

[54] **METHOD AND APPARATUS FOR SELECTIVELY REMOVING PRE-IDENTIFIED ARTICLES FROM A CONVEYOR SYSTEM**

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[51] Int. Cl. B07c 5/344

[58] Field of Search 209/74 M, 74, 111.7; 270/58; 198/38

[56] **References Cited**

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[57] **ABSTRACT**

An article-sorting conveyor system is provided in which articles are identified by type as they randomly enter the system and are thereafter selectively removed from the system by type and quantity at one or more diverting stations. This permits pre-set "orders" for given quantities of given types of the articles to be filled at each diverting station. The article carries an identifying code, such as a binary code, which is read when the article first enters the system to give an article identification signal. This signal passes down the system through a series of shift registers, or the like, at the same rate as the article moves down the system. The article identification signal is checked at each diverting station, and, if the identified type of article is necessary for the predetermined quantity of articles at that station, the article is diverted and counted; if not, the article continues on the conveyor. Once diverted, the article identification signal is deleted from the system.

4 Claims, 5 Drawing Figures

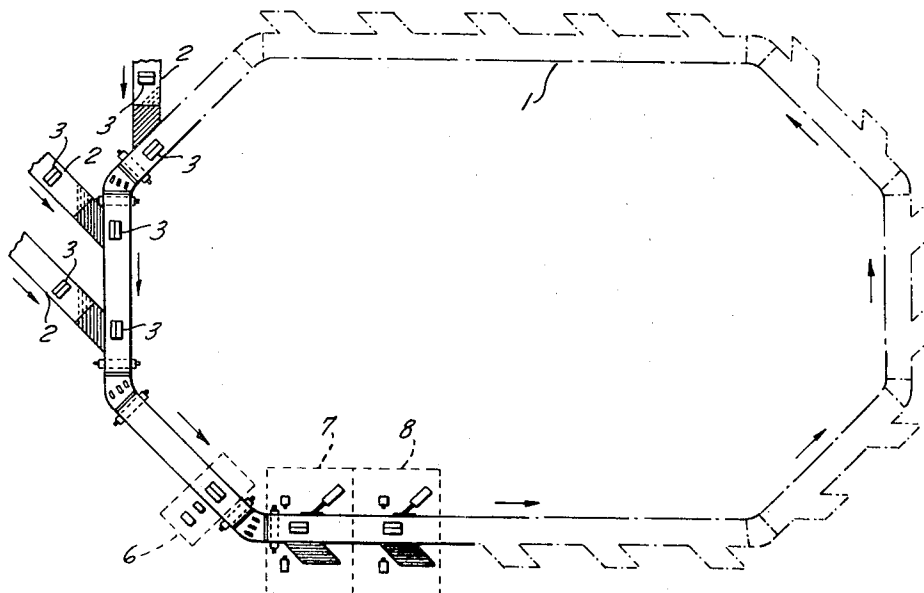


FIG. 1

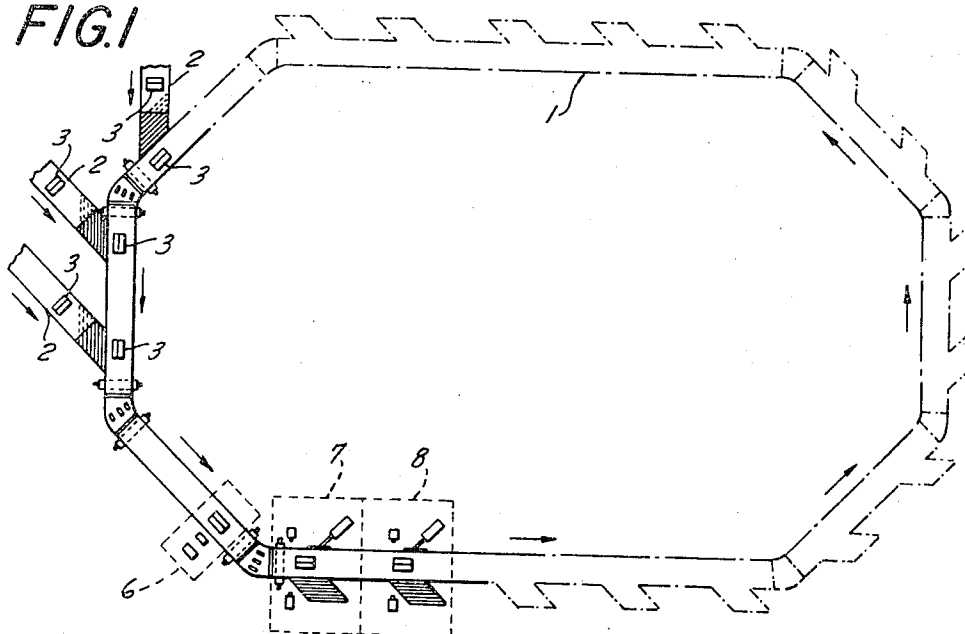


FIG. 2

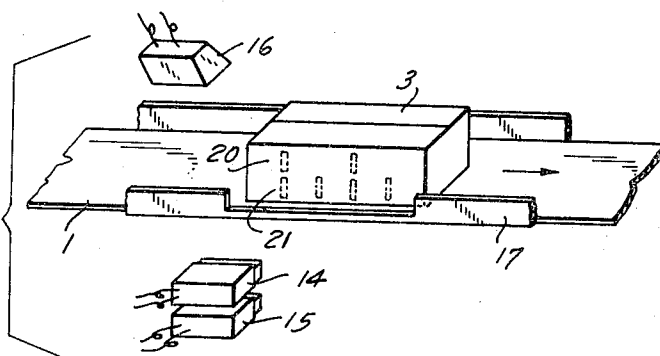
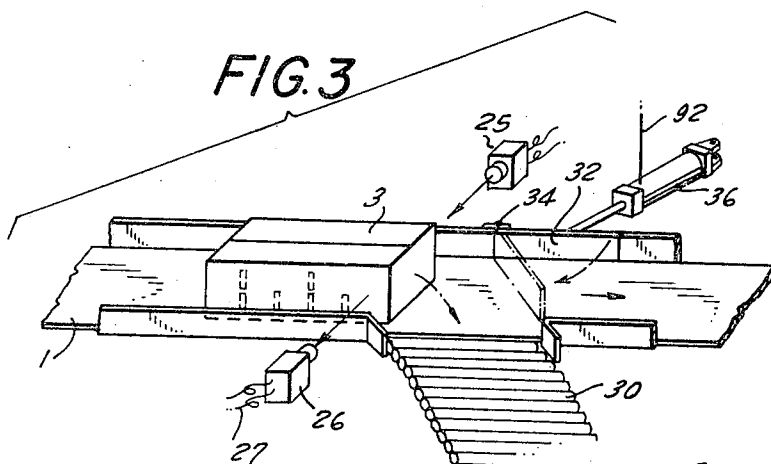


