

June 3, 1969

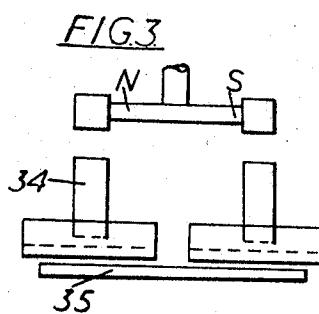
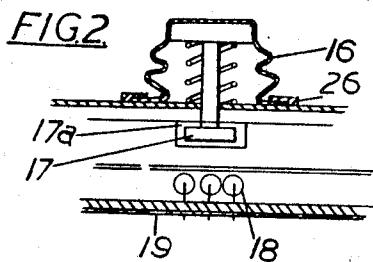
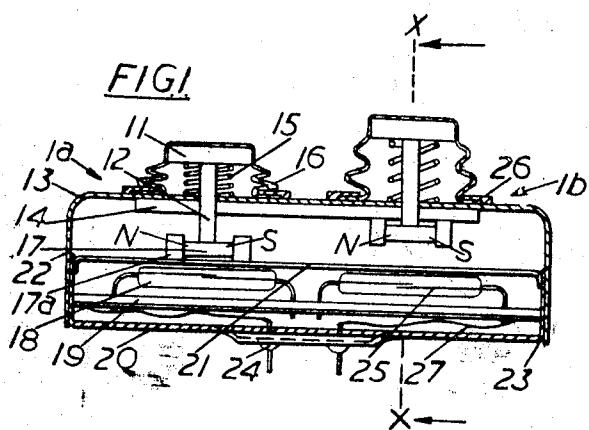
E. R. MYATT

3,448,419

WEATHERPROOF PUSHBUTTON KEY SET EMPLOYING SEALED CONTACTS  
OPERATED BY A PERMANENT MAGNET

Filed Sept. 15, 1966

Sheet 1 of 3



June 3, 1969

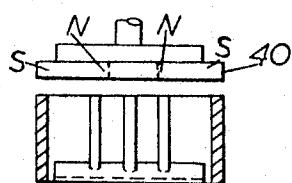
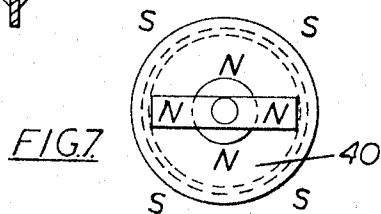
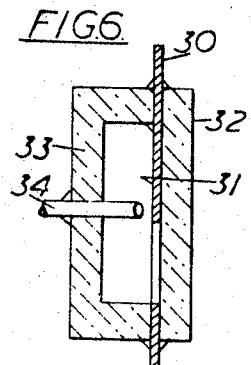
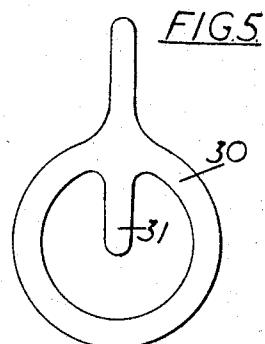
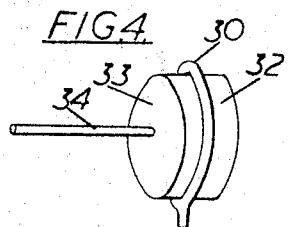
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Sheet 3 of 3

