Dec. 20, 1949 W. A. J. HORNE ET AL 2,491,561

PERMUTATION SWITCH FOR THE IGNITION SYSTEM OF MOTOR VEHICLES

Filed Feb. 20, 1948 2 Sheets-Sheet 1

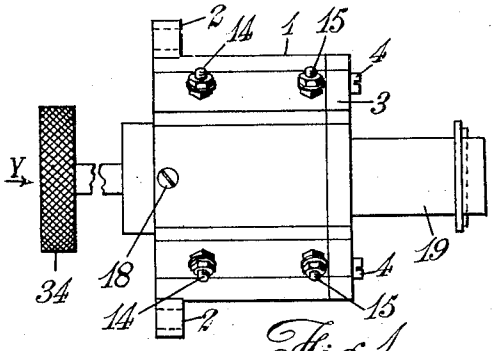



Fig. 1.

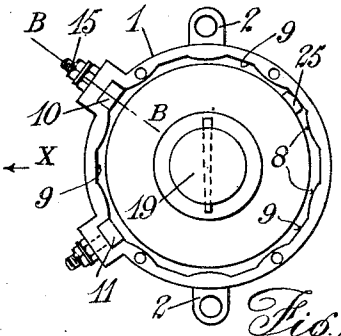



Fig. 2.

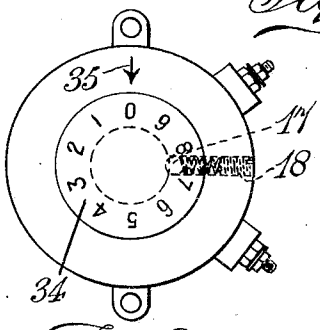



Fig. 3.

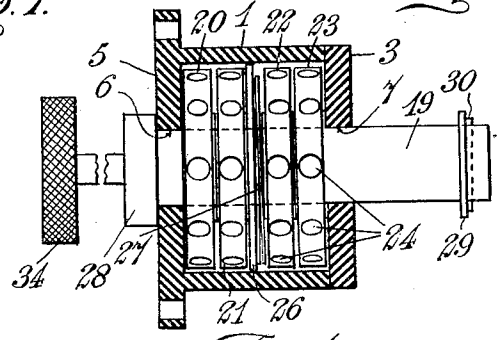



Fig. 4.

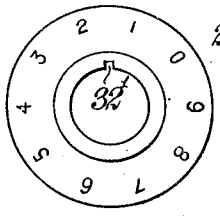



Fig. 5.

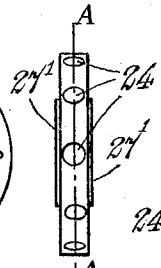



Fig. 6.

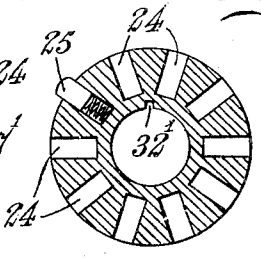



Fig. 7.

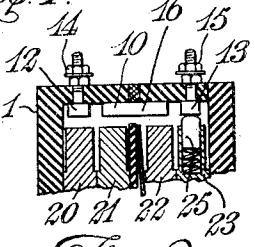



Fig. 8.

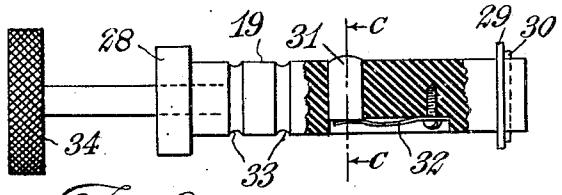



Fig. 9.

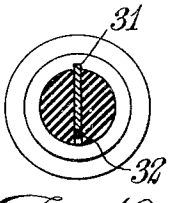



Fig. 10.

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PERMUTATION SWITCH FOR THE IGNITION SYSTEM OF MOTOR VEHICLES

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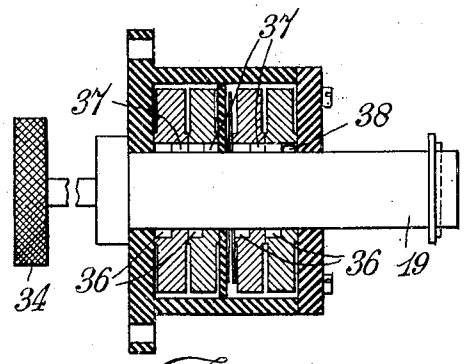



Fig. 11.

