Aug. 17, 1937. A. A. THOMAS 2,090,315

RADIO TUNING DEVICE

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FIG. 1.

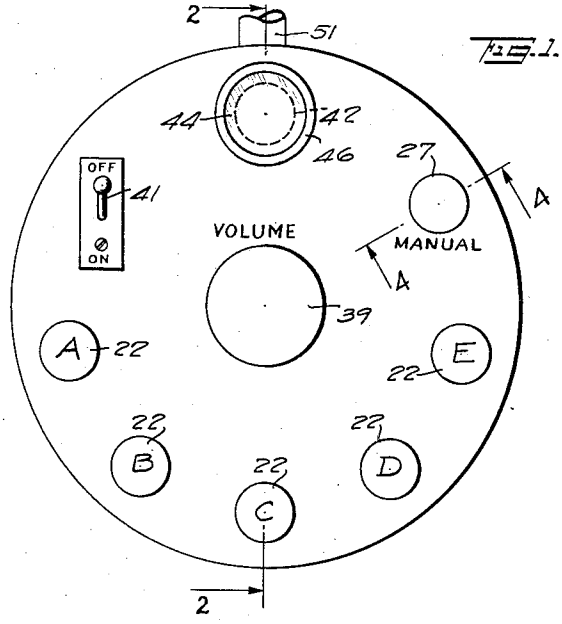


FIG. 4.

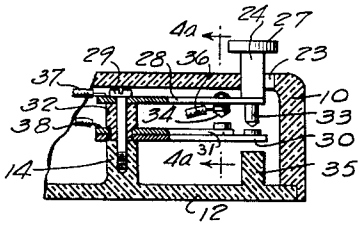
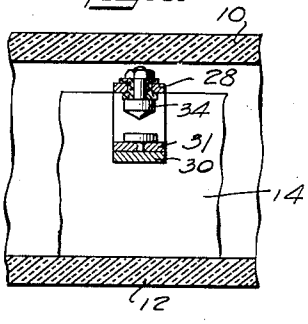


FIG. 4a.



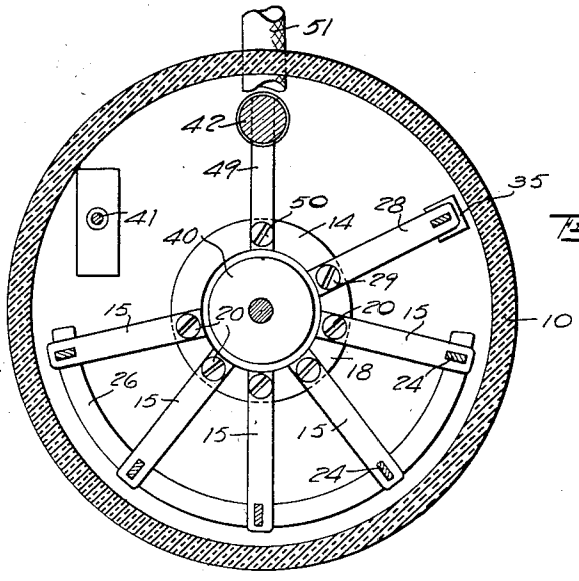
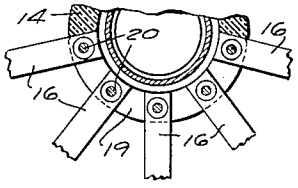


FIG. 3.

FIG. 3a.



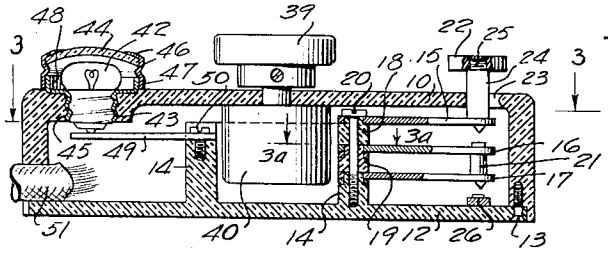


FIG. 2.

INVENTOR

Adolph A. Thomas

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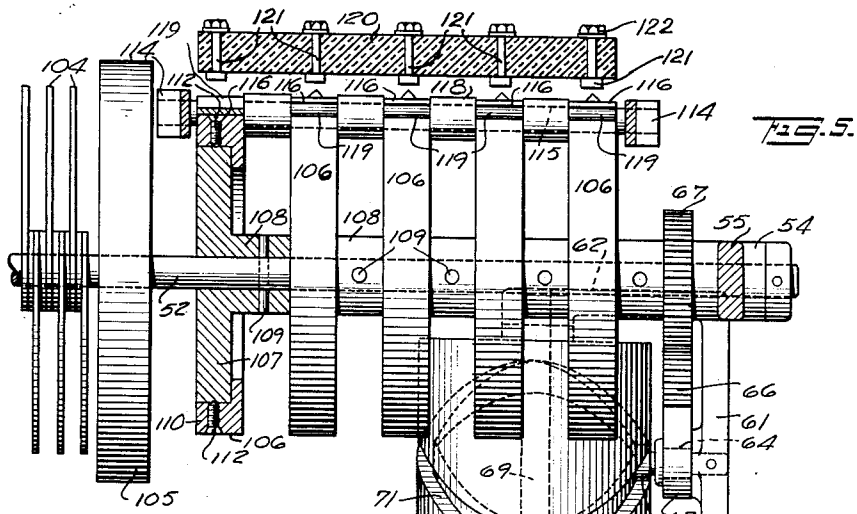


FIG. 5.

