Dec. 8, 1953 C. G. CERNA ET AL 2,662,131

KEY OPERATED SWITCH

Filed July 19, 1951

3 Sheets-Sheet 1

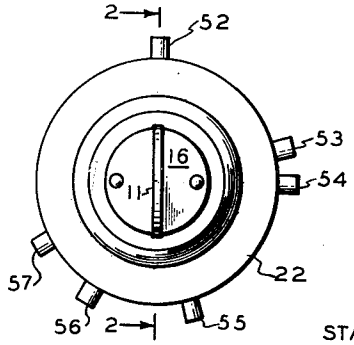


FIG. 1

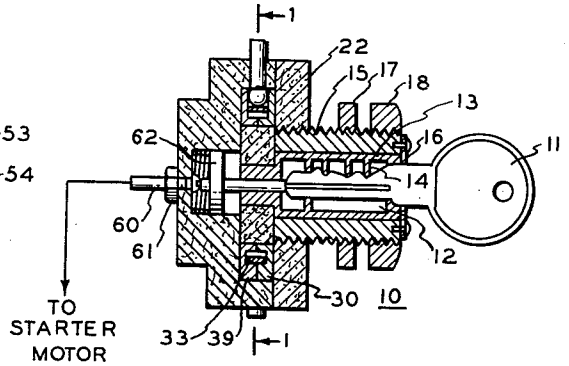


FIG. 2

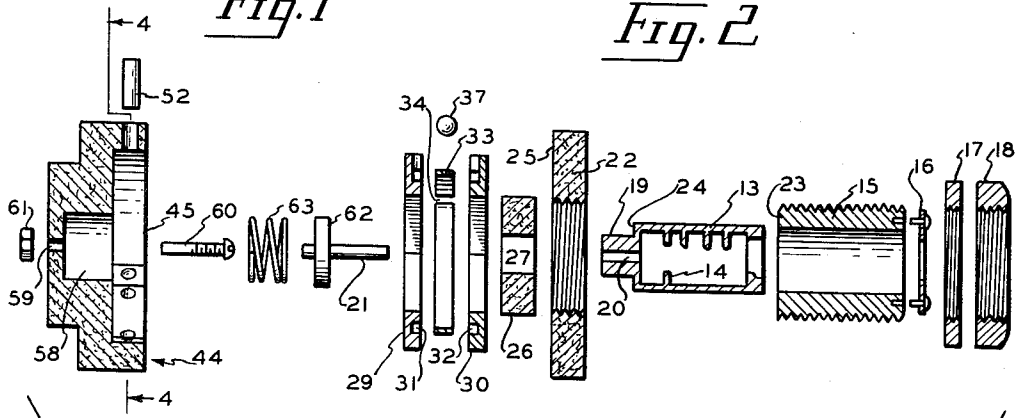


FIG. 3

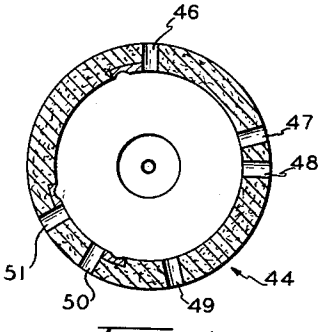


FIG. 4

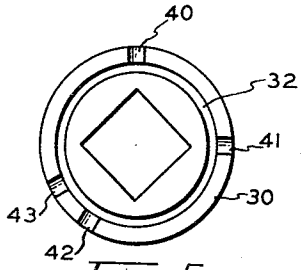


FIG. 5

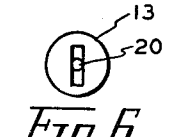


FIG. 6

INVENTORS

CARLOS GIRON CERNA

JOSÉ ANTONIO ARÉVALO

BY

Raphaël Tourover

ATTORNEY

Dec. 8, 1953 C. G. CERNA ET AL 2,662,131

KEY OPERATED SWITCH

Filed July 19, 1951 3 Sheets-Sheet 2

Fig. 7

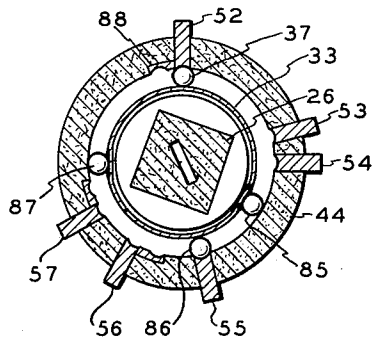


Fig. 9

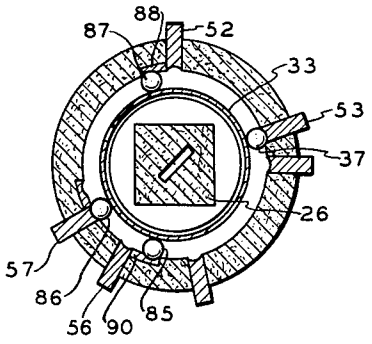


Fig. 8

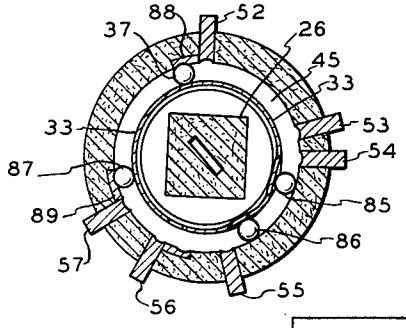
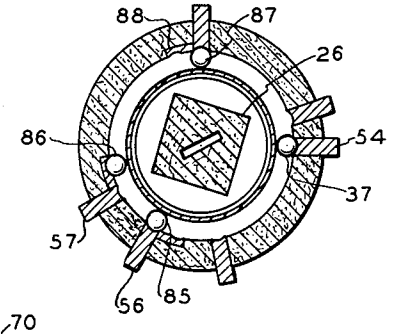


