July 31, 1962 H. A. GORJANC 3,046,909

MATERIAL HANDLING DEVICE

Filed Feb. 24, 1960 5 Sheets-Sheet 1

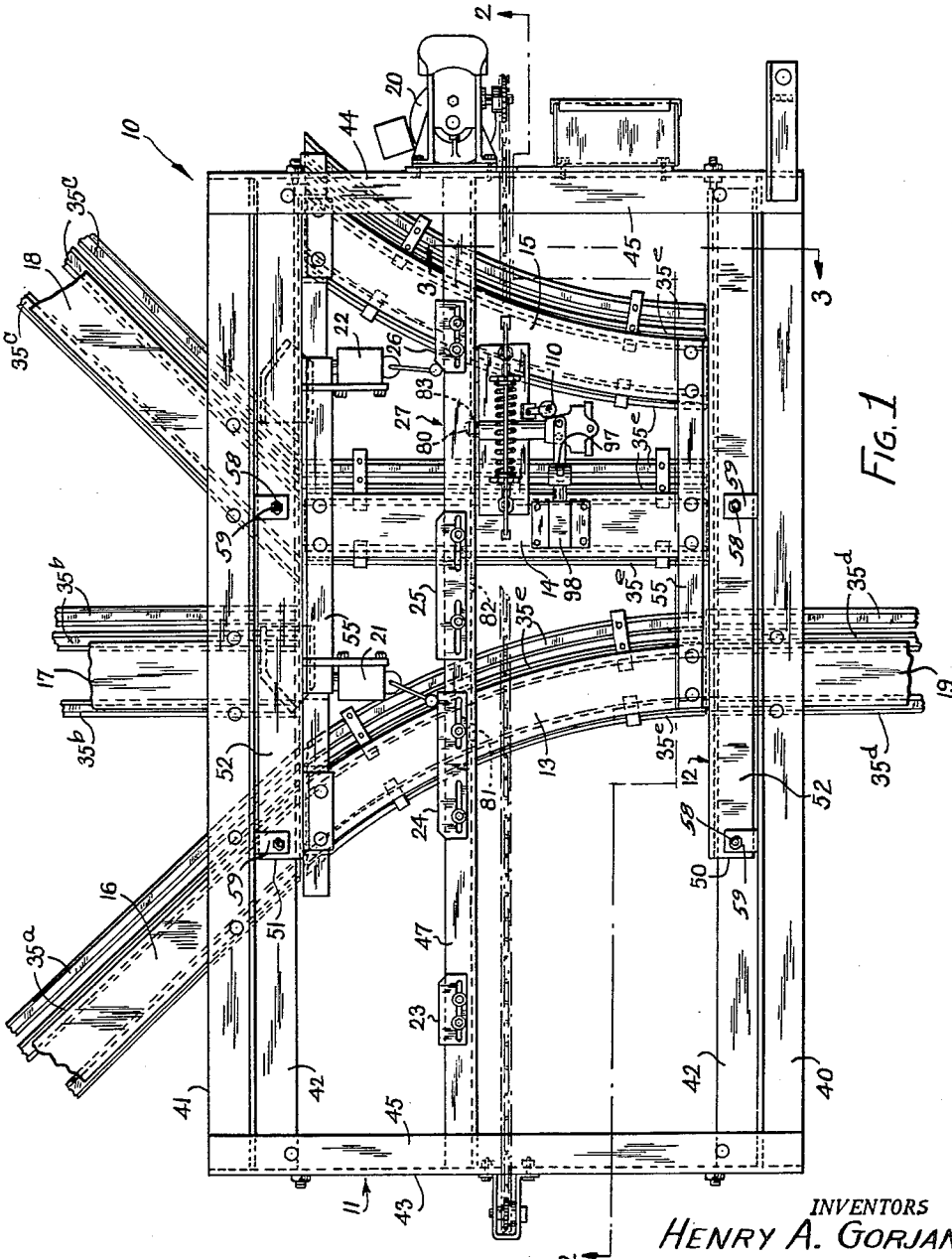

FIG. 1

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MATERIAL HANDLING DEVICE

Filed Feb. 24, 1960 5 Sheets-Sheet 2

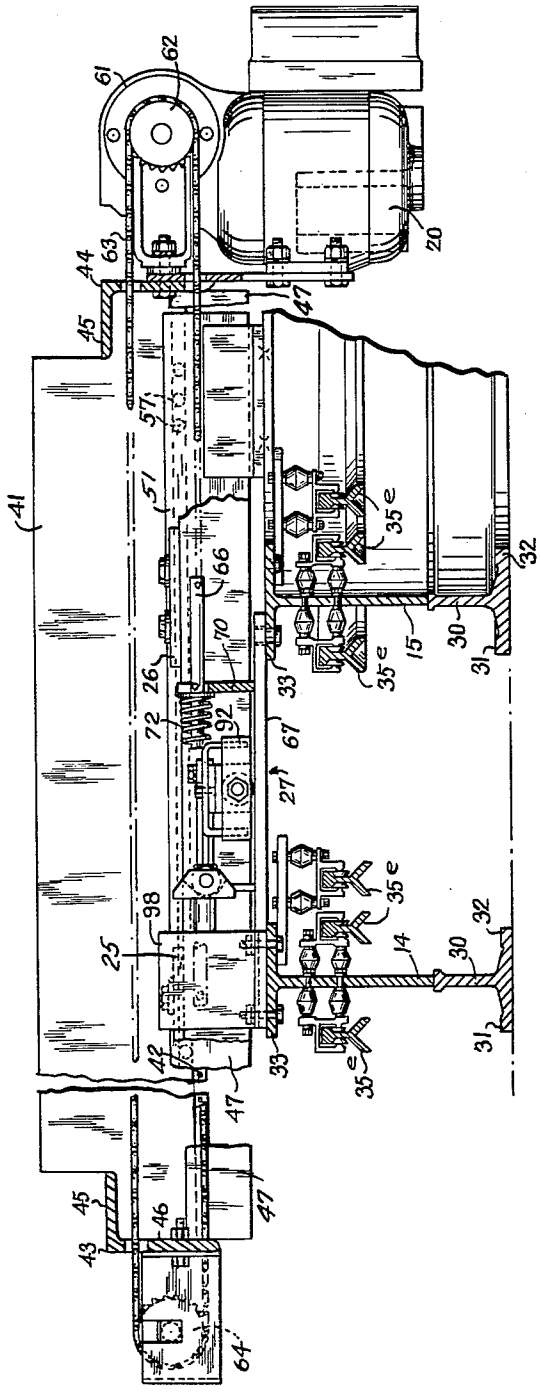

FIG. 2

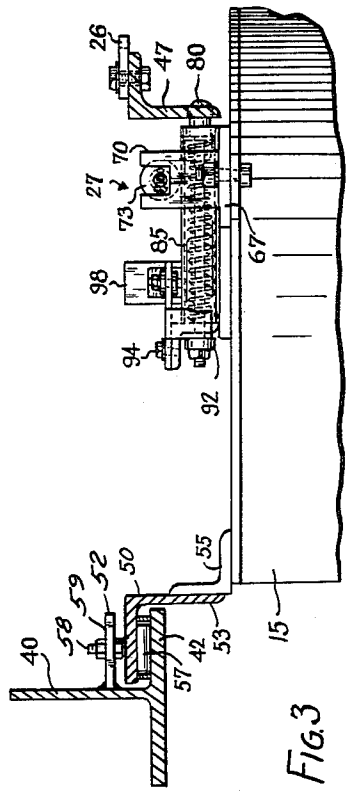

FIG. 3

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MATERIAL HANDLING DEVICE

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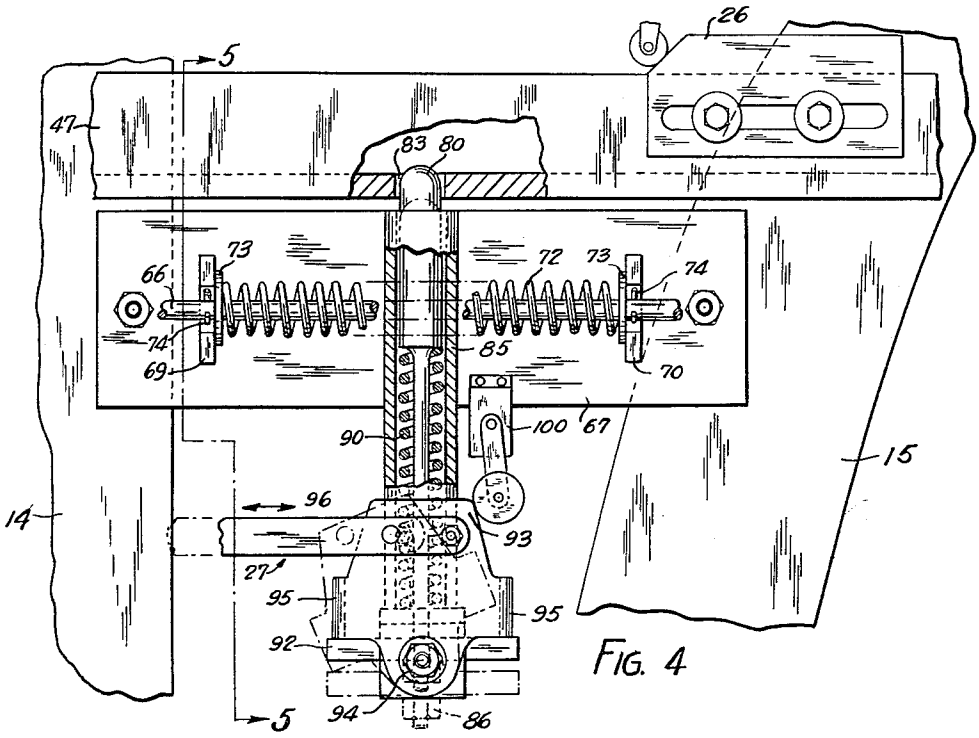

