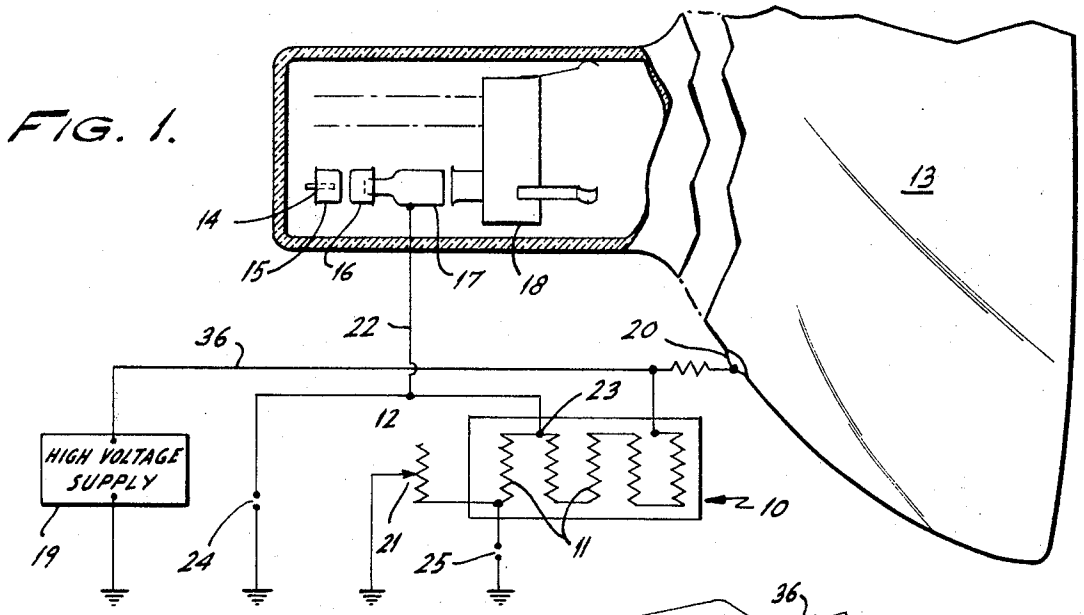
June 30, 1970 B. I. KEPRTA, JR., ETAL 3,518,603

RESISTIVE VOLTAGE DIVIDER

Filed May 29, 1969

FIG. 1.



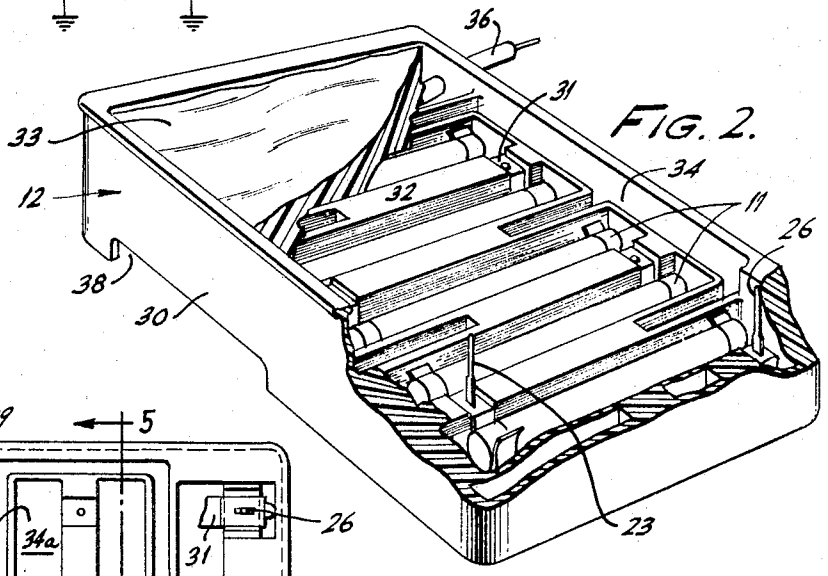
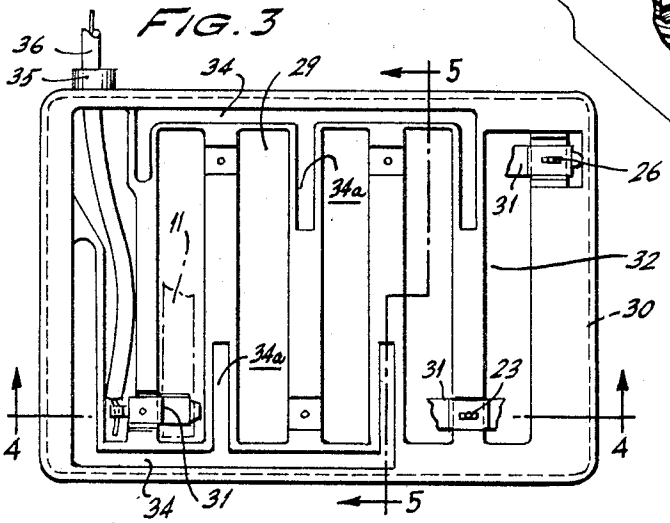


FIG. 2.

