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(54) **Mail handling system.**

(57) A system for handling and sorting mail items is disclosed. Destination of the mail items (16) is read and the mail items are fed into pockets (14) of a rotating carrier (13). A plurality of bins (11) are located beneath the carrier and as a pocket containing a mail item to be received in a specified bin aligns with that bin, the bottom (18) of the pocket is opened to release the mail item. The pockets and bins are arranged around a central hub (12) housing operating elements of the system. A module (17) for feeding mail items to the pockets and for reading destination addresses is mounted radially outwardly of the rotatable carrier. The system is controlled by a controller (28) which operates to allocate bins to destination addresses of the mail items. Sensors are provided to monitor operation of the system and to cause bin full indications to be provided to an operator of the system.

EP 0 476 984 A2

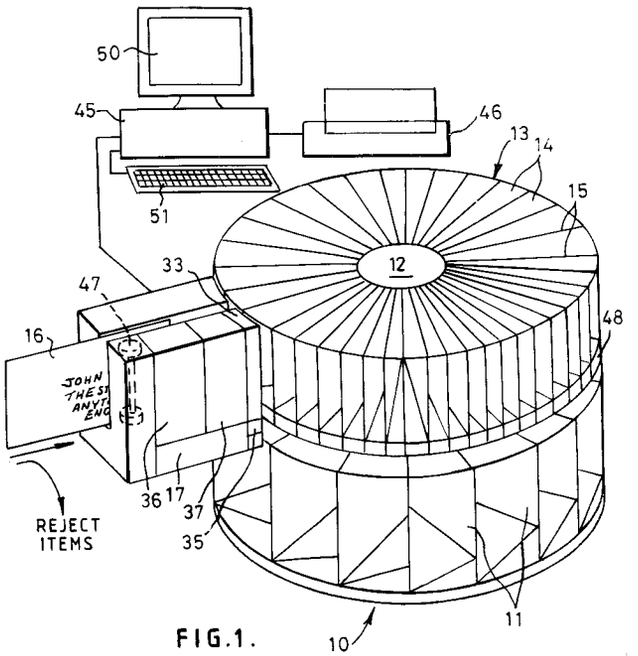

FIG.1.

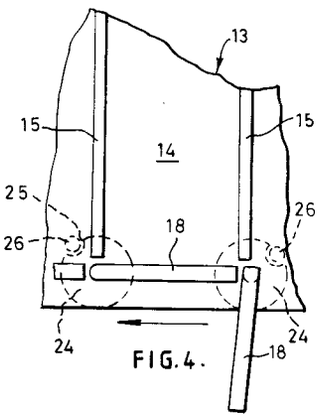

FIG.4.

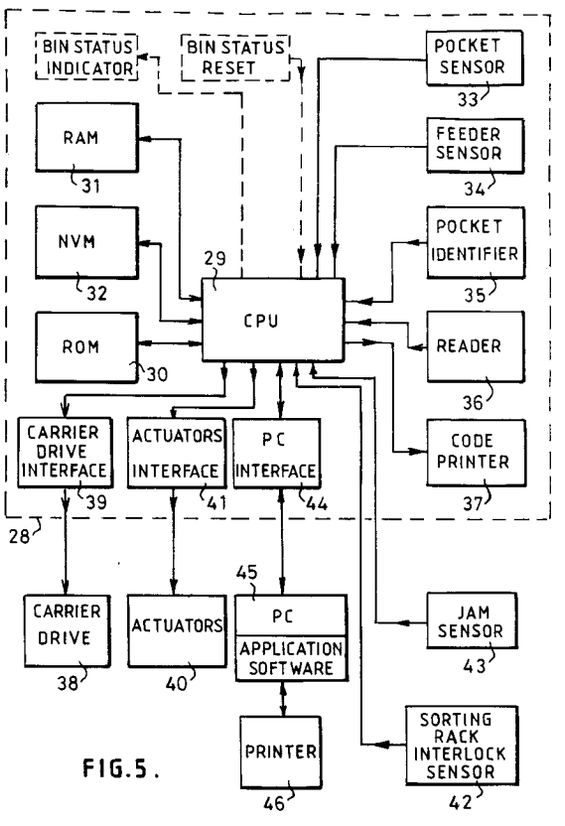

FIG.5.

This invention relates to systems for handling mail items and in particular to systems for sorting mail items in accordance with predetermined criteria.

Postal Authorities offer discounted postage charges to users of the mail service who send large volumes of mail and pre-sort the mail items into bundles determined by destination addresses of the items. When a plurality of mail items such as advertising material are addressed using a mailing list held in a computer database, addresses in the mailing list can be sorted such that the mail items are prepared in the sorted order and hence the items can be franked or postage charges otherwise accounted for and can be handled subsequently to retain the mail items in an order determined by their destination addresses. While such systems enable senders of bulk mail to obtain advantage rates of postage charge, senders of large volumes of mail items such as normal correspondence are usually unable to prepare the mail items in sorted order and hence are unable to qualify for discounted postage charges.

According to one aspect of the present invention a mail handling system includes means to read destination data on mail items, a rotating carrier to receive mail items from said reading means; a plurality of mail item bins arranged in a circular formation below the rotating carrier to receive mail items from the carrier and means operable in response to the destination data read from a mail item to transfer that mail item from the carrier to a selected one of said bins assigned to the destination data read from that mail item.

According to a second aspect of the invention a mail item handling system comprises a plurality of bins arranged in a circular formation around a central hub; a rotatable carrier mounted on said central hub for indexing rotation relative to said bins; said carrier including a plurality of mail item receiving pockets overlying said bins; each pocket including means normally operative to retain a mail item therein and selectively operable to release a mail item therefrom; a plurality of actuator means associated one with each bin respectively and each actuator being selectively operable to operate said mail retaining means of a selected pocket to cause release of a mail item from said selected pocket into the bin associated with the operated actuator; reading means to read destination data from mail items; feeding means to feed mail items sequentially past the reading means to the pockets of the rotatable carrier; drive means to rotate the carrier such that said pockets are brought sequentially into alignment with said feeding means, said feeding means being operated to feed a single mail item into that pocket aligned therewith; and means operative in response to said destination data read from each mail item to operate said actuators such as to release each mail item from the pockets of the carrier into the selected bins in dependence upon said destination data.

