in such a position relative to the machine that the ratio of the portion of the sheet ahead of the point acted upon to the total length of the sheet remains constant, regardless of the length of the sheet.

This invention can be adapted to act at the middle, quarter point, one-third point, or any other point of successive sheets. While the machine can be designed for any maximum variation between the smallest and the largest sheet anticipated, the ratio between the shortest and the longest sheet, in many applications of the invention, is limited practicably to four or less.

While devices of this general type are now known, the present invention is distinguished from any previously known device by the use of three synchronous motors, two of which may be small fractional horsepower motors of the type used in electric clocks. These latter two may be duplicates, thereby reducing the cost of manufacturing the timing mechanism.

The larger of these three motors drives a system of conveyors which carry the sheet at a uniform speed past a measuring finger and then on past the successive machine which are to operate upon each piece.

Each of the other motors is arranged to drive a disc means which makes one revolution for each piece to be folded. One of these motors drives the disc at a low speed A while the sheet is passing over the finger. The other of these motors drives the disc at a high speed B and becomes effective only after the end of the sheet has left the finger.

The motors may be alike and drive the discs through different gear transmissions. The motor that is running and moving the disc may turn the other motor that is not running, or an over-running clutch may be placed between each motor and the pinion through which that motor drives the disc.

The disc carries a switch operating cam which always comes to rest in the same position when the disc has completed one revolution. An electric switch, adapted to be closed by the cam, is placed alongside of the disc in such a position that if a narrow bar or the like were laid crosswise on the conveyor so as to actuate the measuring switch momentarily the bar would arrive at the machine which is to act on the sheet at the same time that the switch-closing cam contacts said electric switch. After the cam has closed this switch, the disc continues to rotate until the disc has made a complete revolution

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and brought the switch-closing cam back to its initial position. In other words, if the motor drives the disc at high speed B only, such would cause the machine to operate on the forward edge of each sheet. However, by providing the slower speed A, and driving the disc at this slower speed only while the piece is passing over the measuring finger, the forward edge of the piece travels further before the machine is actuated. The slower the low speed A is selected, and the longer the disc operates at this speed, the further the forward edge of the sheet travels past the point where the machine will operate upon the sheet. The slow speed A is selected in accordance with the ratio of the folds into which each sheet is to be divided. If the operation is to come at the middle of the sheet, the low speed A is half the high speed B provided by the other motor. If the fold is to be at the quarters point nearest the forward edge of the sheet, the speed A will be three quarter of speed B. If the fold is to be at the last quarter point, the speed A will be one quarter of speed B. If the fold is to be one-third from the front edge, the speed A will be two thirds of speed B; etc. As will appear from a study of the device, an infinite number of operations, or combinations of operations could be obtained, if desired.

By thus driving the disc at slow speed while the sheet is passing the measuring switch, and at a high speed thereafter, the longer the sheet, the more travel is allowed before the machine operates so that the proper point on each sheet can reach the proper location before the switch that starts the machine is closed.

While the timing unit thus far described consisting of a pair of synchronous motors and a disc will time the arrival of only one point of the sheet at the destination where one operation is to be performed, such as folding a sheet in the middle, there may be a number of such units all controlled by the passage of the sheet over the same finger, each providing for a succeeding operation. Thus, there may be three or more units, and as the forward edge of the sheet passes over the finger one of the synchronous motors connected with each disc will start moving the disc. For example, on the first unit the disc may move at half speed, in the second unit at quarter speed, in the third unit at one-eighth speed. As the end of the sheet is reached, another motor will start each of the units turning at full speed. The actual position of the disc will therefore depend upon the length of the sheet and on the relative speeds of the two motors driving each disc. These discs will then give the successive indications for the several folds. The first disc may close a circuit as the middle of the sheet is passing the first folding knife, and thus the sheet is divided in half. The next unit may close a circuit when the middle of the second half—that is the point three quarters of the way from the front end of the sheet—has reached the device which will make the fold that divides the sheet into quarters. The third unit can give the signal to again divide the sheet into two sections and to cause it to be folded a third time, thus folding the sheet into eight parts.

The drawing shows diagrammatically one embodiment of the invention. Here an endless conveyor 1 travels in the direction of the arrow. This conveyor comprises parallel tapes so that the measuring switch finger 2, biased by the spring 3, may project upward between two tapes. One of the pulleys 4 over which the tapes pass is driven by the motor 5 through a belt 6. This is one of three motors including timing motors 7 and 8 which are all synchronously driven by current flowing through lines L1, L2.

