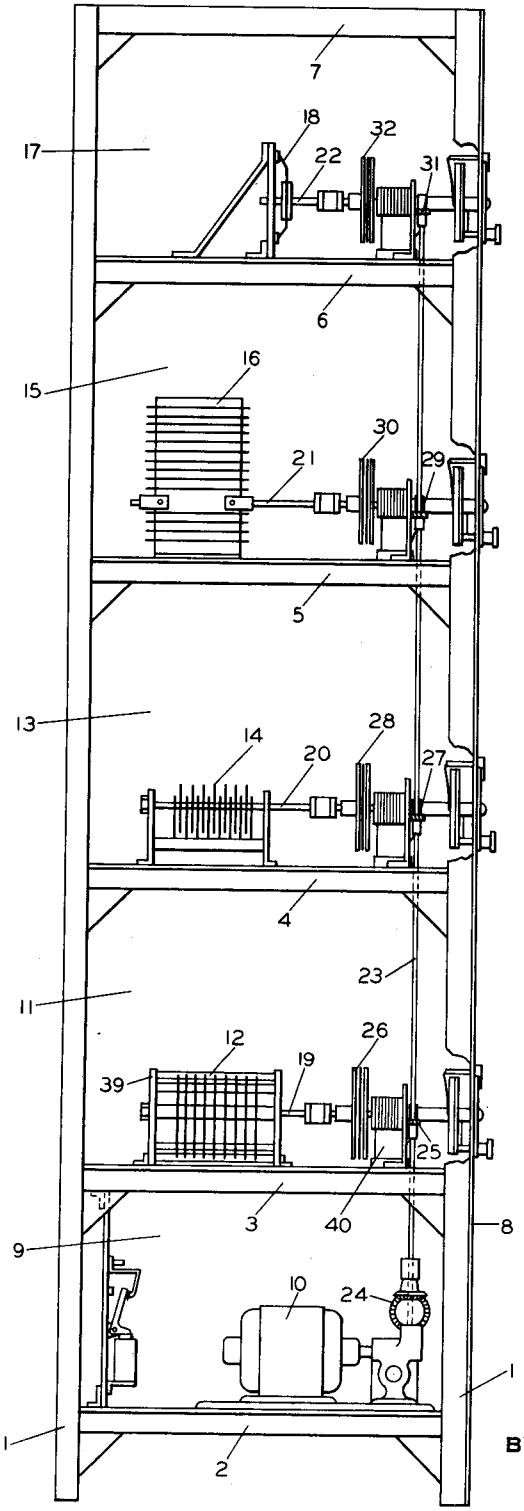
Nov. 13, 1934. S. D. HABERLE ET AL 1,980,585

RADIO TRANSMITTER CONTROL APPARATUS

Filed Oct. 6, 1933 4 Sheets-Sheet 1

Fig. 1



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RADIO TRANSMITTER CONTROL APPARATUS

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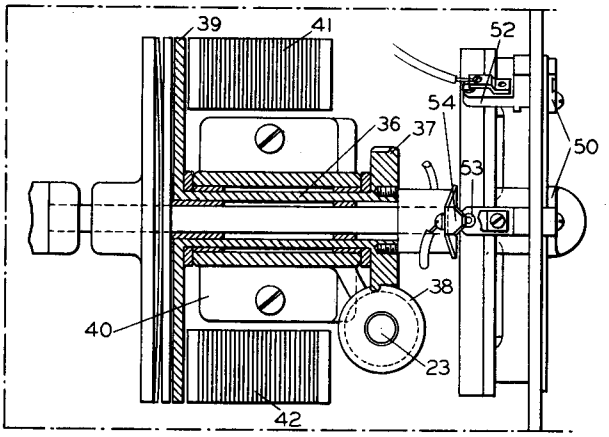


Fig. 2.

