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MEANS AND METHODS FOR CONTROLLING THE OPERATION OF ARTICLE PROCESSING MACHINES PARTICULARLY WRAPPING MACHINES

Filed Nov. 9, 1962 2 Sheets-Sheet 1

Fig. 1.

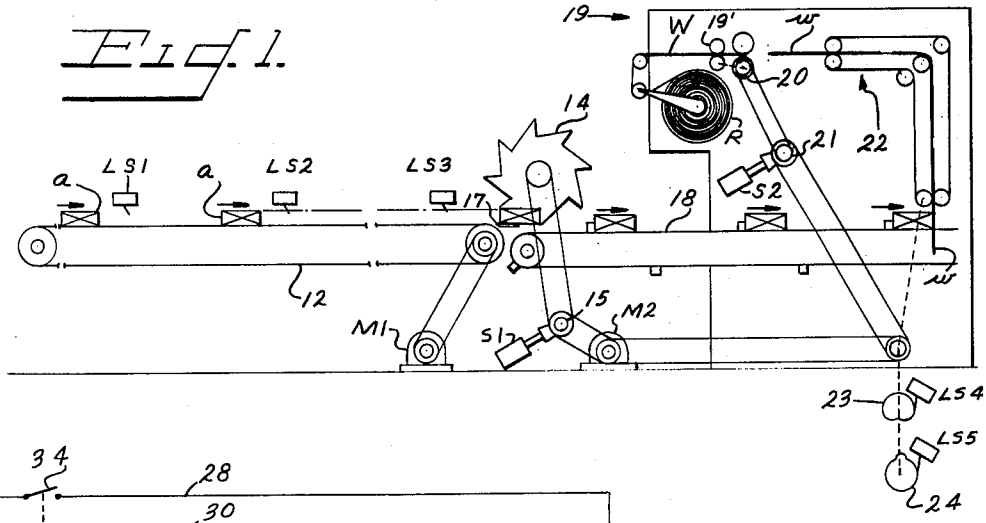
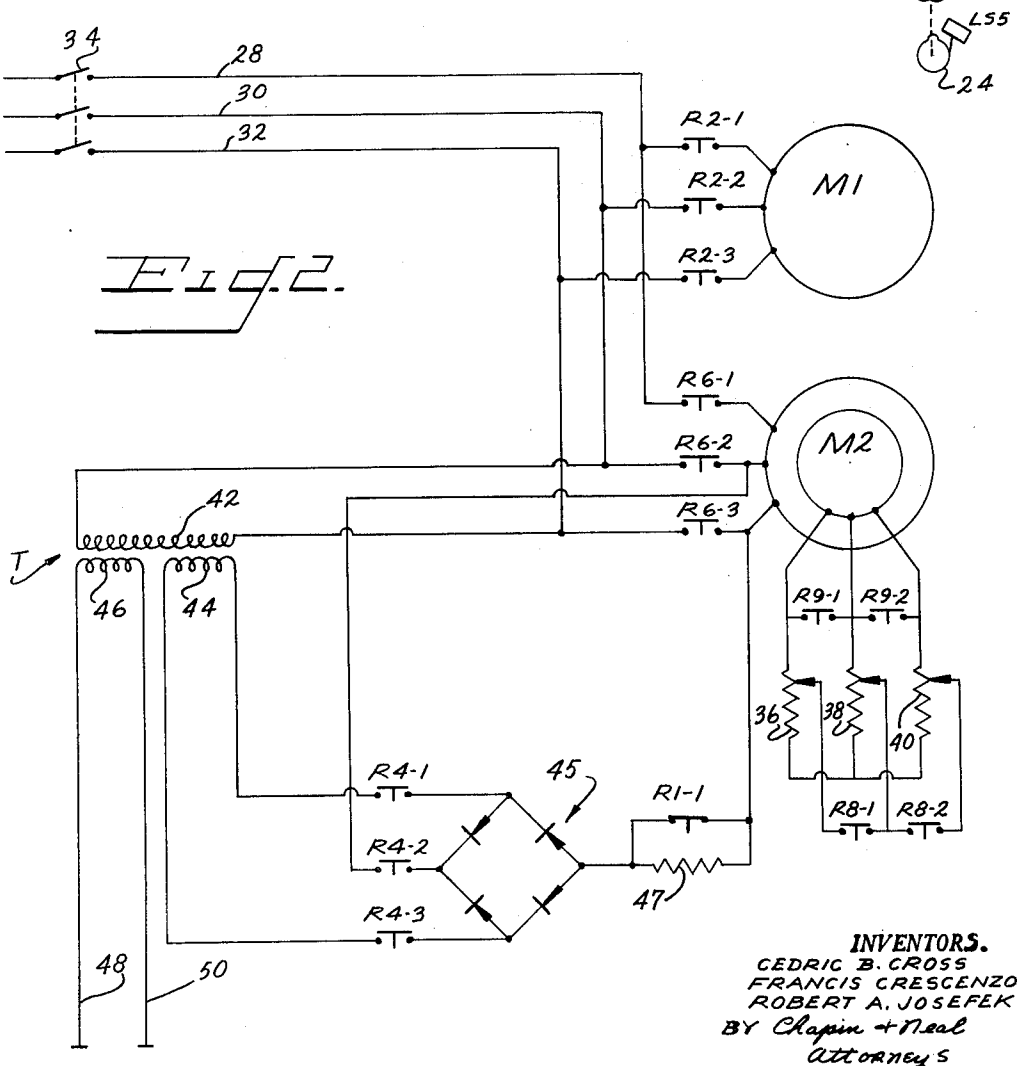


Fig. 2.



