April 20, 1943. T. A. BURDICK 2,317,175

GATE OPERATING CONTROL

Filed Aug. 2, 1940 3 Sheets-Sheet 1

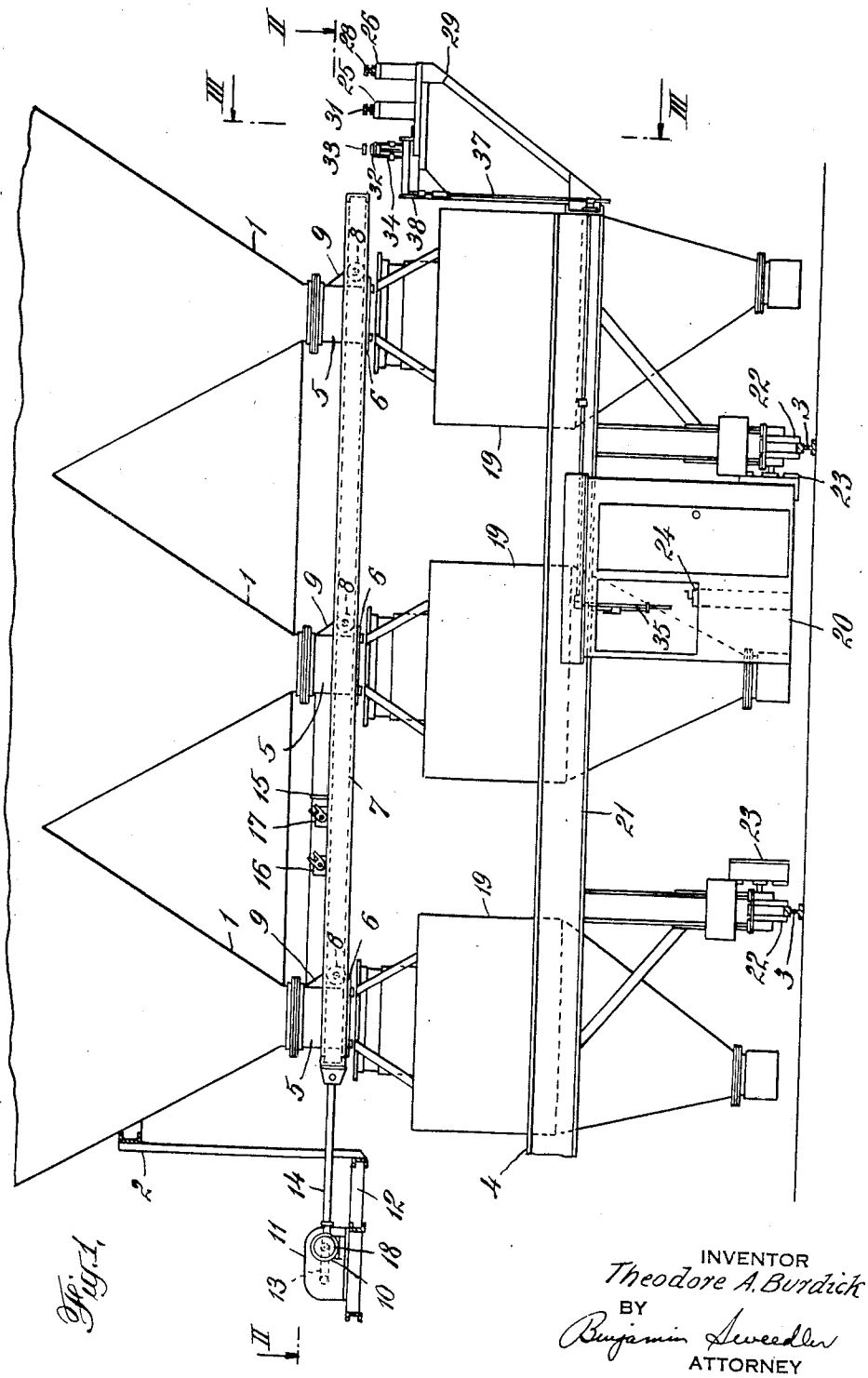


Fig. 1.

