Nov. 13, 1934. J. A. BECKER 1,980,176

UNIDIRECTIONAL CURRENT PASSING DEVICE

Filed June 25, 1931

FIG. 1

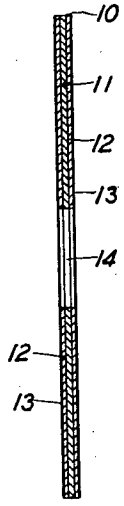


FIG. 2

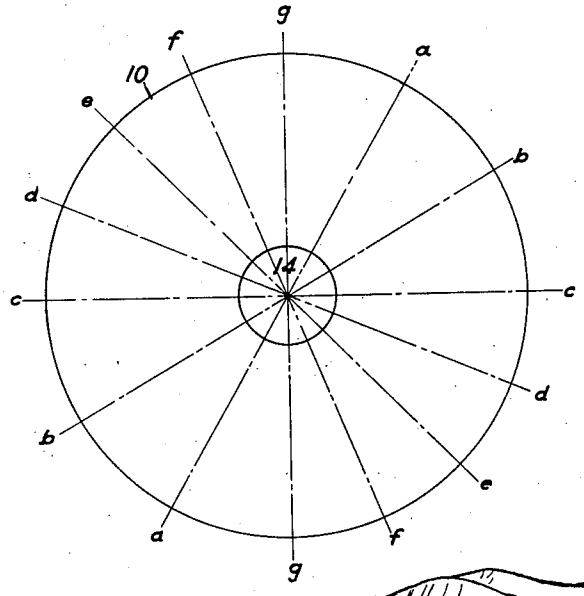


FIG. 3

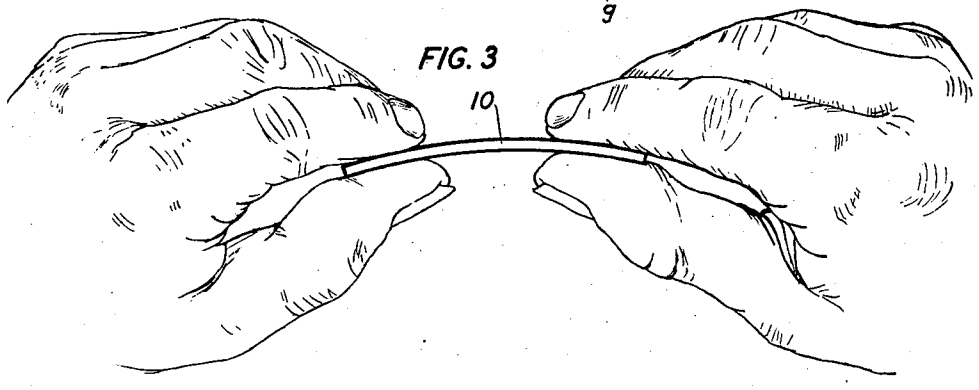


FIG. 4

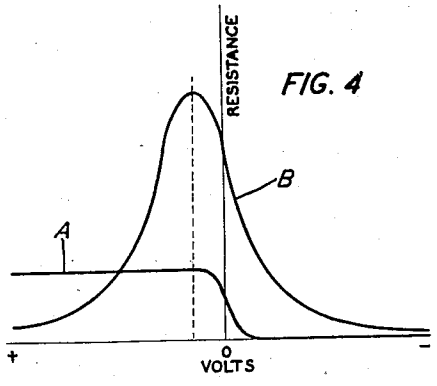
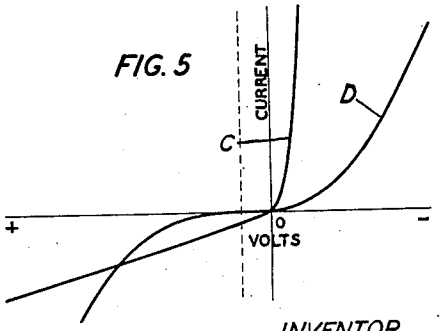


FIG. 5



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UNIDIRECTIONAL CURRENT PASSING DEVICE

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19 Claims. (Cl. 175—366)

This invention relates to unidirectional current passing devices and more particularly to such devices of the so called dry contact type.

An object of this invention is to produce a device which will allow the flow of current more readily in one direction therethrough than in a reverse direction yet which will have a resistance or impedance characteristic of a substantially symmetrical nature.

