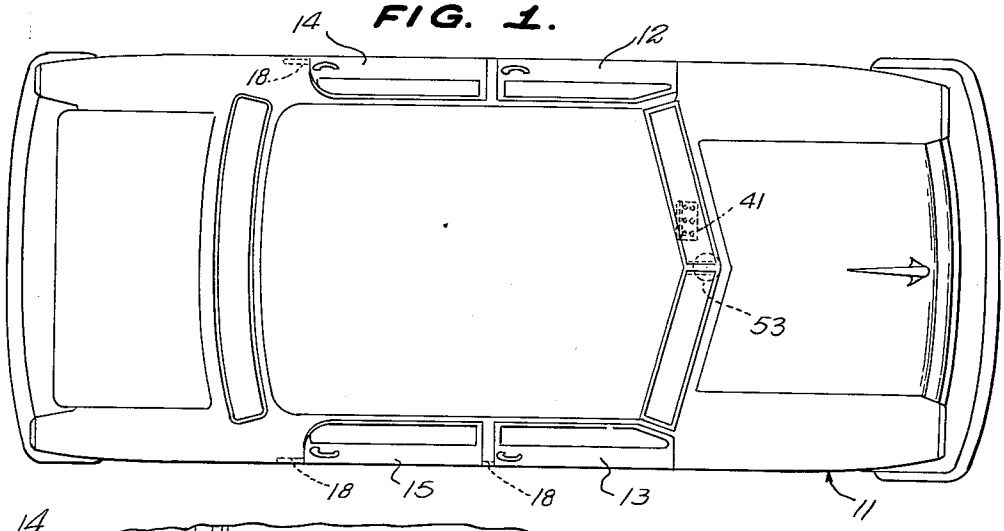
Aug. 2, 1955 R. X. GRAHAM 2,714,521

POLARIZED SAFETY LOCK SYSTEM

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FIG. 1.



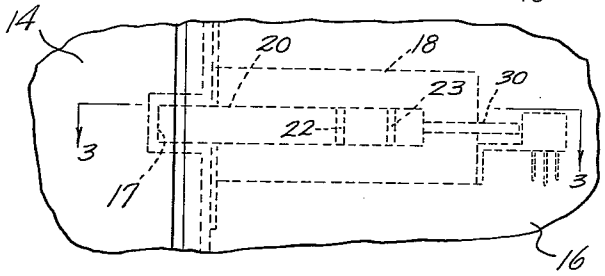


FIG. 2.

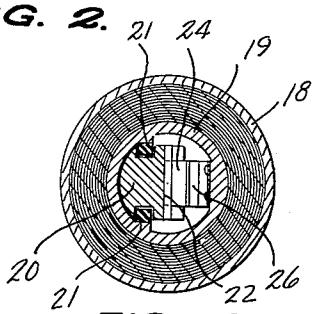


FIG. 4.

FIG. 3.

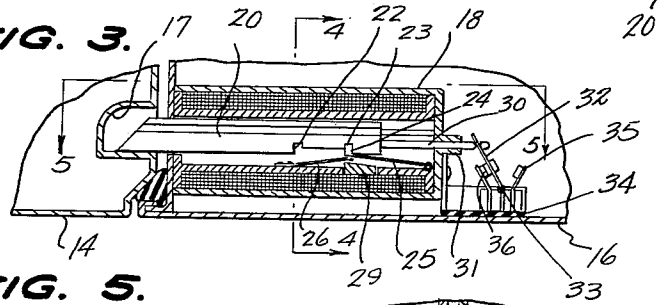
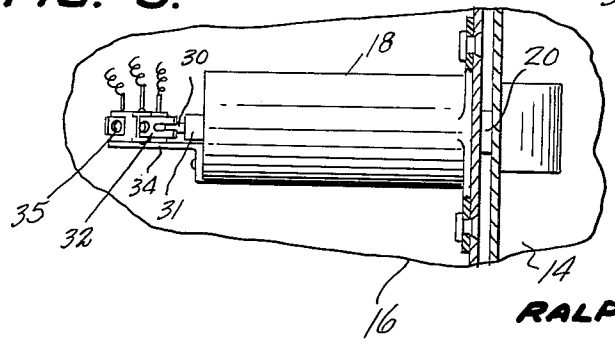


FIG. 5.



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FIG. 6.

