April 30, 1963 W. R. CLORE 3,087,598

ARTICLE DISTRIBUTION SYSTEM

Filed Oct. 1, 1958 3 Sheets-Sheet 1

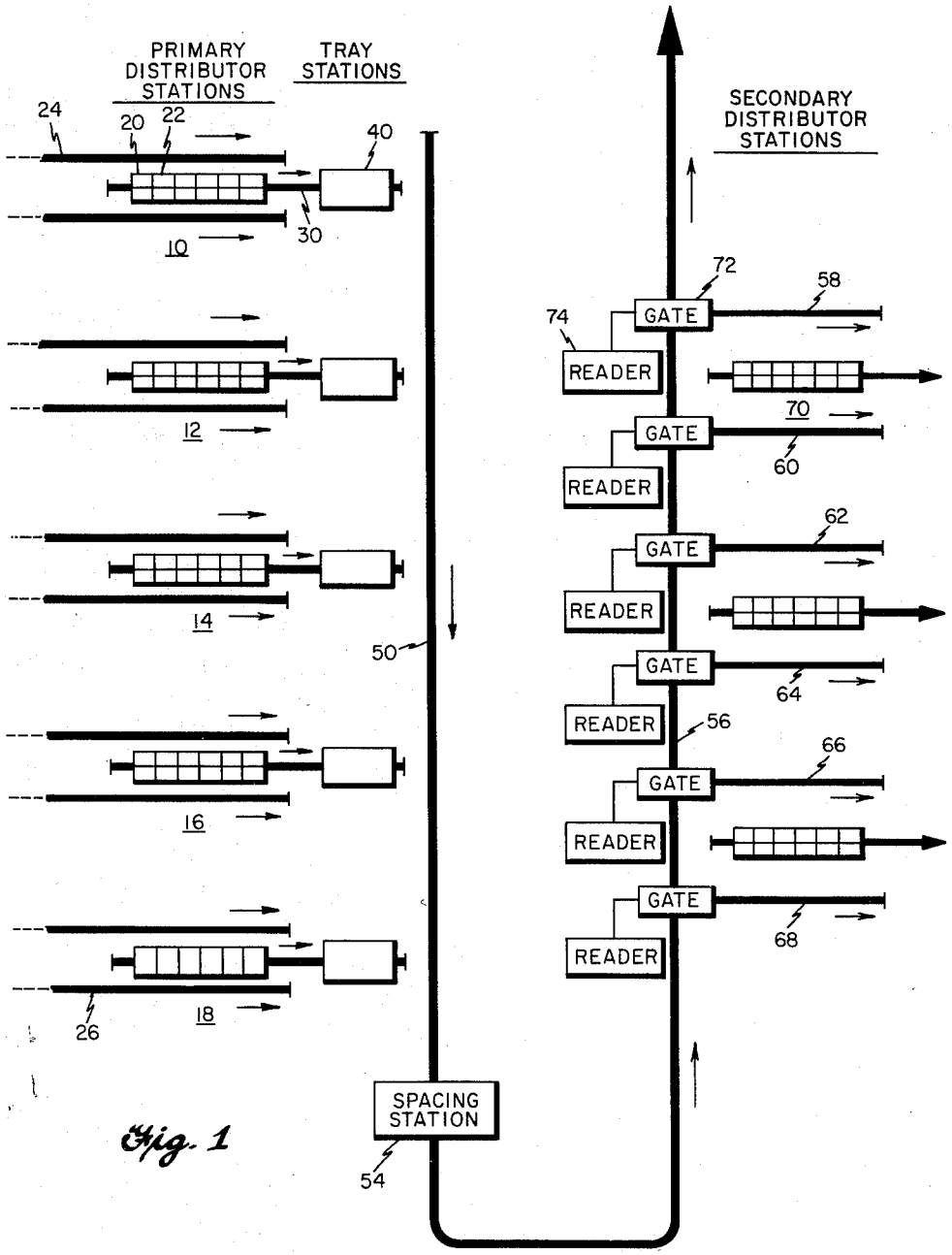

Fig. 1

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Filed Oct. 1, 1958 3 Sheets-Sheet 2

