United States Patent [19]

Khitro et al.

[11] **3,723,674**

[45] **Mar. 27, 1973**

[54] **THUMBWHEEL SWITCH WITH IMPROVED THUMBWHEEL CAMMING STRUCTURE FOR RESILIENT CONTACTS**

[76] Inventors: **Emmanuil Lipovich Khitro,** Nikitinskaya ulitsa, 1911, kv. 62; **Nikolai Nikolaevich Zhekhov,** ulitsa Demyana Bednogo, 20, korpus 2, kv. 48, both of Moscow, U.S.S.R.

[22] Filed: **Jan. 28, 1972**

[21] Appl. No.: **221,741**

[52] **U.S. Cl.**.....**200/11 TW,** 200/6 BB

[51] **Int. Cl.**.....**H01h 19/58,** H01h 21/78

[58] **Field of Search**.....200/11 TW, 6 BB

[56] **References Cited**

UNITED STATES PATENTS

3,558,834	1/1971	Zielke	200/11 TW
3,366,751	1/1968	Capellari	200/11 TW
3,409,747	11/1968	Mincone	200/11 TW
3,567,894	3/1971	Spreitzer	200/11 TW X

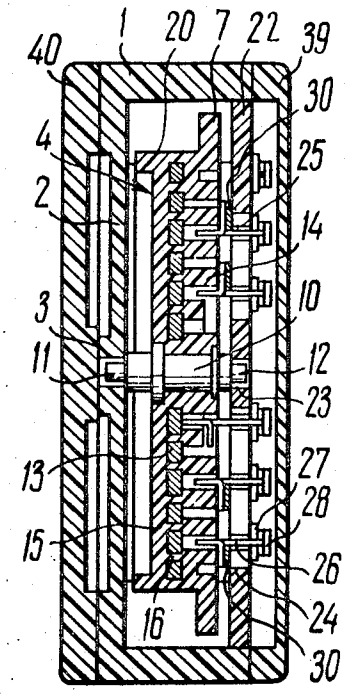
Primary Examiner—J. R. Scott

Attorney—Eric H. Waters et al.

[57] **ABSTRACT**

The essence of the invention consists in a switch which comprises a digit wheel and spring contacts, arranged in a housing together with a means for presetting a program of direct and inverse commutation of circuits by said spring contacts. Said means is made in the form of rings of dielectric material disposed concentrically on a contact member secured on said wheel. The rings have shaped projections. The spring contacts are made in the form of U-shaped contacts and a comb-shaped contact having blades the number of which is equal to the number of the U-shaped contacts. The comb-shaped contact and the U-shaped contacts are placed on a plate mounted in the housing.