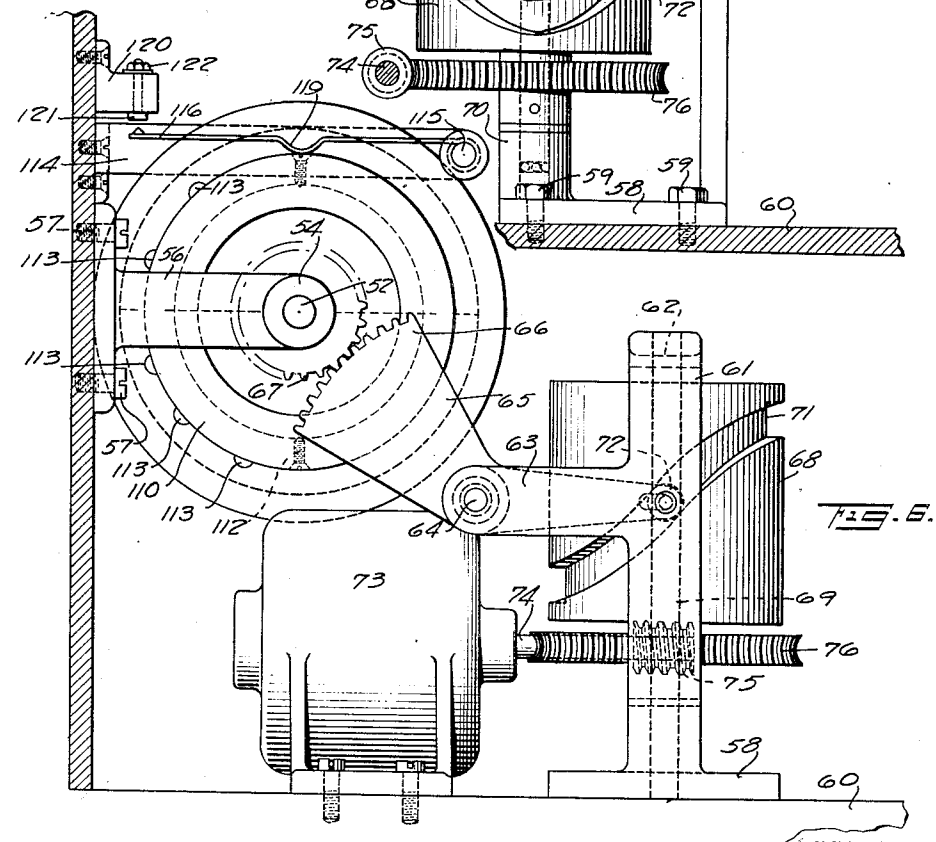


FIG. 6.

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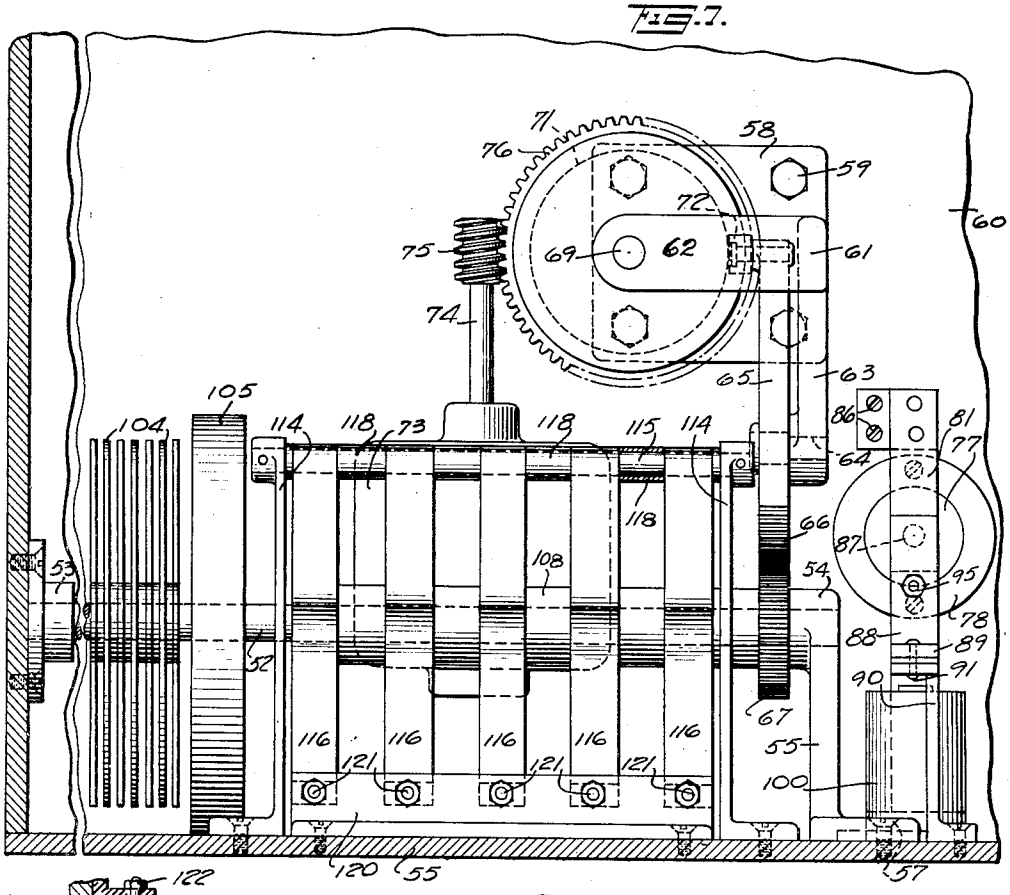
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FIG. 7.



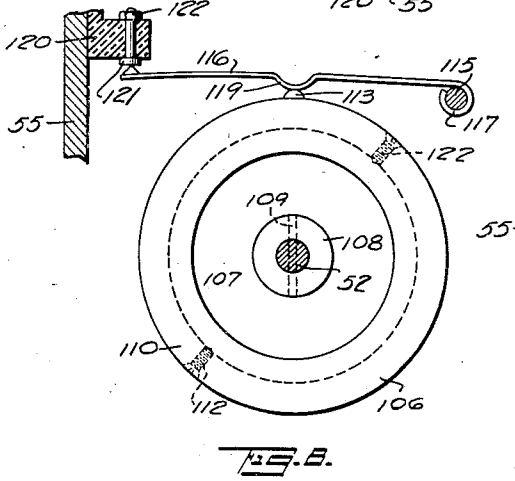


FIG. 8.

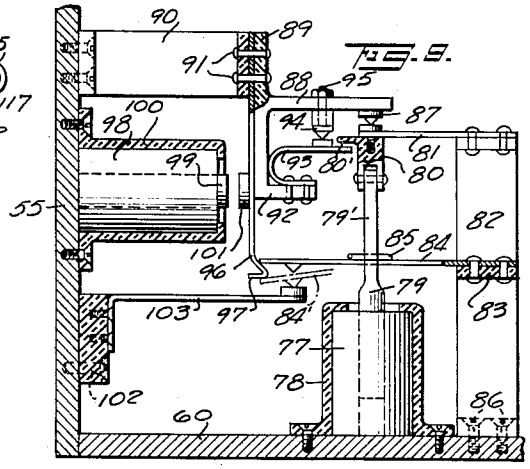


FIG. 9.

