May 21, 1935. L. W. REINKEN 2,002,353

REMOTE CONTROL DEVICE

Filed Feb. 27, 1932 2 Sheets-Sheet 1

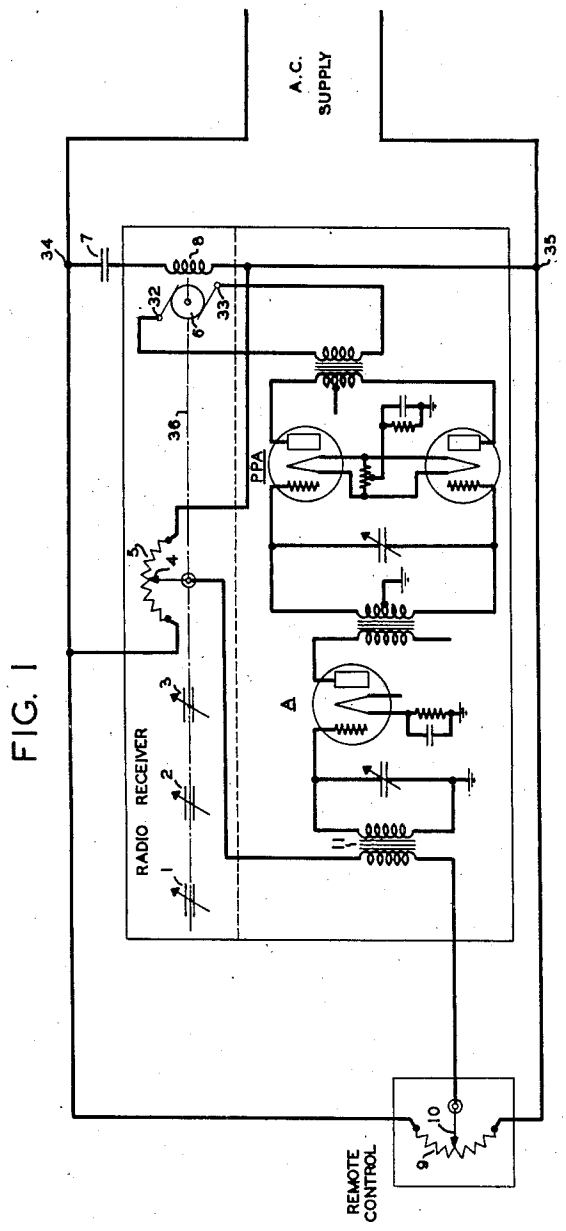


FIG. 1

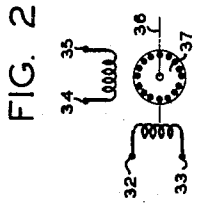


FIG. 2

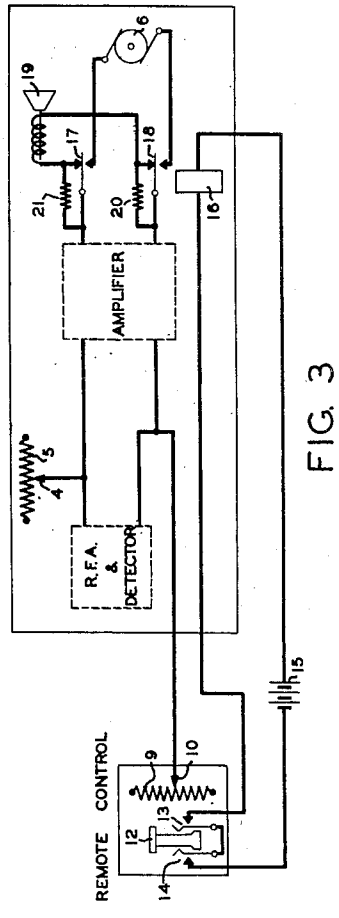


FIG. 3

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May 21, 1935. L. W. REINKEN 2,002,353

