Patents and Perspective on
Surge Protection for Low-Voltage Circuits

Significance:
Part 6: Tutorials, textbooks, and reviews

Chapter 1 – Patents issued 1971 – 1984

These patents are included in this chapter of this Part 6 as they "teach" (using the legal term) applications of surge-protective devices. Only the front pages of the patents are included here. Complete copies, of course, would be available from the U.S. Patent Office. Seven of the nine patents included in this chapter were granted for non-conventional structures and applications of the emerging metal-oxide varistor (MOV) technology, fueled by the enthusiasm generated by the possibility of taking advantage of the flexibility of manufacturing MOVs in structures more complex than a simple disc with only two terminal electrodes. A search on the subject of "MOV" in the U.S. Patent Office yields nearly one hundred patents by other inventors.

All of these nine patents were assigned to the General Electric Company, which lost interest in any of them as the electronics-oriented varistor business was sold off by General Electric, the beginning of a succession of divestitures, acquisitions, and licensing of what has now become for several manufacturers primarily a business of manufacturing simple two-terminal structures that are subsequently incorporated into an SPD package by other manufacturers.

Two other patents included in this chapter deal with transient phenomena in power electronics and are cited in several patents issued to other inventors of surge-protection schemes, although these two do not include any claim associated with MOV applications.

Chapter 2 – Retrospective – 1972-2004

As witness to technology evolution and changing business priorities, this chapter of Part 6 begins – as an acknowledgment to the origins of the technology – with an early patent filed in the US, for which GE acquired a license and launched the "GE-MOV" ®[1] varistors in 1972, blossoming into a full line of two-terminal devices for low-voltage applications[2]. Next, this chapter shows an excerpt from a product specification bulletin listing the wide range of ratings available by the mid-seventies. On the occasion of its Centennial, GE seemed determined to stay in the business of transient protection, as claimed by an advertisement citing its long roots in the field. However, while expansion of the variety of MOV structures continued, as shown by the covers of successive editions (avatars) of the ***Transient Voltage Suppression Manual***, GE eventually did exit the business of low-voltage MOVs, with Harris Semiconductor taking over. That exit was later followed by yet another divestiture, now apparent as the latest MOV avatar when browsing the Internet for present MOV manufacturers – a long way from the 1970s GE-MOVs.

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[1] Then a trademark of the General Electric Company.

[2] The MOV applications to high-voltage surge arresters were also developed during that period, but are not covered in this Anthology, except for the seminal Shakshaug et al. paper which is included as an annex of Part 7.

United States Patent

[11] 3,569,819

[72] Inventors Francois D. Martzloff; William McMurray; John P. Walden, Schenectady, N.Y.

[21] Appl. No 791,750
[22] Filed Jan. 16, 1969
[45] Patented Mar. 9, 1971
[73] Assignee General Electric Company

[54] **RECOVERY SYSTEM FOR SHORT CIRCUITS THROUGH SWITCHING DEVICES IN POWER CIRCUITS**
8 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** **321/12,** 321/4, 321/14, 321/45
[51] **Int. Cl.** **H02m 1/18,** H02h 7/14
[50] **Field of Search** .... 321/4, 11—14, 45, 45C; 307/202; 317/53 (Inquired)

[56] **References Cited**

UNITED STATES PATENTS

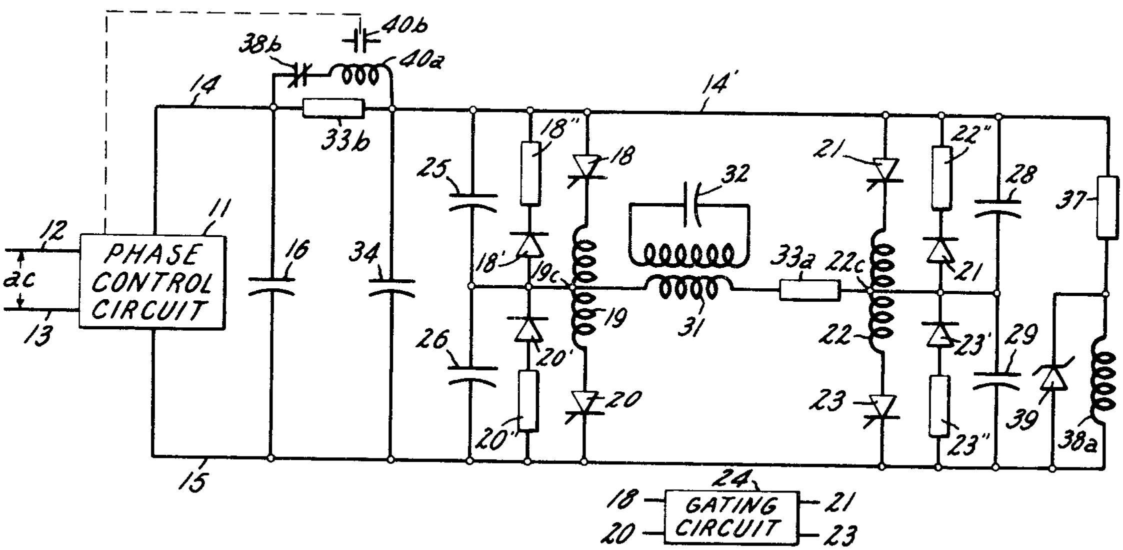
3,406,327 10/1968 Mapham et al. 321/45

OTHER REFERENCES

The Institution of Electrical Engineers, Paper No. 3889E, "An Audio-Frequency High Power Generator Employing Silicon Controlled Rectifiers," pp. 255, 256, May 1962, Copy in Class 321/45

Primary Examiner—William H. Beha Jr.
Attorneys—Frank L. Neuhauser, Oscar B. Waddell, James C. Davis, Jr., Edward W. Goebel, Jr. and Joseph B. Forman

ABSTRACT: When a short circuit or shoot-through occurs in a power circuit having two thyristors in series with commutating circuit inductors, a shunt capacitor isolated from the DC power supply by an impedance automatically resonates with the inductors to turn off both thyristors. A second automatic recovery system for repeated short circuits that occur before the capacitor has recharged operates to temporarily disable the power supply. In a high-voltage inverter the impedance is a resistor functioning to dampen voltage overshoots and to implement a relay or solid state second recovery system.



