A variable resistor is disclosed which indicates its adjusted resistance by light sources whose light changes in brightness or color as the resistance changes. A first resistor strip and a first conductor strip are formed or disposed upon a mount in parallel to each other and connected to a load circuit. A second resistor strip or third conductor strip and a second conductor comprising one or a plurality of conductor strips are also formed or disposed in parallel to each other and the first conductor and resistor strips upon the mount and are connected to a light source circuit. A contactor rides over the first resistor and conductor strips to connect them, and contactors ride over the second resistor strip or third conductor strip and a second conductor strip or strips to connect between the second resistor strip or the third conductor strip and the second conductor strip or strips. These contactors are displaced in unison, and as the resistance inserted into the load circuit changes light emitted from light sources changes in brightness or in color.

17 Claims, 6 Drawing Figures
FIG. 5

FIG. 6
VARIABLE-SLIDE RESISTOR INCLUDING LIGHT SOURCE HAVING INTENSITY DEPENDENT UPON RESISTOR SETTING

BACKGROUND OF THE INVENTION

The present invention relates to generally a variable resistor and more particularly a variable-slide resistor of the type in which light emitted from a light source changes in brightness or color as the resistance changes.

The conventional variable-slide resistors used in stereophonic audio reproducing systems in order to change the volume of each channel are not provided with means for indicating the resistance so that the visual recognition of the adjusted resistance of the variable resistor is impossible. Therefore the signal levels of the channels must be adjusted auricularly, but in practice the auricular adjustment is extremely difficult because the audio signals from the loudspeakers are mixed.

SUMMARY OF THE INVENTION

One of the objects of the present invention is therefore to overcome the undesirable difficulties encountered in the conventional variable resistors.

Another object of the present invention is to provide a variable-slide resistor which may indicate its adjusted resistance by light sources so that the visual recognition of the adjusted resistance may be possible.

A further object of the present invention is to provide a variable-slide resistor which may automatically indicate the adjusted resistance corresponding to the position of a sliding member or knob of the variable resistor.

A still further object is to provide a variable-slide resistor provided with means for indicating an adjusted resistance which is simple in construction yet highly reliable in operation.

Briefly stated, according to the present invention, a first resistor strip and a first conductor strip, which, for example, are inserted into an audio circuit of one channel, are connected by a sliding contactor riding over them, and a second resistor strip or third conductor strip and a second conductor or conductors, which are inserted into a light source circuit or indicator circuit, are connected by a sliding contactor or contactors riding over or bridging between them. One end of each of the first resistor and conductor strips is connected to the load circuit in series. One end of the second resistor or third conductor is connected to one terminal of a power supply while one end or ends of the second conductor or conductors are connected to the other terminal of the power supply. The second resistor or third conductor is connected to each of the second conductors through a light source which may be located, for instance, in a lighting means of a sliding member such as a knob. As with the conventional variable resistor, the resistance of the load circuit changes as the sliding member is displaced from one end of the first resistor to the other end. So does the resistance of the light source or indicator circuit so that brightness of light emitted from the light source changes gradually. Thus, the adjusted resistance may be visually indicated. Therefore, when the variable resistors in accordance with the present invention are incorporated in a stereophonic sound reproducing system, the audio signals of both channels may be adjusted by the comparison of brightness of light emitted from the light sources in the variable resistors.

Alternatively, if it is desired to indicate whether a variable resistor is operating or not, or to indicate the position of a sliding member or knob, a third conductor is used instead of the second resistor. Furthermore, the contactors riding over the second and third conductors and the second and third conductors may be eliminated when the light sources are directly connected to an external power supply.

When it is desired to change the brightness of light of a light source depending upon the position of a sliding member from a reference point selected between the both ends of the first resistor, the second conductor is divided into two sections at a point corresponding to the reference point. One terminal of the light sources is connected to the reference point of the second resistor while the other terminals are connected to the two sections of the second conductor, respectively.