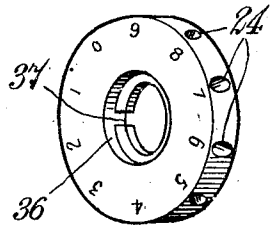



Fig. 12.

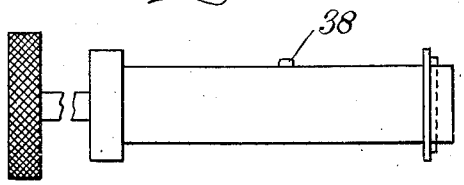



Fig. 13.

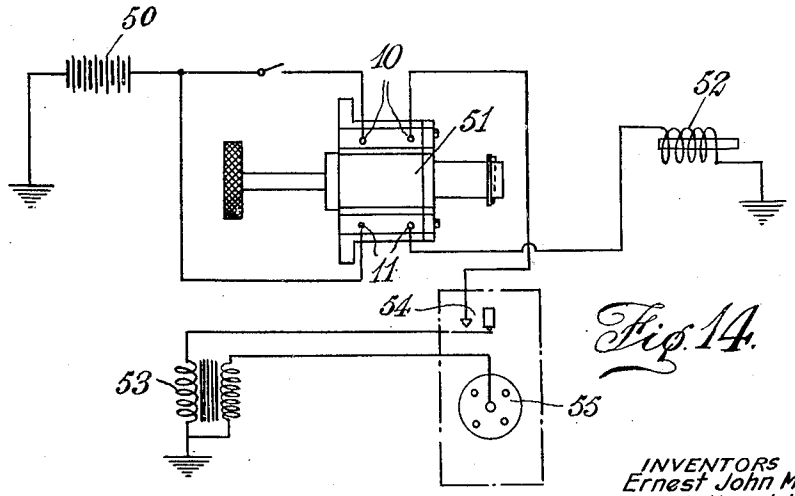



Fig. 14.

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Patented Dec. 20, 1949 2,491,561

# UNITED STATES PATENT OFFICE

2,491,561

## PERMUTATION SWITCH FOR THE IGNITION SYSTEM OF MOTOR VEHICLES

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Application February 20, 1948, Serial No. 9,794
In Great Britain February 24, 1947

8 Claims. (Cl. 200—43)

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This invention relates to a permutation switch for the ignition system of a motor vehicle and/or a magnetic lock.

The chief object of the present invention is to provide a switch of the character previously mentioned for the ignition circuit of a motor road vehicle, the switch being such that when the vehicle is left unattended no unauthorized person can operate the switch and start the engine of the vehicle.

Another object is to provide a switch as previously mentioned, which is simple in construction, easy to operate and which can be cheaply manufactured.

It is preferred that the switch should be positioned under the bonnet of the vehicle and can be operated from the instrument board, but it will be obvious that a nefarious person can lift the bonnet and short circuit the switch. It is, therefore, desirable that the bonnet should be locked by an electro-magnetic lock which may be energised to effect the unlocking of the bonnet by switching means also embodied in the said ignition switch.

According to the present invention there is provided a permutation switch for closing one or more electrical circuits, the switch comprising a plurality of individually rotatable elements each element having a contact member for contact with one or more relatively fixed terminals, means for individually rotating the elements the means bearing indicia for indicating the positions of the contact members carried by the elements, and means for housing the elements and also the fixed terminals, the arrangement being such that by rotating the elements an electrical circuit may be closed or a plurality of circuits closed in sequence by the contact of the contact elements with the fixed terminals.

In order that the said invention may be clearly understood and readily carried into effect, the same will now be described more fully, by way of example, with reference to the accompanying drawings in which:

Figure 1 is a side elevation of a permutation switch according to the present invention.

Figure 2 is an end elevation in the direction of the arrow X, the cover being removed.

Figure 3 is an end elevation in the direction of the arrow Y.

Figure 4 is a longitudinal vertical section.

Figure 5 is an elevation of one of the discs.

Figure 6 is a side elevation thereof.

Figure 7 is a section on line A—A of Figure 6.

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Figure 8 is a section on line B—B of Figure 2.

Figure 9 is an elevation, partly in section, of the shaft mounting the discs.

Figure 10 is a cross section of the shaft on line C—C of Figure 9.

Figure 11 is a longitudinal section of a permutation switch according to the present invention showing a modified form of construction.

Figure 12 is a perspective view of a modified form of disc.

Figure 13 is an elevation of a shaft for mounting the modified form of disc, and

Figure 14 is a wiring diagram showing suitable electrical connections for the permutation switch and magnetic lock.

