

[54] **A SELECTIVE CONTROL SYSTEM FOR DISPATCHING ARTICLES ON A CONVEYOR**

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[51] Int. Cl. ...**G06k 17/00**, **G11b 27/14**, **G05b 19/30**

[58] Field of Search 340/172.5; 209/74, 114, 122; 214/11; 118/2; 307/40

[56] **References Cited**

UNITED STATES PATENTS

3,384,237	5/1968	Leonard.....	209/122
3,356,061	12/1967	Wiggins.....	118/2
3,105,601	10/1963	Smoll.....	214/11
3,198,351	8/1965	Paglee.....	214/11
3,223,255	12/1965	Graybeal et al.	214/11

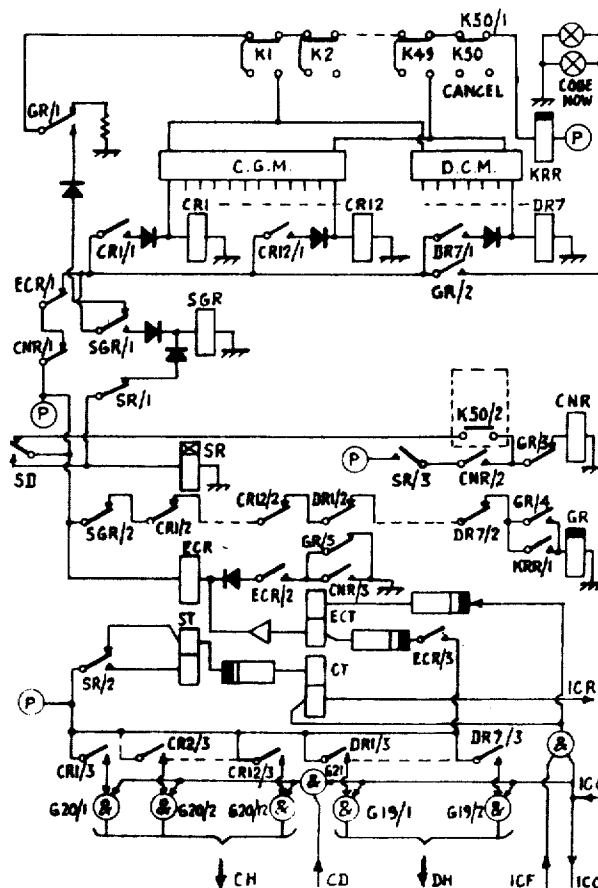
3,571,807	3/1971	Candy.....	340/172.5
3,272,354	9/1966	Harrison et al.....	214/11
3,328,597	6/1967	DeWitt et al.....	307/40
3,593,308	7/1971	Fagan.....	340/172.5
3,260,349	7/1966	VanderMeer.....	104/88
3,576,540	4/1971	Fair et al.....	340/172.5
3,610,159	10/1971	Fickenscher.....	104/88
3,312,949	4/1967	Henig.....	340/172.5

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[57] **ABSTRACT**

A control system is proposed which is of more special but not exclusive application to the dispatching of articles on a conveyor and where the conveyor can be carrying many objects at one time which are destined for discharge at different points. Dispatching of an object is accompanied by entry into a computer type store of a count representation and a representation which identifies the action to be performed when the count representation has been decremented to a significant value. Decrementing of the count representation is effected after predetermined elapsed intervals or events which in the case of the conveyor system correspond to set distances covered by the conveyor.

7 Claims, 5 Drawing Figures



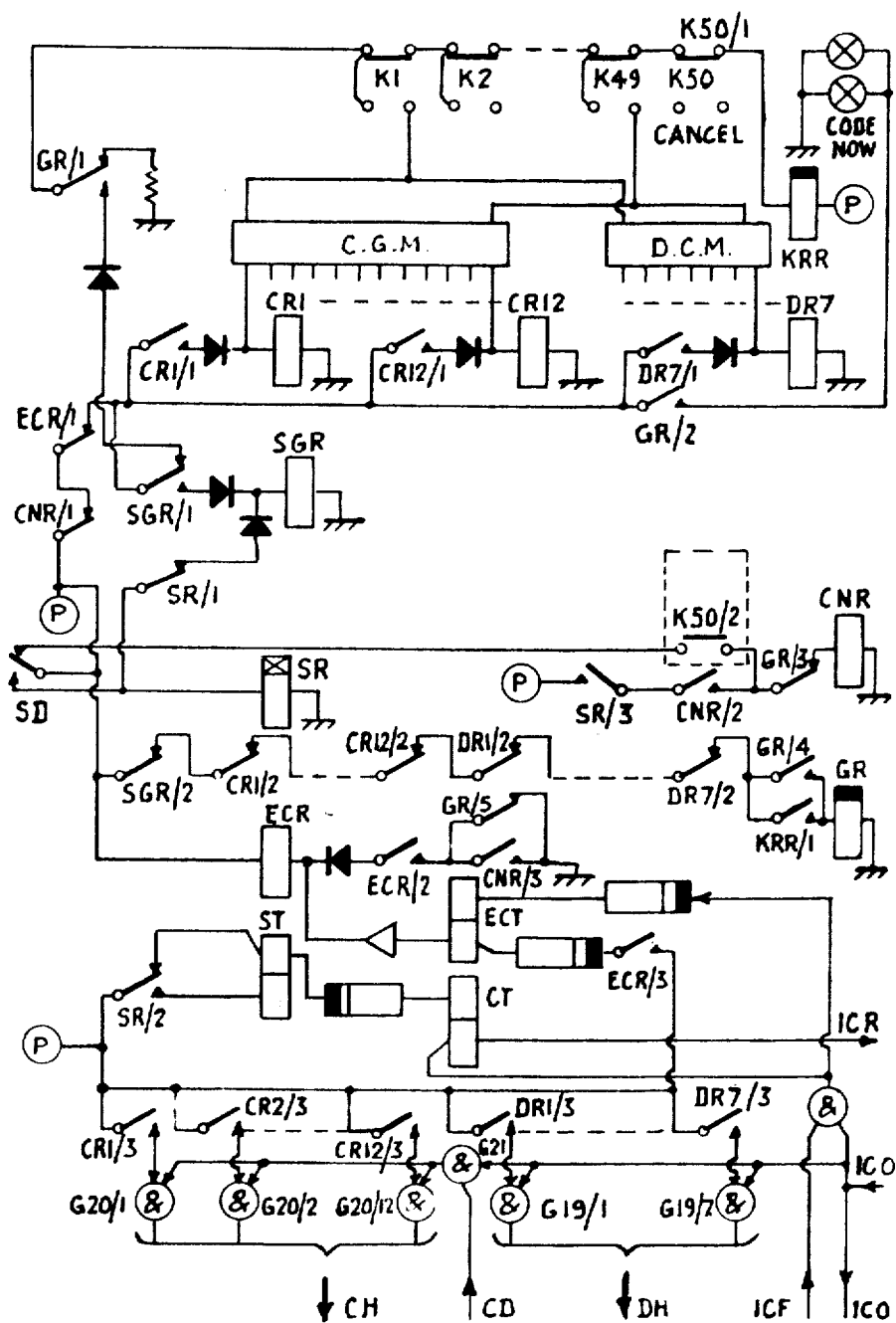


Fig. 1.

