April 22, 1924.

W. FONDILLER

1,491,343

LOADING COIL

Filed May 21, 1921

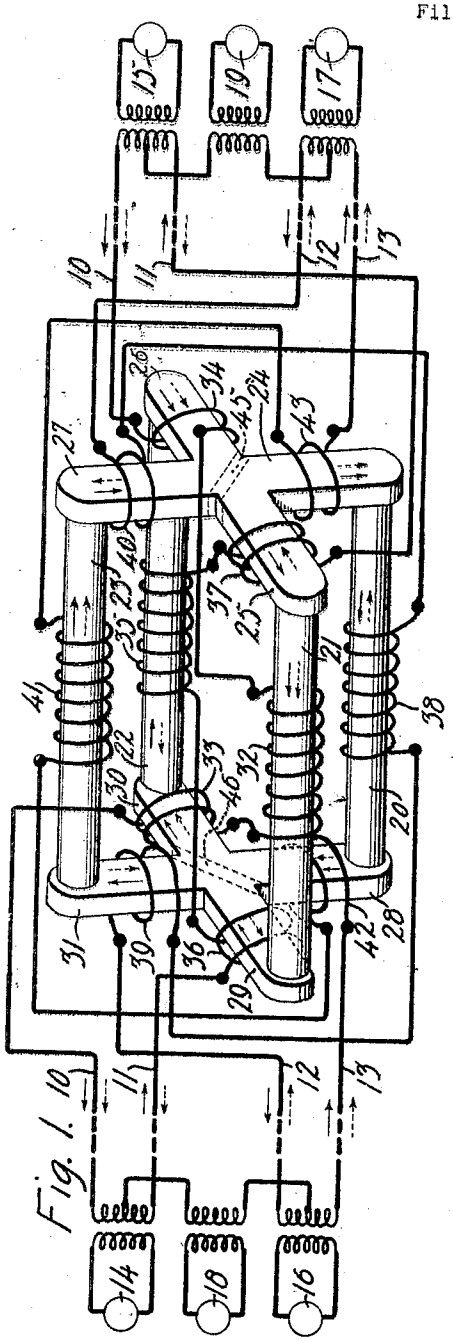

Fig. 1.

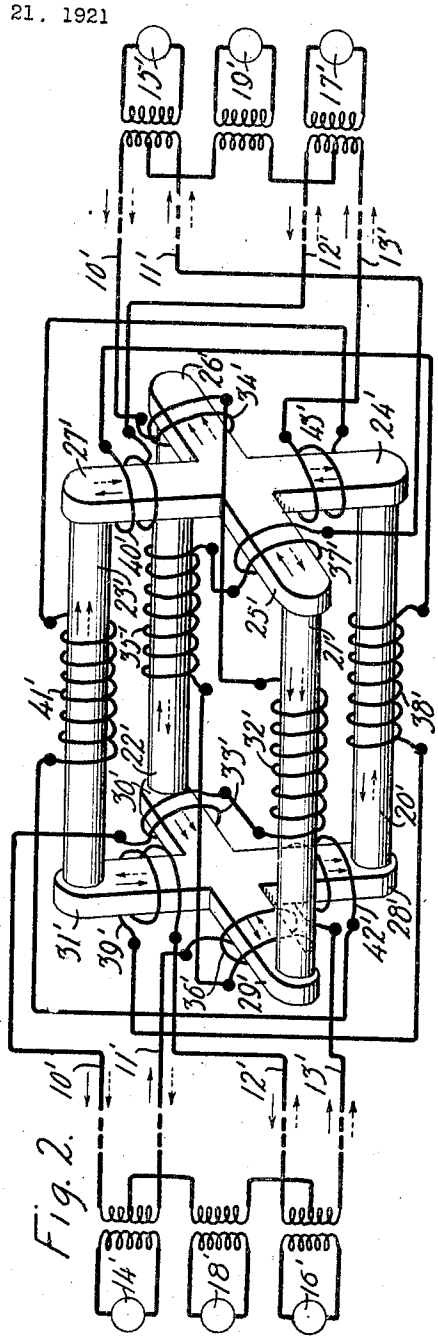

Fig. 2.

Inventor:
William Fondiller:
by W. E. Beattie Atty.

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UNITED STATES PATENT OFFICE.

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LOADING COIL.

Application filed May 21, 1921. Serial No. 471,316.

