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Chittenden et al.

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[54] DOCUMENT SORTING SYSTEM

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[52] **U.S. Cl.** ..... **209/74 M**

[51] **Int. Cl.** **B07c 3/10**

[58] **Field of Search** ..... 209/74, 74 M, 111.7, 111.8, 209/110; 250/219 CA

[56] **References Cited**

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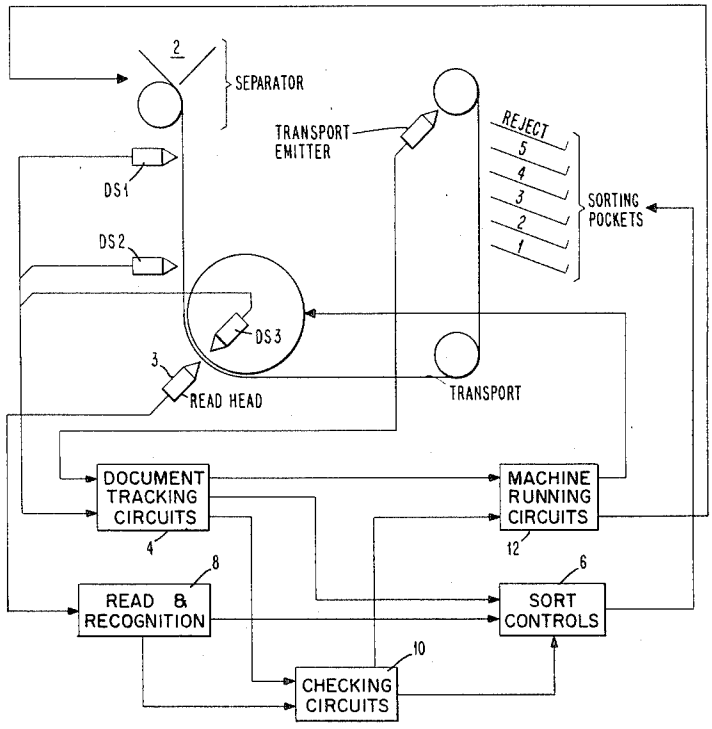
[57] **ABSTRACT**

A magnetic ink character reader/sorter having improved means for processing the character signals, storing the pocket selection control signals derived therefrom, and checking the overall operation of the machine. The documents are read by an improved single-gap recognition system, and the sorting information derived therefrom is supplied to a plurality of buffers in accordance with control signals derived from the motion of a document transport.

