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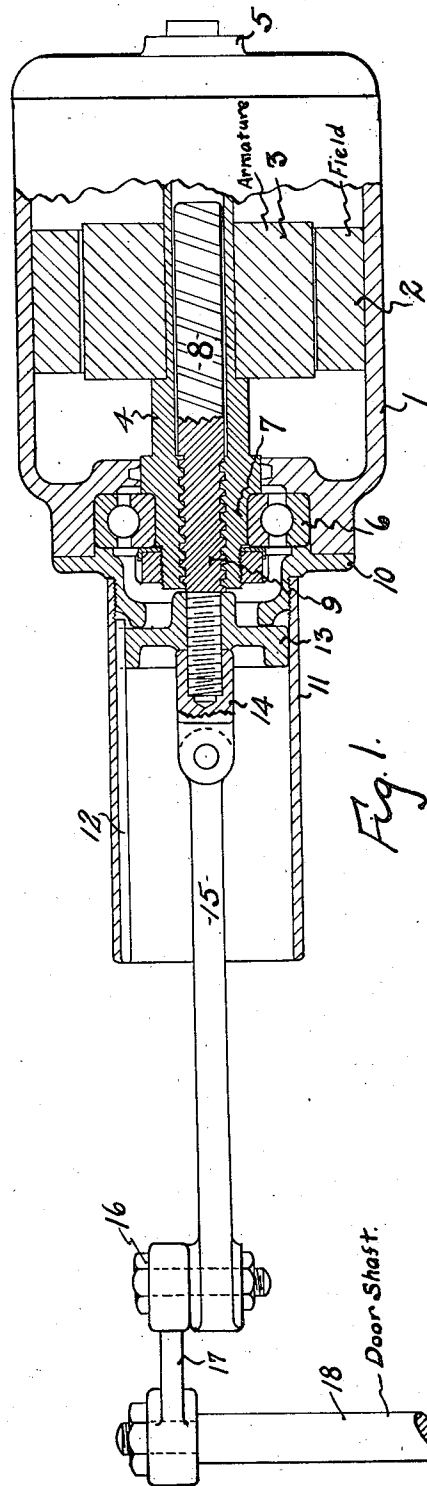
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DOOR OPERATING APPARATUS

Filed April 26, 1934

2 Sheets-Sheet 1



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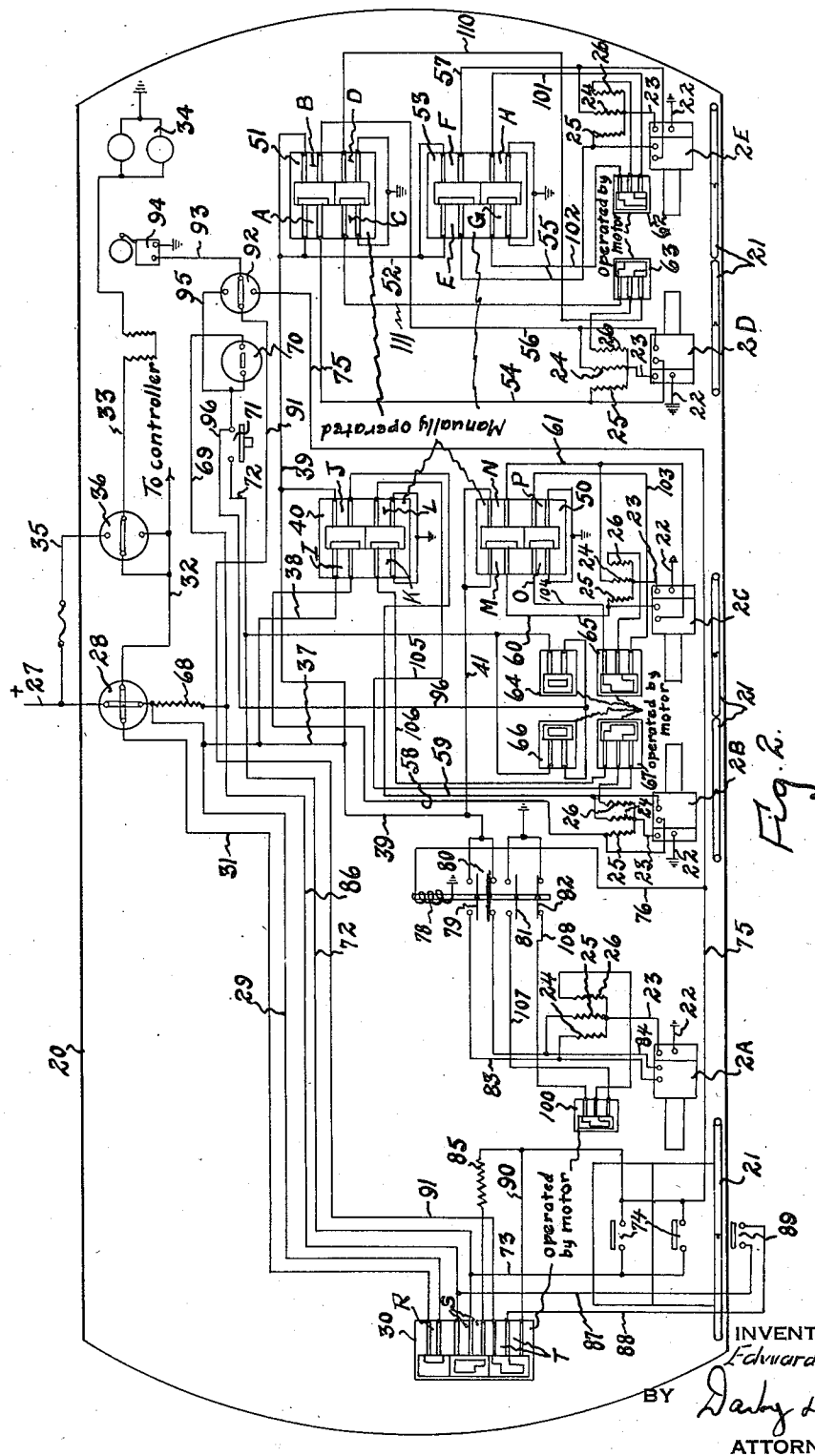
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UNITED STATES PATENT OFFICE