An embodiment of the invention will be described by way of example with reference to the drawings in which:-

Figure 1 is a general view of a system in accordance with the invention,

Figure 2 is sectional view through a portion of a rotating mail carrier and a bin of a mail receiving rack,

Figure 3 is a radial section through the rotating carrier and the mail receiving rack,

Figure 4 illustrates a mechanism for releasing a mail item from the carrier into a bin of the rack,

Figure 5 is a block diagram of an electronic control for the mail handling system,

Figure 6 is a flow chart of the operation of the mail handling system,

Figure 7 is a general view of a modification of the system shown in Figure 1, and

Figure 8 illustrates the feeding of mail items from a hopper or franking machine to the sorting system.

Referring first to Figure 1, a mail item handling system includes a sorting rack 10 having a plurality of mail item receiving bins 11 arranged in circular formation around central hub 12. A circular mail carrier 13 in the form of a carousel is disposed above the sorting rack and is rotatable on the hub relative to the sorting rack 10. The carrier 13 comprises a plurality of mail receiving pockets 14 defined by walls 15 extending in a substantially radial direction. The bins 11 of the sorting rack are identical. Similarly, the pockets 14 of the carrier are identical. Accordingly it will be understood that description hereinafter relating to any bin or any pocket applies to all the bins and to all the pockets respectively.

Mail items 16 are fed by feeding means 47 along a feed path extending radially of the carrier 13 one at a time through a reading and printing module 17 and thence into the pockets 14 of the carrier 13. The mail items are disposed in a vertical plane while being fed through the module 17. As illustrated in Figure 1 the feeding means comprises driven feed rollers which engage the mail item 16. However it will be appreciated that other forms of mail item feed such as driven belts may be employed to feed the mail items to the module 17. The feeding means may have a differential speed facility to enable the feeding means to be controlled in such manner that sufficient time is allowed for the reading of the destination address data and the printing of the bar code of each mail item as it is fed through the module 17 while still carrying out the process of feeding mail items in sequence continuously.

The module 17 includes reading means 36 to read the destination address and post code of each mail item 16 which is fed through the module. The module 17 also includes printing means 37 operable to print a code, for example a bar code, on each mail

item to enable further handling of the mail items under control of signals obtained from reading of the bar code. The module 17 is secured by a mounting to the central hub 12 and is so orientated that mail items, after being fed through the module 17, are fed radially relative to the carrier 13 into that one of the pockets 14 of the carrier which is aligned with the module 17. The carrier 13 is rotated in steps such that the pockets are brought into alignment sequentially with an outlet feed path of the module 17. The carrier may have 250 pockets and may be rotated in steps at such a rate that a sequence of 50 pockets are aligned with the outlet of module 17 per minute. A sensor 33 is provided adjacent the outlet of the module 17 to check that the pocket aligned with the outlet of the module 17 is empty and a mail item is ejected from the module 17 into the pocket only if the sensor 33 indicates that the pocket is empty. It will be appreciated that the radially outer end of each pocket 14 is open to receive mail items ejected from the module 17.

Each pocket 14 of the carrier 13 is provided with a unique identification mark 48 which on rotation of the carrier passes a sensor 35 on the module 17. Accordingly signals output from the sensor 35 provide an indication of that one of the pockets which is aligned with the outlet of the module 17 at any time and thereby identifies those ones of the pockets into which specific ones of the mail item are fed respectively.

The sorting rack 10 includes a plurality of bins 11 less in number than the number of pockets 14 in the carrier 13 and for example may include 64 bins. Each bin is capable of stacking a quantity of mail items as is shown in Figure 2. Each pocket of the carrier is provided with a bottom panel 18 which is pivotally mounted on the carrier. The bottom panels 18 of the pockets are normally in a closed position to retain a mail item in the pocket and are selectively movable to an open position to release a mail item from the pocket. As shown in Figure 2, the bottom panel 18 of pocket 14_n has been moved to its open position to release the mail item into the bin 11_b. A guide 19 extends partially across the bin and slopes downwards in the direction of travel of the pockets 14. When the bottom panel of a pocket is moved to its open position, the mail item drops into engagement with the guide and is moved by the carrier across the guide until finally it drops into the bin. A continuously rotating paddle, or paddles, 20 projecting from a downstream wall 21 of the bin knocks the mail item and causes it to fall from its vertical orientation onto the sloping base 49 of the bin or, if there are already mail items received in the bin, onto the top of the stack 59 of mail items in the bin. The paddles 20 may be driven by drive means 58 located in the central hub. The upper part of the bin is provided, adjacent the downstream wall 21 thereof with a cam face 22 effective to engage the bottom panel as it passes the cam face and thereby to move the bottom panel toward its closed position. The bottom panel is fully closed and retained in its closed position by a self resetting actuator, for example a spring toggle, so that the pocket 14_n is ready to receive a further item of mail when it is next aligned with the outlet of the module 17.

The bottom panels may be opened selectively by the mechanism illustrated in Figure 3. The bottom panel 18 is pivoted on an axis 23 extending radially of the carrier and aligned with a leading wall 15 of the pocket. A member 24 which may be a partial disc is secured to the bottom panel. The disc has a cut away portion 25. Each bin 11 has associated therewith an actuator pin 26 operable by an actuator 40. The actuator pin 26 is located immediately above the bin with which it is associated such that when the pin is moved to an operated position by its actuator, the pin lies in the path of the cut away portion of the disc member 24 and as the carrier is rotated the pin engages in the cut away portion 25 of the disc member 24 and causes rotation of the disc member 24 which results in moving of the bottom panel to its open position and consequent release of the mail item into the bin. Figures 3 and 4 illustrate the location of the member 24 on the carrier and the actuator pin located on the hub 12. The actuator 40 for operating the actuator pin 26 is located within the hub 12. The hub carries means 27 to rotatably support the carrier and a drive motor 38 to apply a stepping drive to index the carrier relative to the bins of the sorting rack.