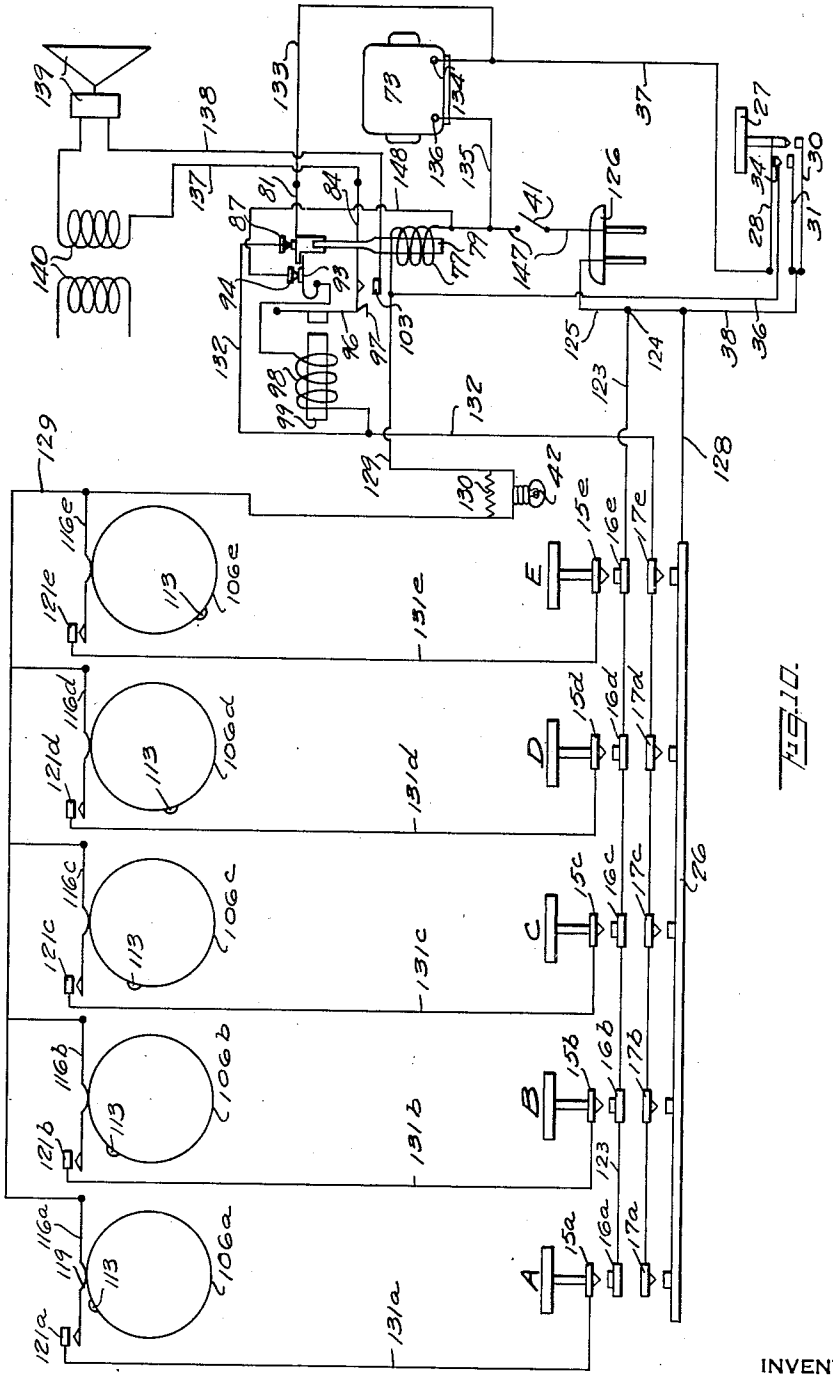
INVENTOR

Adolph A. Thomas

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RADIO TUNING DEVICE

Filed July 30, 1929 4 Sheets-Sheet 4



INVENTOR

Adolph A. Thomas

Patented Aug. 17, 1937

2,090,315

UNITED STATES PATENT OFFICE

2,090,315

RADIO TUNING DEVICE

Adolph A. Thomas, New York, N. Y., assignor to Radio Corporation of America, New York, N. Y., a corporation of Delaware

Application July 30, 1929, Serial No. 382,117

13 Claims. (Cl. 250—20)

My invention relates to radio receivers, and its object is to provide a simple and reliable device for controlling the tuning shaft from a distance to bring in a desired station. The main purpose of this invention is to produce a remote tuner of compact structure with as few parts as possible, so that it can be applied to any type or make of receiver at little cost.

According to my invention, the tuning shaft of a receiver is driven by a small electric motor though an automatic reversing connection which moves the shaft slowly back and forth over the indicator range. A set of cams or other form of switch-operating members on the tuning shaft represents a number of selected broadcasting stations, and each cam automatically closes a switch when the corresponding station is in tune. A small box or casing located at a distance from the receiver contains a set of keys or buttons which represent the selected stations referred to. A cable carrying the necessary wiring operatively connects the control box with the receiver. When a key is depressed, the motor circuit is closed and the tuning shaft is turned until the switch corresponding to the actuated key is closed by the associated cam, whereupon an electromagnet is energized to open the motor circuit. The radio shaft is almost instantly stopped in tuning position for the desired station. A lamp in the control box automatically goes on when the station is in tune, and the turning of a knob gives the required volume. The switch-operating cams may be individually adjustable for any station.

In a preferred embodiment of my invention, the control box carries an extra key for tuning in any station on the dial. When this key is actuated, the motor circuit is closed and remains so as long as the key is held down. In other words, the tuning shaft moves over the broadcasting range until the operator gets the program he wants. Then he simply releases the key and the selected station remains in tune because the motor circuit is open. When this manual tuning key is used, the automatic tuning switches controlled by the other keys are idle.

Another important feature of my new remote tuner comprises means for keeping the loudspeaker silent until the selected station is brought in. This prevents unnecessary noises, frequently disagreeable, during the process of tuning, and it is only when the wanted station is in tune that the loudspeaker is automatically turned on. This silent tuning applies only to the automatic keys that bring in certain preselected stations. When the manual tuning key is actuated, the loudspeaker circuit remains closed so that the operator can hear each broadcast program and make his selection.

