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W. C. DUNLAP, JR

2,668,262

ASYMMETRICALLY CONDUCTIVE DEVICE

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Fig. 1a.

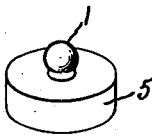


Fig. 1.

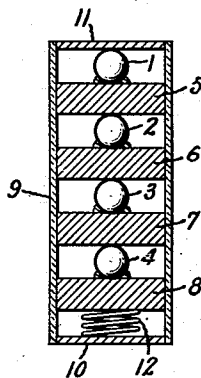


Fig. 2.

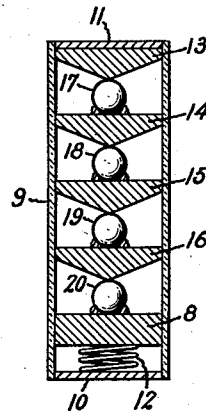


Fig. 3.

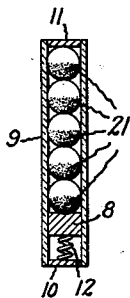
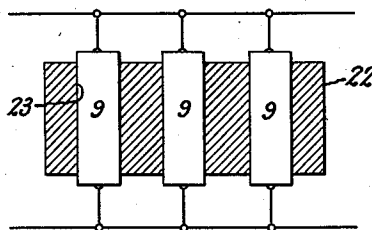


Fig. 4.



Inventor:
William C. Dunlap, Jr.,
by *Paul G. Frank*
His Attorney.

UNITED STATES PATENT OFFICE

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ASYMMETRICALLY CONDUCTIVE DEVICE

William C. Dunlap, Jr., Schenectady, N. Y., assignor to General Electric Company, a corporation of New York

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3 Claims. (Cl. 317-234)

1

My invention relates to asymmetrically conductive devices and, more particularly, to such devices employing substantially spherically shaped semi-conductors, such, for example, as germanium or silicon.

The use of asymmetrically conductive devices utilizing a small area and a large area contact between a pair of electrodes and a semi-conductive wafer to provide rectifying action between the electrodes is well known. It has recently been discovered that substantially spherical shaped semi-conductive pellets may be mass produced. This new technique forms the subject matter of patent application Serial No. 134,826, filed in the name of Harper Q. North on December 23, 1949, and assigned to the assignee of the present invention.

As is well known in the art, mass assembly of asymmetrically conductive devices employing the conventional "whisker" to obtain a small area contact is extremely difficult. It has also been difficult to mass produce asymmetrical devices which have voltage and current ratings throughout a relatively wide range. Therefore, any method for mass producing asymmetrical devices should be an attempt to obviate the heretofore-mentioned difficulties.

Accordingly, an object of my invention is to provide a new and improved asymmetrically conductive device suitable for mass production.

Another object of my invention is that this device be readily constructed in various voltage and current ratings.

A further object of my invention is to provide a new and improved asymmetrically conductive device obviating the use of the conventional whisker electrode.

In accordance with the illustrated embodiments of my invention, semi-conductive pellets, such, for example, as germanium pellets, are serially arranged in individual devices. The number of pellets in a particular device determines the voltage rating thereof. By arranging the individual devices in parallel in a single unit, I have found it possible to increase the current rating. Various embodiments illustrating but a few possible methods of serially arranging semi-conductive pellets in a single device have been shown. It should be understood, therefore, that these embodiments have not been shown to limit the invention thereto, but have been shown to facilitate a better understanding of my invention.

For further objects and advantages and for a better understanding of my invention, attention

2

is now directed to the following description and accompanying drawing in which Figs. 1, 2, and 3 illustrate separate embodiments of my invention whereby semi-conductor pellets may be serially arranged, and Fig. 4 illustrates an embodiment of my invention whereby the serially connected units of Figs. 1, 2 and 3 may be arranged in parallel.