9 Claims, 6 Drawing Figures



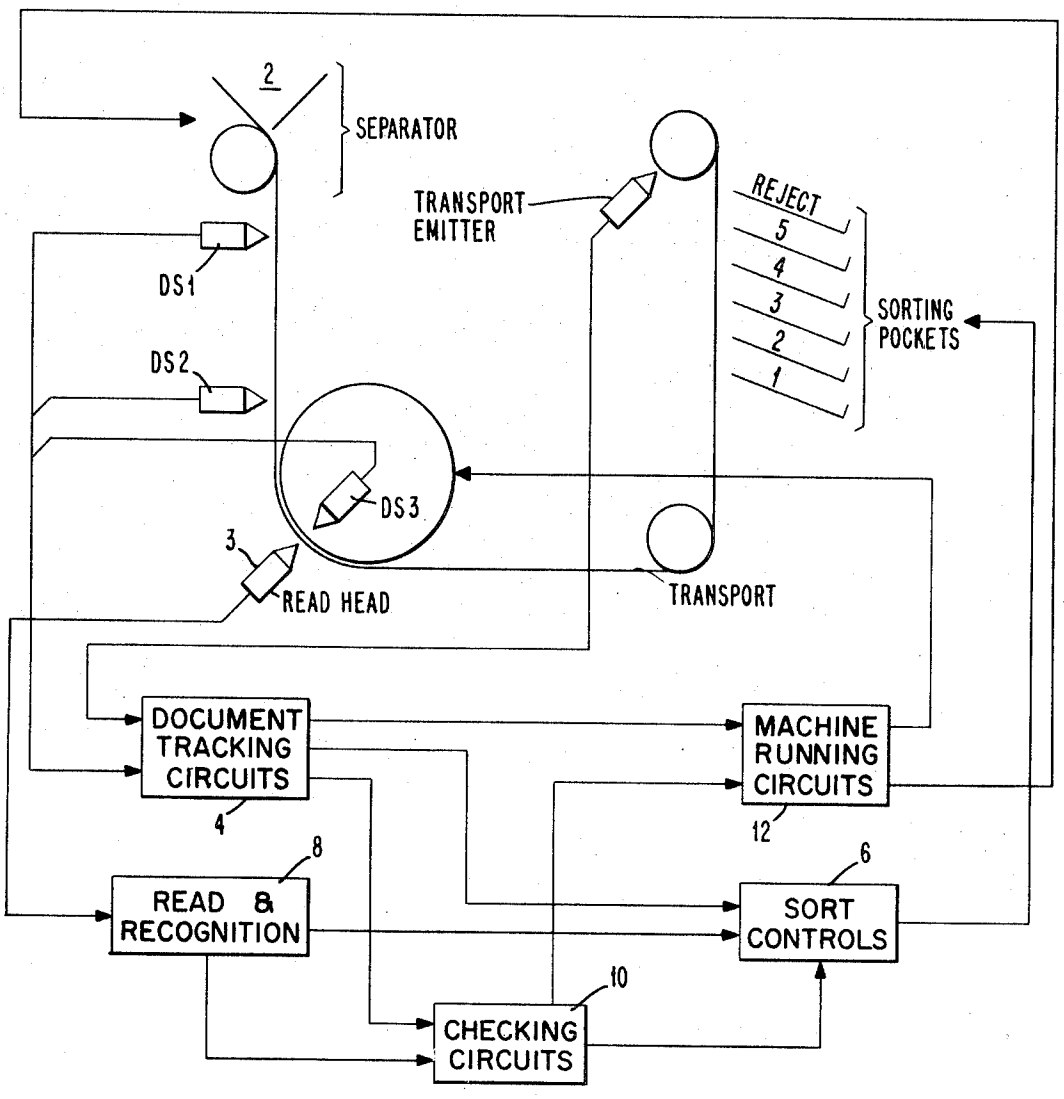


FIG. 1

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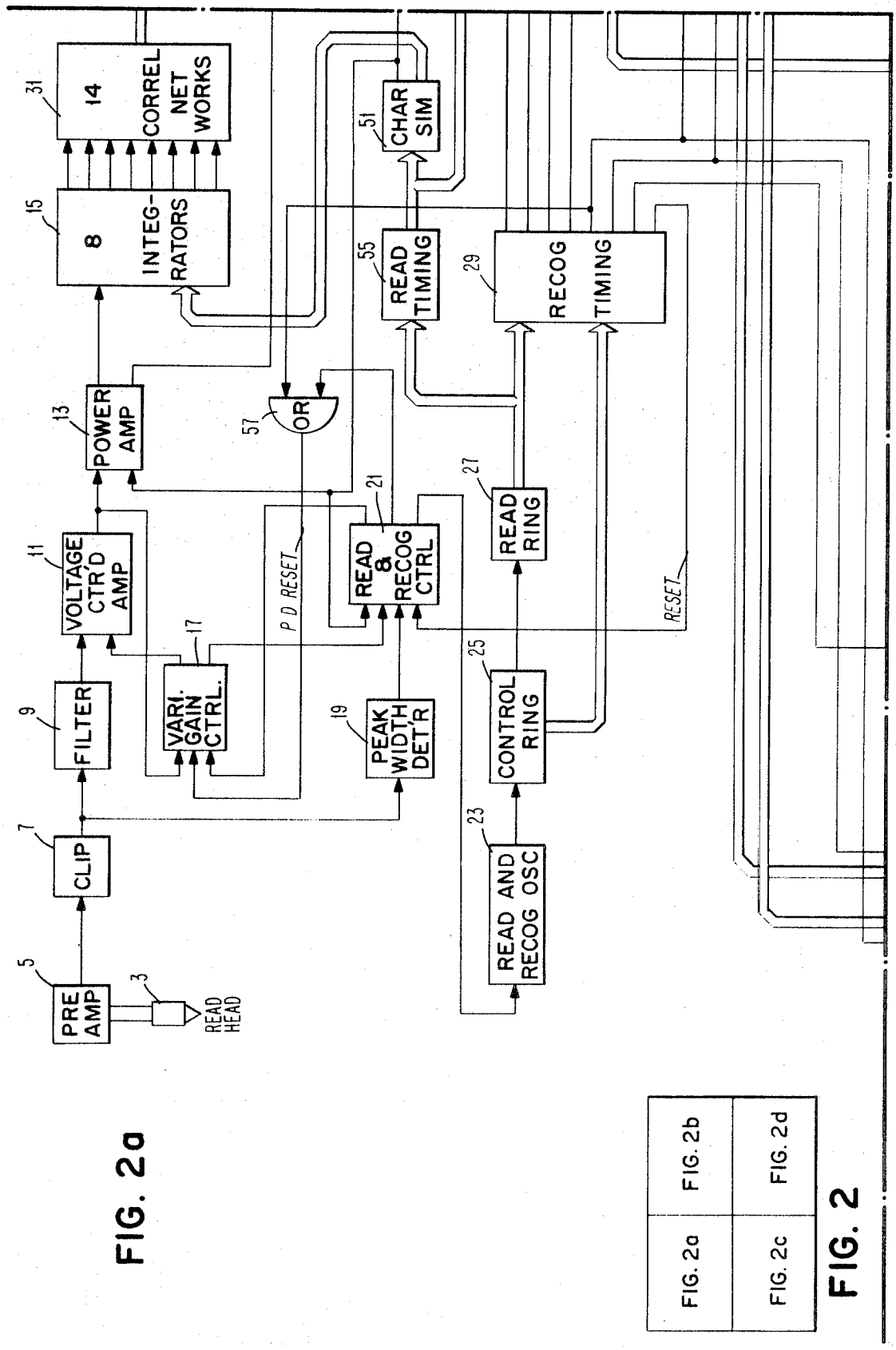
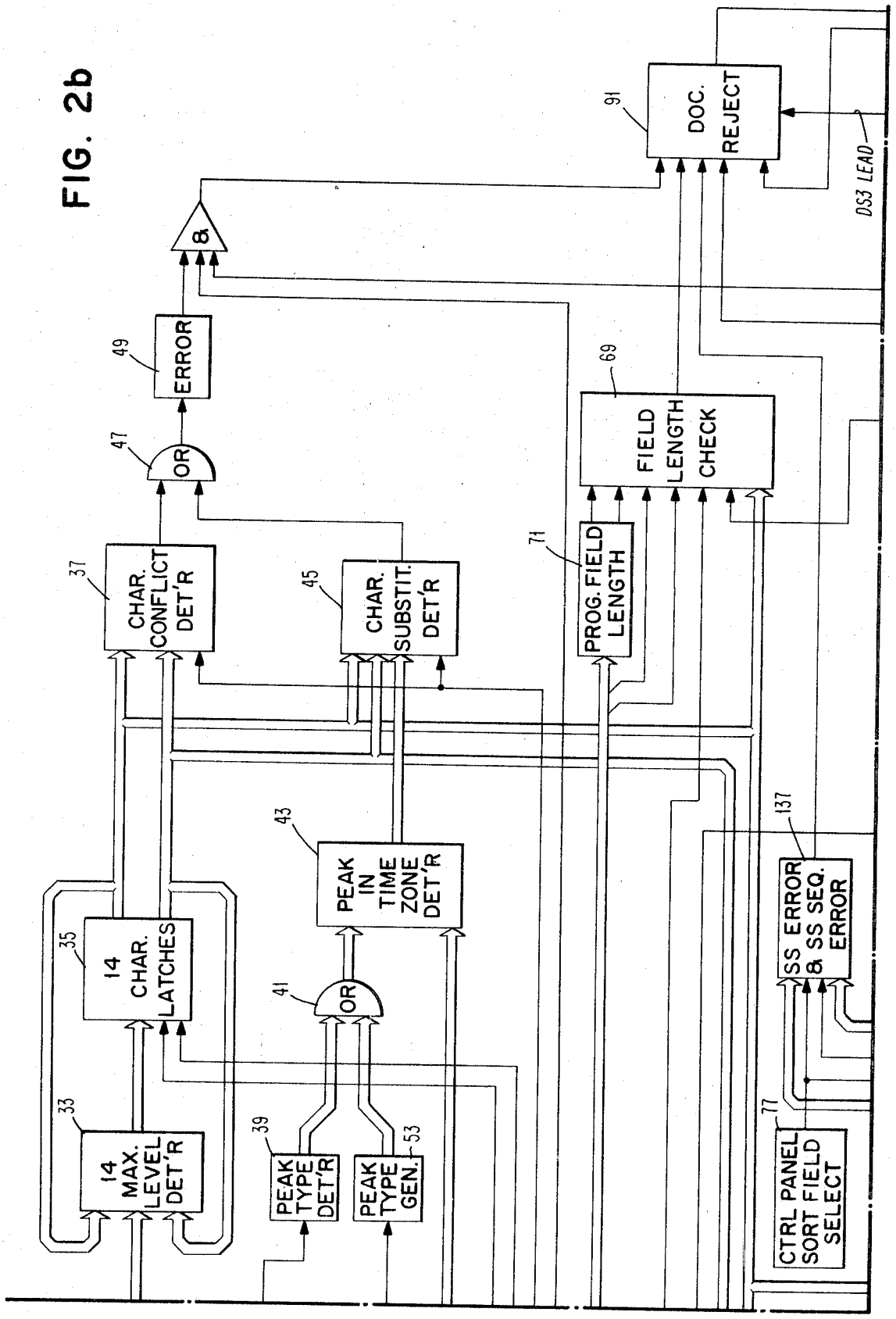