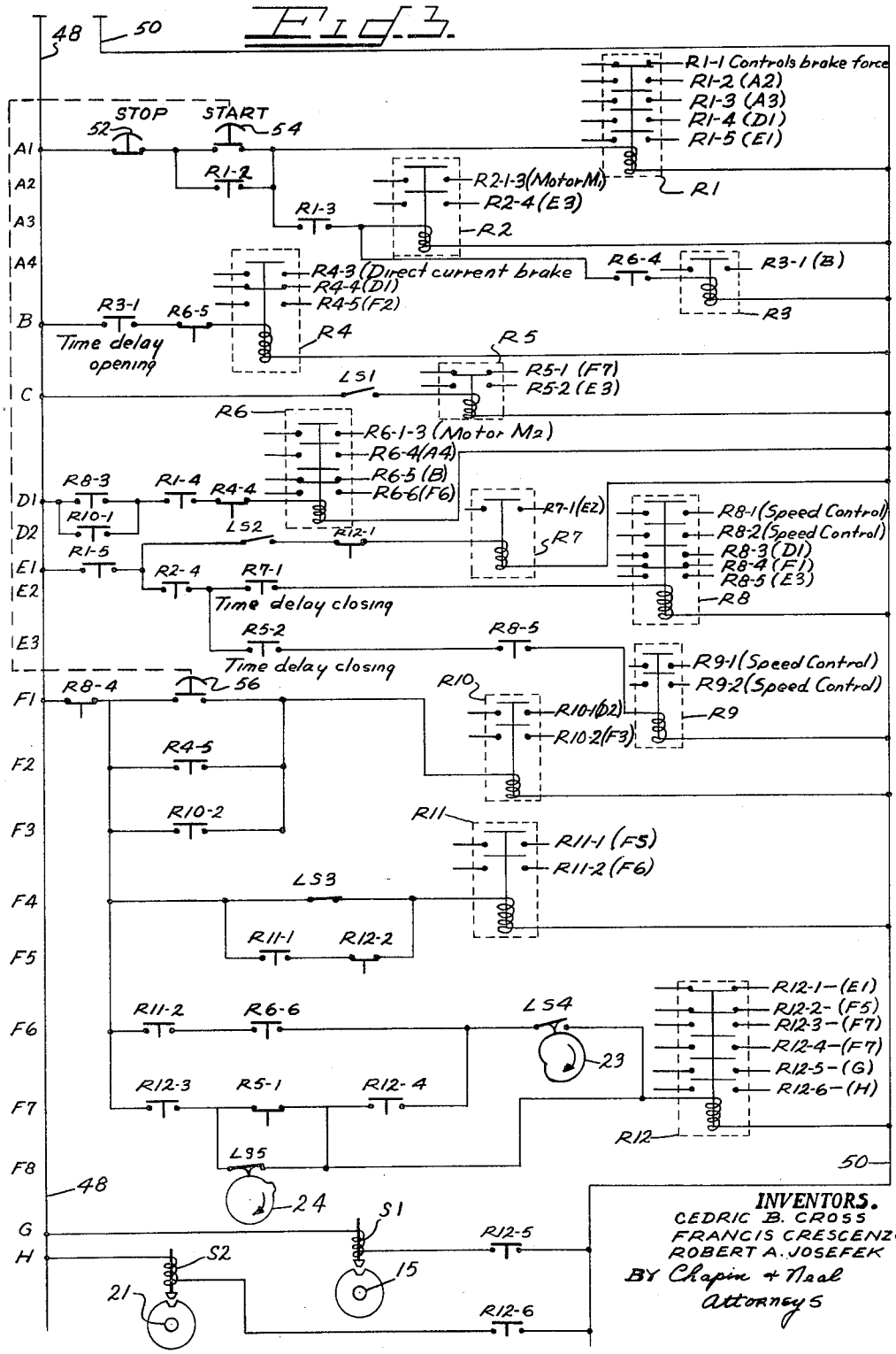
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Fig. 3.



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MEANS AND METHODS FOR CONTROLLING THE OPERATION OF ARTICLE PROCESSING MACHINES PARTICULARLY WRAPPING MACHINES

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The present invention relates to control systems for article processing machines, and more particularly to improvements in controlling the rate of operation of such machines in accordance with the number of articles which are positioned for advance to the machines.

While the broader aspects of the present inventive concepts are not limited to use with a particular type of machine, the invention will, for ease of description, be described in its application to wrapping machines.

It has been accepted practice in the past to provide a feed conveyor for receiving articles and from which articles are fed into a wrapping machine. Usually a feeder is provided which controls the advance of the articles into the machine and spaces them apart to facilitate the wrapping operation. Most frequently articles have been loaded onto such feed conveyors by hand. If the supply of articles on the feed conveyor becomes exhausted, the wrapping machine is simply shut down. Likewise, when articles are on the feed conveyor the machine has simply been started by throwing a switch which initiates full speed operation.

In an effort to obtain further manufacturing economies, it has become desirable to automatically advance articles to these feed conveyors and thereby eliminate the manual labor previously required. Other efforts to reduce manufacturing costs have resulted in substantially increased rates of operation for wrapping machines which result in excessive wear and strain and require considerable power when they are abruptly stopped or started.

It is, therefore, one object of the invention to provide an improved method and control system for a feed conveyor and an article processing machine which will give maximum efficiency in the operation of the machine in matching its operation to the number of articles on the feed conveyor, and particularly to do so in a manner which accommodates automatic feeding of articles to the feed conveyor.

Another object of the invention is to accomplish the above ends in a manner reducing the power requirements for the machine, and also minimizing the wear and strain on the component parts of the machine.

Where articles are automatically fed to the feed conveyor of a wrapping machine, other problems can arise in the feeding of the individual wrappers which are to be enfolded about the articles. It is desirable that each article, which is passed by the feeder to the machine, be completely wrapped and carried beyond the heat sealing elements thereof so as to eliminate the possibility of rejects which have been heated too long. Likewise, it is desirable that each wrapper released from a wrapper supply be folded about an article, otherwise the wrappers could either cause the spoiling of subsequent wrapped

articles or even a jamming of the machine. These latter problems of course occur when the wrapping machine is started and stopped.

