

[54] STORAGE MEANS WITH SHIFTABLE UNITS

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[51] Int. Cl. B60m 1/34, A47b 53/00

[58] Field of Search 104/148 R, 149, 15; 312/198-201; 214/16 B

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[57]

ABSTRACT

A series of storage stacks, such as bookcases, are mounted on a track with controlled power means for moving them to provide a single aisle between any two stacks. The remaining stacks are in contact with each other thereby conserving space and lighting means. The movement of the stacks is controlled so that all stacks move together without any separation when an aisle is being changed.

8 Claims, 4 Drawing Figures

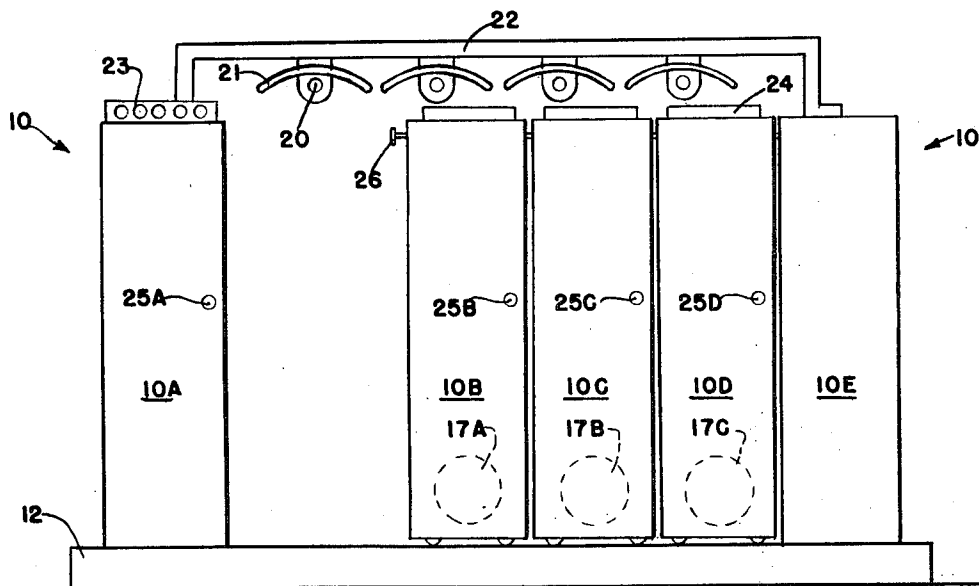


FIG. 1

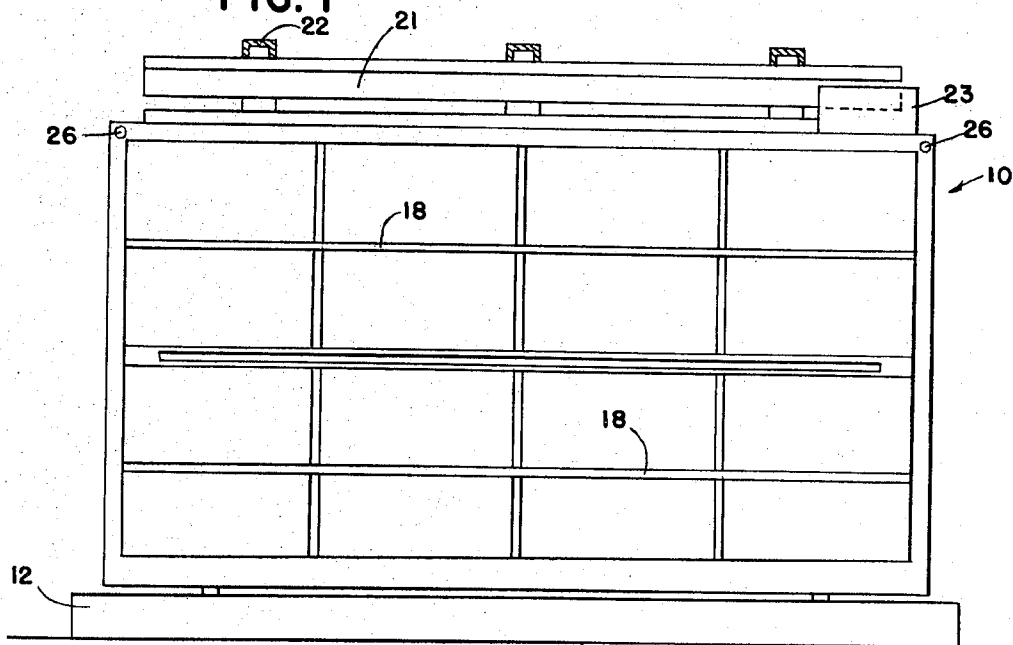


FIG. 2

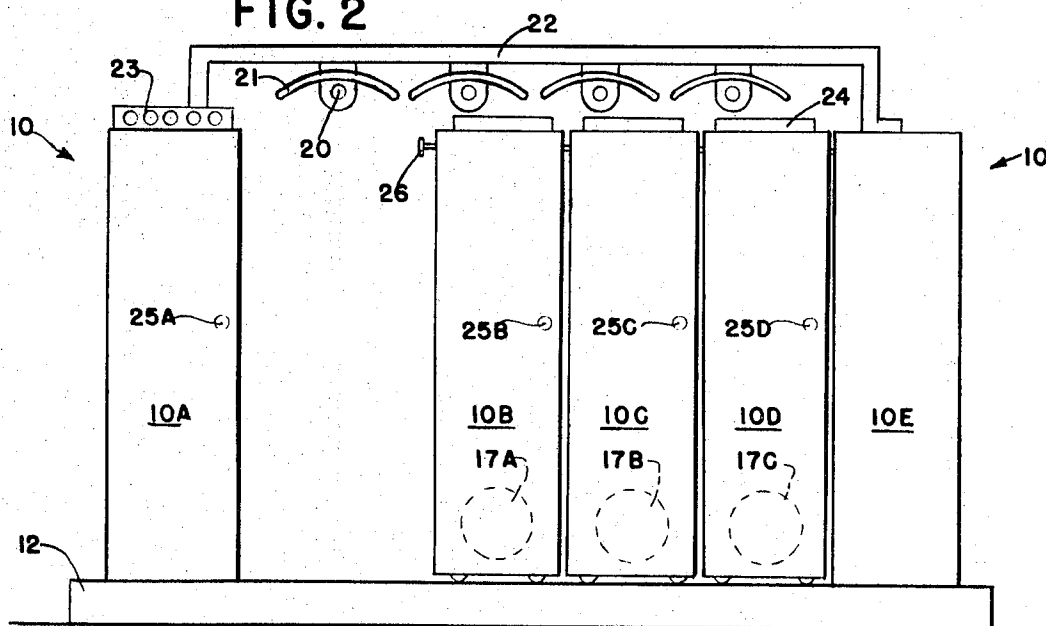
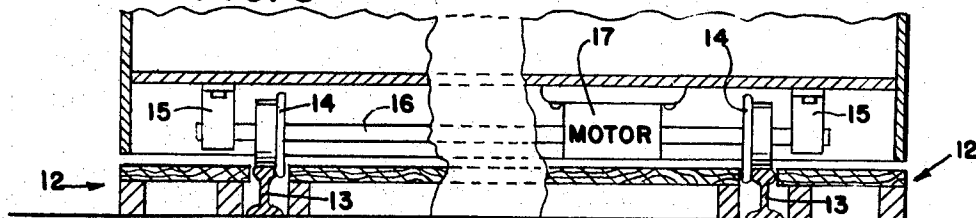
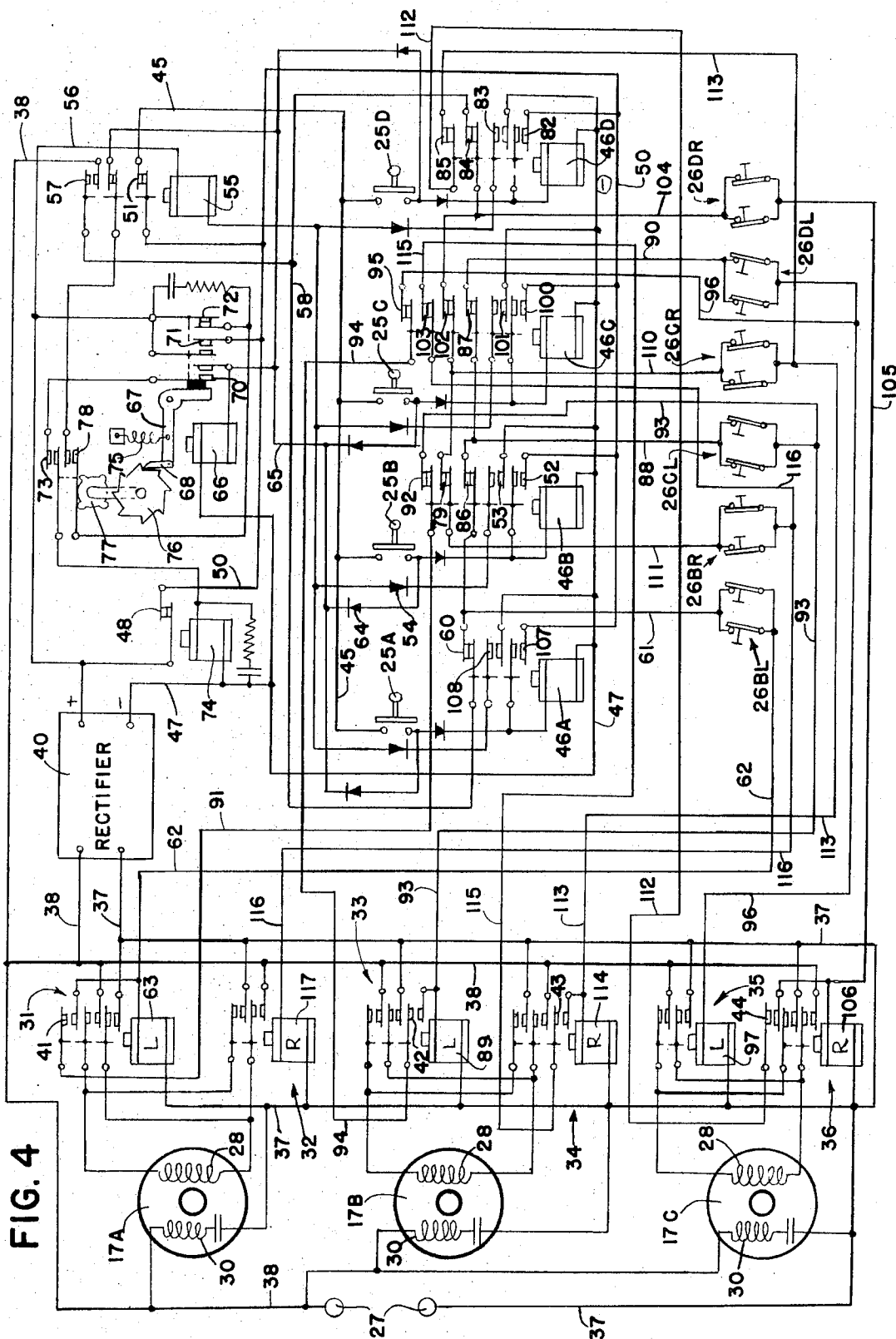


FIG. 3





STORAGE MEANS WITH SHIFTABLE UNITS

A series of storage stacks, such as bookcases, are mounted on a track with controlled power means for moving them in unison to provide a single aisle between any two stacks. The remaining stacks are in contact with each other thereby conserving space and lighting means. The movement of the stacks is controlled so that all the stacks move together without any separation when an aisle is being changed.

