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(54) Document-handling apparatus.

(57) Individual raw document forms are picked selectively from any of a plurality of stacks to be recorded then assembled as a pack. The stacks, in canisters, are aligned on ramps with access to the forward document in each stack. A movable carriage or shuttle is commanded to align with a desired stack where the forward document form is grasped and removed. After picking selected documents, the shuttle transports them individually to a feed mechanism for delivery to a processor for magnetic recording and printing. A predetermined set of completed documents are then gathered and bound as an individualized pack, as in the form of an airline ticket.

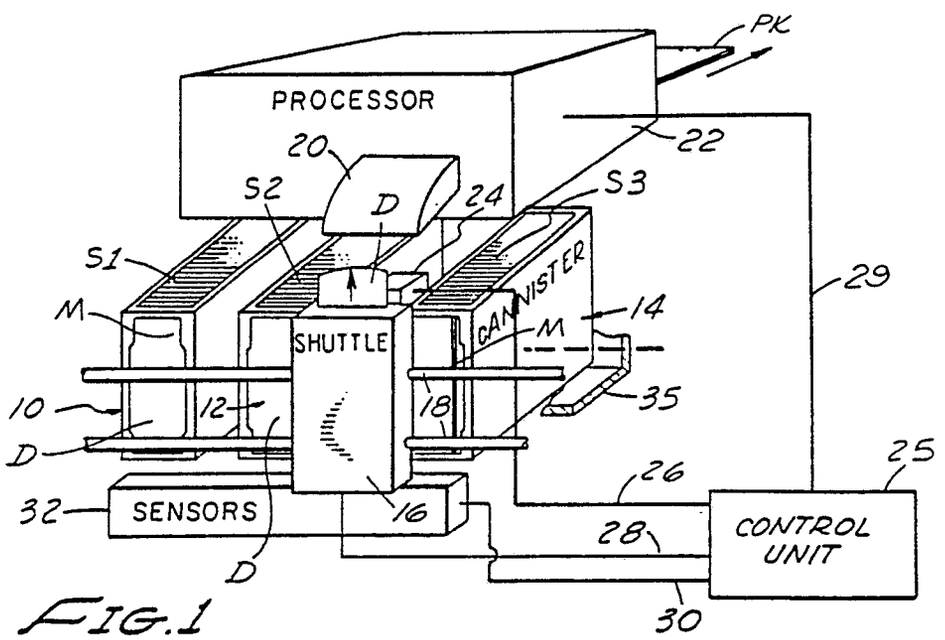

FIG.1

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DOCUMENT-HANDLING APPARATUS

Background and Summary of the Invention

Computer techniques have greatly expanded the possibilities for automatically processing documents. In the preparation of individual complex documents, the need may arise to select individual raw sheets or document forms from a plurality of stacks to create a pack. Specifically, it may be desired to select individual document forms from several stacks, individually process them as by recording data, then assemble them to provide a document of several pages, for example in the form of an airline ticket. In such a system, flexibility and accuracy are important considerations.

In general, the present invention embodies apparatus for selectively drawing single document forms from several stacks for processing. The disclosed apparatus holds stacks of sheets in canisters positioned and aligned for cooperation with a shuttle-carrying picker. The picker is controlled to select a single form and draw it from a canister. The form is transported by a shuttle to a processor for the custom recording of data as by magnetic medium and printing. The sheets are then bound together as a pack. Accordingly, the system can effectively fabricate a custom pack of individual sheets that are completed from different document forms and recorded in accordance with specific data. The system is well suited to the preparation of airline tickets.

Brief Description of the Drawings

In the drawings, which constitute a part of this specification, exemplary embodiments exhibiting various objectives and features hereof are set forth, specifically:

FIGURE 1 is a perspective and block diagram illustrating a system incorporating the present invention;

FIGURE 2 is a perspective fragmentary view of a portion of the system of FIGURE 1;

FIGURE 3 is a fragmentary sectional view taken along the line 3-3 of FIGURE 2;

FIGURE 4 is a fragmentary perspective view of another portion of the system of FIGURE 1;

FIGURE 5 is an enlarged fragmentary view of a portion of the structure shown in FIGURE 4;

FIGURE 6 is a sectional view taken vertically through the structure of FIGURE 2;

FIGURE 7 is a block diagram of the control and processing elements of the system of FIGURE 1;

FIGURE 8 is a block and schematic diagram of a processor as shown in FIGURE 7;

FIGURE 9 is a block diagram of a portion of the control unit of FIGURE 7; and

FIGURE 10 is a flow diagram illustrating the operation of the system of FIGURE 1.

Description of Illustrative Embodiments

Referring initially to FIGURE 1, raw document forms D are provided in stacks S1, S2 and S3, held in canisters 10, 12 and 14, respectively. The forms D comprise flexible card stock and carry a magnetic recording stripe M as may be seen on forms in the outside canisters 10 and 14. The stripes M extend the full length of the forms D and may comprise tape or printed medium as well known in the prior art. Some preliminary printed indicia also may be provided on the forms.

The forward ends of the canisters 10, 12 and 14 as shown are open and accessible to a shuttle 16 which incorporates a document picker (disclosed in detail below) and moves laterally in relation to the canisters on a pair of parallel rods 18. A picked document form D is shown in the shuttle 16, aligned for delivery through a guide 20 to a processor 22. Within the processor 22, the individual forms D are custom recorded, assembled and stapled to be delivered as an individual pack PK. Thus, a custom pack PK of individualized documents, varying in number, is accomplished in a rapid, convenient and accurate manner under control of a unit 25.

