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(54) Automatic vending machine.

(57) This invention relates to automatic vending machines and components therefor, and in one aspect is adapted to permit the automatic dispensing of rented video cassettes and the return of such video cassettes into a store in the automatic vending machine for future dispensing. In another aspect this invention relates to a method of operation of automatic vending machines.

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AUTOMATIC VENDING MACHINE

FIELD OF INVENTION

This invention relates to automatic vending machines and components therefor, and in one aspect is adapted to permit the automatic dispensing of rented video cassettes and the return of such video cassettes into a store in the automatic vending machine for future dispensing. In another aspect this invention relates to a method of operation of automatic vending machines.

BACKGROUND OF INVENTION

A variety of vending machines are in common use comprising a store for items which may be mechanically dispensed from the store through an opening accessible to a patron -- for example, cigarette vending machines. Usually, the store in such a machine comprises a stack or column containing identical items, for example, the same brand of cigarette. The lowermost item in the stack may be ejected upon activating a mechanism. If a variety of items are to be dispensed, a plurality of stacks, one for each brand, and a plurality of ejectors, one for the bottom of each stack, are necessary. In another type of vending machine, a plurality of compartments each containing one item may be provided, each compartment accessible through a door to the compartment which opens, permitting the contents to be removed, upon the patron depositing sufficient coinage. The latter type of vending machine is vulnerable to vandalism since the contents of each compartment may be exposed by forcing the door to the compartment.

Until recently, vending machines have not been adapted to permit the dispensing and return of items on a rental basis. Video cassettes are relatively expensive when compared to the type of items typically dispensed from vending machines and at the same time are capable of numerous viewings. They therefore are an ideal item to be rented from and returned to a machine. In this application, the essential deficiency of vending machines commonly in use where the store comprises a plurality of stacks or columns is that each stack can carry only one title. While a stack will permit a number of copies of the same video cassette to be carried in the stack, the variety of titles is limited to the number of available stacks. Given the size of video cassettes and the practical limits on the size of vending machines, a limit of twenty stacks is reasonable. Where the store comprises a plurality of compartments each with an access door, a greater variety of inventory may be stored, however, practical problems remain since there are limits to the amount of inventory which may be stored and each compartment containing a video cassette worth approximately $100.00 would be exposed to vandalism.

In one machine permitting the rental and return of articles (in a preferred embodiment video cassettes) taught by United States Patent Number 4,458,802 ("Maciver"), a video cassette store in the form of a carousel mounted to rotate about a vertical axis and having a number of circumferentially spaced compartments is disclosed. Each video cassette corresponds to its own particular compartment in the store. Rotation of the carousel registers each circumferentially spaced compartment corresponding to a selected video cassette with a delivery receptacle. For dispensing the video cassette from the compartment, an ejection lever pushes the selected cassette from the compartment into the delivery receptacle. To return a video cassette, the patron manually places it in the delivery receptacle, a bar code is read identifying the cassette and the carousel rotates until the compartment corresponding to the cassette being returned registers with the delivery receptacle.

To operate the machine a patron presents to the machine a hire token which has been made available to the patron only if a predetermined deposit has been made to provide a positive amount on the card which is readable by an optical or magnetic sensor. The hire token, upon presentation, is stored in the machine. The patron then inserts a payment token which may be in the form of one or more coins, or, in the alternative, the machine will keep a permanent record of the details of the patron and of the article rented to him so that an account can be sent periodically to him. The patron may then select a video cassette. Upon return of the video cassette the hire token is released, or, if the video cassette is overdue and charges are owing, the hire token is not released until the charges are paid. More desireable would be the provision of an automatic vending machine which will read any banking transaction or credit card (for example, Visa™, American Express™, Master Card™) to conduct a financial transaction with any patron presenting a valid banking transaction or credit card, rather than limiting authorized transactions to patrons presenting a valid "hire token in the form of a card 29" identifiable with a known patron.

One of the essential aspects of United States Patent Number 4,458,802 ("Maciver") is that when the patron returns the cassette to the machine after use of the cassette, the machine upon recognizing the code on the article previously selected by the patron, accepts it into its own particular compartment in a store. Therefore, a returned article is stored in its own compartment stored in the machine memory and which cassette then becomes accessible for further dispensing. "Maciver" acknowledges by his disclosure of two further modified versions of the machine that the preferred embodiment employing circumferentially spaced compartments in a rotatable carousel registrable with a delivery receptacle has a limited capacity to store a large inventory permitting both variety and duplication of titles. In one of the modified versions (seen in Figure 22 of "Maciver") there is provided a plurality of stacks of cassettes contained in columns. Control circuitry allows a customer to remove the cassette from the bottom of the stack. To return the cassette, the patron slides it into the top of any one of the columns. In the other modified version (seen in Figure 23 of "Maciver") there is provided a plurality of compartments, each for containing one video cassette corresponding to the particular compartment, and a plurality of closure gates for guarding access to each compartment. Control circuitry opens the appropriate gate corresponding to the compartment containing the selected title and opens the appropriate gate to permit a cassette being returned to be redeposited in its own particular compartment. "Maciver's" proposals are illustrative of the deficiencies of the prior art. If a plurality of stacks is employed there is a practical limit to the number of such stacks employable and therefore the variety of titles which may fit into a machine of manageable size is limited. If a plurality of separate compartments each with its own closure gate is employed, each closure gate is vulnerable to vandalism. This is a practical problem, since even a modest inventory of one hundred video cassettes could be worth $10,000.00. In addition, a machine employing a large number of closure gates would be mechanically complex and therefore susceptible to failure.

Another machine permitting the rental and return of video cassettes is taught by United States Patent Number 4,414,467 ("Gould"). That patent teaches a vending ordering terminal at which a patron can selectively preview a video cassette before purchasing or renting it. "Gould" also teaches the use of a mechanism which ascertains the address in a store of a video cassette to be vended. As far as is apparent from the disclosure in "Gould", the store is activated at the address of the selected video cassette so as to eject the video cassette from the store: the use of one of six columns of vending apparatus and one of four rows of vending apparatus motors in combination generates a matrix address selecting one of twenty-four vending apparatus motors which may be activated to eject or vend the selected video cassette. A return chute permits a patron to return the rented video cassette. For cassette recognition purposes means are provided to read a code on the video cassette to enable the machine to selectively reject the return of the video cassette deposited. As best may be determined from "Gould", a returned video cassette is not automatically returned to an address in a store which may be recalled from machine memory and be accessible for further dispensing. Furthermore, insofar as "Gould" discloses a vending mechanism which ejects a video cassette from an address in a store, "Gould" illustrates another deficiency apparent in the prior art. Since only twenty-four addresses may be selected in the store, the variety of titles which may be stored is limited to twenty-four.

In another aspect, "Gould" teaches a complete transaction terminal wherein a customer inserts a magnetically encoded credit card into a card reader, thereby providing customer identification which is sent to a computer memory. The computer will store data representative of the rental or return of a video cassette including matching the patron to the vended cassette and the charges for the transaction. A number of peripherals necessary for communication between the patron and the computer are provided in the terminal including a keyboard, information display screen, bar code sensor to scan a video cassette vended from or returned to the terminal so that it may be registered in the computer memory, and a receipt printer.

It will be appreciated by those skilled in the art that aspects of United States Patent Number 4,414,467 - ("Gould") relating to transaction terminals are known in respect of banking transaction terminals. Particularly, transaction terminals for conducting banking transactions between a customer and the proprietor of the terminal are in common use. See for example United States Patent Number 4,134,537 ("Glaser") which teaches a banking transaction terminal essentially comprising a method of taking a customer through a transaction in an error-free manner. The terminal is initially activated by inserting a card identifying the user, for example, a magnetically encoded credit card. A keyboard and screen for displaying messages are provided. In another aspect, "Gould" teaches a security chest to house all components of the terminal system, which may include a supply of cash and a cash dispensing mechanism, and may also include a depository for receiving customer deposits. The depository mechanism for receiving deposits from a depository slot may include a printer so as to print an identifying deposit number on each deposit, and means to transport the deposit to a depository bin. As far as is apparent from the disclosure in "Glaser", no automatic means are provided to read, scan or otherwise confirm the face value of the money comprising the deposit.

In another banking transaction terminal taught by United States Patent Number 4,442,346 ("Bosinger") there is disclosed a transaction terminal having a plurality of twenty circumferentially disposed compartments radially spaced from a centre of a carousel which compartments may each be rotated selectively to register with an access opening so that only the selected article is accessible through the opening. A particular denomination of bank note may be associated with a particular compartment. Similarly, currency may be deposited into an empty compartment. The device disclosed in "Bosinger" is designed to provide control means to ensure that only the selected compartment is visible through the opening to a user. As far as is apparent from the disclosure in "Bosinger", currency deposited in one of the circumferentially disposed compartments is not accessible for subsequent dispensing to a customer making a withdrawal.

It is therefore an object of this invention to provide an improved automatic vending machine and components therefor and a method of operation therefor.

It is a further object of this invention to provide a secure store and method of access to same for articles stored in an automatic vending machine.

It is a further object of this invention to provide improved means for dispensing articles from an automatic vending machine and improved means for return of such articles to a compartment in a store in the machine where each article may be recalled and is accessible for further dispensing.

Further and other objects of the invention will be apparent to those skilled in the art from the following summary of the invention and detailed description thereof.

SUMMARY OF INVENTION

According to one aspect of the invention, there is provided an automatic vending machine having a front face for a store and comprising a shelving matrix mounted inside the automatic vending machine, the shelving matrix having a plurality of spaced compartments, each compartment having one opening, open in one direction for access from that direction, robotic means having members and guides therefor which extend to provide access to each storage compartment in the shelving matrix through the one opening in each storage compartment and are moveable when aligned with a storage compartment into and out of the compartment so as to be able to remove an article from the storage compartment or return an article to the storage compartment, an access opening through the front face of the machine and an access compartment open at opposite ends for access at one end by the robotic means from the inside of the automatic vending machine to feed or empty the access compartment and accessible at the other end by a patron from the outside of the machine through the access opening, and machine intelligence means for controlling the operation of the robotic means communicating between the shelving matrix and access compartment, the machine intelligence means including means for: recalling the location in the shelving matrix of a specific article selected by a patron, instructing the robot to remove the article from storage and carrying the article so as to register with the access compartment, reading a unique identifying code on the article selected and retaining the identity of the article in memory upon registering the article with scanning means proximate the access compartment or opening, identifying the article upon its return through the access opening and access compartment by scanning means, instructing the robot to remove the returned article from the access

compartment, and instructing the robotic means to carry the article to register with the vacant compartment in the shelving matrix nearest the access compartment and insert the article in such vacant compartment, storing the location of the returned article in machine memory for subsequent recall and retrieval.

According to another aspect of the invention, there is provided an automatic vending machine having a front face for a secure store and comprising a shelving matrix mounted inside the automatic vending machine, the shelving matrix having a plurality of spaced compartments, each compartment having one opening, open in one direction for access from that direction, each compartment having a bottom, each bottom having one opening, opening in the one direction the compartment opens in, the bottom having a slot through the bottom extending parallel to the one direction and opening in the one direction through the end of the bottom proximate the one opening in the compartment, robotic means having members and guides therefor which extend to provide access to each storage compartment in the shelving matrix and are moveable when aligned with a storage compartment into and out of the compartment so as to be able to remove an article from the storage compartment or return an article to the storage compartment, an access opening through the front face of the machine and an access compartment normally laterally spaced from the access opening and moveable into, and out of alignment therewith, means to move the access compartment into and out of alignment with the access opening, the access compartment open at opposite ends for access at one end by the robotic means from the inside of the automatic vending machine to feed or empty the access compartment and accessible at the other end by a patron from the outside of the machine when the access compartment is moved into alignment with the access opening to expose only the contents of the access compartment to access from the outside of the vending machine to dispense or retrieve an article through the access opening, the robotic means to move the access compartment into registration with the access opening, the access opening being ineffective to retrieve or input articles from or into the interior of the machine until the access compartment is aligned therewith, and machine intelligence means for controlling the operation of the robotic means communicating between the shelving matrix and access compartment, preferably where rental of articles, for example, video tapes, is performed by the machine, the machine intelligence means including means for: recalling the location in the shelving matrix of a specific article selected by a patron, instructing the robot to remove the article from storage and carrying the article so as to register with the access compartment, instructing the robot to move the access compartment so as to register with the access opening, reading a unique identifying code on the article selected and retaining the identity of the article in memory upon registering the article with scanning means proximate the access compartment or opening upon the return of an article, instructing the robot to move the access compartment so as to register with the one access opening, identifying the article with scanning means upon a patron inserting the article through the access opening into the access compartment, removing the returned article from the access compartment, and instructing the robotic means to carry the article to register preferably with the vacant compartment in the shelving matrix nearest the access compartment and insert the article in such vacant compartment, storing the location of the returned article in machine memory for subsequent recall and retrieval.

Preferably the robotic means has three directions of movement, vertically, horizontally and into and out of the storage compartment or access compartment. According to a preferred embodiment of the invention, the robotic means for communicating between each storage compartment in a shelving matrix and the access compartment may comprise a first moveable member guided along a first axis of movement by two parallel spaced guides extending perpendicular to the opposite ends of the first member, the first moveable member including a guide extending longitudinally therein to support movement of a carriage therein along a second axis of movement which is perpendicular to the first axis of movement, the first member and carriage moveable along perpendicular axes of movement so as to enable alignment of the carriage with each compartment of the shelving matrix and the access compartment, the carriage further having means for being extensible and retractable to enable movement transverse to the plane of opening of each storage compartment in the shelving matrix and the access compartment, comprising lower, middle and upper members, each moveable relative to the other for sliding one on the other in a direction into each compartment or the access compartment for removal of an article from the compartment or access compartment or placement of an article into the compartment or access compartment.

In one embodiment where each compartment has a bottom, each bottom having one opening, opening in the one direction the compartment opens in, the bottom having a longitudinal slot through the bottom extending parallel to the one direction the compartment opens in, the robotic means includes means to raise and lower the robotic means below the bottom or each compartment to extend through the slot to engage and lift the article from the bottom or insert the article into the compartment and lower the robotic means below the slot to disengage and deposit the article so as to rest on the bottom of the compartment.

Preferably, the means for enabling movement for each of the first moveable member, carriage and an element of the carriage which is extensible and retractable, comprises three stepping motors, one for each axis of movement, and an electronic circuit for each motor to translate digital instructions from a computer controlling the operation of the robotic means into discreet revolutions of each motor.

According to another preferred embodiment of the invention, the automatic vending machine may comprise at least two oppositely spaced parallel shelving matrices mounted against opposing walls inside the automatic vending machine, each matrix having a plurality of uniformly spaced compartments each having one opening, opening in the direction of the oppositely spaced parallel shelving matrix for access from that direction, and robotic means spaced between the two oppositely spaced shelving matrices having members and guides therefor which extend to provide access to each storage compartment in both shelving matrices and are moveable when aligned with a storage compartment in either matrix to enable movement transverse to the plane of the shelving matrix into and out of the compartment so as to be able to remove an article from a storage compartment in either of the opppositely spaced matrices or return an article to a storage compartment in either of the oppositely spaced matrices.