2,034,415

DOOR OPERATING APPARATUS

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7 Claims. (Cl. 105—341)

This invention relates to improvements in door operating apparatus for vehicles such as subway cars, street cars, electric trains and the like.

The main object of this invention is to provide an improved and simplified form of electrically operated door mechanism for vehicles.

The multitude of objects of this invention involve the many functions of the apparatus and will best be understood by detail description of the construction and operation thereof.

This invention resides substantially in the combination, construction, arrangement, relative location of parts and circuitual connection, all as will be set forth in the description in connection with the drawings and in the appended claims.

In the drawings,

Figure 1 is a longitudinally central cross sectional view through the door operating motor of this invention;

Fig. 2 is a circuit diagram of the apparatus of this invention employing the motor of Figure 1 as applied to a three door vehicle having a single folding door at the rear, a double folding door at the center of the vehicle and a double folding door at the forward end thereof.

The motor comprises a suitable casing 1 having the usual field winding 2 diagrammatically illustrated and the usual armature 3 likewise diagrammatically illustrated. The armature 3 is mounted upon a shaft 4 which is journaled in the casing in the bearings 5 and 6. This shaft has a central bore extending therethrough and has at the end 7 internal threads on the bore. At 8 is a longitudinally, slidable shaft having peripheral threads intermediate the ends thereof at 9 for engagement with the internal threads in the portion 7 of the shaft. The casing 1 has a cap 10 at one end with an externally threaded boss upon which a tube or cylinder 11 is supported. This tube has an internal longitudinal rib 12 which interlocks with a slot on the periphery of the disc 13 which is secured to the end of shaft 8.

Likewise attached to the threaded end of the shaft is a lug 14 which is pivotally connected through the link 15 to an arm 17, rigidly secured to the shaft 18 upon which a door or similar device to be operated thereby may be mounted. Link 15 and lever 17 are pivotally connected by means of a pin or bolt 16. When the motor is energized causing the armature 3 and the shaft 4 to revolve, the shaft 8 travels longitudinally to the left and does not turn because of the interlocking of the disc 13 with the rib 12. The movement of shaft 8 through the connections causes the rotation of shaft 18. When the motor is energized in the reverse direction, the shaft 8 returns to the position shown revolving the shaft 18 in the opposite direction.

The motor as described and as applied to a circuit such as shown in Figure 2, is designed so as to withstand energization when stalled. As will appear from the description of the operation of the circuit, the motor remains energized at the end of its stroke in either direction thereby holding shaft 18 in the extreme of either of its positions until the motor is energized in the reverse direction.

