United States Patent

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[33] **Japan**
[31] **44/122844**

[54] **ADJUSTING RESISTANCE**
20 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** **338/183**
[51] **Int. Cl.** **H01c 9/02**
[50] **Field of Search** 338/183, 176, 178, 182

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ABSTRACT: An adjustable resistance comprising a box-shaped body including an upper wall having an elongated slit and a bottom plate provided with a resistance element and a conducting element on the inside surface of the bottom plate, a fixed insulating plate being located beneath the upper wall of the body and having an elongated slit substantially aligned with said elongated slit in that upper wall, a movable insulating plate and a spring member both having registering apertures, a sliding contact support or carrier made of an insulating material and having a knob which is passed through said registering apertures of the spring member and the movable insulating plate to project outwardly through said aligned slits, a plurality of projections being provided on the sliding contact support, and a sliding contact piece mounted on the lower surface of the sliding contact support, whereby under the resilience of the spring member said sliding contact piece is urged against said resistance element and said conducting element.

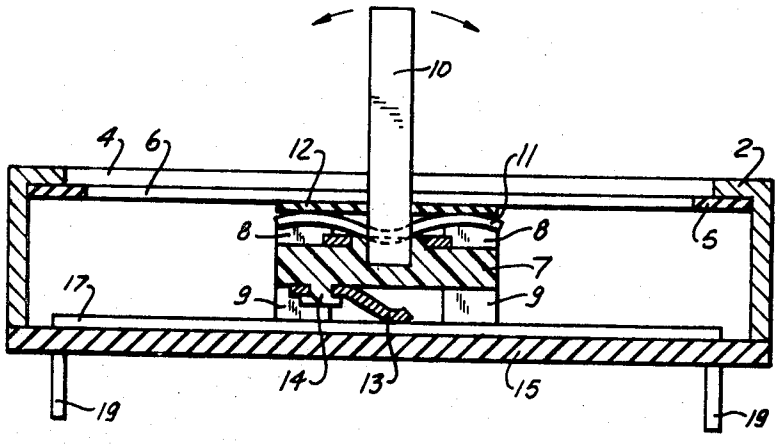

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FIG. 1

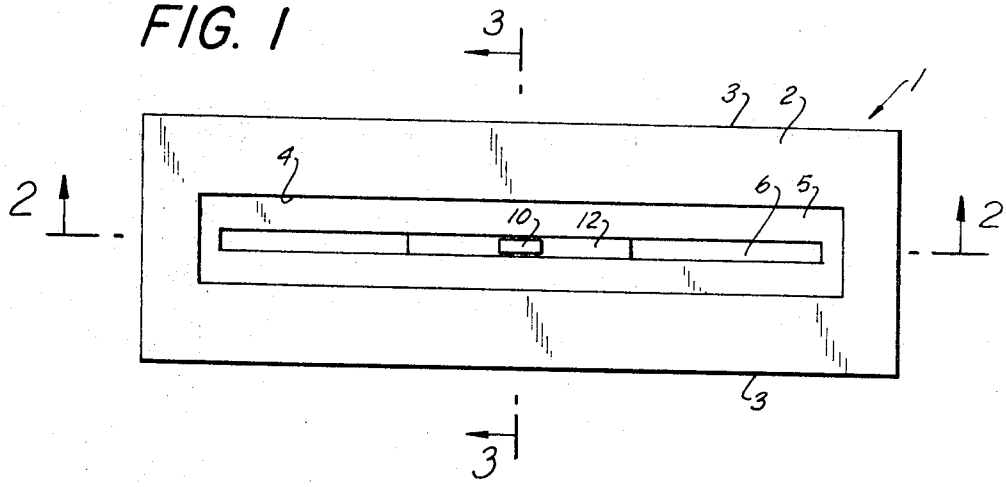

FIG. 2

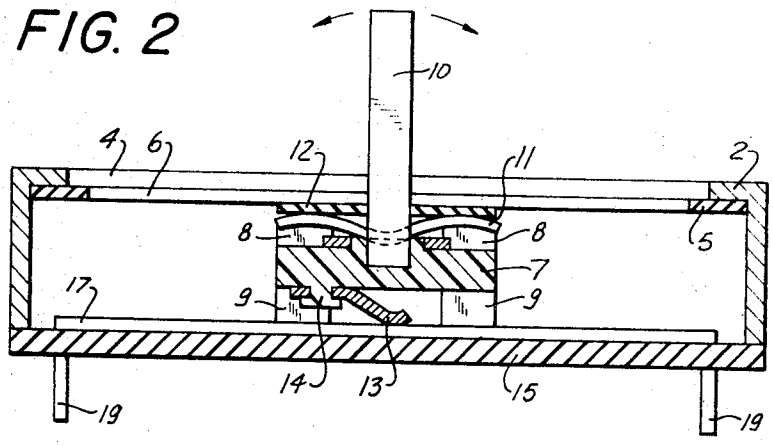

FIG. 3

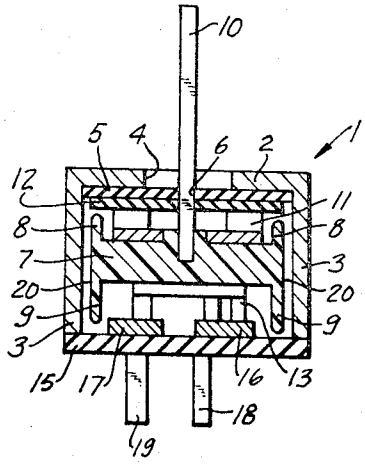

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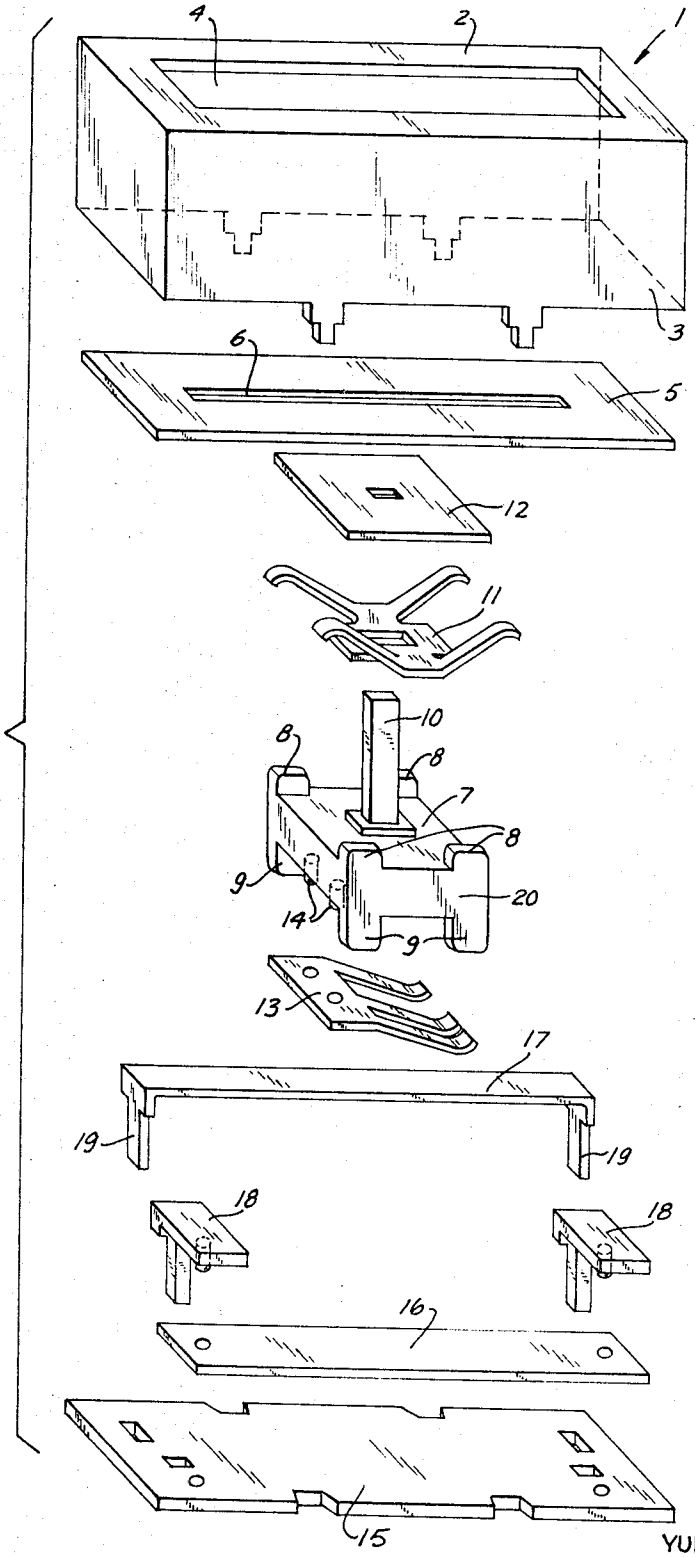
FIG. 4



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ADJUSTING RESISTANCE

This invention relates generally to an adjustable resistance, and more particularly to a device of that type having a box-shaped rectangular body and a contact slidable on a rectilinear resistance element seated on the bottom plate of the box-shaped body under the manual control of a knob projecting from the upper surface plate of the body. The resistance is particularly well adapted for use as an adjustable volume control in a communication receiver, but its applicability is not limited thereto.