The invention will now be illustrated with reference to the following drawings of an embodiment of the invention which is adapted for the purchase or rental of video cassettes.

DESCRIPTION OF DRAWINGS

Figure 1 is a perspective view of the exterior of an automatic vending machine.

Figure 2 is a close-up of a keyboard for a patron to communicate with an automatic vending machine.

Figure 3 is an exposed perspective view of a video cassette titles display seen in part of Figure 1.

Figure 4 is a side view in section of a video cassette titles film strip and position sensor, seen in part of Figure 3.

Figure 5 is a frontal view of the automatic vending machine seen in Figure 1, providing a partial sectional view of the front of the machine exposing one video cassette storage matrix.

Figure 6, seen with Figures 3 and 4, is a side view of part of the automatic vending machine seen in Figure 1, providing a sectional view exposing two parallel shelving matrices spaced oppositely on either side of a robotic assembly.

Figure 7 is a perspective view of a robotic assembly and a portion of the two parallel shelving matrices seen in Figure 6.

Figure 8 is a close-up perspective view of shelving compartments for storing video cassettes in a shelving matrix.

Figure 9 is a close-up frontal view of storage compartments seen in part of Figure 8.

Figure 10 is a close-up side view of a storage compartment holding one video cassette, seen in part of Figures 8 and 9.

Figure 11 is a frontal view of the shelving matrix and robotic assembly seen in Figure 7, including details of elements of the robotic assembly.

Figure 12 is a close-up perspective view of drive means enabling a vertical axis of movement in the robotic assembly in Figure 11.

Figure 13 is a close-up perspective view of drive means enabling a horizontal axis of movement in the robotic assembly in Figure 11.

Figure 14 is a close-up frontal view of a transverse movement carriage shown in part of Figure 11.

Figure 15 is a top plan view of part of the structure shown in Figure 14, shown extended in two different directions.

Figure 16 is a side view of the part of the structure shown in Figures 14 and 15, shown extended in two different directions.

Figure 17 is a perspective view of the structure shown in Figures 14,15 and 16.

Figure 18 is a frontal view of the storage compartment shown in Figure 9, including a part of the structure shown in Figure 14 inserted into the compartment.

Figure 19 is a frontal view of the storage compartment seen in Figure 18, including the step of lifting the video cassette.

Figure 20 is a side view of the storage compartment seen in Figures 18 and 19, including the step of retracting the video cassette from the compartment.

Figure 21 is a close-up perspective view of part of the machine compartment assembly, and part of the operation thereof seen in part in Figure 11.

Figure 22 is a top view of part of the structure shown in Figure 21 illustrating part of its operation.

Figure 23 is a sectional view of a connection between components of the machine seen in Figure 13.

Figure 24 is an exploded perspective view of means for attaching components shown in Figure 23.

Figure 25 is a top plan view of the attachments shown in Figure 24.

Figure 26 is a block diagram representation of the automatic vending machine.

DESCRIPTION OF PREFERRED EMBODIMENT OF THE INVENTION

Referring to the drawings, there is shown in Figure 1 an automatic vending machine 32, having a front face 33. The front face 33 of the automatic vending machine has, an access opening 44 through which a patron may insert or remove an article, a transaction keyboard 35, light emitting diode display 37, slot 39 for dispensing a transaction quotation or receipt and slot 41 for receiving a credit card.

A titles display 43 comprising an endless film strip 45 is moveable to register a column of frames 47 in the film strip 45 (seen best in Figure 3) with a selection window 49 on the front face 33 of the machine 32. Three frames 51 may appear in a single column 47 of frames 51, therefore the transaction keyboard 35 (best seen in Figure 2) may include keys 53,55,57 for selecting the matching titles 53', 55', 57', aligned in the selection window 49. Three liquid crystal displays 54', 56', 58' are provided adjacent each title 53', 55', 57' and may display information such as price pertaining to the particular frame 51 selected. With particular reference to Figures 3 and 4, the film strip 45 is supported for rotation by cylinders 59, each of which is supported on a vertical axis for rotation. A stepping motor 61 is capable of advancing the film strip 45 a predetermined amount, by enabling the rotation of a gear 63, the sprockets of which engage perforations 65 in the film strip. An upper optical sensor 67 detects the absence of a break in a light beam when perforation 71 is aligned with sensor 67. A lower optical sensor 69 detects a sequence of breaks in a light beam when perforations 65 pass by sensor 69. Signals from sensors 67,69 provide information by way of feedback to computer "B" (seen in Figure 26) to enable the computer to confirm its calculation of the exact position of the film strip 45 in relation to a known position corresponding to alignment of perforation 71 and sensor 67.

The inside of the automatic vending machine 32 comprises shelving matrices 34,73 for holding video cassettes 36, robotic means 38 which extend to provide access to the video cassettes 36 held in each storage compartment 40 of the shelving matrix 34,73 and only one moveable access

compartments assembly 42 fed or emptied by the robotic means 38 and which is slideable so as to register with only one access opening 44, and machine intelligence means - (best described in relation to Figure 26) for controlling the operation of the automatic vending machine 32.

With reference to Figure 6 (seen with Figures 3 and 4) the store for the video cassettes 36 comprises a front shelving matrix 34 and a rear shelving matrix 73 between which is placed the robotic means 38 which extend to provide access to each video cassette 36 held in either the front shelving matrix 34 or rear shelving matrix 73. Shelving matrices 34,73 together dispose not fewer than four hundred (400) storage compartments 40 (of which the front shelving matrix 34 is seen in Figure 5), each one of which may hold a video cassette 36 bearing its own unique identifying data in the form of a bar code 48.

With reference to Figures 6, 7 and 11, there is shown a robotic assembly 38. Horizontal 50,75 and vertical 52,77 frame elements provide a supporting structure for a first moveable member 54, which is slideable along a horizontal axis of movement 56. Horizontal frame elements 50,75 comprise longitudinally extending channels or guides 58 - (best seen in Figures 11, 12 and 13) for the first moveable member 54. First moveable member 54 includes a longitudinally extending channel or guide 60 (best seen in Figure 6) to support movement of a transverse movements carriage 62 (seen in Figures 6, 11, 14, 15 and 16) along a vertical axis of movement 64. Movement of the first moveable member 54 and the transverse movement carriage 62 along horizontal 56 and vertical 64 axes of movement respectively enables alignment of the transverse movement carriage 62 with each compartment 40 in the shelving matrices 34,73 or alignment with the moveable access compartment 66 (best seen in Figures 11 and 21).

With reference to Figures 11, 14, 15 and 16 transverse movement carriage 62 comprises a lower track 68 and an upper track 70 mutually engaged by linear gears or teeth and driven by an endless belt so as to be extensible and retractable into and out of a storage compartment 40 along an axis of movement 72 which is transverse to the plane of opening of each storage compartment 40.

With reference to Figures 11 and 12 there is provided a vertical stepping motor 74 directly engaging an endless belt 76 circulating within first moveable member 54. As appears from Figures 24 and 25, one point on the endless belt 76 is affixed to an element. With regard to the transverse movement carriage 62, endless belt 76 is affixed thereto to enable movement of the carriage 62 along a vertical axis 64. With reference to Figures 11 and 13, there is provided a horizontal stepping motor 78 which engages endless belt 80 to drive vertical shaft 82 inside vertical frame element 52. Vertical shaft 82 directly engages synchronous upper and lower endless belts 84,85 circulating within horizontal frame elements 50,75. The first moveable member 54 is mounted on horizontal frame elements 50,75 by U-shaped brackets 86,88 which engage longitudinally extending guides 58 on the frame elements so as to be slideably engageable therewith. Endless belts 84,85 are affixed to U-shaped brackets 88,86 respectively to enable movement of the first moveable member 54 along a horizontal axis 56. With reference to Figures 11, 14, 15 and 16 there is provided a transverse stepping motor 90 directly engaging an endless belt (not shown) to drive the transverse extension or retraction 72 of carriage tracks 68,70.

With reference to Figures 5 and 11 there is shown generally a moveable access compartment assembly 42 comprising generally an access compartment 66 slideably engageable with a horizontal track 92 so as to register with an access opening 44 (seen in Figures 1 and 21). With particular reference to Figures 21 and 22, access compartment 66 is open at opposite ends comprising an inwardly directed end 94 and an outwardly directed end 96 (which is only shown indirectly from a perspective interior to the automatic vending machine). Horizontal guide track 92 comprises longitudinally extending channels 98,99 for slideably supporting access compartment on four rotatable bearings 100 extending into channels 98,99. Locking bar 102 is pivotally attached to access compartment 66 and is engageable with vertical slot 104 in stationary plate 106. In the operation of the automatic vending machine the robotic means 38 comprising generally horizontal 56, vertical 64 and transverse 72 axes of movement inserts a video cassette 36 through an inwardly directed opening 94 into the access compartment 66, at which time a bar code 48 on the video cassette 36 is read by a bar code scanner 108 proximate the opening 94. The robot 38 then lifts the locking bar 102 out of the vertical slot 104, thereby releasing the initial position of the access compartment 66 and slides the compartment 66 from its initial position 110 (best seen in Figure 21) for loading the video cassette to a secondary position 112 (best seen in Figure 22), aligning the outwardly directed opening 96 of the access compartment 66 with the access opening 44. A closure gate 114 attached adjacent to the outwardly directed opening 96 of the access compartment 66 obstructs the access opening 44 when the access compartment is in its initial loading position 110. When the access compartment is in its secondary position 112, the inwardly directed opening 94 of the access compartment 66 is obstructed by stationary plate 106 (seen best in Figures 11 and 21) thereby exposing only the contents 36 of the access compartment to access from the outside of the automatic vending machine 32 through the access opening 44. In the return of a video cassette, the access compartment is selected in its secondary position 112 permitting the patron to insert the returned video cassette 36 through the access opening 44 into the access compartment 66 aligned therewith, at which time the bar code 48 on the video cassette 36 is read by the scanning device 108 (best seen in Figure 21).

In the operation of the robotic means 38 for communicating a video cassette 36 between a storage compartment 40 and the access compartment, reference is made generally to Figures 8, 9, 10, 11, 14, 15, 16, 17, 18, 19 and 20. Each storage compartment 40 substantially corresponding to the exterior dimensions of a video cassette 36 includes support for the bottom surface of the video cassette 116 (Figure 9) comprising two oppositely spaced longitudinally extending horizontal flanges 118,119. A longitudinally extending space 120 below the support flanges 118,119 and, the gap 121 between the flanges 118,119 receives the upper track 70 of the transverse movement carriage 62. Upper track 70 is provided with vertical prongs 122 for supporting the video cassette 36 against any lateral slippage when it is nesting on the upper track 70. In removing a video cassette 36 from a storage compartment 40, the transverse movement carriage 62 is aligned with the compartment 40 containing the selected video cassette. Upper track 70 is extended into space 120 and raised vertically until the track 70 occupies the gap 121 between flanges 118,119 and the video cassette 36 rests on the track 70 (best seen in Figures 18, 19 and 20). The cassette 36 is then retracted from the compartment 40 (best seen in Figure 20). With reference to Figures 15 and 16, transverse movement carriage 62 is extensible and retractable to select video cassettes 36 from either the front shelving matrix 34 or the rear shelving matrix 73.

In inserting a video cassette 36 into the access compartment 66, the transverse movement carriage 62 is aligned with the inwardly directed opening 94 of the access compartment 66 and the upper track 70 is extended. Access compartment 66 includes a support for the bottom surface of the video cassette 116 (best seen in Figures 21 and 22) comprising two oppositely spaced longitudinally extending flanges 124,125 providing a gap 126 therebetween sufficient to provide clearance for top surface of the upper track 70. The transverse movement carriage 62 is lowered vertically until the bottom surface 116 of the video cassette 36 rests on flanges 124,125, and is then retracted. The sequence of operation of the robot 38 may be reversed to comprise the steps of registering the access compartment 66 in its secondary position 112, moving the compartment to its initial position 110, lifting and retracting the returned video cassette 36 from the access compartment 66, aligning the transverse movement carriage with the vacant storage compartment 40 in the shelving matrices 34,73 nearest the moveable access compartment assembly 42, extending the upper track 70 bearing the video cassette 36 into longitudinal space 120 and vertically lowering the transverse movement carriage 62 until the bottom surface 116 of the video cassette 36 rests on flanges 118,119 in the storage compartment 40.

With reference to Figure 25 there is shown in block diagrammatic form a representation of machine intelligence means functionally interconnected through input/output hardward 151 with peripheral hardware for controlling the operation of the automatic vending machine 32. A worker skilled in the art will readily comprehend the electrical circuitry of the hardware represented by Computer A^{155}, Computer B^{157}, Computer C^{159}, their associated input/output devices and the peripheral components which either provide input to the computers or communicate with a customer or operator. Various other components and system configurations can be used and would be known by a worker skilled in the art and the present components and system configuration are therefore shown for illustrative purposes only. It will further be understood by those skilled in the art that the functional operation of the machine intelligence means and its associated peripheral hardware is controlled by a computer application program stored in permanent storage devices such as a Read Only Memory (ROM) for issuing a sequence of instructions as to how the Central Processing Unit (CPU) is to deal with various information input to the machine intelligence means. The different expressions by people skilled in the art of software used to operate the machine will be as numerous depending upon the hardware selected and the individual approach by the author of such software. Therefore from the following description of the structure of the machine intelligence means and sequence of operation of the machine intelligence means used, those skilled in the art would be readily capable of writing their own expression of the application program.

