May 19, 1970 R. L. METCALF 3,512,427

PUSHBUTTON ROTARY CONTROL APPARATUS FOR AN ELECTRICAL SWITCH AND THE LIKE

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FIG. 1

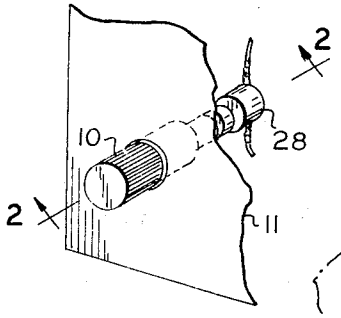


FIG. 5A

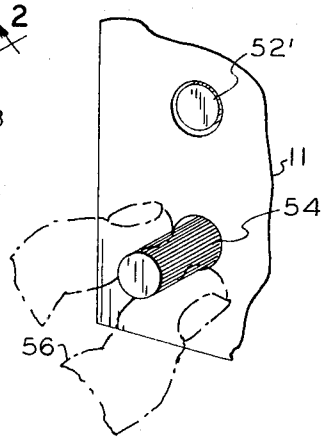
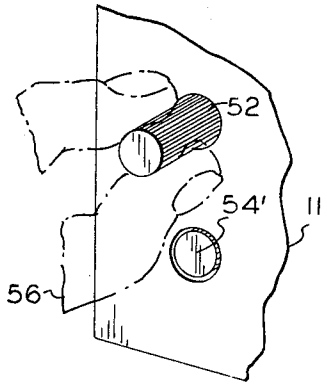


