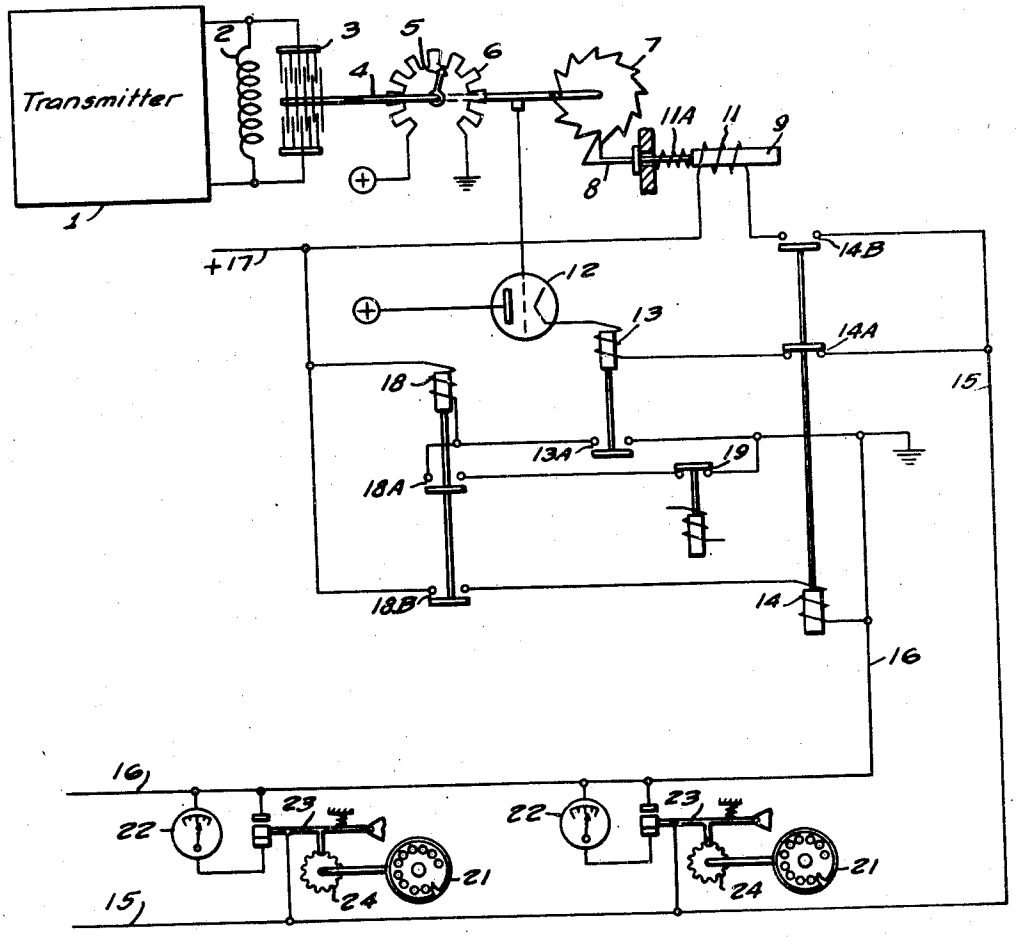
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REMOTE TUNER CONTROL SYSTEM

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REMOTE TUNER CONTROL SYSTEM

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Our invention relates to apparatus for controlling from one point, the position of a mechanism located at a distant point, and for indicating at the first-mentioned point the position of the distant apparatus at any time. The particular apparatus to which we apply our above-mentioned invention is to the controlling and indicating of the position of a tuning capacitor on a radio circuit such as the tank circuit of a radio transmitter.

In connection with the operation of radio transmitters, it is sometimes desirable to be able to control the carrier frequency generated by the transmitter, and to alter this frequency at will from any one of a number of points located at considerable distance from the transmitter. It is, of course, then desirable to have an indicator of the tuned frequency thus controlled at each one of the stations from which the control may be carried out. The indicating portion of such apparatus, to be satisfactory, must be responsive to the actual position of the tuning condenser or other controlled element at the transmitter, and not merely to the position of the device at the remote station by which the attempt to control the transmitter frequency was applied.

One object of our invention is accordingly to provide a position controlling and indicating system for a mechanism by means of which the position of the mechanism may be altered at will from a plurality of stations distant therefrom, and in which an indicating device at the station will respond to the actual position of the distant mechanism.

Another object of our invention is to provide a system of control for a variable impedance in an electric circuit by which the value of the impedance may be controlled from any one of a number of stations distant therefrom, and in which each station is provided with an indicator of the setting of the variable impedance.