Heretofore, various types of volume control devices have been proposed, some of them rotary and some of them rectilinear in adjusting movement. Although most of these conventional types of volume control devices have operated satisfactorily, there are still some inconveniences when they are actually employed in various fields of applications, particularly insofar as smoothness of operation is concerned, and such smoothness is essential for precise adjustment.

Therefore, the primary object of this invention is to provide an improved type of sliding adjustable resistance which can overcome all of the inconveniences experienced in the conventional types of such devices.

Another object of the present invention is to provide an improved type of sliding volume control device which is simple in construction and cheap in manufacture.

Still another object of the present invention is to provide an improved construction of a sliding volume control device which has substantially no play between the movable member and the stationary members, and the operation of which is extremely stable.

A further object of the invention is to provide an improved construction of a sliding volume control device wherein the sliding movement is performed substantially between molded plastic members, whereby the movement thereof has an extremely smooth touch.

These and other objects of the invention can be achieved by an improved construction of adjustable resistance which comprises a box-shaped body including an upper wall having a longitudinal slit and a lower bottom plate of insulating material having a resistance element, and preferably a conducting element, mounted on the inside surface of the bottom plate. A fixed insulating plate is located beneath the body upper wall, that plate having a longitudinal slit substantially aligning with said slit in said upper wall of the box-shaped body. A movable insulating plate and a spring member each have a registering aperture, and an insulating sliding contact support or carrier having a knob are accommodated in said box-shaped body so that the knob projects through said apertures of said spring member and said movable plate and also through said aligned two slits, said sliding contact support having downwardly projecting portions engaging said bottom plate, said contact support carrying a downwardly projecting sliding contact, whereby said sliding contact is urged against said resistance element and said conducting element and said movable insulating plate is also urged against said fixed insulating plate under the action of said spring member.

The nature, principle, and utility of the present invention will be better understood from the following detailed description when read in conjunction with the accompanying drawings, in which:

FIG. 1 is a top plan view of the adjustable resistance according to the present invention;

FIG. 2 is a longitudinal sectional view taken along the line 2–2 in FIG. 1;

FIG. 3 is a cross-sectional view of the adjustable resistance according to the invention taken along the line 3–3 in FIG. 1; and

FIG. 4 is an exploded perspective view of the adjustable resistance.

Referring to FIGS. 1 through 4, there is indicated an example of an adjustable resistance according to the present invention, which comprises a box-shaped housing or body **1** having an upper wall **2** and sidewalls **3,3**. The upper wall **2** is provided with an elongated opening **4** extending along its longitudinal axis. Inside of the box-shaped body **1**, a fixed insulating plate **5** made, for instance, of phenolic resin is disposed underlying said upper wall **2**, and the fixed plate **5** is provided with an elongated opening **6** registering with, but preferably of narrower width than the opening **4**.

In the box-shaped body **1**, there is also included a sliding contact support **7** made, for instance, of polyacetal resin (of trade name "DELRIN") in such a manner that the sliding contact support or carrier **7** is freely slidable inside of the box-shaped body **1**. The sliding contact support **7** is provided with upwardly and downwardly projecting portions **8** and **9** formed integral therewith and projecting respectively upwardly and downwardly at the four corners of the sliding support **7**. A knob **10** is also provided integral with said sliding contact support **7** so that it projects upwards from the central portion of the upper surface of the sliding support **7** and passes through the opening **6** of the fixed insulating plate **5**.

Also inside of the box-shaped body **1** are a spring member **11** and a movable insulating plate **12** made, for instance, of polyacetal resin (of trade name "Duracon"), both having holes at the central portion thereof, and the knob **10** of the sliding contact support **7** passes through these holes. Thus, the movable insulating plate **12** is urged against the fixed insulating plate **5** under the action of the spring member **11**, and when the knob **10** is manually moved in either direction along the opening **6** of the fixed insulating plate **5**, the movable plate **12** slides along the undersurface of the fixed plate **5**. For obtaining better sliding between these two plates **5** and **12**, if it is desired, a lubricant such as grease may be applied therebetween.