Fig. 10



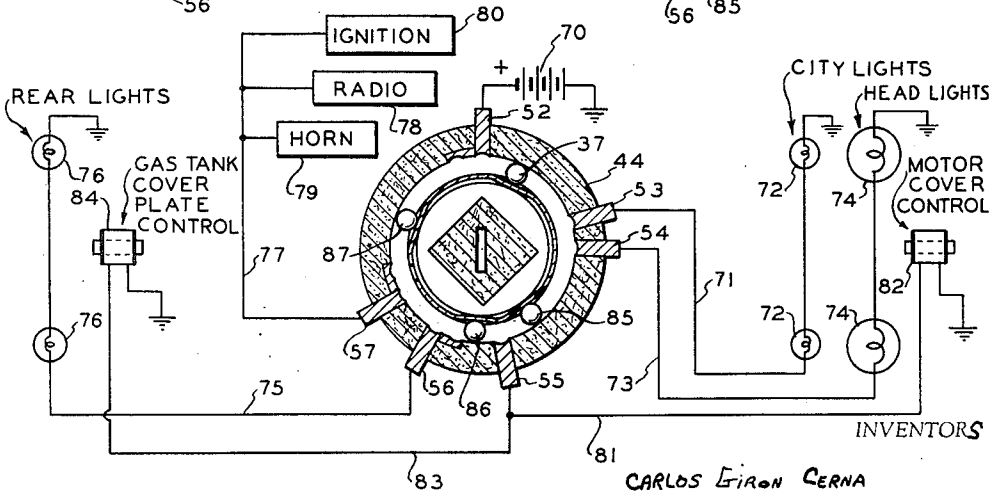


Fig. 11

BY

Raphaël Tourover ATTORNEY

Dec. 8, 1953 C. G. CERNA ET AL 2,662,131

KEY OPERATED SWITCH

Filed July 19, 1951 3 Sheets-Sheet 3

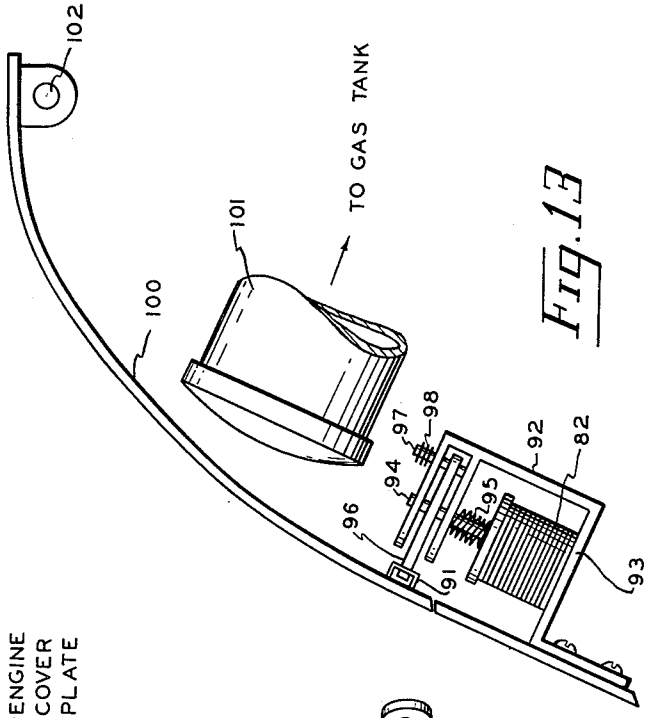


FIG. 13

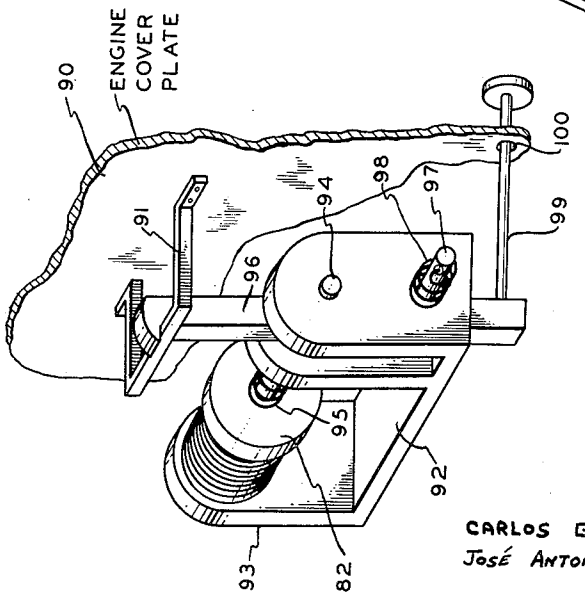


FIG. 12

INVENTORS

CARLOS GIRON CERNA

JOSÉ ANTONIO ARÉVALO

BY

Raphaël Tourover

ATTORNEY

Patented Dec. 8, 1953

2,662,131

UNITED STATES PATENT OFFICE

2,662,131

KEY OPERATED SWITCH

Carlos Girón Cerna and José Antonio Arevalo,
Guatemala City, Guatemala

Application July 19, 1951, Serial No. 237,626

Claims priority, application Guatemala
August 17, 1950

11 Claims. (Cl. 200—44)

1

The present invention relates generally to multiplex switches, and more particularly to key operated multiplex switches, and to systems for applying key operated multiplex switches to the control of electrical circuits in automotive vehicles.

Briefly, the invention includes a key operated switch having a pair of co-axial cylinders between which are located a plurality of metallic balls, fixed in their circumferential positions with respect to the inner one of the cylinders, which is rotatable with respect to the outer one of the cylinders in response to turning of the key. The inner cylinder is electrically conductive. The outer cylinder is fabricated of non-conductive material, but contains radial contacts extending therethrough at preselected points about the circumference thereof, so that a circuit may be completed between one or more of the contacts and the inner cylinder, via one or more of the metallic balls in accordance with the rotational position of the inner cylinder.

To one of the contacts is connected the positive terminal of a source of potential, say a storage battery, for example, the remaining terminal of which is grounded. When any one of the conductive balls is located under that one of the contacts, accordingly, positive voltage is transmitted to the inner conductive cylinder, and thereby to all the conductive balls. Any one or more of the conductive balls which may be in contact with contacts in the outer cylinder then transmit positive voltage to these contacts, and the latter may be connected with appropriate circuits to be controlled.

In a preferred embodiment of the invention is provided one additional pair of contacts, the first of the latter contacts being stationary and the other movably axially of the cylinders above referred to into contact with the first, by axial movement of the key, as distinguished from rotation of the key.

The various circuits which may be controlled by the multiplex switch above briefly described may be utilized to energize various lighting circuits, circuits for energizing accessories such as radio, horn or the like, ignition circuits, and circuits for unlocking various normally locked cover plates, on the automotive vehicle, such as a cover plate for providing access to a gasoline tank.

