

Feb. 13, 1968

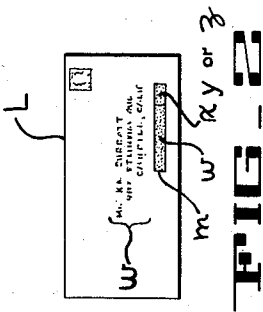
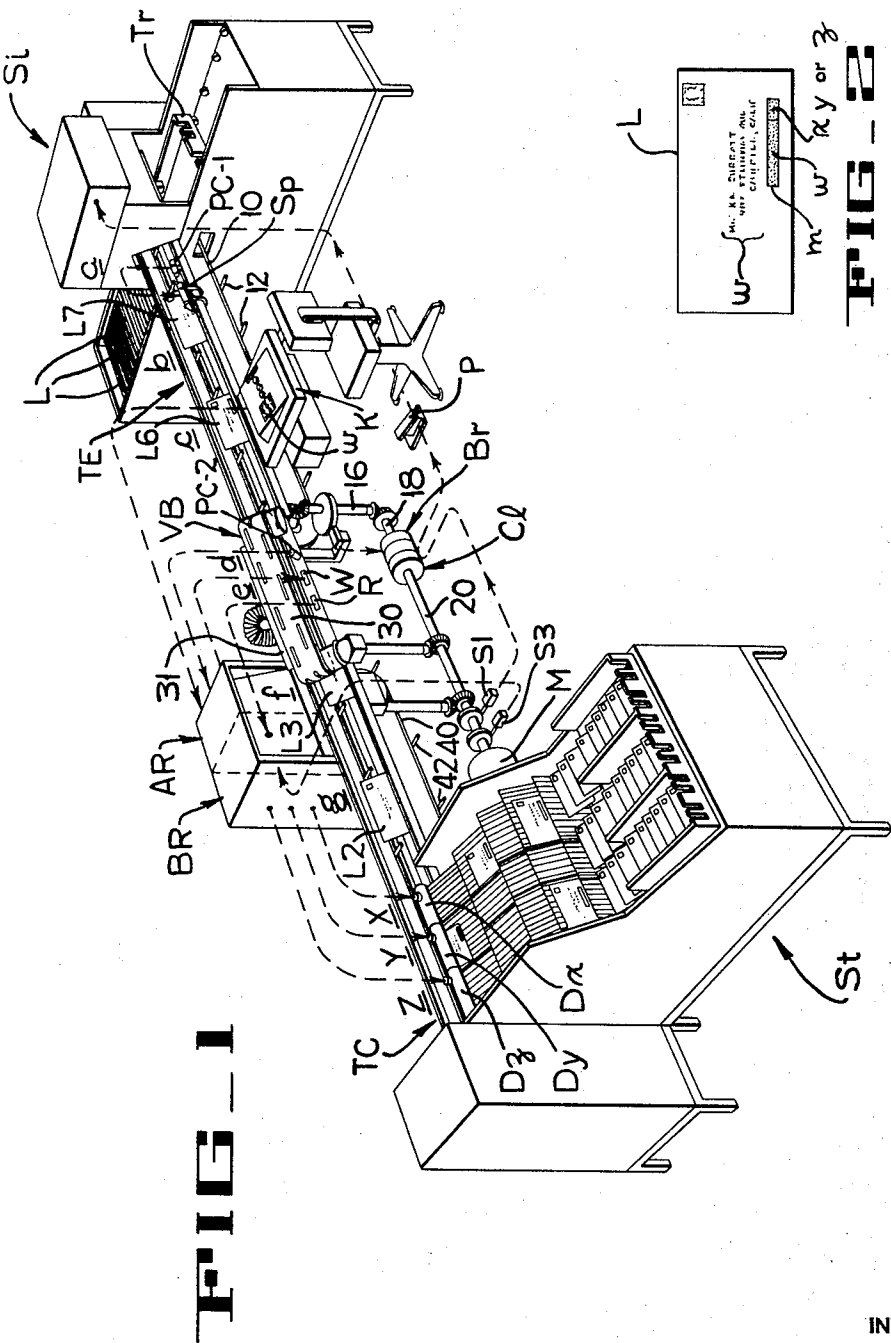
R. HEANEY ET AL