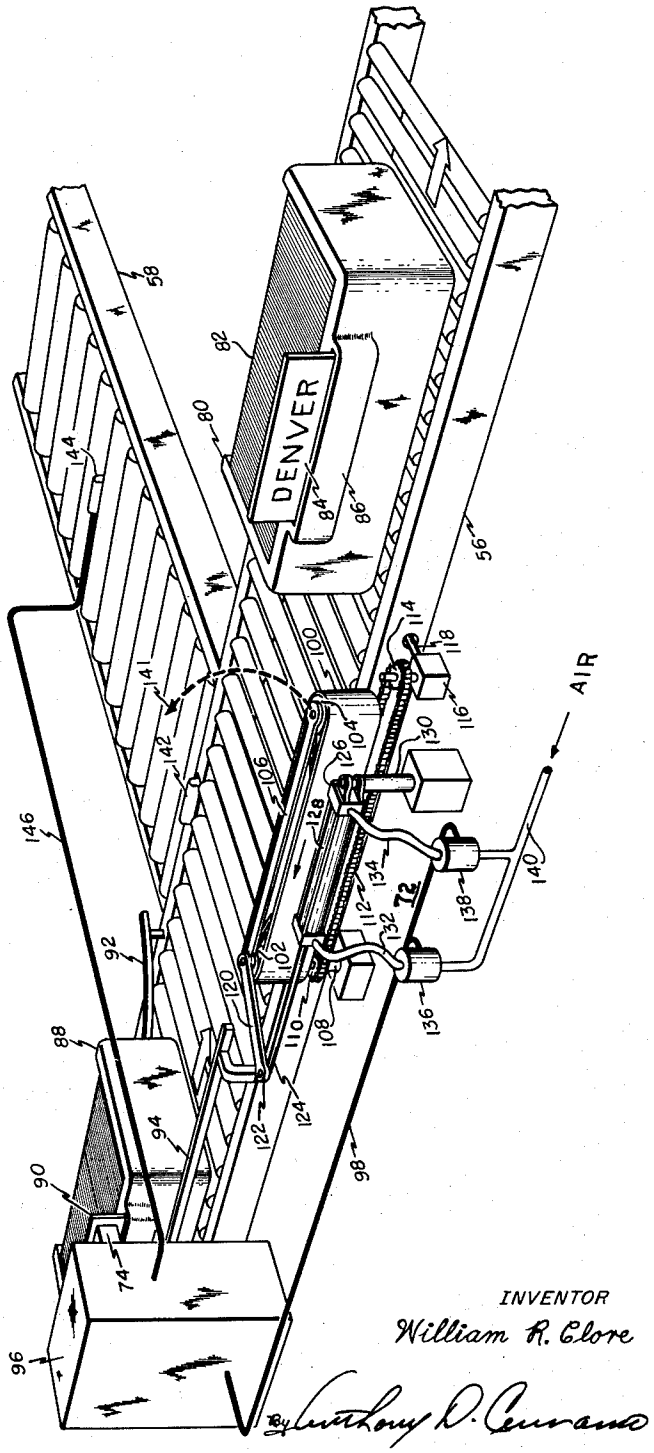

Fig. 2

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Filed Oct. 1, 1958 3 Sheets-Sheet 3