REMOTE CONTROL DEVICE

Filed Feb. 27, 1932 2 Sheets-Sheet 2

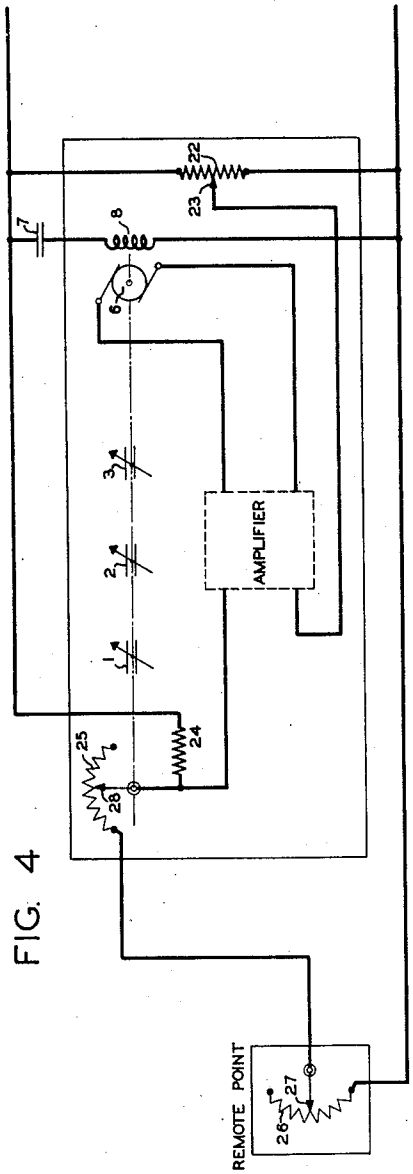


FIG. 4

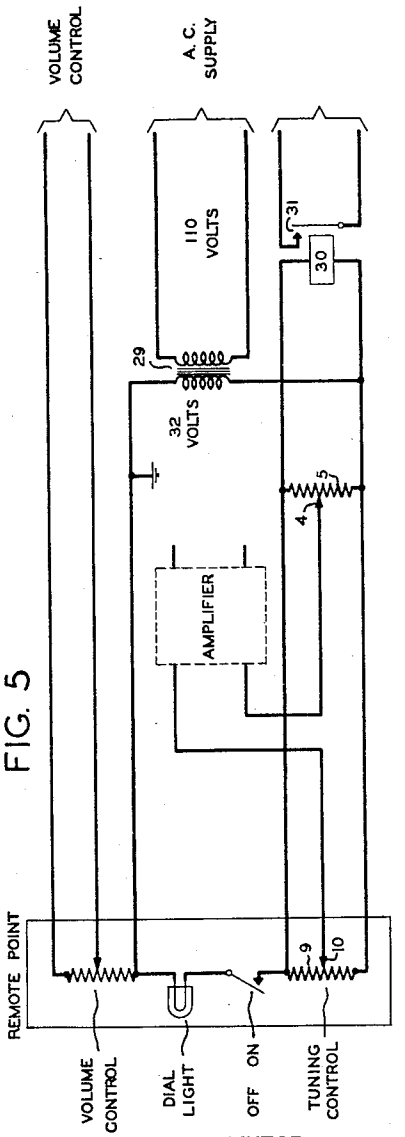


FIG. 5

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Patented May 21, 1935 2,002,353

UNITED STATES PATENT OFFICE

2,002,353

REMOTE CONTROL DEVICE

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Application February 27, 1932, Serial No. 595,560

3 Claims. (Cl. 250—40)

This invention relates to remote control devices, and particularly to remote control devices adapted for use with radio receivers.

The object of the invention is to produce an improved form of remote control which is especially adapted for radio receivers and which is rugged, economical, efficient, precise, rapid, and easy to operate.

The particular features of the invention will be pointed out in the description.

In the drawings:

Fig. 1 is a circuit diagram of one form of the remote control device of my invention, applied to a radio receiver shown schematically;

Fig. 2 is a diagram of an alternative form of motor to that shown in Fig. 1, which may be connected in the same system;

Fig. 3 is a circuit diagram showing the remote control device of Fig. 1 with the amplifier of the remote control device also acting as the audio amplifier of the radio receiver, and showing auxiliary means for turning the radio receiver on and off;

Fig. 4 is a circuit diagram of another form of my invention, applied to a radio receiver shown schematically; and

Fig. 5 is a circuit diagram of my invention showing the circuit connections for a complete remote control unit, that is, one which includes means for switching the set on and off and controlling the volume of the received signal, as well as for tuning the set.