This application is an improvement on the structure described in copending U.S. application Ser. No. 69,012, filed Sept. 2, 1970, by Tucker and Becker. Both applications are assigned to the same assignee. All the features and structures of this prior application are incorporated herein by reference.

Movable storage stacks for books and small parts have been in use for some time to conserve space and to add security against unauthorized removal of contents. Prior stacks have, in most cases, been difficult to operate, requiring a sequence of manual operations to open a desired aisle. Most of the prior stacks have been movable by a sequence of operations which included a separation of adjacent stacks when the two have been moved in the same direction. Such an operation provides opening and closing of spaces between stacks which presents a certain amount of danger to hands or fingers which may be caught in the open spaces.

The present invention includes a control system which is completely automatic, being operated by push buttons which anyone can use. When the opening of an aisle requires the movement of two or more stacks, the stacks start at the same time and move together as a unit. This action saves time and, as noted above, is a safety feature. While the units are designed to be operated by electrical power, the stacks can be pushed manually with little effort since the wheels are mounted on ball bearings and the stacks are not connected to any chains, operating rods, or power screw means which would act as restraints.

The main feature of the invention is the circuit means which provides for the simultaneous movement of all the stacks to the right or left of an aisle to be opened. This is only one of a number of safety features which have been incorporated in the storage means. The other safety features are not shown or described in this specification since they are not part of the invention and since they have been fully described in the above mentioned invention.

For a better understanding of the present invention, together with other details and features thereof, reference is made to the following description taken in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE FIGURES

FIG. 1 is a side view of one of the storage stacks.

FIG. 2 is a side view of all the stacks in one group, showing an open aisle.

FIG. 3 is a cross sectional view of the base of one of the stacks, showing the rails, the wheels, and the position of the motor.

FIG. 4 is a schematic diagram of connections of the electrical control system which operates the stacks.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIGS. 1 and 2, the assembly of stor-

age stacks 10 includes five stacks, two of which are stationary, and three which are movable. If desired, only one of the stacks can be stationary with four movable portions. A sub-floor 12 is mounted under all the stacks and contains the rails (see FIG. 3) which support flanged wheels 14 rotatably secured to the underpart of the stacks by pillow blocks 15. The wheels 14 are secured to a shaft 16 driven by an electrical reversible motor 17. Each of the stacks may be divided into shelves 18 or other compartments for the storage of books, magazines, or machine parts.

A series of lamps 20 is mounted above the stacks, each lamp positioned at a point above an aisle when the stacks are separated. In order to conserve lighting costs, only one of the lamps 20 is lighted at any time. The lamps include flat reflectors 21 and are secured in position by two or three supporting bars 22. Most of the circuit elements for controlling the lighting and motors are enclosed in a container 23 mounted on top of one of the stationary stacks 10. Each movable stack also contains a local circuit in a box 24 mounted on top of the upper stack shelf.

The stack movement is initiated by an operator depressing a push button 25 adjacent to the aisle to be entered. The button 25 operates a stepping switch and the first actuation opens the aisle by moving the stacks away from it. After the operator has finished his mission, he pushes the button 25 a second time thereby normalizing part of the circuit and making the system ready for another aisle opening. When the motors 17 are activated, they move their associated stacks to fill the open aisle and open up another. As soon as the opening is closed, all the motors stop. The motor cut-off action is accomplished by a sensing switch 26. Each movable stack has four such switches 26 mounted at the upper corners on each side of the stack.

The control circuit is shown in schematic form in FIG. 4. The circuit is powered by sixty hertz from a power line which is connected to terminals 27. Three motors 17A, 17B, and 17C are connected across the power line, each being capable of running in either direction. A main winding 28 and a starter winding 30 in series with a capacitor permit the reversible action by reversing the current in one of the windings.