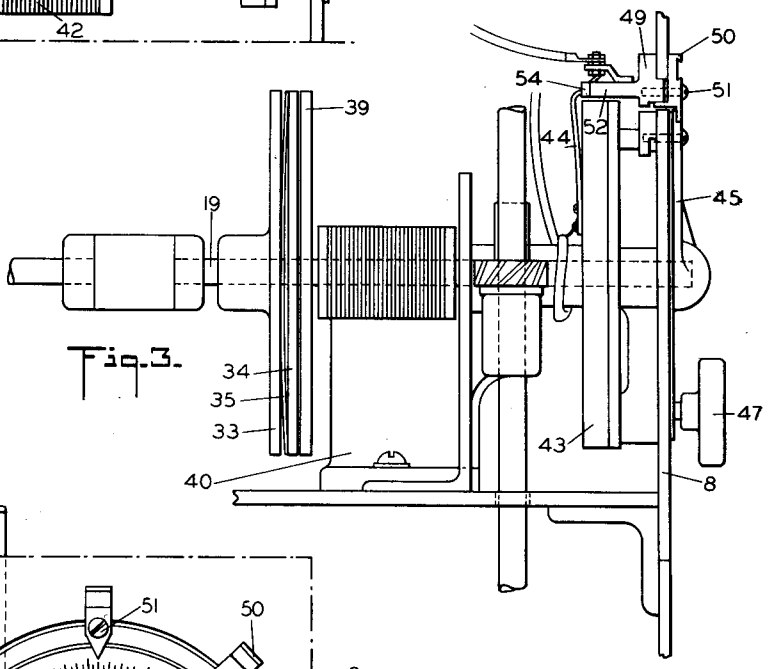


Fig. 3.

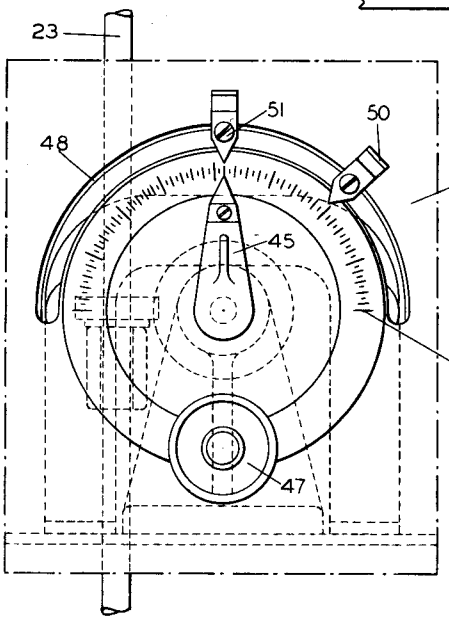


Fig. 4.

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RADIO TRANSMITTER CONTROL APPARATUS

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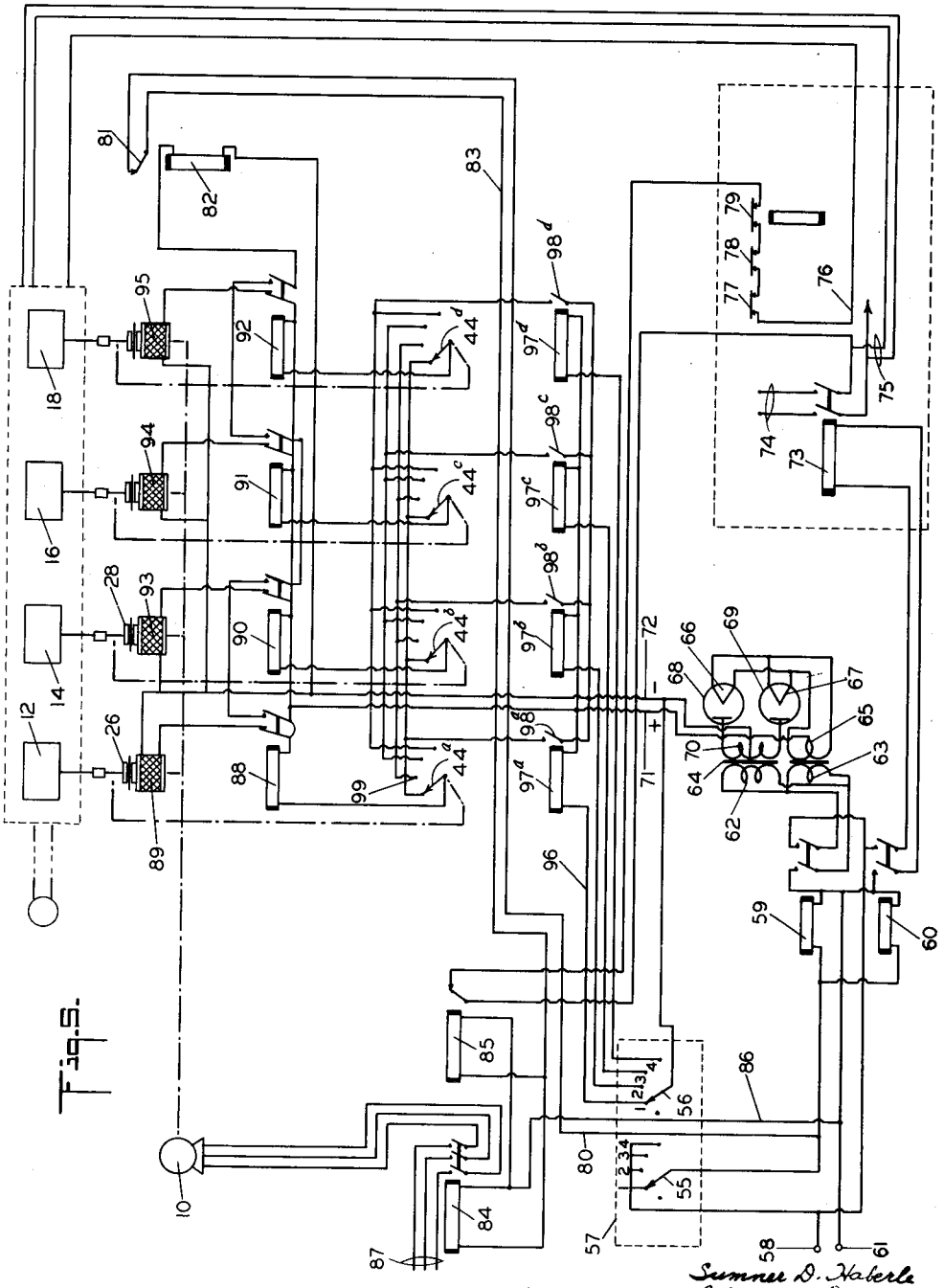


