J. B. SPEED.

TETRAHEDRONAL MAGNETIC UNIT.

APPLICATION FILED SEPT. 3, 1918.

1,401,564.

Patented Dec. 27, 1921.

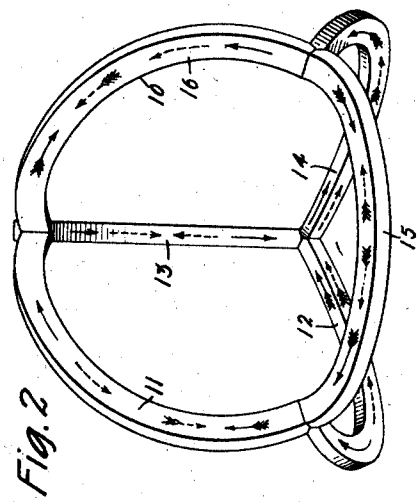

Fig. 2

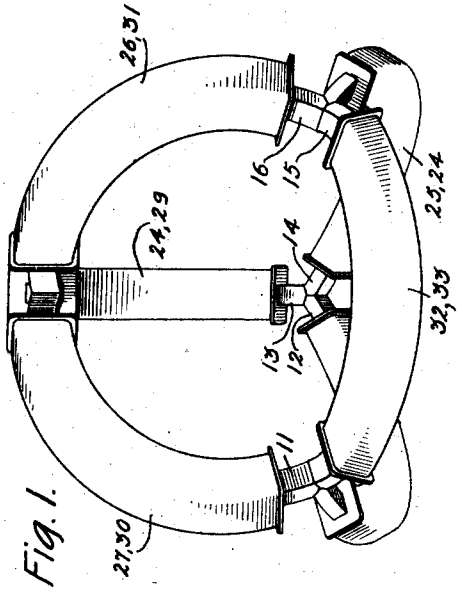

Fig. 1.

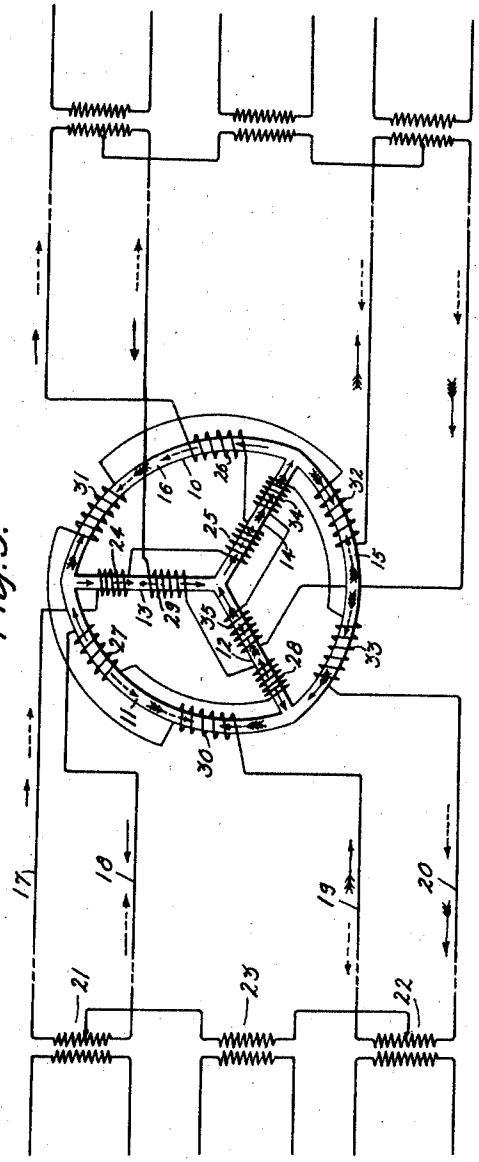

Fig. 3.

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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.

TETRAHEDRONAL MAGNETIC UNIT.

1,401,564. Specification of Letters Patent. Patented Dec. 27, 1921.

Application filed September 3, 1918. Serial No. 252,381.

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, State of New York, have invented certain new and useful Improvements in Tetrahedronal Magnetic Units, of which the following is a full, clear, concise, and exact description.