FIG. 2a

FIG. 2a	FIG. 2b
FIG. 2c	FIG. 2d

FIG. 2

FIG. 2b


91
DOC. REJECT
DS3 LEAD
&
49
ERROR
47
OR
69
FIELD LENGTH CHECK
71
PROG. FIELD LENGTH
37
CHAR. CONFLICT DET'R
45
CHAR. SUBSTIT. DET'R
43
PEAK IN TIME ZONE DET'R
137
SS ERROR & SS SEQ. ERROR
35
14 CHAR. LATCHES
41
OR
33
14 MAX. LEVEL DET'R
39
PEAK TYPE DET'R
53
PEAK TYPE GEN.
77
CTRL PANEL SORT FIELD SELECT

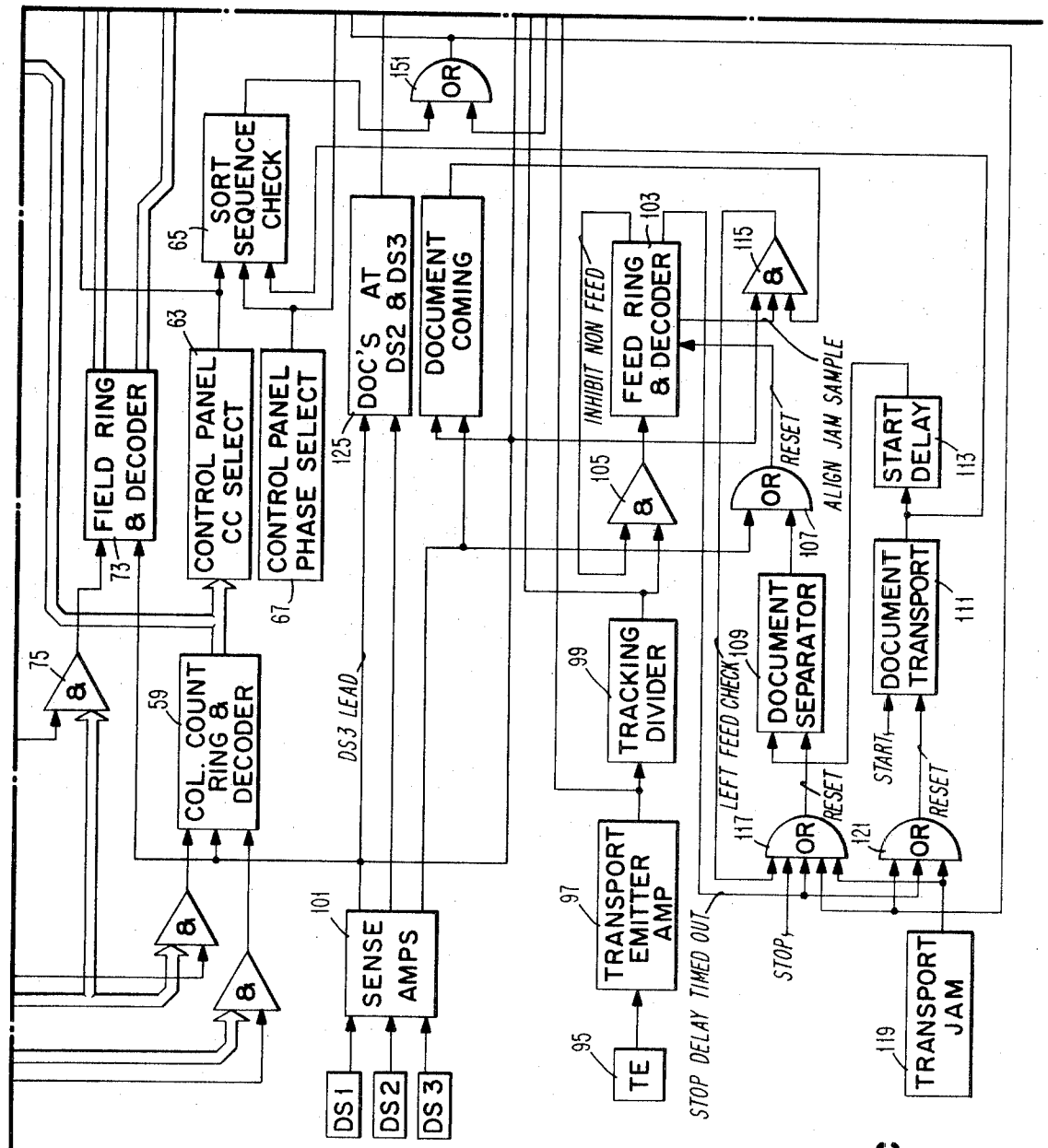

FIELD RING & DECODER
73
CONTROL PANEL CC SELECT
63
CONTROL PANEL PHASE SELECT
67
SORT SEQUENCE CHECK
65
DOC'S AT DS2 & DS3
125
DOCUMENT COMING
151
OR
INHIBIT NON FEED
FEED RING & DECODER
103
115
&
105
&
OR
RESET
ALIGN JAM SAMPLE
START DELAY
113
DOCUMENT TRANSPORT
111
DOCUMENT SEPARATOR
107
LEFT FEED CHECK
109
TRACKING DIVIDER
99
COL. COUNT RING & DECODER
59
DS3 LEAD
75
&
&
&
SENSE AMPS
101
TRANSPORT EMITTER AMP
97
TE
95
DS 1
DS 2
DS 3
STOP DELAY TIMED OUT
117
121
OR
RESET
START
STOP
TRANSPORT JAM
119