3,368,672

ARTICLE CLASSIFYING APPARATUS

Filed Jan. 17, 1966

2 Sheets-Sheet 1



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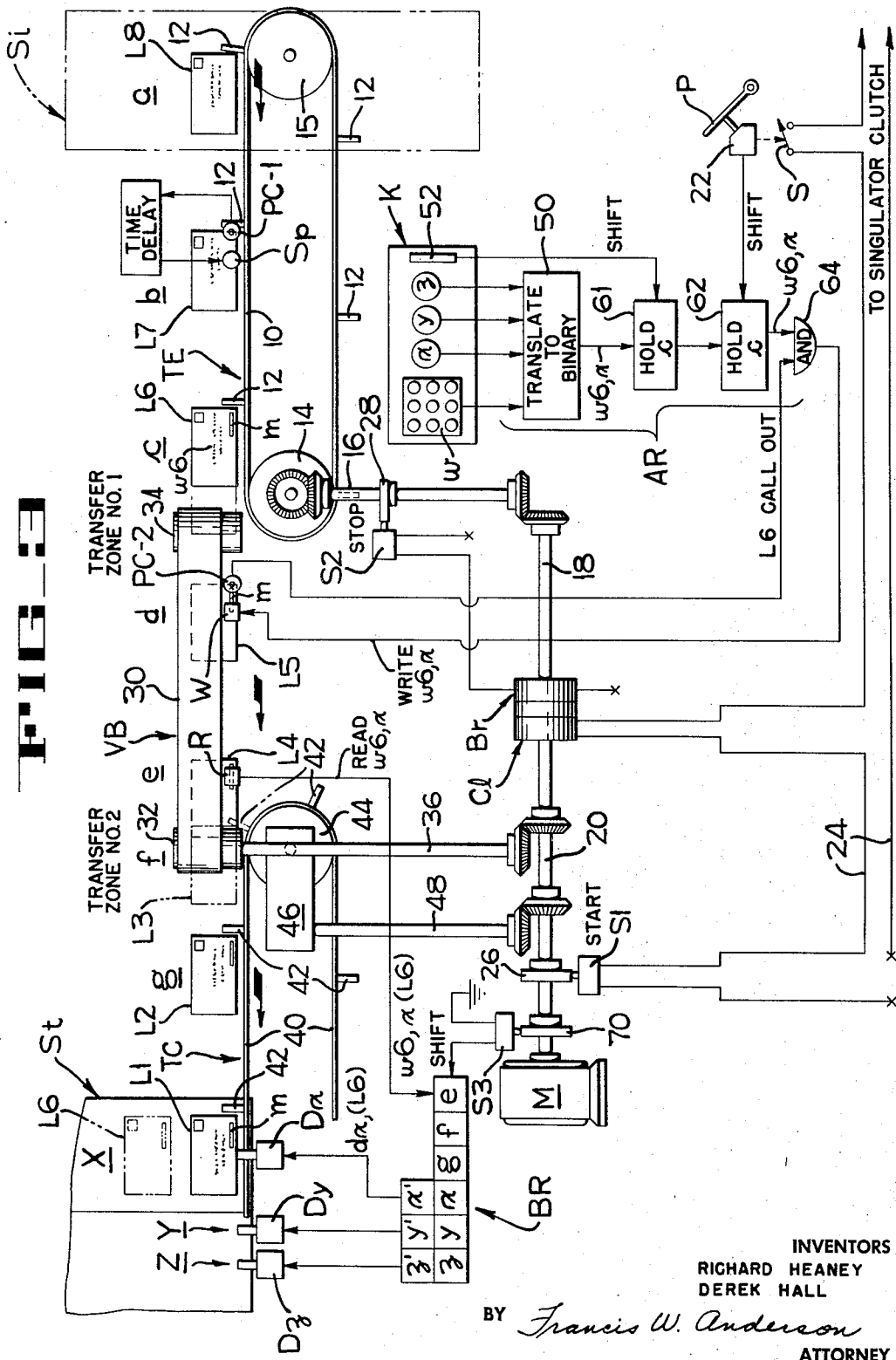
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2 Sheets-Sheet 2



