

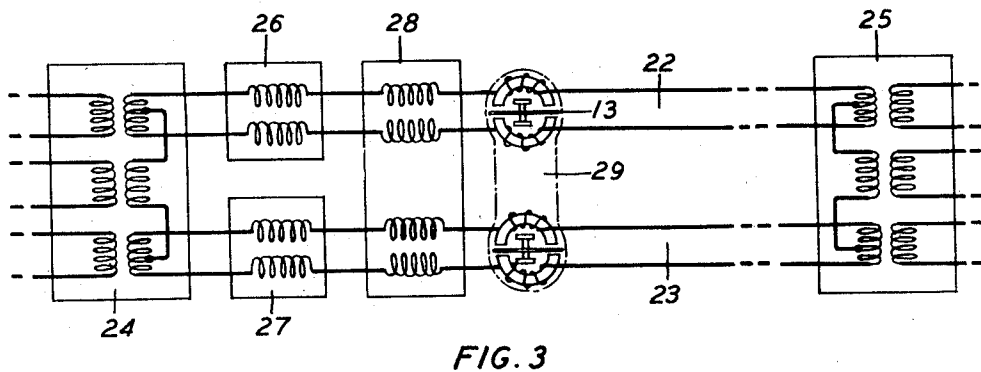
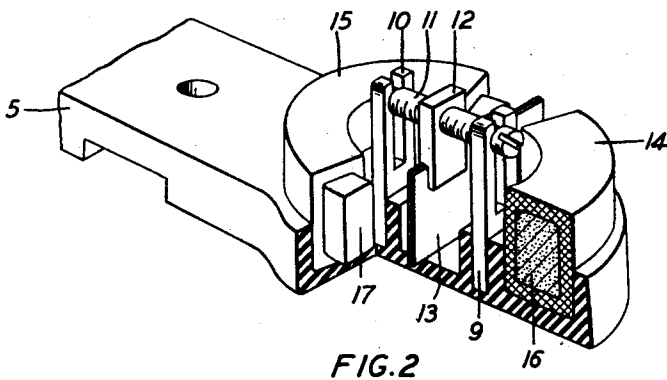
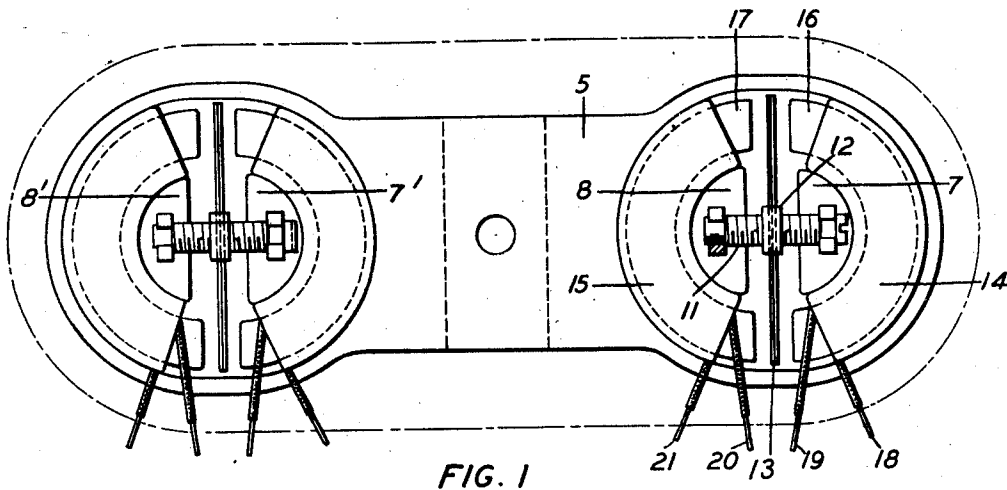
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INDUCTANCE DEVICE

Filed Jan. 30, 1931



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UNITED STATES PATENT OFFICE

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INDUCTANCE DEVICE

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Application January 30, 1931. Serial No. 512,297

8 Claims. (Cl. 171-242)

This invention relates to inductance devices and more especially to such devices in which the inductance may be adjusted or varied.

The addition of loading inductances to telephone lines to improve transmission has been carried on for a number of years in a manner which is well known in the art, both in the case of simple telephone lines and in the case of phantom telephone systems. To provide good transmission characteristics in a phantom system, the two side circuits must be accurately balanced and considerable difficulty has been experienced in properly balancing the side and phantom circuits especially where very exacting requirements are placed upon the circuits as to transmission characteristics. Cross-talk between the phantom and side circuits is one of the results of an imperfect balance of inductance, capacitance or resistance.