Fig. 5.

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RADIO TRANSMITTER CONTROL APPARATUS

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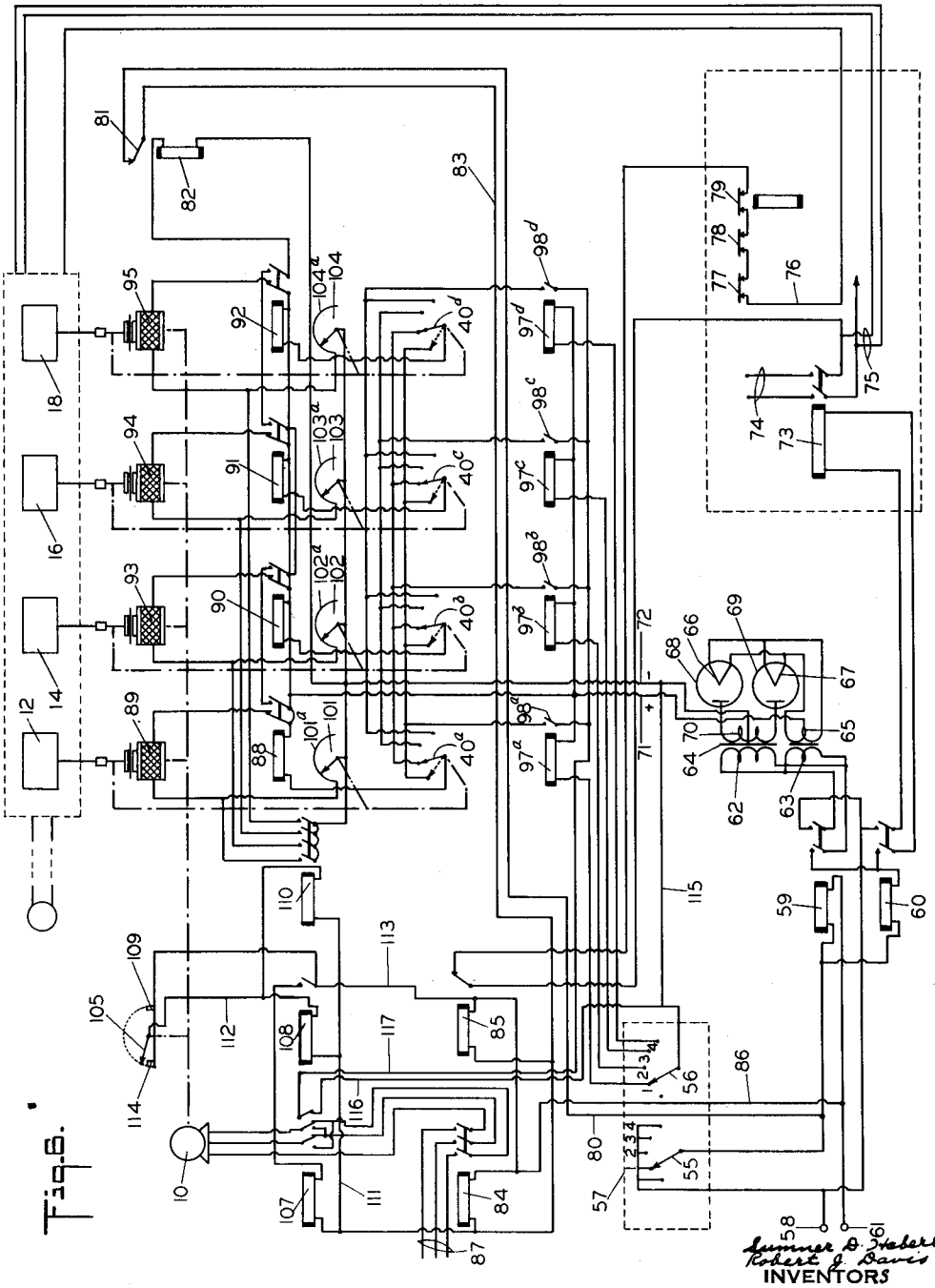