United States Patent

[11] 3,600,664

[72] Inventors **Leon J. Goldberg; Francois D. Martzloff, both of Schenectady, N.Y.**

[21] Appl. No. **4,246**

[22] Filed **Jan. 20, 1970**

[45] Patented **Aug. 17, 1971**

[73] Assignee **General Electric Company**

[54] **OVERCURRENT PROTECTION FOR SOLID-STATE VOLTAGE REGULATOR**
9 Claims, 9 Drawing Figs.

[52] **U.S. Cl.** .... **323/9,** 323/43.5 S, 323/45, 323/62

[51] **Int. Cl.** **G05f 1/20,** G05f 1/30

[50] **Field of Search** .... 317/16, 33, 33 SC; 321/14; 323/9, 43.5, 45, 57, 62

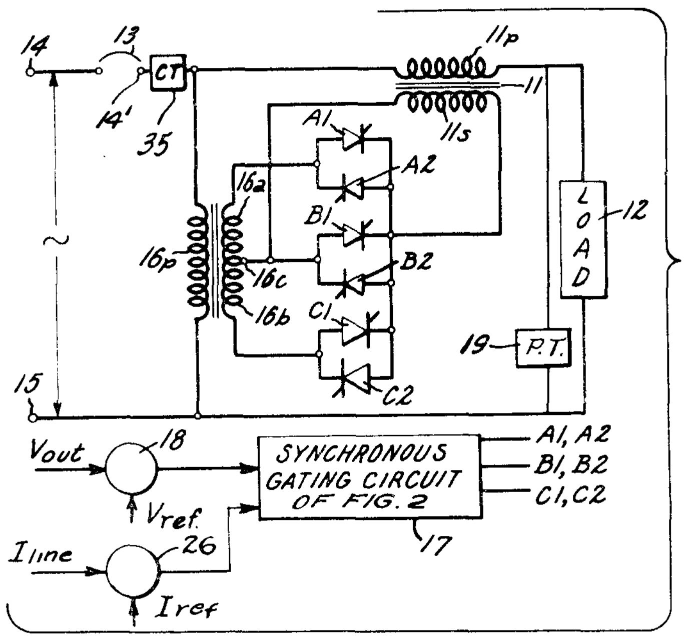
[56] **References Cited**

UNITED STATES PATENTS

3,281,652	10/1966	Perrins	323/43.5 X
3,461,378	8/1969	King	323/45 X
3,495,129	2/1970	Donner et al.	323/43.5 X
3,514,688	5/1970	Martin	323/43.5 X

Primary Examiner—J. D. Miller
Assistant Examiner—A. D. Pellinen
Attorneys—John F. Ahern, Paul A. Frank, Julius J. Zaskalicky, Donald R. Campbell, Frank L. Neuhauser, Oscar B. Waddell and Joseph B. Forman

ABSTRACT: A solid-state voltage regulator constructed with low current rating step changing solid-state switches, or pairs of switches, is protected against overcurrents in the interval before the opening of a slow-acting circuit breaker. The overcurrent is transferred from one switch to another in sequence rapidly to take advantage of the short time current overcapacity, or is diverted to a shunting protective switch which can have other functions. Alternatively, one switch has a high current rating, and the overcurrent is diverted to the heavy-duty switch.



United States Patent [19]

Martzloff

[11] **3,742,419**

[45] **June 26, 1973**

[54] **INTEGRAL SENSOR FOR MONITORING A METAL OXIDE VARISTOR**

[75] Inventor: **Francois D. Martzloff,** Schenectady, N.Y.

[73] Assignee: **General Electric Company,** Schenectady, N.Y.

[22] Filed: **Sept. 30, 1971**

[21] Appl. No.: **185,184**

[52] **U.S. Cl.** .... **338/20,** 73/362 SC, 338/22

[51] **Int. Cl.** **H01c 7/10**

[58] **Field of Search** .... 338/13, 20, 21, 324, 338/325, 322; 73/362 SC; 323/68, 69

[56] **References Cited**

UNITED STATES PATENTS

3,622,849	11/1971	Kelley	323/69 X
2,747,158	5/1956	LeBel	323/69

FOREIGN PATENTS OR APPLICATIONS

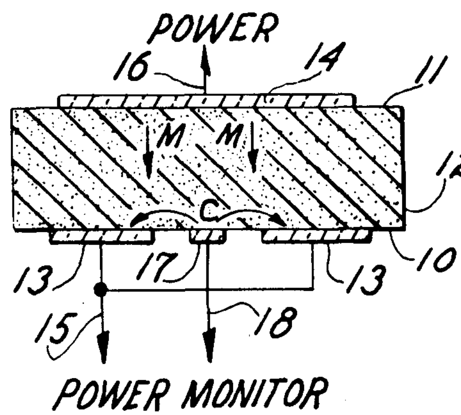
783,669	9/1957	Great Britain	73/362 SC

Primary Examiner—C. L. Albritton
Attorney—Frank L. Neuhauser, John F. Ahern et al.