Computer A^{155} (seen in Figures 25) generally gives instructions to translation 153 circuit for activation of each of vertical stepping motor 74, horizontal stepping motor 78 and transverse stepping motor 90. Stepping motors 74,78,90 are known in the art to advance in axial rotation in discrete increments of arc in response to an input signal from a translator 153. The translator 153 decides the step sequence in which the coils of the stepping motor 74,78,90 are energized in response to a command from computer A to activate the motor 74,78,90 for a defined number of degrees of rotation. In one preferred embodiment the motors 74,78,90 when instructed through a translator 153 interface will rotate 1.8 degrees for each instruction. It will be appreciated by those skilled in the art that the content of an instruction sufficient to rotate the motor 1.8 degrees will be determined by the instruction sequence table provided by the particular manufacturer. For convenience sake however, it may be said that the presence or absence of one bit of information or a single pulse is sufficient for a rotation of 1.8 degrees. In the present embodiment of the invention, each stepping motor 74,78,90 (and motor 61 controlled by computer B^{157}) is mechanically engaged to a different advantage. Therefore one pulse producing 1.8 degrees of rotation produces a different absolute linear movement in the robotic members moved by each motor 74,78,90. The correlation between the number of degrees of rotation of each motor 74,78,90 and the linear movement of the associated robotic members 62,54,68,70 is stored in nonvolatile memory (EPROM) of Computer A^{155}. In this regard, the compartments 40 of the shelving matrices 34,73 are equally spaced and spaced in relation to the linear movement activated by 1.8 degree rotation of a motor 74,78,90 since such value is the limit of alignment possible between the robotic assembly and a compartment. The values comprising the linear movement necessary to cause the robotic assembly 38 to register with a given compartment 40 are stored in EPROM memory of Computer A^{155} and are distinct for each of the three axes of movement, 64,56,72. With reference to both Figures 17 and 26, generally the position of the robotic assembly 38 in relation to the shelving matrices 34,73 is registered in volatile computer memory of Computer A^{155} by first locking into a position which is known by means of aligning the robotic assembly 38 with vertical sensors 157 and horizontal sensors 158 which are located at a known position in relation to matrices 34,73. Sensors 157,158 will send a feedback signal to Computer A^{155} when robotic assembly is aligned. In this regard, with particular reference to Figures 7,11, and 17 there is shown a plate 159 on transverse movement carriage 62 to register with sensor 157 to verify a known vertical position. (Sensors 157,158 are light beams. A signal may be indicated by the interruption or non-interruption of the light beam.) Plate 161 registers with horizontal sensor 158 to verify a known horizontal position (seen in Figure 11). The known position of sensors 157,158 is referred to as "home". The vertical and horizontal position of "home" need not be at intersecting axes since the distance between the vertical 157 and horizontal 158 sensors is constant and may be stored in nonvolatile memory. Once the robotic assembly 38 is registered with "home" it is not necessary to maintain a constant feedback from sensors to determine the position of robotic assembly 38 since each pulse sent to each motor 74,78,90 will generate a value of linear movement in each axis 64,56,72 which is known and stored. In this aspect, Computer A^{155} is programmed with an algorithm to constantly sum in volatile memory (RAM) the position of the robotic assembly: the "home" condition is added to RAM, pulses sent to motors 74,78,90 are calculated to equal a linear movement which is added to RAM, and the sum indicates the present position.

While it will be apparent from the description that the number of pulses is linked to the distance travelled between compartments 40 the time interval between pulses (in a preferred embodiment) may be calculated and varied along a curve plotted by time to provide for accelleration and decelleration of each stepping motor 74,78,90. For a given distance to be travelled between compartments an accelleration/decelleration curve based upon the inertia of the motor so that it will stop at the end of the curve has been calculated in the form of an algorithm stored in EPROM. While Computer A thereby controls the robotic as-

sembly, Computer C through an input/output interface 165 issues instructions to Computer A[155] as to which compartments 40 it is to access or return a video cassette to. While the sequence of this access/return operation is described below, a number of additional sensors to provide input to Computer A are provided in a preferred embodiment to verify the position of a video cassette throughout the sequence of operation of the robotic assembly. With particular reference to Figures 17 and 21, closure gate 114 is provided with a sensor 167 to verify that it is either open or closed when plate 168 registers with sensor 167. Moveable access compartment 66 is provided with two sensors 169,171 to verify the presence or absence of a video cassette fully inserted into the moveable access compartment 66. A bar code scanner 108 (also seen in Figure 25) scans the code 48 on a video cassette 36. In one embodiment the scanner 108 is manufactured by Intermec Systems Corporation, model 'non-contact scanner 1301' and inputs the information to a reader model number '9300' to be input to Computer A[155] through an RS-232 convention hardware coupling. Referring now to Figures 11,14,15,16 and 17, the transverse movement carriage 64 having carriage tracks 68,70 which slide over one another so as to extend and retract, is provided with sensors 173,175 to verify the position of extension or retraction. Transverse movement carriage 62 is provided with a vertical housing 177 (seen best in Figure 14) to shield a video cassete 36 from falling off of track 70. To verify that video cassette 36 is resting fully within extent of vertical housing 177, two sensors 179,181 (seen best in Figure 17) are located in housing 177.

Referring to Figure 25, Computer B[157] generally controls the titles display 43 (seen in Figure 3) and peripheral hardware for interaction with a customer through keyboard 193,195 (identified as parts 35 in Figures 1 and 2), liquid crystal display 183 (depicted as 54', 56', 58' in Figure 1), and light emitting diode display 185. Computer B[157] gives instructions to translator 187 circuit for activation of banner stepping motor 61. Banner stepping motor 61 is identical to vertical, horizontal, and transverse stepping motors 74,78,90 in its structure. When banner stepping motor advances 1.8 degrees of rotation, film strip 45 advances a known linear amount. The position of the film strip 45 in relation to the selection window 49 is registered in volatile memory of Computer B[152] by first locking into the "home" position of sensor 67 (also seen in Figures 3 and 4) which will send a feedback signal to Computer B[152] when single perforation 71 is aligned with sensor 67. An index sensor 69 will send a feedback signal to Computer B[152] when each one of multiple perforations 65 is aligned with sensor 69 as film strip 45 advances. A definite number of pulses from computer B to banner stepping motor -- in the preferred embodiment 160 pulses -- will advance the banner strip 45 a linear distance equal to the linear interval between perforations 65. Each column 47 of frames 51 on the film strip 45 is spaced from the next adjacent column 47 by a linear interval related to the linear interval between perforations 65. Computer B is programmed with an algorithm to constantly sum in volatile memory (RAM) the position of the film strip 45, the "home" condition is added to RAM, pulses sent to motor 61 are calculated to equal a linear advancement of film strip 45 which is added to RAM and confirmed by feedback from index sensor 69, and the sum indicates the particular column 47 aligned in window 49. The title of the video cassette associated with a particular frame 51 selected (as described below) may be stored in volatile memory for reference when a frame 51 is selected by a customer. An accelleration/decelleration curve similar to that described with reference to motors 74,78,90 is provided in the form of an algorithm stored in EPROM. To select a particular video cassette 36 represented by one of the frames 51 depicted on the film strip 45, the sequence of operation is controlled by both Computers B and C which are functionally interconnected through I/0 191. A customer inserts a magnetically encoded card (for example an ABA format plastic credit card) into the magnetic card reader 41. Card reader 41 is linked by input/output hardware 151 to Computer C[189]. Computer C[189] in its rest mode waits for a peripheral slot 41 represented by magnetic card reader 41 to be addressed. When peripheral slot 41 is addressed, Computer C[189] will then read the card and go through a routine to verify that the card is valid. Computer C[189] will then activate keyboard lights 193 and keyboard key 195. Keyboard lights 193 associated with keys for selecting mode of rent, return or buy (best seen in Figure 2) will light up. When a customer presses one of rent, return or buy keys, Computer C knows that a transaction sequence has commenced and Computer C[189] will then address Computer B and turn over control of selection of a video cassette to Computer B subroutines. Once Computer B is given control by Computer C it will address keyboard 195 and wait for instructions. Light emitting diode display 185 can display a sequence of instructions to a customer as stored in EPROM memory of Computer B[157]. A customer will then push right 197 or left 199 directional arrow keys on keyboard 195. Depressing either one of directional keys 197,199 initiates an accelleration/decelleration program in the form of an algorithm stored in EPROM which instructs the banner stepping motor 61 to circulate the film strip 45 until key 197,199 is released. Accelleration/decelleration program will ensure that when the directional key 197,199 is released, the film strip 45 will come to rest with the column of frames 47 closest the window 49 at the time the key 197,199 is released registering accurately with window 49. A customer will then select one of titles 53', 55', 57' aligned in the window by depressing one of selection keys 53,55,57. Computer B[157] will then relate to the column 47 registered in the window 49 with the particular selection key 53,55,57 to identify a top, middle or bottom position of frames 51. Frame 51 will be related to a memory address in RAM containing information relevant to the particular video cassette represented by the frame 51 selected, for example title, cost and title code. Once the title code is addressed in RAM it may be compared to another list of video cassettes (in volatile RAM memory) in stock in the automatic vending machine 32 to confirm that the selected title code is available. The liquid crystal display 183 will then display information relevant to the selected title adjacent that frame selected as appears from windows 54', 56', 58' of liquid crystal display 185 best seen in Figure 1. Computer B[157] will then communicate information relevant to the transaction including the code of the video cassette selected and its location in the shelving matrices to Computer C and turn over control to Computer C to complete the transaction.

With particular reference to Computer C[189], seen in Figure 25, it generally controls the functional interaction between Computers A, B and C as well as telecommunications via a 201T modem. In a preferred embodiment, the 201T modem is manufactured by Motorolla, model '202T modem' of an asynchronous mode and utilizes Bell Communications Software "Datapac 3201^{TM}" to communicate with a host computer. The host computer may be that of the owner for monitoring the status of machine 32 or it may be that of a commercial database providing (in volatile memory) a list of invalid credit cards.

Once Computer C[189] receives from Computer B the code of the video cassette selected by the customer and its location in the shelving matrices, it will instruct Computer A to retrieve the selected video cassette by giving it the address of the particular compartment 40 which is to be accessed by the assembly 38. Computer A will then retrieve the selected video cassette through a routine, manipulating stepping motors 74,78,90. Computer A will wait for a customer to remove the video cassette 36 from the moveable access compartment 66 at which time sensors 169,171 will sense the absence of the tape. Computer A will then slide closure plate 114 in front of access opening 44. Computer C will then address the keyboard 195 and allow the customer to either end the transaction or select another video cassette. If the transaction is over, the entire transaction sequence (for example: compartment accessed, video cassette code title corresponding to bar code 48, video cassette rental price, buying price in default of return, time video cassette removed by customer, customer credit card number) will be stored in volatile memory transaction buffers of Computer C[189]. Computer C will then print out a quotation of the transaction through printer 203 for the customer records. After the receipt is printed, Computer C instructs Computer B to return to a display mode circulating film strip 45.

The transaction sequence for the purchase of a video cassette is the same as that for rental, save and except for the price.

To return a video cassette, a customer inserts a magnetically encoded credit card into the magnetic card reader 41, and presses the return key 195. Computer C will instruct Computer B to open the access opening 44 by registering moveable access Compartment 66 with said opening 44. Computer B waits for the video cassette to be inserted as verified by sensors 169,171 and then closes the opening 44. The bar code scanner 108 reads the bar code 48 on the inserted video cassette and inputs the code to Computer A. Computer A sends the bar code to Computer C which sends it on to Computer B. Computer B takes the code and scans its volatile memory (RAM) to confirm that the video cassette belongs to the machine 32. If the video cassette belongs to the machine 32, Computer B will search its volatile memory list of shelving matrices 34,73 and find the first vacant compartment 40 in the shelving matrices nearest the access compartment 66. Computer B will send the address of this vacant compartment 40 to Computer C which will in turn hand off the address to Computer A while instructing Computer A to put the returned video cassette 36 in the vacant compartment. Computer B then stores the location in the shelving matrices 34,73 of the returned video cassette in its volatile memory for access when the machine is next in the rental or purchase mode previously described. Computer C will then address the keyboard 35 (described as 193,195 in Figure 25) to give the customer the option of ending the transaction or continuing. If the transaction ends, a receipt is printed by printer 203 and discharged through slot 39. In this manner it is possible to maintain a circulation of a total number of video cassettes between customers and the machine 32 of a number greater than the storage capacity of the shelving matrices 34,73 without an operator being required to replace video cassettes into their own particular compartment in a store. The machine 32 may always store video cassettes to the maximum capacity of the machine. In view of the telecommunications capacity of Computer C through modem 201 the operator of the machine may remotely poll the inventory circulation of machine 32 and build up a market profile of the most advantageous number and variety of video cassettes which may circulate through the machine.

As many changes can be made to the embodiment of the invention without departing from the scope of the invention, it is intended that all material be considered as illustrative of the invention and not in a limiting sense.

Claims

1. An automatic vending machine having a front face for a store and comprising a shelving matrix mounted inside the automatic vending machine, the shelving matrix having a plurality of spaced compartments, each compartment having one opening, open in one direction for access from that direction, robotic means having members and guides therefor which extend to provide access to each storage compartment in the shelving matrix through the one opening in each storage compartment and are moveable when aligned with a storage compartment into and out of the compartment so as to be able to remove an article from the storage compartment or return an article to the storage compartment, an access opening through the front face of the machine and an access compartment open at opposite ends for access at one end by the robotic means from the inside of the automatic vending machine to feed or empty the access compartment and accessible at the other end by a patron from the outside of the machine through the access opening and machine intelligence means for controlling the operation of the robotic means communicating between the shelving matrix and access compartment, the machine intelligence means includes means for: recalling the location in the shelving matrix of a specific article selected by a patron, instructing the robot to remove the article from storage and carrying the article so as to register with the access compartment, reading a unique identifying code on the article selected and retaining the identity of the article in memory upon registering the article with scanning means proximate the access compartment or opening, identifying the article upon its return through the access opening and access compartment by scanning means, instructing the robot to remove the returned article from the access compartment, and instructing the robotic means to carry the article to register with the vacant compartment in the shelving matrix nearest the access compartment and insert the article in such vacant compartment, storing the location of the returned article in machine memory for subsequent recall and retrieval.

2. An automatic vending machine having a front face for a secure store and comprising a shelving matrix mounted inside the automatic vending machine, the shelving matrix having a plurality of spaced compartments open in one direction for access from that direction, robotic means having members and guides therefor which extend to provide access to each storage compartment in the shelving matrix through the one opening in each storage compartment and are moveable when aligned with a storage compartment into and out of the compartment so as to be able to remove an article from the storage compartment or return an article to the storage compartment, an access opening through the front face of the machine and an access compartment normally laterally spaced from the access opening and moveable into, and out of alignment therewith, means to move the access compartment into and out of alignment with the access opening, the access compartment open at

opposite ends for access at one end by the robotic means from the inside of the automatic vending machine to feed or empty the access compartment and accessible at the other end by a patron from the outside of the machine when the access compartment is moved into alignment with the access opening to expose only the contents of the access compartment to access from the outside of the vending machine to dispense or retrieve an article through the access opening, the robotic means to move the access compartment into registration with the access opening, the access opening being ineffective to retrieve or input articles from or into the interior of the machine until the access compartment is aligned therewith, and machine intelligence means for controlling the operation of the robotic means communicating between the shelving matrix and access compartment, the machine intelligence means includes means for: recalling the location in the shelving matrix of a specific article selected by a patron, instructing the robot to remove the article from storage and carrying the article so as to register with the access compartment, instructing the robot to move the access compartment so as to register with the access opening, reading a unique identifying code on the article selected and retaining the identity of the article in memory upon registering the article with scanning means proximate the access compartment or opening, upon the return of an article instructing the robot to move the access compartment so as to register with the one access opening, identifying the article with the scanning means upon a patron inserting the article through the access opening into the access compartment, removing the returned article from the access compartment, and instructing the robotic means to carry the article to register with the vacant compartment in the shelving matrix nearest the access compartment and insert the article in such vacant compartment, storing the location of the returned article in machine memory for subsequent recall and retrieval.

