March 29, 1932. L. P. HYNES 1,851,431

DOOR MOTOR

Filed Feb 8, 1924

Fig. 1

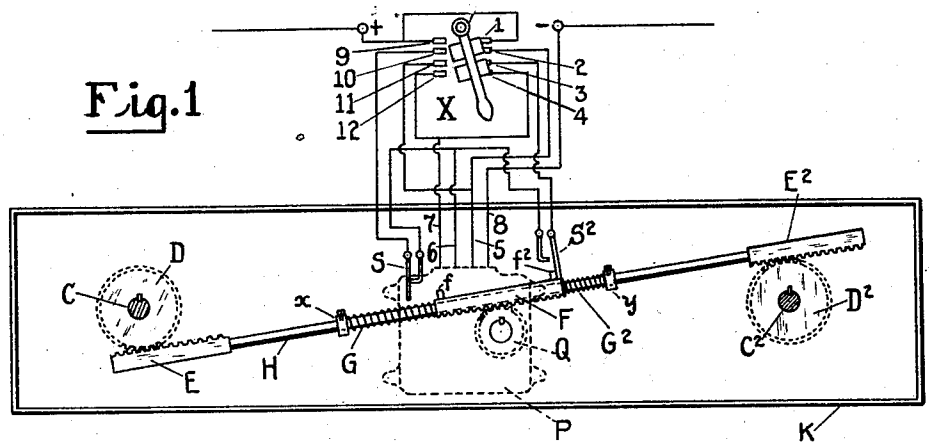
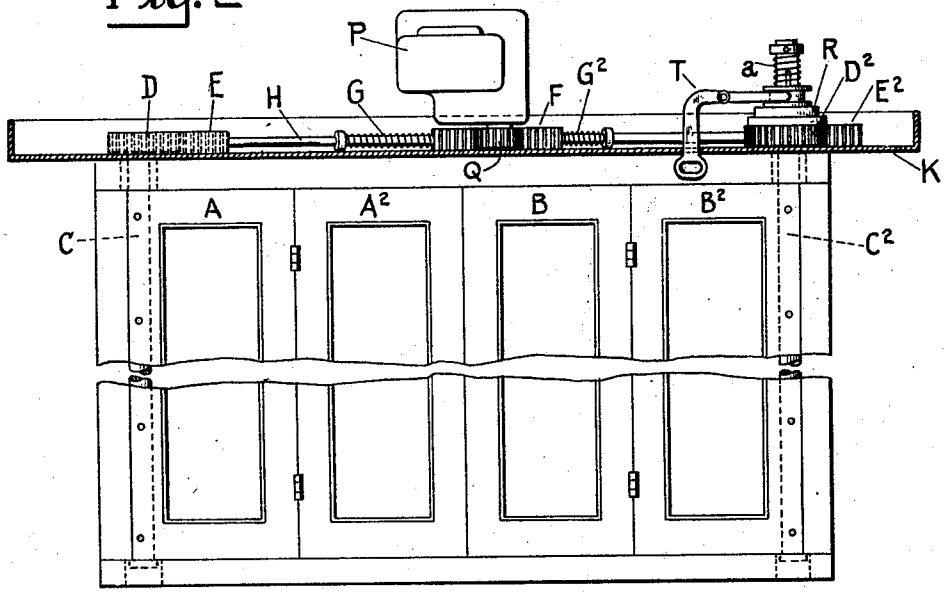


Fig. 2



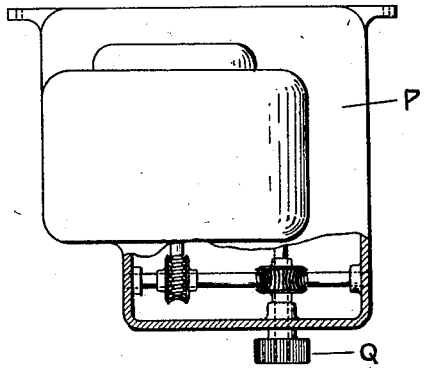


Fig. 3

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Patented Mar. 29, 1932 1,851,431

