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RESISTANCE TRIMMER

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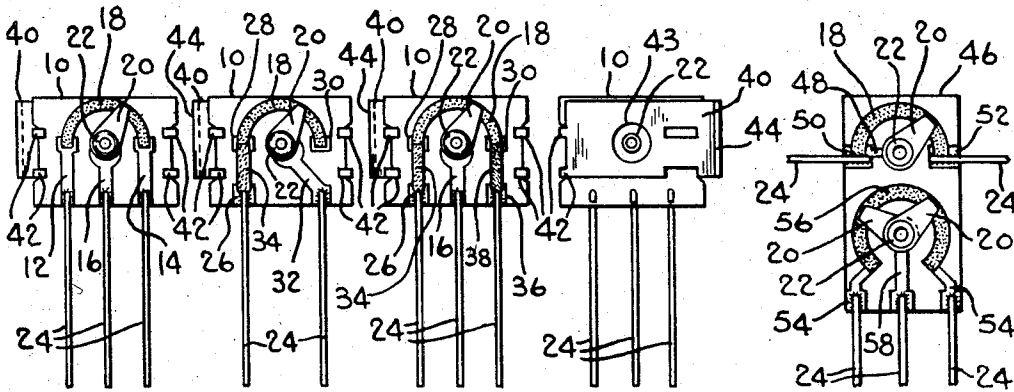


FIG. 1 FIG. 2 FIG. 3 FIG. 4 FIG. 5

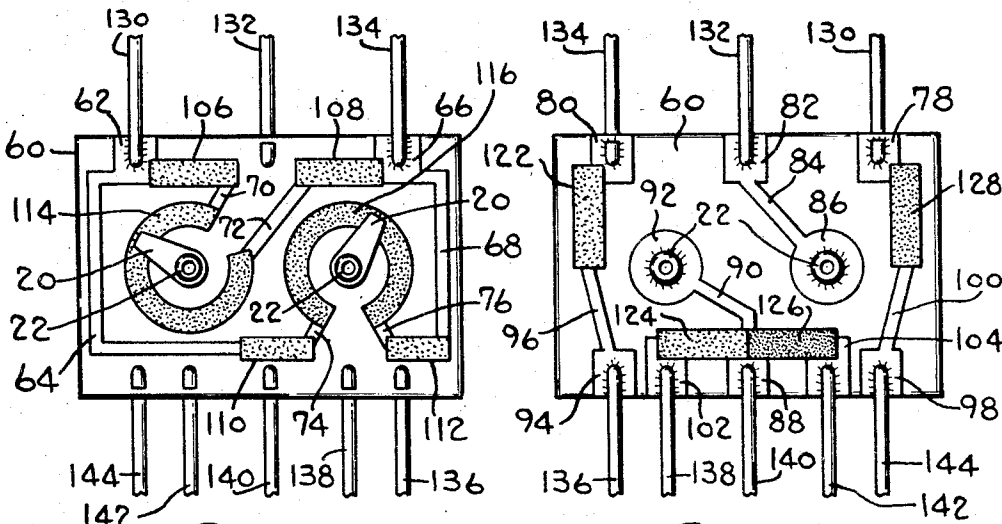


FIG. 6

FIG. 7

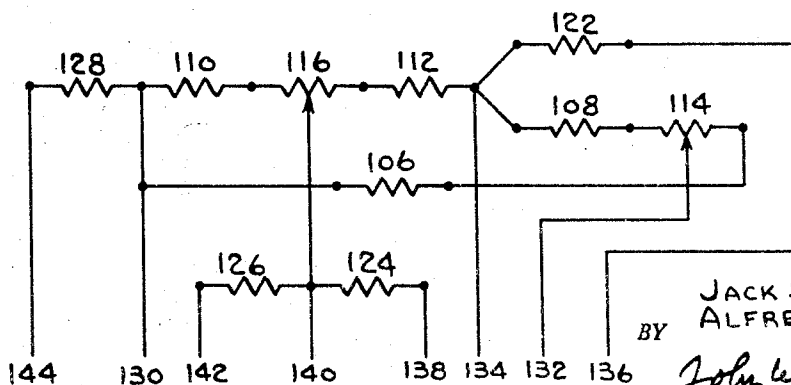


FIG. 8

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RESISTANCE TRIMMER

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1 Claim. (Cl. 201—55)

This invention relates to improvements in variable resistors, particularly to such resistors which may be initially adjusted to balance a circuit and left in such adjusted state.

For example, if it is necessary to replace the transistor in the circuit of a hearing aid, skill and considerable time is required to match the original transistor and compensate for any unbalance in the circuit.

One of the objects of this invention, therefore, is to provide a relatively small and inexpensive resistance trimmer which may be utilized as an additional component in a circuit to make an initial compensation of any unbalance arising upon the replacement of an original component.

It is the present practice in the art of producing printed circuits to specify close tolerances on the individual components. However, it is difficult to provide closely tolerated resistors on a single plate due to changes in resistor value occurring after the paint has been applied and adjusted.

