Feb. 7, 1928. 1,658,722

L. P. HYNES

ELECTRIC DOOR MOTOR

Filed Feb. 4. 1925

Fig. 1

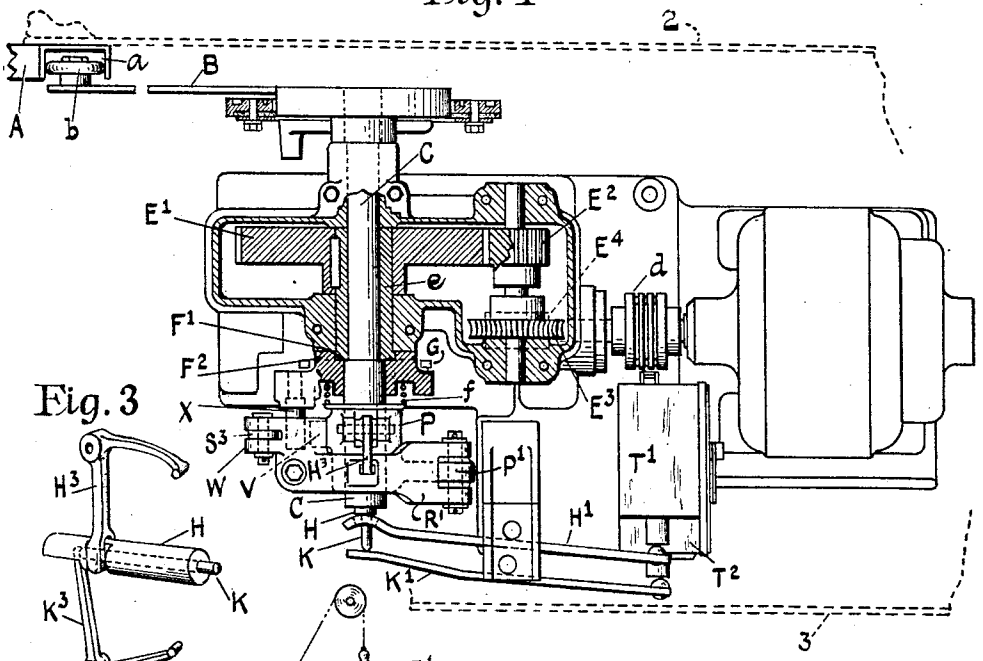


Fig. 3




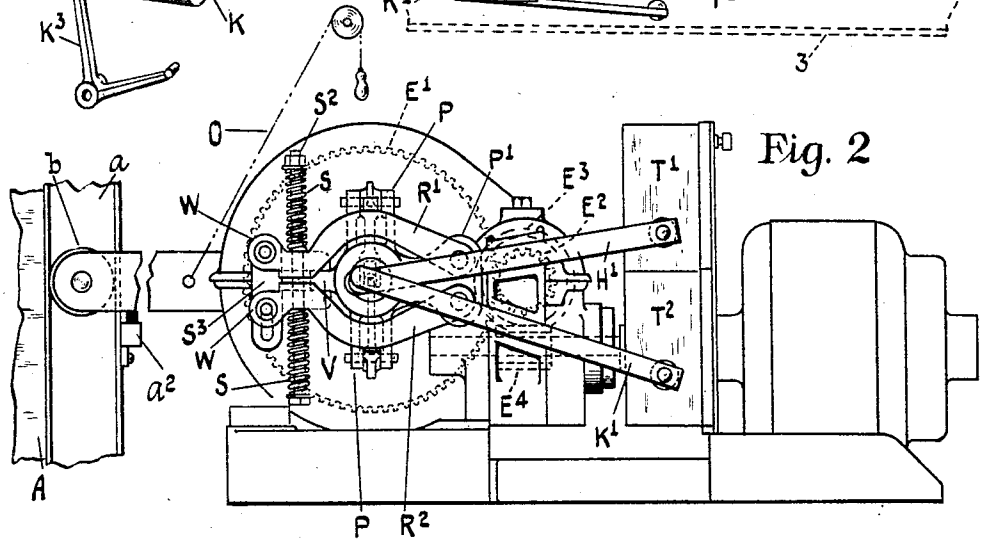


Fig. 2

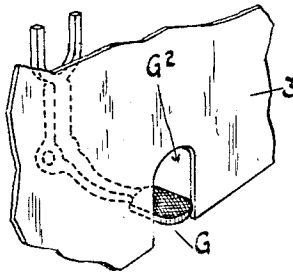


Fig. 4

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# 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.