It will be appreciated that the mail item retaining means need not comprise a panel but may consist of any member effective to retain a mail item in the pocket and which can be operated to release the mail item as required. For example, instead of a panel the member may comprise a plurality of spaced elements pivotable about the axis 23. The member 24 may be of a form other than a disc with a cut away portion. The essential requirement being that engagement of the member 24 by an operated actuator pin 26 causes the mail item retaining means to release a mail item from the pocket. The mail item retaining means may be reset from it mail item release position to its normal mail item retaining position as it passes the cam face 22 at the downstream end of the bin as described hereinbefore. However if desired the mail item retaining means may be reset at a single position located immediately upstream of the feed path outlet of the module 17. It will be appreciated this latter arrangement will require sufficient clearance between the bottom of the carrier and the tops of the bins for the passage of any of the bottom panels which are in the mail item release position.

During operation of the mail handling system, the sorting rack is stationary. However, to facilitate removal of stacks of mail items from the bins, the rack may be rotatable to a limited extent when the system is in a standby mode. It will be understood that the

radially outer ends of the bins are open to permit manual removal of the stacks of mail items accumulated in the bins. An interlock is provided to ensure that, after such rotation, the rack is relocated with the correct orientation prior to operational use for sorting mail items. It will be appreciated that due to mal-function a mail item released from a pocket of the carrier may fail to fall clear of the carrier. Torque control of the drive to index the carrier may be provided in order to respond to jamming of a mail item and to provide a shut down signal.

The design of handling equipment described hereinbefore permits all sensors, actuators and drive devices to be housed in the stationary part of the equipment.

Operation of the equipment is controlled by a computer 45 via a slave controller 28 which may be housed in the module 17. As illustrated in the block diagram of Figure 5 the slave controller comprises a central processor device 29 such as a microprocessor to which is connected a read only memory (ROM) 30 storing program sequences for controlling operation of the microprocessor, a random access memory (RAM) 31 for use by the microprocessor as a working memory and a non-volatile memory (NVM) 32 for storing status data in the event of power failure to enable recovery of operation of the equipment after power is restored. The sensor 33 for checking that a pocket 14 aligned with the outlet of the module 17 is empty, feed sensors 34 for detecting mail items fed by the feeding means to the module 17 and the sensor 35 for sensing the identification mark 48 of the pocket aligned with the module 17 are connected to provide inputs to the microprocessor 29. Output from reading circuits 36 of the module 17 are input to the microprocessor and print signals from the microprocessor are output to print control circuits of the printing means 37 of the module 17.

A motor drive 38 for indexing of the carrier 13 is controlled by the microprocessor via an interface 39. Solenoids of the actuators 40 for operating the pins 26 are energised selectively by the microprocessor via an interface 41. An interlock sensor 42 for indicating that the sorting rack is correctly orientated and a jam detect sensor 43 provide signals to the microprocessor to inhibit operation of the equipment if the sorting rack is not correctly orientated or if a mail item jam occurs.

An interface 44 provides communication between the microprocessor 29 and the computer 45 which conveniently may be a personal computer. The computer 45 operates under the control of application software to provide required control of operation of the microprocessor 29.

Reference to the flow chart of Figure 6 will now be made to describe operation of the mail item handling system. After starting operation, the mail item destination data is read and the code is printed on the item. The identification mark 48 of the pocket currently aligned with the outlet of module 17 is sensed and the pocket is checked to determine if it is empty. If the pocket is not empty, further operation is stopped and a fault signal is generated. If the pocket is empty, the mail item is ejected into the pocket. Determinations are made as to whether a bin assignment is required corresponding to the destination data read from the mail item by the reader 36 and whether there is bin capacity available. If required, a bin 11 is assigned to that destination data. The sensor 35 senses the pocket identification marks 48 as the carrier is indexed and when it is ascertained that there is conformity between a pocket holding a mail item and the bin specified to receive that mail item the actuator pin 26 associated with that bin is operated to open the bottom panel of the pocket to release the mail item into the specified bin. Means are provided to determine when a bin is full so as to provide a bin full signal to an operator and so that, when a bin becomes full, a determination can be made as to whether another bin can be assigned for that destination data. If there is a bin available, further mail items having that destination data are directed to that later assigned bin. When a full bin has been emptied, the sensor is reset manually so that the bin may then continue to receive mail items.

Assignment of bins to correspond to destination addresses may be effected in sequence as the address data is read from successive mail items or with reference to an expert system software shell, stored in the personal computer 45, which has learned the characteristics of the mailing profile to generate a prediction of the distribution of destination addresses of the mail items. If a mailing list is in use, this prediction may be obtained by reference to the mailing list. Where required more than one bin may be assigned to a specific destination address code. The computer 45, or the microprocessor 29 of the slave, may be programmed to maintain a record of the number of mail items distributed to each individual bin and to generate the bin full signal together with an indication of which bin is full when a predetermined number of mail items has been distributed to any one of the bins. Emptying of a bin accompanied by resetting of the bin indicator effects resetting of the count of items for that bin to zero. The computer 45 can display, on its screen 50, bin identifications of those bins containing sufficient mail items to be banded. The display on the screen may comprise each bin identified, for example, by a bin number with the status of each bin. Resetting of the bin status upon removal of a stack of items from a bin may be effected on a keyboard 51 of the computer 45. Alternatively, as shown in Figure 7, indicators 52 with reset push buttons 53 may be provided on the sorting rack 10.