In a convenient manner of carrying the present invention into effect, a cylindrical casing 1, formed from an insulating material such as that known under the registered trade-mark "Bakelite," is provided with lugs 2 for its attachment to the underside of the instrument board, for instance, of a car. One end of the casing is provided with a cover 3 which is secured to the casing by set screws 4. The other end of the casing is closed by a wall 5 which is provided with a central hole 6, a similar and aligned hole 7, being formed in the cover. Interiorly and longitudinally of the casing are ten ribs 8, of arcuate form in cross section and between these ribs are relatively flat spaces 9. Moulded in the casings are two longitudinally aligned and radially disposed sets of contacts 10, 11 each set comprising outer contacts 12, 13, connected to terminals 14, 15 respectively, and a central contact 16 shown more particularly in Figure 8. In the end wall 5 of the casing is a radial hole which houses a spring loaded ball 17, the ball and spring being retained by a grub screw 18. The holes 6, 7 in the casing wall and cover respectively constitute a bearing for a shaft 19 formed from an insulating material preferably that known under the registered trademark "Bakelite." On this shaft are mounted four similar brass discs 20, 21, 22 and 23, one of the discs being shown in Figures 5, 6 and 7. In the periphery of each disc are ten equally spaced blind holes 24 and in a selected hole is removably disposed a spring loaded plunger 25. On one face of each of the discs are digits 0 to 9 corresponding to the number of holes in the periphery of each disc. Thus the plunger 25 can be located in one of the holes according to a selected number. The discs are arranged in pairs on the shaft 19 and between the pairs is an insulating washer 26 also a spring washer 27 which prevents any side

play between the discs. As each disc has to be rotated individually, undue friction between the discs and also the washer and spring washer is prevented by bosses 27' formed on each disc. The shaft 19 is slidable longitudinally with respect to the discs and this movement is limited at one end by a flange 28 and at the other end by a washer 29 which is retained on the shaft by a pin 30. Diametrically of the shaft 19 is a key 31 which is loaded by a spring 32 and this key is so positioned that when the shaft is fully pushed into the casing 1 the key 31 will engage in a key-way 32', in the disc 23 and permit its rotation by the shaft. The other discs have similar key-ways and, as the shaft is pulled and rotated, the key-way in the adjacent disc 22 will be engaged permitting this disc to be rotated. The operation is repeated to effect the rotation in turn of the discs 21 and 20. In order that the key 31 should be correctly located laterally of each disc 22, 21, the shaft is provided with circumferential grooves 33 which are temporarily engaged by the spring loaded ball 17. Washer 29 will center key 31 laterally of disc 20. A knob 34 controls the movements of the shaft and on this knob are digits 0 to 9, Figure 3, corresponding to the numbering on the discs. When, however, the discs are locked to the shaft and the cipher on the knob is made to register with a fixed mark, such as the arrow 35 shown in Figure 3, the ciphers on the discs will be opposite the set of terminals 10. Thus, if the plungers were inserted in the holes indicated by ciphers, contact would be made with the set of terminals 10. It will therefore be apparent that the plungers 25 can be inserted in the discs according to a code, the numbers forming the code corresponding to the holes selected in a counter-clockwise direction from zero, assuming that the operation to close the circuits is made in a clockwise direction. During the rotation of each disc plunger 25 rides over the ribs 8 and is temporarily lodged in the grooves 9 thus locating the disc in selected positions. Conveniently, the set of contacts 10 may be utilised for closing the ignition circuit; the set 11 being employed for closing the circuit of the magnetic lock. Assuming that the ignition circuit is to be closed and that the selected code is 3264, the operation is as follows. The knob 34, assuming flange 28 to be in contact with wall 5, is rotated in any direction until the key 31 engages the key-way in the disc 23. The disc is then turned until the numeral 3 on the knob registers with the mark 35 on the casing. The effect of this rotation of the disc 23 is that its plunger is brought into contact with the contact 13. The shaft is then pulled and if the key-way of the adjacent disc 22 does not happen to be in alignment with the key, the latter will be depressed against the action of its spring and will be located centrally laterally of the outermost groove 33 in the disc 22 since the shaft will be temporarily engaged by the spring pressed ball 17. The shaft is then turned until the disc is engaged. When this is done the disc is rotated in a clockwise direction until the numeral 2 registers with the mark on the casing. A similar procedure is followed with respect to the other discs, viz. 21 and 20 and on the conclusion of these operations all of the plungers will be in contact with the set of contacts 10. Since the disc 20 is in electrical contact with the disc 21 and disc 22 with disc 23, the pairs being insulated from each other by the washer 26, a series connection is made through contact 12, discs 20, 21, contact 16, discs 22, 23 and contact 13. Obviously the manipulation of a code can be effected by pulling the shaft out to its fullest extent and then pushing it in to operate in turn discs 20, 21, 22 and 23.



