

[54] AUTOMATIC VEHICLE DOOR LOCK CIRCUIT

[75] Inventor: **Douglas E. Mark**, Davison, Mich.

[73] Assignee: **General Motors Corporation**, Detroit, Mich.

[22] Filed: **June 1, 1972**

[21] Appl. No.: **258,520**

[52] U.S. Cl. **180/112, 70/264**

[51] Int. Cl. **B60r 21/00**

[58] Field of Search 180/107, 111, 112, 180/113, 114; 70/264

[56] References Cited

UNITED STATES PATENTS

3,695,381	10/1972	Okada et al.	180/112
3,722,615	3/1973	Okada et al.	180/112
3,630,305	12/1971	Kazaoka	180/113

Primary Examiner—Allen N. Knowles

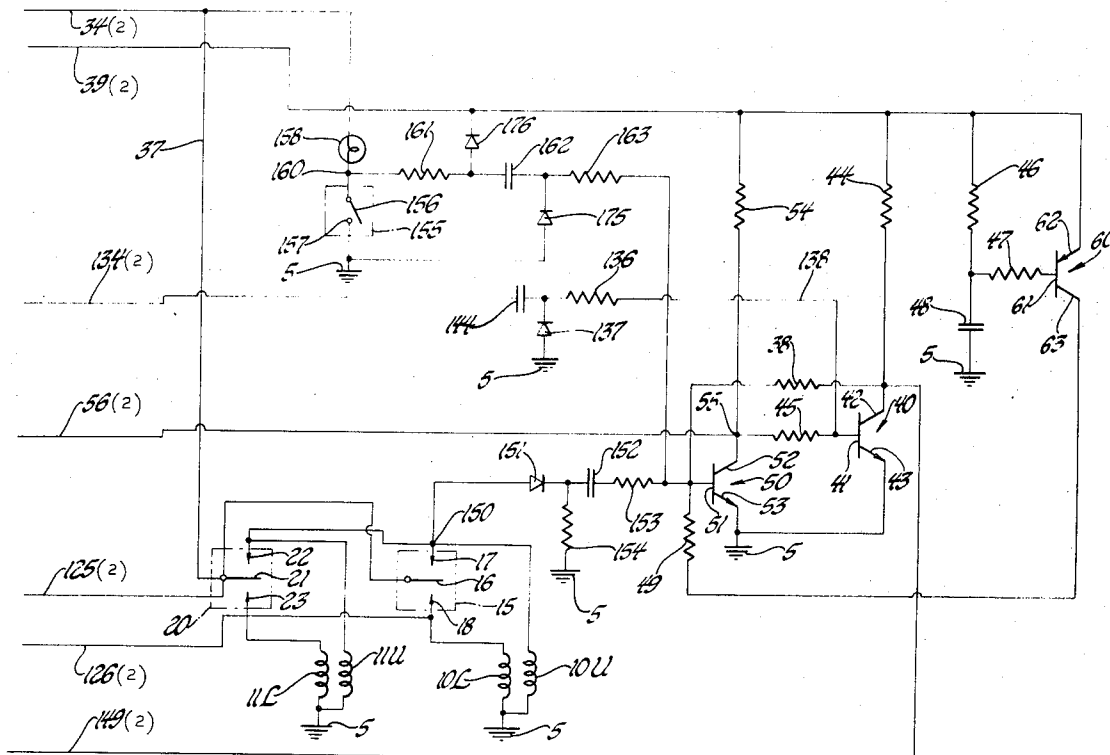
Attorney—Eugene W. Christen et al.

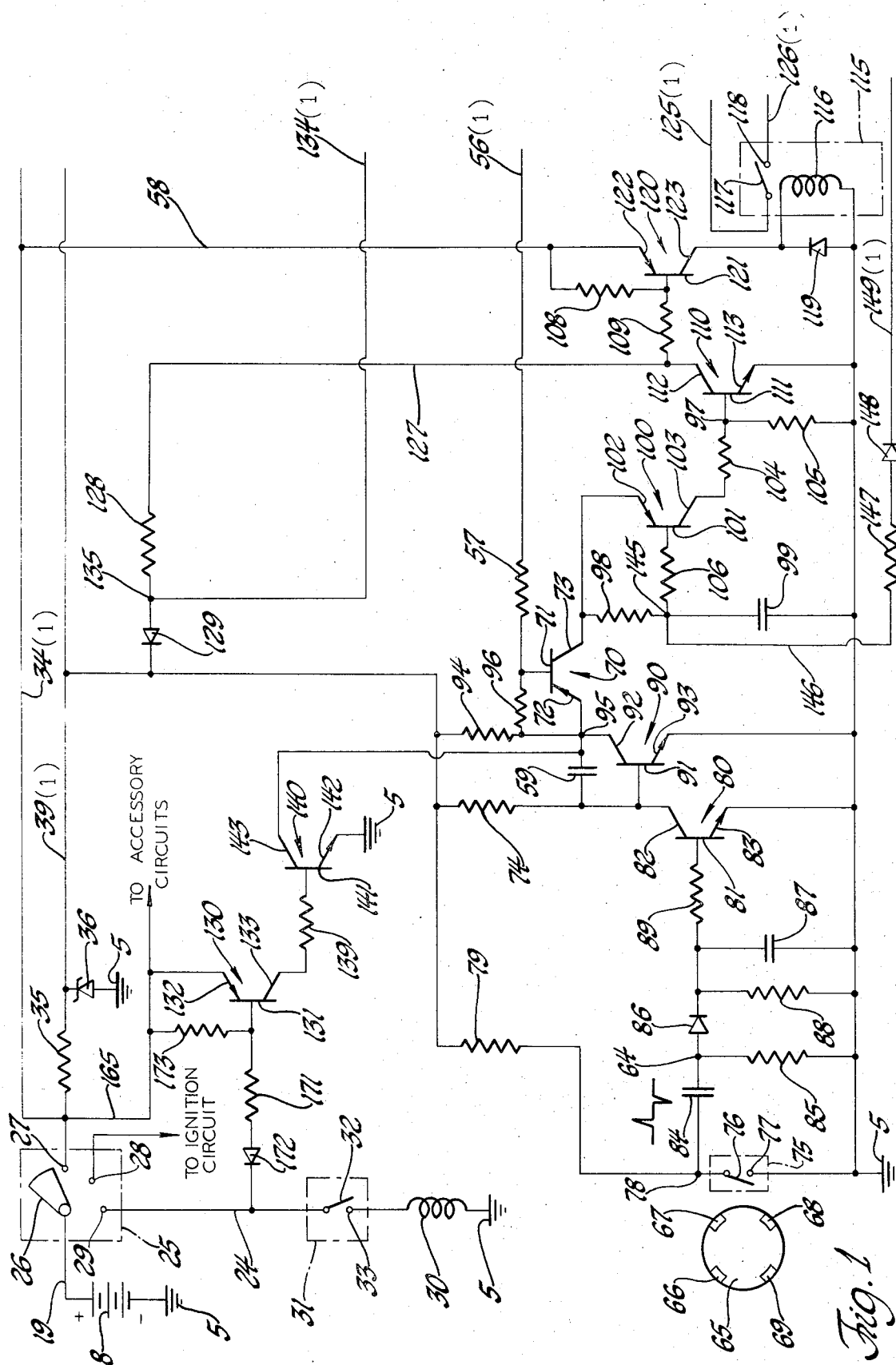
[57]