FIG.8

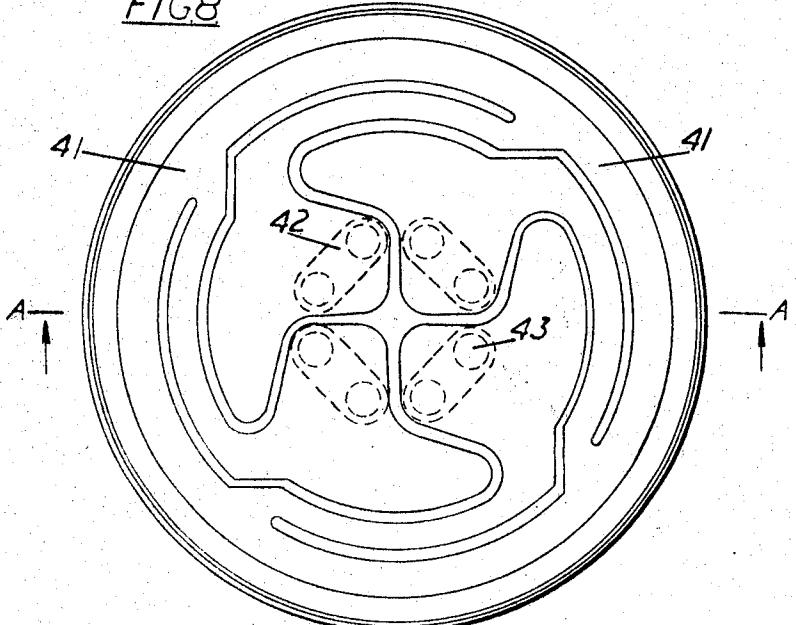
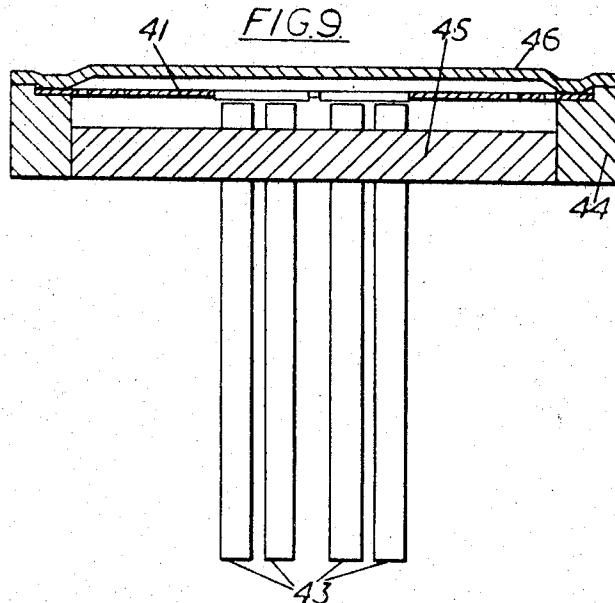


FIG.9



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**WEATHERPROOF PUSHBUTTON KEY SET EMPLOYING SEALED CONTACTS OPERATED BY A PERMANENT MAGNET**

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Int. Cl. H01h 9/04, 1/66

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14 Claims

## ABSTRACT OF THE DISCLOSURE

A pushbutton key set is provided with weather-proofing by having each of a plurality of pushbuttons sealed into a box by a flexible bellows cover. Pushbutton shafts are extended from the pushbuttons into the box with magnets attached to the ends within the box. Reed contacts, or other magnetically responsive contacts, are placed within the box to be closed when a magnet is brought within a certain distance by pressing on the pushbutton. Inside the top cover of the box there is a plate of magnetic material which acts as a keeper for each magnet in its reset condition and which also gives the pushbutton a snap action, due to the attraction between the magnet and the plate.

This invention relates to keys, and in particular to those designed for outdoor use in all weather conditions.

According to the present invention there is provided a weatherproof key including a pushbutton for operating one or more electrical contact device of the type having their contact making members hermetically sealed inside an enclosure, at least the moving member of each said contact device being of magnetic material, a flexible cover sealing said pushbutton to a container within which the controlled contact device is located, a permanent magnet mounted so as to be movable towards and away from said contact device or devices so as to control the condition thereof, and spring means urging said pushbutton to its nonoperated condition.

Embodiments of the invention will now be described, with reference to the accompanying drawings in which:

FIG. 1 is a cross sectional view of a keyset showing two keys according to the invention.

FIG. 2 is a cross sectional view of FIG. 1 through XX.

FIG. 3 illustrates diagrammatically the use of an alternative type of sealed contact device to the reed relay as shown in FIGS. 1 and 2.

FIG. 4 is a perspective view of the sealed contact device shown in FIG. 3.

FIG. 5 is a plan view of an annulus with an integral movable contact member forming part of the sealed contact device shown in FIG. 4.

FIG. 6 is an enlarged diagrammatic view in longitudinal section of the device shown in FIG. 4.

FIG. 7 illustrates diagrammatically the use of another alternative type of sealed contact device to the reed relay shown in FIGS. 1 and 2.

FIG. 8 is a plan view of the further type of sealed contact device as shown in FIG. 7, with the top cap removed.

FIG. 9 shows a cross-sectional view along the line A—A of the sealed contact device shown in FIG. 8.

Referring now to FIGS. 1 and 2, there are shown two keys 1a and 1b according to the invention, one of the keys 1a being in the operated condition and the other 1b being in the nonoperated condition.

Each key comprises a button 11 mounted on a rod

2

12 which passes through a top cover 13 and a plate of magnetic material 14. The button 11 is normally held in its nonoperated position by a spring 15 which is covered by a flexible cover 16.

