Sept. 21, 1971 S. SAUL 3,606,955

AUTOMATIC WAREHOUSING SYSTEM WITH MEANS CONTROLLING ELEVATOR MOVEMENT AND/OR LOAD CARRIER HORIZONTAL SPEED FOR STABILIZING LOAD CARRIER

Filed April 9, 1970 4 Sheets-Sheet 1

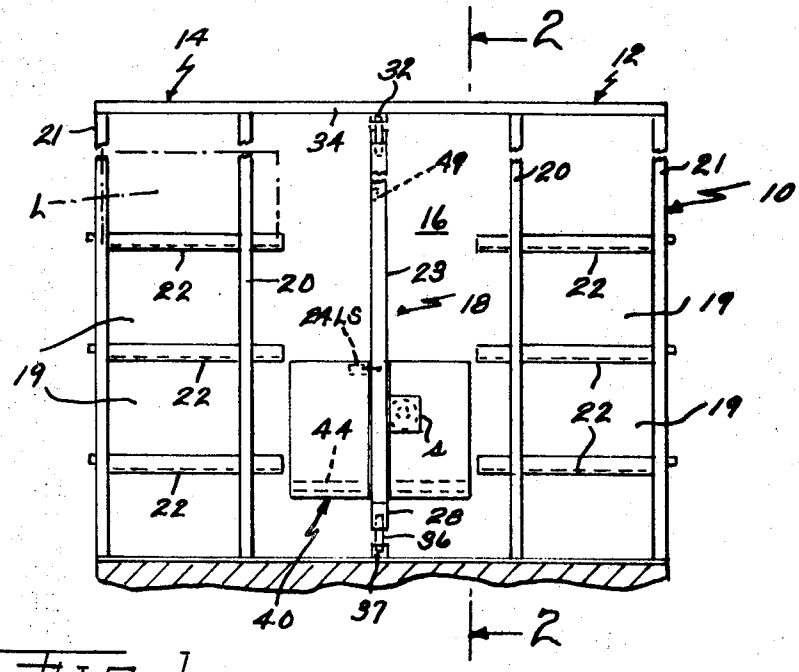