FIG. 2c

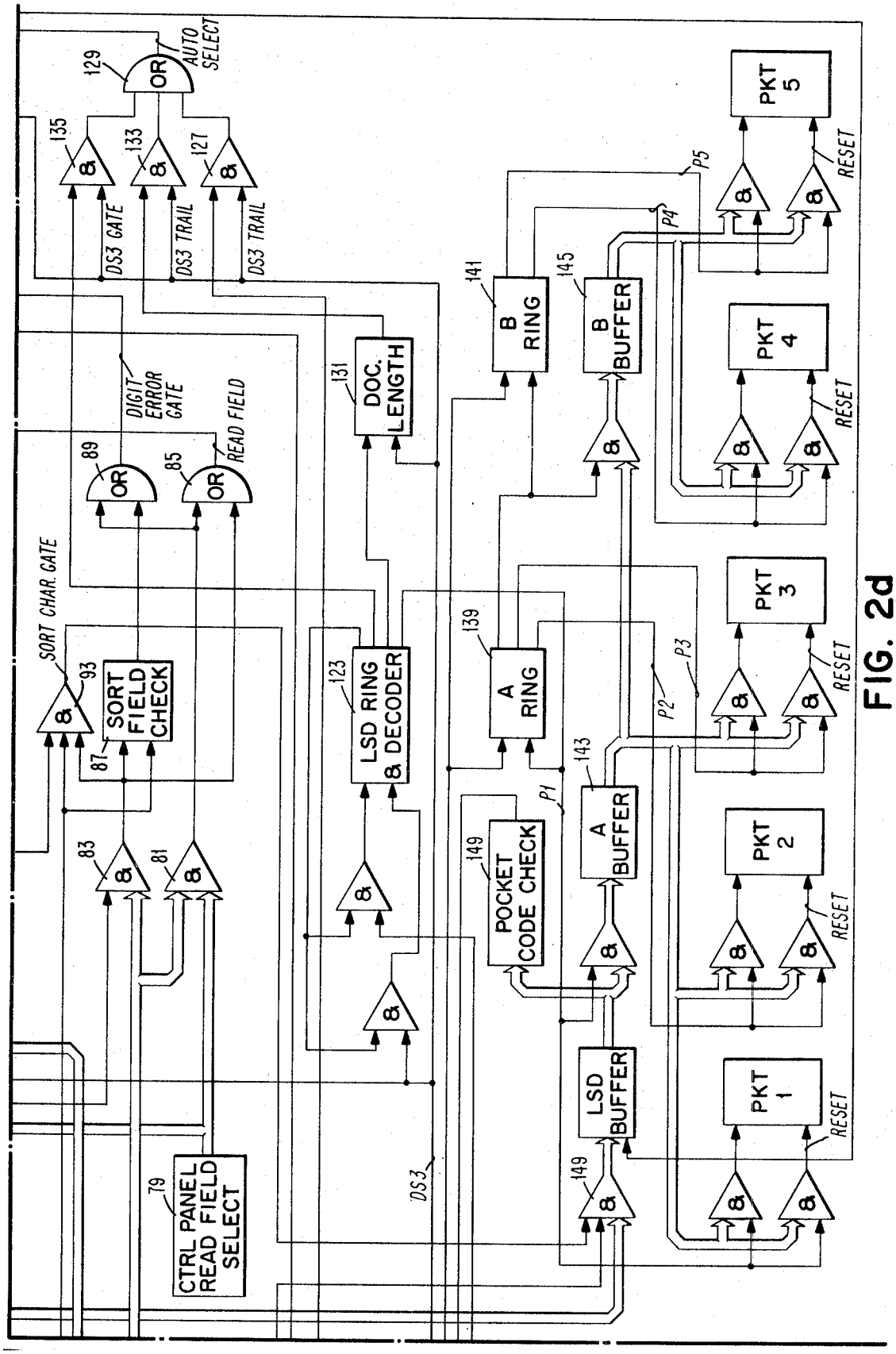

CTRL PANEL READ FIELD SELECT
79
SORT CHAR. GATE
93
SORT FIELD CHECK
87
83
81
DIGIT ERROR GATE
89
READ FIELD
85
OR
AUTO SELECT
129
135
133
127
DS3 GATE
DS3 TRAIL
DS3 TRAIL
DS3
131
DOC. LENGTH
123
LSD RING & DECODER
139
A RING
141
B RING
149
POCKET CODE CHECK
143
A BUFFER
145
B BUFFER
LSD BUFFER
P1
P2
P3
P4
P5
PKT 1
PKT 2
PKT 3
PKT 4
PKT 5
RESET

FIG. 2d

DOCUMENT SORTING SYSTEM

BACKGROUND OF INVENTION

This invention relates to document sorters and particularly to an improved document sorter for sorting bank checks having magnetic ink characters imprinted thereon.

Such sorters are already in existence, but are constructed and arranged so that they are large, high-speed, high-capacity machines. For many users, their volume of sorting operations is not large enough to render the use of the larger sorters economically justifiable. Accordingly, there has been a need for a simplified low speed sorter for sorting documents having magnetic or magnetizable characters thereon, such as conventionally bank checks.

SUMMARY OF THE INVENTION

Briefly described, this invention contemplates a document sorter in which analog signals are generated by the movement of magnetized characters on a document moving past a single-gap reading head. The documents are supplied from a bottom-feed hopper and are suitably aligned for reading prior to passing the reading head. Following the reading station, the documents are transported to a stacker section, where a plurality of successive deflector mechanisms are provided, individually selectable to divert a document into a selected pocket associated with the deflector, where the documents are sequentially stacked in the order in which they are deposited within the pocket.

The read and recognition system operates through a process of waveform generation and identification that utilizes integration and correlation techniques to provide a digital signal on one of 14 output lines. As a character of magnetized ink passes under a single-gap read head, a signal is generated in the head which is characteristic of the printed character. A peak detector is used to determine the leading edge of the character and a set of integrators begin to integrate the signal one-half time zone after the peak detector indicates a leading edge. The integrated signal is presented to 14 correlation networks whose outputs are compared with one another by maximum level circuitry to determine which signal is largest and hence, which character was scanned. If the character is not readable, none of the 14 output lines is energized.

The recognition circuitry also includes means for generating synchronizing signals for its internal operation, as well as generating signals for synchronizing the sort and run control circuitry to indicate the passage of a read cycle for each of the characters sensed. The system further includes means for designating the column and/or field on which the documents are to be sorted, coordinating the information derived from the documents with desired criteria set up on an operator's control panel. Appropriate checking circuits are provided to indicate proper operation of the sort and selection operations. Checking circuits are also provided which include means for determining whether or not the documents are of appropriate length and have appropriate spacing by utilizing the signals from a plurality of document sensors located at specific points along the document transport path.

The actual sorting controls are governed by timing pulses derived from pulse generators operated synchronously with the document transport mechanism, with appropriate frequency dividers and counting rings to derive signals which, when combined with signals from the document sensors, can be utilized to indicate the location of a document in the transport path. The same signals are also utilized for the control of buffers which contain the destination information for the documents, and serve to govern the pocket selector devices which select the appropriate final pocket for the document.

It is therefore a principal object of the present invention to provide an improved document sorting system for documents bearing magnetizable characters thereon.

A further object of the invention is to provide an improved magnetic ink character recognition system cooperating with

suitable logic control circuits to control the sorting of documents bearing magnetizable characters thereon in accordance with the information reflected by the magnetizable characters.

