

April 9, 1935.

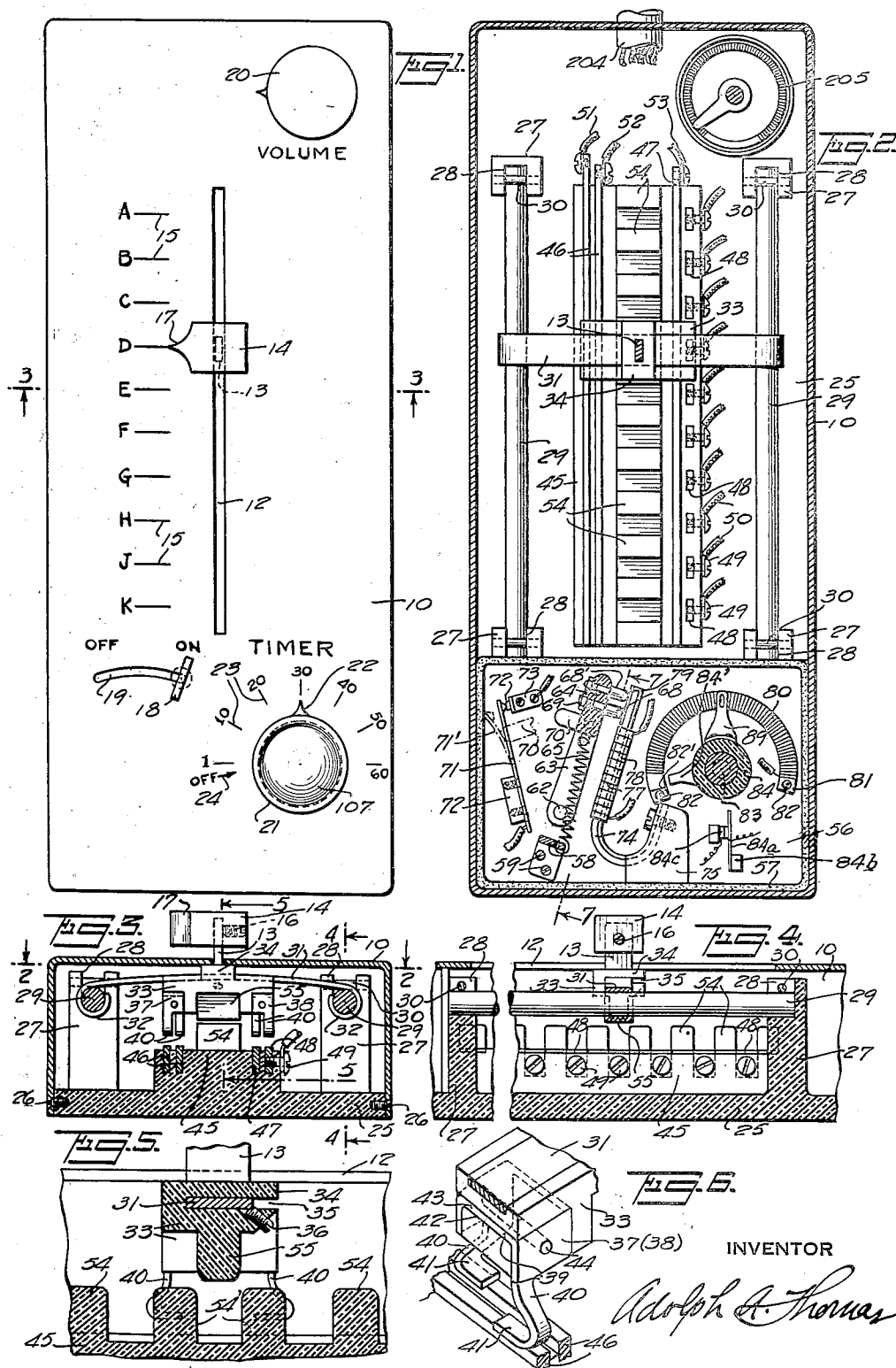
A. A. THOMAS

1,997,158

RADIO TUNING APPARATUS

Filed Dec. 10, 1929

4 Sheets-Sheet 1



April 9, 1935.