## ELECTRIC DOOR MOTOR.

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

Fig. 1 is a plan view partly in section and Fig. 2 is a front elevation of my motor;

Figs. 3 and 4 show details.

My invention relates to the operation of car doors, by an electric, instead of the customary pneumatic, motors. Such doors are usually of the sliding type and receive their straight-line movement by means of a motor-driven radial arm which, at its outer end, carries a slide or roller that travels in a vertical guide on the rear edge of the door. It has been proposed to operate this radial arm electrically by means of a gear wheel on the arm shaft, this gear wheel being driven by a pinion which, in turn, is driven by a non-reacting worm gear on the shaft of the electric motor. Moreover, a yielding connection in the form of a drive-spring has been interposed between the door and the worm-gear and this spring controls a switch, sometimes called a torsion switch, in the motor circuit by which the said circuit will be broken in the event of the door being blocked. My present improvement is based on an organization of the kind thus described and includes fundamentally a manual clutch or disconnector interposed in the chain of driving mechanism at a point between the non-reacting worm-gear and the door. Since the said worm-gear is of the non-reacting type, the result is that a failure of the motor will leave the door set in the position at which it happens to be at the time the failure occurs. Yet the non-reacting gear is important for serving the function of an abutment against which the aforesaid spring-controlled switch may act. Thereby the spring, when the obstruction is removed, can act to throw the door forward instead of throwing the motor backward. Hence I locate the said clutch or disconnector on the door side of the abutment formed by the worm-gear and I also so organize it that, after it has been disengaged manually it will be locked in its disengaged condition to permit the manual operation of the door as a substitute for the motor operation thereof when the motor is not disabled. It would, however, be objectionable if it were necessary to manually release the locked-out clutch each time that the motor resumes its normal condition. Therefore I so organize my apparatus that the locked-out clutch will be automatically released and re-engaged when the motor restarts. Thus the doorman has to merely throw his motor controller to the door-opening or door-closing position just as if there had been no failure, and the motor will automatically re-engage itself with the door and resume its normal operation thereof. This result I accomplish by the following means. The aforesaid drive-spring of the torsion switch that controls the motor circuit is under compression substantially all the time, though not under sufficient pressure to work the circuit-switch. That compression is due to the fact that the spring stands between the non-reacting worm-gear on one side and a door load, more or less great, on the other side. The compression remains even if the motor is at rest. I utilize this existing compression of the door-spring to automatically lock out the clutch and I provide the clutch with an actuating spring of its own to re-engage it when the clutch is unlocked. When the motor restarts and rotates the clutch member that pertains to the worm-gear far enough to bring its teeth into register with those on the clutch member that pertains to the door-arm shaft then the clutch-spring acts to snap it into engagement and the motor takes up its door-working load. Hence my clutch is not only located in the gearing train between the worm and the door, but at a point therein between the drive-spring and one end of the train, so that, when disengaged, it will rotate one clutch member far enough to lock it out of engagement with the other. Moreover, it requires for releasing a relative movement of the two members greater than will be caused by the subsequent manual operation of the door from end to end of its run. Otherwise the said manual movement of the door would release the clutch and permit it to re-engage while the motor is still disabled and while the action is manual instead of electrical. The release and re-engagement must be produced only by the resumed motor operation and not by the temporary manual operation.