UNITED STATES PATENT OFFICE

LEE P. HYNES, OF ALBANY, NEW YORK, ASSIGNOR, BY MESNE ASSIGNMENTS, TO CONSOLIDATED CAR-HEATING COMPANY, INC., OF ALBANY, NEW YORK, A CORPORATION OF NEW YORK

DOOR MOTOR

Application filed February 8, 1924. Serial No. 691,437.

For a detailed description of the present form of my invention, reference may be had to the following specification and to the accompanying drawings, wherein

Fig. 1 is a plan and

Fig. 2 is an elevation of my device;

Fig. 3 shows the gearing.

My invention relates to a means for utilizing an electric motor for the operation of car doors in place of the pneumatic motors heretofore commonly used therefor. In particular I purpose to adapt an electric motor for operating folding doors, the main door of each folding pair having a vertical shaft along its outer edge. The two vertical shafts are operated simultaneously by an overhead motor, through the agency of a horizontal rack-bar which is moved longitudinally by the motor through a spring sleeve on the bar. This spring sleeve is also provided with rack teeth which are engaged by a pinion driven by the motor through a very high-ratio reduction-gearing having no back action. The spring sleeve is free to slide on the rack-bar except as restricted by the springs. The springs are interposed between the respective ends of the sleeve and certain adjustable stops on the bar. Thus the motor drives the doors through the intervention of one or the other of these two springs. In addition, I locate a switch near the normal end of travel of the sleeve at each end. This switch is in the motor circuit and serves as a limit switch to break that circuit when the doors are in either closed or open position. In addition, I make these switches serve as torsion switches, by giving the springs a long range of compression substantially equal to the range of travel of the door. By this means the motor having the aforesaid high-ratio gearing can operate, even with the doors locked, and make its normal run, but, instead of moving the doors, it will compress the spring and finally operate the limit switch, just as it would do if it worked the doors instead of the spring. This device enables me to eliminate from the organization the torsion switches that have heretofore been found necessary in the case of electrically-operated doors, and in that manner to materially simplify and cheapen the construction. I also interpose a manual clutch, between one, at least, of the vertical door-shafts and its operating pinion, whereby, in an emergency the door can be disconnected from the motor mechanism and opened or closed by hand. That expedient renders the door-operation practicable under the conditions of actual service and adds but little to the cost and complexity of the mechanism.

Turning to the drawings, A, A^2 represent the two leaves or sections of one of the two doors, the corresponding leaves or sections being marked respectively B and B^2. C represents a vertical shaft on the left-hand edge of door A adjoining the door-frame, and C^2 a similar shaft on the right-hand edge of the door B. These two vertical shafts have suitable bearings in the door-frame at top and bottom, while the leaves A^2 and B will be provided with the customary guides. Thereby the simultaneous rotation of the shafts C and C^2 for 90 degrees will either open or close both doors.

The motor P, together with the associated mechanism, is contained in a pressed steel channel K above the door which constitutes a suitable base. The motor P is shown by a full-line contour in Fig. 2, but is only indicated by dotted lines in Fig. 1, to permit a clear showing of the mechanism. In both figures the final motor-pinion is shown at Q. That pinion Q, as appears in Fig. 3, is operated by the armature shaft through two sets of worm gearing giving a reduction-ratio of 60 to 1, as an example of a large reduction. On the upper end of the said vertical door-shaft C is a pinion D and a corresponding pinion D^2 is applied to the upper end of door-shaft C^2 with an interposed clutch R which is normally closed by a spring *a*, but is capable of being lifted manually by a lever T to disconnect the said shaft and pinion.