The circuit of Fig. 2 illustrates the application of a motor of this type to the operation of the doors of a vehicle. The vehicle is indicated as outlined at 20 and is provided with two pairs of double leaf folding doors 21 and a single double leaf folding door 21' which, as illustrated, is the rear door of the vehicle. The motors for operating these doors are shown at 2A, 2B, 2C, 2D and 2E.

The motor 2A opens and closes the door 21'. The motors 2B and 2C open and close the left and right hand sections of the center door respectively while the motors 2D and 2E open and close the left and right hand sections of the front door respectively. Each motor is provided with four terminals, two for the field winding and two for the armature. One terminal of each armature is grounded through the connection 22 and the other terminal of the armature is connected in each case by wire 23 to the common point of the three resistances 24, 25 and 26, which are provided for each motor. At 27 is the connection from the positive side of the current source which, in the case of a subway car for example, is the six hundred volt direct current, third rail. As of course is common with such systems, the negative side of the current source is grounded. Connection 27 extends to one of the fixed contacts of the double pole switch 28. The opposite contact of this switch is connected by wire 29 to one of the spring fingers R of the drum switch 30 which is operated by the motor 2A. The other spring finger R is connected by a wire 31 to the left hand fixed contact of switch 28. The corresponding contact is connected by wire 32 to the car controller which controls the vehicle operating motors. Thus the motors which operate the vehicle are energized through the controller in accordance with the usual practice, which controller is in turn energized through the contact R of the drum switch. Wire 32 is connected by a jumper to the left hand contact of a single pole, double throw switch 36 and the corresponding contact is connected by wire 33 through a suitable resistance to the grounded signal lights 34. When these lights are energized in normal operation the vehicle operator, who is at that end of the car, knows that the rear door 21' is fully closed.

Wire 29 is connected by wire 37 to wire 39, which, in turn, is connected to the upper spring 60

fingers I and J and A and B of the drum switches 40 and 51. As illustrated in the drawings, the upper spring finger I is connected by wire 38 to wire 37 which is the same thing as if it were connected directly to wire 39. Drum switches 40, 50, 51 and 53 are manually operated. Wire 39 is also connected by wire 41 to the upper spring fingers M and N of drum switch 50. Wire 39 is also connected by wire 52 to the upper spring fingers E and F of drum switch 53.

The lower spring finger A of drum switch 51 is connected by wire 54 to resistance 25 and to one terminal of the field winding of motor 2D. In a similar way the lower spring finger E is connected by wire 55 to the resistance 25 and one terminal of the field winding of motor 2E. The lower spring finger B of switch 51, is connected to wire 56 to resistance 24, and the other terminal of the field winding of motor 2D. The lower spring finger F is connected by wire 57 to resistance 24 and the other terminal of field winding of motor 2E. The lower spring finger I of drum switch 40 is connected by wire 58 to resistance 25 and one terminal of the field winding of the motor 2B. Lower spring finger J is connected by wire 59 to resistance 24 and the other terminal of the field winding of the motor 2B. Lower spring finger M of drum switch 50 is connected by wire 60 to resistance 25 and one terminal of the field winding of motor 2C. Lower spring finger N is connected by wire 61 to resistance 24 and the other terminal of the field winding of motor 2C.

At 62, 63, 64, 65, 66 and 67 and 100 are drum switches which are operated by the motors 2E, 2D, 2C, 2B, and 2A, respectively.

The lower contact of switch 28 is connected through resistance 68 to wire 69 which connects to one terminal of the snap switch 70. The other terminal of this switch is connected to one of the terminals of push-button switch 71 and the other terminal thereof is connected by wire 72 to the middle spring finger S. Wire 72 is connected by wire 73 to one terminal of one or more of the switches which are treadle operated in accordance with well known practice. The other terminals of the treadle operated switches are connected by wire 75 to one terminal of the single pole, double throw switch 92. Wire 75 is connected by wire 76 to the grounded solenoid winding 78 of a relay. The plunger of this relay is provided with the four contact members 79, 80, 81 and 82, each of which cooperate with a pair of fixed contacts. Members 80 and 82 interconnect their associated contacts as shown in the drawings when the solenoid is deenergized. One contact controlled by member 79 is connected by wire 83 to resistance 24, and one terminal of the field winding of motor 2A. One contact controlled by the member 80 is connected by wire 84 to resistance 25 and to the other terminal of the field winding of motor 2A. The lowermost spring finger S of drum switch 30 is connected through resistance 85 to wire 75. Wire 69 is connected by wire 86 to the uppermost spring finger S. Wire 86 is connected by wire 87 to one terminal of the switch 89 which is of the type frequently employed on vehicle doors as a sensitive edge or reversing switch as is well known in the art.