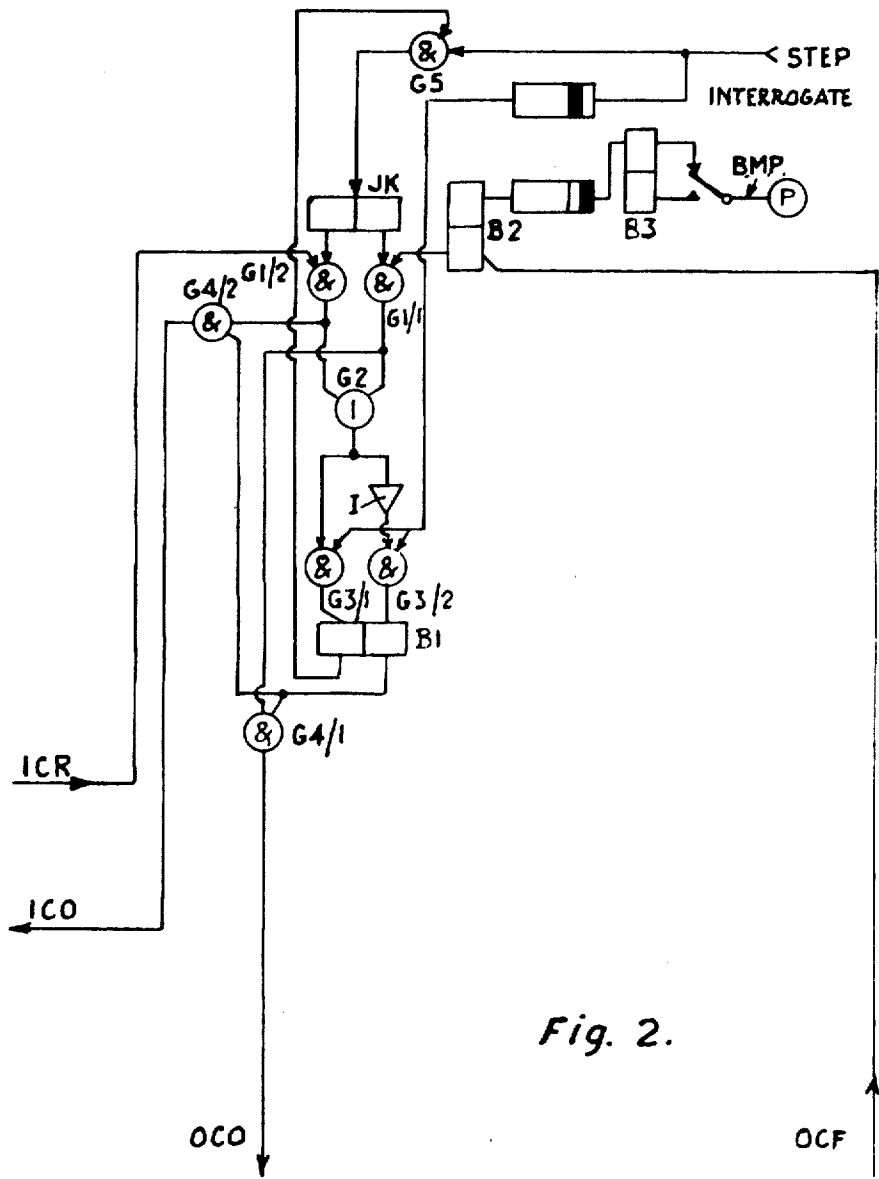


Fig. 2.

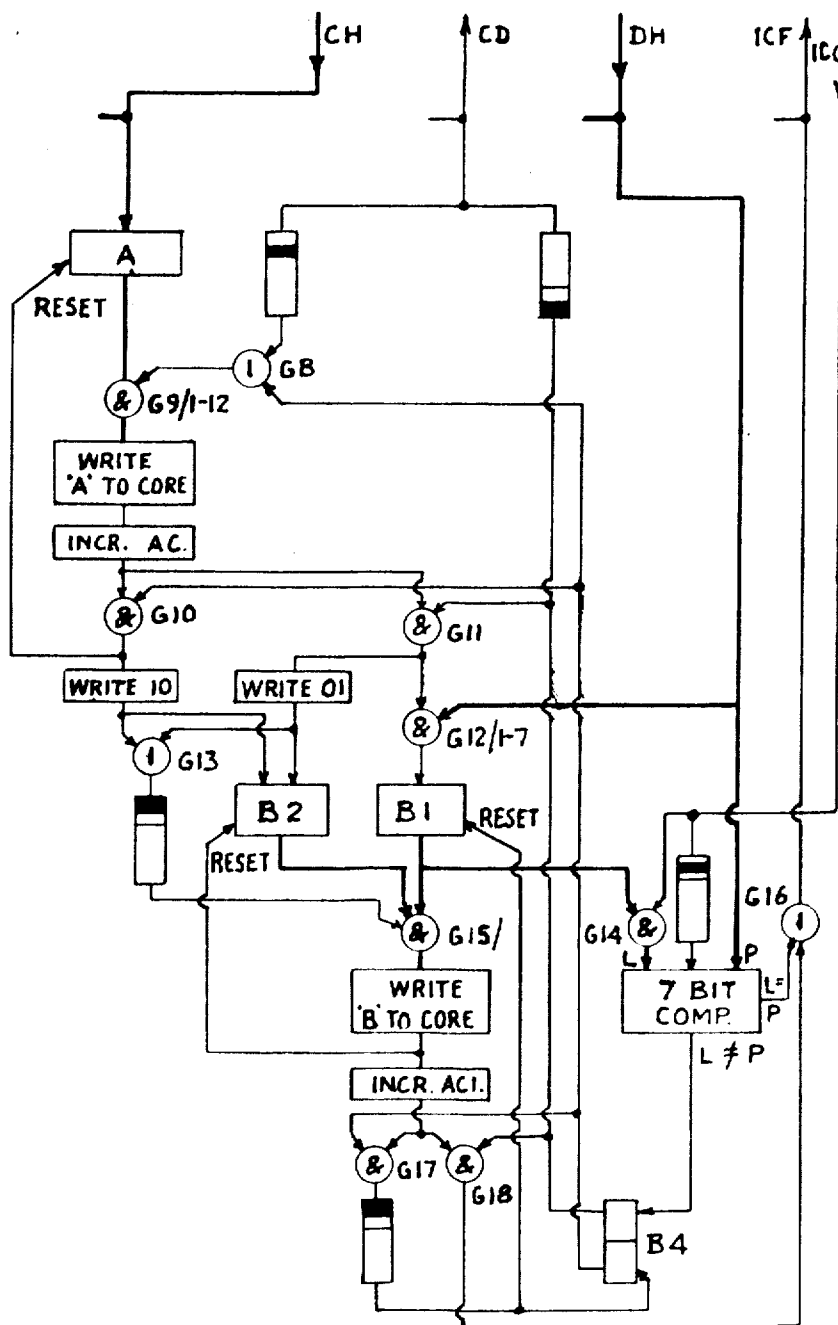


Fig. 3.