It will usually be sufficient to provide such a clutch for only one of the two doors, to permit of its manual operation, in an emergency, by thus unclutching it from its motive pinion. H is a horizontal rack-bar having at one end a rack E meshing with pinion D on door-shaft C, and at its opposite end a similar

rack E^2 meshing with pinion D^2 on door-shaft C^2. The rack-bar H will be mounted independently of the door in suitable bearings to permit of its longitudinal reciprocation, and, since it engages opposite sides of the respective pinions D and D^2, such reciprocation will cause the two doors to swing either toward each other for closing or away from each other for opening. On the rack-bar H is a loose actuating sleeve F which is also provided with rack-teeth meshing with the aforesaid motor-pinion Q. The respective ends of sleeve F bear against long, open springs G, G^2 which are coiled around bar H and rest against adjustable stops x and y thereon. On the opposite ends of the sleeve there are projections f, f^2 which, at the end of the opening and closing strokes of the sleeve, engage one or the other of the two spring switches S, S^2 in the motor-circuit. These two switches are in the circuit of the reversible element of the motor—say, the armature—whereby the opening of one limit switch, at the end of a door-closing run, will leave unopened the other limit switch in the reverse circuit, so that the subsequent closure of that reverse circuit by the control-switch will cause the motor to start on its reverse, or door-opening, run. The control-switch is shown at X and it may be assumed, for instance, that it is in its door-closing position and that the motor has completed its door-closing operation and then stopped with the limit-switch S^2 open, the switch S being closed. The door-closing circuit is from the plus terminal to switch plates 1 and 2, thence to the armature wires 5 and 6, thence to the limit-switch S^2 and then, if said limit-switch were closed, to the contacts 3 and 4, to the field-magnet wires 7 and 8, and, finally, to the minus terminal of the circuit. The subsequent movement of the switch X to the left would then close the door-opening circuit through contacts 9 and 10, limit-switch S, which is now closed, armature wires 6 and 5 (thereby reversing the motor) to contacts 11 and 12, to field-magnet wires 7 and 8 (the field-magnet remaining unreversed) and, finally, to the minus terminal.

The character of the springs G and G^2 is an important factor of my construction. First they have such a degree of stiffness that they will not yield materially when the motor is operating the doors at a time when the doors are free from obstruction; second, they have such length and coil-spacing that, while their resistance to compression will be overcome by the motor without undue increase of current in the motor coils, yet such resistance will not increase materially over a long length of spring-contraction. Thereby, even if the doors should be blocked at the beginning of a run, the motor would not be stopped, but would not only compress the spring but continue to compress it for a long distance sufficient to enable one of the projections f, f^2 on the sleeve to reach and operate the corresponding limit-switch, the doors in the meanwhile remaining blocked and motionless. The absence of a high degree of tension in the spring prevents it from subsequently closing the door with a violent slam. Heretofore, it has been proposed to provide an electric door-motor with torsion-switches that would act temporarily to relieve the motor if the door encountered an obstruction and also with limit-switches that would only act at the end of the run, and were merely dependent on the position of the door and not upon spring tension. By the construction aforesaid I am enabled to do away with one of the sets of switches heretofore considered necessary, with no impairment of the apparatus, but with a material simplification thereof. The safety of the motor and of any passenger who might be caught in the door is still preserved over the entire range of travel of the door and yet the motor circuit will ultimately be broken. It should be also observed that, by virtue of the worm gearing the springs G, G^2 can not react to reverse the motor mechanically when the current is cut off by a limit-switch at a time when the springs are under tension. But the said springs can react at any point in the operation to move the doors when a temporary obstruction is removed.

What I claim as new and desire to secure by Letters Patent is:

1. An electric door-motor, provided with a worm gearing, a rack-bar supported for longitudinal movement so as to operate the door, a movable member propelled by said gearing, a driving spring between said movable member and the rack-bar and a limit-switch actuated by said movable member and controlling the motor.