Fig. 6.

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UNITED STATES PATENT OFFICE

1,980,585

RADIO TRANSMITTER CONTROL APPARATUS

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Application October 6, 1933, Serial No. 692,364

2 Claims. (Cl. 250—17)

The invention relates to radio transmitters and with particularity to an improved apparatus for controlling the adjustment of tuning thereof.

An object of the invention is to provide an improved form of remote control for a multi-range radio transmitter.

A further object is to provide an improved remote control circuit for a radio transmitter whereby the anode and cathode potentials are automatically applied in displaced time relation.

A feature of the invention relates to a remote control system for a multi-range transmitter for selectively tuning the transmitter to different ranges, and for delaying the application of anode potential until the automatic tuning operation has been completed.

A further feature relates to the combination of a panel type radio transmitter having a plurality of separately adjustable electric units, together with a common drive mechanism and remote control means for selectively and automatically adjusting one or more of said units simultaneously.

A still further feature relates to the novel organization, arrangement and relative location of the parts which go to make up an efficient and easily adjusted "remote-control" transmitter.

In the drawings, Fig. 1 is a side elevational view of a transmitter panel with the side plates removed;

Fig. 2 is a detail top plan view of a portion of the tuning and selecting mechanism;

Fig. 3 is a detail elevational view of a portion of the tuning and selecting mechanism;

Fig. 4 is a front view of the dial and adjustable contact mechanism shown in Figs. 1 and 3;

Fig. 5 is a schematic wiring diagram of the electrical system used to control remotely the apparatus of Figs. 1 to 4; and

Fig. 6 is a schematic wiring diagram of a modification of the system of Fig. 5.

Referring more particularly to Fig. 1, there is shown a framework consisting of vertical uprights 1 in the form of angle irons suitably united by horizontal angle bars 2 to 7. The front face of the framework carries a suitable panel 8, preferably of sheet metal or, if desired, of insulating material, on which are supported the various tuning dials described below. Supported on the crossbars 2 to 6 are respective shelves dividing the framework into compartments, each compartment having mounted therein tuning or adjusting units associated with a corresponding section of the transmitter. In the lowermost compartment 9 is situated the common driving motor 10 and the associated power control equipment. Compartment 11 may contain a variable condenser 12 and associated apparatus for tuning one section of the transmitter, for example, the antenna circuit. Compartment 13 may contain a variable condenser 14 and associated apparatus for tuning a different section of the transmitter, for example, a feedback circuit. Compartment 15 may contain a variometer 16 and associated apparatus for adjusting or tuning a different section of the transmitter, for example, the plate circuit of the oscillator 2. Similarly, compartment 17 may contain a multi-tap rotary switch 18 and associated apparatus for tuning a still different section of the transmitter. It will be understood, of course, that the tuning units shown are merely illustrative, and if desired, any other well-known forms of electrical tuning or adjusting elements having other circuit functions may be employed. In any event, each of the devices 12, 14, 16, 18 comprises a fixed and a movable member. For example, the condenser 12 consists of the usual stator plates and rotor plates, the latter being attached to a rotatable shaft 19. Similarly, the rotor plates of condenser 14 are attached to a shaft 20. The rotor (not shown) of the variometer 16 likewise is attached to shaft 21, while the rotor of the multi-tap switch 18 is attached to shaft 22.