In order to close the circuit of the magnetic lock and permit the opening of the bonnet, 2 is added to each digit of the original code number that is to say the code number for the magnetic lock will be 5486. Thus each disc will be moved two "click" positions beyond that required to close the ignition circuit to bring the plungers in contact with the set of contacts 11. In order to set the switch so that it can only be closed by the use of a code, the discs are rotated in turn through a number of "click" positions.

In the modified construction shown in Figures 11 to 13, each disc has an annular recess 36 and a slot 37. Secured in the shaft in any convenient manner is a dog 38, which, when the shaft is rotated, rides in the recess 36, but which can be brought into engagement with the slot 37 and effect the rotation of the disc.

Figure 14 shows suitable electrical connections for the permutation switch and magnetic lock when fitted to a motor vehicle. Referring to Figure 14, 50 is the car battery, 51 the permutation lock, 52 the magnetic lock, 53 the ignition coil, 54 the make and break, and 55 the distributor.

The magnetic lock may be of any appropriate construction and be fixed in any convenient position in order to lock the bonnet when the car is left unattended. The ordinary ignition key may be retained for use when it is deemed that the use of the permutation lock is unnecessary.

It will be appreciated that a permutation switch according to the present invention may be used with an electro-magnetic lock intended for use other than the locking and unlocking of the bonnet of a motor vehicle.

What we claim is:

1. A permutation switch comprising a housing, a shaft mounted in said housing for rotative and axial movement and being formed of insulating material, said shaft having an operating portion projecting from the housing in any of its axial positions, four discs freely mounted on said shaft within said housing, said discs being formed of conducting material and each having a number of radial sockets in its periphery and the number of sockets being the same for all discs, a removable contact for each disc selectively mounted in any of the sockets of such disc, said discs being arranged in two pairs with the discs of each pair in electrical contact but with the discs of adjacent pairs insulated from each other, a key carried by the shaft intermediate the ends thereof and being mounted for yielding movement into the shaft, all of said discs being provided with keyways into any of which the key may be selectively positioned by proper axial and rotative movement of the shaft, said shaft being provided with stops at its opposite ends for engaging the corresponding ends of the housing to limit axial movement of the shaft so as to position the key in the keyway of either of the end discs, a plunger carried by the housing for engaging either of two axially spaced circumferential grooves in the shaft to locate the shaft axially of the housing so as to selectively position the key in the keyway of either of the two inner discs, a group of contacts carried at the inner

side of the housing for cooperation with the contacts carried by the discs and having one of such contacts arranged for cooperation with the contacts carried by the two inner discs and two of such contacts arranged for cooperation with the corresponding contacts carried by the end discs.

2. A permutation switch according to claim 1 wherein the contact carried by each disc is a spring loaded contact and wherein the interior of the housing is provided with longitudinally extending ribs engageable by the contacts whereby a "click" indication may be given of the degree of rotation of the discs.

3. A permutation switch comprising a housing, a shaft mounted in said housing for rotative and axial movement and being formed of insulating material, said shaft having an operating portion projecting from the housing in any of its axial positions, four discs freely mounted on said shaft within said housing, said discs being formed of conducting material and each having a contact carried on its periphery, said discs being arranged in two pairs with the discs of each pair in electrical contact but with the discs of adjacent pairs insulated from each other, a key carried by the shaft intermediate the ends thereof and being mounted for yielding movement into the shaft, all of said discs being provided with keyways into any of which the key may be selectively positioned by proper axial and rotative movement of the shaft, said shaft being provided with stops at its opposite ends for engaging the corresponding ends of the housing to limit axial movement of the shaft so as to position the key in the keyway of either of the end discs, a plunger carried by the housing for engaging either of two axially spaced circumferential grooves in the shaft to locate the shaft axially of the housing so as to selectively position the key in the keyway of either of the two inner discs, a group of contacts carried at the inner side of the housing for cooperation with the contacts carried by the discs and having one of such contacts arranged for cooperation with the contacts carried by the two inner discs and two of such contacts arranged for cooperation with the corresponding contacts carried by the end discs.

