J. F. BALDWIN, JR.
PHANTOM CIRCUIT LOADING.
APPLICATION FILED JUNE 27, 1916.

1,210,884.

Patented Jan. 2, 1917.

Fig. 1.

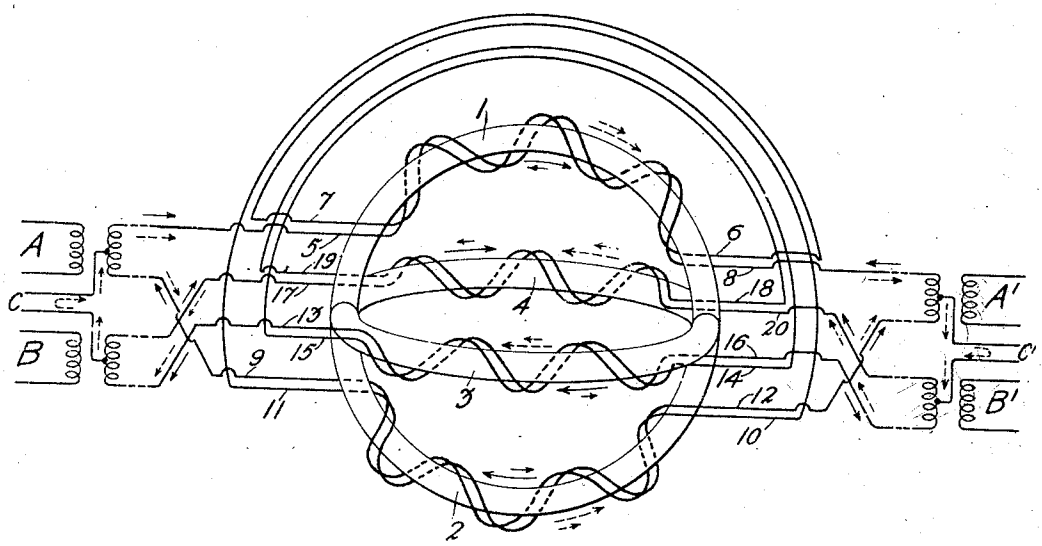
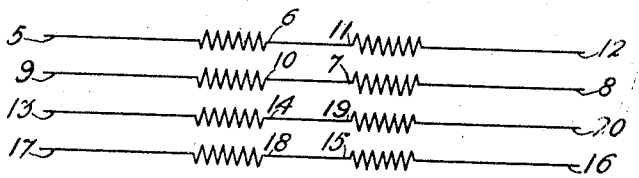


Fig. 2.



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UNITED STATES PATENT OFFICE.

JOHN FRANKLIN BALDWIN, JR., OF EAST ORANGE, NEW JERSEY, ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

PHANTOM-CIRCUIT LOADING.

1,210,884. Specification of Letters Patent. Patented Jan. 2, 1917.

Application filed June 27, 1916. Serial No. 106,119.

To all whom it may concern:

Be it known that I, JOHN FRANKLIN BALDWIN, JR., a citizen of the United States, residing at East Orange, in the county of Essex and State of New Jersey, 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 telephone loading systems, and more particularly to a means for simultaneously loading two physical circuits and their derived or phantom circuit.

In an arrangement described and claimed in an application filed in the name of J. B. Speed, Serial No. 88,072, filed March 31, 1916, and assigned to the same assignee as the present application, the simultaneous loading of two physical circuits and their derived phantom circuit is provided for by means of a unitary structure comprising two toroidal core members intersecting at right angles on a common diameter. In this structure the two line windings individual to one of the physical circuits are located on opposite halves of one toroid, while the line windings individual to the other physical circuit are located on opposite halves of the other toroid. Each physical circuit is thus loaded independently of, and without interference with, the other physical circuit. Furthermore, when phantom circuit currents flow through the windings, the distribution of flux is such as to load the phantom circuit as well.

It is an inherent characteristic of a loading coil of the kind just described that the phantom circuit inductance is only 50% of the physical circuit inductance. This is due to the fact that in phantom circuit operation the windings of each pair are connected in parallel in the circuit, whereas in physical circuit operation the windings of each pair are connected in series in each physical circuit. It has been found in practice, however, taking into consideration the mutual capacity of the phantom circuit as compared with the mutual capacity of the physical circuit, that in order to load a phantom circuit to the best advantage, its inductance should be approximately 60% of the physical circuit inductance.

The present invention may be considered an improvement upon the invention covered by the application hereinbefore mentioned, in that it provides a winding arrangement particularly applicable to the magnetic structure described in the said application, whereby the phantom circuit inductance may be raised to 60% of the physical circuit inductance or any other ratio between phantom circuit inductance and physical circuit inductance may be obtained. To this end this invention provides additional windings which are distributed over the branches of the magnetic core. These windings are connected, for example, so as partially to neutralize the inductive effect of the main windings when physical circuit currents flow therein, while adding to the inductive effect of the main windings when phantom circuit currents flow therein. A specific manner in which this may be accomplished is illustrated in the accompanying drawings, in which—

Figure 1 represents a loading unit, having the winding arrangement of this invention, arranged for simultaneously loading two physical circuits and their derived phantom circuit; and Fig. 2 illustrates diagrammatically the connection of windings employed.