ABSTRACT

An automatic vehicle door lock circuit for automatically locking the doors at a predetermined speed. A set signal, produced upon the energization of this circuit, triggers a bistable multivibrator memory circuit to the condition which produces a door unlock signal upon the output thereof. An electrical vehicle speed signal, produced when the vehicle has reached the predetermined speed, and the door unlocked signal are applied across the emitter-base electrodes of a type PNP transistor which, in combination with another type PNP transistor, produce an electrical lock doors signal of a predetermined duration. Another type PNP transistor, responsive to this lock doors signal, completes an energizing circuit for the lock solenoids in each of the vehicle doors to operate the lock mechanism thereof to the door locked condition. At the conclusion of the lock doors signal, a doors locked signal is produced to trigger the bistable multivibrator memory circuit to the condition which removes the door unlocked signal from the output thereof.

10 Claims, 2 Drawing Figures





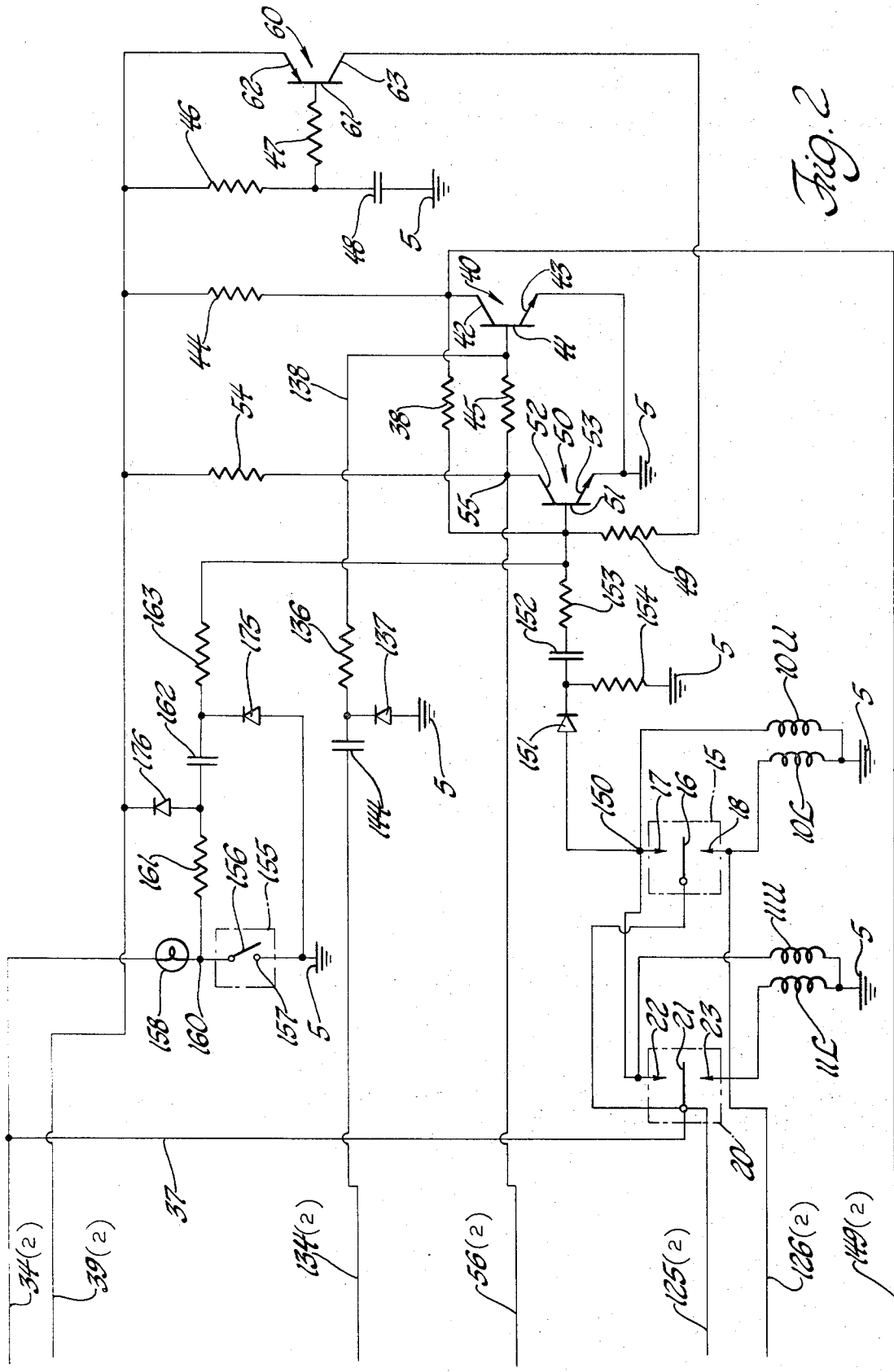


Fig. 2

AUTOMATIC VEHICLE DOOR LOCK CIRCUIT

This invention is directed to an automatic vehicle door lock circuit and, more specifically, to a circuit of this type which automatically locks the vehicle doors when the vehicle has reached a predetermined speed.

Each door of a vehicle is conventionally provided with a door locking mechanism, each of which may be independently locked manually from inside the vehicle, preferably by means of a garnish molding button and, additionally, each front door may be locked from the outside by means of a key.