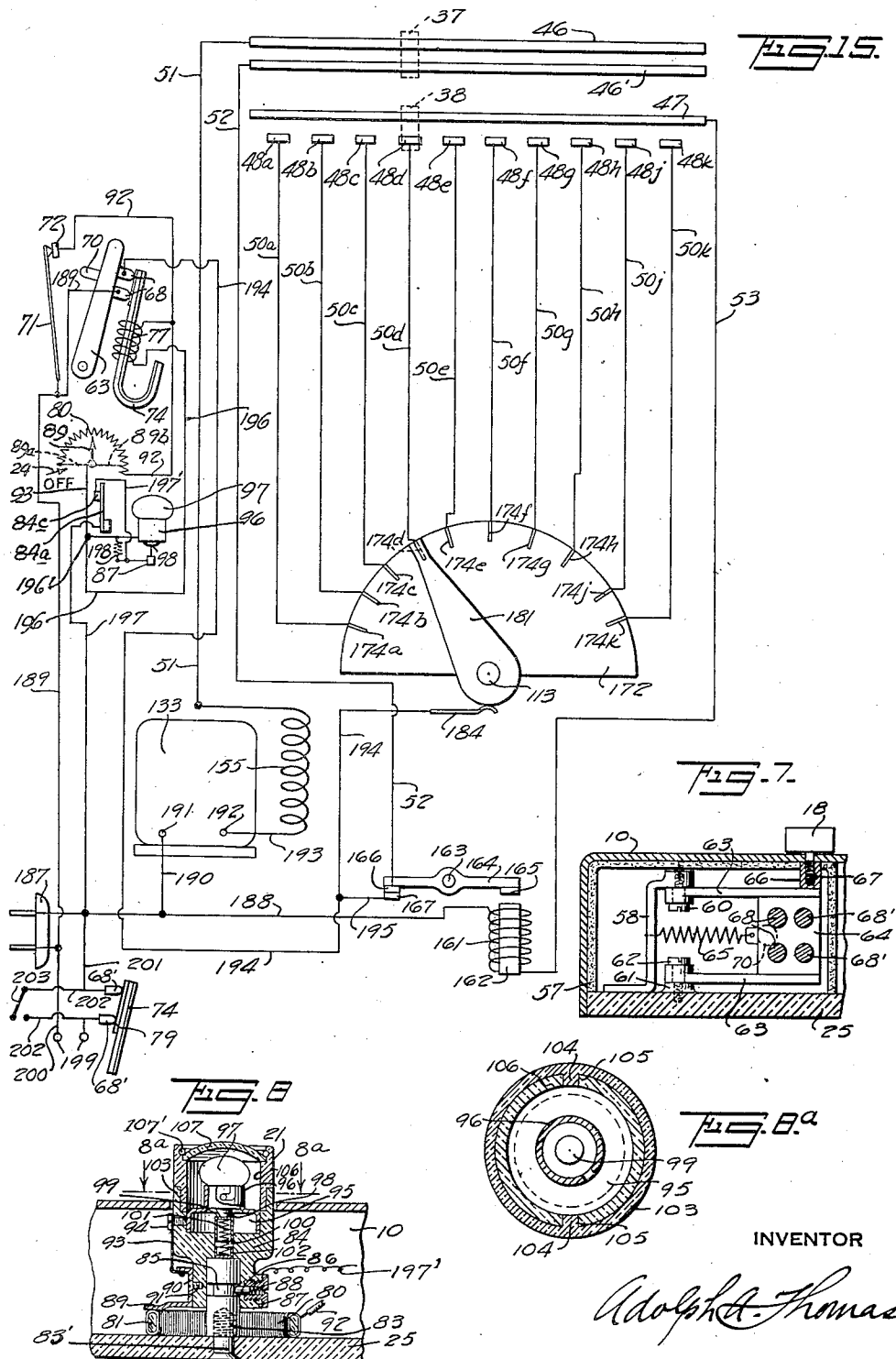
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4 Sheets-Sheet 2



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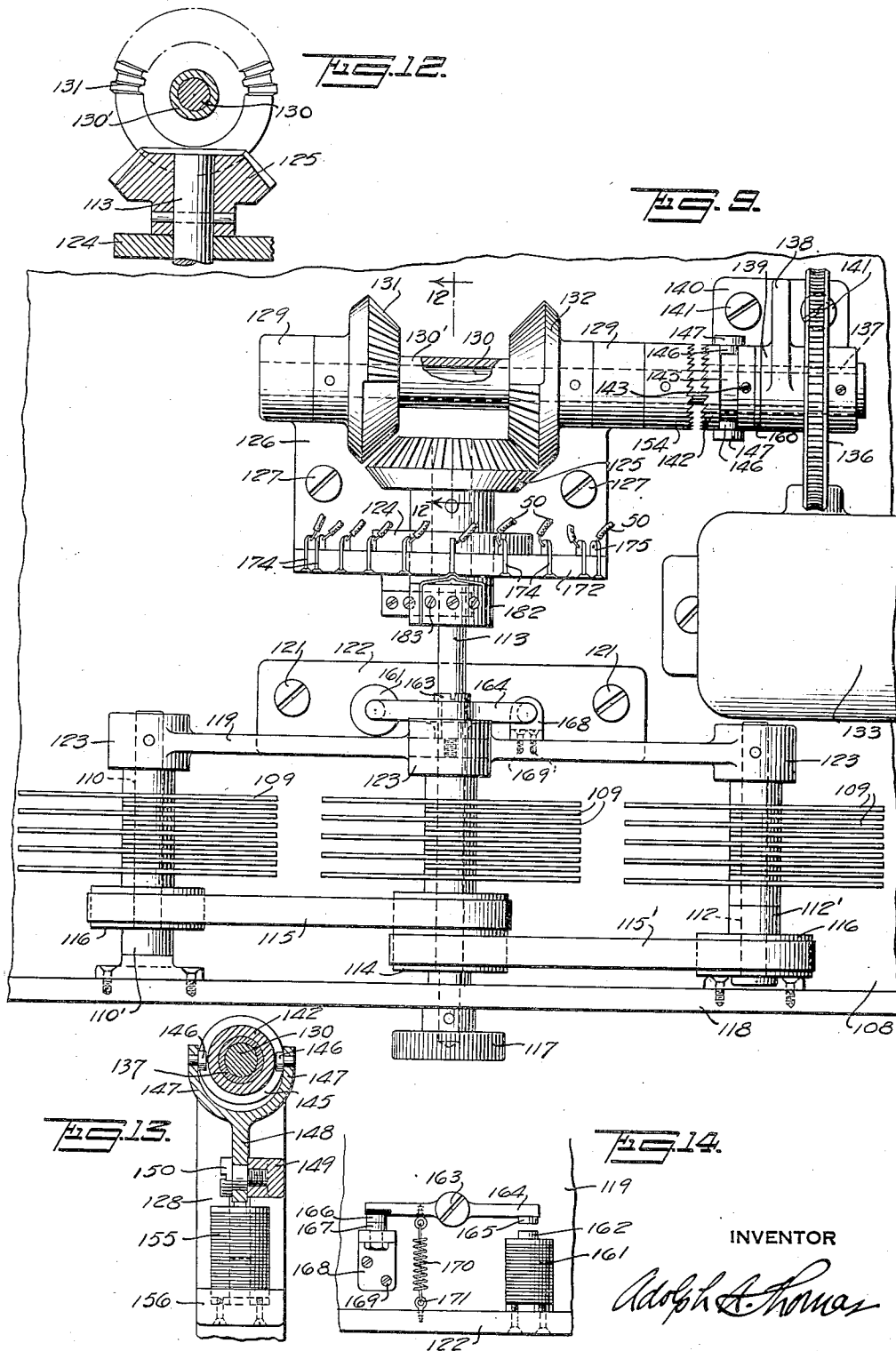
A. A. THOMAS