The stacks S1, S2 and S3 of forms D each comprise sheets of a distinct format. In relation to an airline

ticket, for example, the forms D might be: a title page form, a baggage check form and a ticket form. Accordingly, the pack PK might comprise: a title page, three tickets and a baggage check. Thus, the individual forms D may be variously selected to accomplish a specific individual document pack PK.

To accomplish the processing, individual forms D are moved from the shuttle 16 to the guide 20 by a feed mechanism 24, partly shown in FIGURE 1. From the guide 20, forms D are printed, magnetically recorded and assembled as a set. On command, the set is stapled together as a pack PK and delivered from the processor 22.

The operations of the mechanical portion of FIGURE 1 is sequenced by a control unit 25 connected by cables 26, 28, 29 and 30 respectively to the feed unit 24, the shuttle 16, the processor P and a set of position sensors 32 (shown as a single block in FIGURE 1). The position sensors 32 comprise electrical apparatus for sensing the aligned positions of the shuttle 16 with one of the canisters 10, 12 or 14 or the feed unit 24. The aligned positions are manifest by distinct electrical signals utilized by the control unit 25 to pick a specific set of forms D.

Considering the mechanical portions of FIGURE 1 in somewhat greater detail, reference will now be had primarily to FIGURE 2 showing select operating components of the shuttle 16 and the canisters 10, 12 and 14 along with an operating portion of the feed mechanism 24. The aligned canisters 10, 12 and 14 are supported in a housing frame 35 (fragmentarily represented) and are canted or offset from the vertical (see canister 12, FIGURE 6) to hold the form stacks S1, S2 and S3 on ramps. That is, the individual documents in the stacks S1, S2 and S3 are held in vertical alignment in the canisters 10, 12 and 14 which are removably set in the housing frame 35 (FIGURE 6).

In the individual removably mounted canisters 10, 12 and 14, the bottom and top edges of the stacks depart from the horizontal at an angle of flow. Generally in accordance herewith, it has been determined that the angle of flow should be between about eighteen and about twenty-five degrees. In one operating embodiment, an angle of approximately twenty- two degrees has been found effective, see the angle designated 37 in FIGURE 6.

Structurally, the canisters 10, 12 and 14 (FIGURE 2) are similar, each comprising a pair of opposed side walls 34 in the form of thirty-degree regular parallelogram metal sheets. Specifically, considering canister 14, for example, a sheet metal bottom 36 (FIGURE 2, lower right) is affixed to the bottom ends of opposed side walls 34 along with a closure plate 38 at the rear. As shown, the tops of the canisters are open to facilitate loading and inspection. Also as illustrated by the canister 14, the front end is substantially open, but obstructed by side-mounted verticals 42 and 44 which define restraining corner tabs 46 to abuttingly engage the forward document of the stack S3 at its corners. Note that the rear surface edges of the restraining tabs 46 define bevels 48 (see FIGURE 3). That is, referring to FIGURE 3, document forms D (forward in the stack S3) must flex for passage over the bevel 48 at the inside of the restraining tab 46. Thus, the tabs 46 allow the foremost forms D to be picked individually from each of the stacks with some flexing of the sheet. The picking operation is accomplished by the shuttle 16 (FIGURE 2) while aligned in facing relationship with the desired document form D.

The shuttle 16 includes a block frame 49 that matingly receives parallel rods 18 rigidly mounted with the main frame 35. The rods 18 support the shuttle 16 while affording freedom of lateral motion for access to the stacks S1, S2 and S3. The shuttle 16 is driven by a belt 50 closed in a loop by attachment at the top of the shuttle frame 49. The belt 50 is carried on spaced-apart idlers 52 and 54 (extreme left and right) along with a drive wheel 56 (top) mechanically coupled to a stepping motor 58 as indicated by a dashed line 59. Accordingly, the stepping motor 58 actuates the belt 50 through the drive wheel 56 moving the shuttle 16 to positions as commanded by the control unit 25. Thus, forms D are picked selectively from one of the canisters 10, 12 or 14, carried to the feed mechanism 24 and delivered to the processor 22. Generally, the shuttle 16 incorporates a vacuum apparatus 67 and solenoids for picking and delivering the forms D.

Document forms D are picked from the canisters 10, 12 and 14 by four bellows or suction cups 88, 89, 90 and 91 (FIGURE 4) extending from the frame 49. The cups are carried on solenoids 92 affixed at the back of the frame 49. Power connections 94 (electrical and pneumatic) supply electrical power to the solenoids 92 and vacuum to the cups 88 through 91.

The power connections 94 also supply air pressure to a manifold 96 (FIGURE 4, lower right) which incorporates a pair of nozzles 98 to provide an "air knife" for isolating forms D.

The structure of the manifold 96 and the nozzles 98 is illustrated in greater detail in FIGURE 5. Specifically, the manifold 96 defines a flat, horizontal passage and the nozzles 98 define vertical passages of "T-shaped" cross-section for aerating the bottom edge of the forward form in the stack. Note that the leg 100 of the nozzle extends somewhat perpendicular to the plane of the stacked forms D. In that regard, the manifold 96 is illustrated in FIGURE 6 (bottom, center) showing the relationship of an air jet to the next

document D.

FIGURE 6 also illustrates the manner in which a stack, e.g. stack S1 is advanced in the canister 10, as individual document forms D are withdrawn by the shuttle 16. As document forms D are withdrawn from the stack, a rider 104 in the canister 12 maintains the forms D in vertical alignment. Specifically, the rider 104 includes a plate 106 suspended from a bracket 108 fixed on a roller 110 at the top of the canister. Accordingly, as forms D are withdrawn, the rider 104 moves to the left under the force of gravity, maintaining the stack S1 upright.

