United States Patent [19]

Gerber

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[54] **ELECTRIC LOCK AND KEY ASSEMBLY**

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[*] Notice: The portion of the term of this patent subsequent to Feb. 19, 1991, has been disclaimed.

[22] Filed: **Oct. 1, 1973**

[21] Appl. No.: **401,991**

Related U.S. Application Data

[62] Division of Ser. No. 214,675, Jan. 3, 1972, Pat. No. 3,793,500.

[52] **U.S. Cl.** ..... **317/134,** 200/44, 307/10 AT

[51] **Int. Cl.** **B60n 25/04**

[58] **Field of Search** ..... 200/44; 317/135 A, 134

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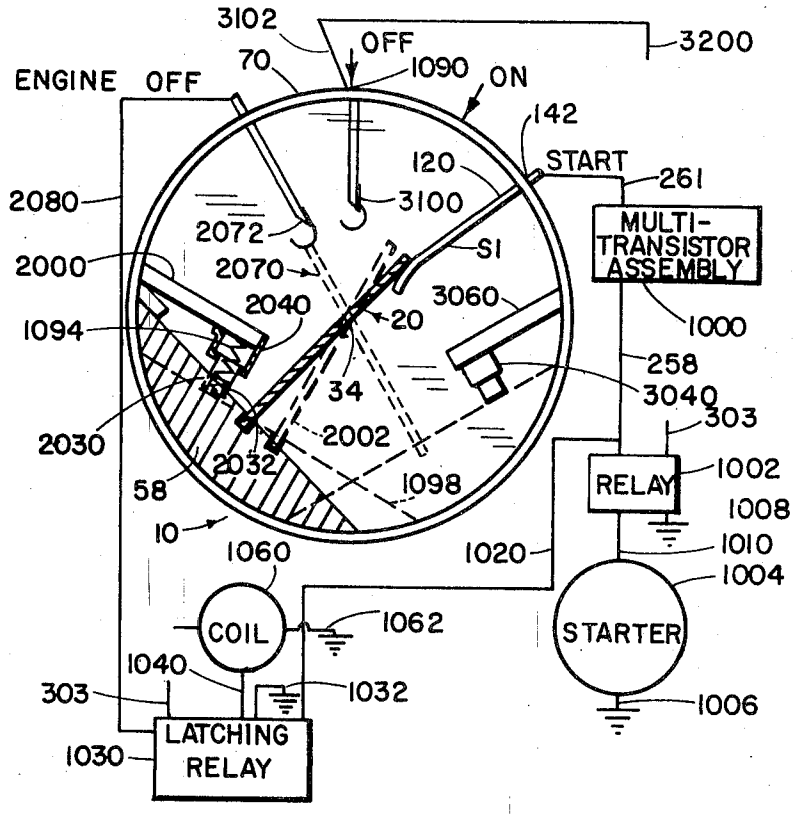
Primary Examiner—L. T. Hix

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[57] **ABSTRACT**

An electric lock and key assembly for energizing a target circuit, such as for controlling automobile ignition or door unlocking, in response to the engagement of the protrusions of a moving key with a plurality of conductive circuit closing means, which latter deliver current to a plurality of certain electronic switching means such as transistors, which latter will not cause said target circuit to be energized unless all of the certain transistors are energized by the proper key.

