

Sept. 18, 1951

A. WIRK

2,568,600

LOW-OHMIC ELECTRICAL RESISTANCE

Filed Aug. 12, 1950

Fig. 1

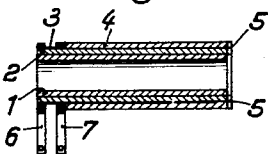


Fig. 2

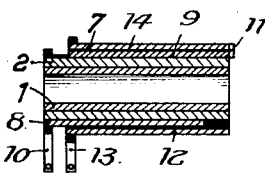
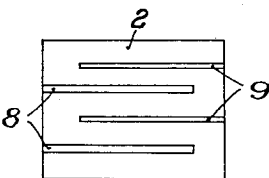


Fig. 3



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UNITED STATES PATENT OFFICE

2,568,600

LOW-OHMIC ELECTRICAL RESISTANCE

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Application August 12, 1950, Serial No. 179,068
In Germany August 19, 1949

9 Claims. (Cl. 201—63)

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This invention is concerned with low-ohmic electrical resistances which have within the range of short waves a substantially constant, substantially phase-free resistance value.

A brief review of the prior art is rendered below in order to support the understanding of the invention.

Laminated resistances are known, comprising a tubular insulating member covered, for example, with a carbon resistance layer. While such resistances are, within a certain range, nearly independent of the frequency, their resistance values are for some purposes too high. Attempts to reduce the resistance value by proper proportioning of the resistance layer failed because it is difficult to produce such carbon resistance layer in durable corresponding thickness. So-called "comb" resistances were therefore made which carry upon the resistance layer metallic strips arranged in the manner of the teeth of a comb. The strips are connected with the lead-in conductors, and the structure therefore forms in this manner a parallel connection of a plurality of laminated resistances of high resistance values resulting in a laminated resistance having the desired low resistance value. So far as the dependency on the frequency is concerned, such resistances operate like the usual laminated resistances; that is, they have the inductance of a straight conductor, which is still too great to furnish a resistance having a substantially phase-free characteristic within the range of short and ultra-short waves.

In order to eliminate this inductance, it was proposed to produce the resistance as a bifilar strip bent upon itself in the manner of a hairpin, the two arms of which were by suitable means spaced from each other by a small gap, for example, by the use of a mica layer. Such a resistance has a small inductance L , due to the small magnetic inner field which is embraced by the two arms and has a great capacitance C due to the large area of the strip and the small gap between the two arms. This condition is desired for the purpose of obtaining for low-ohmic resistances a possibly small time constant T , resulting in the equation

$$T = \frac{L}{R} - R \cdot C$$

with small L and great C , nearly in zero. However, this resistance structure is unsuitable for solving the problem, since the resistance value of the bifilar strip rises at high frequencies, due to the current shifting, to a multiple of its direct

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current value. Small resistance values cannot be obtained in this manner.

It is proposed, in accordance with the invention, to arrange the current path, which extends between the terminals of the resistance, in bifilar concentric manner relative to an intermediate resistance layer which corresponds to the desired resistance value.

The various objects and features of the invention will appear from the detailed description of some embodiments which will presently be rendered with reference to the accompanying drawings. In these drawings,

Fig. 1 shows in diagrammatic sectional view an example of a resistance made in accordance with the invention, the parts including the various layers being indicated on a greatly enlarged scale;

Fig. 2 indicates a modification in similar diagrammatic representation; and

Fig. 3 illustrates a detail of Fig. 2 in developed view.

Like parts are indicated by like reference numerals throughout the drawings. Known details and elements will be referred to only to the extent required for explaining the invention.

The structure shown in Fig. 1 comprises a tubular ceramic member 1 on which is disposed, for example, by spraying, a resistance layer 2. The latter may be a mixture containing silver and carbon black. Upon this resistance layer 2 is disposed a thin lacquer layer 3 of a suitable thickness, the lacquer layer serving as an insulating intermediate layer between the resistance layer 2 and a further resistance layer 4, which is disposed on the lacquer layer 3, e. g., by spraying. The resistance layer 4 is connected with the resistance layer 2 by means of the metallic member 5 disposed at one end of the structure. At the opposite end the resistance layer 2 is conductively connected with a terminal tab 6 and the resistance layer 4 is similarly connected with a terminal tab 7. The spacing between these tabs 6 and 7 is determined by the length of the two resistance layers 2 and 4, i. e., by the resistance value thereof. The tabs are insulated from each other by the lacquer layer 3, the tab 6 forming a terminal for the resistance layer 2 and the tab 7 forming a terminal for the resistance layer 4.

The current path in the above described structure therefore extends concentric and bifilar between the two terminals 6 and 7 over the two serially related resistance layers 2 and 4 which correspond to the desired resistance value.