As explained above, after a form D is picked from a select stack, the shuttle 16 carries it to the feed mechanism 24 (FIGURE 4, right) for delivery to the processor (FIGURE 1). The document feed mechanism 24 includes a roller 64 affixed in a yoke 70 which incorporates a stepper motor (not shown) to drive the roller 64 as described below. The yoke 70 is mounted on a reciprocating solenoid mechanism 72, the combination being supported on a beam 74 which is integrally fixed to the main frame 35 along with the canisters 10, 12 and 14 (FIGURE 2).

The solenoid mechanism 72 (FIGURE 4) carries a bracket 76 which extends away from the solenoid to overlap a plate 78 rigidly affixed to the shuttle frame 49. Accordingly, as the shuttle frame 49 moves transversely with respect to the feed mechanism 24, a sliding guide relationship exists between the bracket 76 and the plate 78.

Individual document forms D are lifted from the shuttle 16 by the roller 64, being back supported by an idler 82. That is, when the shuttle 16 is aligned with the feed mechanism 24, the rollers 64 and 82 are aligned in facing relationship with a form D between them (not shown). Initially, the roller 64 is spaced apart from the document being held withdrawn by a spring 84. To lift the document, the solenoid 72 stresses the spring 84 moving the roller 64 to engage a document forcing it against the idler 82. The stepper motor in the yoke 70 then actuates the roller 64 lifting the document through the channel 86 into the processor 22 (FIGURE 1).

Within the processor P, individual forms D are magnetically recorded and custom printed in accordance with signed data from the control unit 25. Completed forms D are collected in sets then bound together to emerge as the pack PK (FIGURE 1). The structure of the control unit 25 and the processor P may vary widely; however, in one embodiment, they comprise a microcomputer along with document processing units. Specifically, as shown in FIGURE 8, a document D is moved through a number of processing stations.

With regard to movement of the forms D, in view of the well known and highly advanced document handler art, as in the field of financial paper processors, a representative apparatus, mechanism 100 for propelling the document forms D is fragmentarily represented. Specifically, a roller 101 is shown actuated by a drive unit 103 to propel the document D. The mechanism 100 moves the document forms D in sequence through a magnetic stripe transducer 105, a printer 107 and a stapler 109. The individual processing units 105, 107 and 109 may take various forms as well known in the prior art to be compatible with the individual forms D and to provide the document pack PK. Specifically, the magnetic transducer 105 records data on the magnetic stripe M of forms in response to data signals from the control unit 25 (FIGURE 7). The printer 107 prints indicia on forms responsive to print-data signals from the control unit 20. Finally, the control unit 25 actuates the stapler 109 to bind a predetermined set of forms D together as the pack PK.

The operation of the composite system is sequenced by the control unit 25 (FIGURES 1 and 7) which also provides document data. Recapitulating to some extent, the control unit (FIGURE 7) in addition to being coupled to the processor 22, the sensors 32 and the stepper motor 58, also is connected to a vacuum valve 126, a solenoid switch 128 and a jet valve 130. Note that the sensors 32, as illustrated in FIGURE 7, actually constitute four individual sensors 112 each of which provides a unique digital signal when the shuttle 16 is aligned to pick or deliver a document. The unique signals may be formatted as a two-bit binary code and supplied to a comparator that also receives a two-bit command code within the control unit 25. On the detection of coincidence, the comparator cuts the stepper motor 58. As the stepper motor 58 (FIGURE 2) drives the shuttle 16, the shuttle is stopped at the select positions to pick and deliver document forms D. In picking, the form D is lifted by cooperative actions as: the jet valve 130 provides a jet from the nozzles 98, the vacuum valve 126 actuating the suction cups 88, 89, 90 and 91 (FIGURE 4) and the solenoid switch 128 actuating the solenoids 92.

After the shuttle 16 (FIGURE 1) has picked a form D, the stepper motor 58 is actuated to move the shuttle into alignment with the rollers 82 and 64 (FIGURE 4). The critical position again is determined by alignment with one of the sensors 112 as determined by a command signal matching a sensor signal. With such alignment, the document form D is delivered through the guide channel 86 to the processor 22 (FIGURE 1).

In the processor 22, the document form D is completed by recording the magnetic stripe and printing indicia on the document. For example, in the case of an airline ticket, the magnetic stripe transducer 105 may record the passenger's name, the ticket price and various codes indicating locations of flight origination and destination, use limitations and so on. The printer 107 might deposit humanly readable indicia of the same information in more detailed form along with instructions, conditions and so on.

A predetermined set of recorded document forms D are accumulated in. the stapler 109. Then, on receiving a command signal, the stapler 109 binds the set of forms D together and delivers them as a pack PK (FIGURE 1).

In the disclosed embodiment, the control unit 25 incorporates a command register 150 (FIGURE 9) for sequentially containing data related to the processing of individual document forms D. If a microcomputer is utilized in the control unit 25, the command register may be variously programmed. As illustrated, the command register 150 (FIGURE 9) carries data in several distinct fields. An initial field 152 indicates the ticket number and is followed by a field 154 designating the page number of a composite ticket. Note that the two fields 152 and 154 together constitute the document number. Data from these fields return to memory for a record of the ticket.

A field 156 carries the data to be recorded on the magnetic stripe of each document and is supplied to the magnetic transducer 105. A field 158 carries the data to be printed which, accordingly, is supplied to the printer 107. Finally, fields 159 and 160 control the selection and assembly of individual documents in a pack. Signals from the field 159 comprise a two-bit binary code and are applied to a comparator 163. The following chart indicates the code format of signals in the field 159.

Shuttle Position (Form Selection)	Code
Stack S1	00
Stack S2	01
Stack S3	10
Processor	11

If a form D is to be picked from the stack S1, the register field 159 (FIGURE 9) provides a signal representing binary "00" to the comparator 163. When the shuttle 16 (FIGURE 1) is aligned with the stack S1, the sensor 112 provides a signal representing the same binary bode, "00". The coincidence of the code signals stops the motor 58 (FIGURE 2) halting the shuttle to pick a form from the stack S1. Similar positioning is performed with respect to the other stacks and the processor.

