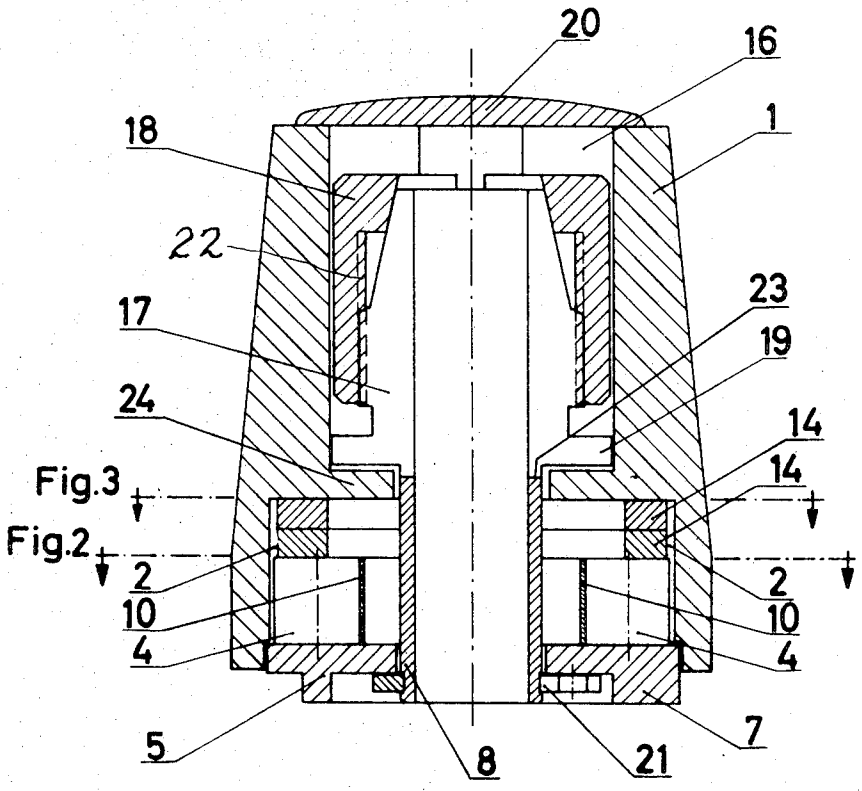
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CONTROL KNOB WITH INTEGRAL DETENT AND STOP MECHANISMS

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Fig. 1




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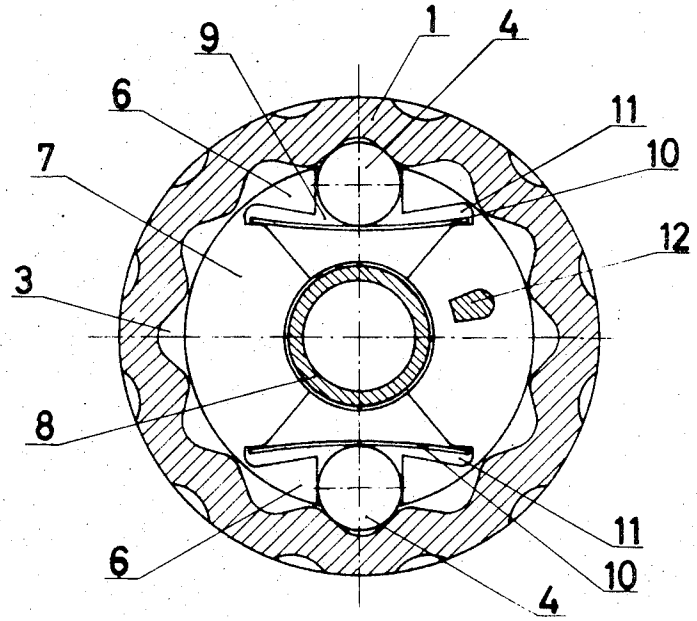
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Fig. 2




