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Habegger et al.

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[54] **METHOD AND APPARATUS FOR SORTING ARTICLES ON A CONVEYOR UTILIZING A SHIFT REGISTER AND A TIME VARYING CODE CONTROL MECHANISM**

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[52] **U.S. Cl.** ..... **214/11 A,** 214/152

[51] **Int. Cl.** **B65g 43/00**

[58] **Field of Search** ..... 214/11 R, 11 A, 11 C, 152, 214/60; 198/38

[56] **References Cited**

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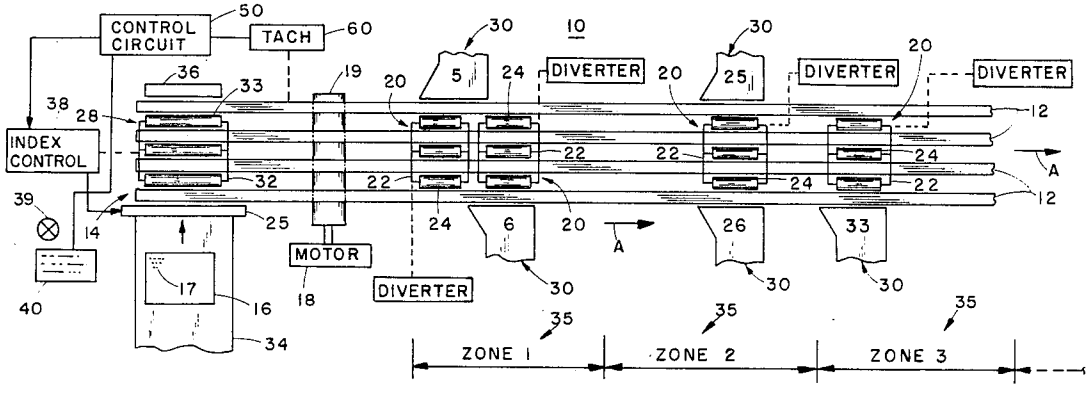
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Assistant Examiner—R. B. Johnson
Attorney, Agent, or Firm—Peter P. Price et al.

[57] **ABSTRACT**

A sorting conveyor is divided into discrete discharge zones each assigned a unique zone identification code and each including one or more discharge locations having one or two discharge chutes aligned therewith and assigned a chute identification code. Each article inducted onto the conveyor is assigned a digital code a portion of the bits of which correspond to the code assigned to a chute within a zone. The article code is applied to a shift register memory and shifted in synchronism with the conveyor movement to be applied to a zone control circuit during a timer interval corresponding to the entry of the article into the discharge zone. A code generator synchronized with the conveyor movement produces a time varying code repeated for each zone time interval and which is compared with a location code assigned to each discharge location and uniquely identifying the position on a discharge chute within a discharge zone. An article diverter is actuated to discharge an article onto a discharge chute when the zone and chute codes coincide with the article code and the location code assigned to a discharge chute corresponds to the generated time varying code.

27 Claims, 5 Drawing Figures



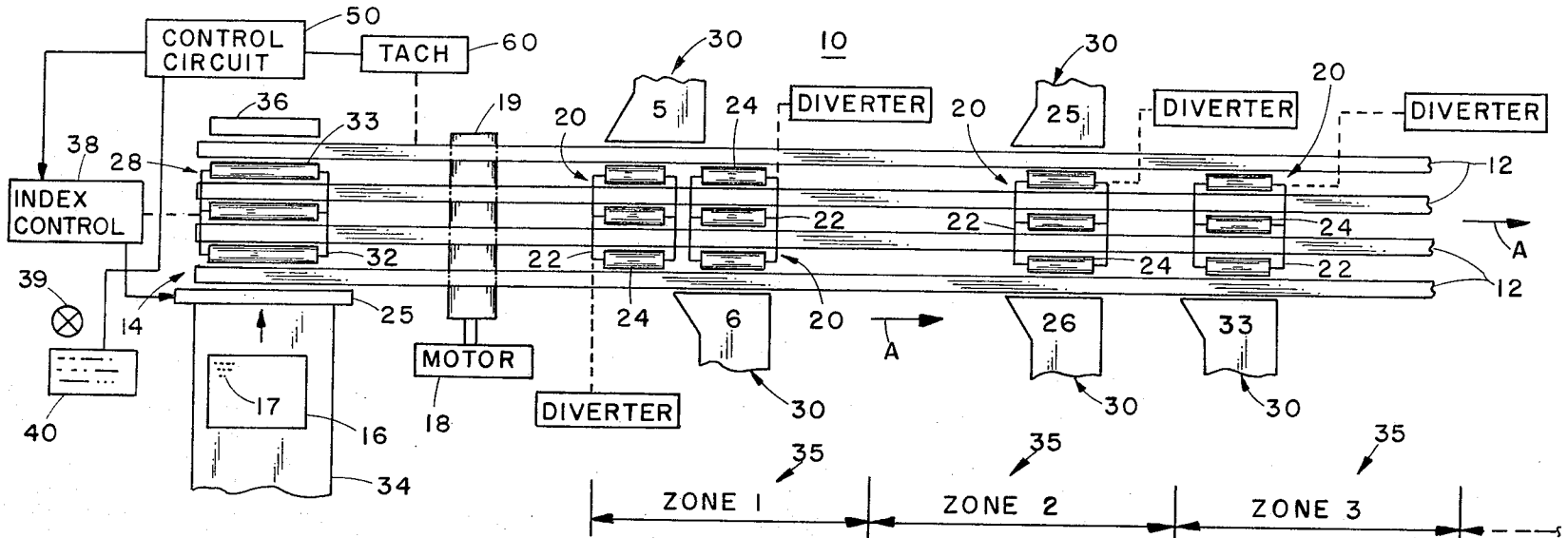


FIG 1

CHUTE NO	ARTICLE CODE	(8 BIT BINARY)	
4	000001	00	ZONE 1
5	000001	01	
6	000001	10	
7	000001	11	
24	000110	00	ZONE 2
25	000110	01	
26	000110	10	
27	000110	11	
32	001000	00	ZONE 3
33	001000	01	
34	001000	10	
35	001000	11	
	ZONE CODE (6 BIT)	CHUTE CODE (2 BIT)	

