Nov. 1, 1927. H. VADERSEN 1,647,259

ADJUSTABLE COIL

Filed Jan. 20, 1926

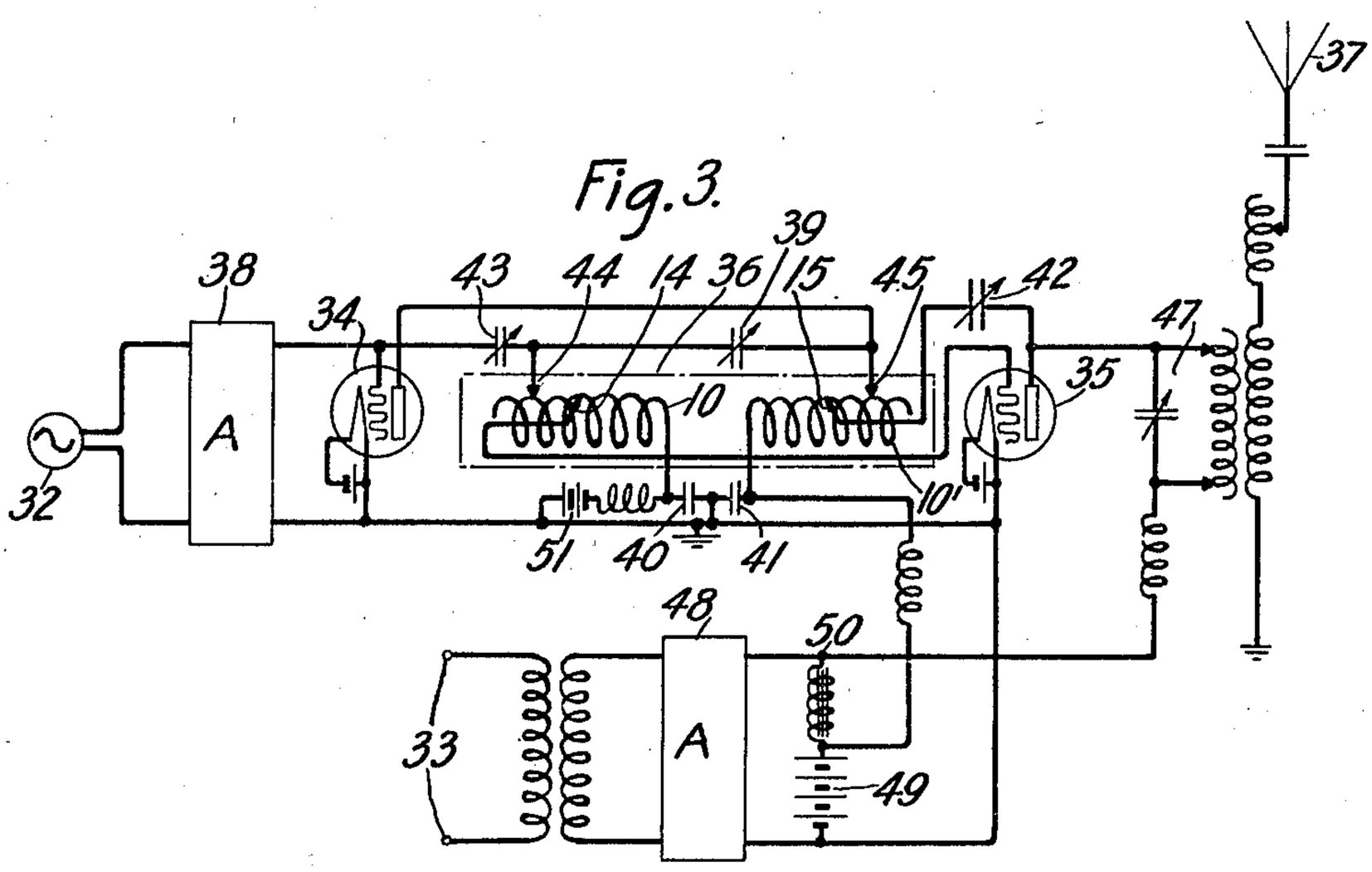

Fig. 3.