A sliding conductive contact piece **13** is attached to the lower surface of the sliding contact support **7**, for instance, by passing projections **14** on the support **7** through holes provided in the sliding contact piece **13** and heading over the tips of the projections **14**. A resistance element **16** and a conducting element **17** of strip form are fixed on the upper surface of the insulating bottom plate or base **15** of the box-shaped body **1**, so that the sliding contact piece **13** contacts the resistance element **16** and the conducting element **17** when the insulating bottom plate **15** is attached to the bottom of the box-shaped body **1**. Furthermore, the projections **9** extending downwardly from the sliding contact support **7** engage the upper surface of the insulating bottom plate **15** at positions laterally outside of the resistance element **16** and the conducting element **17** under the resilient force of the spring member **11**. Numerals **18,18** designate the two terminals of the resistance element **16**, and numerals **19,19** designate the two terminals of the conducting element **17**.

The sliding adjustable resistance according to the present invention and having a construction as described above is assembled as follows.

The fixed insulating plate **5** is initially inserted inside of the box-shaped body **1** so that the plate **5** underlies the lower surface of the upper wall **2** of the box-shaped body **1**. Next, the knob **10** of the sliding contact support **7**, on the lower surface of which the sliding contact piece **13** is attached, is passed through the central holes of the spring member **11** and the movable insulating plate **12** in that order, and the sliding contact support **7** thus assembled is thereafter inserted inside of the box-shaped body **1** so that the knob **10** projects through the aperture **6** of the fixed insulating plate **5** and the aperture **4** of the body **1** to the outside of the body **1**.

Finally, the insulating bottom plate **15** made, for instance, of phenolic resin and on the upper surface of which are fixed the resistance element **16** and the conducting element **17**, is attached to the bottom portion of the body **1**.

With the sliding volume control device thus assembled, the movable insulating plate **12** contacts, face-to-face, with the fixed insulating plate **5** under the resilient action of the spring member **11**, and at the same time, the downwardly projecting

portions 9,9 of the sliding contact support 7 are urged onto the upper surface of the insulating bottom plate 15.

In addition, the upwardly projecting portions 8,8 of the sliding contact support 7 are located very close to the movable insulating plate 12, and the sidewalls 3,3 of the body 1 are located very close to the side surfaces 20,20 of the sliding contact support 7.

In operation, when the knob 10 of this sliding adjustable resistance device is manually moved in either direction along the aperture 6 of the fixed insulating plate 5, the sliding contact support 7 integral with the knob 10 and supporting the sliding contact piece 13, spring member 11, and the movable insulating plate 12 therewith, is moved inside of the box-shaped body 1. The downwardly projecting portions 9,9 slide along the upper surface of the insulating bottom plate 15, the movable insulating plate 12 slides along the lower surface of the fixed insulating plate 5, and the sliding contact piece 13 is moved slidingly along the surfaces of the resistance element 16 and the conducting element 17, whereby the resistance value of the utilized portion thereof can be varied in accordance with the movement of the knob 10.

Since the adjustable resistance device according to the present invention is so constructed that the spring member 11 and the movable insulating plate 12 are attached to the sliding knob 10 so that the movable insulating plate 12 is urged against the fixed insulating plate by means of the spring member 11, and also because the downwardly projecting portions 9,9 of the sliding contact support 7 are urged against the insulating bottom plate 15 for vertically supporting the sliding contact support 7, undesirable play at the time when the knob 10 is moved in either direction can be completely eliminated and an even and smooth movement of the sliding parts can be assured.

Furthermore, because the downwardly projecting portions 9,9 provided at the four corners of the sliding contact support 7 are urged against the insulating bottom plate 15 by means of the spring member 11, and because the movable insulating plate 12 is urged against the fixed insulating plate 5 by the resilient force of the same spring member 11, unwanted twisting movement of the sliding contact support 7 can be prevented even if a twisting force (as indicated by the arrow marks in FIG. 2) is applied to the knob 10, rendering the movement of the sliding contact support 7 extremely stable.

In addition, the sliding motion of the volume control device of this invention is carried out between the downwardly projecting portions 9,9 of the sliding contact support 7 and the insulating bottom plate 15 and also between the movable insulating plate 12 and the fixed insulating plate 5, all of these members being made of insulating materials far softer than metal, whereby the feel or touch obtained at the time of the sliding motion is extremely smooth.

