May 6, 1941. W. T. POWELL 2,241,157

REMOTE CONTROL SIGNALING SYSTEM

Filed Nov. 10, 1938 2 Sheets-Sheet 1

Fig. 2

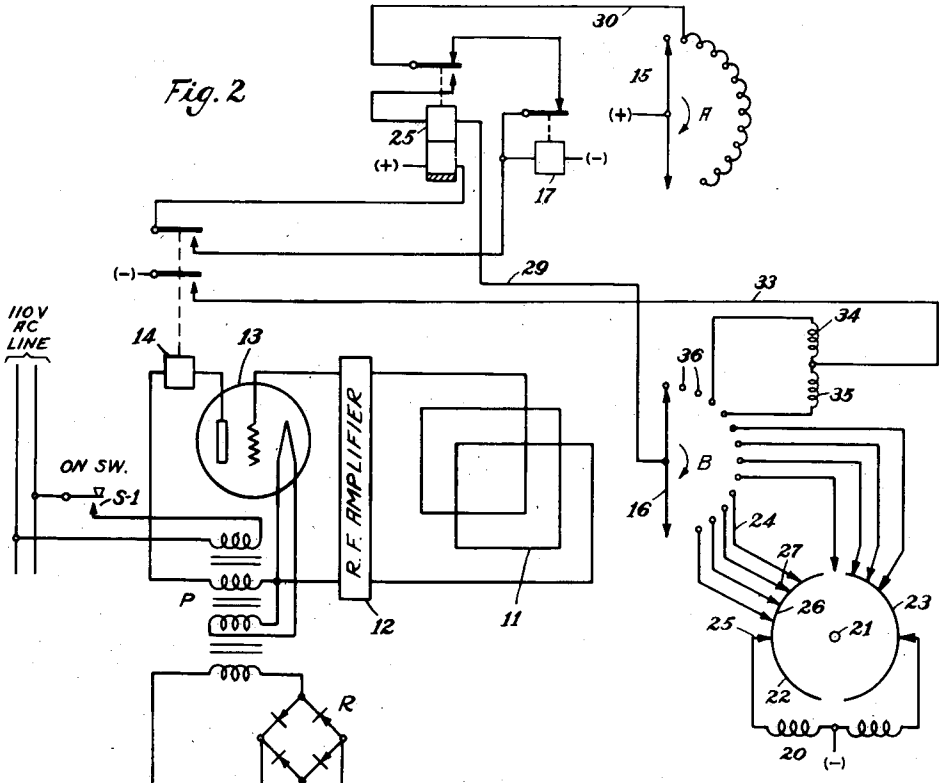


Fig. 1

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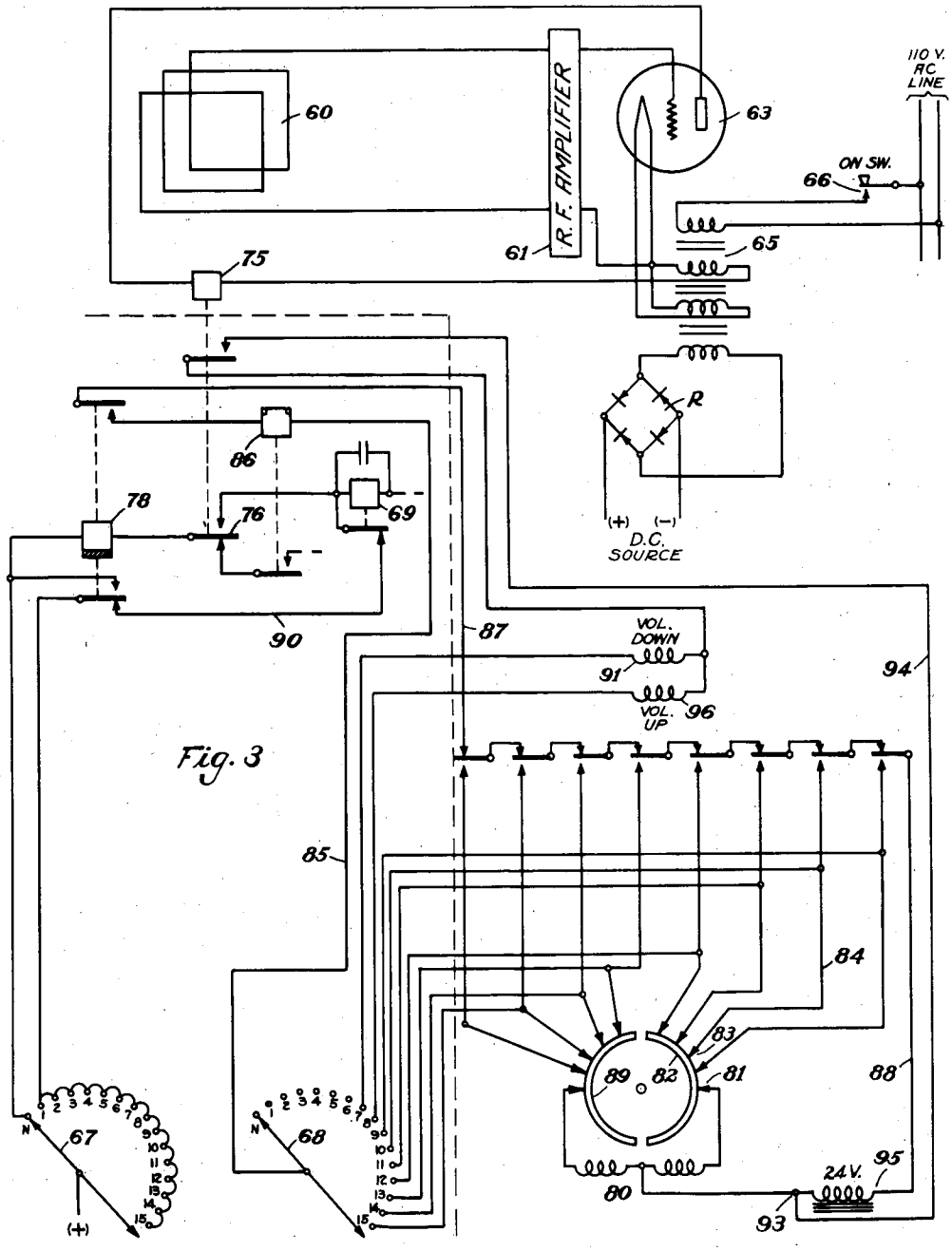


Fig. 3

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UNITED STATES PATENT OFFICE

2,241,157

REMOTE CONTROL SIGNALING SYSTEM

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Application November 10, 1938, Serial No. 239,852

1 Claim. (Cl. 250—20)

This invention relates to remote control systems.

In one type of remotely controlled system it has been proposed to utilize remotely generated impulses of radio frequency energy, transmitted without wire connection, to direct the selection of a selectively operated device which may be a remotely controlled radio receiver. However, prior systems of this type have required complicated interacting mechanisms which are expensive to make and which are subject to operating failures. Furthermore such systems have been so designed that they are susceptible to "foreign" current disturbances that can cause faulty operation.

In accordance with the main feature of the present invention, there is provided a remotely controlled system of this type in which simplified mechanical devices and novel circuit design are used to the end that simple, reliable operation can be effected.

Other features and advantages of the invention will appear from the detailed description and claim when taken with the drawings in which

Fig. 1 is a diagrammatic showing of a unit comprising a radio frequency transmitter adapted to transmit low intensity radio frequency selecting impulses into the air under the control of an impulse sender;

Fig. 2 diagrammatically represents a selecting unit, including circuits, adapted to effect a selecting operation under the control of impulses received from the transmitter;

Fig. 3 diagrammatically illustrates a modified selecting unit.

Referring especially to Fig. 1, the reference character 5 designates a radio frequency vacuum tube oscillator or generator of any well known design adapted to transmit radio frequency impulses into the air through a loop antenna 6 under the control of an impulse sender S. This impulse sender may be of the construction commonly employed in automatic telephone systems of which one type is disclosed in the patent to Manson #1,555,683 granted September 29, 1925. This impulse sender includes shunt springs 7 which complete the filament circuit of the vacuum tube in the radio frequency current to the loop antenna whenever the dial of the sender is operated away from its normal position. This sender also includes impulse springs 8 and 9 which in the restoring movement of the dial periodically interrupt the plate circuit of the generator and thereby develops a desired number of radio frequency impulses occurring in timed sequence. This transmitting unit, however, may be of any well known construction wherein such properly timed radio frequency impulses may be transmitted into the air, since the present invention is concerned primarily with the network for receiving such impulses and for utilizing them to effect a selecting operation in response thereto as illustrated in its preferred form in Fig. 2.

