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309, 308; 29/620

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[54] **RESISTOR AND METHOD OF ADJUSTING**
RESISTANCE
2 Claims, 2 Drawing Figs.

[52] U.S. Cl..... **338/309,**
29/620, 338/195

[51] Int. Cl..... **H01c 7/00**

ABSTRACT: A resistor is formed on an insulating support between a pair of electrode terminals, a portion of the resistor extending out of the direct field established between the electrodes. The resistance value is precisely adjusted by removing resistor material in the fringing field.

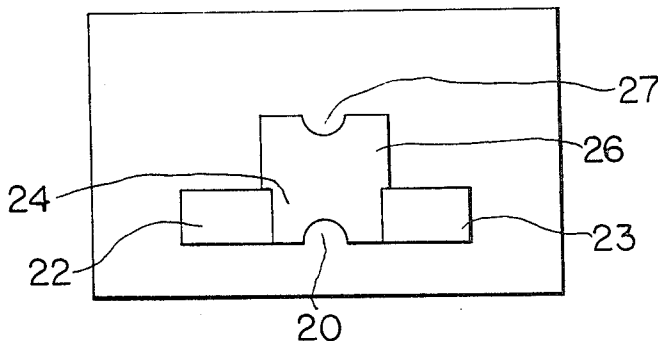


FIG. 1

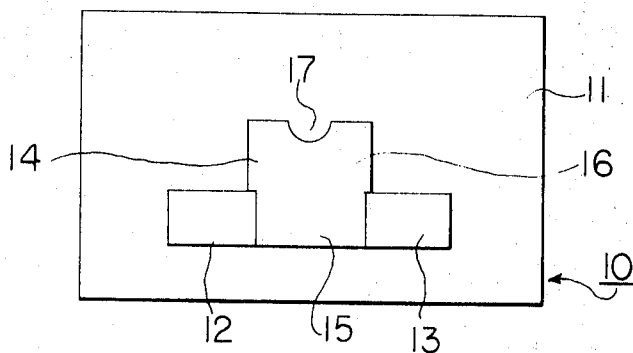


FIG. 3

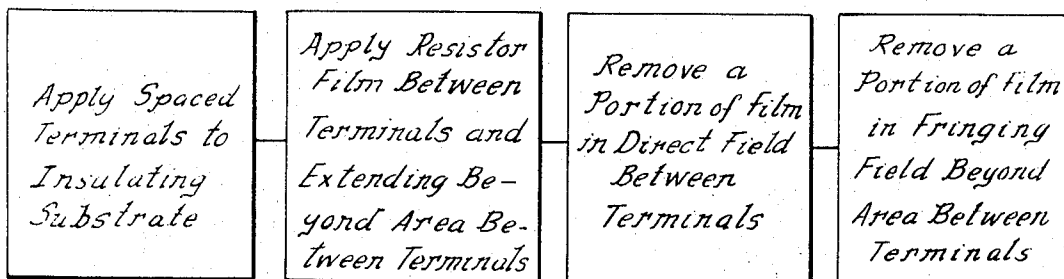
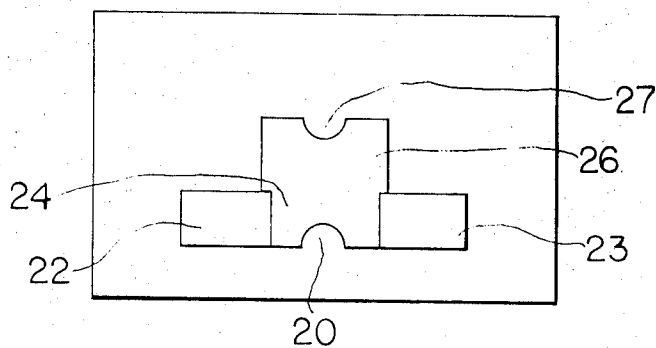


FIG. 2



RESISTOR AND METHOD OF ADJUSTING RESISTANCE**BACKGROUND OF THE INVENTION**

This invention relates to thick film resistors, and more particularly to adjusting deposited thick film resistors to their final value.