3. The automatic vending machine as claimed in Claim 1 or Claim 2, wherein the shelving matrix mounted inside the automatic vending machine comprises at least two oppositely spaced parallel shelving matrices mounted against opposing walls inside the automatic vending machine, each matrix having a plurality of uniformly spaced compartments each compartment having one opening, opening in the direction of the oppositely spaced parallel shelving matrix for access from that direction.

4. The automatic vending machine as claimed in any preceding Claim, wherein the shelving matrix having a plurality of spaced compartments, each compartment having one opening, open in one direction for access from that direction, comprises each compartment having a bottom, each bottom having one opening, opening in the one direction the compartment opens in, the bottom having a longitudinal slot through the bottom extending parallel to the one direction and opening in the one direction through the end of the bottom proximate the one opening in the compartment.

5. The automatic vending machine as claimed in any preceding Claim, wherein the robotic means having members and guides therefor which extend for communicating between each storage compartment in a shelving matrix and the access compartment, comprises a first moveable member guided along a first axis of movement by two parallel spaced guides extending perpendicular to the opposite ends of the first member, the first moveable member including a guide extending longitudinally therein to support movement of a carriage therein along a second axis of movement which is perpendicular to the first axis of movement, the first member and carriage moveable along perpendicular axes of movement so as to enable alignment of the carriage with each compartment of the shelving matrix and the access compartment, the carriage further having means for being extensible and retractable to enable movement transverse to the plane of opening of each storage compartment in the shelving matrix and the access compartment, comprising lower, middle and upper members, each moveable relative to the other for sliding one on the other in a direction into each compartment or the access compartment for removal of an article from the compartment or access compartment or placement of an article into the compartment or access compartment.

6. The automatic vending machine in any one of Claims 3 to 5, wherein the robotic means providing a carriage which is extensible and retractable to enable movement transverse to the plane of opening of each storage compartment comprises a carriage which is extensible and retractable in opposite directions and the carriage is spaced between the two oppositely spaced parallel shelving matrices and extends and retracts to provide access to each storage compartment in both shelving matrices.

7. The automatic vending machine in Claim 4, having a longitudinal slot in the bottom of each compartment, wherein the robotic means includes means to raise and lower the robotic means below the bottom of each compartment to extend through the slot to engage and lift the article from the bottom or insert the article into the compartment and lower the robotic means below the slot to disengage and deposit the article.

8. A method of dispensing an article from an automatic vending machine when a patron using the vending machine inputs into the vending machine a selection for an article, the machine having an opening communicating through the face of the machine, a shelving matrix mounted inside the machine having a plurality of spaced compartments, each compartment suitable for storing any one of a plurality of articles, and robotic means mounted inside the machine suitable to carry an article from any storage compartment in the shelving matrix to an opening communicating through the face of the machine, the method of dispensing comprising the steps of:

(a) determining the position of the article selected by the patron using machine intelligence means

(b) manipulating the robotic means in a vertical and horizontal direction until the robotic means is aligned with the storage compartment containing the article selected by a patron

(c) moving robotic means for manipulating the article in a direction extending into the storage compartment containing the article selected by a patron and retracting the article from the compartment

(d) moving the robotic means carrying such article in a vertical and horizontal direction until the robotic means is aligned with an opening communicating through the face of the machine, making the article accessible to the patron.

9. A method of dispensing an article from an automatic

vending machine when a patron using the vending machine inputs into the vending machine a selection for an article, the machine having an opening communicating through the face of the machine, a shelving matrix mounted inside the machine having a plurality of spaced compartments, each compartment suitable for storing any one of a plurality of articles and robotic means mounted inside the machine suitable to carrying an article from any storage compartment in the shelving matrix to a movable access compartment normally laterally spaced from the opening communicating through the face of the machine and alignable therewith, the method of dispensing comprising the steps of:

(a) determining the position of the article selected by the patron using machine intelligence means

(b) manipulating the robotic means in a vertical and horizontal direction until the robotic means is aligned with the storage compartment containing the article selected by a patron

(c) moving robotic means for manipulating the article in a direction extending into the storage compartment containing the article selected by the patron and retracting the article from the compartment

(d) moving the robotic means carrying an article by a patron in a vertical and horizontal direction until the robotic means is aligned with a movable access compartment normally laterally spaced from an opening communicating through the face of the machine.

(e) moving robotic means carrying the article selected by a patron in a direction extending into the access compartment normally laterally spaced from an opening communicating through the face of the machine, depositing the article in the access compartment, and then retracting the robotic means from the access compartment

(f) moving the access compartment in a laterial direction until the access compartment is aligned with an opening communicating through the face of the machine, making the article in the access compartment accessible to a patron.

10. A method of returning an article to an automatic vending machine when a patron using the vending machine activates the return of an article to the vending machine, the machine having an opening communicating through the face of the machine, a shelving matrix mounted inside the machine having a plurality of spaced compartments each compartment suitable for storing any one of a plurality of articles, and robotic means mounted inside the machine suitable to carry an article from an opening communicating through the face of the machine to any vacant storage compartment in the shelving matrix, the method of returning comprising the steps of:

(a) when a patron activates the return of an article to the automatic vending machine, manipulating the robotic means in a vertical and horizontal direction until the robotic means is aligned with an opening communicating through the face of the machine

(b) when the patron returns the article through an opening communicating through the face of the machine, moving the robotic means in a direction extending into the opening communicating through the face of the machine containing the article returned by a patron and retracting the article from said opening

(c) moving the robotic means carrying the article returned by the patron in a vertical and horizontal direction until the robotic means is aligned with any vacant storage compartment

(d) moving the robotic means carrying the returned article in a direction extending into the nearest vacant storage compartment, depositing the article in the storage compartment and then retracting the robotic means from the storage compartment

(e) constantly determining the location in the shelving matrix of every article returned to the machine through the use of machine intelligence means.

11. A method of returning an article to an automatic vending machine when a patron using the vending machine activates the return of an article to the vending machine, the machine having an opening communicating through the face of the machine, a shelving matrix mounted inside the machine having a plurality of spaced compartments, each compartment suitable for storing any one of a plurality of articles, and robotic means mounted inside the machine suitable to carry an article from a movable access compartment normally laterally spaced from the opening communicating through the face of the machine and alignable therewith, to any storage compartment in the shelving matrix, the method of returning comprising the steps of:

(a) when the patron activates the return of an article to the automatic vending machine, manipulating the robotic means in a vertical and horizontal direction until the robotic means is aligned with a movable access compartment normally laterally spaced from an opening communicating through the face of the machine

(b) moving the access compartment in a lateral direction in conjunction with moving robotic means aligned therewith in a lateral direction until the access compartment and the robotic means are aligned with an opening communicating through the face of the machine

(c) when the patron returns the article through the opening in the face of the machine into the movable access compartment aligned therewith, moving the access compartment in a lateral direction in conjunction with moving the robotic means aligned therewith in a lateral direction until the access compartment is laterally spaced from the opening communicating through the face of the machine, thereby occluding said opening

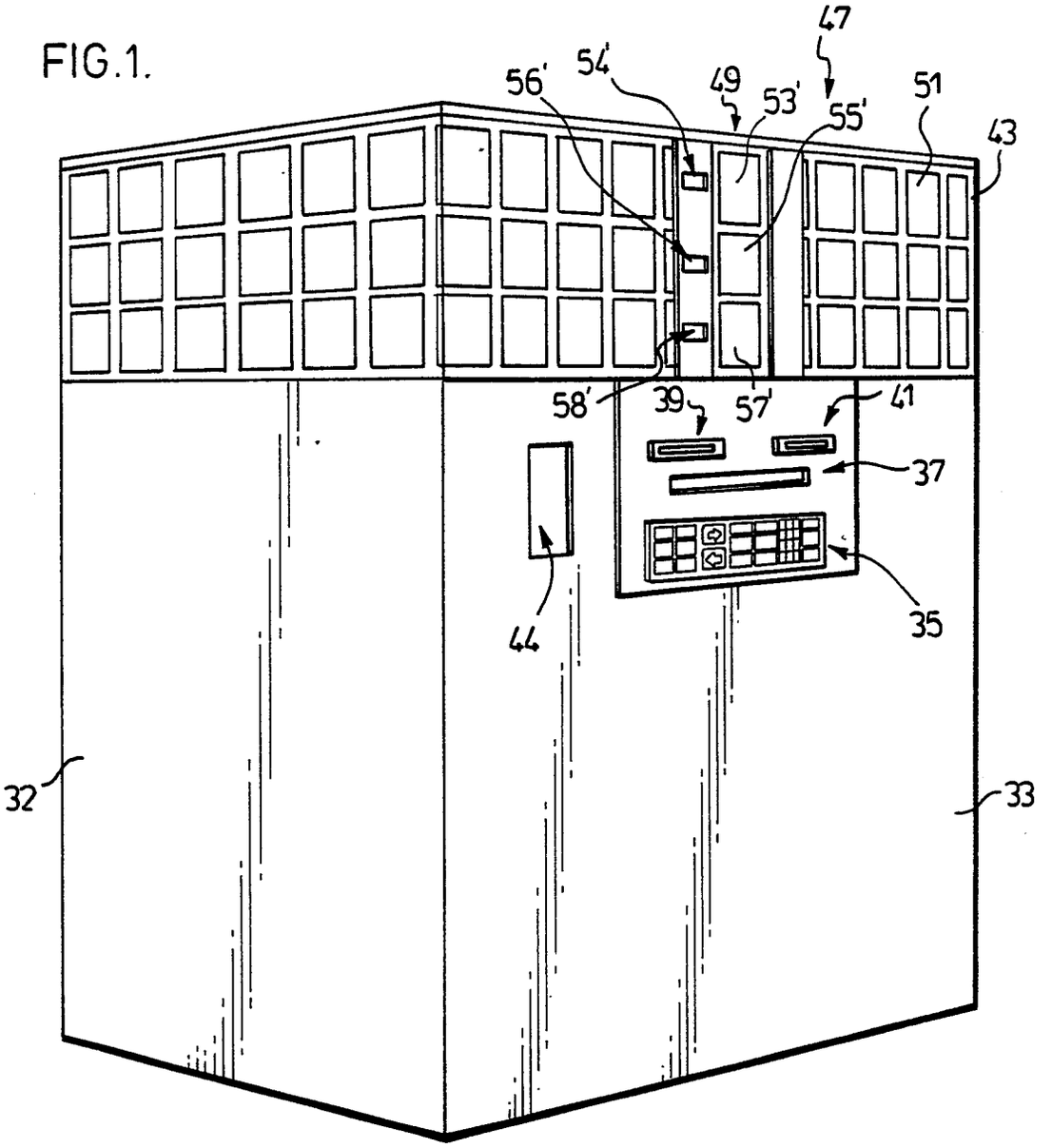
(d) moving the robotic means in a direction extending into the movable access compartment containing the article returned by the patron and retracting the article from said movable access compartment

(e) moving the robotic means carrying the article returned by the patron in a vertical and horizontal direction until the robotic means is aligned with the nearest vacant storage compartment

(f) moving the robotic means carrying the returned article in a direction extending into the vacant storage compartment, depositing the article in the storage compartment and then retracting the robotic means from the storage compartment

(g) constantly determining the location in the shelving matrix of every article returned to the machine, through the use of machine intelligence means.

FIG.1.


47
56'
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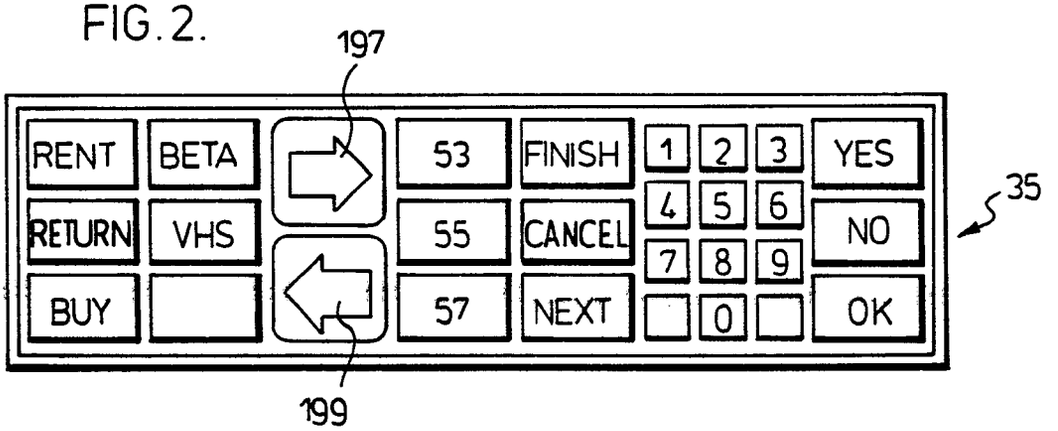
49
53'
55'
51
43
58'
39
57'
41
37
44
35
32
33

FIG.2.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BETA
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FINISH
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2
3
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RETURN
VHS
55
CANCEL
4
5
6
NO
7
8
9
BUY
57
NEXT
0
OK
35
199

FIG.3.

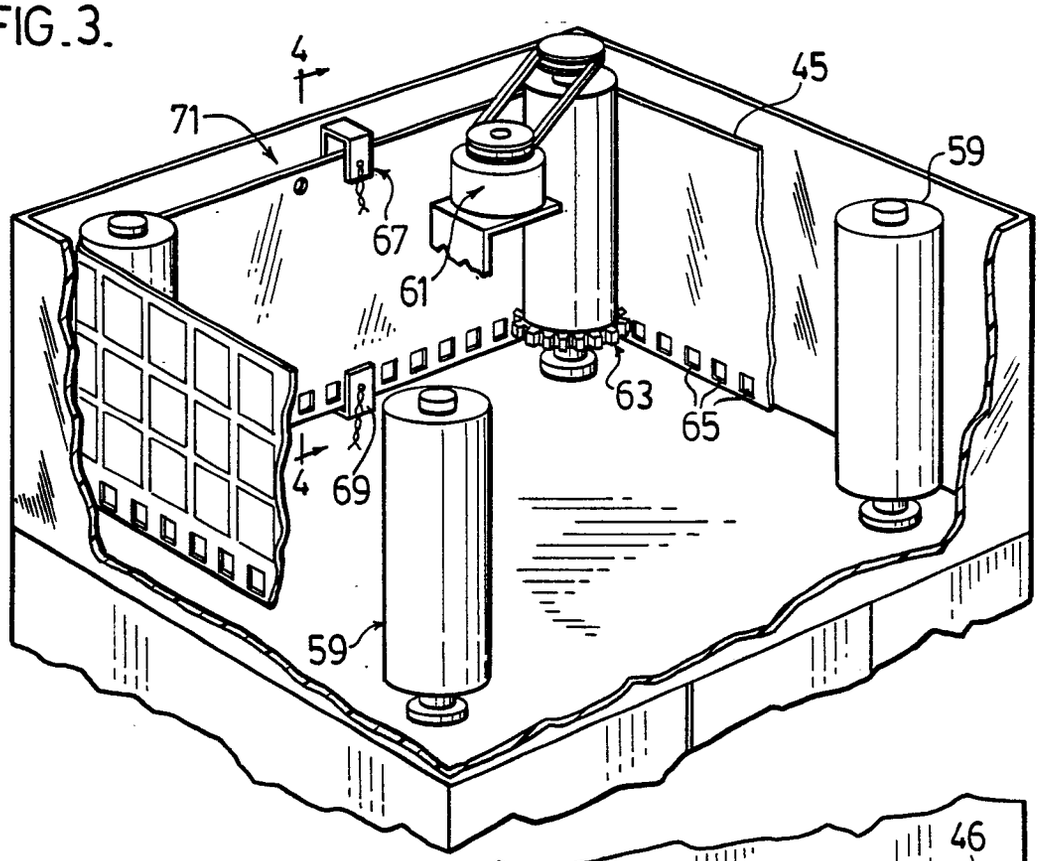


FIG.4.

