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CONSTANT INDUCTANCE, CONTINUOUSLY VARIABLE, RESISTOR

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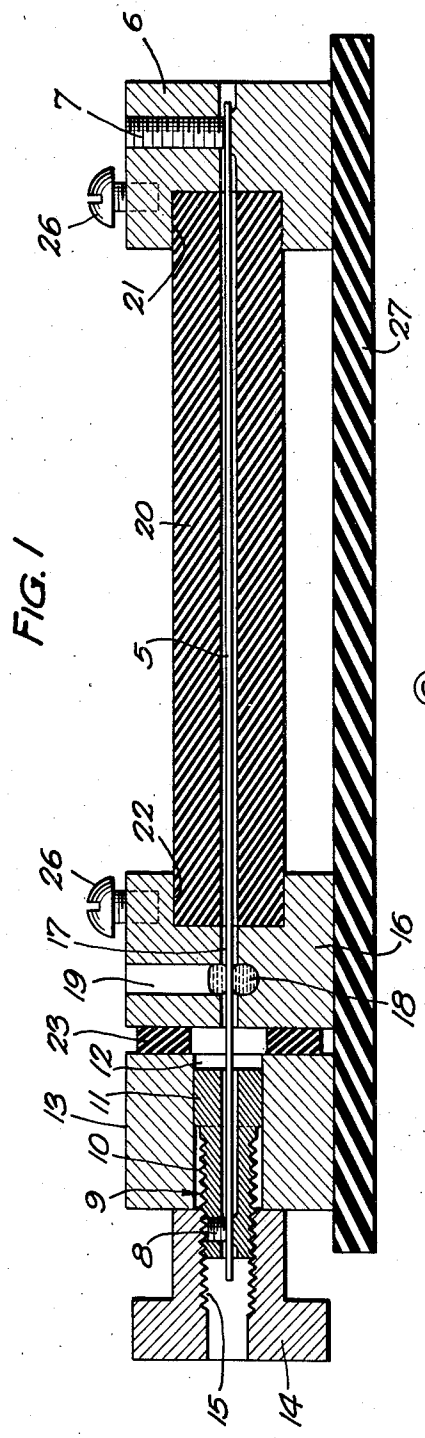


FIG. 1

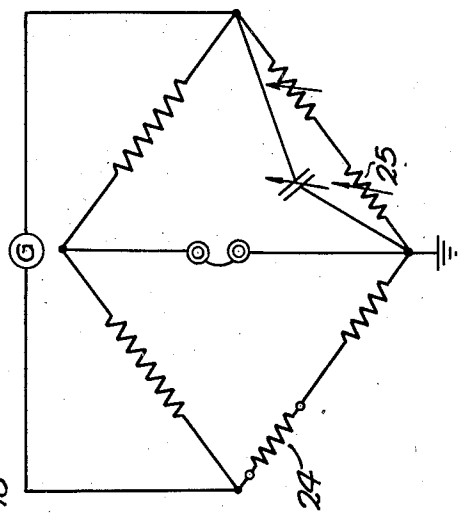


FIG. 2

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CONSTANT INDUCTANCE, CONTINUOUSLY VARIABLE, RESISTOR

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6 Claims. (Cl. 201—63)

This invention relates to electrical apparatus and more particularly to a constant inductance, continuously variable, resistor.

In calibrating highly accurate electrical equipment, it is sometimes desirable to employ a variable resistor in the calibrating circuit to vary the resistor over a relatively small range. For example, in measuring the phase angle in decade resistance boxes such as used in certain types of telephone testing equipment, it is sometimes desirable to employ a constant inductance, continuously variable, resistance having a range of .01 ohm. In order to obtain such a limited range of resistance variation, while maintaining constant inductance in the resistor element, it has been attempted to vary the temperature of the resistor element, to alter the contact pressure, or to employ a resistor wire provided with a sliding contact. However, these and other methods have not been entirely satisfactory in some cases where a high degree of precision is required. Furthermore, the inductance of the resistor using the methods noted of varying the resistance may not be sufficiently constant.

It is an object of the present invention to provide an efficient, effective and highly accurate, constant inductance, continuously variable resistor.

In accordance with one embodiment of this invention, a variable resistor may be provided comprising a resistor wire fixed at one end to a block which also serves as a terminal, and attached at the other end to a threaded sleeve whereby tension may be applied to the wire to vary the resistance. A mercury cup, which serves as a second terminal, is positioned a selected distance from the fixed end of the wire and in contact with the wire.

Other objects and advantages of the present invention will be apparent from the following detailed description taken in conjunction with the following drawing, wherein:

Fig. 1 is a longitudinal sectional view of a resistor constructed in accordance with this invention, and

Fig. 2 shows diagrammatically a circuit with which this resistor may be used.

When a wire is stretched, its resistance may change due to a reduction in the cross section of the wire. However, if a tension is applied to the wire which is not great enough to stretch it enough to deform it permanently, that is, to such an extent that the tension is sufficient only to stretch it within its elastic limits, the change in the cross section of the wire will be relatively slight, whereas the change in the resistance may be relatively great. In fact, this change in resistance may be several times that which would be indicated as due to a change in the cross section of the wire. For example, using a nickel silver spring wire having a diameter of .01" and an active length of 10", it was found that the resistance of the wire without stress was approximately 1.7 ohms. Stretching this wire approximately 1/64 of an inch caused the resistance of the wire to increase by approximately .01 ohm. Stretching a 10" wire 1/64 of an inch amounts to an increase in length of approximately .15%, whereas an increase in resistance of .01 ohm over an original resistance of 1.7 ohms amounts to an increase of .60%. This is, obviously, four times the increase that would be indicated as due to the decrease in the cross section of the wire. It has also been found that if a wire is stretched within its elastic limits, as the tension is reduced, the resistance will decrease at substantially the same rate that it increased as the tension was applied. Thus, it is feasible to calibrate a variable resistor constructed in accordance with this invention.