In the drawing, A is the sliding door and

B the radial operating arm therefor which, at its outer end, has a roller $b$ that travels up and down in a vertical groove $a$ on the door as the arm rotates. That is a well known arrangement except that I have added a stop $a^2$ on the door itself to arrest the door-closing movement of the arm when it reaches its horizontal or approximately horizontal position. Thereby the closing movement of the door is not stopped, as heretofore by the front edge of the door hitting the door jamb, but by the arm B hitting stop $a^2$. Thus I secure a definite and accurate position for the closed door independent of the usual cushion on the door edge. The said cushion is likewise independent of the stop and can have a wide range of compression without making uncertain the position of the door when closed. $E^1$ is a spur-gear wheel that is keyed to a sleeve $e$ which is loose on the door-arm shaft C. A pinion $E^2$ drives wheel $E^1$ and on the shaft of the pinion is a worm-wheel $E^3$ engaged by a worm $E^4$ on the motor shaft which contains a flexible coupling $d$. The worm and gear-wheel are cut with a non-reacting pitch that will cause it to block any reverse rotation of the worm-wheel tending to rotate the worm. On the inner end of the sleeve $e$ aforesaid is one clutch-member $F^1$, while the companion-clutch-member $F^2$ is on the enlarged portion of door-arm shaft C, being loose thereon and also free to slide thereon longitudinally.

Any form of clutch may be employed for the purposes of the invention, but, as shown by dotted lines in Figure 1, the clutch selected for illustrative purposes is of the type in which the clutch members are provided with complemental overlapping clutch teeth. The said member $F^2$ is moved automatically towards its position of engagement with member $F^1$ by a spring $f$, and is moved manually toward its position of disengagement therefrom by a foot-lever G (see Fig. 4). It should be understood that this motor apparatus is located under the seat of a car adjacent to the car door. Back of it is the side wall of the car which is indicated in Fig. 1 by the dotted line 2, and in front of it is the riser of the seat indicated by dotted lines 3 in Figure 1. The said foot-lever G is so mounted that its treadle will come just inside a window $G^2$ in the riser 3 so as to be accessible to the toe of the doorman when he desires to open the clutch. The fork of the said foot-lever embraces the clutch-member $F^2$ (see Figure 1), and disengages it from member $F^1$ by a forward movement of the fork against the force of spring $f$ whenever the treadle is depressed by stepping on it.

The front portion of the door-arm shaft C is hollow and contains two push-rods, one a tubular rod H and the other a solid rod K that is inside of H. Both rods project beyond shaft C to engage the respective levers $H^1$ and $K^1$ which work the respective switches $T^1$ and $T^2$. These switches serve both as limit switches to open the motor circuit at the end of the door run, when the door arm is finally blocked, leaving the reverse motor circuit partially set up ready to be closed by the doorman's switch and also as emergency switches to break the motor circuit at any point in the run of the door if it becomes blocked. The aforesaid rods H and K are moved forward by two angle levers $H^3$ and $K^3$, shown in Fig. 3, both of which at their inner ends project through a slot in door-shaft C (see Figure 1), and engage the rods H and K. $H^3$ is forked at its lower end, the branches of the fork entering notches on opposite sides of rod H, while the upper non-forked end of $K^3$ enters a slot in rod H between the branches of said fork on $H^3$ and bears against the end of rod K (see Figure 3). The levers $H^3$, $K^3$ are pivoted in a yoke P which is secured to the door shaft and rotates with it. On the right side of yoke P is a wing $P^1$ to which are pivoted the yoke levers $R^1$ and $R^2$ which, at their outer ends, are held against a stud V on the yoke, by springs S, S and a bolt $S^2$. The bolt $S^2$ passes freely through both $R^1$ and $R^2$ and any tendency of either of the two levers to spread away from its bearing on stud V is resisted by both springs S, S. On the rear of each yoke-lever is a projection W and a link $S^3$ is pivoted at its upper end to the said projection W on yoke-lever $R^1$. The lever end of link $S^3$ is slotted and enters a fork on the projection W of the lower yoke-lever $R^2$ wherein there is a bolt passing through the slot. The function of link $S^3$ is to restrict the spreading apart of the two yoke-levers to a degree that will only cause the certain opening of the limit switch and prevent the re-engagement of the clutch when the door is worked by hand. The said projections W normally bear on opposite sides of the aforesaid stud V which extends from the left side of yoke P and a pin X on the front face of clutch-member $F^2$ enters between them. By this arrangement the clutch member $F^2$, although loose on door-shaft C, can not rotate thereon unless it spreads apart through the agency of pin X, the yoke-levers $R^1$, $R^2$ against the pressure of springs S, S. But the horizontal legs of the angle-levers $H^3$, $K^3$ bear at their outer ends against the outside of the respective yoke-levers. Also the yoke P to which those levers are pivoted is fast on the door-arm shaft C. Hence if the clutch members $F^1$ and $F^2$ are locked together, the motor-driven gear wheel $E^1$, to which clutch member $F^1$ is fastened, will also drive member $F^2$, and through pin X thereon, will moreover drive the door shaft C through the agency of yoke-lever $R^1$ (or the yoke-