FIG. 3



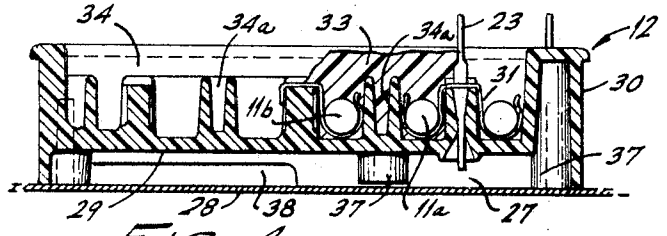


FIG. 4.

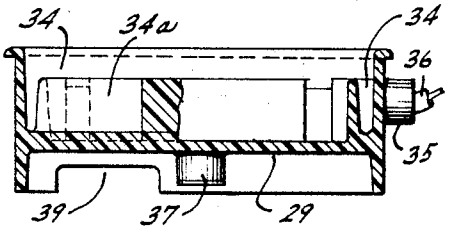


FIG. 5.

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RESISTIVE VOLTAGE DIVIDER

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Int. Cl. H01c 1/02, 1/16
U.S. Cl. 338—260 6 Claims

ABSTRACT OF THE DISCLOSURE

A high voltage, multi-element resistance string packaged in an arc-resistant protective housing filled and sealed with potting compound. The package is so designed as to maximize the resistance to arcing. There is provision, under certain over-voltage conditions, for inducing a controlled arc to chassis and thus for protecting associated electronic equipment.

BACKGROUND OF THE INVENTION

The field of the invention concerns the packaging of high-voltage components and particularly resistive dividers which are used in television sets for deriving a predetermined voltage from a source of higher voltage and for supplying this predetermined voltage to the focus electrode. Although of broader applicability, the invention is particularly concerned with color television apparatus.

In the manufacture of cathode ray tubes and gun structures therefor, precautions are taken to insure that the gun parts are clean and free of undesirable particles or sharp edges which might induce arcing in those electrodes which are connected to high voltage. One precaution frequently taken during the manufacturing process is to connect parts of the tube to a source of very high voltage, for example about 50,000 volts, to burn off microscopic projections and thereby minimize the possibility of future arcs. Experience has shown that, in spite of these precautions, particles of phosphor may be dislodged from the screen during shipment of the tube and bits may settle near the anode portion of the gun and provide a cause for a possible arc during future operation of the tube. Arcing from such causes is not uncommon, and it has been known to control location of these arcs through the provision of spark gaps. Such gaps have been provided in the connections to the screen grid, control grid, and cathode and focus electrodes, with the objective that an arc, if such occurs, preferentially will traverse a spark gap to ground, rather than finding its way through more sensitive parts of the circuit which might be damaged thereby. The recent emphasis on color television has aggravated these arcing problems, because of the very high anode potential (frequently in excess of 26,000 volts) present in such tubes.

SUMMARY OF THE INVENTION

Our invention provides a novel insulated package or housing for high-voltage components, particularly for the high-voltage resistance strings which are utilized in television equipment as voltage dividers in the derivation of the focus voltage from the anode potential. This package substantially eliminates the possibility of a destructive arc occurring in the divider, while including provision for inducing a non-destructive arc to chassis, should an arc occur in the cathode ray tube. In accordance with the invention, if an arc occurs from the anode to the focus electrode, the arc will continue through spark gaps provided in the voltage divider, rather than jumping to the screen grid, control grid and cathode (the two latter elements being near ground potential) and thence through more sensitive circuit parts.

In providing a solution to these problems, we have recognized that when a non-conductive, e.g., plastic, housing is filled with a potting material there is created an interface or junction where the surface of the potting compound meets and seals to the plastic of which the housing is composed. This interface provides a path through which high voltage can arc along the interface area and thence to ground.

It is a primary object of our invention to maximize the length of this path and thereby to maximize the resistance to arcs arising from breakdown in the voltage divider. Conveniently we have maximized this resistance by extending the interface along a serpentine path.