19 Claims, 10 Drawing Figures



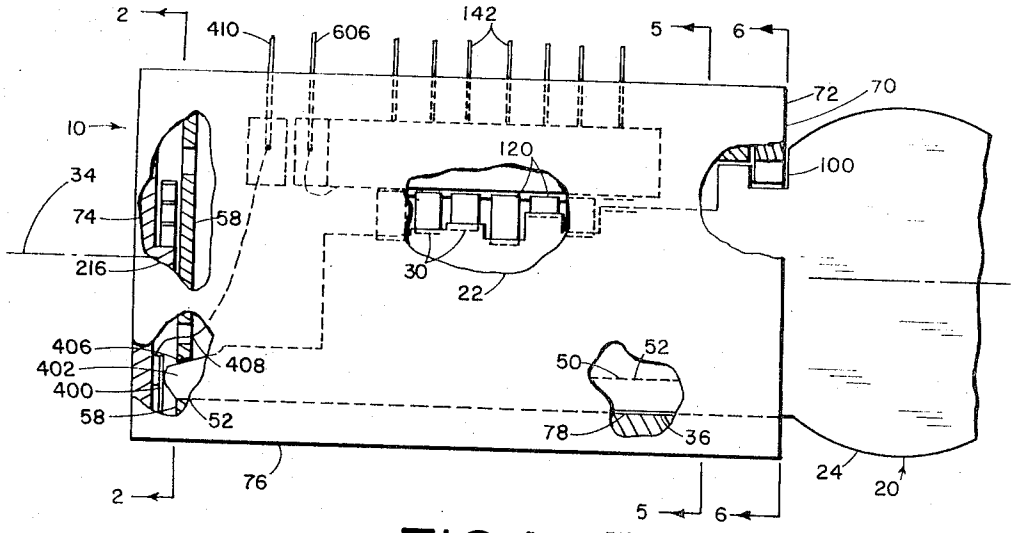


FIG. 1

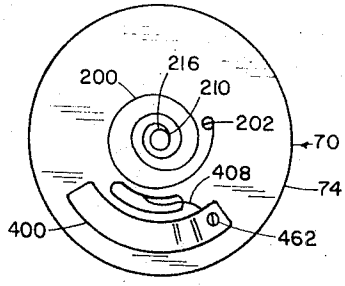


FIG. 2

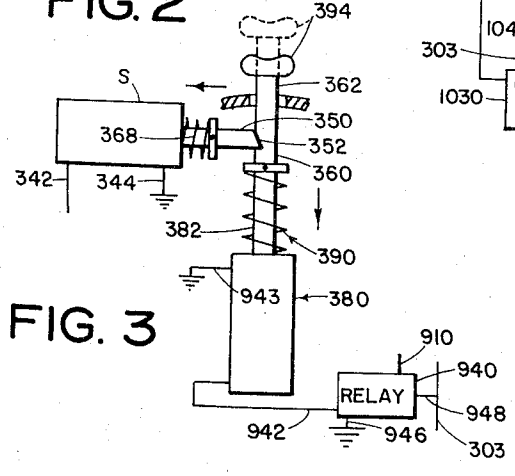


FIG. 3

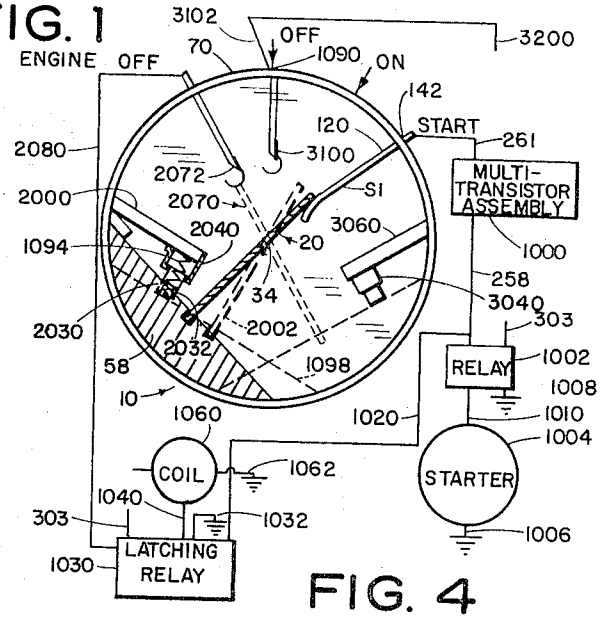


FIG. 4

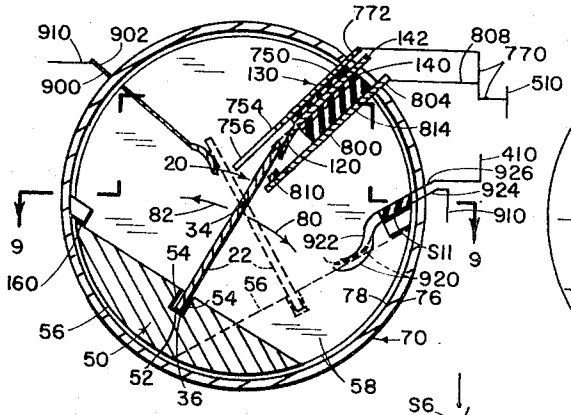


FIG. 5

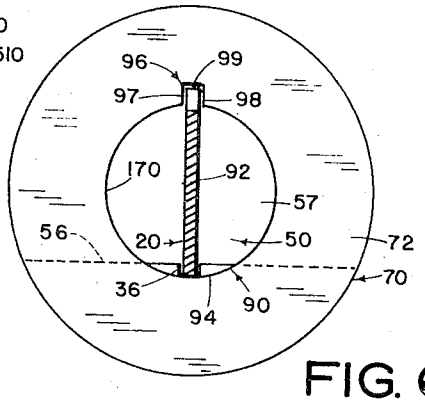


FIG. 6

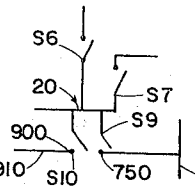


FIG. 5A

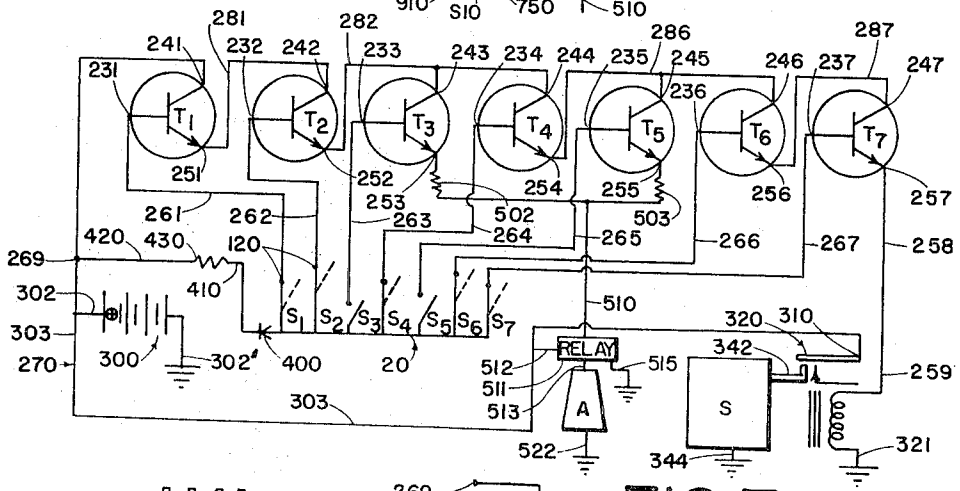


FIG. 7

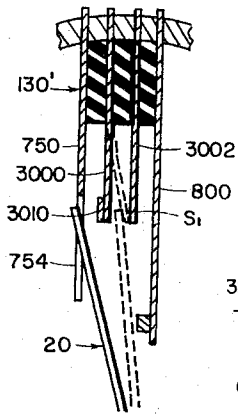


FIG. 8

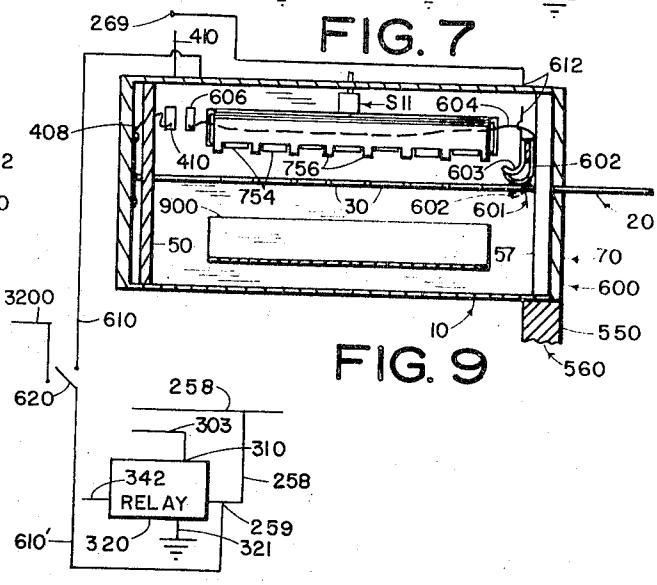


FIG. 9

ELECTRIC LOCK AND KEY ASSEMBLY

CROSS-REFERENCE TO RELATED APPLICATION

This application is a division of Ser. No. 214,675, filed Jan. 3, 1972 now U.S. Pat. No. 3,793,500.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a side elevation of the electrical lock and key assembly of this invention, shown with the key in a vertical plane position of insertion, and with various parts of the housing broken away to show interior parts, some of which are shown in cross section, certain other interior parts being indicated in dotted lines.

FIG. 2 is a sectional view taken along the line 2—2 of FIG. 1.

FIG. 3 is a view of a sample door locking plunger assembly with a door locking and unlocking plunger splenoid system of this invention mounted thereon.

FIG. 4 is a wiring diagram showing how the switch of this invention is related to the starter and ignition coil of an automobile when viewed as an ignition switch.

FIG. 5 is a sectional view of this invention taken along the line 5—5 of FIG. 1, having front and back contact assembly electrical alarm plates being shown in cross section, a dotted position of the key being shown in engagement with a relocker contact, which latter is shown as connected to the door plunger locking solenoid.

FIG. 6 is a sectional view taken along the line 6—6 of FIG. 1 and showing a notch system in the outer housing for preventing the key from being rotated except when it is fully inserted.

FIG. 7 is a wiring diagram showing how contacts of the contact assembly of FIG. 1 are connected through transistors to a target circuit and also how special contacts on the contact assembly are connected through transistors to an alarm circuit.

FIG. 8 is a detail showing a modified contact assembly for use with a non-energized key, in which the key and one contact are shown in dotted lines in position for causing that one contact to engage a mating contact, the open position of the two contacts and the key being shown in full lines, the view being substantially as it would be seen along the line 5—5 of FIG. 1, if FIG. 1 contained this modified contact assembly of FIG. 8 but the contacts and key being shown in FIG. 8 as though the entire outer housing were rotated approximately 40° counter-clockwise from the position shown in FIG. 5.

FIG. 9 is a top plan view of the lock and key assembly of FIG. 1, with the top half of the outer housing removed for showing the contact assembly and particularly for illustrating a special conductive device used, only when the lock and key assembly is used as an ignition switch, for engaging a metallic key whenever the key is in the key receiving means to prevent doors from being locked when the key is in the ignition switch. FIG. 9 also show the door locking plunger unlocking solenoid of FIG. 3 and a portion of its plunger.