[57] **ABSTRACT**

A body of sintered metal oxide material having first and second opposed surfaces and a third surface disposed therebetween has first and second electrodes in contact with the first two opposed surfaces for establishing a main conductive path through the device and a third electrode in contact with one of the two opposed surfaces and spaced very close to the corresponding electrode for establishing a monitoring conductive path for sensing the operating temperature of the body as a function of the resistance thereof. The monitoring path may also be established by a pair of third electrodes positioned on opposite sides of the surface interconnecting the first two surfaces whereby the monitoring path intersects the main conductive path. The sintered metal oxide material has varistor characteristics.

13 Claims, 6 Drawing Figures



United States Patent [19]
Tasca et al.
[11] 3,711,794
[45] Jan. 16, 1973

[54] SURGE SUPPRESSION TRANSMISSION MEANS

[75] Inventors: Dante M. Tasca, Philadelphia, Pa.; John D. Harnden, Jr.; Francois D. Martzloff, both of Schenectady, N.Y.

[73] Assignee: General Electric Company

[22] Filed: Oct. 21, 1971

[21] Appl. No.: 191,216

[52] U.S. Cl. ....333/96, 333/97 R, 333/81 A, 333/13, 338/216, 338/21, 329/162
[51] Int. Cl. H01p 1/00, H01p 1/22, H01c 7/12
[58] Field of Search...333/97 R, 81 AB, 17, 13, 24.2, 333/2, 96, 97 S; 338/20–21, 216, 220; 317/61.5; 339/147; 329/161–162

[56] References Cited

UNITED STATES PATENTS

2,428,001	9/1947	Tubbs	333/96
2,440,748	5/1948	Johnson	338/21 X
2,498,335	2/1950	Hunt	329/162
2,548,881	4/1951	Ferrill, Jr.	333/96 X
2,602,828	7/1952	Norton	338/20 X
2,798,207	7/1957	Reggia	338/81 A
2,911,601	11/1959	Gunn et al.	333/81 B
3,014,188	12/1961	Chester et al.	333/98 S
3,096,494	7/1963	Jacobs et al.	329/161 X
3,259,857	7/1966	Garstang	333/79
3,426,299	2/1969	Dixon, Jr.	333/24.2 X
3,611,073	10/1971	Hamamoto et al.	338/20 X
3,663,458	5/1972	Masuyama et al.	252/518

OTHER PUBLICATIONS

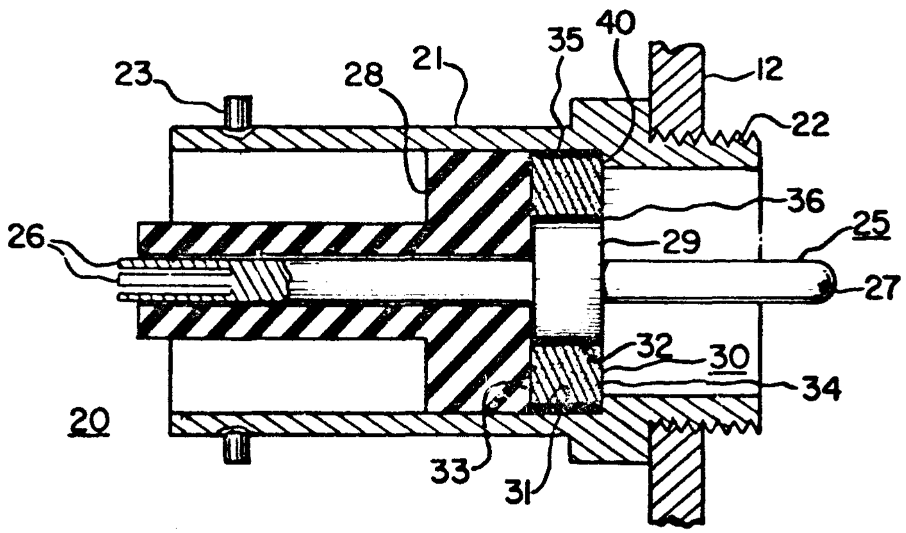
Gunn, M. W., "Wave Propagation in Rectangular Waveguide Containing a Semiconducting Film" Proc. IEE. Vol. 114 2–1967, pp. 207–210.

Primary Examiner—Eli Lieberman
Assistant Examiner—Wm. H. Punter
Attorney—Frank L. Neuhauser et al.

[57] ABSTRACT

In a coaxial connector a generally toroidal shaped member of metal oxide varistor material is connected between the inner and outer conductors of the connector. The metal oxide varistor material has an alpha in excess of 10 in the current density range of from 10^{-3} to 10^{2} amperes per square centimeter. The spacing of the peripheral portions of the member is set so that a high impedance is presented to normal applied voltage between the peripheral portions. For voltages applied between the peripheral portions progressively in excess of the normal voltage rapidly decreasing impedance is presented by the toroidal member in accordance with the alpha of the material thereby limiting the variation in voltage between the peripheral portions of the toroidal shaped member.

11 Claims, 13 Drawing Figures



RD 5808

United States Patent [19]

Anderson et al.

[11] **3,845,358**

[45] **Oct. 29, 1974**

[54] **INTEGRATED POLYCRYSTALLINE VARISTOR SURGE PROTECTIVE DEVICE FOR HIGH FREQUENCY APPLICATIONS**

[75] Inventors: **Thomas E. Anderson**, Normal, Ill.; **Francois D. Martzloff**, Schenectady, N.Y.

[73] Assignee: **General Electric Company**, Schenectady, N.Y.