Fig. 1

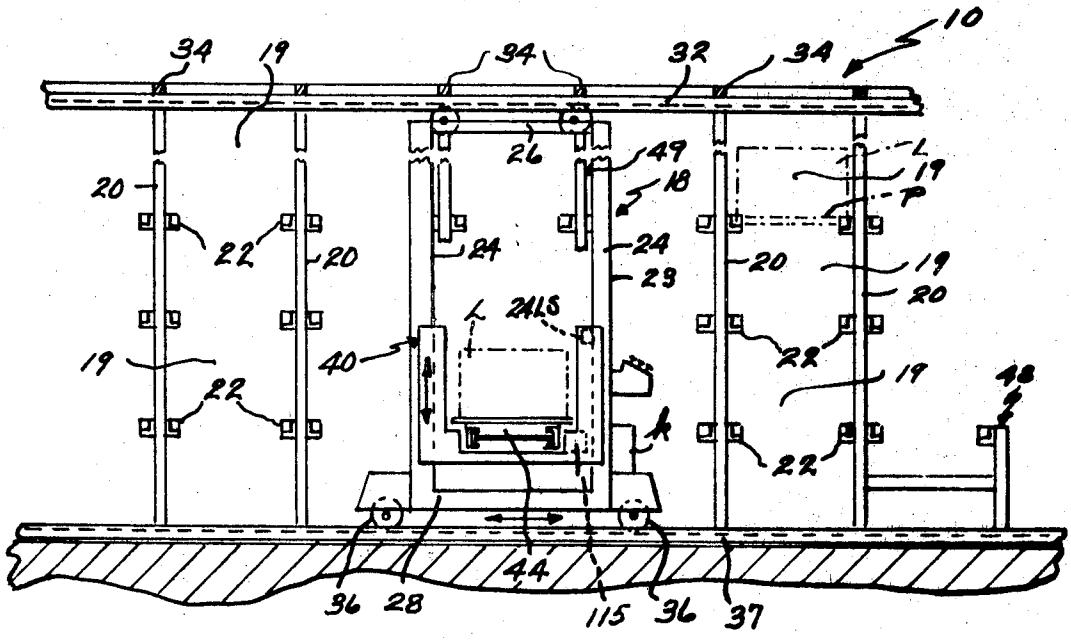



Fig. 2

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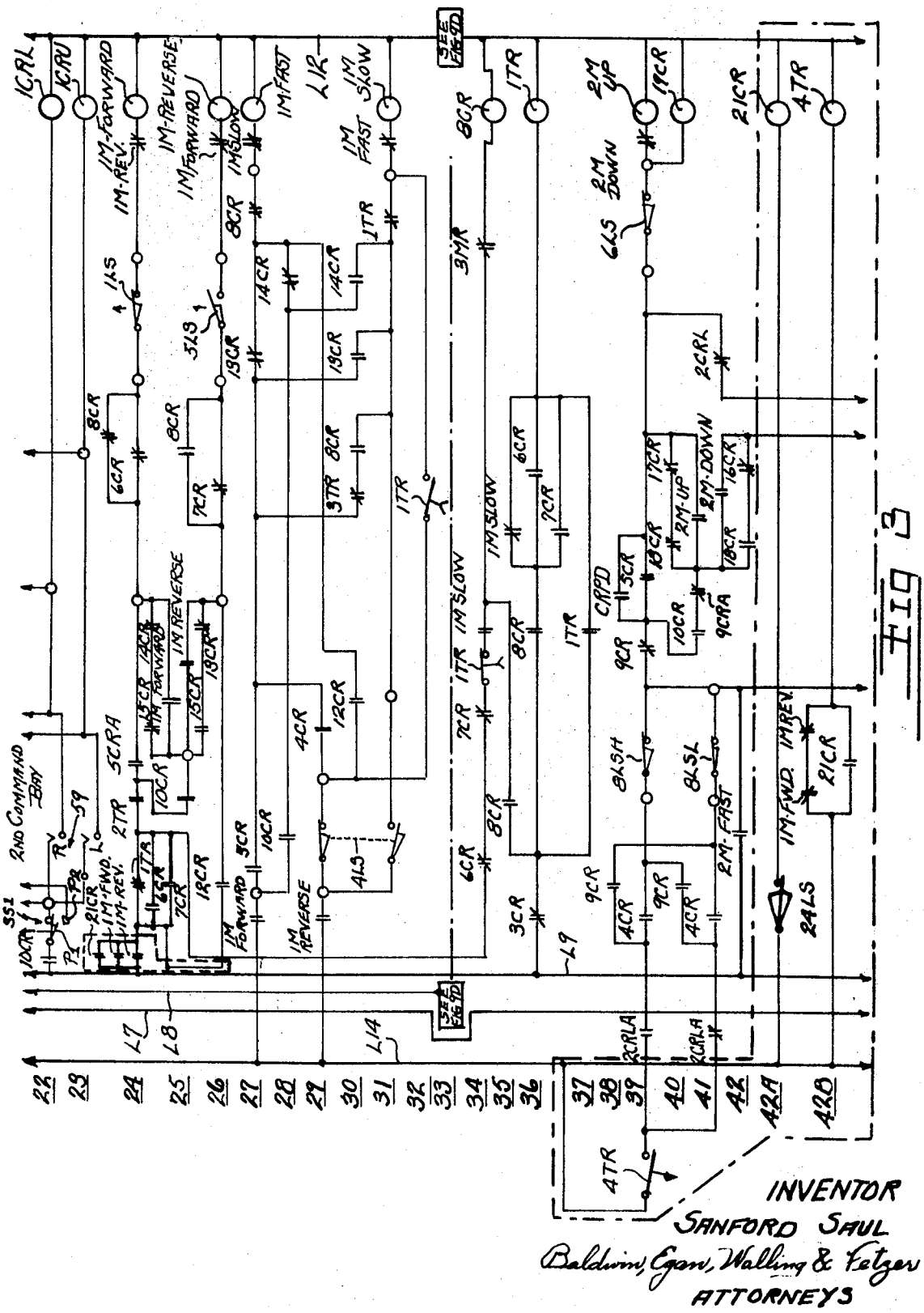



FIG 3

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Filed April 9, 1970 4 Sheets-Sheet 3