To provide for the operation of the door locking mechanism to the locked and unlocked conditions electrically, each door is provided with a lock solenoid which, upon energization, operates the door lock mechanism to the door locked condition and an unlock solenoid which, upon energization, operates the door lock mechanism to the door unlocked condition. To complete the energizing circuit for each the lock and unlock solenoids, a single pole-double throw electrical switch is installed on the inside of at least the two front doors whereby all of the door locking mechanisms may be electrically operated by either the driver or the front seat passenger. Usually, but not necessarily always, the electrical control of the lock mechanism of all doors originates in the front doors, the lock and unlock solenoids of the rear doors being followers only. That is, the lock solenoids and the unlock solenoids of all of the vehicle doors may be energized by operating the manually operable door lock switch mounted on the inside of either the driver side front door or the passenger side front door.

To prevent the unwarranted intrusion of the occupied vehicle passenger compartment, for example when the vehicle is stopped in abeyance of a traffic signal, it is desirable that all of the vehicle door lock mechanisms be operated to the door locked condition while the vehicle passenger compartment is occupied. As the driver and/or the passenger may neglect to operate the lock mechanism to the door locked condition, a circuit which automatically locks the vehicle doors when the vehicle has reached a predetermined speed is desirable.

It is, therefore, an object of this invention to provide an improved automatic vehicle door lock circuit for automatically locking the vehicle door when the vehicle has reached a predetermined speed.

It is another object of this invention to provide an improved automatic vehicle door lock circuit for automatically locking the vehicle doors when the vehicle has reached a predetermined speed which is provided with sensing circuitry for producing a door unlocked signal upon the energization of any door unlock solenoids and a door opened signal upon the opening and relasing of any one of the vehicle doors after the lock mechanism has been automatically energized.

It is an additional object of this invention to provide an improved automatic vehicle door lock circuit for automatically locking the vehicle doors when the vehicle has reached a predetermined speed which is provided with a circuit for preventing the operation thereof at any speed while the vehicle transmission is in "Neutral."

It is a further object of this invention to provide an improved automatic vehicle door lock circuit for automatically locking the vehicle doors when the vehicle has reached a predetermined speed which will auto-

matically relock any door which has been unlocked after the operation thereof while the vehicle is operating at or greater than the predetermined speed.

In accordance with this invention, an improved automatic vehicle door lock circuit for automatically locking the vehicle doors when the vehicle has reached a predetermined speed is provided wherein circuitry responsive to a door unlocked signal, produced upon the initial energization of the circuitry of this invention or upon the energization of any of the door unlock solenoids or upon the reclosing of any one of the vehicle doors which has been opened after the operation of the circuit of this invention, and a vehicle speed signal, produced when the vehicle has reached the predetermined speed, produces a lock doors signal of a predetermined duration and circuitry responsive to the lock doors signal completes an energizing circuit for all of the lock solenoids in parallel to operate the lock mechanism of each vehicle door to the locked condition.

For a better understanding of the present invention, together with additional objects, advantages and features thereof, reference is made to the following description and accompanying drawing in which:

FIG. 1 schematically sets forth a portion of the automatic vehicle door lock circuit of this invention and, FIG. 2 schematically sets forth the remainder of the automatic vehicle door lock circuit of this invention.

As is well known in the automotive art, the lock mechanism of each vehicle door may be operated to the door locked condition by the energization of an associated lock solenoid and may be operated to the door unlocked condition by the energization of an associated unlock solenoid upon the operation of manually operable, single pole-double throw electrical door lock switches through which the lock and unlock solenoids may be selectively energized from a source of direct current potential, which may be the vehicle storage battery 8 of FIG. 1. As electrically operable door lock mechanisms are well known in the automotive art and, per se, form no part of this invention, in the interest of reducing drawing complexity, only the lock and unlock solenoids and the door lock switches which cooperate with the automatic vehicle door lock circuit of this invention have been shown in the drawing. In FIG. 2, the right and left front door lock solenoids have been referenced by the numerals 10L and 11L, respectively, and the right and left front door unlock solenoids have been referenced by the numerals 10U and 11U, respectively. With four-door vehicles, the right and left rear door lock solenoids and the right and left rear door unlock solenoids may be connected in parallel with the front door lock solenoids and the front door unlock solenoids, respectively. In the interest of reducing drawing complexity, the rear door lock and unlock solenoids are not shown in the drawing. The right and left front door lock switches may be of the single pole-double throw type having a movable contact and two stationary contacts 17 and 18. In FIG. 2, the right front door lock switch 15 is shown to have a movable contact 16 and two stationary contacts and the right front door lock switch 20 is shown to have a movable contact 21 and two stationary contacts 22 and 23.

As point of reference or ground potential is the same point electrically throughout the system, it has been illustrated in the drawing by the accepted schematic symbol and referenced by the numeral 5.

The movable contact 26 of a conventional automotive type ignition switch 25 having a movable contact and three stationary contacts 27, 28 and 29, is connected to the positive polarity terminal of battery 8 through lead 19. Ignition switch 25 may be a conventional automotive type ignition switch having an "Off" position, in which position it is shown in FIG. 1, a "Crank" position in which movable contact 26 is in electrical contact with stationary contacts 28 and 29 and a "Run" position in which movable contact 26 is in electrical contact with stationary contacts 27 and 28. Ignition switches of this type are normally spring biased to automatically return to the "Run" position from the "Crank" position upon the release of torque upon the ignition key, in a manner well known in the automotive art. While in the "Crank" position with the vehicle transmission in the "Neutral" or "Park" position, the cranking motor solenoid 30 is connected across battery 8 through lead 19, movable contact 26 and stationary contact 29 of ignition switch 25, lead 24, the closed contacts 32 and 33 of transmission neutral switch 31 and point of reference or ground potential 5 and the vehicle ignition circuit is connected across battery 8 through lead 19, movable contact 26 and stationary contact 28 of ignition switch 25. The transmission neutral switch 31 may be a conventional single pole-single throw type electrical switch well known in the automotive art which is operated to the electrical circuit closed condition with movable contact 32 in electrical contact with stationary contact 33 with the vehicle transmission shifted to either the "Neutral" or "Park" position in a manner well known in the automotive art. After the vehicle engine has been cranked and is in the running mode, the torque on the ignition key is released and movable contact 26 is spring biased to return to the "Run" position in which it is in electrical contact with stationary contacts 27 and 28 which maintains the ignition circuit energized across battery 8 and also connects the accessory circuits and the automatic vehicle door lock circuit of this invention across battery 8.

In FIG. 1, the output potential of battery 8 is shown to be regulated by series resistor 35 and Zener diode 36 connected across stationary contact 27 of ignition switch 25 and point of reference or ground potential 5. It is to be specifically understood that this potential regulating arrangement is desirable but not absolutely necessary for the practice of this invention.