As evidence of the simplicity of my remote tuner, I may point out that only two electromagnets are needed for all the control circuits. If the silent tuning feature is not desired, only one electromagnet is necessary. The switch mechanism in the control box is exceedingly simple, comprising only a number of key-actuated spring blades which may conveniently be arranged in radial fashion. There are no electromagnets in this box, which can therefore be made unusually small, flat and light, for placing in almost any spot. It can be put on a desk or table, or on the arm of a chair; it can be held in the lap or taken to bed. The operation of the control box is so simple that a child can use it.

The practical advantages and novel features of my invention will be understood from a detailed description of the accompanying drawings, in which—

Fig. 1 shows a circular form of my new control box in top view;

Fig. 2 is a cross-section on line 2—2 of Fig. 1;

Fig. 3 illustrates a plan view on section line 3—3 of Fig. 2;

Fig. 3*a* represents a fragmentary section on line 3*a*—3*a* of Fig. 2 to show the common connector for the radial switch arms;

Fig. 4 is a fragmentary sectional view on line 4—4 of Fig. 1, showing the manual tuning key and associated switches;

Fig. 4*a* is an enlarged section on line 4*a*—4*a* of Fig. 4;

Fig. 5 shows a front view of the driving connections and switch mechanism associated with the tuning shaft of the radio receiver, certain parts being sectioned for clearness;

Fig. 6 is a side view of Fig. 5, looking from right to left;

Fig. 7 represents a plan view of the apparatus shown in Figs. 5 and 6;

Fig. 8 is a detached side view of one of the cam disks on the tuning shaft in switch-closing position;

Fig. 9 shows the two electromagnets of the tuning system and their associated switches for controlling the motor circuit and the loudspeaker circuit; and

Fig. 10 is a diagram of circuit connections between the remote control box and the operating mechanism of the tuning shaft.

Referring to the first sheet of the drawings, which show the remote control box, there is an

outer casing 10 provided with a removable bottom 12 attached in any practical way, as by screws 13. The parts 10 and 12 are preferably made of insulating material of the bakelite type, and the box as a whole is colored and ornamented to suit the taste of the manufacturer. The top of the box is here shown integral with the body, but it may obviously be a separate plate, in which case the bottom 12 may be molded or cast integral with the body of the box. It is convenient to make the box of cylindrical shape, which adds to its compactness and pleasing appearance, but any other practical shape may be used.

The bottom plate 12 is provided at the center with an upstanding cylindrical support 14, which is preferably formed as an integral projection. The insulating support 14 carries three sets of spring arms 15, 16 and 17, each set in this instance comprising five arms. This number, however, is merely arbitrary, for it has been assumed that the present embodiment of the invention is capable of automatically tuning in five stations. Manifestly, the number of stations to be handled by the tuning box depends upon the manufacturer, but under our present system of chain broadcasting there is hardly any locality that can not get all the best programs from five or six stations. As shown in Fig. 2, the switch arms 15, 16 and 17 are spaced by insulating blocks 18 and 19, which are secured to the cylindrical support 14 by bolts or screws 20. The spacing blocks 18 and 19 may be in the form of arcuate strips of bakelite or similar material, and are in effect separable sections of the cylindrical support 14. There is no harm if the heads of bolts 20 are in contact with the upper spring arms 15, because the bolts are fully insulated from switch arms 16 and 17. If desired, the heads of bolts 20 may be used as binding posts for connecting the switch arms 15 in circuit. Each aligned pair of switch arms 16 and 17 is mechanically connected by an insulating pin or lug 21, which may be attached to either arm.

The switch arms 15, 16 and 17 are actuated by suitable keys or buttons 22 extending through slots 23 in the top of the box. The key stems 24 are secured in any practical way to the free ends of switch arms 15. The heads of keys 22 are attached to the stems 24 after the bottom plate 12 has been fixed in place and the key stems project through slots 23. An ordinary screw-threaded connection 25 may be used to mount the key heads on stems 24. In Fig. 1, the keys 22 are differentiated by the letters A to E, which are supposed to represent five selected stations. In other words, when a person wants station A, he simply pushes down key A; when station D is desired, key D is pushed down; and so on. When a key 22 is actuated, the connected switch arm 15 is forced into contact with switch arm 16, and switch arm 17 is moved into contact with a circular conducting bar or strip 26, which is common to all switch arms 17. It is clear from Fig. 2 that switch arms 15 and 16 are closed before switch arm 17 strikes the contact bar 26. When the actuated key is released, the switch arm 17 leaves the contact bar 26 before the switch arms 15 and 16 separate. The reason for this relative timing of the switches will be explained in connection with the circuit diagram of Fig. 10. The switch arms 15, 16 and 17 are preferably in the form of spring blades with just enough resiliency to permit operation of keys 22 by easy pressure, so that even a child can use the control box. The inherent resiliency of the spring blades 15, 16 and 17 causes them to return instantly to normal open position when the keys are released.

An extra key 27, which I call the manual tuning key, is for the purpose of operating the tuning shaft to sweep the indicator dial from one end to the other until the desired program or station is found. In other words, key 27 is actuated when it is desired to tune in any station not represented by keys A—E, which bring in only certain preselected stations. The shank 24 of key 27 is connected to the free end of a switch arm 28, which is secured at its inner end to the circular support 14 by a screw or bolt 29. Below the switch arm 28 are two switch arms 30 and 31, which are mounted on support 14 by means of an insulating block 32. A metallic pin or lug 33 fixed on the free end of arm 28 is adapted to engage switch arm 30 when key 27 is pushed down. An insulated contact piece 34 connected to spring arm 28 engages switch arm 31 when arm 28 is forced down by key 27. The arrangement of contact pieces 33 and 34 is such that, when key 27 is depressed, the contact piece 33 strikes switch arm 30 before the contact piece 34 strikes switch arm 31. This insures the positive closing of the two switches. A stop 35 on the bottom plate 12 limits the downward movement of key 27. The head of key 27 may be colored differently from the heads of the automatic tuning keys 22, and all key heads are preferably molded of bakelite or similar insulating material.

The three switch arms 28, 30 and 31 are spring blades of good conducting material and having the right amount of resiliency, as explained in connection with switch arms 15, 16 and 17. The two spring blades 30 and 31 are in effect a single switch member, for they are always in metallic contact with each other. The only reason for using two switch arms is to insure a firm closure of both contact pieces 33 and 34 when the key is pushed down. Any other practical switch construction may be used with key 27. The insulated contact piece 34 acts as a terminal for a circuit conductor 36. A conductor 37 is connected to switch arm 28, and for this purpose the bolt or screw 29 may be used as a binding post. The switch arms 30 and 31 are connected in circuit through a conductor 38 which is common to both.