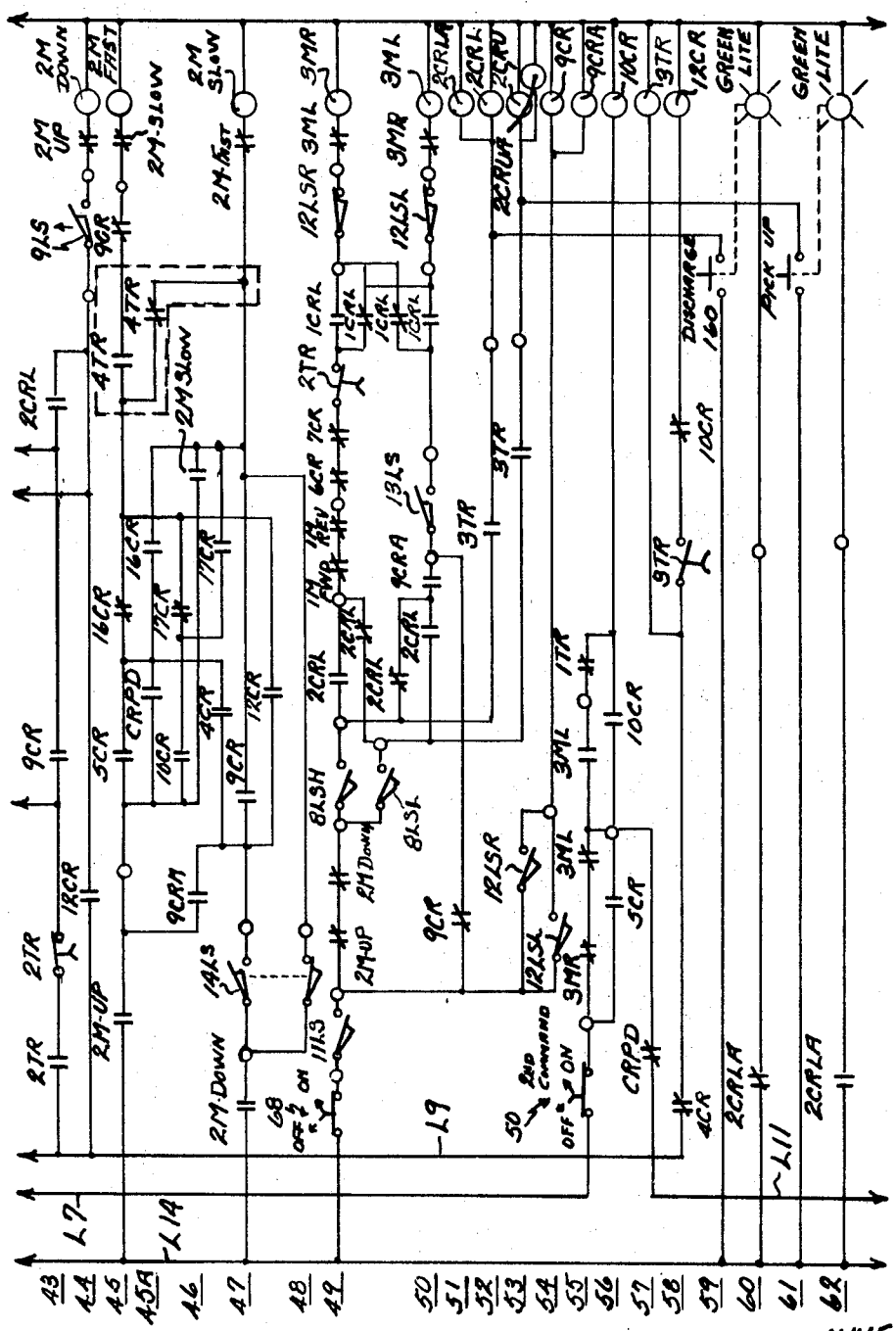



FIG. 4

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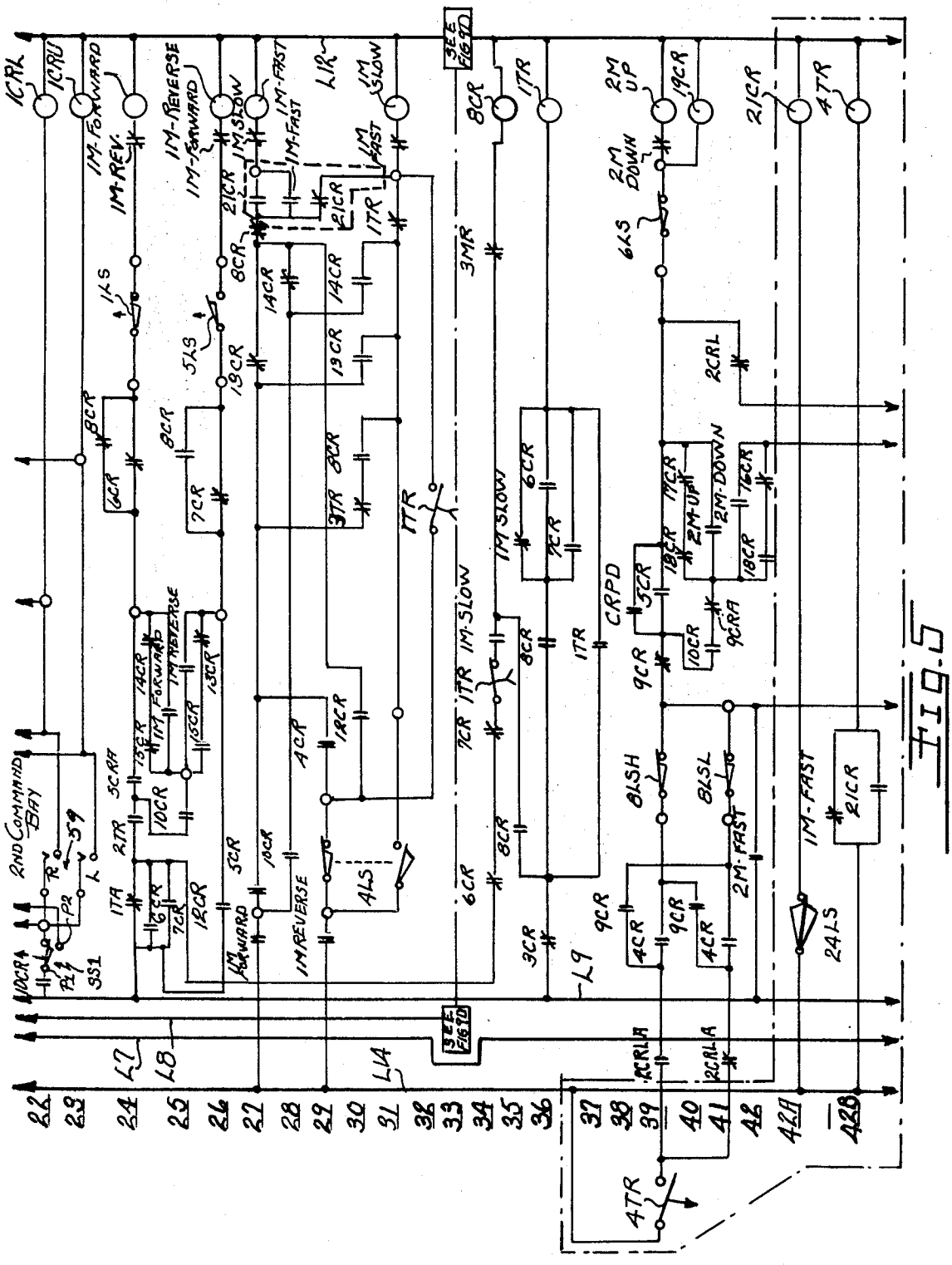