FIG. 5A is a wiring diagram showing how front and rear conductive alarm associated plates and also how a doorlocking contact of the switch are wired into the circuit of FIG. 7.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1 the electrical lock and key assembly of this invention is there generally shown at **10**, and comprises a key **20** having a forward insertion section **22** and a rearward handle section **24**.

The key **20** has on the exterior of its insertion section **22** a plurality of raised portions of protrusions **30**, which latter extend outward various distances from an axis of rotation **34** of the key and likewise respective distances from a guided surface of the key, which latter surface can be the undersurface **36** of the key. The guided surface or undersurface **36** extends forwardly and rearwardly along the key **20**.

A key guide **50** has a slot **52** extending from the forward to the rearward end thereof. The slot **52** is upwardly opening and has vertical parallel side surfaces which can be called guide surfaces **54**, which latter are ordinarily in guiding relationship or guiding engagement with the guided surface or undersurface **36** of the key **20** for directing the key lineally upon insertion of the key into the guide **50**.

The guide **50** has a bottom portion **56** which interconnects two cylindrical end portions, a forward cylindrical end portion **57**, and a rearward cylindrical end portion **58**.

An outer housing **70** is provided having forward and rearward end walls **72** and **74** interconnected by a cylindrical central portion **76**, which latter is concentric about the axis **34** of rotation of the key. The central portion **76** of the housing is cylindrical not only on its outer side but also on its inner surface **78**, which latter receives the cylindrical forward and rearward end portions **57** and **58** of the guide **50** slidably thereagainst so that the guide **50** also rotates about the axis **34**.

As best seen in FIG. **5**, the key **20**, if twisted, can define a movement in a clockwise direction or counterclockwise direction, as seen from the right end of FIG. **1**. The clockwise direction is indicated by the arrow **80** in FIG. **5** and the counterclockwise direction by the arrow **82**.

As best seen in FIG. **6**, once the key is inserted through a keyhole **90** in the forward end **72** of the housing **70**, as is made possible by a vertically elongated chamber entrance **92** extending through the end wall **57** of the guide **50**, whereby the key and the key guide **50** can both be rotated clockwise or counterclockwise with respect to the housing **70**.

Referring to FIG. **6**, the keyhole **90** can be said to have a main portion **94**, and there is a small recess **96** in the upper wall of the main keyhole portion **94**, the recess **96** having opposed spaced wall portions **97** and **98** closesly and slidably receiving an edge portion **99** of the key **20**, the edge portion **99** being the upper edge portion.

As best seen in FIG. **1**, the upper edge portion **99** of the key has a notch **100** therein which is disposed opposite the walls **97** and **98** of the recess **96** so that as the key is rotated, the notch will receive the walls **97** and **98** permitting the key to be rotated. But it will be seen that this can only happen when the key is fully inserted into the housing **70** with the exception of its enlarged outer end **24**. This is because the notch **100** is opposite the recess surfaces **97** and **98** only when the key is fully inserted.