While ignition switch 25 is in the "Run" position, movable contact 26 in electrical contact with stationary contacts 27 and 28, vehicle door lock solenoids 10L and 11L of FIG. 2 may be energized from battery 8 upon the operation of movable contact 16 of door lock switch 15 into electrical contact with stationary contact 18 thereof or upon the operation of movable contact 21 of door lock switch 20 into electrical contact with stationary contact 23 thereof, and vehicle door unlock solenoids 10U and 11U may be energized from battery 8 upon the operation of movable contact 16 of door lock switch 15 into electrical contact with stationary contact 17 thereof or upon the operation of movable contact 21 of door lock switch 20 into electrical contact with stationary contact 22 thereof. This energizing circuit may be traced from battery 8, through lead 19, movable contact 26 and stationary contact 27 of ignition switch 25, lead 34(1) of FIG. 1, leads 34(2) and 37 of FIG. 2, and either of door lock switches 15 and 20 to point of reference or ground potential 5.

Upon the operation of movable contact 26 of ignition switch 25 into electrical contact with stationary contact 27, the automatic vehicle door lock circuit of this invention is energized by battery 8 through lead 19, movable contact 26, and stationary contact 27 of ignition switch 25 and lead 39(1) of FIG. 1 and lead 39(2) of FIG. 2, upon which a regulated potential appears of a positive polarity thereon with respect to point of reference or ground potential 5.

To determine whether the doors were last in a locked or unlocked condition, a memory circuit having first and second input circuits and an output circuit responsive to the application of an electrical signal across a selected one of the input circuits for producing an electrical door unlocked signal upon the output circuit indicating at least one of the door lock mechanisms is in the unlock condition and responsive to the application of an electrical signal across the other one of the input circuits for removing the door unlocked signal from the output circuit is provided. This memory circuit may be a conventional bistable multivibrator circuit, FIG. 2, of a type well known in the art consisting of type NPN transistor 40 having the usual base 41, collector 42 and emitter 43 electrodes and type NPN transistor 50 also having the usual base 51, collector 52 and emitter 53 electrodes and resistors 38 and 45. As the collector-emitter electrodes are connected across the positive and negative polarity terminals of battery 8 with ignition switch 25 in the "Run" position through lead 39(2), respective collector resistors 44 and 54 and point of reference or ground potential 5, these type NPN transistors are properly poled for forward collector-emitter conduction therethrough. The input circuits of this bistable multivibrator memory circuit are across the base electrode 41 of transistor 40 and point of reference or ground potential 5 and across the base electrode 51 of transistor 50 and point of reference or ground potential 5 and the output circuit is the collector electrode 52 of transistor 50.

With ignition switch 25 in the "Run" position, movable contact 26 in electrical contact with stationary contacts 27 and 28, a direct current potential appears across lead 39(1) of FIG. 1 and 39(2) of FIG. 2 of a positive polarity upon leads 39(1) and 39(2) with respect to point of reference or ground potential 5. In FIG. 2, the potential drop across base bias resistor 46 and current limiting resistor 47 places the base electrode 61 of type PNP set signal transistor 60 at a potential less positive than that present upon the emitter electrode 62 thereof as there is no initial charge upon capacitor 48. Consequently, emitter-base current flows through transistor 60 until capacitor 48 has become charged. While emitter-base current is flowing through transistor 60, an electrical set signal current flows through the emitter electrode 62 and collector electrode 63 thereof, current limiting resistor 49 and the emitter-base electrodes of type NPN transistor 50 of the bistable multivibrator memory circuit to point of reference or ground potential 5. This electrical set signal current produces base-emitter current flow through type NPN transistor 50 to trigger this device conductive through the collector-emitter electrodes thereof. Transistor 50 is maintained conductive after capacitor 48 has become charged by base-emitter current supplied through collector resistor 44 and coupling resistor 38. With type NPN transistor 50 conducting through the collector-emitter electrodes, a ground potential

door unlocked signal is present upon the output circuit thereof at junction 55 to which base electrode 71 of type PNP transistor 70 of FIG. 1 is connected through leads 56(2) of FIG. 2 and 56(1) of FIG. 1 and current limiting resistor 57.

Member 65 of FIG. 1 may be any member which may be conveniently rotated at a speed equal to or proportional to vehicle speed which is arranged to carry a plurality of permanent magnets, four of which are illustrated in FIG. 1 and referenced by the numerals 66, 67, 68 and 69. For example, member 65 may be a drum mounted upon the vehicle driveshaft, it may be a member mounted upon the transmission speed takeoff, or a member mounted upon any other vehicle part which is rotated at a speed equal to or proportional to vehicle speed. It is only necessary that the permanent magnets rotated therewith are in operative relationship with normally open contacts 76 and 77 of reed switch 75 to operate these contacts to the electrical circuit closed condition at a frequency proportional to vehicle speed by passing in close proximity thereto in a manner well known in the reed switch art. While contacts 76 and 77 of reed switch 75 are open, the potential upon junction 78 is of a positive polarity with respect to point of reference or ground potential 5 and of a magnitude substantially equal to the magnitude of the direct current potential appearing across lead 39(1) and point of reference or ground potential 5. While the contacts 76 and 77 of reed switch 75 are closed, the potential upon junction 78 is substantially ground potential, the current flow through reed switch 75 being limited by resistor 79. Consequently, a square waveform signal appears across junction 78 and point of reference potential 5 which is differentiated by capacitor 84 and resistor 85 to produce a positive and a negative polarity spike for each square waveform signal separated by the width thereof upon junction 64 across resistor 85. Diode 86 permits only the positive polarity spikes of this differentiated signal to be applied across integrating capacitor 87. Consequently, capacitor 87 charges with each positive polarity spike of the differentiated signal appearing across resistor 85 and discharges through resistor 88 during the periods between these positive polarity spikes. As the speed of the vehicle increases, the period between the positive polarity spikes of the signal appearing across resistor 85 decreases until capacitor 87 becomes sufficiently charged to produce base-emitter current flow through current limiting resistor 89 and the base electrode 81 and emitter electrode 83 of type NPN transistor 80 to trigger this device conductive through the collector electrode 82 and emitter electrode 83, in a manner well known in the transistor art, this flow of current being limited by collector resistor 74. The values of integrating capacitor 87 and resistor 88 are selected to provide a time constant which permits integrating capacitor 87 to become sufficiently charged to a magnitude sufficient to produce base-emitter current flow through type NPN transistor 80 when the vehicle has reached the predetermined speed at which the doors thereof are to be automatically locked. Conducting transistor 80 drains base drive current from the base electrode 91 of normally conducting type NPN transistor 90 to extinguish the flow of current through the collector electrode 92 and emitter electrode 93 of transistor 90, consequently, the potential upon junction 95 goes positive with respect to point of reference or ground potential 5 of magnitude

substantially equal to the potential available upon line 39(1). Transistor 90 is maintained not conductive through the collector-emitter electrodes so long as the speed of the vehicle is at or greater than the predetermined speed. A capacitor 59 is connected across collector electrode 92 and base electrode 91 of transistor 90 to provide hysteresis to this switching action when low information rate speed signals are used. While transistor 90 is not conductive, a vehicle speed potential signal appears across junction 95 and point of reference or ground potential 5 which is of a positive polarity upon junction 95 with respect to point of reference or ground potential 5.

