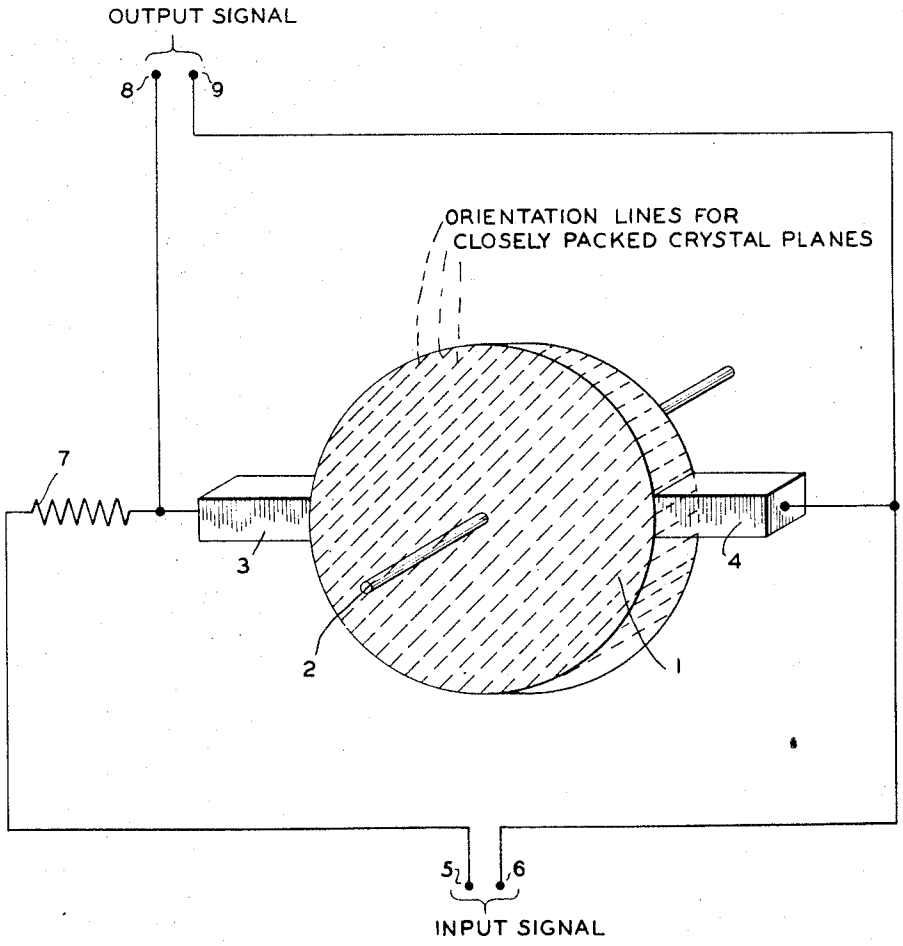
Aug. 5, 1958 J. F. BLACK 2,846,553

VARIABLE RESISTOR

Filed Sept. 28, 1956



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United States Patent Office

2,846,553

Patented Aug. 5, 1958

2,846,553

VARIABLE RESISTOR

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Application September 28, 1956, Serial No. 612,769

3 Claims. (Cl. 201—55)

My invention relates to electrical circuits and more particularly relates to variable resistors for use therein.

In conventional continuously variable resistors, resistance values are changed by varying the spacing between fixed and movable contacts. Stated differently, this operation requires translational motion of the movable contact relative to the fixed contact. In contradistinction I have invented a new type of continuously variable resistor in which a resistor body is rotated between two fixed contacts, the composition of the resistor being such that the resistance represented by the body and the two contacts varies as the body is rotated.

Accordingly it is an object of the present invention to eliminate the necessity of translational contact motion in continuously variable resistors.

Another object is to provide a new and improved continuously variable resistor of the character indicated.

Still another object is to improve continuously variable resistors through the use of electrically anisotropic semiconductor materials.

These and other objects of my invention will either be explained or will become apparent hereinafter.

Certain semiconductor materials as, for example, indium selenide, graphite, and antimony sulfide, are characterized by a crystalline structure of trigonal or rhombic symmetry composed of many well defined, parallel, closely packed planes of cleavage. When an electric current is passed through a body of such material in a direction perpendicular to these planes, the electrical resistivity of the body will be found to be relatively high and will represent a maximum resistivity value for the body. Further, if a current is passed through the body in a direction parallel to these planes, the resistivity of the body will be found to be relatively low and will represent a minimum resistivity value. Moreover, if current is passed through the body at an angle with respect to the crystal planes which is other than 0 or 90°, the resistivity of the body will attain some value intermediate the maximum and minimum values. This variable resistivity property is defined as electrical anisotropy.