As may be seen in Fig. 1, this apparatus is essentially a variable resistance device based on the phenomenon that applying a variable tension to a wire 5 changes its resistance. The wire is attached at one end to a block 6, of conducting material, by a set screw 7. The other end of the wire is similarly attached by a set screw 8 to a threaded sleeve 9 which is slidably positioned in an aperture 12 extending through a block 13. The head 11 of the sleeve 9 is squared to prevent the sleeve from rotating while the body 10 of the sleeve is threaded. A control knob 14, having an internally threaded portion 15, is mounted adjacent the block 13 and its threaded portion 15 engages the threaded portion of the sleeve 9 so that the sleeve may be moved into or out of the block 13 by rotating the knob 14.

Electrical contact is made with one end of the wire through the block 6 and set screw 7. In order to maintain a fixed active length and, consequently, a substantially constant inductance in the wire at all times, instead of using the block 13 as the other contact, in which case when tension was applied to the wire and the wire stretched, the inductance would change, a third block 16, of conducting material, is positioned at a point along the wire and serves as a second terminal, the wire extending through an aperture 17 in the block. Contact is made with the wire by a quantity of mercury 18 positioned in

a well 19 formed in the block 16 as shown in Fig. 1. By using a mercury contact, the movement of the wire is in no way impeded while, at the same time, excellent electrical contact is had therewith. Furthermore, since the distance between the point on the wire which contacts the mercury and the point on the wire contacted by the block 6 remains constant regardless of changes in the length of the wire itself, due to increasing or decreasing tension, the inductance of the wire also remains substantially constant.

In order to space and insulate these three blocks from each other, a tube 20 of insulating material having high dimensional stability, such as a phenolic condensation product, is positioned between the blocks 6 and 16, one end of the tube being mounted in a recessed portion 21 of the block 6 and the other end of the tube being mounted in a similarly recessed portion 22 in the block 16, the wire extending through the interior of the tube. The tube, in addition to serving as a spacer element, insulates the enclosed wire against changes in temperature. The block 16 is spaced and insulated from the block 13 to which the threaded knob 12 is attached, by a large washer 23, of an insulating material having high dimensional stability, such as phenol fibre. Thus, when tension is applied to the wire, the spacing of the elements of the apparatus remains substantially constant. The apparatus may be mounted on a supporting block 27 of any suitable insulating material.

In the operation of this apparatus, the circuit or device with which it is desired to use this resistor, may be connected to the resistor through a pair of terminals 26, one of which is mounted on the block 6 and the other of which is mounted on the block 16. A bridge circuit for measuring, in terms of inductance, the phase angle of certain types of resistors is shown diagrammatically in Fig. 2, the variable resistor constructed in accordance with this invention being designated 24, and the resistance to be measured is designated 25. In using this apparatus, the operator rotates the control knob 14 until the tension on the wire is sufficient to produce the desired resistance in the test circuit.

The range of this apparatus may be extended as desired by using a longer wire or by using parallel elements. Also, it has been found that with some alloys used in making spring wire, the elastic limit is such that the resistance of the wire may be increased several times that indicated in the example cited above. Thus, this invention may be made applicable to many uses requiring a variable resistor having a relatively small range while maintaining throughout the resistance variations a constant inductance.

While but one embodiment of this invention has been shown and described, it will be understood that many changes and modifications may be made therein without departing from the spirit or scope of the present invention.

What is claimed is:

1. In a constant inductance, variable resistance, a terminal, a resistance element fixed at one end to said terminal, means for applying stress to said resistance element to vary its resistance, and a quantity of mercury in contact with said resistance element, said mercury serving as a second terminal for said resistance element.

2. In a constant inductance, variable resistance, a pair of terminal blocks, said blocks being spaced by a tube of insulating material, a resistance element extending through said tube and fixed at one end to one of said terminal blocks, a well in the other block having a quantity of mercury therein for contacting said resistance element, and means for applying stress to said resistance elements to vary the resistance thereof.

3. A constant inductance, variable resistance, comprising a resistance element, means for applying a mechanical stress to the resistance element to vary its resistance, and means for contacting a fixed length of said resistance element as the stress is changed.

4. A constant inductance, variable resistance, comprising a resistance element fixed at one end, means for applying a mechanical stress to the resistance element to vary its resistance, and means for contacting a fixed length of said resistance element including a quantity of mercury in contact with said resistance element.

5. In a constant inductance, variable resistance, a pair of spaced terminal blocks, a resistance element fixed at one end to one of said blocks, a longitudinally movable member, means for moving said member longitudinally to apply tension to said resistance element, and means on the other of said blocks for contacting a fixed length of said resistance element.

6. In a constant inductance, variable resistance, a pair of spaced terminal blocks, a resistance element fixed at one end to one of said blocks, a threaded sleeve, means for supporting said sleeve, said sleeve being non-rotatably mounted in said supporting means, the other end of said resistance element being attached to said sleeve, means for engaging said sleeve to move said sleeve longitudinally to apply tension to said resistance element, and means on said second block for contacting said resistance element.

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