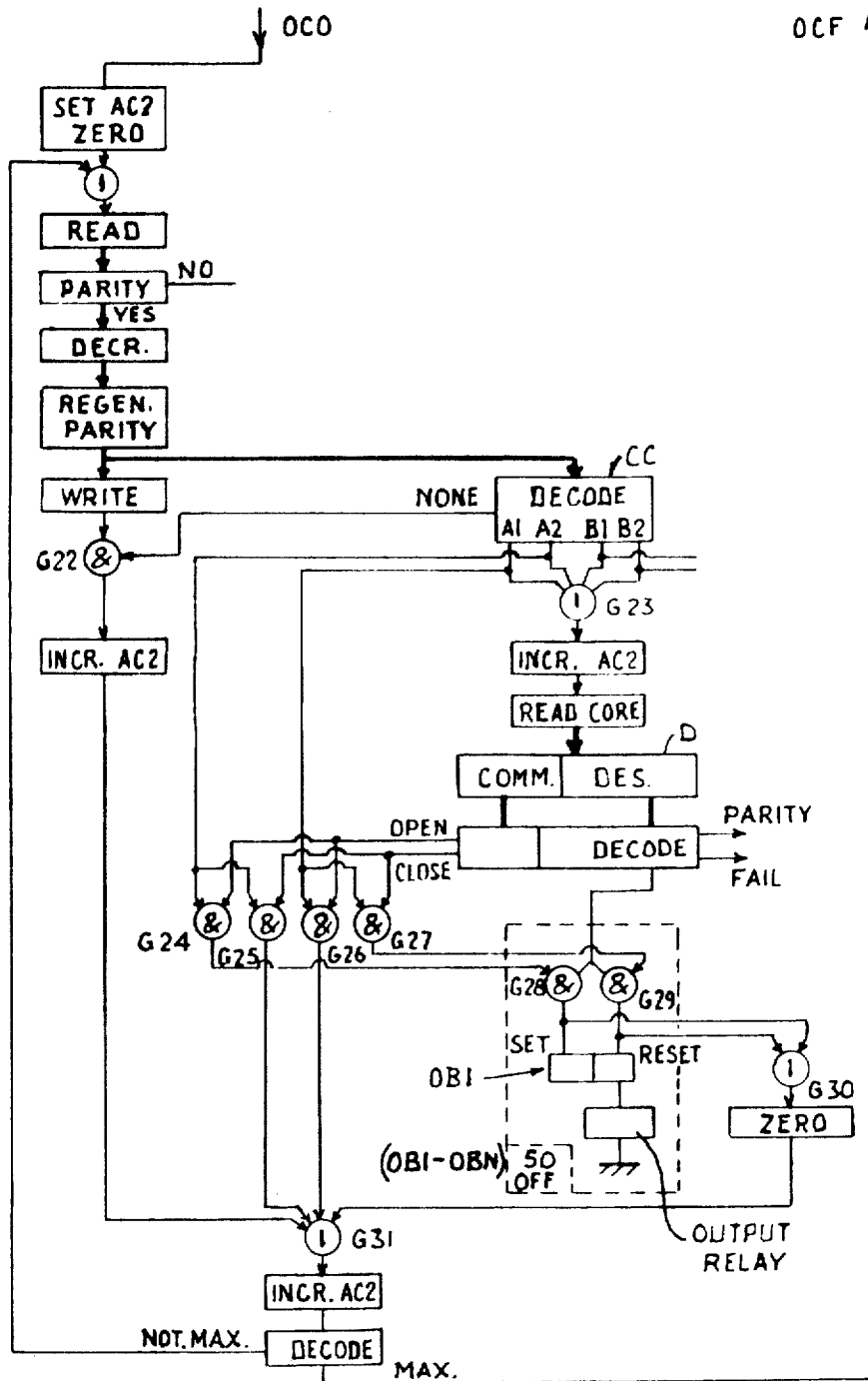
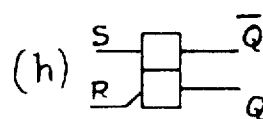
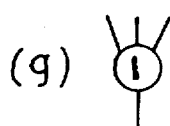
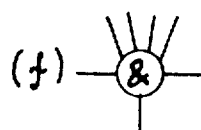
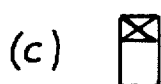
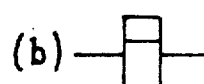
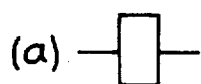
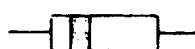


Fig. 4.



(i)



(j)



(k)

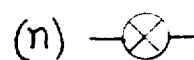
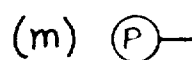
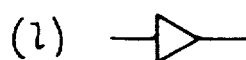
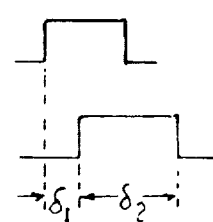
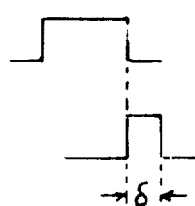
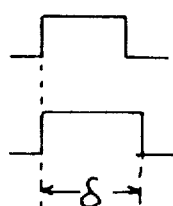


Fig. 5.

SELECTIVE CONTROL SYSTEM FOR DISPATCHING ARTICLES ON A CONVEYOR

FIELD OF THE INVENTION

This invention relates to control systems for controlling actions with regard to objects at points along their route and relates more especially but by no means exclusively to apparatus for controlling a parcel sorting machine.

BACKGROUND OF THE INVENTION

In control apparatus for controlling actions in respect of routed objects at points along their route, such for example as in a parcel sorting machine of the type employed in Post Office Sorting Departments, it is desirable for the facility to be provided to enable an operator to place an object on a conveyor and operate a key indicative of the required destination or route to determine at what point the object is to be released from the conveyor.