FIG. 5B



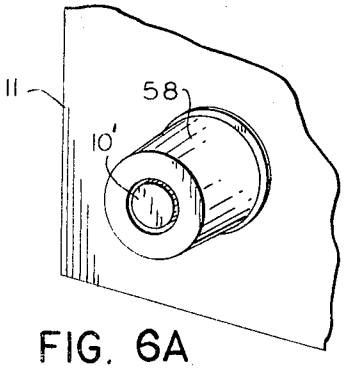


FIG. 6A

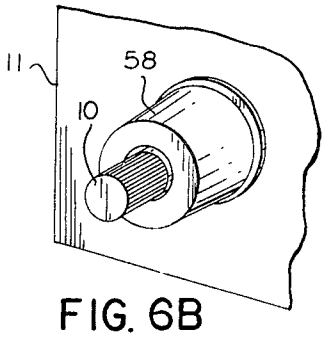


FIG. 6B

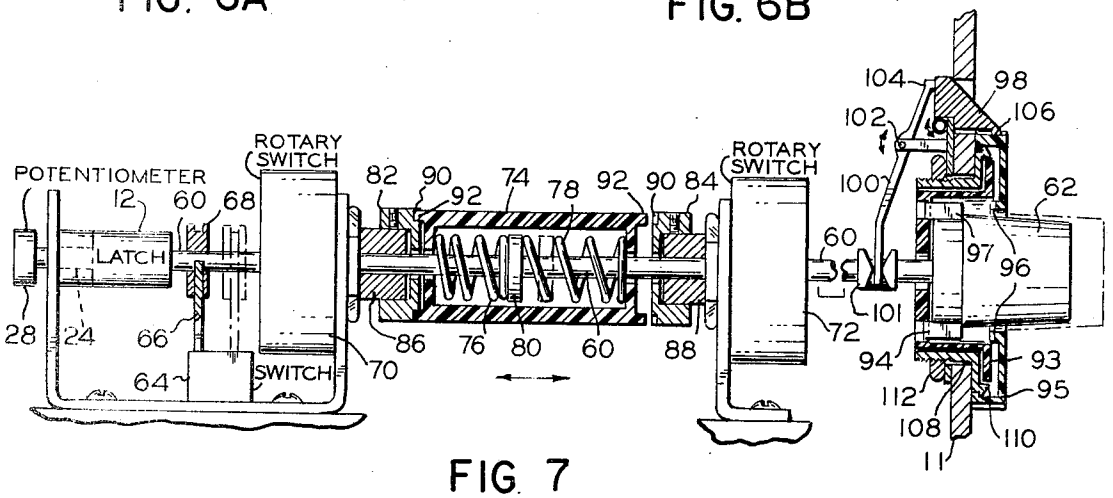


FIG. 7

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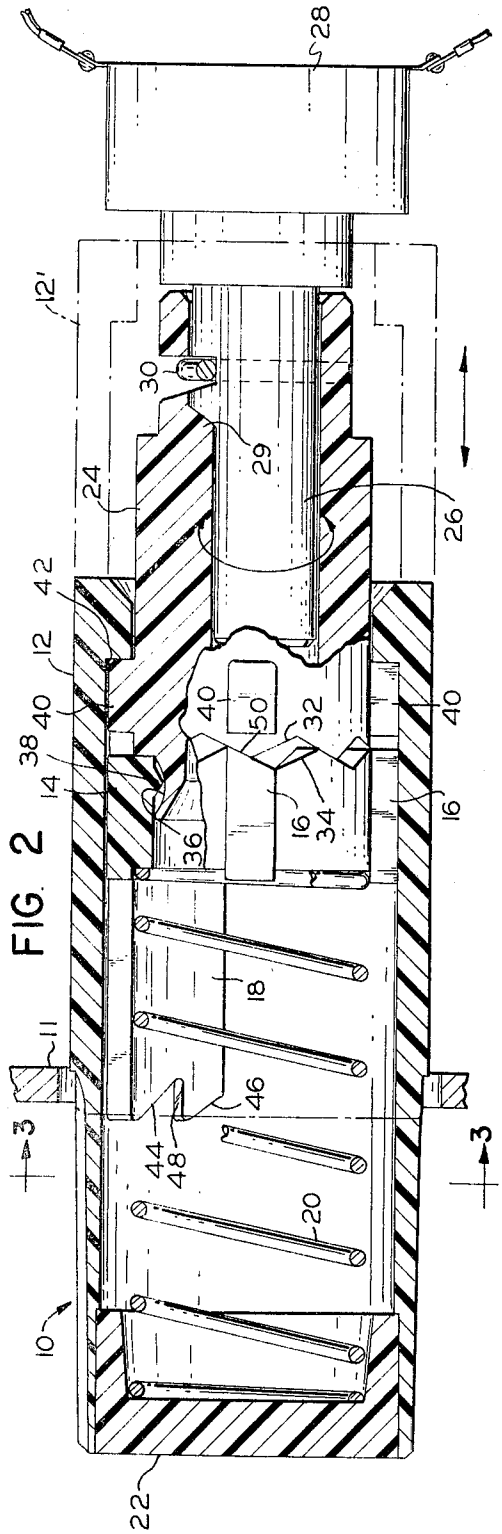


FIG. 2

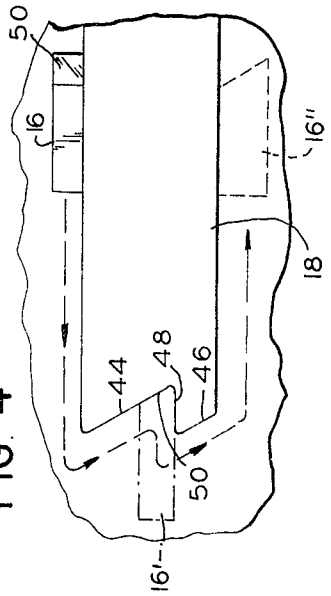


FIG. 4

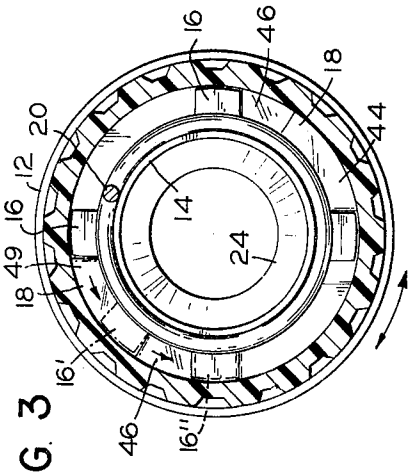


FIG. 3

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PUSHBUTTON ROTARY CONTROL APPARATUS FOR AN ELECTRICAL SWITCH AND THE LIKE