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Fig. 2.

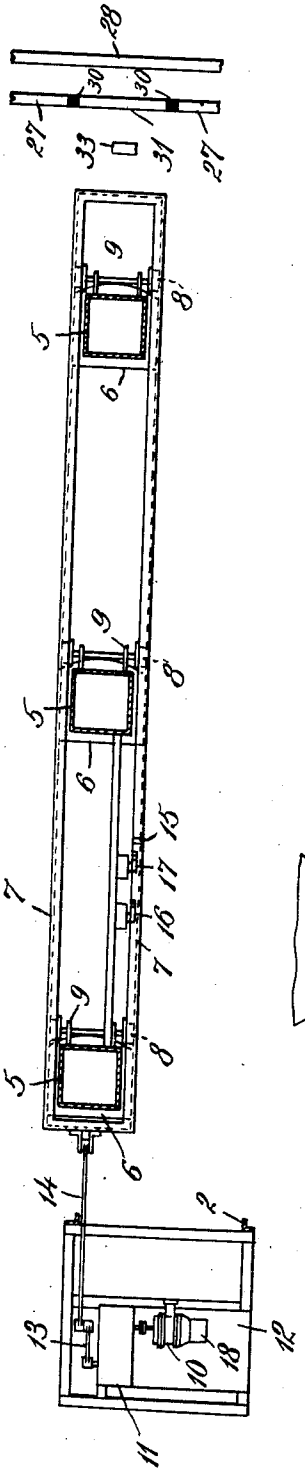
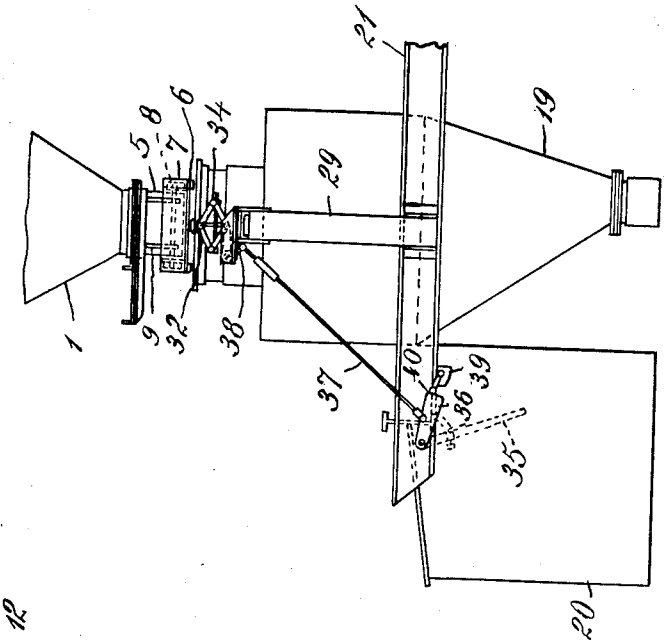


Fig. 3.