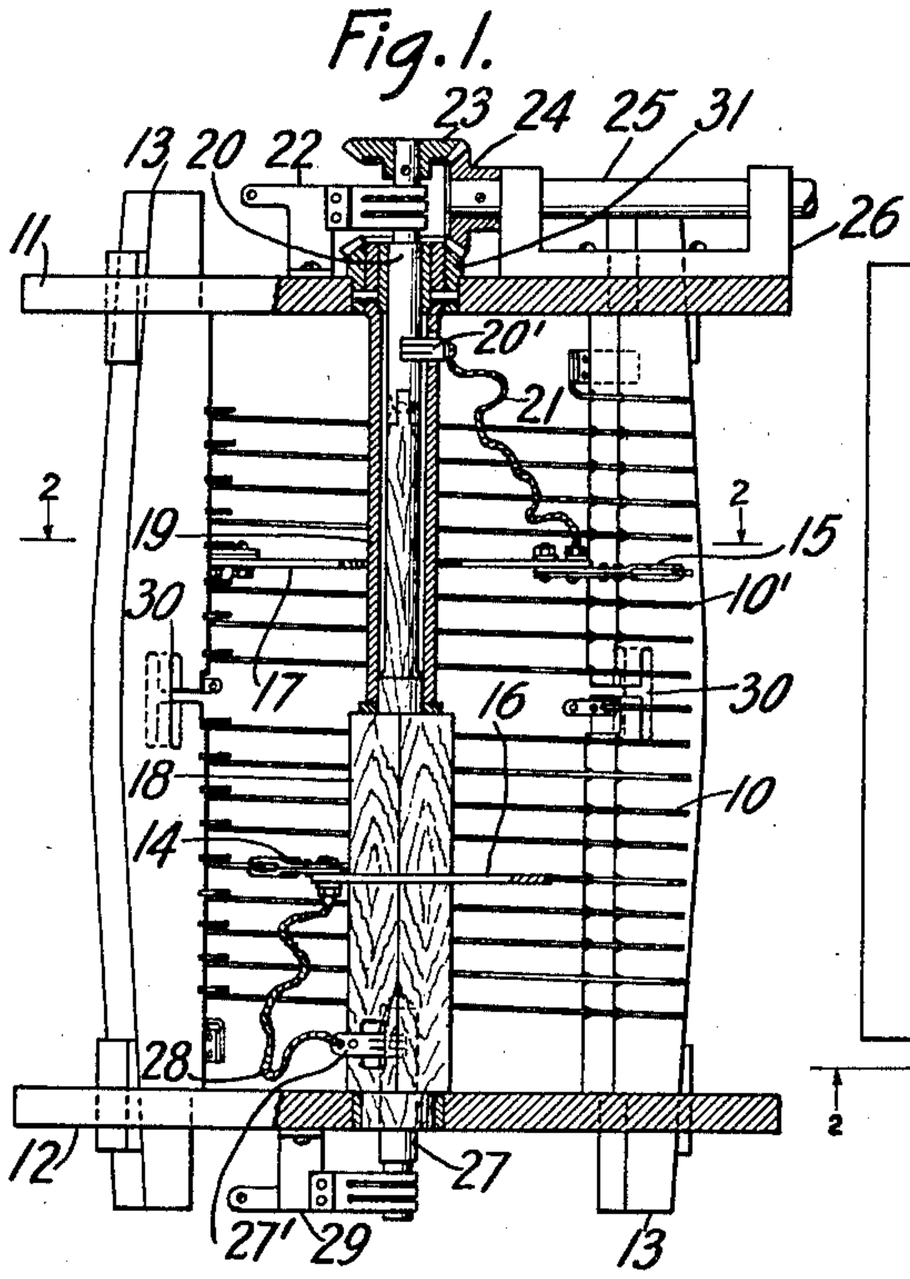

Fig. 1.