We have provided multiplex switch structure of particularly simple character, composed of separate elements capable of being rapidly and simply assembled to form a complete switch structure. The basic concept on which the switch

2

is based, on the other hand, enables extremely flexible selective energization of a multiplicity of discrete electrical circuits in various desired combinations.

It is, accordingly, an object of the present invention to provide a novel multiplex switch.

It is a further object of the invention to provide a novel multiplex switch which is operable in response to selective rotation and to translation of a key.

It is another object of the invention to provide a multiplex switch capable of selective closure of various combinations of electrical circuits, in response to selective actuation of a single control member, which may be, specifically, a key.

Still another object of the invention resides in the provision of a multiplex switch consisting of an easily assembled group of pre-fabricated parts, each of extremely simple character, per se.

Still a further object of the invention resides in the provision of a multiplex switch having two concentric cylinders, relatively rotatable, one of which is conductive, and the other of which is non-conductive but contains circumferentially spaced contacts extending radially therethrough, and a plurality of conductive extensions carried by the conductive cylinder and rotatable therewith, into contact with various ones of the circumferentially spaced contacts selected in accordance with the rotated position of the rotatable cylinder.

The above and still further features, objects and advantages of the present invention will become apparent upon consideration of the following detailed description of a specific embodiment of the invention, especially when taken in conjunction with the accompanying drawings, wherein:

Figure 1 is a view in front elevation of a device in accordance with the invention;

Figure 2 is a transverse section taken on the line 2—2 of Figure 1;

Figure 3 is an exploded view, in transverse section on the line 2—2 of Figure 1, and corresponding generally with Figure 2;

Figures 4, 5 and 6 are views in front elevation of various of the elements of Figure 3;

Figures 7-10 inclusive are views in transverse cross-section taken on the line 1—1 of Figure 2, showing various operative positions of the switch structure of the invention;

Figure 11 is a functional circuit diagram of the invention as applied in an automotive vehicle, with the switch structure in one of its positions;

Figure 12 illustrates in perspective a solenoid

operated latch release as applied to a motor cover; and

Figure 13 illustrates in side elevation a solenoid operated latch release as applied to a further cover.

Referring now more specifically to the accompanying drawings, the reference numeral 10 identifies generally a key operated switch, shown in Figure 2 with key 11 inserted in a lock 12. The character of the lock, per se, forms no part of the invention, but comprises generally a cylindrical tube 13, having internally thereof various protuberances and conformations 14 such that only a properly shaped key may be capable of insertion in the lock. The cylindrical tube 13 may be secured within a hollow cylindrical member 15, which is externally threaded, by means of a cover plate 16. A pair of nuts 17 and 18 may threadedly engage the external threads of cylindrical member 15, and may serve to secure the cylindrical member 15, and thereby the lock and switch structure, to a suitably apertured wall (not shown).

The cylinder 13 may be co-extensive with the cylinder 15, and fit snugly therein, but is rotatable with respect thereto. The cylinder 13 may be provided with an extension 19 of rectangular cross-section, having therein an axial aperture 20 of reduced diameter, through which may extend a pin 21, capable of sliding in the aperture 20.

An annular member 22 is provided, which is fabricated of insulating material, and which is internally threaded so that it may threadedly engage the cylinder 15. In assembled relation, with the cylinder 13 internally of the cylinder 15, and with the annular member 22 threadedly engaging the cylinder 15, the arrangement is made such, as viewed in Figure 2 of the accompanying drawings, that the end wall 22 of the cylinder 15 is flush with the shoulder 23 of the cylinder 13 and with the wall 25 of the annular member 22. Accordingly, the extension 19 extends to the left, as seen in Figures 2 and 3, beyond the end wall 22, the shoulder 23 and the wall 25.

There is further provided a member 26 having an internal rectangular aperture 27 adapted to be force fitted to the extension 19, so that the member 26 is forced to rotate when the cylinder 13 rotates in response to rotation of the key 11. The member 26 is generally of square transverse cross-section and has a thickness equal to the length of the extension 19.

Two further members 29 and 30 are provided, which have generally circular transverse cross-section, and of very substantially smaller diameters than the diameter of the annular member 22. The members 29 and 30 are provided with square openings, centered on the axis of the members, and having such sizes that the members 29 and 30 may nest on the member 26. To this end the combined thicknesses of the members 29 and 30 is equal to the thickness of the member 26. It follows that any rotation of the member 26 is response to rotation of the key 11 will be accompanied by corresponding simultaneous rotation of the members 29 and 30.