The conveyor system may include several conveyor

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runs. The illustration shows a conveyor system adapted to successively fold a piece into eight layers.

Mounted along the conveyor system are any desired number of machines M1, M2, M3 which act successively on pieces of material such as a sheet 10 carried by the conveyor system. The operation of each of the machines M1, M2, and M3 is controlled by one of the electric devices 20, 40, and 60, each controlled by one of the timing units generally indicated as 21, 41, and 61. There may be as many such units as there are machines operating on each piece. Since these units are duplicates, only the timing unit 21 controlling the machine M1 will be described here in detail.

The conveyor system includes besides the power driven conveyor 1, sets of folding rolls 11, 12A, and 13A, that cooperate in receiving the sheet 10 with movable knives 14, 15, and 16 operated by the machines M1, M2, and M3, respectively. As shown, the continuing conveyor belts or tapes 1A and 1B are driven by drive belts 6A and 6B from the tapes 1. Accordingly, the linear velocities of all parts of the conveyor system are proportional, but not necessarily the same. The machines M1, M2, and M3 may be electro-magnetically operated as with solenoids or motors. For example, each of said machine when energized by one of the relays 20, 40, or 60, will cause its knife to move into the groove between the folding rolls and cause the sheet 10 to be rolled between the rolls to fold the same. It is to be noted that switch 24 in the timer 21 controls the relay 20, which in turn operates the machine M1, and the dwell of the cam 23 on switch 24 may be for a short period of time.

Lines L1 and L2 are connected to motor 5 driving the conveyor continuously at constant speed. The timing unit 21 has a disc 22 which carries a cam 23. The disc is free to revolve about stud 29.

A synchronous motor 7 is equipped to drive shaft 32 through a reduction gear in the direction of the arrow 33. The pinion 34 is driven through a conventional over-running clutch (not shown) by the shaft 32 so that the pinion 34 can turn in the direction of the arrow when the shaft 32 is at rest. A second synchronous motor 8, similarly equipped, drives shaft 35. The pinion 36 is driven from the shaft 35 by an over-running clutch. In this manner, either motor 7 or 8, when running, can turn the disc 22 in the direction of the arrow. By selecting the motor speeds and the sizes of the pinions 34 and 36, the disc 22 may be driven at any two speeds desired.

One motor 7, runs only while the piece is passing over the measuring finger 2 and while this is happening the coil 55 is energized and the switch 13 is open. While this motor is running, disc 22 will turn far enough to remove cam 23 from the switch 12 to connect lines 58 and 63, and therefore when the piece has passed the finger 2 the coil 55 is deenergized and the switch 13 is closed so that the motor 8 will operate.

The speed at which the disc 22 is driven by motor 7 is so related to the speed at which it is driven by motor 8 that the desired proportional point on a sheet 10 will be operated on by the machine M1. Thus, if the middle point of the sheet 10 is to be operated on (folded into halves) the speed at which the motor 7 drives the disc 22 will be one-half that at which the motor 8 drives it. It is to be understood, of course, that the dimensions and speed of the conveyor system are proportioned so that the sheet 10 reaches the required position under the machine M1 at the required time, as explained above.

In the control generally indicated at 41, the relative speed of its two motors corresponding to the two motors 7 and 8 would be selected so that the point at which the machine M2 is to operate on sheet 10 would have reached by the sheet when the device 40 is actuated. By way of illustration, if the operation to be performed by M2 were to fold the sheet 10 into quarters, the speed at which motor 7 drives disc 22 in unit 41 would be one-quarter of

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the speed at which motor 8 drives disc 22. The speeds of the motors 8 in both units might be the same.

In the device 21 illustrated, the shaft 35 runs 5 times as fast as the shaft 32. The pinions 36 and 34 have been so selected that motor 7 drives disc 22 at half the speed of motor 8. However, if two identical clock motors are to be used, each can be provided with a different gear transmission so that shaft 35 runs twice as fast as shaft 32. In that case, the pinions 34 and 36 will also be duplicates.

