T. W. FINDLEY.

ELECTRICALLY OPERATED TROLLEY DOOR.

APPLICATION FILED JULY 6, 1915.

1,222,090.

Patented Apr. 10, 1917.

2 SHEETS—SHEET 1.

Fig. 1

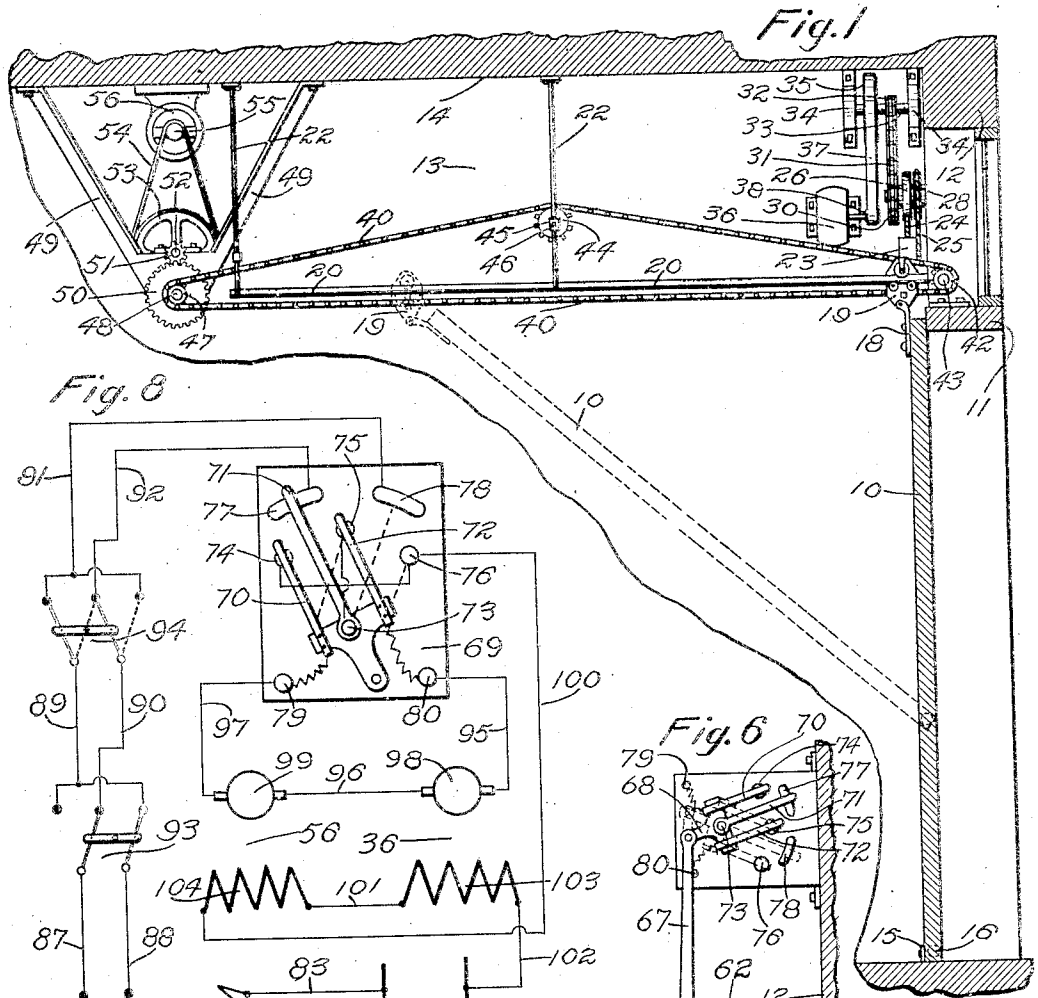


Fig. 8

Fig. 6