The positive polarity vehicle speed potential signal appearing across junction 95 and point of reference or ground potential 5 is of the proper polarity relationship to produce emitter-base current flow through the emitter electrode 72 and base electrode 71 of type PNP transistor 70, base bias resistor 96 placing base electrode 71 at a potential less positive than the emitter electrode 72, while the ground potential door unlocked signal is present upon junction 55 of FIG. 2. The circuit may be traced from junction 95, through the emitter-base electrodes of type NPN transistor 70, through current limiting resistor 57 and lead 56(1) of FIG. 1, lead 56(2) of FIG. 2 and the collector-emitter electrodes of transistor 50 of the bistable multivibrator memory circuit to point of reference or ground potential 5. This flow of emitter-base current through type PNP transistor 70 triggers this device conductive through the emitter electrode 72 and collector electrode 73 thereof. Base bias resistor 98 places the base electrode 101 of type PNP transistor 100 at a potential less positive than that present upon the emitter electrode 102 thereof while capacitor 99 is in a discharged state, consequently, emitter-base current flows through type PNP transistor 100 until capacitor 99 has become charged. This emitter-base current triggers transistor 100 conductive through emitter electrode 102 and collector electrode 103 to establish a circuit for the flow of current from junction 95, through the emitter-collector electrodes of transistor 70, the emitter-collector electrodes of transistor 100 and resistors 104 and 105 in series to point of reference or ground potential 5. This flow of current produces a lock doors potential signal across resistor 105 which is of a positive polarity upon junction 97 with respect to point of reference or ground potential 5 for the duration of time required to charge capacitor 99. From this description it is apparent that type PNP transistors 70 and 100 are responsive to the ground potential door unlocked signal appearing upon the output circuit, junction 55, of the bistable vibrator memory circuit of FIG. 2 and to the vehicle speed potential signal appearing across junction 95 of FIG. 1 and point of reference or ground potential 5 to produce an electrical lock doors signal across junction 97 and point of reference or ground potential 5 of a predetermined duration as determined by the time-constant of the parallel combination of resistor 98 and the emitter-base electrodes of transistor 100 and current limiting resistor 106 in series and capacitor 99.

As the lock doors signal appearing across junction 97 and point of reference or ground potential 5 is applied across base electrode 111 and emitter electrode 113 of type NPN transistor 110 until capacitor 99 has become charged in the proper polarity relationship to produce base-emitter current flow through a type NPN transis-

tor, base-emitter current flows through type NPN transistor 110 for the duration of the lock doors signal to trigger this device conductive through the collector electrode 112 and emitter electrode 113. With transistor 110 conducting through the collector-emitter electrodes, a circuit is completed for the flow of current through the emitter electrode 122 and base electrode 121 of type PNP transistor 120, resistor 108 placing the base electrode 121 at a potential less positive than emitter electrode 122, which may be traced from lead 34(1), lead 58, the emitter electrode 122 for producing base electrode 121 of type PNP transistor 120, current limiting resistor 109 and the collector-emitter electrodes of transistor 110 to point of reference or ground potential 5. The flow of emitter-base current through transistor 120 triggers this device conductive through the emitter electrode 122 and collector electrode 123 to supply an energizing current for the operating coil 116 of a relay 115 having a normally open movable contact 117 and a stationary contact 118. Upon the energization of operating coil 116 of relay 115, movable contact 117 is operated into electrical circuit closed condition with stationary contact 118 thereof to complete an energizing circuit for the lock solenoids of FIG. 2 which may be traced from lead 34(1) of FIG. 1, leads 34(2) and 37 of FIG. 2, lead 125(2) of FIG. 2, lead 125(1) of FIG. 1, the closed contacts 117 and 118 of relay 115, lead 126(1) of FIG. 1, lead 126(2) of FIG. 2 and lock solenoids 10L and 11L in parallel to point of reference or ground potential 5 to lock the vehicle doors when the vehicle has reached the predetermined speed. Diode 119 quenches any transients which may be generated by operating coil 116 as a result of the switching action of transistor 120. From this description it is apparent that transistors 110 and 120 are responsive to the lock doors signal appearing across junction 97 and point of reference or ground potential 5 for completing an energizing circuit for the lock solenoids in parallel across the source of direct current potential, battery 8.

For the duration of the lock doors signal appearing across junction 97 of FIG. 1 and point of reference or ground potential 5, the potential upon junction 135, FIG. 1, is substantially ground. At the conclusion of the duration of the lock doors signal when capacitor 99 has become charged, emitter-base current ceases to flow through the emitter-base electrodes of transistor 110 to extinguish this device. When the transistor 110 extinguishes, the circuit for emitter-base current flow through transistor 120 is interrupted to extinguish this device which interrupts the energizing circuit for operating coil 116 of relay 115 and a doors locked potential signal appears upon junction 135 of a positive polarity with respect to point of reference or ground potential 5 from line 34(1), line 58, series resistors 108 and 109, lead 127 and current limiting resistor 128. Diode 129 is a blocking diode which prevents the potential appearing across Zener diode 36 and point of reference or ground potential 5 from appearing upon junction 135 when transistor 110 is conducting and also clamps junction 135 to within one diode drop of the potential appearing across Zener diode 36 and point of reference or ground potential 5 while transistor 110 is extinguished. This positive polarity doors locked potential signal upon junction 135 is applied through lead 134(1) of FIG. 1, lead 134(2) of FIG. 2, differentiating capacitor 144, resistor 136, lead 138 across the other

input circuit, base electrode 41 and emitter electrode 43 of type NPN transistor 40, of the bistable multivibrator memory circuit. Diode 137 prevents the base electrode 41 of transistor 40 from going more than one diode drop below ground potential by extinguishing all negative going pulses from capacitor 144. This positive polarity doors locked signal applied to the other input circuit of the bistable multivibrator memory circuit produces base-emitter current flow through type NPN transistor 40 to trigger this device conductive through the collector-emitter electrodes. With transistor 40 conducting through the collector-emitter electrodes, base drive current is drained from transistor 50 of the bistable multivibrator memory circuit to extinguish this device. With transistor 50 extinguished, the door unlocked signal is removed from the output circuit thereof as the potential upon junction 55 becomes positive with respect to point of reference or ground potential 5. This positive polarity signal is applied to the base electrode 71 of type PNP transistor 70 of FIG. 1 through lead 56(2) of FIG. 2 and lead 56(1) and resistor 57 of FIG. 1, a condition which extinguishes transistor 70.