lever $R^2$ if the motor is reversed) and the yoke P that is fixed to the said door-shaft. If the door should be blocked, the motor torque will act through pin X to force one or the other of yoke-levers $R^1$, $R^2$ outward away from stud V against the pressure of springs S, S and thereby oscillate the corresponding angle-lever $H^3$ or $K^3$ and operate the switch $T^1$ or $T^2$. These switches each act to break the acting motor circuit, and so stop the motor. They also close a circuit for the reverse direction of the motor which circuit, however, remains incomplete and inactive until the doorman throws his switch for such reversal of the motor. Thus each switch acts as a torsion switch that will arrest the motor, in the event of an accidental block, and also acts as a limit-switch to break the motor circuit at the end of its run while leaving the circuits in condition for the reverse run of the motor when the doorman throws his switch.

In the event of the motor failing to act, it will be evident that the door, by reason of the non-reacting worm gear, would be left fixed in whatever position it chanced to be when the failure occurred. Then the doorman can release the door by stepping on the pedal of foot-lever G and so disconnecting the two clutch members $F^1$ and $F^2$. But such a release of the door involves also the release of the tension on springs S, S, which instantly react, through pin X, on clutch member $F^2$, giving it a certain range of rotation on door-shaft C sufficient to throw its clutch teeth out of register with those on clutch member $F^1$. That locks the clutch in its disengaged position. Otherwise the clutch would immediately re-engage when the doorman took his foot off the lever G. Since the clutch has been thus locked out, the door will remain free provided its range of movement by hand is not of such extent and direction as will cause the clutch to re-engage by again bringing the teeth of clutch member $F^1$ into register with those of clutch member $F^2$. On this account the door-arm has less than 180 degrees of movement, coming about to the horizontal at the door-closing end of its stroke, for the purpose of locking the door closed but to a point above the horizontal at the door-opening end of its stroke. Then if the spring throws the clutch member so far around when the foot lever G trips it that a rotation of the other member must be 180 degrees to bring it into reclutching register then no degree or direction of hand operation that the construction permits will cause such reengagement to take place. However, when the motor is restarted it can rotate the gear wheel $E^1$, and its sleeve *e* to which clutch member $F^1$ is attached to an unlimited extent and thereby bring the clutch teeth into register before the gear wheel has made one complete rotation. Thereupon the clutch members will snap into engagement and the motor be in full normal control of the door.

If the motor failure occurs when the door is closed it will be necessary to first unlock the door by an arm-lifter such as the cord or chain O to bring the arm B out of its horizontal or dead-centered position which causes the locking of the door. This lifting of the door arm B involves a backward movement of the door which the worm gear would not permit but by virtue of the clutch and drive spring S, S, the door will be released from the motor by stepping on foot-lever G and the clutch locked out by the spring. Then the door arm can be lifted and the door opened by hand. Such a lifter is not required for the door-open position of the arm because it does not come down on that side to a horizontal position.

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

1. Electric door-operating mechanism comprising an electric motor, non-reacting gearing between the motor and the door, a manual disconnector between the door and the said gearing and lock-out means controlled by said gearing for said disconnector.

