June 6, 1961 H. INGOLD 2,987,200

STORAGE SYSTEM

Filed Jan. 23, 1959 4 Sheets-Sheet 1

Fig. 1

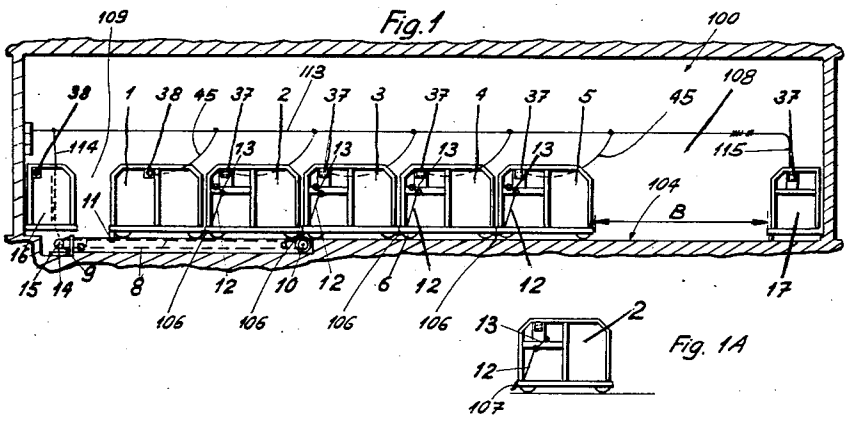


Fig. 1A

Fig. 2

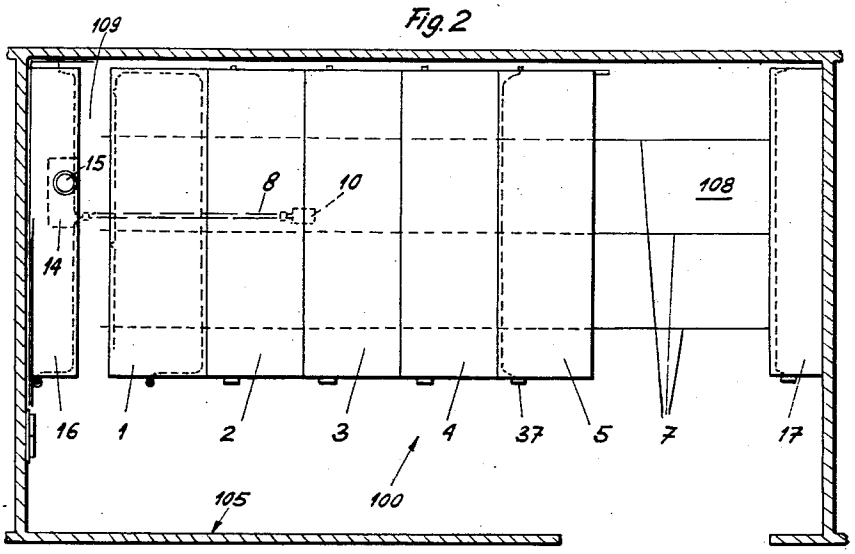
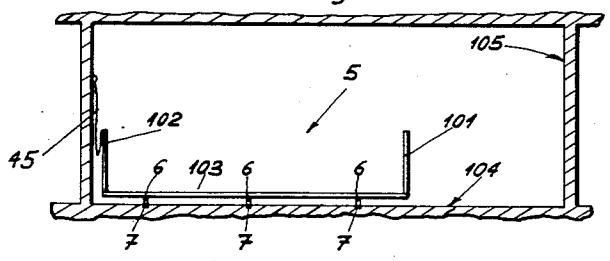


Fig. 3



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STORAGE SYSTEM

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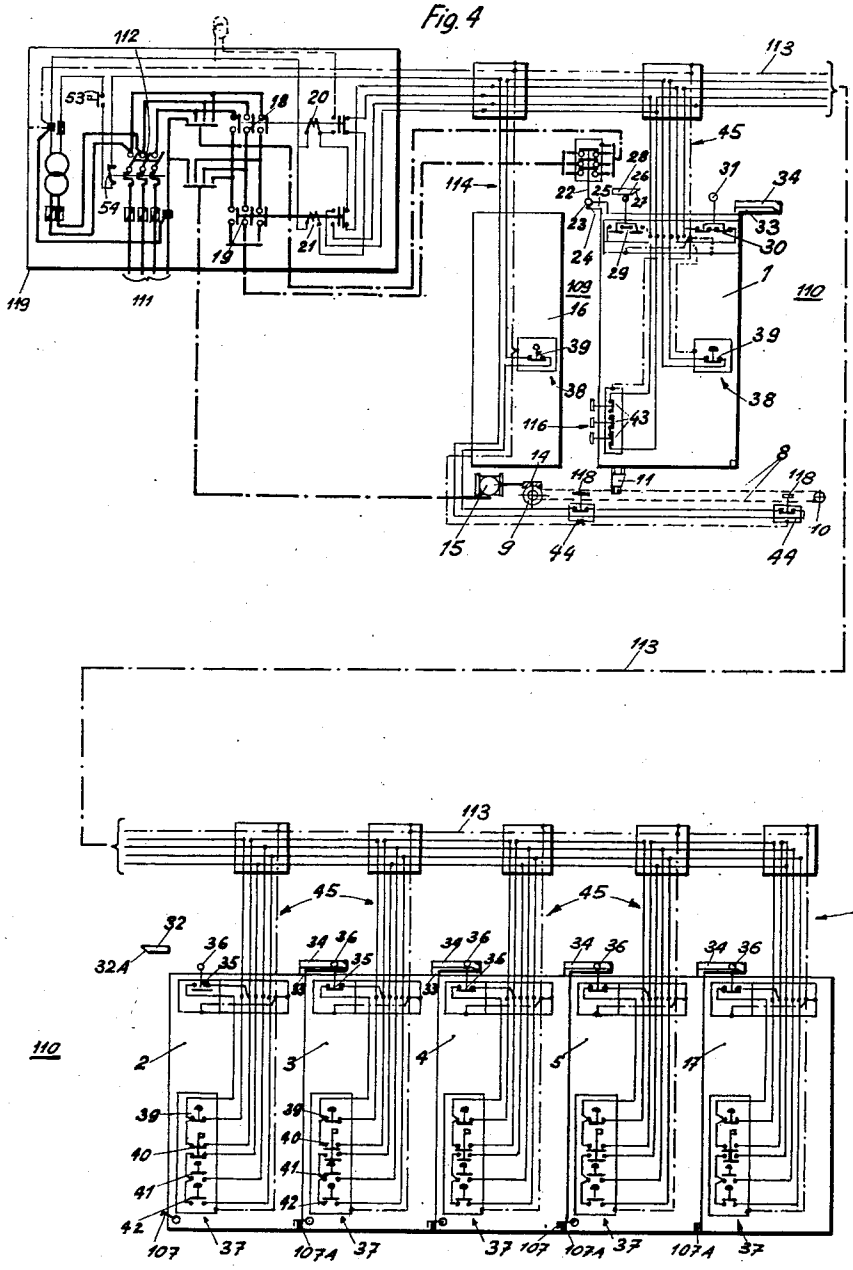
Fig. 4