Accordingly, it is a further object of the invention to provide improved means for insuring that each article passed by the feeder to the wrapping machine is enfolded in a wrapper and carried past the heat sealing elements thereof and preferably discharged from the machine, and further that each wrapper released from a supply means is enfolded about an article.

In accordance with these inventive concepts there is provided a control system for an article processing machine and a feed conveyor therefor. The control system initiates operation of the machine in a predetermined sequence wherein the machine operates first at a reduced speed and then at a speed just below its maximum speed, and then finally at the maximum speed. These rates of operation and the feeding of articles to the machine are controlled by the number of articles on the feed conveyor which are positioned for advance to the machine. Once the machine is operating, its rate alternates between maximum speed and a slightly reduced speed which are preselected to be slightly above and below the expected rate at which articles are to be fed to the feed conveyor. Further, in the case of a wrapping machine, the feeder which releases the articles to the machine and the wrapper release means are spaced at preselected distances from the point where the wrappers and articles meet. The operation of the feeder and release means are controlled independently of the machine, so that the first released wrapper is folded about the first released article and the last released wrapper is folded about the last released article. Preferably the feeder and wrapper release means are spaced from this meeting point the same number of "stations"; considering the meeting point as one station and each wrapper and article between the meeting point and the release means and feeder respectively as an additional station. With equal "station" spacing, the feeder and release means are then actuated simultaneously.

The above and other related objects and features of the invention will be apparent from a reading of the following description of the disclosure found in the accompanying drawings and the novelty thereof pointed out in the appended claims.

In the drawings:

FIG. 1 is a diagrammatic showing of a wrapping machine embodying the present invention;

FIG. 2 is an electrical diagram of a portion of the control system for the wrapping machine; and

FIG. 3 is a diagrammatic showing of the remaining portion of the electrical control system.

FIG. 1 diagrammatically illustrates the present invention as it would be practiced in a wrapping machine environment. An infeed belt-type conveyor **12** is driven by a motor M1. Articles *a* may be fed onto the conveyor **12** from the discharge end of a preceding machine or they may manually be fed thereon or the articles may be collected from several sources and then automatically fed to the conveyor **12**.

In any event, articles on the conveyor **12** are fed onto a plate **17** which leads to a feed wheel **14** which is driven by a motor M2, through a jack shaft **15**. As articles continue to be fed onto the conveyor **12**, they will back up, in abutting relation behind the feed wheel

14. The function of the feed wheel is to pass one article at a time to conveyor 18, having spaced flights for carrying the articles to a wrapping machine 19. The articles are thus advanced to the wrapping machine in spaced apart relation and in proper timed relation to the operation of various instrumentalities thereof. The wrapping machine 19, including conveyor 18, is also driven directly from the motor M2.

Individual wrappers *w* are provided for each article by severing successive lengths from the leading end of a web W drawn from a supply roll R. The web is advanced by a pair of rolls 19' and is severed by a knife roll 20, both of which are driven from the motor M2 through jack shaft 21. The severed wrappers *w* are then advanced to the point where they meet the articles *a* by a set of conveyor belts 22. The belts 22 are driven directly from the motor M2 in proper timed relation to the movement of the flights of conveyor 18.

It is contemplated that the wrapping machine 19 will be capable of high rates of operation in order to fully take advantage of the benefits of the present invention, though this is not a necessity. Suitable high-speed wrapping machines of the type referred to and having similar wrapper forming mechanism, are disclosed in U.S. Patent No. 2,810,246 and reference is made thereto for details of operation. The feeder may also take other forms, but reference may be had to U.S. Patent No. 2,912,092 which discloses in greater detail the mode of operation of the feed wheel 14.

The electrical circuit now to be described varies the rate of operation of the wrapping machine 19, the paper feed mechanism, and feeder 14 in a manner which approaches the maximum efficiency where varying rates of article flow may be expected.

Certain elements described in the electrical circuit are also found in FIG. 1. These include limit switches LS–1, LS–2 and LS–3 which are spaced from the feed wheel 14 along the length of the conveyor 12. Solenoid S1 is mounted adjacent the jack shaft 15 and is arranged, when energized, to engage a slipping clutch arrangement which will stop operation of the feed wheel 14 independently of the operation of the motor M2. Likewise, a solenoid S2 is effective upon a slipping clutch arrangement on jack shaft 21 to interrupt operation of the paper feed rolls 19' and knife 20, also independently of the operation of the wrapping machine 19. Further, cams 23 and 24 are driven from the motor M2 to rotate once for each cycle of operation of the machine 19 for timing purposes, later described.

Referring now to FIG. 2, the electrical circuit comprises 3 main lines, 28 30 and 32, which are connected to an appropriate source of three-phase alternating current by a ganged switch 34. The motor M1 is a three-phase motor which is connected to the power lines 28, 30 and 32 by relay contacts R2–1, R2–2 and R2–3. The motor M2 is a three-phase wound rotor motor which is arranged to be connected to the power lines 28, 30 and 32 by relay contacts R6–1, R6–2 and R6–3. The winding of the rotor of motor M2 is connected to variable tap resistors 36, 38 and 40. Relay contacts R8–1 and R8–2 are arranged to short out the major part of the resistors 36, 38 and 40, while relay contacts R9–1 and R9–2 are arranged to short out these resistors completely. These contacts are the immediate means for controlling the speed of motor M2.

Lines 30 and 32 are connected to the primary 42 of a transformer T. One secondary 44 of this transformer is connected to a rectifying circuit 45, through relay contacts R4–1 and R4–3. The output of this rectifying circuit is connected across one field winding of the motor M2 through relay contacts R4–2, with a resistor 47 being connected in series therewith. Closure of the contacts R4–1, R4–2 and R4–3 will result in a direct current being impressed upon one of the field windings of the motor M2 and result in a braking action on this motor for purposes which later appear. Relay contacts R1–1 are provided to short out resistor 47 where a stronger braking action is required.

The transformer T is provided with a second secondary 46, the output of which is connected to lines 48 and 50 across which various control relays are connected.

