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Jan. 9, 1923.

1,441,532

P. R. FORTIN.
ELECTRICAL APPARATUS.
FILED JULY 1, 1920.

2 SHEETS-SHEET 1

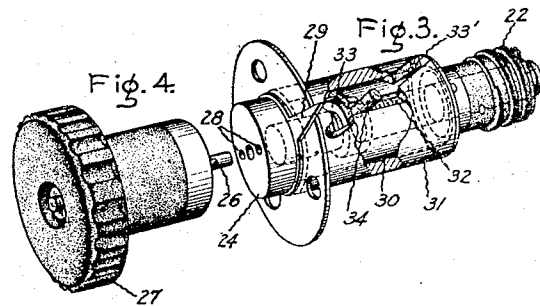
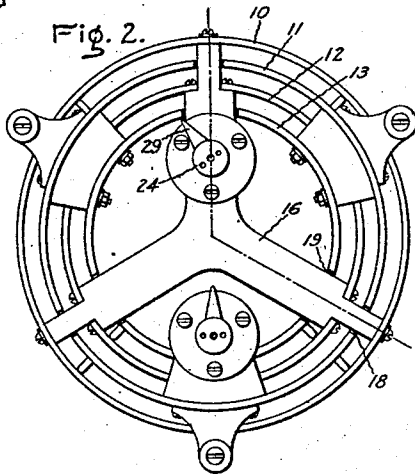
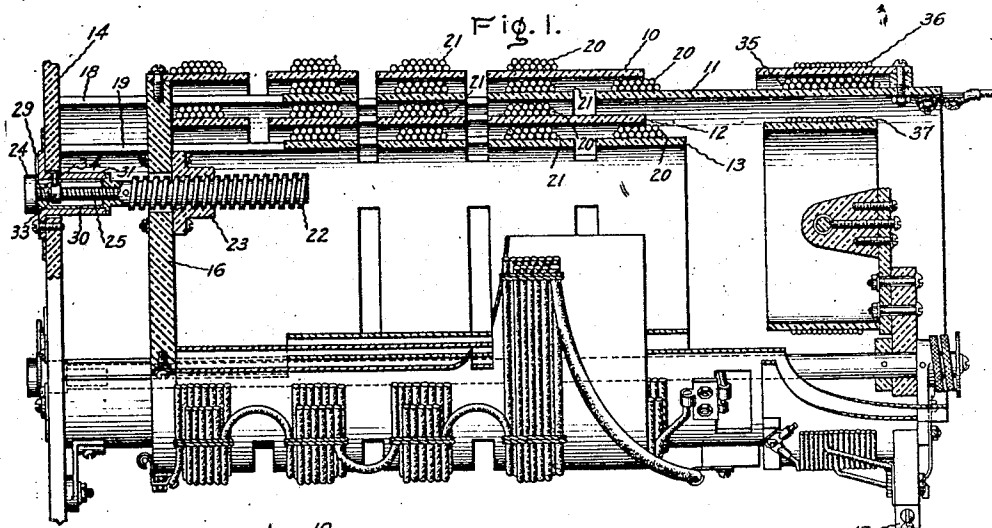


Fig. 5.

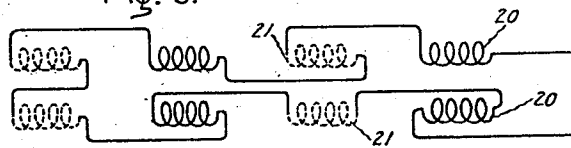
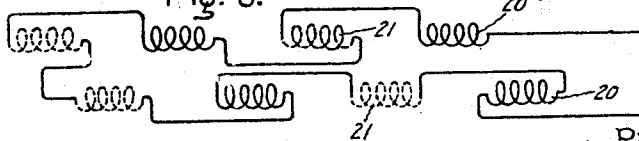


Fig. 6.



Inventor:
Paul R. Fortin,
by *Albert G. Davis*
His Attorney.