Referring to Fig. 1, AA′ represents one physical circuit, BB′ represents another physical circuit and CC′ represents a phantom circuit derived from said physical circuits in the well-known manner. As herein illustrated, the loading unit has four semi-toroidal magnetic core sections, 1, 2, 3 and 4, joined together in such a manner as to form in effect two complete toroids intersecting at right angles on a common diameter. The two toroids may be of any suitable magnetic material. For example, they may conveniently be formed of finely divided iron, the individual particles of which are insulated from one another, the core structure being molded by high pressure into the required form, in the manner described and claimed in an application for patent in the name of J. B. Speed, Serial No. 89,409, filed April 6, 1916, assigned to the same assignee as the present application.

Core section 1 has located upon it a main winding 5—6 and an auxiliary or supplementary winding 7—8. Similarly there is located on core section 2 a main winding 9—10, and an auxiliary winding 11—12; core section 3 has located upon it a main winding 13—14, and an auxiliary winding

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15—16, and core section 4 has located on it a main winding 17—18 and an auxiliary winding 19—20.

As will be seen from an inspection of the drawing, the auxiliary winding of each core section is connected in series with the main winding of the opposite core section; furthermore, it will be seen that when physical circuit currents are flowing, for example in circuit A, in the direction indicated by the solid arrows, the effects of the main winding 5—6 on core section 1 and of the main winding 9—10 on core section 2 are additive to produce a flux in the toroid 1—2 in a clockwise direction, as indicated by the large solid arrows. The effects of auxiliary windings 7—8 of core section 1 and auxiliary windings 11—12 of core section 2, are also additive but tend to produce a flux in the toroid 1—2 in a counter-clockwise direction as indicated by the small solid arrows, thus to a predetermined extent opposing the action of the main windings and counteracting, to the desired extent, their inductive effect. A similar effect will be produced by the main and auxiliary windings of core sections 3 and 4 by physical circuit currents flowing in the circuit BB'. When, however, phantom circuit currents flow through the four main windings and four auxiliary windings of the loading unit in the direction indicated by the dotted arrows, it will be seen that in each branch of the magnetic circuit the auxiliary winding acts to produce a flux in the same direction as that produced by the main winding on that section, as indicated by the small and large dotted arrows respectively. It will at once be apparent that the employment of auxiliary windings as herein shown provides a means of controlling the ration of phantom circuit inductance to physical circuit inductance, and that by a proper selection of the number of turns to be employed in the auxiliary windings, any desired ratio of phantom circuit inductance to side circuit inductance is obtained.

While in the embodiment of the invention herein described and shown the auxiliary windings are arranged to add to the inductive effect of the main windings when said windings are traversed by the phantom current, and to detract from the inductive effect of the main windings when said windings are traversed by the physical circuit current, it will be obvious that said auxiliary windings may be arranged to have the reverse effect, if desired. It will also be understood that while in the drawing a core structure is shown in which the core members are round in cross-section, they may, if desired, have other cross-sectional forms. The term "toroid", 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. An inductance coil comprising two toroidal core members intersecting at right angles on a common diameter, main windings on each of the semi-toroidal core sections thereby formed, and a supplementary winding on each of said sections, the supplementary winding of one section being in series with the main winding of the opposite section.

2. An inductance coil comprising two toroidal core members intersecting at right angles on a common diameter, a main winding on each of the semi-toroidal core sections thereby formed, and a supplementary winding on each of said sections, said supplementary windings being so connected as to add to the inductive effect of the main windings of the two sections lying in the same plane when said windings are connected in parallel, and to detract from said inductive effect when such windings are connected in series.

3. An inductance coil comprising two toroidal core members intersecting at right angles on a common diameter, a main winding on each of the semi-toroidal core sections thereby formed, and a supplementary winding on each of said sections, said supplementary windings being so connected as to modify in one way the inductive effect of the main windings of the two sections lying in the same plane when said windings are connected in parallel, and to modify in the opposite way said inductive effect when such windings are connected in series.

4. An inductance coil having two toroidal core members intersecting at right angles on a common diameter, a main winding on each of the semi-toroidal core sections thereby formed, and a supplementary winding on each of said sections, the supplementary winding of each section being connected in series with the main winding of the opposite section in such a manner as to add to the inductive effect of the main windings of opposite sections when said main windings are connected in parallel, and to detract from said inductive effect when said main windings are connected in series.

5. An inductance coil having two toroidal core members intersecting at right angles on a common diameter, a main winding on each of the semi-toroidal core sections thereby formed, and a supplementary winding on each of said sections, the supplementary winding of each section being connected in series with the main winding of the opposite section in such a manner as to modify in one way the inductive effect of the main windings of opposite sections when said

main windings are connected in parallel, and to modify in the opposite way said inductive effect when said main windings are connected in series.

6. The combination of four line conductors forming two physical circuits and a phantom circuit, and an inductance coil comprising two toroidal core members intersecting at right angles on a common diameter, main windings on each of the semi-toroidal core sections thereby formed, one of said main windings being in series with each of said line conductors, and a supplementary winding on each of said sections, said supplementary windings being so connected with respect to said main windings as to have opposite effects on the inductance included in said line conductors, depending on whether said conductors are traversed by physical circuit currents or phantom circuit currents.

In witness whereof, I hereunto subscribe my name this 26th day of June, A. D. 1915.

JOHN FRANKLIN BALDWIN, JR.