A series of six relays 31 through 36 control the actuation and the direction of the three motors. When none of the relays are actuated there is no power supplied to the motors and they do not run. Actuation of any of the three relays 31, 33, or 35 causes the associated motor to turn in a direction which moves its stack to the left. In like manner, actuation of any of the relays 32, 34, or 36 causes the associated motor to move the stack to the right.

One side of each relay winding is connected to a power conductor 37 and one of the terminals 27. The other side of each relay winding is connected respectively to a pair of the sensing switches 26 which are operated whenever the stacks are moved close to each other. The other power conductor 38 is connected to one side of each starter winding 30, to a normally open contact on each of the motor relays, and to a rectifier 40 which supplies direct current to many of the control components.

In addition to the two normally open contacts on relays 31 through 36, a pair of contacts 41, 42, 43, and 44 are mounted on relays 31, 33, 34 and 36, to complete a circuit which will bypass four of the sensing

switches 26 in order to speed up the movement of the stacks and make them move simultaneously. These circuits will be described in greater detail when the operation of the entire control unit is discussed. The bypass contacts are connected in series with normally closed contacts on a series of relays which are controlled by the manually operated selector buttons 25.

There are four selector buttons 25A through 25D, corresponding to the four aisles between the five stacks 10. Each button is normally held in its open position by resilient means and, when operated, a circuit is closed between a common D.C. power conductor 45, a relay winding 46, to a negative conductor 47. If the stacks are in the positions as shown in FIG. 2, and button 25B is depressed, then only one stack is to be moved and the short-circuiting contacts 41 through 44 are not operated. However, the operation of moving the single stack will now be described to show how the basic circuits are actuated.

Depression of button 25B completes a circuit which can be traced from the positive terminal of rectifier 40 (FIG. 4) through contacts 48, over conductor 50, through contacts 51, then over conductor 45 to switch 25B. The circuit continues through winding 46B to conductor 47 and the negative terminal of rectifier 40. This action operates five contacts, closing two 52 and 53 and opening three 86, 79, and 92. Contacts 52 are holding contacts and, when closed, send current from conductor 50, through winding 46B to conductor 47 and the negative terminal. Contacts 53 complete a circuit which can be traced from the negative terminal, over conductor 47, through contacts 53, diode 54, relay winding 55 to conductor 56 and the negative terminal of rectifier 40. This action opens contacts 51 and thereby opens the current path which first operated winding 46B. The winding still passes current because of holding contacts 52.

When winding 55 receives current, contacts 57 are closed and a circuit is completed from the upper terminal 27 of the A.C. supply, over conductor 38, through contacts 57, over conductor 58, through contacts 60, over conductor 61, through switches 26BL, and conductor 62, to winding 63, and conductor 37, to the lower terminal 27 of the A.C. supply. This action actuates relay 31, closing both its contacts to send alternating current through winding 28, starting motor 17A to move stack 10B to the left. The stack continues to move to the left until projections 26 of switches 26BL make contact with the edge of stationary stack 10A and the switches are opened. Relay 31 is now normalized as motor 17A stops. However, current still flows through winding 46B because of the holding circuit through contacts 52.

When switch 25B is first closed another circuit is completed which may be traced from the positive terminal of the rectifier, through contacts 48, over conductor 50, through contacts 51, switch 25B, diode 64, conductor 65, stepping relay winding 66, and conductor 47 to the negative terminal. This action attracts relay armature 67, lowering pawl 68, closing contacts 70 and 71, and opening contacts 72. When the stepping relay is operated the first time, contacts 70 and 71 are closed as long as the operator keeps button 25B depressed. However, no current flows through contacts 70 because they are in series with contacts 73 which are open at this time. Also, contacts 71 cause no action

because they are in parallel with closed contacts 48, operated by winding 74.

When the operator removes pressure from switch 25B it is opened and current is cut off from winding 66 thereby permitting armature 67 to return to its original position, moved by the force of spring 75. Pawl 68 turns the toothed wheel 76 and cam wheel 77 to close both contacts 73 and 78. During the time interval between the first and second actuation of switch 25B, when the operator is in the open aisle, relay winding 74 receives no current and contacts 48 remain closed.