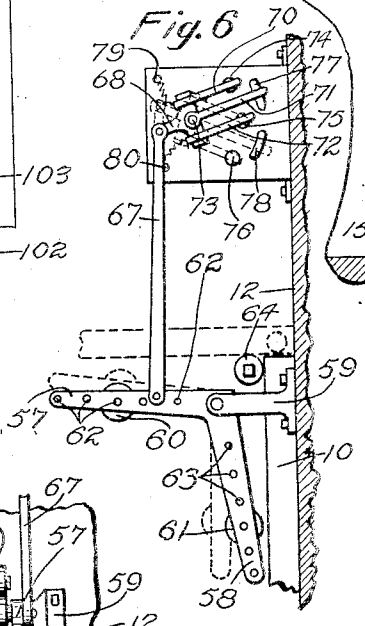
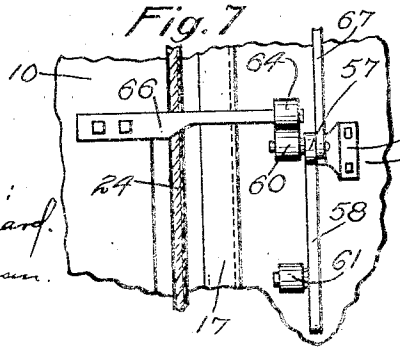


Fig. 7



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2 SHEETS—SHEET 2.

Fig. 2

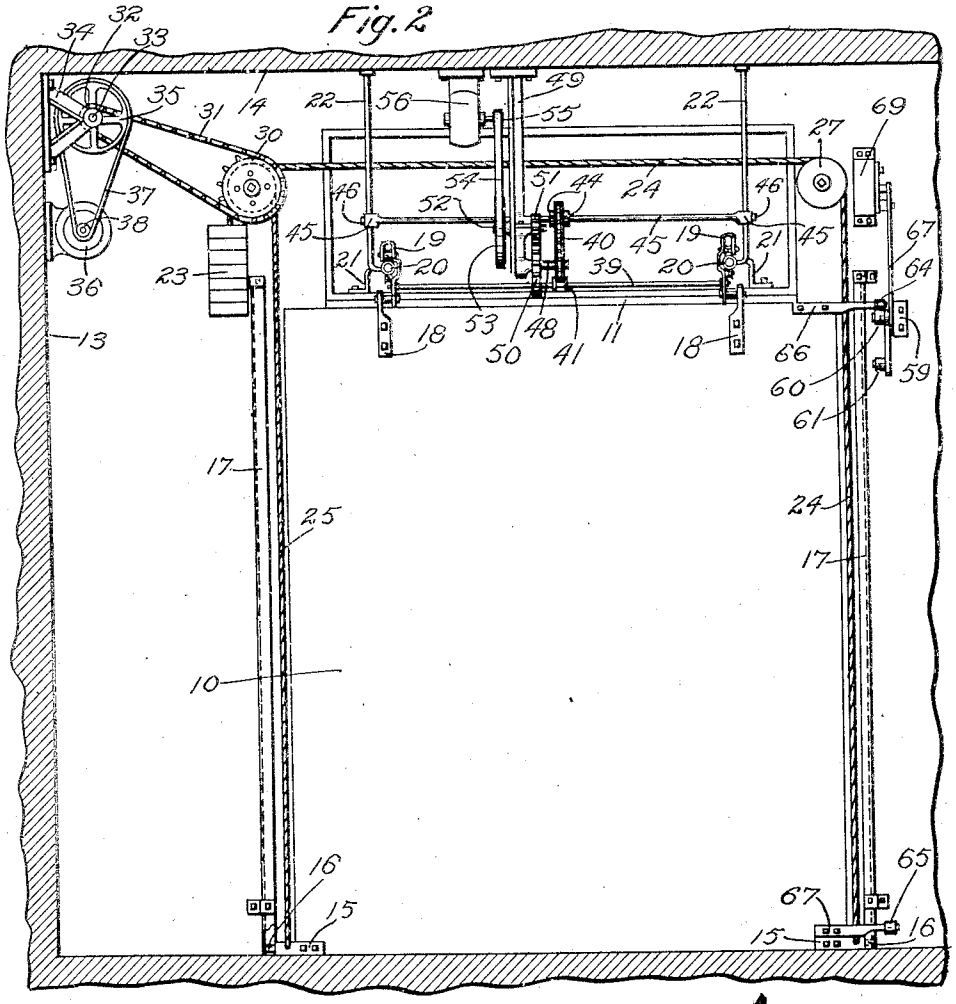


Fig. 9.