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STORAGE SYSTEM

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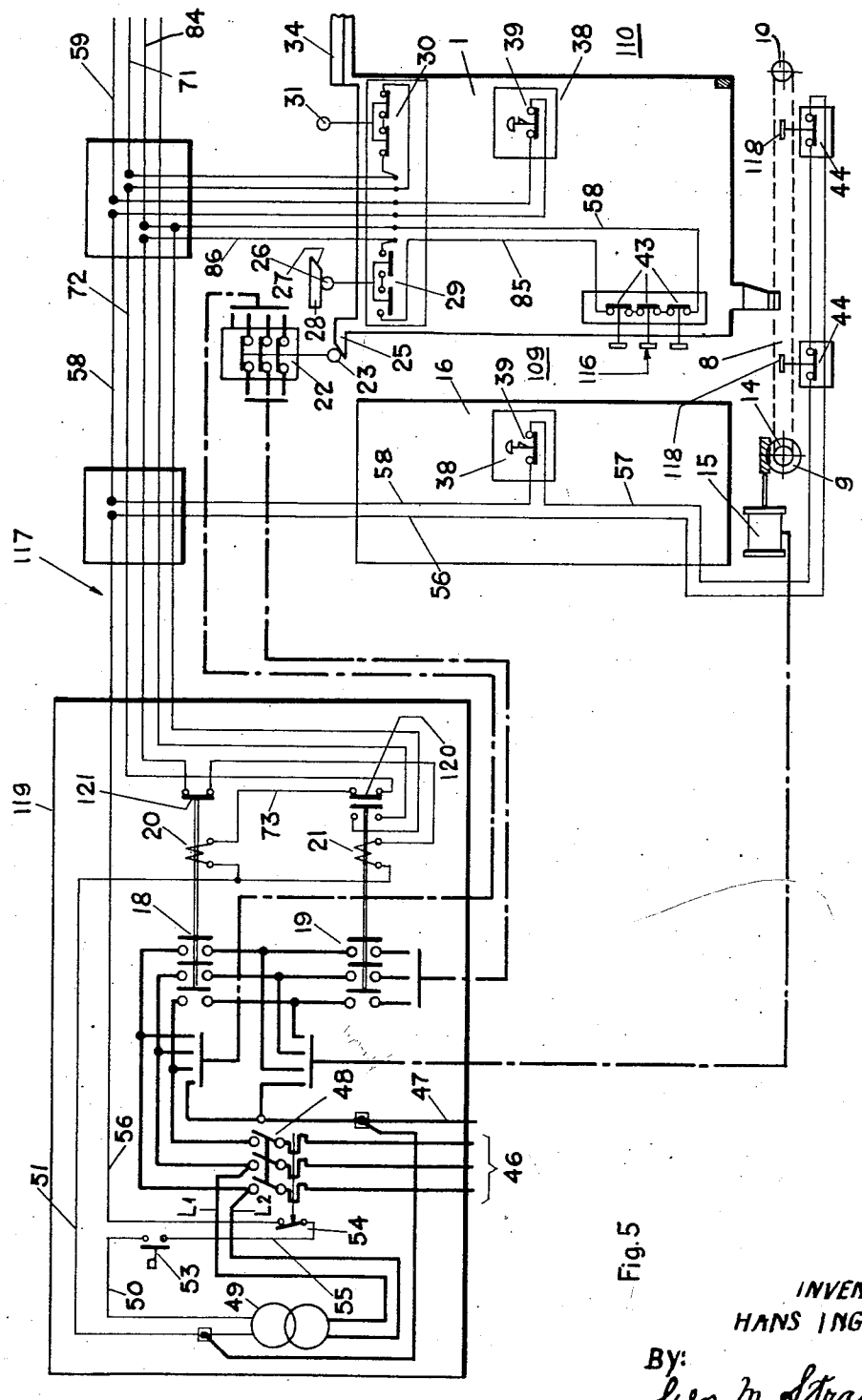

