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Dumas et al.

[11] **3,846,731**

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[54] **VARIABLE RESISTANCE ASSEMBLY**

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[52] **U.S. Cl.** **338/127**, 338/162

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

[58] **Field of Search** 338/127, 126, 125, 174, 338/162, 165, 176, 183; 323/94

[56] **References Cited**

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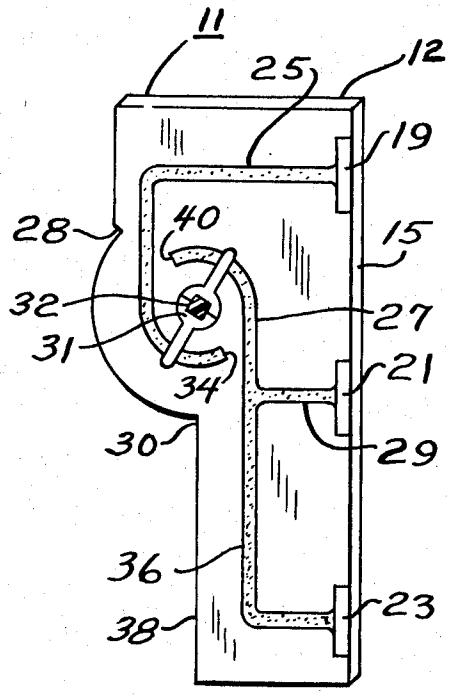
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Assistant Examiner—David A. Tone
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[57] **ABSTRACT**

An assembly having a variable resistance for providing a variable voltage dividing function, and; hence, a controllable voltage such as to the anode of a television picture tube.

5 Claims, 5 Drawing Figures



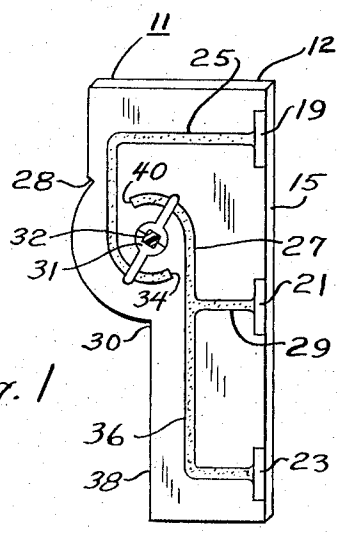


Fig. 1

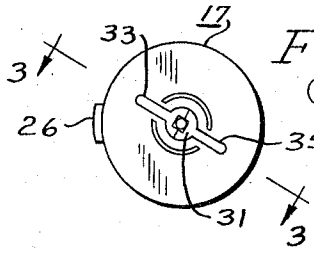


Fig. 2

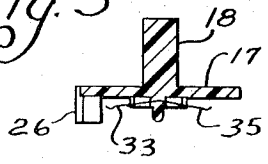


Fig. 3

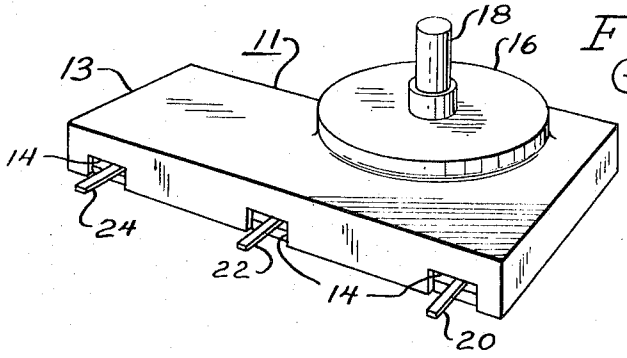


Fig. 4

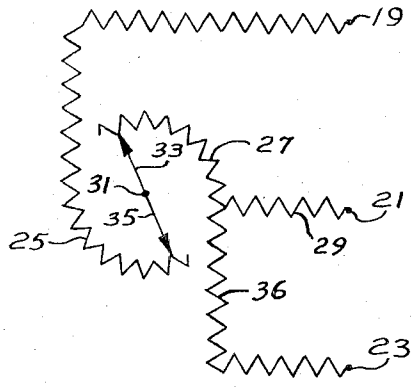


Fig. 5

VARIABLE RESISTANCE ASSEMBLY

BACKGROUND OF THE INVENTION

In present cathode ray tubes, and more specifically, in most television picture tubes, it is desirable to provide an assembly to control and adjust the voltage provided to the focus anode. Various types of prior art resistance assemblies or variable voltage dividers have been provided for this purpose. Variable voltage dividers usually comprise resistance elements, a contactor adjustably engaging the resistance elements, a knob for changing the position of the contactor relative to the resistance elements, and several terminals for connecting the voltage divider to the associated electronic circuitry. Prior art devices known to the inventors are relatively expensive, and are also susceptible to unstable operation caused by changes in temperature and humidity conditions.