Referring now to FIG. 3, it will be seen that there are a total of 8 circuits, connected across the lines 48 and 50, which have been appropriately designated A, B, C, etc. Likewise, the lines of these circuits have been numbered in an appropriate fashion, that is, lines A1, A2, A3, etc. It would also be pointed out that the contacts of the various relays seen in FIG. 2 are shown in association with the relay coils and also in the various circuits which they control. Legends indicate the lines in FIG. 3 or the elements of FIG. 2 which are controlled by these relay contacts.

Line A1 comprises a stop switch 52 and a momentary contact start switch 54. Both are connected in series with the coil of relay R1. In line A2, hold-in relay contacts R1–2 are connected in parallel across the start switch 54. Line A3 comprises series connected relay contacts R1–3 and the coil of both of which are connected in parallel with relay R1. Line A4 comprises series connected relay contacts R6–4 and the coil of relay R3, both of which are connected in parallel with relay R2.

Line B comprises relay contacts R3–1 connected in series with normally closed relay contacts R6–5 and the coil of relay R4.

Line C comprises limit switch LS–1 connected in series with the coil of relay R5.

Line D1 comprises relay contacts R8–3, R1–4, normally closed relay contacts R4–4 and the coil of relay R6, all of which are connected in series. Line D2 comprises relay contacts R10–1 connected in parallel across contacts R8–3.

Relay contacts R1–5 are connected in series with lines E1, E2 and E3. Line E1 further comprises limit switch LS–2, normally closed relay contacts R12–1 and the coil of relay R7, all connected in series. Line E2 further comprises relay contacts R7–1 and the coil of relay R8. Line E3 further comprises contacts R2–4, R5–2, R8–5, all connected in series with the coil of relay R9.

All of the lines F1 through F8 are connected in series with relay contacts R8–4 in line F1. Line F1 further comprises a momentary closed switch 56 which is ganged with the start switch 54 and connected in series with the coil of relay R10. Line F2 comprises relay contacts R4–5 connected in parallel across the switch 56. Line F3 comprises relay contacts R10–2 also connected in parallel across the switch 56. Line F4 further comprises normally closed limit switch LS–3 connected in series with the coil of relay R11. Line F5 comprises contacts R11–1 and R12–2 connected in series with each other and in parallel across limit switch LS–3. Line F6 comprises relay contacts R11–2, R6–6 and limit switch LS–4, all connected in series with the coil of relay R12. Line F7 comprises series connected relay contacts R12–3, normally closed contacts R5–1 and contacts R12–4, connected in parallel across the contacts R11–2 and R6–6. Line F8 comprises limit switch LS–5 which is connected in parallel across contacts R5–1 and also in series with relay R12.

Line G comprises solenoid S1 connected in series with relay contacts R12–5.

Line H comprises solenoid S2 connected in series with relay contacts R12–6.

The operation of this circuit is as follows:

When the main switch 34 (FIG. 2) is closed, only one circuit is completed across the lines 48, 50 (FIG. 3). This circuit is through relay contacts R8–4 (line F1) and limit switch LS–3 (line F4) to energize relay R11. Closure of relay contacts R11–1 completes a holding circuit which will maintain relay R11 energized in the event switch

LS–3 is open. There is no reaction to closure of contacts R11–2 at this time.

Next, the machine is prepared for operation by closure of the ganged start switches 54 and 56 to energize the following circuits. In line A1, relay R1 is energized and closure of contacts R1 is of no consequence for the moment. Closure of relay contacts R1–2 maintains relay R1 energized after the start switch is released. Closure of contacts R–13 (line A3) causes energization of relay R2. Closure of contacts R1–4 (line D1) prepares relay R6 for energization. Closure of contacts R1–5 prepares the circuits through lines E1, E2 and E3 for energization. Energization of relay R2 and closure of contacts R2–1, R2–2 and R2–3 results in the actuation of motor M1 so that the conveyor 12 is now operating at this time. Closure of relay contacts R2–4 (line E2) partly prepares relays R8 and R9 for energization. Closure of switch 56 results in energization of relay R10. Closure of relay contacts R10–1 (line D2) completes the circuit for energization of relay R6. Closure of contacts R10–2 maintains relay R10 energized upon release of switch 56. Closure of relay contacts R6–1, R6–2, and R6–3 result in operation of the motor M2 at approximately a 50% rate. At this time the full value of resistors 36, 38 and 40 (FIG. 2) is placed in the rotor windings of this motor to obtain the desired low speed. Closure of relay contacts R6–4 (line A4) completes energization of relay R3. Energization of relay R3 causes closure of contacts R6, but relay R4 is not energized at this point inasmuch as relay contacts R6–5 have been simultaneously opened. Closure of relay contacts R6–6 completes the circuit for energizing relay R12 (through line F6) upon the cam 23 (FIG. 1) rotating to the appropriate point for the feed wheel 14 to stop in a given predetermined position. That is, when motor M2 is actuated, the cams 23 and 24 rotate constantly. Upon energization of relay R12, contacts R12–5 and R12–6 cause solenoids S1 and S2 (lines G and H and FIG. 1) to energize and thereby stopping operation of the feed wheel 14 and the paper feed mechanism 20 in fixed predetermined positions. A hold-in circuit is now provided through either contacts R12–3 or R12–4 to maintain relay R12 energized when switch LS–4 opens as cam 23 continues to rotate. Upon energization of relay R12, contacts R12–1 (line E1) open preventing energization of relay R7 in response to closure of limit switch LS–2. Likewise contacts R12–2 open to break the hold-in circuit around limit switch LS–3.

The end result of closing the main switch 34 and the start switches 54 and 56 is that relays R1, R2, R3, R6, R10, R11 and R12 are energized. The motor M1 is operating at a fixed rate. The motor M2 is operating at approximately half of its maximum rate. The solenoids S1 and S2 are energized preventing operation of feed wheel 14 and paper feed rolls 19′ and knife 20. At this time the remaining components of the wrapping machine 19 are operating continuously as they are driven by the motor M2.