Motor 10 drives a main vertical shaft 23 through suitable reduction gearing 24 and shaft 23 is in turn coupled through reduction gearing 25 and clutch 26 to shaft 19. Similarly, shaft 20 is coupled to shaft 23 through the reduction gearing 27 and clutch 28; shaft 21 is coupled to shaft 23 through reduction gearing 29 and clutch 30; and shaft 22 is coupled to shaft 23 through reduction gearing 31 and 32.

As shown more clearly in Figs. 2 and 3, each clutch, e. g., clutch 26, comprises a disc 33 of non-magnetic material which is fastened to the associated shaft 19, and supported on disc 33 is another disc 34 of iron or other magnetic material. Disc 34 is preferably attached to disc 33 by a leaf spring 35 in such a manner that it is incapable of rotation with respect to disc 33, but is capable of slight bodily displacement longitudinally of shaft 19.

Mounted for rotation about shaft 19 is a sleeve 36 which carries at its right-hand end a gear 37 in mesh with an associated gear 38 on shaft 23. Sleeve 36 carries at its left-hand end a disc 39 of non-magnetic material. As shown in the drawings shaft 19 is provided with suitable bearings in bearing brackets 39 and 40.

Fixedly mounted on opposite sides of the shaft 19 are electromagnets 41, 42, which when energized cause disc 34 to be positively coupled to the continuously rotating disc 39, it being understood that when the magnets are deenergized,

there is a slight gap between the discs 34 and 39, as shown in the drawings. Fastened to shaft 19 is a disc 43 of insulating material which carries a combined contact arm and detent 44. Shaft 19 extends outwardly through the panel plate 8 and carries a pointer 45 which is adapted to register with a suitably marked scale 46 on the front of the panel to indicate the angular position of shaft 19 and contact arm 44. Preferably also, a manually operable knob 47 is provided and is coupled through suitable gearing (not shown), so that shaft 19 and its associated tuning unit may be rotated manually independently of motor 10. Associated with each dial is an arcuate slot 48 in the panel 8 and adjustably mounted in the slot 48 are a series of contact carriers. As shown more clearly in Figs. 2 and 3, each of these carriers comprises two members 49 and 50 which are coupled together by a fastening screw 51. Member 49 carries an arm 52 which terminates in a V-shaped recess in which is mounted a suitable contact face 53. The contact carriers may be located at any desired points in the slot 48 corresponding to the desired selective position of the associated tuning unit. By means of the screw 51 members 49 and 50 may be loosened and moved to any desired position, and then screw 51 may be tightened to fasten the contact carrier in selective position. It will be understood, of course, that while the drawings show two contact carriers for each dial, a greater or less number may be employed, dependent upon the number of selective positions desired, i. e., dependent upon the number of wave lengths to which the transmitter is to be tuned. It is obvious, of course, that if the panel 8 is of metal as above described, the contact carriers will be insulatingly mounted therein. The contact arm 44 terminates at its upper end in a V-shaped contact shoe 54 and is adapted to enter each of the V-shaped notches 53 in succession as the shaft 19 rotates. The arrangement is preferably such that when member 54 engages a contact 53, suitable circuits are closed to deenergize electromagnets 41, 42, and the members 53 and 54 also act as a detent to retain the shaft 19 in its selected position. As will be described below, the desired contacts 53 are electrically marked under control of suitable electrical circuits, and since the shaft 23 is continuously rotating, the tuning shafts 19, 20, 21, 22 also continue to rotate until the associated contact arms 44 engage the selectively marked members 53.

Referring to Fig. 5, a description will now be given of a preferred form of electric circuit for remotely controlling the various tuning devices 12, 14, 16 and 18. In Fig. 5 parts corresponding to those in Figs. 1 to 4 are schematically shown and bear the same designation numerals. For the purpose of remotely controlling the adjustment of the various tuning units there are provided two manually operable switches 55 and 56 on a suitable remote control panel 57. Instead of operating the switches 55 and 56 manually at the remote control point, these switches may be located, if desired, at the transmitter panel and operated by a suitable selective mechanism such as step-by-step Strowger switches from a remote point. Each of the switches 55 and 56 is provided with a set of fixed contacts, each contact corresponding to one of the wave lengths to which the set is to be tuned. It will be assumed for the purpose of explanation that each of the tuning units of the transmitter is adapted to be tuned to four separate wave lengths, in which event there will be provided with each dial 45 (Figs. 1 to 4), four contact carriers 50. It is well known that in ordinary radio transmitters the various tuning or adjustable circuit units must be moved to different angular positions, depending upon their function in the circuit. For this reason the contact carriers for each dial are separately mounted for manual adjustment. For example, if it is desired to tune the transmitter to 100 meters, the first contact carrier 50 of the set associated with the shaft 19 will be positioned at one point previously determined. The first contact carrier 50 of the set associated with shaft 20 will likewise be positioned at a previously determined point, which may or may not be the same, angularly speaking, as that of the first-mentioned carrier. Likewise, the remaining fixed contact carriers of the sets associated with shafts 21 and 22 will be adjusted manually to their predetermined positions at which the transmitter is to transmit at 100 meters.