A further object of the invention is to provide a document sorting system utilizing a read and recognition system operating through a process of integration-correlation techniques to provide a digital signal for controlling the sorting operation. The system also includes means for generating synchronizing signals for internal operation of the recognition system as well as providing suitable signals for designating the column or field on which the documents are to be sorted.

A further object of the invention is to provide a document sorting system including improved checking circuits for indicating proper operation of the certain selection operations.

A further object of the invention is to provide an improved document sorting system in which the sorting controls are governed by timing pulses derived from pulse generators operated synchronously with the document transport equipment; these signals, when combined with signals from the document sensors, being utilized to indicated the location of the document in the transport path.

Still another object of the invention is to provide a document sorting system in which signals derived from the document transport mechanism in conjunction with signals obtained from sensing location of documents are utilized for the control of buffers which contain the destination information for the documents and serve to govern a selection mechanism for directing the document to an appropriate sorting pocket or destination.

The foregoing and other objects, features and advantages of the invention will be apparent from the following more particular description of a preferred embodiment of the invention, as illustrated in the accompanying drawings.

In the drawings:

FIG. 1 is a highly schematic illustration of the organization of the principal parts of a magnetic ink character reader and sorter, according to the present invention.

FIG. 2 is a diagram illustrating the proper relationship of the drawings FIGS. 2*a*, 2*b*, 2*c*, and 2*d*.

FIGS. 2*a*, 2*b*, 2*c*, and 2*d* taken together illustrate in diagrammatic form a document sorter control system in accordance with the preferred embodiment of the present invention.

Similar reference characters refer to similar parts in each of the several views.

DESCRIPTION OF A PREFERRED EMBODIMENT

FIG. 1 of the drawings illustrates in a general manner a document sorting arrangement which embodies a reading, sort control and checking circuit arrangement in accordance with the preferred embodiment of the present invention. The various portions of the sorter are illustrated diagrammatically and are primarily to show the various functions which are accomplished by the system.

Documents to be sorted are stacked in a separator area 2, from whence they are fed one at a time along a transport path indicated by the generally U-shaped configuration shown in the drawing. At three locations along the transport path document sensing devices are located for purposes which will be explained later in the specification. These document sensing devices are designated as DS1, DS2, and DS3. Document sensors DS1 and DS2 are located along the initial portion of the document transport path where certain mechanical functions such as alignment of the documents are performed. Document sensor DS3 is located at the point where the information is read from the documents. The outputs of these sensors are supplied to document tracking circuits indicated generally by the rectangle 4, from which outputs are provided indicating whether or not the documents are of proper length, and whether or not there is adequate spacing between the documents for proper operation of the system. Outputs from the document tracking circuits are also used in connection with

controlling the operation of the machine running circuits, the various checking circuits and the sort control circuits. To determine the precise location of documents as they travel through the transport path, a transport emitter is provided, which generates pulses at predetermined intervals of the document travel, since the emitter is mechanically coupled to the transport system, and operates synchronously with the system. Signals from the transport emitter are supplied to the document tracking circuits and are utilized in determining the location of the documents for the purposes of directing them to the proper sorting pockets. Sorting pockets include a plurality of stackers or other suitable document receiving means, each of which is provided with an appropriate mechanical selector gate in a manner well known in the art, so that oncoming documents may be diverted into a selected one of the sorting pockets. Five numbered pockets are shown, being numbered consecutively **1** through **5**, plus a sixth "reject" pocket. However, it is to be understood that the system is not limited to any particular number of pockets and either more or fewer may be utilized. The control of the sorting deflectors and hence the selection of pockets for the documents is governed by sort control circuits **6**, which receive inputs from the read and recognition circuits **8**, the document tracking circuits **4**, and the checking circuits **10**. Information read from and the documents at the read station by read head **3** is analyzed and suitable output signals indicative of the character on which the documents are to be sorted are supplied from the read and recognition circuits **8** through the sort control **6**, where the pocket designations are stored and moved in consecutive order through a series of buffers governed by the operation of a plurality of cascade-connected ring circuits which in turn are governed by the operation of the transport emitter, as will be explained later in the specification. Also, there are provided machine running circuits **12**, which govern the operation of the document transport mechanism, and the separator mechanism, so that documents are fed to the document transport mechanism for subsequent analysis and sorting at appropriate times, and so that the apparatus is shut down in the event of improper conditions indicated by operation of checking circuits **10**.

It is to be understood that the mechanical features of the document sorter are not germane to the present invention, and may take any one of a number of different forms, and hence the mechanical features in the present system will not be described in any further detail. Moreover, in the circuits and combinations to be subsequently described, the precise details of the circuitry employed is not pertinent to the present invention since any one of a number of well-known means may be employed. For example, the buffer storage may constitute vacuum tube or transistor triggers or latches, magnetic core memories, or electromagnetic relays, as one example of the use of various components all of which are well known in the art.

Referring now to FIGS. **2***a* through **2***d* of the drawings, there is shown in schematic form a sorting control system constituting a preferred embodiment of the invention.

Mechanical details of the sorter are not shown but may be of the type well known in the art in which documents to be sorted are supplied from a suitable feed hopper, are transported past a station at which the data is read from the documents, and thereafter transported to a plurality of selectable stacker pockets, wherein the documents are stacked in accordance with the information which has been read from the document. Such mechanical details are not shown or described herein since they are not germane to the present invention and they take any of the number of well-known forms, as previously pointed out.

When the documents pass the recognition station, a read head **3** has analog voltages induced therein in accordance with the characters which are scanned by the head, these analog voltages being amplified by preamplifier **5** and a clipping circuit **7**, to form signals of suitable shape and amplitude for further preprocessing. A filter **9** filters out unwanted components of the analog signal, and supplies the filtered signals to a voltage controlled amplifier **11**. From this amplifier, the signals are supplied through a power amplifier **13** to the inputs of a plurality of integrators shown as one element **15**. These integrators are of a conventional electronic nature, and are arranged to integrate the signals supplied thereto from amplifier **13**. The output of the voltage-controlled amplifier **11** is also supplied as one input to a variable gain and peak detector **17**, which is arranged to control the amplification of the amplifier **11**, so as to maintain proper outputs to the power amplifier **13**. The clipped signals supplied from the clipping circuit **7** are also routed to a peak width detector **19**, and are then supplied to the input of a read and recognition control circuit **21**.

The reading cycle of the machine is set into operation by peak signal indications from the analog circuits supplied via the read and recognition control circuits **21** to control the read and recognition oscillator **23**, which supplies output signals at a suitable rate to a control ring **25** and a read ring **27**. The read cycle is divided by these rings into eight segments, for example, the first seven of which are used for reading zones and the eighth of which provides a final or recognition zone. The read zone signals are routed to analog circuits for character analyzing while the control ring generates recognition pulses for the digital circuits during the eighth time segment. The signals are combined in the recognition timing circuits **29**, the last of the output therefrom being a reset pulse, which serves to reset the read cycle circuitry at the time of its occurrence.