[22] Filed: **June 29, 1973**

[21] Appl. No.: **375,132**

[52] U.S. Cl. **317/61**, 317/61.5, 317/68, 338/21

[51] Int. Cl. **H02h 9/04**

[58] Field of Search 338/21, 20; 317/61.5, 68, 317/41, 61

[56] **References Cited**

UNITED STATES PATENTS

3,162,831	12/1964	Heath	338/21
3,304,529	2/1967	Forwald et al.	338/21
3,740,701	6/1973	Harnden	338/21 X
3,764,566	10/1973	Matsuoka et al.	338/21 X

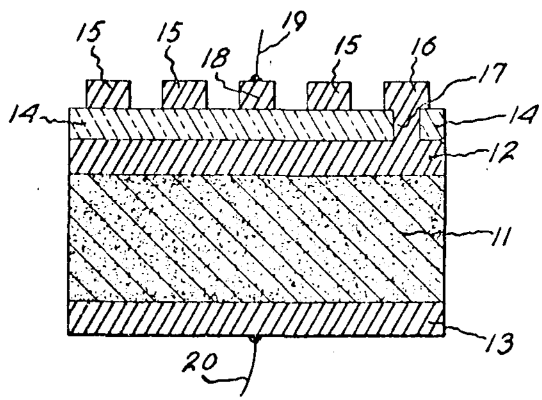
Primary Examiner—James D. Trammell

Attorney, Agent, or Firm—Paul I. Edelson; Joseph T. Cohen; Jerome C. Squillaro

[57] **ABSTRACT**

A polycrystalline varistor of the bulk effect zinc oxide base type adapted for use in voltage surge suppression on VHF signal lines is disclosed. The device comprises a unitary body including a spiral inductor electrically in series with the varistor element to prevent capacitive loading of the protected signal line.

9 Claims, 3 Drawing Figures



United States Patent [19]

Martzloff

[11] **3,863,111**

[45] **Jan. 28, 1975**

[54] **POLYCRYSTALLINE VARISTOR SURGE PROTECTIVE DEVICE FOR HIGH FREQUENCY APPLICATIONS**

[75] Inventor: **Francois D. Martzloff,** Schenectady, N.Y.

[73] Assignee: **General Electric Company,** Schenectady, N.Y.

[22] Filed: **June 29, 1973**

[21] Appl. No.: **374,933**

[52] **U.S. Cl.** **317/61.5,** 317/53, 317/67, 317/50, 333/76, 333/13, 338/21, 338/216

[51] **Int. Cl.** **H02h 3/20,** H02h 3/22

[58] **Field of Search** .... 317/61, 61.5, 66, 235 A, 317/234 A, 261; 338/20, 21, 216; 200/166, 222; 333/70 C, 70 S, 79, 80 R, 80 T, 70 CR, 73 C, 76

[56] **References Cited**

UNITED STATES PATENTS

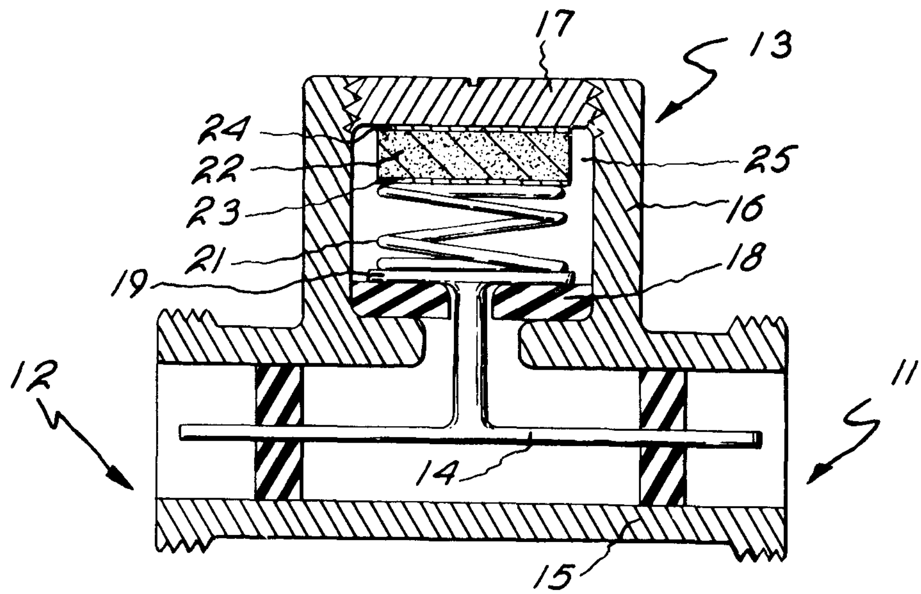
2,176,211	10/1939	Cork et al.	333/73 C
2,896,128	7/1959	Fuller et al.	317/61
3,274,447	9/1966	Nelson	317/61
3,310,766	3/1967	Downing et al.	338/20
3,496,435	2/1970	Manley	317/261
3,521,200	7/1970	Matsushima et al.	333/79
3,611,073	10/1971	Hamamoto	338/20
3,703,665	11/1972	Yereance	317/61
3,711,794	1/1973	Tasca et al.	338/21
3,728,584	4/1973	Kuhlow	317/234 A

Primary Examiner—J. D. Miller
Assistant Examiner—Patrick R. Salce
Attorney, Agent, or Firm—Donald R. Campbell; Joseph T. Cohen; Jerome C. Squillaro

[57] **ABSTRACT**

A polycrystalline varistor of the bulk effect zinc oxide base type adapted for use in voltage surge suppression on VHF signal lines is disclosed. The device comprises a connector having a housing attached thereto containing a polycrystalline varistor and a conductive spring member. The spring member is configured to provide for the proper mechanical positioning of the varistor and to provide an electrical inductance in series with the varistor to prevent capacitive loading of the protected signal line.

9 Claims, 2 Drawing Figures



United States Patent [19]

Burgess et al.

[11] **4,103,274**

[45] **Jul. 25, 1978**

[54] **RECONSTITUTED METAL OXIDE VARISTOR**

[75] Inventors: **James F. Burgess**, Schenectady; **Roland T. Girard**, Scotia; **Francois D. Martzloff; Constantine A. Neugebauer**, both of Schenectady, all of N.Y.

