Aug. 6, 1940. W. E. NEWMAN 2,210,425

AUTOMATIC TUNING CONTROL SYSTEM

Filed July 10, 1937 3 Sheets-Sheet 1

Fig. 1.

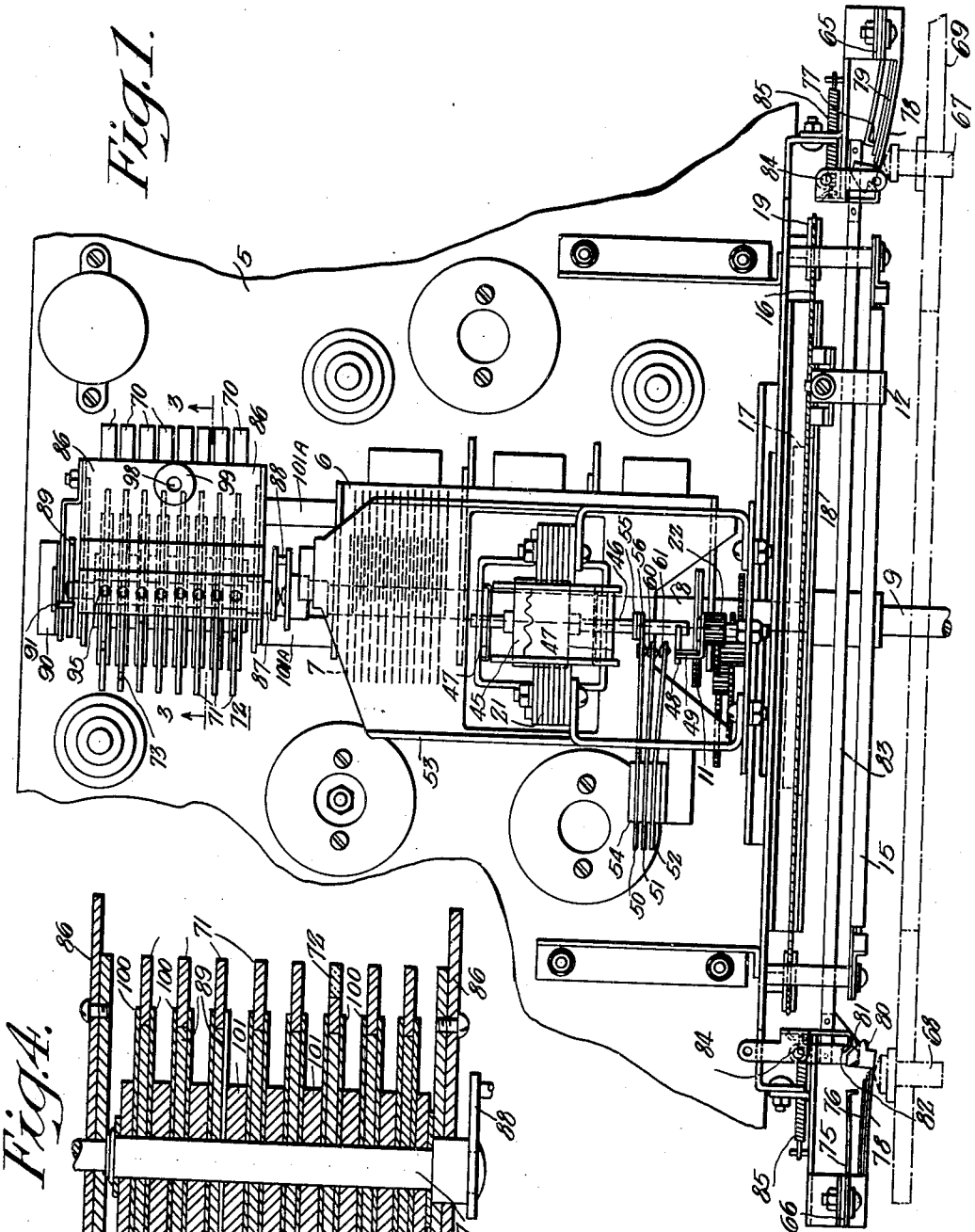


Fig. 4.

