March 27, 1928. 1,664,044

M. OSNOS ET AL

CONDUCTOR FOR HIGH FREQUENCY WORK

Filed Oct. 20. 1925

Fig. 1

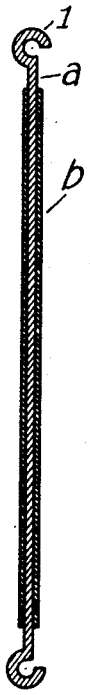


Fig. 2

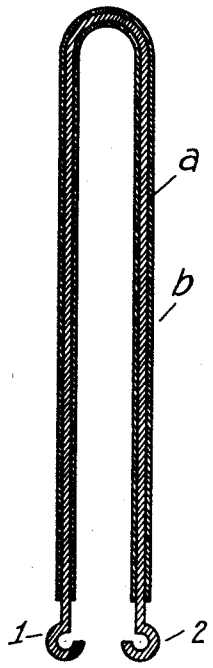


Fig. 3

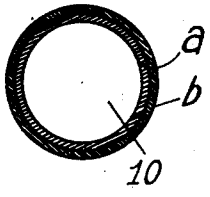
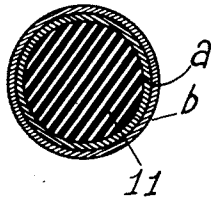


Fig. 4



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Patented Mar. 27, 1928. 1,664,044

UNITED STATES PATENT OFFICE.

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CONDUCTOR FOR HIGH-FREQUENCY WORK.

Application filed October 20, 1925, Serial No. 63,617, and in Germany September 5, 1924.

Our invention relates to inductance devices using a magnetic material and, more particularly, to a novel form of conductor, especially adapted for high frequency work where large amounts of heat must be dissipated.

An object of the invention is to provide a conductor of the above kind which will be cheap to make and efficient in use.

Other objects will be apparent from the following description and appended claims when considered with the accompanying drawing in which,

Fig. 1 illustrates a conductor made according to the invention.

Fig. 2 is a modification, showing the conductor bent upon itself, and

Figs. 3 and 4 represent further modifications in cross-section.

The subject matter of the invention is a current conductor for high frequency purposes, which may act, for instance, as a choke coil, transformer, frequency changer, coupling means, and the like. In short, it may be used for all such services for which heretofore the usual transformers or choke coils have been employed such as, for instance, for key work and telephony.

In the attempt to utilize iron and other magnetic materials for these purposes, one meets this difficulty that the energy losses become very great for the reason that for a small volume of iron, a high number of ampere turns per centimeter are necessary. This holds true particularly for very high frequencies. Incidentally there occurs pronounced heating of the arrangement, while, on the other hand, it has heretofore not been possible to provide adequate cooling, on the ground that the known coil arrangements constitute concentrated heating centers presenting comparatively small cooling surfaces.

In accordance with the present invention, the said disadvantage is obviated because the iron constitutes the surface of the conductor or the iron covers the latter, and further, the conductor is elongated in shape and arrangement. This advantage is thereby obtained, viz that in virtue of the high overload capacity of the current conductor, a high number of ampere-turns per cubic centimeter may be used, while at the same time, on account of the arrangement chosen, the length of the magnetic flux path remains within low limits.

The iron or other suitable magnetic material can be placed upon the surface of the linear conductor by various processes. For instance, it may be deposited by galvanic precipitation or deposition, by the so-called bimetal drawing method, by spraying, etc. However, it is of considerably greater advantage to continuously wrap around the surface of the conductor a very fine, most suitably insulated capillary wire, as this means an extensive subdivision of the eddy-current paths and consequently a considerable diminution of the losses.

The thickness of the iron wire used, and the number of the layers of iron-wire turns (provided a plurality of layers is needed), depend entirely upon the frequency employed. In order to safeguard the surface from oxidation, it is a recommendable plan to coat the surface with chromium, an amalgam, or some similar means.

Instead of using a massive or solid conductor in the manner as hereinbefore described which is externally surrounded in the usual manner by air or another cooling medium, the said conductor could be given the shape of a hollow body through the interior of which there is passed a convenient cooling agent. The massive conductor could also be replaced by this sort of arrangement, upon a massive or a cylindrical insulating body, there is first brought a layer or stratum of the current-conducting material to be used, whereupon the iron wrapper, winding, or envelope is placed upon said layer.

Referring to the drawing, in Figs. 1 and 2, *a* represents the conductor which may be copper, provided at its ends with eyes 1 and 2 for securing necessary connecting wires. A coating or covering *b* of magnetic material is shown upon the conductor *a*. This coating is quite thin and for purposes of illustration is one-tenth of one millimeter in thickness.

In Fig. 2 the conductor is bifilar, that is, it is bent back on itself to save space.

In Fig. 3, the conductor *a* is shown hollow, the hollow space being denoted by 10.

As explained above, a cooling fluid may be passed thru the hollow space 10. The conductor *a* has the magnetic coating *b*.

In Fig. 4, the conductor *a* is shown as applied to a core 11 of insulating material, the conductor *a* being covered by magnetic material *b* as in the other cases.

The use of a linearly stretched conductor is practically limited by the amount of energy to be dissipated. Under certain circumstances, it may be suitable to wind the stretched wire in some constructionally appropriate form so that it occupies less space. But in this regard, attention must be paid that by such wrapping or winding—as is true of a simple coil—no increase in self-inductance will be produced in the internal conductor. On the contrary, it is necessary to always provide bifilar winding or wrapping. More suitable than the simple stretched length or piece of conductor with lead-in at one end and lead-off at the opposite end is the bifilar arrangement. In other words, there should be at least one to-and-fro arrangement so that no loop field can be set up for the conductor.

As a stretched conductor in the foregoing sense, if the frequencies are sufficiently high, there can be used also an iron wire without special wrapper, in view of the fact that the physical effect in such an arrangement is approximately the same as before described for a current conductor made of non-magnetic material.

Having described our invention, we are entitled to all modifications thereof that fall fairly within the spirit and scope of the following claims:

1. A high frequency conductor comprising an inner nonmagnetic conducting member, a thin magnetic layer surrounding said conducting member and in direct contact therewith, said layer being designed to provide maximum magnetic permeability irrespective of tensile strength and means for neutralizing the leakage flux which passes through said outer magnetic layer, said neutralizing means being provided in winding said conductor bifilar fashion.

2. A high frequency conductor comprising an inner nonmagnetic hollow cylindrical conducting member, a thin magnetic layer surrounding said conducting member and in direct contact therewith, said layer being adapted to provide maximum magnetic permeability irrespective of tensile strength, insulating material of fluid form adapted to cool said conductor contained within said hollow cylindrical conducting member, and means for neutralizing the leakage flux which passes through said outer magnetic layer, said neutralizing means being provided in winding said conductor bifilar fashion.

3. A high frequency conductor comprising, an inner nonmagnetic hollow cylindrical conducting member, a thin magnetic layer surrounding said conductor and in direct contact therewith, said layer being designed to provide maximum magnetic permeability irrespective of tensile strength, and means for neutralizing the leakage flux which passes through said outer layer, said neutralizing means being provided in winding the conductor bifilar fashion.

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