United States Patent [19]

Dumas et al.

[11] **3,898,606**

[45] **Aug. 5, 1975**

[54] **CONSTANT CURRENT VARIABLE VOLTAGE DIVIDER**

[75] Inventors: **Christ J. Dumas**, Forest View; **Leo J. Aubel**, Deerfield, both of Ill.

[73] Assignee: **American Plasticraft Company**, Chicago, Ill.

[22] Filed: **Aug. 30, 1973**

[21] Appl. No.: **393,077**

[52] **U.S. Cl.** **338/48**; 338/174

[51] **Int. Cl.** **H01c 9/02**

[58] **Field of Search** 338/48, 174

[56] **References Cited**

UNITED STATES PATENTS

3,585,559 6/1971 Rozema et al. 338/48

Primary Examiner—Gerald Goldberg

Attorney, Agent, or Firm—Leo J. Aubel

[57] **ABSTRACT**

A constant current variable voltage divider comprising thick film resistive elements including adjustments for varying the voltage applied to a utilization device.

4 Claims, 18 Drawing Figures

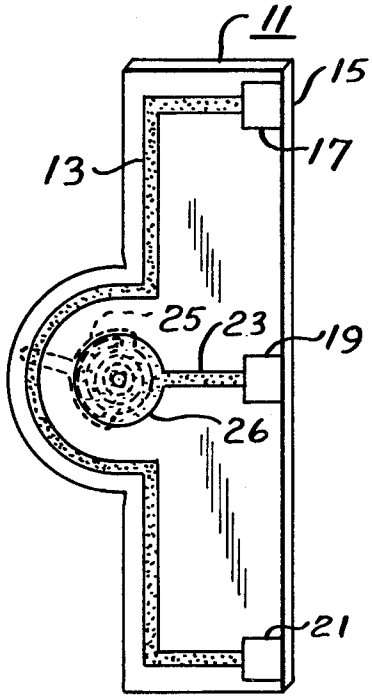


Fig. 1

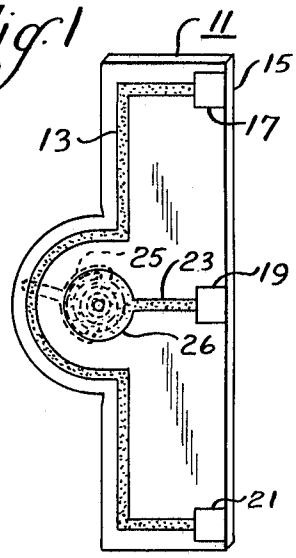


Fig. 2

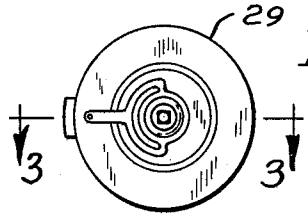


Fig. 3

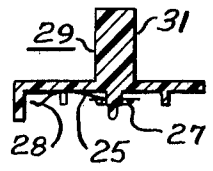


Fig. 4

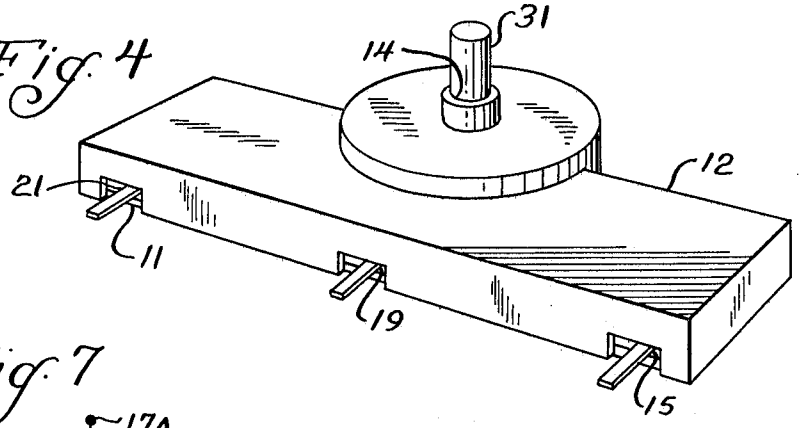
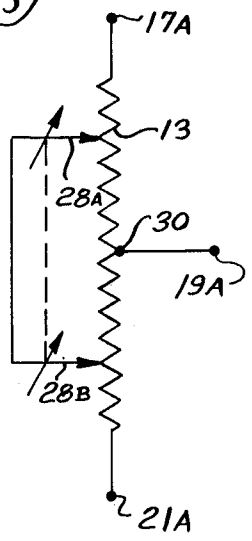