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3,368,672

ARTICLE CLASSIFYING APPARATUS

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Filed Jan. 17, 1966, Ser. No. 520,961

8 Claims. (Cl. 209—73)

This invention relates to article classifying apparatus and more particularly to apparatus of the type wherein articles are classified by means of a code or the like imprinted on or carried by the article. The embodiment of the invention to be described in detail is a post office type installation wherein the articles to be classified are letters, although in its broader aspects the invention is not limited to this use.

In a letter coding and classifying system of the type to which this invention relates, singulated letter mail is received and advanced by a transport-easel conveyor in front of a coding operator. The operator reads the address on the mail and enters it in a keyboard as an extractive code version of the information written on the letter. More general information, such as whether the letter is for local or out of town distribution, etc., is entered directly into the keyboard. The keyboard information is stored. The letter will have been sprayed with a magnetic material, and as the magnetic material passes a letter sensor the coded information is abstracted from storage and written on the magnetic material with a conventional magnetic write head, as the letter moves past a write head.

The coded letter continues its advance and the coded general information is read by a reading head. This information is stored in an analogue shift register, and is used to operate discharge devices further along the conveyor system, the discharge devices in the example given responding to the directly entered general information.

In systems of this type it is desirable to have the conveyor section that advances letters past the writing and reading heads move continuously, and it is likewise advantageous to have the transport conveyor that carries the coded letters past the discharge devices move continuously. The continuous motion of the write-read conveyor, which is usually a vacuum belt conveyor, is particularly advantageous when magnetic heads are employed. Continuous motion of the transport conveyor is desirable, because this conveyor may be quite long in order that it may pass a number of coding stations and a number of discharge devices. To start and stop such a conveyor involves problems resulting from inertia, in both the starting and stopping of the conveyor, and in arresting of letters on the conveyor.

On the other hand, it is desirable that the reading and coding be operator-paced. This means that the operator should have control over the transport easel conveyor which advances letters before him for reading and operation of his coding keyboard. The intermittent, operator-paced operation of the easel conveyor; the continuous operation of the vacuum belt conveyor running past the write and read heads; and the continuously running transport conveyor running past the discharge devices; provide problems in synchronization both as to the physical handling of the letters, and as to keeping track of the letters relative to their respective codes. The requirement is that

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a given letter, having received a given code at a coding station on the intermittent, operator-paced easel conveyor, will be discharged at the selected discharge device, along the continuously running letter transport conveyor.

Briefly, in accordance with the present invention, the mechanical transport and transfer operations are carried out to attain the operation referred to above, by providing a synchronizing or interlock control. This is operated by the continuous drive means for the vacuum belt and transport conveyors. The control is functionally in series with a foot pedal or manually operated control at the read and code station for the easel conveyor. The control and the physical letter transport arrangements are so related that regardless of when the operator depresses his foot pedal for intermittent, stepwise advance of his easel conveyor (after the coding operation has been completed), the easel conveyor will not advance so as to deliver a letter to the vacuum belt conveyor, until the latter is in a position which insures that the vacuum belt conveyor will pick up the letter at one of a series of predetermined positions along its length. A letter at any of these positions on the vacuum belt conveyor will be properly delivered to the transport conveyor leading to the discharge devices. In the example given, proper delivery to the transport conveyor means that the letter will be delivered just ahead of an approaching letter advancing lug on the transport conveyor.

In the system of the present invention, since the vacuum belt and transport conveyors are driven continuously and synchronously, so long as letters do not slip on the vacuum belt, no mechanical synchronizing problems appear once the letters are properly picked up by the vacuum belt. However, in addition to this, track must be kept of the code imparted to the letters for proper operation of the discharge devices. In the present invention, the codes move in analogue with the letters, as the latter are carried along by the continuously operated conveyors, the analogue motion of the coded information being effected by a synchronizing switch. This switch is operated by the continuous conveyor drive, and its supplies pulses to a shift register which has received the code from the read head at the vacuum belt. This apparatus causes the code to move with the letters, for ultimate operation of a discharge device, via comparison devices that check the codes as they are shifted by the synchronizing pulses.

