

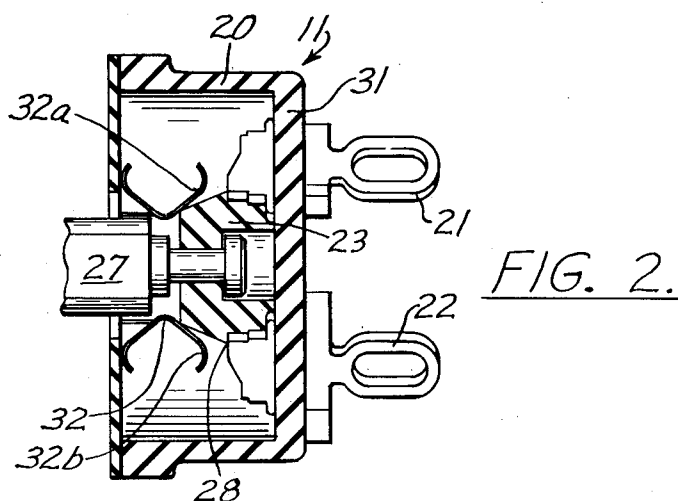
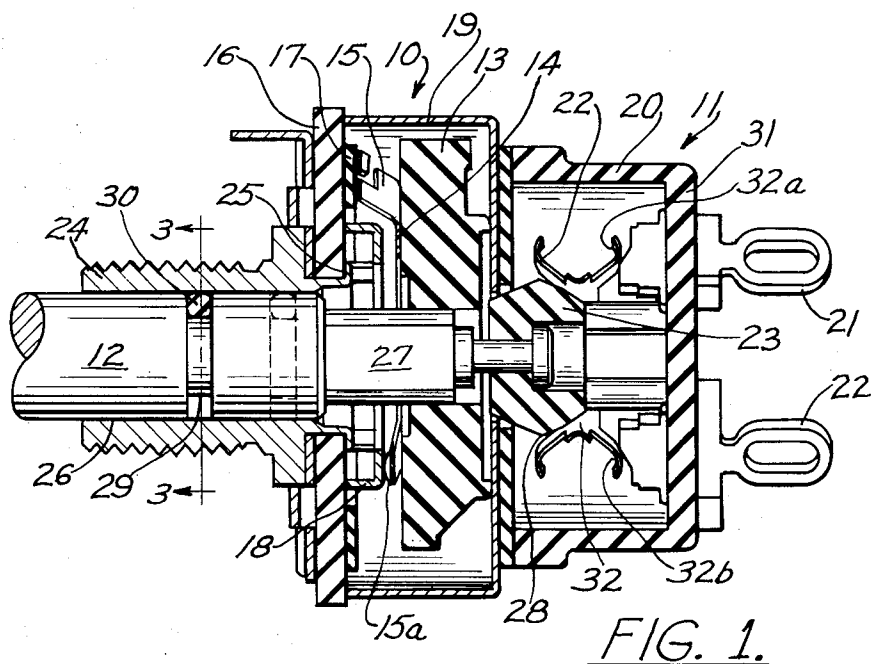
Sept. 12, 1961

S. O. BENDER
GROUNDING MEANS FOR ELECTRICAL CONTROLS
WITH A RECIPROCATING SHAFT

2,999,991

Filed June 20, 1960

2 Sheets-Sheet 1



INVENTOR.
STANLEY O. BENDER

BY
Jennings B. Thompson
ATT'Y.

Sept. 12, 1961

S. O. BENDER
GROUNDING MEANS FOR ELECTRICAL CONTROLS
WITH A RECIPROCATING SHAFT

2,999,991

Filed June 20, 1960

2 Sheets-Sheet 2

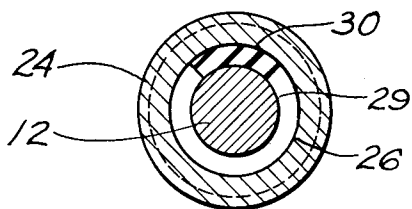


FIG. 3.