FIG 4

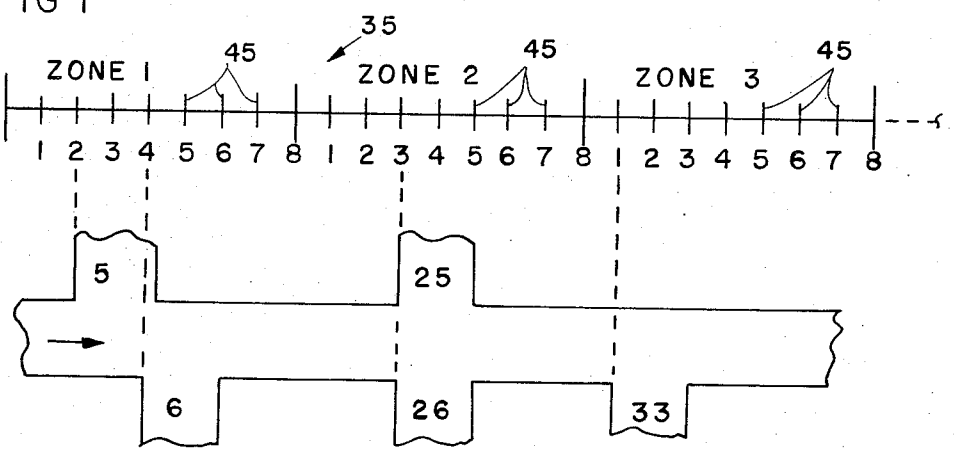


FIG 2

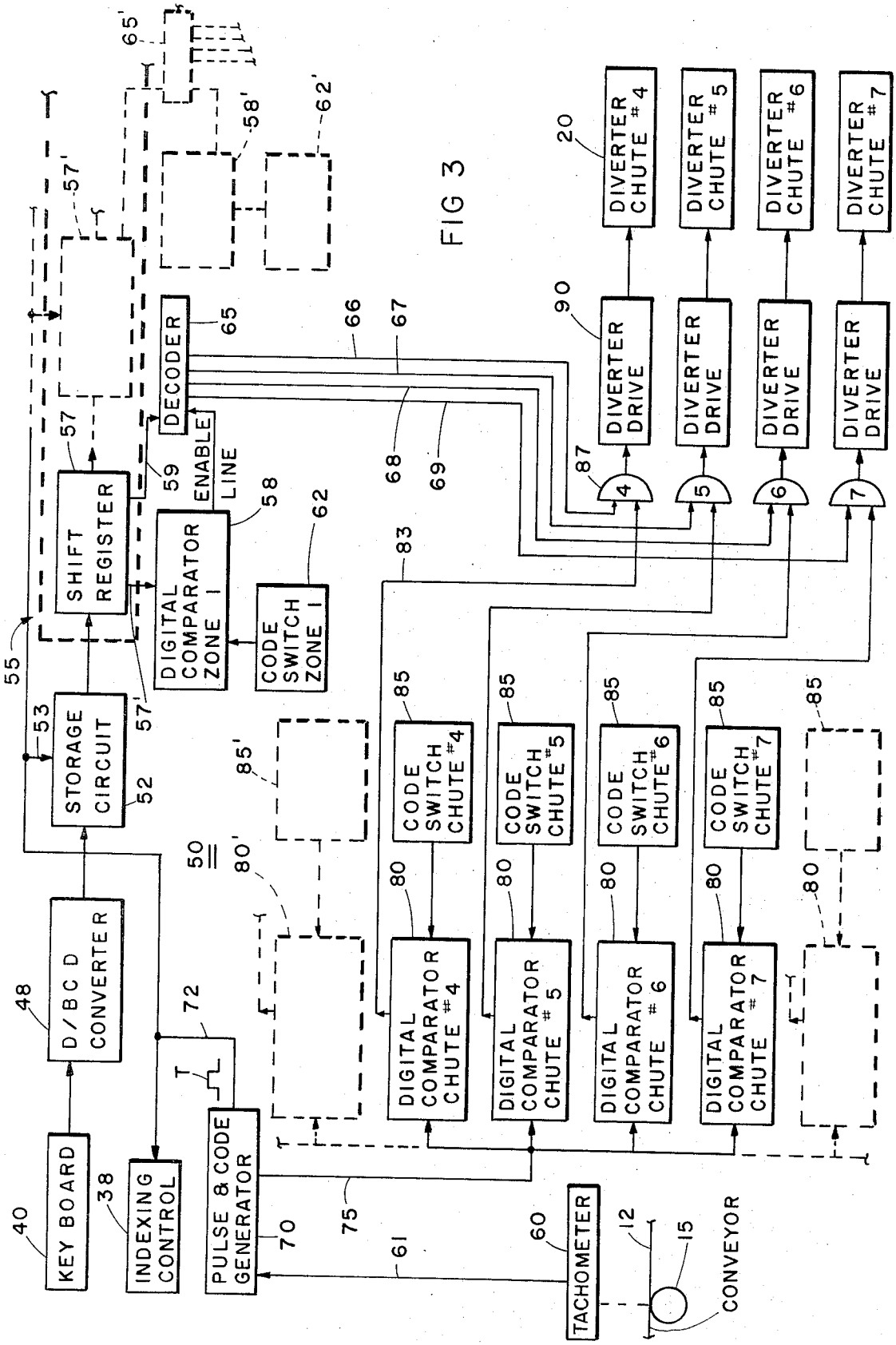

KEY BOARD
INDEXING CONTROL
PULSE & CODE GENERATOR
D/BCD CONVERTER
STORAGE CIRCUIT
SHIFT REGISTER
DECODER
ENABLE LINE
DIGITAL COMPARATOR ZONE 1
CODE SWITCH ZONE 1
CODE SWITCH CHUTE #4
CODE SWITCH CHUTE #5
CODE SWITCH CHUTE #6
CODE SWITCH CHUTE #7
DIGITAL COMPARATOR CHUTE #4
DIGITAL COMPARATOR CHUTE #5
DIGITAL COMPARATOR CHUTE #6
DIGITAL COMPARATOR CHUTE #7
DIVERTER DRIVE
DIVERTER CHUTE #4
DIVERTER CHUTE #5
DIVERTER CHUTE #6
DIVERTER CHUTE #7
TACHOMETER
CONVEYOR