The present invention is also featured by the provision of a package for high voltage components having formed integrally therewith means providing a spark gap of predetermined location and dimension.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a partial diagrammatic view of a cathode ray tube which includes, in the anode circuit thereof, voltage divider means of the kind contemplated by this invention;

FIG. 2 is a perspective, substantially full-size illustration, partially in section, of a voltage divider housed in an insulated package embodying the principles of this invention;

FIG. 3 is a plan view of the package or housing shown in FIG. 2, but illustrated without potting compound therein; and

FIGS. 4 and 5 are sectional views of the housing taken, respectively, along lines **4–4** and **5–5** applied to FIG. 3.

DESCRIPTION OF THE PREFERRED EMBODIMENT

With initial reference to FIG. 1, the voltage dropping resistance string shown at **10** comprises a series-connected chain of resistors **11** enclosed within an insulated housing **12** which has the form shown in FIGS. 2–5 and which will be described in detail below.

In the illustrated embodiment the chain of resistors **11** is utilized as a voltage divider in a color television receiver. FIG. 1 shows a somewhat diagrammatic illustration of a color cathode ray tube **13** of known type. Such a tube includes three guns within the neck of the tube envelope. For the sake of clarity in illustration only one such gun has been shown in full lines. The electrode elements of the illustrated gun comprise a cathode **14**, a control grid **15**, a screen grid **16**, a focus grid **17** and an anode **18**.

As will be understood, in practice the three guns of a color tube are usually subjected to the same focus potential. In the illustrated embodiment this potential is derived from the high voltage supply **19** through the agency of the focus voltage divider **10** of the present invention. The high voltage supply is of known type and provides about 26,500 volts at the anode button **20**. A controllable voltage from about 300 to 600 volts is applied to the screen grid **16** by circuit connections not shown. The focus grid **17** is connected, by way of conductor **22**, to a suitable point **23** in the chain of resistors, and the voltage at the focus grid **17** is controllable by the potentiometer **21**, being variable from about 4,000 to about 6,500 volts to provide adjustment in the sharpness of the picture.

To protect the cathode and other gun parts against damage of the kind mentioned above, a pair of spark gaps **24** and **25** are provided in the circuit. As explained above arcs may occur in the course of the life of the tube, especially when the set is warming or cooling, and the spark gaps provide the necessary protection against the resultant overvoltage.

In particular accordance with this invention, the two spark gaps are embodied in the focus voltage divider in the form of metal lugs or terminals, one of which is shown at **23** and the other at **26**. These lugs are secured in the housing **12**, which may be formed of polypropylene, being embedded in a suitable silicone rubber potting material **33**, in the manner shown in FIG. 4, whereby to provide an air gap **27** between the lower end of the lug and the metal chassis **28**. The length of this air gap is controlled to determine the voltage at which arcing will occur, and an air gap of desired length may readily be provided during the manufacture of the housing by causing the lug **23** to bottom against an appropriate tool or surface. The spark gap at lug **26** is provided in identical manner.

As is clear from FIGS. 2–5 the housing has a floor **29** and lateral wall structure **30** which together provide a receptacle for the five resistors **11** of the string which comprises the illustrated voltage divider. These resistors, which are shown in FIGS. 2 and 4, may be of any suitable type and are connected in series through the agency of saddle-like clips **31** which are disposed to span the upper surface of walls **32** upstanding from the floor **29** of the housing and which walls provide receptacles individual to the several resistors. Advantageously, the lugs **23** and **26** are staked in the clips **31**. This provides a solderless electrical connection between the resistor, clip, and lug.

As shown in FIGS. 2 and 4 the housing **12** is filled with the non-conductive potting compound **33**, after insertion of the resistors and mounting clips, and comprises the upper surface of said housing. As mentioned above the interface between the potting compound and the plastic material of the housing provides a path for high-voltage arc, and to maximize the length of this path the housing is provided with re-entrant portions or slots which extend between the ends of resistors **11** and the exterior housing wall **30**. Such slots appear at **34** and are shown to best advantage in FIGS. 4 and 5. As shown in FIGS. 2 and 3, such slots include transverse portions **34***a* which extend between the ends of adjacent resistors which are not connected by saddle clips **31**. A substantial voltage difference exists between such unconnected ends and they are therefore a potential source of arcing.