The computer may display status indications and messages to assist an operator of the mail handling

system. A printer 46 may be connected to the computer 45 to enable reports to be printed. Such reports may provide information relating to use of the system and mailing characteristics to enable a best match to postal discounted services to be achieved. The printer may also be used to print self adhesive labels for identifying contents of mail bags in accordance with requirements of postal authorities.

In addition to assigning bins to receive mail items bearing specified destination address data, one or more bins may be assigned to receive mail items which do not bear address data within the sorting criteria or for which the address data cannot be read by the reading means 36. Mail items need not be handled for address facing prior to feeding to the handling system because any items incorrectly orientated may be received in a specified bin and removed from the bin and fed back into the system by the operator.

Figure 8 illustrates the use of the mail sorting system for sorting mail items fed from a hopper or franking machine 54. If the items are disposed in a horizontal plane when fed from the hopper or franking machine 54 to the module 17, the feeding means includes means 55 to rotate the mail items 16 from a horizontal disposition to a vertical disposition.

The feeding means also includes means 56 to check that the dimensions of each mail item are within predetermined limits and any mail item found to have a dimension exceeding the predetermined limit therefor is ejected into a reject bin 57.

Claims

1. A mail handling system characterised by means (36) to read destination data on mail items (16), a rotating carrier (13) to receive mail items from said reading means (36); a plurality of mail item bins (11) arranged in a circular formation below the rotating carrier (13) to receive mail items from the carrier and means operable (18, 26) in response to the destination data read from a mail item to transfer that mail item from the carrier to a selected one of said bins assigned to the destination data read from that mail item.

2. A mail handling system as claimed in claim 1 further characterised in that the carrier (13) comprises a carousel rotatable about an axis and having a plurality of pockets (14) each for receiving a single mail item (16) from the reading means (36), each pocket being defined by walls (15) extending substantially radially of the carrier and having mail retaining means (18) normally operative to retain a mail item in the pocket and selectively operable to release the mail item into a selected one of the bins (11).

3. A mail handling system as claimed in claim 2 further characterised in that the mail retaining means (18) comprises a member (18) normally extending in a mail retaining position adjacent the bottom of the pocket between the walls (15) defining the pocket; said member (18) being pivotally mounted and being pivotable from said mail retaining position to a mail release position; a plurality of actuators (26,40) associated one with each bin (11) respectively; each said actuator (26, 40) being selectively operable to engage an element (24) secured to said member (18) during passage of a selected one of the pockets (14) over the bin (11) associated with the actuator to pivot the member to said mail release position and reset means (22) operative to reset the member to the mail retaining position prior to the pocket receiving a further mail item from the reading means (36).

4. A mail item handling system as claimed in claim 2 or 3 further characterised by means (33) operative to check that the pocket (14) aligned to receive a mail item from the reading means (36) is empty.

5. A mail item handling system as claimed in any one of claims 2, 3 or 4 further characterised in that the carrier (13) includes identification marks (48) unique to each pocket (14) thereof and including means (35) to sense said marks to provide an indication of the position of each pocket (14) relative to the bins (11).

6. A mail item handling system as claimed in any preceding claim further characterised by the provision for each bin (11) of a guide (19) extending partially over the bin (11) and inclined downwardly in the direction of movement of the carrier (13), said guide (19) being effective to support a lower edge of a mail item (16) released from a pocket (14) of the carrier (13) and to guide the mail item toward a wall (21) located downstream of the bin (11) in the direction of movement of the carrier (13).

7. A mail item handling system as claimed in claim 6 further characterised by means (20) disposed adjacent the downstream wall (21) of each bin (11) operative to cause a mail item (16) guided into the respective bin (16) by the guide (19) to fall from a substantially vertical orientation adjacent the downstream wall (21) onto a base (49) of the bin or a stack of items supported by the base of the bin.

8. A mail item handling system as claimed in claim 7 further characterised in that the means (20)

operative to cause the mail item (16) to fall comprises a rotatable paddle (20) effective to knock the mail item.

9. A mail item handling system as claimed in any preceding claim further characterised by computing means (28,45) operable to assign a selected bin or bins (11) to receive mail items (16) bearing predetermined address data.

10. A mail item handling system as claimed in any one of claims 1 to 8 further characterised by computing means (28,45) operable to assign bins (11) sequentially to receive mail items (16) in dependence upon address data read from the mail items.

11. A mail item handling system as claimed in any one of claims 1 to 8 further characterised by computing means (28, 45) operable to predict a distribution characteristic of mail to be handled and to assign bins (11) in dependence upon said prediction.

12. A mail item handling system as claimed in any preceding claim further characterised by printing means (37) operable to print a code on each mail item (16), the code printed on a mail item being dependent upon destination data read by the reading means (36) from that mail item.

13. A mail item handling system as claimed in any preceding claim further characterised by bin status indicator means (50; 52) to provide an indication relating to quantity of mail items (59) received in each bin (11).

14. A mail item handling system as claimed in claim 13 further characterised in that the bin status indicator means (50;52) provides an indication when any of the bins (11) is full.

15. A mail item handling system as claimed in claim 13 or 14 further characterised by means (28) to maintain a record of the number of items received in each bin (11) and to operate the bin status indicator means (50;52) in accordance with said maintained record.

16. A mail item handling system as claimed in claim 15 further characterised by manually operable reset means (51;53) to reset the record of the number of items in a selected bin (11) to zero when a stack (59) of received mail items (16) is removed from that bin (11).

17. A mail item handling system characterised by a plurality of bins (11) arranged in a circular formation around a central hub (12); a rotatable carrier (13) mounted on said central hub (12) for indexing rotation relative to said bins (11); said carrier (13) including a plurality of mail item receiving pockets (14) overlying said bins; each pocket including means (18) normally operative to retain a mail item (16) therein and selectively operable to release a mail item therefrom; a plurality of actuator means (26, 40) associated one with each bin (11) respectively and each actuator being selectively operable to operate said mail retaining means (18) of a selected pocket (14) to cause release of a mail item (16) from said selected pocket into the bin (11) associated with the operated actuator (26); reading means (36) to read destination data from mail items (16); feeding means (47) to feed mail items (16) sequentially past the reading means (36) to the pockets (14) of the rotatable carrier (13); drive means (27, 38) to rotate the carrier such that said pockets (14) are brought sequentially into alignment with said feeding means (47), said feeding means (47) being operated to feed a single mail item (16) into that pocket (14) aligned therewith; and means (29, 40) operative in response to said destination data read from each mail item (16) to operate said actuators (26) such as to release each mail item from the pockets of the carrier into the selected bins in dependence upon said destination data.