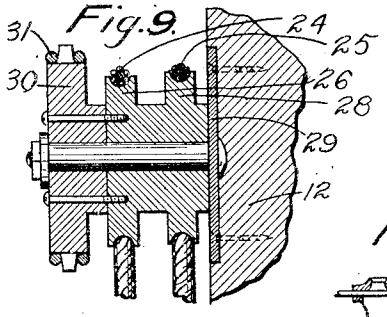


Fig. 3

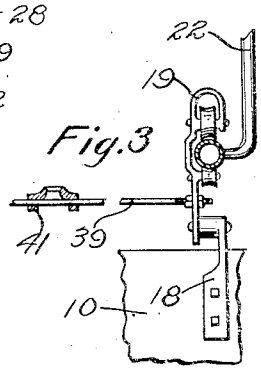


Fig. 4

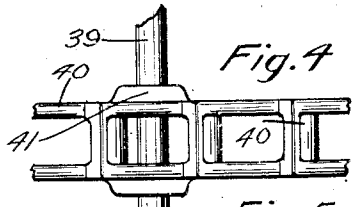
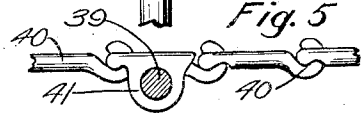


Fig. 5



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UNITED STATES PATENT OFFICE.

THOMAS W. FINDLEY, OF MINNEAPOLIS, MINNESOTA.

ELECTRICALLY-OPERATED TROLLEY-DOOR.

1,222,090. Specification of Letters Patent. Patented Apr. 10, 1917.

Application filed July 6, 1915. Serial No. 38,346.

To all whom it may concern:

Be it known that I, THOMAS W. FINDLEY, a citizen of the United States, residing at Minneapolis, in the county of Hennepin and State of Minnesota, have invented certain new and useful Improvements in Electrically-Operated Trolley-Doors, of which the following is a specification.

My invention relates to electrically-operated trolley doors and has for its object to provide a trolley door with novel electrical means for operating the same from any number of places, and means for automatically stopping said operating device when the door is either entirely opened or closed.

The full objects and advantages of my invention will appear in connection with the detailed description thereof and are particularly pointed out in the claims.

In the drawings, illustrating the application of my invention in one form,—

Figure 1 is a fragmentary side elevational view of a part of a building, a trolley door and my novel operating device. Fig. 2 is a fragmentary front elevational view of the parts shown in Fig. 1 as seen from within the building with my novel automatic stopping device in addition. Fig. 3 is a front elevational detail view of one of the horizontally-traveling supporting trucks as seen in Fig. 2, showing the manner of applying power to the same. Figs. 4 and 5 are enlarged top and side views, respectively, of a portion of the chain and drive rod shown in Fig. 3. Fig. 6 is a side elevational view of the automatic stopping device seen from the front in Fig. 2 and drawn to a somewhat large scale. Fig. 7 is an enlarged front elevational view of the cam rollers and shifting lever shown in Fig. 6. Fig. 8 is a wiring diagram of my complete operating device including the automatic means of stopping the same. Fig. 9 is an enlarged sectional side elevational view of the pulleys and drive sprocket, which gives the door its vertical motion.

The form of trolley door to which my invention is shown applied in the drawings consists of a door 10, covering a door jamb 11 in a wall 12 of a building whose wall 13 and ceiling 14 carry the parts which support and operate said door. Door 10 is provided at its lower extremities with arms 15 carrying rollers 16 which roll in U-grooved guides 17, thus permitting the lower portion of the door 10 to have vertical motion. At the upper portions of door 10 are fastened hinge plates 18 which are hinged to trucks 19. Trucks 19 roll on trolley rods 20 supported by brackets 21 fastened to the door jamb 11 and by rods 22 hung from the ceiling 14. The weight of the door 10 is counterbalanced by a counterweight 23 to which is attached ropes 24 and 25, of which the rope 24 passes about pulleys 26 and 27 and is attached to one of the arms 15, and of which rope 25 passes over pulley 28 and is attached to the other of arms 15. When the door 10 is closed it laps over door jamb 11 in the vertical position shown in full lines in Fig. 1, and as it is opened it takes positions similar to that shown in dotted lines in Fig. 1 and finally assumes a horizontal position, as shown in dotted lines in Fig. 6.