The purpose of this is to assure that the operator inserts the key fully so that it can be rotated because this full position of insertion must be achieved in order to place the protrusions **30** opposite mating contacts **120** of a contact assembly **130.**

The contact assembly **130** has a row of contacts thereon disposed side-by-side and extending in a plane extending forwardly and rearwardly with respect to the outer housing and disposed at an acute angle of about 40° with respect to the vertical, by way of example, and extending inwardly toward a center of the cylindrical surface **78** of the inner side of the outer housing. The contacts **120** are insulated from each other by either air space or insulation, and preferably they are held together by insulation, best seen in FIG. **5** at **140,** and which is attached to the outer housing for holding the contact assembly in place with terminals **142** extending completely through the housing from each of the contacts **120,** as best seen in FIG. **5.** Each of the contacts **120** can be made of flexible material such that its inner end is adapted to flex somewhat as the key **20** engages it and is best seen in FIG. **5** in full lines, although the dotted line position of the inner end of a contact **120** shows the relaxed and normal position of a contact.

A stop **160** is attached to the inner side of the outer housing in a position for engaging an upper surface of the central portion **56** of the rotating guide **50** at a time when the key is rotated clockwise, as seen in FIG. **5,** sufficiently for its protrusions to have contacted the mating contacts **120,** but preventing further clockwise rotation of the key so as to prevent the contacts **120** from being broken off.

Rotation of the key is impossible except when it is fully inserted and, for that reason, the walls **97,98** of the recess **96** and also the entire annular circular portion of the end wall **72** of the housing **70** can altogether be called the blocking means **170** and blocks rotation of the key when it is less than fully inserted.

Referring to FIG. **2,** a rearward biasing spring **200** of a spiral configuration has its outer end anchored to the rearward side of the rearward wall **58** of the guide **50** and has its inner end suitably secured by means at **210** to a boss **216** which protrudes inwardly from the center of the rearward wall **74** of the outer housing **70,** the boss **216** also serving to space the guide from the wall **74** to provide room to accommodate the spring **200.**

The rearward biasing spring **200** constantly urges the key toward a vertical planar position of original insertion to cause it to return from a position of contacting the contacts **120.**

In FIG. **7** is a wiring diagram in which a plurality of switches are shown at S_1, S_2, S_3, S_4, S_5, S_6 and S_7, each of these swltches representing the connection made when one of the protrusions **30** of the metallic conductive key **20** touches one of the mating contacts **120** of the contact assembly **130.**

In FIG. **7** a plurality of electronic switching means are shown and illustrated by transistors T_1, T_2, T_3, T_4, T_5, T_6, and T_7, respectively, each of which has a base or first terminal **231, 232, 233, 234, 235, 236** and **237,** respectively; and each having a collector or second terminal **241, 242, 243, 244, 245, 246** and **247,** respectively; and each having a third or emitter terminal **251,** 252, 253, 254, 255, 256 and **257,** respectively.

The transistors T_1 to T_7 are sequentially arranged T_1 being the first and T_7 being the last, and the first terminal **231** to **237** respectively of each of the transistors is connected each to a terminal **142** of a different one of the switches S_1 to S_7, this being accomplished by wires in the sequence **261** to **267,** respectively.

The second or collector terminal **241** of the first transistor T_1 is connected to a terminal **269** of a target circuit **270** to be later described.

The third terminal **251** of the first of the transistors T_1 is connected by a wire **281** to the second or collector terminal of the second transistor T_2. A wire **282** connects the third or emitter terminal **252** of the second transistor T_2 to the second or collector terminals **243** and **244** of the transistors T_3 and T_4.

The third terminal **254** of transistor T_4 is connected by a wire **286** to the second or collector terminals of the transistors T_5 and T_6. The third or collector terminal **256** of the transistor T_6 is connected by a wire **287** to the second or collector terminal **247** of the transistor T_7.

The target circuit **270** has in it a source of electrical power illustrated by an automobile battery **300,** which latter has a grounded terminal **302'** and has its other terminal connected by a wire **302** to a wire **303,** which latter is connected to the terminal **269,** which latter can be considered one of the terminals of a target circuit **270.**

The wire **303** is connected to one of the terminals **310** of a relay **320,** which latter has its other terminal grounded at **321.** The relay **320** may be for the purpose of permitting current from the wire **303** to reach a solenoid S which latter is connected to the relay at **342** and has its other terminal grounded at **344.**

The solenoid S can be an unlatching solenoid for door unlatching and is seen in FIG. **3,** the solenoid S appears again in more complete detail showing its core **350** extending outwardly and into a notch **352** of a plunger **360** of a door-locking mechanism generally indicated at **362.**

The core **350** is urged continually toward a locking relationship with respect to the plunger **360** by means of a spring assembly **368.**

The door-locking plunger **360** is adapted to be automatically locked by means of a locking solenoid **380,** which latter has a core **382** suitably attached to the plunger **360** for causing reciprocatory movements thereof. The core **362** of the solenoid **380** urges the plunger **360** upwardly whenever the solenoid **380** is not energized because of the action of a spring assembly **390** associated with the core **382** and solenoid **380.** But when the solenoid **380** is energized, the plunger **360** will move downwardly from the dotted line position of its top **394** to the full-line position of its top and as shown in FIG. **3** for causing door locking. The remainder of the door-locking mechanisms associated with the plunger **360** are not shown since they are all common and the plunger **360** will itself be recognized as being of the type which commonly protrudes from the uppper side of the door of an automobile or usually pushed downward by the finger of an operator.

In the wiring diagram of FIG. **7,** the line indicated at **20** represents the conductive key itself with its inner end touching and making contact with an end contact **400** seen in FIGS. **1** and **2,** which latter is resilient and elongated and is attached by a securing means **402** to the rear end wall **74** of the housing.

The end contact **400** is of a size for extending along substantially a 45° segment of a circle on the axis **34** so

as to be in contact with an inner end portion **402** of the key **20** as the key rotates and as later described.

As best seen in FIG. **1**, this inner end portion **402** extends through an opening **406** in the cylindrical rearward end portion **58** of the guide **50** so as to permit it to engage the end contact **400**.