Still another object of our invention is to provide a system by means of which the output frequency of an oscillation generator may be varied at will from any one of a plurality of stations distant from the generator, and in which each station is provided with an indicator, which will show the frequency being generated at any particular time.

Other objects of our invention will become apparent on reading the following description taken in connection with the drawing in which:

The single figure is a schematic diagram of an electrical distribution system for controlling the position of a tuning condenser of a radio transmitter, from a plurality of distant points in accordance with the principles of our invention.

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Referring in detail to the drawing, a radio transmitter 1 is provided with a conventional tank circuit comprising a pair of reactance elements 2 and 3, the latter being variable by mechanical positioning of one of its parts, the position of said part being controlled by a shaft 4. The shaft 4 may be supported in any manner well known in the art and may carry a movable contact 5 of a voltage divider 6 having its terminals connected respectively to the positive and grounded negative ends of a direct current voltage source (not shown). The shaft 4 is arranged to be rotated by a toothed wheel 7 and ratchet 8, this ratchet being attached to a movable magnetic core 9 of a relay winding 11. It will be evident from the foregoing description that sending a pulse of current through the winding 11 will move its magnetic core against the bias of spring 11A after which cessation of the current flow through the winding 11 will permit the spring 11A to return to its undisplaced position thereby moving the ratchet 8 to rotate the wheel 7 through the angular distance corresponding to one tooth on its periphery. Thus the toothed wheel 7 and shaft 4 are rotated through a predetermined angle for each pulse of current sent through the winding 11, and the angular position to which the shaft 4 is ultimately turned depends upon the number of pulses sent through winding 11 by dialing switch 21. Such wheel and ratchet operated by an electrically energized winding are too well known in the switching art to require more detailed description.

As the ratchet wheel 7 thus rotates shaft 4, it will be evident that the potential of the movable contact 5 varies in proportion to the number of pulses of current sent through the winding 11. The movable contact 5 is connected to the control electrode of an electron discharge tube 12 preferably of a high transconductance type and having its anode connected to the positive terminal of a direct current voltage source (not shown) and having its cathode connected through the energizing winding of a relay 13 and thence through the normally closed contact 14A of a second relay 14 to one line wire 15 of a distribution circuit running to the various distantly located stations from which it is desired to control the tuning of the tank circuit 2—3. The other wire 16 of the above-mentioned distribution circuit is connected to ground and to the negative terminal of the last-mentioned voltage source. The energizing winding of the relay 11 is connected at one

end to the positive terminal 17 of another direct current source (not shown) which has its negative terminal connected to ground, and has its other end connected through a pair of normally-open contacts 14B, controlled by the relay 14, to the line wire 15, above mentioned. One terminal of the energizing winding of the relay 14 is connected to ground, and its other terminal is connected to the positive terminal 17, above mentioned, through a pair of normally-open contacts 18B which are controlled by a relay 18. The energizing winding of the relay 18 has one terminal connected to the positive terminal 17, above mentioned, and has its other terminal connected to ground through a pair of normally-open contacts 13A which are actuated by the above-mentioned relay 13. The last-mentioned terminal of the energizing winding of the relay 18 is likewise connected to ground through a pair of locking-in contacts 18A controlled by the relay 18 which are in series with a pair of normally-closed contacts 19.

At each station to which there is a distribution circuit, comprising the line wires 15 and 16, there is located a control device in the form of a dial switch 21 of the type customarily used on dial telephones and also an indicating voltmeter 22 of conventional type having its scale calibrated to correspond with the frequencies to which the tank circuit 2—3 of transmitter 1 is tuned. The dial switch 21 is arranged when in its rest-position to connect the voltmeter 22 in shunt across the line wires 15 and 16. On the other hand, as soon as the dial switch is moved from its rest-position, the movable member 23 breaks contact with the terminal of the meter 22 and connects directly to the line wire 16. It is also arranged to operate a motor (not shown) to rotate shaft 4 to the position at which the variable reactance 3 is at one extreme of its variable range. Cam switch 24 connected to the moving dial is arranged to make and break contact with the hinged terminal of switch 23 once for each numbered position on the dial. Thus, when the dial is turned to any numbered position, for example, the fourth, under the urge of its bias spring tending to return it to its rest-position, the dial switches alternately make and break a short circuit across the distribution lines 15—16.