[73] Assignee: **General Electric Company**, Schenectady, N.Y.

[21] Appl. No.: **722,388**

[22] Filed: **Sep. 13, 1976**

[51] **Int. Cl.**^{2} **H01C 7/10**

[52] **U.S. Cl.** .... **338/21**; 29/610 R; 29/621; 252/518; 338/20; 338/327

[58] **Field of Search** .... 338/20, 21, 327; 29/610, 621; 427/101; 428/412, 328-330; 252/518, 518.1, 518.3; 260/37 PC

[56] **References Cited**

U.S. PATENT DOCUMENTS

3,503,029	3/1970	Matsuoka	338/20
3,935,157	1/1976	Schiller et al.	260/37 PC
3,999,159	12/1976	Matsuura et al.	338/21

OTHER PUBLICATIONS

Chemical Abstracts, vol. 85, 1976, p. 571.

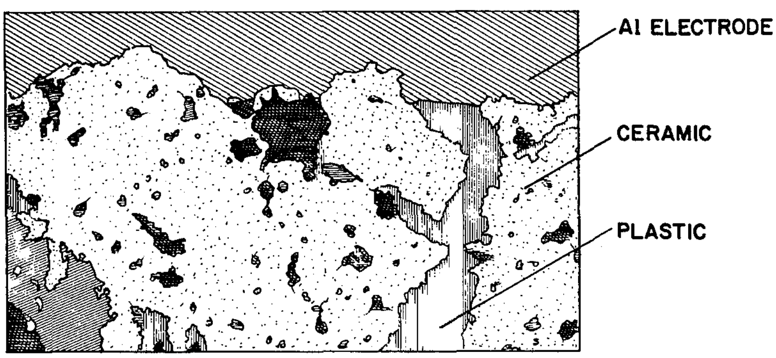
Primary Examiner—C. L. Albritton

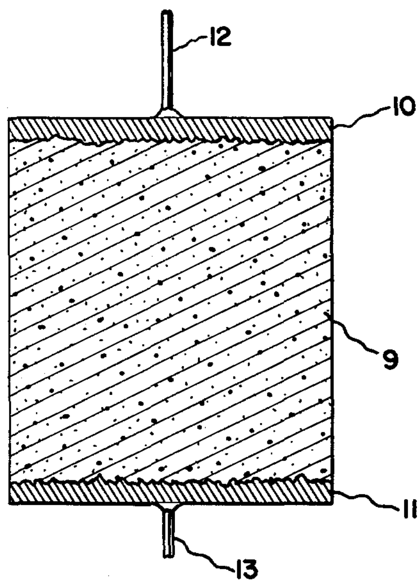
Attorney, Agent, or Firm—Lawrence D. Cutter; Joseph T. Cohen; Marvin Snyder

[57] **ABSTRACT**

Reconstituted metal oxide varistors are formed by hot pressing powdered metal oxide varistor ceramic with plastic resin. Metal electrodes may be pressed directly into the ceramic-plastic composite to provide improved contact characteristics.

25 Claims, 6 Drawing Figures





United States Patent [19] [11] 4,212,045
Martzloff [45] Jul. 8, 1980

[54] MULTI-TERMINAL VARISTOR CONFIGURATION

[75] Inventor: **Francois D. Martzloff**, Schenectady, N.Y.

[73] Assignee: **General Electric Company**, Schenectady, N.Y.

[21] Appl. No.: **972,448**

[22] Filed: **Dec. 22, 1978**

[51] **Int. Cl.**[2] **H02H 1/04**
[52] **U.S. Cl.** **361/127**; 338/21; 361/56
[58] **Field of Search** 361/56, 91, 127; 338/20, 21

[56] **References Cited**

U.S. PATENT DOCUMENTS

2,935,712	5/1960	Oppenheim et al.	338/20
3,764,854	10/1973	Craddock	361/127

FOREIGN PATENT DOCUMENTS

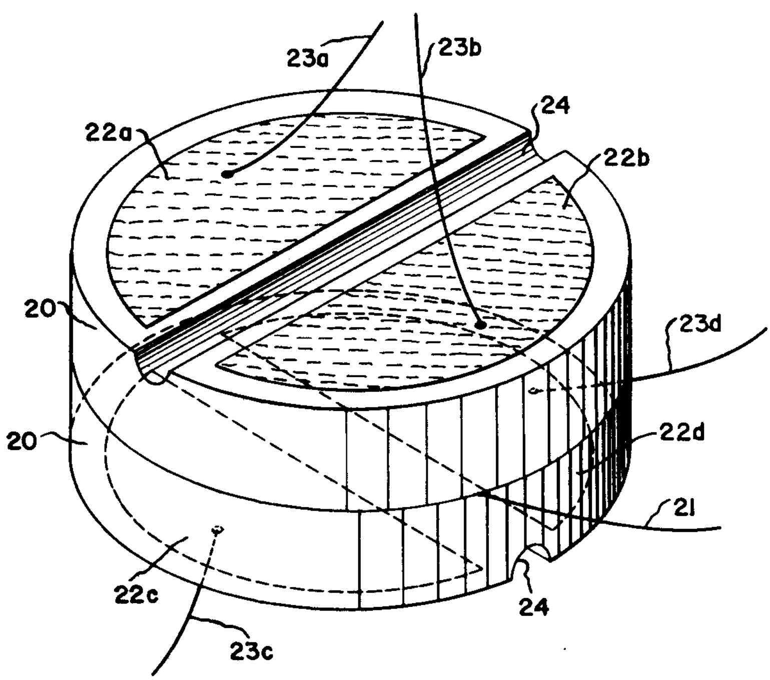
7507645	1/1976	Netherlands	338/21

Primary Examiner—Harry E. Moose, Jr.
Attorney, Agent, or Firm—Lawrence D. Cutter; James C. Davis; Marvin Snyder

[57] **ABSTRACT**

A pair of varistor disks, each having one face thereof coated substantially entirely with electrode material and another face thereof coated with spaced-apart electrode material, such as in two semicircular patches, are joined together so that said faces coated with a single electrode are coincident. This configuration reduces by a factor of two the over-all area required for equal current density as compared with certain prior varistor configurations. The varistor of the present invention also exhibits a lower diameter-to-thickness ratio and hence provides a significantly stronger mechanical structure. Additionally, the varistors of the present configuration may be readily provided with grooves between electrode surfaces so as to increase the inter-electrode spacing, without significantly reducing the mechanical strength of the device. The invention of the present structure also permits flexible lead configurations.