FIG 3

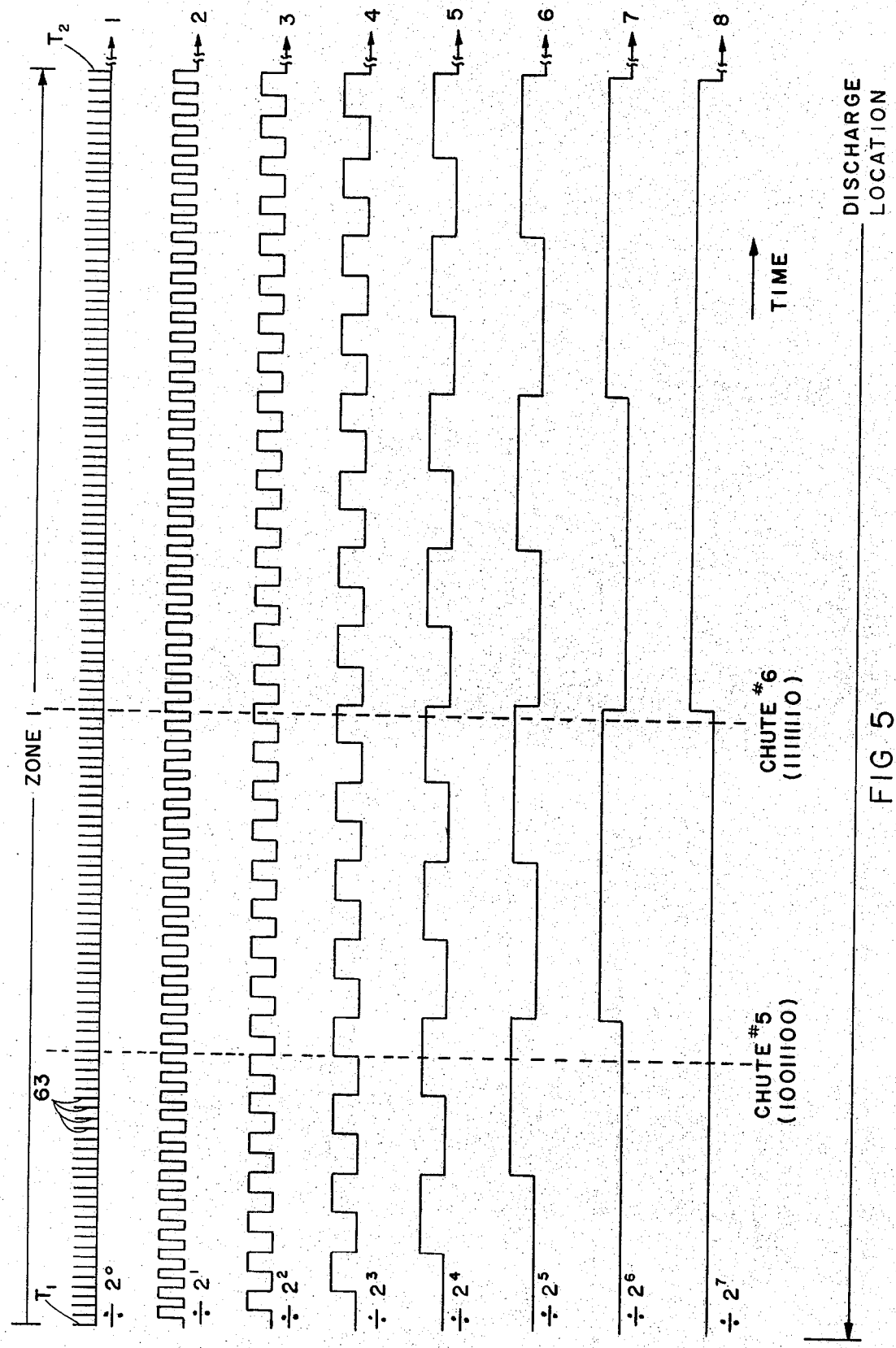

ZONE 1
63
T_1
T_2
1
2
3
4
5
6
7
8
$\div 2^0$
$\div 2^1$
$\div 2^2$
$\div 2^3$
$\div 2^4$
$\div 2^5$
$\div 2^6$
$\div 2^7$
CHUTE #6 (1111111O)
CHUTE #5 (1001100)
TIME
DISCHARGE LOCATION

FIG 5

METHOD AND APPARATUS FOR SORTING ARTICLES ON A CONVEYOR UTILIZING A SHIFT REGISTER AND A TIME VARYING CODE CONTROL MECHANISM

BACKGROUND OF THE INVENTION

The present invention relates to sorting systems and particularly to a control system for a sorting conveyor.

There are several known systems employed to control the diverting of articles inducted onto a sorting conveyor. Such known systems include the detection of a code impressed upon the article by a sensor at each discharge location such that when the article aligns with the discharge location identified by the same code, the article is diverted. Although providing flexibility of positioning the discharge chutes along a sorting conveyor, this system relies upon the detection of a code positioned on the article which requires alignment of the article with respect to the code sensing mechanism. Frequently, this alignment is very difficult if not impossible to achieve in a commercial installation. Also, the expense of the sensing equipment necessary at each chute outweighs the flexibility obtained by employing such a control.