A further object of this invention is the manufacture of a unidirectional current passing device or electric rectifier of the copper oxide type which will have a resistance characteristic of a substantially symmetrical nature.

A feature of this invention resides in the method of manufacture of a unidirectional current passing device whereby a symmetrical resistance or impedance characteristic is obtained.

Another feature of this invention resides in a copper oxide rectifier having a substantially symmetrical resistance characteristic.

It is known that a metallic blank, for instance, of copper, may be heat treated to form a thin layer of the metallic oxide of the metal, in the case of copper, of cuprous oxide, on one or both surfaces of the blank which metal-metallic oxide unit when introduced into an electric circuit, will be found to pass currents more readily in one direction than in a reverse direction; and it will be noted, also, that currents will pass more readily when the applied potential is such that current flows from the oxide to the mother metal and and will vary with the value of applied potential. If the potentials were varied in value, and caused at each value to produce a current flow in each direction through the rectifying unit, and the computed values of resistance or impedance plotted against such potentials, an irregular and unsymmetrical resistance characteristic would be evident.

In accordance with this invention, such a unit is subjected to flexural or bending stresses along lines passing through its central portion, whereby, although its asymmetrical or unidirectional current passing characteristic is not lost, the unit is caused to have a substantially symmetrical resistance characteristic.

A more complete understanding of this invention will be obtained from the detailed description which follows taken in conjunction with the appended drawing, wherein:

Fig. 1 is a sectional view to an enlarged scale of a unidirectional current passing unit or device;

Fig. 2 is a plan view of the device of Fig. 1;

Fig. 3 illustrates a manner in which the device of Fig. 1 may be bent or flexed in accordance with this invention;

Fig. 4 shows graphically the resistance or impedance characteristic of the unidirectional current passing device or unit of Fig. 1, before and after treatment in accordance with this invention; and

Fig. 5 shows graphically the current characteristic of the unidirectional current passing device or unit of Fig. 1, before and after treatment in accordance with this invention. Referring now to the drawing, particularly Figs. 1 and 2, there is shown a unidirectional current passing device or unit or rectifying element 10 comprising a central layer 11 of mother metal, for instance, copper, relatively thin layers 12 of oxide, for instance cuprous oxide, and contact layers 13 of reduced copper in intimate and permanent contact with the outermost surfaces of the oxide layers 12. The central opening 14 is provided so that the unit described may be suitably mounted when in use. Such a unit may be formed, by taking a metal blank, for instance of copper, heating it to a high degree to cause the formation of an oxide layer on each surface thereof and thereafter cooling it to a substantially lower temperature from which it is quenched in a suitable bath. When the blank is heated, a layer of cuprous oxide is formed thereon immediately adjacent the mother metal. By quenching in the bath, the outermost portion of the oxide is reduced to copper to provide a contact surface on the cuprous oxide layers. In use as a rectifying device, as is well known, the layer 11 provides one terminal for the device and the layers 13 connected in parallel provide another terminal therefor.

The resistance or impedance characteristic of a unit thus formed was found to be similar to that illustrated by the curve A of Fig. 4. The current characteristic of the same unit is indicated by curve C of Fig. 5. In these figures, the notation "+" means that the potential is applied so as to cause current flow through the unit in the high resistance direction thereof, that is, from the copper to the cuprous oxide, and the notation "—" means that the potential is applied so as to cause current flow through the unit in the low resistance direction, that is, from the copper oxide to the copper.

In accordance with this invention, the unit described is subjected to flexing or bending along a plurality of lines passing preferably through the central portion of the unit. This result may be obtained in one way by successively grasping the unit between suitable members at the extremities of diametral lines such as *a—a*, *b—b*, *c—c*, etc. and then flexing or bending successively along lines which will be substantially at right angles to these diametral lines. This flexing or bending may be accomplished, for example, by grasping the unit between a pair of fingers of each hand and successively bending the unit as illustrated in Fig. 3.

After being treated in the manner outlined, the resistance or impedance characteristic of the unit

is found to be that indicated by curve B of Fig. 4 and the current characteristic, that indicated by curve D of Fig. 5. The resistance characteristic is substantially symmetrical about a positive potential value as is also the current characteristic which latter is substantially an exponential curve. The unit, however, retains its asymmetrical or unidirectional current passing characteristic. It is capable of use in a modulation system, being more advantageous than other types of rectifiers because of its symmetrical impedance or resistance characteristic.