FIG. 4

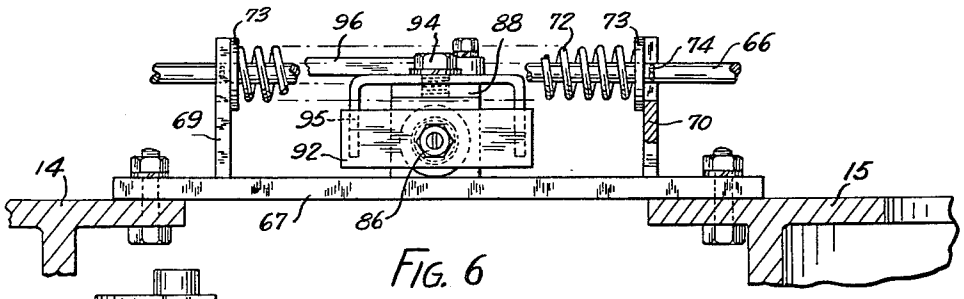

FIG. 6

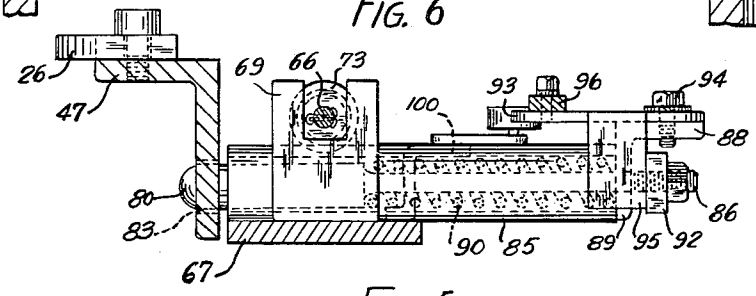

FIG. 5

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MATERIAL HANDLING DEVICE

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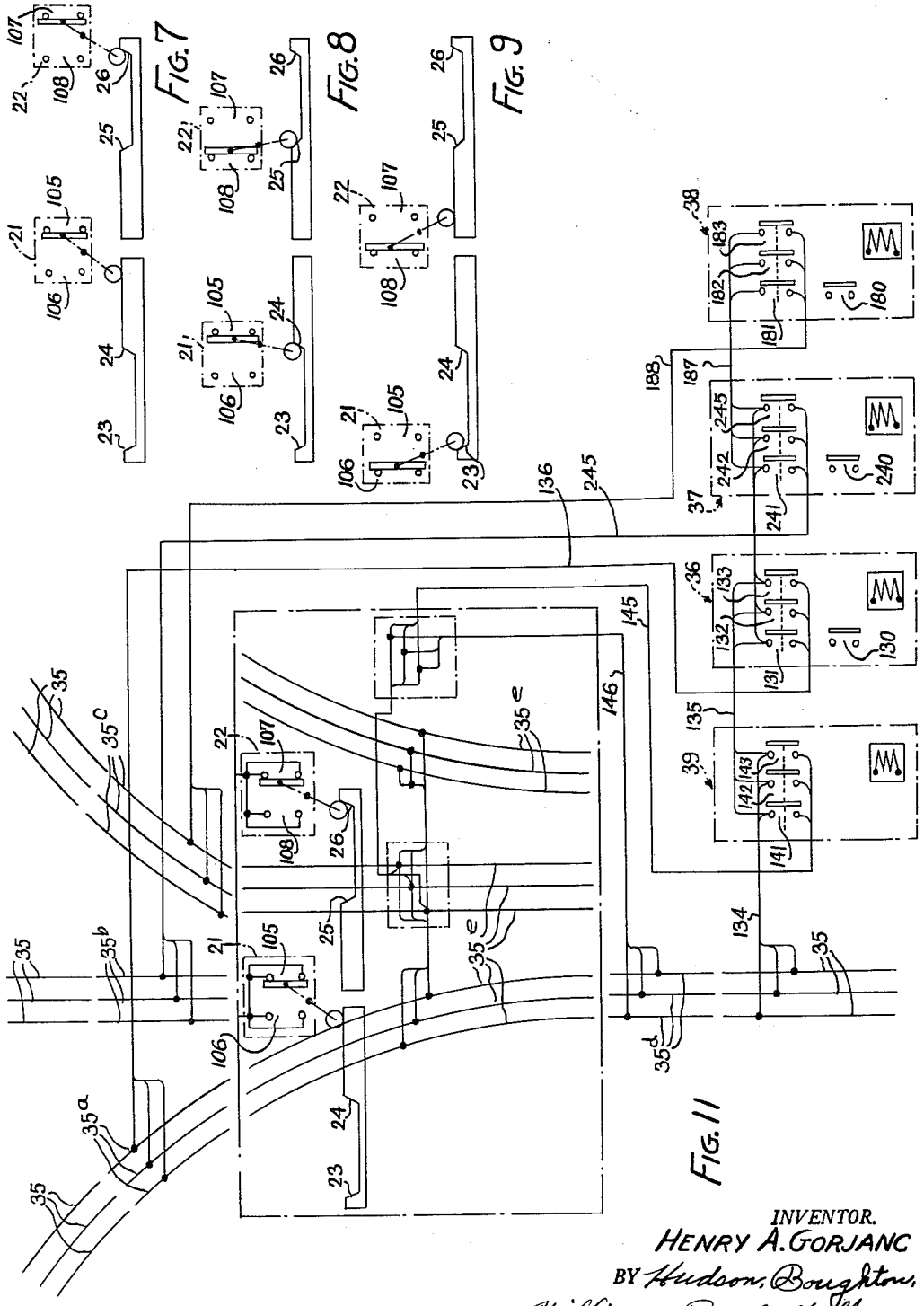

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MATERIAL HANDLING DEVICE

Filed Feb. 24, 1960 5 Sheets-Sheet 5

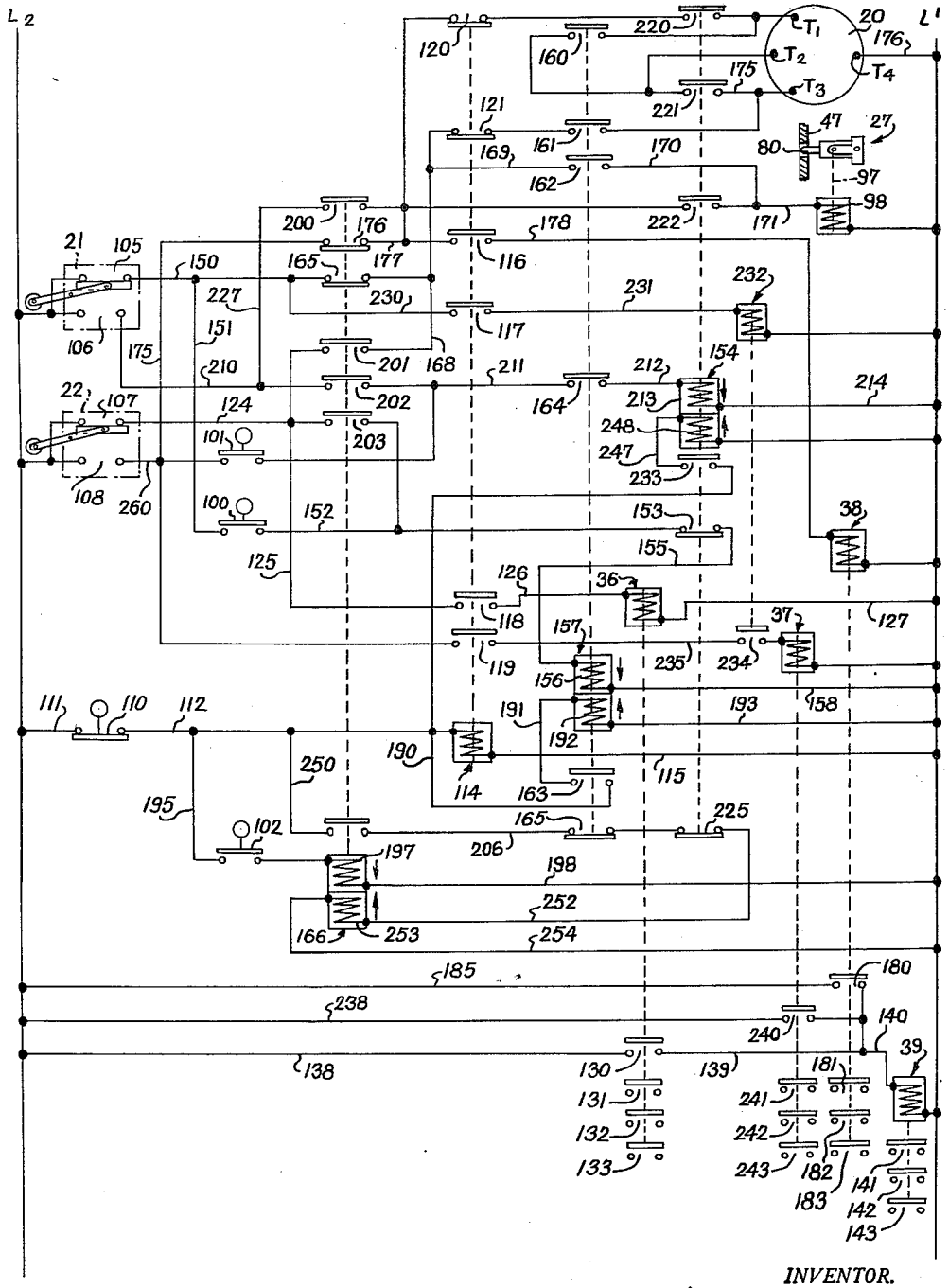

FIG. 10

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United States Patent Office

3,046,909
Patented July 31, 1962

3,046,909

MATERIAL HANDLING DEVICE

Henry A. Gorjanc, Wickliffe, Ohio, assignor to The Cleveland Crane & Engineering Company, Wickliffe, Ohio, a corporation of Ohio

Filed Feb. 24, 1960, Ser. No. 10,702
6 Claims. (Cl. 104—102)

This invention relates to material handling systems of the overhead monorail type, and more particularly to such a system having a motor operated switch therein for selectively connecting a single rail on one said of the switch with any one of a plurality of rails on the other side of the switch to provide a plurality of courses for carriers traveling in either direction along the rails to follow.