The receiving unit comprises an antenna 11 preferably of the loop type in which the radio frequency impulses are intercepted. The radio frequency signals or impulses, thus intercepted, are amplified in a radio frequency amplifier 12 comprising one or more vacuum tube amplifying stages. It will be understood that the amplifier 12 should effect such amplification that it will operate an electrostatically controlled arc device 13 coupled thereto, of the type commonly sold under the trade name "Thyratron." The plate circuit of this Thyratron is energized from one winding of the power transformer P, the primary winding of which is connected through an "on" and "off" switch S1 to a commercial source of alternating current preferably of 110 volts 60 cycle frequency and herein designated an A. C. line. An additional winding of the mentioned transformer energizes the cathode of the Thyratron tube. A further winding of the transformer energizes a full wave rectifier R to afford a source of direct current. The plate circuit of the Thyratron includes a relay 14 so that as the Thyratron 13 periodically effects the flow of its plate current in response to a series of radio frequency impulses, the relay 14 will be likewise energized and deenergized in accordance with these impulses. This source furnishes power for the various relays and magnets shown in the diagram. However, in order to simplify the showing, the several circuits have not been traced to this source but instead the positive designation (+) and the negative designation (—) have been used.

The energization and deenergization of the relay 14 controls the operation of a progressively movable stepping switch of the construction employed in automatic telephone systems and of the type disclosed in the patent to Forsberg et al. #1,472,465 granted October 30, 1923. This switch comprises two parallel rows of stationary contacts arranged in pairs or sets spaced in parallel relation in the arc of a circle. A pair of brushes or wipers 15 and 16 one of which is individual to the end row is mounted on a common shaft

arranged to step the brushes progressively into engagement with successive sets of fixed contacts under the control of a stepping magnet 17. The stepping magnet actuates a pawl (not shown) which, on its return movement engages a ratchet, likewise not shown, on the shaft on which the brushes of the stepping switch are mounted. The stepping switch, when in its normal position has its brushes in engagement with a "home" set of the fixed contacts which are not connected in any circuits.

The mentioned switch in several positions of its brushes is adapted to complete desired circuits for a selecting unit which in the present instance comprises a reversible motor 20 having mounted on its shaft 21, two semi-circular commutator segments 22 and 23. It should be mentioned that the motor shaft 21 may be coupled to the tuning element of a radio receiver (not shown) in the manner more fully disclosed in the patent to Manson and Graham #1,926,393 granted September 12, 1933. It will be understood however, that instead of operating a reversible tuning motor, the stepping switch may control circuits for effecting the operation of any other selectively operable controlling unit.

In considering the operation of the system, let it be assumed that a desired station or program selection can be effected by transmitting ten radio frequency impulses. The impulse transmitter at the transmitting unit is actuated by rotating the dial for example as in a clockwise direction. As soon as the dial is off normal to close its shunt springs 7, uninterrupted radio frequency current is transmitted from the generator 5 and through the antenna 6 into the air. This signal is intercepted on the antenna 11 of the receiving system. The intercepted signal is amplified by the amplifier 12 which in turn operates the Thyratron 13 coupled thereto, causing pulsating direct current to flow in its plate circuit for energizing the relay 14. As soon as the relay 14 is energized, it completes a circuit from the positive pole of the current source, lower winding of the slow releasing relay 25, uppermost front contact and armature of relay 14, winding of the stepping magnet 17 of the multiposition switch, to the negative pole of the current source. The stepping magnet 17 attracts its armature but the pawl connected thereto does not rotate the shaft of the switch until the stepping magnet deenergizes. As the dial at the transmitting unit rotates to its normal position in a counterclockwise movement, it actuates its impulse springs 8 and 9 to interrupt the radio frequency current being transmitted by the generator 5 and the antenna 6. In response to each of the interruptions in the radio frequency current effected by the impulse springs, the relay 14 deenergizes, however, the relay 25, since it is of the slow releasing type, remains energized during the brief interruption of the radio frequency current caused by the dial and only deenergizes when its circuit is interrupted for a longer interval. Thus the relay 25 holds its armature attracted during the transmitting of impulses so that the release circuit, to be described, of the stepping switch is not completed. In response to each of the interruptions of the radio frequency current and the consequent deenergization of the relay 14, the circuit for the stepping magnet 16 previously described as extending through the uppermost armature of relay 14, is interrupted and in response to each interruption, the stepping magnet advances the switch brushes 15 and 16 one step into engagement with the next set of fixed contacts.