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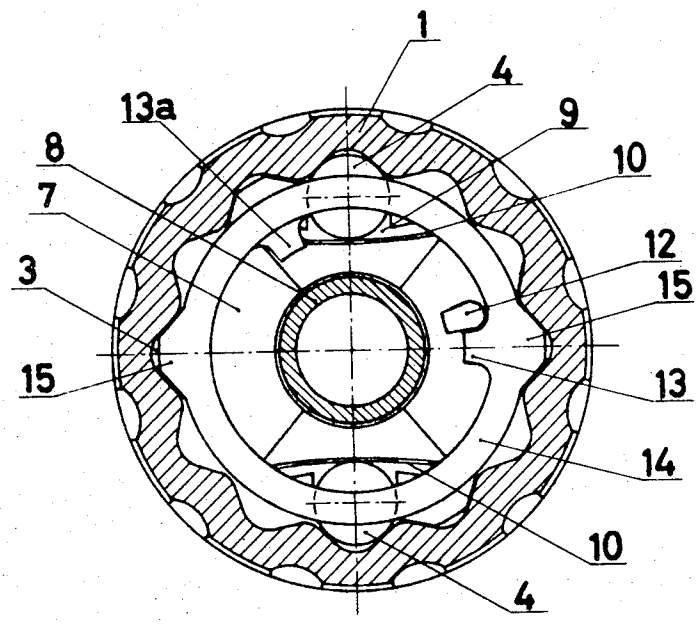
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Fig. 3




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United States Patent Office 3,570,325 Patented Mar. 16, 1971



3,570,325

# CONTROL KNOB WITH INTEGRAL DETENT AND STOP MECHANISMS

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Filed Sept. 29, 1969, Ser. No. 861,549
Int. Cl. G05g 5/06
U.S. Cl. 74—527 10 Claims

## ABSTRACT OF THE DISCLOSURE

An integral instrument knob and detent device for controlling rotary switches and like devices requiring multiple discrete angular position shaft control.

A shaft for the device to be controlled protrudes through a panel, and the knob is installed and tightened thereon. The detent positions are formed by a contoured surface inside a cavity within the body of said knob. Two cylindrical rollers (or balls) are provided, and are held against the contoured surface by a leaf spring mounted on a base adapted for non-moving mounting on the panel. The ball or roller is constrained against any but radial movement. Stops are provided by a pair of rings built to engage the contoured surface, and are therefore adjustable rotationally in integral detent steps.

## CROSS REFERENCE TO RELATED APPLICATIONS

This application is filed under the provisions of 35 U.S.C. 119 with claim for the benefit of the filing of an application covering the same invention filed Sept. 28, 1968, Ser. No. P 17 75 830.4 of the Federal Republic of Germany.

## BACKGROUND OF THE INVENTION

### Field of the invention

The invention relates generally to instrument shaft rotation control knobs, and more particularly to a knob containing integral detent and rotational stop means for use with rotary switches and the like.

### Description of the prior art

In the prior art, it has been common for rotary switches and the like to include built-in detent means to "click-stop" at each discrete switch position as a knob is turned. There is no particular disadvantage to this arrangement in which the detent mechanism is built to match the switch construction, so long as the full step range of the switch is to be used, and standard rotary switches are satisfactory for the particular application. Certain special switches are extant however, where unique angular separation between steps, etc., make the provision of a separate detent mechanism desirable, or even necessary. Moreover, there are other devices which, like rotary switches, are panel mounted, rotary shaft controlled and not manufactured with detent mechanisms, even on an optional basis. These other devices include variable resistance and capacitance elements. If such devices are to be step controlled, a separate detent mechanism is obviously required. In the prior art, this would have to be provided by separate structure. The result was often bulky and expensive special hardware. The manner in which the present invention overcomes the prior art disadvantages with a novel and flexible structural approach will be apparent from the description to follow.

## SUMMARY

In view of the prior art structures available and the disadvantages thereof, it was the general object of the



present invention to provide a relatively simple and flexible detent and stop mechanism within the control knob itself. The structure is such that stops are readily preset. Also, variations and certain aspects of the design permit changeover of the angle between the adjacent detent through substitution of another knob body, as will be seen as this description proceeds. The assembly of the overall integral knob and detent device is such that most of the parts can be used as standard parts, and a complete line of knobs for different detent situations can be provided with a minimum of non-interchangeable structure.