Another approach generally employed is to assign an article inducted onto the sorting conveyor a predetermined identification code which is fed into a shift register memory and shifted therealong in synchronism with the conveyor movement. Each discharge location has a code assigned thereto and is coupled to an output of the shift register such that when coincidence between the code assigned the article and the code assigned a discharge chute is detected, the diverter for the discharge chute is actuated to divert the article from the conveyor system. Such a system is useful in installations where discharge chutes are fixed at evenly spaced locations such that the code inserted into the shift register can be shifted along at regular intervals by clock pulses. In systems, however, where discharge chutes are randomly spaced or frequently moved from place to place, the control cannot be easily adapted to accommodate such variations.

More recently, a system has been proposed whereupon each discharge location is assigned an identification code and includes electronic circuitry thereat for counting timing pulses from the time an article is inducted at a fixed position on the sorting conveyor until the article is predicted to be in alignment with the discharge location. When the article is inducted onto the conveyor, a unique code assigned to the article identifies the chute at which the article is to be discharged and activates the counter at the discharge chute location to achieve synchronization therebetween.

In this system, discharge chutes can be positioned at intervals physically spaced in a corresponding relationship to the time intervals and conveyor movement between the timing pulses employed. This permits some degree of flexibility for the initial installation of the discharge chutes at random locations but requires rewiring of the counters when for example, a discharge chute is to be moved to a different location along the conveyor line. Additionally, such a system requires relatively complex and expensive electrical circuitry at each discharge location. As the size of the installation increases thereby increasing the number of discharge

chutes employed, the circuitry cost may become prohibitive.

SUMMARY OF THE PRESENT INVENTION

The present invention solves the problems of the known prior control systems by providing a control system adapted for random spacing of discharge chutes along a conveyor line together with the capability of moving the discharge chutes and easily reprogramming the control for new chute locations. This provides a sorting conveyor system adaptable to a variety of physical locations within a warehouse or the like. In addition, a unique coding system is employed which vastly simplifies the circuitry required at each discharge location as well as that required for the master control circuit.

Apparatus embodying the present invention includes a sorting conveyor having a plurality of discrete discharge zones each including one or more discharge locations thereat with one or two discharge chutes assigned to each discharge location. An article inducted onto the conveyor is assigned a unique data code comprising a plurality of bits some of which identify a discharge zone in which the article is to be diverted while the remaining bits identify the discharge chute within the zone at which the article is to be diverted. The article code is applied to the memory circuit which is controlled in synchronism with the conveyor movement to shift the article code in synchronism with the conveyor movement. A code comparator and a chute decoder are provided for each zone and are coupled to the memory circuit. A code generator provides a repetitive time varying code having pulses related in time to the conveyor movement and which is applied to comparator means for each discharge chute. A chute location code associated with each chute is also applied to the comparator. The diverter mechanism for a discharge chute is actuated upon the coincident detection of the assigned article code with the corresponding zone and chute code and the location code assigned each chute with the coorresponding time varying generated code as an article aligns with the desired chute.

It is an object of the present invention to provide an improved control system for a sorting conveyor which permits the random spacing of discharge chutes.

It is another object of the prevent invention to provide an improved method for diverting articles from a sorting conveyor onto predetermined discharge chutes.

A further object of the present invention is to provide an improved control system for a sorting conveyor which easily permits a discharge chute position to be changed.

Another object of the present invention is to provide a control system for a sorting conveyor which employs a unique coding arrangement.

Still a further object of the present invention is to provide a control circuit which is relatively inexpensive and permits the random spacing and relocation of discharge chutes with a minimum of adjustment to the control system.

These and other objects of the present invention will become apparent upon reading the following specification together with accompanying drawings in which:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary plan schematic view of a sorting conveyor system embodying the present invention;

FIG. 2 is a schematic diagram of a portion of the conveyor system shown in FIG. 1 illustrating the division of the conveyor into discharge zones and the division of the discharge zones into discharge locations;

FIG. 3 is a circuit diagram in block form of a control system embodying the present invention;

FIG. 4 is a table illustrating assigned article codes and corresponding zone and chute codes for the discharge chutes shown in FIGS. 1 and 2; and

FIG. 5 is a waveform diagram showing the time varying code generated by the code generator circuit of FIG. 3 and which is synchronized with the conveyor movement.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIGS. 1 and 2, there is shown in schematic form a sorting conveyor **10** comprising a plurality of longitudinally extending chains or belts **12** receiving articles **16** at an induction station **14** at one end thereof. The conveyor is of conventional design with the chains **12** moving in a direction indicated by the arrows A and driven by a conveyor drive motor **18** coupled to the chain by suitable coupling means **19.** The chains are spaced from each other with interleaved mechanical diverting mechanisms **20** positioned at each discharge location.

Each diverter **20** comprises a vertically movable frame **22** housing a plurality of powered rollers **24.** The frames and rollers are actuated by a diverter control **26** for each discharge location which raises the frame with an article on the rollers and rotates the rollers in one direction or the other to divert the article into a discharge chute **30** positioned on the left or right side of the conveyor. The construction of the diverters is conventional and is not discussed in detail here.

Although the sorting conveyor system illustrated in FIG. 1 is of the chain type with roller diverting mechanisms, the present invention can likewise be used with other sorting conveyors including a closed loop sorting conveyor system employing discrete article carrying trays such as that described in U.S. Pat. No. 3,034,665 to R. L. Speaker.

The induction station **14** includes a transfer mechanism **28** which is a vertically movable frame **32** with a plurality of article receiving powered rollers **33** therein. Frame **32** is reciprocated between a normally upward position where it can receive articles **16** from a powered infeed conveyor **34** when released by an indexing stop **25** at the end of conveyor **34.** Mechanism **28** positions the articles so received against a stop **36,** and when momentarily lowered, inducts the article onto chains **12** of conveyor **10.** A control circuit **50** (described in detail below) receives timing signals from an electro-optical tachometer **60** of conventional design to periodically provide an induct signal to an indexing control **38** which momentarily lowers frame **30** to induct an article onto the conveyor at a known reference time.