To open and close this door I employ a device to move trucks 19 and door 10 horizontally and another device to lift door 10 vertically. The latter device is shown in Figs. 1, 2 and 5. As best seen in Fig. 5, pulleys 26 and 28, which carry ropes 24 and 25 and are integral, are used to drive said ropes and so lift the door 10. This drive is procured by means of a sprocket wheel 30 rigidly attached to pulleys 26 and 28, which sprocket wheel is driven by means of a chain 31 from another sprocket wheel 32 fast on a countershaft 33. Countershaft 33 is journaled in bracket bearings 34, secured to wall 13, and carries a pulley 35 fast thereon belted directly to a series-wound motor 36 by means of a belt 37 and a motor pulley 38, said motor also being secured to wall 13. As can be seen from the relative sizes of pulleys and sprocket wheels, the arrangement is such as will give a slow vertical motion to the lower portion of door 10.

The device for giving horizontal motion to the door 10 through trolley trucks 19 is shown in Figs. 1, 2, 3, 4 and 5. A rod 39 is rigidly secured to the two trucks 19, as clearly shown in Figs. 2 and 3, and is attached to a chain 40 by means of a special link 41, best shown in Figs. 3, 4 and 5. Chain 40 extends the whole length of the trolley 20 and passes over a sprocket wheel 42 journaled on a bracket 43 attached to door jamb 11 over a tightening sprocket wheel

44 journaled on a trolley brace rod 45, which rod can be raised and lowered on rods 22 by means of set-screws 46, and over a driving sprocket wheel 47 fast on a countershaft 48 journaled in a bracket 49 secured to the ceiling 14. A spur gear 50 fast on the countershaft 48 meshes with a spur gear 51 fast on a second countershaft 52, which shaft 52 is also journaled in the bracket 49 and is further provided with a pulley 53 fast thereto belted by means of a belt 54 to the pulley 55 of a series-wound motor 56 secured to the ceiling 14. The relative sizes of the pulleys, sprockets and gears are such as will make the horizontal velocity of the chain 40 equal to the vertical velocity of the ropes 24 and 25 with equal speeds of motors 36 and 56.

My invention is entirely automatic and the motion imparted to the door is stopped when the door reaches its fully closed or opened position by means shown in Figs. 2, 6 and 7. Two arms 57 and 58, integral and pivoted to a bracket 59 attached to the wall 13, in a position shown in Fig. 2, are provided with rollers 60 and 61 whose axes may be secured in any of the holes 62 and 63, and said arms are oscillated through a small angle by means of said rollers, which are engaged through rollers 64 and 65 attached to arms 66 and 67 to the extreme top and bottom of one side of door 10. Arm 57 is pivotally connected by means of a link 67 to an arm 68 of a pole changing and circuit-breaking switch 69 attached to the wall 12. The arm 68 of switch 69 is of insulating material and carries fingers 70, 71 and 72 and is pivoted at 73 through finger 71. The finger 70 can make contact with either of two contact blocks 74 and 75, the finger 71 with either of two contact blocks 77 and 78 and the finger 72 with either of two contact blocks 75 or 76. The fingers 70 and 72 are connected by flexible wires to binding posts 79 and 80. The positions of the parts shown in Fig. 6 in full lines illustrate the condition after the door has been closed, and the same in dotted lines illustrate the condition after it has been opened. Roller 64 engages with roller 60 and roller 65 with roller 61, each tending to swing the arms 57 and 58 and thus operate the switch 69.

