Aug. 16, 1966 R. L. DAVIS 3,267,406

NON-INDUCTIVE ELECTRICAL RESISTOR

Filed May 1, 1964

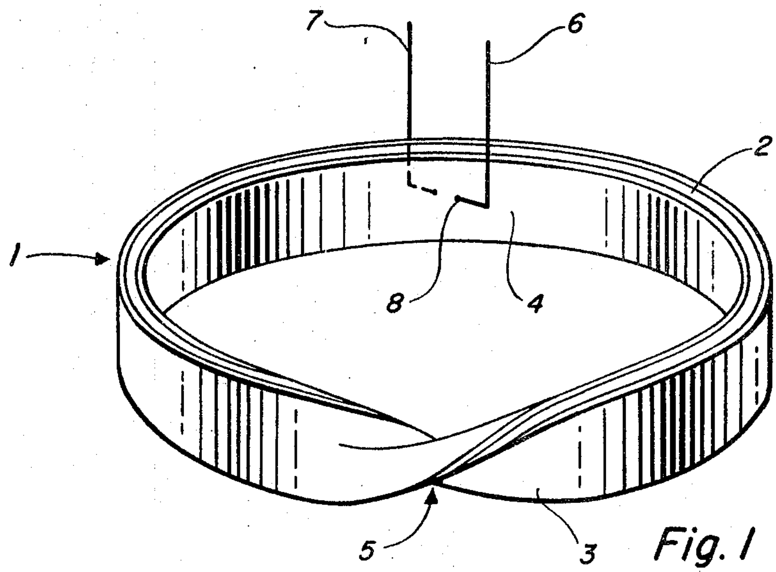

Fig. 1

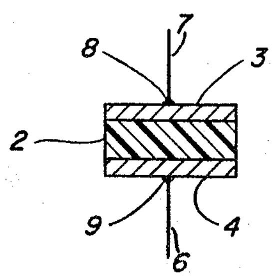

Fig. 2

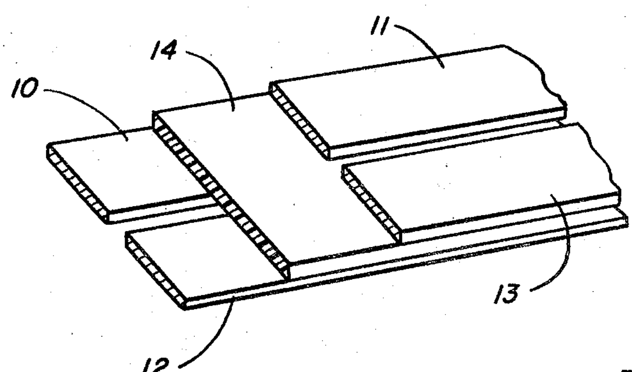

Fig. 3

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United States Patent Office 3,267,406
Patented August 16, 1966

3,267,406
NON-INDUCTIVE ELECTRICAL RESISTOR

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Filed May 1, 1964, Ser. No. 364,341
3 Claims. (Cl. 338—63)

This invention relates to electrical resistors, particularly to non-inductive electrical resistors.

In high voltage, high frequency electronic circuits, especially in pulse applications such as radar, the design and operation of these circuits is greatly affected by unknown reactance in the circuit components themselves or in unwanted coupling between components. A large amount of time and money has been expended to develop components that display in these applications the particular electrical function for which it was designed. Under ideal circumstances, a resistor should essentially provide only resistance to the circuit, a capacitor only capacitance and an inductor only inductance.

This has been a problem in the resistor field and particularly in low resistance resistors. Previously known low resistance resistors have displayed in high frequency and pulse applications some form of deleterious reactance or coupling with other components.

It is therefore an object of this invention to provide a non-inductive resistor which is both simple and inexpensive to produce and flexible in usage.

It is a further object of this invention to provide a resistor which has no residual self inductance or mutual inductance.

It is a further object to provide a resistor which is non-reactive at high frequencies.

Various other objects and advantages will appear from the following description of one embodiment of the invention, and the most novel features will be particularly pointed out hereinafter in connection with the appended claims.

This invention contemplates utilizing insulated resistive material in the form of a mobius surface with electrical leads attached diametrically opposite each other to the resistive material as a non-inductive resistor.

For a better understanding of the invention, reference may be had to the accompanying drawings in which:

FIGURE 1 is a perspective view of one embodiment of this invention,

FIGURE 2 is a cross-sectional view of the mobius strip showing the location of the resistor, insulator and electrical leads and

FIGURE 3 is a cutaway view of a section of a resistor which embodies this invention.