Signals from the field 160 of the register 150 also have a two-bit binary code format to control the stapler 109. The code format is shown in the following chart:

Order in Code	Representation
00	first document of pack
01	intermediate document in pack
10	intermediate document in pack
11	last document in pack

As document forms D are processed and completed, the codes control the stapler 109. Essentially, under control of the stapler control 164, forms are stacked until a form D is processed designated as the "last" by a code "11". When the "last" form is complete, the set is bound as a pack PK by the stapler 109.

In view of the above descriptions, an overall sequence of operation will now be recounted with specific references to structural elements and the flow diagram of FIGURE 10. At the outset, a document data word is loaded into the command register 150 of the control unit 25 (FIGURES 1, 7 and 9). From fields in the register 150, data is accessible for recording and control. Initially, the control unit 25 actuates the stepper motor 58, driving the shuttle 16 (FIGURE 1) to scan for alignment with the stack S3. The step is symbolized by a block 170, FIGURE 10. At the select location, the aligned sensor 112 (FIGURE 7) manifests alignment by a matching binary signal for the comparator 163. Consequently, the shuttle 16 is stopped at the stack S3.

The system next proceeds as indicated by the block 172 (FIGURE 10) to pick a document. The picking

operation involves actuating the vacuum valve 126, the solenoid switch 128 and the jet valve 130 (FIGURE 7).

The control unit 25 (FIGURE 7) next actuates the shuttle stepper motor 56 (FIGURES 2 and 7) to scan the shuttle 16 to the feed mechanism 24 (FIGURE 4) as indicated by the block 174 in FIGURE 10.

With the shuttle in position, a "start" signal is necessary indicating completion of the prior form D as indicated by a gate block 176. When the gate conditions are met, the control unit 25 actuates the document feed unit 124; and the document form D (FIGURE 6) is lifted from the shuttle 16 to the processor 22 (FIGURE 1).

Note that with the movement of the document D into the processor as indicated by the block 178, the selection sequence repeats to pick and deliver the next document form D specified for the desired pack. The operation is illustrated by a return line 180 in FIGURE 10.

The document form D previously delivered to the processor 22 is recorded by a magnetic record as indicated by block 182 in FIGURE 10 and printed as indicated by the block 184. These operations simply involve passing data from the fields 156 and 158 (FIGURE 9) to the transducer 105 and the printer 109 respectively (FIGURE 8). The completed form D is then placed in a set as indicated by the block 186. If the completed form D is the last document for a pack (block 188), the stapler 109 is actuated. On completion of a form D, the process is repeated by the qualification of the gate block 176 to institute another cycle.

Thus, the system effectively picks individual raw forms from any of a plurality of stacks and delivers them to be recorded and bound into packs. In view of the various aspects of the system described above, and the various possible implementations, the scope hereof should be as determined in accordance with the following claims.

Claims

1. An apparatus for selectively assembling sets of document sheets from individual stacks in accordance with a predetermined format, comprising:
plural canister means, each for holding a stack of document sheets, said canister means having an open end to expose a surface of a forward document sheet and through which said document sheets may be drawn;
receiver means for receiving said document sheets;
carriage means including a movable shuttle, said carriage means further including means to move said shuttle to carry document sheets from said plural canister means to said receiver means; and
control means for receiving signals representative of said predetermined format to control said carriage means to pick a specified set of documents in accordance with said predetermined format.

2. An apparatus according to claim 1 wherein said receiver means includes processor means and said control means controls said processor means.

3. An apparatus according to claim 2 wherein said processor means includes means for recording data on said document sheets as provided from said control means.

4. An apparatus according to claim 3 wherein said means for recording comprises a magnetic transducer.

5. An apparatus according to claim 3 wherein said means for recording comprises a printer.

6. An apparatus according to claim 1 further including a housing means for removably receiving said canister means in an aligned configuration with said open ends facing said carriage means.

7. An apparatus according to claim 6 further including beveled restraining means in said canister means to bear against a forward document sheet and about which said document may be drawn by flexure.

8. An apparatus according to claim 1 wherein said control means includes a command register for data specifying said predetermined format.

9. An apparatus according to claim 8 wherein said receiver means includes processor means and said control means controls said processor means in accordance with said predetermined format.

10. An apparatus according to claim 9 wherein said command register controls said carriage means.

11. An apparatus according to claim 10 wherein said processor means includes means for recording data on said document sheets as provided from said control means.