This device involves a flexible casing mounted on the forward edge of the door and arranged to close the switch 89 when pressure thereon is caused by the door striking a person or object in its path when closing. The other terminal of switch 89 is connected by wire 88 to the middle

spring finger T. Lower spring finger T is connected by wire 90 to wire 75. Upper spring finger T is connected by wire 91 to the left hand terminal of switch 92. The corresponding terminal of this switch is connected by wire 93 to the signal device 94 which is grounded. The upper terminal of switch 92 is connected by wire 95 to wire 96 which wire terminates at the lower spring finger of each of the switches 64 and 66. The upper spring finger of these switches are connected by a wire to wire 72.

The uppermost spring finger of switch 100 is connected by wire 108 to one of the terminals controlled by member 82. One of the terminals controlled by member 81 is connected by wire 107 to the lowermost spring finger of switch 100. The middle spring finger is connected to the resistance 26. The other two contacts controlled by members 80 and 81 are grounded as shown, while the two remaining contacts controlled by members 79 and 80, are connected to wire 39. The uppermost spring finger H of drum switch 53 is connected by wire 101, to the lowermost spring finger of drum switch 62. The uppermost spring finger G is connected by wire 102 to the upper spring finger of switch 62. The middle spring finger is connected to resistance 26. The lower spring fingers G and H are grounded. Upper spring finger D of drum switch 51 is connected by wire 110 to the lowermost spring finger of drum switch 63. The uppermost spring finger of this switch is connected by wire 111 to the upper spring finger C of drum switch 51.

The lower spring fingers C and D are grounded. The upper spring finger P of drum switch 50 is connected by wire 103 to the lower spring finger of drum switch 65. The upper spring finger of this switch is connected by wire 104 to the upper spring finger O of drum switch 50. The lower spring fingers O and P of this switch, are grounded as shown. The upper spring finger L of drum switch 40, is connected by wire 105 to the lower spring finger of drum switch 67. The upper spring finger of this switch is connected by wire 106 to the upper spring finger K. The lower spring fingers K and L are grounded.

In describing the operation of the apparatus set forth in Fig. 2, it will be assumed, as shown in this figure, that all of the apparatus is in door closed position and set for normal operation. Current flows in the positive side of the current source through wire 27, down through switch 28, (it being noted that the movable poles of this switch as is usual with a double pole switch, are not interconnected) resistance 68 to wire 69, where it stops at switch 70 which is normally closed, and also through wire 86 to upper spring finger S which is out of circuit with the other spring fingers, through wire 87 to the sensitive edge switch 89 which is open. Current also flows through wire 29, spring fingers R which are interconnected, wire 31, the other leg of switch 28, through wire 32, to the motor controller, the rear door being closed so that spring fingers R are interconnected. Current is delivered to the main controller and through it to the motors so that the car may be operated.

Current also flows from wire 29 through wire 38, interconnected spring fingers I wire 58, resistance 25, wire 23, armature of motor 2B and thus to ground through connection 22. Current also flows through the field winding of this motor and through resistance 24, back to the common connection of the resistances. Resistance 26 is connected from one terminal of the arma-

ture winding, through the upper pair of spring fingers of drum switch 67 and thence through wire 106, through interconnected spring fingers K to ground. The result is, that the motor is energized and the armature is shunted through resistance 26. Thus the motor 2B holds the left hand section of the center door 21 closed. Current flows from wire 37, through wire 39, contact member 80, wire 84, resistance 25 and through the armature winding by way of wires 23 and 22 to ground. Current also flows through resistance 24 to the other terminal of the field winding. The armature wire 23 is connected through resistance 26, and the upper pair of spring fingers of switch 100, and through wire 108 and contact 82 to ground. Thus motor 2A is energized with reduced current to hold the door 21' closed. Current also flows from wire 39, through wire 41, spring fingers M, wire 60, resistance 25, wire 23, armature winding of motor 2C, and thus to ground through 22 holding the right hand section of the center door 21 closed. Current is also delivered from wire 60 to one terminal of the field winding, the other terminal of which is connected through resistance 24 to resistance 25. Resistance 26 is connected through the upper pair of spring fingers of switch 65, wire 104 and interconnected spring fingers O of switch 50 to ground. In a similar way, wire 39 supplies current through drum switch 51 and 53 and 63 and 62 to motors 2D and 2E respectively holding both sections of the front door closed. It will be seen then, that with the parts in the position illustrated in the figure all doors are closed and are held closed by the energized motors whose armatures are shunted by the resistance.