Since it has been assumed that the impulse transmitter effects ten interruptions in the radio frequency current, the stepping magnet 16 will be energized and deenergized ten times causing the brushes of the stepping switch to engage the tenth set of fixed contacts therein. This completes a circuit for the reversible motor 20 from the negative pole of the source, left hand field winding of the motor, contactor 25 in engagement with commutator 26, contactor 27, conductor 24, switch brush 16, conductor 29, upper winding of the slow releasing relay 25, its front contact and armature, conductor 30, switch brush 15, to the positive pole of the current source. It will be noted that the slow releasing relay 25 is locked operated in this circuit so that at this time it is independent of the control of the relay 14. With this last described circuit completed, the motor 20 rotates in a counterclockwise direction until its contactor 27 is in the non-conducting space between the commutator segments 23 and 26, at which time the motor ceases to operate in as much as it has effected the desired tuning operation. Also at this time, the circuit for the slow releasing relay 25 is interrupted so that it deenergizes. As soon as this is effected, a release circuit is completed from the negative pole of the current source, winding of the stepping magnet 17, its armature and back contact, back contact and armature of the relay 25, conductor 30 and thence successively through the fixed contacts of the upper row and brush 15 of the switch, to the positive pole of the current source. Under the control of this circuit the stepping magnet steps the switch to its home position as illustrated in Fig. 2. Thus the stepping switch is restored to its normal or "home" position at the conclusion of its operation instead of at the beginning of its operation as in former arrangements of this type, thereby reducing the duration of the period required for station selection.

It should be noted that if through error, the operator again sends ten impulses, the selecting unit will not cause an incorrect selecting operation, since the circuits will operate in the manner just described to advance the switch brushes 15 and 16 into engagement with the tenth set of contacts of the switch, but since switch brush 16 and fixed contact engaged thereby are connected through the conductor 24 to the contactor 27 which is positioned between the commutator segments, the locking circuit for the slow releasing relay 25 will not be completed and the stepping magnet 17 will merely restore the switch brushes to their normal position.

If the present selective system is used in controlling the operation of a radio receiver, it is essential that it be possible to effect changes in the volume of the signal reproduced by the radio receiver. In order to effect this result, the system is arranged so that a predetermined number of impulses from the transmitter will effect an increase in volume and a different predetermined number of impulses will effect a decrease in volume. For example, in the arrangement shown, the transmission of three impulses can effect a decrease in volume. In response to these three impulses the stepping switch is operated in the manner previously described until its brushes are in engagement with the fourth set of contacts. The operator at the transmitting station depresses the push button PB before dialing, which prevents the return of the dial to the posi-

tion for opening shunt spring 7. This causes an uninterrupted radio frequency current to be transmitted which in turn maintains the relay 14 energized as long as the button is depressed. With the relay 14 energized, a circuit is completed from the negative pole of the current source, inner armature and front contact of the relay 14, conductor 33, to the positive pole of the source, through winding 34 of the reversible motor which is coupled to the volume control mechanism (not shown) of the radio receiver. The relay 14 is maintained energized until the desired volume is being reproduced, at which time the operator removes his finger from the push button and allows shunt springs 7 to open, which deenergizes relay 14. Relay 25 thereupon deenergizes so that the selfinterrupting stepping circuit for the stepping magnet 17 of the switch is completed through the back contact and armature of relay 25 and through the successive contacts and switch brush 15 of the switch until it is restored to its normal position.

In the event that the operator desires to increase the volume, four impulses are transmitted so that the stepping switch advances its brushes 15 and 16 into engagement with the fifth set of switch contacts. The operator by depressing the push button PB can energize the field winding 35 of the volume control motor in the manner similar to that already described until the desired volume of reproduction is effected. Then the control network restores to normal as previously described.