As the front end of the sheet reaches finger 2, current flows through line L1, switch 2, lines 50, 51, 52 to each of the units 21, 41, and 61. Current will then flow through the motor 7 through a connecting line 52 and from the motor through line 53 to the line L2. At the same time, current flows from 50 through line 54 through the solenoid 55 and line 56 to line L2. Before the sheet 10 had reached the measuring finger 2, line 57 was connected with L1 through the switch 13. This switch is open when the sheet closes to switch 2. As current flows through the motor 7, it rotates the disc 22 at slow speed. The first effect is that the cam 23 allows the switch 12 to close. The switch connects motor 8 with line 57 but as current has been cut off from line 57 by the switch 13 the motor 8 will not run. Simultaneously, the same thing has happened in each of the other timing units, such as 41 and 61.

When the end of the sheet 10 passes finger 2, the spring 3 raises the finger and opens the circuit through the wire 50. This causes the motor 7 in unit 21 (and similar motors in units 41 and 61) to stop and, simultaneously, the switch 13 is closed. This causes the current to flow through lines 57 and 58 into motor 8. The circuit through the motor 8 is completed through lines 63 and L2. The disc 22 will now travel at high speed.

The same thing happens in the other units although the distance through which their discs will have moved will be different in each timing unit because of the different rates at which the respective motors 7 are designed to drive the respective discs. The disc now continues to turn in the direction of the arrow until the cam 23 closes the switch 24. When this happens, current flows from L1 through 64, 65, switch 24 and line 66 to actuate the relay 20 which, in turn, sets the machine M1 in motion, as follows:

The relay 20 closes contacts 71 when energized which completes a circuit to the machine M1 from line L1 through a wire 72, contacts 71, a wire 73, machine M1, and a wire 74 back to the line L2. The relays 40 and 60 operate identically to control machines M2 and M3, and hence these connections are not shown in detail. However, as explained above, the machines M1, M2, and M3 operate in sequence.

After having energized the machines by the switch 24 and the corresponding switches in timers 41 and 61 the motor 8, 8A and 8B will continue to turn their discs 22, 22a and 22b until the cam 23 in timer 21 opens the circuit at switch 12, which stops the motor 8 also; and similar cams, switches and motors in timers 41 and 61 function likewise.

Operation

The sheet 10 to be folded may pass from a previous processing device (for example, a sheet ironer in a laundry) on to the conveyor strips 1. The sheet 10 is carried along towards the right of the conveyor strip 1, and the leading edge of the sheet 10 will contact the switch to cause closure of the same. As the sheet 10 advances, it holds the switch 2 closed, so that the motor 7 will continue to rotate the cam 23 at its slower speed. However, when the trailing end of the sheet 10 passes the switch 2, the switch will be opened into the position shown which will cause cessation of operation of the motor 7, and simultaneous operation of the motor 8 through the action of the relay control switch 13, as described above.

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Assuming, for example, in order to more fully explain the operation of his invention, that the distance from a point adjacent to the switch 2, to the point adjacent knife 14, is four feet, and a sheet of substantially eight feet in length is passed along the conveyor belt 1. With the switch 2 closed, and the motor 7 operating, then the leading edge of the sheet 10 will pass from the point in a right hand direction, and because it is 8 feet long, it will pass from 4 feet beyond, or to the point beyond the knife 14 of the machine M1. When the trailing edge of the sheet 10 then permits opening of the switch 2, the knife 14 will register substantially with the center of the sheet. During this time, in the timing device 21, the cam 23 which contains a reference point X, will have traveled from the position shown around to the dotted line position wherein the reference point X is indicated at X1. At this time, the cam will cause closure of the switch 24 for a predetermined period of time, depending upon the geometry of the parts. This closure of the switch 24 will cause energization of the relay 20 and hence, operation of the machine M1 to cause the folding knife 14 to move into the groove between the rolls 11, so that the rolls 11 can draw the sheet down between them and deliver the same onto the belt 1A for subsequent folding operations in the machines M1 and M3.

After being acted upon by the first folder the sheet 10 will pass down through the other two folders. As explained above, the second folder will divide into quarters. In the timing device for this second operation therefore the motor 7A will operate at one fourth of the speed of the motor 8A. In addition, the motor 8A may drive the cam 22A four times the distance that the motor 8A drives the same plus extra distance to provide for travel time along the conveyor, as will be explained below. The third folder will fold into eighths and the timing motors will have an eight to one ratio plus travel time. Such ratios permit a single switch to perform the measuring operation for different operating devices that act proportionally on a given sheet to be processed.