This invention has as an object the improvement of the transmission characteristics of telephone circuits.

Another object of this invention is the reduction of cross-talk between side and phantom circuits.

A further object is the accurate loading of telephone lines.

A still further object is the accurate balancing of the electrical characteristics of the side and phantom circuits of a telephone line.

Two of the electrical characteristics, namely, capacitance and inductance, being by their nature complementary, can be adjusted for by the inclusion in the circuit of the correct value of either. Generally, however, an inductance device is used.

The objects of this invention are attained by inserting auxiliary adjustable inductances in the circuits associated with the main loading inductances. Each auxiliary inductance consists of windings mounted on two C-shaped cores so arranged that the free ends of the cores are adjacent to each other but separated by an air gap. A magnetic material armature is mounted in the air gap and is movable toward and away from the free ends of the cores. The movement of the armature changes the reluctance of the magnetic circuits and hence the inductance of the auxiliary coils.

The invention will be better understood from the following description and attached drawing illustrating one form which the invention may take and in which:

Fig. 1 is a top view of a mounting of a pair of auxiliary inductances for use with phantom circuit loading coils;

Fig. 2 is a view in elevation of the device of Fig. 1; and

Fig. 3 illustrates schematically the application of inductances according to this invention to a phantom telephone circuit.

Referring now to Figs. 1 and 2 a base plate 5 of a non-magnetic and electrically non-conductive material and of the general form shown is adapted for mounting on top of a loading coil case indicated by dotted lines.

Recesses are formed at either end of the base plate to receive the coil structures. Projections 7 and 8 formed as part of the base plate, serve to properly position the coils and also to support fork-shaped upright non-magnetic metallic pieces 9 and 10. Uprights 9 and 10 are provided on the inside of the forked portions with shallow notches for receiving threaded rod 11 which is provided on one end with a slot. Pieces 9 and 10 may be of brass or other tensile non-magnetic material so that there is sufficient spring action to hold rod 11 in position when it is snapped into the notches provided in the forked portions.

A member 12 is provided as shown with a hole near the upper edge which is threaded to receive rod 11 substantially as shown.

Piece 12 supports armature 13 of magnetic material as shown. Armature 13 is fastened to piece 12 in any suitable manner. As indicated in the drawing, a slot may be cut along the lower edge of piece 12 and the armature forced into the slot. The dimensions of armature 13 are such that there is but slight clearance between its free edges and the bottom and sides of the recess in plate 5.

Coils 14 and 15 mounted on cores 16 and 17 are forced into the recess and are held in position by the friction between the sides of the recess and the outside of the coil structures and between projections 7 and 8 and the inside of the coil structures. An adhesive may be used to increase this friction, or a clamp may be used. Leads 18, 19, 20 and 21 provide the means for connecting the coils to external circuits.

The coils and armature are positioned so that the armature is in a plane parallel to the planes of the free ends of cores 16 and 17. With the structure as just described, if rod 11 is turned about its axis by means of a screw driver or similar tool, armature 13 is caused to move in a plane parallel to the plane of the free ends of the cores and approaches the free ends of one of the cores while receding from the others.

The reluctances of the magnetic paths through the cores are changed due to the varying air

gaps and hence the inductances of the coils are changed.

The use of the device of this invention is a loaded phantom circuit is shown schematically in Fig. 3. This is the well known phantom circuit arrangement consisting of one phantom circuit and two side circuits. The two side circuits 22 and 23 form the sides of the phantom circuit. The repeating coils for such a circuit are shown generally at 24 and 25, the loading coils for the side circuits are indicated at 26 and 27, the main phantom circuit loading coils are indicated at 28 and the auxiliary adjusting coils at 29. It is to be understood that the auxiliary coils 29 may be used in the side circuits as well as the phantom circuit.

No further description of the circuit is believed necessary. It is also believed that it will be readily apparent that if the phantom loading coils are slightly unbalanced, such unbalance is easily taken care of by changing the location of armature 13 relative to the free ends of the cores of the auxiliary inductances. This is done by turning the screw 11.

The device as described will adjust for inductance or neutralize capacitance unbalance in the circuit. To adjust for resistance unbalance one of the leads of the pairs 18—19, 20—21, is left somewhat longer than necessary and by means of a clip connector the correct length of the lead is determined. The surplus length of the lead is cut off and connection made to the external circuits.