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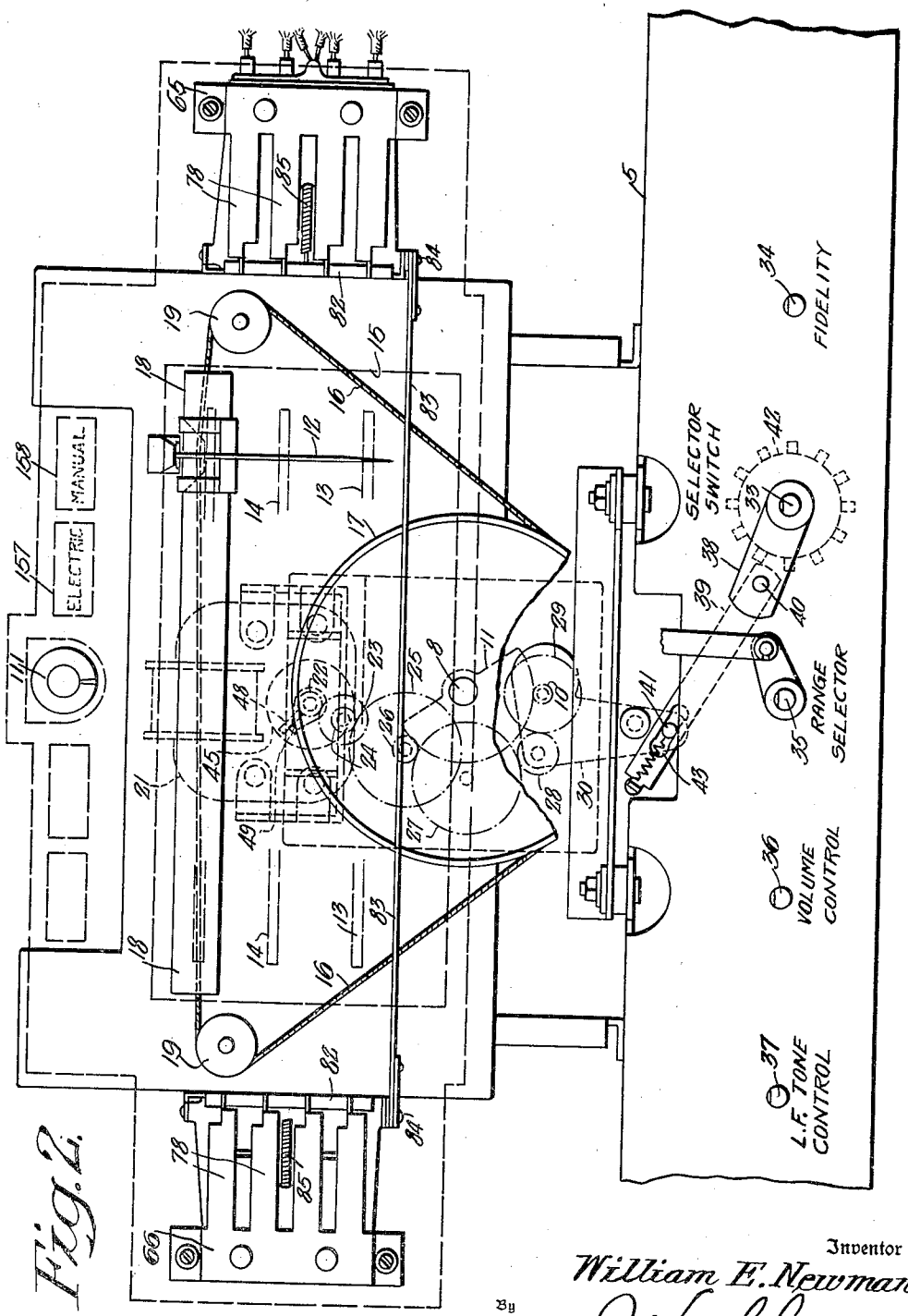


Fig. 2.

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Fig. 3.

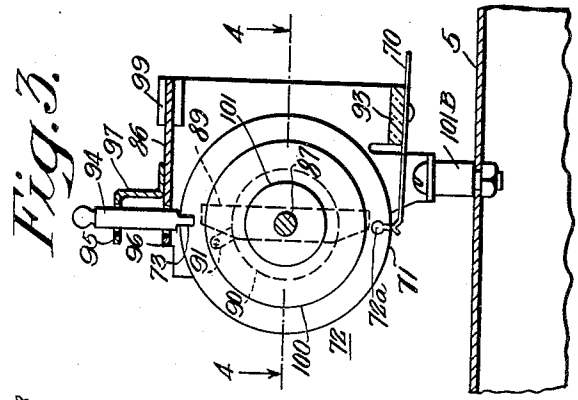


Fig. 5.

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UNITED STATES PATENT OFFICE

2,210,425

AUTOMATIC TUNING CONTROL SYSTEM

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Application July 10, 1937, Serial No. 152,921

4 Claims. (Cl. 250—40)

The present invention relates to automatic tuning control systems for radio receiving apparatus and the like and more particularly to a system for automatic tuning of the electrical type wherein the tuning element of the controlled apparatus is actuated by electric motor means, as distinguished from present known systems employing mechanical means for the same purpose.

The present invention further relates to an electrical automatic tuning control system of the preselection type whereby any one of a plurality of preselected tuning adjustments may be effected automatically by the operation of a series of selector buttons or switches associated with or remotely located with respect to the apparatus controlled.

It is a primary object of the present invention to provide an improved and simplified automatic tuning control system of the electrical preselection type.

It is a further object of the present invention to provide a tuning control system of the character above referred to which is provided with means for selective adjustment whereby it may function in response to manual, electric, or remote operation.

It is also a further object of the present invention to provide an automatic tuning control system of the type above referred to having a simplified electrical selector mechanism and a circuit in conjunction with a reversible electric motor means for operating the tuning control element of radio receiving apparatus and the like.