If, for example, the sheet to be folded in the folding machine is four feet long (in comparison to the example set out above with a sheet eight feet long), when the trailing edge of the sheet opens the switch 2, the leading edge of the sheet 10 would be under the knife 14. However, because the motor 7 drives the cam 22 at half the speed of the delivery tapes 1, the cam 23 will be in substantially the position X2 which is approximately half way to the position X1. Thereafter with the switch 2 open, the motor 8 will take over at twice the speed that the motor 7 drove the same, so that while the sheet 20 travels only another two feet, the cam 23 will have moved from the point X2 to the point X1. Hence, it is seen that for a four foot sheet, the structure described above has still folded the same in the center.

Assuming, as in the above examples, that the sheet is only two feet long, when the leading edge of the sheet reaches a point Y3 in its travel, the trailing edge thereof would permit opening of the switch. During this interval of time in passage of the two foot sheet, the motor 7 will drive the cam 23 from the point X shown to the point X3. It is seen here that the sheet has to travel a distance Y3 to Y4 and in addition half the distance of Y to Y3. In other words, it has to travel substantially three additional feet before the folding knife 14 is brought into operation. In the timing device 21, the cam 23 will have moved to the point X3 as pointed out above under operation of the motor 7, and thus will have to move three times as far in one and a half times the amount of time. However, because the motor 8 travels at twice the speed of motor 7, the cam 22 will be rotated at this higher speed and accordingly, the timing device will travel twice the distance so that even with a shorter piece, the knife 13 will still come down on the center of the piece measured to fold the same substantially into halves. The subse-

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quent folding operations continue likewise to perform additional folds.

While he has described in detail one form his invention may take, it is to be understood that modifications thereof are possible and, inasmuch as the showing has been diagrammatic for the purpose of making a clear and concise description, it is to be understood that the device is conducive to alterations without departing from the spirit of the invention. For example, although he has shown the sheet 10 which is flexible in traveling along a horizontal path, it will be understood that with highly flexible items, it may be better to have them travel down inclined surfaces or even to cause them to travel vertically between supporting or backing rolls which travel at the same speed as the traveling belts and rolls. It is further to be understood that although specific dimensions are set out in the examples above, that the present invention is conducive to alteration in many respects to perform the identical function at more convenient positions. For example, it might be desirable to have any one of the conveyor belts longer or shorter to cause travel of the piece that might be measured at some distance away. Such additional travel can be taken up in my device by moving the switch 24 in the timing device to different positions in relationship to the degrees of travel of the cam. In other words, if the switch were moved clockwise more, it would permit more travel along the belts than in the position shown. Likewise, if the switch 24 were rotated in a counter-clockwise direction less travel would be accommodated by the machine. It is well understood in the arts that certain maximums are encountered and certain minimums and, accordingly, for most practical purposes, it will suffice to state that the device that he has invented is adjustable to accommodate several different lengths which might be encountered in a given processing machine.

In the above description, he has described a device employing only a single measuring switch 2. With such a single switch, it is obvious that where very long sheets are encountered that the spacing of one sheet after another would have to be sufficient to permit for travel time along the conveyor system and through the folding rolls. Obviously, such structure may not be suitably rapid in some installations. Accordingly, in devices for folding long sheets as well as short ones, he may apply a pair or more of measuring switches 2 which could operate different timer units similar to 21 that could in turn sequentially operate the folding mechanisms. In this manner, the devices could accommodate long sheets of such length that one will just clear one folding stage as the succeeding sheet comes into a position in which it will be folded thereafter. Another alternative would be to switch out different sets of timers to accommodate different lengths of sheets most expeditiously, so that all of one general length could be processed at one time, and all of another general length processed at another time. Obviously, many other different arrangements and modifications of his invention in addition to this will also occur to others skilled in the art.

While he has shown and described one specific embodiment of his invention, it is to be clearly understood that he has to be limited in his invention only by the scope of the appending claims.

What is claimed is:

1. In a machine adapted to operate on a sheet, means for moving a sheet at a constant speed past the machine, detector means in the path of said sheet, a rotatable cam, means including a first constant speed motor for rotating said cam from its initial position at one speed while the sheet passes said detector means, circuit means connecting said detector means and said first constant speed motor for initiating rotation of said cam thereby upon engagement of said detector means by a sheet, a second device including a constant speed motor for rotating said cam at a different speed after the sheet has passed said

detector means, circuit means for initiating rotation of said cam by said second device constant speed motor upon disengagement of said detector means by the sheet, and an actuator for the machine engaged by said cam in its travel.