A principal object of the invention is the provision of an improved material handling system including a monorail switch shiftable between at least three operative positions by a reversible electric motor, the motor being responsive to a switch control circuit which is conditioned upon actuation to energize the motor for shifting of the switch to a preselected position, and which circuit will remain so conditioned even though there be a power failure so that upon a return of the power the motor will continue to shift the switch to its preselected position.

Another object of the invention is the provision of a material handling system of the above mentioned character which comprises conductor bars associated with the rails for providing electric current to carriers or the like traveling thereon, and in which the switch control circuit comprises means for controlling both the energization of the switch operating motor and the actuation of baffle or blocking contactors for de-energizing conductor bars leading into the switch to thereby prevent a carrier from running into an open switch.

Still another object of the invention is the provision in an improved overhead monorail system of a switch including a switch operating and baffling control circuit which comprises latching type relay means for controlling both the energization of the switch operating motor and the actuation of the baffle contactors, and which circuit comprises limit switches which act directly to de-energize the motor and the baffle contactors when the switch moves into a selected operative position.

The invention may be further briefly described as residing in certain combinations and arrangements of parts and other advantages thereof will be apparent to those skilled in the art to which it pertains from the following description of a presently preferred embodiment described with reference to the accompanying sheets of drawings forming a part of this specification, and in which:

FIG. 1 is a fragmentary plan view of a material handling system embodying this invention and having a three position motor operated switch therein;

FIG. 2 is an enlarged sectional view of a portion of the switch of FIG. 1 taken along line 2—2 thereof with portions broken away;

FIG. 3 is an enlarged sectional view of a portion of the switch of FIG. 1 taken along line 3—3 thereof;

FIG. 4 is a fragmentary top view on an enlarged scale showing the latch mechanism of the switch of FIG. 1;

FIG. 5 is a sectional view approximately on line 5—5 of FIG. 4;

FIG. 6 is an end view of the latch mechanism with parts in section and broken away;

FIG. 7 illustrates the positions of the limit switches when the switch is aligned for use of the left track as illustrated in FIG. 1;

FIG. 8 illustrates the positions of the limit switches when the switch is aligned for use of the center track;

FIG. 9 illustrates the positions of the limit switches when the switch is aligned for use of the right track;

FIG. 10 is a schematic diagram of the switch and baffle contactor control circuit, and

FIG. 11 is a diagram of the conductor bar and baffle contactor circuit.

While the present invention is susceptible to embodiment in either shifting tongue-type or shifting rail-type track switches, the particular switch shown in the drawings as exemplifying the invention is of the shifting rail-type. It is to be understood, however, that there is no intention to thereby limit the invention to the specific forms disclosed, but it is my intention to cover all modifications and alternative constructions falling within the spirit and scope of the invention as expressed in the appended claims.

Referring to the illustrated switch **10** of the embodiment of this invention, an outer or fixed frame assembly **11** supports an inner or movable frame assembly **12** which is adaptable to use in switches of either the shifting tongue or shifting rail type and, for purposes of illustrating one embodiment of the invention, is here described as having three movable rail sections **13**, **14** and **15** and which may be shifted to any of three operative positions to determine which of three rails **16**, **17** and **18** on one side of the switch will be connected with a single rail **19** on the other side of the switch to provide a continuous path for a carrier passing through the switch.

In the operative position illustrated in FIG. 1, the rail **19** and the rail **16** are connected or aligned by the movable rail section **13** which is curved, thereby providing a curved path of travel for a carrier. The inner frame **12** is shiftable in either direction by means of a reversible electric motor **20**, and may be shifted to the left from the illustrated position to a center position with the rail section **14**, which is straight, connecting the rails **19** and **17** to provide a straight path of travel for a carrier. The frame **12** may be shifted still farther to the left to assume a position with the rail section **15**, which is curved, connecting the rail **19** with the right hand rail **18**.

It will be recognized that carriers may pass through the switch **10** in either direction so that a carrier entering the switch on the rail **19** may exit on any one of the rails **16**, **17**, or **18** depending upon the position of the inner frame **12**, and a carrier may enter from any of rails **16**, **17** and **18** and exit on rail **19**. The reversible electric motor **20** is under the control of a circuit, more fully described hereafter, which includes two cam actuated limit switches **21**, **22** which are preferably mounted on the movable frame **12** and are adapted to be actuated by cam means such as cam elements **23**, **24**, **25** and **26** adjustably mounted on the fixed frame **11**.

When the movable frame **12** is occupying one of the mentioned operative positions, it is held from moving therefrom by a solenoid operated locking means, indicated generally at **27**. The solenoid of the locking means **27** and the motor **20** are energizable by the above mentioned control circuit to release and shift the frame **12** to an operative position other than the one occupied; and the limit switches **21** and **22** will, at the proper point in the movement of the frame **12**, de-energize the motor **20** and the solenoid of the locking means, releasing the latter to secure the frame **12** in the selected operative position.

The rails **16**, **17**, **18** and **19** and the movable rail sections **13**, **14** and **15** are of conventional monorail construction and will not, therefore, be described in detail. Suffice it to say that each includes a rail member having a web **30** terminating at its lower edge in horizontal flange portions **31**, **32** extending from the opposite sides of the web for supporting the wheels of the overhead monorail carriers (not shown) and having upper flange portions **33**.

A plurality of conductor bars **35** are associated with

each of the rails 16, 17, 18, 19 and with the rail sections 13, 14 and 15, and serve to supply electric power to self-propelled carriers through current collectors carried thereby. In order to prevent a carrier from running into an open switch, means are provided to de-energize portions 35*a*, 35*b*, 35*c* and 35*d* of the conductor bars 35 associated with the entering rails such as 16, 17, 18 or 19 respectively, and portions 35*e* associated with the rail sections 13, 14 and 15, during shifting of the frame 12 from one of its operating positions to another. The conductor bar portions to be de-energized are separated from the main conductor bar portions 35 by air gaps. The de-energization is referred to as blocking or baffling and is automatically effected by blocking contactors 36, 37, 38 and 39 forming part of the control circuit more fully described hereafter.

The outer frame assembly 11 is supported in any conventional manner above the rails 16, 17, 18 and 19 and comprises spaced horizontal inverted T-shaped members 40 and 41 extending transversely of the rails and having lower inwardly extending flange portions 42 for slidably supporting the inner or movable frame assembly 12. The members 40 and 41 are connected at their ends by left and right side members 43, 44 having inwardly directed flange portions 45 and downwardly directed portions 46. In addition, the outer frame 11 comprises a transverse angle member 47 extending between and welded to the side members 43, 44 midway between the members 40, 41. The angle member 47 serves as a frame locking abutment means and as a support for the limit switch operating cam means 23, 24, 25 and 26.

