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W. F. GRIMES

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RADIO SIGNALING SYSTEM

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Fig. 1

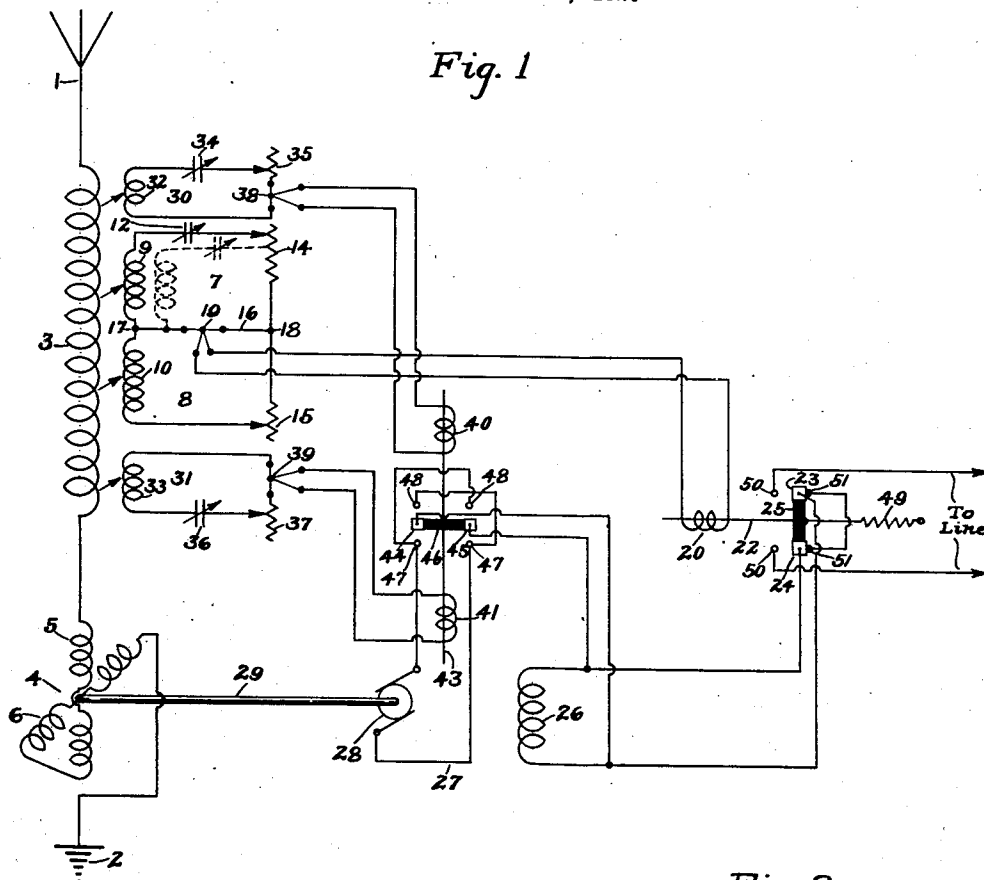


Fig. 2

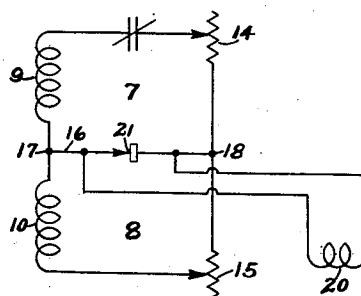
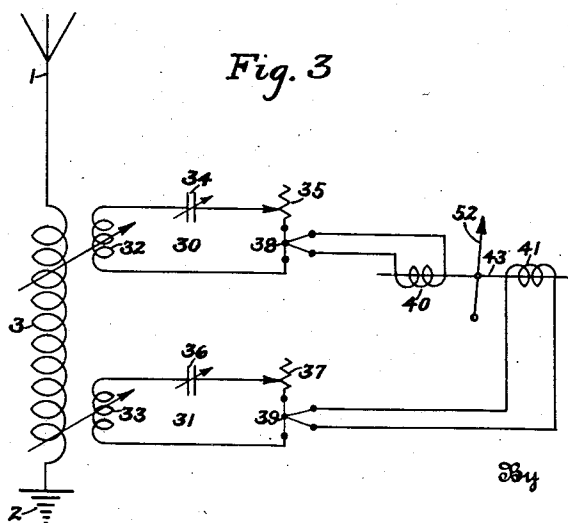


Fig. 3



Inventor
William F. Grimes

W. F. Grimes
Attorney

UNITED STATES PATENT OFFICE.