To all whom it may concern:

Be it known that I, WILLIAM FONDILLER, a citizen of the United States, residing at New York city, in the county of New York, State of New York, have invented certain new and useful Improvements in Loading Coils, of which the following is a full, clear, concise, and exact description.

This invention relates to inductance devices and more particularly it relates to a unitary loading device for a duplex circuit.

As is well known in the art, it is frequently desirable to add inductance units at one or more points to a signaling line in order to improve its transmission characteristics.

An object of this invention is to provide a unitary inductance device which may be inserted in a duplex circuit for simultaneously loading the two physical circuits and the derived phantom circuit whereby the use of an inductance device for each of these circuits is rendered unnecessary.

One form of the inductance device this invention may have, comprises four parallel members with a cross at each end of the parallel members for joining them. The inductance for each wire of each physical circuit comprises a winding on one of the parallel members and may also comprise supplementary windings on arms of the crosses, which supplementary windings may be included in each side circuit in such a manner that the ratio between the physical and phantom loading may be made any desired value.

This type of inductance device possesses advantages over the toroidal type of loading coil in that the loading coil of this invention comprises only straight portions which may be readily wound without the necessity of providing special and expensive machinery. It is preferable that the magnetic means joining the units of the four parallel members should each be in the form of a cross, since it has been found that such an arrangement tends to eliminate more completely cross talk between the side circuits and the phantom circuit of the three talking circuits loaded by the device, than it is possible to obtain from magnetic joining means of other types, such as a toroid or a rectangular frame.

This invention will be better understood by reference to the following detailed description, taken in connection with the accompanying drawings in which Fig. 1 represents an inductance device according to this invention, arranged to load two physical circuits and the derived phantom circuit, in which non-magnetic gaps are provided in the cross members of the core for increasing the ratio of phantom to side circuit loading, and Fig. 2 represents a modification of Fig. 1 in which the ratio of phantom to side circuit loading may be adjusted by varying the number of turns of the supplementary windings located on the cross members.

Fig. 1 discloses two two-wire circuits comprising line conductors 10 and 11, and 12 and 13, respectively. 14 and 15 are signaling devices which may be employed for transmitting signals such as telephone currents over line conductors 10 and 11 while the signaling devices 16 and 17 are arranged to signal over line conductors 12 and 13. The signaling devices 18 and 19, by connections well known in the art, are arranged for signaling over the phantom circuit derived by employing line conductors 10 and 11 in parallel for transmission of the signaling currents in one direction and line conductors 12 and 13 in parallel for the transmission of the signaling currents in the opposite direction.

The inductance device disclosed in Fig. 1 for simultaneously loading the physical circuits and the derived phantom circuit comprises four parallel members 20, 21, 22 and 23 which are at one end joined by a cross comprising the four arms 24, 25, 26 and 27 and are joined at the other end by a cross comprising the four arms 28, 29, 30 and 31. Line conductor 10 is loaded by the main inductance winding 32 on core member 21 and by the two supplementary windings 33ª and 34 on the cross arms 30 and 26. Line conductor 11 is loaded by the main inductance winding 35 on core member 22 and by the supplementary windings 36 and 37 located on the cross arms 29 and 25. Similarly line conductor 12 is loaded by the main inductance winding 38 and supplementary windings 39 and 40; and line conductor 13 is loaded by main inductance winding 41 and the supplementary windings 42 and 43.

If we assume that the instantaneous physical current in the two side circuits is in the direction of the full arrows adjacent the