When the stepping switch is operated the second time, contacts 70 and 71 are again closed. This time current is sent through contacts 73 to winding 74 to open contacts 48. When contacts 48 are opened, the locking circuit which includes contacts 52 is broken and current is removed from winding 46B normalizing all its contacts and restoring the control circuit to its original condition. The circuit is now ready for a second operator.

Now let it be assumed that the stacks are in the position shown in FIG. 2 and that an operator wishes to open the fourth aisle between stacks 10D and 10E. The operator depresses button 25D, sending current through winding 46D by way of contacts 48, conductor 50, contacts 51, conductor 45, contacts 25D, winding 46D, to conductor 47 and the negative terminal. This action operates the relay closing contacts 82 and 83 and opening contacts 84 and 85. Contacts 82 are locking contacts as described above and retain current in winding 46D after switch 25D is opened. Contacts 83 are the operating contacts and they control the circuit to activate all three motors 17A, 17B, and 17C to move the three stacks 10B, 10C, and 10D to the left to open the desired aisle.

When contacts 83 are closed, they complete a circuit which may be traced from the rectifier positive terminal over conductor 56, through relay winding 55, contacts 83 to the negative terminal. This action closes contacts 57 and activates a circuit from the A.C. upper terminal 27, over conductor 38, through contacts 57, conductor 58, contacts 60, 86, and 87. Conductor 88 and 90 are now connected to the A.C. power line, but at this time all the safety switches 26 are held open except 26BL. Current from contacts 60 flows over conductor 61 through safety switches 26BL, then over conductor 62 to winding 63 in relay 31, closing all its contacts and starting motor 17A to move stack 10B to the left. Contacts 41 are closed at this time and a bypass circuit can be traced from conductor 62 through contacts 41, then over conductor 91, contacts 92, conductor 93, to winding 89 in relay 33, activating it and starting motor 17B to move stack 10C to the left. When relay 33 is activated, contacts 42 are closed and another bypass circuit is completed which can be traced from conductor 93, through contacts 42, over conductor 94, through contacts 95, and conductor 96 to winding of relay 35 and the lower terminal of the A.C. supply 27. The two motor contacts on relay are closed and motor 17C is energized to move the third movable stack to the left. The net result is that all three stacks 10B, 10C, and 10D move together without separating to open the aisle between stack 10D and 10E. If button 25C had been depressed, stack 10D would not move because contacts 95 would then have been opened and the bypass circuit over conductor 96 would be open and relay 35 would not be activated.

If all three movable stacks 10B, 10C, and 10D are in the left position with an open aisle between 10D and 10E, the movement of the stacks to the right is similar to the action described above because the corresponding circuits are similar. To move stack 10D to the right, button 25C is depressed and winding 46C receives current, closing contacts 100 and 101, and opening 87, 102, 103, and 95. As before, contacts 100 are holding contacts, while contacts 101 send a D.C. current through winding 55, closing contacts 57. The A.C. power then flows through contacts 57 and 84 to conductor 104 and switches 26DR, the only safety switches that are now closed. The current continues over conductor 105 to winding 106 in relay 36. The two motor contacts are closed and motor 17C then moves stack 10D to the right to open an aisle between stacks 10C and 10D. In this case the motion of a single stack does not require the use of a bypass pair of contacts nor a bypass conductor.