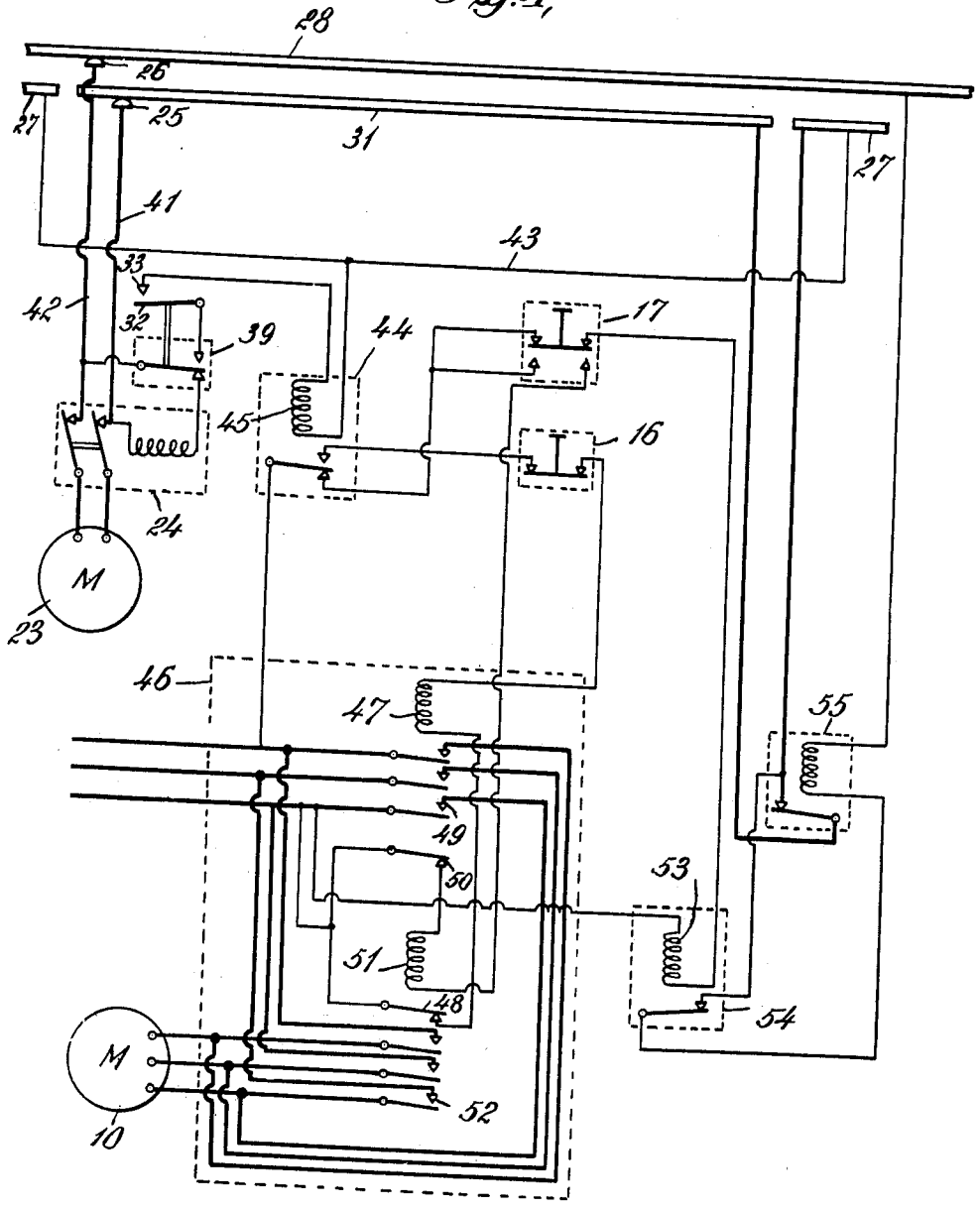
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Fig. 4.



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Patented Apr. 20, 1943 2,317,175

UNITED STATES PATENT OFFICE

2,317,175

GATE OPERATING CONTROL

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Application August 2, 1940, Serial No. 349,851

10 Claims. (Cl. 214—41)

This invention relates to mechanically operated closure means for hoppers which discharge material into movable receivers, and relates particularly to mechanically operated gates for the hoppers of coal bins which discharge coal to larry cars for delivery to by-product coke ovens.

Coal for charging into coke ovens is delivered from coal storage bins to the ovens by a larry car which receives the coal from the coal bin discharge gates and drops the coal into the ovens through suitable charging holes. Due to the weight of the coal bin discharge gates and of the coal pressing against the gates, manual operation of the gates has been unsatisfactory and has even resulted in injury to the operators caused by the jerking and strain necessary to move the gates. It has been proposed to employ power operated means to open and close the gates for discharge of coal to the larry car and to provide a locking control to prevent operation of the larry car to move it from beneath the gates while the gate operating mechanism is in position to hold the gates open. Gate operating means heretofore suggested have required the larry car operator to leave his cab to operate the gates, and have involved a movable part on the larry car for engagement with a fixed part on the bin to operate the gates, which parts in operation tend to wear excessively, require frequent repair and manual manipulation. Further, the locking control means heretofore proposed have not been operative to close the gates in the event of accidental displacement of the larry car.