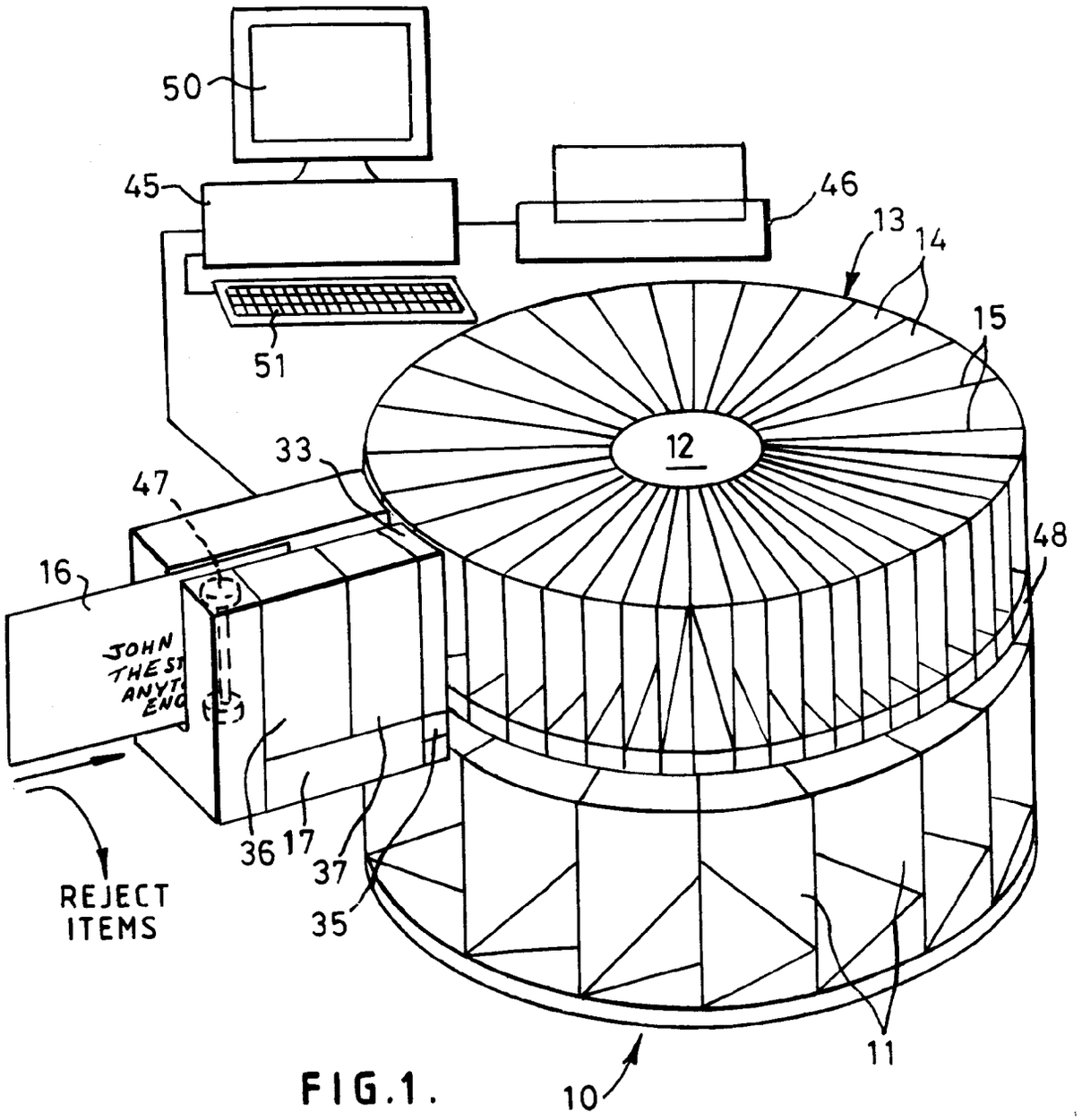
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FIG.1.

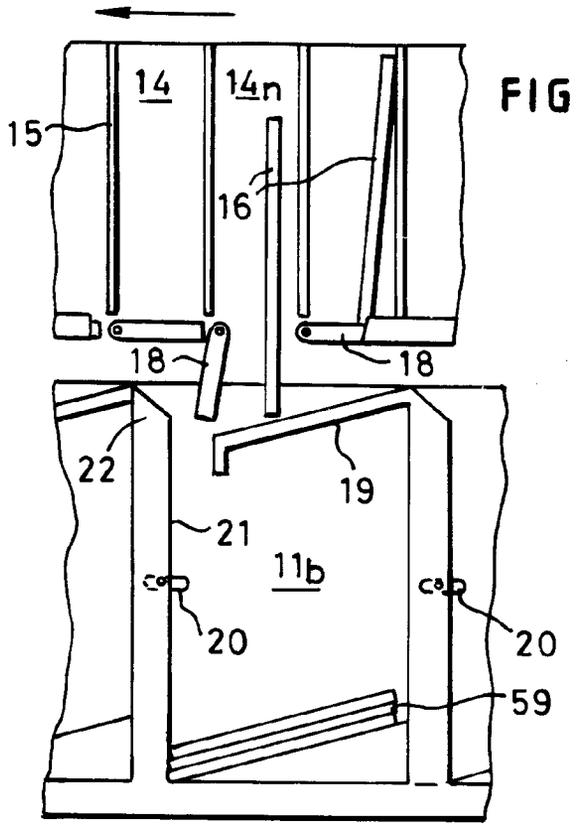


FIG.2.