12. An apparatus according to claim 11 wherein said means for recording comprises a magnetic transducer.

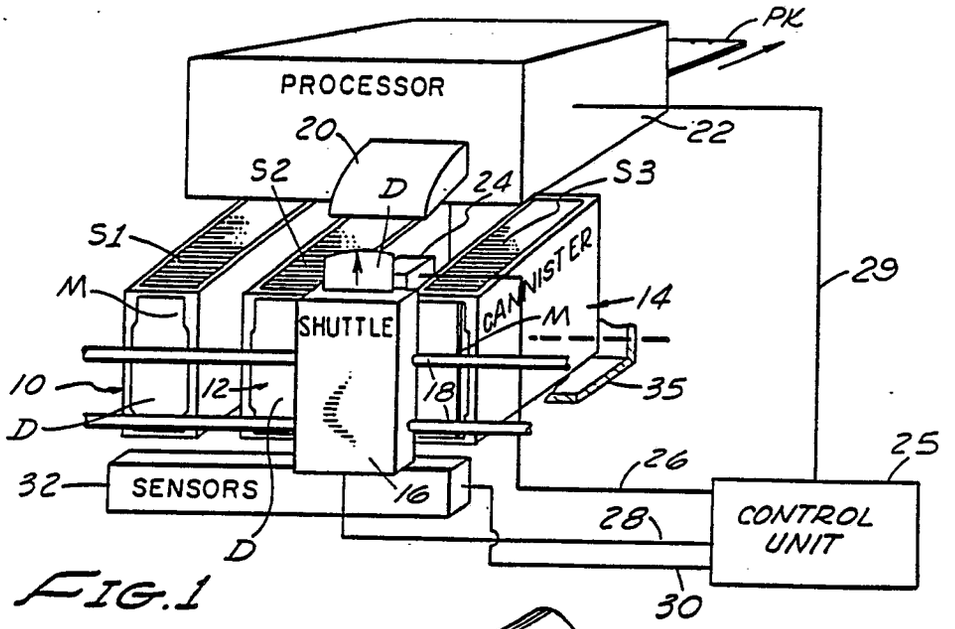

PROCESSOR
PK
20
22
S2
D
24
S3
S1
M
SHUTTLE
CANISTER
14
29
M
10
12
18
35
D
25
26
32
SENSORS
16
28
CONTROL UNIT
D
30

FIG. 1

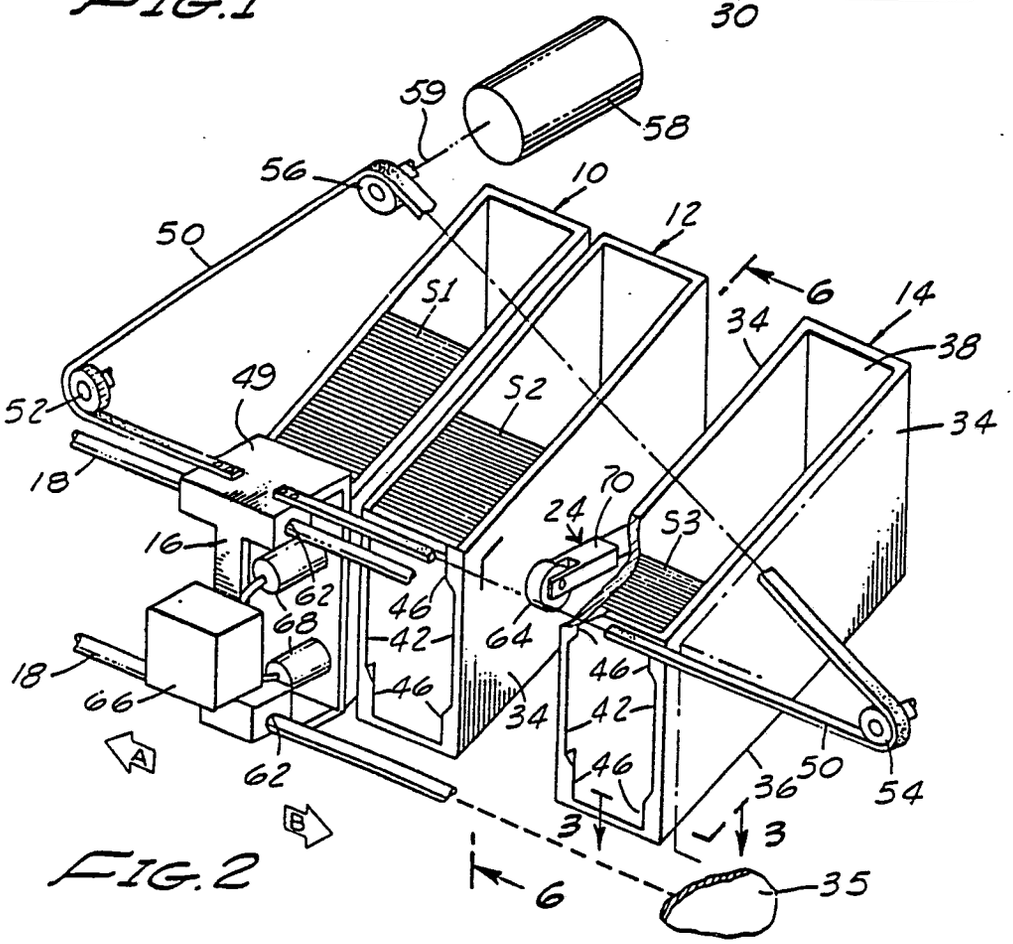