FIG. 3



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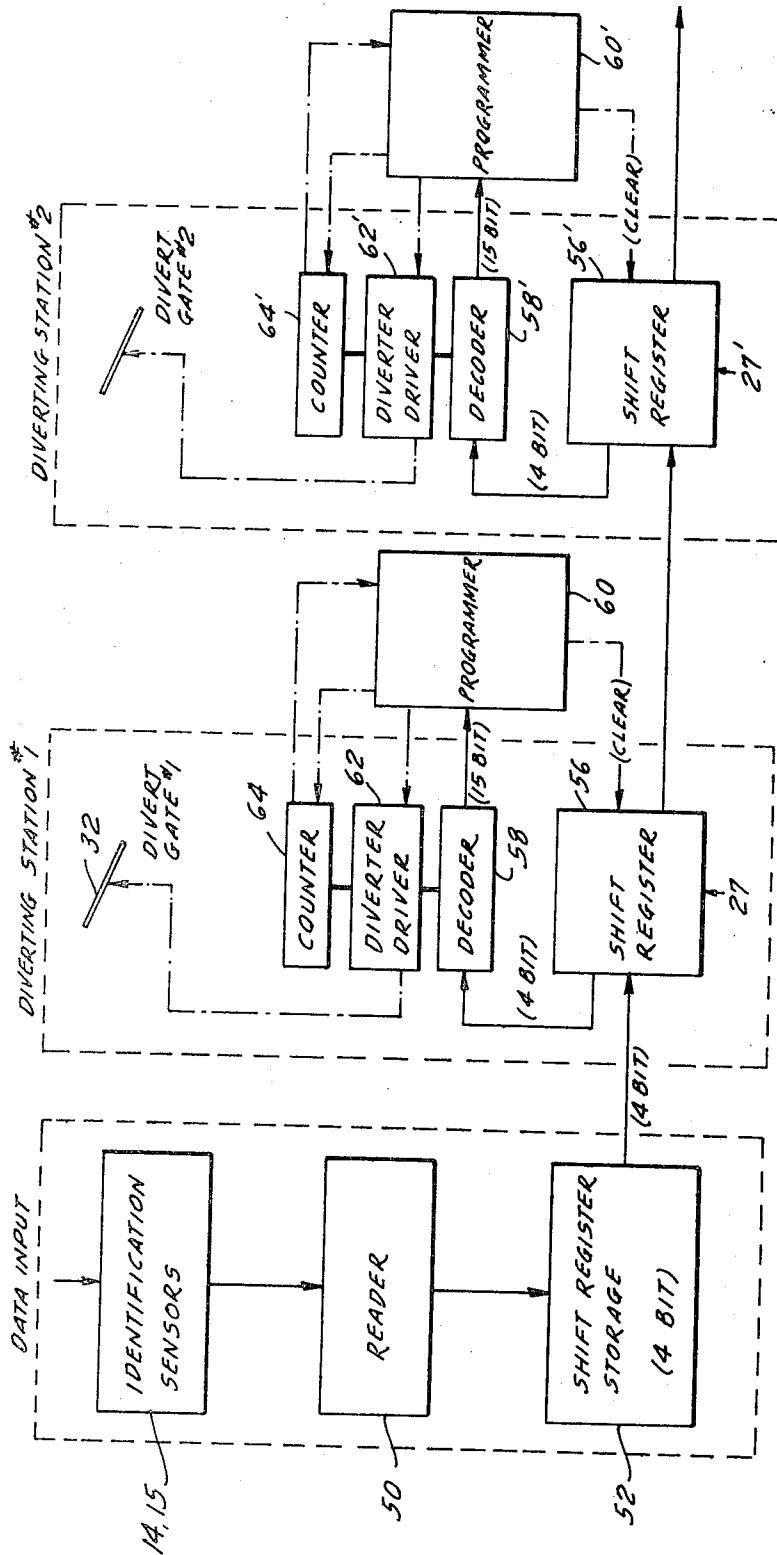