Fig. 5

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STORAGE SYSTEM

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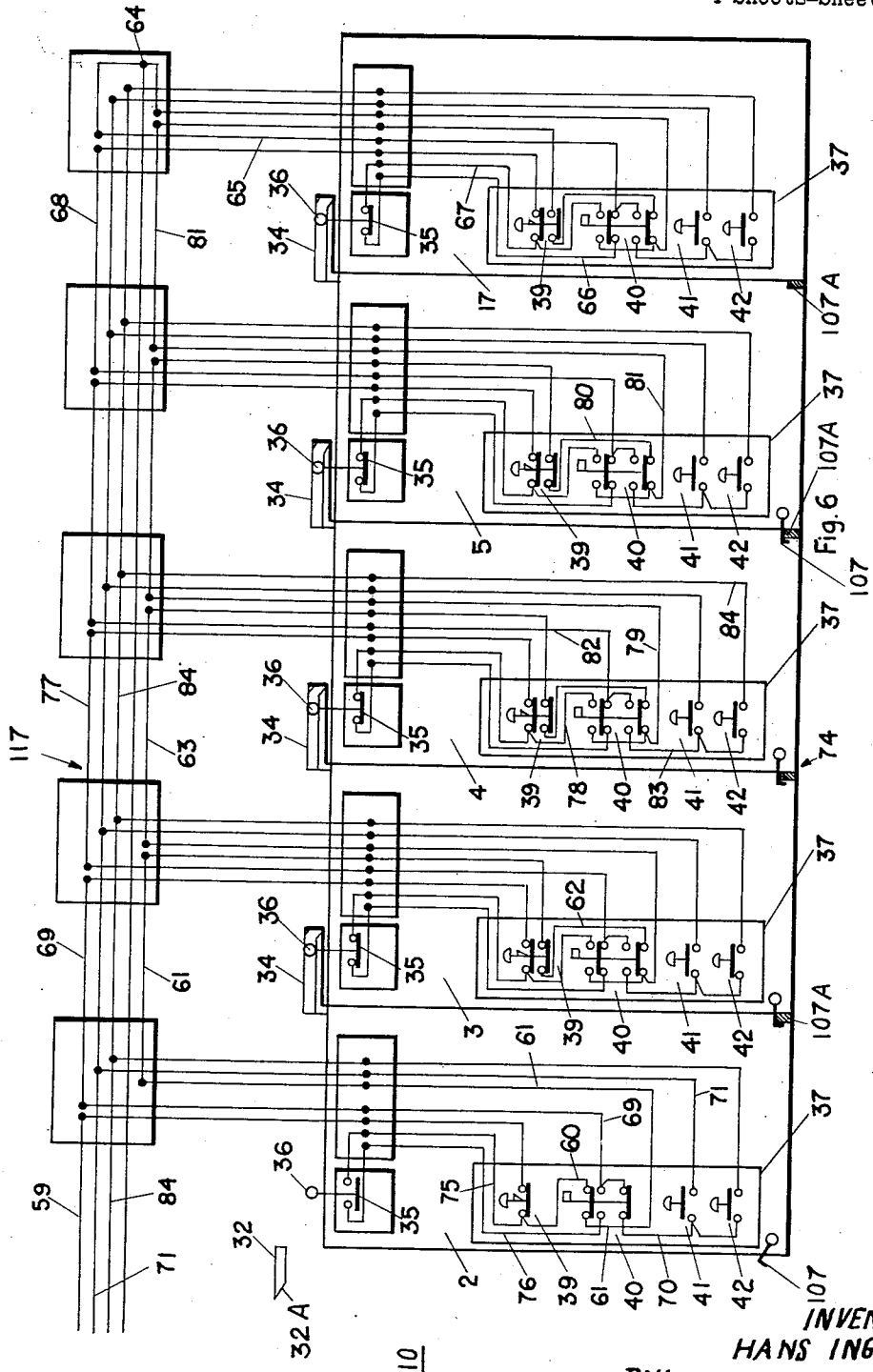

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United States Patent Office 2,987,200 Patented June 6, 1961

2,987,200

STORAGE SYSTEM

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Claims priority, application Switzerland Jan. 24, 1958
5 Claims. (Cl. 214—16)

The present invention relates, in general, to a storage system and, in particular, to a storage system in which a plurality of movable storage receptacles or containers are selectively movable to provide an access corridor or opening between adjacent receptacles.

There are known prior art storage systems in which a number of movable containers are disposed adjacent one another and these containers can be selectively shifted to provide an access corridor between any two of the containers. Such systems are provided with a drive mechanism which comprises an electric motor which drives a toothed rail or rack which is engaged with a worm gear. The rack extends over the maximum length of the storage system and serves as a coupling member, each container being connectable with the drive motor. Such systems are both complicated and expensive due to the fact that the drive member or rack extends over the entire length of the system.

It is an object of the present invention to provide means which serve to attain the elimination of the disadvantages of the prior art storage systems.

It is another object of the present invention to provide a storage system which is of generally simplified construction and relatively inexpensive to construct and maintain.

It is another object of the present invention to provide a storage system which is so constructed that the effective length of the drive mechanism is substantially equal to the maximum width of the access corridor which can be defined between any pair of adjacent storage receptacles.

It is another object of the present invention to provide a storage system in which the coupling mechanisms between adjacent mechanisms need not serve to connect the receptacle with a drive member.

It is another object of the present invention to provide a storage system in which an unauthorized individual cannot effect the movement of the receptacles so as to prevent injury to individuals in an access corridor who are unaware that the receptacles are about to be displaced.

It is a further object of the present invention to provide a storage system of the described type which is key operated but which cannot be operable if two operators attempt simultaneous key control from different parts thereof.

These and other objects of the invention will become further apparent from the following detailed description, reference being made to the accompanying drawings showing preferred embodiments of the invention.

In the drawings which illustrate the best modes presently contemplated for carrying out the invention:

FIG. 1 is an end elevation, in section, of a storage system pursuant to the present invention;

FIG. 1A is a detail view illustrating one of the movable receptacles shown in FIG. 1;

FIG. 2 is a top plan view of the system illustrated in FIG. 1;

FIG. 3 is an end view of one of the receptacles;

FIG. 4 is a wiring diagram illustrating the circuit for controlling the operation of the system illustrated in FIG. 1; and

FIGS. 5 and 6, placed end to end, together constitute a wiring diagram similar to FIG. 4, but in modified form.