2. An electric door-motor, provided with a non-reacting driving connection, a longitudinally movable rack-bar, a door operating gear wheel engaged by the rack-bar, a sliding sleeve on said rack-bar having rack-teeth engaged by a gear-wheel driven by the motor through said non-reacting gearing, and a driving spring interposed between said sleeve and the rack-bar.

3. An electric door-motor having a non-reacting driving connection actuated thereby, a longitudinally movable rack-bar, a moving member driven by said gearing, a spring between said member and the rack-bar, a door-operating shaft, a gear wheel for said shaft engaged by the rack-bar and a clutch controlling the operation of said shaft by the rack-bar.

4. A door-operating motor located above a pair of folding doors, vertical shafts for said doors, a rack-bar movable horizontally and oppositely geared to the respective shafts, a stop on said rack-bar, a movable member

operated by the motor, a spring between said member and said stop, and a limit-switch operated by said movable member and controlling the motor.

5. A door-operating motor located above a pair of folding doors, vertical shafts for said doors, a horizontally moving rack-bar geared to the respective shafts, a stop on said rack-bar, a sliding sleeve on said rack-bar, a spring between said sleeve and said stop, and a pair of limit-switches engaged by said sleeve at the respective ends of its reciprocating travel.

6. A door operating mechanism comprising an electric door motor, a door operating rod provided with stops, a movable element operated by said motor and yieldably interposed between the motor and said stops so that movement imparted to said element by said motor will be transferred to said rod, and a motor switch so located as to be operated by the yieldably mounted movable element at the end of its travel independently of the travel of said rod.

7. An electric door motor for folding doors provided with a rectilinearly movable door actuating bar mounted to move with respect to the doors to be operated, a movable member driven by the motor through a non-reacting connection, a spring between said member and the said bar so that said bar may be actuated by movement of said member, and a limit switch operated by said movable member and controlling the motor.

8. A door closing mechanism comprising a pair of vertically disposed rotatable shafts, doors mounted on said shafts, an electric motor located above said shafts, a horizontally movable door operating member engaging both shafts so as to rotate them, a moving member operated by the motor through a non-reacting connection, a driving spring between said member and the said door operating member, and a limit switch operated by said member and controlling the motor.

9. An electric door motor provided with a compression spring, a worm gearing having a high ratio of reduction connected to and operated by said motor, a movable actuator member operated by said gearing and bearing against one end of said spring, a rotatable door shaft, means engaged by the other end of said spring for operating said shaft, and a motor switch operated by said actuator member at the end of its travel.

10. An electric door motor having a definite range of action determined by a limit switch, a spring, a rectilinearly movable operating connection between said spring and the door to be operated, means operated by the motor for building up a tension to said spring while movement of the door is obstructed, said operating connection being so arranged that said spring will supply power to operate the door upon removal of said obstruction.

11. A door operating mechanism comprising a gear, an electric door motor provided with a non-reacting driving connection between it and the gear, a door operating rod, and a movable element mounted on said rod and operated by said gear, said element having a yieldable engagement with said rod, together with a motor switch operated by said movable element at the end of its travel independently of the door travel.

12. A door operating mechanism comprising an electric door motor, a door operating rod provided with spaced apart stops, an actuating element operated by said motor and movably mounted on said rod, springs interposed between the actuator element and said stops, so that movement imparted to said actuator element by the motor will be transferred to said rod, said springs having a compression range corresponding to the range of travel of the door, and a motor switch so located as to be operated by the actuator element at the end of its travel independently of the travel of said rod.

13. An electric door motor provided with a non-reacting driving connection, a movable member mounted to travel in a straight line and propelled by said driving connection, a rectilinearly movable door-actuating-rod mounted independently of the door to be operated, and a spring having one end bearing against said movable member and its other end engaging said rod, so that movement of said member will compress said spring and impart corresponding movement to said rod.

Signed at Albany, county of Albany and State of New York, this 5th day of February, 1924.

LEE P. HYNES.