Referring again to the recognition portion of the system, the technique employed herein segments the character waveform into seven equal time zones, starting one-half of a time zone after the first peak occurs. Recognition of a waveform requires information relative to the amplitude and polarity of the signal in each time zone. This information is obtained by integrating the waveform in the integrators **15**.

The read cycle begins with the detection of the first peak by the peak detector **17**. After one-half time zone delay, the timing ring is started which controls division of the character into a suitable number of time zones by generating seven integration intervals, for example. The first integrator integrates over all seven time zones, the second integrator integrates over the last six time zones and so on. The value of the integral for the first time zone is obtained by subtracting the level stored on the second integrator from the level stored on the first integrator. The eighth integrator is required to determine the value of the integral for the seventh time zone.

At the end of the seventh integration interval all the information required for recognition is stored on the capacitors in the eight integrators contained in **15**. The information is analyzed by supplying the signals from the integrators to correlation networks which combine the information contained in the integrators to provide the required output signals, the highest magnitude of which will represent the value of the character which was scanned. In the present example, 14 correlation networks are utilized to provide 14 outputs.

The maximum amplitude signal of the fourteen signals supplied from the correlation networks **31**, is determined by the use of 14 maximum level detectors **33**, which detect the highest in the group of 14 voltage levels and provide a digital output indicating the character which has been scanned. The outputs of the maximum level detectors **33** are supplied to the character latches **35**, one of which is provided for each of the possible characters to be recognized.

As shown in the drawings, outputs from the character latches are returned and utilized as inputs to the maximum level detectors **33**. The outputs from the character latches are also supplied to character conflict detection circuits **37**, which provide an output indication in case more than one or no character latch should be set for a particular read cycle.

Another check on the operation of the apparatus is provided by supplying the output from the power amplifier **13** to peak type detector **39**, the outputs from which are supplied as one input to a plurality of OR circuits **41**, and from thence to a

detector arrangement 43 which detects peaks in particular time zones. The output from the detector circuits 43 is supplied as one input to a character substitution detector 45, the other inputs being from the character latches 35.

The character conflict detector 37 constitutes a majority logic circuit whose output indicates the condition of one and only one active input for each of the 14 possible inputs.

Improper registration or a gross distortion of the input waveform can cause incorrect identifications, in the nature of substitutions. This occurs mostly because recognition by the particular system utilized in this invention is based on the comparison of direct current voltage levels which could be produced by any number of inputs. There are no specific specific requirements that the waveforms themselves rather than their energy content must meet. The character substitution detector 45 provides a check against such substitution errors. A plurality of comparators is used to detect peaks of various levels while the character is being scanned. The outputs of these comparators are gated into suitable latches on a time zone by time zone basis and at the end of a read cycle the state of these latches is compared with the outputs from the character latches 35. One or more discrepancies will provide an output from 45 to an input of the OR-circuit 47, which supplies an input to the error latch 49. The output from the error latch 49 is combined with additional signals to provide a suitable signal to cause rejection of the document as will be later explained.

Referring again to FIG. 2*a* of the drawings, the present invention provides character simulation circuits 51 which provide a diagnostic facility in which a manual control is provided for the read zone signals supplied to the integrators and to the peak type generator 53. The output of peak type generator 53 is supplied to OR-circuits 41, the output of which is connected to the peak in time zone detector 43. The character simulator circuits 51 allow the system to be put into a diagnostic or checking mode in which the read system is forced to analyze a chosen character. Normally this manual control is switched off to allow normal system operation. However, during the simulated mode, the read timing is gated by circuits 55 for continuous running and a DC level is supplied via the character simulator circuits 51 to the inputs of the integrator circuits 15. Thus, the stored valves in the integrators at recognition time can be controlled by the read zone timing from the character simulator circuitry. A character or special symbol which should be read by the system can be set up in this way to provide a basic check on the reading system. Also, at this time signals can be supplied from read timing circuits 55 to the peak in time zone detector 43 by suitable manual selection. The simulated peaks can accordingly be utilized to check the proper operation of the character substitution detector circuits 45 for proper operation. One additional circuit illustrated in FIG. 2*a* is the resetting circuit for the peak detector designated PD RESET which is supplied to the voltage gain and peak detector 17 from the output of an OR-circuit 57, the inputs thereto being supplied from the read and recognition control circuitry 21 and from an output of the recognition timing circuits 29. A reset circuit is also provided for the read and recognition control 21 on a line designated as reset and extending from the output of the recognition timing circuits 29 to an input of the read and recognition control circuits 21. These resetting circuits provide for the resetting of detector 17 and the read and recognition control circuits 21 at appropriate times to bring a recognition cycle to an end.

The system also includes a column count circuitry for counting the digits within a field on a document which is to be sorted. The circuitry includes a column count ring and decoder 59, and a program field length check circuit 71. Column count ring and decoder 59 is reset at the beginning of each document and at the close of each field read on the document. All outputs from the counter and decoder circuits are routed to the operator's control panel to a plurality of selector switches thereon designated as CONTROL PANEL CC SELECT, reference character 63. Operation of the selector switches on the control panel will select the particular column count to be utilized. The selected sort column line is returned from the control panel to indicate the sort column selected. This line is also sampled for a sort sequence check by checking circuits 65. This circuitry will signal an improper sequence between the sort column switch and the control panel phase select switches 67. An error signal is generated if the column switch is not advanced after the phase switch is restored to a phase 1 position. The document transport is sampled in the sort sequence checking circuit by an output signal from the document transport latch, which insures that the checking is not done while the machine is engaged in feeding documents. The column count output is also distributed to a field length check circuit 69, via the program field length circuit 71, the latter two circuits being found in FIG. 2*b* of the drawings. The circuit requires a document to be rejected if the selected fields do not have the specified digit length. Certain of the fields have fixed lengths as indicated by the branching output lines going directly to the field length check circuits 69 from the column count ring and decoder 59, while others may be programmed by the program field length circuits 71 to have varying field lengths.