The members 29 and 30 are provided each with an annular groove, as 31 and 32, of equal diameter and thickness in each of the members 29 and 30, within which is placed a metallic spring 33, in the form of a thin cylinder having a break at 34. The spring 33 is so constructed and arranged that it must be slightly compressed in order to be inserted in the annular groove 31, 32, in order that it may apply force in a direction radially outward against the walls of the grooves, and in assembled relation the members 29 and 30 are placed on the member 26, with their adjoining walls in close contact, and with the spring 33 in the annular grooves 31, 32.

The members 29 and 30 are further provided with radial grooves of semi-circular gross-section, in their outer walls, extending radially from their outer walls 2 along respectively adjoining walls of the members 29 and 30, the grooves being so shaped and formed as to provide, when the members 29 and 30 are in contact in the assembled condition of the switch, radial apertures of circular cross-section which extend to the annular grooves 31. Within each of these radial apertures is located a small metallic ball, as for example ball 37, each of which rests on the spring member 33. There are utilized in all four balls, and, accordingly, there are provided four axial apertures, which, in Figure 5, are numbered 40, 41, 42, 43, respectively. It will be noticed that the apertures are not uniformly spaced about the circumference of the members 29, 30, and it may be stated that while the spacing of the apertures may be varied in accordance with the desired operation of a switch arranged in accordance with the principles of the present invention, for any desired mode of operation the relative spacing of the apertures is important.

There is provided an additional member of generally circular transverse cross-section, numbered 44, and having a maximum outer diameter equal to the outer diameter of the member of the cylindrical member 22. The member 44 is provided with an axial cylindrical recess 45, within which may nest the members 29 and 30, with sufficient play to permit relative rotation, and a plurality of cylindrical apertures may extend radially therefrom, these being numbered 46 to 51, inclusive, and extending radially from the outer diameter of the member 46 to the recess 45.

It will be seen from Figure 4 of the accompanying drawings, that the radial apertures 46 to 51, inclusive, are not uniformly spaced about the circumference of the member 44, and it will appear as the description proceeds that the spacing of the apertures 46 to 51 bears a definite relation to the spacing of the apertures 40 to 43, inclusive, of the member 30. Within each of the apertures 46 to 51, inclusive, extends a metallic contact member or pin, as 52 to 57, and the member 44 being itself of insulating material, the contacts 52 to 57 are mutually insulated. The member 44 is arranged to remain stationary during rotation of members 29, 30, in response to rotation of key 11. Various balls, as 37, are arranged to rotate within the circular recess 45 during rotation of the members 29 and 30 in response to the rotation of key 11, being pressed against the inner cylindrical wall of the recess 45 by the cylindrical spring 33. Accordingly, when any ball comes in contact with any one of contacts 52 to 57, inclusive, firm electrical contact is made between the contact and the ball, and thereby with the spring 33. If voltage is applied, for example, to contact 52, that voltage will be transmitted to the spring 33 when the contact 52 is in contact with any one of the four balls, and from the spring will be transmitted to the remaining balls. If, then, any one of the remaining balls is in contact with any one of the remaining contacts, as 53 to 57, inclusive, the positive voltage applied to the contact 52 will be transferred to those particular contacts. All the con-

tacts 53 to 57 may be connected with electrical circuits, which may thus be energized.

There is provided in the member 44 a further recess 58 of circular cross-section, radially reduced in diameter with respect to the diameter of the recess 45, as well as still another small aperture 59 extending entirely through the remaining lateral wall of the member 44. Through the small aperture 59 extends a small bolt 60, which may be secured to the lateral wall by means of a nut 61, the bolt 60 then providing an electrical contact. To the pin 21 is secured a small piston 62, which is capable of translation within the recess 58, and which serves during such translation to center the pin 21. A helical spring 63 is provided between the inner wall of the recess 58 and the piston 62, which tends to press the piston 62 to the right, as seen in Figure 3, and thereby to maintain separation between the head of the bolt 60 and the pin 21. The pin 21 extends, as has been explained heretofore, through the aperture 20 in the shoulder 19, and into the hollow cylinder 13. Accordingly, the key 11 may be pressed axially of the cylinder 13, thereby to actuate the pin 21 against the force exerted by the helical spring 63 and into contact with the head of the voltage 60. When this occurs an additional circuit is closed in the switch structure, which may be used to contact a starter of a motor vehicle, as shown in Figure 2.