Although this invention has been disclosed with reference to a specific device and the method and means of treatment thereof, it is to be understood that it is to be limited in scope by the appended claims only.

What is claimed is:

1. A unidirectional current passing device constituting in and of itself a rectifier consisting of a rectifying member initially flexed successively along a plurality of lines, having a substantially symmetrical resistance characteristic about a positive voltage.

2. A unidirectional current passing device comprising a metal blank having a layer of metallic oxide thereon and being initially flexed successively along a plurality of lines, said oxide coated blank having a substantially symmetrical resistance characteristic.

3. A unidirectional current passing device comprising a copper blank having a layer of cuprous oxide thereon and initially flexed successively along a plurality of lines, said device having a substantially symmetrical resistance characteristic.

4. A unidirectional current passing device consisting of a dry contact type rectifying disc initially flexed successively along a plurality of lines constituting in and of itself a rectifier having a substantially symmetrical resistance characteristic with respect to voltage, said symmetry being about a point removed from the origin for such characteristic.

5. An electrically conductive device consisting of a dry contact type rectifying disc initially flexed successively along a plurality of lines in and of itself ordinarily offering less resistance to current flow in one direction than in the reverse direction when an alternating potential is applied thereacross, which offers a maximum resistance to current flow at substantially one value only of potential, an increment or decrement of the same amount in said potential resulting in substantially the same value of current flow through said device in either direction.

6. An electrically conductive device as claimed in claim 5 in which the potential at which the resistance is a maximum is of a polarity tending to cause a current flow in the high resistance direction of said device.

7. A rectifier of the cold contact type comprising a disc initially flexed successively along a plurality of diametral lines, consisting of a copper blank having a layer of cuprous oxide thereon said rectifier, having a substantially symmetrically resistance characteristic.

8. An electrically conductive device comprising a disc initially flexed successively along a plurality of lines and consisting of a metal blank having a layer of the oxide of the metal thereon, said device offering such resistance to the flow of current therethrough for alternating potentials that the current characteristic therefor follows substantially an exponential curve.

9. An electrically conductive device comprising a disc initially flexed successively along a plurality of lines and consisting of a copper blank having a layer of cuprous oxide thereon, said device offering such resistance to the flow of current therethrough for alternating potentials that the current characteristic thereof follows substantially an exponential curve.

10. The method of making a unidirectional current passing device which comprises heat treating a metal blank to form a layer of an oxide of said metal thereon and thereafter flexing said blank successively along a plurality of lines.

11. The method of making a unidirectional current passing device which comprises heat treating a copper blank to form a layer of cuprous oxide thereon, and thereafter flexing said blank successively along a plurality of lines.

12. The method of making a unidirectional current passing device which comprises treating a metal blank to form a layer of an oxide of the metal thereon, and thereafter flexing said blank successively along a plurality of lines through the central portion thereof.

13. The method of making a unidirectional current passing device which comprises heat treating a metal blank to form a layer of an oxide of said metal thereon, and thereafter mechanically flexing said device successively along a plurality of lines.

14. The method of producing a unidirectional current passing device of the dry contact type having a symmetrical resistance characteristic which comprises heating a metal blank to form a layer of an oxide of said metal thereon, and thereafter flexing said blank successively along a plurality of lines in all directions.

15. The method of producing a unidirectional current passing device of the dry contact type having a symmetrical resistance characteristic which comprises treating a copper blank to form a layer of cuprous oxide thereon, and thereafter flexing said blank successively along a plurality of lines in all directions.

16. The method of making a rectifier of the cold contact type comprising a copper blank having a layer of cuprous oxide thereon and having a substantially symmetrical resistance characteristic which comprises bending said blank successively along a plurality of lines.

17. The method of making a rectifier of the cold contact type comprising a metal blank having a layer of the oxide of said metal thereon and having a substantially symmetrical resistance characteristic which comprises bending said blank successively along a plurality of lines in all directions through the central portion thereof.

18. An electrical conductor having a symmetrical resistance characteristic and consisting of a member initially flexed successively along a plurality of diametral lines and of copper oxide coated copper.

19. An electrical rectifier comprising a member of copper oxide coated copper initially flexed successively along a plurality of lines.

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