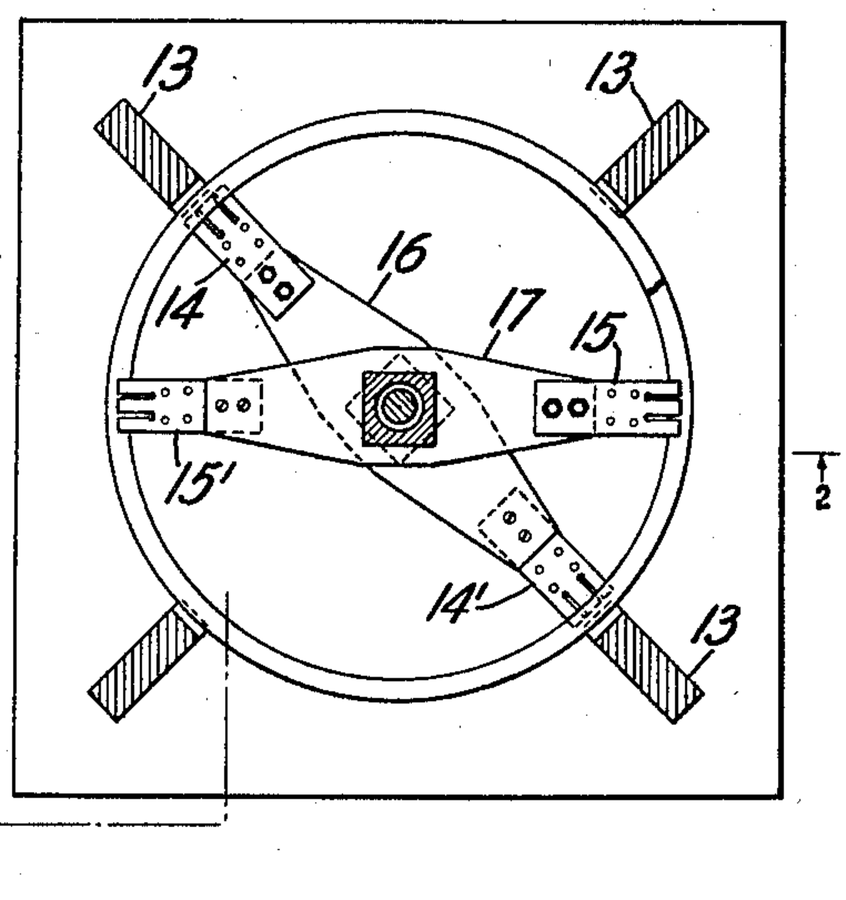

Fig. 2.

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UNITED STATES PATENT OFFICE.

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ADJUSTABLE COIL

Application filed January 20, 1926. Serial No. 82,467.

This invention relates to adjustable coils and more particularly to adjustable inductances.

In certain radio circuits, providing amplifiers for high frequency waves, it has been found advantageous to use tuned coupling circuits. By the use of such circuits, a very high degree of discrimination between waves of different frequencies may be secured. As a result, interference by undesired waves is prevented. When resonant coupling circuits are introduced, however, a tendency to establish oscillations in the amplifying system is increased. To prevent such oscillations, the coupling circuit may be balanced and neutralizing condensers, for compensating the inherent capacity of space discharge tubes, are commonly provided. The coupling circuit is balanced by tapping the tuning inductance at its midpoint so as to divide it into sections having unity ratio of turns. These sections are included in the respective balanced paths.

The coupling circuit, referred to above, has been employed in receiving circuits and the inductances have been designed to have unity ratio of turns; but heretofore the number of turns of the inductance included in the balanced paths has been fixed.

In accordance with the present invention, the coupling circuit, including tube capacity neutralizing means, is included in a circuit, wherein it is desirable to be able to adjust the number of turns of the inductance sections. More specifically it is included in a radio transmitter circuit, and the inductance is made adjustable in order to control the power transmitted.

The present invention provides an adjustable inductance that enables the power to be controlled and in addition maintains unity ratio between turns of the inductance sections included in the balanced paths of the coupling circuit.

An object of the invention is to control a plurality of adjustments of a coil simultaneously.

Another object is to control a plurality of adjustments of a variable coil by a single operation.

A further object is to prevent disruptive discharge across a dielectric material provided for supporting a coil structure when high voltages are applied to the coil conductors.

A feature of the invention is a coil having turns in separate circuits and wipers, which are adapted to be moved simultaneously along the coil conductor in opposite senses, for maintaining a definite relation between the turns in the separate circuits.

Another feature is a wiper driving mechanism adapted to enable a plurality of wiper arms to be rotated simultaneously through equal or other predetermined angles in opposite senses by a single operation.

A still further feature is a slotted insulating member adapted to support the coil conductors and to allow close spacing of the turns thereof without breakdown at high voltages.

The invention is embodied in a coil structure which for convenience may be considered an inductance, but which may equally well be a coil of any other kind, such as a resistor. The coil conductor is preferably arranged in a solenoid and may comprise a plurality of sections mounted upon a single frame. One or more wipers connected to each section of the coil are attached to arms mounted upon separate rotatable shafts connected to a common gear mechanism provided with a single driving shaft.

The coil sections are arranged end to end coaxially upon insulating supports. To enable close spacing of the adjacent end lines of the sections without danger of breakdown of the insulation, when high potential energy is supplied to the sections, the insulating supports are provided with a slot of any suitable shape for increasing the surface area between the adjacent end turns.

The invention is illustrated in the drawings wherein Fig. 1 is a side view partly in section of the inductance coil of this invention.