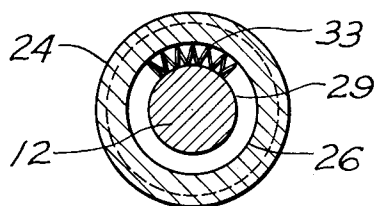


FIG. 4.

INVENTOR.
STANLEY O. BENDER.

BY
James B. Thompson
ATT'Y.

1

2,999,991

GROUNDING MEANS FOR ELECTRICAL CONTROLS WITH A RECIPROCATING SHAFT

Stanley O. Bender, Elkhart, Ind., assignor to CTS Corporation, Elkhart, Ind., a corporation of Indiana

Filed June 20, 1960, Ser. No. 37,364

11 Claims. (Cl. 338-162)

This invention relates generally to electrical controls and, in particular, to combination variable resistors and push-pull switches where the operating shaft for the control must reciprocate as well as rotate.

In the conventional variable resistor the contacts which move along the resistive and conductive elements are normally mounted on spring arms. These spring arms serve to resiliently hold the contacts firmly against the elements along which they travel. The reaction to this force exerted against the contacts by the spring arms is usually transmitted to the contact carrier mounted on the shaft which, in turn, would cause the shaft to move further into the control if it was not restrained. This restraint is usually accomplished by the combination of a groove, a C-washer, and the end of the mounting bushing. The C-washer engages both the groove in the shaft and the end of the mounting bushing and prevents the shaft from moving further into the control. This arrangement not only prevents longitudinal movement of the shaft in one direction but also provides a positive electrical connection between the shaft and the mounting bushing through the C-washer. Since the mounting bushing is connected to the housing of the control and the panel on which it is mounted, the control is thoroughly grounded. That is, there is a positive electrical connection between the control shaft of the control and the ground at all times. However, in controls where it is necessary for the shaft to reciprocate as well as rotate, this C-washer is not present; and it becomes necessary to provide an alternate method of grounding the shaft to the mounting bushing.

Generally, a shaft journaled in a metal bearing will be in contact with one side or other of the bearing most of the time and will, therefore, be grounded most of the time. However, it will not be grounded all of the time, and this is what causes static and other noise in the circuit in which the control is used. For example, whenever a control is operated manually, the shaft moves from one side of the bearing to the other with a frequency which varies directly with the nervous characteristics of the operator. As the shaft moves back and forth at random within the bearing, there is a constant making and breaking of the electrical connection between the shaft and the bearing. During the intervals in which the shaft is not grounded, any extraneous signal which happens to be present is collected by the human body operating the control and transmitted to the shaft. This signal generates a current in the shaft which, in turn, induces an unwanted signal in the current carrying parts of the variable resistor. This spurious signal causes static and noise in the circuit in which the control is connected and is particularly noticeable if the control happens to be in an audio circuit. By providing a continuous and positive ground connection for the shaft ahead of where the shaft enters the current carrying section of the variable resistor, any current induced in the shaft can be drained to ground before causing any static or noise.

It is the object of this invention then to provide an electrical control in which the shaft is positively grounded at all times.

It is a further object of this invention to provide economical and simple means for positively grounding the

2

shaft of a variable resistor and switch combination in which the shaft must reciprocate as well as rotate.

An electrical control in accordance with this invention has its shaft resiliently held against one side of its bearing in such a way that it will be electrically connected to the bearing at all times. This is accomplished simply, economically, and efficiently, by disposing a segment of resilient material in a groove in the shaft so that the material is compressed between the shaft and the bearing. The segment is designed to encompass less than half the circumference of the shaft which causes the compressed segment to force the shaft against the bearing diametrically opposite from the segment. The point of contact between the shaft and the bearing may change, that is, it may move around the bore of the bearing; but the connection between the two members will not be broken. This arrangement insures that the shaft is held in contact with the bearing with sufficient force that the connection will not be broken in ordinary usage, and yet not to the extent that the shaft becomes difficult to operate.

