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W. W. BROWN

AUTOMATIC ANTENNA REGULATION

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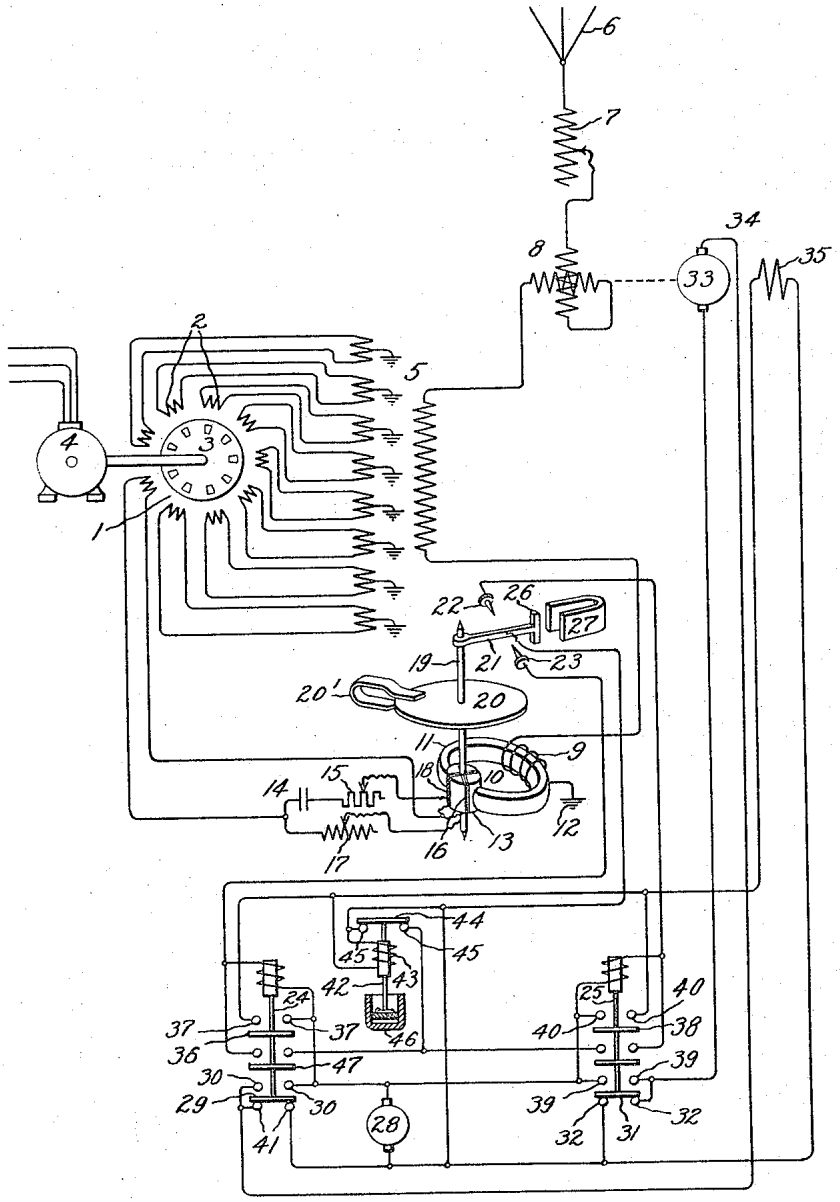

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UNITED STATES PATENT OFFICE.

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AUTOMATIC ANTENNA REGULATION.

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My present invention relates to improvements in means for regulating the resonant wave length of an antenna system.

It is an object of my invention to provide means whereby the desired relation between capacity and inductive reactances may be automatically maintained.

In carrying my invention into effect, I employ a phase relay having a rotary armature provided with two differentially related windings spaced 90° apart and supplied from a substantially constant source of alternating current. Cooperating with these windings is a stationary field member having a winding connected in series relation with the antenna. If the antenna is exactly in tune with the electromotive force supplied from the constant source, no rotation of the phase relay armature will occur. If, however, any change occurs in the capacity of the antenna, the phase relation of the antenna current and the armature currents will change, with the result that the armature will rotate either in a forward or in a reverse direction. This rotation is taken advantage of to control switching means whereby the inductive reactance of the antenna circuit may be altered to restore the tuning of the antenna to normal.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims. My invention, itself, however, both as to its organization and method of operation will best be understood by reference to the following specification taken in connection with the accompanying drawing in which the single figure shows diagrammatically a circuit organization whereby my invention may be carried into effect.