The system also includes field selection, with appropriate checking circuitry associated with the field selection circuits. The field selection circuits include a field ring and decoder 73, which determines the field encountered on a document and the sequence of the opening and closing special symbols, in accordance with the information supplied thereto from the output of the character latches 35. The inputs to the field ring and decoder circuits are supplied via an AND-circuit 75, governed by the recognition timing circuits 29 to supply the character signals from latches 35 through AND-circuit 75 to the field ring and decoder 73. The ring is advanced by special symbols and is reset at the leading edge of the document by the document sensing circuits to be subsequently described. The field lines are gated with sort field select signals and read field select signals from the operator's control panel, as provided by the circuitry designated by reference characters 77 and 79. However, only one sort field can be selected while any number of read fields can be selected. The read field select gate 81, and the sort field select gate 83, supply output signals to the inputs of an OR-circuit 85, the output of which is designated as Read Field. This signal is supplied to the field length check circuit 69, so that all selected sort and read fields are checked for digit length. The output of the column count select on the control panel, reference character 63, is supplied as one input to sort field check circuit 87, another input to 87 being the output of the AND-circuit 83, the sort field check circuit requiring that only the digits up to and including the sort digit be checked for digit error. The output of AND-circuit 81 and the output of sort field check 87 are supplied as inputs to the OR-circuit 89, the output of which is designated as digit error gate. The digit error gate signal forms one of a plurality of inputs to the document reject circuits 91, in FIG. 2*b*. A further check includes the AND-circuit 93, which has inputs from the recognition timing circuits 29, the control panel selection for column count, and the output of AND-circuit 83. Thus, the selected sort field and the selected column count are gated to provide an output from AND-circuit 93 designated as Sort Char. Gate which ties the character being read to the sorting circuitry to be subsequently described. This signal occurs once during the reading of each document.

Referring now to FIG. 2*c* the transport and document synchronizing circuitry will be described.

A suitable emitter mechanically coupled to the document transport system, such as a transducer which provides a plurality of output pulses during operation of the document transport, is designated by the reference character 95. This emitter provides the basic timing to the run and the sort controls. With this emitter mechanically coupled to the document transport, timing pulses are supplied thereby which are exactly synchronized with the transport speed regardless of variations in the speed of the drive motors for the transport. These pulses

are amplified and shaped by the transport emitter amplifier **97**, to provide a first series of pulses which represent specified increments of document travel, for example, one-fourth of one inch. A tracking divider **99**, which comprises suitable frequency-dividing circuits provides output pulses representing larger increments of document travel, for example, 1 inch.

Reference points are established for the documents at various locations in the document transport by the use of suitable document sensors, indicated by the rectangles designated DS1, DS2, and DS3. These document sensors may be of the sonic type and are arranged to generate pulses at both the leading and trailing edges of the documents as well as a gate signal which is present while the document is located at the sensor station. Signals from the document sensors are amplified and suitably shaped in conventional sense amplifiers **101**.

Next, considering the portions of the system involved with the running of the document sorter, a first feature is the provision of a feed ring and decoder **103**, by which the presence and progress of a document in the area between the feed hopper and the read station area is tracked. This ring also serves as the basic timing ring for the machine running control by providing an output signal designated STOP DELAY TIMED OUT which governs the operation of the sorter and indicates either an empty hopper or a document jam condition. When the feed ring reaches its highest count, a signal is supplied therefrom designated INHIBIT NONFEED which removes the advancing or control pulses to the feed ring and decoder **103** via an AND-circuit **105**. That is to say, when the nonfeed signal from the output of the feed ring and decoder **103** is present, then AND-circuit **105** is enabled to permit the pulses from the tracking divider **99** to enter the feed ring and decoder and cause it to advance. If the count reaches the condition where the nonfeed signal is cut off, then AND-circuit **105** will be disabled and the count pulses will no longer be fed to advance the ring. Accordingly, in such circumstances the ring will remain in the high count condition until reset by a reset signal as supplied from an OR-circuit **107**. OR-circuit **107** is supplied with inputs from the first document sensor DS1, the signal indicating a trail condition, that is to say, that the trailing edge of the document is at the location of sensor DS1, or by an input signal from a document separator latch **109**, which governs the operation of the document separator in the mechanical portion of the machine.

The document transport is set into operation by a start signal supplied to a latch **111** designated Document Transport which also supplies an input to the sort sequence check circuit **65**. Following a delay imposed by the start delay **113**, a signal is supplied to the document separator latch in **109**, this delay being allowed in order to permit the document transport mechanism to reach its normal speed before the documents are fed. All the systems operations take place during the time that the document transport is in motion and the document transport may be halted either by a jam condition or as previously pointed out, the signal STOP DELAY TIMED OUT. Since the document separator latch resets the feed ring **103**, a document must be fed before the ring advances to the point where the STOP DELAY TIMED OUT signal is generated or both the separator and the transport mechanism latches will be reset. However, if a document is fed, the feed ring **103** will be reset by the signal DS1 trail before the STOP DELAY TIMED OUT signal is reached. Under these circumstances the machine will remain in a running condition provided documents are fed at a rate faster than the STOP DELAY TIMED OUT signal can occur. A jam in the portion of the transport extending from the separator to the reading station is detected by sensing whether or not the documents reach the sensor DS3 before a signal ALIGN JAM SAMPLE is generated by the feed ring **103**. An ALIGN JAM SAMPLE signal supplied from feed ring and decoder **103** to the input of AND-circuit **115** will, with other conditions being present, cause a signal known as LEFT FEED CHECK to be supplied to the input of an OR-circuit **117** the output of which resets the document separator latch in **109**, to stop the feeding of documents in the event of a jam in the initial portion of the transport. Further along in the transport path, suitable mechanical means may be utilized for the detection of jams and a signal from this transport jam detector means, designated **119**, will supply an input to OR-circuit **117** as well as OR-circuit **121**, to thereby cause both the document feeding to stop as well as the document transport to stop. In the case of the document separator being stopped by the LEFT FEED CHECK, the output therefrom will cause OR-circuit **107** to supply a reset signal to feed ring and decoder **103**, so that after a suitable stop delay, a signal on the line STOP DELAY TIMED OUT will be supplied to both the document separator and the document transport latches through OR-circuits **117** and **121**, thus bringing the transport to the stop reset condition following sufficient time for the documents to run out. This differs from the case where a jam is detected in the subsequent portion of the transport, which will cause both the separator and the transport latches **109** and **112** to reset simultaneously and immediately.

To insure proper operation of the sorting apparatus, the length of the documents as well as the space between the documents must be accurately checked. In the present system, a ring and decoding circuit **123**, designated as LSD ring and decoder, is utilized along with the document sensors DS2 and DS3 to check document length and spacing. At the time a document leaves the location of document sensor DS3, the document has been checked for either short or long length, ans also has been checked to see whether or not a short gap has occurred between that document and the following one. The positive check on the short gap between two documents is made at the time the trailing edge of the first document passes DS3, as the result of combining the signals from DS2 and DS3 in the circuit **125**, designated "documents at DS2 and DS3." The output of this circuit is combined with the signal DS3 trail in an AND-circuit **127**, the output of which is supplied through an OR-circuit **129** to the document reject circuit **91**, thereby causing both the first and second documents to be rejected. The short document is also checked at DS3 trail time by sensing the document length indicator **131**, which combines a DS3 lead signal with a minimum length document count signal supplied from the ring **123** when it reaches a predetermined count, the output of the document length indicator **131** being combined with a DS3 trail signal in AND-circuit **133**, which supplies its signal through OR-circuit **129** to the document reject circuit **91**. Also, a second predetermined count signal is supplied from the LSD ring and decoder **123** at a predetermined count which indicates maximum length of document and this is combined with a DS3 gate signal and AND-circuit **135**, which supplies an input to OR-circuit **129** and, hence a signal to document reject circuit **91**. Accordingly, the check for all these conditions will generate an AUTO SELECT signal which causes the document or documents to be rejected. Sort select errors and sort select sequence errors are detected by comparison circuits **137** which compare the read field select signals from the control panel selection circuit **79**, the control panel sort field selection from reference **77**, the output from the field ring and decoder **73**, and a DS3 trail signal so that errors detected by the circuits **137** are supplied therefrom to another input to the document reflect circuits **91**.