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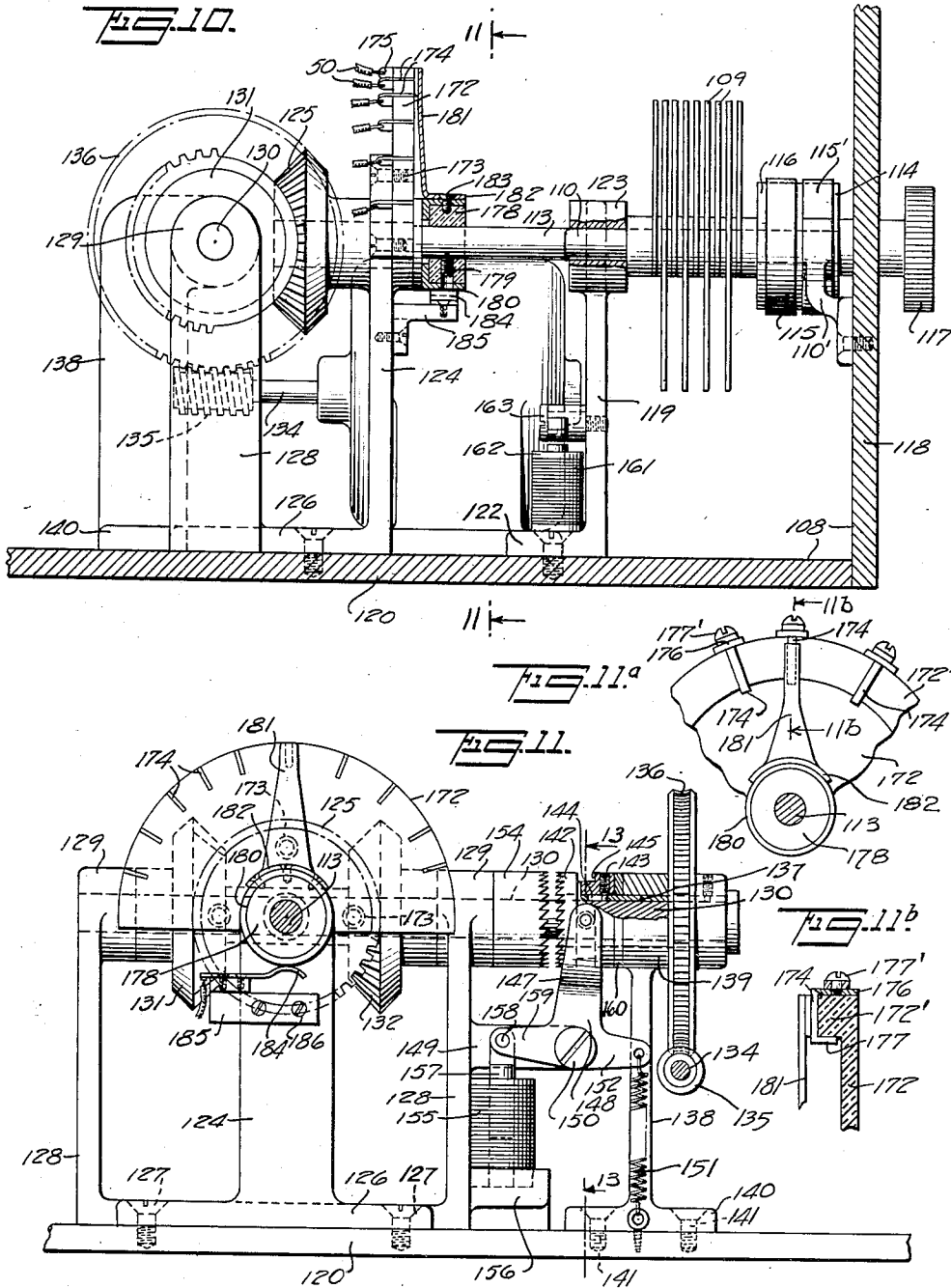
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4 Sheets-Sheet 4



INVENTOR

Alfred A. Thomas

UNITED STATES PATENT OFFICE

1,997,158

RADIO TUNING APPARATUS

Adolph A. Thomas, New York, N. Y.

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20 Claims. (Cl. 250—20)

My invention relates to the art of radio reception and its object is to provide a simple compact device for controlling the operation of a radio receiver from a distance to tune in any selected station. In a preferred form of my invention, the control device also includes a thermostatic time switch for automatically turning off the radio receiver after a predetermined interval. All the parts can be housed in a small oblong box which is operatively connected to the receiver by an electric cable. As will appear later, the mechanism in the control box comprises but few parts, which are cheap to make, easy to assemble, and not liable to get out of order.

A slidable key or button on top of the control box moves along an indicator for selecting any desired station. When the button is pushed down, certain electric circuits are closed to actuate the tuning shaft of the receiver until the selected station is in tune. A knob on the box permits the control of tone volume, and a switch enables the operator to shut off the set at any time. This switch may also be controlled by a thermostat to open all circuits after a predetermined lapse of time. The operation of the thermostat is controlled by a timing knob which regulates the passage of current through a heating coil mounted on the thermostat. When the timing knob is set, a person is assured that the receiver will be automatically turned off after so many minutes. This makes it safe for a person to go to sleep to the soft sound of radio music as children especially like to do. A signal light on the box may be used to indicate when the time control is on. If remote control is not desired, my novel tuning device may be mounted directly on the radio cabinet. In either case, the receiver is always free to be tuned by hand in the old way.