The manner in which these features and advantages may be attained will be apparent to those skilled in the art from the following detailed description of an embodiment of the invention.

In the drawings:

FIGURE 1 is a perspective of a letter sorting apparatus embodying the invention, with electrical connections illustrated diagrammatically in dotted lines.

FIGURE 2 is a view of a letter and magnetic code strip thereon.

FIGURE 3 is a schematic, electro-mechanical diagram of the system, with the singulator omitted. Here, the electrical connections are indicated in solid line, schematically.

General description

Referring to the drawings, the major components of the system are a letter tray *Tr*; a singulator *Si* for removing letters *L* individually from a stack in the tray, a

transport easel conveyor TE for receiving letters L from the singulator, a magnetic sprayer Sp, and a read and code station (c) at which an operator sits and operates a keyboard K for coding information into a storage and shift register AR. By operation of an easel conveyor control pedal P, the letters are transferred to a continuously running vacuum belt conveyor VB, wherein the coded material is abstracted from the register AR and written on the letters by a write head W. The coded information is read from the letters as they pass by a read head R, and entered into a storage and shift register BR. The letters are then transferred to a continuously moving transport conveyor TC, which advances the letters to a stacker St, having discharge stations X, Y and Z, for receiving sorted or classified articles in response to the action of discharge devices Dx, Dy and Dz, disposed along the conveyor TC. As mentioned, the coding and writing operation is effected through the register AR, and the sorting is performed by the register BR, the latter comprising principally shift registers and a directory or a set of comparison devices for finally classifying the articles into sets X, Y or Z, in accordance with the general information codes thereon.

Typical letter

As seen in FIGURE 2, a typical letter L is assumed to bear address information w. A magnetic strip m has been sprayed onto the letter for receiving coded information w as to the address, etc., as well as coded information x, y or z relative to classes or sorts to be performed on the machine. The latter will usually be broad classes, e.g., out of town, local and air mail, which information is keyed directly.

Transport easel conveyor

The transport easel conveyor TE includes a letter transport band 10 having uniformly spaced letter advancing lugs 12. The band is trained over a drive pulley 14 and over an idler pulley 15, within the singulator Si, FIGURE 1. The details of the transport easel conveyor are not critical to the invention. A suitable construction is shown in the patent to Sassen et al. 3,219,204, Nov. 23, 1965, assigned to the assignee of the present invention.

The easel conveyor TE is driven intermittently under control of the operator. The driving pulley 14 is driven by bevel gear shafts 16, 18, a clutch Cl, a brake Br, a main drive shaft 20 and a motor M. The read and code operator operates a pedal P, which controls a control box 22 (FIG. 3) that mechanically or electrically closes an easel conveyor control switch S when the pedal P is depressed. A power circuit 24 has connected in series a "start" switch Sl, the magnetic clutch Cl (which may be a one revolution clutch), the pedal control switch S, and a singulator clutch (not shown) in the singulator Si, FIGURE 1. The singulator and clutch are like that of the aforesaid Sassen et al. patent.

The singulator Si picks up the letters individually from a stack of letters in the tray Tr, and transfers them individually onto the band 10 and ahead of a pusher lug 12. The details of this synchronization are not critical to the present invention and may be like those shown in the aforesaid Sassen et al. patent. When the pedal P is depressed by the read and code operator, the switch S is closed, and this sets up the circuit for advancing the easel conveyor TE one pitch.