It is an object of this invention to provide a material handling apparatus comprising a material delivery hopper having a discharge orifice, an electrically propelled car for receiving discharged material, and an interlocking control device in fixed relation to the hopper and actuated from the car to open and close the discharge orifice when the car is in receiving position, to close the orifice when the car is not in receiving position, and to cut off power from and prevent movement of the car from receiving position while the discharge is open. Other objects and advantages of this invention will appear from the following detailed description thereof.

The apparatus of my invention involves a closure operating motor to open or close the discharge orifice of a material delivery hopper, and a movable contact mounted on an electrically propelled car and adapted to be moved into engagement with a stationary contact when the car is in position to receive material from the hopper, to complete a closure control circuit to effect actuation of the motor to open the discharge orifice and simultaneously open a switch interrupting the flow of power to the motor which propels the car. An auxiliary circuit is provided having a switch which is moved by a member fixed to a closure operating part to open the auxiliary circuit to shut off power from the car operating motor and prevent movement of the car as long as the closure is in open or partially open position. Upon movement of the above mentioned movable contact out of engagement with the stationary contact, the closure operating motor is actuated to close the discharge orifice, and when the gates are fully closed, the auxiliary circuit is completed, permitting energization of the motor operating the car.

In the following description and in the drawings the invention is exemplified in apparatus involving coal bin hoppers with mechanically operated bin gates for delivery of coal to larry charging cars of by-product coke ovens. It will be understood, however, that the invention is capable of various modifications, is applicable to other apparatus such as apparatus for the delivery of other material than coal to trucks from storage hoppers, and is not to be construed as limited to the details of the present disclosure other than as defined in the appended claims.

In the drawings,

Figure 1 is an end elevation of coal bin gate operating mechanism involving my invention,

Figure 2 is a horizontal section taken on the line II—II of Figure 1,

Figure 3 is a vertical section taken on the line III—III of Figure 1, and

Figure 4 is a wiring diagram of the electrical circuits employed in effecting operation of my coal bin gate operating mechanism.

The apparatus shown in Figures 1, 2 and 3 comprises coal bin hoppers 1 supported by framework 2 above tracks 3 on which larry charging car 4 is operated. The hoppers 1 are provided at their lower ends with orifices 5 and gates 6 for discharge of coal to charging car 4 when the latter is moved to a position beneath the hoppers. The gates 6 are carried by gate connecting members 7, which travel on rollers 8 mounted in brackets 9 fixed to the hoppers 1, so that the gates 6 may be reciprocated as a unit to open or close all of the orifices 5 simultaneously. Gates 6 are moved to open and closed positions by a reversible motor 10 and speed reducer 11 which are mounted on a support 12 in fixed

relation to the hopper 1 and which actuate a lever 13 connected by a link 14 to the gate connecting members 7. Projection 15 on the members 7 operates limit switches 16 and 17 to cut off power to the motor 10 when the gate has been fully opened and closed respectively. Spring operated brake 18 is provided to stop the motor and prevent over-travel of the gates 6 when the current to the motor is cut off.

The larry car 4 comprises hoppers 19 and the control cab 20 supported by framework 21 and movable along the tracks 3 on flanged wheels 22 driven by the motors 23 which are controlled by controller 24 in the cab 20. Power to operate the motors 23 is supplied from a pair of sliding contacts or shoes 25 and 26 supported by bracket 29 on framework 21 of the car for engagement with power supply rails 27 and 28 disposed along the length of the coke oven battery parallel thereto. Power supply rail 27 is intercepted by insulators 30 to cut off a rail segment 31 opposite the hoppers 1 from the remainder of the rail 27. As shown in Figures 1 and 4, the shoe 25 engages the rail segment 31 when the larry car 4 is in position to receive coal from the hoppers 1.