FIG. 4

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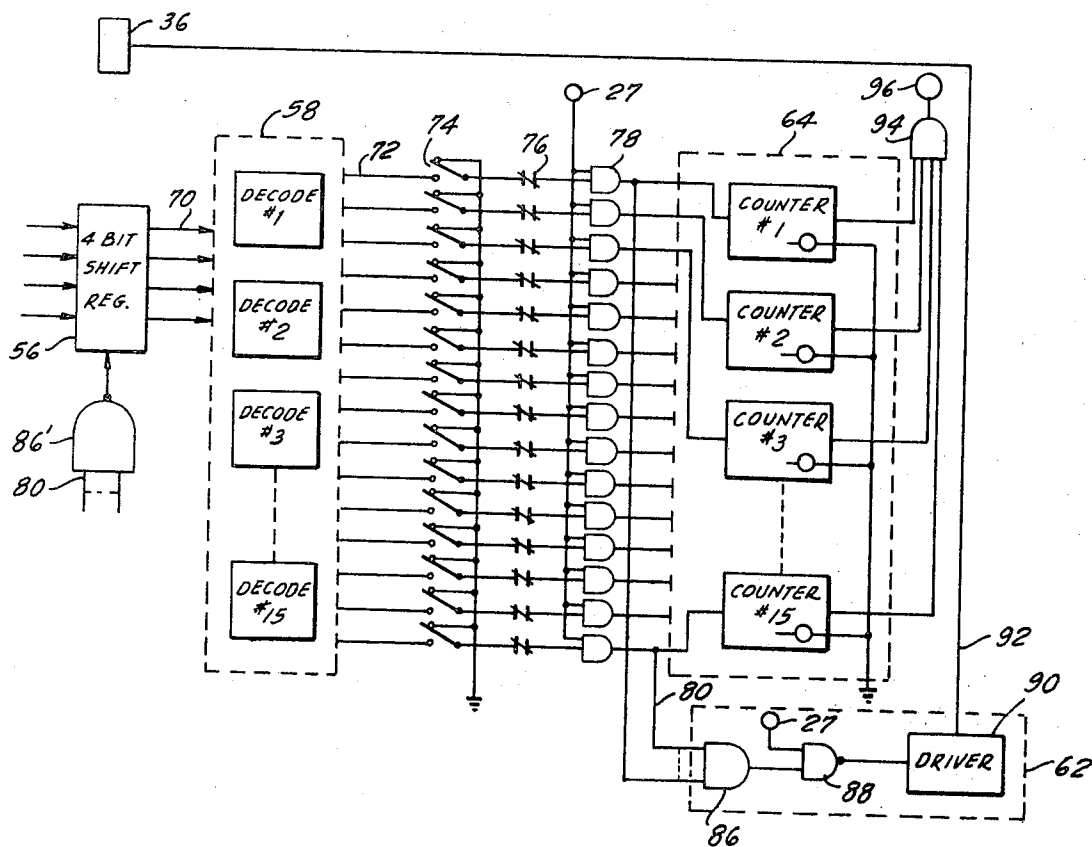


