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DEVICE FOR VARYING RESISTANCES

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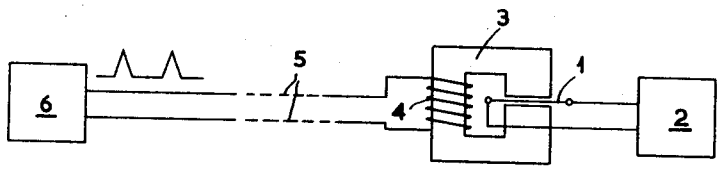

FIG. 1

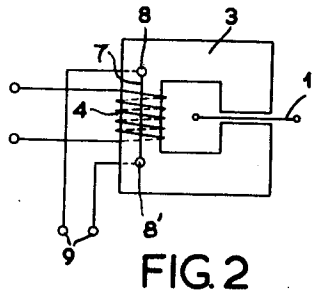

FIG. 2

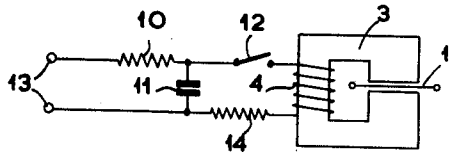

FIG. 3

INVENTOR

ADRIANUS J. W. M. VAN OVERBEEK

BY

Frank R. Trifari

AGENT

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DEVICE FOR VARYING RESISTANCES

Adrianus Johannes Wilhelmus Marie van Overbeek, Eindhoven, Netherlands, assignor to North American Philips Company, Inc., New York, N.Y., a corporation of Delaware

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The invention relates to a device for varying the electrical resistance of a resistive element; the resistive element is made of a substance whose resistivity varies strongly under the action of a magnetic field.

The phenomenon of a strong variation of an electrical resistance under the action of a magnetic field occurs not only with bismuth, but also with certain compounds such as indium antimonide and indium arsenide. This property may be utilized for varying a resistance by arranging a resistance element, preferably in the form of a wire or strip, between the poles of an electro-magnet and by varying the energizing current of the electro-magnet.

The invention has for its object to provide a device for varying such a resistance, in which the adjusted resistance value is maintained, even when the magnet energizing current ceases to flow. This provides the advantage that the resistance value once adjusted does not change with certain changes in the current supply system.

The invention provides that the magnetic field is produced by a permanent magnet with a winding coupled thereto, provision being made of means to supply to the winding a controllable number of pulses, which have, at will, a magnetizing or demagnetizing effect; the amplitude and the duration of each pulse are chosen so that the pulses produce a given, preferably slight, variation in the remanence of the magnet.

After each pulse the resistance value of the element will have changed also to some extent and by the choice of the number of pulses and their strength any desired resistance variation, within certain limits, may be obtained. As a rule the pulse amplitude must be of the order of a few amperes to produce a remanence variation. This value is, of course, dependent upon the size of the magnet and the number of turns of the winding. The duration of a pulse is generally of the order of one microsecond. As a matter of fact, the supply of a sequence of pulses will vary stepwise the resistance as well as the remanence, but by a correct choice of the pulse duration and the pulse height, the value of each step may be reduced at will.

It is, of course, not useful to push the demagnetisation so far as to effect a complete disappearance of the remanence. The device in which the resistor is provided may, if necessary, comprise means to supply a signal which arrests the supply of pulses when the resistance value has dropped below a given limit.

The pulses may be supplied one by one by means of a manually operable switch; in this case, use is preferably made of capacitor discharges. As an alternative, use may be made of a known pulse generator comprising gas-filled discharge valves or vacuum valves or transistors operated manually or automatically. In order to ensure the occurrence of the same pulse duration and pulse amplitude, each pulse is also in this case preferably produced by a capacitor discharge.

The invention will be described more fully hereinafter with reference to the drawing.

