L. ESPENSCHIED.
CORE FOR MAGNETIC COILS.
APPLICATION FILED SEPT. 17, 1917.

1,251,651.

Patented Jan. 1, 1918.

Fig. 1

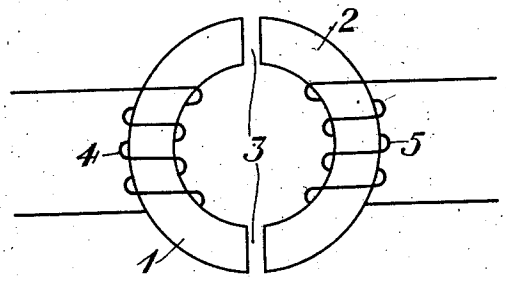


Fig. 2

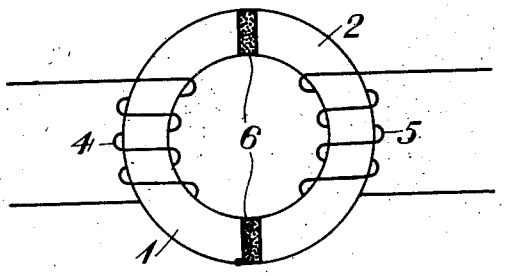
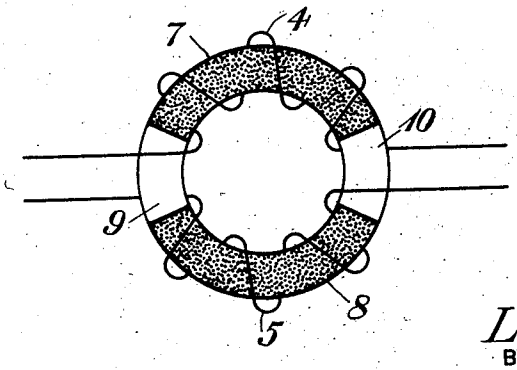


Fig. 3



INVENTOR
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BY
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UNITED STATES PATENT OFFICE.

LLOYD ESPENSCHIED, OF HOLLIS, NEW YORK, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

CORE FOR MAGNETIC COILS.

1,251,651. Specification of Letters Patent. Patented Jan. 1, 1918.

Application filed September 17, 1917. Serial No. 191,775.

To all whom it may concern:

Be it known that I, LLOYD ESPENSCHIED, residing at Hollis, in the county of Queens and State of New York, have invented certain Improvements in Cores for Magnetic Coils, of which the following is a specification.

My invention relates to improvements in the construction of magnetic coils, more particularly coils of the ring type used in telephone work as loading coils and the like. Such coils are usually constructed with a core in the form of a magnetic ring made up of a bundle of wires or laminations upon which the coil is wound. In order that the coil shall be self restoring with respect to its impedance constants after being subjected to the effect of magnetizing currents, the core is made discontinuous by the provision of an air gap, whereby a demagnetizing action occurs at the core pole faces of the air gap, tending to restore the core to normal conditions.

The provision of an air gap in the core results, however, in a decrease of the permeability of the core as a whole, as well as an energy loss due to stray magnetic fields at the air gap itself. It is the purpose of the present invention to overcome these defects, by increasing the effective permeability of the air gap, without materially sacrificing the beneficial stabilizing "end" effects, (*i. e.* self demagnetization) of the discontinuous core, at the same time decreasing the reluctance of the magnetic circuit as a whole. These and other objects of the invention may be attained by inserting in the air gap of a ring core a disk of compressed iron dust, thus converting the air gap from a single air gap to a series of very minute and intermixed gaps. The core would be then physically constituted of core sections composed of continuous iron interposed with short core sections composed of a composit material which is non-continuous magnetically.

The invention may be more fully understood by reference to the accompanying drawing, Figure 1 of which illustrates diagrammatically the air gap core as usually constructed, Fig. 2 illustrating the same as modified in accordance with the present invention, and Fig. 3 representing a modification of the structure of Fig. 2.

Referring to Fig. 1, the core is constructed in the form of two magnetic segments 1 and 2 of a ring, the segments being separated by non-magnetic spaces 3 forming the so-called air gaps. Upon the segments 1 and 2 coils 4 and 5 are wound, as shown, the two windings being thus inductively related. The segments may, if desired, be constructed of parallel wires or laminations running circumferentially of the ring.

In accordance with this invention it is proposed to increase the permeability of the air gap, and thereby decrease the reluctance of the core as a whole, by inserting in the air gaps, disks 6 of compressed iron dust, consisting of iron ground into very fine particles, specially treated and insulated, and then molded into shape under very high pressure. The air gap is thus converted from a single air gap to a plurality of very minute gaps separated by intermixed magnetic material.