In Figures 7 to 11, inclusive, is illustrated various positions of the switch structure, in response to various rotations of the key 11.

Referring first to Figure 11 of the accompanying drawings, there is shown in cross-section the member 44, and extending radially therethrough the various contacts 52 to 57, inclusive. It will be noted that the contact 52 is connected to the positive terminal of a battery 70, the negative terminal of which is grounded. The contact 53 is connected by means of a lead 71 to the lamp bulbs 72, which may serve, for example, for city driving. The contact 54 is connected by a lead 73 to lamps 74, which may be used as road driving headlights. Contact 56 is connected by a lead 75 to lamps 76, which may be located at the rear of the automotive vehicle. The contact 57 is connected by a lead 77 to various accessories in the automotive vehicle, for example, the radio receiver and the horn, and may also control the ignition circuit. The contact 55 is connected by a lead 81 to a solenoid 82, which may serve to release the motor cover of the automotive vehicle, while the same contact 55 may be connected by a lead 83 to a further solenoid 84, which may serve to release the normally locked gas tank cover of the automotive vehicle.

The various electrically operated components of the vehicle, which are controlled by the switch, in accordance with the preferred embodiment of the invention herein disclosed, are obviously matters of choice. Separate contacts may, for example, be provided for the ignition circuit, for the various solenoids, and for the various lamp circuits, or any desired combination of these may be controlled from a single contact.

In the position shown in Figure 11 of the accompanying drawings, it will be seen that no one of the conductive balls is located in contact with the contact 52, and accordingly that the battery 70 is completely isolated from all the circuits there illustrated. Accordingly, in the position shown in Figure 11 the switch is entirely inactive, and no circuits are energized. It will be seen that for this position the key is vertical, or has not been subjected to rotation.

The key may be turned slightly counter-clockwise, roughly to an angle of 30°, at which time the ball 37 may be placed in contact with the contact pin 52, conveying positive potential to the spring 33.

For purpose of convenience in reference the three balls in addition to the ball 37 will be numbered respectively 85, 86, 87.

With the ball 37 in contact with the contact pin 52 the ball 86 is in contact with the contact pin 55, and the remaining balls 85 and 87 are not in contact with any pins. It follows that positive potential is conveyed to the contact pin 55, and since this pin is connected via leads 81 and 83 to the solenoids 82 and 84, these are energized and the gas tank cover plate and the motor cover plate are released. No other circuits are, however, energized.

The key 11 may be rotated counter-clockwise a further distance, approximately to an angle 45°. In this position the ball 37 remains in contact with the pin 52 despite the fact that it has been displaced through an angle of approximately 15 degrees, since there is provided a conductive inset extension of the pin 52 in the inner wall of the recess 45, that recess being numbered 88, and having therein a slight depression for receiving the ball 37. Accordingly, in the position of the key corresponding with the illustration provided in Figure 8, positive potential from the battery 7 is applied to the spring 33, and thereby to the remaining ones of the balls, but in this position the ball 86 is no longer in contact with the pin 55, but on the other hand the ball 87 has been brought into contact with the pin 57, by virtue of a metallic extension 89 of the pin 57, which is provided with a slight depression adapted to receive the ball 83. Accordingly, the contact pin 57 is energized, and thereby power is conveyed to the ignition system 80, the radio 78, and the horn 79, the remaining circuits of the automotive vehicle remaining unenergized.

In Figure 9 is illustrated the internal arrangement of the contact balls for a rotation of the key 11 approximately 45° to the right. In this position the ball 87 is in contact with the recessed extension 88 of the pin 72. Thereby, again, the spring member 33 conveys positive potential from the battery 70 to the remaining contact balls. The ball 37 is now in contact with the contact pin 53, while the ball 85 is in contact with a recessed extension 90, of the pin 56, and the ball 86 is in contact with the contact pin 57. Accordingly, for this position of the key pins 53, 56 and 57 receive positive potential from the battery 70, and accordingly, the city lights 72, the rear lights 76, and the accessory system containing radio 78, horn 79, and ignition 80, are of all simultaneously energized.