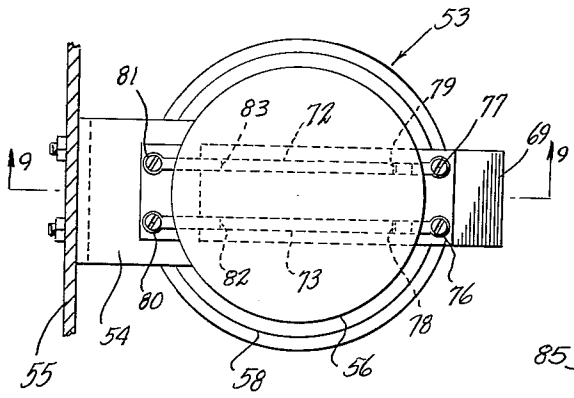


FIG. 11.

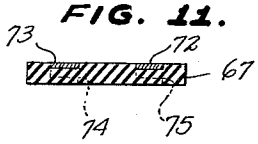


FIG. 9.

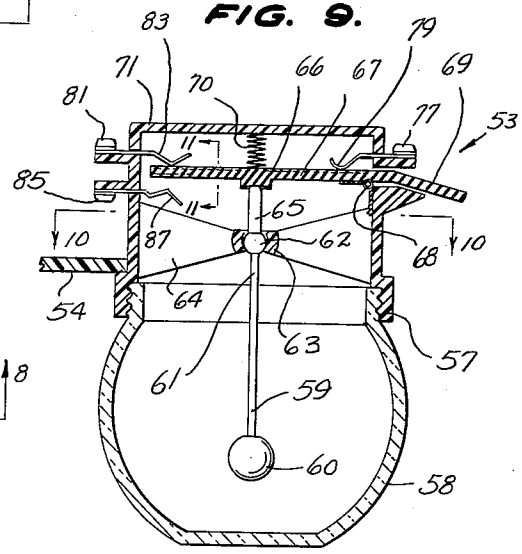


FIG. 7.

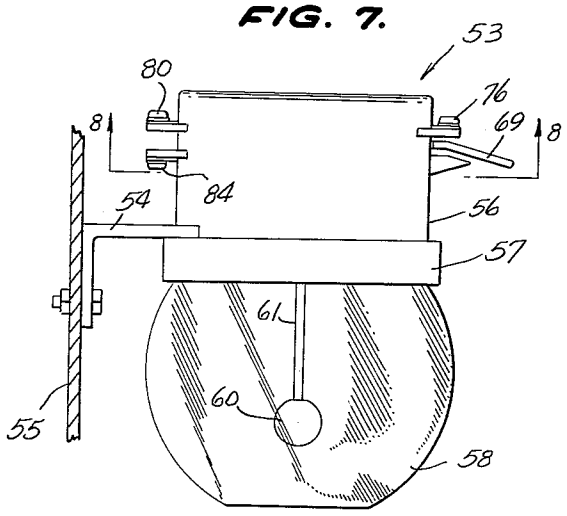


FIG. 10.

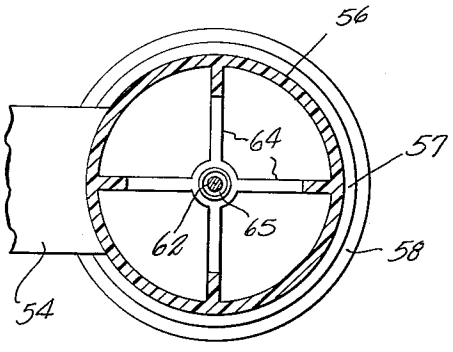
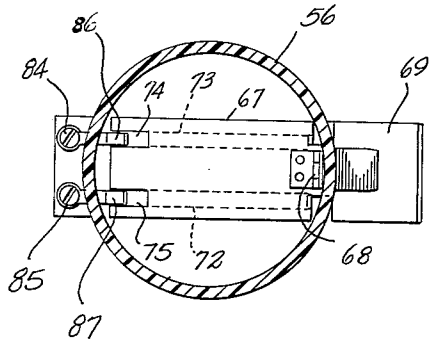


FIG. 8.



