INSTRUMENT KNOB HAVING INTEGRAL DETENT MECHANISM AND PANEL MOUNT SOCKET MEANS

Inventors: Heinz Ernst Johannes Kroll, Heroldberg; Horst Dieter Ziegler, Nurnberg, both of Germany

Assignee: International Standard Electric Corporation, New York, N.Y.

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Primary Examiner—William F. O’Dea
Assistant Examiner—F. D. Shoemaker
Attorney—C. Cornell Remsen, Jr., Walter J. Baum, Paul W. Hemminger, Percy P. Lantzky and Thomas E. Kristofferson

ABSTRACT
A rotary instrument knob with integral detent and stop means. An integral bushing or "termination socket" is provided whereby the knob may be assembled onto a panel in a rotationally predetermined orientation. The detent mechanism includes an indentation contour on a flange end of the termination socket within the knob body. The knob body is constructed in sections whereby the assembly of stop rings, detent balls and spring retaining means may be accomplished and then enclosed within the knob body by snap-fit assembly of the knob body shell over those elements.

10 Claims, 3 Drawing Figures
The present invention relates to a rotary knob capable of being mounted to the control shaft of an apparatus and which, on its side facing the apparatus, is provided with a hollow space for receiving an arresting or click-stop device serving to fix the positions of rotation of the shaft. Such types of rotary knobs are required above all for rotary switches comprising a control knob mounted to the control shaft thereof, and by which certain switching positions of the shaft can be adjusted. The fixing or arresting of switching positions of a control shaft, as is well known, is effected with the aid of a click-stop or arresting device which is joined to the apparatus to be operated, or which, e.g., may be built into the apparatus. In conventional types of rotary switches this click-stop device consists of biased or pretensioned balls which, for the purpose of effecting their engagement, are provided with fixed arresting positions. It may, for example, be surrounded by a spacing portion forming part of the housing, whereas the remaining parts of the housing are composed of static parts which are piled on top of each other, surrounding the shaft. Electric rotary switches of this type and construction have already been extensively miniaturized, in that the parts thereof are being designed very small. This miniaturization, however, can only be carried out within certain limits in view of the occurring actuating forces, even if the latter are being kept as small as possible, because there have to be avoided any unwanted variations or changes in shape of the switch, or of the parts which are important for performing the functions thereof, respectively. The result of this is that known types of rotary switches cannot be further reduced in size.

For avoiding this disadvantage has already been proposed to provide in the rotary knob of the rotary switch a hollow space which, on its side facing the apparatus to be operated, is designed as an engaging contour in which the hold members slide which, in turn, are guided by an engaging or arresting body which is arranged in this hollow space. This engaging or arresting body, at the same time, is provided with means for allowing it to be mounted to the apparatus.

The foregoing proposal was based on the consideration that the rotary knob, for serving as a handle, must have a certain size, but that the space enclosed thereby, is not fully utilized, whereas the apparatus itself is supposed to be of a space-saving construction. The present invention is based on the same consideration and has for its object to provide a rotary knob suitable for being mounted to a shaft and which, at the same time, contains a click-stop device, so that it will thus become possible for certain devices in which a shaft is to be turned or adjusted, to be miniaturized to very small dimensions. According to the invention, and with respect to a rotary knob of the type mentioned hereinbefore, this is accomplished in that the engaging member of the click-stop device is a termination socket which is provided with a shaft-passage opening and is joined to a rotary knob in the axial direction, with this termination socket, on its side facing the apparatus, is provided with means allowing to be mounted to the apparatus and, on its side not facing the apparatus, is designed to carry an engaging or arresting member supported by a guiding ring (guide ring) which is coupled in a motion-locking fashion to the shaft, are permitted to slide.

The invention offers the advantage, according to which it is possible, merely by interchanging the rotary knob, to provide certain which they are each a control knob 3 which is to be fixed or engaged in predetermined rotational positions, with a click-stop or arresting device. In so doing, it is still possible, as up to now, for the rotary knob to be mounted from one side. A further advantage capable of being achieved by the invention, resides in the fact that such types of devices may have very small dimensions in which they are required to have, for example, when intended to be built into printed circuit boards.

Moreover, the present invention offers the advantage that a limiting stop function which might be required in certain cases, may be replaced from the apparatus into the rotary knob, thus resulting in a further saving of space in the apparatus. According to an advantageous further embodiment of the invention, this is accomplished in detail that into the hollow space of the rotary knob there is inserted a limiting stop device which, in a motion-locking fashion, is joined thereto, and with the aid of which it will become possible to prevent the shaft from being turned beyond a predetermined angle.