line conductors, the direction of the flux produced in the core members is shown by the full line arrows on each core member. Similarly, instantaneous current in the phantom circuit in the direction indicated by the dotted arrows, will produce a flux in the loading coil in a direction indicated by the dotted arrows on the core members. As shown by these arrows, the flux for side circuit 10, 11 starting for example in core member 23 passes through arms 27 and 24, parallel member 20, cross arms 28 and 31, back to parallel member 23, and the directions of the flux for the two main windings and the four supplementary windings are all in the same direction. Similarly, the flux for the side circuit 12, 13, starting for example in parallel member 22 traverses cross arms 26 and 25, parallel member 21, cross arms 29 and 30, back to parallel member 22; and the directions of the flux for the two main windings and the four supplementary windings surrounding the described rectangle are all in the same direction. A portion of the phantom circuit flux traverses parallel member 23 of side circuit 12, 13, cross arms 27 and 25, parallel member 21 of side circuit 10, 11, cross arms 29 and 31, back to parallel member 23; and another portion of the phantom circuit flux traverses core member 20 of side circuit 12, 13, cross arms 24, 26, parallel member 22 of side circuit 10, 11, cross arms 30 and 28, back to parallel member 20. If desired, non-magnetic gaps 45 and 46 may be provided in the cross arms arranged in such a manner as to offer high reluctance to the side circuit flux and but little reluctance to the phantom circuit flux. These non-magnetic gaps as is well known in the art and as described and claimed in my Patent No. 1,253,365 of January 15, 1918, serve to increase the ratio of phantom to side circuit loading, this ratio increasing with an increase in the width of the non-magnetic gap. Inasmuch as the fluxes of the supplementary windings are arranged in this figure to aid the main windings for side circuit currents and oppose for phantom circuit currents, it follows that after the ratio of side to phantom loading has been determined roughly by the width of the non-magnetic gaps for given main and supplementary windings,—the number of turns of the supplementary windings may be varied to accurately determine this ratio. From the above description of the direction of the flux in each of the main windings and the supplementary windings, it will be evident to those skilled in the art that the flux for each of the three talking circuits is arranged in such a manner that cross talk therebetween is minimized.

Fig. 2, discloses a modification of Fig. 1 in which the ratio of phantom to side circuit loading may be increased to any desired value without the necessity of providing non-magnetic gaps in the cross arms as shown in Fig. 1. This increase in phantom to side circuit loading is obtained by winding the supplementary windings in such directions that they aid the main inductance windings for phantom currents but oppose them for side circuit currents. It is therefore evident that increasing the number of turns of the supplementary windings with regard to its main inductance winding will increase the ratio of phantom to side circuit loading while decreasing the number of turns of the supplementary windings will decrease this ratio. Inasmuch as Fig. 2, is similar to Fig. 1, except that the non-magnetic gaps 45 and 46 have been omitted, and the direction of the winding of each of the supplementary windings has been reversed in each case, it is not believed necessary to describe Fig. 2 in detail. Corresponding parts of the two figures have therefore been given similar reference numerals except that the numerals for Fig. 2 are designated as 10′, 11′, etc.

It is to be understood that this invention is not limited to the use of windings on both the parallel members and the cross arms, since the windings on either the parallel members or the cross arms, may be omitted, if desired. It is also to be understood that the structure described above may be variously modified without departing in any wise from the spirit of this invention, as defined in the appended claims.

What is claimed is:

1. An inductance device having a core comprising two co-axial rectangular frames at right angles to each other, the longitudinal sides of said rectangles being separable from the radial sides and an inductance winding on each side of each rectangle.

2. An inductance device having a core composed of two crosses, four separable arms joining the ends of said crosses, and windings placed on a plurality of the sides of said core.

3. A loading coil for a plurality of physical circuits and a derived phantom circuit comprising a core comprising four parallel members and a cross at each end of said members, each of said crosses having an arm resting on the end of one of said members and a winding on each of said members for one of said physical circuits.

4. A loading coil for a plurality of physical circuits and a derived phantom circuit comprising a core comprising a plurality of parallel members, and means at each end of said members for joining said members, a winding on each of said parallel members for one of said circuits, and a plurality of windings on said means, one of said windings on one of said means being connected to one of said windings on one of said parallel members.

5. A loading coil for two physical two-wire circuits and the derived phantom circuit having a core comprising four parallel members, a cross at each end of said members for joining said members, a main winding on each of said parallel members for one of said wires, and a supplementary winding on each arm of each cross.

6. A loading coil for two physical circuits and the derived phantom circuit having a core comprising four parallel members, a cross at each end of said members for joining said members, a main winding on each of said parallel members for one of the wires of said circuits, and a supplementary winding on each arm of one of said crosses for one of the wires of said circuits, the main winding on each parallel member being directly connected to a supplementary winding on an arm of said cross adjacent another of said parallel members.

7. A loading coil for two physical circuits and the derived phantom circuit having a core comprising four parallel members, a cross at each end of said members for joining said members, a main winding on each of said parallel members for one of the wires of said circuits, and a supplementary winding on each arm of one of said crosses for one of the wires of said circuits, the main winding on each parallel member being directly connected to a supplementary winding on an arm of said cross adjacent another of said parallel members, said supplementary windings being wound in such a direction as to aid the main windings for phantom circuit currents and opposing said main windings for side circuit currents.

In witness whereof, I hereunto subscribe my name this 19th day of May, A. D. 1921.

WILLIAM FONDILLER.