Adjacent the input end of induction station **14** there is provided an operating platform **39** with a data keyboard **40.** With an article at rest against the indexing stop **25,** an operator positioned on platform **39** can read an article destination code **17** applied to each article **16** to be sorted and program the control system with the article code which uniquely identifies the discharge chute to which the article is to be diverted. Once the operator types the article code on keyboard **40,** the indexing stop **25** releases the article which is transported onto the power roller transfer mechanism **28.** Transfer mechanism **28** is actuated by a signal from circuit **38** to release an article onto conveyor **10** when the next induct signal is applied to circuit **38** from circuit **50.**

As seen in FIGS. 1 and 2, the sorting conveyor **10** is divided into a plurality of discharge zones **35** numbered consecutively **1, 2, 3,** etc. Only three zones are shown for purposes of illustration in the figures. The discharge zones **35** are in turn each divided into a plurality of discharge locations **45,** each being capable of having left and right discharge chutes **30** associated therewith. For the purposes of illustration only, FIG. **2** shows a discharge zone having eight individual discharge locations, each capable of including two discharge chutes.

As will become readily apparent, the system is adapted to include as many discharge zones as necessary and each zone can be conveniently subdivided into as many discrete discharge locations as needed. Generally, only a few discharge locations will be employed, the remaining locations being available for repositioning the discharge chutes or adding additional chutes.

As seen in FIG. **2,** zone **1** includes discharge chutes numbered **5** and **6.** Chute No. **5** is on the left side of conveyor **10** and is located at discharge location No. **2.** Chute No. **6** is on the right side of conveyor **10** and located at discharge location No. **4.** Zone **2** includes a pair of discharge chutes **25** and **26** on the left and right side of conveyor **10** and positioned at discharge location No. **3.** Zone **3** includes one discharge chute **33** on the right side and located at discharge location No. **1.** The representation of FIG. **2** is merely illustrative showing the possible random distribution of discharge chutes along the conveyor instead of the regularly spaced symmetrical chute distribution frequently required by many known systems.

By subdividing the sorting conveyor **10** into a plurality of discrete zones, an article code identifying the zone and chute can be provided and which requires relatively inexpensive circuitry synchronized with the conveyor movement to track an article as it travels along the conveyor through the various zones. By subdividing the zones into a plurality of discharge locations, a repetitive time varying code generated in synchronism with the conveyor movement can be employed together with a location code uniquely identifying the positioning of a discharge chute within a zone to provide a diverting control signal when an article is in alignment with a desired discharge chute. The design of the control circuit utilizing this dual code system is discussed with reference to FIGS. **3, 4** and **5.**

Data keyboard **40** is coupled to the control circuit **50** by means of a decimal to binary coded decimal convertor **48.** The operator, upon examining an article at the induction station, types in the chute number at which the article is to be diverted (or some other suitable indicia). Convertor **48** converts the information received into an eight bit binary code uniquely identifying the chute and the zone in which it is located. This article code is shown for the chutes of FIG. **1** in FIG. **4.**

It is noted here that although the preferred embodiment is coded for four discharge chutes for each zone by employing the last two digits of the binary code associated with the article as the bin identification digits: the number of discharge chutes within a zone can be expanded as desired by redistributing the bits of the ar-

ticle code as desired or if necessary, adding additional bits and expanding the code detecting circuitry for the different code arrangement.

The output of the convertor **48** is applied to a storage circuit **52** having a clock input line **53** and an output which is coupled to a memory circuit **55** comprising a plurality of serially coupled shift registers **57.** Memory **55** is, therefore, a shift register type of memory incorporating a plurality of shift register modules which may be integrated circuits and each of which has an output which is coupled to a digital comparator associated with one of the zones. Comparator **58** is associated with zone **1** and receives a digital code from the shift register **57** by means of a six bit line **57'** which applies the six most significant digits of the article code stored in the shift register memory to the comparator.

A code switch **62** associated with zone **1** is of conventional construction and applies a six bit code to comparator **58.** When an article to be discharged to one of the chutes in the zone enters the zone, the six most significant digits of the article code in register **57** and the six bit binary code from switch **62** coincide. Comparator **58** detects the coincidence and generates an enable pulse applied to a decoder circuit **65.**

The two least significant bits of the article code are applied to the decoder from shift register **57** by means of a two line conductor **59.** Decoder **65** is a two-line to four-line decoder-demultiplexer which is a commercially available integrated circuit and which is programmed to detect the applied two bit data signal and activate one of the output lines **66, 67, 68** or **69** when enabled by circuit **58** and when the two least significant digits of the article code stored in shift register **57** correspond to one of the discharge chute codes programmed into decoder **65.**

Each of the remaining zones **2, 3** and etc., also include as seen in phantom lines in FIG. **3,** a corresponding shift register, digital comparator, decoder and code switch which uniquely identifies the zone. As seen in FIG. **3,** the detail circuitry for only bins **4, 5, 6** and **7** in zone **1** are specifically shown. The circuitry for the remaining discharge chutes and zones are generally the same and are added as seen by the phantom blocks of FIG. **3.**

To provide circuit **50** with timing information related to the conveyor movement, a conventional electro-optical tachometer **60** is coupled to the conveyor chain **12** by means of a mechanical coupling such as gear **15.** Tach **60** applies relatively high frequency pulses to the pulse and code generator **70** via conductor **61.** In the preferred embodiment, each revolution of gear **15** represented **40** inches of conveyor movement and tachometer **60** produced 1,000 pulses during this time interval which for a conveyor speed of 200 feet per minute is approximately equal to one second. The pulse and code generator **70** comprises a plurality of series connected commercially available frequency divider integrated circuits which divide the tach pulses to provide phase pulses. The phase pulses (**63** in FIG. **5**) are frequency divided further to provide the various integer sub-multiple frequency divided outputs to an eight line output conductor **75.** Conductor **75** is coupled to each of a plurality of digital comparators **80** associated with each one of the discharge chutes in the system. The eight line time varying code signals uniquely identifying each phase pulse interval are shown in FIG. **5** on time axes labeled **1–8.**