FIG. 5

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METHOD AND APPARATUS FOR SELECTIVELY REMOVING PRE-IDENTIFIED ARTICLES FROM A CONVEYOR SYSTEM

BACKGROUND OF THE INVENTION

Various forms of package-sorting devices have been designed for selectively removing articles from conveyor belts. These include systems, such as the present one, in which the article itself bears identification that is used for sorting purposes.

In some of these systems the article is read at each sorting or diverting station and a decision made; in other systems the article is read initially as it enters the system and the information as to identification travels down the system with the article on some form of synchronized basis. The present invention relates to the latter system.

Prior U.S. Pats. of interest include Burkhardt, No. 3,141,540, Schneider, No. 3,259,240, Cutaia, No. 3,352,417 and Sanner, No. 3,460,673. The Burkhardt patent discloses a shift register control for article-handling devices. When an article enters the conveying path, a command signal is fed to the first section of the control register which signal designates the switch which is to divert the entering shipment at a later diverting station. The command signal is transmitted step-wise along the path as the article proceeds.

The Schneider patent identifies articles entering the system by means of a code on the article and passes a sorting signal on a shift register with the article for controlling sorting.

The Sanner patent is a document sorter which uses a binary code gated into a shift register and serially shifted into subsequent registers associated with various stacker pockets to sort the cards as they move down the system. Cutaia is similar.

SUMMARY OF THE INVENTION

The method and apparatus of the present invention are directed to the filling of "orders" for predetermined numbers of each of a series of articles passing along a conveyor belt to each diverting station.

In operation, the various articles are fed in random order to a common conveyor belt, from production lines, from inventory, or from both. The items are carried by the conveyor past various diverting stations.

The articles, however, each have a particular form of identification readable by a detecting means. Preferably, the identification is a binary code located on the side of the article, and, in the preferred form of the invention, is a code applied in luminescent material, i.e., material that is normally invisible but emits visible radiation when subjected to ultraviolet light. Thus, the reading takes place in the presence of an ultraviolet light.

Since the code is normally a position code and the detector senses the presence or absence of the luminescent or other material in each of a predetermined number of positions, it is best to have a secondary marking above or below the primary position on the article which is always present in that position and so serves as a "clock" code.

As the randomly positioned articles pass down the conveyor belt the photocell detector reads the identification code and the second detector reads the clock code so that the article is identified. This identification is put into a sequential memory system such as a series of step registers which can be passed, step-wise, from

one diverting station to the next as the article moves down the belt past the diverting stations. Thus, the identifying information, the article identification signal, is in the appropriate step register associated with a diverting station as the article reaches that diverting station.

Associated with each diverting station is the necessary apparatus for diverting an article from the conveyor. This diverter is controlled by a pre-set diverter control at each station which has been set for the number of each desired type of article sought at that station. If the information in the register indicates that the article is of the type sought at that station, the diverter control will actuate the diverter and the article will be removed. At the same time the article will be counted and, when sufficient articles of the particular identification have been collected at that station, the diverter control will be de-activated so that it will no longer react to supply articles of that particular identification. In addition, the identification of the article will be removed from the step register so that it will not pass down to the next diverting station.

Once the total desired number of each type of article has been collected, i.e., diverted, at a given diverting station, an indication to that effect is given so that the operator will know that entire particular "order" is now filled.