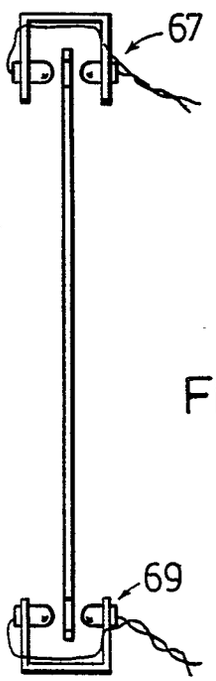


FIG.6.

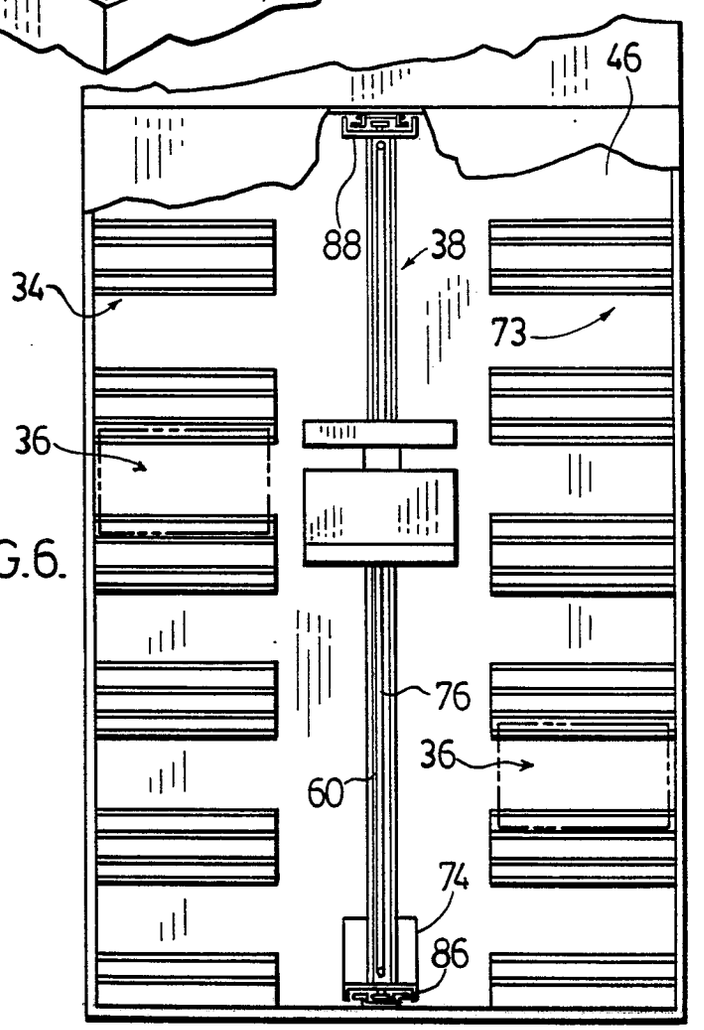


FIG.5.

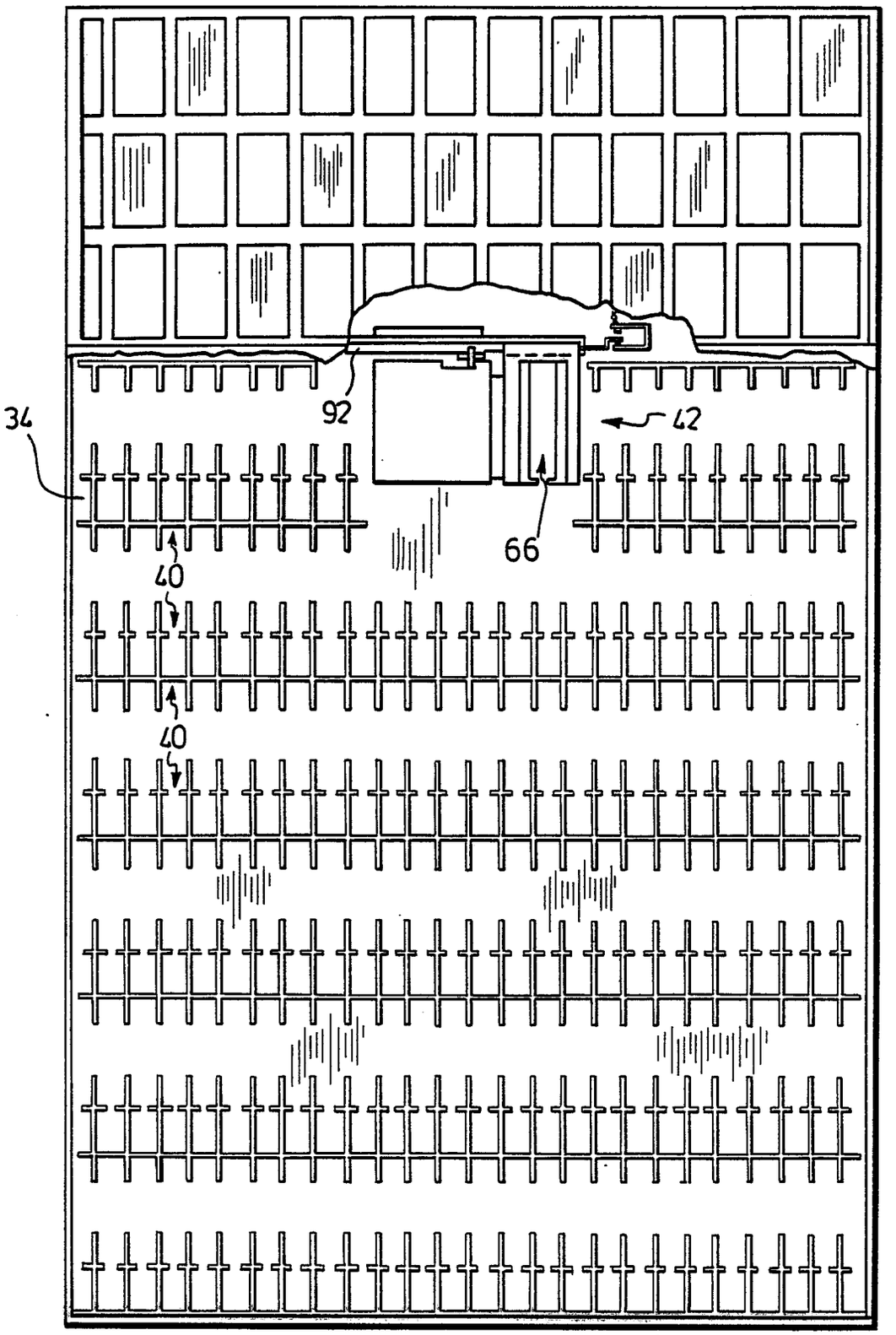


FIG. 7.

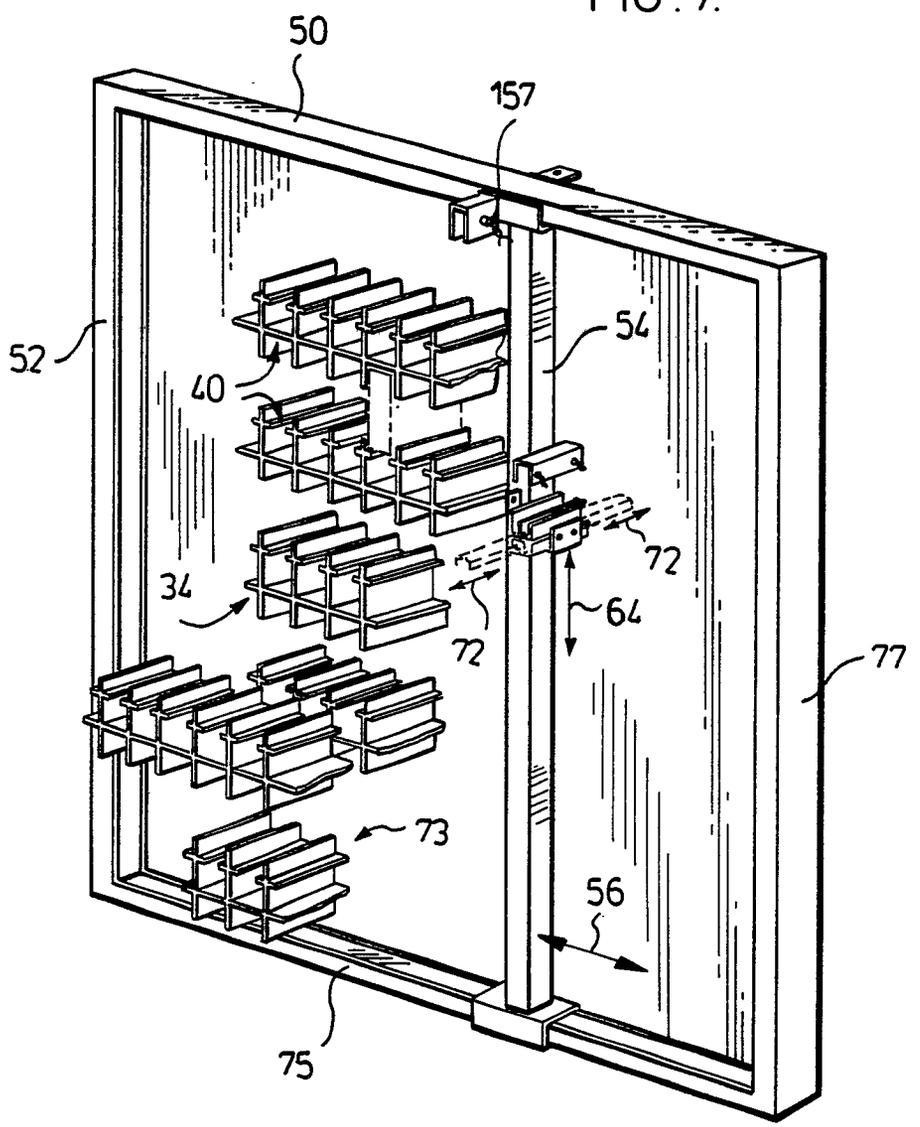


FIG.8.

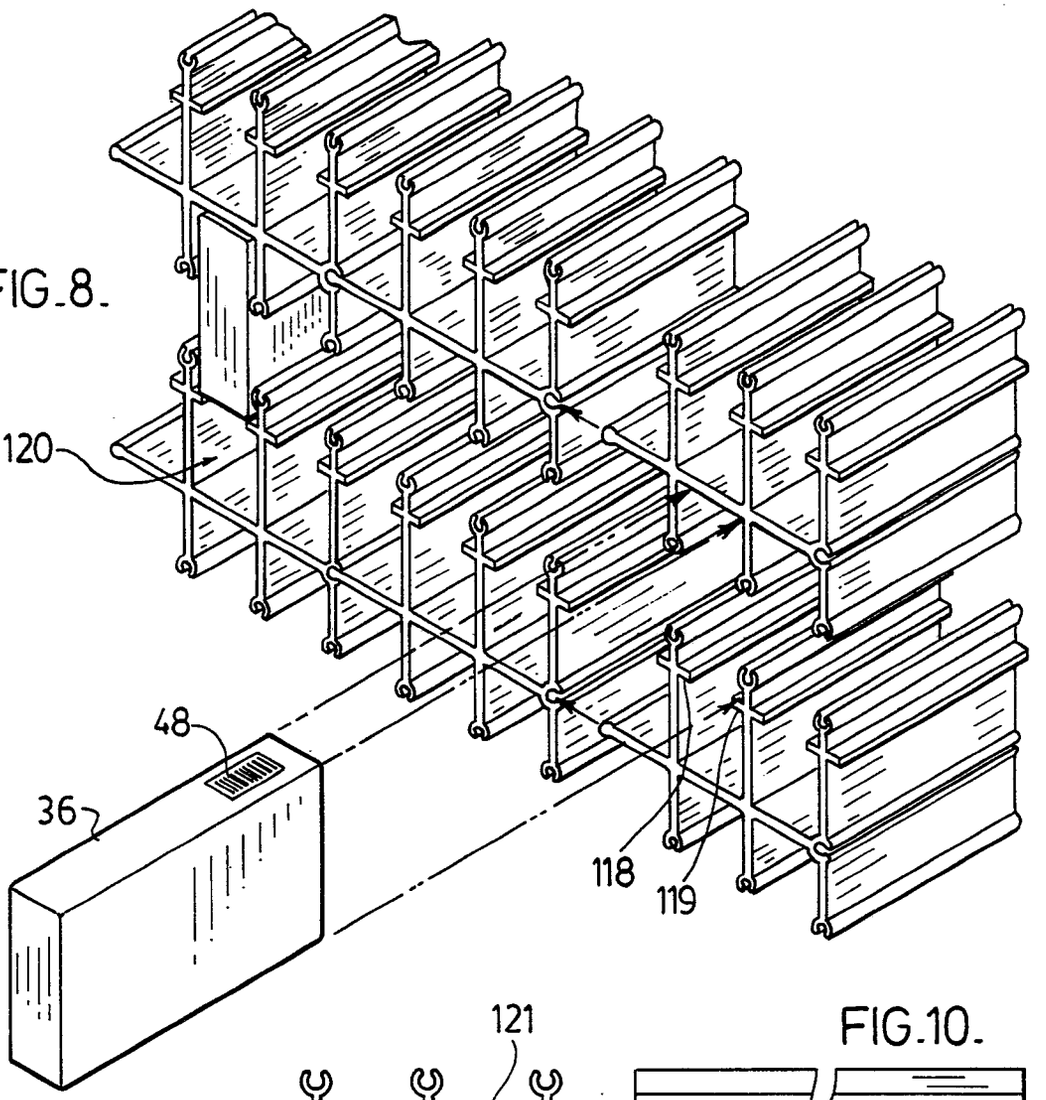


FIG.9.