Referring to Fig. 1, a plurality of semi-conductive pellets 1, 2, 3, and 4 are respectively soldered to flat metallic plates or electrodes 5, 6, 7, and 8 to form a plurality of unitary structures. The individual assemblies of the pellets and the plates are stacked in an insulated tubular shaped envelope 9. Envelope 9 is provided with a metallic cap 10 at one end and with a similar cap 11 at the other end. In the embodiment shown, these caps are cemented to envelope 9. To provide the same pressure on the pellets in every unit, a resilient member 12 is located between plate 8 and cap 10. In each unit the contact between the pellet of one assembly and the flat plate of the adjacent assembly establishes a small area contact while the soldered connection between the plate and the pellet provides a large area contact.

Since it has been found that a conical shaped electrode abutting a spherical pellet more nearly simulates the point contact desired, I have devised the embodiment of Fig. 2. In this embodiment, the apex of conically shaped electrodes 13, 14, 15, and 16 contact pellets 17, 18, 19, and 20 to obtain the small area contacts. These pellets are soldered to the base of the electrodes to obtain the large area contact. In general, the assembly of this unit is the same as in the embodiment of Fig. 1.

Referring to Fig. 3, there is shown an asymmetrically conductive device which does not employ plate electrodes between the individual pellets. The pellets 21 are coated over substantially half of their surface with a ferromagnetic material. This coating acts as the large area or broad contact for the individual pellet and makes a tangential point contact between itself and an adjacent pellet. The pellets are stacked in an envelope similar to those in the embodiments of Figs. 1 and 2 and may be oriented in the tube by establishing a magnetic field within the tube as the pellets are inserted.

Referring to Fig. 4, an arrangement is shown for mounting the asymmetrically conductive devices 9 of Figs. 1, 2 or 3 for connection in parallel. A supporting block 22 has a plurality of parallel cylindrical holes 23 extending entirely through the block. Each hole 23 has a diameter to accom-

3

modate a device 9 inserted therein. Any suitable means such as cementing or clamping may be employed for securing the device 9 to the block. Connections are made from opposite external ends of the respective devices to a pair of parallel lines, as shown. Block 22 preferably comprises a conductive metal to prevent electrostatic inter-coupling of the various inserted devices 9.

Modifications of this invention will occur to those skilled in the art and it is desired to be understood, therefore, that this invention is not to be limited to the particular embodiments disclosed, but that the appended claims are meant to cover all the modifications which are within the spirit and scope of this invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. An asymmetrically conductive device comprising an insulating container having metallic covers located over opposite ends thereof, spherical pellets of a semiconductor material, a number of electrodes equal to the number of pellets, said electrodes having a largest outside dimension and said container having a smallest inside dimension which are substantially equal and certain of said electrodes having a substantially flat surface and a conically-shaped surface opposite to said flat surface, said conical surface forming a point contact, each of said pellets being bonded over a relatively large surface area thereof to the flat surface of one of said electrodes, said pellets and said electrodes being alternately arranged along a geometric axis between said covers, and a resilient member located along said axis to provide a force on said pellets and said electrodes to maintain good contact therebetween, each of said point contacts being in engagement with the adjacent pellet.

2. An asymmetrically conductive device comprising a tubular insulating container, a plurality of spherical pellets formed of a semiconductor

4

material, a plurality of metallic electrode means each bonded to a relatively large surface area of one of said pellets to form a plurality of unitary structures, said structures being substantially coaxially disposed in said tubular insulating container with the pellets of certain of said structures each in engagement with the electrode means of an adjacent one of said structures, a pair of metallic cover members forming a closure means for each end of said container, and resilient conducting means disposed within said container for maintaining adjacent ones of said structures in engagement and for completing a circuit between said cover members through said structures.

3. An asymmetrical conductive device comprising a tubular insulating container having conductive covers located over the ends thereof, spherical semiconductor pellets, the diameter of said pellets and the inner diameter of said container being substantially equal, ferromagnetic material forming a substantially hemispheric coating for each of said pellets, said pellets being arranged within said container with the coated and uncoated portions respectively of adjacent pellets in tangential point contact engagement, and resilient means positioned along the longitudinal axis of said container to maintain conduction between said covers through said pellets and said resilient means.

WILLIAM C. DUNLAP, JR.

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