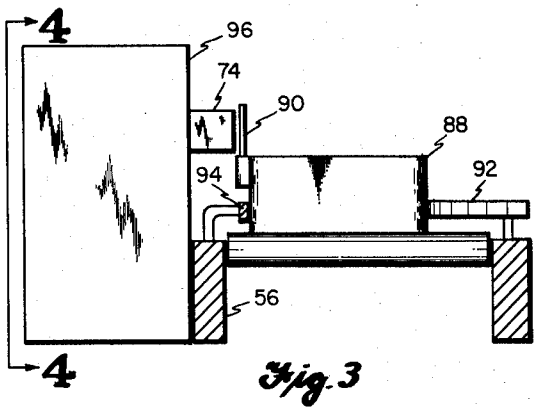

Fig. 3

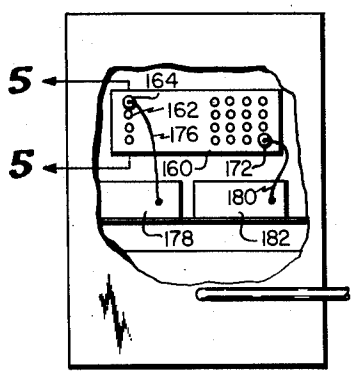

Fig. 4

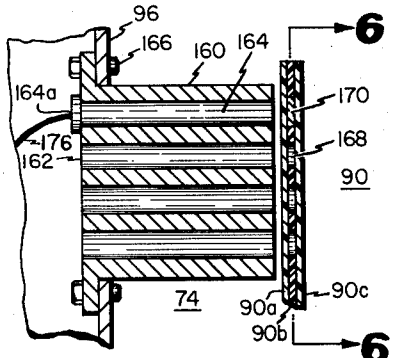

Fig. 5

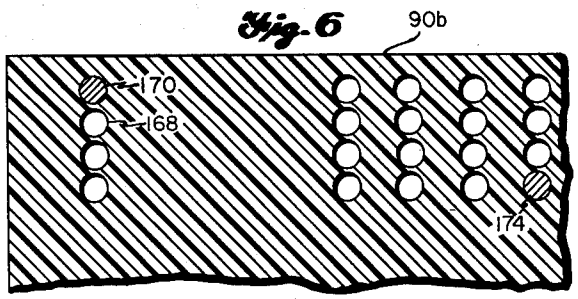

Fig. 6

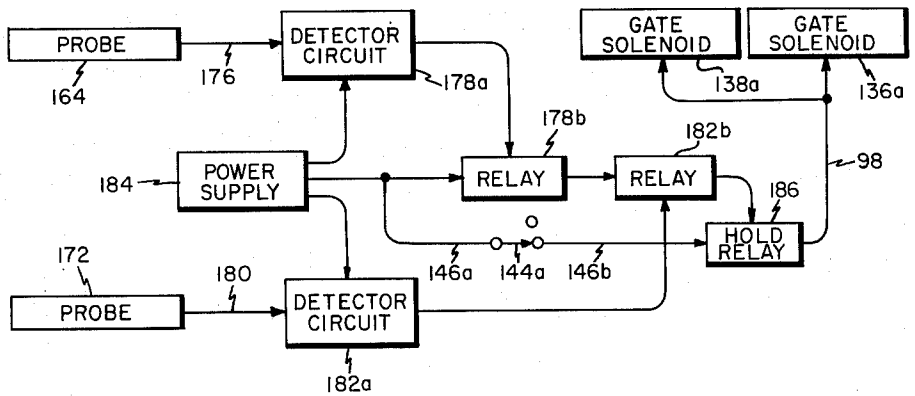

Fig. 7

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United States Patent Office 3,087,598 Patented Apr. 30, 1963

3,087,598

ARTICLE DISTRIBUTION SYSTEM

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Filed Oct. 1, 1958, Ser. No. 764,579
3 Claims. (Cl. 198—38)

This invention relates to branched conveyor systems and routing means for articles carried thereby; and more particularly it relates to an automatic gate control system for distributing a flow of articles to a plurality of destinations in accordance with indicia borne by said articles.

Although the invention is adapted for modification into various forms and is applicable to a variety of alternate uses, the same is herein illustrated and described more specifically in connection with a postal service installation wherein the system of the invention has utility in expediting the sorting and delivery of mails.

At present, even in the largest postal installations the distribution of sorted and semi-sorted mails is carried out almost entirely by manual means. Since the actual sorting process is a human hand and eye operation, the efficiency of the whole system depends on the degree of utilization which is made to the available labor. In general, however, it is quite impossible to make correct and timely predictions as to the load distribution of incoming mails to be routed to various sorting areas. As a result, it frequently happens that some areas are swamped with a deluge of inpouring mails and confusion reigns, whereas in other areas personnel are relatively unoccupied.