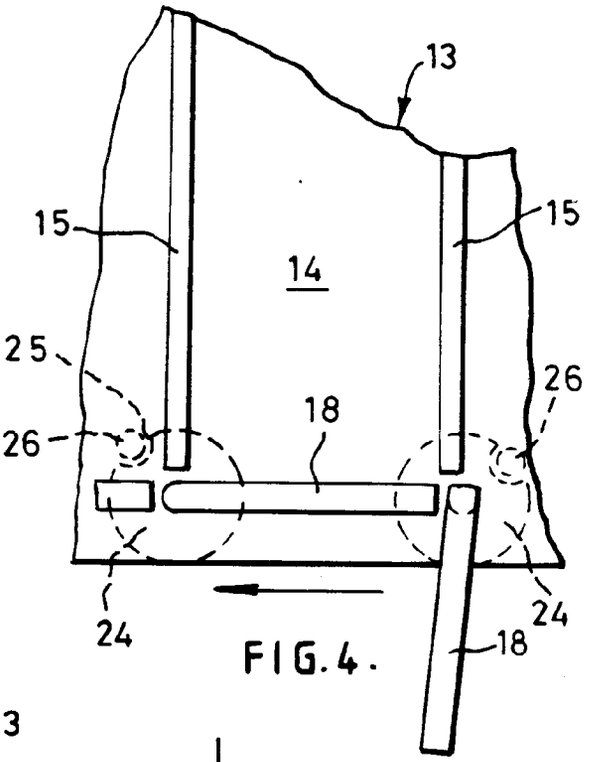


FIG.4.

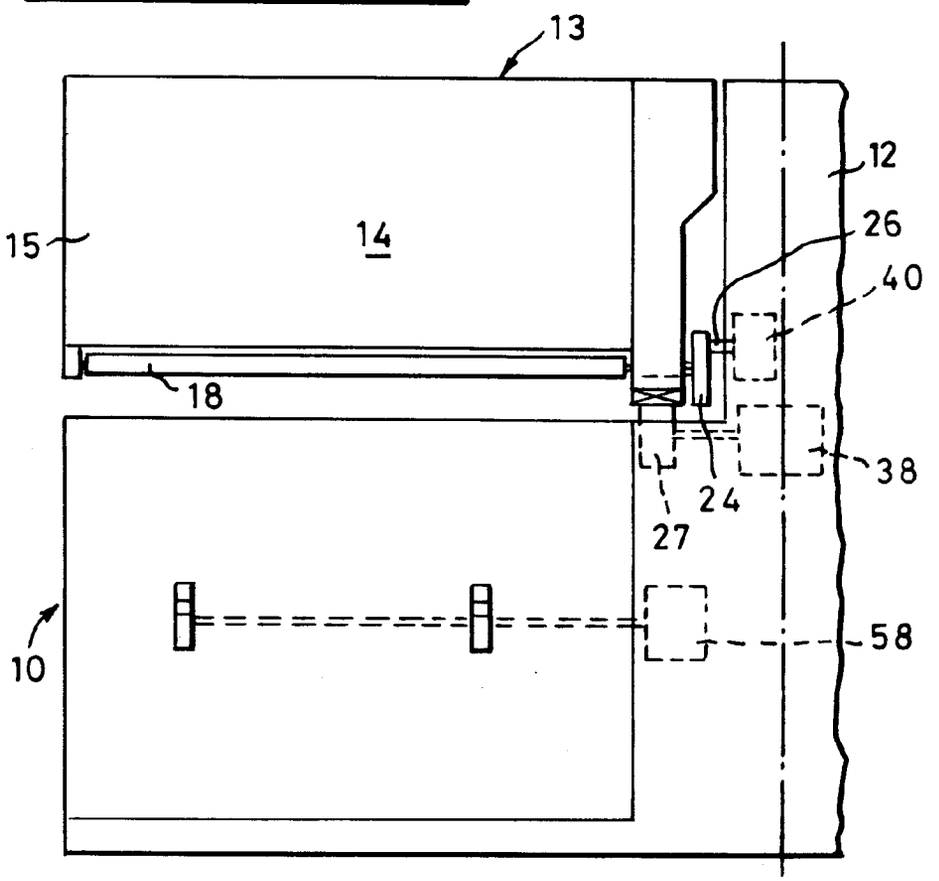
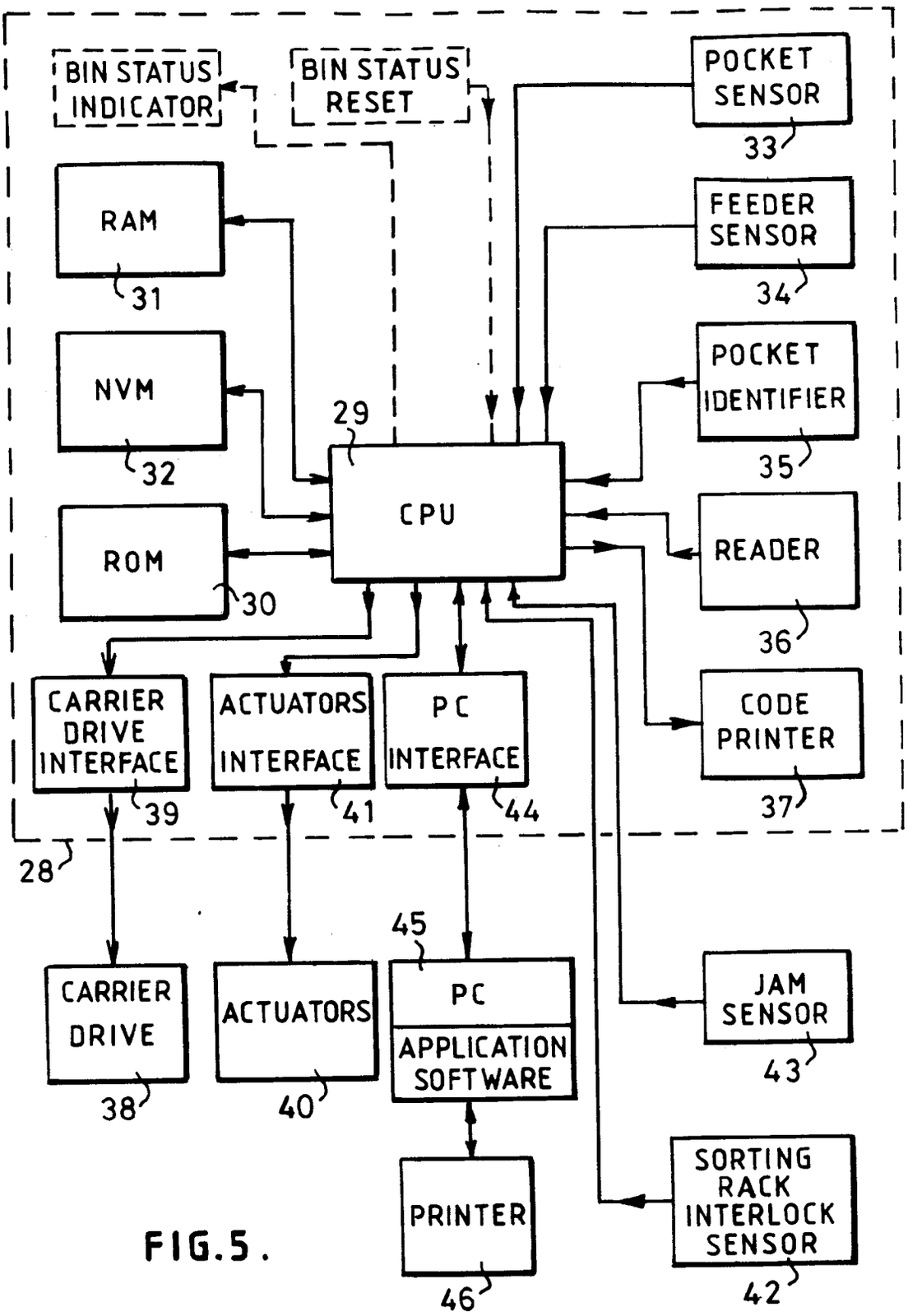