Assuming for the purpose of explanation that the transmitter is to be tuned to its second lowest wave length, that is to say, the second contact carrier 50 of each set is to be selectively marked. Under this assumption the switches 55 and 56 will be manually or remotely positioned on the second off-normal contact. In this position, a circuit is closed from the power main 58 through the switch 55, thence in parallel through relays 59 and 60, to the power main 61. Relay 59 when energized, closes its contacts and completes a circuit from the alternating current mains 58, 61 in parallel, to the primary windings 62, 63 of transformer 64. Transformer 64 is provided with a secondary winding 65 for heating the cathodes 66, 67 of suitable rectifier tubes 68, 69. A high potential secondary winding 70 provided on transformer 64 is connected in full wave arrangement with the anodes of the rectifiers 68, 69, thus providing a direct current supply for the wires 71, 72. When relay 60 operates as above described, it in turn operates relay 73. Relay 73 when operated connects the current supply wires 74 to the wires 75 which supply heating current to the filaments or cathodes of the various tubes (not shown) in the transmitter. The wire 76 which controls the high potential current for the anodes of the various tubes is only partially connected in circuit through one of the contacts of relay 73 and through the various safety contacts 77, 78, 79. The contacts 77, 78, 79 may, for example, be controlled by doors or other parts of the transmitter so that when these doors are open for inspection, the high potential supply is disconnected.

Coincident with the operation of relays 59, 60, there is closed a circuit from the main 58, switch 55, wire 80, contact 81 of relay 82, wire 83, thence in parallel through the windings of relays 84, 85 and conductor 86, to the main 61. Relay 84 when operated, completes the circuit from the three-phase mains 87 to the motor 10, which is preferably of the three-phase type. Relay 85 when operated opens the circuit over the conductor 76, thus preventing the application of high potential to the anodes of the various transmitter tubes until all the tuning units are automatically adjusted to their selected positions, as will be described. At this time also a circuit is traceable from the positive conductor 71 through the inner back contact of clutch-

control relay 88, thence through the winding of the clutch magnet 89 (corresponding to magnets 41, 42 of Fig. 2), thence to the negative conductor 72. A similar circuit is traceable from the positive conductor 71, through the inner back contacts of clutch control relays 90, 91, 92, to energize the associated clutch magnets 93, 94, 95. It will be understood that the magnets 93, 94, 95 correspond to electromagnets 41, 42, associated with the respective clutches 38, 30, 32 (Fig. 1). The energization of the magnets 89, 93, 94, 95 causes the rotatable elements of the associated tuning units to be coupled to the common drive shaft 23 which is driven by motor 10. It is to be noted that in the drawings all elements having a common drive are interconnected by dot-dash lines. Consequently, each of the clutch magnets being energized, causes each of the associated switch arms 44^a, 44^b, 44^c, 44^d to rotate, if these respective contact arms are not in the proper position. Since it was assumed that the remote control switch 56 was positioned on the second contact, then a circuit is traceable at this time from the negative conductor 72, switch 56, wire 96, switch marking relay 97^b, to the positive conductor 71. Relay 97^b in turn closes a circuit from the negative conductor 72 through its front contact 98^b and thus electrically marks the second contact associated with each of the switch arms 44^a, 44^b, 44^c, 44^d. It will be understood that the switch contacts associated with the arms 44^a to 44^d are schematically indicated in Fig. 5 and represent the contact carriers 50 (Figs. 2, 3 and 4). Arms 44^a to 44^d therefore rotate clockwise until they engage their associated second contacts. Assuming that arm 44^a engages its second contact before any of the remaining contact arms engage their second contacts, then a circuit may be traced from the negative conductor 72, front contacts 98^b, contact 99, arm 44^a, clutch control relay 88, thence to the positive conductor 71. Relay 88 upon being operated, opens the above-described circuit for the clutch magnet 89 and thus the tuning unit 12 becomes stationary in the selected position. The remaining arms 44^b, 44^c, 44^d continue to rotate until they contact with their respective marked contacts. Upon their engagement with these contacts the respective clutch magnets 93, 94, 95 are deenergized as already described for the magnet 89, thus causing the tuning units 14, 16, 18 to remain stationary in their adjusted positions. When all of the clutch-control relays 88, 90, 91, 92 are operated, a circuit is closed from the negative conductor 72 through the winding of relay 82, thence through the outer front contacts of relays 92, 91, 90, 88 in series, to the positive conductor 71. Relay 82 when operated, opens its contact 81, thus causing the release of relays 84 and 85. Relay 84 upon restoring to normal, breaks the circuit for motor 10, while relay 85 in restoring to normal, completes the circuit over conductor 76 and thus enables high potential to be applied to the anodes of the various tubes in the transmitter.