In Figure 10 of the accompanying drawings, the key 11 has been turned clockwise through an additional small angle, with respect to the position it had in Figure 9 of the accompanying drawings. Ball 87 is now directly in contact with the contact pin 52 rather than with the recessed extension 88, thereof, bringing the ball 37 into contact with the pin 54, the ball 85 directly into contact with the pin 56, and the ball 86 into contact with a recessed extension of the pin 57. Accordingly, potential is conveyed from the battery 70 to the pins 54, 56 and 57, thereby energizing the headlights 74, the rear lights 76, and the acces-

sories consisting of the radio 78, the horn 79, and the ignition 80.

It is now apparent, that, by virtue of the non-uniform spacing of the balls 37, 85, 86, 87, and of the pins 52 to 57, inclusive, that groups of circuits may be selectively energized for various positions of rotation of the inner cylinder 29, 30, in response to rotation of the key 11. Clearly, within the principles of the invention, additional contact balls and pins may be provided, as well as additional contact pins, as 52–57, and the spacings of each of these may be varied, to provide desired combinations of circuit control.

Referring now to Figures 12 and 13 of the accompanying drawings, there is shown the structures of solenoid operated latches for releasing the motor cover plate and the gas tank fill-pipe cover plate, in response to energization of the present switch.

In Figure 12 is illustrated the solenoid 82, for actuating a latch for an engine cover plate 90, to the inside wall of which is secured a U-shaped bracket 91. The solenoid 82 is secured to one arm 93 of a bracket 92, which is itself secured to the frame of the vehicle. The solenoid serves, when energized, to actuate an armature 94, against the pressure supplied by a helical spring 95. The armature 94 is in the form of an elongated pin, and extends through a latch-hook 96, normally hooked over the U-shaped bracket 91. The latch-hook 96 is secured to a pin 97, which serves as a pivot for the latch hook 96, and a helical spring 98 is provided, secured at one end to pin 97, and at its other end to latch-hook 96. The helical spring 98 is biased to tend to latch the latch-hook 96.

When the solenoid is energized, however, the pin 94 is withdrawn, and releases the latch-hook 96 for pivoting in unlatching relation to the bracket 91. Unlatching may be accomplished by means of the finger or by any elongated tool, such as a screw driver, inserted through an appropriate opening. It is found convenient, however, to supply a permanently available actuating rod, as 99, secured to latch 96, and extending externally of engine cover plate 90, as via an opening 100.

Similar arrangement is provided for unlatching the cover plate 100, which covers the pipe 101 which leads to the gas tank, thereby preventing unauthorized access thereto. The cover plate 100 is pivoted at point 102, and held by a latch-hook 96, which secures a bracket 91, secured to the cover plate 100. Since the parts of the latch-release are identical in the Figures 12 and 13, identical numerals of reference are employed, and further specific description dispensed with.

While we have illustrated and described one specific embodiment of the present invention, it will be realized that variations of arrangement and details may be resorted to without departing from the true spirit of the invention as defined in the appended claims.

What we claim and desire to secure by Letters Patent of the United States is:

1. A multiplex switch comprising a cylindrical structure having a plurality of relatively circumferentially displaced axial apertures, a metallic ball contained in each of said apertures, a single spring for resiliently pressing all of said balls outwardly of the apertures containing the balls, a further insulating structure comprising a cylindrical recess having a wall of circular cross section of diameter substantially equal to the diameter of said cylindrical structure and a height adequate to receive said cylindrical structure in said recess, a plurality of contact pins extending axially into said recess through said wall of circular cross section, means for rotating said cylindrical structure relative to said further insulating structure to preselected relative positions, selectively to make contact between said balls and said pins.

2. A multiplex switch comprising an insulating structure of cylindrical transverse cross section having a first axial recess of greater diameter and a second axial recess of lesser diameter, and an axial aperture extending entirely therethrough, a metallic pin passing through said axial aperture, a metallic piston contained within said second axial recess, and a helical spring in said recess for normally spring pressing said piston out of contact with said pin, a cylindrical rotatable structure in said axial recess of greater diameter, said cylindrical rotatable structure comprising a plurality of axial apertures, a contact member in each of said axial apertures, a single spring for resiliently pressing all said contact members outwardly of said axial apertures, and a plurality of contacts fixed to said insulating structure for selective contact with said contact members.