The inner frame assembly 12, including the rail sections 13, 14, 15 comprises L-shaped or angle members 50 and 51 parallel and adjacent to the T-shaped members 40, 41 respectively, and each having a horizontal portion 52 overlying one of the adjacent flange portions 42 of the T-shaped members, and each having a depending vertical portion 53 having an angle member 55 secured thereto as by welding and itself welded, riveted, or otherwise secured to the upper flange portions 33 of the rail sections 13, 14 and 15 for support thereof. Any suitable antifriction means such as roller bearings 57 may be interposed between the horizontal portions 52 of the members 50, 51 and the adjacent horizontal flange portions 42 of the T-shaped members 40, 41 to support the inner frame assembly 12 on the outer frame assembly 11 and to facilitate the shifting of the inner frame assembly. Movement of the inner frame assembly 12 relative to the outer frame assembly 11 is limited by adjustable stops 58 carried by members 59 welded to the vertical flanges of the T-shaped members 40, 41.

The reversible electric motor 20 is preferably a single phase A.C. motor. A gear reduction means 61 is conveniently provided on the motor 20 and rotates a sprocket 62 in driving engagement with a flexible transmission means in the form of a chain 63 which leads around a sprocket 64 suitably supported on the frame member 43 through which the chain passes in openings provided therefor.

The ends of the chain 63 are connected to opposite ends of a rod 66 forming part of a resilient or shock absorbing connection to the inner or movable frame assembly 12. A base plate 67 is suitably supported across the rail sections 14 and 15 and serves as a support for the hereafter described shock absorbing connection and the locking means 27.

As is best illustrated in FIGS. 4, 5, and 6, the base plate 67 is provided with a pair of bifurcated upright members 69 and 70 extending therefrom. A coil compression spring 72 surrounds the rod 66 and is confined between the upright members 69 and 70 and between end washers 73. A cotter pin 74 or the like passes through the rod 66 outside of each end washer 73 and is adapted to pass through the bifurcation in each of the upright members 69, 70. It will be apparent that the movement of the chain 63 in a sense to shift the inner frame 12 in either direction will cause the rod 66 to shift compressing the spring 72 between a cotter pin held washer 73 and one of the upright members 69, 70 until the frame begins to move.

The locking means 27, which is supported by the plate 67, comprises a spring loaded plunger 80 which is adapted to be received in openings 81, 82 and 83 in the angle member 47, and serves to secure the movable frame 12 in any of its operative positions. The plunger 80 is reciprocably carried in a tube 85 and has an extension 86 terminating in a threaded end.

The tube 85 has secured at one end an angle member 88, a depending leg 89 of which confines a compression spring 90 in the tube, which spring biases or urges the plunger 80 into engagement with the abutment or angle member 47. A cross plate or bar 92 lying adjacent the angle leg 89 has an opening receiving the extension 86 of the plunger 80, and the extension has a retaining and adjusting nut thereon. The spring 90 acts to extend the plunger 80 and normally draws the cross bar 92 toward the leg 89 of the angle member 88.

An operating lever 93 is pivotally secured at 94 to the angle member 88 and has depending side ears 95 in engagement with the cross bar 92. The lever 93 is connected by a link 96 to the armature 97 of an actuating solenoid 98 forming a part of the locking means 27. When the solenoid is energized, upon closing of a control switch 100, 101 or 102 of the control circuit (FIG. 10) described hereafter, the armature pulls in, rocking the lever 93 and camming one of the ears 95 against the cross bar 92 as shown in dotted lines in FIG. 4, thereby retracting the plunger 80 against the action of the spring 90 and releasing the frame 12 for shifting movement.

In the control circuit illustrated in FIG. 10, the control switches 100, 101 and 102 are adapted to condition the circuit to move the inner frame 12 to its left rail aligning position as viewed in FIG. 1, to its right rail aligning position, and to its center rail aligning position respectively. The control switches 100, 101 and 102 are illustrated in FIG. 10 as being switches which are adapted to be positioned along the rails 16, 18 and 17 respectively to be tripped or closed by self-propelled carriers approaching the switch 10 and thereby effect the throwing of the switch to the proper positions to receive the carriers.

The circuit of FIG. 10 illustrates all of the relays with their respective contacts in their normally open and normally closed positions, that is with their actuating coils deenergized and with the latching type relays unlatched. The limit switches 21 and 22 are of the maintained contact type, and the switch 21 has contacts 105 and 106 while the switch 22 has contacts 107 and 108. In FIGS. 7 and 10 the contacts 105 and 107 are shown closed and the contacts 106 and 108 are shown open, thereby corresponding to the FIG. 1 position of the frame 12 in which the left hand rail 16 is connected or aligned with the rail 19 by the rail section 13.

A switch 110 is mounted so as to be actuated to a closed position when the locking nose or plunger 80 is released by the solenoid 98 to extend into an opening in the abutment member 47 for locking the movable frame 12 in a selected position. The closing of the switch 110 upon locking of the frame 12 in a selected operative position completes a circuit which may be traced from a power line L1 through a conductor 111, switch 110, a conductor 112, the actuating coil of a control relay 114, and a conductor 115 to a power line L2. The energization of the relay 114 closes its normally open contacts 116, 117, 118 and 119, and opens its normally closed contacts 120 and 121.

With the switch 10 in its FIG. 1 position the previously mentioned blocking contactor 36 is energized by a circuit which can be traced from the power line L1 through the closed contacts 107 of the limit switch 22, conductors

124, 125, now closed contacts 118 of the relay 114, a conductor 126, the actuating coil of the blocking relay 36 and a conductor 127 to the power line L2. The normally open contacts 130, 131, 132 and 133 of the blocking relay 36 are thereby held closed with the contacts 131, 132 and 133 completing a circuit including conductors 134, 135 and 136 (FIG. 11) for energizing the conductor bar portions 35*a* associated with the left rail 16. The contacts 130 complete a circuit from the power line L1 through conductors 138, 139, 140 and the actuating coil of the blocking contactor 39.

The last mentioned contactor is thereby energized and its normally open contacts 141, 142 and 143 are closed to effect the energization of the conductor bar portions 35*d* and 35*e* through conductors 134, 145 and 146.

When the switch 10 is in the FIG. 1 position the conductor bar portions 35*b* and 35*c*, which are controlled by the blocking contactors 37 and 38 respectively in a manner more fully described hereafter, are not energized and prevent the possibility of a carrier running along rails 17 or 18 into the switch 10.

The switch 10 can be thrown from its left rail aligning position described above to either its center rail aligning position or its right rail aligning position by closing of either the center control switch 102 or the right control switch 100 respectively. Closing of the left control switch 101 would have no effect since the limit switch 22 has its contacts 108 open preventing the completion of any circuits through the switch 101 from the power line L1.