If all three movable stacks are on the left and the operator depresses the 25A button to move all three movable stacks to the right, the motor 17C will be energized as described above. Motors 17A and 17B are energized as follows: When relay winding 46A is activated by switch 25A, contacts 107 and 108 are closed and contacts 60 are opened. This action sends A.C. power through contacts 57, over conductor 58, through contacts 84, 102, and 79, thereby applying voltage to conductors 104, 110, and 111. Since safety switches 26DR are the only switches closed at this time conductor 104 is the only conductor of this group carrying current. When motor relay 36 is activated to start motor 17C, contacts 44 are closed and another bypass circuit is completed. This circuit can be traced from conductor 105 and contacts 44, over conductor 112, to contacts 85, then over conductor 113 to winding 114 in relay 34, to activate the relay, close the motor contacts and start motor 17B. The actuation of relay 34 closes contacts 43 and completes another bypass circuit which can be traced from conductor 113 and contacts 43, over conductor 115, through contacts 103, then over conductor 116 to winding 117 in motor relay 32, to activate the relay, close the two motor contacts and start motor 17A to move stack 10B to the right. The three stacks 10B, 10C, and 10D move to the right together and when safety switches 26DR are opened by contact with the face of stack 10E, the entire motor circuit is disabled, stopping all three motors.

The depression of button 25B, when all three movable stacks are in the left position, moves two stacks 10C and 10D by circuits which are similar to the ones described above.

The embodiments of the invention, in which an exclusive property or privilege is claimed, are defined as follows:

1. In a shiftable storage means including a plurality of movable stacks, supporting means for each of said stacks, including a reversible electric motor and two relay means for each of said stacks for controlling the direction of the motors and stacks, and a plurality of safety switches secured to the sides of each movable stack for cutting off the current to the motors when the

stacks move too close to each other; the improvement which comprises: a normally open pair of relay contacts mounted on one of said relay means for completing a bypass circuit around a safety switch on an adjacent stack for permitting both stacks to be moved in unison in a desired direction to open a space between stacks.

2. A storage means as claimed in claim 1 wherein said normally open contacts are closed whenever the relay, on which said contacts are mounted, is activated.

3. A storage means as claimed in claim 1 wherein all the safety switches are each respectively connected in series with an operating winding on said relay means for stopping the motor whenever a stack closes an access aisle and its safety switch is operated by contact with the adjacent stack.

4. A storage means as claimed in claim 1 wherein said bypass circuit includes the winding of said relay means, a pair of normally closed contacts on a second relay that remains unactuated during a shifting operation, said normally open contacts, the closed safety switch adjoining the open aisle, and a source of alternating current power.

5. A storage means as claimed in claim 1 wherein one of said relay means for controlling the direction of the motors applies A.C. power to send the stack in one direction and the other of said relay means for controlling the same motor applies A.C. power to send the motor in the reverse direction.

6. A storage means as claimed in claim 5 wherein one of said normally open relay contacts is mounted on each one of said relay means except the relay means that controls the left hand movable stack to move to the right and the relay means that controls the right hand movable stack to move to the left.

7. A storage means as claimed in claim 1 wherein there are two safety switches mounted on each side of each of the movable stacks, said switches being connected in parallel.

8. In a shiftable storage means including a plurality of movable stacks, supporting means for each of said stacks including a reversible electric motor and two relay means for applying A.C. electrical power to the motors to control their motion and direction, two safety switches secured to each side of each movable stack for cutting off the A.C. power to the motors when the stacks move too close to each other; the improvement which comprises: a normally open pair of relay contacts mounted on each of said relay means except the relay means that controls the left hand movable stack to move to the right and the relay means that controls the right hand movable stack to move to the left; each of said pair of relay contacts connected to a bypass circuit around a safety switch for supplying control power to an adjacent stack for permitting both stacks to be moved in unison in a desired direction to open a space between stacks; said bypass circuit including the winding of said relay means, a pair of normally closed contacts on a second relay that remains unactuated during a shifting operation, the closed safety switch adjoining the open aisle, and a source of A.D. power.

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Notice of Adverse Decision in Interference

In Interference No. 100,955, involving Patent No. 3,865,446, P. P. J. Mastronardi, STORAGE MEANS WITH SHIFTABLE UNITS, final judgment adverse to the patentee was rendered May 3, 1983, as to claims 1-6 and 8.
[*Official Gazette July 12, 1983.*]