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U.S. Cl. 74—471 17 Claims

ABSTRACT OF THE DISCLOSURE

A pushbutton rotary control for an electrical circuit component, such as a rotatable potentiometer or switch, in which its control knob is moved between two different longitudinal positions by a pushbutton latch mechanism and rotated to vary switch settings. The latch mechanism includes a cam actuated latch member which automatically rotates about 45° to latch and unlatch such mechanism when the knob is pushed and thereby determines the two longitudinal positions of such knob. A coupling means separate from the latch mechanism may be used to selectively couple the knob drive shaft to the control shafts of two different rotary switches in such two longitudinal positions. Also the control knob may be provided with two rotatable scales, one for each switch, which are selectively connected to such knob by its longitudinal movement.

BACKGROUND OF THE INVENTION

The subject matter of the present invention relates generally to control apparatus for adjusting electrical circuit components, and in particular to such an apparatus including a pushbutton rotary control which may be moved between two longitudinal positions and also rotates in either longitudinal position for adjusting a rotary switch and the like. This is achieved by a simple cam actuated latching mechanism which is operated by pushing the control knob to latch and unlatch the cam members and cause such knob to move between its two longitudinal positions.

The control apparatus of the present invention is especially useful when employed in cathode ray oscilloscopes or other electrical instruments having a control panel of limited size. The control apparatus may be used for the adjustment of rotary switches, variable resistance potentiometers, two position sliding switches and other variable electrical components such as tuning capacitors, et cetera. The controls now used are usually limited to a single adjustment function, while the present control apparatus is capable of at least three separate functions, including two rotary adjustments and one longitudinal adjustment by means of a single knob. Thus the present apparatus increases the amount of adjustment functions possible per panel area without adding more control knobs. In addition to its adjustment function the control apparatus of the present invention also acts as an indicator of the adjustment performed, by the longitudinal position of its knob. The knob may be moved completely out of the way in its retracted longitudinal position to enable adjacent knobs to be mounted closer together without interfering with their adjustment. This increases the density of the number of control knobs which can be employed in a given area without decreasing the manual operating space around the knob.

The pushbutton latching mechanism is of a simple, inexpensive and trouble free construction which also enables rotational adjustment of the knob in either of the two longitudinal positions which are determined by relative movement between a cam member having a cam surface portion and a latch member having a cam follower portion. The latch member is automatically rotated approximately 45° when moved longitudinally with respect to the cam member to latch and unlatch such members and provide the two longitudinal knob positions. The latching mechanism is extremely versatile and its cam member can either be employed as the control knob, or it can be connected to a drive shaft attached to a separate control knob. As a result of such latching mechanism the control apparatus of the present invention is provided with an increased number of adjustment functions and requires less panel mounting space, at very slight increase in cost.

It is therefore one object of the present invention to provide an improved control apparatus for adjustment of electrical components which is capable of longitudinal movement and rotation in either of two longitudinal positions.

Another object of the present invention is to provide an improved control apparatus in which a single knob can perform a plurality of adjustment functions and by changing its longitudinal position indicates the function performed and enables more adjustment space for adjacent knobs.

A further object of the present invention is to provide an improved control apparatus having a pushbutton knob which performs rotary adjustment functions on a pair of rotary switches or the like in two different longitudinal positions of such knob, and has a pair of rotatable dials which are selectively connected to the knob for rotation therewith to indicate the rotational adjustment position of such switches.

Still another object of the present invention is to provide a control apparatus for adjusting an electrical component in which a pushbutton cam actuated latching mechanism is employed of simple, inexpensive, trouble free construction that greatly increases the versatility and the number of adjustment functions which can be performed by such apparatus.

BRIEF DESCRIPTION OF DRAWINGS

Other objects and advantages of the present invention will be apparent from the following detailed description of certain preferred embodiments thereof and from the attached drawings of which:

FIG. 1 is an oblique elevation view of one embodiment of the control apparatus of the present invention;

FIG. 2 is an enlarged sectional view taken along the line 2—2 of FIG. 1;

FIG. 3 is a vertical section view taken along the line 3—3 of FIG. 2;

FIG. 4 is an enlarged view of a portion of the latching mechanism of FIG. 2, showing movement of the cam follower portion of the latch member;

FIGS. 5A and 5B are oblique elevation views showing the operation of a pair of control apparatus mounted closely adjacent to one another;

FIGS. 6A and 6B are oblique elevation views showing another embodiment of the control apparatus of the present invention in which the control knob is mounted inside the knob of a second control; and

FIG. 7 is a partial section view showing still another embodiment of the control apparatus of the present invention employing a shaft coupling separate from the latching mechanism.

