J. B. SPEED.

PHANTOM CIRCUIT LOADING.

APPLICATION FILED MAR. 31, 1916.

1,221,238.

Patented Apr. 3, 1917.

Fig. 2.

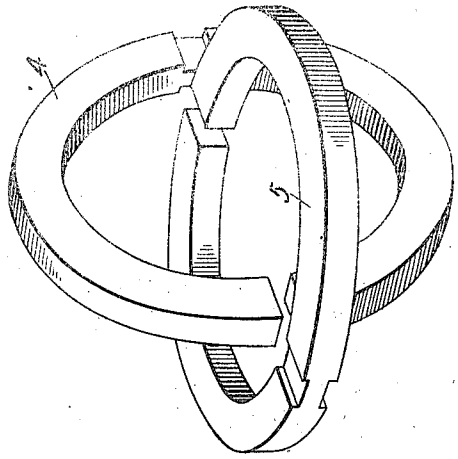


Fig. 1.

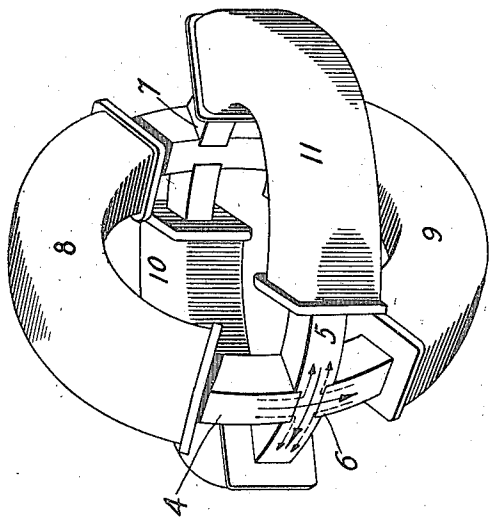
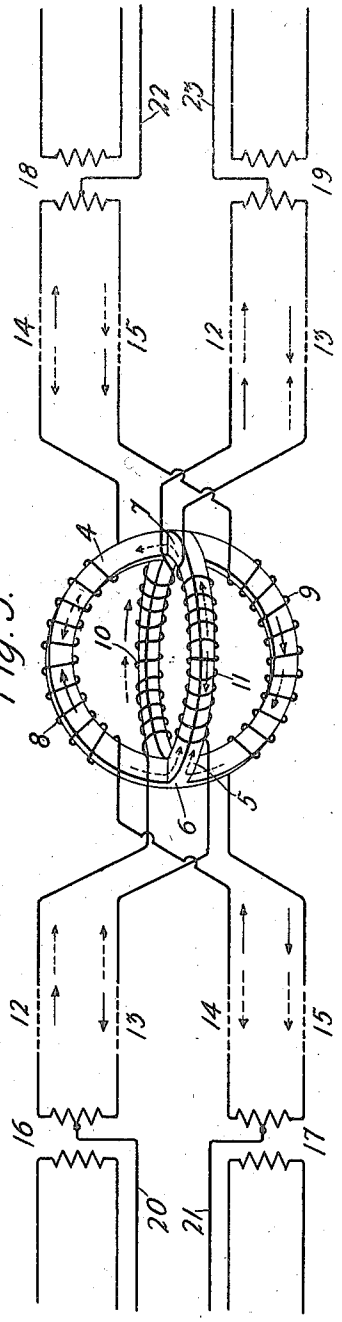


Fig. 3.



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UNITED STATES PATENT OFFICE.

JAMES BUCKNER SPEED, OF NEW YORK, N. Y., ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

PHANTOM-CIRCUIT LOADING.

1,221,238. Specification of Letters Patent. Patented Apr. 3, 1917.

Application filed March 31, 1916. Serial No. 88,072.

To all whom it may concern:

Be it known that I, JAMES BUCKNER SPEED, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Phantom-Circuit Loading, of which the following is a full, clear, concise, and exact description.

This invention relates to the loading of phantom circuits in telephony and more particularly to a magnetic structure by the use of which both the physical or side circuits, and the phantom or derived circuit, may be loaded without causing mutual interference.

Its object is to provide a structure which permits of such loading, provides for sufficient added inductance in the phantom circuit, and allows independent operation of the circuits.

This invention provides a magnetic structure having four core-sections symmetrically arranged around a common axis. These core sections are conveniently and preferably in the form of semi-toroids meeting at their diametrical extremities in a resulting structure which in effect comprises two toroidal cores intersecting at right angles on a common diameter. Windings are placed on each semi-toroid, the windings on opposite halves of one toroid being connected respectively in the two line conductors of one physical circuit, while the windings on the opposite halves of the other toroid are connected in circuit with the two line conductors of the other physical circuit.