Referring now to FIGS. 1 through 4 of the drawings in detail, there is shown a storage system **100**, pursuant to the present invention, which, generally speaking, is characterized in the provision of one movable storage container or receptacle which is fixedly coupled to a drive mechanism, a plurality of such containers being interconnectable, said drive mechanism having an effective length substantially equal to the maximum distance of displacement of said receptacles and as shown in FIG. 1 being longer than the width of two adjacent containers, and provision being made for control and locking means to operate said system.

As best shown in FIGS. 1 and 2, the system **100** is provided with five movable storage receptacles or containers designated **1**, **2**, **3**, **4** and **5**, respectively. Each container has a front end wall **101**, a rear end wall **102** and a base **103**. The base is provided with three casters or wheels **6**, equally spaced widthwise thereof, which ride on rails **7** provided on the floor **104** of a storage room **105**. Each unit may be provided with trays (not illustrated) or similar devices for storing, for example and not by way of limitation, books, files, etc.

A drive device or mechanism for the system is mounted within or under the floor **104**. As here shown, the drive or traction mechanism comprises a sprocket chain **8** which extends in a direction transversely of the receptacles, as best seen in FIG. 2.

The chain is trained over a pair of spaced sprocket wheels **9** and **10** which are mounted in horizontal relation with one of the sprocket wheels being adjustably displaceable relative to the other to tension the chain.

The first receptacle **1** is fixedly secured to the chain, as at **11**, so as to serve as a motive or drive receptacle for the remaining movable receptacles **2**, **3**, **4** and **5**. The latter receptacles are connectable individually one to another, with the receptacle **2** being connectable to the drive receptacle. This is effected by means of coupling mechanisms **106** operative between the movable receptacles. Said coupling mechanisms include a pivotally mounted coupling hook **107** at the front of each of the receptacles **2**, **3**, **4** and **5** which is pivotally movable by a control rod **12** mounted laterally thereof on the same receptacle. Each control rod is operable by a reversible handle **13** so as to raise the companion coupling hook **107** from the inoperative or decoupling position thereof shown in FIG. 1A to a raised or coupling position. It will be understood that each coupling hook **107** is beveled at its front or free end so that in coupling position, a companion catch ratchet **107A** of an oncoming receptacle runs onto the hook so that the catch ratchet is forced up and falls down over the coupling nose of the hook, whereby coupling is effected. It will be understood that catch ratchets are provided at the rear of each of receptacles **1**, **2**, **3** and **4**.

In addition to the five movable receptacles, provision is made for a front stationary receptacle **16** and a rear stationary receptacle **17** with the receptacles **1** to **5** being movable therebetween. In the disposition of the receptacles shown in FIGS. 1 and 2, an access corridor **108** is formed between receptacles **5** and **17** with said corridor or opening being of maximum width, as indicated by the reference character B. It will be understood that the effective length of the sprocket chain or drive traction member **8** exceeds width B by a relatively small amount, for example and not by way of limitation, by 10%. In addition, it will be noted that a safety corridor or access opening **109** is provided between the drive receptacle **1** and the front end receptacle **16** in which a person can move without danger.

The sprocket chain **8** extends beyond the front of receptacle **1** and is driven by the previously mentioned

sprocket wheel 9. A transmission gear 14 positively connects the wheel 9 to an electric drive motor 15.

The position of receptacles 1 to 5 illustrated in FIGS. 1 and 2 is a service position in which all of the receptacles are pulled forward.

This provides an access opening 108 from which access may be had to the rear of receptacle 5 or to the rear stationary receptacle 17 in order to remove articles therefrom or to supply articles thereto. The various movable receptacles are all connected together in tandem by the coupling devices 106 therebetween.

Referring now to the wiring diagram illustrated in FIG. 4, there is shown another position of the receptacles in which receptacles 2 to 5 are moved up to the rear stationary receptacle 17, while the drive receptacle 1 is in its front end position, the same as in FIG. 1, so as to provide an access opening 110 between the rear of receptacle 1 and the front of receptacle 2.

Motor 15 is of the reversible type. The motor energizing circuit includes a switch 19 for forward rotation or operation of the motor and a switch 18 for reverse or rearward rotation or operation thereof. Switch 18 is operable by a relay 20 and switch 19 is operable by a relay 21. When the drive receptacle 1 reaches its front end position, as shown in FIGS. 1, 2 and 4, the motor control circuit is automatically opened.

In this position, a control roller 26, mounted on receptacle 1, runs onto the inclined surface 27 of a control nose 28, which is mounted rearwardly of stationary receptacle 16, as shown in FIG. 1, and opens a control circuit switch 29. In addition, an emergency limit switch 22 is provided to halt the forward operation of the motor 15. Switch 22 has a control roller 23 which is raised by the inclined surface 24 of a control nose 25 provided on receptacle 1 when the latter reaches its forwardmost end position, whereby to interrupt the main circuit of the motor. Said main circuit is shown in heavy line in FIG. 4 and extends from the current-supply 111, through the manual On-Off switch 112, and the forward and reverse relay switches 19 and 18, to the motor.

A limit switch 30 is provided for the reverse operation of the motor. Said switch has a control roller 31 which in the rear end position of drive receptacle 1 runs onto a fixed control nose 32 (shown in the lower half of the figure) which guides the roller downwardly and opens switch 30 in the motor control circuit.

Each movable receptacle is provided on its rear with a control extension 33 having a control groove 34. In addition, receptacles 2 to 5 and 17 are each provided at the front therof with a limit switch 35 having a control roller 36. Each receptacle has a switchboard or panel, which is indicated at 37 for receptacles 2 to 5 and 17, and at 38 for receptacles 1 and 16. Each panel 37 has four switches 39, 40, 41 and 42. Switch 39 is of the pushbutton type and functions as an emergency switch. Operation of switch 39 opens the control circuit for the drive motor 15 and deenergizes the latter. Switch 40 is a key operated twin switch which can be closed only with a key. A single key for operating switch 40 is given to the operator of the system 100. Switch 41 is a pushbutton type stop switch. Operation of switch 41 closes the control circuit for the reversing relay 20. Switch 42 is also a pushbutton type and operation thereof closes the control circuit for the forward relay 21.