5 A permanent magnet 17 to which are attached two soft iron blocks 17a is fixedly mounted to the end of the rod 12 opposite to the button 11, and this operates reed switches 18 when the button 11 is pressed. These reed switches each have two contacts of magnetically and electrically conductive material sealed into opposite ends of a tube of, for instance, glass.

The reed switches 18 are mounted on a printed wiring board 19, the whole being in a weatherproof container formed by the base plate 20 sealed to a nonmagnetic plate 15 21 by a seal 22. This nonmagnetic plate thus divides the container of the keyset into an upper compartment which contains the pushbuttons and their components, such as the magnet 17 of the pushbutton 1a, and the other containing the reed switches and the printed wiring board. Electrical connections are made to the reed switches by hermetically sealed terminals 24.

20 When the operator presses a button such as 11, the pressure is opposed by the spring 15 and by the action of the permanent magnet 17. This permanent magnet 17 is held against the plate of magnetic material 14 which provides a low reluctance path for the magnetic flux and hence acts as a keeper for the magnet 17.

When the pressure exerted by the operator on the pushbutton 11 is sufficient to compress the spring 15 and 30 to overcome magnetic attraction between the magnet 17 and the magnetic material 14, the magnet 17 separates from the plate 14. As soon as this happens, the magnetic force is greatly diminished due to the air gap between the magnet and the plate. Thus the excess pressure exerted on the pushbutton to overcome the magnetic force causes the pushbutton to be rapidly depressed until the magnet comes into contact with the nonmagnetic plate 21. As the magnet 17 travels from its nonoperated to its 35 operated condition its flux pattern changes. In the nonoperated condition the majority of the flux lines lie in the magnetic plate 14 since the permeability of this plate is far higher than that of the air which otherwise surrounds the magnet. In the operated position however the magnet is far enough away from the magnetic plate 14 for the plate 14 to have only a very minor influence on the magnetic field compared with the reed relay contacts 25 which are much closer. Thus in the operated position the majority of the flux lies in the reed switch contacts 25 and causes the contacts of the controlled reed switches to be 40 closed.

45 When the button 11 is depressed the flexible cover 16 is compressed or "concertinaed" as shown in FIG. 1 so that a weatherproof seal is maintained.

The pushbutton 11 on being released returns to its nonoperated position by the action of the compressed spring 15, assisted by the attractive forces between the magnet 17 and the fixed magnetic plate 14. The contacts 25 of the reed switches 18 open, so that the reed switches 18 50 become non conductive until the button 11 is again pressed. The weatherproofing is provided by the seals 22, 23 and by the collar 26 which clamps the flexible cover 16, for the pushbutton 11, to the top cover 13.

Electrical connections are made through the base plate 65 20 to the reed switches 18, by hermetically sealed terminals 24, and wires 27 to the printed wiring board 19 which is a convenient way of mounting the reed switches, and may be used to provide interconnections between the 70 keys of a keyset as necessary for any desired signalling code.

As already mentioned, the non-magnetic plate 21 divides the box formed by the top cover 13 and the base plate

20 into two compartments sealed from each other by seals 22. This protects the printed wiring board against any ingress of moisture or harmful gases through damage to the flexible cover 16. It also provides a stop for the push button 11 and prevents the magnet 17 from striking the reed switches 18 and damaging them in any way.

The magnet 17 must at all times be kept in the correct orientation with respect to the reed switches 18 and to ensure this the rod 12 to which the magnets 17 are attached is keyed in some manner with the top cover 13 and the magnetic plate 14 so that it cannot revolve. The top cover 13, and the magnetic plate 14 thus act as a bush for the rod 12 to slide in, preventing any locking of the button 11 due to the rod 12 twisting sideways as the button 11 is pushed.

As shown in FIG. 2, there are three reed switches, but any reasonable number may be used providing sufficient space is available and the magnet 17 is large enough to operate them all.

Other types of sealed contact devices may be used in place of the reed switches, two examples being shown in FIGS. 3 to 8.

Referring now to FIGS. 3, 4, 5 and 6, FIG. 3 shows diagrammatically how the sealed contact device of FIGS. 4, 5 and 6 may be used in the weatherproof key set in place of the reed relay 18.

The movable member is provided by an annulus 30 of electrically and magnetically conductive material which is continuous around its periphery and which has an inwardly projecting tongue 31. This is sealed as shown, into two ceramic caps 32, 33, a fixed contact member 34, also made of electrically and magnetically conductive material, being sealed through the cap 33.