FIG.3.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BIN STATUS RESET
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NVM
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CPU
ROM
30
READER
36
CARRIER DRIVE INTERFACE
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41
PC INTERFACE
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CODE PRINTER
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45
CARRIER DRIVE
38
ACTUATORS
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APPLICATION SOFTWARE
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PRINTER
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SORTING RACK INTERLOCK SENSOR
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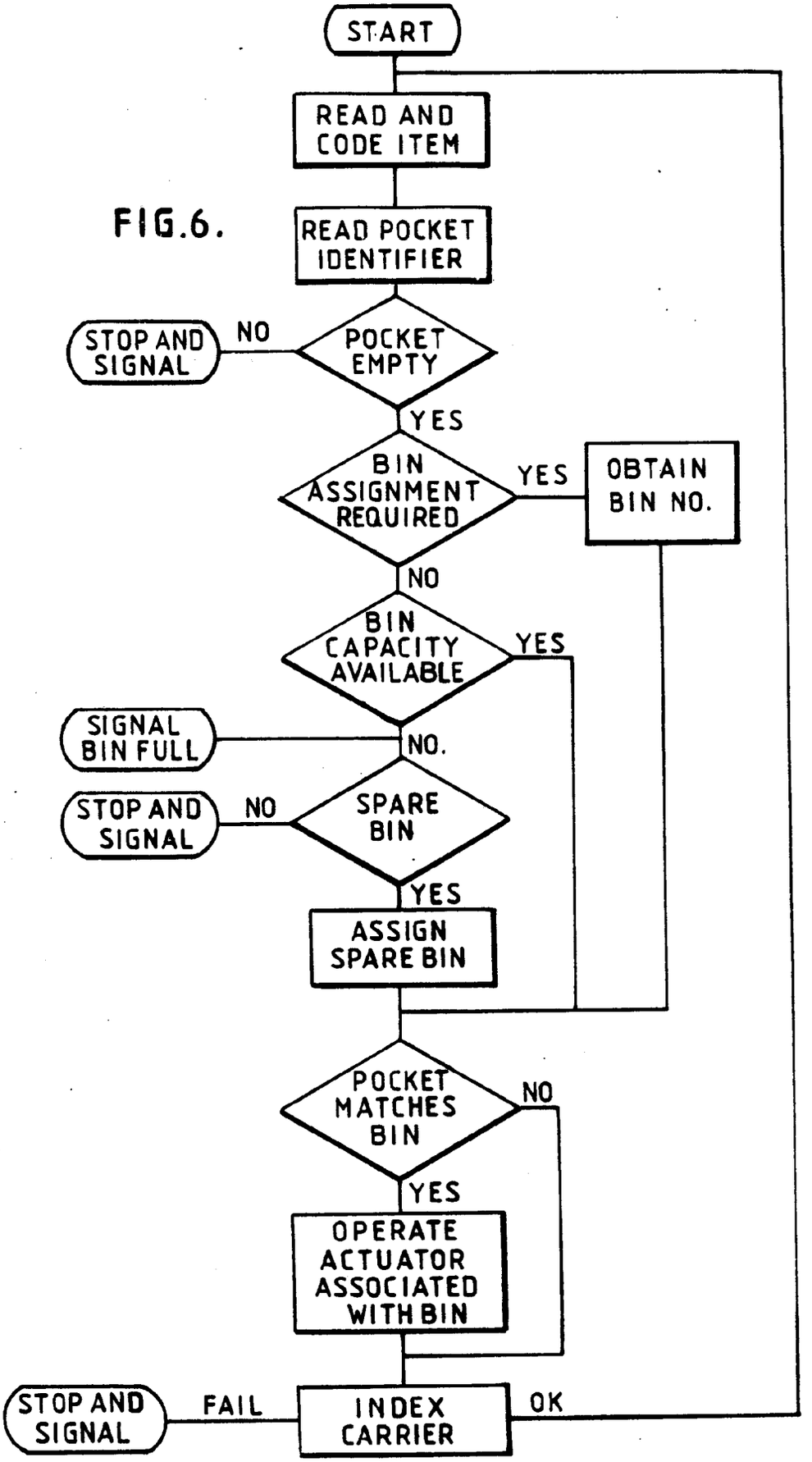
FIG.5.