In modern radio receiving systems and the like, particularly of the superheterodyne type, automatic frequency control of the receiving circuits by present known means may be provided to effect exact tuning of the apparatus to a received signal in conjunction with the normal variable tuning means, and it is a further object of the present invention to provide an improved automatic tuning control system embodying automatic frequency control and electrical preselection tuning control in combination whereby the electrical preselection control may effect approximate tuning for response to a predetermined signal, and the automatic frequency control may effect exact tuning subsequent to the operation of the preselection means.

In an electrical type of tuning control an electric motor means is utilized for rotating the main tuning element of the controlled apparatus and, in accordance with the invention, operation of the motor means, through movement of a portion thereof, is caused to engage mechanical means for actuating the tuning control element and electrical means for suppressing the automatic frequency control element until a preselected tuning adjustment is effected by the operation of the motor.

It is, therefore, a still further object of the invention to provide an improved and simplified electric motor control system including a selection mechanism for a plurality of differing preselected tuning adjustments and means for automatically controlling the exact tuning operation in predetermined sequence.

It is also an object of the present invention to provide conjointly operable electrical and mechanical control means for selectively adjusting the apparatus for manual, electric and remote control in conjunction with an automatic frequency control system whereby the latter is suppressed or rendered ineffective by operation of the motor means. It is also contemplated that certain other portions of the receiving system may be controlled or rendered ineffective by the operation of the tuning control means, such as the sound output conjointly with the suppression of the automatic frequency control system.

The invention will be further understood from the following description when considered in connection with the accompanying drawings and its scope will be pointed out in the appended claims.

Referring to the drawings:

Figure 1 is a top plan view on a reduced scale of a portion of a radio receiver provided with an automatic tuning control system embodying the invention,

Figure 2 is a front view in elevation of the apparatus and system shown in Fig. 1 and is on the same scale as Fig. 1,

Figures 3 and 4 are cross-sectional views in elevation and plan, respectively, of a portion of the apparatus shown in Fig. 1, Fig. 4 being on an enlarged scale, and

Figure 5 is a schematic circuit diagram of an automatic tuning control system embodying the invention and including the apparatus shown in Figs. 1 to 4, inclusive.

Referring to Figs. 1 to 4, inclusive, 5 is the chassis of a radio receiver on which is mounted a variable tuning control device 6 such as a variable condenser of the three-unit type, one unit of which is indicated by the dotted lines 7. The tuning control device is of the rotary type, as is well known, having a control shaft 8 which

is driven through a speed reducing mechanism from a tuning control shaft indicated at 9. The speed reducing mechanism may comprise a pinion indicated at 10 on the inner end of the shaft 9 and a half gear 11 which meshes with the pinion 10, all as outlined in dot and dash lines in Fig. 2. As any suitable manual tuning control drive may be provided for the operation of the variable tuning condenser, further description is believed to be unnecessary.

Likewise, the tuning indication may be provided by any suitable means, such as by a pointer 12 movable over a series of scales indicated at 13 and 14 across the face of the dial 15 through a connection provided by a cord 16 movable over a sheave 17 secured to the shaft 8, the cord being secured to the pointer which moves on a guide rail 18. Idler pulleys 19 are provided at each end of the scale for the cord 16.

The tuning control shaft 8 may also be driven electrically by an electric motor 21 through a gear train comprising a series of gear wheels and pinions 22, 23—24, 25—26, 27, 28 and 29, the last being mounted on the manual tuning control shaft 9 with the pinion 10 and the remainder of the gears being mounted on fixed pivots or shafts except the pinion 28, which is movable into and out of mesh between the gear wheels 27 and 29 on a rocker arm 30 on a radius about the axis of the pinion 10.

When the rocker arm 30 and the pinion 28 are in the position shown the gear train is completed from the pinion 22 through to the main tuning control shaft 8 through the intermediary of the pinion 10 and the half gear 11, which is also used for manual tuning.

It will be seen that when the rocker arm is moved counter-clockwise a short distance, the pinion 28 is withdrawn from engagement between the gears 27 and 29, thereby disconnecting the manual tuning control elements from the motor of electric drive gear train. This permits easier manual tuning, since the friction load of the gear train is removed from the manual tuning control shaft 9.

The operation of the link pinion 28 between the manual tuning control and motor drive gear trains is actuated by a rotary control shaft 33 mounted in the front apron of the chassis 5 in a position to project frontally therefrom on a line with other control shafts indicated at 34, 35, 36 and 37 for various portions of the receiving apparatus.