Moreover, a plurality of light sources emitting light of different colors may be used so that the adjusted resistance may be indicated by the color and brightness of light. In this case, the second embodiment is divided into a plurality of sections the number of which is equal to the number of light sources. Each section of the second conductor is connected through each light source to the second resistor.

As described above, the variable resistors in accordance with the present invention incorporate the light sources or indicators so that the adjusted resistance may be visually indicated. More particularly, it is so arranged that the further from a central point of the second resistor the sliding member or contactor is located, the dimmer the light becomes, and the light is brightest when the sliding member is located at the midpoint of the second resistor. This arrangement is therefore best adapted for use with a stereophonic sound reproducing system. Furthermore, the color of light of the indicator may be changed depending upon an adjusted resistance or the position of the knob of the variable resistor so that the adjusted resistance may be immediately monitored from a remote place. Furthermore, the position of a knob may be readily recognized so that the operation of a variable resistor may be much facilitated.

The present invention will become more apparent from the following description of the preferred embodiments thereof taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a first embodiment of the present invention;

FIG. 2 is a sectional view taken along the line II—I of FIG. 1;

FIG. 3 is a sectional view taken along the line III—III of FIG. 1;

FIG. 4 is a top view of a mount of the variable resistor shown in FIG. 1;

FIG. 5 is a circuit diagram of the variable resistor shown in FIG. 1; and

FIG. 6 is a circuit diagram of a sixth embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

First Embodiment, FIGS. 1–5

Referring to FIGS. 1–5, a mount 1 formed from an
insulating material has a pair of spaced apart projections 2 extended uprightly from both side edges as best shown in FIG. 2. Upon the upper surface of the mount 1 are disposed a first resistor 3 and a first conductor 4 in parallel with each other as best shown in FIG. 4. In similar manner, a second resistor 6 with a center terminal 5 and a second conductor, which is divided into two sections 7 and 7a, are also disposed in parallel to each other. It should be noted that the two sections 7 and 7a of the second conductor are staggered from each other.

That is, the spacing between the second resistor 6 and the section 7a of the second conductor is shorter than that between the second resistor 6 and the section 7. Both first and second resistors 3 and 6 have terminals 8 and 9, respectively, which are bent downwardly at right angles from both ends of the first and second resistors 3 and 6 so as to extend through the mount 1 for external connection. The first and second conductors 4 and 7 and 7a have also similar terminals as best shown in FIG. 2.

A metallic casing member 10 inverted U-shaped in cross section is mounted upon the mount 1 with ears or lugs 10a and 10b of the casing member 10 engaged with mating notches 1a and 1b of the mount 1 (see FIG. 4). A sliding member 12, which is formed from an insulating material, has stepped portions 13 formed in the undersurface of the sliding member 12 at both sides thereof for engagement with the pair of projections 2 of the mount 1 so that the movement of the sliding member 12 in the longitudinal direction may be guided by the pair of projections 2. A knob shaft 14 extends upwardly from the center of the upper surface of the sliding member 12 through a groove 11 formed at the top of the casing and has a knob 21 attached at the top end thereof. The knob shaft 14 may be formed integrally with the sliding member 12, or may be a separate part securely fixed thereto. As best shown in FIG. 2, to the undersurface of the sliding member 12 are attached a contactor 15 for slidable contact with the first resistor 3 and the first conductor 4 and contactors 16, 17 and 17a for slidable contact with the second resistor 6, and the two sections 7 and 7a of the second conductor, respectively. A covering plate 18 is attached to the undersurface of the top of the casing member 10, and springs 19 are loaded between the upper surface of the sliding member 12 and the undersurface of an friction plate 20, attached to the undersurface of the covering plate 18.

The knob shaft 14 and the knob 21 attached thereupon constitute the operating means. The knob 21 has a blind hole the opening of which is covered with a transparent or semitransparent cover plate 22. Two light sources or bulbs 23 and 24 disposed within the blind hole of the knob 21 are electrically connected to the contactors 16, 17 and 17a through lead wires 25 and 26 (see FIG. 5).