There is thus provided an arrangement whereby each of the tuning units may be operated individually and separately by remote means to different angular positions with respect to the remaining units, and means are also provided whereby the application of anode potential is delayed until all the tuning operations are complete. It will be understood, of course, that the shafts carrying the arms 44^a to 44^d are mounted for 360° rotation, in which event the motor 10 is of the nonreversible type. It is believed that the manner in which the tuning units may be selectively operated to the other positions than those assumed will be obvious from the foregoing description. In each case all the clutch magnets are simultaneously energized from the remote point to initiate the tuning operation, and may be selectively deenergized in non-simultaneous order, depending on the relative angular positions of the various contacts associated with switch arms 44^a to 44^d.

Referring to Fig. 6, there is shown a modified form of electrical circuit for achieving the remote control. This embodiment differs from that of Fig. 5 merely in that the rotatable tuning circuit elements are designed for forward and reverse rotation through approximately only 180°, whereas in the embodiment of Fig. 5 they are designed for rotation through 360°, always in the same direction. In general, the circuits of Fig. 6 are the same, and function the same, as those already described in connection with Fig. 5, and accordingly parts of Fig. 6 corresponding to those of Fig. 5 bear the same designation numerals. In addition to the apparatus of Fig. 5, Fig. 6 employs a set of reverse-control commutators 101, 102, 103, 104, there being one commutator for each of the tuning units and clutch magnets 89, 93, 94 and 95, respectively. A common "limit" or reversing switch 105 is also provided for controlling the direction of rotation of the reversing three-phase motor 10. In addition, a reversing relay 107 is provided for reversing the polarity of two of the three-phase wires from the mains 87 to the motor 10.

For purposes of explanation let it be assumed that the transmitter has been previously left with the movable arms 40^a, 40^b, 40^c, 40^d on the "second" contact sets shown, and also let it be assumed that the transmitter is now to be adjusted remotely to bring the said arms to the "first" contact sets. At the remote control panel 57, the switches 55 and 56 will be set on the contacts as shown in the drawings, causing the relays 59, 60 and 73 to operate as above described, and resulting in the application of D. C. to the wires 71 and 72 through rectifiers 68 and 69. A circuit may now be traced from the positive conductor 71, inner back contact of relay 88, winding of clutch magnet 89, commutator segment 101^a, brush 101, to the negative wire 72. Magnet 89 being thus energized, couples the tuning unit 12 to the main shaft 23 (Figs. 1 to 4). Relays 84 and 85 are at this time operated as above described under control of relay 82. Relay 85 prevents the high potential conductor 76 being connected through to the anodes of the various tubes which, however, have their filaments lighted under control of relay 73. Under these conditions relays 107 and 108 are normal and it will be assumed that the mains 87 are connected through the back contacts of the relay 107 so as to operate the motor 10 in a clockwise direction. It will also be understood that at the time magnet 89 was energized, the remaining magnets 93, 94, 95 were likewise energized through the back contacts of their associated relays 90, 91, 92, respectively. Consequently, all the tuning units being coupled to the motor 10, are simultaneously rotated and at the same time arms 40^a, 40^b, 40^c, 40^d, are likewise rotated in a clockwise direction. Relay 97^a is energized through switch 56 as above described, but the negative wire 72 is not con-