The foregoing and other practical advantages and novel features of my control box will be understood from a description of the accompanying drawings, in which—

Fig. 1 shows a top view of a remote control device embodying my invention;

Fig. 2 is an inside plan view of the box on section line 2—2 of Fig. 3;

Fig. 3 represents a transverse section on line 3—3 of Fig. 1;

Fig. 4 is a fragmentary longitudinal section through the box on line 4—4 of Fig. 3;

Fig. 5 shows an enlarged fragmentary view along the broken line 5—5 of Fig. 3;

Fig. 6 is a detached enlarged perspective of

contact fingers operated by the push button on the box;

Fig. 7 is a section on line 7—7 of Fig. 2, to show a side view of the snap-over switch member operable either by hand or by a timed thermostat;

Fig. 8 shows a vertical section through the timing knob and associated parts;

Fig. 8a is an enlarged section on line 8a—8a of Fig. 8, except that the signal lamp is omitted for clearness;

Fig. 9 shows a plan view of the tuning condensers and associated operating mechanism in the radio receiver;

Fig. 10 is a side view of Fig. 9 looking from left to right;

Fig. 11 represents a side view on line 11—11 of Fig. 10;

Fig. 11a is a fragmentary face view of an insulating support carrying station-selecting contacts which are radially adjustable for any station;

Fig. 11b is a section on line 11b—11b of Fig. 11a;

Fig. 12 is a section on line 12—12 of Fig. 9, showing a detail of the intermittent bevel gear connection between the motor shaft and the tuning shaft;

Fig. 13 shows a section on line 13—13 of Fig. 11 to illustrate certain details of the electromagnetic clutch between the motor shaft and the shaft on which the bevel gears in Fig. 9 are mounted;

Fig. 14 is a side view of the motor switch and associated electromagnet; and

Fig. 15 is a diagram of circuit connections between the receiver and the remote control box.

Referring to Fig. 1, the remote control box 10 is provided on top with a longitudinal slot 12 through which projects a shank 13 carrying a push button 14. The shank 13 is slidably mounted so that the push button 14 is slidable along a station indicator on top of the box. In the present instance this indicator comprises a series of marks or lines 15 representing ten selected stations, which are identified by the letters A to K. The push button 14, which is removably attached to shank 13 by a set-screw 16, has a pointer 17 arranged to be brought in register with any one of the station marks 15. After a station has been selected by sliding the push button 14 to proper position, the button is depressed to close certain operating circuits for rotating the tuning shaft of the connected radio receiver. When the selected station is in tune, the radio shaft is automatically stopped and the operator releases button 14. These circuits and the operat-

ing mechanism controlled thereby will be fully explained in due course.

Still referring to Fig. 1, a finger piece 13 projects through a slot 19 to operate a suitable on-off switch in the control box. It is assumed that the finger piece 13 is in "on" position when the button 14 is operated to tune in a station. A rotary knob 20 permits regulation of the volume of reproduction as desired. In a preferred form of my invention, the remote control box 10 is provided with a rotary knob 21 for controlling a time switch to shut off the radio receiver automatically after a predetermined interval. A pointer 22 movable with knob 21 cooperates with a time scale 23, which I have arbitrarily marked with seven periods representing minutes, but any other suitable division of time may be employed. When the pointer 22 is on the "off" mark 24, the time switch is disconnected.

I shall now describe the mechanism inside of box 10, and for this purpose reference will be had to Figs. 2-3a. The bottom of box 10 is formed by an insulating base 25, which may conveniently be cast or molded as one piece from suitable material, such as bakelite, porcelain, hard rubber, and others along the same line. If the base 25 is of metal, such as aluminum, it will be necessary to provide separate insulation for the electric contacts carried by the base. For this reason it is simpler to make the base of insulating material. The upper or cover part of the box may be stamped from a single piece of sheet metal and removably secured to base 25 by screws 26 or otherwise. The cover part of the box is not attached to the base until all the mechanism inside the box has been properly assembled. After the box is closed, the hand-operable parts 14, 13, 20 and 21 are attached to their respective supports. Two pairs of posts or brackets 27 project upwardly from base 25, and may be formed integral therewith. The posts 27 are provided with slots or recesses 28 for receiving the ends of a pair of parallel rods 29, which may be locked in place by removable cross-pins or screws 30. The rods 29 support a leaf spring 31 which is slightly bowed upwardly to hold the push button 14 normally in raised position. A simple way to mount the spring 31 on rods 29 is to bend the ends 32 of the spring around the rods, as shown in Fig. 3. It goes without saying that the spring 31 is attached to the rods before the latter are mounted on the supporting posts 27.

The spring 31 carries an insulating block 33 which may be molded as a single piece of bakelite, hard rubber, fiber and the like. The block 33 has a central projection 34 which is provided with a slot 35 for receiving the central portion of spring 31 in a tight fit, as best shown in Fig. 5. A set-screw 36 secures the block 33 to the spring against possible slipping. Since the projection 34 of block 33 is narrow and engages only the central portion of spring 31, the block does not interfere with the movements of the spring when the button 14 is depressed and released. It is understood that the spring 31 is sufficiently flexible to yield under slight pressure on button 14. The normal upward curvature of spring 31 instantly restores the connected parts to normal position when the push button 14 is released. The shank 13 which carries the button 14 may be an integral extension of block 33, or it may be attached to the block as a separate piece. The ends of spring 31 are mounted on rods 29 with sufficient play to permit easy slidable adjustment of the spring on the supporting rods

by means of the slidable button or finger piece 14.

The insulating block 33 on spring 31 carries a pair of contact pieces 37 and 38. Since these contact pieces are alike in structure, a detailed description of one will suffice for both. Referring to Fig. 6, where one of the contact pieces is shown in enlarged perspective, this contact piece consists of a U-shaped member 39 having a pair of yieldable extensions 40 arranged in offset relation and terminating in contact shoes 41. The ends of the insulating block 33 are slotted at 42 to receive the base or bridge 43 of each U-shaped member 39. One or more pins, bolts or rivets 44 securely connect the contact pieces 37 and 38 to block 33. The U-shaped members 39 can be stamped from sheet brass, and the extensions 40 are preferably bent outwardly to provide sufficient resiliency for the contact shoes 41. The contact pieces 37 and 38 carried by the insulating block 33 may be of any other practical construction than the one which I have just described in detail.