WILLIAM F. GRIMES, OF WASHINGTON, DISTRICT OF COLUMBIA.

RADIO SIGNALING SYSTEM.

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To all whom it may concern:

Be it known that I, WILLIAM F. GRIMES, a citizen of the United States of America, and a resident of Washington, District of Columbia, have invented certain new and useful Improvements in Radio Signaling Systems, of which the following is a specification.

My invention relates broadly to radio signaling systems, and more particularly to an apparatus for controlling the frequency of the signaling system whereby the signaling frequency may be maintained at a constant value irrespective of the tendency of slight variations in frequency which may occur from time to time in the signaling system.

One of the objects of my invention is to provide an apparatus which may be connected to the usual antenna circuit of the radio signaling system for maintaining the frequency of the circuit at a constant value whereby the signaling frequency is defined to all practical purposes within constant limits.

Another object of my invention is to provide an arrangement of apparatus wherein a plurality of control circuits may be coupled to the antenna circuit, a pair of the circuits being balanced with reference to each other for the desired signaling frequency so that any tendency of the antenna circuit to depart from the selected signaling frequency causes an unbalancing of the control circuit, effecting associated circuits to return the antenna circuit to its initial frequency.

Another object of my invention is to provide circuit arrangements for returning the antenna system to a particular signaling frequency where there is tendency for the same to depart from the desired frequency to a value either higher or lower than the desired frequency.

Another object of my invention is to provide means whereby the circuits of my control apparatus function sharply and without inertia to fix the frequency of the antenna system.

Other and further objects of my invention will be pointed out in the following specification by reference to the accompanying drawings, in which:

Figure 1 is a schematic diagram illustrating the arrangement of my control appa-

ratus with relation to an antenna system whereby the frequency of the same is maintained constant; Fig. 2 is a modified arrangement of balanced circuit which may be employed in the arrangement illustrated in Fig. 1; and Fig. 3 shows an application of my invention as an indicator of the frequency of the antenna system.

My invention may be applied to any circuit of alternating current, but more particularly to those of radio frequency. The fundamental operation of the apparatus depends on the reactive characteristics of tuned and untuned circuits. The reactance of an untuned circuit remains relatively constant over a wide band of frequencies while that of a tuned circuit is extremely critical near the frequency at which the reactance of the circuit is zero. Two circuits of this nature are so connected with reference to the circuit whose frequency is to be controlled that the electromotive forces induced in them, at that frequency for which the reactance of the tuned circuit is zero, are equal and opposite in phase. Normally, there will be no current flow across a common portion of these circuits, but due to slight changes in the induced frequency the two circuits become unbalanced, causing a current to flow in this common portion of the circuits. A responsive device is actuated by this current to control a frequency adjusting apparatus in the circuit whose frequency is to be controlled. Means are provided for limiting the adjusting operation in both upper and lower limits.

My invention has been illustrated as applied to a radio transmission antenna system, the character of the source of oscillations being of relatively slight importance.

Referring more particularly to Figure 1 of the drawings, reference characters 1 and 2 represent an antenna ground system, including in the circuit an inductance 3 and a frequency adjusting element 4 which may be a variometer having a stationary winding 5 and a rotatable winding 6. I provide two circuits 7 and 8 which are coupled to the inductance 3 by means of inductances 9 and 10 respectively. The circuit 7 is tuned by variable condenser 12 while the circuit 8 is untuned and the respective circuits are adjustable by means of resistances 14 and 15.