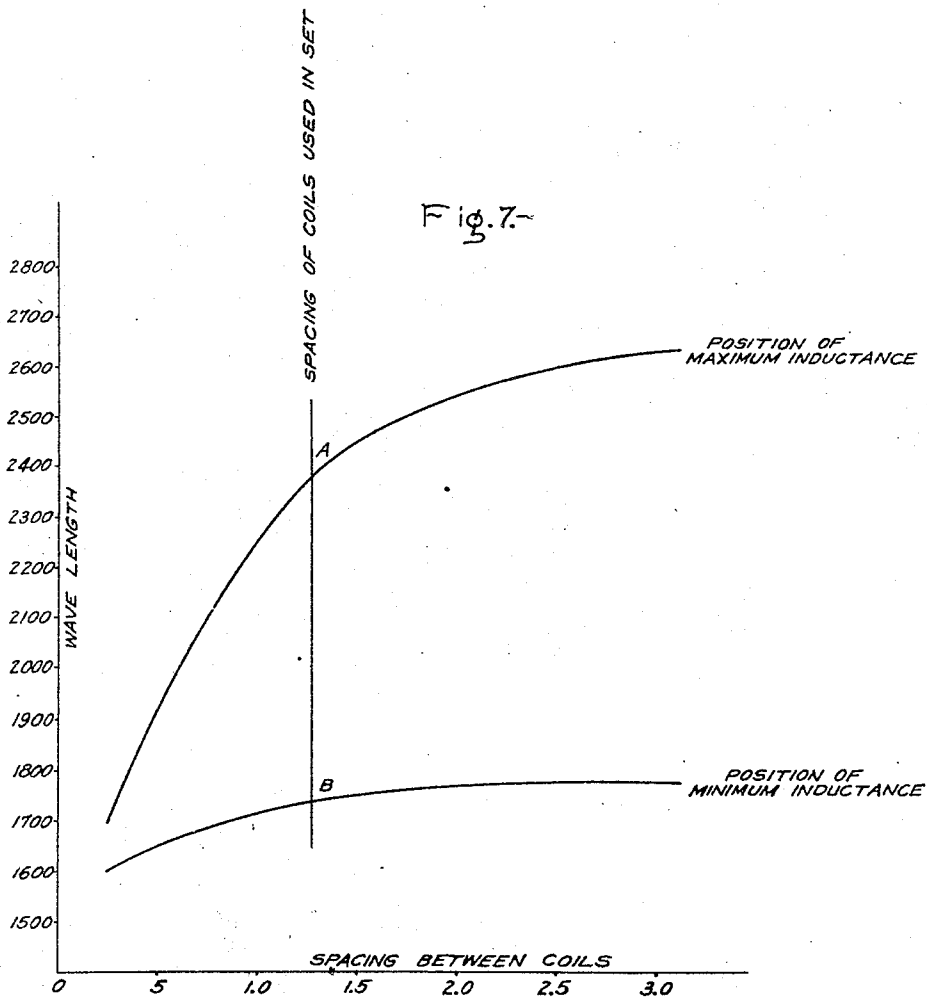
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2 SHEETS-SHEET 2



Inventor:
Paul R. Fortin,
by *Albert G. Davis*
His Attorney

Patented Jan. 9, 1923.

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UNITED STATES PATENT OFFICE.

PAUL R. FORTIN, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

ELECTRICAL APPARATUS.

Application filed July 1, 1920. Serial No. 393,233.

To all whom it may concern:

Be it known that I, PAUL R. FORTIN, a citizen of the United States, residing at Schenectady, in the county of Schenectady, State of New York, have invented certain new and useful Improvements in Electrical Apparatus, of which the following is a specification.

This invention relates to devices for varying the inductance of an electric circuit, such for example, as those now employed in the wireless art. As is well known, in tuning a high frequency circuit for the sending and receiving of waves of a definite length, use has commonly been made of an adjustable inductance called a variometer. This as usual consists of a plurality of coils movable relatively to one another, so as to vary their mutual inductance. My present invention seeks to provide a device of this character, which while compact and simple in construction shall permit of a variation of inductance over a wide range. To this end an embodiment of the invention comprises a series of concentric cylinders, upon each of which is placed a plurality of coils, adjacent coils on any one cylinder being oppositely wound. Alternate concentric cylinders are rigidly connected together and one of the sets thus formed is movable axially to vary the inductive relation between the coils of the two sets.

Referring to the accompanying drawing, Fig. 1 is a side elevation of a device embodying my invention, certain of the parts of which are shown in section; Fig. 2 is a front elevation with the panel board removed; Fig. 3 is an enlarged detail view showing the means for moving and indicating the portions of the cylinders; Fig. 4 is an enlarged perspective view of the removable operating knob; Figs. 5 and 6 are diagrammatic views showing the spacial arrangements of the coils; and Fig. 7 is a diagram showing the relation between the wave length and distance between adjacent coils.