The insulating base 25 is provided at the center with a longitudinal bridge or platform 45, which is preferably integral with the base, although it may be attached to the base as a separate piece. The insulating bridge 45 carries a pair of contact rails or bars 46 which may be flat strips of brass or other good conducting metal set firmly into a pair of slots. The upper edges of rails 46 project slightly over the top surface of bridge 45, as best shown in Fig. 3. The switch members 48 are in line with the contact fingers or extensions 40 of the connecting piece 37. The insulating bridge 45 also carries a third rail or bar 47 and a series of individual contacts 48. These contacts represent the selected stations A-K and are therefore arranged in alignment with the indicating marks or lines 15 on top of the control box. This will be clear by comparing Figs. 1 and 2. The separate contacts 48 are securely held in properly spaced slots in bridge 45. Binding screws 49 are connected to contacts 48 for attaching conductors 50. The three contact bars 46 and 47 and the individual contacts 48 are jammed so tight in their respective slots that no separate fastening means is necessary, although screws and the like may be used for that purpose if desired. One end of each bar may project beyond the bridge 45 to permit the easy attachment of conductors 51, 52 and 53, as shown in Fig. 2.

Referring to Fig. 3, it is seen that when the button 14 is pushed down, the contact fingers 40 of connecting piece 37 engage the two insulated rails 46. At the same time, the contact fingers 40 of connecting piece 38 engage the rail 47 and one of the individual contacts 48. The rails 46 and connecting piece 37 constitute a switch in the circuit of an electric motor that drives the tuning shaft of the radio receiver. When the connecting piece 38 spans the rail 47 and a selected contact 48, an electromagnet is energized to open the circuit of the motor. The control of the motor circuit will be described later on. The contact shoes 41 of spring fingers 40 on switch pieces 37 and 38 adjust themselves individually to any inequalities in the upper surface of rails 46 and 47 and contacts 48. This automatic adjustment of spring fingers 40 insures good electrical contact between the shoes 41 and the associated switch terminals in bridge 45 when the finger piece 14 is pushed in.

I may provide means to prevent the button 14 from being pushed in unless the pointer 17 is

substantially in line with one of the station marks 15. For this purpose the insulating bridge 45 is provided along the center with spaced lugs 54. The insulating block 33 carried by spring 31 has a central projection 55 adapted to enter the space 54' between a pair of lugs 54 when the key 14 is depressed. The corners of lugs 54 and projection 55 may be rounded or bevelled to permit easy entrance of the projection into space 54'. This operation, however, can not take place unless the pointer 17 is substantially in line with one of the station marks 15. Therefore, when the button 14 is free to be pushed in, the operator is assured that it is in correct position for the selected station. Fig. 5 shows that the projection 55 of block 33 is correctly positioned between a pair of lugs 54. If the projection should be moved slightly to one side or the other (which would mean that the pointer 17 is off the station marks), the key 14 is locked against operation, except perhaps for a slight initial movement which is of no consequence. The bottom of projection 55 is normally held by spring 31 above the top surface of lugs 54, so that the finger piece 14 is always free to be shifted along the station indicator.

One end of control box 10 has a recess or chamber 56, which may be lined with heat-insulating material 57, such as asbestos, cork, compressed wood pulp, earthenware and the like. A bracket 58 secured to base 25 by screws 59 carries a screw 60, and a lug 61 on the base supports a screw 62 in line with screw 60. The two aligned screws 60 and 62 form bearing pins for a U-shaped frame 63. The sides of this frame may be metal pieces connected by an insulating plate 64 of bakelite or other suitable material. A contracting coil spring 65 is connected at its ends to bracket 58 and plate 64, as best shown in Fig. 7. A lateral hollow lug 66 on frame 63 is screwthreaded inside to receive a screw 67 extending from finger piece 13. This makes it a very simple matter to disconnect the finger piece 13 from the pivoted switch frame 63 when it is necessary to remove the cover portion of box 10 from the base 25. The insulated plate 64 carries two pairs of switch contacts 68 and 68', which may conveniently be the rounded heads of bolts passing through the plate and secured by nuts 69. These bolts and nuts may also be used as binding posts for the contacts.

It is evident from Fig. 2 that the pivoted switch frame 63 is a snap-over member actuated by spring 65 with an abrupt movement from one position to the other, and the spring holds the switch securely closed and open. When the switch 63 is moved to "off" position, a projection 70 on plate 64 strikes a spring arm 71 and moves it away from a stationary contact 72. The spring arm 71 is mounted at one end on a lug or post 72 projecting from base 25, and the free end of this arm is normally held in engagement with contact 72, which is mounted on a suitable bracket 73 secured to base 25. The members 71 and 72 constitute a normally closed switch, for a purpose that will presently be explained. The dotted outline 71' shows the switch arm 71 in open position, and the dotted outline 72' indicates the position of projection 70 when the switch 63 is open.

A thermostat bar 74 is rigidly mounted at one end on a block 75 projecting from the bottom plate 25 of the control box. One or more screws or bolts 76 hold the thermostat bar rigidly connected to the block. The thermostat bar 74 is of

usual bimetallic construction (for example, brass and iron) and is preferably U-shaped or curved at the secured end. This curved form of the bar gives a greater freedom of movement, but any other practical form and type of thermostatic element may be used. An insulated heating coil 77 is mounted on thermostat bar 74. One method of mounting the coil is to wind heating wire on a sheath or covering 78 of asbestos fibers. This wire need not be insulated, but care should be taken that the turns of the wire do not touch each other. If the wire is wound tight over the asbestos covering, the individual turns sink into the soft fibers and will remain permanently in place. Instead of using the insulating mounting 78 for coil 77, I may use insulated wire wound directly on thermostat bar 74, and any other practical expedient may be employed to support the coil 77 in proper heating relation to the thermostat bar. Nichrome wire is particularly efficient for heating coils, and only a few turns of this wire are necessary for the required heating of thermostat bar 74.