A connection between the shaft 33 and the rocker arm 30 is provided by a lever 38 secured to the shaft 33 and rotatable therewith, and a connecting rod or link 39 pivotally connected with the lever 38, as indicated at 40, and also pivotally connected with the lower end of the rocker arm through a pin and slot connection 41. The shaft 33 is rotatable to carry the arm 38 from a position shown in a clockwise direction to three angular spaced positions for operating a switch also connected with the shaft and mounted on the rear face of the chassis apron, as indicated at 42. The pin and slot connection 41 is such that the outer end of the slot indicated at 43 engages the pin 41 and moves the low end of the rocker arm to the right when the switch is adjusted to its third position by clockwise rotation of the shaft 33. As shown, the shaft 33 and lever 38 are in the extreme counter-clockwise position corresponding to a first position of adjustment for the switch 42. Connections for and operations of the switch will be hereinafter described.

The tuning motor is mounted on top of the variable condenser or variable tuning element for the purpose of facilitating assembly and adjustment. The motor is of the low voltage, alternating current, shaded-pole type and is reversible. The rotor, indicated at 45, is axially movable in response to energization of the motor in a frontal direction by action of the field thereon and is arranged for such axial movement when energized, for the reason that it is depended upon to eliminate operating relays and the like in actuating a switch and in closing a mechanical connection with the tuning drive gear train.

In the drawings (Fig. 1) the motor armature is shown in its forward position and, for the purpose of permitting axial movement, the armature is mounted upon an extended motor shaft 46 journaled in spaced end bearings 47, the front end of the shaft being extended to a position adjacent to the initial pinion 22 of the gear train and being axially in alignment with the pinion 22, as shown. The motor shaft engages the drive mechanism or gear train by a pin and arm coupling comprising a radial pin 48 on the outer or front end of the motor shaft and a curved arm 49 secured to the pinion 22. This arrangement permits the motor to start without load as the shaft moves forward and rotation continues until the pin and arm engage, thereby applying load to the motor after it has started. By this arrangement the size and power of the motor may be reduced to a minimum, as is desirable.

The switch for controlling certain portions of the receiving system hereinafter described may be arranged to be actuated by the axial or longitudinal movement of the motor shaft when energized and in its present preferred form comprises a plurality of spaced elongated flat spring elements 50, 51 and 52 secured adjacent one end to a frame 53, on which the motor is mounted, between insulating blocks indicated at 54.

The opposite ends of the flat spring switch members extend radially inwardly toward the motor shaft to a position wherein the spring member 50 more adjacent to the armature may be engaged and moved by a collar 55 secured to the shaft when the latter moves forward in response to energization of the motor. The spring member 50 extends around the shaft in spaced relation thereto and is also provided with a washer 56 between the collar and the spring member.

The operation of the motor shaft in connection with the switch is such that pairs of contacts 60 and 61 are closed to connect the switch springs as the motor shaft moves forward to cause the driving connection between the motor shaft and gear train or drive mechanism to be established. These contacts, as will hereinafter be described, cause the receiver output to be silenced or reduced and the automatic frequency control system to be suppressed, whereby the latter may come into operation to effect exact tuning to a predetermined station or signal subsequent to the main tuning operation by the electrical means. In addition, the axial movement of the motor shaft, in combination with the pin and arm drive, provides quick disengagement of the motor from the mechanism driving the tuning element or condenser when the motor is deenergized.

The motor is energized through a plurality of individual selector switches 65—66 (Fig. 1) as-

sociated with the tuning dial and arranged, in the present example, in two rows, of four each at opposite sides of the dial. The switches are actuated by individual buttons indicated at 67 and 68 carried by the escutcheon or panel front indicated at 69.

The motor energizing circuits through the individual switches are connected in parallel and each circuit includes a connection to ground or chassis through a spring contact 70 and a selector ring 71 (Fig. 3) in a selector mechanism 72 positioned at the rear of the tuning element of the receiver and connected for rotation therewith. The number of rings in the selector mechanism correspond to the number of selector switches and buttons and may be provided in any desired number within reasonable limits to permit preselection of a desired number of stations or signals. In the present example, eight selector switches and eight selector rings are provided, although the system is not limited to this number. However, it has been found that there are usually not more than eight stations normally available in any locality for constant daily reception and therefore this number of selector switches and rings is shown by way of example as a practical embodiment of the invention.

The motor circuit is closed to energize the motor by operation of the switches indicated at 65 and 66 and is opened to deenergize the motor by one of the individual elements of the selector mechanism, such as that shown more clearly in Fig. 3, the circuit being opened when the spring contact 70 disengages from the metallic ring 71 and sweeps upon a narrow insulating segment 72a inserted in the periphery of the ring at a point diametrically opposite to a slot 73. The arrangement, therefore, is such that the selector switches serve to energize the motor and the selector mechanism serves to deenergize the motor, causing it to stop when the circuit is opened at a predetermined point corresponding to the position of the insulating segment on each ring with respect to the tuning mechanism, as will hereinafter be described.

The switches on the panel comprise elongated spring contact fingers 75, 76 secured at one end and having free ends which are brought into engagement as indicated at 77 when a button such as the button 67 is depressed.