During each zone period which corresponds to the movement of a point on the conveyor through one discrete discharge zone, a clock pulse T is developed by generator **70** and employed to reset the divider circuits of the generator. The clock pulse is also applied to conductor **72** and serves as an induct pulse for the index control **38** as well as a shift pulse for the storage circuit **52.** This signal causes the article code from the keyboard and temporarily stored in the storage circuit **52** to be shifted into the first shift register **57** of memory **55** and shifts the article codes in the register memory to the next of the series of register modules. In this manner, the article code follows the movement of the article from zone to zone in synchronization with the conveyor movement.

During the time interval when the article is traversing a discrete discharge zone, the time varying code developed by circuit **70** is applied to the bank of digital comparators **80.** Each comparator **80** is a commercially available eight bit comparator which also receives a continuous eight bit digital code from one of the digital code switches **85** which are associated with each of the discharge chutes **30.** During a zone period (i.e., the time an article requires to transverse a discharge zone), the location code assigned the discharge location and selected by a switch **85;** and the time varying code from generator **70** will coincide. When this occurs, the comparator **80** will apply an output signal on line **83** which is applied to an AND gate **87** associated with the discharge chute.

Upon the coincident arrival of a signal on line **83** and a signal from decoder **65** which is applied to the other input terminal of the AND gate **87,** the gate applies a signal to the diverter drive circuit **90** for the chute. Circuit **90** in turn applies a signal to the diverter **20** causing its actuation and the transfer of the article from the conveyor onto the assigned discharge chute **30.** Having briefly described circuit **50** and its overall operation, a detailed description of the diverting of an article onto discharge chute **6** of zone **1** is presented to provide a more thorough understanding of the control system and the coding arrangement of the present invention.

OPERATION

Referring now to FIGS. **3, 4** and **5,** the article code generated by the convertor **48** in response to a signal from keyboard **40,** is shown for each of the four bin locations in zones **1, 2** and **3.** The first six bits, i.e., the most significant bits of the code, are employed as a zone identification code which is applied to comparator **58** as described above. The remaining least significant two bits is employed as a chute identifying code and applied to decoder circuit **65** for each zone from memory **55.** It is seen in the table of FIG. **4** that the zone **1** code is 000001; zone **2** is 000110 and zone **3** is 001000. The four chutes of each zone are conveniently coded with the two digits as 00, 01, 10 and 11. Chute **6,** which is seen in FIG. **2,** is at location **4** in zone **1** and an article to be diverted thereto will have an eight bit article code 00000110.

The positioning of chute **6** at location **4** also corresponds to a unique eight bit code generated by the code generator **70** and which occurs within a zone period in relationship to the position of chute **6** within the zone. This code is seen in FIG. **5** and can be identified by following the vertical line extending from the discharge

location axis corresponding to location 4 in zone 1 (FIG. 2) through (from top to bottom) the eight output lines of the generator 70. The time varying code at the time in the zone period corresponding to location 4 and also the location code set in the code switch 85 for chute 6 is 11111110. The eight lines from circuit 70 represent the frequency division of the phase pulses 63 by 1, 2, 4, 8, 16, 32, 64 and 128. The first clock pulse which occurs as an article inducted onto the conveyor enters zone 1, is indicated as T_1 on the diagram. As the article travels along the conveyor, the time varying code will vary as seen by following the time axis for the signals on lines 1–8 of FIG. 5. The location code for chute 5, for example, is 10011100 which uniquely identifies bin 5 and which occurs in timed coincidence with the arrival of an article at chute 5. It is noted here that the zones are positioned such that they begin at an even zone width or multiple integer thereof from the induction station 14. Clock pulse T_1 occurs as an article enters zone 1, clock pulse T_2 occurs as the article enters zone 2 and so forth. This delay caused by the spacing of the induction station from zone 1 can be accommodated by for example, incorporating a predetermined number of shift registers in storage circuit 52 such that the article code will be shifted from storage circuit 52 into the first shift register 57 of memory 55 as the inducted article enters zone 1.

The time varying code generated by circuit 70 and illustrated by the diagram of FIG. 5 is repeated for each zone period and will be identical at a given instant of time for each of the periods. Thus, a discharge location at a predetermined position at each zone will have the same location code and corresponding time varying code. The article will only be discharged, however, when the article code has been detected by comparator 58 indicating that the article is to be discharged in the zone set in code switch 62; and at a discharge chute identified and detected by decoder 65 as being present within the zone. In this manner, therefore, each discharge chute is identified by a dual code which, due to the cyclical nature of the time varying code generated by circuit 70, obviates the need for individual counters at each discharge location and, therefore, greatly simplifies the circuitry. Since a discharge location can have two chutes, the chute code programmed in decoder 65 provides the control signal which actuates a diverter 20 to divert an article to the desired chute. In cases where two chutes are aligned opposite the conveyor, a single diverter is employed to serve two chutes. In such case, the diverter drives 90 are appropriately coupled to the diverter to control its direction of operation.

If it is desired to move the location of the discharge chute within a zone, all that is required is to reset the code switch 85 associated with the discharge chute in accordance with the time varying code at that instant of time in the zone period corresponding to the new location of the chute. A waveform similar to that of FIG. 5 can serve as a chart from which the new location code can be ascertained by drawing a vertical line from the new discharge location (i.e., the bottom line in FIG. 5), through the eight lines. The discharge location will always align with one of the phase pulses 63 shown in line 1 of FIG. 5 which are frequency divided tach pulses. In the preferred embodiment, the phase pulse interval represents movement of approximately 0.3 inches of the conveyor for the tachometer frequency used. Thus for each 0.3 inch increment of conveyor movement, a unique time varying code is available for positioning a chute with a corresponding location code. If greater resolution is necessary, the drive for tachometer 60 can be varied to provide a higher pulse repetition rate for the desired conveyor speed or the phase pulse frequency used can be higher.