Articles not diverted at a given diverting station continue to pass along the belt with their identification signal in the associated step registers until they reach a diverting station programmed to call for them, at which point they are then diverted. Articles not diverted at any station can leave the belt at the end and go into inventory or, alternatively, be recycled back to the beginning.

Various quantities of information may be used in the system, but we have here shown one using a four-bit identification code and register, capable of identifying 15 separate articles (the zero code unit is not used because this might represent an unmarked package).

The article identification can pass down the line simultaneously with the article in either a synchronous or asynchronous system. In the synchronous system a clock pulse is sent to each diverting gate at a rate equal to that by which the articles move down the conveyor. In the asynchronous system there are article detectors at that gate and so identify the article with the identification in the shift register. In either system the article identification in the shift register is advanced to the next gate each time the article arrives at the next gate.

DRAWINGS

The invention is illustrated in the following drawings: FIG. 1 is a plan view of the apparatus of the system showing the conveyor belt, the input of articles on the belt for sorting, and the diverting stations for filling orders.

FIG. 2 is a perspective of the article identification portion of the system, as an article enters the system for distribution.

FIG. 3 is a perspective view of one article diverting station.

FIG. 4 is a schematic drawing showing the logic circuitry of the system.

FIG. 5 is a drawing showing the circuitry for pre-selecting the quantity of each type article to be diverted

at a diverting station. It is used to control the diverting gate at that station.

DETAILED DESCRIPTION OF THE INVENTION

FIGS. 1, 2 and 3 show the mechanical aspects of the system of the invention. In FIG. 1 a conveyor belt 1 is shown, which is used to carry articles around a circular path past a series of diverting stations. Three inputs 2 to the belt are shown. The inputs deliver articles 3 to the conveyor belt directly from the production line in a plant, from inventory, or from other sources. These articles are usually packaged consumer products of one nature or another. Several articles 3 are shown on the input chutes 2 and on the conveyor 1.

The system includes a vertical identification station 6 and a series of diverting stations, of which two, 7 and 8, are shown. Any desired number of diverting stations can be used as indicated by the various dotted outlines around conveyor 1. It should be noted that identification station 6 is between the last input chute 2 and the first of the diverter stations 7. This is so the articles may be identified prior to arriving at the diverting stations.

FIG. 2 shows the identification station 6 as a package passes through it from left to right for identification purposes. The station includes the belt 1, two photodetectors or sensors 14 and 15, placed one above the other, a source of ultraviolet light 16 and guide rails 17, if necessary.

An identification code is carried on the side of package 3 facing the detectors 14 and 15. Any of a series of codes may be used, but the preferred code is a dual bar code of the well-known type. It is preferably made of luminescent material, that is, material which is normally invisible or only slightly visible and which fluoresces or phosphoresces when exposed to ultraviolet radiation. The code is a two-line binary code in which the lower line 21 is the so-called "clock" code having luminescent material in each possible position, and the upper line 20 is an information code having luminescent materials in selected positions above the positions of the clock bars. By using a code of this nature, one may identify a number of articles equal to 2^n , where n is the number of positions in the information code. Normally, to avoid error, the code is not used when no positions are filled in the information code, so that the number of articles that can be identified is $2^n - 1$. This would mean that, for the four position bar code illustrated, 15 articles could be identified. The number of positions is, of course, up to the user, but in the below description we shall refer to the four position code by way of illustration.

The information code is on the upper line 20 and the clock code on the lower line 21. Ultraviolet light 16 illuminates both code lines on article 3 as it passes the detectors, so detector 14 can read the identification data on line 20 and detector 15 the clock-timing data on line 21. Normally there would be a single photodetector in each of detectors 14 and 15 so that the information and data codes would be read on a serial basis with the position near the leading edge of article 3 being read first as it moves on belt 1. The data from the information code 20 would later be converted from serial to parallel data. If desired, it could, of course, be read in parallel in the first instance.

The type of code is not part of our invention. Any code can be used which serves to identify the different types of articles as they pass the first detecting station

and produce an article identification signal corresponding to the article type.

A typical diverting station, such as station 7 or station 8, is shown in FIG. 3. Belt 1 is shown moving from left to right with a package 3 entering the diverting station. The station includes package detection means. This can be of any type, but is here shown as a light source 25 on one side of belt 1 directed at a photodetector 26 at the other side. When package 3 enters the station it breaks the beam and so makes its presence known. A signal 27 is produced on the output of detector 26 indicating the presence of an article. The circuitry thereafter can be actuated as controlled by this signal.