It is another object of this invention, therefore, to provide resistance trimmer which can be made as a component part of a printed circuit without increasing the total cost and requiring too much space, which trimmer can be adjusted after the printed circuit unit has been completed to compensate for deviations of the other impedance elements on the plate.

In the accomplishment of these objects a resistance element in the shape of a segment of an annulus is screened onto the ceramic base plate and a rotor pivotally eyeleted to the plate at the radial center of the annulus. The free end of such rotor rides on such resistance element and may be slid along such element to provide the proper balance. When a setting is reached, the position of the rotor is fixed to prevent shifting by an adhesive seal.

The various modifications of this invention, its characteristics and applications may be best understood from the following description of specific embodiments when read in connection with the accompanying drawings in which:

Fig. 1 is a view in front elevation of a resistance trimmer embodying the present invention;

Fig. 2 is a view in front elevation of a first modification of such resistance trimmer;

Fig. 3 is a view in front elevation of a second modification of such resistance trimmer;

Fig. 4 is a view in rear elevation of the resistance trimmer shown in Fig. 3;

Fig. 5 is a view in front elevation of a third modification of such resistance trimmer;

Fig. 6 is a view in front elevation of a printed electronic circuit unit incorporating a resistance trimmer embodying the present invention;

Fig. 7 is a view in rear elevation of the printed electronic circuit unit viewed in Fig. 6; and

Fig. 8 is a schematic diagram of the circuit of the printed electronic circuit unit shown in Figs. 6 and 7.

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In all of the modifications shown in the drawing the resistance trimmer is mounted on a ceramic plate, electrical characteristics of which may vary in accordance with required specifications. In all cases, however, the plate has sufficient structural strength to support a resistance trimmer including the rotor pivotally eyeleted to the plate. In the modifications shown in Figs. 1-5 incl. the resistance trimmer is shown as a separate component which may be connected with other impedance elements of an electronic circuit. For example, such a resistance trimmer can be used with replacement component to adjust such component to match the characteristics of the original component. In the modification shown in Figs. 6-8 incl. the resistance trimmer is a part of a printed electronic circuit and its use permits the fixed resistances of such circuit to be applied inexpensively without close tolerance. Close tolerance is obtained after assembly by setting the trimmer.

In modification of Fig. 1 the base plate 10 is provided in the manner well known to those skilled in this art with conductors 12, and 14 which run from the edge of plate to enlarged ends onto which the resistance element is bonded. A conductor 16 extends from the edge of such plate and terminates in an enlarged circular portion which surrounds a small opening through the ceramic plate 10. A resistance element 18 in the form of a segment of an annulus is bonded to the plate 10 and the enlarged ends of the conductors 12 and 14. In this modification as well as in all of the modifications the resistance element is made by screening or otherwise applying onto the plate a paint of carbon-containing material which is hardened or set by heating. The value of such resistance element is determined within practical ranges by the characteristics of the paint and the size of the painted area. A rotor or slider 20 is pivotally mounted on the plate 10 by an eyelet 22 which extends through the opening in the plate 10 and is peened over on the rear side of such plate. The rotor is made of flexible metal and near the end thereof it is desirable to form a dimple which will ride on the resistance element 18 without damage thereto. Wire leads 24 are connected to the outer ends of the conductors and soldered in the manner customary in the making of printed electronic circuits. The resistance trimmer of this modification is completely adjustable through a half circle from a zero resistance to a maximum resistance. A resistance trimmer of this type is frequently used as a voltage divider, particularly where the voltage ratio must be equal to tolerances of $\pm 1\%$. Heretofore it has been extremely expensive and difficult to select a matching pair of resistance elements to within such close tolerance. The resistance element of this trimmer may be applied using normal broad tolerances and the rotor 20 adjusted to give the desired voltage ratio at the close tolerances. After the rotor has been set it is preferable to seal it with an adhesive to prevent its shifting.

The first modification shown in Fig. 2 varies from trimmer of Fig. 1 in the following details. The conductor 12 is replaced by two conductive pads 26 and 28 between which extends a fixed resistance element 34. The conductor 14 is replaced by a conductive pad 30 and the adjustable resistance element 18 extends from pad 28 to pad 30. The conductor 16 is replaced by a similar conductor 32 which functions in the same manner. Only two wire leads 24 are used. The fixed resistance element 34 provides a minimum resistance when the rotor is positioned over pad 28. The value of this minimum resistance may be made as specified.

In the second modification shown in Figs. 3 and 4 the resistance trimmer is variable through a half circle and has fixed minimums at both ends of the variable portions.

This modification varies from the first modification in the following particulars. The conductor 32 is replaced by the original conductor 16. A conductive pad 36 is added at the edge of the plate as shown and a fixed resistance element 38 is bonded to such plate and the pads 30 and 36. In this modification there are three wire leads 24 connected as shown.

The modifications of Figs. 1-4 incl. may be provided with a mounting bracket 40 which has integral ears 42 bent around the edges of the plate 10 to hold the mounting bracket to such plate. The bracket is provided with a hole 43 spacing it from the eyelet 22 and at one side has a lateral projection 44 by which it can be secured to a chassis or the like.