The usual situation in respect to the shaft of a rotary switch or other devices to be controlled, is that the control shaft projects through an equipment panel or deck. In the present invention, the knob is preferably made with two internal coaxial cavities or bores, one from each axial end of the generally cylindrical knob body.

For purposes of description, the cavity adjacent to the panel, when the knob is installed on the shaft to be controlled, will be referred to as the lower cavity and the other (outward from the panel) one will be referred to as the upper cavity. The upper cavity is preferably covered by a cap piece after assembly and tightening on the shaft. A sleeve assembly (in one or two parts), comprising a hollow tube size to slide over the shaft to be controlled, is inserted into the upper cavity and projects, through a clearance hole in the body web or disc section separating the two cavities, into the lower cavity substantially to the bottom of the knob assembly. The sleeve assembly includes an expanded portion having a many sided perimeter which fits into the corresponding shape of the upper cavity. This tends to lock the sleeve assembly and the knob body together rotationally.

The upper end of the sleeve assembly is formed as a collet with a jam nut which can be tightened over a tapered threaded portion of the said sleeve assembly from the cap end of the upper cavity when the knob assembly is installed on the shaft to be controlled. The lower cavity has an internal circumferential shape, such as a "hill and valley" outline as a part of the detent structure. Within the lower cavity, at least one stop ring keyed to the internal surface contour and at least one detent member, which may be a cylinder or a ball, reside in the lower cavity. A base with a central clearance hole fits over said sleeve assembly at the bottom of the lower cavity and is retained to the sleeve axially but with rotational freedom. This base tends to retain the balls or rollers and the stop rings axially and is fitted with leaf springs to keep the detent members under outward radial spring pressure against the said surface contour. The base is intended to be firmly attached to the panel, through which the shaft to be controlled, protrudes.

Accordingly, in operation, the knob body, stop rings and sleeve assembly rotate as the knob is turned, and the base remains stationary, as do the ball or cylinder detent members, except for small radial movement as the detent member follows the said surface contour.

The full details of the structure of the invention and its manner of operation will be more fully understood as this description proceeds with references to the drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an axial sectional view of a typical knob and integral detent mechanism in accordance with the present invention.

FIG. 2 is a sectional view taken perpendicular to the axis of the knob assembly between the stop rings and the detent devices to illustrate the details of the latter.

FIG. 3 is a sectional view taken at the top of the lower cavity of the device of FIG. 1 showing the stop ring details.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

A typical embodiment of the present invention is depicted in the views of FIGS. 1 through 3.

Referring now to FIG. 1, the view is that which would result by sectioning the assembled device axially by a plane containing the axial center line of the knob and the center lines of two opposite detent members. The body **1** is similar in external appearance to instrument knobs already familiar to those skilled in this art. The body **1** may be metal, or one of the many plastic materials commonly used for instrument knobs. In fact, all of the parts of the assembly are susceptible of fabrication from a wide variety of materials. One exception to that generalization is the leaf spring element, which is preferably spring steel, bronze, or like resilient material.

The body **1** will be seen to include an upper cavity **16** and a lower cavity **2**, separated by an internal web or disc section **24**. The sleeve **8** will be seen to extend about the center line from the bottom of the knob assembly to a joint with a collet assembly **17**. The base of this collet assembly has an enlarged or expanded base section **19**, which in turn has a many sided outer perimeter (hexagonal or octagonal, for example). It is to be understood that the horizontal cross section of the upper cavity **16** has a corresponding shape, so that **19** fits snugly within cavity **16** and engages it rotationally so that knob body **1** and the collet **17** are constrained to turn together. It is intended that the collet **17** will fit over the shaft to be controlled, as does sleeve **8**; however, the collet **17** is slotted axially at least within the length of the jam nut **18**. This coaxial jam nut **18** engages threads at **22**, and it is to be understood that this threaded portion is tapered, so that as the nut **18** is tightened, the slotted collet body grips the shaft tightly.

In practice, there are good reasons for making the collet **17** and the sleeve **8** as one piece, eliminating the mating surface **23**. If this is done, the support for parts internally is improved and the resulting combined part is herein called a sleeve assembly. It would normally be inserted through the open end of the upper cavity **16** before the cap **20**, is emplaced.