Fig. 7



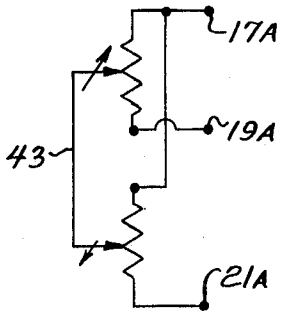


Fig. 6

Fig. 5

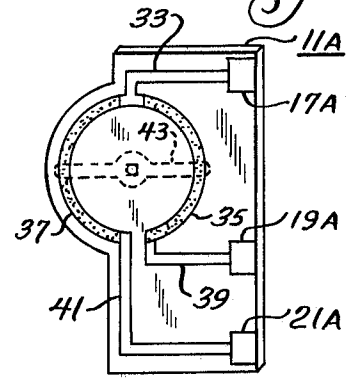


Fig. 8

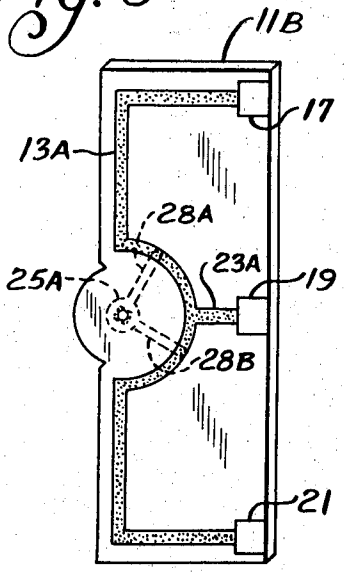
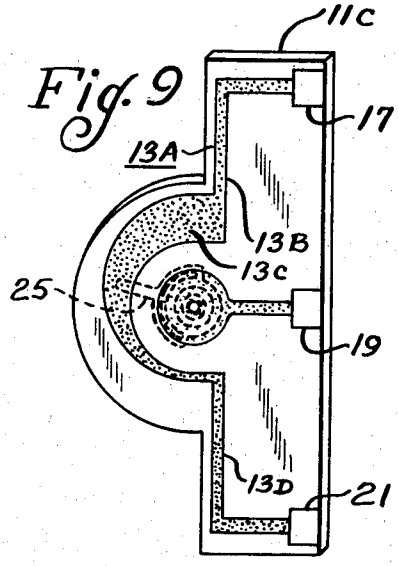