In the embodiment of the invention illustrated in FIG. 1 and FIG. 2, non-inductive resistor 1 comprises non-conductive ribbon 2 of an insulative material such as Mylar (polyethylene terephthalate) on both sides of which resistive ribbons 3 and 4 have been applied. Resistive ribbons 3 and 4 can be made of a resistive material such as Tophet A (80 Ni, 20 Cr) or for very low resistances, aluminum. The combined ribbons, 2, 3 and 4 are then twisted as shown at point 5 and resistive ribbon 3 connected to resistive ribbon 4 such as by soldering so as to form a mobius strip. Resistive ribbons 3 and 4, when connected form a single mobius surface. Electrical leads 6 and 7 are then attached such as by soldering to diametrically opposite points 8 and 9 of resistive ribbons 3 and 4 to complete the resistor.

It is understood that the resistive ribbons 3 and 4 may be replaced by resistive wire such as Manganin (84 Cu, 12 Mn, 4 Ni) bifilar wire wherein the insulation normally provided would replace non-conductive ribbon 2. By bifilar wire, it is meant two parallel strands of wire covered by and separated by the same insulator. The spacing between the wires provided by the insulation should be maintained when the respective wires are connected together to form the mobius strip so as to have minimum reactance in the resistor.

In operation, a high frequency electrical current inserted across electrical leads 6 and 7 will travel in opposite directions between the leads through resistive ribbons 3 and 4. The electromagnetic fields generated by these currents thereby cancel each other resulting in an essentially non-inductive, non-reactive resistor as shown in Table I.

TABLE I

Conductor	Resistance (ohms)	Reactance (200 kc.)	Resistive Material
Ribbon	12.7	0.0305 microhenries	Tophet A.
Do	80	0.1 picofarad	Do.
Wire	50.3	0.090 microhenries	Manganin.
Do	62	0.069 picofarad	Do.

The mobius resistor listed first in Table I was pulsed at 1000 volts and had a measured rise time of 0.1 microsecond.

It was found that the reactance and/or resistance of a resistor embodying this invention was unaffected by handling or changes in form. Once the resistor is connected as described above in a mobius strip, the resistor need not be maintained in any particular form such as that shown in FIG. 1 but can be wound around a cylindrical core or a card or for that matter rolled in a ball providing the resistive ribbons are insulated from each other as is well known in the art. A mobius strip resistor was wound on a cylindrical core without any effect to its operation thereby enabling compact packaging of the resistor.

Further, as shown in FIG. 3, two sets of resistive ribbons 10 and 11 and 12 and 13 respectively were applied side by side on the same non-conductive ribbon 14 with about a 1/16 inch spacing and the combined unit connected as described with respect to FIG. 1 so as to form two mobius strip resistors using ribbons 10 and 11 as one resistor and ribbons 12 and 13 as the other resistor. In this form, it was found that neither resistor in any way affected the operation of the other resistor. These resistors were then connected successively in series and in parallel and measurements made of the resulting resistance and reactance. It was found that the resultant resistance value changed in accordance with the usual series-parallel effect without changing the time constant from that of a single resistor. Thus, a group of mobius strip resistors can be arranged for most any resistance value either by series connection or parallel connection and still maintain the time constant. Since these resistors can be wound around any form and not change the reactance, a group of resistors can be made on the same non-conductive ribbon and the combined resistor wound around a common form with a comparable size to present resistors.

It will be understood that various changes in the details, materials and arrangements of the parts, which have been herein described and illustrated in order to explain the nature of the invention may be made by those skilled in the art within the principles and scope of the invention as expressed in the appended claims.

What is claimed is:

1. A non-inductive electrical resistor comprising in combination, a ribbon of non-conductive material having opposite surfaces defining a continuous uniform surface in the form of a mobius strip, at least a single uniform layer of resistive material disposed in continuous manner

circumferentially throughout and in parallel coextensivity on said opposite surfaces, and a pair of electrical leads connected to the layer of resistive material at points aligned with each other on opposite surfaces of the non-conductive material.

2. The combination of claim **1** in which the resistive material comprises a plurality of resistive layers and each layer is uniformly and continuously disposed throughout and in parallel coextensivity on the said opposite surfaces.

3. The combination of claim **2** in which each resistive layer has a pair of electrical leads connected thereto at points aligned with each other on opposite surfaces of the non-conductive material.

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