A "start" cam 26 on the main drive shaft 20 has a lobe which cyclically closes a start switch Sl. When the switch Sl is closed, and when the pedal P is depressed, the magnetic clutch Cl is engaged, as is the singulator clutch. The transport easel conveyor shaft 18 thereupon makes a turn, advancing the easel conveyor band 10 by an increment equal to the spacing between the lugs 12. When the band 10 is advanced by this increment, a "stop" cam 28 on the easel conveyor shaft 16 operates a stop switch S2, energizing the electro-magnetic brake Br. This pre-

vents over travel of the band 10 past a predetermined letter pick-up position. Thus, regardless of when the read and code operator depresses the pedal P, the easel conveyor TE cannot start and advance one pitch, until the read and code conveyor lugs 12 are synchronized with the drive to the vacuum belt and transport conveyors VB, TC, in the proper pickup position. This results from the series circuit of the start switch Sl, operated by the cam 26 on the main drive shaft; the clutch Cl; and the pedal P.

Vacuum belt conveyor

The vacuum belt conveyor VB receives the letters from the easel conveyor at transfer zone No. 1, and carries them to transfer zone No. 2 for pickup by the transport conveyor TC. The vacuum belt conveyor is of a type that is conventional in this art and includes the usual perforated vacuum belt 30 and a vacuum box 31 (FIG. 1), between the reach of the belt. The vacuum belt 30 is trained around a drive pulley 32 and an idler pulley 34 and a pulley 32 is driven continuously by means of a bevel gear shaft 36 driven from the main shaft 20. The letters are carried along on the underside of the far reach of the vacuum belt 30, as seen in FIGURE 1. The letters are carried past the magnetic write head W and hence past the magnetic read head R, as mentioned. These heads are beneath the lower edge of the far reach of the vacuum belt, and the portions of the letters bearing the magnetic strips project below the lower edge of the far reach of the vacuum belt for presentation to the magnetic heads. These details are not critical to the invention.

Transport conveyor

The transport conveyor TC comprises a letter transport band 40 having uniformly spaced letter advancing lugs 42. The band 40 is driven by a drive roller 44 and is trained around an idler roller (not shown). The drive roller 44 is driven by a gear box 46 and a bevel gear shaft 48 driven by the main shaft 20. Thus, both the vacuum belt and transport conveyors are driven continuously when the motor M is running.

Disposed at the delivery end of the transport conveyor TC is the stacker St. The stacker may have any number of sections, but only there are shown, namely, at stations X, Y and Z. Each station has a discharge device Dx, Dy and Dz, which devices are remotely controlled by the code handling system. The stacker St may be of the same design as that disclosed in the aforesaid Sassen et al. patent. It is claimed in the copending application of Sassen et al., Ser. No. 433,834 filed Jan. 25, 1965, which is a divisional application of the application that matured into the aforesaid patent. The details of the stacker are not critical to the invention, and insofar as an understanding thereof is required, reference is made to the aforesaid patent and pending application.

Mechanical operation

The operation of the mechanical units of the system will be briefly described. Letters L from the stack are picked up individually from tray Tr by the singulator Si and deposited on the band 10 of the easel conveyor TC. These letters are engaged by one of the lugs 12 on the band 10 as shown by letter L8, at station (a), FIGURE 3. The letters are carried past a spray control photocell PC-1, at station (b), FIGURE 3. When the trailing letter edge clears PC-1, this activates a time delay circuit of conventional design, so that when the letter (L7 in FIG. 3) is properly positioned, a strip m of magnetic material is sprayed along the lower edge of the letter face by the spray unit Tp. The details of the spray unit are not critical to the invention. Devices for spraying magnetic ink on paper and the like for coding and other recording purposes are well known in the art.

The letter continues on to the read and code station (c), letter L6 being at this station in FIGURE 3.

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After transferring the address information w from the letter to the keyboard K, and after selecting a key X, Y or Z, the operator at station (c) presses his foot pedal P, closing switch S. When the lobe on the "start" cam 26 closes the start switch S1, the clutch C1 is magnetically engaged, causing the shafts 18, 16 to advance the easel band 10 by one increment. This causes the letter L6 at station (c) to cross transfer zone No. 1 and, the leading end of the letter L6 is picked up by the underside of the far reach of the vacuum belt 30. The vacuum belt is continuously running, and is seen advancing a letter L5 across the write station (d) in FIGURE 3. The write head W imparts the coded information w ; and x , y or z on the magnetic strip m , as will be explained presently.