A preferred form of the invention is shown in the attached drawings, in which:

FIGURE 1 is a longitudinal sectional view through a combined variable resistor and switch mounted in tandem so as to be operated by a common shaft, and showing the shaft in its outwardmost position with the switch closed and indicating with dotted lines the location of the resilient segment when the shaft is in its inwardmost position;

FIGURE 2 is a longitudinal sectional view of the switch only showing the position of its component parts when the shaft is in its inwardmost position and the switch is open;

FIGURE 3 is a cross-sectional view taken along the line 3-3 in FIGURE 1 and showing the position of the O ring segment which forms an essential part of this invention; and

FIGURE 4 is a cross-sectional view of the shaft in its bearing and illustrating how a coil of wire can be used to accomplish the objects of the invention.

Referring to the attached drawings, the preferred form of the invention will be described in detail.

Shown in FIGURE 1 is a variable resistor and switch combination of conventional design. The variable resistor, generally indicated by the number 10, and the switch, generally indicated by the number 11, are arranged in tandem on a common operating shaft 12. Since this invention has particular utility when the operating shaft must reciprocate as well as rotate, a push-pull type switch is shown.

The variable resistor 10 has the usual rotor and stator sections. The rotor section consists of the contact carrier 13 with the bridging contactor 14 mounted thereon. The contact carrier is made of non-conductive material and is mounted on the shaft 12 so that the shaft can freely reciprocate therethrough, but which will rotate when the shaft is rotated. In the device shown, this is accomplished by providing the shaft 12 with milled flats 27 which engage a correspondingly flat-sided opening in the contact carrier.

The stator section consists of a base of insulating material 16, upon which is mounted a resistive strip 17 and a conductive collector ring 18. The resistive strip and conductive ring provide circular paths which are bridged by spring arms 15 and 15a which slide along the resistive strip and collector ring as the contact carrier 13 is rotated by the shaft 12. Enclosing the rotor and stator is the housing 19.

The switch 11 is mounted on the end wall of the housing 19 and in axial alignment with the variable resistor

10 and the shaft 12. Terminals 21 and 22 extend through the rear wall 31 into the switch housing 20 where they are engaged by the ends 32a and 32b of the contactor 32 when the switch is closed as shown in FIGURE 1. In this position the shaft 12 is in its outwardmost position and the actuator 23 is holding the ends of the contactor against the terminals. The ends 32a and 32b of the contactor 32 are biased inward toward each other and considerable force is required to force them over the ridge 28 of the actuator. This causes them to move rapidly down the sloping edges leading away from the ridge 28 and gives the switch a "snap" action on closing and opening. In FIGURE 2 the shaft 12 has moved to its inwardmost position and the actuator 23 has forced the ends 32a and 32b of the contactors 32 out of engagement with the terminals 21 and 22.

Providing a bearing for the shaft 12 is the mounting bushing 24 which has a bore 26 in which the shaft 12 is journaled. The mounting bushing is attached to the base 16 of the variable resistor by swaging its end over against the inside wall of the base 16 as at 25.

In the portion of the shaft 12 which remains inside the bore 26 as the shaft reciprocates, the groove 29 is turned. Disposed in the groove is a segment of a rubber O ring 30. This segment preferably is made of rubber with a durometer of 70 to 90 Shore hardness and with a moderately high modulus of elasticity.

As set out above, the object of this invention is to provide means to hold the shaft 12 against one side of the bore 26 so that the shaft will be grounded at all times. This is accomplished by the O ring segment 30. The groove 29 is designed so that the radial distance between it and the bore 26 is less than the cross-sectional thickness of the O ring segment. This, of course, is exactly how grooves are designed when conventional O rings are used, but there the result is the centering of the shaft. Here, by using a segment of the O ring only, the shaft is forced out of the center of the bearing and held against the side diametrically opposite from the segment. To function properly, the segment must not encompass more than half the periphery of the shaft. In FIGURE 3 a segment of 90° is shown as this was the length found most satisfactory. It doesn't matter whether the segment rotates with the shaft or remains stationary with the mounting bushing, the shaft is at all times held in contact with one side of the bore 26.