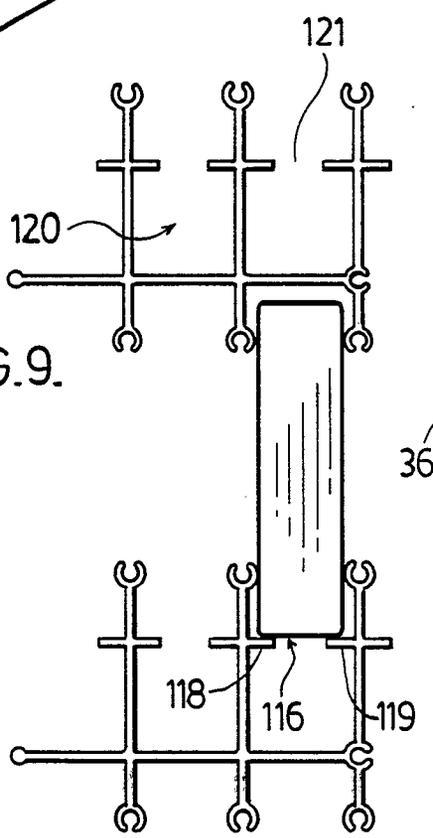


FIG.10.

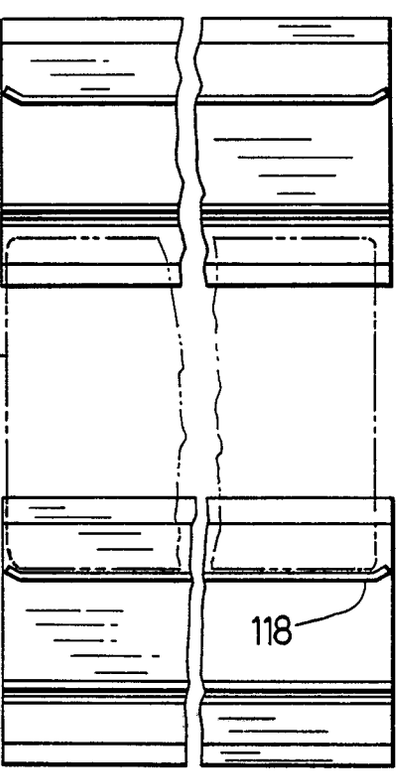
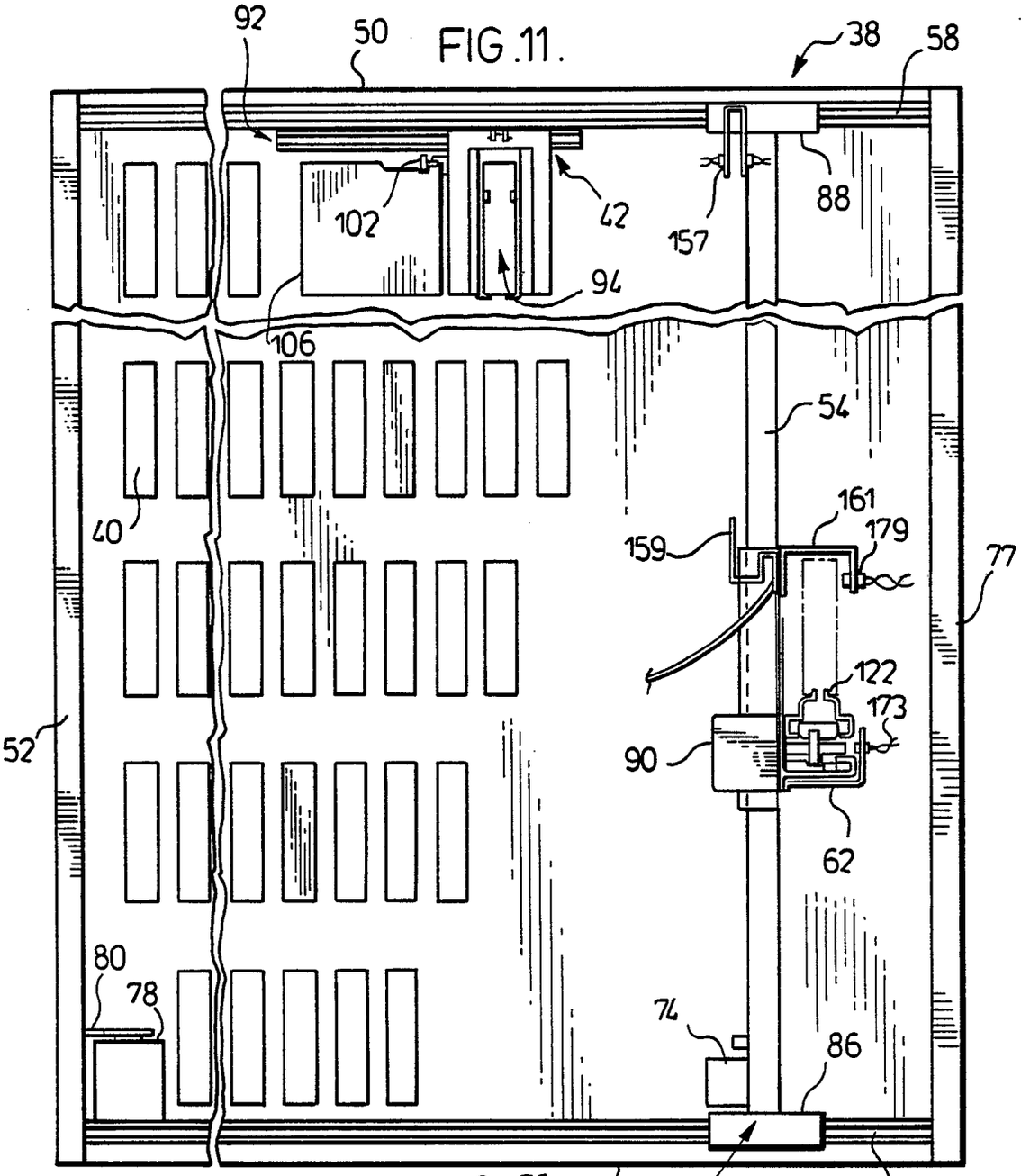


FIG.11.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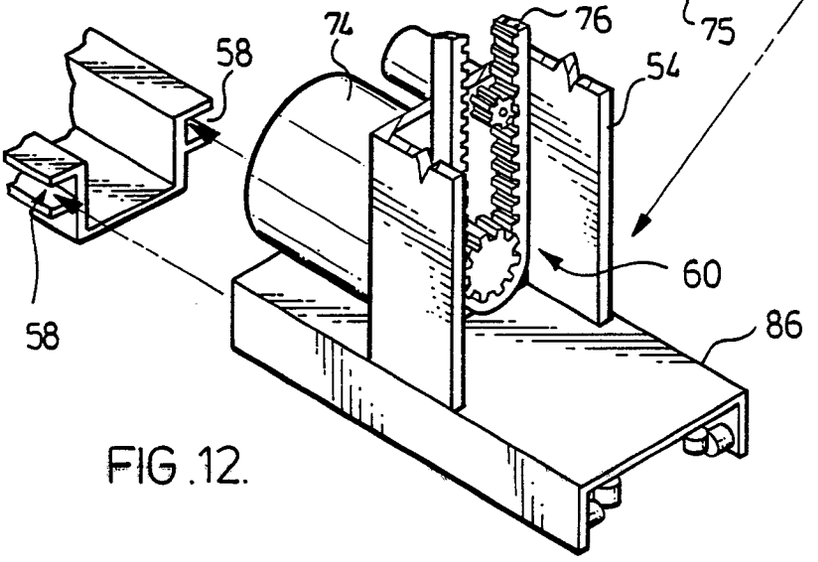
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FIG.12.

FIG. 13.

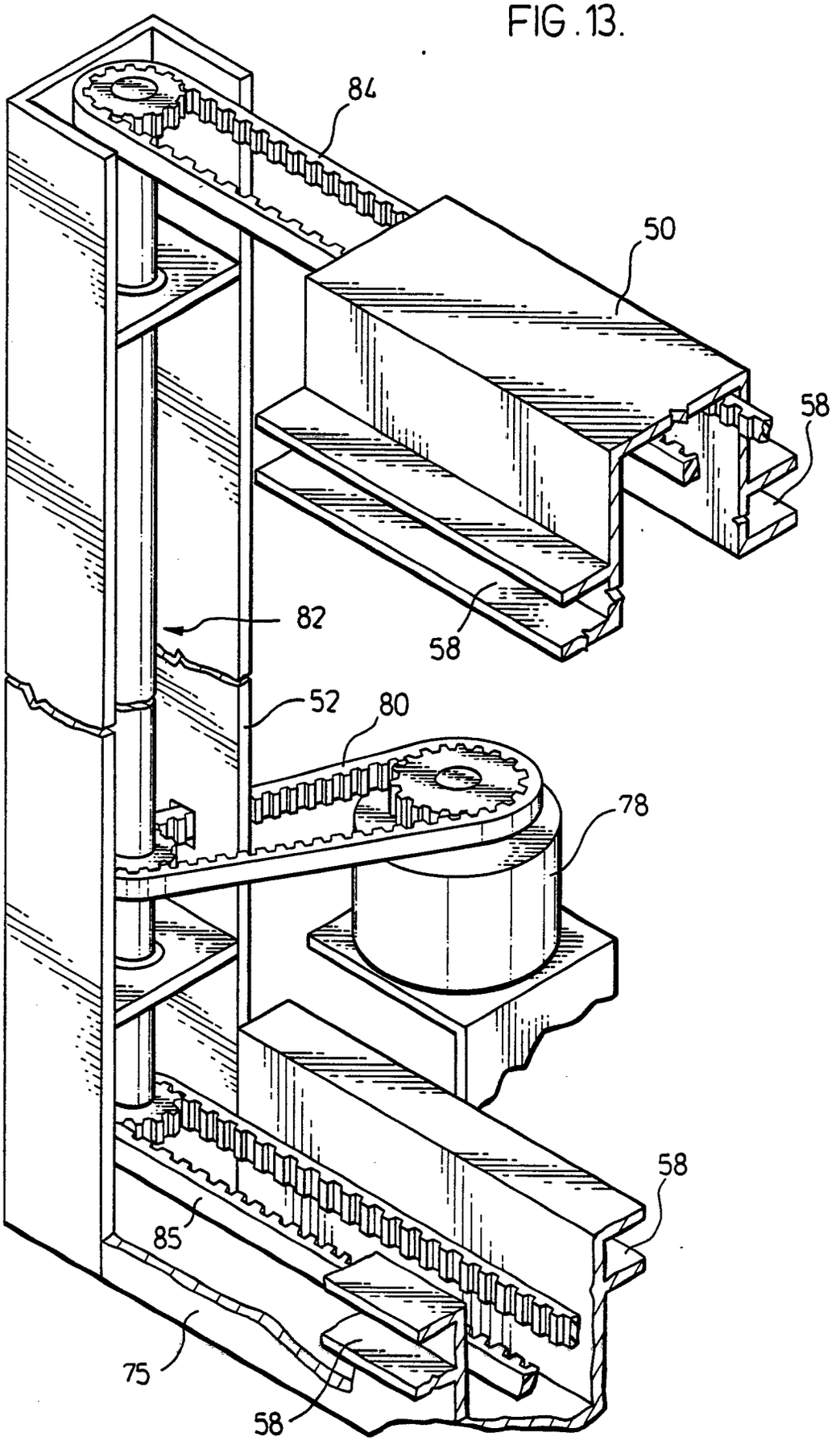
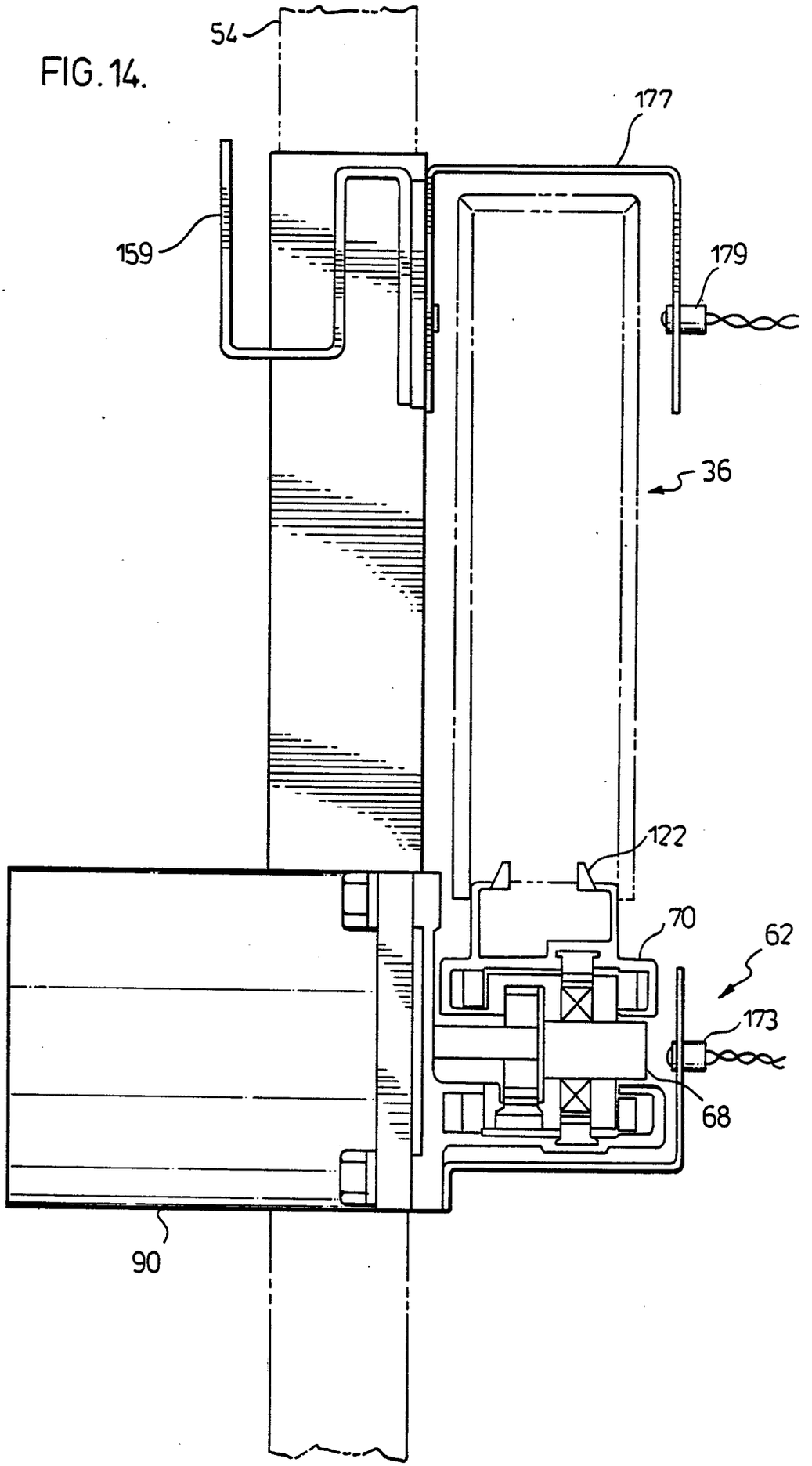


FIG. 14.