Next, the mode of operation of the first embodiment with the above construction will be described with further reference FIG. 5. One terminal of each of the two sections 7 and 7a of the second conductor is connected to the negative terminal of an external power supply 27, while the center terminal 5 of the second resistor 6 is connected to the positive terminal.

When one moves the knob 21 in the longitudinal direction, the sliding member 12 smoothly moves along the pair of projections 2 of the mount 1 within the casing member 10. As a result, the contactor 15 attached to the undersurface of the sliding member 12 slides over the first resistor 3 and the first conductor 4, so that a resistance between one of the terminals 8 and the terminal 4a of the first conductor 4 may be varied as with a conventional variable resistor. The contactors 16, 17 and 17a also slide over the second resistor 6 and the two sections 7 and 7a of the second conductor. More particularly, when the sliding member 12 is displaced in the direction indicated by the arrow C, the contactor 17 slides over the section 7, whereas when the sliding member 12 is displaced in the direction indicated by the arrow D (see FIGS. 3 and 4), the contactor 17a slides over the section 7a. Therefore, when the sliding member 12 is displaced in the direction C from the center terminal 5, the light bulb 23 is turned on, while when the sliding member 12 is displaced in the direction D, the light bulb 24 is turned on. That is, the closer to the center terminal 5 the slider 12, and hence the contactor 16 is, the brighter the light bulb 23, and the further the contactor 16 is displaced from the center terminal 5 in the direction C, the dimmer the light bulb 23 becomes. In like manner, the closer toward the center terminal 5 the contactor 16 is in the direction D, the brighter the light bulb 24 becomes, and the further from the center terminal 5 the sliding contactor 16 is, the dimmer the light bulb 24 becomes. Light emitted from either of the light bulb 23 or 24 may be seen through the cover plate 22.

Second Embodiment

While the two light bulbs 23 and 24 are used in the first embodiment, only one light bulb or source connected directly electrically to the power source may be used in the second embodiment. That is, in the second embodiment it suffices to provide only the first resistor 3 and the first conductor 4.

Third Embodiment

The third embodiment also uses only one light source or bulb. One of the terminals of the second resistor 6 is connected to one terminal of the external supply source 27, and instead of the two sections 7 and 7a of the second conductor, a single second conductor strip is formed so that the resistor 6 and the second conductor 7, the length of which is nearly equal to that of the second resistor, may be electrically connected to each other through the light source or bulb. Thus, the brightness of light emitted from the light source may be linearly changed as the resistance changes.

Fourth Embodiment

The fourth embodiment also uses only one light source. Instead of the two conductor sections 7 and 7a, a single conductor strip is formed and electrically connected to the center terminal 5 of the second resistor 6 through the light source. Thus, when the contactor 16 in contact with the second resistor 6 is at the center of the resistor 6, the light source may emit the brightest light, but when the contactor 16 is moved away from the center terminal 6 in either direction C or D, the light becomes dimmer.

Fifth Embodiment

In the fifth embodiment whose circuit diagram is shown in FIG. 6, two light sources 23 and 24 emitting light with different colors are used instead of the light sources emitting light of the same color. The mode of
operation is substantially similar to that of the first embodiment, except that the color of light emitted from the light source changes depending upon whether the sliding member 12 is displaced in the direction C or D. As with the first embodiment, light emitted from the light source changes in brightness as the contactor 16 is displaced from the center terminal 5 of the second resistor 6.

Sixth Embodiment, FIG. 6

Instead of only two light sources, the sixth embodiment employs a plurality of light sources emitting light of different colors. As shown in FIG. 6, the second conductor member is divided into a plurality of sections 7, 7a, 7b, 7c and so on, the number of which equals that of light sources. Thus, the color of light observed changes depending upon the position of the contactor 15. In the sixth embodiment it should be noted that instead of the resistor member 6a, a conductor member 6a may be used and that the center terminal 5 of the first embodiment may be eliminated.