If an additional chute is added to a zone (as for example, a chute 4 or 7 in zone 1 of FIG. 1), an available decoder output line for the zone is used to determine its chute code. The location code is determined as discussed above. In such case, a code switch and comparator (80, 85) are also added together with an AND gate and diverter drive. These units can be in the form of plug-in modules to simplify the addition of chutes. Also with this system, the chutes can easily be redesignated by merely changing the code switches 62.

By employing the tachometer and phase pulses together with circuit 70 to generate a repetitive time varying code, it is seen that the conveyor speed can increase or decrease without affecting the diverting accuracy of the system. If for example, the conveyor speed decreases, the time scale of FIG. 5 merely is expanded as is the location axis such that the relationship between the occurrence of the time varying code and the chute location code will remain in coincidence with the arrival of an article with the chute. Likewise, the shifting of the article code in the shift register memory 55 will occur at a slower rate corresponding to the reduced conveyor speed.

It will become apparent to those skilled in the art that various modifications to the present invention can be made. For example, as briefly mentioned above, a discharge zone can be subdivided into a greatly increased number of discharge locations, each accommodating a pair of discharge chutes on opposite sides of the conveyor. It is necessary only to provide an article code which will uniquely identify the zone in which the discharge chute is positioned and the chute within the zone. The circuits employed in the system can easily be expanded as needed for particular installations to accommodate the desired discharge chute density. Additionally, if greater resolution is desired for the discharge chute positioning, the pulse and code generator 70 can be expanded upon to provide a ten, twelve or etc., bit time varying code for uniquely identifying any number of bins within a discharge zone. These and other modifications will, however, fall within the scope of the present invention as defined by the appended claims.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows.

1. A method of diverting articles from a sorting conveyor onto a desired discharge chute comprising the steps of:

segmenting a sorting conveyor into a plurality of discharge zones along the length of the conveyor each having at least one discharge location for a discharge chute;

providing an article code for each article inducted onto said conveyor which uniquely identifies a discharge zone and chute therein;

storing article codes provided as articles are inducted onto the conveyor in a memory circuit having a plurality of output terminals each associated with one of the discharge zones;

shifting the article codes within said memory in timed relationship to the conveyor movement to successive output terminals associated with associated successive discharge zones through which an article is traveling;

generating a repetitive time varying code in timed relationship to the conveyor movement and having a period corresponding to the movement of an article through a discharge zone;

comparing the article code at the output terminals of said memory means with a zone code assigned each discharge zone;

comparing the time generated code with a location code assigned each discharge location; and

diverting an article from said conveyor onto a discharge chute upon the coincident correspondence of the zone identification code with the article identification code and the location code with the time varying code.

2. The method of claim **1** and including the steps of:

segmenting the article code into a zone identification code and a chute identification code;

comparing the zone code with the zone identification code;

comparing the chute code with the chute identification code; and

diverting an article only when the compared codes coincide.

3. The method of claim **2** wherein the last named comparing step comprises the step of decoding the chute identification code present at the output terminals of said memory circuit by a decoding circuit having preassigned chute identification codes therein which program the decoding circuit to respond to a correspondingly coded chute within a discharge zone.

4. In a sorting conveyor system divided into a plurality of discharge zones each including one or more discharge locations for a discharge chute, a control system for actuating a diverter for a discharge chute when an article inducted onto said conveyor is aligned with the desired chute comprising:

means for providing an article code uniquely identifying a discharge zone and chute to which said article is to be diverted;

memory means synchronized with said conveyor movement for receiving said article code and transferring said code to sequential output terminals of said memory in synchronism with the movement of said conveyor through discharge zones;

means for providing a zone code uniquely identifying each zone within said conveyor system;

first comparator means associated with each discharge zone and coupled to an output terminal of said memory means associated with a discharge zone and to said zone code providing means associated with the same zone for comparing at least a portion of the article code at the memory output terminal with the zone code;

means for generating a time varying code in timed relationship to said conveyor movement;

means for supplying a chute location code for each discharge chute within said system;

second comparator means associated with each discharge chute for comparing said time varying code with said chute location code and for generating an output signal in response to the coincident detection thereof; and

circuit means coupled to said first and second comparators and responsive to signals therefrom for actuating a chute diverter when an article is aligned with said discharge chute as indicated by the coincidence of said codes.

5. The system as defined in claim **4** wherein said means for generating a time varying code comprises:

a tachometer coupled to said conveyor for developing electrical tachometer output signals whose frequency is related to the speed of said conveyor; and

a code generating circuit coupled to said tachometer output signals for providing a multiple bit output code comprising signals which are integer submultiples of the frequency of said tachometer output signals.

6. The system as defined in claim **5** wherein said code generating circuit further develops clock pulses having a period of occurrence corresponding to the movement of an article through a discharge zone and which are applied to said memory means to shift said article codes to sequential output terminals thereof.

7. The system as defined in claim **4** wherein said circuit means includes decoding means associated with each discharge zone and coupled to said output terminals of said memory means to detect a chute code included in said article code for a chute of a discharge zone and coupled to said first comparator and enabled by an output signal therefrom to actuate a chute diverter only when the chute code is detected by said decoding means.

8. The system as defined in claim **4** wherein said memory means comprises a shift register memory.

9. The system as defined in claim **4** wherein said means for providing a zone code comprises a digital code switch for each discharge zone.

10. The system as defined in claim **4** wherein said means for supplying a chute location code comprises a digital code switch for each discharge chute.