In arrangements of this type, provision must be made for preventing transient electrical effects or surges of foreign current from causing incorrect operation of the system. In the present arrangement, it will be noted that the contacts 36 are left blank, that is not connected to the control equipment. Thus one or two recurring surges which might operate the Thyratron tube and might effect stepping of the switch, will have no effect on the tuning adjustment, so that the system will effect a selecting operation only in response to radio frequency impulses of predetermined recurrence.

In the modified form of the invention shown in Fig. 3 the control unit is provided with a circuit arrangement for operating the reversible motor from an alternating current source. In this modified arrangement, the radio frequency impulses are intercepted on a loop antenna 60 and introduced into the radio frequency amplifier 61 which may comprise one or more amplifying stages including vacuum tubes. The output of this amplifier is introduced into the input of an electrostatically controlled arc discharge device 63 or "Thyratron." This Thyratron functions in the manner described to energize the relay 75 included in its plate circuit, in response to each series of radio frequency impulses. The plate circuit of this Thyratron is energized from one winding of the power transformer 65, the primary winding of which is connected through an "on" and "off" switch 66 to a commercial source of alternating current preferably of 110 volts 60 cycle frequency and herein designated an A. C. line. An additional winding of the mentioned transformer energizes the cathode of the Thyratron tube while a further winding of the transformer energizes a full wave rectifier R to afford a source of direct current. In this arrangement also, there is provided a multi-stage progressively movable switch having the brushes or wipers 67 and 68, which are stepped by a stepping magnet 69 over the respective sets of contacts. The switch may be of the type previously referred to. At the right of the broken vertical line in Fig. 3 there is illustrated a reversible alternating current motor having its shaft coupled to the tuning element or elements of a device such as a radio receiver which is to be selectively operated. Above this motor there is illustrated a series of keys which may be located at the radio receiver or other device to be controlled so that by the operation of these keys the radio receiver or other device may be selectively operated independently of the remote control arrangement which is associated therewith.

With this brief description of the mechanism employed, it is believed that this modified form of the invention will best be understood by describing the steps involved in adjusting the receiver or other device to effect a desired condition. Let it be assumed that the operator at a distant point desires to select station #4, the operator will then operate the dial sender at the remote point to transmit ten impulses. As soon as the dial is rotated from its normal position the shunt springs 7 are closed which results in energizing the radio frequency generator to transmit uninterrupted radio frequency current through the loop 6 into the air. This continuous radio frequency current is intercepted on the loop 60 associated with the receiving unit. The uninterrupted radio frequency signal thus intercepted is amplified by the radio frequency amplifier 61 and operates the Thyratron which in turn energizes the relay 75 in its plate circuit. The relay 75, when operated, closes its lowermost armature 76 and front contact. This completes a circuit from the negative pole of the direct current source, winding of the stepping magnet 69, front contact and armature 76, winding of the slow releasing relay 78, switch brush 67, in its normal position, to the positive pole of the direct current source. The completion of this circuit energizes the slow releasing relay 78 which thereby interrupts the release circuit of the switch and energizes the stepping magnet 69 to advance the switch brushes 67 and 68 into their #1 position. In the further operation of the impulse sender at the remote station 10, impulses in properly timed sequence, are transmitted through the loop 6. In response to each of these impulses the relay 75 operates its armature and subsequently retracts them again. In response to each attraction of the armature 76 of the relay 75, the stepping magnet 69 is energized from the negative pole of the direct current source, winding of the stepping magnet, front contact and armature 76, winding of the slow releasing relay 78 through the lower front contact and armature of this relay, brush 67 and the contact with which it is now in engagement, and thence to the positive pole of the direct current source.