10 Claims, 4 Drawing Figures



United States Patent [19]

Bloomer et al.

[11] **Patent Number: 4,467,245**

[45] **Date of Patent: Aug. 21, 1984**

[54] **CURRENT-LIMITED SPARK GAP FOR TRANSIENT PROTECTION**

[75] Inventors: **Milton D. Bloomer; Francois D. Martzloff,** both of Schenectady, N.Y.

[73] Assignee: **General Electric Company,** Schenectady, N.Y.

[21] Appl. No.: **468,000**

[22] Filed: **Feb. 18, 1983**

[51] **Int. Cl.³** **H01K 1/68**

[52] **U.S. Cl.** **315/75;** 315/127; 315/207; 315/240; 361/56; 361/111

[58] **Field of Search** .... 315/73–75, 315/125–127, 207, 240, 241 R; 307/126, 130; 361/56, 111, 126

[56] **References Cited**

U.S. PATENT DOCUMENTS

2,888,639	5/1959	Petermichl et al.	361/56 X
3,660,719	5/1972	Grenier	361/56

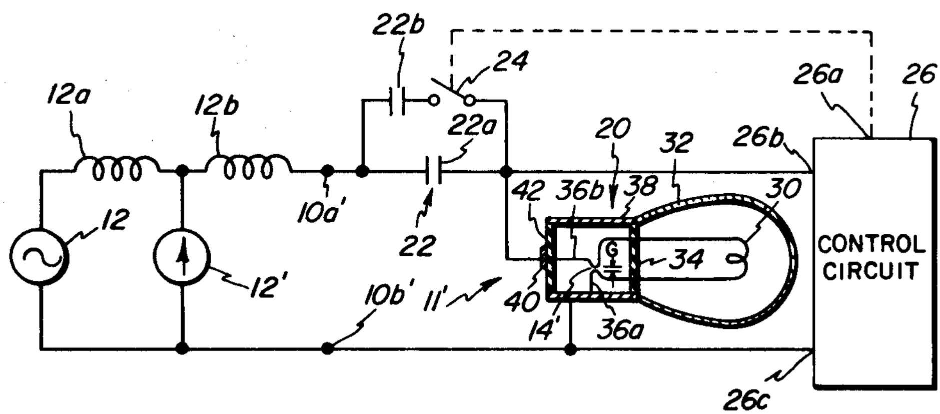
Primary Examiner—Eugene R. LaRoche

Attorney, Agent, or Firm—Geoffrey H. Krauss; James C. Davis, Jr.; Marvin Snyder

[57] **ABSTRACT**

High voltage transients are effectively clamped by means of a spark gap, in parallel connection with a load to be protected, and having a capacitor in series with the parallelled load-spark gap combination. The series capacitor limits follow-through current through the spark gap to a level permitting survival of the spark gap. Where the load is an incandescent lamp, the spark gap is formed by shaping the lamp internal lead structure, such that an additional external spark gap component is not required.

13 Claims, 2 Drawing Figures



United States Patent Office

3,682,841
Patented Aug. 8, 1972

3,682,841
VOLTAGE DEPENDENT RESISTORS IN A BULK TYPE

Michio Matsuoka, Takeshi Masuyama, and Yoshio Iida, Osaka-fu, Japan, assignors to Matsushita Electric Industrial Co., Ltd., Osaka, Japan

Filed Dec. 1, 1970, Ser. No. 93,971
Claims priority, application Japan, Dec. 12, 1969, 44/100,447; Dec. 16, 1969, 44/102,203, 44/102,204, 44/102,205, 44/102,206; Dec. 23, 1969, 44/569; Apr. 6, 1970, 45/29,908
Int. Cl. H01b *1/06*
U.S. Cl. 252—518 5 Claims

ABSTRACT OF THE DISCLOSURE

A voltage dependent resistor of the bulk type. The resistor has a sintered body consisting essentially of, as a major part, zinc oxide (ZnO) and, as an additive, 0.05 to 10.0 mole percent of beryllium oxide (BeO) and 0.05 to 10.0 mole percent, in total, of at least one member selected from the group consisting of bismuth oxide (Bi_2O_3), cobalt oxide (CoO) manganese oxide (MnO), barium oxide (BaO), strontium oxide (SrO) and lead oxide (PbO). Electrodes are provided which are in contact with said body.

This invention relates to voltage dependent resistors having non-ohmic resistance due to the bulk thereof and more particularly to varistors comprising zinc oxide and beryllium oxide.