With transistor 40 of the bistable multivibrator circuit conducting through the collector-emitter electrodes, a discharge circuit is provided for capacitor 99 of FIG. 1, which may be traced from junction 145, lead 146, current limiting resistor 147, blocking diode 148 and lead 149(1) of FIG. 1 and lead 149(2) and the collector-emitter electrodes of transistor 50 of FIG. 2 to point of reference or ground potential 5. The discharge of capacitor 99 conditions the circuit of this invention to energize operating coil 116 of relay 115 upon the next appearance of a lock door signal across junction 97 and point of reference or ground potential 5.

In the event the unlock solenoids should be energized through one of the manually operable door lock switches 15 or 20 of FIG. 2 by the operation of either movable contact 16 or 21 to the corresponding respective stationary contacts 17 or 22, an electrical unlock solenoid energized signal appears across junction 150 and point of reference or ground potential 5 of a positive polarity upon junction 150 with respect to point of reference or ground potential 5. This positive polarity unlock solenoid energized signal is applied across the selected one of the input circuits of the bistable multivibrator memory circuit, the base-emitter electrodes of transistor 50, through diode 151, differentiating capacitor 152 and resistor 153. Resistor 154 provides a discharge circuit for differentiating capacitor 152. As this positive polarity unlock solenoid energized signal is of the proper polarity relationship to produce base-emitter current flow through a type NPN transistor, transistor 50 is triggered conductive through the collector-emitter electrodes thereof to place the door unlocked signal upon the output circuit of the bistable multivibrator memory circuit, junction 55, thereof. With the presence of this door unlocked signal upon junction 55 with capacitor 99 discharged, the circuitry set forth in FIG. 1 becomes operative to re-energize operating coil 116 of relay 115 in a manner previously explained.

Should any of the vehicle doors be opened, movable contact 156 of a conventional door operated door jamb grounding switch 155 would be permitted to close to stationary contact 157 to establish an energizing circuit for dome lamp 158 through leads 34(1) of FIG. 1 and

34(2) of FIG. 2 in a manner well known in the automotive art. With door operated grounding switch 155 closed while the door is open, a ground potential appears upon junction 160. Upon the reclosure of the door, a door opened potential signal appears across junction 160 and point of reference or ground potential 5 of a positive polarity upon junction 160 with respect to point of reference or ground potential 5. This door opened potential signal is applied across the selected one of the input circuits of the bistable multivibrator memory circuit, the base-emitter electrodes of type NPN transistor 50, through resistor 161, differentiating capacitor 162 and resistor 163. As this door opened potential signal is of the proper polarity relationship to produce base-emitter current flow through a type NPN transistor, transistor 50 is triggered conductive through the collector-emitter electrodes to place the door unlocked signal upon the output circuit of the bistable multivibrator circuit, junction 55. With the door unlocked potential signal present upon junction 55, the remainder of the circuitry of this invention operates to reenergize operating coil 116 of relay 115 in a manner previously explained.

By providing the discharge circuit for capacitor 99 through the collector-emitter electrodes of transistor 40 previously described, should any door be unlocked by the operation of either of door lock switches 15 or 20 to energize the unlock solenoids 10U or 11U or should any door be opened and reclosed while the vehicle is operating at or greater than the predetermined speed, the circuitry of this invention will operate to automatically relock the doors.

There are certain applications in which the vehicle transmission is placed in the "Neutral" position and the wheels rotated, such as in an automatic car wash where the wheels are rotated by rollers while brushes engage the tire sidewalls. While the vehicle transmission is in the "Neutral" position, movable contact 32 of transmission neutral switch 31 is closed to stationary contact 33. To prevent the operation of the door lock mechanism with the vehicle transmission in the "Neutral" position and the wheels rotated by an external force, the emitter electrode 132 and base electrode 131 of a type PNP transistor 130, FIG. 1, are connected across battery 8 through lead 19, movable contact 26 and stationary contact 27 of ignition switch 25, lead 165, the emitter-base electrodes of transistor 130, resistor 171, diode 172, the closed contacts 32 and 33 of transmission neutral switch 31 and cranking motor solenoid 30 to point of reference or ground potential 5. Resistor 173 provides a base bias for transistor 130. Consequently, emitter-base current flows through PNP transistor 130 to trigger this device conductive through the emitter electrode 132 and collector electrode 133. With transistor 130 conducting through the emitter-collector electrodes, base drive current is supplied to the base electrode 141 and emitter electrode 143 of type NPN transistor 140 through current limiting resistor 139. This base drive current supplied to transistor 140 produces conduction through the collector electrode 143 and emitter electrode 142 thereof to place junction 95 at substantially ground potential. Consequently, transistors 70 and 100 will not produce a lock doors signal while transistor 140 is conducting.

Diodes 175 and 176 of FIG. 2 prevent the junction between capacitor 162 and resistor 163 from going more than one diode drop below ground and prevent

the junction between capacitor 162 and resistor 161 from going more than one diode drop higher than the regulated potential upon lead 39(2).

While specific transistor types and electrical polarities have been set forth in this specification, it is to be specifically understood that alternate transistor types and compatible electrical polarities may be substituted therefor without departing from the spirit of the invention.

While a preferred embodiment of the present invention has been shown and described, it will be obvious to those skilled in the art that various modifications and substitutions may be made without departing from the spirit of the invention which is to be limited only within the scope of the appended claims.