DESCRIPTION OF PREFERRED EMBODIMENTS

As shown in FIGS. 1 and 2, one embodiment of the control apparatus includes a pushbutton rotary control knob **10** mounted to extend through a control panel **11**. The knob **10** is formed by a hollow, cylindrical cam member **12** containing a latch member **14** which moves relative to the cam member to latch and unlatch such members. Four equally spaced cam follower portions **16** on the outside of the latch member move along a pair of cam surface portions **18** on the inside of the cam mem-

ber to cause the latch member **14** to move longitudinally and rotationally within the cam member **12** in a path shown in FIG. 4. A coil spring **20** is provided within the cam member **12** between the latch member **14** and a knob cap **22** secured to the front end of the cam member to resiliently urge such latch member inwardly into contact with a connector member **24**. The connector member **24** is contained within the cam member **12** so that one end may extend partially out of such connector member and is connected to the control shaft **26** of a rotatably adjustable electrical component **28**. This electrical component **28** may be a rotary switch, variable resistance potentiometer, a tuning condenser or other element.

The right end of the connector member **24** is keyed to the control shaft **26** by a key portion **29** and a locking clip **30** is inserted into notches provided in such member and such shaft to prevent the shaft from being pulled out of the connector member during longitudinal movement of the knob **10**. The left end of the connector member **24** is provided with a serrated edge **32** which meshes with a similar serrated edge **34** provided on the right hand end of the latch member **14** to normally couple them together for simultaneous rotation. The left end of the connector member **24** is also provided with an annular groove **36** into which an annular projection **38**, formed on the latch member **14**, extends to loosely connect such latch member to such connector member, while enabling relative rotation of such members during latching and unlatching. Thus there is sufficient longitudinal movement of the projection **38** within the groove **36** to enable the serrated edges **32** and **34** to disengage when the cam follower **16** reaches the left end of the cam surface **18** and to allow a 45° rotation of the latch member when it is moved for latching between position **16** shown in solid lines and position **16'** shown in dash-dot lines, and when it is moved for unlatching between position **16'** and position **16''**, as shown in FIG. 4.

The cam follower projections **16** on the latch member **14** also function as guides, two of which are always positioned on opposite sides of each of the cam surface portions **18**. Thus the cam surface portions function as guide tracks to control longitudinal movement of the latch member. In a similar manner four guide projections **40** are provided equally spaced around the outer surface on the left end of the connector member **24** for guiding longitudinal movement of such connector member. The guide projections **40** also serve as stops by engaging an annular shoulder **42** provided on the inside of the right end of the cam member **12** to prevent movement of the connector member **24** completely out of such cam member.

As shown in FIG. 4, the raised cam surface **18** includes a pair of ramp portions **44** and **46** connected by an intermediate portion **48** at the left end of such cam surface. To latch the knob **10** in the retracted longitudinal position shown in phantom lines in FIG. 2, such knob is pushed to the right. This causes the cam follower **16** on the latch member **14** to move longitudinally to the left in FIG. 4 along the upper side of the cam surface **18** in the direction of the arrow. As the cam follower **16** reaches the end of the upper side of the cam surface portion **18**, it proceeds back down along the ramp surface portion **44** until it comes to rest against the intermediate surface portion **48** in the latched position **16'**. In order to enable the cam follower to move from the position **16** to the position **16'**, the latch member **14** must rotate approximately 45° with respect to the connector member **24**, as shown in FIG. 3. This rotation is caused by the sloping end **50** of the cam follower **16** engaging the corner formed between the upper side of the cam surface portion **18** and the ramp portion **44**, so that the cam follower moves back down the ramp portion **44**, while the guide projection **40** on the connector member **24** moves back along the top side of the cam surface.