2. In a timing device, a cam travelling in a closed orbit for performing a control function during traverse in the orbit, a switch alongside of said orbit for effecting the function, a synchronous motor adapted to move the cam from its initial position at one speed, means for operating said motor during a limited interval of travel of the cam in the orbit, a second synchronous motor adapted to be put into operation automatically when the first motor ceases to function to move the cam at a second higher speed for actuating said switch as it passes, circuit means connected to said motors for respectively operating said motors and means for stopping said second motor when the cam has completed its trip around its orbit.

3. Apparatus adapted to operate on sheets of different lengths at a number of points on each sheet proportionately spaced, comprising a plurality of separate machines, each machine operating on each point of a predetermined sheet as it passes the machine, means for moving the sheet at a constant speed past said machines, a single detector in the path of said sheet, a rotatable piece for each machine, each piece including a cam, means including a first constant speed motor for each of said pieces to rotate its piece at some preset speed while the sheet is passing over the detector, circuit means connecting said detector with said constant speed motors for initiating rotation of the cam moved thereby upon engagement of said detector by a sheet, other means associated with each of said pieces including a second constant speed motor for rotating its cam at a different speed after the sheet has passed the detector, circuit means initiating rotation of said last mentioned constant speed motors upon disengagement of said detector by the sheet, and an actuator for each of said machines spaced along the path of its cam so that as the point of each sheet to be operated on by a particular machine at a set proportion of the length of the sheet from the forward end passes said machine, the actuator will give an energizing impulse for the machine to perform its operation.

4. In a timing device, a number of discs each carrying a cam, a switch alongside of each disc, a synchronous motor for each disc adapted to turn it about its axis from its initial position at one speed, a circuit means for operating all of said motors during a limited time interval, a relay in said circuit, a second synchronous motor for each of said discs placed in operation automatically when the motors previously mentioned cease to operate to move each disc at a second speed actuating the switches alongside of each disc, and means for stopping said second motor of each disc independent of the second motors on the other disc, when that particular disc has completed one full revolution.

5. In a timing device, a number of discs each carrying a cam, a switch alongside of each disc, a synchronous motor for each disc adapted to turn it about its axis from its initial position at one speed, a circuit controlling the operation of all of said motors during a limited time interval, a second circuit including a relay held open when current is flowing through the first circuit, a second synchronous motor for each of said discs placed in operation automatically when the second circuit is established, each of said second synchronous motors moving its particular disc at a second speed independent of the speed

of the other motors and actuating the switch alongside of that particular disc, and means for stopping each of said second synchronous motors independently of the others when the particular disc with which said second synchronous motor is associated has completed one full revolution.

6. In a folding machine having means for advancing articles of varying length to be folded along a predetermined path, and folding means for folding the articles; means for controlling the folding operations in a manner to cause the articles to be folded in fractional folds comprising a cyclically operable actuator for causing operation of said folding means, a first switch sensitive to the passage of the leading edge of an article to be folded along said path for measuring the article, a second switch sensitive to movement of said actuator away from a predetermined position and its return thereto, a plurality of electrically controlled drive means for said actuator, one drive means being controlled by said first switch and the other drive means being controlled by said second switch, and means rendering said second switch ineffective while said first switch is performing its measuring function.

7. In a folding machine having means for advancing articles of varying length to be folded along a predetermined path, and folding means for folding the articles; means for controlling the folding means in a manner to cause the articles to be folded in fractional folds comprising a cyclically operable actuator for causing operation of said folding means, a first switch sensitive to the passage of the leading edge of an article to be folded along said path, a second switch sensitive to movement of said actuator away from a predetermined position and its return thereto, and a plurality of electrically controlled drive means for said actuator, one drive means being controlled by said first switch and another drive means being controlled by said second switch.

8. Apparatus adapted to operate on sheets of different lengths at a number of points on each sheet at proportionate points, comprising, a machine adapted to operate on a sheet, means for moving a sheet at a constant speed past said machine, detector means in the path of said sheet, a rotatable piece including a disc having a cam, means including a first constant speed motor for rotating said disc from its initial position at one speed while the sheet is passing over the detector, circuit means connecting said detector means and said first constant speed motor for initiating rotation of said disc and cam thereby upon engagement of said detector means by a sheet, a second device including a constant speed motor for rotating said disc and cam at a different speed after the sheet has passed the detector, a circuit means for the second device including a switch held open by said cam when in its initial position and a relay operated switch held open by the current rotating the first device, said relay operated switch being closed to initiate rotation of said second device upon disengagement of said detector means by the sheet, and an actuator for the machine engaged by said cam in its travel.

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