Fig. 9



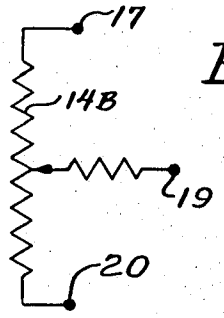


Fig. 10

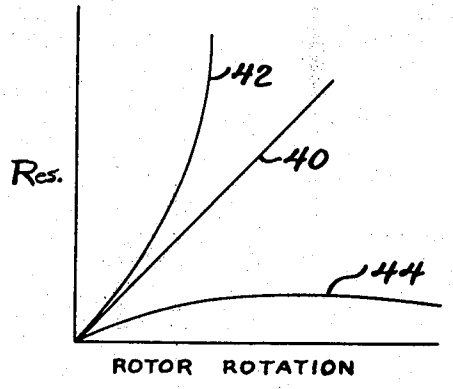


Fig. 11

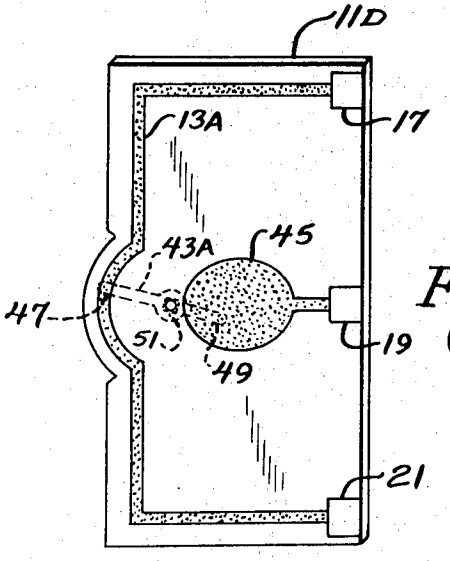


Fig. 12

Fig. 13

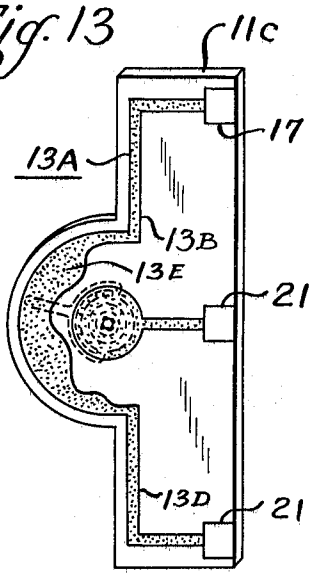


Fig. 14

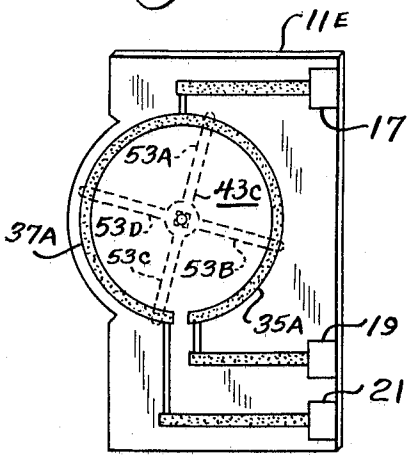


Fig. 15

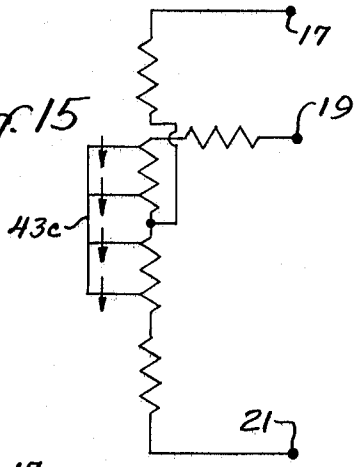


Fig. 16

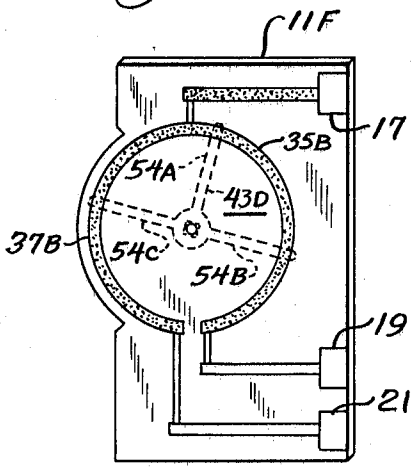
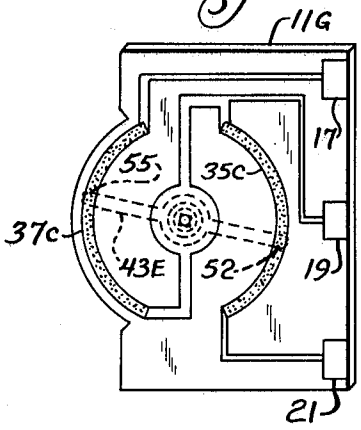


Fig. 17



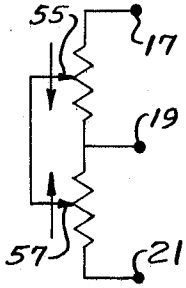


Fig. 18

CONSTANT CURRENT VARIABLE VOLTAGE DIVIDER

BACKGROUND OF THE INVENTION

The present invention is directed to a thick film apparatus or assembly comprising essentially a voltage divider wherein the current flowing through the divider is essentially constant. Certain embodiments of the invention are particularly useful for providing the voltage to the focus anode of a television picture tube.

This invention is related to the invention discussed and claimed in U.S. patent application Ser. No. 319,929, filed Dec. 29, 1972, in the names of Christ J. Dumas and Leo J. Aubel for Variable Resistance Assembly. The present invention is however, directed to a voltage divider wherein the current flowing through the resistive element is essentially constant; that is, the device includes a thick film element having a fixed resistance; and a given potential is tapped or coupled from the resistance. A variable tap is moveable along the thick film and the tap is connected directly, such as to an electrode, or through a second resistive film to the electrode to provide an adjustable voltage output.