59
58
56
10
50
12
6
14
S1
34
38
49
52
S2
34
18
70
24
S3
16
62
46
64
68
42
18
46
46
66
34
42
A
62
46
36
50
54
B
3
3
6
35

FIG. 2

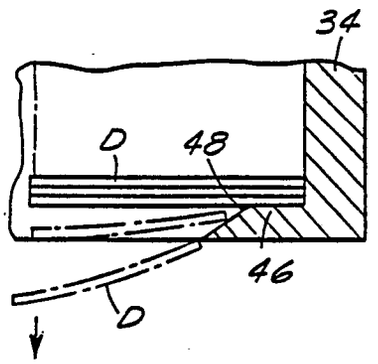


FIG. 3

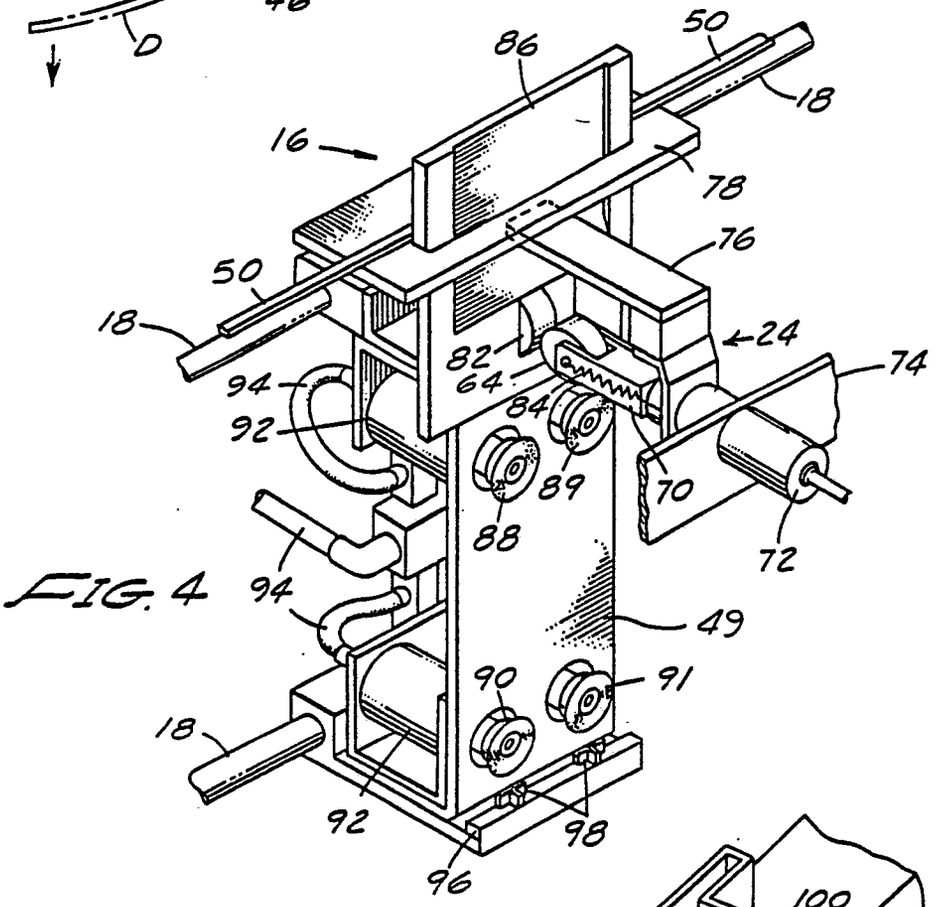


FIG. 4

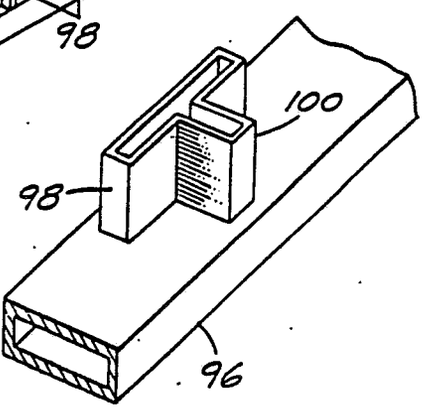
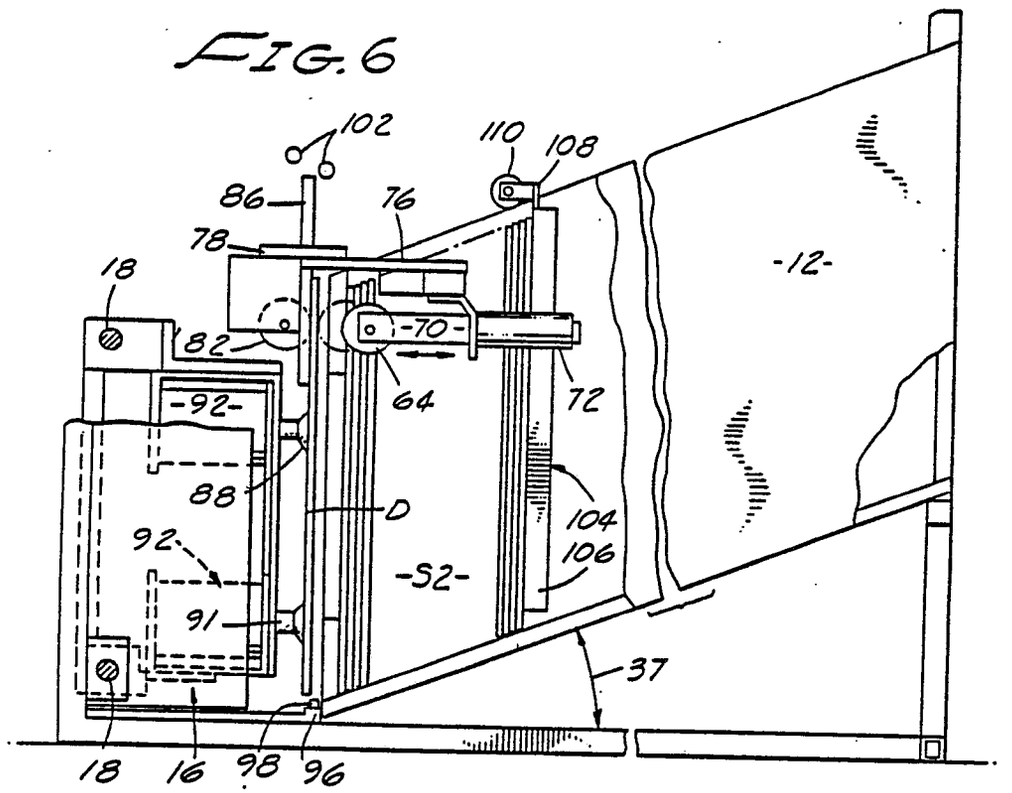