FIG. 1

United States Patent Office 3,606,955 Patented Sept. 21, 1971



3,606,955

# AUTOMATIC WAREHOUSING SYSTEM WITH MEANS CONTROLLING ELEVATOR MOVEMENT AND/OR LOAD CARRIER HORIZONTAL SPEED FOR STABILIZING LOAD CARRIER

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Filed Apr. 9, 1970, Ser. No. 26,964
Int. Cl. B65g 1/00
U.S. Cl. 214—16.4A 16 Claims

## ABSTRACT OF THE DISCLOSURE

A warehousing system which includes an arrangement for preventing or materially reducing substantial stress and instability of a vertically elongated load carrier of the system, during horizontal stopping and/or starting of the load carrier mechanism. The powered load carrier may comprise vertically elongated horizontally movable mast structure with an elevator movable vertically with respect to the mast structure, for depositing loads into and removing loads from a storage rack. The load carrier is power driven by electric motors and is provided with a control system for controlling the movement of the load carrier components, and in one embodiment means are provided in the control system for preventing vertical movement of the elevator above a predetermined level with respect to the mast structure during horizontal movement of the mast structure. Likewise, during positioning movement of the elevator with respect to the mast structure above the predetermined level, the load carrier is positioned at a selected load handling position and is prevented from horizontal movement until such time as the elevator drops down to or below the predetermined level. In another embodiment, if the elevator has moved above the aforementioned predetermined level, during positioning movement, the control system is such that the load carrier is prevented from being actuated into high speed horizontal travel but instead is maintained at a reduced horizontal speed until such time as the elevator drops down to or below said predetermined level.

This invention relates to warehousing systems of the type having a storage frame comprising vertically and horizontally arranged storage volumes or bins, and a mechanized load carrier movable generally horizontally and vertically alongside the storage frame for selectively transporting a load into or picking up a load from selected bins of the storage frame. The load carrier may comprise a generally horizontally movable conveyor portion which travels alongside the storage frame and provides vertically elongated mast structure or track means for an elevator portion capable of delivering loads to different levels in the storage frame. The elevator, in turn, may carry a laterally extensible extractor or load handling portion for inserting loads into the storage bins and returning loads therefrom. In U.S. Patent 3,402,835 of Sanford Saul dated Sept. 24, 1968, there is disclosed an automatic warehousing system and control circuitry therefor, with such warehousing system being of the general type with which the present arrangement can be readily used.

## BACKGROUND OF THE INVENTION

As automatic warehousing systems become larger, with resultant increases in the heights of the storage frame structures, and thus the heights of the load carrier structure, the problem of maintaining stability in the load carrier, which is of a much greater height than its width and breadth, and the problem of maintaining alignment between the load carrier and the selected storage bin or



bins in the load handling cycle of the load carrier, becomes more complex and difficult, especially as the operating speeds of the load carrier increase. Stability of the load carrier and good alignment between the load carrier and the storage frame is necessary so that the load handling extractor will be in proper position with respect to the storage frame for inserting and/or removing a load from the selected storage bin at each load handling position. It will be understood that, if the elevator portion of the load carrier is adjacent the upper section of the mast structure, upon sudden decelerating from high speed travel or stopping and/or starting of the horizontally movable conveyor portion of the load carrier, considerable stress and resultant stability problems usually arise due to the increased level of the center of gravity of the load carrier having a raised elevator.

## SUMMARY OF THE INVENTION

The present invention provides a warehousing system having control circuitry for controlling the operation of the load carrier, and which limits the upward vertical movement of the elevator to a safe maximum height when the horizontally movable conveyor portion of the load carrier is in motion, and which prevents horizontal movement of the conveyor portion when it is positioned at a selected storage location and while the elevator is above the aforementioned safe maximum level, and which permits horizontal movement of the conveyor portion of the load carrier only after the elevator has moved to a level to or below the predetermined maximum safe level. In another embodiment, if the elevator has moved above the chosen level during positioning movement of the load carrier, the latter may commence or continue its horizontal travel movement but is prevented from accelerating into high speed horizontal travel until the elevator moves to or below said chosen level. The purpose is to avoid substantial increased stress and unstable conditions during horizontal starting and stopping of the load carrier.

Accordingly, an object of the invention is to provide a novel warehousing system.

A further object of the invention is to provide a warehousing system having a powered load carrier for depositing loads into or removing loads from the storage frame in the system, and wherein the load carrier construction is of elongated, generally upright configuration, and which includes in the control circuitry arrangement thereof, means for limiting the vertical movement of the elevator portion of the load carrier to a safe maximum height while the load carrier is involved in horizontal movement.

A still further object of the invention is to provide a warehousing system having a powered load carrier for handling loads to and from a storage frame in the system and wherein the load carrier includes a vertically elongated conveyor portion and an elevator portion movable vertically on said horizontally movable conveyor portion, and which includes a control system for preventing movement of the conveyor portion when the elevator is operating at a level above a predetermined, maximum height on the conveyor portion so as to avoid an unstable condition in the event of sudden starting and/or stopping of the horizontally movable conveyor portion.