This invention relates to arrangements involving a number of associated magnetic circuits, a specific application being found in cores for inductance coils of the type used for loading a number of related telephone circuits. It may also be applied to repeating coils, retardation coils, etc.

An object of this invention is to provide a compact and efficient magnet core comprising a plurality of symmetrically arranged magnetic circuits.

A magnetic circuit embodying this invention comprises six limbs, arranged to outline a tetrahedron. When this structure is used as a loading unit, the windings are preferably so arranged that each set of three limbs outlining a face of the tetrahedron carries three windings, one on each limb, connected in series to provide the loading for one of the line conductors; in this way each limb serves as part of the magnetic circuits for two line conductors, with the result that an economy of material and space is obtained and that the several windings materially aid each other in producing the required inductance.

In the accompanying drawing:

Figure 1 shows a loading unit embodying this invention;

Fig. 2 is a view of the core of the unit with the windings removed; and

Fig. 3 shows schematically an arrangement of one of the units in a telephone or like system.

The preferred form of the invention as shown in the drawing comprises a loading unit having a core 10 formed of six symmetrically arranged arcuate limbs or sections 11, 12, 13, 14, 15 and 16 of equal length and arranged to outline a regular tetrahedron.

The arrangement of the loading unit in a telephone system is shown in Fig. 3 and though but one loading unit is there illustrated, it will be understood that in actual practice as many units are used and at such intervals as circumstances require. The line conductors 17, 18, 19 and 20 provide two physical circuits 21 and 22 and a derived phantom circuit 23.

The line conductor 17 of physical circuit 21, as traced through the loading unit, comprises three series-connected windings 24, 25 and 26 on limbs 13, 14 and 16, respectively. The line conductor 18 of physical circuit 21 includes the series-connected windings 27, 28 and 29 on limbs 11, 12 and 13, respectively. Similarly, the line conductor 19 of physical circuit 22 comprises the windings 30, 31 and 32 on limbs 11, 16 and 15, and the line conductor 20, comprises the windings 33, 34 and 35 on limbs 15, 14 and 12, respectively.

It will be seen that by the above arrangement each section or limb of the core carries two windings, the two windings on each of the two non-adjacent limbs 13 and 15 being in the same physical circuit, and that the windings for each of the four line conductors are distributed on three limbs outlining one of the four faces of the tetrahedron. This symmetrical disposition of the windings for the different line conductors and circuits results in an equality of mutual interaction between the windings and the effective utilization of the fluxes produced by currents in the different windings. It will be understood that the two different windings on each limb, instead of being arranged as shown in the diagrammatical representation of Fig. 3, are preferably arranged so as to extend along the same portion of the limb, as may be accomplished, for instance, by twisting the conductors for the two windings together before they are wound on the limb.

With this arrangement current passing through physical circuit 21 in the direction indicated by the full-line arrows adjacent to the conductors produces fluxes in the two magnetic circuits provided by limbs 13, 14 and 16, and limbs 11, 12 and 13, respectively. The direction of the fluxes in these magentic circuits is indicated by small full-line arrows adjacent to the respective windings on the core in Fig. 3 and on the corresponding portions of the core in Fig. 2. Thus the fluxes produced by the windings 24, 25 and 26 of physical circuit 17 are in the same direction around the magnetic circuit composed of the limbs 13, 14 and 16 on which these windings are mounted, and these fluxes therefore re-

inforce one another. Likewise, the fluxes produced by windings 29, 28 and 27 all follow the same direction in the magnetic circuit formed by the limbs 13, 12 and 11 carrying these windings. The flux in the common limb 13 due to the winding 24 of line conductor 17 is in the same direction as and aids the flux due to winding 29 of line conductor 18.

In like manner current in physical circuit 22 flowing in the direction indicated by the feathered full-line arrows adjacent to the conductors 19 and 20 will produce corresponding mutually aiding magnetic fluxes in the magnetic circuits composed by the limbs 11, 16 and 15, and limbs 15, 14 and 12, respectively, as indicated by the feathered full-line arrows on the core in Figs. 2 and 3.