Key switch 40 is connected in parallel with switch 35 so that its operation is effective only when switch 35 is open.

However, this is the case only for the receptacle which closes an access opening between two receptacles, where the closing receptacle is moving in a forward direction, as toward receptacle 16, to effect the closing, as is illustrated in FIG. 4, where in order to close opening 110, receptacle 2 must move forwardly, it being noted that its switch 35 is open. This permits supervision by the operator of the access opening being closed so that a person cannot be pinned between the closing receptacles.

The panels 38 of the drive receptacle 1 and the stationary end receptacle 16 are each equipped with an emergency switch 39 which can be operated to deenergize the drive motor and stop movement of the system. The lines from the panels on each of the movable receptacles are formed into a freely suspended cable 45 which permits for the movement of the particular receptacle. Each cable 45 is suspended from a main overhead cable which extends from the power source 111 over the entire system, the panel on receptacle 16 being connected thereto by cable 114 and the panel on receptacle 17 being connected thereto by cable 115.

As an additional safety feature, shielding slats 116 project from the front of receptacle 16 into the safety corridor 109 between receptacles 1 and 16. These slats operate switches 43 in the control circuit for motor 15 when they are depressed by contact with a person standing in the corridor to deenergize the motor and prevent operation of the system.

System 100 operates as follows:

Assume that the receptacles are in the position thereof shown in FIG. 4 with an access corridor opening 110 defined between receptacles 1 and 2 and the system is to be brought into the condition thereof with the access opening 110 closed and the receptacles 1 to 5 coupled together, as shown in FIG. 1.

When the work in corridor 110 is finished and the corridor is empty, the operator of the system inserts his switch key into the keyhole of switch 40 of receptacle 2 and turns the key to close the switch, the opening 110 being visible to him. If he now depresses the pushbutton of switch 41, the closing control circuit for motor 15 is closed so as to energize relay 20 which closes switch 18. Motor 15 begins to operate and drives the chain 8 so that receptacle 1 is moved rearwardly toward receptacle 2.

When the pushbutton of switch 41 is released, the control circuit is opened to deenergize relay 20 and to open switch 18. The system becomes stationary. With the closing of the opening 110 by rearward movement of receptable 1, the receptacles 1 to 5 are connected together and the motor 15 is deenergized since the roller 31 of the limit switch 30 on receptacle 1 has run onto the inclined surface of the stationary member 32 to open the limit switch. At the same time, roller 36 on the front limit switch 35 of the receptacle 2 has ridden up into the control groove 34 of the rearwardly extending projection 34 on receptacle 1 to close switch 35 on receptacle 2. The system is now in closed condition. The coupling handles 13 are all tilted to the left, as shown in FIG. 1, so that all the receptacles 1 to 5 are coupled together. The switch key in switch 40 is now turned and withdrawn therefrom.

If it is then desired to open a corridor between receptacles 5 and 17, one of the key operated switches on the receptacles 1 to 5 is closed and the pushbutton switch 42 on the same receptacle is depressed. This closes the opening control circuit for motor 15 to energize relay 21 to close the forward operating switch 19 which closes the main circuit for motor 15.

Motor 15 rotates and drives chain 8, via transmission gear 14, in such a direction that the coupled receptacles 1 to 5 move to the left, or forwardly, viewing FIG. 1. When the pushbutton of the depressed switch 42 is released, the receptacle train halts. However, if the pushbutton is maintained depressed, the receptacle train continues in a forward direction until the limit switch roller 26 of the forward limit switch 29 on receptacle 1 runs onto the inclined plane 27 of the fixed control member 28 to open limit switch 29 whereby to interrupt the control current flow and halt the system. At this moment the maximum corridor width B between receptacles 5 and 17 has been attained, as shown in FIG. 1. To close the access opening 108, the drive motor 15 can be operated, as previously explained, only from the panel of receptacle

17 from which the operator can observe corridor 108. Depression of one of the emergency pushbutton switches 39 immediately stops movement of the receptacles.

Due to the fact that the receptacles 1 to 5 may be all coupled together when not in use, as in FIG. 1, and due to the fact that an access opening can be created between any pair of receptacles as needed, much space can be saved in the room 105 where the receptacles are located.

For example, said room may be a library, a file room or a stock room. Said space saving provides for an increase of the number of receptacles which can be used in any fixed room and a consequent increase in storage capacity.

The system 100 has the advantage of greater simplicity over the prior art systems of the same general type because the drive mechanism is much smaller and the coupling devices can be made extremely simple since they serve only to intercouple adjacent receptacles and need not intercouple the receptacles and the drive mechanism.

In such a system, it is of utmost importance that unauthorized individuals must not be able to operate the system to prevent injury to people in an access corridor which may be closed without their knowledge. Consequently, it will be apparent that in the described system provision is made for locking means in the form of the key operated twin switches 41 which must be closed before the control means for the system can be operated. There should be only a single key available which must be entrusted to one individual who must assume the responsibility that no accident of the described type will occur.

In the described system this results from the fact that as long as the system is in an inoperative condition and has an open access corridor, the locking switch can be opened only at a single receptacle, namely the receptacle which defines one side of the corridor. Since the locking switch can be operated only at this special receptacle, it is not possible to move a receptacle which does not define one side of the corridor so as to close the corridor without the operator having full vision thereof.

As long as there is only a single key outstanding, such a system operates correctly and safely. However, there exists the possibility that a reserve key is given out and used without authorization, or that the system is otherwise manipulated in such a manner that it can be controlled simultaneously from another point away from the access opening. Such an undesired operation can be completely eliminated with a system of the type illustrated in FIGS. 5 and 6 wherein the reference numerals which are similar to those used in FIGS. 1 through 4 indicate similar parts.