The control of the sorting of the documents themselves is governed by the LSD-ring **123** and the associated decoding circuit, and two sorting control rings designated as the A-ring **139**, and the B-ring **141**, which have associated therewith two buffers, designated as A-buffer **143**, and B-buffer **145**. The rings are of the binary type and are connected in series so that a ring is reset when the preceding ring reaches a predetermined count. However, the LSD ring is reset at DS3 lead time and becomes locked at its highest count. Before the ring is locked a shift pulse is passed to the A-ring **139** to reset it. The cycle time of each ring, that is the time between being reset and generating an advance signal, is the short gap distance between documents plus the short document distance trans-

lated in terms of time intervals. This cycle time guarantees that all appropriately sized documents can be properly sorted. In this instance, the count in each of the rings represents the leading edge of the document at a particular point in the transport.

The sorting cycle begins while a document is passing the read station, where the document sensor DS3 is located. During the reading of the character the sort character gate signal, which is the output of AND-circuit 93 will gate the character output signals from the character latches 35 into the LSD-buffer 147 via the AND-circuit 149. At shift A time, the count which resets the A-ring 139, the sort character is shifted into the A-buffer 143 by the pulse on line P1. This allows the LSD buffer to clear and be prepared to accept another sort character from the next document. While the sort character is in the A buffer, the count in the A ring represents the leading edge of the document from which the sort character originated. At shift B time, as determined by the signals from the document transport emitter 95, the sort character is gated into the B buffer. Since each pocket is assigned a character code, a pocket is opened at the predetermined leading edge sampling time if the associated character buffer contains the assigned pocket number. However, if the buffer is empty or contains the wrong character, the pocket selector circuit is not activated. Thus, the leading edge of the documents govern the energization of the circuitry which opens or closes the actual selector pockets. A rejected document is not selected by any of the pocket selectors 1 through 5, and accordingly, it reaches the last physical pocket in the machine by merely closing any open pocket gate as it travels down the transport. The sort character code is checked in the LSD buffer by the pocket code check circuits 149 to determine if there is more than one character in the buffer. In such case an input is supplied to the OR-circuit 151, the output of which supplies a signal to the document separator and document transport control latches 109 and 111, respectively, as well as to the document reject circuits 91, causing the document to be rejected and stopping the document separator and document transport.

While the invention has been particularly shown and described with reference to a preferred embodiment thereof, it will be understood by those skilled in the art that the foregoing and other changes in form and details may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

1. In a document sorting system for sorting documents having sorting information thereon, comprising one or more characters and including scanning means for scanning said sorting information and developing therefrom analog signals representative of the scanning information, a document transport system for transporting said documents from a document feed device past said scanning means and delivering said documents to a selected one of a plurality of stacker pockets, a recognition system connected to said scanning means and effective to analyze said analog signals and provide digital character output signals unique for each character in said sorting information, and sort control means connected to said recognition system for selecting a stacker pocket in accordance with sorting information desired from said document, the combination with the foregoing of

first checking means for checking the operation of said recognition system, comprising analyzing means connected to said scanning means for deriving a supplemental set of character signals from said analog inputs, comprising means connected to said analyzing means and effective to provide an error signal when the digital character output signals from said recognition system do not match the supplemental signals from said analyzing means, and

document reject control means governed by said sort control means comprising means for inhibiting the selection of a stacker pocket when an error signal is produced.

2. The combination as claimed in claim 1, in which the number of criteria for deriving the supplemental set of character signals from said analog signals is less than the criteria for deriving said digital character output signals.

3. The combination as claimed in claim 2, in which the criteria for deriving the supplemental set of character signals includes the presence or absence of peak signals at predetermined times in said analog signals.

4. In a document sorting system for sorting documents in accordance with sorting information thereon, and including document handling means for feeding said documents singly, from a document feeder and separator transporting said documents past a reading station and thence to a selected one of a plurality of document stackers, the combination with the foregoing of control means for the document handling means including

first latch means for governing said document transport means including manual means for setting said latch in an on condition to thereby energize said transport,

a start time delay means,

second latch means connected to said first latch means via said start time delay means for energizing the document separator after a predetermined time interval following the energization of said first latch means, including manual means for resetting said second latch means,

transport emitter means effective to produce repetitive pulses in accordance with the operation of said transport means,

document sensing means for sensing the presence of a document in said transport at different locations, and

circuit means governed by said transport emitter means and said document sensing means for resetting said second latch means.

5. The combination as claimed in claim 4, further including counter and decoding means connected to said transport emitter means, and first jam detector circuit means combining selected outputs of said counter and decoding means and said document sensing means for detecting a document jam between said separator means and said reading stations,

said first jam detector means being connected to said second latch means for resetting said second latch means.

6. The combination as claimed in claim 5, further including second jam detector means connected to reset said first and said second latch means simultaneously, said second jam detector means being rendered operative by a document jam in said transport between said reading station and said document stackers.

7. In a document sorting system for sorting documents having sorting information thereon, comprising one or more characters and including scanning means for scanning said sorting information and developing therefrom analog signals representative of the scanning information, a document transport system for transporting said documents from a document feed device past said scanning means and delivering said documents to a selected one of a plurality of stacker pockets, a recognition system connected to said scanning means and effective to analyze said analog signals and provide digital character output signals unique for each character in said sorting information, the combination with the foregoing of sort control means connected to said recognition system for selecting a stacker pocket in accordance with sorting information desired from said document, comprising

a plurality of storage buffers, connected in cascade,

means for supplying sorting information to the first of said buffers in accordance with sorting information desired from said document,

means governed by said document transport means for advancing the sorting information from buffer to buffer in synchronism with the motion of the documents in said transport,

and circuit means governed by said buffers for controlling the movement of said documents to selected ones of said pockets.

8. The combination as claimed in claim 7, in which more than one sorting pocket is selected by each buffer.

9. The combination as claimed in claim 8, further including two-position pocket deflection mechanisms associated with each pocket, and connected to said buffers to be positively operated to their two positions by first and second pocket control signals supplied from said buffers.

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