A letter L4 is seen crossing the read station (e), where the general information code x , y or z is sensed by the magnetic read head R. The w (address) code has no response here, it is to be read and used for classification in another machine, such as that shown as that shown in FIGURE 2 of the aforesaid Sassen et al. patent.

A letter L3 is shown in phantom line at the transfer zone No. 2, station (f), just as the letter about to be picked up by a lug 42 on the band 40 of the transport conveyor TC. It is at the transfer zone No. 2 station (f), where the synchronizing action of the cam 26 on the main drive shaft 20, and the start switch S1 are of importance. It is necessary that a letter at station (f) be advanced onto the band 40 in a zone that is between a pair of lugs 42, and preferably adjacent the trailing lug of this pair. Since the letters do not slip on the vacuum belt 30, the position in which they are ready to be released from the vacuum belt can be considered mechanically equivalent to the position at which they are picked up, namely, transfer zone No. 1. Also, since the vacuum belt 30 is continuously moving, the position on the vacuum belt at which the letter L6 at transfer zone No. 1 is picked up by the belt is only a matter of timing the easel conveyor TE. This timing is determined by the cam 26 operating the start switch S1 for the clutch C1, and the cam and switch are relatively adjusted, considering the geometry of the lugs 12 on the band 10 of the easel conveyor, and the position thereof relative to the vacuum belt 30, to provide the transfer conditions required at station (f), transfer zone No. 2.

On the transport conveyor TC, a letter L2 is shown at a station (g), which is one lug pitch or increment downstream of station (f). A letter L1 is shown at station X, wherein it is opposite a remotely controlled or solenoid operated discharge device Dx. The latter device, which is part of the stacker St, can be constructed in accordance with the aforesaid Sassen et al. patent, these details not being critical to the invention. In the preferred embodiment of the invention, the speeds of the transport band 10, the vacuum belt 30, and the transport conveyor belt 40 are respectively 70 (max.), 72, and 60 inches per second.

Code handling

The relationship of the coding and discharge device control circuits to the mechanical units of the invention described will now be explained. In the example to be given, it will be assumed that the sorting apparatus is intended to sort or classify letters in three groups corresponding to stations X, Y and Z on the transport conveyor. As mentioned, stations X, Y and Z may represent out-of-town mail, local mail and air mail. The information w is the address or destination information for the letter. Although the details and the nature of the coding system are not critical to the present invention, in a letter sorting system of the type described, information w is set in on a set of keys indicated correspondingly at w , in the keyboard K. This information can be put into the keys w in the form of an extractive code (e.g., abbreviations), and it is translated into binary information by a translator 50, having the usual logic circuits and the like, the details of which are not critical to the present invention.

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In fact, a trained operator could mentally translate and enter the information w into the system directly, by translating the alpha-numeric information on the letter into a binary code. The information as to stations X, Y and Z is determined upon observation by the operator, and one of the X, Y or the Z keys is depressed accordingly. This information is also translated into binary information by the translator 50, but could be entered as binary information by the operator.

The binary information, which is information $w6$ for letter L6 at station (c) and which will be assumed to be information x corresponding to sorting station X at the stacker St, is sent to a hold shift register 61, also indicated by a small c . The small c indicates that the information now being handled originated at the read and code station (c). The register may be made up of the usual set of series connected flip-flops in accordance with the digital computer and control engineering principles. The details of these are not critical to the present invention, and the design of these is explained in "Design of Transistorized Circuits for Digital Computers" by Pressman, published by John F. Rider, Inc., New York; or "Digital Computer and Control Engineering" by Ledley, published by McGraw-Hill Book Company, Inc., New York; or "Transistor Circuit Design" by Walston and Miller, also published by McGraw-Hill. These publications enable those skilled in the art to provide the details of data handling circuit adequate for practicing the present invention.

After the information w and x , y or z has been coded, the operator depresses a completion key 52. This sends a shift signal to the hold register 61 for station (c). The information $w6$, x is now transferred to a second hold register 62, for station (c). The code information here awaits depression of the pedal P by the operator, after he has completed the coding and wishes to advance the easel to bring letter L7 to the read and code station.