After the adjustments have been made, a cover of a non-magnetic and preferably non-metallic material is placed over the device and any extra length of lead required to effect the resistance balance may be folded and secured beneath the cover.

With devices such as described variations as high as 80 microhenries have been obtained. This is sufficiently large to adjust for any variations met in practice. As to resistance adjustment, practically any variation can be obtained but usually not more than .08 ohms adjustment is required which can be obtained as outlined above.

The advantages of the present device can be better appreciated when it is realized that formerly adjustments were made by adding lumped quantities, such as inductances, in the form of small coils, to the line conductor of too small inductance. The addition of such a coil, while taking care of inductance unbalance, is likely to cause resistance unbalance, and a capacitance unbalance due to the capacity of such added coil to ground.

With the present device, the symmetrical construction avoids capacitance unbalance and the simple resistance adjustment is necessarily very small and can readily be made in the manner that has been pointed out. One such device having permalloy dust cores which has been found very satisfactory has the following overall dimensions—length $3\frac{1}{2}$ "', width about $1\frac{1}{2}$ "' and a height of about $\frac{3}{4}$ "'.

It is to be understood that, whereas the present invention has been described in connection with the loading coil of a phantom circuit, it is not to be limited to such use, but may be applied wherever a delicate inductance adjustment is required without changing the other electrical characteristics of the circuit.

The specific structure of the invention as described may be modified without departing from

the spirit and scope of the invention as defined in the appended claims.

What is claimed is:

1. A variable inductance device comprising a plurality of main windings, a plurality of auxiliary windings, each one of said auxiliary windings connected in series with and adapted to cooperate with a specific one of said main windings, and common means adapted to vary the inductance of certain of said auxiliary windings in one direction while simultaneously varying the inductance of certain others of said auxiliary windings in the opposite direction.

2. A variable inductance device comprising a plurality of main windings arranged in pairs, a plurality of auxiliary windings also arranged in pairs, each pair of said auxiliary windings adapted to cooperate with a specific pair of said main windings, and means adapted to vary conversely the inductance of said auxiliary windings in pairs.

3. A variable inductance device comprising a plurality of main windings arranged in pairs, a plurality of auxiliary windings also arranged in pairs, each pair of said auxiliary windings adapted to cooperate with a specific pair of said main windings, and means adapted to increase the inductance of one winding of an auxiliary pair while simultaneously decreasing the inductance of the other winding of said pair.

4. A variable inductance device comprising a plurality of main windings arranged in pairs, a plurality of auxiliary windings also arranged in pairs, each pair of said auxiliary windings adapted to cooperate with a specific pair of said main windings, and means adapted to vary conversely the reluctance of the magnetic circuits of said auxiliary windings in pairs.

5. A variable inductance device comprising a plurality of main windings arranged in pairs, a plurality of auxiliary windings, also arranged in pairs, each pair of said auxiliary windings adapted to cooperate with a specific pair of said main windings, magnetic material cores associated with said auxiliary windings, a magnetic material armature for each pair of said auxiliary windings, and means adapted to vary the position of said armature relative to the ends of said cores.

6. A variable inductance device comprising a plurality of main windings arranged in pairs, a plurality of auxiliary windings also arranged in pairs, each pair of said auxiliary windings adapted to cooperate with a specific pair of said main windings, magnetic material cores for said auxiliary windings, the cores of each pair of said windings being arranged so that their free ends are adjacent each other, an armature positioned between the free ends of each pair of cores, and means adapted to move said armature toward the free ends of one core and away from the free ends of the other core.

7. An inductance adjusting coil for use in connection with main inductance coils, said adjusting coil comprising auxiliary inductance windings mounted on C-shaped cores, each of said auxiliary windings adapted for connection in series with a specific winding of one of the main inductance coils, said auxiliary windings arranged in pairs, an armature for each pair of auxiliary windings, and means to move said armature toward one C-shaped core of a pair while simultaneously moving it away from the other core of the pair whereby the inductances of the windings of the pair are conversely varied.

8. In combination with a main inductance coil having a pair of windings, a variable inductance

device adapted to be mounted near said main inductance coil comprising a base plate, pairs of windings mounted thereon, each pair of said windings adapted to cooperate with a specific pair of said main inductance coil windings, magnetic material cores for the windings of said variable inductance device, said cores being so arranged that their free ends are adjacent each

other, a piece of magnetic material mounted between the free ends of each pair of cores, and means adapted to move said piece of magnetic material toward the free ends of one core of a pair and away from the free ends of the other core of the pair. 80

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65	140
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75	150