Current in the phantom circuit flowing, for instance, in the direction indicated by the broken-line arrows adjacent to the conconductors, produces, as will readily be seen, fluxes in the direction indicated by the dotted plain and feathered arrows on the core sections. The magnetic effects of phantom circuit current in the two windings 24 and 29 on limb 13 are opposed and cancel each other; and the same is true of the phantom circuit current effects on limb 15. The effective magnetic fluxes due to their phantom circuit current therefore have their paths through the magnetic circuit composed of the four limbs 11, 12, 14 and 16, and the fluxes due to the eight windings on these limbs, being in the same direction relative to the circuit, aid one another.

The specific arrangement of the windings and their connection to the line conductors, may, as will be understood, be varied to meet the requirements of economical manufacture of loading units of the type embodied in this invention and of the efficient operation of systems of which they form a part.

While the above description has reference more particularly to the application of the improved magnetic unit to the loading of telephone circuits and the like, it is to be understood that this invention is not limited to such a use but is applicable to other apparatus capable of general application.

What is claimed is:

1. A magnet core comprising six limbs outlining a tetrahedron.

2. A magnet core comprising six curved limbs outlining a tetrahedron.

3. A core for inductance coils comprising six limbs outlining a tetrahedron.

4. A core for inductance coils comprising six equal limbs outlining a tetrahedron.

5. A core for inductance coils comprising six curved limbs outlining a tetrahedron.

6. In an inductance coil for use with four line conductors arranged to provide two physical circuits and a derived phantom circuit, a core comprising six limbs outlining a tetrahedron, the windings for each line conductor being wound on three limbs outlining a face of the tetrahedron.

7. In an inductance coil for use with four line conductors arranged to provide two physical circuits and a derived phantom circuit, a core comprising six limbs outlining a tetrahedron, the three limbs outlining each face of the tetrahedron, each carrying a winding for one of the line conductors.

8. In an inductance coil for use with four line conductors arranged to provide two physical circuits and a derived phantom circuit, a core comprising six limbs outlining a tetrahedron, the windings for each line conductor being wound on three limbs outlining the face of the tetrahedron, and the windings being so arranged that the fluxes induced in response to current in a physical circuit are in the same direction around each face outlined by the sides carrying the windings for the line conductors of said physical circuit and are in the same direction through the limb common to both of said faces.

9. In an inductance coil for use with four line conductors arranged to provide two physical circuits and a derived phantom circuit, a core comprising six limbs outlining a tetrahedron, the windings for each line conductor being wound on three limbs outlining the face of the tetrahedron, and the windings being so arranged that the fluxes induced in response to current in a physical circuit are in the same direction around each face outlined by the sides carrying the windings for the line conductors of said physical circuit and are in the same direction through the limb common to both of said faces, and that the fluxes induced by current in the phantom circuit are in the same direction through a magnetic circuit formed by four of the limbs of the tetrahedron.

10. In combination with four line conductors arranged to provide two physical circuits and a derived phantom circuit, an inductance unit comprising six limbs arranged to outline a tetrahedron, two windings on each limb, one winding on each of the three limbs outlining each face of the tetrahedron forming a part of the same line conductor, the two windings on each of two non-adjacent limbs being common to the line conductors of one of the two physical circuits.

11. An inductance coil having a core comprising six limbs outlining a tetrahedron and windings individual to said limbs.

12. An inductance coil comprising a core of six equal and curved limbs outlining a tetrahedron and windings individual to said limbs.

13. A tetrahedrally shaped inductance coil comprising a core of a plurality of limbs and a winding on at least one of the limbs that bound each side of the tetrahedron.

14. An inductance coil having a core comprising a curved limb, a second curved limb joining one end of said first limb, a third curved limb having one end connected to the junction of said first two limbs, a fourth curved limb having one end connected to that end of said first limb remote from said second limb and having its other end connected to that end of said third limb remote from said first and second limbs, and means for joining the remaining end of the second mentioned limb to a plurality of the other limbs.

15. An inductance coil physically shaped to outline a tetrahedron and comprising a plurality of limbs, a winding on each of said limbs, the windings of the limbs that outline a face of the tetrahedron being electrically connected with each other.

16. An inductance coil physically shaped to outline a tetrahedron and comprising a plurality of limbs and a plurality of separate windings on each limb.

In witness whereof, I hereunto subscribe my name this 28th day of August, A. D., 1918.

JAMES BUCKNER SPEED.