Unlike **19**, the tightening or jam nut **18** is either of circular cross-section or a many sided cross-section sufficiently small to be susceptible of free rotation, within **16** in the process of tightening or loosening. Depending on the ordinary options of fabrication, it would be expected that the nut **18** might be tightened through the use of a socket wrench or possibly a screwdriver, or other special tool, inserted in the head of **18**.

Within the lower cavity **2**, a pair of substantially identical stop indexing rings are both labeled as **14**. These are contained between that portion of the knob body **1** at the top of the lower cavity **2** and the oppositely disposed rollers **4**. The said rollers **4** are retained in the assembly by base **7**, which is, in turn, held by retainer ring **21**, which engages a groove in **8**, as illustrated. A pair of leaf springs **10**, mounted from a slot **11** in base **7**, tend to exert outward radial pressure against the rollers **4**, to cause them to engage the valleys in the surface contour in the lower cavity **2**. This aspect of the structure will be more fully understood from FIG. 2. If, as previously indicated, the collet **17** and the sleeve **8** are in fact one piece, the base part **7** is more effectively supported. Otherwise, the internal assembly is held together by downward pressure exerted by the collet **17** (once it is firmly clamped to the shaft), at **23**. The knob body **1** is axially held with a small amount of free play by the disc section **24** as it inter-relates with the other internal parts.

The base **7** as a minimum, requires an anti-rotation engagement with the panel surface. Such may be provided by a slight elongation downward of the projection **5**, so that it can engage a corresponding hole or indentation in the panel. Otherwise, various other common means, such as machine screws (not illustrated) running from the opposite side of the panel and tapping into the base **7** can provide base anchoring, albeit with less flexibility than afforded by the engagement of a projection, such as **5**, in a corresponding panel hole. The rollers **4** will be understood to have their axes disposed parallel to the longitudinal axis of the knob or shaft. Therefore, the roller surface engages the knob body lower cavity internal surface contour over the full roller length.



Referring now to FIG. 2, the section taken as indicated on FIG. 1 shows the knob body with arbitrary outside finger-grip fluting and with the aforesaid surface contour in the inside wall of the lower cavity **2**. Thus, valleys or concavities, as typically shown at **3**, provide seating for the rollers **4**. The base **7** includes guides **6**, which constrain the rollers **4** from any but the radial motion, when the knob body **1** is rotated, and the rollers ride up over the convex portions of the surface contour, against the compression of leaf springs **10**. The slot **11** will be understood to provide a seat in the base **7** for springs **10**. The shallower slot **9**, provides a radial slot in which rollers **4** are seated. The remaining base material in this vicinity produces the guide **6** in the form of shoulders defining the radial slot, as illustrated.

A post **12**, projecting from the base **7**, extends beyond the height of the rollers **4**. Its function will be more fully understood in connection with FIG. 3.

Referring now to FIG. 3, an additional horizontal section of the knob assembly is shown, from a plane indicated on FIG. 1, i.e., looking downward from the top of lower cavity **2**. The rings **14** are seen riding on top of the rollers **4**. Each of these rings has an inward directed projection **13**. As illustrated, **13***a* corresponds to the same projection on the lower of the two rings. Outward directed projections **15** serve to index the ring within the preselected opposite pair of concavities in the aforesaid surface contour. It is not essential that two such projections **15** be employed. A single outer projection being capable of providing the keying function, one of the two projections illustrated could be eliminated.

The upper ring is shown abutting the post **12** and is therefore against the stop, insofar as further counter clock-wise rotation of the knob is concerned. It will be seen that **13***a* (as arbitrarily located) would abut the post **12** after rotation of three clock-wise detent positions, forming the other stop position.

It will be immediately apparent that the positions of these stops is preselectable, since the rings **14** may be emplaced at any 30° interval. In the illustration, the contour surface concavities are spaced 30°, however this is a design detail and may be selected to suit other requirements. The rings **14**, if they are to be interchangeable within knob bodies of different detent angular spacings, should have only the single external keying projection **15**, as aforesaid.