For the purpose of enabling a better understanding of the invention, these and advantageous further embodiments of the invention will now be described in detail with reference to an example of embodiment shown in FIGS. 1 to 3 of the accompanying drawings in which:

FIG. 1 shows a longitudinal section taken through a rotary knob comprising a click-stop device and a limiting stop device according to the invention;

FIG. 2 shows a top view taken in the direction indicated by the arrow "A" of this rotary knob, with the front plate or panel removed, and

FIG. 3 shows a cross section taken along line B-C taken through the rotary knob shown in FIG. 1.

According to FIG. 1, the shown rotary knob 10 comprises an internal housing 20 and an external housing surrounding the latter at least partly in a form-molding manner, and composed of three parts 20, 40, 50 capable of being placed on top of each other, with the reference numerals 30 indicating the bottom of the housing carrying the internal housing, and with the reference numeral 40 indicating the sleeve of the housing provided with corrugated handling areas 41, and with the reference numeral 50 indicating the cover of the housing (housing cap) terminating the sleeve of the housing at its top end. By means of a resilient holding or retaining pawl 51 this housing cap is detachably latched to the sleeve of the housing 40. The bottom of the housing 30 meets with one face sided end against the neighboring face side of the sleeve of the housing 40 and is likewise detachably mounted in the internal housing by means of a snap-action joint. To this end the detachable bottom of the housing 30 is provided on its inside with a circular groove 31, and the internal housing 20 is provided on its outside facing the bottom of the housing, with a circular cam 21 fitting into the circular groove 31. An indicator 32 molded to the bottom of the housing 30 serves to indicate the respective rotational position of the rotary knob 10. For readjusting and fixing in position of the indicator 32, the circular cam 21 is provided along its circumference with slots 22 arranged in an angular division corresponding to the engaging positions of the rotary knob 10, with these slots 22 capable of being engaged by a radial inwardly directing nose portion 33 as molded to the inner circumference of the detachable bottom part 30 of the housing.

The mechanical connection between the sleeve of the housing 40 and, consequently, of the rotary knob 10 and the control shaft 60 of the apparatus to be operated, is effected via a collet or holding fixture 70 which is provided with a shaft-passage opening 71, which is accommodated in a hollow space 23 not facing the apparatus, and forming part of the internal housing 20. To this end the sleeve of the housing 40 comprises a collar 42 extending into this hollow space, to which the tightening or tension nut 80 of the collet or holding fixture 70 is pressed via a shaft plate (washer) 90 arranged therebetween.

Both the tightening or tension nut 80 and the shaft plate (washer) 90 are arranged in a hollow space 52 of the housing 40, this is apparent from the collet cap, of the sleeve of the housing 40 respectively. Since the shaft plate 90, in turn, is lying closely against one neighboring face side of the sleeve of the housing 40, this simultaneously establishes a mechanical connection between the internal housing 20 and the external sleeve of the housing 40.

Besides the collet or holding fixture 70, i.e., parts of the arrangement for effecting the axial fixing, the internal housing 20 contains the entire click-stop or arresting device for retaining the positions of rotation. As an engaging or arresting
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member of the click-stop or arresting device there is used a termination socket 100 which is connected to the rotary knob 10 in the axial direction, and is provided with a shaft-passage opening 101, hence which has to be supported stationary, e.g., on the front panel 110 of the apparatus to be operated, for example. For this purpose the termination socket 100 comprises one part projecting out of the internal housing 20, on which means are provided for allowing mounting to the apparatus. In the example of embodiment shown in FIG. 1, therefore, there are provided on this part, a shoulder 102 resting against the front panel 110, and a circular groove 103 arranged beforehand on the shoulder, for receiving a not shown guard or retaining plate. In order to avoid relative movements between the termination socket 100 and the front panel 110 of the apparatus, the termination socket is moreover provided with a stop element 104 which, for example, is designed to have the shape of a nose engaging the front panel. On the side not facing the apparatus, hence in the inside of the knob, the stop element 104 may simultaneously serve as a stationary limiting stop for restricting the rotary movement of the control shaft 60. The shown stop member 104 enables a particularly simple torsiion-proof mounting of the termination socket 100 to the apparatus or the front panel 110 thereof respectively, because during assembly of the rotary knob 10, the stop member merely has to be inserted into a corresponding recess provided in the front panel. The necessary torsional resistance, however, may also be obtained in any other way, for example, by providing a recess in the termination socket 100 which is then engaged by a nose or engaging portion arranged on the front panel 110 of the apparatus. The termination socket 100 can also be joined in a completely different way to the apparatus, for example, by way of screwing or cementing (gluing). The axial adherence between the termination socket 100 and the control shaft 60 is secured by a guard or retaining ring 120 which is arranged in an annular groove 24 of the internal housing 20, lying closely against a collar 105 of the termination socket within the range of its face side pointing into the hollow space 27 of the internal housing.