A problem exists in this connection in that it is normally required that a substantial number of objects may be travelling simultaneously along the conveyor and it is therefore necessary that actions pertaining to the objects, in the form of opening of selected gates shall be effected selectively at the required positions of the conveyor.

It may readily be appreciated also, that where in the event, for example, of a parcel for a destination proceeding along a conveyor in a parcel sorting machine, this parcel is followed by a further parcel for a different destination, a desired one of a series of gates provided along the conveyor is required to open when reached by the first parcel to allow the first parcel to pass through it but to close again before the following parcel can pass through it.

Further, it may be desirable in certain forms of sorting apparatus, to arrange that a gate opened for the passage of a first object may remain open in the event of the first object being followed immediately by a further object destined for the same gate.

SUMMARY OF THE INVENTION

According to the present invention there is provided a control system for controlling actions with regard to objects travelling along a predetermined route including main storage means, means for successively recording in said storage means in respect of each of a plurality of successive objects a first count representation for predetermining the number of intervals to elapse between the object passing between a predetermined point and a point at which an action is to be initiated, for recording a first action representation by which the action to be initiated is identifiable, decrementing means responsive to successive such intervals elapsing for decrementing the first count representation and response means responsive to a predetermined significant decremented representation being attained for initiating readout of the action representation and applying it to select the respective action to be initiated.

It is to be understood that elapsed intervals may be intervals of fixed time, distance or mere intervals between occurring events.

The system may also incorporate means for setting up in registers representations of the count representa-

tion and the respective action representation for an object being committed to the apparatus and the means for making a comparison of the action representation set up with a stored action representation for the previously committed object to enable in the event of the compared representations being the same the action effective on said previous object to be effective also on the object being committed.

Where such means for making a comparison as are referred to in the previous paragraph are provided, the apparatus may be operable in the event of said action representations not being the same, to read into a first location of the storage device the count representation corresponding to the previous object and into the respective second location a representation of the action to be removed.

First and second buffer storage means may also be provided for storing count and action representations respectively corresponding to the previous object, the apparatus being operable following said comparison for utilizing said buffer stores to receive the count and action representation for the object being committed for subsequent non-destructive read out into respective first and second address locations of the storage means.

The logical functioning of the apparatus may be effected by providing means for generating a repetitive clock signal the frequency of which is many times greater than the rate of occurrence of said successive intervals, a scanner circuit being responsive to said clock signals for alternately scanning a number of inputs at which signals appear corresponding respectively to the passage of an object past a start point (preferably said predetermined point) and the passage of said successive intervals to initiate the appropriate logical functioning of the apparatus.

It may further be mentioned that the representations of the actions to be performed with regard to the respective objects may preferably comprise two parts, one part representative of the location of an action and the other part representative of the action to be effected at the respective location.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the present invention may be more clearly understood and readily carried into effect, the same will be further described by way of example, with reference to the accompanying drawings in which:

FIG. 1 illustrates in diagrammatical form a keyboard of a Post-Office Sorter together with associated interface and input circuits for object routing apparatus for controlling a Post Office type Sorter,

FIG. 2 illustrates a scanning circuit operable to select the appropriate logical functioning of the apparatus,

FIG. 3 illustrates input cycle control apparatus which governs the initial reading in of representations to the storage means,

FIG. 4 illustrates output controlling apparatus which governs the initiation and selection of the appropriate action to be taken on objects, and

FIG. 5 illustrates logic circuit symbols used in FIGS. 1 to 4.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Before details of description of the specific apparatus is given which is illustrated in the drawings, it is convenient to discuss the apparatus in general terms. The specific apparatus illustrated is intended to control a Post Office Sorting Machine which comprises a belt conveyor along the sides of a sloping belt of which there are provided at spaced intervals, outlet gates which are required to be opened to permit the discharge of parcels from the conveyor to correct further routes or bags.

In order to achieve the above result, the operator is provided with a keyboard and on committing a parcel to the conveyor, an appropriate destination key is pressed and this is required to initiate the opening of the appropriate gate from the conveyor when the parcel in question arrives thereat. If moreover, the next parcel on the conveyor is destined for the same gate, it is desirable but not essential that this gate remain open to accept the next parcel also.

The apparatus operates by utilizing a main storage means in the form of a magnetic core storage device and operates by counting down codes stored in locations in the storage device corresponding to the distance from a predetermined point determined by the passage of a parcel past a synchronizing unit to the discharge gates of the conveyor. The relevant initial count for a gate is entered by the apparatus into the storage device whenever a parcel is committed to the conveyor, an appropriate key is depressed on the keyboard and a synchronizing signal is received to indicate that the parcel has reached a fixed reference point on the conveyor. All the count representations in the storage means are decremented by a specified amount after the passage of the conveyor through each successive interval, of say, 2 inches and when the decremented count in any particular address location in the storage means reaches a significant count (say zero), a corresponding action representation also stored in the storage means is read out to initiate the opening of the appropriate gate of the conveyor.

Two features which may be included but which are not always essential may now be briefly mentioned:

When the next parcel is committed to the conveyor, similar count and action representations may be entered to the storage means in a similar manner and these may be used to initiate the closing of the gate for the first parcel before the second parcel reaches it.

The apparatus may also be provided with means whereby each count representation may be used more than once to initiate actions which are separated by fixed intervals of time or distance. For example if the action to be performed consists of a two-part motion then two different count levels may be recognized as significant for the initiation of the two different parts of the action, and/or two different levels may be recognized as significant for the initiation of open and/or close instructions, thereby providing a means of adjusting the logical timing to allow for time delays in mechanical operations.

From the foregoing it may be appreciated that two basic logical functions have to be performed by the apparatus. Firstly, when a parcel is passing a synchronization point at the start of its journey down the conveyor,

after depression of an appropriate key by the operator, information corresponding to the depression of the key is required to be stored in the storage means. Secondly, after the passage of the conveyor over each successive predetermined interval of say, 2 inches, the apparatus is required to decrement the count representations in the storage means, correspondingly to the intervals covered and to look at the decremented count representations to ascertain whether a significant count at which an action should be initiated has been reached.

As will be seen hereafter, the initiation of these actions is effected by a cycle access scanner which is illustrated in FIG. 2 and this looks in turn for a 2-inch movement pulse from the conveyor and for a synchronizing pulse from a photo-electric detector which detects the presence of a parcel at the predetermined start or reference point for the conveyor. The scanner scans the inputs at a frequency determined by a clock pulse generator which is much higher than the frequency of occurrence of the predetermined intervals associated with the conveyor. When either signal is sensed, the cycle access scanner interrupts scanning and drives the appropriate logical function.