With these conditions, it will be presumed that an article is advanced along conveyor 12. Limit switch LS–1 closes, momentarily energizing relay R5. Relay contacts R5–1 (line F7) open immediately, but there is no resultant action. Contacts R5–2 (line E3) close only after a time delay of 10 seconds so that relay R9 cannot be energized by a single article on conveyor 12, even if R8 had been previously energized to close contacts R8–5. Thus, if switch LS–1 is closed simply for the time required for a single package to pass thereby the only effect on the circuit is a momentary energization of relay R5.

Presuming that this single package next passes beneath limit switch LS–2, there will be no resultant effect on the circuit inasmuch as relay R12 is energized and contacts R12–1 (line E1) are open.

This first article will next pass beneath limit switch LS–3 causing de-energization of relay R11 since the hold-in circuit therefor had been broken by energization of relay R12. Relay contacts R11–1 open further interrupting this hold-in circuit. Also contacts R11–2 open breaking one of the paths for energization of relay R12.

This first article will be advanced onto the plate 17 and as subsequent articles are fed onto the conveyor 12, a line of abutting articles will build up behind the wheel 14. When this line of articles reaches switch LS–3, deenergization of relay R11 is no longer momentary, but nothing occurs as a result of this condition. The line of packages will continue to build up until switch LS–2 (line E1) is closed for more than a momentary interval, but there is no change in the circuit as contacts R12–1 are open. When the line of articles finally reaches switch LS–1, relay contacts R5–1 (line F7) will remain open for a full machine cycle so that when switch LS–5 is opened by the constantly rotating cam 24, relay R12 will be deenergized. Contacts R12–5 (line G) and R12–6 (line H) will open de-energizing solenoids S1 and S2 to simultaneously initiate operation of the feed wheel 14 and paper feed rolls 19′ and knife 20 which are driven at half speed by motor M2. Relay contacts R12–1 (line E1) close resulting in the immediate energization of relay R–7. Contacts R7–1 close after a fixed time delay so that the wrapping machine will operate with the article feed and wrapper forming mechanism functioning at approximately half speed for a finite interval, which need not be too great; 1½ seconds has been found sufficient. After this delay contacts R7–1 close to energize relay R8 (line E2). Contacts R8–1 and R8–2 close to shunt out the major portions of the resistors 36, 38 and 40 to thereby increase the speed of motor M2 and the parts driven thereby to slightly less than their maximum rates, say 97%. Contacts R8–3 (line D1) close to maintain relay R6 energized as contacts R8–4 (F1) open to de-energize relay R10 and open contacts R10–1 (line D1) which had previously provided an energization path for relay R6. Contacts R8–5 close further preparing relay R9 for energization. It will be remembered that relay R–5 is energized at this time. Contacts R5–2 are provided with a time delay in closing which is greater than the time delay for closing contacts R7–1. Thus, after motor M2 has been operating at 97% of maximum speed for a finite time, contacts R5–2 close to energize relay R–9. A time delay of 10 seconds after closing of switch LS–1 has been found suitable. Upon energization of relay R9, contacts R9–1 and R9–2 close to entirely shunt out the resistors 36, 38 and 40 (FIG. 2) so that the motor M2 now operates at its maximum rate.

At this point relays R1, R2, R3, R5, R6, R7, R8 and R9 are energized, while the remaining relays are de-energized.

The rate of operation of wrapping machine 19 with motor M2 at maximum speed, is preselected to be slightly greater than the expected rate of feed of articles to the conveyor 12. For example, if the expected rate of feed of articles to conveyor 12 is 300 per minute, the maximum rate of operation of the wrapping machine would be 305 articles a minute. This would mean that the line of articles would gradually diminish until switch LS–1 opens to de-energize relay R5. Contacts R5–1 have no effect on the circuit at this point. However, opening of contacts R5–2 de-energizes relay R9. Contacts R9–1 and R9–2 open to place a small resistance load (through resistors 36, 38 and 40, FIG. 2) into the rotor circuit of motor M2 and again drop its speed to 97% of maximum. The rate of operation of the wrapping machine is now approximately 295 articles a minute and the line of articles on the conveyor 12 will again increase as switch LS–1 must remain closed for 10 seconds for the contacts R5–2 to again close and energize relay R9 to return the motor M2 to maximum speed.

In what may be referred to as normal operation, the wrapping machine alternately operates at a rate slightly above and then at a rate slightly below the expected rate of feed of articles to the conveyor 12. The rate of feed of conveyor 12 is greater than the maximum rate of operation of the machine 19 so that the line of articles will

be maintained in abutting relation behind the feed wheel 14. Operation of the wrapping machine is continuous and articles are fed thereto wtihout the need of mechanically or otherwise interlocking this machine with a preceding machine to obtain synchronization in the event there is any variation in the rate of feed of articles to the conveyor 12.

If, after reaching normal operation, the feeding of articles is interrupted or materially reduced, the line of articles will be reduced to open switch LS–2 when motor M2 is operating at a 97% rate. When this occurs, relay R7 is de-energized opening contacts R7–1 immediately to de-energize relay R8. The following occurs as a result of de-energizing relay R8. Contacts R8–1 and R8–2 open to impose the full value of resistors 36, 38 and 40 (FIG. 2) across the field winding of motor M2 for its operation at a 50% rate. Contacts R8–3 (lineD1) open to de-energize relay R6. Contacts R8–4 close to prepare relay R10 for energization. Contacts R8–5 open to prevent energization of relay R9. De-energization of relay R6 results in the following. Contacts R6–1, R6–2 and R6–3 (FIG. 2) open to disconnect the motor M2 from power lines 28, 30 and 32. Contacts R6–4 (line A4) open to de-energize relay R3. Contacts R6–5 close to energize relay R4. Contacts R6–6 open but have no present effect on the circuit.