FIG. 5

FIG. 6


102
110
108
86
76
78
18
-12-
82
-70-
64
72
-92-
88
D
104
92
106
-52-
91
37
18
16
98
96

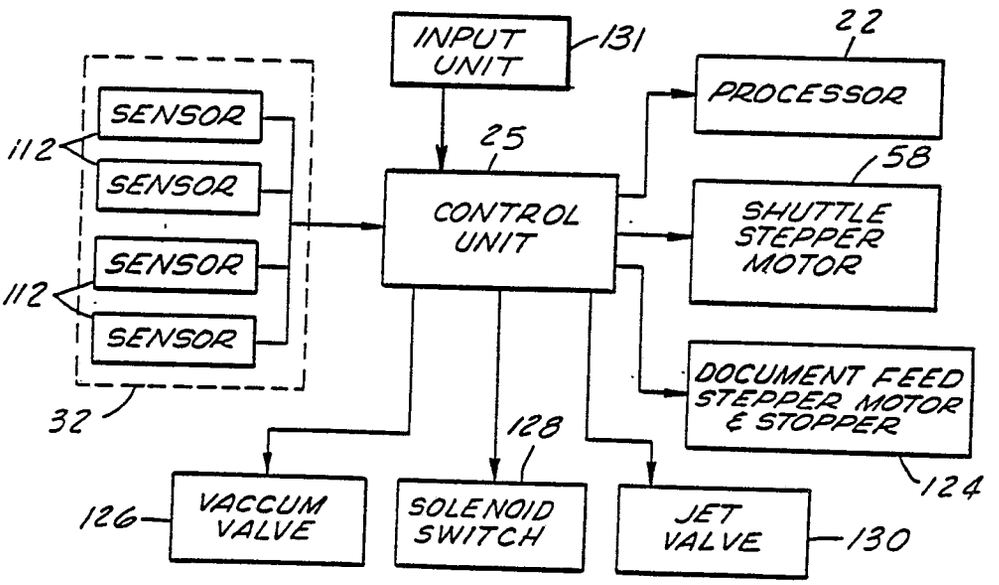

INPUT UNIT
131
22
PROCESSOR
SENSOR
112
SENSOR
SENSOR
112
SENSOR
25
CONTROL UNIT
58
SHUTTLE STEPPER MOTOR
DOCUMENT FEED STEPPER MOTOR & STOPPER
124
32
128
126
VACCUM VALVE
SOLENOID SWITCH
JET VALVE
130