In FIG. 6, reference numerals 23, 23a, 23b and 24 denote light sources or bulbs; and 17, 17b, 17c and 17d, contactors adapted to be made into contact with the conductor sections 7, 7b, 7c and 7d respectively, as the sliding member 12 or the knob is moved in the direction C or D so that one of the light sources may be turned on.

What is claimed is:
1. A variable resistor comprising:
   a. a case member with an open bottom and an elongated slot formed at the top thereof;
   b. a mount formed from an insulating material and attached to said case member at said open bottom so as to define a hollow case;
   c. a first resistor means and a first conductor means on said mount in parallel with each other and to said elongated slot;
   d. a second resistor means and at least one second conductor means on said mount in parallel to each other and to said elongated slot, a terminal connected to the midpoint of said second resistor means, said second conductor means being divided into two sections at a point corresponding to said midpoint of said second resistor means, a second terminal connected to said two sections of said second conductor means;
   e. a sliding member formed from an insulating material, disposed within said case, provided with an operating means extending upwardly and outwardly through said elongated slot and slidably along said elongated slot and said mount;
   f. a first contactor attached to said sliding member for slidable contact with said first resistor means and said first conductor means so as to short-circuit between them, and at least one second contactor attached also to said sliding member for slidable contact with said second resistor means and said at least one conductor means so as to short-circuit between them; and
   g. at least one light source means attached to said operating means and electrically connected in series to said second resistor means and said at least one conductor means, said light source means comprising two light sources, each of which is interconnected between said contactor in slidable contact with said second resistor means and contactor in slidable contact with each of said two sections of said second conductor means.
2. A variable resistor as defined in claim 1 wherein said light source means emit light of different colors.
3. In a variable resistor of the type comprising a case member having an open bottom and an elongated slot formed at the top thereof, a mount of an insulating material attached to said case member at said open bottom so as to define a hollow case, a first elongated resistor and a first elongated conductor on said mount and parallel with each other and with said elongated slot, a sliding member formed in an insulating material disposed within said case and having operating means extending upwardly and outwardly through said elongated slot and slidably along said elongated slot and said mount, and a first contactor attached to said sliding member for slidable contact with said first resistor and said first conductor so as to provide a short-circuit between them; the improvement wherein said variable resistor further comprises second elongated resistor means and second elongated conductor means on said mount in parallel to each other and said elongated slot, second and third contactor means attached to said sliding member for slidable contact with said second resistor means and said second conductor means respectively, light source means attached to said operating means and electrically connected between said second and third contactor means, terminal means attached to said second resistor means, and terminal means attached to said second conductor means.
4. The variable resistor of claim 3 wherein said operating means of said sliding member comprises a knob supporting member extending upwardly through said slot, an open-ended knob affixed to the end of said knob supporting means, said light source means being disposed within the open end of said knob, and a transparent plate covering the open end of said knob.
5. The variable resistor of claim 3 wherein said second conductor means comprises one conductor, and said light source means comprises a single lamp.
6. The variable resistor of claim 3 wherein said terminal means connected to said second resistor means comprises a terminal electrically connected to the midpoint of said second resistor means.
7. The variable resistor of claim 6 wherein said second conductor means comprises first and second elongated conductors spaced at different distances from said second resistor means, said first and second conductors being shorter than said second resistor means and extending from alignment with opposite ends of said second resistor means to overlap in the region of the mid-point of said second resistor means, said third contactor means comprising contactors separately contacting said first and second conductors, and wherein said light source means comprises first and second lights connected between said second contactor means and separate contacts of said third contactor means.
8. The variable resistor of claim 3 wherein said second conductor means comprises a plurality of elongated conductors spaced at different distances from said second resistor means, said separate conductors being of lengths shorter than said second resistor means and being disposed to be overlapped with respect to each other only at their respective ends, wherein said third contactor means comprises a separate contact aligned to contact each of said separate conductors, and wherein said light source means comprises a plural-
ity of separate light sources each connected between said second contactor means and a separate contact of said third contactor means.