In the third modification shown in Fig. 5 there are two resistance trimmers mounted on a single ceramic base plate 46 to provide a gang unit. The upper trimmer has a conductor 48 leading from an eyelet hole in the plate 46 to a terminal pad 50 at the edge of such plate. Another conductive pad 52 is positioned at the edge opposite the pad 50 and the resistance element 18 extends to each of said pads. The rotor 20 is pivotally mounted by the eyelet 22 as in the case of the previous modifications. The lower trimmer has two end conductors 54 leading from the lower corners of the plate 46 to a circular shaped resistance element 56. A center conductor 58 leads from an eyelet hole in the plate 46 to the bottom of such plate. The element 56 extends angularly for substantially 270° and is applied in the same manner as the resistance element 18. The lower trimmer has two rotors 20 pivotally carried by the single eyelet 22, each rotor being individually adjustable. Wire leads 24 are soldered to the two pads 50 and 52 of the upper trimmer and similar wire leads 24 are soldered to the two conductors 54 and the center conductor 58. The gang unit thus constructed operates in the same manner as the single resistance trimmers previously described except that it may be used with several components and effect more than one circuit.

The printed circuit embodied in the modification of Figs. 6-8 incl. includes with the other impedance elements of the circuit a pair of resistance trimmers embodying the present invention. The ceramic base plate 60 which constitutes the structural support for the circuit printed thereon has on the front face thereof: a conductive pad 62 from which a conductor 64 extends part way along the left edge and along the bottom; a conductive pad 66 from which a conductor 68 extends along the opposite edge of the base plate; and connective conductors 70, 72, 74 and 76 positioned as shown. On the back face of the base 60 there is: a conductive pad 78 opposite to pad 62; a conductive pad 80 opposite the pad 66; a conductive pad 82 connected by a conductor 84 to an enlarged conductive area 86 surrounding an eyelet hole in the base plate 60; a conductive pad 88 connected by a conductor 90 to an enlarged conductive area 92 surrounding another eyelet hole in the base plate 60; a conductive lead mounting pad 94 connected with a conductor 96; a conductive lead mounting pad 98 connected with a conductor 100; and lead mounting pads 102 and 104. All of the conductive pads, areas and conductors are screened onto the base plate 60 and fired in the manner well known in this art.

Resistance elements are applied to the base plate 60 in the manner previously described. On the front face there is: a fixed resistance element 106 extending from the pad 62 to the conductor 70; a fixed resistance ele-

ment 108 extending from the pad 66 to the conductor 72; a fixed resistance element 110 extending from the conductor 64 to the conductor 74; a fixed resistance element 112 extending from the conductor 68 to the conductor 76; an adjustable resistance element 114 extending circularly from the conductor 70 to the conductor 72; and another adjustable resistance element 116 extending circularly from the conductor 74 to the conductor 76. The rotors 20, identical with those previously described, are pivotally supported in the base plate 60 by the eyelets 22 so that free ends slide along the adjustable resistance elements 114 and 116. On the rear of the base plate 60 there is: a fixed resistance 122 extending from the pad 80 to the conductor 96; a fixed resistance 124 extending from the pad 102 to the pad 88; a fixed resistance 126 extending from the pad 88 to the pad 104; and a fixed resistance 128 extending from the pad 78 to the conductor 100. Wire leads 130, 132, 134, 136, 138, 140, 142 and 144 are attached respectively to the pads 62 and 78, 82, 66 and 80, 94, 102, 88, 104, and 98 on the base plate 60.

In applying the resistance elements to the plate 60, a normal broad tolerance of $\pm 20\%$ can be used and after the circuit is completely fabricated each of the resistance trimmers are adjusted to obtain the close tolerance of $\pm 1\%$ at the desired ratio. The trimmers are sealed with an adhesive to prevent shifting. Units of this type have been subjected to extremes of temperature and humidity and do not deviate more than $\pm 1\%$ from the desired ratio. The application of the resistance elements for the resistance trimmers is done at the same time as the application of the other fixed resistance elements and no additional manufacturing cost is incurred. The increase in manufacturing cost caused by adding the rotors and eyelets is more than offset by the decrease in cost which would have been necessary to apply fixed resistances within the tolerance of $\pm 1\%$ which would have been necessary if the resistance trimmers were not used.

What we claim and desire to secure by this patent is:

A resistance trimmer including an insulating base plate, a conductor bonded to said plate and extending inwardly from an edge thereof to an inner end, a pair of conductive areas bonded to said plate in spaced relation to each other and to said conductor, a resistance element bonded to said plate and to said conductive areas and having a curving portion, a plurality of rotors, means pivotally mounting these rotors on said base plate in superposed relation and in electrical contact with each other and with the inner end of said conductor, said means including a single eyelet passing through apertures provided in the inner ends of said rotors and through an opening provided in the base plate adjacent to the inner end of said conductor, said rotors having the outer free ends thereof in direct sliding engagement with the curving portion of said resistance element.

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