For use with present day electronic equipment, it is important that voltage dividers be relatively small, compact, readily mountable on the associated chassis, and that such dividers exhibit stable operating characteristics that are independent of the humidity or temperature of the surrounding environment.

The inventive variable resistance assembly is further directed to a so-called thick-film type of device. A thick film may be conveniently of a conductive material of metal deposited on a ceramic substrate. It has been found that variable resistance assemblies or voltage dividers formed of thick film provide a stable reliable resistance.

A metallic conductive pad or terminal is normally formed on the substrate to facilitate the making of electrical connections from the film to the associated electronic circuitry. More specifically, electronic wire terminals can be soldered to the conductive pads.

For one specific application, the inventive resistance assembly is used to supply a constant voltage to the focus electrode of a television picture tube. In such application, the input ends of the resistance assembly is connected to a relatively high potential supply in the 20KV to 30KV range and the other end of the divider is connected to a ground or reference. An intermediate output terminal of the assembly connects an adjustable voltage in the 0KV to 20KV range to the focus electrode of the picture tube.

Accordingly, it is an object of the present invention to provide an improved variable resistance assembly that is reliable even while operating in various different environmental conditions.

It is still another object of the present invention to provide an improved variable resistance assembly that is readily assembled, and is relatively inexpensive.

It is a further object of the present invention to provide a new and improved variable voltage divider having a plurality of thick film resistive paths.

Still another object of the present invention is to provide an improved voltage divider assembly having a conductive film formed on a ceramic substrate and having an adjustable contactor mounted on the substrate for varying the effective resistance provided by the film.

The foregoing objects and other features of the invention will be apparent from the following more particular description of a preferred embodiment of the

invention as depicted in the accompanying drawings wherein:

DESCRIPTION OF THE DRAWINGS

FIG. **1** is an isometric view of the substrate portion of a variable resistance assembly in accordance with the invention;

FIG. **2** is a plan view of the rotatable electrical contactor for the variable resistance assembly;

FIG. **3** is a cross sectional view taken along the lines **3—3** of FIG. **2** and reversed in orientation to conform with the showing of FIG. **4**;

FIG. **4** is an isometric view of the assembled variable resistance assembly of the invention; and,

FIG. **5** is an electrical representation of the structure of FIG. **1.**

DESCRIPTION OF THE INVENTION

The present invention is directed to a variable resistance assembly on which are formed various thick film resistive paths of a suitable electrical resistance, known in the art.

Refer now to the drawings, FIGS. **1–4** illustrate the inventive variable resistance assembly or voltage divider, generally indicated by the numeral **11.**

The variable resistance assembly **11** comprises a ceramic substrate **12** which may be formed of a suitable material such as alumina. The substrate **12** may have any suitable shape and in the embodiment shown, comprises a modified rectangle with a reduced portion as at **38** to provide a stop surface for the associated contactor assembly **17,** shown in FIG. **2.**

Electrically resistive paths **25, 27, 29** and **36** are deposited on the substrate **12** in a desired pattern. The resistive paths each comprise a thick film; that is, a compound of electrically resistive material with a suitable dispersion of metal. Several commercially available materials may be used to form the thick film.

As can be seen in FIG. **1,** the resistive path **25** has one end electrically in contact with a terminal pad **19** formed of a metallic base material which is deposited by any suitable known means onto the ceramic substrate **12.** The terminal pad **19** is preferably formed of a material to which the conductive connector **20** (see FIG. **4**) may be conveniently soldered for making electrical connections thereto.

In the present embodiment, two other terminal pads **21** and **23** similar to pad **19** are mounted in spaced relation on one edge of the substrate **12.** Terminal pad **19** is the high voltage terminal of the assembly; terminal pad **21** provides an adjustable voltage to the focus anode of the associated television picture tube as will be described; and, terminal pad **23** is connected to reference or ground potential.

The resistive path **25** which is in electrical contact with terminal pad **19,** extends from pad **19** along the ceramic substrate **12** and terminates in a free, unconnected or open end **34.** The free end of resistive path **25** is conveniently formed in a circular shape.

A second resistive path **27** which is in electrical contact with terminal pad **21** extends from pad **21** and joins or connects to resistive path **36** which is electrically connected to terminal pad **23.** The junction of resistive paths **29** and **36** extend into and join resistive path **27** which terminates in a free, unconnected or open end **40.** The free end portion of resistive path **27** is conveniently formed in a circular shape.

An electrical contactor **31** having two outwardly extending leaves **33** and **35**, (see FIG. **2**) is mounted for rotation on a suitable pin **32** to make electrical contact with the resistive path portions **25** and **27** adjacent the open ends **34** and **40**, for purposes to be explained hereinbelow. Since, in this embodiment, contactor **31** is arranged to be rotatable, the resistive path portions, which it contacts are conveniently circular in shape, as mentioned above. It will, of course, be understood that the contactor **31** could be arranged to be movable along an essentially straight line and in such arrangement the resistive paths could be straight.