4. A permutation switch comprising a housing, a shaft mounted in said housing for rotative and axial movement and being formed of insulating material, said shaft having an operative portion projecting from the housing in any of its axial positions, four discs freely mounted on said shaft within said housing, said discs being formed of conducting material and each having a contact carried on its periphery, said discs being arranged in two pairs with the discs of each pair in electrical contact but with the discs of adjacent pairs insulated from each other, a key carried by the shaft intermediate the ends thereof, an annular recess in each disc for selectively receiving the key to permit relative rotation of the disc and shaft and a keyway in each disc for selectively receiving the key to cause rotation of the disc with the shaft, said shaft being provided with stops at its opposite ends for engaging the corresponding ends of the housing to limit axial movement of the shaft so as to position the key in the keyway of either of the end discs, a plunger carried by the housing for engaging either of two axially spaced circumferential grooves in the shaft to locate the shaft axially of the housing so as to selectively position the key in the keyway of either of the two inner discs, a group of contacts carried at the inner side of the housing for cooperation with the contacts carried by the discs and having one of such contacts arranged for cooperation with the contacts carried by the two inner discs and two of such contacts arranged for cooperation with the correspond-



5. A permutation switch according to claim 4 wherein the contact carried by each disc is a spring loaded contact and wherein the interior of the housing is provided with longitudinally extending ribs engageable by the contacts whereby a "click" indication may be given of the degree of rotation of the discs.

6. A permutation switch comprising a housing, a shaft mounted in said housing for rotative and axial movement, four discs freely mounted on said shaft within said housing, each of said discs having a contact carried thereby, the discs being arranged in two pairs with the contacts of each pair electrically connected but with the contacts of the two pairs electrically insulated from each other, a key carried by the shaft intermediate the ends thereof, all of said discs being provided with keyways into any of which the key may be selectively positioned by proper axial and rotative movement of the shaft, said shaft being provided with stops at its opposite ends for engaging the corresponding ends of the housing to limit axial movement of the shaft so as to position the key in the keyway of either of the end discs, a plunger carried by the housing for engaging either of two axially spaced circumferential grooves in the shaft to locate the shaft axially of the housing so as to selectively position the key in the keyway of either of the two inner discs, a group of contacts carried in the housing for cooperation with the contacts carried by the discs and having one of such contacts arranged for cooperation with the contacts carried by the two inner discs and two of such contacts arranged for cooperation with the corresponding contacts carried by the end discs.

7. A permutation switch comprising a housing, a shaft mounted in said housing for rotative and axial movement, four discs freely mounted on said shaft within said housing, each of said discs having a contact carried thereby, the discs being arranged in two pairs with the contacts of each pair electrically connected but with the contacts of the two pairs electrically insulated from each other, a key carried by the shaft intermediate the ends thereof, all of said discs being provided with keyways into any of which the key may be selectively positioned by proper axial and rotative movement of the shaft, a group of contacts carried in the housing for cooperation with the contacts carried by the discs and having one of such contacts arranged for cooperation with the contacts carried by the two inner discs and two of such contacts arranged for cooperation with the corresponding contacts carried by the end discs.

8. A permutation switch comprising a shaft supported for rotative and axial movement, four discs freely mounted on said shaft, each of said discs being provided with a contact, the discs being arranged in two pairs with the contacts of each pair electrically connected but with the contacts of the two pairs electrically insulated from each other, interfitting portions between the shaft and each disc for selectively rotating each disc upon proper axial and rotative movement of the shaft, a group of contacts supported adjacent the discs for cooperation with the contacts carried by the discs and having one of such contacts arranged for cooperation with the contacts carried by the two inner discs and two of such con-

tacts arranged for cooperation with the corresponding contacts carried by the end discs.

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ERNEST JOHN MUNDAY.


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## Certificate of Correction

Patent No. 2,491,561 December 20, 1949

WILLIAM ARTHUR JOHN HORNE ET AL.

It is hereby certified that errors appear in the printed specification of the above numbered patent requiring correction as follows:

Column 3, lines 61 and 62, for the words "of the outermost groove 33 in the disc 22 since the shaft" read *of the disc 22 since the outermost groove 33 in the shaft*; column 6, line 5, after the syllable and hyphen "correspond-" insert *ing contacts carried by the end discs.*;

and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 18th day of April, A. D. 1950.

[SEAL]

THOMAS F. MURPHY,
*Assistant Commissioner of Patents.*

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[SEAL]

THOMAS F. MURPHY,
*Assistant Commissioner of Patents.*