Fig. 8 is the wiring diagram in which the various connections are clearly shown. The power is taken from a direct current source from leads 81 and 82 and can be led from lead 81 through wire 83 to an adjustable rheostat 84, which is used to control the speed with which the door can be operated, and from thence through wire 85 to a three-way switch 86, and from thence through wires 87, 88, 89 and 90, 91, 92 to and through a plurality of four-way switches 93 and 94, which may be situated in remote and different places and control the device, to the contact blocks 77 and 78 of switch 69. Within switch 69 block 75 is connected to pivot 73, and blocks 74 and 76 are connected together. From switch 69 the current can be led from binding posts 79 and 80 by means of wires 95, 96 and 97 to and through the armatures 98 and 99 of motors 36 and 56, and from contact plug 76 by means of wires 100, 101 and 102 through the field coils 103 and 104 of motors 36 and 56 to the other power source lead 82. Following the current path, as shown in Fig. 8, when the door is closed, from lead 81 through wire 83, rheostat 84, wire 85, three-way switch 86, wire 88, four-way switch 93, wire 89, four-way switch 94, wire 91 to contact 78, it is noticed that the path ends, indicating that the current is off. If now any of switches 86, 93, 94 is changed, the circuit is completed. Assuming switch 94 to take the position shown in doted lines, and following the current path, it will be seen that the path from lead 81 now continues through lead 92 to contact 77 and from thence on through finger 71, contact 75, finger 72, binding post 80, wire 95, armature 98, wire 96, armature 99, wire 97, binding post 79, finger 70, contact 74, contact 76, wire 100, field coil 104, wire 101, field coil 103 and wire 102 back to lead 82. The motors are hence supplied with current and move the door until the arm 58 causes the movable element of switch 69 to take its other position, as indicated by dotted lines in Fig. 8. The current whose path continued through contact 77 is now broken at that point and the motors stop. If now any of switches 86, 93 or 94 are changed, the current path is again brought back through lead 91 and continues from contact 78 through finger 71, pivot 73, contact 75, finger 70, binding post 79, wire 97, armature 99, wire 96, armature 98, wire 95, binding post 80, finger 72, contact 76, wire 100, field coil 104, wire 101, field coil 103 and wire 102 back to lead 82. Thus the path is again completed but the current passes through the armatures in a reversed direction. As long as the fields are constantly connected to the same lead 82, the current through them is always in the same direction and hence the armatures revolve in reversed directions, causing the door to become closed, and arm 57 now throws back the movable element of switch 69 and so breaks the circuit, leaving the door closed.

The reason for using series motors is as follows: When the closed door is first being opened the armature 98 of motor 36 revolves much more slowly than the armature 99 of motor 56 due to the relatively different speeds of the top and bottom of the door. The counter electromotive force generated in motor 36 is hence small and the voltage drop across armature 98 is also small. On the other hand, armature 99 revolves rapidly and the drop across the same is very large.

As the current is the same for both armatures and fields the power consumed by motor 56 is greater than that consumed by motor 36, and as motor 56 is at a better advantage to do work on account of the position of the door, the power is being used to the best advantage. The same advantageous effects, reversed, take place when the open door is being closed.

From the foregoing description it becomes evident that my invention is entirely automatic, highly efficient and extremely simple, and, above all, fool-proof and may be operated to either close or open the door from any number of different places by turning any of the switch buttons located at such places.

I claim:

1. A device for raising a weight having an extended surface and for shifting the position of said surface from vertical to horizontal during the raising operation, comprising a lifting member secured to a lower portion of said weight and a shifting member secured to an upper portion of the weight, and means for differentially and simultaneously operating said lifting member and shifting member.

2. A device for raising a weight having an extended surface and for shifting the position of said surface from vertical to horizontal during the raising operation, comprising a lifting member secured to a lower portion of said weight and a shifting member secured to an upper portion of the weight, an electric motor for operating the lifting member, an electric motor for operating the shifting member, and a source of current supply connecting both of said motors in series whereby the relative speeds of the motors are governed to accord with the differential rate of movement of the points of attachment of the lifting and shifting devices, respectively, with the weight through the corresponding variation in the resistance to be overcome by the respective motors.

3. A device for raising and lowering a weight having an extended surface and for shifting the position of said surface from vertical to horizontal, and vice versa, during said operations, comprising a lifting member secured to a lower portion of said weight and a shifting member secured to an upper portion of the weight, means for differentially and simultaneously operating said lifting member and shifting member in either direction, and means for terminating either the lifting or lowering action of said operating means at a fixed limit of movement of the weight in either direction.