Furthermore current is supplied to the main controller and signal lights 34 are energized through switch 36 and wire 33 to indicate that the door is properly closed.

When the vehicle is brought to a stop, the operator may open the front doors 21 as follows: He rotates the drum of switch 51 so that the contacts thereof interconnect fingers B and fingers D. The current then flows from wire 39 (which is always energized when switch 28 is closed) through spring fingers B, wire 56, one terminal of the field of motor 2D and also through resistance 24 to the armature of motor 2D and thus to ground. Current also flows through resistance 25 to the other terminal of the winding. Motor 2D is thus energized in a reverse direction and as soon as it begins to move, it operates drum switch 63 so that the connection between the upper pair of spring fingers thereof is broken a second time, this circuit having already been broken when switch A is operated from the position shown in the figure. Thus the motor 2D continues to open the door until near the end of the stroke when the lower pair of spring fingers of drum switch 63 will have been energized, thereby throwing resistance 25 across the armature circuit, slowing the motor down, and supplying it with enough current to hold the door open without overheating of the motor. It is hardly necessary to trace the circuits for accomplishing the energization of motor 2E to open its half of the front door when switch 53 is swung over to interconnect spring fingers F and spring fingers H. The operator at the same station or another operator at another station, as may be desired, may, in a like manner, reversely energize the motors 2B and 2C by operating

switches 40 and 50 respectively to interconnect the pairs of spring fingers J, L, N, and P.

When the center doors open, drum switches 64, 65, 66 and 67 are likewise operated to interconnect the spring fingers thereof in an obvious manner. As is apparent, each section of the forward or center doors may be opened independently of the other section. The operation of either section of the center door causes the operation of the corresponding drum switch 64 or 65, with the result that wire 95 is connected to wire 72, thus closing the circuit controlled by push-button switch 71. Current will then flow from the source through wire 69, switch 70, (which is normally closed and which, when opened, prevents the following operations, namely, of opening the rear door) wire 96, either or both of drum switches 64 and 66, back through the connection to wire 72, wire 73 to the treadle switches 74. If there is a passenger standing on the treadle at the rear door with the intention of leaving the vehicle, one or both of these switches will be closed with the result that current will flow through wire 75, wire 76, and winding 78 to ground. The energization of the winding 78 will move the plunger so that members 79 and 81 interconnect their contacts and members 80 and 82 disengage their contacts. Current then flows from normally energized wire 39, through member 79, wire 83, the field winding of motor 2A and wire 84 across which are connected the resistances 24 and 25, and whose common terminal is connected to ground through wire 23, the armature of motor 2A and wire 22. The disengagement of member 82 from its contacts will break the shunt of the armature through resistance 26. As this door approaches full open position, drum switch 100 will be operated to interconnect the lower spring fingers thereof, again shunting the armature through resistance 26 and slowing the member down to a stop.

The operation of motor 2A likewise operates drum switch 30 breaking the connection between spring fingers R and disconnecting the main car controller from the current source so that the car may not be started and also breaking the circuit to the signal lamps 34 indicating that the door is open. The operation of drum switch 30 also interconnects all spring fingers S. The result is that current may then flow from resistance 68 through wire 86, the upper pair of spring fingers S to the treadle switch 74, providing a different circuit for these switches in the event that the center doors are closed, breaking the circuit thereto through either or both of switches 64 and 66. Current also flows from wire 86 to the sensitive door edge switch 89. Current flows from the lower spring finger S through the holding resistance 85, wire 75, wire 76 and winding 78 to ground, maintaining the relay switch in operated position. The circuit from switch 89 continues through wire 88, the lower pair of spring fingers T and wire 90 to wire 75. However, as soon as the door 21' is fully open, the lower pair of spring fingers are disconnected which is occurring at the time that the circuit through the lower pair of spring fingers T is being made to switch 89. The result is, that the holding circuit for winding 78, through resistance 85, is broken. If the treadle has been cleared so that switches 74 are open, the door will then begin to close, since winding 78 will be deenergized and the contact members 79, 80, 81 and 82 will return to the positions shown in the drawings. The door will continue to close

until fully closed breaking all connections between spring fingers S and T and making the connections through spring fingers R to light the lights 34 and put the power back on the main controller.