1 Claim, 6 Drawing Figures



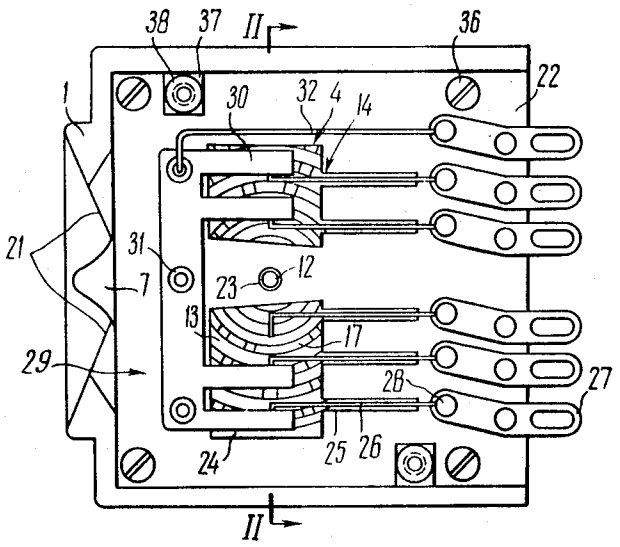


FIG. 1

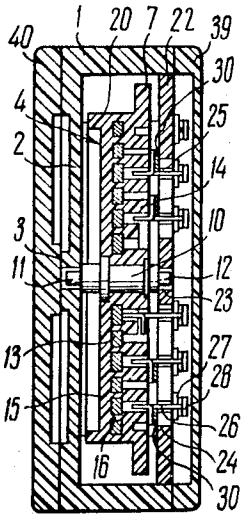


FIG. 2

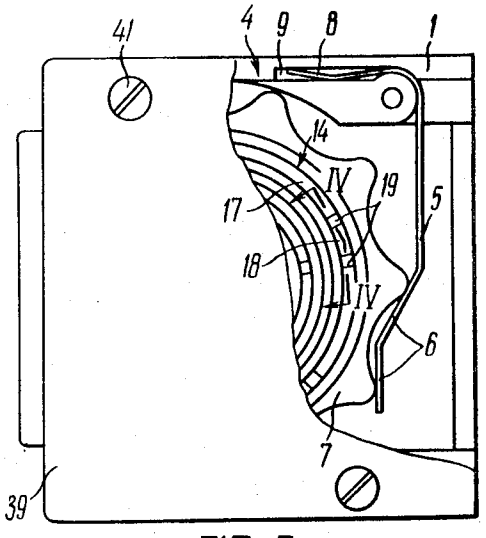


FIG. 3

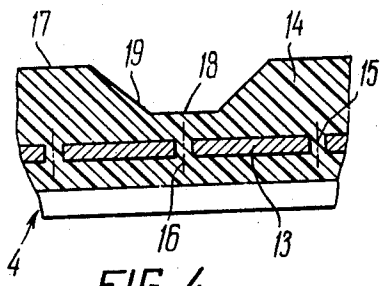


FIG. 4

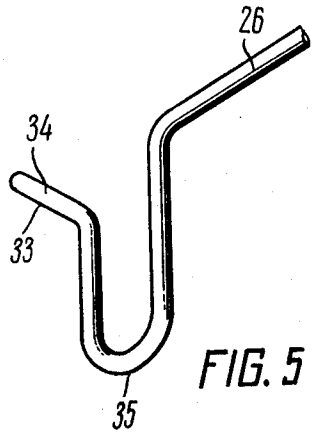


FIG. 5

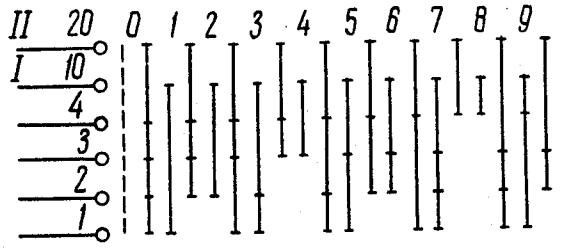


FIG. 6

THUMBWHEEL SWITCH WITH IMPROVED THUMBWHEEL CAMMING STRUCTURE FOR RESILIENT CONTACTS

The present invention relates to commutation devices and, more specifically, to switches.

Well known in the art are switches with a housing accommodating a thumbwheel or digit wheel (sometimes called a limb) and spring contacts with a device presetting a program of direct and inverse commutation by these spring contacts.

These switches are built around co-parallel printed circuit boards with working patterns presetting the program of commutation. Arranged between boards or plates is a member, e.g., a wheel, carrying spring contacts on both its faces. These contacts together with the patterns effect the prescribed program of commutation.

The manufacture of contact elements of known switches is a highly time- and labor-consuming process. This mainly concerns such elements as printed circuit boards or contact plates. In addition, such constructions are disadvantageous in that the permanent sliding of the spring contacts of the wheel about the working patterns of the boards under considerable pressure results in intensive wear of the working surfaces of the contacts and patterns. This is accompanied by transfer of the coating material (galling) onto the insulating gaps between individual pattern parts or sections of the printed circuit boards. The latter is associated with the permanent sliding of the contacts along the working surfaces of the patterns without a break during the switching operation of the wheel, and in the process of operation of the switch this leads to a progressive decrease in the insulation resistance between the pattern parts of the printed circuit boards, a deterioration of their dielectric properties and to an electrical breakdown of these boards.

Such constructions are also featured by low efficiency during manufacture of switches of different types with various diagrams of commutation since in this case it is necessary to replace all contact elements, namely, the limb or wheel with the spring contacts and printed circuit boards.

An object of the present invention is to provide a switch having a high service life and being reliable in operation.

This object is attained by providing a switch whose housing accommodates a digit wheel and spring contacts with a device presetting a program of direct and inverse commutation effected by the spring contacts, in which, according to the invention, the presetting device is made in the form of insulating rings disposed concentrically on a contact member secured on the wheel and having shaped projections. The spring contacts are made in the form of U-shaped contacts and a comb-shaped contact having blades the number of which equals to that of the U-shaped contacts, said comb-shaped and U-shaped contacts being positioned on a board or plate secured in the housing so that the non-contacting surface of the U-shaped contact corresponding to the rings interact with the shaped projections of the rings and, at the same time, first contacting surfaces of the U-shaped contacts are in electric contact with the corresponding blades of the comb-shaped contact, in which case second contacting surfaces of the U-shaped contacts interact with the contact member.

The herein described construction of the switch permits the wear of the spring-contact working surfaces and that of the contact member to be reduced, and this increases the life of the switch and its reliability in operation. This construction is suitable for mass production of switches having different circuit diagrams of commutation.