The circuits 7 and 8 have a common portion 16 between points 17 and 18, which common portion includes a device for usefully employing the circulating currents which are set up when the two circuits become unbalanced by slight change in the induced frequency.

In Fig. 1 this device is represented as a thermoelement 19 which becomes heated upon the passage of radio frequency current through the portion 16 from point 17 to point 18, and generates an electromotive force energizing the relay solenoid 20. The means for energizing this solenoidal coil 20 when the circuits 7 and 8 become unbalanced may have various forms. A crystal detector 21 may be utilized to rectify the current flowing in the portion 16 from point 17 to point 18, the potential difference actuating the solenoid 20. A dynamometer or moving coil relay may be used to cause a positive closing of the control circuit when current exists in the portion 16. The coil 20 is arranged to operate upon an armature 22 which may be in the form of a plunger carrying a pair of contacts 23 and 24 insulated from each other as indicated by member 25. These contacts form the terminals for the field winding 26 of a driving motor 27. The driving motor 27 has its armature 28 connected by shaft 29 with the axis of the rotary coil 6 of the variometer 5, so that rotation of the motor causes a change in the mutual inductive relationship of the coil 5 and 6, adjusting the frequency of the antenna circuit either upwardly or downwardly in accordance with the direction of rotation of the variometer coil. The motor is illustrated as a shunt wound machine, and means are provided for reversing the connections of the armature 28 and field 26 for causing rotation of the motor in opposite directions where the shift in frequency is either upwardly or downwardly and where the variometer coil 6 is to be rotated in either one or the other direction. This reversing means comprises frequency limiting circuits 30 and 31 detuned from each other to such a value as will determine the range through which the frequency of the signaling circuit may vary. The circuits 30 and 31 are coupled with the inductance 3 by means of inductances 32 and 33 respectively. The frequencies of the circuits 30 and 31 are fixed by means of variable capacity 34, resistance 35, variable capacity 36, and resistance 37 in the respective circuits. As the frequency of the signaling circuit approaches the natural frequency of either circuit 30 or 31 the circulating current in these circuits will reach such a value that the thermoelements 38 and 39, or other devices as heretofore described with reference to circuits 7 and 8, will function to reverse the connections between the armature and the field of arma-

ture 27, thereby reversing the direction of rotation of the motor and consequently adjusting the frequency of the antenna system. This is accomplished by solenoids 40 and 41, energized by devices 38 and 39 respectively, to move armature 43 carrying contacts 44 and 45 separated by insulating piece 46. When solenoid 41 actuates armature 43 the contacts 44 and 45 connect with terminals 47 connecting the armature 28 with the field 26. When solenoid 40 actuates spring controlled armature 43 the contacts 44 and 45 connect with terminals 48, reversing the connections between the armature 28 and field 26.

In the operation of the invention any variation in frequency in the antenna circuit causes an unbalancing of circuits 7 and 8 and a corresponding flow of current in portion 16, causing solenoid 20 to be energized. Armature 22 is attracted which shifts contacts 23 and 24 into connection with terminals 50 connecting the motor to the line. Should the current flow cease in the portion 16 the solenoid 20 becomes de-energized and member 25 is returned under action of spring 49 to terminals 51 which short the field winding 26 setting up a counter-electromotive force and bringing the motor to an abrupt stop, accurately controlling the position of the variometer coil 6 without inertia. The motor rotates in the direction corresponding to the position of armature relay contacts 44 and 45 depending upon the energization of circuit 30 or 31. The motor runs until the movement of the variometer has returned the frequency of the signaling circuit to such a value that there is no current flow in circuit 16, whereupon armature 22 is released and the field winding shunted, bringing the motor to a stationary position.

The principle of my invention is further illustrated by the schematic wiring diagram in Fig. 3 wherein the two detuned circuits 30 and 31 actuate the solenoidal windings 40 and 41 to control the position of an indicator 52 by means of armature 43. The magnetic pull of the solenoids will vary in accordance with the approximation of the signaling frequency to resonance with the frequencies of the circuits 30 and 31 respectively.