When the switch 63 is in "on" position and no current is passing through coil 77, the free end of thermostat bar 74 engages the two pairs of insulated contacts 68 and 68', as shown in Fig. 2. The contracting coil spring 65 holds the contacts 68 and 68' in firm pressure engagement with thermostat bar 74. To prevent undue wear on the soft metal of the thermostat bar, I provide the latter with a plate 79 of hard yet good conducting metal to engage the switch contacts 68 and 68'. The switch plate 79 need not be insulated from the thermostat bar if the latter is properly insulated. As will subsequently appear, the contacts 68 are in the circuit of the motor that operates the tuning shaft, and the contacts 68' are included in the power supply circuit to form a main on-off switch for the radio receiver. If a particular circuit arrangement so requires, each pair of contacts 68 and 68' may be closed by a separate insulated plate 79. Both pairs of contacts 68 and 68' need not be mounted on the same member, and any other practical construction of motor switch and main switch may be used.

Referring to Fig. 2, it is apparent that, as long as the thermostat bar 74 is in normal position, the switch 63 is free to be moved by the finger piece 13 from one position to the other. Let us assume that the heating coil 77 is in circuit. As the temperature of thermostat bar 74 increases, the free end of the bar slowly moves toward the left (as viewed in Fig. 2), and pushes the switch frame 63 along with it. The switch contacts 68 and 68' remain closed until the thermostat bar 74 has moved the pivoted frame 63 sufficiently far to cause the tensioned spring 65 to snap the switch frame quickly to "off" position. The snap-over movement of frame 63 quickly pulls the contacts 68 and 68' away from the plate or plates 79 on thermostat bar 74, and then the projection 70 opens the switch arm 71 to break the circuit of heating coil 77. Therefore, as soon as the main switch 63 has been moved to "off" position by the heated thermostat bar 74, the latter begins to cool and returns to normal position. The switch member 63, however, remains open until closed again by means of the finger piece 13. The length of time required to heat the thermostat bar 74 until it reaches its snap-over position manifestly depends on the strength of the electric current flowing through coil 77. To be more accurate, the heating effect of this coil is proportional to the

square of the current. Therefore, as the current in coil 77 is decreased, a correspondingly longer time is required to heat the thermostat bar to switch-operating temperature, and vice versa.

5 Referring to Figs. 2 and 3, a simple way to regulate the current in heating coil 77 is by means of a resistance 80 controlled by the timing knob 21. The resistance wire 80 is wound on an annular insulating core 81 secured to the base 25 in any practical way, as by screws 82. A fixed metal post 83, connected to base 25 by a screw 83' or otherwise, supports an insulating shell 84 for rotary movement. The shell 84 may be a molded piece of bakelite, hard rubber, porcelain, and the like. An annular groove 85 in post 83 receives the end of a spring-pressed pin 86 carried by a hollow set-screw 87 mounted in shell 84, so that the shell is free to rotate on the post and is locked against axial displacement. A small coil spring 88 in set-screw 87 holds the pin 86 pressed lightly against the bottom of groove 85. If it should be necessary to remove the shell 84 from post 83, the set-screw 87 is taken off. The screw 87 may also be used as a binding post. The insulating shell 84 carries a resilient contact arm 89 arranged to bear with a pressure contact on the top of resistance coil 80. The contact arm 89 has an extension 90 adapted to receive one or more screws 91 for attaching the arm to shell 84. An insulating extension 84' on shell 84 is adapted to open a switch arm 34a when the rheostat arm 89 strikes a shoulder 82' on core 81. That happens when the pointer 22 (see Fig. 1) is in "off" position 24. The switch arm 34a may be a spring blade secured at one end to a lug 34b on base 25, and at its free end normally engaging a fixed contact 84c suitably mounted on the base. The switch arm 34a is only a light spring which is incapable of moving the rheostat arm 89 away from the stop shoulder 82' on account of the spring pressure with which the rheostat arm bears down on the top of core 81.

Still referring to Fig. 3, one end of resistance coil 80 is attached to a conductor 92, and a conductor 93 (which may be a short metal strip) is connected at one end to extension 90 of contact arm 89. The other end of conductor 93 is secured to a binding post 94 mounted on shell 84 and at its inner end in permanent contact with a metal cup 95, which is firmly seated inside the shell. The binding post 94 is in the form of a removable screw which also holds the cup 95 rigidly in place. A cylindrical extension 96 on cup 95 acts as a socket for receiving a small electric lamp 97. One terminal of the lamp is in contact with the metal socket 96, which in turn is electrically connected to binding post 94. The insulated central terminal 98 of lamp 97 is in permanent contact with a metal thimble 99 mounted in an axial opening 100 of shell 84. A coil spring 101 of conducting metal holds the thimble 99 pushed against the central lamp contact 98. The lower end of spring 101 rests in a metal cup 102, which is always in good electrical contact with the metal post 83. A flexible conductor attached to the rotary shell 84 by screw 87 is electrically connected with lamp contact 98 through the metallic parts 99, 101, 102, 83 and 86.