When the pedal P is thus depressed, the control box 22, actuated by the pedal, supplies a shift signal to the hold register 62, so that the coded information $w6$, x is transferred to an AND circuit 64. The operator has now completed his portion of the coding of letter L6 and is ready to code letter L7, the translating device 50 having been cleared as described. The letter L6, upon depression of the pedal P, advances to transfer zone No. 1 and onto the vacuum belt 30. The code $w6$, x remains in hold register 62, and is an input to AND 64.

When the letter L6 reaches station (d) it moves on until its trailing edge clears a photocell PC-2 upstream of the write head W. A letter L5 is actually shown in this position in FIGURE 3. By conventional circuitry an L6 shift pulse is now sent to AND 64, so that the code information $w6$, x is now sent to the write head W by AND 64. The write head then writes the coded information on the magnetic strip m of the passing letter. However, this all takes place automatically, the read and code operator at station (c) having been occupied with the incoming letters L7, L8, etc.

The vacuum belt 30 carries the letter to the read station (e), wherein the read head R reads the coded information on the magnetic strip m . A letter L4 is actually shown at station (e) in FIGURE 3, but in the sequence of events being described it will be assumed that the letter L6 is now being read by the read head R at the station. The binary coded information $w6$, x for the letter L6 is now transferred as a series of pulses to the first section "e" of the shift register BR. The designation "e" in the shift register BR indicates that this is an analogue to station (e) along the vacuum conveyor, and the same designations are applied in the other sections of the register.

A shift cam 70 is mounted on the main shaft 20 and has a lobe which closes a shift switch S3 in synchronism with the advance of the lugs 42 on the band 40 of the

transport conveyor TC. Thus at timed intervals, a shift signal is sent to the register section "e," which advances the binary coded information to a register "f" which is an analogue to station (f) on the apparatus. It is to be understood that the register BR may receive the binary information w, as well as x, y or z, but as previously explained, the information w is for utilization by a sorting machine that follows the apparatus of the present invention. The information w passes through the register BR, but is not read out there and utilized.

After the transport conveyor TC has advanced one shift, another shift signal is sent from switch S3, shifting the information from register section "f" to section "g." On successive shift pulses, the information is sent on to register sections "x," "y" and "z." Comparators x', y' and z' are connected to sense the coded information x, y and z, and when a match occurs, the comparator produces a discharge signal. In this example, the signal corresponds to the general information on letter L6, which was assumed to be information code x. This sends a discharge signal dx to the discharge device Dx at station X, thereby kicking off letter L6 into the stacker mechanism. The information w6 remains on the magnetic strip m, but is not utilized in this apparatus. Because of the action of the synchronizing or start switch S1, which insures proper pickup of the coded letter L6, and of the interlocked relation of the drive to the vacuum belt 30 and the transport belt 40, the shift signal switch S3 keeps track of the letters and insures that they will be discharged at the station X, Y or Z corresponding to the general coded information and introduced to the system by the keys at the keyboard K.

It can thus be seen that in accordance with the present invention, coded articles (such as letters) can be introduced into the system by a read and code operator who can pace the easel conveyor in accordance with his coding performance. Once the coding operation is completed, the letters are locked into the system by a combination of mechanical and code synchronizing switches and shift registers, so that the letters are selectively discharged at stations X, Y or Z at the stacker St, without further attention by the operator.

Having completed a detailed description of the invention so that those skilled in the art can practice the same we claim:

1. Article classifying apparatus comprising an easel conveyor for advancing singulated articles, an article transport conveyor having article advancing means for advancing singulated articles at a uniform spacing, a plurality of article discharge devices disposed along said transport conveyor having article advancing means for said conveyors, means disposed along said vacuum belt conveyor means for reading a code on the articles as they move by, means for driving said transport and vacuum belt conveyors continuously and in synchronism, series transport shift register means for receiving the code from said code reading means and shifting the code along in analogue with selected increments of motion of said transport conveyor, discharge shift register means for receiving the code from the last of said transport shift register means and advancing the code along in analogue with the motion of articles past said article discharge devices, comparator means associated with said discharge register means for operating said discharge devices, means operated in synchronism with said transport conveyor for providing shift pulses to said transport and discharge shift register means, means for driving said easel conveyor intermittently under control of a coding operator, and means for synchronizing said continuous and intermittent driving means for causing articles to be picked up by said vacuum belt conveyor means in a position compatible with the transferring of articles to the article advancing means on said transport conveyor.