A retractible contact 32 operated from the control cab 20 and supported by the bracket 29 is provided to engage a stationary contact 33 to complete a gate control circuit when the car is in position to receive coal from the hoppers. As shown more particularly in Figure 3, the retractible contact 32 is moved up or down to engage or be disengaged from the contact 33 by means of a pantograph mechanism 34 operated from the control cab 20 by a hand lever 35 which moves a lever 36, link 37 and bell crank 38 to extend or collapse the pantograph. A double throw switch 39, operated by a projection 40 on the lever 36, cuts out the controller 24 (Figure 1) of the propulsion motors 23 to prevent operation of the charging car 4 when the retractible contact 32 is extended.

The wiring diagram (Figure 4) shows the wiring of the apparatus, the switches being shown in the positions they occupy when the larry car 4 is in position beneath the hoppers 1 to receive coal but before the discharge gates 6 have been opened. Contact or shoe 26, in engagement with rail 28, and contact or shoe 25, in engagement with the insulated segment 31 of rail 27, are connected to supply power to the propulsion motors 23 through the leads 41 and 42. Controller 24 for the propulsion motors 23 is connected across the leads 41 and 42. Double throw switch 39, connected in series with the controller 24, breaks the car control circuit to prevent operation of the car when the retractible contact 32 is extended to engage stationary contact 33, and completes a gate control circuit from rail 28 through lead 42, retractible contact 32, stationary contact 33, and through a shunt 43 around the insulated segment 31 to rail 27. A double throw relay switch 44, operated by a coil 45 in the gate control circuit between the contact 33 and the rail 27, completes a gate opening circuit through reversing starter 46 when the gate control circuit is closed by extension of the retractible contact 32, and completes a gate closing circuit through the reversing starter 46 when the gate control circuit is opened by withdrawal of the retractible contact 32. The gate opening circuit is connected across the power source of the gate operating motor 10, and includes the double throw relay switch 44, the limit switch 16, and the coil 47 and switch 48 of the reversing starter 46. When the coil 47 is activated by completion of the gate opening circuit, it closes the contacts 49 of the starter 46 to operate the motor 10 to open the gates 6, and opens a switch 50 in the gate closing circuit. The gate closing circuit is also connected across the power source of the gate operating motor 10 and includes the double throw relay switch 44, the double throw limit switch 17, and the coil 51 and switch 50 of the reversing starter 46. When the coil 51 is activated by completion of the gate-closing circuit, it closes the contact 52 of the starter 46 to operate the motor 10 to close the gates 6, and opens switch 48 of the gate opening circuit. Limit switch 16 in the gate opening circuit is moved by projection 15 on the gate operating means 7 and breaks the gate opening circuit to stop the gates 6 when the gates are fully open; and double throw limit switch 17 in the gate closing circuit is moved by the projection 15 on the gate operating means 7 and breaks the gate closing circuit to stop the gates when the gates are closed.

The double throw limit switch 17 also forms part of an auxiliary circuit across the power source of the gate operating motor 10 which includes double throw relay switch 44 and coil 53 of relay switch 54. When the gates are closed, relay switch 44 and switch 17 complete the auxiliary circuit and coil 53 operates the relay switch 54, which in turn actuates a relay switch 55 and completes the connection between the insulated segment 31 in rail 27 and the remainder of the segmented rail 27 to supply power to the propulsion motors 23 of the larry car 4. Double throw relay switch 44 breaks the auxiliary circuit immediately when the gate control circuit is completed and the switch 17 keeps the circuit broken as long as gates are open. Breaking the auxiliary circuit operates the relay switches 54 and 55 to cut off the supply of power to the car from the insulated segment 31, and prevents movement of the car as long as the circuit remains broken.

The operation of my device is as follows: Larry car 4 is centered under the hoppers 1 in position to receive coal from the hoppers and with contact 25 in engagement with insulated segment 31 of rail 27. Retractible contact 32 on the car 4 is then extended into engagement with stationary contact 33 by operating hand lever 35. Movement of the hand lever 35 operates double throw switch 39 to cut out the propulsion motor controller 24 and to complete a gate control circuit through the retractible and stationary contacts 32 and 33 and the coil 45 of double throw relay switch 44. On completion of the gate control circuit, the relay switch 44 breaks the auxiliary circuit to actuate relays 54 and 55 to cut off power from rail segment 31 and completes a gate opening circuit through limit switch 16 and reversing starter 46 to cause the reversing starter to operate motor 10 to open the gates 6. The opening of the gates causes projection 15 on the gate connecting member 7 to move switch 17 from a position in which it completes the auxiliary circuit to a position in which it breaks the auxiliary circuit and forms part of a gate closing circuit. When the gates 6 are fully open, projection 15 on the gate connecting member 7 opens limit switch 16 to break the gate opening circuit and cause reversing starter 46 to cut off power from the motor 10.