The inductance may be made very small by

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the use of a very thin lacquer layer 3 resulting in a small inner field, and the capacitance may be made great by suitably choosing the dielectric constant of the lacquer and by suitably dimensioning of the lacquer layer. It is possible in this manner to obtain in low-ohmic resistances frequency independence within the range of short waves, even in cases where the resistance value is smaller than 1 ohm.

Instead of forming both layers 2 and 4 as resistance layers, it is possible to form only one such layer as a resistance layer, employing for the other layer a metallic layer which is a good conductor. For example, if the layer 4 is formed as a resistance layer, the layer 2 may be omitted and a metallic tube, e. g., a brass tube, may be employed as a carrier in place of the ceramic tube 1. The current path will then extend from the terminal 6 over the metallic tube (taking the place of the tube 1 and resistance layer 2), and then over the conductive member 5 and back to the terminal 7 over the resistance layer 4 which is insulated from the metallic tube by a thin lacquer layer 3.

As shown in Fig. 2, the invention may also be applied in connection with the so-called "comb" resistances. The ceramic tube 1 is in this case provided with a resistance layer 2 which may be sprayed thereon. This resistance layer, which appears in Fig. 3 in developed view, carries a plurality of metallic strips 8 and 9 in comblike arrangement, as is also indicated in Fig. 3. Fig. 2 shows two of the strips 8 and 9 in section, the strips 8 being interconnected by means of the terminal tab 10, and the strips 9 being interconnected over the metallic member 11, for example, with a conductive silver layer 12 which is interconnected with the terminal tab 13. The silver layer 12 is sprayed on after placing on the resistance arrangement an insulating lacquer layer 14. The current path extends in this structure from the terminal tab 10 to the individual conductively interconnected metallic strips 8 and from there to the conductively interconnected strips 9 over the intermediate resistance layer 2 and over the metallic member 11 and the silver layer 12 to the terminal tab 13.

It will be seen that the current path between the two terminals extends again concentric and bifilar through the interconnection of the resistance layer 2 which corresponds to a desired resistance value. The inductance is small and the capacitance is great, making the structure, in the presence of a small resistance value, independent of the frequency within the range of short waves.

It may be mentioned, in conclusion, that a protective layer of electrically oxidized aluminum may be used in place of the insulating lacquer layer such as the layer 3 in Fig. 1 or 14 in Fig. 2, and that suitable insulating means may be employed which have a suitable and favorable dielectric constant and which can be applied in very thin layers:

I claim:

1. A low-ohmic resistance which has in the range of short waves a substantially constant, substantially phase-free resistance value comprising means forming a current path which extends concentric and bifilar over a resistance layer having a predetermined resistance value.

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2. The structure defined in claim 1, wherein said current path is formed by means comprising a tubular insulating carrier member, a resistance layer on said insulating member, conductive strips arranged on said insulating layer in the manner of the teeth of a comb, first terminal means conductively connected with one series of said strips, a conductive layer disposed concentrically with said resistance layer, second terminal means connected with said conductive layer, and an insulating intermediate layer disposed between said conductive layer and said resistance layer.

3. A low-ohmic resistance which has in the range of short waves a substantially constant, substantially phase-free resistance value comprising concentrically disposed current-conducting layers, an intermediate insulating layer between said conducting layers, means for conductively interconnecting said conducting layers at one end thereof, and terminal means for each of said conducting layers disposed at the other end thereof, said terminal means being insulated from each other and spaced from each other by a predetermined gap.

4. The structure defined in claim 3, together with a tubular insulating carrier member for said current-conducting layers.

5. The structure defined in claim 3, wherein a resistance layer constitutes one of said current-conducting layers.

6. The structure defined in claim 3, wherein a resistance layer constitutes the outer one of said current-conducting layers while a conductive metallic layer constitutes the inner layer.

7. The structure defined in claim 3, wherein a resistance layer constitutes the outer one of said current-conducting layers while the inner layer is formed by a metallic tubular carrier member.

8. A low-ohmic resistance which has in the range of short waves a substantially constant, substantially phase-free resistance value comprising a tubular insulating carrier member, a resistance layer on said carrier member, two sets of respectively conductively interconnected longitudinally extending metallic strips disposed on said resistance layer, an insulating layer on said metallic strips, and a conductive layer on said insulating layer.

9. An electrical resistance of the class described comprising means forming an insulating carrier member, a plurality of conductive layers disposed on said carrier member, a protective layer of electrically oxidized aluminum disposed between adjacent conductive layers, means for interconnecting said conductive layers at one end thereof, and terminal means for said conductive layers at the other end thereof.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,111,710	Van Loon	Mar. 22, 1938
2,498,755	Fulmer et al.	Feb. 28, 1950
2,518,225	Dorst	Aug. 8, 1950