Fig. 2 is a view in section taken on line 2—2 of Fig. 1.

Fig. 3 illustrates the coil of this invention incorporated in a radio transmitter circuit.

Like reference characters have been used in the several figures of the drawings to indicate corresponding parts.

The coil shown in Fig. 1 includes a conductor arranged in a solenoid having two sections 10 and 10′ respectively. The solenoid conductor is supported by a frame

including end plates 11 and 12 and transverse members 13 of insulating material. In contact with the conductor of coil section 10 are wipers 14 and 14′ and in contact with the coil section 10′ are wipers 15 and 15′. These pairs of wipers are attached to respective wiper arms 16 and 17. The wipers 14′ and 15′ as illustrated have no connection to an external circuit but may readily be so connected if desired. All of the wipers function as guides for the arms 16 and 17 and one or both may be used to make connection to the section of the coil with which it is associated. The arm 16 is mounted upon and slidable along a shaft 18, whereas the arm 17 is mounted upon and slidable along a hollow shaft 19.

The shaft 18 includes a reduced portion extending through the center of the hollow shaft 19 to a point beyond the end plate 11. This extension includes a conducting portion 20. A brush 20′ electrically engages the member 20 and is connected to the wiper 15 by a conductor 21. The brush 20′ is mounted upon the shaft 19 and extends through a slot provided therein. A terminal brush member 22 also electrically engages the member 20 and serves as a means for connecting the wiper 15 to an external circuit.

A gear 23 is attached to the end of the member 20 and meshes with a pinion 24 attached to a driving shaft 25 by means of which the shaft 18, arm 16 and wiper 14 may be rotated. The shaft 25 is journaled in a bearing member 26 supported by the end plate 11.

The shaft 18 carries at its opposite end a conducting extension 27. A brush 27′ engages this extension and is connected to the wiper 14 by a conductor 28. A terminal brush 29 is connected to the extension 27 for enabling external electrical connection thereto.

The hollow shaft 19 is also provided with a gear 31 in mesh with the gear 24 as a means of driving this shaft, the arm 17 and the wiper 15.

The gears 23 and 31 are arranged differentially with respect to the gear 24 so that when the shaft 25 is rotated, the shafts 18 and 19, and hence the arms 16 and 17 and the associated wipers are rotated in opposite directions. By selecting the relative size of the gears 23 and 31, the rate of rotation of one wiper may be made to be different from that of the other wiper for a given angle of rotation of the shaft 25.

Between the adjacent end turns of the coil sections 10 and 10′ the insulating members 13 are provided with T-shaped slots 30. These slots serve to increase the surface area of the insulating member between the adjacent turns of the coil sections. By this means the coil sections may be placed close together and a compact coil structure is provided, without increasing the liability of breakdown between sections at high voltage.

In Fig. 3 is shown a radio transmitter circuit including an adjustable coil of the design illustrated in Figs. 1 and 2. This circuit comprises a source of carrier waves 32, a line or circuit 33 adapted to be connected to a source of signal waves, high frequency amplifiers 34 and 35, a balanced coupling circuit 36, and an antenna 37.

The carrier wave source 32 is connected to an amplifier represented by block 38, which may be any one of many well-known forms, preferably including space discharge tubes. The output terminals of the amplifier 38 are connected to the control electrode and cathode of the amplifier 34. The amplifier 34 is in turn connected in tandem with the amplifier 35 by the resonant coupling circuit 36.

The amplifier 35 is coupled by means of a resonant circuit 47 to the antenna 37. The line 33 is connected to an amplifier, represented by block 48, which may be one of many forms, but preferably includes a space discharge tube for amplifying signal frequency waves.

The amplifier 48 is connected to the anode circuit of amplifier 35 and is arranged to supply signal frequency waves to modulate the carrier wave by the well-known constant current method invented by R. A. Heising. Space current is supplied to the amplifier 34 by a battery 49 and to amplifier 35 by the same battery in series with signal frequency choke coil 50.

The resonant circuit 36 comprises the inductance having sections 10 and 10′ and an adjustable condenser 39. The inductance 10—10′ is like that illustrated in Figs. 1 and 2. The sections 10 and 10′ are connected in series with condensers 40 and 41 which have negligible impedance for waves having frequencies of the order of the resonant frequency of circuit 36. These condensers serve to block current from the batteries 49 and 51. Since the battery 49 is of relatively high voltage there is a high voltage between the adjacent end turns of sections 10 and 10′.