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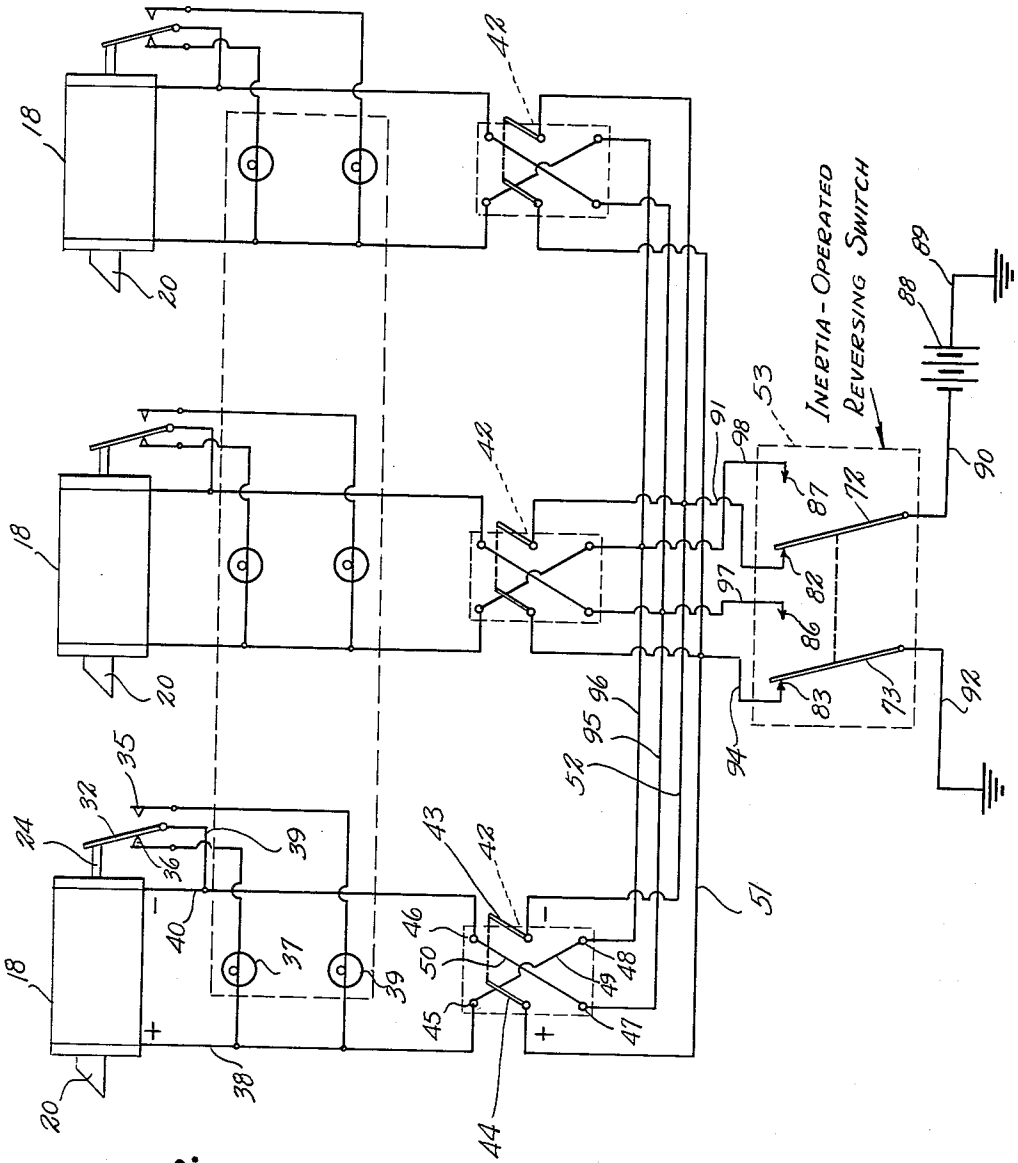


FIG. 12.

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POLARIZED SAFETY LOCK SYSTEM

Ralph X. Graham, East Braintree, Mass.

Application April 21, 1953, Serial No. 350,191

4 Claims. (Cl. 292—144)

This invention relates to electrically operated door lock systems, and more particularly to an improved electromagnetic door locking system for a motor vehicle.

A main object of the invention is to provide a novel and improved electrically operated door lock system for a motor vehicle, said system involving simple components, being reliable in operation, and being arranged so that it is automatically placed in unlocking position in case of an accident to the vehicle.

A further object of the invention is to provide an improved electromagnetic door locking system for a motor vehicle, wherein each door of the motor vehicle is individually controlled, and wherein indicator means are provided to inform the vehicle operator as to whether the various doors of the vehicle are either locked or unlocked, the improved system involving inexpensive components, being sturdy in construction, and providing improved safety in operation of the vehicle as over conventional door locking arrangements of the prior art.