Referring more particularly to Figs. 1 and 2, 10, 11, 12 and 13 represent a series of concentric cylinders, two of which 11 and 13 are stationary and secured at their forward end to the panel board 14. Cylinder 11 is also secured at its rear end by an upright 15. The remaining two cylinders 10 and 12 are supported from a spider 16, the

arms of which extend through slots 18 and 19 in the cylinders 11 and 13. On the periphery of each of these cylinders is wound a plurality of coils 20 and 21. On each cylinder, coils 20 alternate with coils 21 and are oppositely wound thereto, and all of the coils 20 and 21, are connected in circuit in series as is indicated in Figs. 5 and 6. Cylinders 10 and 12 are adapted to be moved in an axial direction by engagement of a screw 22 with a collar 23 secured to the spider 16. The screw 22 is operated from a disc 24 on the outside of the panel board through the connecting rod 25. Disc 24, in turn, is rotated by engagement of projections 26 on the knob 27 with the sides of openings 28 formed in the face of the disc. A pointer 29 is designed to indicate the position of the movable coils and in order to provide for a motion of the pointer 29 that is considerably slower than that of the feeding screw 22, the pointer is secured to a tube 30 which rotates within a stationary casing 31. Tube 30 is provided with a straight slot 32 and casing 31 with a helical slot 33. Rod 25 is screw-threaded and carries an internally screw-threaded collar 33 provided with a pin 34 which projects through the slot 32 into slot 33. As the shaft 22 is rotated to move the cylinders, pin 34 being constrained to follow the helical slot 33 in a stationary casing 31 rotates, but a fraction of the angle threaded by the screw 22, and in turning carries with it the tube 30 and the pointer 29.

To the rear of the inductance coils are mounted the antenna, plate and grid coils 35, 36 and 37. These are employed in wireless transmission, but as they form no part of the present invention they will not be particularly described.

As shown in Fig. 1, which represents one of the extreme positions of adjustment, coils 20, on each of the cylinders 10 and 12 lie directly over the oppositely wound coils 21 on each of the cylinders 11 and 13 and one of the coils 21 on each of the cylinders 10 and 12 lies directly over one of the oppositely wound coils 20 on each of the cylinders 11 and 13. The twelve coils of this group substantially neutralize one another and the remaining coils 20 on cylinders 11 and 13, and coils 21 on cylinders 10 and 12 are the only ones that are effective. The inductance of the circuit in this position is a

minimum. In the other extreme position, which is indicated diagrammatically in Fig. 5, like coils lie directly within one another with the result that their effects are additive and the inductance of the circuit is a maximum. The inductances may be adjusted to any value between the maximum and minimum by setting the coils in some intermediate position. A setting approximately halfway between those shown in Figs. 1 and 5 is shown in Fig. 6.

In the practical construction of the variometer above described, particularly when the same is to be used on a ship or motor vehicle, economy of space is one of the factors to be considered. In the spacing of the coils on the cylinders care should be taken on the one hand not to place them so close together that the inductive effect of one coil is largely destroyed by its proximity to oppositely wound adjacent coils, nor on the other hand to place them so far apart as to require the use of extremely long supporting cylinders. The spacing of the coils at a considerable distance from one another gives rise to the disadvantage that in the manipulation of the variometer a range is encountered where a considerable movement of the operating means gives but a slight variation of inductance. Fig. 7 shows the relation of the wave length to which a wireless sending or receiving apparatus is adjusted (plotted as ordinates) and the distance apart of the coils (plotted as abscissae). It is preferred to space the coils so that the instrument will operate in the neighborhood of vertical line A—B.

What I claim as new and desire to secure by Letters Patent of the United States is:—

1. In an electrical apparatus, two series connected oppositely wound coils and a third coil in series with said first mentioned coils, said coils being relatively movable between two positions in one of which positions said third coil and one of said first mentioned coils are arranged so that one

lies within the other, and in the other of said positions said third coil and the other of said first mentioned coils lie in close inductive relation to one another.

2. In an electrical apparatus, two series connected oppositely wound coils, a third coil in series with said first mentioned coils, said coils being relatively movable between two positions, in one of which positions said third coil is in close inductive assisting relation to one of said first mentioned coils and in the other of said positions said third coil is in close inductive opposing position to the other of said first mentioned coils, in one of said positions one of said coils lying within the other.

3. In an electrical apparatus, two series connected oppositely wound coils and a third coil in series with said first mentioned coils, and movable from a position in inductive assisting relation to and within one of said first mentioned coils to a position in inductive opposing relation to and within the other of said first mentioned coils.

4. In a device of the character described, a series of coils arranged on concentric cylinders, alternate concentric coils being mechanically connected, and thereby forming two interspaced sets, and means for moving one set of coils axially with reference to the other set.

5. In a device of the character described, a series of concentric cylinders, alternate cylinders being mechanically connected to form two interspaced sets, a plurality of coils, on each of said cylinders, adjacent coils on any cylinder being oppositely wound and means for moving one set of cylinders axially with reference to the other set from a position in which coils of one set lie directly within assisting coils of the other set, to a position in which coils of one set lie directly within opposing coils of the other set.

In witness whereof, I have hereunto set my hand this 30th day of June, 1920.

PAUL R. FORTIN.