I employ a body of electrically anisotropic semiconductor material having first, second, and third mutually perpendicular axes, the first axis being an axis of rotation, the second and third axes defining respectively lines of minimum and maximum electrical resistivity for the body. Hence, any other axis coplanar with the second and third axes defines a line of intermediate resistivity for this body.

First and second contactors are equidistantly spaced circumferentially about the body and are in electrical contact therewith. The contactors are so positioned as to define a line therebetween which intersects the first axis and which is coplanar with the second third axes.

When the body is rotated about its first axis, therefore, the electrical resistivity of the body and the contactors, as measured between the contactors, varies continuously between maximum and minimum values.

Hence, when a voltage is applied between the contactors, and the body is rotated, a variable current will flow between the contactors. This current will have a minimum value when the body is rotated to a position in which the third axis is aligned with the contactors and will have a maximum value when the body is rotated to a position in which the second axis is aligned with the contactors.

An illustrative embodiment of my invention will now be described with reference to the accompanying drawing.

An electrical input signal is applied between input terminals 5 and 6 and is thereafter impressed across a series circuit which comprises in the order named a resistor 7, a first contactor 3, an electrically anisotropic semiconductor body 1, and a second contactor 4. An output signal is developed between the contactors and appears across output terminals 8 and 9.

The body 4 is disc shaped and is rotatable about the axis of a shaft 2 which extends through the center of the body in a direction perpendicular to the surface of the disc. This shaft axis therefore defines a first axis for the body which, of course, is an axis of rotation. The body has a crystalline structure characterized by a plurality of closely packed small planes of cleavage having a direction of orientation as indicated in the drawing. An imaginary line extending through the body in a direction parallel to the crystal planes and perpendicular to the shaft 2 defines a second axis which represents a line of minimum resistivity for the body. Similarly, another imaginary line extending through the body coplanar with the second axis and perpendicular to both the second axis and the shaft 2, defines a third axis which represents a line of maximum resistivity for the body. Further, an infinite number of additional imaginary lines can extend through the body and be coplanar with the second and third axes and perpendicular to the shaft. Each of these additional lines defines another axis which represents a line of intermediate resistivity for the body.

As body 1 is rotated about the axis of the shaft 2, the resistance of the contactors and the body, as measured between the contactors, will vary continuously, the resistance having a minimum value when the second axis is aligned with the contactors and a maximum value when the third axis is aligned with the contactors.

Therefore, the resistance between the contactors and resistor 7 together form a voltage divider network, the contactors and body together acting as a rheostat in the voltage divider network. When the input signal is a fixed voltage, the output signal will be a voltage which varies in accordance with the changes in the resistance of the contactors and body 1.

The ratio between maximum and minimum values is high but of course will vary with the type of semiconductor material used. For example, when this material is indium selenide, the ratio can be on the order of 100.

In addition, a minimum resistance on the order of 10^{-4} ohms or a maximum resistance on the order of 10^{6} ohms can be obtained depending upon the type of material.

While I have shown and pointed out my invention as applied above, it will be apparent to those skilled in the art that many modifications can be made within the scope and sphere of my invention as defined in the claims which follow.

What is claimed is:

1. A variable resistor comprising an electrically anisotropic semiconductor body having first, second and third mutually perpendicular axes, said body being rotatable about said first axis, said second and third axes respectively defining lines of maximum and minimum electrical resistivity for said body; and a pair of contactors equi-

distantly spaced circumferentially about said body and in electrical contact therewith, the positions of said contactors defining a line which intersects said first axis and which is coplanar with said second and third axes, the electrical resistivity of said body and said contactors as measured between said contactors having a maximum value when said line is coincident with said second axis and having a minimum value when said line is coincident with said third axis.

2. A variable resistor comprising an electrically anisotropic semiconductor body having first, second and third mutually perpendicular axes, said body being rotatable about said first axis, said second and third axes respectively defining lines of maximum and minimum electrical resistivity for said body; and a pair of contactors equidistantly spaced circumferentially about said body and in electrical contact therewith, the positions of said contactors defining a line which intersects said first axis and which is coplanar with said second and third axes; and means to rotate said body about said first axis, the electrical resistivity, as measured between said contactors, varying as said body is rotated, said resistivity having a maximum value when said line is coincident with said second axis and having a minimum value when said line is coincident with said third axis.

3. In an electric circuit, a variable resistor compris-

ing an electrically anisotropic semiconductor body having first, second and third mutually perpendicular axes, said body being rotatable about said first axis, said second and third axes respectively defining lines of maximum and minimum electrical resistivity for said body; and a pair of contactors equidistantly spaced circumferentially about said body and in electrical contact therewith; means to apply a voltage between said contactors whereby a current flows through said pieces and said body; said current having a maximum value when said body is rotated to a position in which said third axis is aligned with said contactors and having a minimum value when said body is rotated to a position in which said second axis is aligned with said contactors.

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