Considering in general terms the input cycle referred to above, when a keyboard key is operated, a "code now" lamp, which is shown in FIG. 1, is extinguished and the keyboard is inhibited from further operations and two code words are generated. The first of these code words is a count representation which determines the necessary conveyor travel before the associated parcel is to be discharged. The second code word contains information as to which of the conveyor gates is to be operated for this particular parcel and constitutes part of the subsequently to be produced action representation. It may be useful moreover at this point to mention that action representations stored in the storage means comprise a destination word which indicates which of the conveyor gates is to be operated for a particular parcel and also an instruction as to what the nature of the operation (i.e. open or close) is. The two words set in by the keyboard are then held to await the arrival of a synchronizing pulse indicating the passage of the parcel past a predetermined point. In addition, a cancel key is provided which the operator can depress in the event of making an erroneous keyboard operation to return the stored information to zero.

When the synchronizing pulse is received to direct the cycle access scanner to initiate an input cycle, the destination word for the present parcel is compared with a stored destination word for the previous parcel and if these two words are the same, that is there are two consecutive parcels on the conveyor for the same destination, no further action is required to be taken and the cycle access scanner is released again to the scanning mode of operation. If however, the two destination words are different, stored count and destination words for the previous parcel are written into respective core locations the latter word also being accompanied by two command code bits to indicate a "close" action command. Thus the core store will now carry in respect of the previous parcel not only a count, destination and action code for opening a gate but also a count destination and action code for closing that gate. The count and destination words for the present

parcel are then read into buffer stores which previously held the previous parcel information and also into the next two address locations in the core storage device. The access scanner is then released again to the scanning mode.

Referring now to output cycle operation in general terms, when the cycle access scanner is instructed by receiving an input pulse corresponding to the passage of a predetermined interval of distance, each count word in the storage device is decremented and checked and if the result of the check is significant and indicates that a point of the conveyor passage has been reached where an action is to be effected, the next address in the core storage device is read out and this carries the destination and action word by way of an "action" representation. The code read out is utilized to initiate the appropriate opening or closing action for the conveyor gate in question. It will be recalled that all the count words in the storage means are decremented at each predetermined interval of the conveyor movement and following each such output cycle, the access scanner is released to its scanning mode.

From the foregoing and particularly with reference to the general outline of the operation of the input cycle, it may be appreciated that the core storage device is required, in the event of one parcel on the conveyor being followed by another parcel destined for a gate which is different from the gate for which the first parcel is destined, to provide count and action representation storage for the opening of the first gate and the closing of the first gate. Accordingly, the storage device is required to have a maximum of two count storage locations for each possible parcel on the conveyor and two action storage locations for each possible parcel on the conveyor. Thus, for a conveyor which from a practical point of view will carry no more than 64 parcels, the storage device is required to have 256 storage locations or addresses. It is convenient moreover for the count code representations to be stored in "even" addresses in the storage device and for destination and command or action representations to be stored in "odd" addresses of the storage means.

Bearing in mind the above, it will be appreciated that for the purposes of the output cycle operation, the apparatus is required to decrement the codes only in the even locations of the storage device. Further, the apparatus is arranged so that for a count representation stored at an even location of the storage device, the corresponding action or destination and command representation is stored in the next odd location in the storage device.

In order to provide the selection of the locations within the storage device, two separate address location counters, which may be referred to as AC1 and AC2, not shown in the drawings, are provided. AC1 provides that instructions regarding successive parcels loaded to the conveyor will be entered to successive locations of the storage device. AC2 is independent of AC1 and controls the decrementing of count representations in all "even" locations during output cycles and AC2 also operates to identify the location of an appropriate action representation when a significant count is attained.

Reference may now be made in greater detail to the present example of the invention with reference to

FIGS. 1 to 4 of the drawings referred to above. However, reference to FIG. 5 will first clarify the logical symbols used.

Referring to FIG. 5 the symbol shown at (a) is a normal relay, symbol (b) is a slow to release relay and the symbol at (c) is a slow to pick relay.

The relay contacts shown at (d) and (e) are normally open and normally closed (back) contacts.

The symbol (f) represents an AND gate in operation of which the output is a 1 output only when all inputs are 1 inputs. The symbol (g) represents an OR gate in operation of which the output is a 1 when any input is a 1 input.

The symbol (h) represents a bistable toggle or latch, in operation of which an input at S going momentarily to a 1 condition sets output Q to a 1 output and sets output $\bar{Q}$ to a 0 output. An input R going momentarily to a 1 condition sets output Q to a 0 state and sets output $\bar{Q}$ to a 1 state.

Symbols (i), (j) and (k) are timing elements. Symbol (i) represents an element which in operation produces a fixed pulse of duration δ from the beginning of an input signal. Symbol (j) is an element which in operation produces a fixed pulse of duration δ from the trailing edge of an input signal and element (k) in operation produces after a fixed delay $\delta 1$ from the leading edge of an input signal, a fixed pulse of duration $\delta 2$. These functions are illustrated diagrammatically beneath the symbols (i), (j) and (k).

Symbol (l) represents an inversion element which produces a 1 output in response to 0 input and vice versa.

Symbol (m) represents wherever shown, a positive supply point with respect to common or ground.

Symbol (n) represents an indicator lamp.

For the sake of clarity, it is to be understood that a logic state 1 is a voltage level approximating to the supply voltage and a logic state 0 corresponds to ground voltage.

Referring to FIG. 1, this shows a count generating matrix CGM and a destination generating matrix DGM connected to a keyboard having keys, K1 to K50, K50 being a "cancel" key. Also shown is the "code now" lamp referred to above and the power supply terminals denoted P for convenience. In addition, a number of relays are provided which are best referred to in discussion of the operation. The relays and switches are shown in the quiescent or de-energized condition and on applying the power to the circuit, provided that no keys on the keyboard are operated, the "all keys released" relay KRR will be operated, the contacts GR1 of the guard relay GR and the keys K1 to K50 being in the de-energized condition. The matrix CGM has associated registers with relays CR1 to CR.12. The matrix DGM has register relays DR1 to DR7 and provided there is no stray information on the registers, so that the above mentioned register relays are all de-energized and the contacts thereof are in the condition shown, the closure of the relay KRR energizes the guard relay GR over the contacts SGR/2 of the synchronizing guard relay SGR. The guard relay is therefore latched over its contacts GR/4 and the operation of contacts GR/3 de-energizes the cancel relay CNR, any previous cancel function now being complete. Operation of contacts GR/5 to the energized

condition and de-energization of the cancel relay open-circuits the "end of cycle" relay LCR which therefore enables the power supply to be connected to the keyboard via GR/1, CNR/1 and ECR/1. Also, the latching on of the guard relay GR disables the current path to the relay KRR the function of which is now completed. The "code now" lamp is also illuminated via contacts GR/2, CNR/1 and ECR/1.