3. A multiplex switch comprising a first cylinder having a first plurality of at least three contacts arranged in non-uniform spacing about its periphery, a second cylinder having at least three second contacts arranged in non-uniform spacing about its periphery, means for relatively rotating said first and second cylinders, one of said first plurality of contacts being an input contact, a plurality of independent circuits connected respectively to the remainder of said first plurality of contacts a conducting path, electrically interconnecting all said second contacts, and means for relatively positioning said first plurality of contacts and said second contacts for selective contact therebetween during relative rotation thereof by said means for relatively rotating.

4. A multiplex switch, comprising, a stationary cylindrical annulus having a plurality of at least three first contacts extending radially therethrough, said contacts distributed non-uniformly about said cylindrical annulus, a cylinder located internally of said cylindrical annulus and rotatable with respect thereto, at least three rolling contacts secured at fixed positions along the periphery of said cylinder, said fixed positions non-uniformly spaced, and a conducting path electrically interconnecting all said rolling contacts, said rolling contacts positioned for selective contact with different ones of said first contacts as a function of different rotational positions during rotation of said cylinder.

5. A multiplex switch, comprising, a stationary cylindrical annulus having a plurality of at least three first contacts at the inner periphery thereof, said first contacts non-uniformly spaced about said inner periphery, a further cylindrical structure located internally of said cylindrical annulus and rotatable with respect thereto, at least three rolling ball contacts secured at fixed positions along the periphery of said cylindrical structure, said fixed positions non-uniformly spaced, and means comprising a conducting path electrically interconnecting all said rolling ball contacts, said rolling ball contacts positioned for selective contact with different selected ones only of said first contacts as a function of different rotational positions of said further cylindrical structure.

6. In a multiplex lock, a first cylinder of insulating material, a second cylinder adjacent said first cylinder and concentric therewith, a plurality of at least three contacts secured to said first cylinder in non-uniform spacing about a circular path, at least three further contacts secured to said second cylinder in non-uniform spacing about said circular path, a conductive path electrically interconnecting all said further contacts, and means for relatively rotating said first and second cylinders the spacings of said first mentioned contacts and of said further contacts about said circular path being substantially different.

7. The combination in accordance with claim 6 wherein said first cylinder peripherally surrounds said second cylinder.

8. The combination in accordance with claim 7 wherein said second cylinder comprises an annular structure having a plurality of radially extending peripheral receptacles, said further contacts consisting of metallic balls retained within said receptacles and free to rotate therein.

9. In a multiplex switch, a first cylinder of insulating material having an annular wall, a plurality of electrical contacts extending radially entirely through said annular wall, said electrical contacts non-uniformly spaced about said annular wall, a second cylindrical structure nesting internally of said annular wall and rotatable with respect thereto, at least three radially extending receptacles located peripherally in said second cylindrical structure and non-uniformly spaced about the periphery of said second cylindrical structure, a metallic ball freely supported in each of said radially extending receptacles, a cylindrical metallic spring secured to said second cylindrical structure and arranged and constructed to press said metallic balls outwardly of

said receptacles while maintaining an electrically conductive path therebetween, said metallic balls extending in the path of said contacts.

10. The combination in accordance with claim 9 wherein is further provided a pair of spring separated contacts located and separated axially of said second cylindrical structure, rotatable key operated means for rotating said second cylindrical structure, said pair of spring separated contacts actuable into contact in response to axial motion of said key.

11. In a multiplex switch, a first plurality of at least three non-uniformly spaced contacts, at least three second non-uniformly spaced contacts, means for relatively moving said first plurality of contacts and said second contacts in a single path, means for applying voltage to one of said first plurality of contacts, means for connecting load circuits to the remainder of said first plurality of contacts, and a conductive path electrically interconnecting all said second contacts, the spacings between contacts of each of said first plurality of contacts and said at least three contacts such that different combinations of contact pairs are made for different relative positions of said contacts along said path.

CARLOS GIRÓN CERNA.
JOSÉ ANTONIO AREVALO.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,591,646	Schaefer	July 6, 1926
1,828,747	Perry	Oct. 27, 1937
2,201,881	Bryant	May 21, 1940
2,546,744	Hasselbaum	Mar. 27, 1951