It will be noted that contacts R6–5 close simultaneously with de-energization of relay R3. Contacts R3–1 have a time delay in opening of a relatively short time, about ½ second and for that short interval relay R4 is energized. Closure of contacts R4–1, R4–2 and R4–3 (FIG. 2) connects the rectifier 46 to the transformer secondary 44 and also connects its output to one field winding of the motor M2. This provides a braking force which quickly reduces the speed of motor M2 without bringing it to a stop. Contacts R4–4 open, but have no present effect on the circuit. Contacts R4–5 close to energize relay R10. Energization of relay R10 results in closure of contacts R10–2 which maintains relay R10 energized and also closure of contacts R10–1 which prepares relay R6 for re-energization.

After this short application of a braking force, contacts R3–1 open to de-energize relay R4. Contacts R4–1, R4–2 and R4–3 open to remove the direct current previously imposed to create the braking force. Contacts R4–4 close to re-energize relay R6. Contacts R4–5 open, but relay R10 remains energized through hold-in contacts R10–2.

Re-energization of relay R6 results in closure of contacts R6–1, R6–2 and R6–3 to reactuate motor M2 to operate at its 50% rate. Closure of contacts R6–4 energizes relay R–3 as contacts R6–5 open simultaneously to prevent energization of relay R4 as contacts R3–1 close. Contacts R6–6 open but have no present effect on the circuit.

Articles are now fed to and wrapped by the machine at 50% of the maximum rate. This rate of operation will continue so long as the line of articles remains between switches LS–3 and LS–2. Articles fed past the switches LS–2 and LS–1 will have to effect on the circuit other than to momentarily energize relays R5 and R7, but not for a time sufficient to close contacts R5–2 and R7–1. Even if a group of abutting articles were to cause switch LS–2 to be closed for the stated 1½ seconds, the effect would simply be the same as if the length of the articles had again reached LS–2, the motor M2 would again operate at a 97% rate, but in the case of a group of articles, operation would soon revert back to the 50% rate.

Assuming now that the line of articles has built up to switch LS–2, relay R7 will be energized for a period sufficient to close contacts R7–1 and energize relay R8. As soon as this occurs, the circuit reverts to the condition previously described in connection with operation at a 97% rate. Thus relay R10 is de-energized and relay R6 is maintained energized by contacts R8–3.

Assuming, on the other hand, that the line of articles continues to diminish after the rate of operation has been reduced to 50%, switch LS–3 will be deactuated, viz. closed to energize relay R11. Contacts R11–1 will close preparing a hold-in circuit therefor. Contacts R11–2 will close; contacts R6–6 are closed at this time so that upon the next closure of switch LS–4, the circuit will revert to the condition described after switch 34 and ganged start switches 54 and 56 had been closed. Thus the motor M1 operates as usual, motor M2 is operating at a 50% rate and solenoids S1 and S2 are energized to prevent feed of articles to the machine 19, and to prevent operation of the wrapper feed rolls 19′ and knife 20.

Use of the stop switch 52 (line A1) is usually under emergency conditions. When the switch 52 is opened, relays R1, R2 and R3 are immediately de-energized. Motor M1 is de-energized and coasts to a stop. Motor M2 is de-energized upon contacts R1–4 opening to de-energize relay R6. At this time a braking force is applied to motor M2 to prevent injury to machine components or an operator in case an accident has occurred. Contacts R6–6 (line B) close to energize relay R4 for the delay period provided for opening contacts R3–1. Contacts R4–1, R4–2 and R4–3 close to impose a direct current across one coil of motor M2 as previously described. This direct current is greater than previously described since contacts R1–1 are now closed to short out resistor 47. The greater braking force brings the machine to a halt more rapidly for emergency situations.

One factor has not as yet been taken into account in the present description and that is the possibility of random packages actuating switches LS–1 or LS–1 and LS–2 or LS–1, LS–2 and LS–3 simultaneously with the closure of switch LS–5 by the rotating cam 24.

Considering first a random simultaneous closure of switches LS–1 and LS–5 which occurs after the line of packages had built up to close LS–2. At this time relay R12 will be de-energized and the same results will occur as described previously in connection with de-energization of this relay. In short, closure of contacts R12–1 result in energization of relay R8 and operation of the feeder 14, feed rolls 19′, knife 20 and machine 19 at a 97% rate after a short period of operation of these elements at a 50% rate. The effect of such a random closure is simply to initiate operation at the 50% and 97% rates somewhat earlier than would otherwise occur.

Considering next a random simultaneous closure of switches LS–1, LS–2 and LS–5, after the line of packages has built up to actuate switch LS–3. Relay R12 will be de-energized and the solenoids S1 and S2 also de-energized as contacts R12–5 and R12–6 are opened. Relay contacts R12–1 close for energization of relay R7, but a random package will not maintain switch LS–2 closed for a time sufficient for closure of time delay contacts R7–1. The motor M2 remains at its 50% rate as a single article is fed by the feeder 14 and a single wrapper is fed by the mechanism 20. Presuming that switches LS–1 and LS–5 are not again actuated simultaneously, operation of the feeder 14 and wrapper feed 22 will continue until LS–3 is de-actuated to energize relay R11 and close contacts R11–2. R6–6 is closed at this time so that upon the next closure of LS–4 relay R12 will be re-energized to prevent further operation of the feeder 14 and wrapper feed 22. Since closing of the switch LS–2 by a random package has no effect on the circuit, it will be apparent that the same rate will occur if the switches LS–1 and LS–5 are actuated simultaneously once the line of articles has built up to switch LS–3.

If random packages actuate switches LS–1 and LS–3 simultaneously with actuation of switch LS–5, there will again be single cyclic operation of feeder 14 and wrapper feed mechanism. However, if articles are being fed onto the conveyor 12 when there are no articles thereon, as for the first time, then there is the possibility that no arti-

cle will be fed by the feeder while a wrapper will be fed by the mechanism **20**. This will result in unused wrapper, as will be more fully apparent from the following description which could possibly foul the machine, though it is more likely that the next wrapped article will be a reject. In any event, it is preferred to hand load packages from the wheel **14** back into the discharge end of the conveyor **12** to prevent feeding of an unused wrapper.