It is the practice to conduct the hand sorting operation on the basis of regional destinations such as geographical areas, states, cities, zones or carrier routes. Accordingly distribution cases are provided having perhaps 50–100 regional separations. Previously it has generally been the practice to have the contents of a particular separation box picked up only at appointed times. Often because of scheduling difficulties as above set forth, the quantity of mail addressed to a particular destination exceeds the capacity of the compartments provided so that sorters must resort to makeshift and unsatisfactory temporary storage expedients which interfere with the routine sorting procedures, thus further slowing up the operation at a critical time when sorting should be proceeding at top efficiency.

These and other difficulties are largely overcome by the system of the invention, whereby trays of mail with coded signal cards attached may be intermixed at random on a conveyor with the assurance that each will be automatically and efficiently routed to its proper destination.

It is an object of the invention to provide a branched conveyor system having automatic gate control means for distributing a flow of articles to a plurality of destinations in accordance with indicia borne by said articles.

It is another object to provide an improved coding system for article identifying indicia compatible with improved reliable sensing means therefor.

It is also an object to provide a novel combination of indicia adapted for automatic identification by non-contacting sensing means of the proximity detector type.

Further, more specific and general objects of the invention will become apparent in the following detailed description, taken in connection with the appended drawings, in which:

FIG. 1 is a flow diagram of a portion of a branched conveyor installation in accordance with one application of the invention to an article distribution system.

FIG. 2 is a perspective showing of the mechanical arrangement of a conveyor intersection in accordance with one preferred embodiment of the invention.

FIG. 3 is a section at right angles to the main conveyor of FIG. 2, showing certain elements thereof in elevation.

FIG. 4 is a fragmentary side view of a portion of FIG. 3, taken on the line 4—4 thereof.

FIG. 5 is a fragmentary section on the line 5—5 of FIG. 4.

FIG. 6 is a section on the line 6—6 of FIG. 5.

FIG. 7 is a block diagram of the electrical circuitry of the invention in accordance with one preferred embodiment thereof.

Referring to FIG. 1, there is shown schematically a portion of a postal installation including primary and secondary mail distribution areas. In the primary distribution area to the left a group of distributors' stations are indicated generally by the numerals 10–18. Each distributors' station as at 10 includes a plurality of distribution cases as at 20 and 22, each manned by a distributor who sorts mail and distributes the same into a plurality of compartments provided in his distribution case, according to regional destinations. Each group of distributors is supplied with mail on a side ledge conveyor as at 24. In the figure, ten such conveyors are shown entering from the left, it being understood that the conveyors as at 24 and 26 are loaded with incoming mail at a culling and postage cancelling area not shown.

As the individual separations in the distribution cases become full, or at appointed times, the distributors are notified by public address system to place the contents of a certain separation box onto a conveyor belt as at 30 which runs beneath the distribution cases. The belt 30 carries this primary sort of loose mail to a tray station as at 40, where the same is placed in trays adapted to carry signal cards which are inserted into suitable holders on the trays. These trays, containing mail referred to as the primary sort, are placed on a conveyor 50.

The conveyor 50, which also receives mail trays in a similar manner from the other distributors' stations 12–18, carries the trays to a stop gate and spacing station 54 which holds and releases the trays one at a time at spaced intervals onto a main feed conveyor 56 which transports the trays to the secondary distribution area shown at the right side of FIG. 1. Conveyor 56 is adapted for automatic diverting onto a plurality of side ledge conveyors 58–68 servicing secondary distribution stations as at 70 which are similar to the primary distributors' stations as at 10 hereinabove described.

Each of the diverting gates as at 72 is controlled by an automatic card reader as at 74 which reads the signal cards previously inserted into the trays at the tray station as at 40. Each of the card readers is responsive to only one particular combination of indicia. If this combination is detected by the reader on a card carried by a passing tray, the reader as at 74 will operate its associated diverting gate as at 72, routing the tray from the feed conveyor 56 to the associated side ledge conveyor as at 58.

This system is shown in more detail by FIG. 2, which illustrates the mechanical features of one gate section in accordance with one preferred embodiment of the invention. A first tray 80, carrying letter mail 82 and a signal card 84 visually indicating the geographical destination thereof, is shown passing on the feed conveyor 56. It is seen that the signal card 84 is inserted into a side rack 86 provided on the tray 80.