11. A sorting conveyor divided into a plurality of discharge zones each having one or more discharge locations for discharge chutes for a control system comprising:

means for providing an article code identifying a discharge zone and chute at which an article is to be discharged;

means for providing a repetitive time varying code related to the conveyor movement and uniquely identifying each discharge location within a zone; and

circuit means receiving said article code and said time varying code in timed relationship to the movement of said conveyor to divert an article at a discharge chute identified by said article code and at a location identified by said time varying code.

12. The system as defined in claim **11** wherein said time varying code is initiated as an article enters a zone and repeated as an article passes through successive zones.

13. The system as defined in claim **12** wherein each discharge zone is assigned a zone code uniquely identifying the zone and corresponding to the zone identification portion of an article code as an article enters and travels within the zone.

14. The system as defined in claim **13** wherein said circuit means comprises:

memory storing article codes accompanying articles as they are inducted onto said conveyor;

means for shifting said article codes to sequential output terminals of said memory associated with said zones and in synchronization with the conveyor movement;

comparator means for comparing the assigned zone code and zone identification portion of the article code, and the time varying code and the location code assigned a chute; and

control means coupled to said comparator means for actuating a chute diverter to divert an article into the desired discharge chute as it aligns therewith as indicated by the coincidence between the respective codes.

15. In a conveyor system comprising a sorting conveyor divided into a plurality of discrete discharge zones each including one or more discharge locations each capable of having one or more discharge chutes associated therewith, a control system for discharging articles onto predetermined discharge chutes during a zone period in which said article is aligned with said predetermined chute by actuating a chute diverter, said control system comprising:

means for generating an article code uniquely identifying a discharge zone and chute of said conveyor;

memory means coupled to said generating means and including a plurality of output terminals each associated with one of said discharge zones;

means for entering an article code into said memory means as an article is inducted onto said conveyor and for sequentially shifting an article code to said output terminals of said memory means in synchronism with the movement of said conveyor to a zone;

means for providing a zone code identifying each discharge zone;

first comparator means coupled to said memory means and to said zone code providing means for each zone for comparing said zone code and at least a portion of said article code to develop an enable signal when said codes coincide;

means for generating a time varying code repeated for each zone period and uniquely identifying each divert location in the zone;

means for supplying a location code for each discharge location;

second comparator means coupled to said last named generating means and to said supplying means for providing a control signal in response to the coincidence between said time varying code and said location code; and

circuit means coupled to said comparators and to diverters for said discharge locations for actuating a predetermined discharge chute when said enable and said control signal are provided by said comparators.

16. The system as defined in claim **15** wherein said article code is segmented into a zone identification code applied to said first comparator from said memory means and a chute identification code applied to said circuit means from said memory means, said circuit means including decoding means associated with each discharge zone.

17. The system as defined in claim **16** wherein each of said decoding means for a zone is programmed to detect chute identification codes corresponding to chutes within the associated zone and provide an output signal in response to the presence of an enable signal from said first comparator and a detected chute code.

18. The system as defined in claim **17** wherein said memory means comprises a shift register memory.

19. The system as defined in claim **18** wherein said generating means comprises:

a tachometer coupled to said conveyor for developing electrical tachometer output signals whose frequency is related to the speed of said conveyor; and

a code generating circuit coupled to said tachometer output signals for providing a multiple bit output code comprising signals which are integer submultiples of the frequency of said tachometer output signals.

20. The system as defined in claim **19** wherein said code generating circuit further develops a clock pulse during each zone period which is applied to said shift register memory to shift stored article codes therein.

21. The system as defined in claim **20** and further including an induction station for inducting articles onto said conveyor, and a control circuit for actuating said induction station to induct an article, said control circuit coupled to said code generating circuit for receiving clock pulses therefrom to induct an article onto said conveyor in response to a clock pulse.

22. A sorting conveyor and control system comprising:

a sorting conveyor including a plurality of discharge zones each having at least one discharge location and diverter associated therewith and at least one associated discharge chute;

means for providing an article code uniquely identifying a discharge zone and chute for each article inducted onto said conveyor;

memory means coupled to said providing means for receiving said article codes as articles are inducted onto said conveyor and for sequentially shifting said code to sequential output terminals of said memory means as an inducted article enters each discharge zone;

means coupled to said conveyor for generating a time varying repetitive code in timed relationship to the conveyor movement and a clock pulse applied to said memory means for periodically shifting said article code in said memory in timed relationship to the conveyor movement;

means for providing a unique zone code identifying each discharge zone;

means coupled to said zone code providing means of each discharge zone and to said memory for comparing an article code at an output terminal of said memory means associated with a predetermined zone and said zone code for said predetermined zone for producing an enable signal in response to the coincidence therebetween;

decoding means associated with each discharge zone and coupled to said memory means and said comparing means and responsive to at least a portion of an article code in the presence of said enable signal to develop a first signal when a discharge chute in an associated zone is identified;

means for supplying a location code uniquely identifying each discharge location for discharge chutes within a zone;

means coupled to said generating means and said supplying means for comparing said time varying

code and said location code for developing a second signal in response to the coincidence therebetween; and

control means coupled to said decoding means, to said last named comparing means, and to said diverters for actuating a predetermined diverter in response to the coincident arrival of said first and second signals thereby diverting an article from said sorting conveyor onto the desired discharge chute associated with said predetermined diverter.

23. The system as defined in claim **22** wherein said means for providing an article code includes an electrical keyboard actuatable to transfer discharge chute information accompanying an article to be inducted into said memory means.

24. The system as defined in claim **22** wherein said memory means comprises a shift register memory.

25. The system as defined in claim **22** wherein said generating means comprises:

a tachometer coupled to said conveyor for developing electrical tachometer output signals whose frequency is related to the speed of said conveyor;

a code generating circuit coupled to said tachometer and responsive to said tachometer output signals for providing a multiple bit output code comprising signals which are integer submultiples of the frequency of said tachometer output signals.

26. The system as defined in claim **22** wherein said means for providing a unique zone code comprises an adjustable digital code switch.

27. The system as defined in claim **22** wherein said means for supplying a location code comprises an adjustable digital code switch.

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