In FIGS. **1**, **2** and **9**, a wire **408** can be seen leading from the end contact **400** to the key energizing terminal **410** which is suitably mounted on and extends through the outer housing **70**.

In FIG. **7**, a wire **420** connects the terminal **269** of the target circuit **270** to a resistor **430**, which latter protects the transistors T_1 to T_7 from excessive current, the resistor **430** being connected to the inner end of the metallic key **20** by means of the end contact **400**, but also by means of two elements not shown in FIG. **7**, namely, the wire **408** and the key energizing terminal **410**, seen in FIGS. **1** and **9**.

Referring to FIG. **7**, the emitter or third terminals **253** and **255** of the transistors T_3 and T_5 are shown as connected to suitable resistors **502** and **503** respectively.

A wire **510** leads from the resistors **502** and **503** to a terminal of a relay **511** which latter has a terminal **512** connected to the heavy current wire **303** and an output terminal for heavy current at **513** connected to an electrical alarm A grounded at **522**. The relay **511** is grounded at **515**.

The alarm A can be of any signalling or humanly sensible type such as an audible alarm different from the automobile horn or it can be the automobile horn itself.

In operation, the circuit of FIG. **7** and lock and key assembly **10** of FIG. **1** will begin operation upon insertion of the key **20** through the outer housing **70** at the key-hole **90** while the key is held in the vertical plane in the example shown.

Rotation of the key toward the contact plate **130** will not be possible until the key has been fully inserted because it is only in that position that the notch **100** in the key will be opposite the walls **97** and **98** of the key recess **96**. Since full insertion is thus made easy for the operator to recognize, the inner end **402** of the key will then surely be in contact with the end contact **400** for the operation of the circuit of FIG. **7**. When the key has its protrusions **30** in engagement with the flexible mating contacts **120** of the contact assembly **130**, then because it is the proper key, only the contacts **120** of the switches S_1, S_2, S_4, S_6, and S_7 will be engaged by protrusions of the key and the contacts **120** of the contact assembly **130** which form terminals of the switches S_3 and S_5 will not be engaged by protrusions of the proper key.

As thus described, all of the transistors which can be called target circuit operating transistors T_1, T_2, T_4, T_6 and T_7 are operated for delivering current from the third or emitter terminal **257** of the transistor T_7 through a wire **258** to the solenoid terminal **259** of the relay **320** for operating the relay **320** so that it energizes the solenoid S, which latter, as seen in FIG. **3** will then retract its core **350**, whereby the spring **390** will cause the door-locking plunger **360** to move upward into unlocked position, shown in dotted lines in FIG. **3**.

However, the operation of an unauthorized or foreign key, not shown, is different. The foreign key would possibly have protrusions in the wrong places which would then engage those contacts **120** which form parts of the switches S_3 and S_5 of FIG. **7**, whereby one or both of the transistors T_3 and T_5 would be energized in accordance with whether one or both of the switches S_3 and S_5 are energized respectively, whereby the transistors T_3 or T_5, or both, would deliver current to the audible alarm **520** which would make a loud noise sounding substantially different than ordinary automobile horns, indicating that a theft has been taking place. It is possible, however, for the alarm **520** to actually be the automobile horn itself, or to be an alarm means of any kind that is sensible in any way.

It is understood that FIG. **7** is only an illustration. Any numbers of transistors may be used, and also, instead of transistors, the electronic switching means used can be switching diodes or relays.

To prevent the locking of the automobile doors when the key has been left in the ignition switch, a special system is used as illustrated in FIG. **9** in which the entire electrical lock and key assembly is being used as an ignition switch in an automobile, whereby the outer housing **70** is mounted in the dashboard of the automobile of which a portion is shown at **550** in FIG. **9**, the automobile itself not being shown, with the exception of the numeral **560** indicating the automobile broadly as represented by the dashboard portion **550**.

The understanding of FIG. **9** is best accomplished by realizing that FIG. **9** is a composite view, since most of the parts of FIG. **9** are useful as an ignition switch, but FIG. **9** also illustrates the position of a door-locking contact **900** and of a substitute modification door-locking switch **S11**, both of which are later described herein and are used only when the switch is used as a door lock and are not used when the switch is used as an ignition lock. Most parts which are peculiar to my new electrical lock when this electrical lock is used as an ignition lock to be found in FIG. **4**. But an exception to this is the feature of a later described lock-out prevention switch generally indicated at **601** in FIG. **9**.

The purpose of the lock-out prevention switch **601** is to prevent an operator from becoming accidentally locked out of his car by shutting and locking his door while his keys are at his ignition switch as later described in detail.

The lock-out prevention switch **601** is in electrical association with the door-unlocking solenoid S of FIG. **3**, although this association is indirectly through the relay **320** which controls the door locking solenoid S as later described.

Referring to FIG. **9**, a system for preventing doors from being accidentally locked while the key remains in the ignition is now to be described. For this system, the lock and key assembly **10** in FIG. **9** is to be considered to be an ignition switch mounted in the dashboard of an automobile, the dashboard being indicated at **550** and the automobile being indicated generally at **560** as represented by that portion thereof which is the only part shown, namely, the dashboard portion.

The key guide **50** and the outer housing **70** together define a key-receiving and housing assembly **600** on which a circuit-closing device generally indicated at **601** is mounted in the position for being engaged by the key **20** at a time when the key **20** is but slightly inserted into the housing **70** so that it is substantially impossible for the key to be in an ignition switch without engaging the circuit-closing assembly **601**.