The mode of operation of the above-described control system is substantially as follows:

When the tuning reactor 3 is stationary at any one position at which it has previously been set, the movable contact 5 has a corresponding position on the voltage divider 6 and thus impresses a certain voltage, corresponding to this setting of the reactance element 3, on the control electrode of the electron tube 12. The amount of current flowing through the electron tube 12 is thus controlled to correspond with the position of the shaft 4 and the voltages of the system are so designed that, even when the control electrode of the tube 12 is made most strongly positive by the movable contact 5, the current through the energizing winding or relay 13 is insufficient to cause movement of the contact 13A away from the normally-open position shown in the drawing. The contacts of the other relays 11, 14 and 18 are likewise in the positions shown in the drawing. Thus the contacts 14A in series with the relay winding 13 are closed and current is able to flow from the cathode of the electron tube 12 to the line wire 15. Since all of the dial switches 21 in the control stations are likewise in the positions indicated in the drawing, current is able to flow from the line wire 15 through the cam switch 24, switch 23 and voltmeter 22 to the line wire 16. Since the latter is grounded to the negative terminal of the voltage source supplying current to the anode of the tube 12, a complete circuit exists for the current flow through the voltmeter 22. The magnitude of the current thus flowing through the voltmeter 22 is fixed by the degree of positive potential impressed on the control grid of the tube 12, as above stated, hence the indication of the voltmeters 22 at all stations on distribution circuit 15—16 will correspond to the position of the shaft 4 and thus to the frequency to which the transmitter 1 is tuned.

If now it is desired to change the frequency to which the transmitter 1 is tuned, from one of the stations served by the distribution line 15—16, the dial switch 21 at that station is moved from its rest-position to one of its numbered positions corresponding to the new frequency to which it is desired to operate the transmitter 1. Movement of the dial switch 21 from its rest-position immediately shifts the movable member 23 to break circuit with the voltmeter 22 and make contact with the line wire 16, thereby short-circuiting the line wires 15 and 16. As a result of this short-circuiting, an increased current will flow through the electron tube 12 and relay winding 13 which will be sufficient in magnitude to close contacts 13A and energize the winding of the relay 18. Thus movement of the dial switch 21 from its rest-position has likewise caused the shaft 4 to move the variable reactance 3 to an extreme position. Actuation of the movable element of relay 18 immediately follows closing its contacts 18A and establishing a holding circuit to ground through the normally-closed contacts 19. Any subsequent deenergization of the control winding of relay 13, while it results in an opening of the contacts 13A, will not cause deenergization of the relay 18 because of the presence of the holding circuit just described.

Energization of the relay 18 likewise closes its contacts 18B and results in energization of the control winding of relay 14. Actuation of the movable member of relay 14 thus follows to open the contacts 14A and disconnect the line wire 15 from the electron tube 12 while closure of the contacts 14B connects the line wire 15 to the energizing winding 11 of the tube relay. Current thus begins to flow from the positive terminal 17 through the winding 11 of relay, contact 14B, line wire 15, cam switch 24 and switch 23 and line wire 16 to ground. Thus a pulse of current is sent through the winding 11 of relay to displace the ratchet 8 and wheel 7 and rotate the shaft 4. The value of the variable reactor 3 is thus altered to change the frequency of the transmitter 1 by a predetermined step.

However, as the dial 21 moves toward its rest-position, the cam switch 24 breaks the short circuit across the lines 15—16 thereby interrupting current flow through the winding 11 and permitting the ratchet 8 to snap back to its original position, but without turning the toothed wheel 7 from the position to which it has been rotated. Immediately thereafter, further travel of the dial again closes the cam switch 24 to send a second pulse of current through the winding 11 of the relay thereby operating the ratchet 8 to make another predetermined change in the frequency of the transmitter 1. A number of such changes of the frequency of the transmitter 1 corresponding to the numbered position to which the dial switch has been turned will obviously result from the movement of the dial to its rest-position.

When the dial reaches its rest-position, it is arranged to open the normally-closed contacts 19 for a brief period of time thereby deenergizing the relay 18, which in turn deenergizes the relay 14. Deenergization of the relay 14 opens the contacts 14B which have energized the winding 11 of the relay and no further movement of the ratchet 8, toothed wheel 7, shaft 4, and variable reactor 3 can take place until the dial switch 21 at one of the control stations is again moved from its rest-position.

Deenergization of the relay 14 results in reclosure of the normally-closed contacts 14A to again connect the electron tube 12 through line wire 15, dial switch 21 and voltmeter 22. As a result of a new position which has been assumed by shaft 4 in consequence of the above-described movement, the potential of the control electrode of the electron tube 12 has a new value corresponding to the frequency now impressed on transmitter 1. The indication of voltmeter 22 at each station on circuit 15—16 will thus correspond to the frequency of the transmitter 1 at all settings of the latter.

The resistance of the voltmeter 22 is naturally high so that the current flowing through the electron tube 12 and relay winding 13 is too small to cause actuation of the relay 13 until the resistance of the voltmeter 22 has been cut out of circuit by the dial switch 21. The resistance of the line wires 15 and 16 is likewise easily made small compared with our resistance of the voltmeter even though the distribution circuit covers stations quite remote from the transmitter.