4. A device for raising and lowering a weight having an extended surface and for shifting the position of said surface from vertical to horizontal, and vice versa, during said operations, comprising a lifting member secured to a lower portion of said weight and a shifting member secured to an upper portion of the weight, means for differentially and simultaneously operating said lifting member and shifting member in either direction, means for terminating the action of said operating means including a member which when moved to one position terminates the lifting action and when moved to another position terminates the lowering action of said operating means, and means movable with the weight for actuating said member.

5. A device for raising and lowering a weight having an extended surface and for shifting the position of said surface from vertical to horizontal, and vice versa, during said operations, comprising a lifting member secured to a lower portion of said weight and a shifting member secured to an upper portion of the weight, a pair of series electric motors for operating the lifting member and the shifting member, respectively, a switch which when moved to one position terminates the raising action of said motors and which when moved to another position terminates the lowering action of the motors, and fingers on the weight positioned to engage and move said switch to its respective positions when the weight is fully raised and is fully lowered.

6. A device for raising and lowering a weight having an extended surface and for shifting the position of said surface from vertical to horizontal, and vice versa, during said operations, comprising a pair of electric motors and connections from one of said motors to a lower portion of said weight and from the other of said motors to an upper portion of said weight, a source of current supply connecting both of said motors in series, a switch circuit and switches for controlling said current supply, a pole changer controlled by movement of the weight, and a switch operative in said switch circuit conjointly operated with the pole changer for breaking the circuit and terminating operation of the motors at predetermined raising and lowering limits of the weight.

7. In combination with a trolley door and horizontal rails suspending the same, a pair of electric motors for operating said door, a connection from one of said motors to the lower part of the door operative in the vertical plane of the door, a connection from the other of said motors to the upper part of said door operative in the horizontal plane of the rails, and a source of current supply connecting both of said motors in series whereby the relative speeds of the motors are governed to accord with the differential rates of movement of the points of attachment of the connectors of the respective

motors with the door through the corresponding variation in the resistance to be overcome by the respective motors.

8. In combination with a trolley door and horizontal rails suspending the same, a pair of electric motors for operating said door, a connection from one of said motors to the lower part of the door operative in the vertical plane of the door, a connection from the other of said motors to the upper part of said door operative in the horizontal plane of the rails, a source of current supply connecting both of said motors in series whereby the relative speeds of the motors are governed to accord with the differential rates of movement of the points of attachment of the connectors of the respective motors with the door through the corresponding variation in the resistance to be overcome by the respective motors, a hand-controlled switch for starting operation of the motors, arms on the upper and lower portions of the door, and a switch for terminating operation of the motors in either direction including an arm in the path of the arms on the doors.

9. In combination with a trolley door and horizontal rails suspending the same, a pair of electric motors for operating said door, a connection from one of said motors to the lower part of the door operative in the vertical plane of the door, a connection from the other of said motors to the upper part of said door operative in the horizontal plane of the rails, a source of current supply connecting both of said motors in series whereby the relative speeds of the motors are governed to accord with the differential rates of movement of the points of attachment of the connectors of the respective motors with the door through the corresponding variation in the resistance to be overcome by the respective motors, a hand-controlled switch for starting operation of the motors, arms on the upper and lower portions of the door, a switch for terminating operation of the motors in either direction including an arm in the path of the arms on the doors, and a pole changer connected to and simultaneously operated with said last-named switch.

10. In combination with a trolley door and horizontal rails suspending the same and extending at right angles to the vertical plane of the door, a counterweight having cables connected with the lower portion of the door, an electric motor having operative connection with said cables, a driving belt extending in the plane of the rails and connected with the top of said door, an electric motor for operating said driving belt, and a source of current supply connecting both of said motors in series whereby the relative speeds of the motors are governed to accord with the differential rates of movement of the points of attachment with the door of the cables and driving belt through the corresponding variation and the resistance to be overcome by the respective motors.

11. In combination with a door, a vertical slide for the bottom thereof, a horizontal slide for the top thereof, motors for operating the top and bottom of the door along their respective slides, and means for automatically energizing the motors in accordance to the variation of the load they are caused to take.

In testimony whereof I affix my signature in presence of two witnesses.

THOMAS W. FINDLEY.

Witnesses:
F. A. WHITELEY,
H. A. BOWMAN.