The operation of this device is that when a magnet is brought near to the end of the fixed contact member 34, a flux path is completed through this member, the tongue 31, the pole piece or yoke 35 through the corresponding tongue 31 and fixed contact member 34 of the other relay (see FIG. 3) back to the other pole of the magnet. This causes the tongue 31 to bend and to make contact with the fixed contact member 34 thus completing an electrical connection. This device is described more fully in a British Patent to C. H. Foulkes, No. 1,021,047, which issued in 1966.

Another type of sealed contact device is shown in FIGS. 7, 8 and 9. FIG. 7 shows diagrammatically the way in which this multi-contact sealed device is mounted, in relation to the magnet 40 (see FIGS. 1 and 2 reference 17). In this example the magnet 40 is annular, the outer perimeter being of one polarity and the inner of the opposite polarity.

FIGS. 8 and 9 show the multi-contact device in more detail. FIG. 8 shows a plan view of the movable member 41 which has a number of contact areas 42 plated with electrically conductive material and insulated from the member 41 which is made of magnetically conductive material. The centre part of the movable member 41 moves towards and away from fixed contact members 43 in accordance with the position of the magnet 40. When the magnet is moved by depression of the push-button the contact areas on the movable member are moved towards the fixed contact members 43, which are arranged in pairs, the number of pairs being equal to the number of contact areas, each pair being aligned with a contact area. The contact areas 42 thus connect electrically the contacts in each pair of fixed contact members 43.

The fixed contact members 43 are sealed in an annulus 44 of ferromagnetic material by a glass disc 45. The ends of these members 43 are usually suitably treated e.g. with a precious metal to give a good electrical contact. The glass disc 45 seals one end of the annulus 44 and the other end is sealed by an outer cap 46 of ferromagnetic material. The movable contact member 41 is clamped around its periphery between the cap 46 and the annulus

44 so that it is sealed hermetically within an enclosure with the fixed contact members 43.

This type of switch is described more fully in a patent to D. S. Ridler et al. No. 3,324,432.

It is to be understood that the foregoing description of specific examples of this invention is made by way of example only and not to be considered as a limitation on its scope.

What is claimed is:

1. A weatherproof key comprising a push button for operating one or more electrical contact devices of the type having their contact members hermetically sealed inside an enclosure, a two-ended movable member having one end fastened to said push button, a flexible cover sealing said push button to a container, a controlled contact device located inside the container, a permanent magnet mounted on the other end of said movable member so as to be movable towards and away from said contact device to thereby control the condition thereof, spring means urging said push button to its non operated condition, said push button in its non-operated condition holding said permanent magnet in contact with a piece of ferromagnetic material, said ferromagnetic material acting as a stop for said pushbutton and as a keeper for said permanent magnet, and said ferromagnetic material providing a snap action for said pushbutton due to the force of attraction between it and said permanent magnet.

2. A weatherproof key substantially as claimed in claim 1 in which said container is divided by a partition of a non-magnetic material into portions which are sealed from each other, and in which said magnet is in one of said portions while said contact devices are in the other of said portions.

3. A weatherproof key as claimed in claim 1 in which connections are made to the contact device by means of hermetically sealed terminals.

4. A weatherproof key as claimed in claim 1 in which the contact device is of the sealed reed type, and in which each portion of the contact device is made of electrically and magnetically conductive material.

5. A weatherproof key comprising a push button for operating one or more electrical contact devices of the type having their contact members hermetically sealed inside an enclosure, a two-ended movable member having one end fastened to said push button, a flexible cover sealing said push button to a container, a controlled contact device located inside the container, a permanent magnet mounted on the other end of said movable member so as to be movable towards and away from said contact device to thereby control the condition thereof, spring means urging said push button to its nonoperated condition, said container including a partition of a non-magnetic material dividing the container into portions which are sealed from each other, and in which said magnet is in one of said portions while said contact devices are in the other of said portions, and sealed contact devices being mounted on a printed circuit board located in said other portion.