A still further object of the invention is to provide an improved electromagnetic door locking system for a motor vehicle, said system being inexpensive to install, involving relatively simple and compact parts, and being provided with inertia operated unlocking means, whereby the doors of the vehicle will be automatically unlocked whenever the vehicle is involved in an accident of a type causing a sudden deceleration of the vehicle, thus enabling the occupants of the vehicle to escape therefrom in the event of such an emergency.

Further objects and advantages of the invention will become apparent from the following description and claims, and from the accompanying drawings, wherein:

Figure 1 is a top plan view of a conventional motor vehicle illustrating the arrangement of the various components of an electrically operated door locking system constructed in accordance with the present invention, said system being installed on the vehicle.

Figure 2 is an enlarged side elevational view of the marginal portion of a door frame equipped with an electromagnetically operated door lock according to the present invention, said view being part of the door frame and a portion of the door adjacent thereto of the vehicle illustrated in Figure 1.

Figure 3 is a vertical cross sectional view taken on the line 3—3 of Figure 2.

Figure 4 is a transverse vertical cross sectional view taken on the line 4—4 of Figure 3.

Figure 5 is a horizontal cross sectional view taken on the line 5—5 of Figure 3.

Figure 6 is an enlarged horizontal cross sectional view taken through the fire wall of the vehicle of Figure 1, and showing the inertia-operated switch in top plan view, said switch being part of the door-operating system of the present invention.

Figure 7 is a vertical cross sectional view showing the inertia-operated switch of Figure 6 in side elevation.

Figure 8 is a horizontal cross sectional view taken on the line 8—8 of Figure 7.

Figure 9 is a vertical cross sectional view taken on the line 9—9 of Figure 6.

Figure 10 is a horizontal cross sectional view taken on the line 10—10 of Figure 9.

Figure 11 is an enlarged vertical cross sectional detail taken on the line 11—11 of Figure 9.

Figure 12 is a schematic wiring diagram of the electrical door lock operating system illustrated in Figures 1 to 11.

Referring to the drawings, 11 designates a conventional motor vehicle having the respective front doors 12 and 13 and the respective rear doors 14 and 15. The left front door 12 is located adjacent the driver's seat and is provided with conventional mechanically operated locking means. The remaining doors of the vehicle, namely the doors 13, 14 and 15, are provided with electrically controlled door locks such as illustrated in detail in Figures 2, 3, 4 and 5. Referring now to Figures 2 to 5, wherein the electrically operated lock associated with the door 14 is illustrated by way of example, the car body adjacent the marginal portion of the door is shown at 16. The edge of the door 14 is formed with a bolt receiving socket or recess 17. Secured on the door frame portion 16 and arranged to substantially register with the recess 17 is a tubular solenoid 18, said solenoid having the tubular core 19. Designated at 20 is a permanently magnetized bolt which is formed with opposite longitudinal grooves slidably engaged on ribs 21, 21 of non-magnetic material secured longitudinally in the tubular core 19, whereby the bolt 20 may move longitudinally through the core. The tubular core 19 is preferably of magnetic material, and the tubular solenoid 18 is arranged so that when it is energized with current in one direction the bolt is moved outwardly to locking position, such as the position thereof shown in Figure 3, whereas when the solenoid 18 is energized with current in the opposite direction, the bolt is retracted to unlocking position. This action occurs because the bolt 20 is permanently magnetized, and as a result has a North pole at one and a South pole at the other end. Consequently, the polarity of current applied to the solenoid 18 will cause the bolt to be moved in one direction or the other, in accordance with the well known laws of electromagnetism.

The bolt 20 is formed with spaced notches 22 and 23 at the outer edge thereof, and designated at 24 is a detent lug integrally formed on the end of an armature 25 of magnetic material, said armature 25 being hinged to one end portion of the bore of the tubular core 19, as shown in Figure 3. Designated at 26 is a non-magnetic leaf spring which has one end thereof secured in the tubular core 19 and which engages beneath the free end of the armature 25, as shown in Figure 3, and biases the detent lug 24 inwardly. As shown in Figure 3, the detent lug 24 is thus urged inwardly and is engageable respectively in the notches 22 and 23, to thereby lock the bolt 20 in either its extended position, shown in Figure 3, or in a retracted, unlocking position, wherein the lug 24 engages in the notch 22. Designated at 29 is a pole piece of magnetic material which is secured in the core 19 adjacent to the detent lug 24. The pole piece 29 is arranged to attract the armature 25 when the solenoid 18 is energized, to withdraw the lug 24 from the notch in which it is seated, to free the bolt 20 for movement longitudinally in the core 19. Thus, the bolt 20 is positively secured in either locking or unlocking position until the solenoid 18 is magnetized, and the bolt 20 cannot move unless energization of the solenoid occurs.