When the car 4 has received its load from the hoppers 1, lever 35 is operated to withdraw the

retractible contact 32 and break the gate control circuit. Movement of the lever 35 also moves switch 39 to connect controller 24 to the propulsion motor 23. Breaking the gate control circuit completes the gate closing circuit through the double throw relay switch 44 and double throw limit switch 17 and causes the reversing starter 46 to operate motor 10 to close the gates 6. When the gates 6 are closed, double throw limit switch 17 is moved by the projection 15 on the gate connecting member 7 to break the closing circuit, causing reversing starter 46 to cut off power from the motor 10. Double throw switch 17, in the position to which it is moved by the closing of the gates, completes the auxiliary circuit and acts through relays 54 and 55 to restore power to the insulated segment 31 of the rail 21, permitting energization of the larry operating motors 23.

It is to be noted that the double throw switch 17 forms a positive interlock between the operation of the car and the operation of the gates which cuts off power to the car whenever the gates are open; if, due to some impediment, the gates are not fully closed, the larry car cannot be moved until closing of the gates is effected. It is also to be noted that if, due to some accident, the car 4 is displaced from beneath the hoppers 1 while the gates 6 are open, the engagement between the retractible contact 32 and the stationary contact 33 will be interrupted, the gate control circuit will be broken, and relay switch 44 will cause the reversing starter 46 to operate the motor 10 to close the gates 6 and stop the discharge of coal from the hoppers 1.

The gate operating mechanism of my invention provides a safe and speedy control for discharge of material from a hopper to a movable car and avoids the possibility of discharging material from the hopper except when the car is in position to receive the same. In addition, the control operates automatically to close the gates in the event the car should be accidentally displaced from its position underneath the discharge outlet while the gates are open.

I claim:

1. Material handling apparatus comprising a material delivery hopper having a discharge orifice, a movable receptacle for receiving discharged material, means for moving said receptacle, means to open and close the discharge orifice when the receptacle is in receiving position, control means to effect closing of the orifice when the receptacle is moved from receiving position, and means to prevent operation of the receptacle moving means while the discharge orifice is open.

2. In combination with a material delivery hopper, a gate at the delivery end of said hopper, a reversible motor in fixed relation to the hopper to open and close the gate, an electrically propelled car for receiving material from said hopper, an electric motor for propelling said car, means mounted on the car to control the first-mentioned motor to open and close the gate when the car is beneath the hopper, means operated by the gate to cut off power from the car-propelling motor while the gate is in open position, and control means to effect closing of the gate when the said electrically propelled car is moved from material-receiving position.

3. The combination with a material delivery hopper having a discharge orifice of a closure for the discharge orifice, means including a motor mounted in fixed relation to the hopper to open and close the orifice, an electrically propelled car to receive material from said orifice, control means mounted on the car to actuate the said motor to effect the opening and closing of the orifice, rails to supply power to propel said car, and means operated by the means for opening and closing the orifice to cut off power from one of the rails while the orifice is open.

4. The combination with a material delivery hopper of a gate at the delivery end of said hopper, a reversible motor in fixed relation to the hopper to open and close the gate, an electrically propelled car for receiving material from said hopper, control means mounted on said car to operate the motor to open and close the gate, sliding contacts on said car to receive power to propel the car, rails to supply power to said sliding contacts, insulating means separating a section of one of the rails arranged to be contacted by one of the sliding contacts when the car is in position to receive material from the hopper, a connection between the insulated section and the remainder of the rail, a switch in said connection, and means connected to the gate to open said switch to cut off power from the insulated section when the gate is opened to deliver material from the hopper.