It should be noted that when the cam follower **16** is moved to the left completely past the corner between the upper side of the cam surface **18** and the ramp portion **44**, the cam follower **16** is automatically rotated slightly past such corner and out of alignment with the guide projection **40** so that the serrated edges **32** and **34** are in closer mesh from that shown in FIG. 2. This is caused by the pressure exerted by spring **20** and the fact that the guiding action on the top side of the cam surface **18** of FIG. 4 no longer holds the cam followers **16** in alignment with the guide projections **40**. The annular projection **38** moves to the far left within the annular groove **36**, due to the camming action, and this disengages the serrated edges **32** and **34** to enable rotation of the latch member **14** with respect to the connector member **24**.

In order to unlatch the latch member **14** and the cam member **12** and return the knob **10** to the extended longitudinal position shown in FIG. 2, the cam follower **16** must be moved from the position **16'** along the cam surface portions **48** and **46** and back down the lower side of the cam surface **18** to the position **16''**. This is accomplished by pushing the knob **10** inward a second time until the sloping end **50** of the cam follower clears the corner formed between the intermediate portion **48** and the ramp portion **46** of the cam surface. When this happens, the latch member **14** again rotates slightly with respect to the connector member **24** to cause the serrated edges **32** and **34** to more closely mesh, so that the sloped end **50** engages the ramp surface **46** of the cam and causes further rotation of the cam follower another 45°, as shown in FIG. 3. When the cam follower reaches the right end of ramp surface **46**, the unlatching operation is complete and the spring **20** moves the cam member **12** to the left, thereby causing the cam follower to move to the right along the bottom side of the cam surface **18** into position **16''** which corresponds to the extended position of the knob **10** shown in solid lines in FIG. 2.

As shown in FIGS. 5A and 5B, a pair of control apparatus having knobs **52** and **54** and each similar to that described above with respect to FIGS. 1 to 4, may be mounted closely adjacent to one another on the control panel **11**. Each of these control apparatus is provided with an extended longitudinal position **52** and **54** and a retracted longitudinal position **52'** and **54'**. Thus in FIG. 5A knob **52'** is retracted while knob **54** is in the extended position to enable easy adjustment by the hand **56** of the operator. Similarly, in FIG. 5B knob **54'** is retracted while knob **52** is extended to enable it to be rotationally adjusted. In both cases the inactive knob **52'** and **54'**, which is not being adjusted, has been pushed into its retracted position to provide more manual operating space. If the inactive knob were not in a retracted position, the operator's finger might easily strike the inactive knob accidentally and cause an error in its adjustment.

Another embodiment of the present invention is shown in FIGS. 6A and 6B in which the knob **10** of the control apparatus of FIG. 1 is mounted within outer knob **58**. The outer knob **58** may be connected to another rotary switch or other component whose hollow shaft surrounds and is concentric with the control shaft **26** of the potentiometer **28** or other electrical component adjusted by knob **10**. In the retracted position of the control knob **10'** in FIG. 6A, the top of such control knob is flush with the top of the outer knob **58** to prevent accidental adjustment of control knob **10** and to indicate that the potentiometer **28** is not in use. In addition, a longitudinally actuated switch may be connected to the potentiometer **28** in order to disconnect such potentiometer from the circuit by opening such switch when the control knob **10** is moved to the retracted position shown in FIG. 6A. Such longitudinally adjustable switch is shown in the embodiment of FIG. 7, hereafter discussed. When it is desired to adjust the potentiometer **28**, the push button knob **10** is moved into the extended position shown in FIG. 6B, which indicates such potentiometer is connected into the circuit and may mean that the oscilloscope is being operated in an uncalibrated condition. Thus, as shown in FIGS. 5 and 6, the control apparatus of the

present invention has the advantages of enabling a greater density of controls to be mounted within a given control panel area and serving as an indicator of the adjustment function performed by such knob.