Each physical circuit is thus loaded by the equivalent of a toroidal coil of the customary type. Furthermore, the windings of one physical circuit are so connected with respect to the windings of the other physical circuit that when currents of the phantom circuit flow through them, the resulting diametrically opposed magnetic poles of one toroid will coincide with magnetic poles of opposite polarities in the other toroid. The phantom flux in each toroid thus finds a return path through the other toroid, and a convenient means is provided for simultaneously loading the two physical circuits and the phantom circuit by a single unit without the production of a leakage field.

The arrangement is of particular advantage in providing that the winding in each line conductor of one physical circuit is symmetrically placed with respect to the two windings of the other physical circuit, so that danger of electrostatic and electromagnetic crosstalk between the two physical circuits and between the physical and phantom circuits is eliminated.

The invention will be more clearly understood by reference to the accompanying drawings, in which Figure 1 is a perspective view of the loading unit of this invention; Fig. 2 illustrates a convenient method of constructing the core; and Fig. 3 illustrates how the loading unit may be employed to load two physical circuits and their derived phantom circuit simultaneously.

Referring to Fig. 1, two toroidal core members 4 and 5 are shown intersecting along a common diameter at the points 6 and 7. Coil windings 8 and 9 are located on opposite halves of the toroid 4 respectively, and in a similar manner coil windings 10 and 11 are located on opposite halves of the toroid 5. The two toroids 4 and 5 may be of any suitable magnetic material. For example, they may conveniently be formed of finely divided iron, the individual particles of which are coated with a thin insulating film, the core structure being molded by high pressure, in the manner described and claimed in the present applicant's copending application, Serial No. 89,409, filed April 6, 1916, and assigned to the same assignee as the present application. A convenient mode of interlocking the two toroids is illustrated in Fig. 2 which is self-explanatory.

The manner of utilizing this invention for the loading of two physical circuits and their derived or phantom circuit is illustrated in Fig. 3. The conductors 12 and 13 form one physical circuit and conductors 14 and 15 form another physical circuit, the two physical circuits combining, through the agency of the customary phantom repeating coils, 16, 17, 18 and 19 to form a phantom or derived circuit terminating in conductors 20 and 21 at one end, and 22 and 23 at the other end. As shown in the drawing, windings 8, 9, 10 and 11 of the loading unit are connected in series with the line conductors 14, 15, 12 and 13 respectively.

With this arrangement, physical circuit currents in the conductors 12 and 13 momentarily flowing in the direction indicated

by the solid arrows, set up a flux in the toroid 5 in the direction of the solid arrows, and will have no tendency to set up a flux in toroid 4. Phantom circuit currents, however, flowing in the direction of the dotted arrows in conductors 12 and 13, will set up a flux in toroid 5 in the direction of the dotted arrows, thus resulting in the production of two north poles at the point 7 and two south poles at the point 6, which in the absence of toroid 4 would produce a stray field. Toroid 4, however, provides a return path for this field. Furthermore, the return of the phantom circuit current over conductors 14 and 15 in parallel, as indicated by the dotted arrows, sets up a flux in toroid 4, such as to produce two north poles at 6 and two south poles at 7. Thus, the effect of the phantom fluxes in the two toroids is additive, and the inductive effect thereby obtained is sufficient to load the phantom circuit.

It will at once be apparent that the arrangement herein shown and described is absolutely symmetrical throughout, and one which is capable of loading both the physical circuits and the phantom circuit without the production of stray fields and without danger of the electrostatic or electromagnetic unbalances which are inherent in unitary structures hitherto proposed for similar uses. It will be understood that, while in the drawing a core structure is shown in which the core members are square in cross section, they may, if desired, have other cross sectional forms. The term "toroid", as used herein, is intended to refer to a ring of any desired cross section. It will also be understood that instead of rings, rectangular or other forms of frames might be employed, and that, for want of some broader expression, the term "toroid" is used to denote all such structures.

What is claimed is:

1. A core for inductance coils comprising two toroidal members intersecting on a common diameter.

2. A magnetic core for inductance coils comprising two toroidal members intersecting at right angles on a common diameter.

3. A magnetic core for inductance coils comprising four semi-toroidal sections meeting at their diametrically opposed extremities and spaced ninety degrees apart.

4. A loading unit adapted for use with two physical circuits and a derived phantom circuit comprising four semi-torodial core sections meeting on a common diameter, and a winding on each of said sections, said windings being respectively adapted for inclusion in each of the conductors of said physical circuits.

5. A loading unit adapted for use with two physical circuits and a derived phantom circuit comprising two toroidal core members intersecting at right angles on a common diameter and forming four semi-toroidal core sections, a winding on each of said sections, the windings of two opposite core sections being respectively adapted for inclusion in the line conductors of one of said physical circuits, and the windings on the other two opposite core sections being respectively adapted for inclusion in the two line conductors of the other physical circuit, said windings being so disposed that when phantom circuit currents flow therein, the polarities developed in one toroid at the intersection of the two toroids are opposed to the polarities developd in the other toroid at said points of intersection.

In witness whereof, I hereunto subscribe my name this 30th day of March A. D., 1916.

JAMES BUCKNER SPEED.