In Fig. 1, a radio receiver is shown in block, with gang condensers 1, 2 and 3 for tuning. A potentiometer tap 4 for a potentiometer 5 is mounted on, or geared to, the same shaft as the gang tuning condensers. This shaft is turned by a motor 6. The armature of this motor is provided with current from the output of a two-stage amplifier, the first stage consisting of a single vacuum tube A, and the second, a power stage, consisting of two vacuum tubes PPA arranged in push-pull. The power stage may also be a single tube if desired. The motor field 8 is supplied with current from an alternating current supply through a condenser 7 which controls the phase of this current. It will be noted that potentiometer 5 is connected directly across the alternating current supply. A second potentiometer 9 which is at the remote point from which it is desired to tune the set, is also connected directly across the alternating current supply. A tap 10 on this potentiometer may be adjusted to control the tuning of the set. Taps 4 and 10 to the two potentiometers are connected together through the primary of an input transformer 11 to the amplifier. The amplifier, which, as previously noted, consists, in the showing of Fig. 1, of two stages of amplification, the second stage being push-pull, may be of any desired type and has any usual circuit arrangement. The input circuits to each stage of amplification may be tuned by means of the variable condensers shown, in order to obtain maximum voltage amplification. The circuits of the radio receiver itself are not shown in Fig. 1 and are indicated only by the gang tuning condensers 1, 2 and 3.

If it is desired to change the tuning of the radio receiver from the remote control point, the setting of the tap 10 on potentiometer 9 is changed. Before this change was made taps 4 and 10 were at equal potential points on the potentiometers. With the change in tap 10 there will now be a voltage difference between these two points and, consequently, a voltage across the primary of transformer 11. The phase relationship of the voltage at tap 10 with respect to the voltage at tap 4 will depend on the direction in which the adjustment was made; that is, if tap 10 was adjusted upward on the diagram, the phase at this point will lead, say, the phase at tap 4, while if it was adjusted downward, the phase at this point will lag the phase at tap 4. This voltage difference will be amplified in the amplifier and applied to the armature of motor 6.

Since the phase of the current in the field 8 of the motor has been adjusted by the condenser 7, the motor will turn in one direction or the other, depending on whether the voltage at tap 10 leads or lags the voltage at tap 4. The motor will turn the rotors of condensers 1, 2 and 3 to retune the set in accordance with the change in tap 10. The motor will also adjust the tap 4 on potentiometer 5 to restore the balance between taps 4 and 10. When this balance is restored there will be no voltage difference between taps 4 and 10 and the motor will stop. The condensers are, of course, adjusted so that at this point the set is tuned to the new wave length desired.

In one tuning control unit which operated with eminently satisfactory results, a change was made in the setting of the potentiometer tap 10 corresponding to a difference between the two taps of .01 volt. The input transformer to the first stage of amplification had a step-up of approximately 1:20, so that approximately .2 volt was applied to the grid of the first stage.

The amplification factor of this stage was approximately 10 so that the output was approximately 2 volts. A push-pull stage amplifier was used. The transformer to this stage had a step-up of approximately 1:10 so that approximately 20 volts was applied to the grids of the power tubes, and the output of the power stage was about 3 or 4 watts. The primary of the output transformer was designed to match the plate impedance of the power tube and the transformer had a step-down ratio of about 3:1 so that approximately .5 amperes of current at 7 volts was applied to the armature of the motor 6. The motor shaft 36 was geared to the shaft on which the tuning condensers 1, 2 and 3 and the tap 4 and the local potentiometer 5 were mounted, with a gear reduction of about 1000:1. With this gear reduction it is obvious that extreme accuracy of tuning may be effected; in fact, the tuning adjustment may be made so precise that this remote control device would be suitable for gun control. The accuracy depends on the potential difference per unit adjustment of the potentiometers, and the amount of amplification. Of course, a smaller gear ratio may be used if a slower speed motor is used.

In the tuning unit just described the output of the power amplifier is approximately 3 or 4 watts. The maximum power output which could be obtained with the tubes used was approximately 5 or 6 watts, due to the saturation of the tubes. However, with this set-up and with this limit on the available power, tuning over the entire 180° of possible condenser settings could be effected in approximately 10 seconds.