Each button bears against a grounded metallic strip 78, one for each switch, which serves to move the outer contacts 76 against the inner contacts 75 and to hold the contacts in engagement. A strip of insulating material is provided between the operating finger or strips 78 and the outer contacts 76, as indicated at 79. The flexible or free ends of the operating strips for the buttons are provided with a detent, as indicated at 80, and a cam shaped surface indicated at 81 for moving and engaging with a pivoted latch member indicated at 82. The latch members are arranged to engage with any one of four operating strips on each side of the dial and interconnected by a link member 83 so that movement of one member serves to move the other and to release the switch contacts previously engaged. In Fig. 1 the uppermost switch member is shown closed with the latch engaged with the operating member 78. Both latch members operate about pivot axes indicated at 84 under the action of retracting springs 85. The switch members and the operating fingers are of spring material tending to assume the position shown at the left side of Fig. 1 when released from the closed position shown on the right side of Fig. 1, the switches being thus normally in the open circuit position.

The selector mechanism is mounted as a unit assembly at the rear end of the variable tuning capacitor, as shown more clearly in Figs. 1, 3 and 4 and comprises the unitary frame 86 in which is journaled a shaft 87 in alignment with the condenser shaft 8 and connected therewith by a flexible mechanical coupling means 88.

The rear end of the shaft 87 carries a movable arm 89 which actuates a reversing switch 90 having an operating lever 91 which lies in the path of movement of the arm, whereby the switch is actuated at the extreme ends of the travel of the tuning mechanism to cause the motor to reverse the direction of operation of the tuning shaft. This arrangement greatly simplifies the switching arrangement for stopping the motor at predetermined positions and permits the use of single brush contacts and grounded contact rings in the selector mechanism as well as a series control circuit for the motor, as will hereinafter appear when considering the circuit diagram.

The selector mechanism comprises a series of stacked washers and spring discs secured to the selector shaft 87, as shown more clearly in Fig. 4. The selector rings 71 are preferably of brass and are mounted to rotate on relatively large diameter discs or washers 99 between pairs of spring discs 100 which frictionally engage and grip the contact rings between their peripheral edges. Smaller diameter spacing washers 101 of steel are located between the contact ring and spring washer assemblies so that contact rings are suitably spaced axially along the length of the shaft 87 for easy adjustment. Each ring is provided with a slot 73 and with a diametrically opposite narrow insulating segment or gap 72a and a flexible spring contact 70 is associated with each ring, as indicated in Figs. 1 and 3. The spring contacts 70 are mounted on a suitable strip of insulating material 93 carried by the frame 86. The spring contacts bear against the contact rings at the peripheries thereof and when the insulating segment or gap of a contact ring reaches a contact finger, the motor circuit is caused to be opened and the stopping position of the tuning mechanism is thereby determined when driven by the electric motor means.

The selector rotor may be considered as consisting of a plurality of independently adjustable spring disc and ring assemblies made up by stacking a plurality of circular elements on the shaft comprising spring washers and spacers. Each of the adjustable rings may be locked in a fixed position by inserting a key member 94 through aligned guide openings or holes 95 and 96, respectively, in a bracket 97 and the frame 86 at the top of the frame, and seating the end key member in the slot 73 in the contact ring directly below, as shown more clearly in Fig. 3. Thus, by inserting the key in any one of the holes so that it registers with the key slot on its respective contact ring, it is possible to lock the ring in position so that it will not turn when the condenser rotor is rotated. This enables the setting or logging of stations anywhere within the rotatable range of the condenser. The stations may be logged close together with this arrangement since the contact rings are independently adjustable, one with respect to the other, and when one is adjusted the others are not disturbed.

When the key 94 is not in use it is inserted in an opening 98 in a flexible rubber bushing 99

located in the top of the selector mechanism frame 86.

The selector mechanism frame is mounted at the rear of the condenser frame by suitable studs 101a without imparting a mechanical strain upon the condenser frame. As indicated by Fig. 3, a stud 101B is interposed between the selector mechanism to support the selector mechanism during shipment, this stud being disengaged when the receiver is put into operation.

The electrical circuit arrangement employed in connection with the mechanism shown in Figs. 1 to 4, inclusive, is shown in Fig. 5, to which attention is now directed and in which the circuit elements and parts which have been referred to in the preceding figures are designated by the same reference numerals.

Referring to Fig. 5, the manual tuning control shaft 9 is shown connected with the variable tuning control shaft 8 of the variable tuning control included within the rectangle 110 which, in the present example, may include the variable tuning capacitor or condenser unit hereinbefore referred to and is connected with the selector mechanism shaft 87 which carries the selector rings 71 between the spring discs 100 for rotational adjustment with respect to the shaft 87. The outer end of the shaft carries the arm 89 for operating the reversing switch 90 by means of the operating lever 91.

The contact rings may be held against rotation by the key 94 which causes the insulating segment 72a to align exactly with the contact members or brushes 70 for the various contact rings. Tuning is then manually adjusted for a predetermined desired station by means of a suitable tuning indicator such as a tuning indicator tube 111. This tube is located directly over the dial, as shown in Fig. 2. When the station is exactly tuned in by means of the tuning indicator tube, the key 94 is removed and the same operation is repeated for the various other selector rings until the required number of preselected stations or positions of adjustment of the tuning mechanism are obtained up to and including eight, in the present example. In Fig. 5, only three of the rings are shown for the purpose of simplifying the drawings.