The feeding of single packages and the undesirability of unused wrappers points up another feature of the invention. Thus it will be noted that beyond the feed wheel **14** there are three articles up to the point where the articles meet the wrappers. There are also three wrappers from this point back to the knife **20** of the wrapper forming mechanism. The knife **20** is considered wrapper release means, for once a wrapper is severed thereby it is automatically advanced by belts **21** to the point where it is wrapped about an article. Assuming for the moment that the feed wheel **14** and the wrapper release are simultaneously rendered inoperative (by energization of relay R12) each of the articles previously passed by the wheel **14** will be wrapped in a wrapper previously severed and released by the knife **20**. The machine **19** continues to operate at a 50% rate at this time as motor M2 is in operation. Thus, once an article is fed past the wheel **14** it is assured that the article will be wrapped and discharged from the machine and further that there will be no unused wrappers. This applies to singly fed articles as well, since a single wrapper is released for advancement to the meeting point at the same time, as an article is passed by the wheel **14**. Being spaced the same number of stations away from this meeting point, both will arrive at the proper time for the wrapper to be wrapped about the singly fed article.

It is also contemplated that further timing means could be provided to separately control operation of the knife **20** and feeder **14** where they are spaced a different number of stations from the point of engagement between wrappers and articles. In the broader sense this means that the first released article meets the first released wrapper and the last released article meets the last released wrapper. Thus with three article stations and two wrapper stations actuation and deactuation of the knife **20** would occur one machine cycle after actuation and deactuation of the feeder **14**.

These factors assume greater importance when it is realized that the preferable practice is to continue operation of the wrapping machine so that all wrapped articles will be cleared therefrom. Otherwise there would be the possibility of partially wrapped articles being "baked" by the heat sealing elements of the machine. This would likely require the article to be rejected and could foul the machine. Continued operation of the machine requires that provision be made for maintaining proper timing of the feed mechanisms as has been taken into account in the preceding description. Further, of course, the features relating to providing for the feed of the same number of articles and the same number of wrappers into the machine are of importance in clearing the machine without rejects or the possibility of the machine being fouled.

The advantages of the above described control system are found in the adaptability of the machine to varying rates of flow or interruptions in the flow of articles thereto. It will be seen that, according to the preferred features of the invention, the motor for the wrapping machine is initially started at half its maximum speed. The product feed and wrapper feed are also started at a 50% rate for at least a short period of time. Next, these feeds and the wrapping machine operate at a 97% rate for at least a short period and then finally at their maximum rate. This minimizes the strain on the various components involved since there is never an occasion where they are immediately accelerated from rest to full speed. Similarly the speed of the machine and the feed mechanisms are not brought to an immediate stop when operating at full speed, but instead there is a progressive reduction in speed.

Various modifications and other applications of the features herein disclosed will be apparent to those skilled in the art without departing from the present inventive concepts.

Having thus described the invention, what is claimed as novel and desired to be secured by Letters Patent of the United States is:

1. A control system for a wrapping machine having a belt conveyor for advancing articles thereto, a first motor for driving said belt conveyor, and a feeder for controlling the advance of articles on the belt conveyor and for passing successive individual articles to the machine and in spaced apart relation, said wrapping machine comprising an infeed conveyor having spaced flights for receiving articles from the feeder and advancing them toward a point of engagement with wrappers therefor, means for advancing successive wrappers to this point of engagement, means for supplying individual wrappers to said wrapper advancing means wherein the wrapper advancing means are of a length sufficient to accommodate the same number of wrappers as the number of operative conveyor flights between said feeder and said point of engagement, a second motor for driving the wrapping machine, feeder and wrapper supply means, and means for actuating and de-actuating said feeder and wrapper supply means independently of the operation of said machine and in the same cycle of operation thereof, said last named means comprising means for clutching and declutching the drive for said feeder and supply means from said second motor.

2. A control system for an article processing machine having a belt conveyor for advancing articles thereto and a feeder for controlling the advance of abutting articles on the conveyor and for passing successive articles to said machine, said control system comprising means for detecting a given length of a line of abutting articles, means responsive to actuation of said detecting means for initiating operation of said machine and said feeder at a maximum rate, means responsive to deactuation of said detecting means for initiating operation of said feeder and machine at a slightly reduced rate, a second detector means for sensing a decrease in the length of said line of articles below a length shorter than the length required to actuate said first detector means and means responsive to a sensing of said second detector for initiating operation of said feeder and machine at a greatly reduced rate.

3. A control system as in claim **1** wherein is provided a third detector means for sensing a reduction in the length of the line of articles below a given length which is less than that sensed by said second detector means and means responsive to a sensing of said third detector means for preventing further operation of said feeder.

4. A control system as in claim **3** wherein a motor drive is provided for said feeder and machine, and the means responsive to a sensing of said second detector includes means for temporarily applying a brake force to said motor drive for a short time to quickly reduce operation of said feeder and machine to said greatly reduced rate, and further wherein the means responsive to a sensing of said third detector comprise means for de-clutching said feeder from said motor drive and continuing operation of the motor drive so that any articles fed to the machine may be conveyed therethrough.

5. The method of controlling the flow of articles to an article processing machine which comprises the steps of feeding articles to a belt conveyor, passing the articles from a belt conveyor to the machine in a controlled manner so that a line of articles will be built up on the conveyor, alternately slowing down and speeding up the rate of operation of the machine and the rate at which articles

are passed thereto so that the line of articles will vary between given limits when articles are fed to the belt conveyor at an expected rate which is intermediate the two rates of operation of the machine, greatly reducing the rate of operation of the machine and the operation at which the articles are passed thereto in the event the line of articles on the feed conveyor reduces to a given length, and interrupting the feeding of articles when the line of articles on the conveyor reaches a further reduced length while continuing operation of the machine to insure complete processing of the articles passed thereto.