A second similar tray 88, also on feed conveyor 56, is shown approaching the junction of conveyor 56 with the side ledge conveyor 58 which runs at right angles thereto. The tray 88 also carries a signal card 90 which is shown passing in front of the card reader 74 as is further illustrated in FIG. 3.

As the tray passes the card reader, it is seen that a relatively flexible and curved metal deflector guide 92, fixed-

ly mounted on the far (right) side of conveyor **56**, urges the tray **88** toward the near (left) side of the conveyor and the card reader **74**, so that the near side of the passing tray is pressed into light frictional engagement with a straight and relatively rigid guide rail **94**. The guide rail **94** is fixedly mounted on the near side of the conveyor **56** and extends parallel thereto, in order to guide the tray **88** so that the signal card **90** will pass close to the reader **74** without contacting the same.

In connection with the card reader **74** is a cabinet **96** which contains electronic circuitry associated with the reader **74** and a relay system adapted to automatically control the operation of the gate **72**, to which the control cabinet is connected by an electrical cable **98**.

Although any suitable type of power operated deflection gate may be used, the type illustrated comprises a rubber belt **100** carried on a driven pulley **102** and an idler pulley **104**. The pulleys **102** and **104** are rotatably supported on journals comprising the end pieces of a rectangular framework of which the top side member **106** is visible. This framework is pivotally supported at one end on an upstanding post **108** fixedly secured to the floor, the side of the conveyor **56** or other support means. Hence each element of the framework **106** carrying the belt and pulleys is permitted to swing freely in a horizontal direction, being pivoted about the central axis of the driven pulley **102**. The pulley **102** is secured to an associated sprocket **110**. An endless drive chain **112** passes around both the sprocket **110** and a coplanar sprocket **114** carried on a drive shaft extending upwardly from a gear box **116**. The gear box **116** may be supplied with mechanical power through a shaft **118** connected to the drive system (not shown) for the conveyor **56**. It is seen therefore that the belt **100** revolves continuously around the axes of pulleys **102** and **104** whenever the conveyor **56** is in motion.

In order to actuate the gate **72** and thereby divert a passing tray onto the side ledge conveyor **58**, the frame **106** of the gate is provided with a bell crank **120** whose free end **122** is pivotally secured to the piston rod **124** of a fluid operated piston and cylinder driving device. The end frame **126** of the drive cylinder **128** is pivotally mounted on an upstanding anchor post **130** which may be rigidly secured either to the floor or the side of the conveyor **56**. Fluid is conducted to and from the end-ports of cylinder **128** through a pair of flexible pressure hoses **132** and **134** which connect respectively to a pair of solenoid actuated valves **136** and **138**. Valves **136** and **138** are further connected to a source of fluid pressure such as the air pressure supply line **140**. It will be understood that if an air cylinder is used to actuate the gate, each valve is provided with an exhaust port vented to the atmosphere, whereas if a hydraulic cylinder is used a suitable return pipe to the oil reservoir will be provided.

Normally fluid pressure from line **140** may be applied to line **134** through valve **138**, so that the piston rod **124** will be extended, thus maintaining the gate in the position illustrated, at the side of, and parallel to, the conveyor **56**. When a gate energizing signal is received from the cabinet **96** via cable **98**, valve **138** disconnects line **134** from the pressure supply line **140** and vents line **134** to the atmosphere or to a fluid return pipe. Simultaneously valve **136** connects line **132** to the fluid pressure supply line **140** so that the piston rod **124** will be retracted, causing the gate to swing across the path of the tray **88** in the direction of the arcuate arrow **141**. As the tray **88** advancing on conveyor **56** strikes the gate, the traveling surface of the belt **100** frictionally engages the leading end of the tray and turns it toward the side ledge conveyor **58**.