A knob or other suitable finger piece 39 arranged centrally on top of box 10 is adapted to control a volume regulator 40, which may be a resistance or any other suitable device adapted to increase and decrease the loudspeaker volume when knob 39 is turned. As volume-controlling devices for radio receivers are well known, I need not show or describe any details of part 40, which may conveniently be mounted in the cylindrical support 14. A suitable switch 41 permits the radio set to be turned on and off at will. The switch 41 may be of the well known toggle type, which has a pivoted finger piece that is easily snapped from one position to the other. The control box 10 may also be provided with a small signal lamp 42 screwed into a metal socket 43 and covered by a lens 44 of suitably colored glass or other transparent material. The lamp socket 43 is screwed into an opening 45 in the top of box 10 and constitutes one terminal of the lamp circuit. The lens 44 is fixed in a cap 46, which has a cylindrical flange 47 adapted to fit tight over a similar flange 48 of socket 45. This

simple mounting permits easy removal of cap 46 for access to lamp 42. The central terminal of lamp 42 is in contact with a spring arm 49 which is secured to support 14 by screw 50 or otherwise. An opening in the side of box 10 allows the insertion of a cable 51, which carries all necessary circuit conductors for operatively connecting the remote control box 10 with the radio receiver. In a simpler form of my invention, the signal lamp 42 may be omitted, but it adds to the attractiveness and utility of the control box by flashing a signal when the desired station is in tune. The radial arrangement of the switches controlled by keys 22 and 27 reduces the dimensions of box 10 to a minimum. In actual size the box need not be larger than shown in the drawings and may even be smaller.

The second and third sheets of the drawings show the mechanism in the radio receiver controlled by the switches in box 10. The tuning shaft 52 of any selected make or type of radio receiver is rotatably mounted in bearings 52 and 53. In this instance the tuning shaft runs lengthwise of the cabinet parallel with the front panel 55, but this particular arrangement is not necessary, for sometimes the tuning shaft of a receiver runs from front to rear of the cabinet. The bearing 54 is part of a bracket 56 secured to the front panel 55 by bolts or screws 57. A base plate 58 secured by bolts 59 to the bottom board 60 of the radio compartment carries an upright post or standard 61 which terminates at the top in a cross arm 62. A lateral extension 63 on post 61 carries a pin 64 on which a rocking lever 65 is pivoted. The front end of lever 65 is in the form of (or otherwise carries) a segmental gear 66, which is permanently in mesh with a pinion or gear wheel 67 fixed on the tuning shaft 52. A rotary cam cylinder 68 is mounted on a shaft 69 between base plate 58 and cross arm 62. The lower end of shaft 69 is suitably supported in a bearing 70 on base plate 68 for rotation with minimum friction, while the upper end of this shaft is journalled in the cross arm 62 of standard 61. The rotary cylinder 68 is provided with a cam groove 71, which runs around the cylinder from top to bottom and back again in a continuous curve. A roller 72 on the rear end of lever 63 rides in cam groove 71.

It is clear from Figs. 5 and 6 that the rotation of cylinder 68 in the same direction produces a rocking or oscillatory motion of lever 65, whereby the tuning shaft 52 is rotated back and forth through a predetermined arc to cover the entire broadcasting range. In most types of radio receivers on the market, the range of the station indicator covers a half revolution of the tuning shaft. It may therefore be assumed that for every half revolution of cylinder 68, the tuning shaft 52 is moved from one end of the indicator to the other. In the position of the parts as shown in Figs. 5 and 6, the tuning shaft is about midway on the indicator. It is thus clear that for every revolution of the cam cylinder 68, the lever 63 is rocked clockwise and counterclockwise to actuate the tuning shaft from one end of the indicator to the other and back again. The cam cylinder 68 is rotated continuously in the same direction at properly reduced speed by a small electric motor 73, which has a shaft 74 carrying a worm 75 in mesh with a worm gear 76 fixed on shaft 69 of cylinder 68. The speed reduction between the motor shaft 74 and tuning shaft 52 is preferably such that the latter is operated at about the speed used in hand tuning.

A solenoid coil 77 is fixed in upright position on the bottom board 60 by an insulating cap 78 or in any other practical way. A magnetic core or plunger 79 is movable axially in the central opening of the coil. The extension 79' of plunger 79 carries an insulating head 80 attached to the free end of a spring blade 81, which is mounted on an upright post 82. A lateral extension 83 of post 82 carries a spring arm 84, which is slotted to receive the extension 79' of plunger 79. A cotter pin 85 passing through extension 79' and lying over the spring blade 84 connects the latter to the plunger for downward movement. The supporting standard 82, which is secured to the bottom board 60 by screws 86 or otherwise, is preferably of insulating material, but it may also be a metal casting or of sheet metal, except that then the switch arms 81 and 84 must be insulated from each other. The normal resiliency or set of spring arms 81 and 84 is such that the free end of arm 81 is normally pressed against a contact 87 mounted on an arm 88 of insulating bracket 89.

The front panel 55 carries a horizontal bracket 90 to which the bracket 89 is secured by bolts or rivets 91. It is possible, of course, to make the brackets 89 and 90 as a single member of bakelite, aluminum, or other suitable material. An arm 92 at the lower end of bracket 89 carries a spring arm 93 normally in pressure contact with a terminal 94 mounted on arm 88. The terminal 94 may simply be the head of a bolt 95 secured by the usual nut. A spring arm 96 is secured at its upper end between the brackets 89 and 90 by rivets 91 and terminates at its lower end in a hook or catch 97 arranged to be engaged by the free end of switch arm 84. A coil 98 surrounding a magnetic core 99 is supported in horizontal position from the front panel 55 by means of an insulating cap or shell 100. An armature 101 fixed on spring arm 96 is attracted to the pole of core 99 when coil 98 is energized. When this happens, the catch 97 at the end of arm 96 is moved out of the path of switch arm 84. An insulating block 102 on front panel 55 carries a spring arm 103 arranged to be engaged by spring arm 84 when the latter is moved down into the dotted line position 84'. It goes without saying that the terminals or contact members 87, 93 and 94 are insulated from each other, either by the insulating material of bracket 89, or (if the latter is of metal) by separate insulation.