A further object of the invention is to provide a warehousing system of the aforediscussed type which includes sensor means in the control circuitry for sensing when the elevator moves to a level above a predetermined safe maximum height on the load carrier mast structure and causing deactuation of the motor driving the elevator to stop the elevator from moving further upwardly on the mast structure until such time as the horizontally movable conveyor portion of the load carrier arrives at a preselected position in the storage frame, after which time the control circuit provides for reenergization of the motor driving

the elevator for permitting movement of the elevator to the upper reaches of the mast structure of the load carrier, while preventing energization of the motor unit driving the horizontally movable conveyor portion of the load carrier until such time as the elevator drops down to a level to or below the predetermined safe maximum height of the elevator with respect to the mast structure, at which time the horizontal drive motor for the load carrier can then be energized.

A still further object of the invention is to provide a warehousing system wherein the load carrier can travel in a horizontal direction only at a relatively low speed when the elevator is disposed at a level above a predetermined maximum level, and when the elevator drops down to or below the maximum level, the load carrier can then be accelerated into higher speed travel.

## BRIEF DESCRIPTION OF THE DRAWINGS

Other objects and advantages of the invention will be apparent from the following description taken in conjunction with the accompanying drawings wherein:

FIG. 1 is a broken end view of a mechanized warehousing system embodying the invention;

FIG. 2 is a sectional view taken generally along the plane of line 2—2 of FIG. 1;

FIG. 3 is a fragmentary, schematic illustration of a portion of the control circuit of the automatic warehousing system operable to control the movement of the load carrier for depositing a load into and/or removing a load from the storage frame and which is generally identical to FIG. 9C of the circuitry of the aforementioned U.S. Patent 3,402,835, but wherein encircled in the phantom line enclosures thereof is illustrated circuitry components for sensing when the elevator moves from a safe vertical height position to a height above the predetermined maximum safe height, and for preventing horizontal movement of the conveyor portion of the load carrier, when the elevator is operating at a height above the predetermined safe height;

FIG. 4 is a fragmentary, schematic illustration of another portion of the control circuitry of the automatic warehousing system, operable to control the movement of the load carrier for depositing a load into and/or removing a load from the storage frame and which is generally identical to FIG. 9E of the aforementioned U.S. Patent 3,402,835. In the phantom line enclosure thereof, there is illustrated changed circuitry for controlling movement of the elevator; and

FIG. 5 is a schematic illustration of a portion of the control circuit somewhat similar to FIG. 3 but which includes operating components for providing another embodiment of system wherein the load carrier can be moved horizontally at a relatively slow speed even when the elevator is disposed above a predetermined level but wherein the load carrier is prevented from being accelerated into high speed horizontal travel until such time as the elevator drops down to or below said predetermined level.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now again to the drawings, the exemplary warehousing system illustrated in FIG. 1 may comprise a storage frame **10** having a plurality of storage bay sections **12** and **14** arranged along either side of an aisle **16** so as to permit a load carrier indicated generally at **18** to be moved along the aisle or travel zone and to insert and/or withdraw loads or articles L from the storage bins **19** in the storage sections **12** and **14**.

As shown, each storage section may be constructed of a plurality of vertically extending posts **20, 21** spaced apart by a plurality of generally horizontally extending load supporting members **22**, which at their aisle or inner ends extend inwardly toward the aisle, and which provide a plurality of the aforementioned storage bins, the latter having open load receiving ends defining a generally vertical plane. The loads stored in the storage sections are mounted in the individual bins by bridging the loads across the flanges of the support members **22**. The loads may be carried upon pallets P (FIG. 2) for handling and/or storing purposes. The instant arrangement of storage frame may be generally similar to that disclosed in aforementioned U.S. Patent 3,402,835.

The load carrier **18** may comprise horizontally movable conveyor structure **23** including vertically elongated mast structure **24** connected across the tops thereof by an upper end member **26**, with such mast structure extending upwardly from carriage **28**. The mast structure is preferably disposed along the center line of the aisle **16** and such mast structure may be spaced apart in the direction of the aisle as shown in FIG. 2. The upper end member **26** may be provided with wheels or the like for guiding engagement with an overhead track or guide **32** carried by transverse members **34** connecting the storage sections **12** and **14**. The carriage **28** may be provided with wheels or rollers **36** for rolling engagement with base rail or track **37**. At least one of wheels **36** is power driven for driving the load carrier horizontally along the aisle. Such driving means may be, for instance, a reversible electric motor and geared reduction means indicated generally by reference letter *k*.

Movable vertically relative to the mast structure **24** is the elevator portion **40** of the load carrier. Any suitable means, including, for instance, an electric motor *s* (FIG. 1) may be provided for moving the elevator vertically with respect to the mast structure, thereby providing for storing loads at different elevations in the storage frame sections.

The elevator **40** may have a laterally extensible extractor **44** mounted thereon which may comprise an outer upper frame and an inner lower frame, which preferably provides an extensible table, with such table being extendible in either of the opposite directions transverse to the direction of movement of the load carrier in the travel zone, so as to locate the extractor or load handling mechanism within either of the storage sections **12** or **14**, effective to place the extendible table in position to deposit a load into or remove a load from a selected one of the storage bins. Suitable power means, such as for instance, electric motor **115** (FIG. 2) may be mounted on the elevator **40** and operably coupled to the extractor for actuating the latter. Reference may be had to the aforementioned U.S. Patent 3,402,835 for a more detailed disclosure of suitable extractor mechanism.