The same results may be attained by the modified construction shown in Fig. 3, in which the core gaps are located within the coil windings, instead of between the windings as in Fig. 2. In this form the core is constructed of segments 7 and 8 of compressed iron dust, the segments being separated by spacers 9 and 10 of magnetic material, and the coils 4 and 5 being wound about the segments 7 and 8.

The introduction of the air gaps 3 into the iron magnetic circuit of Fig. 1 increases the reluctance of the magnetic circuit. As a result, the inductance of the coil winding, for a given number of turns, is reduced below the value which would exist in the absence of the air gap. In the case of certain types of coils used in telephone circuits, it is desirable that the coil should be so designed that its impedance constants will return closely to the original values after saturation by service currents so that no superposed magnetism will be retained. In other words the coils should be so designed as to have high grade residual stability.

The required degree of impedance stability can be most economically obtained by the use of discontinuous iron core circuits, the residual stability being obtained by the demagnetizing action of the core pole faces at the air gaps. By using compressed iron dust or other finely divided iron to bridge the air gaps as in Figs. 2 and 3, the reluc-

tance can be decreased and at the same time the demagnetizing action of the air gap can be retained, in a very large measure, because of the fact that the iron dust core material presents a structure in which the iron and air are series components of the magnetic circuit, and each of the very large number of minute air gaps in the material has a self-demagnetizing action associated with it. With reference to the terms "air" and "air gaps" as hereinbefore just used, it should be noted that the discontinuities in the iron circuit are closed through insulating material, which, however, is non-magnetic and has a permeability approximately the same as air. The iron component of the gap spacer on the other hand, has a very much higher permeability than air, as a result of which the reluctance of the magnetic circuit as a whole is reduced and a greater flux follows from a given excitation. Thus the mutual impedance between the windings of a coil having the improved core structure can be maintained at a higher value during the flow of service currents, than if, as in the ordinary construction of air gap coils, a material having a permeability of unity should be used as a gap spacer.

While the invention has been illustrated and described as embodied in certain specific forms, it is apparent that many and widely diversified structures may be used for attaining the desired ends without departing from the spirit of the invention, and it will therefore be understood that all such structures as fall within the scope of the appended claims are to be considered as within the purview of the invention.

What is claimed is:

1. A magnetic coil having a core the magnetic circuit of which is discontinuous, and means for bridging the discontinuities of said circuit consisting of particles of magnetic material separated by non-magnetic spaces.

2. A magnetic coil having a core the magnetic circuit of which is discontinuous, and means for bridging the discontinuities of said circuit consisting of magnetic elements separated by non-magnetic spaces.

3. A magnetic coil comprising a core provided with a gap, and means for bridging said gap consisting of magnetic particles separated by non-magnetic spaces.

4. A magnetic coil comprising a core provided with a gap, and a filler for the gap, said filler consisting of finely divided iron, insulated, and compacted under very high pressure.

5. A magnetic coil having a core of magnetic material, a gap in said core to render said core self demagnetizing so that the impedance constants of the coil will readily return to their normal value after the coil has been subjected to the effect of magnetizing current, and means to reduce the reluctance of the air gap without materially reducing the self-demagnetizing effect of the core, comprising particles of magnetic material arranged in said gap, said particles being separated by non-magnetic spaces.

6. A magnetic coil having a ring core, said core being formed of sections, certain of said sections being of magnetic material, and other of said sections being composed of magnetic particles separated by non-magnetic spaces.

7. A magnetic coil having a ring core, said core being formed of segments of magnetic material, the ends of the segments being separated by gaps, and filler members for said gaps consisting of particles of magnetic material separated by non-magnetic spaces.

8. A magnetic coil having a core of magnetic material, an air gap in said core to render said core self demagnetizing so that the impedance constants of the coil will readily return to their normal value after the coil has been subjected to the effect of magnetizing current, and means to reduce the reluctance of the gap without materially reducing the self-demagnetizing effect of the core.

9. A magnetic coil having a core, said core consisting in part of continuous magnetic material, and in part of discontinuous magnetic material comprising magnetic elements separated by non-magnetic spaces.

10. A loading coil having a core provided with a gap, and means to fill the gap comprising minute particles of magnetic material separated by non-magnetic spaces.

11. A loading coil having a core of magnetic material, a gap in said core to render said core self demagnetizing so that the impedance constants of the coil will readily return to their normal value after the coil has been subjected to the effect of magnetizing current, and means comprising finely divided magnetic material separated by non-magnetic spaces to reduce the reluctance of the gap without materially reducing the self demagnetizing effect of the core.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses, this tenth day of September, 1917.

LLOYD ESPENSCHIED.

Witnesses:
R. S. SURLIFFE,
ALFRED KAUFMANN.