70 The rotary timing knob 21 is mounted on an annular extension 103 of shell 84. It is necessary that this mounting permit removal of knob 21 and yet lock the same to shell 84 for rotation of the latter when the knob is turned. The releasable locking engagement between knob 21 and

shell 84 is effected in the present instance by providing the shell extension 103 with one or more axial ribs 104 arranged to enter slots 105 in the lower end 106 of knob 21. The ribs 104 fit with sufficient tightness in slots 105 to prevent loosening of the knob on the supporting shell 84. To remove the knob, it is only necessary to give it a good pull. There is no occasion for removing knob 21 except when the signal lamp 97 has to be replaced, or the box opened. A lens 107 acts as a cap or cover for knob 21 and lets the light of lamp 97 shine through. It is usual to have the lens 107 of a bright color, like red or green, so that the operator can easily see whether the timing control is on or off. A split ring 107' or other suitable means retains the lens 107 in place. The pointer 22, which moves with the knob 21 over the time scale 23, may be mounted on the knob itself. If this knob is of molded material, such as bakelite, rubber and the like, the pointer 22 may be formed as an integral radial projection to the knob. In this way the pointer 22 is out of the way when the knob 21 is removed to permit opening of the control box. In the broader aspect of my invention, any other practical means may be provided for controlling the rheostat resistance 80 by the rotation of knob 21 or other movable finger piece. It should be noted that the pointer 22 on knob 21 is always in line with rheostat arm 89.

I now shall turn to Figs. 9-14, which show the tuning mechanism controlled by the slidable push button 14 on the control box. In the present instance I have assumed that the receiver contained in radio cabinet 108 has three condenser units 109, which have their movable electrodes mounted on separate shafts 110, 112 and 113. The central shaft 113 carries a pulley 114 connected by belts 115 and 115' to pulleys 116 on the side shafts 110 and 112. In some radio sets all the tuning condensers are mounted on the same shaft and the number of condenser units varies in different makes of receivers. For brevity I shall refer to shaft 113 as the tuning shaft, by which I mean broadly any shaft operable to control suitable tuning elements in the receiver. It is immaterial in my invention what kind of tuning elements are used, or how they are arranged and mounted in the cabinet. The tuning shaft 113 is manually operated by means of a rotary knob 117 arranged at the front panel 118 of the radio cabinet. To simplify the drawings, I have shown the knob 117 attached directly to the outer end of shaft 113, but in practice it is customary to provide a reducing connection between those two parts. A bracket 119 is rigidly mounted on a base board 120 in the radio cabinet by screws or bolts 121 passing through a lateral extension 122 of the bracket. The upper end of bracket 119 has bearings 123 for the condenser shafts 110, 112 and 113. The front ends of the two side shafts 110 and 112 are supported in bearing brackets 110' and 112' which may conveniently be attached to the front panel 118. The parts 119, 122 and 123 may be a single casting of aluminum or other suitable material.

The tuning shaft 113 passes through a post or bracket 124, and the rear end of the shaft carries a bevel gear 125, which is rigidly connected to the shaft in any practical way. The bracket 124 may be an integral extension of a plate 126 secured to the bottom board 120 by screws or bolts 127. The plate 126 is also provided with a pair of upright arms 128, which terminate in bear-

ings 129 for supporting a transverse shaft 130. Two mutilated bevel gears 131 and 132 are fixed on shaft 130 and arranged on opposite sides of bevel gear 125. A sleeve 130' of correct length 5 may be mounted on shaft 130 between gear members 131 and 132 to facilitate their proper spacing. The mutilated gears 131 and 132 have teeth extending for approximately half a circumference, but the teeth of one gear are arranged diametrically opposite to those of the 10 other gear. For convenience I shall refer to these mutilated bevel gears as half-gears. When the teeth of one half-gear move out of mesh with the bevel gear 125, the teeth of the other half-gear begin to engage the central gear to 15 reverse the rotation of tuning shaft 113. In other words, the continuous rotation of shaft 130 in the same direction causes the half-gears 131 and 132 to reverse the rotation of tuning shaft 20 113 at the end of every half revolution.

An electric motor 133 is mounted on baseboard 120, and the motor shaft 134 carries a worm or spiral pinion 135 in mesh with a spiral gear 136 fixed on a rotary sleeve or hollow shaft 137. A 25 post or bracket 138 has a bearing 139 for shaft 137 through which the aligned shaft 129 projects without interfering with the rotation of either shaft independently of the other. Any suitable means may be employed to prevent axial shifting 30 of the hollow shaft 137 in its bearing. A foot-plate 140 forming part of bracket 138 is secured to the baseboard 120 by screws or bolts 141. A clutch ring 142 is slidably mounted on shaft 137, but rotates therewith. A simple way to lock the 35 clutch ring 142 slidably to shaft 137 is to have a set-screw 143 on the clutch ring engaging in an axial groove or slot 144 in the shaft. An annular groove 145 in clutch ring 142 receives a pair of rollers or lugs 146 mounted on yoke arms 147 of a 40 double bellcrank 148. A lateral extension 149 on one of the upstanding arms 123 carries a pin or stud 150 on which the bellcrank 148 is pivoted. A contracting coil spring 151 is connected at its upper end to a lateral arm 152 of bellcrank 148, 45 and the lower end of the spring is attached to the bottom board 129 in any practical way, as by a screw-eye 153. The normal tendency of spring 151 is to hold the slidable clutch ring 142 away from the adjacent clutch member 154 fixed on 50 shaft 130.

Referring to Fig. 11, a solenoid coil 155 is fixed on a suitable block or shelf 156, which may form an integral part of the adjacent post 128. A magnetic core 157 is pivoted at 158 to a lateral arm 55 or extension 159 of bellcrank 148, and this core extends normally partway into coil 155. The aligned shafts 130 and 137 are normally disconnected, so that either may be rotated without actuating the other. When the coil 155 is energized, 60 it pulls down the magnetic core 157 and thereby rocks the bellcrank 148 counterclockwise to throw the slidable clutch ring 142 against the associated clutch member 154. The shaft 130 is thereby 65 connected to the motor shaft 134 and rotates in one direction only. The shafts 130 and 137 remain connected as long as the solenoid 155 is energized. When the solenoid circuit is interrupted, the tensioned coil spring 151 instantly 70 rocks the bellcrank 148 in the opposite direction and shifts the clutch ring 142 out of engagement with clutch member 154, so that the two shafts 130 and 137 are uncoupled. An anti-friction ring or washer 159 may be interposed between the 75 bearing 139 and clutch ring 142. The pressure

with which the clutch ring is normally held against the anti-friction washer 160 by spring 151 is not sufficient to interfere with the free rotation of shaft 137.