The load carrier may commence its movement into the storage frame area for handling loads therein from a position in front of the storage frame sections, and therefore rails **32** and **37** may extend outwardly of the aisle on one end thereof, to enable the load carrier to be located in front of the storage sections **12** and **14** and at a pickup and discharge station, from which position the load carrier may start its movement into the travel zone to deposit loads into and pick up loads from the storage bays. There may be provided pickup and discharge stands (e.g. **48**) located on either one or both sides of the load carrier at the pickup and discharge station, which stands are adapted to be disposed at a suitable height relative to the load carrier, for supporting loads adapted to be deposited into the storage frame sections and for supporting loads brought out from the storage frame by the load carrier, and in a manner well known in the art. Stands **48** may be serviced by suitable load handling mechanism, such as for instance conveyors, fork trucks, overhead cranes or the like.

The programmed operation of the load handling cycle of the load carrier may be controlled by an electrical control circuit as disclosed for instance in aforementioned U.S. Patent 3,402,835, but as modified as hereinafter set forth in the instant application, and more particularly as modified in the circuitry disclosed in FIGS. 3 and 4 of the instant application.

With the load carrier initially disposed at the aforementioned pickup and discharge station, the load carrier may be automatically moved into the aisle **16** and located opposite the selected storage bin or bins in the storage sections **12** and/or **14**. At the selected bins during the control interval, the extractor **44** may be actuated so that a load is deposited in or withdrawn from the selected bin. The load carrier may be located sequentially opposite two storage bins in either of the storage sections **12** and **14** as described in aforementioned U.S. Patent 3,402,835, to accomplish what is known as a two command operation. For example, the load may be deposited in a bin at a first load handling position and another load withdrawn from a bin at the second load handling position and then moved back to the pickup and discharge station; or a single command operation may be carried out whereby the load carrier moves to only one bin for handling a load thereat. Reference may be had to the aforementioned U.S. patent for a detailed description of suitable control circuitry for programming and controlling the operation of the load carrier motors *k*, *s* and **115**.

As described in the aforementioned U. S. patent, relays **1M**, Forward and **1M** Reverse and **1M**, Fast and Slow control the operation of the horizontal drive motor *k* and associated brake mechanism for controlling the movement of the conveyor portion **23** of the load carrier, while relays **2M** Up and **2M** Down and **2M** Fast and **2M** Slow control the operation of the vertical drive motor *s* and associated brake mechanism for controlling the movement of the elevator **40** with respect to the elongated mast structure **24**. During horizontal movement of the load carrier in the travel zone, the coils of relays **2M** Up and **2M** Fast may be energized whereupon the vertical drive motor *s* is powered to simultaneously move the elevator **40** upwardly along the mast structure.

Now in accordance with the invention as illustrated in FIGS. 3 and 4, means are provided to prevent the elevator from moving beyond a predetermined maximum height position with respect to the mast structure during the horizontal movement of the conveyor portion of the load carrier in the travel zone. Accordingly, horizontal and vertical motion of the load carrier components may proceed simultaneously in the conventional manner until the vertically movable elevator reaches a predetermined safe maximum level with respect to the mast structure. It has been determined that this predetermined safe maximum level is preferably at a position no greater than approximately 50% of the height of the load carrier mechanism. As for example in a warehousing system having a load carrier height of approximately 40 feet, the elevator may be moved up approximately 15 to 20 feet above floor level at which time it reaches the predetermined safe maximum level. When the elevator reaches the approximate safe maximum level, if horizontal movement of the load carrier is still occurring, the vertically movable elevator will switch from fast to slow speed and after a short time delay, the vertical elevator will stop due to the deenergization of relay **2M** Up and application of the brake mechanism associated with vertical motor *s*. Referring now to FIGS. 3 and 4, there may be provided a limit switch **24LS** which is in a normally closed position when the elevator is below the predetermined safe maximum level, and which is opened when the elevator moves above said predetermined safe maximum level. For instance, limit switch **24LS** may be mounted on the elevator **40** (FIGS. 1 and 2) and may be actuated as by means of a lug **49** on mast structure **24**.

Accordingly, as the elevator **40** moves upwardly to the predetermined safe maximum level as sensed by the actuator **49**, the limit switch **24LS**, which is a maintained switch, is opened thereby causing relay **21CR** (line **42A**, FIG. 3) to drop out, thereby deenergizing timer relay **4TR** (due to opening of relay contacts **21CR** in line **42B**—FIG. 3) thereby causing normally open **4TR** contacts in line **45** of FIG. 4 to open, causing deenergization of relay **2M** Fast in line **45** and causing relay contacts **4TR** in line **45A** in FIG. 4 to close, therefore causing energization of the relay coil **2M** Slow. After a period of for instance two to three seconds has passed after deenergization of relay coil **4TR** in line **42B**, the timer relay contacts **4TR** in line **39**—FIG. 3, opens to cause deenergization of relay coil **2M** Up in line **39** of FIG. 3, thereby causing the deenergization of vertical motor *s* and application of the associated brake mechanism, and thus causing the vertical movement of the elevator to stop. As aforementioned, the position or level of the elevator with respect to the mast structure is then at its safe maximum height position, and which as aforementioned is preferably no greater than approximately 50% of the total height of the load carrier.