5. The combination with a material delivery hopper of a gate at the delivery end of said hopper, gate operating means in fixed relation to the hopper to open and close said gate, an electrically propelled car for receiving material from said hopper, a contact mounted on the car movable to engage a stationary contact to complete a control circuit when the car is in position to receive material from the hopper, and means in the control circuit for effecting actuation of the gate operating means to open the gate and cut off power from the car motor when the control circuit is completed, said means being constructed and arranged to actuate the gate operating means to close the gate and to restore power to the car after closing the gate when the control circuit is broken by moving the movable contact out of engagement with the stationary contact.

6. The combination with a material delivery hopper of a gate at the delivery end of said hopper, gate operating means in fixed relation to the hopper to open and close said gate, an electrically propelled car for receiving material from said hopper, sliding contacts on the car to receive power to propel the car, rails to supply power to the contacts, insulating means cutting off a section of one of the rails arranged to be contacted by one of the sliding contacts when the car is in position to receive material from the hopper, a switch connecting the insulated section and the remainder of the rail, a control contact connected to the remainder of the sectioned rail, a retractible contact connected to an unsectioned rail and mounted on the car in position for movement to engage the control contact to complete a control circuit when the car is in position to receive material from the hopper, and means in the control circuit between the control contact and the remainder of the sectioned rail to actuate the gate operating means to open the gate and to operate said switch to cut off power from the insulated section when the control circuit is completed, and when the control circuit is broken to actuate the gate operating means to close the gate and to operate the switch to supply power to the insulated section after the gate is closed.

7. The combination with a material delivery

hopper of a gate at the delivery end of said hopper, gate operating means in fixed relation to the hopper to open and close said gate, an electrically propelled car for receiving material from said hopper, sliding contacts on the car to receive power to propel the car, rails to supply power to the contacts, insulating means cutting off a section of one of the rails arranged to be contacted by one of the sliding contacts when the car is in position to receive material from the hopper, a switch connecting the insulated section and the remainder of the rail, a stationary control contact, a retractible contact mounted on the car in position for movement to engage the control contact ot complete a control circuit when the car is in position to receive material from the hopper, a double throw relay switch which is moved to a position in which it completes a gate closing circuit and operates means to close the first mentioned switch when the control circuit is broken, said relay switch being moved to the other position in which it completes a gate opening circuit and operates means to open the first mentioned switch to cut off power from the insulated rail section when the control circuit is completed.

8. The combination with a material delivery hopper of a gate at the delivery end of said hopper, a gate operating member in fixed relation to the hopper to open and close the gate, an electrically propelled car for receiving material from said hopper, a double throw relay switch which in one position completes a gate closing circuit and in the other position completes a gate opening circuit, a retractible contact mounted on said car movable to engage a stationary contact to complete a control circuit and actuate the relay switch to complete the gate opening circuit when the car is positioned to receive material from said hopper, a limit switch to break the gate opening circuit when the gate is fully open, said retractible contact being movable out of engagement with the stationary contact to break the control circuit and actuate the relay switch to complete the gate closing circuit, and a double throw gate actuated switch which, when the gate is open, serves as part of the gate closing circuit, and which, when the gate is closed, breaks the gate closing circuit and completes an auxiliary circuit through the double throw relay switch to actuate a second relay switch to supply power to the car.

9. Material handling apparatus comprising a material delivery hopper having a discharge orifice, a movable receptacle for receiving discharged material, a gate member for opening and closing said discharge orifice, means for moving said gate member to open said orifice when said receptacle is in a position to receive said material, and control means for effecting actuation of said moving means to close said orifice when said receptacle is moved out of material receiving position.

10. The combination with a material delivery hopper of a gate at the delivery end of said hopper, gate operating means to open and close said gate, an electrically propelled car for receiving material from said hopper, a contact mounted on the car movable to engage a stationary contact to complete a control circuit when the car is in position to receive material from the hopper to effect operation of said gate operating means to open the gate, and means in said control circuit to effect operation of said gate operating means to close said gate upon displacement of said car to move the contact on said car out of engagement with said stationary contact.

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