The diverting station includes an outlet chute 30 for selected articles to enter when they are removed from belt 1. This removal is effected by a diverter or gate 32, pivoted at pivot 34, and controlled by an actuating arm, such as solenoid unit 36. Control of unit 36, and so of gate 32, results from the logic system to be hereinafter described. Other methods of mechanically handling the diverging of articles passing along belt 1 may be used at the choice of the designer.

Additional diverting stations may be placed along conveyor system 1. If desired, the last of these stations may divert all articles not previously selected for storage in inventory rather than recycling them about the circular belt 1.

FIG. 4 shows the logic circuitry that is the basis for the operation of the system of this invention. As can be seen, the unit operates on a sectionalized basis. The first section is the data input section which receives the data sensed at the identification station (shown in FIG. 2). This section is followed by diverting stations. Two representative ones, identified as stations No. 1 and No. 2, are shown. Each diverting station has an associated programmer for pre-setting the types and numbers of articles which the operator wishes to have diverted at that particular station. Diverting station No. 1 and its programmer normally would be the same as that of subsequent diverting stations, so only one station and its programmer need be described.

The data input section will be considered first. Data sensors 14 and 15 receive data input corresponding to the identification code 20 and the clock code 21 on the article facing the sensors. This data is passed to a reader unit 50 which serves to interpret the data and produce a parallel output corresponding to the presence or absence of luminescent material in each of the possible bit positions of the information code 20. In the illustration of the example, the output would be four-bit data. This information, an article identification signal, is then passed to a shift register 52 adapted to receive and store these four bits of information. This stored article identification signal is used to later identify each package as it goes down the line in its proper sequence. Accordingly, these four bits of information are passed to shift registers associated with diverting station No. 1. There should be sufficient number of serially related shift registers to carry a number of article identification signals at least equal to the maximum number of articles that can be carried on belt 1 between the identification station and the first diverting station or between the most widely separated pair of diverting stations.

The article identification signals are passed from shift register to shift register in sequence, passing from register 52 to shift registers 56 of diverting station No. 1.

Stepping of the signals is accomplished by use of the presence signal on lead 27 received from the identification photodetector 26 at the diverting station. Thus every time an article arrives at diverting station No. 1 the information in the registers between that station and the identification station is moved forward one step. In this manner the information in the last step of shift register 56 corresponds to the identification of the article then arriving at diverting station No. 1.

Comparably, presence signals from detectors at subsequent diverting stations are used to step article identification signals in the shift registers between that diverting station and the previous station. In this way proper identification of the article, i.e., the article identification signal, is at the later diverting station at the time the article arrives there.

Alternately, rather than having the information stepped down the shift registers by actuation by the presence signal from article identification detector 26, one could accomplish the same result by use of a clock pulse. If this is done, the speed of belt 1 must be so timed and the number of registers used such, that the identification in the last shift register of each diverter station corresponds to the article as it reaches the diverting station.

The decoder 58 is adapted to receive the last article identification signal in shift register 56 and to provide a signal corresponding to the particular article desired. The output of the decoder is a series of lines 72 corresponding to the number of possible types of articles. Thus, if the system is adapted for the identification and sorting of 15 articles, decoder 58 will receive the four-bit signal from shift register 56 and will provide a signal on that one of the 15 lines which corresponds to the particular article identified (see description of FIG. 5).

Programmer 60 enables the operator to pre-set the number of each type of article he wishes delivered to the particular diverting gate, to direct diversion of those which come past the diverting station, to count the number diverted, and to indicate when the total number of each type of article "ordered" has been delivered.

Decoder 58 is connected to diverter driver 62, and the latter actuate divert gate 32 when the article at the diverting station is the one desired. At the same time diverter driver 62 will send a signal to counter unit 64 which counts the number of each identified article diverted. In association with programmer 60 counter 64 serves to de-activate the diverter driver for particular articles whenever the quantity previously pre-set into the programmer has been delivered.

Programmer 60 is also connected to shift register 56 and will reset that register to delete the article identification signal for diverted articles, and to advance following identification signals one step in the shift register whenever an item is diverted, thus removing the identification signal of that item from the system.