It will be noted that in the system just described only a single lead is required from the radio set to the remote point in order to tune the set. Since the potentiometer at the remote point is connected directly across the power line, the remote control unit, which will then consist only of a potentiometer with a lead from the set to the potentiometer tap, may be plugged in at any socket. The plug will, of course, have to be inserted with proper polarity so that the tuning will be in the right direction for the restoration of balance between the two potentiometer taps. Since maximum power output from the amplifier is 5 or 6 watts and since this may be obtained with less than 1 volt potential drop between the potentiometer taps, the lead from the set to the remote point need never carry current at a higher potential than 1 volt, provided the adjustment of the tap 10 is made slowly. Even if no attention is paid to this consideration, only in extreme cases, that is, when the tuning is made from one end of the dial to the extreme opposite end, would it be possible for the maximum voltage on the mains to be present in the lead to the remote control set. If desired, a current-limiting device could, of course, be placed in this lead as a safety feature and to comply with the requirements of the insurance underwriters.

With this device there is no limit to the distance from which remote control may be effected advantageously.

As stated above, the tuning control may be made to operate as fast as desired. If a tuning adjustment is made at the remote point so that the motor begins to operate, it will operate at its maximum speed right up to the point for which the tuning adjustment has been made. This is because a very small voltage, .01 volt in the example given, produces practically the maximum power output which the amplifier can supply. When the tuning point is reached, the motor stops dead, and if its momentum carries it beyond the tuning point, a voltage is set up across the input of the amplifier in reversed phase relationship between the potentiometer taps, so that the motor will operate in the opposite direction and return the tuning condensers to the exact point from which the tuning adjustment was made. However, if the output transformer is properly designed, the secondary will act as a low impedance load across the armature and apply a dynamic braking action, due to the presence of a voltage in the field. This will tend to decrease the amount the motor will carry beyond the tuning point.

It will, of course, be understood that the remote control point may be removed only a few feet from the radio receiver, or may be at a great distance, and that it will normally be desirable to provide a volume control and means for turning the set on and off at the remote point; also that the remote control unit will be suitably housed so that the tuning adjustment may be made, for example, by turning a knob which changes the potentiometer setting.

The condenser 7 may be adjusted to compensate for any phase changes which take place in the amplifier and will also correct for lag in the current in the field winding. In the example given above, its value was approximately 4 or 5 microfarads. The phase adjustment may be made by any suitable means other than the condenser 7, if desired. For example, a resistance of about 1000 ohms may be substituted for the condenser, or it may be made by eliminating any phase correcting means in the field circuit of the motor and placing a resistance of about 1000 ohms in series with the primary of the input transformer to the amplifier, that is, between one of the potentiometers and the primary of transformer 11. In the latter case, this resistance will also, of course, limit the current in this lead.

In Fig. 1 the armature of motor 6 is connected across points 32 and 33 and the field across points 34 and 35. An ordinary two-phase motor may be used, if desired.

In Fig. 2 such a motor is shown connected across corresponding points of Fig. 1. One phase of the stator windings is connected across points 32 and 33, and the other phase across points 34 and 35. The motor shaft 36 is geared to the condensers 1, 2, 3 and potentiometer tap 4 as before. The rotor 37 is shown as a squirrel cage. With this arrangement no moving contacts are necessary, and consequent noise and wear are eliminated. Any suitable form of motor may be used. Any necessary phase correction may be made in the input circuit to the amplifier where it may be made cheaply and efficiently.

In Fig. 3 the tuning device of Fig. 1 is connected and operates in the same manner. The radio frequency amplifier of the receiving set and the detector are shown in the block marked "RFA and Detector", and the output is applied to the audio amplifier of the set which is marked "Amplifier". In this case the audio amplifier also acts as the amplifier for the tuning control unit. When it is desired to change the tuning of the set, a switch 12 in the remote point is operated so as to make contacts 13 and 14. This closes a circuit through a battery 15 and relay 16. The relay operates its armatures 17 and 18 and connects the output of the amplifier to the motor 6. The tuning adjustment is then made by moving the tap 10, and

tuning is effected as before. However, the loud speaker 19 is still connected in shunt to the motor 6, through the resistances 20 and 21, so that if the remote control unit is close enough to the set signals received by the set may be heard at a low volume while the tuning adjustment is being made. If desired, the relay and associated contacts may be omitted and a filter placed in the loudspeaker circuit to cut off frequencies above that used for the remote control system.

The potentiometers, taps, etc., in all of the figures, corresponding to similar elements in Fig. 1, are similarly numbered.