Other objects and advantages of the present invention will be apparent from the following detailed description of a particular, exemplary embodiment thereof, reference being made to the accompanying drawings, in which:

FIG. 1 is a general view of a switch according to the invention with a cover removed;

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

FIG. 3 is a general view of the switch with a partial section of the cover;

FIG. 4 is a sectional view of a digit-wheel ring of the switch, taken along line IV—IV in FIG. 3 (shown in the drawing plane);

FIG. 5 is a view of a portion of a U-shaped contact of the switch, and

FIG. 6 is a diagram of commutation of the switch (binary inverse code).

The switch according to the invention comprises a housing 1 (FIG. 1) shaped as a flat rectangular plastic box with a side wall 2 (FIG. 2) having an aperture 3.

Mounted in the housing 1 is a plastic digit wheel 4. The working positions of the digit wheel 4 are fixed by a metallic retainer spring 5 (FIG. 3) faces 6 of which rest on shoulders 7 of the digit wheel 4. An end portion 8 of the retainer spring 5 is inserted into a slot 9 provided in the housing 1.

The digit wheel 4 has a metal shaft 10 (FIG. 2) with journals 11,12 and a partly embedded contact member 13. Mounted on the latter is a device effecting commutation of spring contacts and consisting of four concentrically arranged rings 14 made of any insulating material, for example, of plastics. The rings 14 are secured along the perimeter of the digit wheel 4 by means of bridges 15 (FIG. 4) which are formed in through holes 16 of the contact member 13 in the process of making the digit wheel 4 by injection moulding. Constructively, rings 14, provided for presetting a program of commutation, consist of a number of projections 17 which are associated with recesses 18 through sloping portions or platforms 19.

Impressed on a cylindrical surface 20 (FIG. 2) of the digit wheel 4 are symbols or numerals from 1 to 9 and a zero mark 0, which are visible through a window 21 (FIG. 1) provided in the housing 1.

Attached to the housing 1 at the side of the rings 14 of wheel 4 is a plate 22 made of an insulating material and having an opening 23, ports 24 and guide slots 25.

The wheel 4 is mounted in the housing 1 between the side wall 2 (FIG. 2) and the plate 22, the journal 11 entering the aperture 3 of wall 2 and the journal 12 entering the opening 23 of the plate 22.

On plate 22 are mounted five U-shaped spring contacts 26 made of bronze. The contacts 26 are located in guide slots 25 and are fixed by rivets 28 together with mounting terminals 27.

On plate 22 is also mounted a bronze comb-shaped spring contact 29 (FIG. 1) having four blades 30. This contact serves as a first common current carrying member secured by means of hollow rivets 31 and electrically connected to one of the mounting terminals 27 through a current-conducting lead 32.

The four U-shaped spring contacts 26 are mounted on the plate 22 so that through their non-contacting surfaces 33 (FIG. 5) they rest on the projections 17 (FIG. 4) of the insulating rings 14. In this case first contacting surfaces 34 (FIG. 5) disposed respectively under the blades 30 (FIG. 1) of comb-shaped contact 29 are pressed to these blades,while the second contacting surfaces 35 (FIG. 5) are disposed above the contact washer 13 (FIG. 2) of digit wheel 4.

The U-shaped spring contact 26 disposed near shaft 10 of wheel 4 is used as a current collector of the second common member which is a contact member 13 of wheel 4.

The plate 22 (FIG. 1) is fixed to the housing 1 by means of screws 36. Mounted in the through holes 37 of the housing 1 are threaded rods 38 serving as coupling members for side covers 39 and 40 (FIG. 2) mounted with the aid of screws 41 (FIG. 3).

The operating principle of the switch disclosed herein consists in that the rings 14 attached to digit wheel 4, and presetting a program of commutation, are turned in each working position of wheel 4, these positions being fixed by the retainer spring 5. In this case the alternation of the projections 17 and recesses 18 is effected depending on a prescribed program of the limb 4 so that they occupy a number of definite positions relative to the U-shaped spring contacts 26 arranged on the plate 22.

Part of the U-shaped spring contacts 26, or at least one of these contacts, with their non-contacting surfaces rest on the projections 17 of the rings 14 in each fixed position of wheel 4, except for the zero position and, at the same time, with their first contacting surfaces 34 contact the blades 30 of the comb-shaped spring contact 29, thereby forming with this contact, as with one of the common bars of the electric circuit, an appropriate circuit of commutation. In this case the other part of the contacts (or at least one of them), whose non-contacting surfaces 33 face the recesses 18, form a gap with surfaces 33 and the recess 18, whereas the second contacting surfaces 35 of the U-shaped spring contacts 26 are in contact with contact member 13 of wheel 4 and form the gap between the first contacting surfaces 34 of the U-shaped spring contacts 26 and the corresponding blades 30 of the comb-shaped spring contacts 29, thus providing for inverse commutation.

At the zero position of the limb 4 all the U-shaped spring contacts 26, except for the current collector contact, are in contact with the corresponding blades 30 of the comb-shaped spring contact 29.