Present techniques call for trimming the required resistor material from an area lying in the direct field of the electrodes. Trimming critically affects the resistance value and requires extremely fine trimming techniques. Present trimming techniques either result in unacceptable tolerance levels or have percentage of adjustment limitations imposed by the amount of area available for trimming.

It is therefore an object of the present invention to provide a thick film resistor trimmed to a very precise value.

It is a further object to provide a method for accurately adjusting such a resistor.

It is a still further object to provide such a resistor adjustable to up to 30 percent.

SUMMARY OF THE INVENTION

Broadly, this invention provides accurate adjustment of a thick film resistor deposited on a substrate between two electrodes. A sufficient amount of the resistor lying outside of the direct area between the electrodes is provided to permit the establishment of a fringing field above the direct field established between the two electrodes.

In one embodiment, the resistor is precisely adjusted by trimming away resistor material wholly contained within the established fringing field. In another embodiment, resistor material in both fields is trimmed.

It has been found that removal of resistor material located in the fringing field has less of an effect than removal of the same amount of material in the direct field i.e., more resistor material must be removed from the fringing field than in the direct field to effect the same unit change in resistance. This discovery permits extremely fine adjustments not possible by conventional methods, and also permits larger percentage adjustments depending on the amount of the available resistor material in the fringing field.

DETAILED DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a top view of a resistor formed according to this invention; and

FIG. 2 illustrates a top view of an alternate embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 1, the component 10 comprises an insulating substrate 11 upon which is positioned a pair of spaced electrodes 12 and 13. Resistor material 14 is deposited between the electrodes. A portion 15 of the material 14 lies in the direct field established between the two electrodes 12, 13 while the remaining portion 16 of the resistor material 14 lies in the fringing field of the electrodes. The resistor 10 has been adjusted to a desired value by removing a selected area 17 from resistor material portion 16. Since resistor material 16

lies within the fringing field, more resistor material can be removed per unit change in resistance than if the material to be trimmed lay in the direct field. This characteristic permits an extremely precise resistance adjustment to be made. Actual trimming may be performed by any desired abrasive technique.

The above adjustment technique may be used to provide the complete adjustment required or it may be used in conjunction with the method of trimming shown in FIG. 2. There, an initial rough adjustment is made by cutting away area 20 from resistor material 24 in the direct field between electrodes 22 and 23. The fine adjustment is made by trimming away the required amount of material 27 from area 26 in the fringing field resistor material.

An example of the invention is as follows. A pair of spaced silver electrodes is deposited on a substrate of Al_2O_3 . Deposited over and between the electrodes as shown in FIG. 1 is a resistance film having a resistivity of 1.1 Kiloohms per square. The film has approximately 50 percent of its area in the direct electrode field with the remaining area in the gradually weakening electrode fringing field.

The overall resistance of the unit was originally 820 ohms and it was desired to trim the value to 1 Kiloohms with an adjustment tolerance of 0.03 percent. Twenty percent of the film lying in the direct field was removed by sand abrasion, bringing the resistance to 960 ohms. Then 60 percent of the area of the fringing field was removed to bring the resistance to the final value of 1,000 ohms.

We claim:

1. A method of precisely adjusting a thick film resistor which comprises the steps of:

positioning a pair of electrode terminal on an insulating substrate;

depositing a resistor film on the substrate overlying the area between said electrode terminals and an additional area extending beyond said area between said terminals, whereby a direct field is established across the film between the electrodes while a fringing field is established across the resistor film lying outside the electrode encompassing area;

first removing a portion of the resistance film lying in said direct field to cause a rough adjustment in the resistance value; and

second removing a portion of the resistance film lying in said fringing field so as to adjust to the final desired resistance value.

2. A resistor comprising an insulating support; a pair of electrode terminals carried by said support; a resistance film on the support having a first portion of nonuniform width extending between and in contact with both of said terminals and across which a direct field will be established, a second portion of said resistance film extending beyond the area confined between the two electrodes and across which a fringing field will be established, the extending portion also being of a nonuniform width, the nonuniform width of the two portion resistance film having been made by removing parts of the film for adjusting resistance value.