The circuit-closing assembly **601** comprises a key-engaging member **602** which is formed of resilient, springy conductive material having one end suitably mounted on the inner side of the cylindrical end wall

57 of the guide **50.** The circuit-closing assembly **601** further comprises a conductive engaged means **603** which is disposed on the side of the outer end of the key-engaging means **602** which faces away from the key, the positions being such that when the key is in a certain position shown in FIG. **9,** it will engage the key-engaging means **602** causing it to flex from a dotted line position shown in dotted lines at **602** to a full-line position in which latter it contacts the conductive engaged means **603** and it is to be understood that the key-engaging means **602** does not engage the conductive engaged means **603** except at times when the key **20** is inserted whereby it has pressed the key-engaging means **602** into the full-line position shown in FIG. **9.**

A wire **604** leads from the key-engaging means **602** to a lead **606** which extends through the housing **70** and which is connected by a wire **610** to the terminal **259** of the relay **320.**

A second wire from the circuit-closing assembly **601** leads from the conductive engaged means **603** and can be seen at **612** in two separated parts since it actually extends through that part of the housing **70** which has been broken away in FIG. **9,** and so the wire **612** extends to the terminal **269** where it causes the circuit-closing assembly **601** to have the effect of conducting current from the terminal **269** over to the relay terminal **259** for energizing the relays so that it tends to hold the solenoid S energized so that it releases the door plunger and maintains it released until such time as the key has been removed from the ignition switch.

This will tend to prevent a person from being locked outside of his car at a time when his ignition key is in the ignition having attached to it probably his door-unlocking key.

A variation has a switch **620** in a wire **610,** the switch **620** being a manual switch somewhere in the dashboard area and known to the driver so that if there are times when he wishes to drive the automobile through a dangerous area and wants the doors to be locked at the same time, he can simply open the switch **620** making a disconnection along the line **610** to temporarily place this circuit-closing assembly **601** out of action so that the doors can remain locked.

An alternate way of setting off the alarm **520** is shown in FIG. **5** in which a conductive alarm associated plate shown at **750** is arranged in disposition closely adjacent to, but not in, the swaths of motion of at least some of the protrusions **30** and in a plane disposed with respect to the outer housing **70** closer to the insertion or vertical position of the key with respect to the swath of motion of the key as it moves toward the contact assembly **130** than is the position of the contacts **120** themselves with respect to the key insertion or vertical position.

The alarm associated plate or front plate **750** has many notches **754** therein of a size for permitting respective protrusions to pass therethrough on their way to the respective contact **120.** In another sense, the alarm associated plate **750** has between its notches **754** a plurality of spaced downwardly extending fingers **756** formed integrally with the conductive plate material of the alarm associate plate **750.** Whenever an unauthorized or foreign key is inserted into the lock, there are so many of these fingers **756** which can be engaged by one of the protrusions of the key which do not match the notches **754** in the front alarm associated plate that an alarm means attached to the plate **750** will very likely be energized. The specific alarm means is not shown in FIG. **5,** but can be the alarm A of FIG. **7,** as is energized by circuit means not to be described.

A wire **770** is connected to a terminal **772** of the alarm plate **750,** which latter extends beyond the outer housing **70.** The wire **770** is connected to the wire **510** of FIG. **7** for operating the relay **511** to energize the alarm A. A wiring diagram showing this can be found in FIG. **5A** in which a switch S-9 is shown of which the switch throw is to be considered to be whatever portion of the key **20** which touches the alarm plate **750** and which the other terminal of the switch S-9 is considered to be the plate **750** itself.

Referring to FIG. **5,** it will be seen that a back alarm associated plate **800** is mounted on the inner side of the outer housing **70** in a position on the opposite side of the key protrusions **30** from the mating contacts **120.** The back alarm associated plate **800** extends generally toward the axis **34** of the switch a greater distance than the front alarm associated plate **750,** whereby, if the protrusions of the foreign key disposed in the lock pass beneath the fingers **756** of the front alarm plate **750** and also pass by the contacts **120,** then they will touch the back alarm associated plate **800** causing energy to pass through the same to its terminal **804,** which latter is connected by a wire **808** to the wire **770** for indirectly operating the alarm A in the same manner as does a key contact with the front alarm associated plate **750.** A small extension **810** is disposed on the key side of the back alarm associated plate **800** so that the extension **800,** which is conductive, and which is conductively attached to the plate **800** will be engaged before key rotation is stopped by the engagement of the central part **56** of the guide with the stop **160** of FIG. **5.**

The back alarm associated plate **800** is separated by insulation **814** from the contacts **120** and parts electrically connected thereto.

Referring to FIG. **5,** when it is desired to lock a door automatically, the key is turned so that its inner end **22** is disposed in the dotted line position of FIG. **5** and in contact with a locking contact **900** which is attached to the housing **70** and extends inwardly therefrom in a position to be engaged by the key **20** at times when the key has been turned counterclockwise through an acute angle of perhaps **35°.** A terminal **902** attached to the locking contact **900** extends through the housing **70** and has a wire **910** attached to it, which latter can also be seen in FIG. **5A** in which a switch **S10** in the wiring diagram of FIG. **5A** represents the switching contact made between the key **20** and the locking contact **900.** The entire key is not diagrammed in FIG. **5A** and the method of showing the switches **S9** and **S10** as coming directly from a line extending horizontally at points in between the positions S_6 and S_7 is a device used to indicate that it is not the protrusions necessarily which cause operation of the switches **S9** and **S10,** but rather any part of the key can close the switches, and it is preferable that the locking contact **900** and also the back alarm associated plate **800** extend far enough downwardly so as to engage a key along its main portion below its protrusions, although this is not necessary if the locking contact **900** is of a great width in a direction along the axis **34,** since it would touch one of the other of the contacts of the proper key anyway.

Switches S9 and S10 depend for their operation upon an energized conductive key **20.** But an alternate locking switch is shown at S11 which is intended for use in

situations in which the key can be either conductive or non-conductive. The switch S11 has two contacts 920 and 922, both of which are elongated and resilient and extend alongside one another. The contact 920 is disposed closer to the top of the central section 58 and is adapted to be pressed upward in a normal position shown in dotted lines in FIG. 5 into the full-line position thereshown, in which latter the contact 920 engages the contact 922 closing the switch, although the contact 920 is not in engagement with the contact 922 whenever the central section 58 is not in engagement with the contact 920.