It will be immediately apparent that there is no compelling reason for fabricating rings **14** with the projections **13** and **15** opposite each other. Properly coordinated with the position of post **12**, these inner ring projections **13** might be located elsewhere within the internal ring perimeter.

It will be apparent that, in the event stops are not required in a particular application, washers or a suitable bushing ring can replace the rings **14**.

It will also be apparent that the structure is adaptable to the use of detent balls at **4**, rather than rollers; however, in that case, it may be necessary to insert a washer below the lower ring **14** (see FIG. 1). This is because the ring to ball contact would be a point which would be close to the inner diameter of the ring **14**, unless the ring itself was constructed with a somewhat larger inside diameter than illustrated.

In addition to the foregoing, it will be obvious that the structure is not limited to the illustrated proportions or

mechanical details, nor is it absolutely necessary that the detent positions be uniformly spaced, if some other arrangement suited a specific purpose.

Other variations within the realm of ordinary skill will suggest themselves to the reader skilled in this art.

What is claimed is:

1. A hand controllable self-detented knob for connection to a rotatable shaft protruding through a panel, comprising:

a knob body of generally symmetrical cross-section;

an internal coaxial cavity within said body, said cavity being open at least on the end toward said panel;

sleeve means fitting axially slideably over said shaft, including an expanded portion thereof for rotationally engaging the inside surface of said cavity, and also including means for gripping said shaft whereby rotation of said knob is transmitted through said sleeve means to said shaft;

a base member including a centrally located hole fitting coaxially with rotational freedom over said sleeve means adjacent to the panel end of said cavity;

means constraining said base member from axial motion with respect to said sleeve means;

means for restraining rotational motion of said base with respect to said panel;

at least one detent member of circular cross-section constrained within said cavity by said base member;

a surface contour of hills and valleys over at least a portion of the inside circumference of said cavity within said body;

resilient means mounted from said base member, for normally retaining said detent member against a concavity said contour surface, thereby to restrain said body from rotational motion with respect to said base, said resilient means allowing said body and therefore said shaft to be rotated in response to an applied torque whereby said detent member moves over said surface contour to another concavity thereon.

2. The invention set forth in claim 1 further defined in that said cavity is separated into upper and lower cavities by a disc section which is integral with said body and includes a centered clearance hole through which said sleeve means extends, and said expanded portion is defined as forming on said sleeve means a shoulder which bears against said integral disc section, thereby to hold said body in position axially.

3. The invention defined in claim 2 further defined in that said contour surface is within said lower cavity, said upper cavity is in the shape of a polyhedral prism, and said expanded portion of said sleeve means has a perimeter shape corresponding to said upper cavity whereby said rotational engagement is effected.



4. The invention set forth in claim 2 in which said resilient means is a leaf spring mounted so as to exert an outward radial force against each of said detent members with respect to said base member.

5. The invention defined in claim 4 in which said detent members are at least two in number and are substantially cylindrical rollers.

6. The invention defined in claim 4 in which said detent members are at least two in number and are substantially spherical.

7. The invention set forth in claim 4 including means attached to said base member for restraining any substantial deflection of said detent members in a direction other than radially.

8. The invention set forth in claim 2 in which at least one ring is inserted in said lower cavity between said disc section of said body and said detent members, said ring having an outside diameter fitting within said contour surface and an inside diameter substantially greater than said sleeve means within said lower cavity, said ring further including an outer perimeter projection keying said ring to a predetermined concavity of said contour surface and an inner perimeter projection, and also including a post mounted on said base member and projecting within the arc of travel of said inner perimeter projection of said ring, thereby to provide a stop for said knob at a selectable rotational position.

9. The invention set forth in claim 8 in which two of said rings are included having their outer projections keyed to first and second preselected concavities of said surface contour, thereby to provide stops for clock-wise and counter clock-wise rotation of said knob.

10. The invention set forth in claim 1 in which said means for causing said sleeve means to grip said shaft includes a tapered and threaded axially split portion of said sleeve means and a jam nut engaged thereon.


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U.S. Cl. X.R.

74—553; 287—53H