Refer now to FIG. **4**. In the completed assembly, a cover or housing **13** is placed over substrate **12**. Suitable apertures **14** in housing **13** accomodate outwardly extending electrical connectors **20, 22** and **24** which connect to terminal pads **19, 21** and **23** respectively. Housing **13** includes a circular portion **16** which houses the contactor assembly **17**. The portion **16** includes a central opening through which the knob **18** of the contactor assembly **17** can extend.

The details of the contactor assembly **17** are more clearly shown in FIGS. **2** and **3**. Contactor assembly **17** includes the conductive contactor **31** having the two outwardly extending flexible leaves **33** and **35**, as mentioned above. Leaves **33** and **35** are mounted on the lower surface, as oriented in FIG. **3**, of contactor **17** and when the contactor is mounted in position, in assembly **11**, the leaves **33** and **35** will be resiliently compressed against the planar surface of the substrate **12** to thus make contact with the circular portions of the respective resistive paths **25** and **27**. The contactor **17** is manually rotatable to be set at a selected position by knob **18** and contactor **17** is constrained in its rotation by a stop **26** formed on its periphery which engages the side of substrate **12** as its opposed limits as at **28** and **30**.

The operation and function of the structure of FIGS. **1–4** can be better understood from reference to FIG. **5** which shows an electrical circuit representative of the resistive paths **25, 27, 29** and **36** as electrical resistors. The reference characters in FIG. **5** are intended to correspond to the reference characters in FIGS. **1–4**. Note also that terminal pads **19, 21** and **23** are indicated as electrical connections.

Referring to FIG. **5**, it will be appreciated that if a high voltage is impressed across terminals **19** and **23**, a given voltage will be developed at the intermediate or focus anode terminal **21**. If the voltage across terminals **19** and **23** remains essentially constant, while the resistance between terminals **19** and **21** is decreased, and the resistance between terminals **21** and **23** remains essentially constant, it will be appreciated that the voltage on terminal **21** will be changed. When the contactor **31** is in the position shown in FIG. **5**, a maximum resistance is effected between terminal **19** and terminal **21**; accordingly, the voltage output at terminal **21** will be at a given potential. If contactor **31** is rotated in a clockwise direction, the effective resistance between terminal **19** and terminal **21** will be reduced and the voltage output on terminal **21** will be changed. Thus, by properly setting contactor **31** (and leaves **33** and **35**), the voltage output on terminal **21** can be adjustably controlled. The contactor **17** is manually rotatable to be set at a selected position by a stop **26** on its periphery which engages the side of substrate **12** as at limit points **28** and **30**.

As mentioned, variable resistance assembly **11** is particularly suitable for use in the focus circuit of a cathode ray tube. In a typical color television picture tube application, the input to the variable resistive assembly **11** is connected to terminal pad **19** as a DC voltage of, say, approximately 25 KV volts and the low potential termination is connected to ground reference terminal pad **23**. The output is connected from terminal pad **21** to the focus anode of the picture tube. The tube is then focused by adjusting the contactor **17** until a voltage in the range of 0–20KV is applied to the focus anode of the tube.

Of additional interest with respect to this invention, is that arcing intermittently occurs between the high voltage anode of a picture tube and the focus grid in the tube. Should such arcing occur, a damaging high frequency pulse of very high KV potential may be impressed upon the power supply connected to the input of the voltage divider. Accordingly, a series resistance such as resistive path **29** can be provided to function as a surge limiting resistor which is effective to create a voltage drop when arcing occurs, and to thus limit the magnitude of the damaging pulse at the input of the voltage divider, and at the power supply.

While the invention has been particularly shown and described with reference to a preferred embodiment 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 variable resistance assembly comprising an electrically non-conductive substrate having at least three terminal pads, first and second electrically resistive paths on said substrate, said paths being electrically separated one from the other, the first resistive path having one end connected to one terminal and the second resistive path dividing into a first portion which connects to a second terminal pad and another portion which connects to a third terminal pad, and the resistive paths each having an electrically open or unconnected end, and an electrically conductive contactor engaging said first and second paths, said contactor being selectively adjustable to increase and decrease the effective length of the resistive paths and hence the effective electrical resistance thereof.

2. A variable resistance assembly as in claim **1** wherein the open end portions of the resistive path are in a circular shape, and the conductive contactor is rotatable relative to engage the resistive paths to change the effective resistance of said resistive paths.

3. A variable resistance assembly as in claim **1** wherein a terminal pad and the first resistive path is connectable to a source of high voltage, the one portion of said second resistive path and the associated terminal pad is connectable to provide a focus anode voltage, and the other portion of said second resistive path is connectable to a reference potential whereby by adjusting the contactor the voltage provided to the focus anode can be controlled.

4. A variable resistance assembly as in claim **1**, said resistive paths have one end connected to a conductive pad and the other end is open.

5. A variable resistance assembly as in claim **1** wherein said resistive paths are formed of a thick film material.

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