Assuming now that the operator depresses one of the keys K1 to K49 of the keyboard and admits a parcel to the conveyor, appropriate count codes and destination codes are registered in the register relays CR1 to CR12 and DR1 to DR7 and by virtue of operation of one or more of these relays, the guard relay GR is de-energized and the power supply to the keyboard is again inhibited. When the synchronization relay detector SD is operated, the synchronization pulse energizes the synchronization guard relay SGR/ and this is latched over SGR/1. It will be understood that detector SD is operated by the parcel traversing a fixed detector located at a predetermined point along the conveyor route. Operation of the relay SGR/2 to the open condition also contributes to the keyboard being inhibited by preventing energization of the guard relay GR. After a slight delay in picking, the slow to pick "synchronization" relay SR picks and operation of contacts SR/1 removes the pick supply from SGR which is now held over SGR/1 until completion of the cycle. Also, operation of contact SR/2 operates the synchronization toggle ST which sets the input cycle demand toggle CT to produce an output signal on the input cycle request line 1CR. On application of the input cycle request signal to the cycle access scanner, the scanner subsequently produces an "input cycle on" signal on the "1CO" line and this signal operates the gates G19/1-7 to enter the "destination" representation to the input cycle, renders the gate G21 operable by a signal CD to be referred to in connection with FIG. 3 and starts the input cycle.

Considering now the input cycle operation of the circuit arrangement in FIG. 3, the signal 1CO as referred to above satisfies the gates G19/1 to G19/7 in the input interface circuit and gates G14/1 to G14/7 (shown for simplicity in the drawing as a single gate G14) interrogate a seven bit comparator circuit which then operates to compare the "destination" code for the previous parcel, if any, stored in buffer store B1 and the destination word which is now fed in via gates G19/1 to G19/7 corresponding to the present parcel. If the two parcels are for the same destination, it is not necessary to take any action for, as explained previously, an operation of a conveyor gate to receive the first parcel can persist to receive the second parcel without any particular instruction to the machine. The comparator therefore, under these conditions, provides an output to the OR gate G16 to produce an "input cycle finish" signal on the line marked 1CF in the drawing. The effect of this signal will be appreciated hereafter.

If the two parcels are for different destinations, the comparator produces an output signal to set the bistable circuit B4 to the on condition to produce an input to the OR gate G8 which therefore renders the gates G9/1 to G9/12 (again shown as a single gate) operative to gate from buffer store A the "count" word for the previous parcel (if any) on the conveyor to the next available even address or the core storage device. On

completion of read-in of this "count" word, the address counter associated with the selection of addresses for the input cycle is operated to set the next available address in readiness for the next incoming count information thereto. Thus, the address counter can be said to be incremented by one.

Following this, the gate G10 resets the buffer store A as indicated by the connection therefrom in the drawing, to a zero condition and sets the buffer store B2 to a condition 1-0 to represent a "closed" gate command for the conveyor gates. Setting of the buffer store B2 to the condition 0-1 can alternatively be effected when required to represent the "open" gate command for the conveyor. The OR gate G13 is then satisfied by the read-in signal to the buffer B2 and operates to satisfy the gates G15/1 to G15/9 (again shown as a single gate for convenience) to gate the "destination" word and the "close" gate command as a combined "action" word from the buffer stores B1 and B2 into the next "odd" address location in the core store. On completion of this the address counter is again incremented by one and the same signal is utilized to reset the buffer store B2 to a zero condition. Following incrementing of the address counter, the AND gate G17 is satisfied and the buffer store B1 is reset to zero, the bistable circuit B4 also being set to the original condition.

Resetting of the bistable circuit B4 provides an input signal CD to the gate G21 which therefore gates the "count" word for the present parcel into the buffer store A and the OR gate G8 is subsequently satisfied by a delayed pulse to write the contents of the buffer store A into the next core location of the storage device. When the reading operation is complete, the address counter is again incremented. Gate G11 is then satisfied and as mentioned previously sets buffer store B2 to 0-1 which represents an "open" instruction. The operation of Gate G11 also satisfies gates G12/1-7 which operate to enter the "destination" word for the present parcel into the buffer store B1. As before G13 is satisfied and after a slight delay, the contents of the two buffer stores B1 and B2, are combined as an "action representation" and are read into the next core address of the storage device via gates G15/1-9. The buffer store B2 is subsequently again reset to the zero condition and the address counter for the storage device is again incremented. The gate G18 is now satisfied by virtue of B4 being in the reset condition and the "input cycle finish" cycle 1CF is produced.

It may now be appreciated that as foreshadowed previously, the input cycle operated logic has read into the core storage device, a "count" word in one location (address say 20) and a combined "close" and "destination" word in the next location (address 21), both words referring to the last parcel entering the machine, and a "count" word in the next location (address 22) and a combined "open" and "destination" word in the next location (address 23), both the latter words referring to the parcel just entering the machine. It will be observed from the sequence of operation therefore that in each case, the "count" word is read into an "even" address location of the core storage device and the "action" words are read into the "odd" address locations of the storage device.

It is convenient now to refer to the logical circuit arrangement outlined in the diagram of FIG. 4. Again, it

can be assumed that the cycle access scanner has reached a point at which a 2-inch movement of the conveyor belt has been reached and as soon as the cycle access scanner is in a position to revert to output cycle operation, the cycle access scanner produces an "output cycle on" request signal to the line labelled OCO in FIG. 4 in a manner to be described hereafter the immediate effect of this is to set a further address counter AC2 not shown to the zero condition in readiness for the commencement of sequential operation on the "count" representations at all the even locations of the core storage device.

The successive operations are illustrated for convenience and ease of understanding by blocks in the diagram of FIG. 4. Thus, on resetting of the address counter to the zero, the OR gate in the output lead thereof, passes a read core command and following a parity check, if satisfactory, the contents of the first core location are decremented by one unit (corresponding to a 2-inch step of the belt) the parity is regenerated and the code is reread into the same core location. In addition, the decremented code is decoded and checked in the checking circuit CC for the presence of a significant level, that is, a count level corresponding to the arrival of a parcel at a point at which a gate is to be opened or closed.

Assuming that the check of the count is not significant, the checking circuit produces an output to the AND gate G22 and the output thereof increments the address counter and subsequently applies an input to the OR gate G31.

At this point reference may be made to the situation where a count in the checking circuit proves to be a significant count, that is, it represents a level at which an action is required to be effected, one of the decoder outputs satisfies the OR gate G23 and the address counter is incremented so that the address which is now set by the address counter is the next following odd address in the core storage device and this address is read out into a buffer store denoted D in FIG. 4. The read out representation is therefore an "action" representation consisting of a "destination" word and an "open" or "close" instruction.