Projecting axially from the end of the bolt 20 is the rod member 30 of insulating material, said rod member extending slidably through an axial bushing 31 provided at the end of the solenoid. The end of the rod member 30 is pivotally connected to the end of a rotatable switch

pole 32 which is pivotally connected at 33 to a bracket 34 of insulating material secured to the end of the solenoid 18. The pole 32 is adapted to conductively engage either one of a pair of contacts 35 and 36, the pole 32 engaging the contact 35 when the bolt 20 is in its retracted, unlocking position, and said pole 32 engaging the contact 36 when the bolt 20 is in its extended, locking position, shown in Figure 3.

As shown in Figure 12, a first pilot lamp 37 is connected between one terminal 38 of the solenoid 18 and the contact 36. A second pilot lamp 39 is connected between terminal 38 and the other contact 35. The pole 32 is connected by a wire 39 to the remaining terminal 40 of the solenoid. Thus, when the bolt 20 is in the extended, locking position thereof shown in Figure 3, the first pilot lamp 37 is connected in parallel with the solenoid 18, whereas, when the bolt 20 is in its retracted, unlocking position, the second pilot lamp 39 is connected in parallel with solenoid 18.

Designated at 41 is a switch assembly which is mounted on the vehicle dashboard adjacent the operator's seat, said switch assembly comprising three independently controlled, manually operated, double-pole, double-throw switches 42. Each switch 42 controls the lock for an associated door 13, 14 or 15 of the vehicle. As shown in Figure 12, each switch 42 comprises the switch poles 43 and 44 and respective pairs of stationary contacts 45, 46 and 47, 48. As shown in Figure 12, the contacts are diagonally interconnected, the contact 45 being connected to the contact 48 by a first reversing diagonal wire 49, and the contact 46 being connected to the contact 47 by another reversing diagonal wire 50. Designated at 51 and 52 are respective supply wires connected to the respective poles 44 and 43.

Designated at 53 is an inertia operated switch which is mounted centrally of the vehicle beneath the rear portion of the hood thereof, as by an angle bracket 54 secured to the fire wall 55 of the vehicle, as shown in Figures 6 and 7. The switch 53 comprises a main cylindrical housing 56 having an internally threaded annular skirt portion 57 in which is secured the transparent bowl 58. The housing 56 is, of course, made of suitable insulating material, such as molded plastic or the like. Designated at 59 is a pendulum member having the weighted bottom portion 60 and the rod portion 61. The rod portion 61 is provided with the pivot ball 62 which is rotatably supported in a spherical socket 63 defined at the inner ends of a plurality of radial supporting arms 64 extending inwardly from the wall of the housing 56. The rod 61 has an upwardly projecting top portion 65 which normally engages beneath a lug 66 formed on the intermediate portion of a lever member 67. The lug 66 has a concave bottom surface in which the top end 65 of rod 61 is receivable, as illustrated in Figure 9. The lever member 67 is hinged at 68 to the wall of the housing 56 and is provided with an externally projecting handle portion 69. The arm 67 is biased downwardly by a coiled spring 70 disposed between the top wall 71 of the housing 56 and the intermediate portion of arm 67, as illustrated in Figure 9.

The arm 67 is formed of insulating material but has secured thereon the parallel contact strips 72 and 73, said contact strips extending substantially for the entire length of the portion of arm 67 in the housing 56 and extending beneath the free end portion of the arm, as shown at 74 and 75. Secured to the wall of the housing adjacent the hinged connection 68 are the respective terminals 76 and 77 having the spring contacts 78 and 79 engaging the end portions of the conductive strips 73 and 72, as shown in Figure 6. Mounted on the opposite portion of the wall of the housing 56 are respective terminals 80 and 81 having spring contacts 82 and 83 engaging the respective conductive strips 73 and 72, in the position of the arm 67 illustrated in Figure 9. Mounted on the wall of the housing 56 below the terminals 80 and 81 are additional terminals 84 and 85 having spring contacts 86 and 87 which are respectively engageable with the end portions 74 and 75 of the conductor strips 73 and 72 when the arm 67 is rotated downwardly from the position thereof shown in Figure 9, as when the pendulum 59 rotates relative to the housing 56 sufficiently to cause the top end 65 of the pendulum rod to disengage from beneath the concaved lug 66. The lever arm 67 will remain locked in this lowered position until the lever arm 67 is rotated in a clockwise direction, as viewed in Figure 9, by means of the handle member 69, to allow the pendulum 59 to swing to a position wherein the top end 65 thereof is disposed beneath the concaved lug 66.