In order to shift the movable frame 12 to the left to assume a position in which the right hand rail 18 is aligned with the rail 19, the control switch 100 is closed, for example by a carrier approaching the switch 10 along the rail 18. Closing of the switch 100 completes a circuit which may be traced from the power line L1 through the contacts 105 of the limit switch 21, conductors 150, 151, switch 100, conductor 152, normally closed contacts 153 of a latching relay 154, a conductor 155, the latch coil 156 of a latching type relay 157 and a conductor 158 to the power line L2.

The completion of this circuit energizes the coil 156 of the latching relay 157 and causes that relay to be mechanically latched, thereby closing and holding its normally open contacts 160, 161, 162 and 163, and opening its normally closed contacts 164 and 165. The now closed contacts 162 of the latching relay 157 complete a circuit for energizing the solenoid 98 of the locking means 27, which circuit may be traced from the power line L1 through the contacts 105 of the limit switch 21, the conductor 150, normally closed contacts 165 of a latching type relay 166, conductors 167, 168 and 169, the now closed contacts 162, conductors 170, 171 and the solenoid 98 to the power line L2, thereby drawing in the armature 97 and withdrawing the plunger 80 from the opening 83 in the member 47 and releasing the frame 12 for movement under the influence of the reversible motor 20.

The withdrawal of the plunger 80 opens the switch 110 de-energizing the control relay 114 and permitting its normally closed contacts to close and its normally open contacts to open, of which the contacts 121 effect energization of the motor 20 from the power line L1 through contacts 105, conductor 150, normally closed contacts 165 of relay 166, conductors 167, 168, the contacts 121, now closed contacts 161 of relay 157, conductor 175 to terminal T3 of the motor 20 and conductor 176 to the power line L2. The now closed contacts 160 of the relay 157 connect terminals T1 and T2 of the motor 20 for the starting thereof in a direction to move the frame 12 toward the selected position for aligning the rail 18 with the rail 19.

Additionally, the opening of the contacts 118 of the control relay 114 serves to break the previously described circuit for energizing the blocking contactor 36, thereby permitting the contacts 131, 132 and 133 thereof to open de-energizing the conductor bar portions 35*a*, and the contacts 130 thereof to open de-energizing the blocking contactor 39. De-energization of the contactor 39, and the consequent opening of the contacts 141, 142 and 143, serves to de-energize the conductor bar portions 35*d* and 35*e* by breaking the previously described energizing circuit therefor. The now open contacts 116, 117 and 119 of the control relay 114 prevent the energization of the other blocking contactors 37 and 38 during the movement of the frame 12. The operation of these blocking contactors and their circuits will become apparent as the description proceeds.

As the frame 12 moves to the left carrying with it the limit switches 21 and 22, and as it passes through the center position, the limit switch 22 will be actuated by the cam member 25 shifting that switch to open its contacts 107 and to close its contacts 103, however this will have no immediate effect on the circuit as it is presently conditioned other than to select which of the blocking contactors will be energized at the completion of the throw. As the frame moves into its position, aligning the rail section 15 with the rail 19 and with the right hand rail 18, the limit switch 21 will be actuated by the cam member 23 opening its contacts 105 and closing its contacts 106. It will be recognized that the opening of the contacts 105 of the limit switch 21 will serve to directly de-energize the motor 20 and the solenoid 98 of the locking means 27 without requiring the actuation of any intermediate relays.

With de-energization of the solenoid 98, the plunger 80 is spring biased to engage in the opening 81 as the frame 12 completes its movement into the selected position. The extension of the plunger 80 effects the closing of the switch 110, and the energization of the control relay 114 through the circuit described above, closing the contacts 116, 117, 118 and 119 and opening the contacts 120 and 121.

The now closed contacts 116 complete a circuit from the power line L1 through the now closed contacts 108 of the limit switch 22, a conductor 175, normally closed contacts 176 of the latching relay 166, a conductor 177, the contacts 116, a conductor 178 and the actuating coil of the blocking contactor 38 to the power line L2.

The blocking contactor 38 is thereby energized closing its normally open contacts 180, 181, 182 and 183. The contacts 180 complete a circuit from the power line L1 through a conductor 185 to actuate the blocking contactor 39 to energize the conductor bar portions 35*e* and 35*d*, while the contacts 181, 182 and 183 energize the conductor bar portions 35*c* through conductors 134, 135, 186, 187 and 188 (FIG. 11).

The carrier on the rail 18 which tripped the control switch 100 now can pass through the switch 10 leaving on the rail 19. Carriers approaching along the rails 16 and 17 will, however, be stopped by the blocked or de-energized conductor bar portions 35*a* and 35*b*.

The closing of the switch 110, upon extension of the plunger 80, also effects the completion of a circuit from the power line L1 through the conductor 112, a conductor 190, closed contacts 163 of the latched relay 157, a conductor 191, the unlatching coil 192 of the relay 157 and a conductor 193 to the power line L2. This circuit unlatches the mechanically held relay 157 returning it to its normal condition and placing the circuit in readiness for the selection of another position of the switch 10.

It will be observed that during the above described movement of the frame 12 the control relay 114 is in a de-energized condition and the latching type relay 157 is mechanically held in. The circuit is therefore conditioned, upon the closing of the control switch 100, to energize the motor 20 for shifting of the switch 10 to a preselected position, and the circuit will remain so conditioned even though there be a power failure so that upon a return of the power the motor will continue to throw the switch to the selected position.

If it is now desired to throw the switch to its center position, for example to receive a carrier approaching

on the rail 17, the center control switch 102 is closed either manually or by the carrier itself. A circuit is thereby established from the power line L1 through the already closed switch 110, conductors 112 and 195, switch 102, a conductor 196, the latch coil 197 of latching relay 166 and a conductor 198 to the power line L2, thereby mechanically holding in the relay 166, opening the normally closed contacts 165 and 176 and closing the normally open contacts 200, 201, 202, 203 and 204 thereof.

Because the limit switches 21 and 22 are now conditioned as shown in FIG. 9, the closing of the contacts 202 completes a circuit which can be traced from the power line L1 through the now closed contacts 106, a conductor 210, contacts 202, conductor 211, normally closed contacts 164, conductor 212, the latch coil 213 of the latching relay 154 and conductor 214 to the power line L2, thereby mechanically latching and holding relay 154 with its normally open contacts 220, 221, 222 and 223 closed and its normally closed contacts 153 and 225 opened. A circuit can then be traced from the power line L1 through the now closed contacts 106, conductors 210 and 227, now closed contacts 200, conductor 228, now closed contacts 222, conductor 171 and the solenoid 98 to the power line L2.

That circuit is effective to retract the plunger 80 and open the switch 110 in the manner described heretofore and resulting in the de-energization of the control relay 114. The opening of contacts 116 of the latter de-energizes the blocking contactor 38, and in turn the blocking contactor 39, to de-energize the conductor bar portions 35*c*, 35*d* and 35*e*.