As shown in FIG. 7, the latching mechanism **12** and **24** of FIGS. 2 to 4 can be employed within the control apparatus with the cam member **12** connected by a drive shaft **60** to a separate control knob **62** projecting through a hole in a front panel **11**. The drive shaft **60** may be fixedly attached to the end cap **22** in the latch of FIG. 2, so that the cam member **12** is moved longitudinally and rotationally by such drive shaft. A longitudinally operated switch **64** may be employed having a slidably mounted actuator arm **66** coupled to the drive shaft **60** for operating such switch by longitudinal movement of the knob **62**. The actuator arm **66** is provided with a notch in one end thereof which engages an annular groove provided in the outer surface of a sleeve **68** which is fixedly attached to the drive shaft **60** by a set screw or the like. Thus longitudinal movement of the knob **62** and drive shaft **60** between retracted position shown in solid lines and the extended position shown in dashed lines causes switch **64** to change the setting of its switch contacts between two different conditions which may connect and disconnect the potentiometer **28** in an electrical circuit or to selectively connect in such circuit two rotary switches **70** and **72** which are also operated by the drive shaft as hereafter described.

The rotary switches **70** and **72** are connected to the drive shaft **60** by a coupling means separate from the latching mechanism **12** and **24**. This coupling means includes a hollow cylindrical coupling member **74** which is mounted between the switches **70** and **72** on the drive shaft **60** and resi liently connected to such drive shaft by a pair of coil springs **76** and **78** provided on opposite sides of an annular collar member **80** fixedly attached to such drive shaft, all of which are contained within the coupling member **74**. One end of each of the springs **76** and **78** is attached to the collar member **80** and their other ends are fastened to the coupling member **74** so that such coupling member rotates with the drive shaft **60**. A pair of connector members **82** and **84** are fixedly attached to the control shafts **86** and **88** of switches **70** and **72**, respectively, and are provided with detent notches **90** for engagement with detent projections **92** on the opposite ends of the coupling member **74**. Longitudinal movement of the drive shaft **60** causes the collar **80** to compress one of the two springs **76** and **78**, thereby urging the coupling member **74** away from the compressed spring and into engagement with the corresponding connector and out of engagement with the connector adjacent the uncompressed spring. Thus in the retracted longitudinal position of knob **62**, drive shaft **60** and collar **80** shown in solid lines in FIG. 7 cause the coupling member **74** to engage connector member **82** and enable rotation of switch **70**, while in their extended position shown in dashed lines they cause the coupling member **74** to engage the connector member **84** to enable rotation of switch **72**.

The switch position readout means for the control apparatus of FIG. 7 includes an inner scale member **93** and an outer scale member **95** mounted concentrically about knob **62** and selectively connected thereto for rotation with such knob. The inner scale member **93** is provided with keyways which are engaged by keys **94** projecting from the back of the knob **62** when such knob is in the retracted position shown. Other keyways **96** are provided on the outer scale member **95** radially positioned for engagement with keys **97** on the top of the knob skirt in the extended position of such knob. As a result, the inner scale member **93** rotates with the knob **62** in the retracted position of knob to indicate the position of the switch **70**, while the outer scale member **95** rotates with the knob **62** in the extended position of such knob to indicate the rotational position of switch **72**. The outer scale member **95** is made of transparent plastic to enable viewing of the inner scale member **93** through such outer member and the two scales are radially displaced from each other to prevent confusion.

A pivotally mounted locking member **98** may be provided for locking the outer scale member **95** against rotation when the knob **62** is in the retracted longitudinal position. When knob **62** is moved to the left, a lock actuator arm **100** pivotally attached to the drive shaft by a pivot connector **101**, is rotated about a pivot arm **102** in a clockwise direction to engage the lock member **98**. This causes lock member **98** to pivot in the clockwise direction about pivot **104** so that a catch projection **106** on such lock member engages one of a plurality of notches provided around the edge of the outer scale member **95** to prevent rotation of such outer scale member. In the extended position of knob **62** the actuator arm **10** pivots in a counter-clockwise direction about pivot arm **102** to release the lock member **98** and enable it to be moved upward into engagement with the front panel **11** by a spring (not shown). It should be noted that the locking member **98** may also function as a pointer for the scales on members **90** and **92**, in which case it can be made of a thin, red colored plastic plate for better indication of the switch position. The entire scale assembly is attached to the front panel by means of an externally threaded clamp sleeve **108** having an outer flange **110** which engages a corresponding shoulder on the outer scale member **95**. The inner and outer scale members are clamped to the control panel **11** by sleeve **108** and its associated nut **112**.