The instruction bits from the buffer store D are decoded to produce an open or close command on the appropriate output lead and the "destination" bits are decoded to one of 49 separate lines (the number of gates in this case associated with the conveyor) to select the gate to be acted upon. For simplicity only one such line is shown.

The "count" level producing a particular output A1 (say) from the decoder is arranged to be the highest significant count and corresponds in this embodiment to a "close" gate command.

If the instruction bits decode to produce a "close" instruction and the count level gives rise to an output A1 of the decoder, the AND gate G27 is satisfied and G29 resets the output bistable OB (of which only one OB1 of the 49 in this case is shown) corresponding to the decoded destination.

If the instruction bits decode to give rise to an "open" instruction and the decoded "count" level is A2 (say), the gate G24 is satisfied and the output bistable in question is set to the "on" position by the gate G28. Outputs from G28 or G29 are operable via OR

gate G30 to produce a signal to "zero" the destination word from the respective location in the core store. The end of zeroing this operation provides an "input" to the OR gate G31. Under these conditions therefore the appropriate instruction is applied by the respective output bistable (via connection not shown) to the requisite gate of the conveyor. The core store is subsequently incremented by virtue of the output from the gate G31 (which latter action is also effective in the event of a non-significant count level being detected) and assuming it is not at the maximum count, the decoder proceeds to read out the next odd location of the core storage device and the sequence repeats right through each odd location until the address counter decodes to the maximum value. At this point, the signal OCF representing the finish of the output cycle is produced on the line so marked in FIG. 4.

In FIG. 4 the count decoder and comparator CC is shown having two output points A1 and A2 and two further output points B1 and B2. A1 and A2 correspond as indicated above, to significant counts for "close" and "open" actions respectively for the conveyor gates. If, as is often required, groups of gates are to be operated, that is a given destination comprises more than one gate, the output points B1 and B2 corresponding to further significant counts are utilized in respect of "close" and "open" commands respectively for the further gate or gates, operation being thereby subjected to delay as compared with operation of the A gates. In this case similar gates and control logic associated with the decoder are provided. Further, the "write" zero command for the action representation in the core location is postponed until the significant B1 or B2 output has been effective.

In the interest of understanding of the more important and significant aspects of the operation of the arrangement, the description of the cycle access scanner has been postponed and will now briefly be referred to with reference to FIG. 2.

The cycle access scanner has two basic inputs, one being the signal ICR derived from the interface circuit illustrated in FIG. 1 and occurring following operation of the keyboard and synchronization detector SD. The other basic input to the cycle access scanner is a belt movement pulse which appears on line B.M.P and occurs for every two inch movement of the conveyor belt. This can be derived from a suitable switching device coupled to the belt drive mechanism. The cycle access/scanner further receives at the input marked STEP, clock pulses from a multi-vibrator not shown, the nominal frequency of which in this case is about 10 KC/S but can be varied to suit the applications. As mentioned previously, the clock pulses operate to alternately look at the ICR and BMP line to initiate an appropriate input or output cycle as soon as it is opportune to do so.

A toggle circuit B3 is connected to follow the state of the belt movement pulses and each time B3 sets, a pulse is generated via a fixed pulse width generating device. This operates a bistable circuit B2 which is resettable at the end of an output cycle by the OCF signal regardless of the state of B3.

Assuming there is no input on the ICR line, and that bistable circuit B2 is in the unoperated or reset condition, the OR gate G2 produces no output and therefore,

by virtue of the inverter 1, the bistable circuit B1 is operated. Successive step pulses corresponding to the leading edge of the clock waveform, satisfy the gate G5 and set the bistable flip-flop circuit JK alternately from one state to the other. When B2 is operated, the next output from the right hand side of the bistable JK satisfies the gate G1/1 and a corresponding interrogation pulse satisfied the gate G3/1 but not the gate G3/2. Therefore the reset state of the bistable B1 is produced. This inhibits the gate G5 to inhibit further step pulses from the bistable flip-flop JK. Moreover, with the bistable B1 in the reset condition and the gate G1/1 satisfied, the gate G4/1 is satisfied which gives a signal representing output cycle on, on the line marked OCO. As will be recalled, this constitutes an input to the output cycle logic described in the foregoing with reference to FIG. 4. On completion of the output cycle, the signal OCF is produced as referred to previously with reference to the operation of FIG. 4 and this sets the bistable circuit B2 to the reset condition and the next trailing edge of an input clock pulse which constitutes an interrogate signal, satisfies the gate G3/2 and therefore sets the bistable B1 permitting step pulses to again reach the bistable flip-flop JK and the scanning continues.

When an input cycle request signal appears on the line ICR, and the gate G1/2 is satisfied by the appropriate condition of the bistable flip-flop JK, with the bistable circuit B1 in the set condition. The gate G4/2 is therefore satisfied to produce an input cycle on signal ICO to the input cycle logic described in the foregoing with reference to FIG. 3. The scanning is interrupted by virtue of removal of the input from bistable B1 to the gate G5. The operation continues until the end of the input cycle as determined by the ICF signal as derived from the input cycle circuit which removes the input cycle request signal ICR from the cycle access scanner so that the scanner then reverts to the scanning condition.

Returning now to the interface and the keyboard equipment referred to previously with reference to FIG. 1, on receiving the "input cycle on" signal on the line ICO, it will be recalled that the input cycle is commenced and at the conclusion thereof, the input cycle finish signal ICF is produced which thereby resets the bistable CT removing the input cycle request ICR and sets the end of cycle toggle ECT. Setting of the toggle ECT initiates the "end of cycle" sequence by energizing the end of cycle relay ECR and energization of the contact ECR/1 to open state removes energization of SGR ready for the reception of a new synchronizing pulse corresponding to the committal of a new parcel to the conveyor. In addition, the register relay contacts CR1 to CR12 and DR1 to DR7 are reset thereby in readiness to receive the new input determined by a further operation of the keyboard. Energization of the contact ECR2, removal of energization of GR/5 or energization of CNR/3 gives rise to energization and latching one of ECR until the cancel function of the logic is completed and the relay GR is energized. Energization of ECR/3 gives rise to removal of energization of ECT thus resetting the pick signal to ECR. With the contact GR/1 as yet unenergized and the keys K1 to K50 unoperated the relay KRR is energized to prove that all keys are released and the energized contacts

KR/1 together with the de-energized contacts SGR/2 and the register relays proving that all information is set at zero, enables the relay GRR to be re-energized as discussed at the commencement of the earlier description of the operation of the keyboard.