The motor 20 is energized through the limit switch contacts 106, now closed contacts 200, 120, and 220, while the now closed contacts 221 connect the terminals T2 and T3 for starting the rotation of the motor in the proper direction.

As the frame 12 is about to move into the center position carrying with it the limit switches 21 and 22, the switch 21 is actuated by the cam element 24 to open the contacts 106 and close the contacts 105, whereby the limit switches are placed in the condition illustrated in FIG. 8.

Opening of the contacts 106 directly de-energizes the motor 20 and the solenoid 98 of the locking means 27 permitting the locking plunger 80 to be extended into the opening 82 when the frame 12 coasts into the position in which the rail section 14 is aligned with the rails 17 and 19. The switch 110 is closed by the extending of the plunger 80 energizing the control relay 114.

A circuit can now be traced from the power line L1 through the now closed contacts 105 of the limit switch 21, conductors 150 and 230, now closed contacts 117 of the relay 114, a conductor 231 and the actuating coil of a relay 232 to the power line L2. The resultant actuation of the relay 232 closes the normally open contacts 234 to complete a circuit from the power line L1 through the still closed contacts 108 of the limit switch 22, conductor 175, now closed contacts 119 of the relay 114, conductor 235, the contacts 234 and the blocking contactor 37 to the power line L2.

The energization of the blocking contactor 37, and the closing of the normally open contacts 240 thereof, is effective to energize the blocking contactor 39 through a conductor 238. The closing of the contacts 241, 242, 243 of the contactor 39 is effective to energize the conductor bar portions 35*b* through the conductors 134, 135, 186 and 245. The carrier on the rail 17 can then proceed to pass through the switch 10.

The closing of the switch 110, upon locking by the plunger 80, also completes a circuit including the conductors 112, 190, now closed contacts 223, a conductor 247 and the unlatch coil 248 of the latching relay 213. Energization of the coil 248 unlatches the relay 213 returning it to its normal condition. The consequent closing of contacts 225 of the relay 213 completes a circuit through conductors 112, 250, now closed contacts 205, conductor 206, now closed contacts 165 of relay 157, the contacts 225, a conductor 252, the unlatch coil 253 of relay 166 and a conductor 254, thereby returning the latching relay 166 to its normal condition and placing the control circuit in readiness for the selection of another operative position of the switch 10.

If it is now desired to throw the switch 10 to the position in which the rail section 15 once again is aligned with the left hand rail 16 and the rail 19, for example to receive a carrier approaching along the rail 16, the left control switch 101 is closed. Inasmuch as the contacts 108 of the limit switch 22 are closed as shown in FIG. 8 a circuit is established from the power line L1 through the contacts 108, conductor 260, switch 101, conductors 261 and 211, contacts 164, conductor 212, latch coil 213 of the relay 154 and the conductor 214 to the power line L2. The contacts of the relay 154 again complete a circuit for energizing the solenoid 98 to unlock the frame 12 and open the switch 110 as was described with reference to the throwing of the switch to the center position from the right rail aligning position.

The opening of the switch 110 de-energizes the relay 114 and effects the energization of the motor 20 and the blocking of all of the conductor bar portions 35*a*, 35*b*, 35*c* and 35*d*. Just before the frame 12 arrives at the newly selected position the limit switch 22 is actuated by the cam member 26 opening the contacts 108 and closing the contacts 107, thereby directly cutting off the energization of the motor 20 and de-energizing the solenoid 98 to release the locking plunger 80. The release of the plunger 80 closes the switch 110 energizing the relay 114 and thereby energizing the proper blocking contactors 36 and 39 to provide current in the conductor bar portions 35*c*, 35*d* and 35*e*. The closing of the switch 114 also unlatches the relay 213 placing the circuit in readiness to throw the switch 10 either to the center position or to the right rail aligning position. If thrown now to the center position, it will be recognized that the relays 166 and 157 will be actuated to energize the motor in the opposite direction to that effected by the relays 166 and 154 when the switch was thrown from the right hand rail aligning position to the center position as described above.

Again, the relays 154, 157 and 166 are each of the mechanically latching type, thereby being adapted to condition the circuit so that an interruption in power will not change the operation thereof upon a resumption of power.

Although the blocking or baffling has been described as applied to all four rails, 16, 17, 18 and 19, and although the carriers have been referred to as entering on rails 16, 17 and 18, the blocking can be omitted on any of the rails without altering the basic control circuit and the carriers can enter along rail 19 and exit from any of rails 16, 17 and 18. Also, although the frames 11 and 12 have been referred to as outer and inner respectively, it will be recognized that other arrangements are possible without departing from the scope of the invention. For example, the frames 11 and 12 could as well be on two levels, that is upper and lower frames. Moreover, when the invention is embodied in shifting tongue type switches, previously mentioned, the movable frame may be reduced to a single member, for example, the tongue itself.

From the foregoing detailed description of a specific embodiment of the invention, it will be apparent that the objects heretofore enumerated as well as others have been accomplished and that there has been provided a novel and improved material handling system including a switch control circuit which is simple and effective, reliable in operation, and so devised that when the circuit is conditioned to throw the switch to a selected operative position the circuit will remain so conditioned until the throw is completed even though a temporary power supply failure occurs. While the invention has been herein described

with reference to a specific embodiment thereof, it is understood that the invention is not limited thereto, but rather the invention includes all such adaptations, modifications and uses thereof as are reasonably embraced by the scope of the claims hereof.

Having described my invention, I claim:

1. In an overhead monorail carrier system, a switch having a first frame; a second frame supporting said first frame for horizontal movement transversely of a rail on one side of the switch; a reversible electric motor mounted on one of said frames and connected by transmission means to the other of said frames; circuit means for controlling said motor for effecting movement of said first frame between first, second and third positions for selectively connecting said rail with any of three rails on the other side of the switch to provide a continuous path of travel for a carrier; said circuit means including first and second limit switches mounted on one of said frames and actuatable by movement between said frames; solenoid operated locking means for releasably retaining said first frame in said positions; a third limit switch actuatable by said locking means; first, second, and third control switches corresponding to said first, second, and third positions and adapted to be selectively connected by said first, second and third limit switches respectively to a power conductor; latching relay means responsive to said first, second, and third control switches and connected to said motor for energization thereof to effect movement of said first frame into said first, second and third positions respectively; and said first and second limit switches adapted to directly de-energize said motor when said first frame moves into a selected position.