What is claimed is:

1. An automatic vehicle door lock circuit for automatically locking the vehicle doors when the vehicle has reached a predetermined speed comprising in combination with a source of direct current potential, a lock and an unlock solenoid for each door which operate the lock mechanism of that door to the locked and unlocked conditions, respectively, and a manually operable door lock switch for selectively energizing said lock and unlock solenoids from said source of direct current potential, a memory circuit having first and second input circuits and an output circuit responsive to the application of an electrical signal across a selected one of said input circuits for producing an electrical door unlocked signal upon said output circuit and to the application of an electrical signal across the other one of said input circuits for removing said door unlocked signal from said output circuit, means for producing an electrical vehicle speed signal when said vehicle has reached said predetermined speed, means responsive to said door unlocked signal and said vehicle speed signal for producing an electrical lock doors signal of a predetermined duration, means responsive to said lock doors signal for completing an energizing circuit for said lock solenoids in parallel across said source of direct current potential, means responsive to the end of said lock doors signal for producing an electrical doors locked signal, and means for applying said doors locked signal across the said other one of said input circuits of said memory circuit.

2. An automatic vehicle door lock circuit for automatically locking the vehicle doors when the vehicle has reached a predetermined speed comprising in combination with a source of direct current potential, a lock and an unlock solenoid for each door which operate the lock mechanism of that door to the locked and unlocked conditions, respectively, and a manually operable door lock switch for selectively energizing said lock and unlock solenoids from said source of direct current potential, a memory circuit having first and second input circuits and an output circuit responsive to the application of an electrical signal across a selected one of said input circuits for producing an electrical door unlocked signal upon said output circuit and to the application of an electrical signal across the other one of said input circuits for removing said door unlocked signal from said output circuit, means for producing an electrical set signal, means for applying said set signal across the said selected one of said input circuits of said memory circuit, means for producing an electrical vehicle speed signal when said vehicle has reached said predetermined speed, means responsive

to said door unlocked signal and said vehicle speed signal for producing an electrical lock doors signal of a predetermined duration, means responsive to said lock doors signal for completing an energizing circuit for said lock solenoids in parallel across said source of direct current potential, means responsive to the end of said lock doors signal for producing an electrical doors locked signal, and means for applying said doors locked signal across the said other one of said input circuits of said memory circuit.

3. An automatic vehicle door lock circuit for automatically locking the vehicle doors when the vehicle has reached a predetermined speed comprising in combination with a source of direct current potential, a lock and an unlock solenoid for each door which operate the lock mechanism of that door to the locked and unlocked conditions, respectively, and a manually operable door lock switch for selectively energizing said lock and unlock solenoids from said source of direct current potential, a memory circuit having first and second input circuits and an output circuit responsive to the application of an electrical signal across a selected one of said input circuits for producing an electrical door unlocked signal upon said output circuit and to the application of an electrical signal across the other one of said input circuits for removing said door unlocked signal from said output circuit, means for producing an electrical vehicle speed signal when said vehicle has reached said predetermined speed, means responsive to said door unlocked signal and said vehicle speed signal for producing an electrical lock doors signal of a predetermined duration, means responsive to said lock doors signal for completing an energizing circuit for said lock solenoids in parallel across said source of direct current potential, means responsive to the end of said lock doors signal for producing an electrical doors locked signal, means for applying said doors locked signal across the said other one of said input circuits of said memory circuit, means responsive to the energization of said unlock solenoids through one of said manually operable door lock switches for producing an electrical unlock solenoid energized signal, means responsive to the closing of any one of said vehicle doors for producing an electrical door opened signal, and means for applying said unlock solenoid energized signal and said door opened signal across the said selected one of said input circuits of said memory circuit.

4. An automatic vehicle door lock circuit for automatically locking the vehicle doors when the vehicle has reached a predetermined speed comprising in combination with a source of direct current potential, a lock and an unlock solenoid for each door which operate the lock mechanism of that door to the locked and unlocked conditions, respectively, and a manually operable door lock switch for selectively energizing said lock and unlock solenoids from said source of direct current potential, a memory circuit having first and second input circuits and an output circuit responsive to the application of an electrical signal across a selected one of said input circuits for producing an electrical door unlocked signal upon said output circuit and to the application of an electrical signal across the other one of said input circuits for removing said door unlocked signal from said output circuit, means for producing an electrical set signal, means for applying said set signal across the said selected one of said input

circuits of said memory circuit, means for producing an electrical vehicle speed signal when said vehicle has reached said predetermined speed, means responsive to said door unlocked signal and said vehicle speed signal for producing an electrical lock doors signal of a predetermined duration, means responsive to said lock doors signal for completing an energizing circuit for said lock solenoids in parallel across said source of direct current potential, means responsive to the end of said lock doors signal for producing an electrical doors locked signal, means for applying said doors locked signal across the said other one of said input circuits of said memory circuit, means responsive to the energization of said unlock solenoids through one of said manually operable door lock switches for producing an electrical unlock solenoid energized signal, means responsive to the closing of any one of said vehicle doors for producing an electrical door opened signal, and means for applying said unlock solenoid energized signal and said door opened signal across the said selected one of said input circuits of said memory circuit.

5. An automatic vehicle door lock circuit for automatically locking the vehicle doors when the vehicle has reached a predetermined speed comprising in combination with a source of direct current potential, a lock and an unlock solenoid for each door which operate the lock mechanism of that door to the locked and unlocked conditions, respectively, and a manually operable door lock switch for selectively energizing said lock and unlock solenoids from said source of direct current potential, a bistable multivibrator circuit having first and second input circuits and an output circuit responsive to the application of an electrical signal across a selected one of said input circuits for producing an electrical door unlocked signal upon said output circuit and to the application of an electrical signal across the other one of said input circuits for removing said door unlocked signal from said output circuit, means for producing an electrical vehicle speed signal when said vehicle has reached said predetermined speed, means responsive to said door unlocked signal and said vehicle speed signal for producing an electrical lock doors signal of a predetermined duration, means responsive to said lock doors signal for completing an energizing circuit for said lock solenoids in parallel across said source of direct current potential, means responsive to the end of said lock doors signal for producing an electrical doors locked signal, and means for applying said doors locked signal across the said other one of said input circuits of said bistable multivibrator circuit.