Upper ends of the contacts 920 and 922 are suitably insulated from each other by insulation means 923 and terminals attached thereto extend through the outer housing 70, as seen at 924 and 926 respectively.

An understanding about how switch S11 would work can be had by considering FIGS. 5, 5A, and 7 together in which it is understood that a terminal 926 of the switch S11 is connected to the wire 410 which leads from the resistor 430 of FIG. 7 through a wire 401 seen in FIG. 1 and FIG. 7 to the key contacting member 400, whereby no conductivity through the key is used since the switch S11 is for purposes in which the need is to make possible switching when the key is non-conductive.

The other terminal 924 of the switch S11 is connected to the wire 910 just described and the wire 910 can be seen in FIG. 3 as connected to the door-locking control relay 940 which is itself connected to one of the terminals 942 of the door-locking solenoid 380, earlier described, and which latter has its other terminal grounded at 943.

The door-locking control relay 940 has one terminal grounded at 946 and has its remaining terminal connected at 948 to the heavy current wire 303 seen in FIG. 7, whereby at times when the switch S11 is closed and power from the power source or battery 300 can reach the relay terminal wire 910 through the FIG. 7 wires 303, 420, resistor 430, wire 410, then the energized relay will cause the solenoid 380 to be energized pulling down on its core 382, and thereby pulling down on the plunger 360 and having the same effect as though the plunger 360 was pushed downward by the operator's hand.

This same result of locking the door by pulling down on the plunger 360 is likewise accomplished by energy passing through the wire 910 from the locking contact 900.

In FIG. 4 the switch is diagrammatically shown in a view similar to FIG. 5, but simplefied to illustrate its operation as an ignition switch. The door locking switch S11 or door locking contact 900 of FIG. 5 are not needed, although the contact assembly 130 would be made substantially the same and the advantages of having a front and rear alarm associated plate 750 and 804 would remain, although these are not shown in FIG. 4 for convenience of illustration. In FIG. 4 a wire 261 leads from one of the terminals 142 of one of the switches which can be called S1 of the diagram of FIG. 1 to a multi-transistor assembly 1000, which latter comprises the resistors T_1 to T_7 of FIG. 7 and the details of the wiring thereof are not repeated in FIG. 4 for convenience of illustration, it being understood that the numeral 261 serves to illustrate a sample wire and that other wires from other terminals 142 of the various switches S_1 to S_7 also extend to the multi-transistor assembly 1000 and in the same manner as do the wires 262 and 267 sequentially of the diagram of FIG. 7. The wire 258 from the multi-transistor assembly 1000 is a low voltage output wire for relay control and can be seen in FIG. 7 and FIG. 4, although in the wiring diagram of FIG. 4 the wire 258 leads to a relay 1002, which latter has another of its terminals connected to a starter 1004, which latter is grounded at 1006, the relay itself is grounded at 1008 and has one of its terminals connected to the high voltage current wire 303 of FIG. 7 so that high voltage current passes from the relay 1002 through a wire 1010 to the starter 1004.

A low voltage wire 1020 connected to the wire 258 leads to a terminal of a latching relay 1030, which latter is grounded at 1032 and receives heavy current at one of its terminals through the wire 303, heavy current from the latching relay leaving another of its terminals through a wire 1040 extending to a coil 1060 which is grounded at 1062.

As thus described, when the key 20 is inserted in the vertical position, in an alignment with an "Off" mark 1090, it is then turned clockwise to a "start" position at which it engages one of the contacts 120 and also any of the other contacts 120 which the proper key would engage, whereby the transistors of the multi-transistor assembly 1000 which are the transistors T_1, T_2, T_4, T_6 and T_7 all receive energy from their various contacts 120 so that energy is passed through the wire 258 to the relay 1002 and from there to the starter so that the car starts with other energy reaching the latching relay 1030 so that the ignition coil 1060 is energized and the car will start.

After the operator has turned the key to the start position, he then releases the key and a spring 1094 mounted on a bracket 2000 fixed to the housing 70 urges against the central section 58 of the guide 50 forcing the central section into a dotted line position shown at 1098 in dotted lines so that the key reaches the dotted position indicated at 2002 at which it no longer contacts the contacts 120.

The key 20 is maintained in the position 2002 because the spring 1094 is prevented from expanding excessively by a telescoping frame assembly 2030 having interlocking parts 2032 and 2040.

With the key in the position 2002, the automobile can be operated.

When the operator desires to stop his car, he turns the key 20 to the position shown at 2070 which is the engine "Off" position. In this position, the key touches the contact 2072 connected by a wire 2080 to the latching relay 1030, whereby the latching relay gets a second impulse which releases its latching so that energy no longer goes to the ignition coil 1060. However, it is to be understood that unless the key is turned to the position 2070, then from the time the key has first touched, the contacts 120 the latching relay will have remained latched energizing the coil 1060.

Referring now to FIG. 8, an alternate contact plate assembly is there shown and is generally indicated at 130'. The contact plate assembly 130' has a similar front alarm associated plate 750 and a similar back alarm associated plate 800, but between them, instead of there being a single contact 130 at each cross-section taken at a right angle to the axis 34, there are two contacts 3000 and 3002 so disposed that when the key 20 strikes a contact 3000, it presses that contact to the contact 3002 and since the contacts 3000 and 3002

form the contacts of the switch S_1 of the diagram of FIG. 7, therefore, the same diagram of FIG. 7 will work, even though the key in the case of FIG. 8 is non-metallic and non-conductive.

If the switch of the type of FIG. 8 is preferred, even though the key is metallic, then an insulative piece **3010** can be fastened to each contact **3000** to insulate it from the key **20**, as shown in FIG. **8.**

A second telescoping assembly **3040** similar to the one shown at **2040** and containing a spring and mounted on a bracket **3060** fixed to the housing **70** is shown in FIG. **4** in a position for urging the central part **58** of the guide back from the position in which the key is opposite the engine "Off" station and contact **3072** to a position in which the key is opposite the "OFF" station **109** from which the key can be withdrawn. The engine "Off" station can also be an accessory's position of the car radio and other accessories.