The rotor 45 of the electric motor is shown in connection with the pin and arm connection with the gear train or driving mechanism for the variable tuning control means and also in connection with the switch comprising the contacts 50, 51 and 52. The link pinion 28 is schematically indicated in connection with the gear train and in connection with the selector switch 42, by the dotted connection 112. The motor circuit is arranged for reversing by means of the reversing switch 90 at the end of the travel of the tuning mechanism and for this purpose the motor is provided with supply terminals 113, 114, between which are connected operating windings 115, and is further provided with a reversing winding 116. The latter is connected between the operating windings 115 and through the reversing switch and may be connected with either of the terminals 113 or 114. For this purpose, the reversing switch is provided with a reversing contact 117 connected with the winding 116 and to reversing contacts 118 connected with the terminals 113 and 114 through leads indicated at 119.

Power is supplied to the motor from a low voltage secondary winding 120 on the power transformer 121 of the receiver, one side of the secondary being grounded as indicated at 122. The remaining side of the secondary 120 is connected through a lead 123 with one of the motor terminals 114. The other motor terminal is connected to ground through any one of a plurality of selectable parallel series circuits, each containing one of the contact rings 71 and corresponding contact brush 70, and one of the selector switches comprising elements 75 and 76.

The connection to ground places the motor across the secondary 120 and causes it to operate in a direction determined by the position of the reversing switch 90. The parallel grounding circuits are those provided for the various selected rings and in the present example may be eight in number, although, for the sake of simplifying the drawings, only three are shown in the circuit diagram of Fig. 5. The electric selector buttons or switches are included in the dotted rectangle 125, which are the switches adjacent to the tuning dial, and the contact members are provided with the same reference numerals.

It will be noted that the contact arms 76 are connected to a common lead 126, while the fixed contacts 75 are each connected to a separate lead such as the leads 127, 128 and 129 leading to a separate one of the selector contact brushes 70. With the brushes in contact with the selector rings, the circuit is completed to ground through the shaft 87, as indicated at 130.

The lead 126 is returned to a fixed contact 131 on the selector switch 42, and the motor terminal 113 is connected to the next adjacent fixed terminal 132 through a lead 133. The next adjacent spaced fixed terminal of the switch, indicated at 134, is connected to a lead 135 for a remote control connection to a group of switches included in a remote control unit indicated at 136 having a series of button operated switches for effecting the same connections as in the unit 125 at the receiver. This contains the same number of switches or selector contacts as the selector switches at the receiver and in the present example only three are shown. The switches comprise movable contacts 137 and fixed contacts 138 operating selectively to control the same circuits as the switches in the unit 125. For this purpose, the fixed contacts 138 are connected through extensible leads indicated at 139 with the fixed contacts 75 in the local control unit at the receiver.

The movable contacts 137 are connected in parallel to an extensible lead 135 corresponding to the lead 126 for the unit 125.

The selector switch 42 is provided with a rotary control element or insulating member 140 which carries a pair of contacts 141 bridging two adjacent fixed contacts, such as the contacts 132 and 134 and is movable from the position shown in a clockwise direction, as indicated by the arrow.

In the position shown, the motor circuit is connected to the remote control unit 136, the connection extending from the terminal 113 through the lead 133, across the contacts 132 and 134 through the jumper connection 141 to the lead 135 and thence the contacts 137 and 138 in the upper switch of the remote control unit to one of the leads 139 corresponding to one of the selector mechanism contact rings. In the present example, the first or left-hand ring is shown in the open circuit position to interrupt the motor circuit at the contact 70 thereby stopping the tuning mechanism. In either position on opposite sides of the insulating segment 72a, the contact 70 closes with the periphery of the selector ring and the circuit is completed through the shaft 87 to

ground 130 and thence to the secondary 120 through the ground 122.

With the selector ring held in position by the key 94, the manual tuning of the receiver to a desired station is effected and thereafter, with the key 94 removed, the tuning mechanism will come to rest in the same position by the opening of the motor circuit at the contact 78 when it engages the insulating segment 72a. Any of the other keys may be depressed to close the switches corresponding to the selector rings, either in the remote control unit or the local unit 125, and for the latter the switch 42 is moved clockwise to a second position to cause the contacts 131 and 132 to be connected by the bridging or jumper contact 141, thus completing the motor circuit through the lead 126 and any one of the selector switches in the unit 125, as hereinbefore described for the remote control unit.

In a third position of clockwise movement from the switch 42, the bridging contact 141 is connected between the contact 131 and a blank contact 142, thereby opening the motor circuit and preventing operation by the electric or the remote control means. At the same time the mechanical connection indicated at 112 and hereinbefore described, particularly in connection with Fig. 2, causes the link pinion 28 to disengage from the gear train, permitting free tuning movement for manual operation by means of the shaft 9 without driving the load caused by the gear train.