2. The apparatus of claim 1, wherein a code writing head is disposed along said vacuum belt conveyor means

and upstream of said code reading means, means for successively storing a code means under operator control for shifting said code in storage from the first to the second storage means, and letter sensing means for shifting said code from the second storage means to said code write head.

3. Article classifying apparatus comprising an easel conveyor for advancing singulated articles, an article transport conveyor having uniformly spaced article advancing means, a plurality of article discharge devices disposed along said transport conveyor and in multiples of said uniform spacing, vacuum belt conveyor means between said conveyors, means disposed along said vacuum belt conveyor means for reading a code on the articles as they move by, means for driving said transport and vacuum belt conveyors continuously and in synchronism, means operated in synchronism with said transport conveyor for providing shift pulses to transport shift register means for shifting a code along in analogue with selected increments of motion of said transport conveyor, means for driving said easel conveyor intermittently under control of a coding operator, and means for synchronizing said continuous and intermittent driving means for causing articles to be picked up by said vacuum belt conveyor means in a position compatible for transferring articles to the article advancing means on said transport conveyor.

4. The apparatus of claim 3, wherein a code writing head is disposed along said vacuum belt conveyor means and upstream of said code reading means, means under operator control for shifting a code in storage, and letter sensing means for shifting the same code out of storage and into said code write head.

5. Apparatus for sorting articles such as code-bearing letters, said apparatus comprising an easel conveyor for advancing singulated articles, an article transport conveyor having uniformly spaced article advancing means, a plurality of article discharge devices disposed along said transport conveyor and in multiples of said uniform spacing, vacuum belt conveyor means between said conveyors, shift register means for storing the code before it is written on the articles, means disposed along said vacuum belt conveyor means for first writing and then reading the code on the articles as they move by, means for driving said transport and vacuum belt conveyors continuously and in synchronism, transport shift register means for receiving the code from said code reading means and shifting the code along in analogue with selected increments of motion of said transport conveyor, discharge shift register means for receiving the code from the downstream transport shift register and advancing the code along in analogue with the motion of articles past said article discharge devices, comparator means associated with said discharge register means for operating said discharge devices, means operated in synchronism with said transport conveyor for providing shift pulses to said transport and discharge shift register electrically operated means, clutch means for driving said easel conveyor intermittently from said conveyor driving means, an operator control circuit for said clutch means, and a switch operated by said conveyor driving means connected into said operator control circuit and the circuit for said clutch means for synchronizing said continuous and intermittent conveyors and for causing articles to be picked up by said vacuum belt conveyor means in a position compatible with the transferring of articles to the article advancing means on said transport conveyor.

6. The apparatus of claim 5, wherein means are provided for shifting code information in said code storing shift register means at the time of operation of said control circuit for said clutch means.

7. The apparatus of claim 6, wherein means are provided for shifting code information in said code storing shift register means to said code writing means in response to the position of an article at said code writing means.

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8. The apparatus of claim 7, wherein said shift pulse providing means for said transport and discharge conveyors is a switch operated by said conveyor driving means.

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ALLEN N. KNOWLES, *Primary Examiner.*

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,368,672

February 13, 1968

Richard Heaney et al.

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

Column 4, line 60, "pickd" should read -- picked --; line 70, "Tp" should read -- Sp --. Column 5, line 19, cancel "as that shown", second occurrence. Column 7, line 50, cancel "having article advancing means for" and insert -- , vacuum belt conveyor means between --.

Signed and sealed this 17th day of March 1970.

(SEAL)

Attest:

Edward M. Fletcher, Jr.

Attesting Officer

WILLIAM E. SCHUYLER, JR.

Commissioner of Patents