In most cases it is appropriate that the drive mechanism for the side ledge conveyor **58** be normally idle, and that the same should advance only when a tray is delivered thereon. Accordingly a pair of limit switches **142** and **144** are provided to start and stop the conveyor **58**. Hence when the gate **72** diverts a tray, the same will strike limit switch **142**, causing the conventional drive system (not shown) for conveyor **58** to be placed in operation. Thereupon the tray is carried off on conveyor **58** to the point where it strikes the second limit switch **144**, thereby stopping the conveyor **58**.

The switch **144** which stops the movement of conveyor **58** may also be utilized to actuate the release mechanism for gate **72**, which has been held in operated position by holding circuits in cabinet **96**. To this end these circuits are connected to switch **144** through a cable **146**.

Referring now to FIGS. 4, 5 and 6, it is seen that the card reader **74** includes an insulation block **160** having a plurality of spaced holes as at **162** bored therein, each adapted to receive a non-contacting metal detector probe as at **164**. The block **160** may extend through a rectangular opening in the cabinet **96** and be secured thereto by means of bolts as at **166**.

The block **160** is of such a length that when the base flange as at **164***a* of a probe as at **164** is seated at the rear of one of the bored openings in the block, the active end of the probe sits flush with the end of the block which points in the direction of a passing signal card **90**.

As is shown in the sections of FIG. 5 and FIG. 6, each signal card preferably comprises three bonded laminations **90***a*, **90***b* and **90***c* of plastic or other electrically insulating material. The center lamination **90***b* is punched, drilled or molded with a plurality of holes as at **168** each adapted to accommodate a metal disc as at **170**. It is apparent that when a card assembly passes in front of the reader **74**, the presentation of a metal disc in direct alignment with one of the metal detector probes will trigger the metal detector.

It is seen that the pattern of holes as at **168** in the center lamination **90***b* of the card corresponds to the pattern of the holes as at **162** in the block **160** which accommodates the metal detector probes. In the illustrated arrangement, only two probes **164** and **172** are used in one card reader. Correspondingly, only two metal discs **170** and **174** are mounted in each signal card.

The probe **164** is connected by a flexible conductor **176** to an electronic panel **178**, and similarly probe **172** is connected by a flexible conductor **180** to a duplicate electronic panel **182**. Thus a probe may be easily inserted in, or removed from, the rear of any hole in the insulating block **160** for the purpose of setting up or altering the code to which the card reader **74** will respond.

Suitable circuitry for the gate control system is shown in FIG. 7, wherein it is seen that the probe **164** is connected by conductor **176** to a metal detector circuit **178***a* adapted to trigger an associated relay **178***b*. Similiarly the probe **172** is connected by conductor **180** to a detector circuit **182***a* adapted to trigger a relay **182***b*. The relays and detector circuits are connected to a suitable power supply **184**. When both metal detector relays **178***b* and **182***b* are energized simultaneously, a conventional hold relay **186** is also energized from the power supply. Once the hold relay is energized, it will remain energized even though one or both of the metal detector relays **178***b* and **182***b* is de-energized, due to its holding circuit from the power supply which includes contacts **144***a* of the limit switch **144** and conductors **146***a* and **146***b*. When the hold relay is energized, it connects the power supply **184** to the gate solenoids **136***a* and **138***a* which actuate the fluid pressure control valves **136** and **138** shown in FIG. 2. These valves in turn control the drive cylinder **128** which actuates the gate **72**.

The operation of the system may be summarized as follows, referring to FIGS. 2 and 7. The card reader **74** is adapted to respond only to a signal card having metal discs in both of the particular two holes shown in FIG. 6, which holes correspond to the location of the probes **164** and **172** in the insulating block **160**. Cards having discs in other locations in the same horizontal rows may trigger the metal detectors independently.

However, the hold relay **186** cannot be energized by operation of either relay **178***b* or **182***b* alone, or by operation of both relays at different times. Hence the gate **72** will not interfere with through traffic on conveyor **56** of trays bearing signal cards adapted to trigger gates on other side ledge conveyors receiving mail to other destinations.