Various voltage dependent resistors such as silicon carbide varistors, selenium rectifiers and germanium or silicon p-n junction diodes have been widely used for stabilization of voltage or current of electrical circuits. The electrical characteristics of such a voltage dependent resistor are expressed by the relation:

$$I=\left(\frac{V}{C}\right)^n$$

where V is the voltage across the resistor, I is the current flowing through the resistor, C is a constant corresponding to the voltage at a given current and exponent *n* is a numerical value greater than 1. The value of *n* is calculated by the following equation:

$$n=\frac{\log_{10}(I_2/I_1)}{\log_{10}(V_2/V_1)}$$

where V_1 and V_2 are the voltages at given currents I_1 and I_2, respectively. The desired value of C depends upon the kind of application to which the resistor is to be put. It is ordinarily desirable that the value of *n* be as large as possible since this exponent determines the extent to which the resistors depart from ohmic characteristics.

Voltage dependent resistors comprising sintered bodies of zinc oxide with or without additives and silver paint electrodes applied thereto, have previously been disclosed. The non-linearity of such varistors is attributed to the interface between the sintered body of zinc oxide with or without additives and the silver paint electrode and is controlled mainly by changing the compositions of said sintered body and silver paint electrode. Therefore, it is not easy to control the C-value over a wide range after the sintered body is prepared. Similarly, in varistors comprising germanium or silicon p-n junction diodes, it is difficult to control the C-value over a wide range because the non-linearity of these varistors is not attributed to the bulk but to the p-n junction. On the other hand, the silicon carbide varistors have non-linearity due to the contacts among the individual grains of silicon carbide bonded together by a ceramic binding

material, i.e. to the bulk, and the C-value is controlled by changing a dimension in the direction in which the current flows through the varistors. The silicon carbide varistors, however, have a relatively low n-value ranging from 3 to 6 and are prepared by firing in non-oxidizing atmosphere, especially for the purpose of obtaining a lower C-value.

An object of the present invention is to provide a voltage dependent resistor having non-linearity due to the bulk thereof and being characterized by a low C-value and high n-value.

Another object of the present invention is to provide a method for making a voltage dependent resistor having the non-linearity due to the bulk thereof and being characterized by a high n-value, without using non-oxidizing atmosphere.

These objects are achieved by providing a voltage dependent resistor of the bulk type comprising a sintered body consisting essentially of, as a major part, zinc oxide (ZnO), and, as an additive, 0.05 to 10.0 mole percent of beryllium oxide (BeO) and 0.05 to 10.0 mole percent, in total, of at least one member selected from the group consisting of bismuth oxide (Bi_2O_3), cobalt oxide (CoO), manganese oxide (MnO), barium oxide (BaO), strontium oxide (SrO) and lead oxide (PbO), and electrodes in contact with said body.

These and other objects of the invention will become apparent upon consideration of the following description taken together with the accompanying drawing in which the single figure is a partly cross-sectional view through a voltage dependent resistor in accordance with the invention.

Before proceeding with a detailed description of the voltage dependent resistors contemplated by the invention, their construction will be described with reference to the aforesaid drawing wherein reference character **10** designates, as a whole, a voltage dependent resistor comprising, as its active element, a sintered body having a pair of electrodes **2** and **3** applied to opposite surfaces thereof. Said sintered body **1** is prepared in a manner hereinafter set forth and is in any form such as circular, square or rectangular plate form. Wire leads **5** and **6** are attached conductively to the electrodes **2** and **3**, respectively, by a connection means **4** such as solder or the like.

The sintered body **1** of the voltage dependent resistor according to the invention comprises a composition consisting essentially of, as a major part, zinc oxide (ZnO) and, as an additive, 0.05 to 10.0 mole percent of beryllium oxide (BeO) and 0.05 to 10.0 mole percent, in total, of at least one member selected from the group consisting of bismuth oxide (Bi_2O_3), cobalt oxide (CoO), manganese oxide (MnO), barium oxide (BaO), strontium oxide (SrO) and lead oxide (PbO) and has the electrodes **2** and **3** in contact with said body.

A higher n-value can be obtained when said additive consists essentially of 1.0 to 8.0 mole percent of beryllium oxide (BeO) and 0.1 to 3.0 mole percent, in total, of at least one member selected from the group consisting of bismuth oxide (Bi_2O_3), cobalt oxide (CoO), manganese oxide (MnO), barium oxide (BaO), strontium oxide (SrO) and lead oxide (PbO).

Table 1 shows the optimal compositions of said additives for producing a voltage dependent resistor having hibh n-value, low C-value and high stability with respect to temperature, humidity and electric load.

The sintered body **1** can be prepared by a per se well known ceramic technique. The starting materials having the compositions described in the foregoing description are mixed in a wet mill so as to produce homogeneous mixtures. The mixtures are dried and pressed in a mold into the desired shape at a pressure of from 100 kg./cm.^{2} to 1000 kg./cm.^{2}. The pressed bodies are sintered

GE-MOV® Metal-Oxide Varistors

GE has been helping customers solve transient voltage problems since the introduction of GE-MOV® varistors in 1972. The GE-MOV® team is constantly researching the causes and effects of transients and developing new solutions to meet all types of transient suppression needs; committed to innovation beyond today's technology.

As the field of electronics has grown rapidly through the use of solid-state components, so have the applications for surge suppressors to protect these transient-sensitive devices. Innovations such as surface-mount technology have also altered the demand profile by adding packaging considerations to functional ones.

As a result of innovation and research, the GE-MOV® line of metal-oxide varistors has expanded to include surface-mount devices, new high-energy packages, connector-pin varistors, and high-temperature, low-profile varistors. These new products supplement the GE-MOV® line of radial, axial, and high-energy packaged varistors, already the broadest in the industry.