FIG.6.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NO
BIN CAPACITY AVAILABLE
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SIGNAL BIN FULL
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STOP AND SIGNAL
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SPARE BIN
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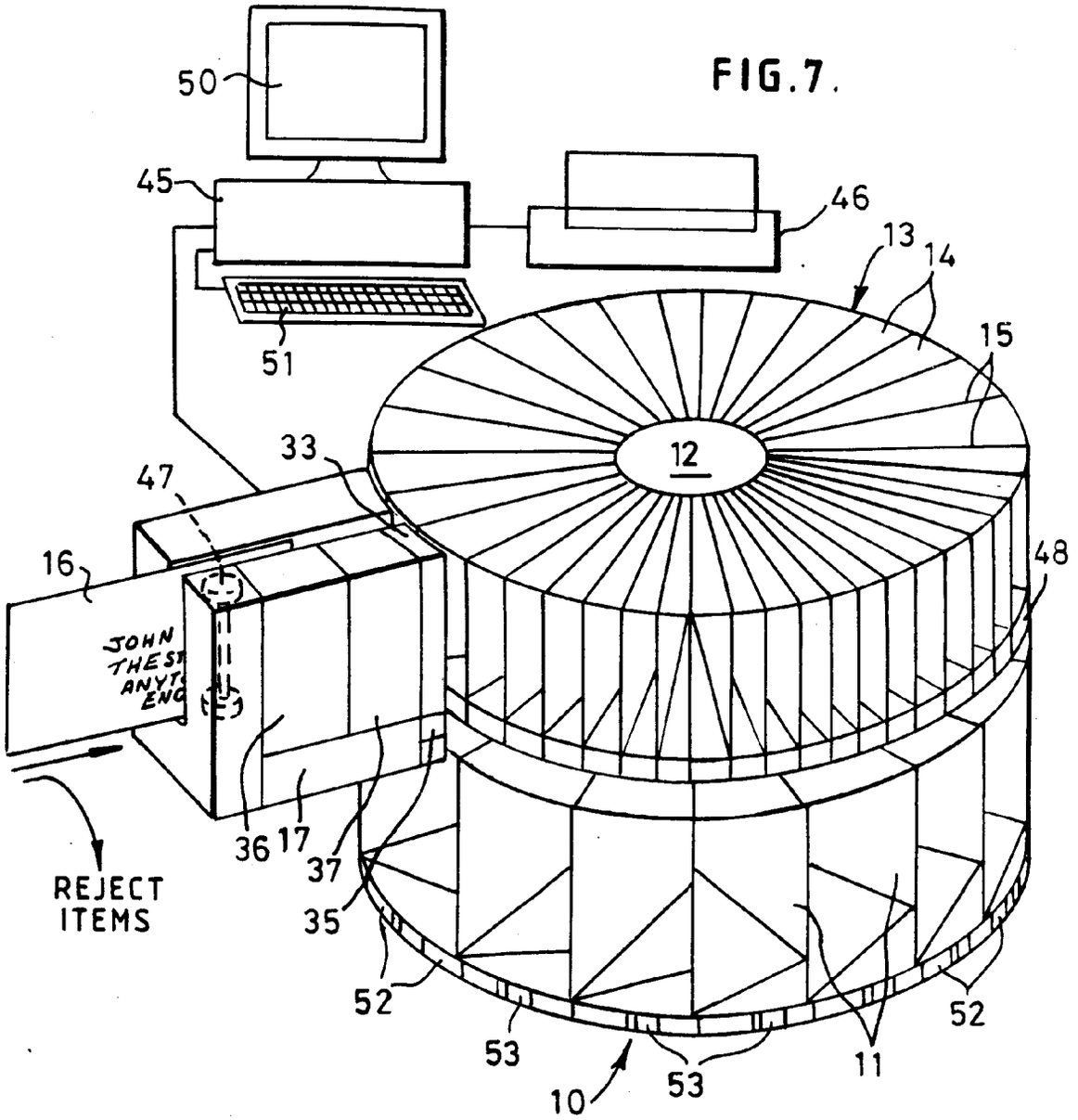
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FIG.7.

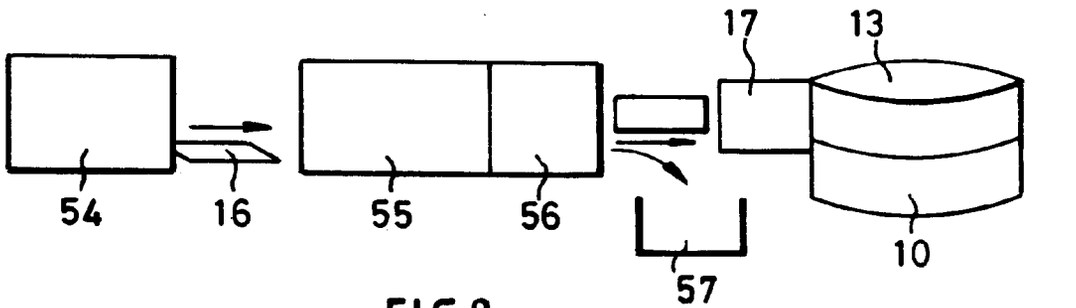
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FIG.8.