Referring now to Figure 12, it will be seen that a battery 88 is provided having its positive terminal grounded by a wire 89. The negative terminal of the battery is connected by a wire 90 to the conductive strip 72 of the inertia operated switch 53. The spring contact 82 is connected by its terminal 80 and a wire 91 to the supply wire 52. The conductive strip 73 is connected by a wire 92 to ground. The spring contact 83 is connected by its terminal 81 and a wire 94 to the opposite supply wire 51. Thus, the supply wires 52 and 51 are connected respectively, in the positions of the contact strips 72 and 73 shown in Figure 12, to the negative terminal of the battery 88 and ground. Therefore, the switch pole 44 will have positive battery polarity. When the switch 42 is operated to cause the respective switch poles 43 and 44 to respectively engage the contacts 46 and 45, the associated solenoid 18 will be connected to the battery 88 and the terminal 38 thereof will have positive polarity, whereas the terminal 40 thereof will have negative polarity. However, if the switch poles 44 and 43 are connected to the opposite contacts, namely, the respective contacts 47 and 48 of the switch, the polarity of the current through the solenoid 18 is reversed. Thus, with the switch poles 44 and 43 in one position, the doors will be locked and with the switch poles in the opposite positions, the doors will be unlocked, since the bolts 20 will be extended or retracted in accordance with the polarity of the current applied to the solenoid, as above explained.

Connected to the contacts 47 of the switches 42 is a first emergency conductor 95, and connected to the contacts 48 of the switches 42 is a second emergency conductor 96. The respective spring contacts 86 and 87 of the inertia operated reversing switch are connected by their terminals 84, 85 and by respective wires 97 and 98 to the respective emergency conductors 95 and 96.

The solenoids 18 are wound so that the bolts 20 will be moved to extended, locking positions when the solenoids are energized with positive potential at terminals 38 and negative potential at terminals 40. These polarities are obtained when the switch poles 44 and 43 engage the respective contacts 45 and 46. When the switch poles 44 and 43 engage the respective contacts 47 and 48, the solenoids 18 are energized with negative potential at terminals 38 and positive potential at terminals 40. This moves the bolts 20 to retracted, unlocking positions. From Figure 12 it will be seen that when the contact elements 73 and 72 are swung clockwise, into engagement with the contacts 86 and 87, as when the pendulum 59 is swung relative to the pendulum housing 56, as where the vehicle is suddenly decelerated or collides with an obstacle, the solenoids 18 are automatically energized with unlocking polarity of applied potential. Thus, the energizing circuit for the solenoids 18 illustrated in Figure 12 comprises the negative terminal of battery 88, the wire 90, the conductor element 72, spring contact 87, the wire 98, the wire 96, the contact 48 of switch 42, the diagonal interconnection 49, the contact 45, the terminal 38, which is thus negative, the solenoid winding, the terminal 40, the contact 46, the diagonal interconnection 50, the contact 47, the wire 95, the wire

97, the spring contact 86, the contact element 73, the wire 92 and ground. Since the positive terminal of the battery 88 is grounded, the solenoid terminal 40 is thus made positive, whereas the solenoid 38 is negative, and the bolt 20 is thus retracted to unlocked position. This occurs simultaneously for all the door locks, and therefore all doors are unlocked in response to the action of the inertia operated emergency switch 53, as in the case of accidents involving a sudden deceleration of the vehicle. Otherwise, with the inertia operated reversing switch in its normal position, shown in Figures 9 and 12, the individual door locks are manually controlled by the respective reversing switches 42.