2. In an overhead monorail carrier system a switch having a first frame; a second frame supporting said first frame for horizontal movement transversely of a rail on one side of the switch; a reversible electric motor mounted on one of said frames and connected by transmission means to the other of said frames; circuit means for controlling said motor for effecting movement of said first frame between first, second and third positions for selectively connecting said rail with any of three rails on the other side of the switch to provide a continuous path of travel for a carrier; said circuit means including first and second limit switches mounted on one of said frames and actuatable by cam means on the other of said frames; solenoid actuatable locking means for releasably locking said frame in said positions; a third limit switch actuatable by said locking means; first, second and third control switches for selecting said first, second and third positions respectively and connected on one side by said first, second and third limit switches to a power conductor in accordance with the position occupied by said first frame; first, second and third latching type relay means connected to said control switches on the other side thereof and adapted to be latched by said first, second and third control switches respectively; said first, second and third relay means selectively connecting said motor through said first and second limit switches to said power line for energization of said locking means and said motor in a sense to move said first frame toward a selected one of said positions; said first and second limit switches being effective to directly de-energize said locking means and said motor when said first frame moves into said selected position; and said third limit switch being effective to unlatch said first, second and third relay means upon said locking means locking said frame.

3. In an overhead monorail carrier system a switch having a first frame, a second frame supporting said first frame for horizontal movement transversely of a rail on one side of the switch; a reversible electric motor mounted on one of said frames and connected by transmission means to the other of said frames; circuit means for controlling said motor for effecting movement of said first frame between first, second and third positions for selectively connecting said rail with any of left, right and center rails respectively on the other side of the switch to provide a continuous path of travel for a carrier; said circuit means including first and second limit switches mounted on one of said frames and actuatable by cam means on the other of said frames; locking means for releasably locking said frame in said positions and having a solenoid for actuation thereof; a third limit switch actuatable by said locking means; first, second and third latching type relay means; first, second and third control switches connecting said first, second and third relay means to a power line through said first, second and third limit switches for selectively actuating said relay means; said solenoid and said motor being connected to said power line by said first, second and third relay means through said first and second limit switches; said first, second and third relay means being actuatable to energize said solenoid to unlock said first frame and to selectively energize said motor in directions effective to move said first frame into said first, second and third positions upon closing of said first, second and third control switches respectively; said first and second limit switches being effective to directly de-energize said motor as said first frame moves into a selected one of said positions and to directly de-energize said solenoid for locking of said first frame in its selected position; and said third limit switch being effective to unlatch any of said latching type relay means upon actuation of said third limit switch by said locking of said first frame.

4. In an overhead monorail carrier system, a switch having a first frame; a second frame supporting said first frame for horizontal movement transversely of a rail on one side of the switch; a reversible electric motor mounted on one of said frames and connected by transmission means to the other of said frames; circuit means for controlling said motor for effecting movement of said first frame between first, second and third positions for selectively connecting said rail with any of three rails on the other side of the switch to provide a continuous path of travel for a carrier; conductor bar means mounted on each of said rails for energization of carrier means; said circuit means including first and second limit switches mounted on one of said frames and actuatable by movement between said frames; solenoid operated locking means for releasably retaining said first frame in said positions; a third limit switch actuatable by said locking means; first, second and third control switches corresponding to said first, second, and third positions and adapted to be selectively connected by said first, second and third limit switches respectively to a power conductor; latching relay means respective to said first, second, and third control switches and connected to said motor for energization thereof to effect movement of said first frame into said first, second and third positions respectively; a conductor bar control relay connected to said third limit switch and actuated in response thereto for de-energizing said conductor bar means upon actuation of said locking means to release said first frame; and said first and second limit switches adapted to directly de-energize said motor when said first frame moves into a selected position.

5. In an overhead monorail carrier system a switch having a first frame; a second frame supporting said first frame for horizontal movement transversely of a rail on one side of the switch; a reversible electric motor mounted on one of said frames and connected by transmission means to the other of said frames; circuit means for controlling said motor for effecting movement of said first frame between first, second and third positions for selectively connecting said rail with any of three rails on the other side of the switch to provide a continuous path of travel for a carrier; conductor bar means mounted along each of said rails for energization of a carrier; said circuit means including first and second limit switches mounted on one of said frames and actuatable by cam means on the other of said frames; solenoid actuatable

locking means for releasably locking said frame in said position; a third limit switch actuatable by said locking means; first, second and third control switches for selecting said first, second and third positions respectively and connected on one side by said first, second and third limit switches to a power conductor in accordance with the position occupied by said first frame; first, second and third latching type relay means connected to said control switches on the other side thereof and adapted to be latched by said first, second and third control switches respectively; said first, second and third relay means selectively connecting said motor through said first and second limit switches to said power line for energization of said locking means and said motor in a sense to move said first frame toward a selected one of said positions; a conductor bar control relay connected to said third limit switch for actuation in response to actuation of said locking means; baffle contactor means for said conductor bar means and connected to said control relay for actuation thereby in accordance with the position of said frame; said first and second limit switches being effective to directly de-energize said locking means and said motor when said first frame moves into said selected position; and said third limit switch being effective to unlatch said first, second and third relay means upon said locking means locking said frame.

6. In an overhead monorail carrier system a switch having a first frame, a second frame supporting said first frame for horizontal movement transversely of a rail on one said of the switch; a reversible electric motor mounted on one of said frames and connected by transmission means to the other of said frames; circuit means for controlling said motor for effecting movement of said first frame between first, second and third positions for selectively connecting said rail with any of left, right and center rails respectively on the other side of the switch to provide a continuous path of travel for a carrier; conductor bars mounted along each of said rails for selective energization for providing power to carriers following said continuous path of travel and for cutting off power to carriers not following said path of travel; said circuit means including first and second limit switches mounted on one of said frames and actuatable by cam

means on the other of said frames; locking means for releasably locking said frame in said positions and having a solenoid for actuation thereof; a third limit switch actuatable by said locking means; a conductor bar control relay connected to said third limit switch for actuation in response to locking and unlocking of said first frame; first, second and third latching type relay means; first, second and third control switches connecting said first, second and third relay means to a power line through said first, second and third limit switches for selectively actuating said relay means; said solenoid and said motor being connected to said power line by said first, second and third relay means through said first and second limit switches; said first, second and third relay means being actuatable to selectively energize said motor in directions effective to move said first frame into said first, second and third positions upon closing of said first, second and third control switches respectively; said first and second limit switches being effective to directly de-energize said motor as said first frame moves into said positions and to directly de-energize said solenoid for locking of said first frame in its selected position; and baffle contactor means for energizing said conductor bars and having the actuating coils thereof connected by said control relay to said first and second limit switches for actuation of said baffle contactor means to de-energize said conductor bars during movement of said first frame and to selectively energize the conductor bars corresponding to said continuous path of travel upon locking of said first frame in its selected position.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

July 31, 1962

Patent No. 3,046,909

Henry A. Gorjanc

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 10, line 50, for "respective" read -- responsive --; column 11, line 30, for "said" read -- side --.

Signed and sealed this 11th day of December 1962.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents