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SWITCHING KEYS WITH CAM FOLLOWER MEANS

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Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5

Fig. 6

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This invention relates to electric lever switches and more particularly to telephone listening and ringing keys.

Telephonic listening and ringing keys comprising a frame, a first and second group of spring contacts mounted on the frame in a first and second operating position, and a shifting member pivotally mounted on the frame to swing clockwise or counterclockwise from a midposition or rest position to either respective one of said first or second operating positions to establish different circuit connections are well known.

An inherent operating characteristic equally well known in listening and ringing keys is the overthrow effect of the shifting member when it is released from one operating position. The inertia of the shifting member may carry it past the rest position to effect the false operation of the switch contacts in the other operating position when released from an operating position. Accompanying the momentary operation of the contacts is a loud "click" sound which may be audible in both a subscriber's subset and a telephone operator's set connected to the current carrying telephone line.

Listening and ringing keys which eliminate the "click" may be referred to as "clickless" keys.

In the prior art, mechanical combinations for eliminating "clicks" in listening and ringing keys may be placed in two general categories. The first category encompasses keys having a single fixed pivot axis for the shifting member of the switch while the second category relates to keys characterized by a shifting member that is mounted to rock around one or the other of two spaced parallel axes of rotation.

The first category of listening and ringing keys has perhaps been more widely used and accepted. In general, the "click" in keys of this class has been eliminated by the addition of resilient members to the basic keys to react on the shifting member of the switch. Some of the combinations in this class include dampering springs, weighted cantilever springs, and contactless plunger springs, to mention but a few of the spring configurations used thereon.

Although keys of the first category are widely used, their disadvantages have been accepted as inherent and must be tolerated as the standards of a clickless key. These disadvantages, as compared to conventional keys, i.e., keys without click eliminating means, may be a large force required to operate the switch, a large pile-up of contact springs, and more weight. It is also pointed out that springs have a tendency to become stress fatigued and aged.

"Clickless" keys in the second category have lagged in public acceptance in spite of their latent potentials. Unfortunately, the advantages of these keys have been overshadowed by an operating characteristic common to keys having shifting members with double pivots. The operating characteristic prevalent in double pivot keys is that both ends of the key may be simultaneously dislocated if a force normal to a plane formed by the intersect of the double pivots is exerted on the shifting member. Attempts to correct this operating condition have only introduced other problems, for instance, by providing "curved" slots for the double pivots of the shifting member, it has been found that the shifting member may be clamped by wedge action in the slots.

Other attempts have included an S-shaped spring placed between the bottom of the shifting member and the frame axially aligned with the shifting member urging the shifting member upward. In this case, the S-shaped spring must be made stiff enough to resist the vertical downward force exerted by an operator on the shifting member. The consequences in this case are usually a noisier switch and one requiring a high operating force.

Accordingly, it is the general object of this invention to provide a new and improved "clickless" listening and ringing key which is economical to manufacture and which is reliable in operation.

It is a particular object of this invention to provide a new and improved actuating means in double pivot lever key switches for eliminating false operation of contact springs in both operating positions.

It is yet another object of this invention to provide a double pivot lever key that may be actuated even by a downward force normal to a plane formed by the intersection of the double pivots of the shifting members.

Another object of this invention is to provide a "clickless" listening and ringing key in which the shifting member may be locked in either operating position.

It is a further object of this invention to provide a waterproof "clickless" listening and ringing key.

The improved "clickless" telephone listening and ringing key which forms the subject matter of this invention and accomplishes the above cited objects comprises a frame, a shifting member mounted on the frame to rock clockwise and counterclockwise from a rest position to first and second operating positions on double pivot axles and a base assembly having a first and second group of spring contacts in respective first and second operating positions. In accordance with the invention, a cam block, a cam roller follower, a resilient means for yielding holding the shifting member in the rest position and detent springs for locking the shifting member in said first and second operating positions are also included.

The cam block is mounted on the base assembly directly below the rest position of the shifting member. The cam roller follower is rotatably mounted on a needle at one end of the shifting member and cooperates with the cam block to guide the shifting member in a circuital path when swung about one of its two pivotal axles. The cam block has two arcuate camming surfaces to match the circuital path scribed by the cam roller follower in each direction of travel. The two camming surfaces of the camming block intersect at a vertex which, if extended, would bisect a plane between the two spaced-apart pivot axles of the shifting member. In the midposition, the shifting member's cam roller follower is directly above and tangent to the vertex of the cam block.

In operation a force within the plane of travel of the shifting member will cause the shifting member to move in a path prescribed by the cam block. In this arrangement, the combination of the shifting member's spaced-apart axles, the cam block and the cam roller follower will not only prevent the overthrow of the shifting member but will also prevent the simultaneous yield of the pivot axes of the shifting member from the frame sockets.

The shifting member may be locked in an operating position by the engagement of the cam roller follower and the detent spring.

The features of this invention which are believed to be novel are set forth with particularity in the appended claims. The invention itself, both as to organization and manner of operation, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawing, in which:

FIG. 1 is a side view in section taken through line 1—1 of the lever key switch of FIG. 2, illustrating one embodi-
ment of the lever key switch in accordance with the invention in the rest position;

FIG. 2 is an end view of the lever key switch shown in FIG. 1 with portions of the spring contacts removed for a clearer view of the shifting member.

FIG. 3 is a fragmentary view of the lever key switch shown in FIGS. 1 and 2 in an operated position.

FIG. 4 is another embodiment of the invention illustrating a clickless, waterproof lever key switch in sectional view of the rest position taken along line 4—4 of FIG. 5.

FIG. 5 is a fragmentary end view of the waterproof lever key switch illustrated in FIG. 4 shown in the rest position.

FIG. 6 is a fragmentary side view of the lever key switch similar to that shown in FIG. 4 in an operating position.

The listening and ringing keys disclosed herein are of such design that the latest manufacturing techniques such as molding and impact extrusion may be used to fabricate a simple, compact and economical switch having only three basic parts, namely, a frame 20, a shifting member 1 and a molded base assembly 40 comprising first and second groups of contact springs 41 and 42 and an integral cam block 43. While it is stated that the switch in accordance with the invention may be made by the manufacturing process stated above or that it comprises only three components, it does not imply that other manufacturing techniques and that more parts having the essential elements cannot be used to practice the invention.

Referring to FIGS. 1–3, one embodiment of the listening and ringing key switch is shown comprising an inverted square-sided U-shaped frame 20 having a pair of oppositely disposed, downwardly extending legs 21 connected by a right angle portion 22 to trave 23 and 24 which form right and left pivot sockets 25 and 26, respectively.

The legs 21 are provided with aligned openings 27 and 28 and travel-limiting means 30 and 31 for shifting member 1. The opening 27 receives a spindle 29 while openings 28 receive fasteners to secure base assembly 40 to the frame 20. The travel-limiting means 30 and 31 may be tabs or projections extending inwardly from both legs 21 in a predetermined location that will limit the travel of the shifting member by engaging corresponding projections on the shifting member 1 or the pivot axes 2 and 3.

The shifting member 1 of the switch shown in FIGS. 1–3 may be a molded member comprising the following elements, right and left pivot axes 2 and 3, respectively, spaced apart in a parallel relationship and normal to the direction of travel of the shifting member 1, handle 4 for swinging the shifting member counterclockwise about pivot axis 2 and clockwise about axis 3, a cam roller follower 5 mounted at the opposite end of the handle 4, a spindle 6 for rotatably supporting the cam roller follower 5, a clearance hole 10 for spindle 29, and spring contact surfaces 8 and 9 for moving the first and second groups of contact springs 41 and 42, respectively.

Normally the shifting member 1 is in the rest or mid-position as shown in FIG. 1. In this position, pivot axes 2 and 3 are seated in assembly 40, respective frame sockets 25 and 26. The shifting member 1 is thereby held in the rest position by springs 7 which are fastened at one end to spindle 29 and spindle 6 at the opposite end. Thus, frame 20 and shifting member 1 are merely held together by springs 7 at this particular stage of construction thus far described. As was mentioned before, in this arrangement the shifting member's axes 2 and 3 may be easily displaced from the pivot sockets 25 and 26 by a downward vertical force since the springs 7 provide the only restraining force. While the spring constant may be increased for this purpose, it is advisable not to do so because movement of the member necessary to swing the shifting member 1. The added energy transferred by the springs 7 must be dissipated by the shifting member and the frame 20 which may result in noise and wear on the moving parts.

In accordance with the invention, cam block 43 solves the above stated problem. The cam block 43 has two arcuate camming surfaces 47 and 48 scribed by the cam roller follower 5 when the shifting member 1 is swung about axle 3 and counterclockwise about axle 2, respectively. The camming surfaces 47 and 48 intersect at a vertex 49 tangent to the cam roller follower 5 when it is in the rest position. Thus, if a force is applied to the shifting member 1, the cam block 43 not only guides the shifting member 1 into a circular path but will also instigate that both pivot axes 2 and 3 will not simultaneously depart from the frame pivot sockets 25 and 26, respectively.

The base assembly 40 not only includes the cam block 43 but also a first and second group 41 and 42 of spring contacts 50 mounted in a first and second operating switch position, respectively, all molded together in a block of insulating material 44.

The spring contacts 50 of the lever key are made identical wherever possible as so as to reduce the number of different parts in each group of contact springs 41 and 42. In order to keep the overall height of the key as small as possible, the springs 50 are "hairpin" shaped. "Hairpin" design reduces the length of the springs and still maintains a substantially flexible spring. Four contact springs 50 are used in a group as shown in FIG. 2. However, the exact number of contact springs 50 in a group may vary to meet the particular electrical circuit requirements. The particular design of the "hairpin" contact spring 50 allows many spring combinations, for instance, the make and/or break operation of the springs may be made by changing the spacing or by modifying the spring contact surfaces 8 and 9 on the shifting member 1 so that the individual spring contacts 50 may be cammed slightly ahead of the other spring contacts. Other designs may include making spring contact surfaces 8 and 9 of conducting material so that two or more contact springs may be made conducting before breaking.

The detent springs 45 and 46 are fastened to the insulated molded block 44 in a predetermined position to provide a three position locking arrangement in combination with the pivot socket 25 and 26 coupled with means 30 and 31 for limiting the travel of the shifting member 1. This is perhaps more evident in FIG. 3. Spring detent 46 locks the shifting member 1 in the clockwise position by engaging cam roller follower 5. It prevents it from moving counterclockwise while travel limiting means 30 prevents shifting member 1 from moving clockwise. Spring 46 yields when a reasonable force moves the shifting member 1 counterclockwise about pivot axle 3. The detent springs 45 and 46 are optional for the key switches and may be added in both operating positions.

Operation of the key switch to control the various circuits is performed manually by means of the handle 4. Movement of the handle 4 to the right coupled with the camming action of cam block 43, as shown in FIG. 3, causes pivot axle 2 to leave the frame socket 25. The shifting member 1 is rotated clockwise about pivot socket 25 on pivot axle 3 until stopped by travel limiting means 30 at a predetermined position, viz., when the spring contacts 50 in group 42 are moved to the left, as shown in FIG. 3. As was mentioned before, the surface 9 on shifting member 1 may be nodule in shape or electrically conducting so that selected springs 50 in group 42 may come in contact with other springs in the group to constitute a make before break switching arrangement.

The spring detent 46 yields to shifting member 1 and locks it in the operating position. When the shifting member 1 is released from the operating position, the springs 7 urge the shifting member 1 to the rest or mid-position as shown in FIG. 1. The contact springs 50 in this arrangement are not needed to return the shifting member 1 to the rest or mid-position and accordingly the contact springs 50 must only be resilient enough to
maintain a suitable pressure of contact against the corresponding pin contact.

When the shifting member is released from the operating position, the shifting member may accelerate to the rest or midposition in which case the energy of the shifting member may be absorbed by the frame pivot socket 25 and pivot axle 2. Therefore, it is advisable to keep the weight of the shifting member to a minimum and the spring constant of springs 7 light. For example, the shifting member may be molded from "Delrin" or nylon and the axles 2 and 3 may be steel inserts.

FIGS. 4-6 illustrate a waterproof locking and ringing key constructed in accordance with the invention. The features of a single pivot and a double pivot key are combined for both waterproofing the switch and making a "clickless" key. While the key shown in FIGS. 1-3 may be waterproofed by the addition of an elastic boot, it is believed that a single pivot key is more adaptable for waterproofing. In the construction of the lever key shown in FIGS. 4-6, certain modifications are necessary for the reasons stated above. These modifications are made on the frame 60, the shifting member 70, the cam block 77, and the cam roller follower 78 as well as the addition of a waterproof gland 73 which are included in the key shown in FIGS. 4-6.

The frame 60 comprises a shell having an opening at both ends, one of these openings is for the base assembly 70 and the other opening is for the shifting member 70 and the gland 73. Double pivot sockets are provided on the frame as shown at 61 and 62 for the shifting member 70. Aligned openings 64 in frame 60 are provided for fastening the base 90 to the frame 60.

Waterproof gland 73 comprises an externally threaded tubular sleeve 80 which flares at one end to form a flange 82 and an elastic thin web 75 which is molded to the inside of the sleeve 80 and to the shifting member 70. Gland 73 is fastened to the frame 60 by the coaction of the flange 82 and nut 65. The shifting member 70 in FIGS. 4-5, unlike that shown in FIG. 1, includes the cam block 77 as well as cam roller follower 78, a bar 71 pivotally mounted on a single fixed pivot 74 in gland 73, a handle 72, a resilient means 79 for holding the cam roller follower 78 to the cam block 77, and detent rollers 93.

The cam block 77 may be a molded insulated block having integral cam pivot points of camming surfaces 88 and 89 and camming surfaces 88 and 89 and frame sockets 61 and 62. In accordance with the invention, the cam surfaces 88 and 89 intersect to form an acute angle. When the shifting member 70 of the switch is in the rest position, the cam roller follower 78 sits in the vertex of the angle thus formed between to both surfaces 88 and 89. The resilient means 79, cam block 77 to the cam roller follower 78 and in so doing the pivot axes 83 seat in the frame sockets 61 and 62 as heretofore mentioned.

Detent spring 91 mounted on the base 90 operates in a manner similar to said detent springs 45 and 46 shown in FIGS. 1-3.

In operation, the waterproof "clickless" listening and ringing key operates slightly different than that previously described for the key shown in FIGS. 1-3.

Referring particularly to FIG. 6, the key is shown in a clockwise operating position. When shifting member 70 is rotated about pivot 74, the cam roller follower 78 rolls up on camming surface 88 moving the cam block 77 downward with respect to the fixed pivot 74. The cam block 77, still seated in frame pivot socket 61, is tilted until surface 92 of core opening 87 and bar 71 come in contact and then the bar 71 in unison with the cam block 77 strikes the contact springs 42 and moves them to the left to a predetermined position. When the handle 72 is released, the shifting member 70 rotates counterclockwise about the single pivot 74 while the cam roller follower 78 rolls down on cam surface 88 while resilient means 79 urges the cam block 77 upwards into the pivot sockets 61 and 62 until the shifting member reaches the rest position as shown in FIG. 4. The cam roller follower 78 rests in the vertex of the angle formed by the two camming surfaces 88 and 89. By this arrangement, namely, the combination of the shifting members 70, the spaced apart pivots, cam block 77, and the cam roller follower 78 will not only prevent the overthrow of the shifting member but will also prevent the simultaneous dislocation of the pivot axes of the cam block 77 from the frame sockets 61 and 62.

While there has been shown and described what are at present considered to be preferred embodiments of the invention, modifications thereto will be readily apparent to those skilled in the art. It is not desired, therefore, that the invention be limited to the embodiments shown and described, and it is intended to cover in the appended claims all such modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. In a switching key, in combination, a frame, a lever pivotally mounted on said frame, a cam block having a bore disposed along a given axis, said cam block being slidable mounted on said lever, said cam block having first and second interacting camming surfaces disposed on opposite sides of said given axis, a cam roller follower fixed to said lever to coat with said first and second camming surfaces, respectively, resilient means urging said cam block to said cam roller follower, double pivotal means for pivoting said cam block about first and second axes of rotation on said frame, respectively, said double pivotal means being positioned in cooperative relationship with said cam roller follower, whereby said lever assumes an intermediate position when said cam roller follower is contiguous to said first and second camming surfaces, a detent spring mounted on said frame, and a detent spring roller mounted on said lever to depress said detent spring to latch said lever in an operated position.

2. The structure defined in claim 1 further including a waterproof gland mounted in sealing engagement with said lever and said frame.

3. The structure of claim 1 wherein said cam block includes contact spring actuating means.

4. The switching key defined in claim 1 further including frame tabs coacting with said double pivotal means for preventing over-travel of said shifting member beyond a switch operating position.

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