It will be obvious to those having ordinary skill in the art that many changes may be made in the details of the above described preferred embodiment of the present invention without departing from the spirit thereof.

I claim:

1. Control apparatus for adjusting an electrical circuit component comprising:

an electrical circuit component having a control shaft;

a pushbutton rotary knob means movable between at least two different longitudinal positions;

coupling means for coupling said knob means to the control shaft in at least one longitudinal position of said knob means to enable rotation of said shaft by said knob means; and

a push-push latch means for enabling the knob means to move longitudinally of said shaft between said two longitudinal positions and for latching said knob means in the one longitudinal position in response to a push of said knob means, and for unlatching said knob means to enable it to automatically return to the other longitudinal position in response to another push of the knob means.

2. Control apparatus in accordance with claim **1** in which the latch means includes a cam actuated latch member which is rotated about the control shaft by longitudinal movement of said knob means to latch and unlatch the knob means.

3. Control apparatus in accordance with claim **2** in which the latch means includes a hollow cam member having an internal cam surface and the latch member is within said cam member and has a cam follower portion which engages said cam surface for moving said latch member longitudinally and for rotating it a predetermined amount with respect to the cam member to latch and unlatch the knob means in said extended and retracted longitudinal positions.

4. Control apparatus in accordance with claim **3** in which the coupling means includes a connector member attached to said control shaft, a coupling member, and actuator means for moving said coupling member relative to said connector member in response to longitudinal movement of said knob means to couple and decouple said knob means to said connector member through said coupling member.

5. Control apparatus in accordnace with claim 4 in which the latch means is separate from the coupling means and the knob means is connected to the latch member and to the coupling member by a drive shaft.

6. Control apparatus in accordance with claim 4 in which the latch means is part of the coupling means with the cam member being part of said knob means and said actuator means, and the latch member being the coupling member between said knob means and the connector member.

7. Control apparatus in accordance with claim 3 in which the latch member is loosely attached to a shaft connector member to permit relative rotation and both members being provided with serrated edges and a spring provided within the cam member to urge said latch member toward said connector member so that they are coupled together for simultaneous rotation by engagement of their serrated edges.

8. Control apparatus in accordance with claim 7 in which the cam member includes a stop shoulder which engages the connector member provided within said cam member to prevent said connector member from moving completely out of said cam member.

9. Control apparatus in accordance with claim 7 in which the connector member and the latch member are both provided with guide portions which engage a guide track portion extending longitudinally along the inner surface of said cam member.

10. Control apparatus in accordance with claim 9 in which the guide portions are projections on opposite sides of a raised guide track portion which is provided with the cam surface, and the guide projections on the latch member also form the cam followers and are rotationally spaced from the guide projections on the connector member when their serrated edges are engaged.

11. Control apparatus in accordance with claim 1 in which the coupling means also connects the knob means to the control shaft of another electrical component for rotational adjustment thereof in the other longitudinal position of said knob means.

12. Control apparatus in accordance with claim 11 which also includes a pair of rotatable scale members and means for selectively connecting a different one of

said scale members to said knob means in each of the two longitudinal positions of said knob means for rotation with said knob means to indicate the positions of the control shafts of the two electrical components rotatably adjusted by said knob means.

13. Control apparatus in accordance with claim 12 in which the two electrical components are rotary switches and which includes a lock means for locking one of the scale members against rotation when the other scale member is connected to the knob means.

14. Control apparatus in accordance with claim 13 in which the knob means is connected by a drive shaft to the coupling means for coupling said knob means to the control shafts of said rotary switches, and the lock means is actuated by longitudinal movement of said drive shaft.

15. Control apparatus in accordance with claim 1 which also includes coupling means for operatively connecting the knob means to a switch which is switched between at least two conditions by longitudinal movement of said knob means.

16. Control apparatus in accordance with claim 1 in which the knob means is mounted within an axial passageway in a second knob connected to the shaft of a second electrical component so that the front of said knob means is flush with the front of said second knob in the retracted position of said knob means.

17. Control apparatus in accordance with claim 16 in which said second component is a rotary switch and the other component is a variable resistance.

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