As shown in FIGS. 2 and 4 the potting compound **33** completely surrounds the resistors **11** and fills the entire space within the housing including the slotted portions **34** and **34***a*. By provision of the slotted portions we have in very simple manner provided an extended serpentine path between points at substantially different potential, rather than the relatively straight line path which would exist in such a housing in the absence of such slotted portions. Considering, for example, the adjacent resistors shown at **11***a* and **11***b* in FIG. 4 it will be appreciated that in the absence of the slot **34***a* which lies between such resistors the path for possible arcing would be the relatively short interface area extending from one resistor across the intervening wall and to the adjacent resistor. The length of this interface is approximately tripled by interposition of the slot **34***a*, since an arc must now travel from the resistor **11***a* to the upper portion of the slot **34***a*, thence downwardly to the bottom of said slot and upwardly out of the same and into the region of the adjacent resistor **11***b*. Paths of similarly extended length are provided between the end of any resistor and the chassis **28**, by the interposition of the lateral moat-like slot portions **34** which extend along the sides of the housing **12**.

The housing includes several bosses molded therein, one is shown at **35** and is apertured to accommodate the lead **36** from the high voltage supply **19**. Several other bosses **37** are disposed along the bottom wall of the housing and serve as means for attaching the same to a chassis. The side wall **30** of the chassis is cut away in several places shown at **38** and **39** in the drawings, this being done to insure that the lower portion of the housing is subjected to the ambient atmosphere and to provide cooling in the event of substantial arcing across the spark gaps **24** and **25**, each of which has an air gap similar to that shown at **27** in FIG. 4.

We claim:

1. A high-voltage resistor, comprising: an electrically non-conductive housing having base and side walls forming an enclosure and interior walls separating said enclosure into a plurality of individual receptacles; a plurality of series-connected resistor portions within said enclosure each of which is contained within a corresponding one of said receptacles; non-conductive material substantially filling said enclosure and potting said resistor portions within said receptacles, the interface between said potting material and the material of which said housing is composed constituting a path subject to possible traversal by arcs between points of substantial potential difference; and means maximizing the length of said path, comprising a plurality of re-entrant portions or slots formed within the structure of the housing and substantially filled with potting material, said slots serving to extend said interface along a path of serpentine configuration.

2. A high-voltage resistor in accordance with claim **1**, and further characterized in that said resistor portions take the form of a plurality of individual series-connected resistors and said slots are interposed between the ends of said resistors and ground and between points of substantial potential difference on adjacent resistors.

3. A high-voltage resistor in accordance with claim **1**, and further including means for making electrical connection to said resistor, said last means having a portion sealed in said base wall and extending into position such that said portion, together with chassis structure to which said resistor is secured when in use, constitute a spark gap for inducing an arc to chassis when said resistor is subjected to substantial overvoltage.

4. In a high-voltage resistor, an electrically non-conductive housing having base and side walls forming an enclosure, elongated resistor means within said enclosure, non-conductive material substantially filling said enclosure and potting said resistor means therein, and means for minimizing arcing from said resistor means to adjacent surfaces at substantially different potential, said means comprising wall structure substantially paralleling said resistor means and spaced from said side walls to provide moat-like slot means substantially filled with potting material and extending along said side walls, said slot means providing a path of extended length along the interface between said potting material and the material of which said enclosure is made.

5. A voltage divider for use in the focus circuit of a cathode ray tube, comprising: an electrically non-conductive housing having base and side walls forming an enclosure and interior walls separating said enclosure into a plurality of individual receptacles; a plurality of series-connected resistor portions within said enclosure, each of which is contained within a corresponding one of said receptacles; non-conductive material substantially filling said enclosure and potting said resistor portions within said receptacles, the interface between the potting material and the material of which said housing is composed constituting a path subject to possible traversal by arcs between points of substantial potential difference; means for maximizing the length of said path, comprising a plurality of re-entrant portions or slots formed within the structure of the housing and filled with potting material, said slots serving to extend the length of the path along said interface; connection means for deriving a focus voltage which is less than the voltage existing between the ends of said voltage divider; and spark gap means including said connection means for inducing a non-destructive arc to supporting chassis structure, should an arc occur in a cathode ray tube with which said voltage divider is associated.

6. A voltage divider in accordance with claim 5, and further characterized in that said connection means extends through and is sealed in said base wall and said base wall is so disposed with respect to said side walls as to ensure that, in use, said base wall will be located in predetermined spaced adjacency to such supporting chassis structure, the construction and arrangement being such that a gap of predetermined length exists between said connection means and chassis structure supporting said voltage divider.

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E. A. GOLDBERG, Primary Examiner

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