The system has the advantage of employing standardized equipment such as ordinary voltmeters and telephone dial switches which are manufactured in large quantities and available at low cost. It is possible to change the number of control stations over a wide range by merely connecting additional stations to the circuit 15—16, and without the necessity of making alterations in other parts of the system. Furthermore, a single pair of line wires performed both the indicating and control functions for the various stations.

We claim as our invention:

1. In combination with a radio transmitter, a variable circuit element therefor controlled by mechanical movement, an electric motor adapted to cause a predetermined magnitude of said mechanical movement upon being energized by a current pulse, an electron tube having a control electrode and a cathode, means for varying the potential of said control electrode relative to said cathode in correspondence with the amount of said mechanical movement, a distribution circuit connecting a plurality of stations remote from said circuit element in series with said electron tube through a first pair of switch contacts, an indicator at each station connected across said distribution system by a movable switch having a rest-position and provided with means for alternately making and breaking a short circuit across said distribution system a predetermined number of times when it is displaced from its rest-position but for connecting said indicator across said distribution system in its rest-position, and means for energzing said motor with a current pulse each time said dial switch makes and breaks the short circuit across said distribution system.

2. In combination with an electric circuit, a variable circuit element therefor controlled by mechanical movement, an electric motor adapted

to cause a predetermined magnitude of said mechanical movement upon being energized by a current pulse, an electron tube having a control electrode and a cathode, means for varying the potential of said control electrode relative to said cathode in correspondence with the amount of said mechanical movement, a distribution circuit connecting a plurality of stations remote from said circuit element in series with said electron tube through a first pair of switch contacts, an indicator at each station connected across said distribution system by a movable switch having a rest-position and provided with means for alternately making and breaking a short circuit across said distribution system a predetermined number of times when it is displaced from its rest-position but for connecting said indicator across said distribution system in its rest-position, and means for energizing said motor with a current pulse each time said dial switch makes and breaks the short circuit across said distribution system.

3. In means for remotely controlling the position of a mechanism, an electric motor adapted to displace said mechanism by a predetermined amount for each of a succession of current pulses flowing through said motor, an electron tube energized from a voltage source and provided with a control electrode, means for impressing a potential on said control electrode relative to its cathode corresponding in magnitude to the various positions of said mechanism, a relay actuated by current flow through said electron tube when said current flow exceeds a predetermined magnitude, means for connecting said relay in series with a distribution circuit and said electron tube, switching means on said distribution circuit adapted in its rest-position to connect a current responsive indicator across said distribution circuit, and in its moving position, to alternately short-circuit and open-circuit a path across said distribution circuit, said relay means being actuated whenever said distribution circuit is short circuited, switching means to disconnect said electron tube from said distribution circuit when said relay is actuated and to connect said distribution circuit in series with the energizing winding on said motor through a voltage source, and means responsive to the return of said movable switching means to its rest-position to disconnect said distribution circuit from said motor winding and re-connect it to said relay means and said electron tube.

4. In combination with a rotatable shaft, a mechanism linking said shaft with an electric motor, said mechanism being of a type which rotates said shaft through a predetermined angle each time said motor winding is energized, an electron tube having principal electrodes and a control electrode, means to impress a voltage on said control electrode which varies with the angular position of rotation of said shaft, a distribution circuit in series with a first switching means and the principal electrodes of said electron tube, a second switching means having a rest-position and means for moving it back to its rest-position when it is displaced therefrom, means for opening said first switching means whenever said second switching means is displaced from said rest-position and for then connecting said distribution circuit to energize a winding on said motor from an electrical power source and means for causing movement of said second switching means from a displaced position to its rest-position to alternately energize and deenergize said winding of said motor periodically for a number

of times corresponding to the displacement of said second switching element from its rest-position.

5. In combination with a rotatable shaft, a mechanism linking said shaft with an electric motor, said mechanism being of a type which rotates said shaft through a predetermined angle each time said motor winding is energized, an electron tube having principal electrodes and a control electrode, means to impress a voltage on said control electrode which varies with the angular position of rotation of said shaft, a distribution circuit in series with a first switching means and the principal electrodes of said electron tube, a second switching means having a rest-position and means for moving to rest-position when it is displaced therefrom, means for opening said first switching means whenever said second switching means is displaced from said rest-position and

for then connecting said distribution circuit to energize a winding on said motor from an electrical power source, means for causing movement of said second switching means from a displaced position to its rest-position to alternately energize and deenergize said winding of said motor periodically for a number of times corresponding to the displacement of said second switching element from its rest-position, and means for connecting a voltage indicated device across said distribution circuit when said second switching means is in its rest-position.

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