The operation of the switch mechanism shown in Fig. 9 is as follows: In the normal position of the parts, the spring arms 81 and 84 hold the solenoid plunger 79 up, with the arm 81 pressing firmly against contact 87. The free end of switch arm 84 is above catch 97 of spring arm 96, and the switch contacts 93—94 are closed by the normal tension of spring arm 93. When the coil 77 is energized, the magnetic core or plunger 79 is instantly pulled down against the tension of the supporting spring blades 81 and 84, and the following operations take place: Switch arm 81 breaks contact with terminal 87, switch arm 93 is forced away from terminal 94 by the lateral extension 80' of head 80, and switch arm 84 is moved into pressure contact with switch arm 103. During the downward movement of switch arm 84, the bevelled catch 97 is pushed to the left and then snaps back again to lock the switch arm 84 in closing position 84'. The extension 79' of plunger 79 slides freely in the slot of switch arm 84, so that the plunger is free to return to normal position while the switch arm 84 remains locked. When coil 98 is energized, the magnetic attrac-

tion between parts 99 and 101 moves the spring arm 96 to the left and thereby withdraws the catch 97 from switch arm 84, so that the latter instantly rises to normal position by its inherent tension. This takes place only when the plunger 79 is in normal raised position, so that the cross-pin 85 does not interfere with the return of switch arm 84.

The tuning shaft 52 carries condensers or other tuning elements 104 and an indicating drum 105. These parts may be of any approved construction and are so well understood that they require no further description. The movements of shaft 52 for automatic tuning are controlled by a series of disks 106 secured on the shaft in properly spaced relation. In the present instance there are five disks, because it has been assumed that five stations are automatically tuned in by the remote control box 10, as previously explained. Since these disks are alike in structure, a description of one will suffice for all. Referring to Fig. 5, where one of the disks is shown in section, it will be seen that each disk has a body portion 107 provided with a hub 108 for receiving a pin 109 which passes through shaft 52. The hubs 108 also serve as automatic spacing means for the disks when they are strung on the shaft. The body portion 107 carries a ring 110, which is radially adjustable and fixed in position by one or more set screws 112. Each ring 110 is provided with a cam 113, which may be formed integral with the ring or attached thereto as a separate piece. The cams 113 of the different disks are arranged in predetermined angular relation, as shown in Fig. 6. The position of each cam 113 determines the position in which the tuning shaft 52 is stopped, as will presently become clear. The body portion 107 and ring section 110 of each disk 106 may be cast of aluminum or other light metal, or they may be molded from composition material of the bakelite type. No particular construction of cam disk is necessary and an ordinary disk may be used without the adjustable ring 110. The latter, however, serves the practical purpose of permitting radial adjustment of cam 113 to change from one station to another. The radial positions of the five cams 113 in Fig. 6 are intended to correspond to the five stations represented by keys A—E of the control box 10.

Two spaced brackets 114 projecting rearwardly from the front panel 55 carry a rod 115 which supports a series of switch arms 116 arranged in alignment with the cam disks 106. The switch arms 116 may be in the form of spring blades bent at 117 around the common supporting shaft 115. Sleeves 118 on shaft 115 hold the switch arms 116 in properly spaced relation. Since the switch arms 116 are connected to a common terminal, the rod 115 is preferably of brass, or other good conducting metal, and is suitably insulated. Each switch arm 116 is offset to form a rounded or bevelled cam 119, which normally rides over the smooth periphery of the associated disk, as shown in Fig. 6. The front panel 55 supports an insulating bar 120 which carries a series of contacts 121. These contacts may be in the form of bolts, which are easily secured to the supporting bar 120 by nuts 122. The insulated contacts 121 are in line with the free ends of switch arms 116. As long as the switch arms 116 ride over the circular periphery of the associated disks 106, the free ends of the arms remain out of engagement with contacts 121 (see Fig. 6). However, when the cam 113 of any disk encounters the cam 119 of the associated switch arm 116, as shown in Fig. 8, the free end of the arm is moved into pressure engagement with the adjacent contact 121.

In the circuit diagram of Fig. 10, the various switch arms and contacts associated with keys A—E and cam disks 106 are distinguished by means of suffix letters *a*—*e*, so as to facilitate the tracing of the circuits for the different keys. The common connection between switch arms 16 is indicated by a conductor 123, which is connected at 124 to the main circuit lead 125 of a suitable plug 126 adapted to be inserted in a house-lighting socket. The other lead 127 includes the on-and-off switch 41, previously referred to. A wire 128 connects the common contact bar 26 to conductor 38, which is shown as an extension of conductor 125. The five switch arms 116 are connected in parallel to a common conductor 129, which leads to one side of coil 77. The other side of this coil is connected to conductor 127. The signal lamp 42 is included in conductor 129 and is preferably shunted by a resistance 130, so that the system will not be disorganized if the lamp should burn out or be removed. The switch arms 15*a* to 15*e* are connected to the corresponding contacts 121*a* to 121*e* by conductors 131*a* to 131*e*, respectively. The switch arms 17*a* to 17*e* are connected to a common conductor 132, which leads to switch contact 87. The switch arm 81 is connected by wire 133 to the motor terminal 134, to which the conductor 37 is also connected. A wire 135 connects the other motor terminal 136 to the circuit lead 127. The switch members 84 and 103 are connected by wires 137 and 138 in the operating circuit of a loudspeaker diagrammatically indicated by the outlines 139. This loudspeaker, which may be of any approved type, is supposed to be connected in the output circuit of the radio receiver through transformer 140, or in any other practical way. As long as switch 84—103 is open, the loudspeaker 139 is inoperative.

Let us suppose that key A is depressed to tune in station A. The circuit of motor 73 is closed as follows, it being assumed that switch 41 remains closed: circuit main 127, wire 135, electric motor 73, wire 133, closed switch contacts 81—87, conductor 132, switch arm 17*a*, contact bar 26, wire 128 and return lead 125. The energized motor drives the tuning shaft 52 through the automatic reversing connection previously described until cam 113 of disk 106*a* strikes cam 119 of switch arm 116*a* and moves the same against contact 121*a*. This energizes coil 77 through the following circuit: main conductor 127, coil 77, conductor 129 (including signal lamp 42), closed switch members 116*a*—121*a*, wire 131*a*, closed switch contacts 15*a*—16*a*, and through conductor 123 to return main 125 of plug 126. The energized coil 77 instantly pulls down the magnetic core 79 which opens the switch contacts 81—87 and thereby breaks the motor circuit. The tuning shaft 52 is therefore stopped in tuning position for the particular station represented by key A and cam disk 106*a*. As soon as the operator receives the signal from lighted lamp 42, he knows that the desired station is in tune and the depressed key is released. This opens the circuit of solenoid coil 77 and allows the switch arm 81 to spring back to normal closing position. This, however, does not close the motor circuit, because the switch arm 17*a* is opened before the solenoid circuit is interrupted by the separation of contacts 15*a*—16*a*. If necessary, a brake may be

used to accelerate the stopping of motor shaft 14.