2. Electric door-operating mechanism comprising an electric motor, an oscillating door-arm driven by the motor, a drive-spring between said motor and the door-arm, a motor-switch controlled by said spring and a manual disconnector having actuator members one of which is movable relative to the other member under the tension of said spring while said members are released from each other.

3. Electric door-operating mechanism comprising an electric motor, gearing between the door and the motor, a manual disconnector interposed in said gearing, means operated thereby for maintaining disconnection of the door from the motor and means automatically controlled by the restarting of the motor for reconnecting the door and the motor.

4. Electric door-operating mechanism comprising an electric motor, gearing between the motor and the door, a manual disconnector in said gearing, a lock-out device for maintaining disconnection of the door from the motor during manual operation of the door and means depending on the starting of the motor for releasing said lock-out device automatically and restoring the connection of the door and motor.

5. Electric door-operating mechanism comprising an electric motor, gearing between the door and motor, a manual disconnector in the gearing, an operating spring for said disconnector, means for locking-out the disconnector against the force of said spring and means for automatically releasing the disconnector on the starting of the motor.

6. Electric door-operating mechanism comprising an electric motor, gearing between the motor and the door, a two-part disconnector, a spring for engaging the disconnector, manual means for disengaging said disconnector, and a drive-spring between the door and motor acting upon the disconnector to bring its parts into a relation so as to maintain its disengaged condition.

7. Door-operating mechanism comprising an electric motor, a rotating radial door-arm, a motor-driven gear wheel sleeved loosely on the door-arm shaft, a clutch member on the gear wheel sleeve and a second clutch member concentric therewith, a spring driving connection between the second clutch member and the door arm together with means for disengaging the clutch members manually.

8. Door-operating mechanism comprising an electric motor, a rotating radial arm, spring gearing between the motor and the door including a non-reacting gear between the motor and the spring, a motor switch controlled by the spring and a stop between the door arm and the door for fixing the closing limit of the door movement independently of the door buffer.

9. Door-operating mechanism comprising an electric motor, separate limit switches for each direction of door movement, a non-reacting gear between the door and the motor, a spring between said gear and the door, and individual operating devices for the respective limit switches controlled by the torsion of said spring.

10. Door operating mechanism comprising an electric motor, gearing between said motor and the door, a toothed clutch in the said gearing, a manual device for disengaging said clutch, and means operated by said gearing for throwing the teeth of the component members of the clutch out of register so that said clutch members may be maintained in disengaged relation.

11. Door-operating mechanism comprising an electric motor, a radial door-arm, a non-reacting gear, a sleeve on the door-arm shaft driven by said gear, a spring-operated clutch between said sleeve and door-arm shaft, a drive spring between the said shaft and one of the clutch members, and a motor switch controlled by the tensioning of said spring.

12. Door-operating mechanism comprising an electric motor, a radial door-arm, a gear-wheel driven by the motor and sleeved on the door-arm shaft, a clutch between said shaft and the gear-wheel sleeve, and a spring driving connection between one clutch member and the said shaft including a pair of spring-pressed parts mounted to move in opposite directions on said shaft and engaging the said clutch member.

13. Door operating mechanism comprising an electric motor, a shaft having a radial door arm, a gear wheel driven by the motor and sleeved on the door arm shaft, a clutch member connected with the said door arm shaft, a second clutch member carried by said sleeve, a spring interposed between the last mentioned clutch member and the shaft, a limit switch for the motor, and an axial operating device therefor on said shaft worked longitudinally of the shaft by the torsioning of the said spring.

14. Door operating mechanism comprising an electric motor, a shaft provided with a door arm, a gear wheel sleeved on said shaft and driven by the motor through nonreacting gearing, a clutch member connected with the shaft, a second clutch member connected with said sleeve, a yoke on said shaft, a spring pressed lever jointed to the yoke and engaging one of the clutch members, a motor switch and an operating rod therefor movable longitudinally of the said shaft by said lever.

Signed at Albany, county of Albany and State of New York, this 31st day of January, 1925.

LEE P. HYNES.