6. A control system for an article processing machine having a belt conveyor for advancing articles thereto and a feeder for controlling the advance of abutting articles on the conveyor and for passing successive articles to said machine, said control system comprising means for detecting a given length of a line of abutting articles on said conveyor, means for initiating operation of said conveyor, means for initiating operation of said machine at a rate considerably below its maximum rate, means responsive to actuation of said detector means for initiating operation of said feeder at the same rate as said machine for a finite time and then initiating operation of said feeder and machine at an increased rate slightly below the maximum rate for a further finite time, and finally initiating operation of said feeder and machine at the maximum rate.

7. A control system as in claim 6 wherein the feeder and the machine are driven from a common power source and means are provided for maintaining the feeder inoperative prior to actuation of said detecting means.

8. A control system as in claim 6 wherein means responsive to deactuation of said detecting means are provided for reducing the rate of operation of said feeder and machine to said rate slightly below the maximum rate and further wherein second detector means are provided for sensing a decrease in the length of the line of articles below a length shorter than the length required to actuate the first detecting means, and means responsive to a sensing of said second detector means for initiating operation of said feeder and machine at a greatly reduced rate.

9. A control system as in claim 8 wherein a motor drive is provided for said feeder and machine, and the means responsive to a sensing of said second detector include means for temporarily applying a brake force to said motor drive for a short time to quickly reduce operation of said feeder and machine to said greatly reduced rate.

10. A control system as in claim 8 wherein is provided a third detector means for sensing a reduction in the length of the line of articles below a given length which is less than that sensed by said second detector means, and means responsive to a sensing of said third detector means for preventing further operation of said feeder.

11. A control system as in claim 10 wherein means are provided for continuing operation of said machine independently of the feeder when the latter is rendered inoperative by a sensing of said third detecting means.

12. A control system for an article processing machine having a belt conveyor for advancing articles thereto and a feeder for controlling the advance of abutting articles on the conveyor and for passing successive articles to said machine, said system comprising a first motor for driving said conveyor, a second motor for driving said feeder and machine, a detector switch, means responsive to the presence of articles on said conveyor at a given distance from said feeder for actuating said switch, means responsive to actuation of said switch for a time sufficient to indicate the presence of a line of abutting articles along said given distance, said last-named means initiating operation of said second motor at a maximum rate, means responsive to deactuation of said switch for initiating operation of said second motor at a slightly reduced rate, a second switch, means responsive to the presence of articles on said conveyor at a lesser given distance from said feeder for actuating said second switch and means operative after operation of said second motor at its maximum rate and in response to deactuation of said second switch, said last-named means initiating operation of said second motor at a greatly reduced rate.

13. A control system as in claim 12 wherein the second motor is a 3-phase motor, the means for initiating operation at a greatly reduced speed include means for temporarily removing power from said second motor and imposing a direct current potential for a short time across one winding thereof to provide a temporary braking force on the feeder and machine.

14. A control system as in claim 12 wherein are provided a third switch, means responsive to the presence of articles on said conveyor at a point between said lesser given distance and said feeder and closely adjacent said feeder for actuating said third switch, means operative in response to deactuation of said third switch for halting operation of said feeder independently of the operation of said machine.

15. A control system for a wrapping machine having a belt conveyor for advancing articles thereto and a feeder for controlling the advance of articles on the belt conveyor and for passing successive individual articles to the machine and in spaced apart relation, said wrapping machine comprising an infeed conveyor having spaced flights for receiving articles from the feeder and advancing them toward a point of engagement with wrappers therefor, means for advancing successive wrappers to this point of engagement, means for supplying individual wrappers to said wrapper advancing means wherein the wrapper advancing means are of a length sufficient to accommodate the same number of wrappers as the number of operative conveyor flights between said feeder and said point of engagement, means for actuating and de-actuating said feeder and wrapper supply means independently of the operation of said machine and in the same cycle of operation thereof, means for detecting a line of articles on said belt conveyor of a given length from said feeder and means responsive to actuation of said detecting means for simultaneously actuating said machine, said wrapping machine being first actuated at a greatly reduced speed and the means responsive to actuation of said detecting means initiating operation of said feeder and said wrapper supply means at the same rate of operation as said machine and in proper timed relation thereto, actuation of said detecting means causing operation of said machine, feeder and wrapper supply means at said considerably reduced rate for a finite time and then initiating operation of said feeder, wrapper supply means and machine at an increased rate slightly below the maximum rate for a further finite time, and finally initiating operation of said feeder, wrapper supply means and machine at their maximum rates.

16. A control system for a wrapping machine having a belt conveyor for advancing articles thereto and a feeder for controlling the advance of articles on the belt conveyor and for passing successive individual articles to the machine and in spaced apart relation, said wrapping machine comprising an infeed conveyor having spaced flights for receiving articles from the feeder and advancing them toward a point of engagement with wrappers therefor, means for advancing successive wrappers to this point of engagement, means for supplying individual wrappers to said wrapper advancing means wherein the wrapper advancing means are of a length sufficient to accommodate the same number of wrappers as the number of operative conveyor flights between said feeder and

said point of engagement, means for actuating and deactuating said feeder and wrapper supply means independently of the operation of said machine and in the same cycle of operation thereof, means for detecting a line of articles on said belt conveyor of a given length from said feeder and means responsive to actuation of said detecting means simultaneously actuating said machine, said feeder and wrapper supply means, second detector means for detecting reduction of the length of the line of articles below a given length which length is shorter than said first mentioned given length, and means operative in response to said second detector means for simultaneously stopping said operation of said feeder and wrapper supply means independently of the continued operation of said machine.

17. A wrapper control system as in claim **16** wherein a further detecting means are provided for detecting a reduction of the length of the line of articles on said conveyor below a length intermediate the lengths detected for said first and second detecting means, and means

responsive to actuation of said further detecting means are provided for initiating operation of said machine, feeder and wrapper supply means at said considerably reduced rate.

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