The system 117 shown in FIGS. 5 and 6 comprises a fixed left receptacle 16 and a fixed right receptacle 17, between which are provided the movable receptacles 125, with the receptacle 1 connected to the motor 15 through the drive mechanism which includes the chain 8.

In the illustrated condition of the receptacles, the receptacle 1 is close to the fixed receptacle 16 while the other movable receptacles 2 to 5 are unlocked at the fixed receptacle 17 so that an access opening 110 is defined between receptacles 1 and 2. Each movable receptacle is provided at its upper right edge with an extension or track 34 in which a limit switch roller 36 mounted on the adjacent receptacle to the right thereof can run. Track 34 and roller 36 are so adapted to each other in height that when the roller is in raised position the limit switch 35 is closed. However, when an access opening is formed between two receptacles, the roller 36 returns to its lowermost position, and its limit switch 35 is opened. Consequently, it will be noted that the track 34 on receptacle 1 is not engaged with the roller 36 on receptacle 2 so that switch 35 on receptacle 2 is open. However, track 34 on each of receptacles 2 to 5 is engaged with the roller 36 on each of receptacles 3 to 17, respectively, so that switches 35 of receptacles 3 to 17 are closed.

The movable receptacle 1 is connected with the traction chain 8 which can be driven in either direction by the drive motor 15 via transmission gear 14, dependent upon the reversal of the switches connected with the respective receptacles, as hereinafter described in detail. In order to disclose a chain rupture, the chain 8 is guided in a channel in the bottom of which there is provided a number of switches 44. Each switch has a projecting plunger 118 which underlies the chain so that upon rupture the chain engages the plunger 118 and the weight thereof opens the switch. It will be noted from FIG. 4 that a similar arrangement is provided in system 100.

To start the motor 15 in forward or reverse direction, as well as to stop the motor, two additional motor switches 18 and 19 are disposed in the stationary portion 119 of the system, as in FIG. 4. These motor switches are operated by relays 20 and 21, respectively, whose energizing circuits are connected to the main network which includes lines leading to switch contacts at the various receptacles and lines connected in series with the various receptacles across switch contacts thereof.

Receptable 1 is provided with a control roller 31. In one end position of this receptacle, in which it abuts receptacle 2, roller 31 rides onto an inclined surface 32A of a stationary rail 32 to open the limit switch 30. In order to limit movement of receptacle 1 to the left, viewing FIG. 5, in which position it is adjacent stationary receptacle 16 provision is made for a second limit switch 22 having a control roller 23 which is engaged by an extension or rail 25 at the forward side of receptacle 1.

Receptacles 2 to 5 and 17 are provided with a control panel 37, and receptacles 1 and 16 each have a control panel 38. Panels 37 each have four switches designated 39, 40, 41 and 42. Each panel 38 has a single switch 39 which functions as an emergency or safety switch. Operation of a pushbutton switch 39 opens a control circuit to deenergize motor 15. Switches 40 are operated with keys so that they can be closed only by the individual possessing the special key, namely the operator of the system. Consequently, it is the function of the present system to provide against incorrect or undesired manipulation of the receptacles as where several keys could be used simultaneously by different individuals in the same system.

Switches 41 are pushbutton operated plug switches which remain in the depressed position. The operation thereof closes the control circuit for relay 20. Switches 42 are of the same type and close the control circuit for relay 21.

The receptacle 1 is additionally provided at its front surface with shielding slats 116 which operate switches 43 to interrupt the control circuit so as to deenergize the motor 15 or to prevent energization thereof when the slats are pressed into the receptacle by a person who may be present in corridor 109 between receptacles 1 and 16. The switches 43 are in series with a special limit switch 29. The latter is provided with a control roller 26 which is operated by an inclined surface 27 on a control member or rail 28 when the receptacle 1 reaches its extreme left-hand position, as shown in FIG. 5, so that the switch 29 is opened. The system is fed by a three-phase network 46 having a grounded conductor 47 and connected across a main switch 48. Two lines L1 and L2 lead from the output side of switch 48 to a transformer 49 to provide low voltage operating current for the relay circuits via lines 50 and 51. Line 51 is connected directly with a grounded conductor 47. Line 50 extends through a switch 53 arranged for key operation and also over a thermal overload relay 54 which is part of the main switch 48.

System 117 operates as follows:

In the initial position, receptacle 1 is adjacent receptacle 16 with the receptacles 2 to 5 and 17 pushed together to form an access corridor 110 between receptacles 1

and 2. From this initial position a corridor will be formed between receptacles 1 and 16 with receptacles 1 and 5 arranged in a closed train abutting receptacle 17. It is assumed that network 46 is energized and that switches 48 and 53 are closed when operation begins.

In the initial position roller 36 on receptacle 2 is disengaged from the groove in rail 34 on receptacle 1 so that limit switch 35 on receptacle 2 is opened while the limit switches 35 of receptacles 3 to 5 and 17 are closed. The operator now inserts his key into switch 40 of receptacle 2. Panel 37 of this receptacle is so located that the operator has full vision into corridor 110 so that he can see if anyone is in the corridor. As the key is turned, switch 40 in receptacle 2 is moved into the illustrated position while said switches in receptacles 3 to 5 and 17 remain in their inoperative positions.

The operator now depresses the button of switch 41 in the panel of receptacle 2 so that the energizing circuit of relay 20 is closed as follows:

The circuit extends from line 50 through switch 53, line 55, switch 54, line 56 through the two closed rupture switches 44, through line 57, through the safety switch 39 on the panel of receptacle 16 to line 58. The latter has a branch to panel 38 of receptacle 1 where the circuit continues across the safety switch 39 of receptacle 1 to line 59. From the latter it extends across the safety switch 39 of receptacle 2, through line 60, through the upper contact bridge of the key-operated switch 40 which is shown in its operated position in receptacle 2, to line 61 and from the latter to the panel of receptacle 3. Since from this point the circuit passes through the panels of receptacles 3, 4, 5 and 17 in exactly the same manner it will suffice to trace the circuit through the panel of receptacle 3.