9. The variable resistor of claim 3 wherein said terminal means connected to said second resistor means comprises separate terminals connected to the ends and mid-points of said second resistor means.

10. In a variable resistor of the type comprising a case member having an open bottom and an elongated slot formed at the top thereof, a mount of an insulating material attached to said case member at said open bottom so as to define a hollow case, elongated resistor means and first conductor means on said mounting parallel with each other and to said elongated slot, a sliding member of an insulating material disposed within said case and provided with operating means extending upwardly and outwardly through said elongated slot and slidable along said elongated slot and said mount, first contactor means attached to said sliding member in slidable contact with said resistor means and said first conductor means so as to provide a short therebetween; the improvement comprising second and third elongated conductive means on said mount in parallel with each other and to said elongated slot, second and third conductor means attached to said sliding member for slidable contact with said second and third conductive means, at least one light source means attached to said operating means and electrically connected between said second and third conductive means, and terminal means connected to said second and third conductive means.

11. The variable resistor of claim 10 wherein said third conductive means comprises a plurality of conductors spaced at different distances from said second conductive means and having lengths shorter than said second conductive means, said separate conductors being overlapped only at their ends, wherein said third contactor means comprises a separate contact arranged to slidable contact each of said separate conductors, and wherein said light source means comprises a separate light source connected between said second contactor means and each of the contacts of said third contactor means.

12. The variable resistor of claim 11 wherein said light sources have different colors.

13. A variable resistor with indicating lamps comprising a case member with an open top and an elongated slot formed at the top thereof; a mount made of an insulating material and attached to said case member to close said open bottom so as to define a hollow space within said case member; at least one pair of a first resistor means and a first conductor means and at least one pair of a second resistor means and a second conductor means, said resistor means and conductor means each being formed on said mount in parallel with said elongated slot; terminal means connected to both ends of each of said resistor means and conductor means and extending through said mount to project from outside said space; a sliding member made of an insulating material disposed within said case and provided with an operating means extending through said elongated slot, said sliding member being slidable along said elongated slot and said mount; at least one contactor attached to the bottom of said sliding member and slidable over said pair of said first resistor means and said first conductor means so as to short-circuit between them and independent contactors attached to said bottom of said sliding member and slidable over said pair of said second resistor means and said third conductor means respectively; and at least one indicating light source mounted upon said operating means and electrically connected to said second conductor means and said third conductor means by way of said independent contactors.

14. A slider-type variable resistor with indicating lamps as defined in claim 13 wherein said second conductor means is comprised of a plurality of separate sections.

15. A slider-type variable resistor as recited in claim 13 further comprising a knob at the top of said operating means outside of said space, said knob having a hole therein, said indicating light source being mounted within said hole, and a transparent cover plate covering the hole in said knob.

16. A slider-type variable resistor with indicating lamps comprising a case member with an open top and elongated slot formed at the top thereof; a mount made of an insulating material and attached to said case member to close said open bottom so as to define a hollow space within said case member; at least one pair of a first resistor means and a first conductor means, and at least one pair of a second resistor means and a second conductor means; said resistor means and conductor means each being formed on said mount in parallel with said elongated slot; terminal means connected to both ends of each of said resistor means and conductor means and extending through said mount to project from outside said space; a sliding member made of an insulating material disposed within said case and provided with an operating means extending through said elongated slot and said mount; at least one contactor attached to the bottom of said sliding member and slidable over said pair of said first resistor means and said first conductor means so as to short-circuit between them, and independent contactors attached to said bottom of said sliding member and slidable over said pair of said second resistor means and said second conductor means respectively; and at least one indicating light source mounted upon said operating means and electrically connected to said second resistor means and said second conductor means by way of said independent contactors.

17. A slider-type variable resistor as recited in claim 16, further comprising terminal means connected to said second resistor means between the ends thereof and extending through said mount.

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