GE-MOV® Specification Guide

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LA	20
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CA	25
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GE-MOV® Features

FAMILY FEATURES:

- Wide Voltage/Energy Range
- Excellent Clamp Ratio
- Power
- No Follow-On Current
- Fast Response Time
- Low Standby
- UL Recognized

TYPE FEATURES:

CH/SM Series
Surface Mount Varistors

- Better Performance
- Higher Reliability
- Lower Equipment Cost
- Saves on Board Height/Bulk/Weight

CP Series
Connector Pin Varistors

- Provides transient protection in connectors
- Available in 22, 20, and 16 gauge sizes

MA Series

- Axial Package
- Wide Voltage Range
- Automatic Insertion

ZA Series

- Radial Package
- Low Voltage Operation

LA Series

- Radial Package
- Line Voltage Operation
- UL Recognized

RA Series

- Low Profile
- High Temperature Capability
- Precise Seating Plane
- In-Line Leads

PA Series

- Rigid Mountdown
- NEMA Creep and Strike Distance
- Quick Connect Terminal
- UL Recognized

DA,DB,BA,BB Series

- High Energy Capability
- Rigid Terminals
- Isolated
- Low Inductance
- Improved Creep and Strike
- UL Recognized

CA Series

- Industrial Discs

Hi Reliability Series

- 100% Prescreened
- 100% Process Conditioning
- Meets Military Specifications

GE Centennial Advertisement

How does GE intend to keep its lead in transient protection?

Staying power.

Most people recognize GE-MOV® varistors as the ultimate in system transient protection. With good reason. These metal oxide varistors, or movistors, are the result of research and experience that stems from the early years of General Electric, celebrating in 1978 its 100th birthday.

You may have shared our excitement along the GE path to leadership. Steinmetz' lightning generator demonstration in 1922. Anderson's lightning measurements on the Empire State Building in the 1930's. The definitive study of surge voltages in residential and industrial circuits formulated by Martzloff and Hahn of GE's Corporate R&D Center in 1970. And, of course, GE's $10 million investment relating to the introduction of GE-MOV® varistors six years ago.

But in our view, the best is yet to come. GE's R&D work on transient protection continues to find more sophisticated materials, better measurements and standardization. Soon, you'll be able to put the resulting new products and new ideas to work for you.

Experience, Innovation. Staying power. It's what you've come to expect, and can expect from GE when you need transient protection.

For the full story on GE-MOV® varistors, call your local authorized GE semiconductor distributor, or write General Electric Co., Electronics Park 7-49, Syracuse, N.Y. 13221. 222-06

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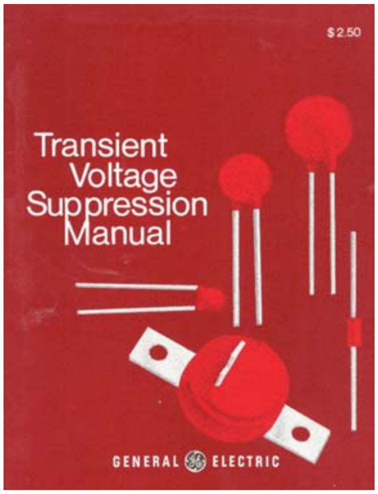
There's more to GE semiconductors than meets the eye

GENERAL ELECTRIC

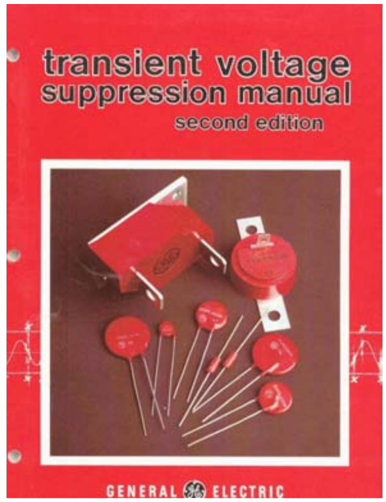
Avatars of the GE Transient Voltage Suppression Manual

1976 - 2004

1976 – First Edition
(A collector's item)



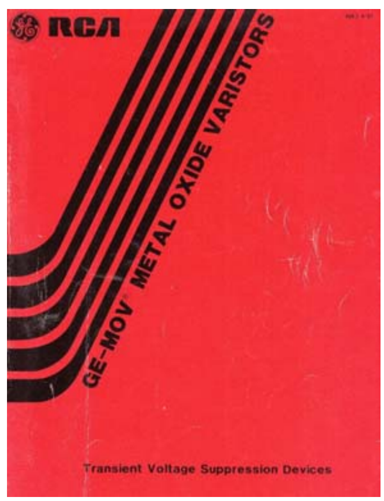
1978 – Second Edition
The line expands



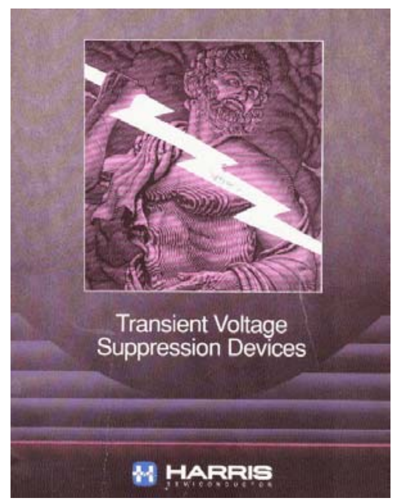
1982 – Third Edition
Bigger is better

1983 – Fourth Edition
(More big discs/)

1986 – Fifth Edition
Last Hurrah for GE-MOV



1992 – Same Text
A New Home



Browsing the Web in 2004 for varistor vendors delivers the following message:

Divested Product Family

The product you're searching for is part of a family that is no longer in the Intersil Corporation product portfolio.

TRANSIENT VOLTAGE PRODUCTS

The former Harris Semiconductor and RCA Solid State family of transient voltage products (Radial Varistors, Multi-Layer Varistors, Industrial MOVs, Diode Arrays and Surgector TVS Thyristors) were sold to Littlefuse, Inc. These include products with prefixes of LA, ZA, CIII, MLA, MLE, AUML, RA, BB, MA, HA, NA and SP.