The circuit extends from line 61 across the lower of the two contact bridges of safety switch 39 to line 62 and through the lower contact bridge of switch 40 to line 63. After the circuit extends through the panels of receptacles 4, 5 and 17 in the same manner, it reaches the coupling point 64 from which it extends across line 65, over the upper contact bridge of contact 40 in receptacle 17, across line 66, through the closed limit switch 35, through line 67 and the upper contact bridge of switch 39 to line 68.

From line 68 the circuit extends in exactly the same manner through the panels of each of receptacles 5, 4 and 3 to line 69. From the latter it extends over the lower contact bridge of switch 40 in receptacle 2 through line 70, through switch 41 which is operated for movement of receptacle 1 to the right and through line 71 and across the limit position switch 30 in the panel of receptacle 1, which in its closed condition indicates that the receptacle is in its right-end position, through line 72 to the inoperative contact 120 of relay 21, which indicates that motor 15 is not running in the respective direction. The circuit continues through line 73 to one end of the coil-winding of relay 20. The other end of the winding is connected to line 51.

Relay 20 being energized closes the motor current switch 18 to energize motor 15 and move receptacle 1 to the right. Under normal conditions, the previously described circuit is not interrupted until the limit position switch 30 is interrupted upon engagement of its roller 31 with rail 32. Relay 20 is immediately deenergized and the motor halts. However, the described starting circuit for relay 20 extends for different purposes over various switches and contacts.

In the previously described system 100, the starting circuit comprises switch 53, which is designed as a key operated switch on the main panel of the system. Consequently, the circuit cannot be energized until the operator closes switch 53 with his key. The circuit of said system also includes the thermal overload relay switch 54. Consequently, if a solid object is located in the corridor the motor is loaded excessively to create an overcurrent which, after a short time, releases the overload protection and switch 54 is opened simultaneously with the main switch 48 to immediately stop the motor. Thereafter, the system cannot be restarted until switch 48 is closed manually.

As in the previously described apparatus, the circuit proceeds through all the safety switches 39 of the various receptacles. These switches are hand-operated without a key so that any one noticing a dangerous situation can stop all movement by pressing a switch 39 on any receptacle. However, if these were the only safety switches present it would be possible to set a receptacle in motion when it is undesirable for the operator. For example, the following might occur:

An individual has obtained a duplicate key to operate the system in the absence of the authorized operator. The authorized operator may wish to effect the described movement of the receptacles. For this purpose he inserts his key into switch 40 and turns it. He now notices that a person or object is present in corridor 110 between receptacles 1 and 2 and asks him to leave the corridor or remove the object before he sets receptacle 1 in motion by operation of switch 41. The other individual, in possession of the unauthorized key, now sets anyone of the key-operated switches 40 on another receptacle, for example receptacle 3, 4, 5 or 17 and then presses the button for switch 41 on this receptacle. Receptacle 1 will start to move and the person in the corridor may be injured.

To prevent this, the present system provides that the circuit for relay 20 extends in series over both contacts of switch 40 in one receptacle, namely receptacle 2, from which the operator has unobscured vision into the corridor, in the closed condition of these contacts, and also over the two contacts of switch 40 on all the other receptacles, which latter switches 40, however, are disconnected.

As a result, if a key is inserted into anyone of the last mentioned switches 40 and the switch is reversed, the energizing circuit for relay 20 is immediately opened. If this relay has not as yet pulled in, it cannot thereafter be energized, not even by pressing switch 41 on receptacle 2. However, if relay 20 has already pulled in, it drops again immediately thereafter. Consequently, any simultaneous use of two keys prevents operation of the system so that the authorized operator is immediately aware of the fact that an unauthorized key has been used.

After completion of the foregoing operation, receptacle 1 will abut receptacle 2 and the access opening will be located between receptacles 1 and 16.

Assume now that the operator wishes to provide an access opening between receptacles 3 and 4. This means that receptacles 1, 2 and 3 must be shifted jointly to the left, viewing FIGS. 5 and 6. The coupling 74 between the two receptacles 3 and 4 (comprising coupling elements 107 and 107A) is first opened, the key is then inserted in switch 40 of receptacle 4 and is turned, thereby automatically reversing switch 40. Pushbutton switch 42 on receptacle 4 is then depressed, whereby to close the following circuit for relay 21.

The circuit runs from line 50, through key switch 53, line 55, over current switch 54, line 56, chain rupture switches 44, line 57, safety switch 39 of receptacle 16, line 58, safety switch 39 of receptacle 1, line 59, the upper contact bridge of switch 39 in receptacle 2, line 75, contact 35 of receptacle 2, which is closed under the action of rail 34, line 76, the upper contact in switch 40 of receptacle 2, which is now closed after the key has been withdrawn, line 69, corresponding parts in receptacle 3, line 77, the upper contact bridge in safety switch 39 of receptacle 4, line 78, the upper contact bridge in safety switch 40 of receptacle 4, which is now closed after operation by the key, line 79, lower contact bridge in safety switch 39 of receptacle 5, line 80, the lower contact bridge in switch 40 of receptacle 5, line 81, corre-

sponding parts in receptacle 17, junction 64, line 65, the upper contact bridge of safety switch 39 of receptacle 17, line 68, corresponding parts in receptacle 5, line 82, lower contact bridge of switch 40 in receptacle 4, line 83, the now closed switch 42 of receptacle 4, line 58, contacts 43, line 85, limit switch 29, which is now closed, line 86, the inoperative contact 121 of relay 20, the winding of relay 21 and line 51.

Relay 21 is thus operated and closes the motor switch 19, the motor being set in operation and moving the receptacle 1, together with the receptacles 2 and 3 coupled thereto, to the left to open an access corridor between receptacles 3 and 4, until the described relay circuit is interrupted by operation of limit switch 29 to deenergize the motor.