nected to the "first" contacts associated with the arm 40^a, since the armature of relay 97^a is connected to said conductor 72 through the outer right contacts of relay 107 which are now open. Arms 40^a to 40^d and brushes 101 to 104 therefore continue to rotate in a clockwise direction until the said brushes 101 to 104 disengage their respective commutator strips 101^a to 104^a. Just before this disengagement the arm 105 engages contact 109, resulting in the operation of relays 108 and 110 over the following circuit: terminal 58, switch 55, conductor 80, contacts of relay 82, conductor 83, conductor 111, thence in parallel through the windings of relays 108 and 110, conductor 112, arm 105, contact 109, conductor 113, conductor 86, terminal 61. Relay 110 in operating short-circuits the clutch control commutators and thus maintains the energizing circuits for the clutch magnets 89, 93, 94, 95. Relay 108 in operating completes the energizing circuit for relay 107 which reverses the polarity to two windings of the motor 10, resulting in a reversal of direction of the motor rotation. As schematically shown in the drawings, the contacts 109 and 114 are preferably long enough to maintain the relays 108 and 110 operated during the short interval required for the reengagement of the arms 101 to 104 with their respective commutator strips on the reverse motion. The various tuning units continue to rotate in a counter-clockwise direction until the arms 40^a to 40^d engage the previously positioned "first" contact sets. This engagement may or may not be simultaneous, depending on the previously adjusted positions of the respective contacts, and while the drawings show the contacts associated with the contacts 40^a to 40^d in relatively equal angular positions, it will be understood that this is merely illustrative, since the position of these contacts will be previously determined by the angular positions of the tuning units necessary to tune or adjust the various circuit elements to the proper points for a given frequency. Let it be assumed that the arm 40^a on the counter-clockwise rotation is the first to engage the "first" contact of its associated set. Under these conditions a circuit may be traced from the negative wire 72, conductor 115, conductor 116, outermost contacts of relay 107, conductor 117, contacts 98^a, arm 40^a, relay 83, to the positive wire 71. Relay 88 in operating breaks the circuit for the clutch magnet 89 and thus stops the tuning unit 12 in its selected position. At this point it should be noted that the relay 108 is preferably of the ratchet link type, that is, it stays in its last operated position, so that when it is energized as above described, its contacts remain closed, even though its coil is deenergized. However, when the coil of relay 108 is again energized, the ratchet opens the contacts which remain open until the relay is again energized. Under the above conditions, therefore, the relay 108 has its contacts still closed, thus maintaining the counter-clockwise rotation of the motor 10. As each of the remaining arms 40^b, 40^c, 40^d engages the electrically marked "first" contacts, the associated clutch control relays 90, 91, 92 are operated, resulting in the deenergization of the associated clutches 93, 94, 95 and the stopping of the associated tuning units in their selected positions. With the relays 88, 90, 91, 92 energized, a circuit is completed through the outermost contacts thereof, through the winding of relay 82 which operates, and by means of its contacts 81, the latter relay opens the circuit for the motor control relay 84, thus bringing the motor to rest. It is clear, therefore, that the clutch control commutators 101 to 104 as well as the selective switch arms 40^a to 40^d will continue to rotate until all the tuning units have been properly positioned. This may require one or more additional reversals of rotation of the motor, depending upon the respective previously adjusted angular positions of the contacts associated with the arms 40^a to 40^d.

At the same time that relay 84 is deenergized as above described, relay 85 is likewise deenergized and completes the plate interlock circuit to the transmitter by completing the connection from conductor 76 through the various safety interlock contacts 77, 78, 79, through the contacts of relay 85, thus insuring that the anode potential is applied to the transmitter tubes only after all the automatic tuning and selective operations have been fully completed. The transmitter is now in condition to be controlled by the remote telegraph key or microphone for the transmission of telegraph, voice-modulated signals, or any other type of radio transmission.

It will be understood, of course, that the broad features of the invention are not limited to the remote adjustment of circuit units for a transmitter, but are equally well suited to adjustment of a receiver where such receiver comprises independently adjustable units such, for example, as the tuning units and the feedback units of a regenerative receiver or the like.

What is claimed is:

1. In combination, a radio set, means controlling the application of cathode heating current to said set, means for controlling the application of anode current to said set, a plurality of separately adjustable tuning units for said set, a motor for driving said units, a plurality of clutches one for each of said units, means for remotely controlling the simultaneous energization of said clutches, means to render said heating current control means effective to apply heating current to the cathodes of the radio set upon the energization of said clutches, means for effecting the selective deenergization of said clutches, and means to prevent the application of said anode current until all said clutches have been selectively deenergized.

2. In combination, a radio set, means to control the application of cathode current to said set, means to control the application of anode current to said set, a plurality of separately adjustable tuning units in said set, a motor for driving said units, clutches between said motor and each of said units, a clutch control relay for each clutch, remote means for effecting the simultaneous energization of said clutches through said control relays and for simultaneously controlling the application of the cathode heating current, and means for preventing the application of the anode current until all the said clutches have been selectively deenergized.

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