By changing the distance between the groove 29 and the bore 26, the amount of compression in the segment can be changed with a resultant change in the force holding the shaft against the bearing.

By using an electrically conductive rubber, an alternate ground connection can be provided by the segment itself which could function should the direct connection between the shaft and the bearing be broken for some reason.

In addition, the means biasing the shaft against one side of the bearing need not be made from a material resilient per se. For example, a coil of steel wire arranged in the groove so that each individual coil is compressed between the groove and the shaft will perform equally as well as a rubber segment. This arrangement is shown in FIGURE 4, where the coil spring 33 extends about one-fourth of the distance around the shaft 12 and is compressed between the shaft and the bore.

Further, the segment need not be rubber since any elastomer will perform equally as well. A segment of a rubber O ring was described as being preferred simply because it is the cheapest and easiest source of arcuate segments of resilient material.

It should also be noted that the segment need not be placed in a groove in the shaft as shown, but it could as easily have been installed in a groove in the bore of the mounting bushing with the same result.

An additional advantage of this invention results from the constant wiping action of the segment as the shaft is

reciprocated and rotated. This wiping action prevents the bearing lubricant from building up on the walls of the bearing which could keep the shaft from making contact with it. The segment tends to rotate with the shaft which allows it to progressively wipe the entire bore of the bearing as the control is operated.

From the above description, it can be readily seen that this invention provides an economical and simple solution to a troublesome problem in electrical controls. Only the preferred form of the invention is described above, and since it is possible to produce other embodiments without departing from the inventive concept disclosed herein, it is desired that only such limitations be imposed on the appended claims as are stated therein.

The invention claimed is:

1. An electrical control comprising, in combination, a shaft, a variable resistor and a switch mounted in tandem on the shaft, a housing for the variable resistor and the switch, a mounting bushing having a bore, the bushing being attached to the housing with the shaft reciprocally and rotatably mounted in the bore of the mounting bushing, a groove in the shaft located within the bore of the mounting bushing, resilient means disposed in the groove in compression between the groove and the bore of the mounting bushing and encompassing less than one half the circumference of the groove.

2. The variable resistor according to claim 1 in which the resilient means is made of an elastomer.

3. The variable resistor according to claim 1 in which the resilient means is a coil spring.

4. The variable resistor according to claim 1 in which the resilient means is made of rubber.

5. The variable resistor according to claim 1 in which the resilient means is made of electrically conductive rubber.

6. An electrical control comprising, in combination, a shaft, a variable resistor and a switch mounted in tandem on the shaft, a housing for the control, a mounting bushing having a bore, the bushing being attached to the housing with the shaft reciprocally and rotatably mounted in the bore of the mounting bushing, a groove in the bore of the mounting bushing, resilient means disposed in the groove in compression between the groove and the shaft of less than one half the circumference of the bore in length.

7. The variable resistor according to claim 6 in which the resilient means is made of an elastomer.

8. The variable resistor according to claim 6 in which the resilient means is a coil spring.

9. The variable resistor according to claim 6 in which the resilient means is made of rubber.

10. The variable resistor according to claim 6 in which the resilient means is made of electrically conductive rubber.

11. In an electrical control having a reciprocating operating shaft, a housing for the control, a mounting bushing with a bore, the bushing being attached to the housing with the operating shaft reciprocally mounted in the bore; a panel to which the mounting bushing is attached, the panel and mounting bushing co-acting to electrically ground the control, means for maintaining the shaft in contact with the bore of the mounting bushing so that the shaft will be electrically grounded at all times, said means comprising, a member made from resilient material installed in compression between the shaft and the bore of the bushing and engaging less than one-half of the circumference of the shaft.

References Cited in the file of this patent

UNITED STATES PATENTS

1,697,046	Chapman et al.	Jan. 1, 1929
2,165,199	Batcheller	July 11, 1939
2,216,054	Stearns	Sept. 24, 1940
2,333,477	Duston	Nov. 2, 1943
2,781,436	Barden	Feb. 12, 1957