The U-shaped spring contacts 26 are lifted and lowered during the rotation of the wheel 4 by means of the sloping platforms 19 connecting the projections 17 and the recesses 18. For practical purposes, U-shaped contacts 26 as well as associated blades 30 of first common contact member 29 are disposed to both sides of shaft 10 for wheel 4 so that contacts are made at diametrally opposite sections of contact member 13 and intermediate rings 14. The coding program is arranged accordingly. The continuous ring portion of member 13, for cooperation with the second common contact 26, is closest to the center of wheel 4, no cooperation of this contact being required with any blade 30.

By providing optimum values of the angle of inclination of the sloping platforms 19 to the surfaces of the projections 17 of the wheel 4 (of the order of 40°), it is possible to ensure a comparatively high rate of breaking and making the contacts when transferring the wheel 4 from one fixed position to another, and this reduces the danger of an arc discharge between the switch contacts, thus allowing the initial electric parameters of the switch, in particular its contact resistance, to be maintained during the whole period of operation. Moreover, all the fins formed by the intersection of the planes of the projections 17 and the sloping platforms 19 pass through the center of the wheel shaft 10, minimizing sliding friction between the non-contacting surfaces 33 of the U-shaped spring contacts 26 and the sloping platforms 19 of the dielectric rings 14 and reducing their wear. This provides for reliable operation of all movable components of the switch.

If the switch is intended for commutating microcurrent circuits, all its contacting elements and terminals, i.e. the U-shaped spring contacts 26, the contact member 13 of digit wheel 4, the comb-shaped spring contact 29 and the mounting terminals 27 are provided with a gold plating.

The schematic diagram of commutation of the switch shown in FIG. 6 illustrates the functional cooperation of the U-shaped contacts 26, the comb-shaped contact 29 and the contact member 13. To the left, in a vertical direction upwards, there is schematically shown (conventionally) a row of the U-shaped contacts (such as 26). Numerals 1, 2, 3, and 4 indicate the numbers of the above-said contacts or the operating digits of the switch. Numerals I and II indicate the first and second common contact members of the electric switch circuits, constituted by one of contacts 29 and by contact member 13, as described earlier.

The horizontal row of numerals 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 indicates the numbers of the fixed positions of digit wheel 4. Located under each numeral of the row is a pair of vertical lines. The presence for electric contact of each of the working digits, with each other as well as with the first and second common contacts, is marked by short cross lines on each vertical line.

Zero position of the wheel 4 corresponds to the pair of vertical lines the extreme left of which one is in the form of a broken line, indicating the absence of electric contact with the common contact I.

The switch provided by the invention is a general-purpose commutation device which can be used in radio and measuring apparatuses, in computers as a coder or a program device, providing for any predetermined scheme of commutation.

The switch has many advantages, both from the viewpoint of its design, such as stable electric parameters, long service life, relatively low wear of the working surfaces of the contacts and contacting elements, high reliability, and its technology such as the possibility of producing a wide range of switches with any prescribed commutation code, by means of replacing only one component — the digit wheel.

Under industrial conditions the wheel can be made in stationary press molds which can be used as general-purpose machines, when equipped with interchangeable elements for the program rings of the wheel. The switch construction can be further modified depending on the prescribed program of commutation by mounting additional spring contacts and plates with the use of the wheel having program rings on both its faces.

The present switch has low weight and small overall dimensions. What is more, by selecting suitable insulating materials (plastics) for the wheel and the plate, with low values of dielectric loss, the switch can be used in high-frequency circuits of radio and measuring devices.

What is claimed is:

1. A switch comprising in combination a housing; a sole rotatable digit wheel disposed in said housing; stationary spring contacts disposed in said housing; means for presetting a predetermined program of direct and inverse commutation of circuits by said spring contacts; a partly embedded contact member of said presetting means being mounted on said wheel; insulating rings of said presetting means, having shaped projections, which are intermediate portions of said contact member, and disposed concentrically therewith; and a stationary plate secured in said housing for supporting said spring contacts; a part of said spring contacts being made in the form of U-shaped contacts; the other part of said spring contacts being made in the form of a comb-shaped spring contact having blades corresponding in number to at least that of said U-shaped contacts; said comb-shaped contact and said U-shaped contacts being arranged so that non-contacting surfaces of said U-shaped contacts, corresponding to said rings, slidingly interact with said projections of the rings; a first contacting surface of each U-shaped contact being also in contact with a blade portion of said comb-shaped contact while a second contacting surface of each U-shaped contact interacts with said contact member; said non-contacting surfaces slidingly engaging said shaped projections and being alternately moved thereby to selectively provide a contact path, and to interrupt the same, between respective ones of said U-shaped contacts and said contact member in accordance with the predetermined program of circuit commutation.

* * * * *