DESCRIPTION OF THE DRAWINGS

FIG. 1 in accordance with the invention, shows a resistive thick film element formed on a substrate and with a variable tap to provide a selected voltage output;

FIG. 2 shows a plan view of the rotor useful with the assembly of FIG. 1 and including a moveable contactor;

FIG. 3 is a view in cross section taken along the lines 3—3 of FIG. 2 to better show the details of the rotor;

FIG. 4 is an isometric view of an assembled voltage in accordance with the invention;

FIG. 5 shows a modification of the resistance assembly of FIG. 1;

FIG. 6 is an electrical representation of the structure of FIG. 7;

FIG. 7 is an electrical representation of the structure of FIG. 8;

FIG. 8 is another embodiment of the invention including dual contacts;

FIG. 9 is another embodiment of the invention showing a varying resistive pattern;

FIG. 10 is an electrical representation of the embodiment of FIG. 9.

FIG. 11 is a graph useful in explaining the purpose of the structure of FIG. 9;

FIG. 12 is an embodiment of the invention similar to FIG. 9, but without an oval resistive pattern;

FIG. 13 shows a variable resistive pattern;

FIG. 14 shows a plurality of contactors similar to FIG. 8;

FIG. 15 is an electrical representation of the embodiment of FIG. 14;

FIG. 16 is a variation of the embodiment of FIG. 14;

FIG. 17 is a variation of the embodiment of FIG. 7; and,

FIG. 18 is an electrical representation of the embodiment of FIG. 17.

DESCRIPTION OF THE INVENTION

Referring to FIG. 1, the adjustable voltage divider assembly 11 of the invention comprises a pattern 13 formed of a resistive base film deposited on a ceramic substrate 15 to provide an electrical resistance path.

The intermediate portion of the film 13 is deposited in the form of a semi-circle to accommodate the rotating movement of the contactor of an associated rotor. The assembly 11 includes a high voltage terminal 17 of a suitable metal deposited on substrate 15 to connect to the upper end (as oriented in FIG. 1) of the film 13. An intermediate voltage terminal 19, similar to terminal 17, and a reference or low voltage terminal 21 also similar to terminal 17 are deposited on substrate 15 and connect to an intermediate point and to the lower end of the film 13, respectively. The intermediate terminal 19 is electrically connected to a second resistive film 23. An electrical connector 25 (see FIG. 3) comprising a first portion 27, which makes contact with circular formed portion 26 of resistive film 23. An arm portion 28 of contactor 25 makes contact with film 13. The contactor 25 is mounted on a rotor 29 which rotor includes a knob 21 which permits manual adjustment of the contactor 25. It will be readily apparent that the moveable rotor 29 and the contactor 25 provide a means for determining the point which the contactor 25 contacts the film 13, and thus for determining the voltage coupled through contactor 25, resistive film 23, and terminal 19 as a voltage output.

FIG. 4 is a view including cover 12 of the assembly 11. The rotor 29 is positioned on the substrate 15, and the cover 12 is positioned to sandwich the rotor between the substrate 15 and the cover 12. Cover 12 includes an opening 14 to accommodate the knob 31 or rotor 29.

FIG. 5 shows the modification of the structure of FIG. 1 wherein the assembly 11A includes the three terminals 17A, 19A and 21A; similar to terminals 15, 17, 19 and 21 in FIG. 1. The contact 17 connects through a deposited metallic contactor 33 which form foreshortened semi-circles. The lower end of film 35 connects through a deposited metallic conductor 39 to terminal 19A and the lower end of film 37 connects through metallic conductor 41 to terminal 21A. An adjustable rotor 43 has its opposite ends contacting the resistances 35 and 37. An electrical representation of the structure of FIG. 5 is shown in FIG. 6 wherein, regardless of whether contactor 43 is moved in either clockwise or counter clockwise direction, the total resistance between terminals 17A and 21A remains essentially constant; however the resistance between terminals 17A and 19A varies thereby providing a voltage output from terminal 19 which varies dependent on the position of rotor 43.

FIG. 8 shows a construction wherein the rotor 25A has two arms 28A and 28B, perpendicularly disposed with respect to one another, which contact the film 13A. Film 13A comprises a first portion extending from terminal 17 to terminal 21 and a second portion 23A connecting the center of path 13A with terminal 19. The two arms 28A and 25B are mounted in essentially a right angle configuration to provide a contact with a circular center portion of resistive film 13A.

FIG. 7 shows an electrical representation of the structure of FIG. 8. As contacts 28A and 28B move along the resistance 13A the total resistance between terminals 17 and 21 remains essentially constant; however, the effective resistance between terminals 17A and 19A is variable dependent on the position of the ganged contacts 28A and 28B.