When the load carrier conveyor portion is positioned in proper location in front of a programmed bin or storage volume, the relays **1M** Forward and **1M** Reverse are deenergized as disclosed in the aforementioned U.S. Patent 3,402,835, whereupon, as can be seen from line **42B** of FIG. 3, relay coil **4TR** is again reenergized, thereby causing relay contact **4TR** in line **39** to close and thereby causing reenergization of relay coils **2M** Up and **2M** Fast, whereupon the vertical elevator will resume its travel to the programmed bin level. After the elevator reaches the programmed level it will stop in confronting relationship to the selected storage bin in the same general manner described in the aforementioned U.S. Saul patent. When the elevator is in position opposite the selected storage bin and in proper position whereby the elevator and associated extractor **44** supports a load slightly above the supporting flange surfaces of the spaced load supports **22** of the selected bin (assuming the load carrier is going to deposit a load), the extensible extractor **44** is projected into the bin preparatory to depositing the load therein.

It will be seen that while the elevator is moving along the upper portion of the elongated mast structure **24** above the predetermined safe maximum level position, and at the time that the conveyor portion **23** of the load carrier is positioned in front of the selected bin column, the motor *k* for the horizontally movable conveyor portion can not be energized due to the relay **21CR** being maintained deenergized by the open **24LS** switch. It is only after the elevator has moved to or below the maximum safe position, or in other words to a position wherein limit switch **24LS** is closed, that the relay **21CR** can be energized to permit energization of the **1M** Forward and **1M** Reverse relays for causing release of the brake mechanism of motor *k* and energization of the horizontal drive motor.

It will be seen therefore, that the vertical holding position of the elevator is determined by the **24LS** limit switch, with such limit switch being actuated by the vertical elevator as it approaches a predetermined safe maximum height position with respect to the mast structure. The **24LS** limit switch maintains its open or its closed position and therefore serves as a memory to indicate if the vertically movable elevator is above or below the predetermined safe maximum height. The **4TR** relay is energized if it is safe for the elevator to travel. If the elevator rises above the predetermined safe maximum position or level during horizontal travel of the load carrier, the **4TR** relay is deenergized thus causing the vertical carriage to stop.

Referring now to FIG. 5 in conjunction with FIG. 4, it will be seen that in the further embodiment of system, if the elevator moves upwardly to the predetermined maximum level as sensed by actuator **49** when the conveyor portion **23** is in fast speed (i.e. relay **1M** Fast in line **27** of FIG. 5 is energized) the limit switch **24LS** will be opened, thus deenergizing relay **21CR** (line **42A**—FIG. 5). However, since the **1M** Fast contact at line **28**, FIG. 5, remains closed, the **1M** Fast relay in line **27** remains energized

and thus the 1M Slow relay in line 31, FIG. 5 is prevented from coming in.

Deenergization of relay 21CR causes deenergization of time relay 4TR thereby causing energization of relay coil 2M Slow (line 47—FIG. 4). After a period of for instance two to three seconds, relay 2M Up in line 39 of FIG. 5 drops out thereby causing deenergization of vertical motor *s* and application of the associated brake mechanism to cause vertical movement of the elevator 40 to stop.

When the elevator is disposed at a level above the predetermined maximum after having delivered a load at a first command bin location, the 24LS switch will of course be open and 21CR deenergized. Accordingly the normally closed contact 21CR at line 29 is closed resulting in energization of relay 1M Slow at line 31, FIG. 5. The normally open contact 21CR in line 27, FIG. 5 remains open, thus maintaining relay 1M Fast deenergized. Relay 4TR in line 42B remains in since the normally closed 1M Fast contact at line 42B, FIG. 5 remains closed. Accordingly, the load carrier can move horizontally at a speed below its maximum horizontal travel speed even though the elevator is above the predetermined safe maximum level, and the load carrier cannot accelerate into high speed horizontal travel until the elevator drops down to or below the aforesaid level to close switch 24LS. Thus undue stress and stability problems are prevented in the load carrier. While only a two speed motor has been illustrated for driving the load carrier, a motor having greater variable speeds could be utilized for horizontal travel.

From the foregoing description and accompanying drawings it will be seen that the invention provides a novel warehousing system having control circuitry for controlling the operation of the load carrier and which in one embodiment limits the upper vertical movement of the elevator to a safe maximum height when the horizontally movable conveyor portion of the load carrier is in motion, and which prevents horizontal movement of the conveyor portion when it is positioned at a selected storage location while the elevator is above the aforementioned safe maximum level, thus permitting horizontal movement of the conveyor portion of the load carrier only after the elevator has moved to a level to or below the predetermined safe maximum level. In another embodiment, the load carrier can travel horizontally at a reduced speed when the elevator is above a predetermined level and can accelerate into higher horizontal travel speed only when the elevator drops down to or below said predetermined level. The control circuitry includes a sensor means actuated as the vertical elevator approaches a predetermined maximum level with the sensor serving as a memory to indicate if the vertically movable elevator is above or below the predetermined position. Accordingly, major stresses are eliminated in the system during horizontal starting and stopping of the load carrier, and the load carrier is expeditiously stabilized.