Referring to the drawing, I have indicated at 1, a well known type of high frequency inductor alternator having a plurality of armature windings 2, and a rotating field member 3 the latter being driven by a constant speed motor 4. Certain of the armature windings are connected to the primary winding of a transformer 5, the secondary winding of which is connected in series with an antenna 6. Included in circuit with the antenna 6 is a manually adjustable tuning coil 7 by means of which initial adjustment of the antenna impedance may be made, a motor operated variometer 8, and the field winding 9 of a phase relay 10. Winding 9 is mounted on a core member 11 composed of thin enameled iron strips and is connected to ground as indicated at 12.

The armature member 13 of the phase relay is energized from one of the armature coils 2 of the high frequency alternator 1. Included in circuit with the latter armature coil is a circuit including two branches, one of which includes a capacity unit 14, an adjustable resistance unit 15 and an armature winding 16, while the other branch includes an adjustable inductance unit 17 and an armature winding 18. Armature windings 16 and 18 are spaced 90° apart on the core of armature 13. With the connection shown, the impedance of the two branches may be adjusted so that the current in one branch may be displaced approximately 180° in phase from that in the other branch.

Mounted on the armature shaft 19 of the phase relay is conducting disk 20 which may be made of copper, aluminum, or other conducting material, and a switch arm 21 adapted to cooperate with a pair of contacts 22 and 23 to selectively control the energization of a pair of directional relays 24 and 25. Cooperating with the disk 20 is a damping magnet 20′. Switch arm 21 is provided at one end with a soft iron armature 26 which cooperates with a magnet 27 whereby arm 21 may be held in central position.

Energization of relay 24 closes a circuit from a generator or source of power 28 through contactor 29, contacts 30, contactor 31 and contacts 32 to the armature 33 of the variometer motor 34. At the same time a circuit is closed to the shunt field winding 35 of the motor 34 through contactor 36 and contacts 37. Energization of relay 24 will, therefore, cause operation of the motor 34 in one direction. Energization of relay 25 closes a circuit to the armature and field windings of motor 34 through contactors 31 and 38 and cooperating contacts 39 and 40. While the direction of the current supplied to the field winding 35 is not changed by energization of relay 25 it will be noted that the direction of the current supplied to the armature 33 of the motor is reversed, with the result that the direction of rotation of motor 35 is reversed. Deenergization of the reversing switches 24 and 25 closes a dynamic braking circuit for the motor armature through contactors 29 and 31 and cooperating contacts 32 and 41, so that over-

running of the variometer motor is prevented.

When the antenna is employed for telegraphy, the phase relay 10 has a tendency to follow the telegraph signals, and unless the signaling key is held down for a relatively long period of time the directional relays 24 and 25 will not remain energized long enough to cause the variometer 34 to operate through the required range. In order to ovecome this defect, I have provided a time delay relay 42 comprising a coil 43, and a contactor 44 which cooperates with contacts 45. A dashpot 46 is connected to contactor 44 so as to retard movement thereof in an upward direction.

When arm 21 engages contact 23, relay 24 is energized and the switch arms or contactors mounted thereon are moved to closed position. A maintaining circuit is now closed for the operating coil of relay 24 from the generator 28 through contactors 44 and 47. After a predetermined period of time, determined by the dashpot setting, contactor 44 is moved by relay 42 away from its cooperating contacts 45, thereby opening the maintaining circuit. If the engagement of arm 21 with contact 23 is of very short, or momentary duration, the deenergization of the operating coil of relay 24 will be controlled by the time delay relay 42, otherwise the deenergization of the relay 24 will be caused by the separation of arm 21 and contact 23.

In the operation of my device as long as the antenna and the high frequency electromotive force generated by machine 1 are in tune, the current supplied to the field winding 9 will be in quadrature with the currents supplied to windings 16 and 18 of the phase relay 10 so that no movement of armature 13 will take place. If, however, the capacity of the antenna changes from any cause, the phase relation of the currents in windings 9, 16 and 18 will change so that rotation of the phase motor or relay 10 will take place in one direction or the other, depending on the nature of the corerction to be made to the antenna. If the capacity of the antenna has decreased the phase relay will rotate in a direction to energize, for example, relay 24 to close a circuit from the source of current supply 28 to the variometer motor 34 which will cause rotation of the variometer to increase the inductance of the antenna circuit. Likewise, when the capacity of the antenna has increased from any cause, phase relay 10 will rotate in the opposite direction and cause energization of relay 25 to cause operation of the variometer 34 in the opposite direction to decrease the inductance of the antenna circuit.

By the use of a phase relay having a pair of differentially related armature windings cooperating with a third winding I obtain a relay which is particularly sensitive to changes in antenna capacity. The use of the damping magnet 20′ in connection with the phase relay makes the operation of the relay deadbeat, and positive in character.