However, when a passing signal card has its metal discs located in position to activate both metal detectors simultaneously, both relays **178***b* and **182***b* will close their contacts at the same time, completing a circuit from the power supply **184** which energized the hold relay **186**. The hold relay will then complete its holding circuit through limit switch contacts **144***a* and simultaneously apply power to gate solenoids **136***a* and **138***a*. Solenoid **136***a* will operate valve **136** so as to connect the air pressure line **140** through air hose **132** to the rod end of air cylinder **128**, forcing the piston (not shown) to the rear of the cylinder and causing the piston rod **124** to retract. Simultaneously solenoid **138***a* will operate valve **138** so as to disconnect the air pressure line **140** from air hose **134** and to vent the hose **134** to the atmosphere, thus relieving the pressure in the closed end of cylinder **128**.

The retracting operation of the drive cylinder will actuate the gate **72** as hereinabove described, diverting the tray **88** onto the conveyor **58**. Operation of limit switch **142** by the tray starts the conveyor **58**, which carries the tray onward until it contacts the limit switch **144**. Switch **144** stops conveyor **58**, and simultaneously opens its contacts **144***a*. Since the relays **178***b* and **182***b* were de-energized after the discs **170** and **174** passed the metal detector probes, the opening of switch contacts **144***a* de-energizes hold relay **186** which in turn de-energizes solenoids **136***a* and **138***a*. Accordingly the gate **72**, which has meanwhile been held across the path of conveyor **56**, is restored to its original position.

Although the invention is not limited to any particular spatial arrangement of the metal detector probes and the metallic elements to be detected thereby, it will be noted that the signal card and the block shown in FIGS. 4 and 6 are adapted to a spatial code wherein a single master column of holes is spaced some distance from a group of holes comprising a plurality of columns. One probe is always located in one hole of the master column as is illustrated by the position of probe **164**, and similarly one metal disc always occupies one hole of the master column, as is illustrated by the position of disc **170**. The master column is spaced from the secondary group of columns by a distance greater than the maximum width of the secondary group. Thus no combination of discs in the secondary columns alone can trigger both the master probe and a secondary probe simultaneously, as is required to operate the gate. That is to say, the signal card is read only when the master column of the signal card is in proximity to the master probe, which is a unique position of the signal card in its travel past the card reader.

The invention likewise is not limited to any particular number of metal detectors. Although only two are used in the illustrated card reader, three or more may be provided. Hence the particular embodiment of the invention shown and described is meant to be illustrative only and not restrictive, since it is obvious that many changes and modifications can be made within the spirit and scope of the invention as is set forth in the appended claims.

What is claimed is:

1. An article distribution system comprising a main conveyor bearing a series of articles to be distributed, a plurality of branch conveyors spaced along the path of said main conveyor and intersecting the same, a diverter gate at each such intersection, said gate being movable from a first position clearing the path of said articles on said main conveyor to a second position for diverting an article on said main conveyor to the intersecting branch conveyor, a non-metallic signal card carried by each of said articles, means for detachably securing said card to its associated article, a plurality of metallic elements spatially arranged on each of said signal cards in accordance with a destination-indicative coded pattern, a plurality of metal detectors each responsive to the presence of an electrical conductor without physical contact therewith and adapted to be triggered by proximity thereto, means for mounting said metal detectors adjacent said intersection and spatially arranged relative thereto in accordance with a location-indicative coded pattern, guide means mounted on one side of said main conveyor and adjacent said intersection for directing the flow of said articles in spaced relation to said metal detectors, whereby said metallic elements are guided in proximity to said metal detectors without contacting the same, and means energized by synergetic action of said metal detectors on coincidence of said location-indicative pattern with said destination-indicative pattern on a passing article for actuating said gate to said second position.

2. A system as in claim 1 wherein each of said metal detectors comprises a probe unit and an electronic chassis unit, wherein said metal detector mounting means comprises a non-metallic block having a plurality of receptacles each adapted to receive said probe unit, and which includes flexible conductors connecting said chassis unit to said probe unit to permit selection and alteration of said location-indicative pattern by transferring said probe from one receptacle to another.

3. A system as in claim 1 wherein each of said signal cards comprises a lamination of non-metallic sheets, one of said sheets having a plurality of spaced apertures therein, at least two of said apertures each containing one of said metallic elements electrically insulated from other elements on said card.

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