When any one of the other keys B—E is actuated to bring in the desired station, the circuits of motor 13 and coil 17 are closed in the same way through the switches controlled by the actuated key and its corresponding cam disk. This is clear from Fig. 10 without the need of tracing each circuit in detail. There is, however, one operation that requires special notice. Since the loudspeaker switch 84—103 remains closed after the release of an actuated key, it is necessary to open this switch when the next key is depressed so as to keep the loudspeaker out of circuit until the next tuning position of shaft 52 is reached. The opening of loudspeaker switch 84—103 is automatically accomplished in the following manner. Let us assume that key B is actuated to bring in station B. The circuits of motor 13 and solenoid coil 17 we need not trace, because they will be understood from what has been said before. When key B is pushed down, coil 98 is energized through the following connections: conductors 147 and 148, closed switch contacts 94—93, coil 98, conductor 132, switch arm 17b, contact bar 26, conductor 128, and the other side 125 of the work circuit. The energized electromagnet 98—99 attracts armature 101 and moves the spring arm 96 away from switch arm 84, which instantly springs up to open position. This opening of the previously closed loudspeaker switch 84—103 takes place as soon as any key is depressed, so that the loudspeaker is silent until the shaft 52 is again in the desired tuning position. The closing of switches 81—87 and 93—94 when coil 17 is de-energized is subsequent to the opening of switch 17—26, so that neither the motor circuit nor the circuit of coil 98 is closed by release of the actuated key.

I explained briefly in connection with Fig. 1 that the separate key 27 was for the purpose of tuning in any station independently of keys A—E. The circuit diagram of Fig. 10 indicates how that is done. When key 27 is pushed down, the circuit of motor 13 is closed as follows: conductors 147 and 135, motor 13, wire 37, closed switch arms 28 and 30, conductors 38 and 125. The motor circuit is therefore closed independently of keys A—E and cam disks 106, so that the motor keeps running as long as key 27 is held down. As soon as the operator hears the desired program, he simply releases the key and the motor stops, leaving shaft 52 in tuning position for the desired station. During the operation of tuning shaft 52 by means of key 27, it is necessary to keep the loudspeaker circuit closed, because the operator is on a fishing expedition, as it were, and wants to hear all the programs that are on the air, so that he can make his selection. When key 27 is pushed down, the circuit of solenoid coil 17 is closed through the following connections: conductor 147, coil 17, conductor 36, closed switch 34—31, and conductor 38 to the other side of the work circuit. When coil 17 is energized, the plunger 19 is pulled down to close the loudspeaker switch 84—103, as previously explained. This switch remains closed not only as long as key 27 is held down, but even after the key is released. The only time that the closed switch 84—103 is opened, is when an automatic tuning key A—E is actuated, as previously explained.

It is clear from the preceding description that I have provided a remote automatic tuning system of simple construction and reliable operation. The cam disks 106 are easily adjustable for any desired station, so that a manufacturer can readily adjust this automatic tuner for the most desirable stations in any particular locality of the country. This change of stations may also be made by the owner of the set, since it is an exceedingly simple matter. The manual tuning key 27 supplements the automatic tuning keys, in that it permits a person to tune the receiver at a distance for any station that happens to be broadcasting. Not the least important feature of this automatic tuning system is the fact that the loudspeaker remains silent until the selected station is in tune.

Although I have shown and described certain specific constructions and circuit arrangements, I want it understood that my invention is not limited to the details set forth. Changes and modifications will perhaps occur to others, without departing from the scope of the invention as defined in the appended claims. I have used the word "key" in the claims as a convenient term to indicate any suitable hand member for operatating the switches in the control box. When I speak of the shaft 52 as a tuning shaft, I do not mean that the tuning elements must be mounted on the shaft, but I include any shaft whose operation controls the position or condition of the tuning elements in the receiver.

I claim as my invention:

1. In a radio receiver, the combination of adjustable tuning elements, a set of individually operable members representing each a certain station, mechanism controlled by said members for adjusting said elements in accordance with an actuated member, a loudspeaker, means controlled by said members for disabling the loudspeaker during the tuning operation, a separate finger piece operatively connected with said mechanism for tuning in any desired station independently of said members, and means controlled by said finger piece for maintaining the loudspeaker active during the tuning operation effected by said finger piece.

2. The combination of a shaft, an electric motor for operating the same, a set of normally open switches comprising each a movable arm, said switches being connected in parallel, means operated by said shaft for moving said switch arms to closed position, each switch arm being closed only when the shaft is in a certain position predetermined which is different for each arm, a second set of normally open switches connected in parallel to each other and in series with said first set of switches, a third set of normally open switches connected in parallel to each other and included in the circuit of said motor, a normally closed switch in the motor circuit in series with said third set of switches, a set of individually operable keys for controlling the second and third set of switches, whereby the actuation of any key closes the motor circuit until said shaft-operated means closes the particular switch arm that corresponds to the actuated key, means whereby each key automatically returns to normal position when released, and electromagnetic means adapted to be energized by the closing of any switch arm to open said normally closed switch and stop the motor.

3. In a radio receiver having a loudspeaker circuit, mechanism for tuning the receiver to any desired station, said mechanism including an electric motor, a normally closed switch in the motor circuit, a normally open switch in the loudspeaker circuit, each of said switches including a movable contact arm, a common actuating member connected to both arms and

normally held in position to keep the first switch closed and the second switch open, electromagnetic means for operating said member to actuate both arms simultaneously, whereby the first switch is opened and the second switch is closed, and means for releasably locking the arm of the loudspeaker switch in closed position without interfering with the return of said member to normal position.