As mentioned earlier, a cancel button K50 is provided on the keyboards and this enables the operator to cancel the previous keyboard operation when he realizes that an error has been made in operating the keys, always provided that a synchronization signal has not yet been effective to cause the access scanner to commence an input cycle. Assuming that a wrong key has been depressed and that the operator depresses the key K50 this inhibits incorrect routing. The fact of a key having been operated results in relays KRR and GR being de-energized and operation of K50 picks cancel relay CNR which holds over contacts CNR/2 and SR3. Operation of contact CNR/1 then removes the supply feed to CR1-12 and DR1-7 and GR picks over KRR1, SGR2 and CR1/2 etc., on the proviso that a synchronization pulse has not been received. The picking of relay GR thus releases the cancel relay in readiness for a further code to be entered by the keyboard.

In some applications it may be desirable that the distance or time interval between the closing of a gate and the arrival at that gate of a parcel which is not to be discharged by that gate should be adjustable independently for each gate without affecting the corresponding interval between the opening of the gate and the arrival of a parcel which is to be discharged. This may be simply achieved by the addition to apparatus shown in the drawings of the following items:

In FIG. 1 an additional "Count Generator Matrix" with corresponding additional register relays CR1(a) to CR12(a) and selection gates G20(a)/1-12. The inputs to the two Count Generator Matrixes are then derived in parallel from a single keyboard operation.

In FIG. 3 an additional set of gates G9(a)/1-12, such that the input from interface gates G20/1-12 is now entered via G9/1-12 directly to the core storage device after B4 has been returned to its reset condition, while the input from interface gates G20(a)/1-12 is stored in Buffer Store A and entered into the core storage device via gates G9(a)/1-12 when B4 is in its "set" condition. It may thus be obtained that the two "count" words used to determine the opening and closing of one gate may be obtained from independently adjustable matrixes, in place of the common adjustable matrix previously described.

In the foregoing description it has been observed that the action representations recorded in the main storage means occupy storage addresses which alternate with addresses which carry count representations. Also, the action representations constitute two code parts, one to represent the action and the other to identify the means for performing the action. It is to be understood in this connection that in certain applications of the invention, the part constituting a representation of the action pertaining to a particular count representation may be recorded in the same address as the respective count representation, representations for identifying the means to perform the actions being recorded in the interleaved addresses. In this event, the input and output cycle logic described with reference to FIGS. 3 and 4,

of the drawings requires modification in respect of the logic, firstly to ensure recording of the respective parts of the action representations in the correct addresses and secondly to initiate correct readout from the respective addresses on the attainment of the requisite significant decremented count representations.

The above is but one variation of the logic which may be readily comprehended by the skilled engineer.

It will be appreciated that the specific embodiment of the present invention as applied to a parcel sorter has been described partly in terms of logic but since the logical components referred to in the description are all components of a type which are well known or readily constructable to persons skilled in the art of electronic logic employing magnetic storage cores and the like, the disclosure of the invention will make it readily apparent to persons skilled in the art in what manner the invention may be effected.

Whilst moreover the present invention has been described in specific relation to a parcel sorter, the invention is not intended to be limited to parcel sorters but to be readily applicable to other forms of object routing apparatus.

Having thus described our invention what we claim is:

1. A control system for an object routing apparatus for controlling diverting of objects from a conveyor, said system comprising: main storage means for providing distinct storage locations for at least one count representation for each of a plurality of objects to be successively routed, said at least one count representation comprising a first count representation predetermining the number of intervals which is to elapse between a predetermined point and a further point at which an action is to be initiated by which the object is to be diverted from the conveyor, and at least one action representation by which the action to be initiated is to be identified, said at least one action representation comprising a first action representation representing a diverting action whereby an object is diverted from the conveyor; means for successively recording a said first count representation in said storage locations in said main storage means for each of said plurality of objects and for recording a said first action representation in said storage locations in said storage means by which the action to be initiated is to be identified; means responsive to the elapsing of successive of said intervals for reading out said first count representations from the corresponding storage locations, for decrementing said first count representations and for reading said first count representations back into said storage locations; comparison means for comparing the decremented first count representations with a predetermined reference and for producing an output signal when a decremented count matches said predetermined reference; response means, responsive to the said output signal produced by said comparison means, for selecting a diverting action to be initiated at said further point when a first decremented count representation produces a match; and diverting means, located at said further point, for diverting an object from the conveyor at said further point responsive to the selection of a diverting action.

2. A control system as claimed in claim 1 wherein said recording means comprises means for recording a

second count representation in said storage means for each of said plurality of objects, said second count representation determining the number of intervals which is to elapse between the passing of the object between said predetermined point and a point at which a further action is to be initiated, and for recording in said storage means a second action representation by which the action to be initiated is identifiable, said second action representation representing a closing action whereby diverting of an object from the conveyor is prevented, said decrementing means decrementing said second count representation responsive to the elapsing of said successive intervals, said comparison means comparing the decremented second count representations with a further predetermined reference and producing a further output signal when a decremented second count matches said further reference, said response means acting responsive to the further output signal produced by said comparison means to select a closing action when a second decremented count representation produces a match, and said diverting means preventing an object from being diverted from said conveyor at said further point responsive to the selection of a closing action.

3. A control system as claimed in claim 2 further comprising buffer storage means for storing the count and action representations pertaining to a last object, further comparison means for comparing an action representation stored in said buffer storage means with the action representation pertaining to a present object and, in the event of these said action representations being the same, retaining the count and action representations in said buffer storage means, and means for applying the count representation and action representation from said buffer storage means to said main storage means when said action representations are different.

4. A control system as claimed in claim 2 wherein said recording means includes independent count representation generating means for generating independent count representations so that the count representations pertaining to different first and second actions are independently predeterminable so as to take account of operating characteristics of a selected said diverting means.

5. A control system as claimed in claim 2 further comprising an input scanner comprising a clock signal generator for producing a clock signal the frequency of which is high in relation to that of said intervals, means responsive to said clock signals from said generator for alternately scanning two inputs one of which corresponds to the passage of an object past said predetermined point and the other of which corresponds to successive said elapsed intervals, and means for discretely initiating an output signal in which representations pertaining to an object are recorded in said storage means or an output signal in which said decrementing is effected, respectively.

6. A control system as claimed in claim 2 wherein said diverting means comprises gate means which open responsive to the first action representation being selected by said response means to permit the discharge of objects from the conveyor and which close responsive to the second action representation being selected by said response means to prevent the discharge of objects from the conveyor.

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7. A control system as claimed in claim 2 wherein said main storage means comprises a magnetic core store, said recording means comprising an address counter for recording the count representations in alternate addresses and representations of actions in intervening addresses, the intervening addresses being arranged to store representations of means for perform-

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ing actions and the respective action, and the alternate addresses being arranged to have recorded therein the representations of the action to be performed by the action performing means identifiable by representations stored in respective intervening addresses.

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