In order to achieve an engaging or arresting turning of the rotary knob 10, it is necessary to provide the termination socket 100 acting as the engaging or arresting member, with an engaging or arresting contour 106. This engaging contour in which holding or engaging members slide which are resiliently supported and retained and guided in a suitable way, is arranged on the face side of the termination socket 100 not facing the apparatus or the front panel 110 thereof respectively. As suitable hold or engaging members there may be considered, in particular, balls 130, 140. The holding body guiding these balls, is designed to have the shape of a ring 150 surrounding the control shaft 60 and in the circular recesses of which the balls are supported. In order to ensure that this guide ring 150 is taken along by the housing 20 capable of rotating about the termination socket 100, when actuating the control shaft 60, it is designed to engage with its segment-shaped projections 151 as arranged along its outer circumference, the correspondingly adapted cutouts or recesses 25 as arranged on the inside of the housing 20.

By a finger (finger-shaped projection) 152 extending inwardly and arranged on the inner circumference of the guide ring 150, and which, in a form-locking manner, engages a longitudinal groove on the control shaft 60, both the engaging and the shaft position can be fixed in relation to one another. To this end, also the inner circumference of the guide ring 150 may be adapted to the profile of the control shaft, e.g., a flat shaft. This might be of significance, for example, in cases where rotors are mounted on the control shaft 60 which are intended to be turned as well, and carry contact members, which in turn, cooperate with stator contact members by performing a corresponding opening and closing. Upon actuating the control shaft 60, the balls 130, 140 are advanced in a step by step fashion to engaging point or fixing thus the position of rotation of the shaft, and for bringing certain stator and rotor contact members into or out of contact respectively. The arrangement of the rotors and stators and of the contact members thereof can be made in the usual way, and is of no significance to the present invention.

In the example of embodiment according to FIG. 3 two diametrically opposing, circular openings are arranged in the guide ring 150 at an equally spaced relation from the shaft 60. In this way it is accomplished that the engaging or arresting pressures of the two balls 130, 140, will annul each other with respect to the loading of the control shaft 60. In order to produce the necessary engaging pressure, a ball-retaining disk 160 which is provided with a shaft-passage opening, is placed by the flexible device against the balls 130, 140. This is accomplished with the aid of a helical compression spring 170 which is retained and guided concentrically in relation to the shaft 60 in a circular groove 26 as provided in the housing 20, and extending in the axial direction. This helical compression spring thus presses the balls 130, 140 against the face side wall of the termination socket 100 and, consequently, against the engaging contour 106. By the holding arrangement of the helical compression spring 170 which is permanently concentrically in relation to the shaft 60, the ball-retaining disk 160 is uniformly pressed against the balls 130, 140, thus resulting in a particular precise and easy-going engagement or arresting in all positions of rotation of the rotary knob 10 at the required actuating moment. The invention, of course, is in no way restricted to the feature of employing in the above mentioned engaging members only. Moreover, it is equally well possible to employ rollers instead of the balls as holding, engaging or arresting members.

In order to restrict the rotary motion of the control shaft 60, there are provided the limiting-stop rings 180, 190 which, with segment-like projecting portions 181 (or 191 respectively) as arranged along the outer circumference thereof, engage the correspondingly adapted recesses or cutouts 25 on the inside of the housing 20. Appropriately, there are used two such limiting-stop rings 180, 190 which, as may be taken from FIG. 1, are placed on top of each other, and are capable of being turned by a certain angular division with respect to the housing of the rotary knob. On their inner circumference, these two limiting-stop rings 180, 190 each comprise an inwardly extending arresting catch 182 or 192 respectively. These two arresting catches 182, 192 together form an angle which is determined by the number of desired positions of rotation (switching positions), and cooperate with a stationary limit stop, such as the stop element 104, in the sense of restricting the rotary motion of the control shaft 60 also at both directions. For example, in the case of a 12-position click-stop device, there is used a limiting-stop device in which the two arresting catches 182, 192 together form an angle of 30°. By differently inserting the two limiting-stop rings 180, 190, however, it is possible to readjust the limit stops in any arbitrary fashion. Moreover, the limit stop may also be completely omitted by removing the rings 180, 190. It is also possible to use one single ring instead of two such rings, which then comprises two arresting catches 182, 192. In this case, of course, the distance or spaced relation between the limiting stops can no longer be readjusted. In cases where only one limit stop is provided, one such limiting-stop ring 180 or 190 with one arresting catch 182 or 192 is sufficient. In this case the shaft 60 can only be turned by 360°, with the respective arresting catch 182 or 192 for restricting the rotary motion, appearing on opposite sides of the stationary limiting stop, e.g., at the stop element 104.