Note that as ganged contacts 28A and 28B move in a clock wise direction, the resistance above the center

contact 28A and 28B are moved in the upward or counter clockwise direction, the foregoing affect is reversed but the total resistance across terminals 17 and 21 remains the same. However, the voltage coupled to terminal 19 is adjustable and dependent on the position of contactors 28A and 28B.

FIGS. 9, 12 and 13 show another embodiment of the invention which provides a variable resistance film. The resistance provided by the film and hence the voltage output relative to the rotor rotation is a non-linear function, and can be either mathematically or empirically tailored, as for example indicated by the curves 40, 42 and 44 of FIG. 11 to provide the desired resistance relative to movement of the rotor.

Referring to FIG. 9, the center portion 13C of resistive film 13B comprises a pattern of relatively increasing width, which connects to film 13D of uniform width. A contactor 25 contacts the variable portion 13C to thus provide a resistance pattern which varies in accordance with line 42.

FIG. 12 shows a variation of the film pattern to FIG. 9 and includes a oval portion pattern of film 45 coupled to path 23B and terminal 19. An electrical contactor 43A is positioned to have one of its ends contact linear film 13A and its other end contact the oval pattern as the contactor 43A is rotated about its axis 51. The resistance relative to the rotor rotation can be determined to provide the desired output as indicated in FIG. 11.

FIG. 13 shows a modification of the structure of FIG. 9 wherein the thin film path 13A comprises a center portion 13D comprising tapers and hop offs to provide a desired output.

FIG. 14 shows an assembly 11E including a structure somewhat as shown in FIG. 7 with the exception that herein the center rotor 43C includes four equally spaced contactors 53A, 43C, 53C and 53D, for contacting the resistive film portions 35A and 37A, at equally spaced positions. The electrical representation of FIG. 14 is shown in FIG. 15 which shows that as the variable contactor 43 moves, the total resistance across terminals 17 and 21 remains essentially constant, however, the voltage output on terminal 19 will vary.

Another variation similar to FIG. 14 is shown in FIG. 16 wherein the moveable contactor 43D includes three contact arms which contact the resistance 35B and 37B.

Still another embodiment of the invention is shown in FIG. 17 wherein the two resistive arms 35C and 37C are contacted by moveable contactor 43E. In this embodiment, the upper end of resistance 35C and the lower end of resistance 35C are connected to terminal 21. The electrical representation of FIG. 17 is shown in FIG. 18 which shows that the contacts 55 and 57 move in a relatively reverse direction to thus vary the voltage provided in terminal 19.

The various embodiments of the invention are useful as variable attenuators, voltage dividers, faders, dampers, voltage control squelch units, and generally in any circuitry wherein it is desirable to provide a resistive pattern to give linear or non-linear voltage outputs.

While the invention has been particularly shown and described with reference to preferred embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

1. A constant current variable voltage divider comprising, an electrically non-conductive substrate having at least one substantially planar surface, a plurality of conductive terminals on said surface, a resistive base film formed on said surface for forming a first electrically resistive path, said first path being electrically connected at its ends to respective terminals, a second resistive base film formed on said surface for forming a second electrically resistive path, said second resistive path comprising an elongated resistive portion and a relatively enlarged resistive portion, said elongated resistive portion having one end thereof connected to a respective third terminal and the other end connected to said relatively enlarged resistive portion, selectively adjustable conductive contactor means supported on said surface for rotatable movement thereon and having a portion thereof in sliding mechanical and electrical contact with said first resistive path and another portion thereof in sliding mechanical and electrical contact with the said relatively enlarged resistive portion, whereby a constant current flow may be maintained between the terminals connecting to said first path and a variable voltage may be selectively coupled by said adjustable conductive contactor means, said second resistive path and said third terminal.

2. A voltage divider as in claim 1 wherein said first resistive path includes a center portion thereof which varies in width, and said contactor adjustably contacts said variable portion whereby the output voltage can be tailored to provide nonlinear output relative to the rotor positioning.

3. A voltage divider as in claim 1 wherein said second resistive path comprises an oval shaped portion, and said contactor comprises two radially extending arms with one arm contacting said first resistive path, said second arm contacting said oval shaped resistive path.

4. A voltage divider as in claim 1 wherein said resistive paths are of variable width to provide a voltage curve tailored to a desired form.

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