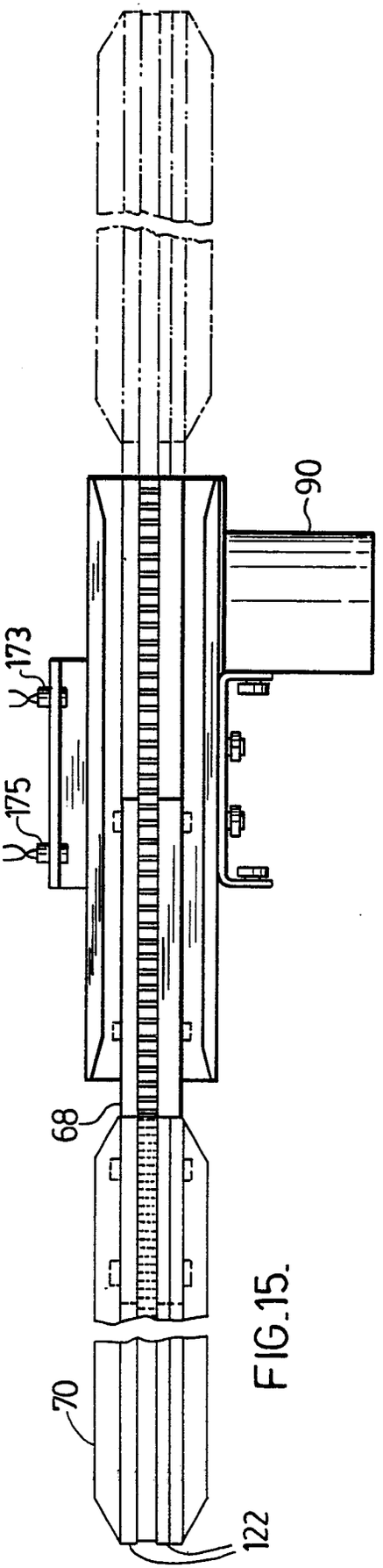


FIG.15.

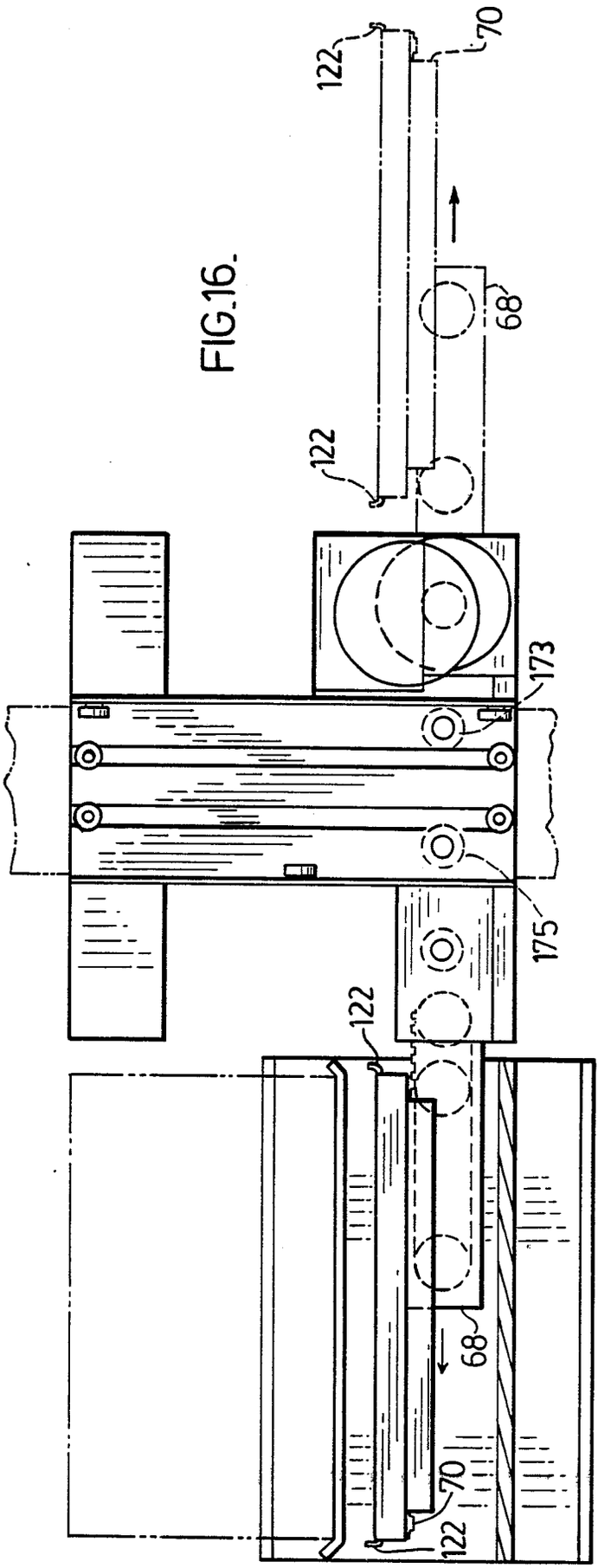


FIG.16.

FIG.17.

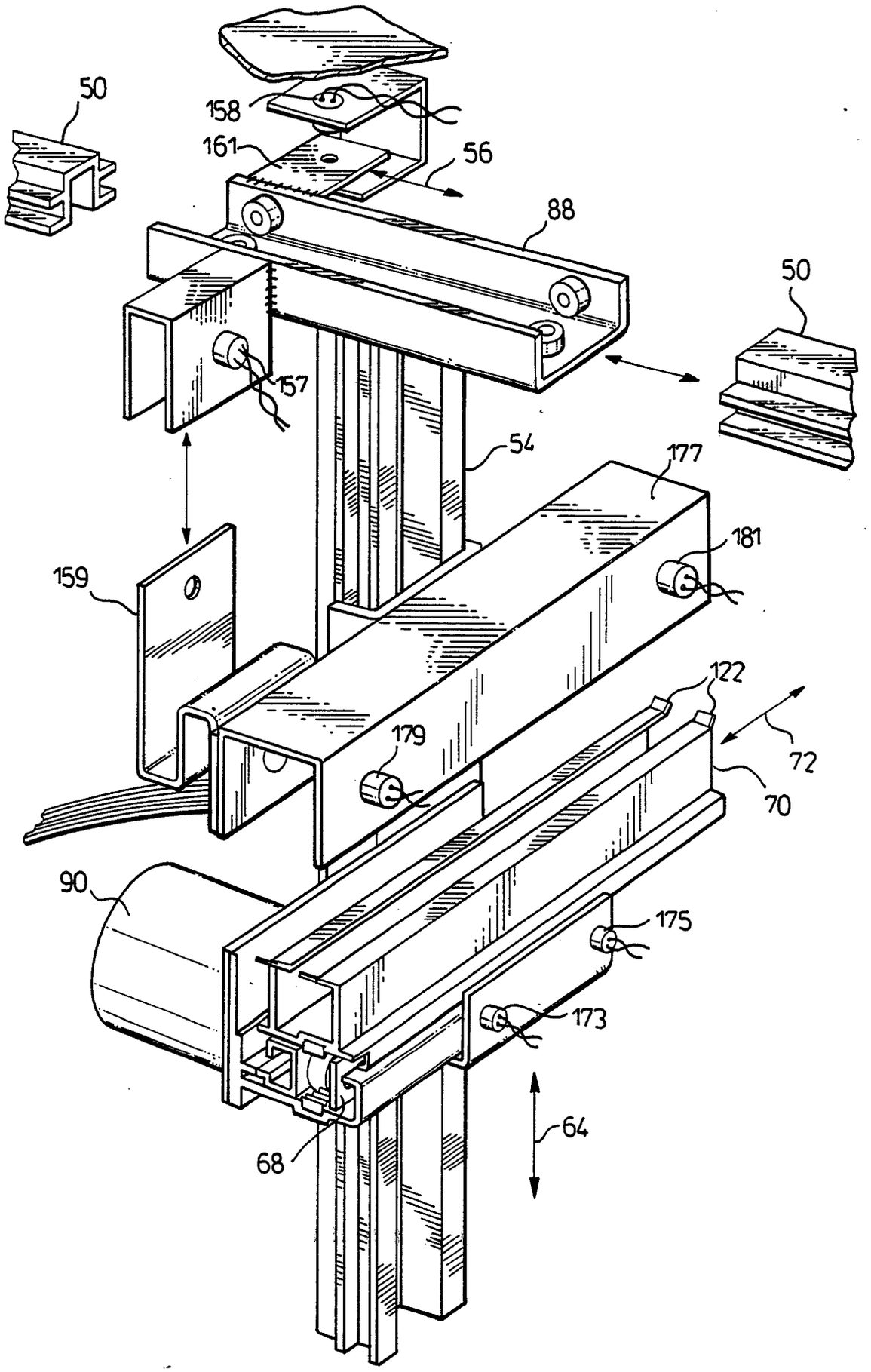

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FIG. 18.

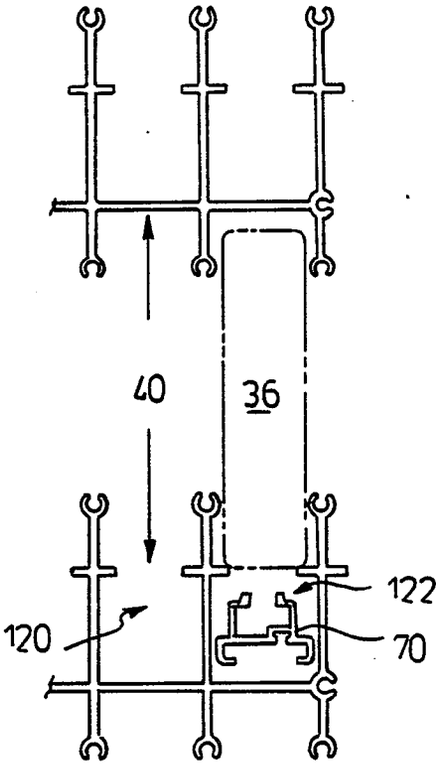

FIG. 19.

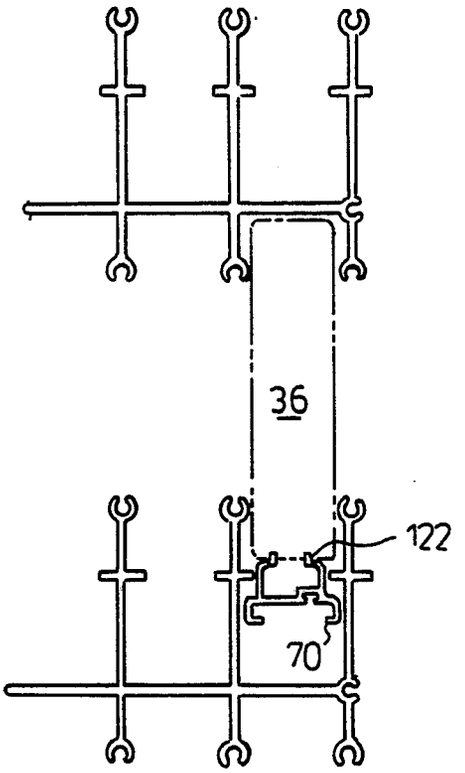

FIG. 20.

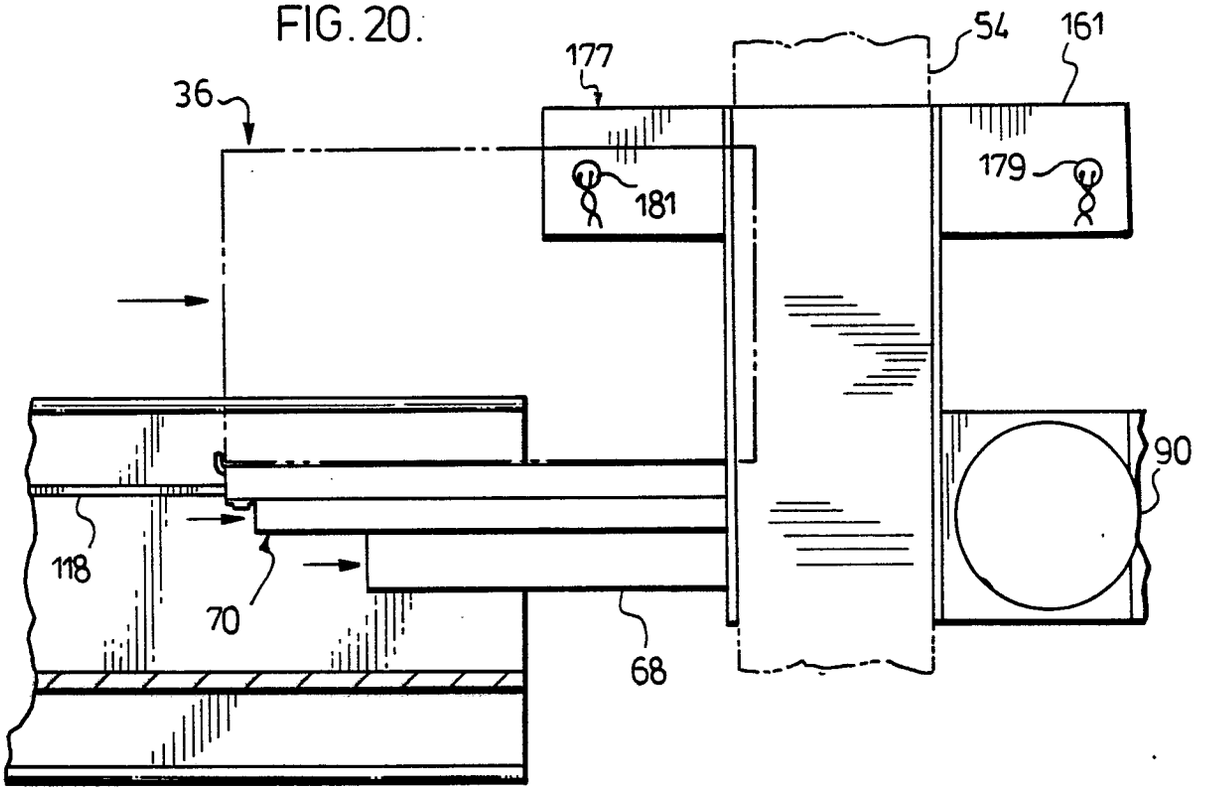

FIG.21.