As above explained, the respective pilot lights 37 and 39 provide an indication as to whether the respective doors are locked or unlocked, since said pilot lights are energized in parallel with the solenoids 18. The manually controlled switches 42 are three-position switches, and during the movement of the vehicle, the poles 44 and 43 of the switches will be in elevated positions out of contact with the stationary contacts of the switch. Thus, the solenoid windings 18 will not be energized unless the poles 43 and 42 are moved into engagement with a pair of switch contacts. However, the doors are held locked or unlocked, by the engagement of the respective locking lugs 24 in the notches 22 and 23 of the bolts 20, in the manner above explained. However, regardless of the positions of the switch poles 43 and 44 of the manually reversing switches, the inertia-operated reversing switch will always be effective to unlock the doors in the event of an emergency or accident causing sudden deceleration of the vehicle.

While the specific embodiment of an improved electrically operated door lock system for a motor vehicle has been disclosed in the foregoing description, it will be understood that various modifications within the spirit of the invention may occur to those skilled in the art. Therefore, it is intended that no limitations be placed on the invention except as defined by the scope of the appended claims.

What is claimed is:

1. An electrically operated door lock system for a motor vehicle comprising a door lock having a bolt-operating solenoid, a permanently magnetized bolt controlled by said solenoid, a source of current, circuit means connecting said source to said solenoid and including a manually operated reversing switch arranged to selectively energize said solenoid with current from said source in either direction, the solenoid being arranged to move said bolt to locking position when energized with current in one direction and to move said bolt to unlocking position when energized with current in the opposite direction, an inertia-operated reversing switch in said circuit means between said manually operated reversing switch and said source, said inertia-operated switch having contact means normally in circuit with and connecting said source to said manually operated switch and other contact means arranged to at times reverse the polartiy of the current aplied to said manually operated switch, and magnetically controlled detent means in said solenoid lockingly engaging said bolt and being movable away from locking engagement with the bolt responsive to energization of the solenoid.

2. An electrically operated door lock system for a motor vehicle comprising a door lock having a bolt-operating solenoid, a permanently magnetized bolt controlled by said solenoid, a source of current, circuit means connecting said source to said solenoid and including a manually operated reversing switch having a pair of movable poles and respective pairs of contacts engaged

by said poles in the oppostie positions of the switch, said contacts being diagonally interconnected, each terminal of the solenoid being connected to interconnected diagonally opposed contacts, the source being connected to said poles, whereby the solenoid will be energized with current in one direction when the poles engage one pair of contacts and with current in the opposite direction when the poles engage the opposite pair of contacts, the solenoid being arranged to move said bolt to locking position when energized with current in one direction and to move said bolt to unlocking position when energized with current in the opposite direction, an inertia-operated switch in said circuit means between said manually operated reversing switch and said source, said inertia-operated switch having contact means normally in circuit with and connecting said source to said poles and other contact means arranged to at times connect said source to a pair of contacts of said manually operated switch with a polarity to energize said solenoid with current in said opposite direction, magnetically controlled detent means in said solenoid lockingly engaging said bolt and being movable away from locking engagement with the bolt responsive to energization of the solenoid, means locking said inertia-operated switch in said second position, and manual means for restoring said inertia-operated switch to said normal position.

3. In a motor vehicle electrical door locking system, a door lock comprising a tubular solenoid including an inner element of magnetic material, a permanently magnetized bolt having opposite magnetic poles at its respective ends, said bolt being slidably mounted in said solenoid adjacent said inner element, and a detent member of magnetic material resiliently mounted in said solenoid, said bolt being formed with a plurality of spaced notches in which said detent member is receivable, said detent member being retracted from said bolt by the magnetic attraction of said inner element when the solenoid is energized, the bolt being moved into locking position when the current in the solenoid is in one direction and into unlocking position when said current is in the opposite direction.

4. In a motor vehicle electrical door locking system, a door lock comprising a tubular solenoid including an inner element of magnetic material, a permanently magnetized bolt having opposite magnetic poles at its respective ends, said bolt being slidably mounted in said solenoid adjacent said inner element, a detent member of magnetic material resiliently mounted in said solenoid, said bolt being formed with a plurality of spaced notches in which said detent member is receivable, said detent member being retracted from said bolt by the magnetic attraction of said inner element when the solenoid is energized, the bolt being moved into locking position when the current in the solenoid is in one direction and into unlocking position when said current is in the opposite direction, a switch arm pivoted to one end of the solenoid, means connecting said bolt to said switch arm, and respective switch contacts carried by the solenoid on opposite sides of the switch arm and being respectively engaged by said switch arm when the bolt is in its respective locking and unlocking positions.

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