However, if the door in closing should strike an obstruction such as a person, so that switch 89 is closed, current will pass through wire 86, wire 87, switch 89, wire 88 and the lower pair of spring fingers T, which remain interconnected until the door is substantially closed, or, at a point where no one could be caught in it, through wire 90, wire 75, wire 76 and winding 78 to ground. The energization of wire 78 again sets up circuits to cause the door to open as previously described. The door will continue to open to full open position because of the interconnection of spring fingers S and the connection between the lower pair being only broken when the door has fully opened. After the door is fully open with the treadle cleared and the obstruction removed so that switch 89 is open, the door will again start towards closed position, the holding circuit through 85 having been broken as the door attained full open position. The door will then continue to close until fully closed unless it strikes another obstruction. After the door has completely closed and an object is caught in the door switch 89 will be closed and the upper contacts of drum switch T will interconnect putting current through wire 91, switch 92, wire 93 and the signal device to ground, notifying the operator of the fact that someone is caught in the door and not to start the vehicle.

The rear door 21' may likewise be opened independently of the operation of the center doors 21. This is accomplished by means of switch 71. When this switch is closed by the operator, current flows from switch 70 through to wire 72, to treadle 74 so that if there is a person present on the treadle so that the switches 74 are closed, the door will then open and the regular cycle of operations will be gone through as previously described.

The operator may likewise open the rear door with no one standing on the treadle by simply moving switch 92 to connect wire 95 directly with wire 75, thereby energizing winding 78. At this time, the bell 94 is taken out of circuit, mainly because its electrical characteristics are such that it would provide a direct short circuit around the winding 78, interfering with the operation of the winding 78. However, this switch is not needed at this time, since the operator is constantly controlling the rear door. Of course, by opening switch 28, all the door operating equipment is thrown out of operation. At this time, current may be supplied to the main controller through wire 35 and switch 36 which will be swung to its other position and thence to the main controller. Likewise by opening the normally closed switch 70, the rear door will be thrown out of operation.

From the above description it will be apparent that this invention resides in many principles of construction and operation which may be in some cases embodied in other physical forms without departure from the scope thereof. I do not therefore, desire to be strictly limited to the disclosure as given for purposes of illustration, but rather to the scope of the appended claims.

What I seek to secure by United States Letters Patent is:

1. In a vehicle as described, the combination comprising a pair of doors, electric motors for operating the doors in either direction, means

including control circuits for energizing one of said motors, means operated by that motor including control circuits connected to the other motor for preparing it for operation and treadle control means in the circuits of the second motor for completing them.

2. In a vehicle the combination comprising at least two doors, an electric motor for operating each of said doors, circuits for energizing both of said motors, means for completing the circuits for one of said motors, means operated by that motor for partially completing the circuits to the other of said motors and treadle control means for completing the circuits of said second motor.

3. In a vehicle the combination comprising at least two doors, an electric motor for operating each of said doors, circuits for energizing both of said motors, means for completing the circuits for one of said motors, means operated by that motor for partially completing the circuits to the second motor, treadle means for completing the second motor circuits, and means in the circuits for each motor and operated by the respective motors for slowing them down at the end of their stroke in either direction.

4. In a vehicle door operating system as described the combination comprising a pair of doors, an electric motor for operating each of said doors, circuits for energizing said motors, manual means in the circuits of one of said motors for energizing it for operation in either direction, means controlled by that motor and connected in the circuits of the other motor for partially completing the circuits thereto to effect operation of the motor in either direction and passenger operated means for completing the circuits to said second motor to operate it in either direction.

5. In a vehicle the combination comprising at least two doors, an electric motor for operating each door, circuits for said motors, means in the circuits of one motor and controlled by the operator of the vehicle for effecting the operation of that motor in either direction, means operated by that motor and connected to the circuits of the other motor for preparing its circuits for operation in either direction and passenger controlled means for completing said circuit.

6. In a vehicle the combination comprising at least two doors, an electric motor for operating each door, circuits for said motors, means in the circuits of one motor and controlled by the operator of the vehicle for effecting the operation of that motor in either direction, means operated by that motor and connected to the circuits of the second motor for preparing its circuits for operation in either direction passenger controlled means for completing the prepared circuits of the second motor and means in the circuits of the second motor for energizing it independently of the first motor.

7. In a vehicle the combination comprising at least two doors, an electric motor for operating each of said doors, circuits for energizing both of said motors, means for completing the circuit for one of said motors, means operated by that motor for partially completing the circuits to the second of said motors, means for completing the circuits to the second of said motors, and means operated by each motor for inserting a resistance in the armature circuit near the end of the stroke of the doors in either direction to slow the motors down to a stop and maintain them energized to hold the doors either opened or closed.

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