In this case also, the circuit for relay 21 extends over the key-operated contact 40 on receptacle 4 and over the non-key operated contacts 40 on all the other receptacles, so that all movement is halted as soon as two switches 40 are operated simultaneously.

Various changes and modifications may be made without departing from the spirit and scope of the present invention and it is intended that such obvious changes and modifications be embraced by the annexed claims.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent, is:

1. In a storage system comprising a plurality of movable storage receptacles disposed in a row and selectively movable to define an access corridor between any two receptacles or at the outerside of either end receptacle, a drive mechanism for effecting said movement of the receptacles, means fixedly securing one of said receptacles to the drive mechanism, means to interconnect all of said receptacles whereby to effect said receptacle movement by movement of said one receptacle, means for limiting the extent of movement of said receptacles to a predetermined maximum displacement distance to thereby define the maximum widthwise dimension of said access corridor, said drive mechanism being dimensioned in accordance with said maximum widthwise dimension, individual controls for effecting forward and reverse movements, respectively, of said one receptacle, an electric motor for operating said drive mechanism, key-operated locking means on each of said receptacles to prevent unauthorized movement thereof, and circuit means for controlling the operation of said motor, said circuit means including said locking means and having means for deenergizing said motor if at least two of said locking means are simultaneously in locking condition.

2. In a storage system comprising a plurality of movable storage receptacles disposed in a row and selectively movable to define an access corridor between any two receptacles or at the outerside of either end receptacle, a drive mechanism for effecting said movement of the receptacles, means fixedly securing one of said receptacles to the drive mechanism, means to interconnect all of said receptacles whereby to effect said receptacle movement by movement of said one receptacle, means for limiting the extent of movement of said receptacles to a predetermined maximum displacement distance to thereby define the maximum widthwise dimension of said access corridor, said drive mechanism being dimensioned in accordance with said maximum widthwise dimension, individual controls for effecting forward and reverse movements, respectively, of said one receptacle, an electric motor for operating said drive mechanism, key-operated locking means on each of said receptacles to prevent unauthorized movement thereof, and circuit means for controlling the operation of said motor, said circuit means including said locking means and having means for deenergizing said motor if at least two of said locking means are simultaneously in locking condition, said locking means comprising switch devices provided in said circuit means.

3. In a storage system comprising a plurality of movable storage receptacles disposed in a row and selectively movable to define an access corridor between any two receptacles or at the outerside of either end receptacle, a drive mechanism for effecting said movement of the receptacles, means fixedly securing one of said receptacles to the drive mechanism, means to interconnect all of said receptacles whereby to effect said receptacle movement by movement of said one receptacle, means for limiting the extent of movement of said receptacles to a predetermined maximum displacement distance to thereby define the maximum widthwise dimension of said access corridor, said drive mechanism being dimensioned in accordance with said maximum widthwise dimension, individual controls for effecting forward and reverse movements, respectively, of said one receptacle, an electric motor for operating said drive mechanism, key-operated locking means on each of said receptacles to prevent unauthorized movement thereof, and circuit means for controlling the operation of said motor, said circuit means including said locking means and having means for deenergizing said motor if at least two of said locking means are simultaneously in locking condition, said locking means comprising switch devices provided in said circuit means, said switch devices being key-operated double switches in circuit with said individual controls so that the latter are operable only in the unlocked condition of said double switches.

4. In a storage system comprising a plurality of movable storage receptacles disposed in a row and selectively movable to define an access corridor between any two receptacles or at the outerside of either end receptacle, a drive mechanism for effecting said movement of the receptacles, means fixedly securing one of said receptacles to the drive mechanism, means to interconnect all of said receptacles whereby to effect said receptacle movement by movement of said one receptacle, means for limiting the extent of movement of said receptacles to a predetermined maximum displacement distance to thereby define the maximum widthwise dimension of said access corridor, said drive mechanism being dimensioned in accordance with said maximum widthwise dimension, individual controls for effecting forward and reverse movements, respectively, of said one receptacle, an electric motor for operating said drive mechanism, key-operated locking means on each of said receptacles to prevent unauthorized movement thereof, circuit means for controlling the operation of said motor, said circuit means including said locking means and having means for deenergizing said motor if at least two of said locking means are simultaneously in locking condition, said locking means comprising switch devices provided in said circuit means, said switch devices being key-operated double switches in circuit with said individual controls so that the latter are operable only in the unlocked condition of said double switches, and means to prevent the unlocking of said double switches except at a receptacle adjacent an access corridor.

5. In a storage system comprising a plurality of movable storage receptacles disposed in a row and selectively movable to define an access corridor between any two receptacles or at the outerside of either end receptacle, a drive mechanism for effecting said movement of the receptacles, means fixedly securing one of said receptacles to the drive mechanism, means to interconnect all of said receptacles whereby to effect said receptacle movement by movement of said one receptacle, means for limiting the extent of movement of said receptacles to a predetermined maximum displacement distance to thereby define the maximum widthwise dimension of said access corridor, said drive mechanism being dimensioned in accordance with said maximum widthwise dimension, individual controls for effecting forward and reverse movements, respectively, of said one receptacle, an electric motor for operating said drive mechanism, key-operated locking means on each of said receptacles to prevent

unauthorized movement thereof, circuit means for controlling the operation of said motor, said circuit means including said locking means and having means for de-energizing said motor if at least two of said locking means are simultaneously in locking condition, said locking means comprising switch devices provided in said circuit means, said switch devices being key-operated double switches in circuit with said individual controls so that the latter are operable only in the unlocked condition of said double switches, means to prevent the unlocking of

said double switches except at a receptacle adjacent an access corridor, and means to prevent the operation of said individual controls except at said adjacent receptacle.

References Cited in the file of this patent

UNITED STATES PATENTS

2,031,392	Taylor	Feb. 18, 1936
2,654,489	Ingold	Oct. 6, 1953
2,706,573	Ingold	Apr. 19, 1955
2,772,639	Ingold	Dec. 4, 1956