As still another advantageous feature of the present invention, since the knob 10 projects out through the aperture 6 in the fixed insulating plate 5 which underlies the upper wall 2, and since that plate is made of synthetic plastic material, the edges of the aperture 6 are far smoother than the edges of the aperture 4 of the upper wall 2 which might be made of metal or other harder material, whereby the knob 10 can be moved smoothly without being subjected to the adverse effect of the uneven edges of the upper wall 2.

Furthermore, when it is desired, the upward-projecting portions 8,8 of the sliding contact support 7 may be brought more closely to the movable insulating plate 12 and by so doing, the tendency of the knob 10 to be twisted can be greatly minimized even if an excessive force is applied to the knob 10 in the direction indicated by the arrow marks in FIG. 2.

While but a single embodiment of the present invention has been specifically disclosed, it will be apparent that many variations may be made therein, all without departing from the spirit of the invention as defined in the following claims.

I claim:

1. An adjustable resistance comprising a housing having a wall with an elongated opening therethrough and, in said housing, an insulating plate beneath said wall and having an elongated opening therethrough registering with said first-mentioned opening, an elongated resistance spaced below said plate, a contact slidable over said resistance, a carrier to which said contact is secured located between said resistance and said plate, a handle on said carrier extending through said apertures and projecting beyond said housing, and spring means active between said carrier and said plate and effective to urge said carrier downwardly toward said resistance.

2. The adjustable resistance of claim 1, in which said spring means is provided with an aperture through which said carrier handle extends.

3. In the adjustable resistance of claim 2, a second insulating plate interposed between said spring means and said first-mentioned insulating plate and having an aperture through which said carrier handle extends, said spring means urging said second plate against said first plate and said second plate sliding over said first plate as said contact is slid over said resistance.

4. The adjustable resistance of claim 3, in which said resistance is mounted on a base, said carrier having downwardly projecting parts engaging and sliding over said base.

5. The adjustable resistance of claim 4, in which said carrier also has upwardly projecting parts extending close to said first-mentioned insulating plate.

6. In the adjustable resistance of claim 1, a second insulating plate interposed between said spring means and said first-mentioned insulating plate and having an aperture through which said carrier handle extends, said spring means urging said second plate against said first plate and said second plate sliding over said first plate as said contact is slid over said resistance.

7. The adjustable resistance of claim 6, in which said resistance is mounted on a base, said carrier having downwardly projecting parts engaging and sliding over said base.

8. The adjustable resistance of claim 7, in which said carrier also has upwardly projecting parts extending close to said first-mentioned insulating plate.

9. The adjustable resistance of claim 1, in which said resistance is mounted on a base, said carrier having downwardly projecting parts engaging and sliding over said base.

10. The adjustable resistance of claim 9, in which said carrier also has upwardly projecting parts extending close to said insulating plate.

11. The adjustable resistance of claim 1, in which said elongated opening in said wall is wider than said elongated opening in said plate.

12. The adjustable resistance of claim 11, in which said spring means is provided with an aperture through which said carrier handle extends.

13. In the adjustable resistance of claim 12, a second insulating plate interposed between said spring means and said first-mentioned insulating plate and having an aperture through which said carrier handle extends, said spring means urging said second plate against said first plate and said second plate sliding over said first plate as said contact is slid over said resistance.

14. The adjustable resistance of claim 13, in which said resistance is mounted on a base, said carrier having downwardly projecting parts engaging and sliding over said base.

15. The adjustable resistance of claim 14, in which said carrier also has upwardly projecting parts extending close to said first-mentioned insulating plate.

16. In the adjustable resistance of claim 11, a second insulating plate interposed between said spring means and said first-mentioned insulating plate and having an aperture through which said carrier handle extends, said spring means urging said second plate against said first plate and said second plate sliding over said first plate as said contact is slid over said resistance.

17. The adjustable resistance of claim 16, in which said resistance is mounted on a base, said carrier having downwardly projecting parts engaging and sliding over said base.

18. The adjustable resistance of claim 17, in which said carrier also has upwardly projecting parts extending close to said first-mentioned insulating plate.

19. The adjustable resistance of claim 11, in which said resistance is mounted on a base, said carrier having downwardly projecting parts engaging and sliding over said base.

20. The adjustable resistance of claim 19, in which said carrier also has upwardly projecting parts extending close to said insulating plate.