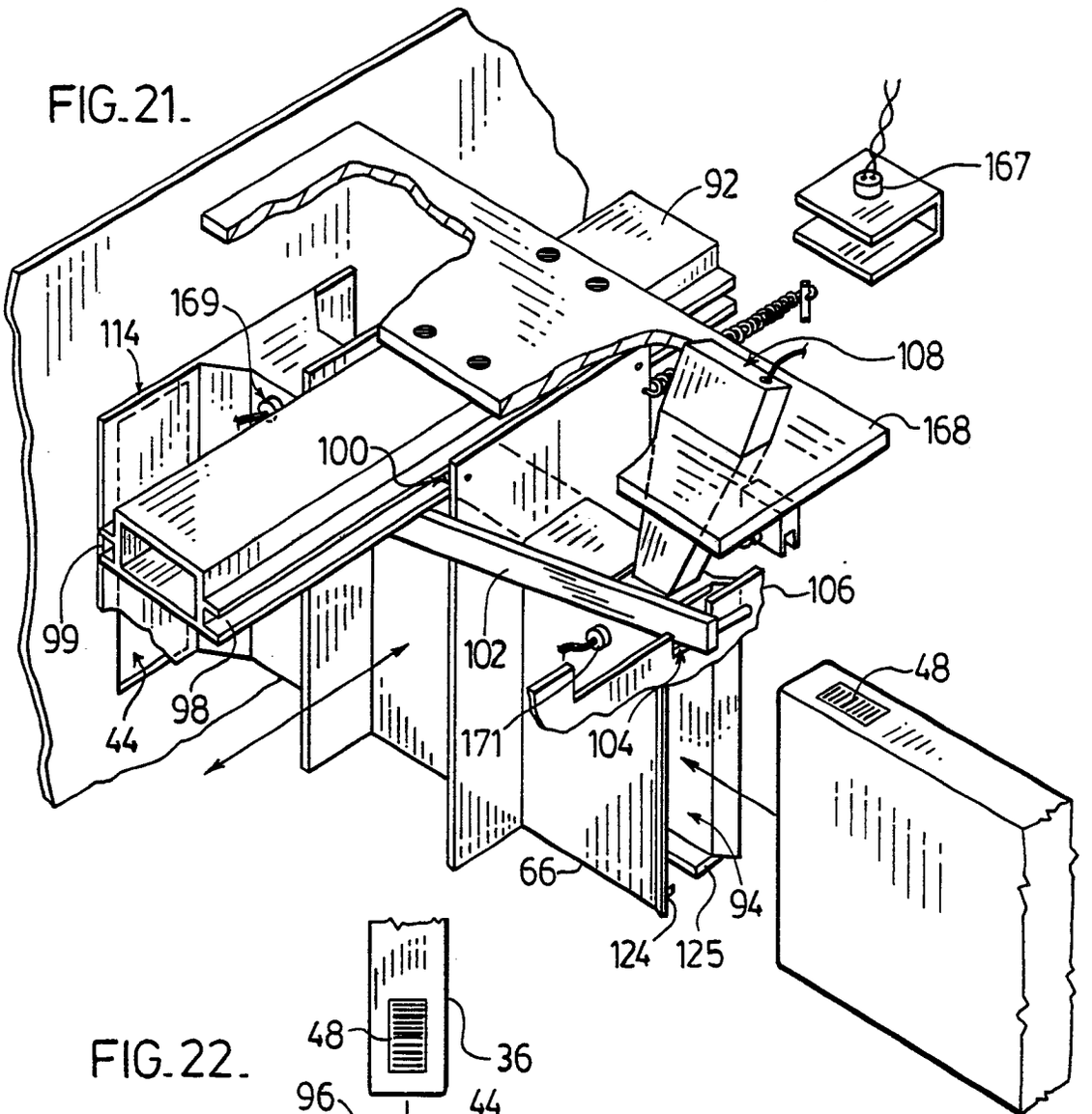
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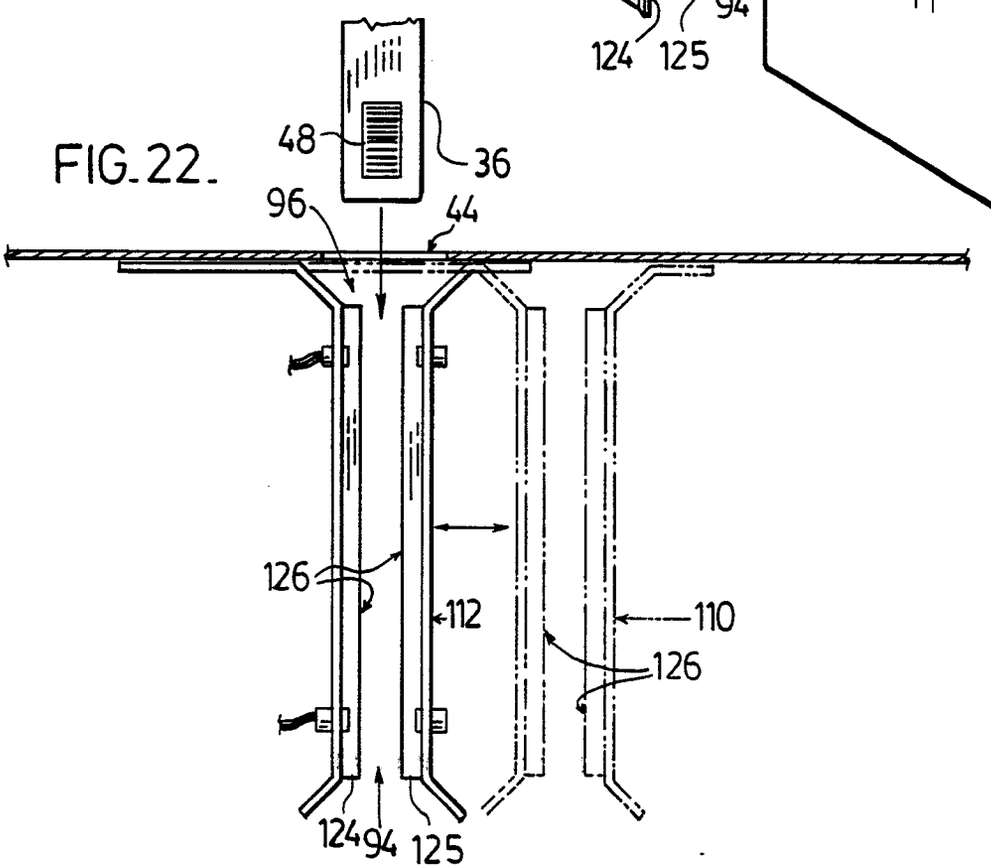
FIG.22.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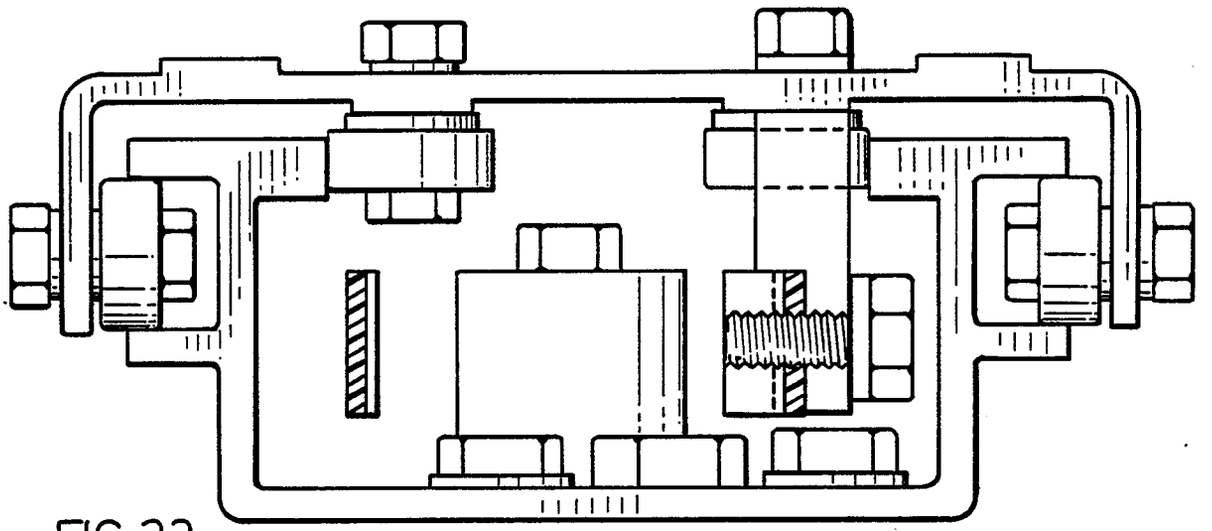

FIG.23.

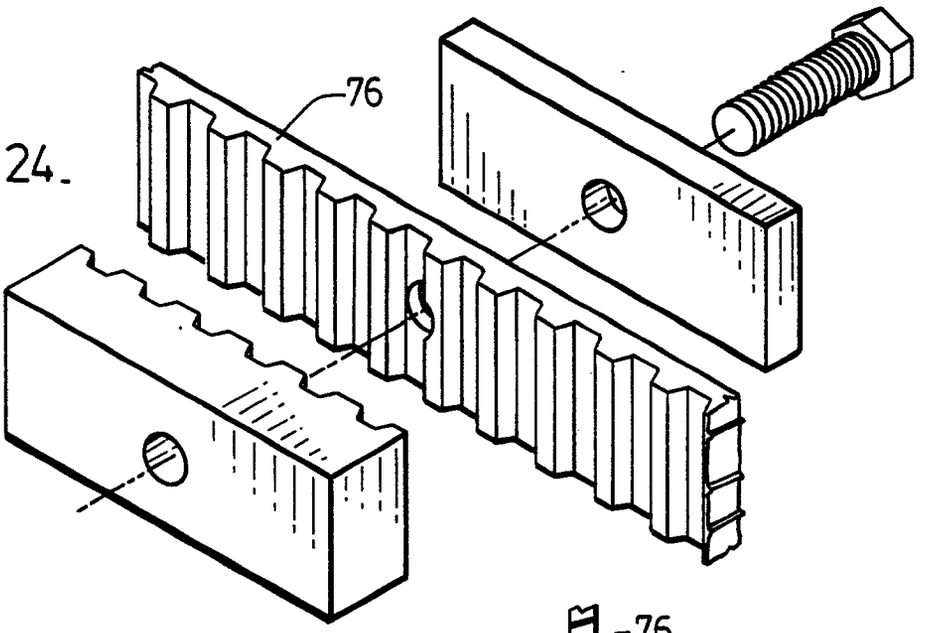

FIG.24.

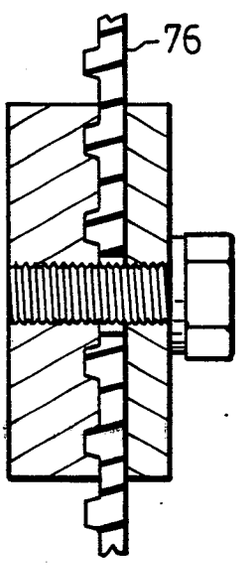

FIG.25.

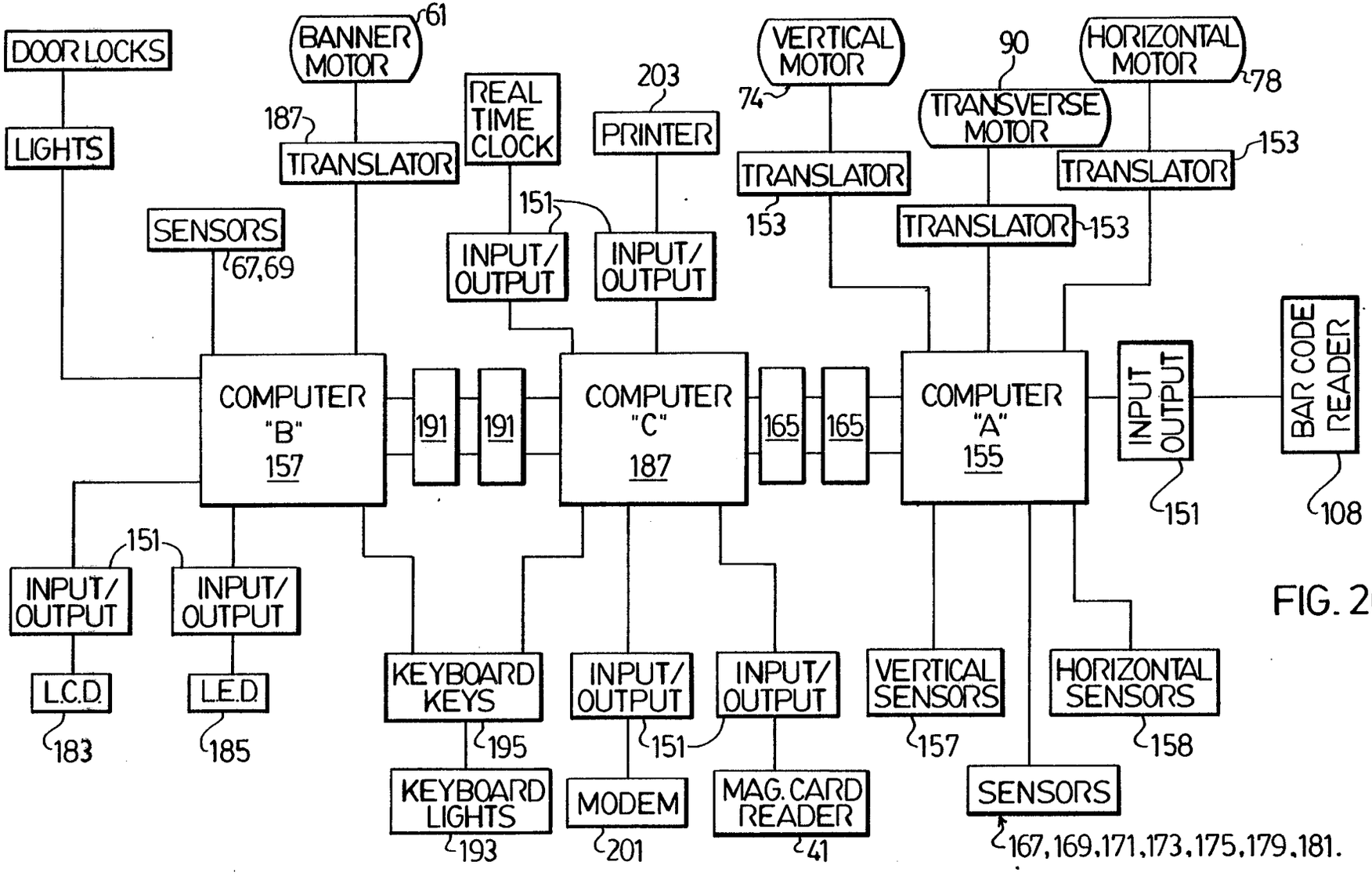

FIG. 26.

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