Shift register 56' is in the circuit for diverting station No. 2 and functions like shift register 56. It is connected to shift register 56 to receive article identification signals from the shift register in the prior diverting station. This identification signal will be only for those articles which have passed the prior diverting station without having being diverted. If diverted, the article identification signal is removed from shift register 56, as previously described, and is not passed along.

The arrangement of diverting stations and programmers is such that a sequential system is followed, of the same nature as above described, for each of the various diverting stations selected. The stations are positioned sequentially along the belt 1 with corresponding diverting station logic circuitry at each sequential diverting station.

FIG. 5 shows one system for operation of the programmer, decoder, diverter driver, and counters.

The article identification signal in the last step of shift register 56 enters decoder 58 through leads 70. Four leads are shown because a four-bit system is being used here for illustration. Decoder 58 has as many decode positions as the number of possible identifications available with the number of bits being used. In this instance, with a four-bit system, there are 15 decode positions. Standard decoding circuitry is used and the decode position and output lead 72 corresponding to the article identified will be energized; the remainder will not. Thus, as a result of the signal received from the shift register 56 and decoder 58, one of the output lines 72 will carry a signal. Each of the lines passes through a switch 74, a normally closed relay 76, and AND gate 78, and then to its respective counter in counting circuit 64. After AND gate 78, it goes through leads 80 (one for each identification line) to OR gate 86 in the diverter driver circuit 62. AND gates 78 are also connected to the article identification output detector 26 and its output 27. Thus it can be seen that if switch 74 is closed and normally closed relay 76 is closed, one of AND gates 78 will be actuated upon receipt of a signal from the article sensor 27 when a signal is received from the shift register, decoded, and passed to a particular decoder line 72. At the same time a pulse will be applied to the appropriate counter of the 15 counters in counter 64.

The counter 64 can be set for whatever number of items is desired. Once that number is reached the particular counter opens its respective relay 76 so no additional pulses can be received through the respective line 72 of decoder 58. As a result, if any additional articles with that particular identification are received, their signal cannot reach AND gate 78 and so cannot actuate the diverter driver 62.

The item identified in FIG. 4 as programmer 60 essentially consists of the respective switches 74 and the setting of the respective counters 64 in FIG. 5. This is the technique for programming the desired number of articles of each identification.

As stated above, OR gate 86 is adapted to receive signals from each of the AND gates 78. If the signal is received from any of those it passes to AND gate 78 which is also connected to the output circuit 27 from the article detector 26. Upon receipt of both signals, AND gate 88 actuates diverting unit 36 by energizing power driver unit 90 which provides energy through lead 92 to actuating unit 36 (FIG. 3).

OR gate 86 is shown in the left-hand portion of FIG. 5 a second time as OR gate 86'. There the output signal is used to erase the article identification signal for a diverted article by resetting the four-bit shift register.

After all required number of each type of articles have been diverted at a given diverting station, and so the "order" has been filled, a signal to that effect may be given. This can be controlled by the counter circuit through an AND gate 94 actuated by lines from the

counters and operating a light 96, or by any other desired means.

What is claimed:

1. A system for selecting and grouping articles bearing coded indicia, said system including
 a conveyor to receive and carry said articles, an article identification station adjacent said conveyor, said article identification station including a detector for reading said coded indicia and producing an article identification signal corresponding thereto, at least one diverting station adjacent said conveyor located after said article identification station, said diverting station including a diverter, a diverter control, an article presence detector, said presence detector operating with said diverter control to actuate said diverter,
 means for passing said article identification signal from said identification station to said diverting station so that said signal will be at said station at the same time as said identified article,
 a programmer adapted to be pre-set for predetermined number and types of said articles to actuate said diverter control, said programmer including a counter for each said type of article,
 means associated with said programmer to deactivate

said diverter control for specific types of articles when said predetermined number of said articles have been diverted at said diverter station,
 means for indicating when said diverter control has been de-activated for all possible article identification signals and thereby indicating when all desired articles of a given type have been diverted,
 means for erasing said article identification signal from said system when said signal has been used to actuate said diverter control, and
 means for recycling those said articles not diverted at any of said diverting stations to said initial detection station, whereby said articles may again pass through said system for possible diverting at one of said diverting stations.

2. A system as set forth in claim 1 in which said means for passing said article identification signal includes sequential shift registers.

3. A system as set forth in claim 2 in which said shift registers are controlled by said article presence detector.

4. A system as set forth in claim 2 in which said shift registers are controlled by clock pulses.

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