It will be understood that the slow releasing relay 78 has such characteristics that it holds its armature attracted even though its energizing circuit is briefly interrupted by the operation of the relay 75 in response to the transmitted series of impulses. However, at the close of the series of impulses when the relay 75 retracts its armatures for a longer period, the slow releasing relay 78 deenergizes to effect the release of the receiving unit as will be further described. In response to each of the ten impulses transmitted by the impulse sender, the operation last described for the stepping magnet 69 will be repeated so that the brushes 67 and 68 will be

stepped into engagement with the tenth set of contacts which are the set of contacts effecting the selection of the #4 station. As soon as the stepping switch has completed its operation in the manner described, a circuit is closed from one pole of the alternating current source, field winding of the reversible motor 80, contactor 81 in engagement with the semi-circular commutator 82, contactor 83, conductor 84, switch brush 68 in its 10th position, conductor 85, winding of the alternating current-operated relay 86, upper front contact and armature of slow releasing relay 78, conductor 87, and thence through the normally closed contacts of the series stations selecting keys, at the radio receiver, conductor 88 to the other pole of the alternating current source. Under the control of this circuit, the motor 80 rotates in such a direction that its contactor 83 is brought into the non-conducting space between the commutator segments 82 and 89 so that the operating circuit of the motor is interrupted. This of course, takes place when the motor has adjusted the tuning element of the radio receiver to effect the #4 station selection. As long as the A. C. relay 86 is energized, that is during the operation of the tuning motor, the slow releasing relay 78 is held operated to prevent the release of the stepping switch. This circuit for relay 78 extends from the negative pole of the current source, front contact and armature of relay 86, back contact and armature of relay 75, winding, lower front contact and armature of relay 76, brush 67 of the stepping switch to the positive pole of the source.

At the conclusion of the reception of the 10 series of impulses and after the mentioned operation of the motor has been completed, the slow releasing relay 78 deenergizes, since its operating circuit is now open at the armature and front contact of relay 86. This completes a self-interrupting circuit for the stepping magnet 69 so that the brushes 67 and 68 of the stepping switch are restored to their normal position as indicated. The selfinterrupting circuit of the motor magnet is traceable from the negative pole of the current source, winding of the stepping magnet 69, its armature and back contact, conductor 90, back contact and armature of the relay 73 through the successive contacts of the stepping switch and its brush 67 to the positive pole of the current source. This circuit of course, is completed at each of the successive contacts of the switch until the switch is restored to its normal position.

In the event that the program reproduced from station #4 is too loud, the operator at the remote point operates the impulse sender to transmit seven impulses which are effective in the manner already described to advance the brushes 67 and 68 of the stepping switch into engagement with the seventh set of fixed contacts thereof. In this adjustment of the switch as long as the push button is depressed to maintain the relay 75 operated, the volume control circuit is maintained completed. This circuit which includes the field winding 91 of a reversible volume control motor is traceable from the terminal 93 of the power transformer, which is connected to the alternating current source, conductor 94, front contact and armature of relay 75, winding 91 of the mentioned motor, switch brush 68 in its seventh position, conductor 85, winding of the alternating current relay 86, upper front contact and armature of slow releasing relay 78 and thence through the normally closed contacts of the station selecting keys and conductor 88 to the other terminal 95 of the power transformer. Thus this circuit is closed as long as the relay 75 is operated, that is as long as push button PB associated with the impulse sender is depressed so that the volume control motor will reduce the volume of the program reproduced by the radio receiver. When the push button at the impulse sender is released, relay 75 deenergizes which in turn effects the release of the slow releasing relay 78 so that the stepping switch is restored to its normal position. In the event that the selected program is not being reproduced at the desired volume, the operator at the distant point will operate the impulse sender to transmit eight impulses. This is effective to advance the stepping switch brushes into engagement with their eighth set of contacts. In this position of the switch, a circuit similar to that described for the field winding 91 of the volume control motor is completed, but in this instance, the circuit is completed through the other field winding 96 of this motor which operates to increase the volume.

What I claim is:

In a remotely controlled radio receiving system, a radio receiver provided with tuning mechanism and with volume control mechanism, means for generating several series of electrical impulses in accordance with predetermined codes, means including a primary relay operated in response to each impulse of several series of properly timed electrical impulses in accordance with predetermined codes, a slow releasing relay operated and maintained operated in response to each series of said impulses, selectively operated circuit controlling means actuated in response to impulses, a reversible motor in said tuning mechanism for operating the same, means including selectively operable keys provided with circuits associated with said radio receiver for controlling said motor to effect a desired operation of said tuning mechanism, another motor for operating said volume control means and circuits for said motors jointly completed by said circuit controlling means and by said slow-releasing relay and by certain of the contacts of said keys.

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