While I have shown the resonance circuit 7 in Fig. 1 as comprising a single tuned control circuit, there may be any number of tuned circuits, as represented by dotted lines 53, enabling the balanced circuit to be operated over any selected band of frequencies. The values of the frequency limiting circuits 30 and 31 are correspondingly changed in selecting different bands of frequencies for control in the antenna circuit.

While I have described my invention in certain specific embodiments, it is to be understood that various changes can be made

within the scope of the appended claims without departing from the spirit of my invention.

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

1. A signaling system, comprising in combination a signaling circuit, frequency adjusting means connected in said circuit, an inductance connected in said circuit, a balanced electrical circuit inductively coupled thereto adapted to become unbalanced upon variation in frequency in the signaling circuit, means actuated simultaneously by said unbalancing for operating said frequency adjusting means, and a plurality of means inductively coupled to said signaling circuit for controlling the direction of movement of said frequency adjusting means.

2. In a signaling system, the combination of a signaling circuit containing an inductance and a frequency adjusting means, a balanced circuit and a plurality of tuned circuits inductively coupled with said inductance, and means connected with said balanced and said tuned circuits whereby variations in frequency in said signaling circuit cause operation of said frequency adjusting means for maintaining the frequency of said signaling circuit constant.

3. In a signaling system, the combination with a signaling circuit, an inductance and a frequency adjusting means in said circuit, a plurality of electrical circuits inductively coupled with said inductance and normally balanced at the signaling frequency, a plurality of tuned circuits inductively coupled with said signaling circuit and means connected to said circuits whereby variations in said signaling frequency cause corresponding operation of said frequency adjusting means whereby said signaling circuit is maintained at constant frequency.

4. In a signaling system, the combination of a signaling circuit, an inductance and a frequency adjusting means connected therein, a pair of frequency limiting means inductively coupled thereto, a pair of circuits normally balanced at the signaling frequency inductively coupled thereto, and means connected with said frequency adjusting means operative upon the unbalancing of said circuits for actuating said frequency adjusting means within limits defined by said frequency limiting means.

5. In a signaling system, the combination of a signaling circuit containing an inductance and a frequency adjusting device, a plurality of circuits inductively coupled with said inductance, a driving motor connected to control said frequency adjusting means, a portion of said plurality of circuits including means arranged to cause rotation of said motor upon variation of frequency of said signaling circuit, and another portion of said plurality of circuits including means arranged to select the direction of rotation of said motor whereby said frequency adjusting means operate to maintain constant the frequency of said signaling circuit.

6. In a signaling system, the combination of a signaling circuit, an inductance and a frequency adjusting means connected in said circuit, a plurality of pairs of control circuits coupled with said inductance, a motor connected with said frequency adjusting means and actuated by said control circuits, one pair of said control circuits including means for starting and stopping said motor upon variation of frequency in said signaling circuit, and the other pair of said circuits including means for determining the direction of rotation of said motor whereby said frequency adjusting means operates to maintain the frequency of said signaling circuit at a constant value.

7. In a signaling system, the combination of a signaling circuit, an inductance and a frequency adjusting means connected in said circuit, a plurality of pairs of control circuits inductively coupled with said inductance, means in each of said circuits for effectively utilizing energy transferred from said signaling circuit, and means actuated by said energy for controlling said frequency adjusting means and maintaining constant the frequency of said signaling circuit.

8. In a signaling system, the combination of a signaling circuit containing an inductance and a frequency adjusting means, a plurality of frequency controlling circuits inductively coupled with said inductance, a motor for controlling the movement of said frequency adjusting means, a switching means actuated by certain of said circuits, to start and stop said motor upon variation in frequency of said signaling circuit, and a second switching means actuated by certain of said circuits to control the direction of rotation of said motor whereby the frequency of said signaling circuit is maintained constant.

WILLIAM F. GRIMES.