I have found that the employment of the time delay relay 42 is especially desirable and necessary where the antenna is used for telegraphy, if proper correction is to be made in the antenna circuit for changes in the antenna wave length. While I have shown the variometer as mounted on the same shaft as the motor armature 33, obviously this connection may be made through gearing or in any suitable manner desired. By the provision of a dynamic braking for the variometer motor, any danger of overrunning by the motor is prevented.

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

1. In combination, an antenna, means including a relay for maintaining the tuning of the antenna substantially constant, said relay including a field winding and an armature cooperating therewith, said armature having a plurality of windings, means for supplying currents having a substantially constant frequency, but differing in phase, to said armature windings, and means for supplying to said field winding a current having a phase relation to the other currents which varies with variations in the capacity of the antenna.

2. In combination, an antenna, means including a relay for maintaining the tuning of the antenna substantially constant, said relay including a field winding and an armature cooperating therewith, said armature having a plurality of windings, means for supplying currents having a substantially constant frequency, but differing in phase, to said armature windings, means for supplying to said field winding a current having a phase relation to the other currents which varies with variations in the capacity of the antenna, and damping means cooperating with said armature.

3. In combination, an antenna, a source of high frequency electromotive force connected therewith, an electromagnetically operable, variable impedance for controlling the tuning of the antenna, a relay including a coil in the circuit of said antenna and a pair of coils supplied with currents having a substantially constant frequency but differing in phase, and means controlled by said relay for controlling the adjustment of said variable impedance.

4. In combination, an antenna, means whereby high frequency electromotive force may be supplied to said antenna, means including a relay for maintaining the tuning of the antenna substantially constant, said relay comprising a motor having a pair of differentially related armature windings and a field winding cooperating therewith, said

differentially related windings being supplied from a source of energy having a substantially constant frequency, and said field winding being energized by a current the phase relation of which with respect to the armature current varies with the capacity of the antenna.

5. In combination, an antenna, means whereby high frequency electromotive force may be supplied to said antenna, means including a relay for maintaining the tuning of the antenna substantially constant, said relay comprising a motor having a pair of differentially related armature windings and a field winding cooperating therewith, said differentially related windings being supplied from a source of energy having a substantially constant frequency and said field winding being energized by current the phase relation of which with respect to the armature currents varies with variations in the capacity of the antenna, and magnetic damping means cooperating with said motor.

6. In combination, an antenna, a source of high frequency electromotive force connected thereto, means including a relay for maintaining the tuning of said antenna substantially constant, said relay comprising an armature and a cooperating field winding, said armature having two windings spaced apart substantially 90°, means for supplying currents differing in phase to each of said armature windings from a source of energy having a substantially constant frequency, and means for supplying to said field winding a current having a phase relation to the armature current which varies with variations in the impedance of the antenna.

7. In combination, an antenna, motor operated means for maintaining the tuning of said antenna substantially constant, switching means for controlling the direction of operation of said motor operated means, a plurality of coils for operating said switching means, means for selectively energizing said coils in accordance with variations in the impedance of the antenna and means for maintaining the energization of said coils for a predetermined period of time independently of said selective means.

8. In combination, an antenna, means for maintaining the tuning of said antenna substantially constant, said means including an impedance unit and a motor, a plurality of magnetically operated switches for controlling the direction of operation of the motor, means for selectively energizing said switches in accordance with variations in the impedance of said antenna and a time delay switch for controlling the operation of said switches.

9. In combination, an antenna, means for maintaining the tuning of said antenna substantially constant said means including an impedance unit and a motor, a plurality of magnetically operated switches for controlling the direction of operation of the motor, means for selectively energizing said switches in accordance with variations in the impedance of said antenna, and an electromagnetic time delay relay adapted under certain conditions to control deenergization of said electromagnetically operated switches.

10. In combination, an antenna, a source of high frequency electromotive force connected thereto, means for maintaining the tuning of the antenna substantially constant, said means including a motor, an impedance unit operated thereby, means selectively energized in accordance with variations in the impedance of the antenna for operating said motor in either direction, and means for closing a dynamic braking circuit to said motor when said selectively energized means are deenergized.

11. In combination, a reversible motor, a pair of magnetically operable reversing switches for controlling the direction of operation of a motor, electromagnetically operable means controlling the energization of the reversing switches, means for maintaining the electromagnetically operable means in a normally inoperative position, and means controlled by the motor for controlling the energization of said electromagnetically operable means.

12. In combination, a reversible motor, means for controlling the direction of operation of said motor, said means including a rotary motor, a switch arm operated by the rotary motor, and a pair of contacts cooperating with said switch arm to control the direction of operation of said reversible motor, magnetic means cooperating with said switch arm to normally hold said arm in an inoperative position, and means controlled by the reversible motor for controlling the energization of the rotary motor.

In witness whereof, I have hereunto set my hand this 24th day of December, 1925.

WILLIAM W. BROWN.