6. An automatic vehicle door lock circuit for automatically locking the vehicle doors when the vehicle has reached a predetermined speed comprising in combination with a source of direct current potential, a lock and an unlock solenoid for each door which operate the lock mechanism of that door to the locked and unlocked conditions, respectively, and a manually operable door lock switch for selectively energizing said lock and unlock solenoids from said source of direct current potential, a bistable multivibrator circuit having first and second input circuits and an output circuit responsive to the application of an electrical signal across a selected one of said input circuits for producing an electrical door unlocked signal upon said output circuit and to the application of an electrical signal across the other one of said input circuits for removing

said door unlocked signal from said output circuit, means for producing an electrical set signal, means for applying said set signal across the said selected one of said input circuits of said bistable multivibrator circuit, means for producing an electrical vehicle speed signal when said vehicle has reached said predetermined speed, means responsive to said door unlocked signal and said vehicle speed signal for producing an electrical lock doors signal of a predetermined duration, means responsive to said lock doors signal for completing an energizing circuit for said lock solenoids in parallel across said source of direct current potential, means responsive to the end of said lock doors signal for producing an electrical doors locked signal, and means for applying said doors locked signal across the said other one of said input circuits of said bistable multivibrator circuit.

7. An automatic vehicle door lock circuit for automatically locking the vehicle doors when the vehicle has reached a predetermined speed comprising in combination with a source of direct current potential, a lock and an unlock solenoid for each door which operate the lock mechanism of that door to the locked and unlocked conditions, respectively, and a manually operable door lock switch for selectively energizing said lock and unlock solenoids from said source of direct current potential, a bistable multivibrator circuit having first and second input circuits and an output circuit responsive to the application of an electrical signal across a selected one of said input circuits for producing an electrical door unlocked signal upon said output circuit and to the application of an electrical signal across the other one of said input circuits for removing said door unlocked signal from said output circuit, means for producing an electrical set signal, means for applying said set signal across the said selected one of said input circuits of said bistable multivibrator circuit, means for producing an electrical vehicle speed signal when said vehicle has reached said predetermined speed, means responsive to said door unlocked signal and said vehicle speed signal for producing an electrical lock doors signal of a predetermined duration, means responsive to said lock doors signal for completing an energizing circuit for said lock solenoids in parallel across said source of direct current potential, means responsive to the end of said lock doors signal for producing an electrical doors locked signal, means for applying said doors locked signal across the said other one of said input circuits of said bistable multivibrator circuit, means responsive to the energization of said unlock solenoids through one of said manually operable door lock switches for producing an electrical unlock solenoid energized signal, means responsive to the closing of any one of said vehicle doors for producing an electrical door opened signal, and means for applying said unlock solenoid energized signal and said door opened signal across the said selected one of said input circuits of said bistable multivibrator circuit.

8. An automatic vehicle door lock circuit for automatically locking the vehicle doors when the vehicle has reached a predetermined speed comprising in combination with a source of direct current potential, a lock and an unlock solenoid for each door which operate the lock mechanism of that door to the locked and unlocked conditions, respectively, and a manually operable door lock switch for selectively energizing said lock and unlock solenoids from said source of direct

current potential, a memory circuit having first and second input circuits and an output circuit responsive to the application of an electrical signal across a selected one of said input circuits for producing an electrical door unlocked signal upon said output circuit and to the application of an electrical signal across the other one of said input circuits for removing said door unlocked signal from said output circuit, means for producing an electrical vehicle speed signal when said vehicle has reached said predetermined speed, means responsive to said door unlocked signal and said vehicle speed signal for producing an electrical lock doors signal of a predetermined duration, means responsive to said lock doors signal for completing an energizing circuit for said lock solenoids in parallel across said source of direct current potential, means responsive to the end of said lock doors signal for producing an electrical doors locked signal, means for applying said doors locked signal across the said other one of said input circuits of said memory circuit, and means for inhibiting said lock door signal while the transmission of said vehicle is in the neutral position.

9. An automatic vehicle door lock circuit for automatically locking the vehicle doors when the vehicle has reached a predetermined speed comprising in combination with a source of direct current potential, a lock and an unlock solenoid for each door which operate the lock mechanism of that door to the locked and unlocked conditions, respectively, and a manually operable door lock switch for selectively energizing said lock and unlock solenoids from said source of direct current potential, a memory circuit having first and second input circuits and an output circuit responsive to the application of an electrical signal across a selected one of said input circuits for producing an electrical door unlocked signal upon said output circuit and to the application of an electrical signal across the other one of said input circuits for removing said door unlocked signal from said output circuit, means for producing an electrical set signal, means for applying said set signal across the said selected one of said input circuits of said memory circuit, means for producing an electrical vehicle speed signal when said vehicle has reached said predetermined speed, means responsive to said door unlocked signal and said vehicle speed signal for producing an electrical lock doors signal of a predetermined duration, means responsive to said lock doors signal for completing an energizing circuit for said lock solenoids in parallel across said source of direct current potential, means responsive to the end of said lock doors signal for producing an electrical doors locked signal, means for applying said doors locked signal across the said other one of said input circuits of said memory circuit, and means for inhibiting said lock doors signal while the transmission of said vehicle is in the neutral position.

10. An automatic vehicle door lock circuit for automatically locking the vehicle doors when the vehicle has reached a predetermined speed comprising in combination with a source of direct current potential, a lock and an unlock solenoid for each door which operate the lock mechanism of that door to the locked and unlocked conditions, respectively, and a manually operable door lock switch for selectively energizing said lock and unlock solenoids from said source of direct current potential, a memory circuit having first and second input circuits and an output circuit responsive

15

16

to the application of an electrical signal across a selected one of said input circuits for producing an electrical door unlocked signal upon said output circuit and to the application of an electrical signal across the other one of said input circuits for removing said door unlocked signal from said output circuit, means for producing an electrical set signal, means for applying said set signal across the said selected one of said input circuits of said memory circuit, means for producing an electrical vehicle speed signal when said vehicle has reached said predetermined speed, means responsive to said door unlocked signal and said vehicle speed signal for producing an electrical lock doors signal of a predetermined duration, means responsive to said lock doors signal for completing an energizing circuit for said lock solenoids in parallel across said source of di-

rect current potential, means responsive to the end of said lock doors signal for producing an electrical doors locked signal, means for applying said doors locked signal across the said other one of said input circuits of said memory circuit, means responsive to the energization of said unlock solenoids through one of said manually operable door lock switches for producing an electrical unlock solenoid energized signal, means responsive to the closing of any one of said vehicle doors for producing an electrical door opened signal, means for applying said unlock solenoid energized signal and said door opened signal across said selected one of said input circuits of said memory circuit, and means for inhibiting said lock doors signal while the transmission of said vehicle is in the neutral position.

* * * * *

20

25

30

35

40

45

50

55

60

65