The positions of the selector switch 42 may be suitably indicated by electric lamps indicated at 144 and 145 through the medium of suitable fixed switching contacts 146, 147 and 148. For the control of said contacts, a second bridging conductor mounted on the movable insulating element 140 is provided at 149 and in the position shown bridges between the fixed contact 148 and a blank contact 150. Energy for lighting the lamps 144 and 145 is provided by the low voltage secondary of the power transformer 121 which is utilized to energize the heaters and filaments of the receiving system. This secondary is indicated at 151 and is also grounded, as indicated at 152, at one terminal. The opposite terminal is connected through a lead 153 to both of the lamps in parallel and from the opposite side of each lamp a separate lead is taken to the switch 42. A lead 154 for the lamp 144 is connected with the terminal 148, while a lead 155 for the lamp 145 is connected to a terminal 146. The terminal 147 between the terminals 146 and 147 is connected to ground as indicated at 156.

Since the switch is shown in the remote control position, the lamp circuit is opened and no indication is provided. When the switch is moved to electric control for local operation of the electric tuning at the receiver, the contacts 148 and 147 are closed by the bridging contact 149, thereby closing the supply circuit through the lamp 144 from the lead 153 to ground 156 and to the secondary 151. When the switch is moved to the third position for manual tuning the lamp circuit is closed to the lamp 145 and the lead 154 in a similar manner indicating manual tuning. The lamps may be placed behind suitable indicating windows in the receiver panel front as indicated in dash lines in Fig. 2 at 157 and 158, the lamp 144 being placed behind the translucent window 157 and the lamp 145 being placed behind the translucent window 158. The windows may include suitable legends as indicated.

The automatic frequency control system includes a tuning control tube indicated at 160 and is responsive to signals applied to a control grid 161 through a grid leak 162 in connection with a grid capacitor 163 from a control lead 164. Since the control lead is connected with a source of biasing potential which varies in polarity and magnitude with variations in frequency on either side of resonance, in the present example, this potential is derived from the automatic frequency control rectifier tube indicated at 165 across an output resistor comprising two sections 166 and 167, the latter being connected to ground as indicated at 168. The lead 164 is connected to the ungrounded terminal 169 of the output resistor 166. Automatic volume control potentials are derived from the resistor 167 through a lead 170 and controlling potentials are also applied to the tuning indicator tube 111 through a lead 171 connected through a suitable filter comprising a resistor 172 and by-pass capacitor 173. As is well known, the tuning indicator tube illustrated is of the RCA 6E5 type, in which a dark segment of varying width appears upon a colored background or screen. The tuning control tube operates to vary the frequency of a portion of the receiving circuit to cause a desired intermediate frequency to be produced whenever a signal is approximately tuned in by the electric tuning mechanism, thereby causing the tuning of the receiver system to exact resonance with the received signal.

Both the selector switch 42 and the contacts associated with the electric tuning motor are arranged to suppress the automatic frequency control operation. For this purpose, the lead 164 is connected with fixed contacts 175 and 176 in the switch 42. A blank contact 177 is provided adjacent to the contact 176 and a grounded contact 178 is provided adjacent to the contact 175. A series of contacts are arranged to be bridged by a bridging connection 179 carried by the rotor 140 of the switch. In the remote control position shown, the contacts 177 and 176 are connected and the automatic frequency control system is operative. Likewise, it is operative in the electric control position when the contacts 175 and 176 are bridged. However, in the manual position, which is the third position in a clockwise direction, the contacts 175 and 178 are connected to ground the lead 164, thereby suppressing automatic frequency control of the tuning system.

This suppressing connection for the automatic frequency control system is likewise provided by the contact 50 in the switch associated with the tuning control motor which is connected through a lead 180 with the lead 164. It will be noted that the contact 52 is grounded and when the motor armature moves upon energization of the motor, the contact 50 is connected through the contact 51 to the contact 52 and ground, thereby suppressing automatic frequency control of the tuning system and preventing the automatic frequency response to adjacent channel signals in passing, where the adjacent channel signal is relatively strong with respect to the selected signal, for which the tuning system is adjusted to stop. When the motor is deenergized, the automatic frequency control suppression is removed by opening of the contacts 50, 51 and 52 and the automatic frequency control system completes the tuning. As the automatic frequency control system forms no part of this invention, a description of any particular system of which there are several well known types is believed to be unnecessary.

In order that the receiving system may not emit sounds when tuning by electric or remote control means, a portion of the receiving system may be arranged to cut off the signals transmitted therethrough and this is most readily obtained by short circuiting a portion of the audio frequency amplifier to ground.

In the present example, the grid circuit 181 of an audio frequency amplifier tube 182 is short circuited to ground through a lead 183 connected with the switch contact 51. The tube 182 is in the audio frequency amplifying channel, as indicated, and it will be seen that when the contact 51 closes with the contact 52 the audio frequency channel will be short circuited, thereby suppressing signals passing through it.