The axial fixing of the limiting-stop rings 180, 190 in relation to the control shaft 60 is effected, on one hand, by the guide or retaining disk 120 as arranged inside the housing 20 of the rotary knob and, on the other hand, by the inwardly projecting joined-on portion 34 of the bottom of the housing 30. For readjusting the limiting-stop rings 180, 190 it is then merely necessary for the bottom of the housing 30 to be removed temporarily; this, however, will not affect the functioning of the click-stop or arresting device.

The rotary knob 10 according to the invention can be mounted in the usual way to a control shaft 60. It is merely
required to provide any suitable kind of device for preventing the termination socket 100 from being turned. As already mentioned, this means for preventing a rotation can be formed by a recess or cutout provided in the front panel 110 of the apparatus. Alone by the employment of one rotary knob according to the invention, switches or other devices capable of being operated by a shaft, can be provided with a click-stop or engaging device.

The rotary knob 10 as shown in FIGS. 1 to 3 can be made of any suitable material. Preferably, however, the three outer parts of the housing of the rotary knob 10, i.e., the bottom 30, the sleeve 40, and the cap 50 of the housing are made from a suitable injection molded plastic material, whereas the internal housing 20, as well as the termination socket 100 are made from a die-casting zinc alloy (injection-molded or die-cast zinc).

What is claimed is:

1. A rotary shaft control instrument knob having self-contained detenting mechanism within the body of said knob, comprising: a termination socket in the form of a bushing having a flanged end and a bore therethrough coaxial with the axis of rotation of said knob to accept the said shaft to be controlled, with rotational freedom, said socket being adapted to be inserted and retained partly through an opening in a panel with said flanged end projecting into the interior of said knob body; means for retaining said knob body against substantial axial movement while permitting rotation thereof with respect to said termination socket; shaft lock means within and rotationally keyed to said knob body for securing rotational continuity between said knob and said shaft; detent means comprising a series of indentations constituting an engaging contour distributed circumferentially about the face of said flange, and at least one rolling member of circular cross section in at least one plane operative against said indentations; resilient means operating against the inside of said knob body for maintaining a compressive force between said rolling member and said flange; guide means keyed to said knob body for imparting circumferential motion to said rolling member as said knob and said shaft are rotated together, whereby said rolling member tends to seat in successive ones of said indentations to produce detenting at positions corresponding to predetermined angular positions of said knob and shaft.

2. Apparatus according to claim 1 including a keying arrangement between the external body of said socket and the perimeter of said opening for retaining said termination socket within said opening in said panel and for locking said socket in place rotationally.

3. Apparatus according to claim 2 in which said retention of said socket in said opening is effected by a locking ring inserted in a circumferential slot in the external perimeter of said socket, said ring bearing against said panel on the side thereof opposite the installation of said knob, and in which said socket includes a shoulder bearing against said panel on the opposite side thereof, whereby said socket is axially locked in position.

4. Apparatus according to claim 1 including an at least partially radially outwardly projecting finger connected to the outer perimeter of said socket within said knob body and at least one stop ring keyed to said knob body and having at least one radially inwardly projection oriented to engage said outwardly projecting finger at a predetermined angular position of said knob and shaft.

5. Apparatus according to claim 1 having two of said stop rings stacked axially and each having multiple peripheral keying means whereby they may be separately keyed to said knob body to provide first and second angular limits of operation of said knob and shaft.

6. Apparatus according to claim 4 in which said knob body is composed of at least two axially assembled hollow parts, a first of said parts containing said stop ring, whereby said knob may be assembled by emplacing said first part in proximate position over said panel opening and inserting said socket through said first part and said panel.

7. Apparatus according to claim 6 including a second hollow knob body part axially snap-fitted into said first part, said second part including an internal surface in a plane normal to the axis of said knob to face said termination socket flange to carry said resilient means bearing against said circular cross section member.

8. Apparatus according to claim 7 in which said shaft lock means are included in said second part, whereby said knob may be further assembled by emplacing said rolling member of circular cross section against said engaging contour and emplacing and locking said second part to said shaft thereby bringing said resilient means to bear against said circular cross section member.

9. Apparatus according to claim 8 having at least two circular cross section members substantially diametrically opposite in position along said engaging contour and said members are balls.

10. Apparatus according to claim 9 in which said resilient means comprises a pressure ring inserted against said balls opposite said engaging contour and a helical spring bearing against said pressure ring and caged in an annular groove inside said knob body second part.

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