In Fig. 4 tuning adjustment is made in the same manner as in Fig. 1, the only difference being that rheostats are used, instead of potentiometers, so that there are only two leads from the set to the remote point instead of three, as in Fig. 1. A potentiometer 22 at the set corresponds to the potentiometer 5 of Fig. 1, and a tap 23 from this potentiometer goes to one side of the input to the tuning control amplifier. Resistance 24, rheostat 25 and rheostat 26 correspond to the potentiometer 9 of Fig. 1. A tap 27 is provided for the rheostat at the remote point, and a tap 28 is provided for the rheostat 25 at the receiver. Tap 28 is adjusted by the motor similarly to the tap 4 of Fig. 1. If an adjustment of the tap 27 is made there will be a potential difference between the taps 23 and 28 which will be applied to the input of the amplifier, as in Fig. 1. The phase relationship of the two points will depend on the direction of the adjustment, also as in Fig. 1. The motor 6 will accordingly rotate in the desired direction and will reset tap 28 to restore the balance, tuning the set accordingly.

In Fig. 5 the wiring diagram for a complete remote control unit is shown, the unit consisting of a volume control, dial light, on-off switch, and tuning control. The tuning is effected in exactly the same manner as in Fig. 1. In addition to the parts numbered the same as corresponding parts in Fig. 1, a volume control potentiometer and tap are provided for controlling the volume of the set, and a dial light and on-off switch are also provided at the control point. In this case it will be noted that the tuning control unit operates across the secondary of a transformer 29 which steps the voltage down to 32 volts. Since insurance rules permit current at this potential to be carried anywhere in a house over loose leads, this allows the tuning control unit to be connected to the set in this manner. When the on-off switch is closed the dial light lights and a circuit is completed through relay 30 which closes switch 31 and turns on the set. Closing the on-off switch also applies a potential across the potentiometers 9 and 5, permitting the tuning of the set, which is accomplished in the same manner as in Fig. 1. The armature of the motor, which is connected in the output of the amplifier shown, turns in a direction corresponding to the direction of the adjustment of tap 10, and turns the rotors of the tuning condensers and re-adjusts tap 4 to a condition of balance with tap 10.

What is claimed is:

1. In a remote control device for a radio receiver, the combination of a radio receiver having an amplifying stage influenced by incoming signals, an energy supply circuit, an electrically balanced circuit by which said energy supply circuit is connected to the input of said amplifying stage, said electrically balanced circuit including a balancing resistance as a part thereof and when balanced preventing the supply of energy to said amplifying stage input and when unbalanced causing energy to be supplied thereto, means remote from said radio receiver for unbalancing said electrically balanced circuit, a motor having its field winding connected to said supply circuit and its armature connected to the output of said amplifying stage, a tuning element for the radio receiver connected to the armature shaft of the motor so as to be operated thereby, and a contact arm for said balancing resistance connected to the armature shaft of said motor and moved thereby over said balancing resistance until said connecting circuit is restored to balanced condition.

2. In a remote control device for a radio receiver, the combination of a radio receiver having a detector and an amplifying stage for amplifying the signal detected thereby, an energy supply circuit, an electrically balanced circuit by which said energy supply circuit is connected to the input of said amplifying stage, said electrically balanced circuit including a balancing resistance as a part thereof and when balanced preventing the supply of energy to said amplifying stage input and when unbalanced causing energy to be supplied thereto, means remote from said radio receiver for unbalancing said electrically balanced circuit, a motor having its field winding connected to said supply circuit and its armature connected to the output of said amplifying stage, a tuning element for the radio receiver connected to the armature shaft of the motor so as to be operated thereby, and a contact arm for said balancing resistance connected to the armature shaft of said motor and moved thereby over said balancing resistance until said connecting circuit is restored to balanced condition.

3. In a remote control device for a radio receiver, the combination of a radio receiver having a detector and an amplifying stage for amplifying the signal detected thereby, a translating device and means for feeding amplified energy from the amplifier to the translating device, an energy supply circuit, an electrically balanced circuit by which said energy supply circuit is connected to the input of said amplifying stage, said electrically balanced circuit including a balancing resistance as a part thereof and when balanced preventing the supply of energy to said amplifying stage input and when unbalanced causing energy to be supplied thereto, means remote from said radio receiver for unbalancing said electrically balanced circuit, a motor having its field winding connected to said supply circuit, a tuning element for the radio receiver connected to the shaft of the motor so as to be operated thereby, means controlled from the remote point for connecting the motor armature to the output of said amplifying stage while the radio receiver is being tuned, and a contact arm for said balancing resistance connected to the armature shaft of said motor and moved thereby over said balancing resistance until said connecting circuit is restored to balanced condition.

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