FIG. 7

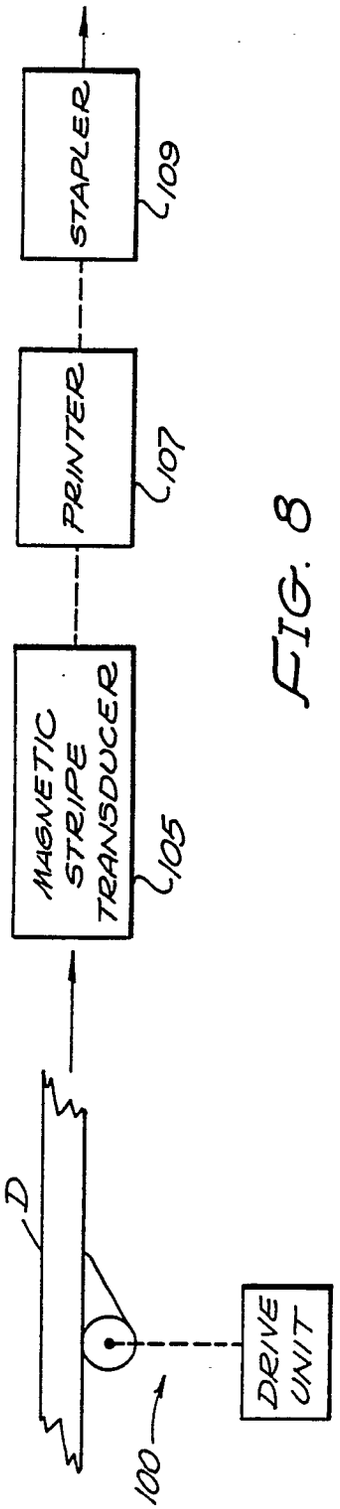

STAPLER
109
PRINTER
107
MAGNETIC STRIPE TRANSDUCER
105
D
DRIVE UNIT
100

FIG. 8

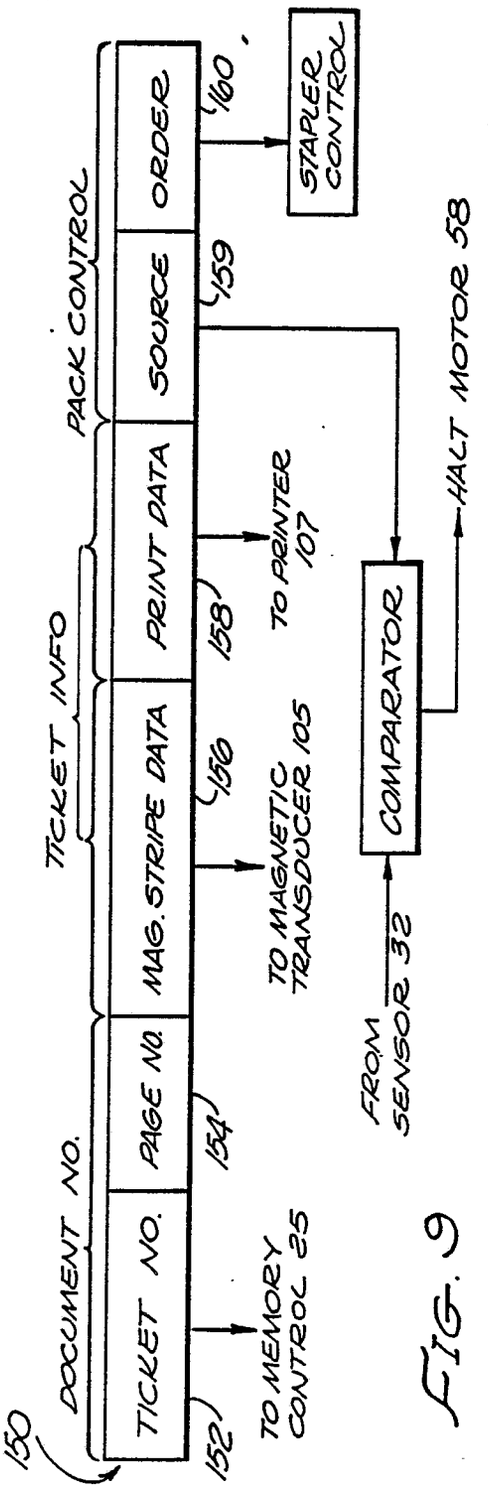
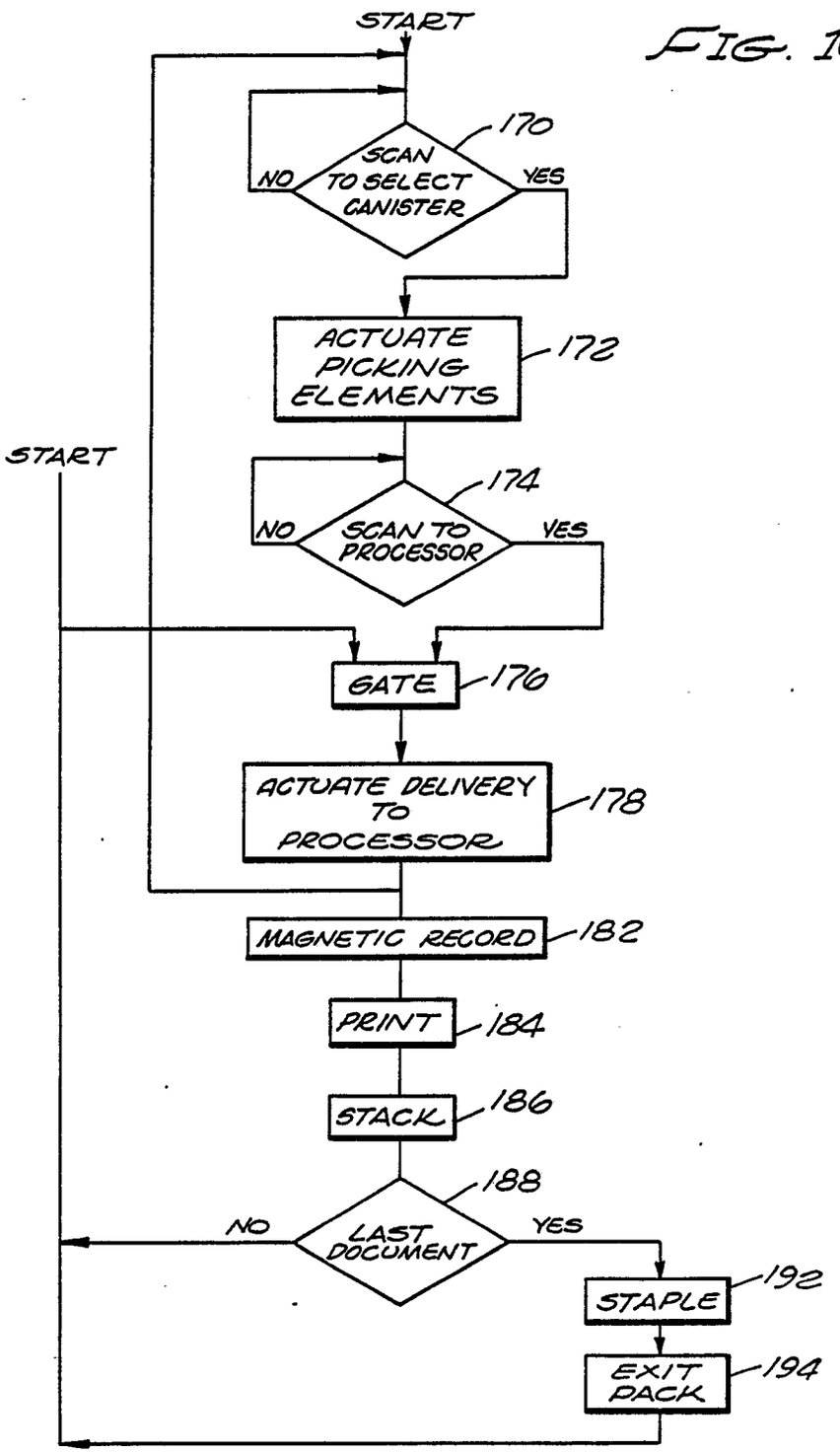

150
DOCUMENT NO.
TICKET NO.
PAGE NO.
MAG. STRIPE DATA
PRINT DATA
SOURCE
ORDER
TICKET INFO
PACK CONTROL
152
154
156
158
159
160
TO MEMORY CONTROL 25
TO MAGNETIC TRANSDUCER 105
TO PRINTER 107
STAPLER CONTROL
FROM SENSOR 32
COMPARATOR
HALT MOTOR 58

FIG. 9

FIG. 10


START
170
SCAN TO SELECT CANISTER
NO
YES
ACTUATE PICKING ELEMENTS
172
START
174
SCAN TO PROCESSOR
NO
YES
GATE
176
ACTUATE DELIVERY TO PROCESSOR
178
MAGNETIC RECORD
182
PRINT
184
STACK
186
188
LAST DOCUMENT
NO
YES
STAPLE
192
EXIT PACK
194