From the foregoing description, it will be seen that in a tuning system in accordance with the invention a reversing switch is arranged to change the direction of rotation of the tuning motor at the end of the travel of the tuning control element in either direction and operates in such a manner that in case the selected tuning position is on the side of the setting already passed over by the selector mechanism, the station is then approached, i. e., the tuning position is approached from the opposite direction. This simplifies the tuning mechanism and circuit as has hereinbefore been referred to and the additional time for travel is compensated by providing a high speed motor.

The selector buttons are interlocking whereby a depressed button is released upon the selection of a second button so that the operation of the system is not interfered with under the condition that two buttons should be depressed at the same time. If this is done, however, it will be seen that the selector mechanism will hunt between the two selected positions and become continuously movable from one end of the scale to the other without stopping. The tuning indicator tube is utilized for manual tuning and for initially setting the frictionally held contact rings for station selection. Automatic frequency control is not operative for manual tuning and is controlled by the manual-electric-remote selector switch, as well as by the end movement of the motor armature.

By providing locking switch contacts, a selected station may be tuned in without waiting for the motor to operate while maintaining pressure on the button. Likewise, the operation of setting up a plurality of selected stations or stopping positions for the tuned mechanism is facilitated by the location of the selector mechanism at the rear of the tuning element and providing a plurality of relatively widely spaced contact rings in a single circuit connection wherein a minimum number of contacts are provided and wherein there is no problem of controlling pressures or contact adjustments. The simple commutator arrangement and reversing switch directly on the condenser shaft causes the operation to be positive and eliminates frequent servicing. The motor circuit is closed by a simple two-point switch and is opened by a simple insulated gap or segment in a plain metallic ring rotated in frictional engagement with the condenser shaft. The system is adapted as well for electric preselection tuning as for remote control and the circuits and switching control elements may be a supplication of the circuits and control elements on the receiver, thereby simplifying construction and installation, as well as operation.

I claim as my invention:

1. In a radio receiving system including variable tuning means provided with a control shaft and a motor for driving said shaft, the combination of means providing a gear train between said motor shaft and said tuning control shaft, a selector mechanism comprising a plurality of contact rings frictionally coupled to said tuning control shaft and each provided with an insulation segment at its outer periphery and with a contact member engaging said periphery, local and remote groups of interlocking control switches connected in the circuits of said contacts for selectively energizing said motor through said rings, and selector switch means for rendering only one of said groups effective to control said energization, and for rendering both of said groups ineffective, and means for conjointly operating said selector switch means to render both of said groups ineffective and for removing the load of said gear train from the tuning control shaft.

2. In a radio receiving system, the combination with variable tuning means having a control shaft, automatic frequency control means and resonance indicating means, of electric motor means having a shaft which moves axially in response to energization of the motor, switch means responsive to axial movement of said shaft for electrically suppressing the automatic frequency control means and the signal output from said receiving system, means providing a gear train between said motor shaft and said tuning control shaft, means for mechanically disconnecting the gear train from said tuning control shaft whereby said last named shaft may be manually operated without the load of the gear train thereon and conjointly suppressing the automatic frequency control means, a selector mechanism connected with said tuning control shaft to rotate therewith and including a plurality of axially spaced contact rings, each of said rings having a narrow insulating gap in the periphery thereof and a contact member engaging said periphery, interlocking control switches, one in circuit with each contact member for selectively energizing the motor means therethrough and means for adjusting the angular relation of the tuning control shaft to said insulating gaps by said manual tuning control means in conjunction with said resonance indicator means.

3. In a radio receiving system, the combination with a variable tuning means provided with a control shaft, of a reversible electric motor for driving said shaft, a speed reducing gearing providing a driving connection between said motor and said control shaft, said gearing and said motor being provided with coaxial shafts and radially extending members adapted to provide a connection between the motor and the gearing, said motor shaft being axially movable to effect said connection, a reversing switch for said motor provided with means whereby it is controlled by the end movement of the rotation of said control shaft, means providing a plurality of contact rings frictionally coupled and grounded to said control shaft and each being provided with an insulation segment at the periphery thereof and with a contact member engaging said periphery, a plurality of control switches each connected in the circuit of a different one of said contacts and with said motor for selectively energizing said motor through single circuits including a common ground, automatic frequency control means for said system having a control circuit, a selector switch in said control circuit and connected with

said motor circuit for rendering said control switches and said automatic frequency control means ineffective, and means connected with said switch and conjointly operable therewith for removing the load of said gear train from said control shaft when said selector switch is operated.

4. In an automatic tuning device for radio receivers, a tuning shaft, an electric motor, means for transmitting motion from the motor to said tuning shaft, means for stopping said motor at one of a plurality of predetermined positions of said tuning shaft, an automatic frequency control circuit, a switch in said circuit movable to a position in which the circuit is rendered inoperative, and means for preventing transmission of motion from said motor to said tuning shaft in response to movement of said switch to said position.

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