The terms and expressions which have been used are used as terms of description and not of limitation, and there is no intention in the use of such terms and expressions of excluding any equivalents of any of the features shown or described, or portions thereof, and it is recognized that various modifications are possible within the scope of the invention claimed.

What is claimed is:

1. In a warehousing system, storage means including a storage frame defining a plurality of storage bins disposed in different bays and at different levels in each bay, with said storage bins having open load receiving ends disposed generally in a plane, load carrier means including a conveyor portion, the latter being movable generally horizontally in a travel zone past said storage frame to different bays, said conveyor portion including generally vertically elongated mast structure, said load carrier means also including an elevator portion mounted for generally vertical movement relative to said mast structure, and load handling means mounted on said elevator portion for movement into and out of a selected bin to pick up or deposit a load thereat, power means for moving said conveyor portion, said elevator portion and said load handling means, and control means for activating and deactivating said power means, said control means including means limiting upward movement of said elevator portion to a predetermined maximum height which is less than the total permissible upward height movement of said elevator, during horizontal movement of said conveyor portion, and permitting energized movement of said elevator portion upwardly beyond said predetermined maximum height when said conveyor portion is stopped.

2. A system in accordance with claim 1 wherein said control means includes means operable for preventing horizontal movement of said conveyor portion when said elevator portion is above said predetermined maximum height with respect to said mast structure.

3. A system in accordance with claim 1 wherein said limiting means includes sensor means operable to sense approach movement of said elevator portion to said predetermined maximum height and being operable to cause deactivation of the power means for said elevator portion and stopping of the latter to limit movement of said elevator portion to said predetermined maximum height during said horizontal movement of said conveyor portion.

4. A system in accordance with claim 3 wherein said sensor means comprises a maintained switch adapted for actuation by actuator means as said elevator portion moves past a predetermined level relative to said mast structure.

5. A system in accordance with claim 4 wherein said switch is mounted on said elevator portion and said actuator means is mounted on said mast structure.

6. A system in accordance with claim 1 wherein said means for limiting the travel of said elevator portion to a predetermined maximum height includes means for preventing actuation of the power means driving said conveyor portion, during vertical movement of said elevator portion at a level above said predetermined maximum height when the load carrier means is at a preselected position in said travel zone.

7. A system in accordance with claim 4 wherein said limiting means includes means operable to deenergize the power means driving said elevator portion when the latter passes beyond said predetermined level, the last mentioned means being responsive to said elevator portion passing said predetermined level and being operable to change the speed of said power means driving said elevator portion from a fast speed to a slow speed, and then to completely deenergize the last mentioned power means to cause stopping of said elevator portion.

8. A system in accordance with claim 1 wherein said storage means includes laterally spaced storage frame sections defining said travel zone therebetween, said extractor portion being movable into either of said storage sections for handling loads thereat.

9. A system in accordance with claim 1 including programming means comprising selective controls for programming said load carrier means for movement thereof to a predetermined location in said travel zone as represented by a selected one of said storage bins.

10. A system in accordance with claim 1 wherein said power means comprises reversible electric motors.

11. A system in accordance with claim 1 wherein said predetermined maximum height is no greater than approximately 50 percent of the total height of said load carrier means.

12. A system in accordance with claim 5 wherein said switch comprises a maintained mechanically actuated limit switch and said actuator means comprises a lug mounted on said mast structure in the actuating path of said limit switch.

13. In a warehousing system, a storage means including a storage frame defining a plurality of storage bins dis-

posed in different bays and at different levels in each bay, with said storage bins having open load receiving ends disposed generally in a plane, load carrier means including a conveyor portion, the latter being movable generally horizontally in a travel zone past said storage frame to different bays, said conveyor portion including generally vertically elongated mast structure, said load carrier means also including an elevator portion mounted for generally vertical movement relative to said mast structure, and load handling means mounted on said elevator portion for movement into and out of a selected bin to pick up or deposit a load thereat, power means for moving said conveyor portion, said elevator portion and said load handling means, said conveyor portion being adapted for multi-speed movement, and control means for activating and deactivating said power means, said control means including means limiting the horizontal travel speed of said conveyor portion when said elevator portion is disposed above a predetermined height with respect to said mast structure, and wherein said control means includes means limiting upward movement of said elevator portion past said predetermined height during horizontal movement of said conveyor portion at a predetermined speed and permitting energized movement of said elevator portion upwardly beyond said predetermined height only after the speed of said conveyor portion is reduced below said predetermined speed.

**14.** A system in accordance with claim **13** wherein said power means for moving said conveyor portion comprises a variable speed electric motor.

**15.** A system in accordance with claim **13** wherein said limiting means includes sensor means operable to sense approach movement of said elevator portion to said predetermined height and operable to cause deactivation of the power means for said elevator portion and stopping of the latter to limit movement of said elevator portion past said predetermined height during horizontal movement of said conveyor portion at said predetermined speed.



**16.** A system in accordance with claim **13** wherein said power means for said conveyor portion and for said elevator portion comprises multi-speed electric motor including a fast speed and a slow speed, said predetermined speed being said fast speed, said control means including means operable to deenergize the power means driving said elevator portion when the latter passes said predetermined height, the last mentioned means being responsive to said elevator portion passing said predetermined height and being operable to change the speed of said elevator portion power means from fast to slow and then operable to stop said elevator portion.

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U.S. Cl. X.R.

187—9