Referring to FIG, 1, reference numeral **1** designates a preferably wire-shaped resistance element of crystalline material, which is included in a circuit, designated by reference numeral **2**, for a radio- or television-receiver, for example. The resistance element may be applied in

known manner to an insulating substratum and, in order to obtain a given minimum resistance, it may consist of a plurality of series-connected zigzag parts, located side by side. The resistance element is located in the air-gap of the permanent magnet **3**, which produces a magnetic field substantially at right angles to the direction of the current, the magnetic field changing the value of resistance **1** in accordance with its intensity. On the core **3** is provided a winding **4**, to which pulses from a pulse generator **6** are fed via a long conductor **5**. The winding **4** does not convey current for the major part of the time, so that the field in the air-gap has a constant value and the resistance of the element **1** remains adjusted to a given, desired value. After each pulse the remanence of the core **3** and hence also the resistance of the element **1** vary slightly. The device thus provides the possibility of remote-control of the resistance without the need for mechanical expedients. The device **6** furthermore comprises the required means to stop the pulse supply at any instant and to invert the polarity, in which latter case the direction of the resistance variation changes. To this end use may be made of a second winding, which magnetizes in a sense opposite to the winding **4**.

The resistance increases at an increasing magnetization of the core. It is of no use to continue the pulse supply during a decreasing magnetization until the magnetization of the core changes in polarity.

In order to avoid such a change in polarity, the core **3** may be provided with a second winding **7**, as is shown in FIG. 2, this winding passing through one or more apertures **8**, **8'** and producing a transverse magnetization, which reduces the longitudinal magnetization, when the pulses are fed to this winding **7**.

FIG. 3 shows a circuit by which pulses can be manually supplied. To the terminals **13** is connected a direct-current source, which charges a capacitor **11** via a resistor **10**. The charge is capable of producing, by closing a switch **12**, as a current pulse via the winding **4**, the desired variation in magnetization. If necessary, the discharge circuit may include a resistor **14**.

The device may be used for control-purposes, in which case a pick-up for the magnitude to be controlled is provided, which pick-up controls a pulse generator. The supply of pulses having a magnetizing or demagnetizing effect in accordance with the deviation of the magnitude from the desired value, is continued until the resistance has attained the value at which the deviation is at a minimum. The resistance controls the control-member.

Moreover, counting of pulses is possible, for example, decimal counting by using a plurality of devices of the kind set forth, in which for example after ten pulses a given variation in the resistance occurs in each device, which variation produces, via a suitable apparatus, a flyback and, moreover, a pulse for the next-following device.

What is claimed is:

1. A device for varying the electrical resistance of a resistive element in discrete steps comprising: a permanent magnet having a gap therein, a resistive element located in said gap, said resistive element having a resistivity which varies under the action of a magnetic field, an electrical winding inductively coupled to said permanent magnet, means for supplying electrical pulses to said winding, each pulse acting to change the remanence condition of the magnet, the magnetic field through said gap and the resistivity of said element, the changed resistivity being maintained until a succeeding pulse is applied.

2. A device as claimed in claim 1, said pulses having a polarity which increases the magnetic field through said gap.

3. A device as claimed in claim 1, said pulses having a polarity which decreases the magnetic field through said gap.

4. A device as claimed in claim 1, certain of said pulses having one polarity which increases the magnetic field and others of said pulses having a polarity opposite to said one polarity for decreasing the magnetic field through said gap.

5. A device for varying the electrical resistance of a resistive element in discrete steps comprising: a permanent magnet having a gap therein, a resistive element located in said gap, said resistive element having a resistivity which varies under the action of a magnetic field, a first electrical winding inductively coupled to said permanent magnet, a second electrical winding inductively coupled to said permanent magnet, said first and second windings being located at right angles to each other, means for supplying electrical pulses to said windings, each pulse acting to change the remanence condition of the magnet, the magnetic field through said gap and the resistivity of said element, the changed resistivity being maintained until a succeeding pulse is applied.

6. A device for varying the electrical resistance of a resistance element in discrete steps comprising: a permanent magnet having a plurality of legs and a gap in one of said legs, a resistive element located in said gap, said resistive element having a resistance which varies under the action of a magnetic field, a first electrical winding inductively coupled to said permanent magnet, a second electrical winding inductively coupled to said permanent magnet, said first and second windings being located on one leg of said permanent magnet at right angles to each other, means for supplying electrical pulses to said windings, each pulse acting to change the remanence condition of the magnet, the magnetic field through said gap and the resistance of said element, the changed resistance being maintained after the application of a pulse until a succeeding pulse is applied.

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