The wiper 14 of section 10 is connected directly to the control electrode of the amplifier 35, whereas the wiper 15 of the section 10′ is connected to the anode of this amplifier in series with a balancing condenser 42. The condenser 42 may be adjusted to compensate for the inherent capacity between the anode and cathode of amplifier 35, thereby preventing singing or parasitic oscillations in the associated circuit.

To vary the power transmitted from the amplifier 35 to the antenna 37, the number of turns of section 10 included in the input circuit of amplifier 35 may be adjusted by means of wiper 14. Thus the voltage of waves supplied from the amplifier 34 to the

input terminals of amplifier 35 may be increased or reduced, and hence the output energy supplied by amplifier 35 to the antenna 37 may be controlled.

For proper functioning of the balancing circuit in compensating the capacity between electrodes of the amplifier, the same number of turns of the coil section 10 must be included in the path between the anode and cathode of the amplifier 35 as the coil section 11 has included in the path between the control electrode and cathode.

To maintain the proper unity ratio of turns in sections 10 and 10′, the wiper 15 must be adjusted simultaneously with the wiper 14 by an equal amount but in an opposite sense. The coil described in connection with Fig. 1 and Fig. 2 enables this adjustment to be made by a single operation as already described. The great advantage of readily effecting power adjustment, without disturbance to the balance of the compensating circuit and without the production of any undesirable oscillations, is accordingly secured.

The inductance 10, 10′ is also adapted, in cooperation with a compensating condenser 43, to balance the circuit of amplifier 34, for the prevention of undesired oscillations therein. The anode and control electrode of this amplifier are connected to variable taps 44 and 45 on the sections 10 and 10′, respectively. These taps permit the impedance of the amplifier circuits to be adjusted so as to match the impedance of the amplifier tubes for obtaining most efficient transmission of power. They may also serve as means for tuning the resonant circuit 36 or for adjusting the inductance 10, 10′ so that the condenser 39 may have a convenient size.

The carrier wave from source 32 is modulated in the amplifier 35 in accordance with signal waves, from the source connected to line 33, which are supplied through a suitable amplifier 48, to the anode circuit of the amplifier 35. The modulated waves are then selectively transmitted to the antenna 37 by the resonant circuit 47.

Although this invention has been described in connection with a specific embodiment, it is readily applicable to numerous other arrangements which will readily occur to persons skilled in the art, hence it is to be limited only by the scope of the appended claims.

What is claimed is:

1. An adjustable coil comprising a bare conductor winding, a plurality of wipers engaging said conductor, means for moving said wipers in opposite directions along said conductor, and means for coordinating the movement of said wipers.

2. An inductance coil which comprises a winding of bare conductor in the form of a helix, a plurality of conductive wipers engaging said conductor, means for imparting a rotary motion to said wipers to respectively move them at any desired fixed speed ratio along said conductor, said means comprising coaxially arranged shafts, gearing, and a driving shaft.

3. An inductance coil comprising a bare conductor arranged in a solenoid, said coil consisting of a plurality of separate sections, an insulating frame supporting said conductor, and including a member having a slot intermediate to the adjacent end turns of said sections, whereby the surface of said member between said sections is increased.

4. In an inductance coil comprising a bare conductor solenoidal winding having a plurality of sections, a wiper engaging each of said sections, a plurality of rotatable shafts coaxially positioned with respect to said winding, means supported by said shafts for maintaining said wipers in engagement with said conductor, and means for rotating said shafts at any desired fixed speed ratio.

5. An inductance coil which comprises a winding of bare conductor, a plurality of wipers engaging said conductor, a plurality of arms attached to said wipers, a plurality of rotatable shafts adapted to support said arms and to rotate said wipers, and means for causing simultaneous rotation of said shafts in opposite directions.

6. An inductance coil comprising a solenoidal winding having a plurality of sections, rotatable shafts arranged coaxially with respect to said winding, wiper arms mounted respectively upon said shafts so as to ratate with and be movable along them, wipers attached to said arms engaging said winding, and means for driving said shafts at any fixed speed ratio to cause said wipers to traverse sections of said conductor.

7. An inductance coil comprising a winding of bare conductor having a plurality of sections, a plurality of wipers engaging said conductor, a plurality of arms attached to said wipers, a plurality of rotatable shafts for supporting said arms and for rotating said wipers, and means for causing simultaneous rotation of said shafts at any fixed speed ratio.

In witness whereof, I hereunto subscribe my name this 19th day of January A. D., 1926.

HERBERT VADERSEN.