6. A weatherproof key comprising a push button for operating one or more electrical contact devices of the type having their contact members hermetically sealed inside an enclosure, a two-ended movable member having one end fastened to said push button, a flexible cover sealing said push button to a container, a controlled contact device located inside the container, a permanent magnet mounted on the other end of said movable member so as to be movable towards and away from said contact device to thereby control the condition thereof, spring means urging said pushbutton to its nonoperated condition, said contact device being of the type having one contact member in the form of a complete annulus of electrically and magnetically conductive material, said one contact member having a resilient tongue inwardly projecting therefrom to provide a movable contact, two ceramic caps sealed all the way around the annulus, one on either side thereof to form therewith a hermetically sealed en-

closure between the caps with a peripheral portion of the annulus outside the enclosure, one of the caps having an interior surface spaced from the tongue to allow for its movement, and a rod of electrically and magnetically conductive material hermetically sealed through the last mentioned cap to provide a fixed contact member and magnetic pole piece co-operating with the movable contact member.

7. A weatherproof key substantially as claimed in claim 6 in which more than one contact device is to be operated and in which the magnetic circuits of the contact devices are in series.

8. A weatherproof key comprising a push button for operating one or more electrical contact devices of the type having their contact members hermetically sealed inside an enclosure, a two-ended movable member having one end fastened to said push button, a flexible cover sealing said push button to a container, a controlled contact device located inside the container, a permanent magnet mounted on the other end of said movable member so as to be movable towards and away from said contact device to thereby control the condition thereof, spring means urging said push button to its non operated condition, the contact device including sealed multiple contacts within a hermetically sealed enclosure and a flat resilient plate of ferromagnetic metal, said flat plate having a peripheral area which is sealed into the enclosure and a plurality of inwardly extending tongues, a contact area of electrically conductive material carried on each tongue and insulated therefrom by a layer of electrically insulating material, and two fixed contacts of electrically conductive material for each tongue, said two fixed contacts being sealed through the enclosure and located near said tongue, whereby upon the application of magnetic flux through the device the tongues move and each contact area bridges its corresponding two fixed contacts to provide an electrical path between them.

9. A weatherproof key substantially as claimed in claim 8 in which the magnet is circular in shape.

10. A push button key set including a second set of keys substantially as claimed in claim 1 mounted to share the same container.

11. A weatherproof push button key set comprising a number of push buttons, an operating shaft for each of said push buttons, each operating shaft passing through a cover plate of the keyset, a bellows-like flexible cover for each push button, each said flexible cover sealing its push button to said cover plate, spring means for each said push button urging it to a non-operated position, a permanent magnet mounted on the inner end of each operating shaft, a sealed reed-type contact device, said contact device having contact members of electrically and magnetically conductive material mounted in alignment with a push button, said push button responding to pressure against the influence of its spring means to drive its magnet to a position adjacent to the sealed contact device whereby said contact device is operated, said push button reverting to its normal position under the influence of its spring means when released, said cover plate including a plate of magnetic material to act as a keeper for said magnet in the non-operated position, and each said magnet being sub-

stantially normal to the shaft of its push button and also being parallel to the contact device which it controls.

12. A keyset substantially as claimed in claim 11 including a partition which divides the key set into two separate sealed portions, one containing said magnet and the associated shaft and the other containing said sealed contact device.

13. A keyset as claimed in claim 12 in which said sealed contact device is mounted on a printed circuit board in said other portion of the keyset.

14. A weatherproof push button key set, including a container having a cover and a bottom plate, said bottom plate being sealed to said cover, said cover having a top plate portion parallel to said bottom plate, a partition of non-magnetic material in said container which is generally parallel to said top and bottom plates and divides said container into an upper and a lower portion, sealing means sealing said two portions one from the other, a set of push buttons each of which has an operating shaft passing through said top plate, a coil spring for each push button, each said coil spring embracing the operating shaft of a push button outside said cover plate and urging the button outwards to its non-operated position, a flexible bellows-like portion for each push button located outside the shaft and the spring means and sealed to said cover plate, a flat plate of magnetic material on the inside of said top plate portion so that each said operating shaft passes therethrough, a permanent bar magnet fastened on the inner end of and at right angles to each operating shaft, each push button in its non-operated position permitting the permanent magnet fastened to its operating shaft to engage said plate of magnetic material, said magnetic material thereby forming a keeper for the magnets and an upper stop for the push buttons, a printed circuit board in said lower portion connected to terminals hermetically sealed through said bottom plate, a set of sealed reed contact devices for each said push button, said contact devices including contact members of electrically and magnetically conductive material, each said set of contact devices being mounted on said printed circuit board in alignment with its push button, each push button responsive to pressure to move against the compressive force of its spring and the attraction between its magnet and said magnetic plate to its operated position in which its magnet abuts said partition, said magnet operating its sealed contact device, and said push button upon release returning to rest under the influences of its coil spring and of the attraction between its magnet and said plate of magnetic material.

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U.S. CL. X.R.