4. The combination of a radio tuning shaft, an electric motor for operating the same, an electromagnet, means for automatically energizing said electromagnet when said shaft is in any one of a plurality of selected tuning positions, manually controlled means for selecting the particular tuning position of the shaft at which said electromagnet is energized, means for breaking the motor circuit and stopping the shaft when said electromagnet is energized, a normally open switch in the loudspeaker circuit, means for automatically closing said switch when said electromagnet is energized, whereby the loudspeaker operates only when the shaft is in selected tuning position, means for automatically locking said loudspeaker switch in closed position when said electromagnet is de-energized, and manually controlled electromagnetic means for releasing said locking means.

5. The combination of a rotary shaft carrying a cam, an electric motor for operating said shaft, a normally open switch comprising a movable arm arranged to be closed by said cam when the shaft is in predetermined position, a manually operable switch normally open and connected in series with said first named switch, a second manually operable switch normally open and connected in the motor circuit, a single movable finger piece for closing both of said manual switches, said finger piece returning automatically to normal position when released by the operator, a normally closed electromagnetic switch in the motor circuit in series with the second manual switch, and circuit connections whereby said electromagnetic switch is energized and thereby opened to break the motor circuit when the first named switch is closed.

6. The combination of a shaft rotatable in opposite directions through a predetermined arc, a single electric motor for operating said shaft, means for automatically reversing said shaft at each end of its arc of travel, a normally closed switch in the motor circuit, an electromagnet adapted to open said switch when energized, a plurality of parallel circuits for said electromagnet, a pair of normally open switches connected in series in each of said circuits, a set of manually operable keys for selectively closing one switch in any pair of said switches, said keys automatically returning to normal position when manually released, means controlled by said shaft for closing the other switch of each pair when the shaft is in predetermined position, the closing of any pair of said series switches causing said electromagnet to be energized and open the motor circuit, a single separate key operable independently of said set of keys, and a normally open switch closed by said separate key to energize the motor and operate said shaft in either direction as long as said key is held down, the manual release of said key instantly breaking the motor circuit and stopping the shaft, said automatic shaft-reversing means causing the shaft to oscillate through its predetermined arc as long as said key is held down.

7. A radio receiver having an adjustable tuning shaft and a loudspeaker circuit, an electric motor for operating said shaft, a normally closed switch in the motor circuit, a normally open switch in the loudspeaker circuit, a set of manually operable keys representing each a selected station, circuit connections controlled jointly by said shaft and any actuated key for automatically opening the motor switch and closing the loudspeaker switch when the shaft is in tuning position for the station represented by the actuated key, means for automatically locking the loudspeaker switch in closed position, and means operated by the actuation of the next key for releasing said locking means to permit opening of the loudspeaker switch until the next selected station is in tune.

8. The combination of a rotary shaft, an electric motor for operating said shaft, a normally closed switch in the motor circuit, a set of normally open switches connected in parallel in the motor circuit and in series with said normally closed switch, manually operable keys for closing any one of said parallel switches, each key representing a certain angular position of the shaft, a second set of normally open switches representing the same shaft positions as said keys, means movable with the shaft for closing said last mentioned switches when the shaft is in predetermined position as represented by the actuated key, connections for closing the motor circuit when a key-operated switch is closed, and electromagnetic means for automatically opening said normally closed motor switch upon the closing of the shaft-operated switch that corresponds to the key-operated switch.

9. In radio tuning apparatus, the combination of a remote control box having a set of manually operable keys representing each a selected station and having one extra key for tuning in any station, a radio receiver having a rotary tuning shaft, an electric motor for operating said shaft, a loudspeaker circuit, electric mechanism controlled by each key for energizing said motor to operate the shaft and automatically de-energizing the motor to stop the shaft in tuning position for the station represented by the actuated selecting key, electric connections controlled by said extra key for closing the motor circuit and operating said shaft as long as the key is held down, a switch for holding the loudspeaker circuit inoperative during rotation of said shaft when a station-selecting key is actuated, means for automatically operating said switch to render the loudspeaker circuit operative when the shaft stops in tuning position for the station represented by the actuated selecting key, and means for causing said switch to hold the loudspeaker circuit operative while the tuning shaft is under the control of said extra key.

10. The combination of a radio tuning shaft, an electric motor for operating said shaft, a set of manually operable members representing each a certain station, electrical connections controlled by any actuated member to energize said motor and rotate the shaft until the station corresponding to that member is in tune, a finger piece manually operable independently of said members, switch means controlled by said finger piece for energizing the motor circuit and operating said shaft as long as the finger piece is held in operative position, a loudspeaker circuit which remains disabled during the operation of said shaft under the control of any one of said members, electrical connections for automatically rendering the loudspeaker circuit operative when the shaft reaches a preselected tuning position,

and means for maintaining the loudspeaker circuit operative when the operation of the shaft is controlled by said finger piece.

11. In a radio signal receiving system, a radio receiver having at least one tuning element, a motor for operating said tuning element, means at said motor including a plurality of conductors for selectively controlling the operation of said motor to predetermined and non-predetermined positions, selectively operable circuit-controlling means for including desired ones of said conductors in an operating circuit for said motor, a remote control station, other conductors connecting said remote control station and said selectively operable circuit-controlling means, mechanism at said remote control station for including said last-mentioned conductors in a circuit to selectively govern the operation of said circuit-controlling means to operate said motor to a predetermined position, and means at said remote control station for operating said motor at will to any desired position.

12. In a radio signal receiving system, a radio receiver having at least one tuning element, a motor for operating said tuning element, means at said motor including a plurality of conductors for selectively controlling the operation of said motor to predetermined and non-predetermined positions, a progressively movable switch for including desired ones of said conductors in an operating circuit for said motor, a remote control station, other conductors connecting said remote control station and said progressively movable switch, mechanism at said remote control station for including said last-mentioned conductors in a circuit to selectively govern the operation of said progressively movable switch to operate said motor to predetermined positions, and means at said remote control station for operating said motor at will to any desired position.

13. In a radio signal receiving system, a radio receiver having at least one tuning element, a motor for operating said tuning element, means at said motor including a plurality of conductors for selectively controlling the operation of said motor, one of said conductors being provided for each desired position of adjustment of said element, a progressively movable switch for completing a circuit for said motor including one of said conductors, a remote control station, conductors connecting said remote control station and said progressively movable switch, and mechanism including a plurality of keys at said remote control station for selectively extending said conductors terminating at said remote control station to complete a circuit for directively operating said progressively movable switch.

ADOLPH A. THOMAS.