Referring to FIG. **4**, a resilient contact **3100** can be seen in a position directly vertically above the axis **34** in a place where it would be contacted by the key only at times when the key is in the vertical plane position of insertion and removal.

A terminal **3102** extending through the housing **70** is connected by a wire **3200** to another terminal of the switch **620**, as seen in FIG. **9**, whereby at times when the switch **620** closes, the contact between the wire **3200** and the wire **610'**, then the wire **3200** is connected to the relay terminal **259.**

Alternatively, the wire **3200** could be directly connected to the wire **259**, but in either case, the effect is that when the key touches the key-left contact **3100** while the key also touches the end contact **400**, the net effect is to make a direct contact between the relay terminal **259** and the end contact **400** of the wiring diagram of FIG. **7**, thus by-passing the transistors of FIG. **7** and causing the relay **320** to operate which then itself causes the terminal **342** of FIGS. **3** and **7** to be energized, this energizing the solenoid S which keeps the door lock plungers **360** unlocked for making it impossible for a man to shut and lock his car door at a time when his ignition key is in the ignition at the insertion and removal position. This works because the key, when not being manually twisted, is urged to the vertical position by the spring-loaded telescoping frame assemblies **2030** and **3040.**

I claim:

1. A lock assembly comprising:

a rotatable key guide within a housing, said key guide being movable from a first position to a second position;

electrical contacts mounted within said housing to form a switching circuit;

a locking solenoid which is energized upon closing said contacts in said switching circuit;

a locking means which is moved from one position to another when said solenoid is energized;

the contacts of said switching circuit being closed when an easily duplicated conductive key having prearranged protrusions moves said key guide from said first position to said second position and said protrusions directly engage said contacts of said switching circuit completing an electrical circuit between said protrusions and said contacts of said switching circuit, whereby said locking solenoid is energized and said locking means is moved without use of a conventional pin-tumbler mechanism.

2. The assembly of claim **1** wherein the housing includes therewithin contacts which activate an alarm system when an improper key is employed.

3. The assembly of claim **1** wherein said switching circuit consists of a plurality of transistors arranged in series so that the circuit will be completed and the lock means moved to an unlocked position only if a key having prearranged fitting protrusions engages said contacts and closes said circuit.

4. The assembly of claim **3** wherein said housing includes contacts which activate an alarm system when an improper key is employed.

5. The assembly of claim **1** wherein said housing includes a mechanical stop to prevent unlimited rotation of said key guide and thereby prevent damage to said contacts.

6. The assembly of claim **1** wherein said contacts are made of flexible material.

7. The assembly of claim **1** wherein said key guide is yieldably urged to return to a predetermined first position after rotation thereof.

8. The assembly of claim **2** wherein the alarm system is an audible alarm system.

9. The assembly of claim **2** wherein said housing includes therein a plurality of spaced apart downwardly extending alarm contacts which, when an improper key is employed, are directly engaged by said key and activate an alarm system.

10. The assembly of claim **9** wherein the alarm system is an audible alarm system.

11. The lock assembly of claim **1** wherein said key is electrically conductive.

12. The lock assembly of claim **1** wherein said electrical contacts are of varying lengths.

13. The lock assembly of claim **1** wherein said protrusions of said key are of varying lengths.

14. The lock assembly of claim **1** wherein said electrical contacts are of varying lengths and said protrusions of said key are of varying lengths to matingly match said contacts.

15. An electric lock comprising:

a. a lock housing;

b. a set of flexible, electrical unlock contacts mounted in said housing, said contacts being insulated from each other;

c. a set of flexible electrical alarm contacts mounted in said housing and located proximate to said unlock contacts;

d. an easily duplicated conductive key having protrusions thereon for directly engaging each of said unlock contacts and engaging none of said alarm contacts, thereby completing an electrical circuit between said protrusions and said unlock contacts;

e. A rotatable key guide located within said housing and adapted to receive said key;

f. unlock circuit means electrically connected to each of said unlock contacts and responsive thereto for producing an unlock electrical signal upon insertion of said key into said key guide and rotation of said key guide so as to directly engage each of said unlock contacts by said protrusions; and

g. alarm circuit means electrically connected to said alarm contacts and responsive thereto for producing an alarm electrical signal upon engagement of one of said alarm contacts.

16. The lock of claim **1** wherein said unlock contacts and said alarm electrical contacts form a planar array.

17. The lock of claim 1 wherein said unlock contacts and said alarm electrical contacts form, respectively, parallel, planar arrays.

18. The lock of claim 17 wherein said unlock contacts extend beyond said alarm contacts.

19. An electric lock comprising:

a. a lock housing;

b. a set of flexible, electrical unlock contacts mounted in said housing, said contacts being insulated from each other;

c. a set of flexible electrical alarm contacts mounted in said housing and located proximate to said unlock contacts, said unlock and alarm contacts substantially overlapping and forming, respectively, planar parallel arrays;

d. an easily duplicated conductive key having protrusions thereon for directly engaging each of said unlock contacts, and engaging none of said alarm contacts thereby completing an electrical circuit between said protrusions and said unlock contacts;

e. a rotatable key guide located within said housing and adapted to receive said key;

f. unlock circuit means electrically connected to each of said unlock contacts and responsive thereto for producing an unlock electrical signal upon insertion of said key into said key guide and rotation of said key guide so as to directly engage each of said unlock contacts by said protrusions; and

g. alarm circuit means electrically connected to said alarm contacts and responsive thereto for producing an alarm electrical signal upon engagement of one of said alarm contacts.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,873,891 Dated March 25, 1975

Inventor(s) Richard W. Gerber

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 12, line 67, "claim 1" should read -- claim 15 --.

Column 13, line 1, "claim 1" should read -- claim 15 --.

The following claim should be added:

-- 20. An electric lock according to claim 19 wherein said housing further includes means for energizing said key upon insertion of same into said key guide. --

Signed and sealed this 17th day of June 1975.

(SEAL)
Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents
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