The foot-plate 122 of bracket 119 carries an 5 electromagnet comprising a coil 161 and a magnetic core 162 (see Fig. 14). A pivot pin or stud 163 projecting rearwardly from bracket 119 supports a lever 164. One end of this lever carries an armature piece 165 arranged to be attracted by 10 the electromagnet when coil 161 is energized. The other end of lever 164 carries an insulated contact 166 which is normally held against a fixed contact 167 mounted on a bracket 168. This bracket may conveniently be attached to the up- 15 right bracket 119 by screws 169 or otherwise. A contracting coil spring 170 attached at its upper end to lever 164 normally holds the insulated contact 166 pressed against the stationary contact 167. The lower end of spring 170 is connected to 20 foot-plate 122 by a screw-eye 171 or otherwise. It is clear from Fig. 14 that the tensioned spring 170 normally holds the armature 165 away from the magnetic core 162. When the coil 161 is en- 25 ergized, the electromagnet pulls down the armature 165 and rocks the lever 164 clockwise to separate the switch contacts 166 and 167. As I shall presently explain, these contacts are in- 30 cluded in the circuit of motor 133. The operation of lever 164 by the magnet coil 161 is so quick that the switch 166—167 is opened without arcing.

Referring to Figs. 9, 10 and 11, the post or bracket 124 carries an insulated plate or disk 172 35 secured by screws 173 or otherwise. The plate 172, which is shown in the form of a half-circle, may be molded of bakelite, fiber, porcelain, hard rubber, or any other suitable insulating material. As explained in connection with Fig. 1, it has been assumed that the remote control box connected to the radio receiver is capable of selecting ten 40 different stations. For this reason the insulating plate 172 carries ten individual contacts 174 which are radially so arranged as to represent the ten stations identified by the indicator on top of the control box. The contacts 174 may be thin brass 45 plates set firmly in radial slots cut in the edge of the semi-circular disk 172. If the contact pieces are forced into the slots to make a tight fit, no additional fastening means are needed, although such may be employed if desired. It will be re- 50 called (see Fig. 2) that conductors 50 are connected to the station-selecting contacts 48 in the control box. These conductors are also connected to the corresponding contacts 174, which may be provided with tails or projections 175 for easy 55 attachment of the conductors.

When the individual contacts 174 are mounted in slots arranged in predetermined radial position, each contact remains fixed for the particular 60 station which it represents. It may sometimes be desirable to change the radial position of one or more contacts to represent other stations than those originally indicated on the control box. One way of easily effecting a radial adjustment of 65 contacts 174 is shown in Figs. 11a and 11b, where the contacts are provided with lateral extensions 176 and 177 adapted to engage the top and bottom of a peripheral flange 172' on disk 172. In other words, the contacts 174 are like U-shaped clamps 70 which grip the flange 172' and may be shifted radially to any desired position. A set-screw 177' may be used to secure each contact in adjusted position, and at the same time the screw may 75 serve as a binding post for a conductor.

The tuning shaft 113 carries an insulating hub or collar 178 which is securely held in position by a set-screw 179, or in any other practical way. A metal sleeve 180 mounted on the insulating collar 178 carries a contact arm 181. A cylindrical extension or base 182 of arm 181 fits over the metal sleeve 180 and is secured thereto by screws 183, which also fasten the sleeve to the insulating hub 178. The arm 181 is sufficiently resilient to press against the contacts 174. A spring finger 184 mounted on an insulated bracket 185 bears constantly against the conducting ring 180. The bracket 185 may be attached to post 124 by screws 186 or otherwise. The parts 183, 181 and 184 may be of brass, bronze, or other good conducting metal.

Referring to the circuit connections in Fig. 15, the station-selecting contacts 48 in the control box and the corresponding contacts 174 in the radio cabinet are differentiated by the suffix letters *a* to *k*. This makes it easy to identify the individual contacts 48 and 174 with the different stations marked on the control box (see Fig. 1). Thus, a glance at Fig. 15 indicates that the connected contacts 48*a* and 174*a* refer to station A on the control box, that contacts 48*b* and 174*b* refer to station B, and so on for the remaining contacts and stations. The individual conductors 53 which connect contacts 48 and 174 are distinguished by the suffix letters *a* to *k* to facilitate the tracing of circuits. For the same reason one of the contact rails 46 is marked 46' in Fig. 15. A plug 187 adapted to be inserted in a wall socket carries a pair of service leads 188 and 189. A conductor 190 connects lead 188 with the motor terminal 191. The other terminal 192 of the motor is connected by a conductor 193 to one side of the clutch coil 155, the other side of which is connected to conductor 51. The motor windings and clutch coil 155 are therefore connected in series through the switch bars 46—46'. Any other practical connection may be used for simultaneously energizing and de-energizing the clutch coil and the motor. A conductor 194 connects the contact finger or brush 184 to one of the contacts 68 on the snap-over switch frame 63 in the control box. The insulated contact 166 mounted on the pivoted lever 164 is connected to conductor 52, which is also connected to switch bar 46' in the control box. The stationary switch contact 167 is connected to conductor 194 by wire 195.

Still referring to Fig. 15, it will be seen that one side of the thermostatic heating coil 77 is connected to conductor 92, which leads from one end of rheostat resistance 89 to the stationary switch contact 72. The other side of heating coil 77 is connected by conductor 196 to binding post 196' to which the conductor 93 is also connected. A conductor 197 leads from the service main 188 to switch arm 84*a*, and conductor 197' connects the switch contact 84*c* to binding post 87 and thereby to the central contact 98 of signal lamp 97, as previously explained. It will also be remembered that the metal socket 96 of the lamp is connected by conductor 93 to the rheostat arm 89. It is thus evident that the heating coil 77 is shunted by resistance 89, and that the lamp 97 is in series to those two elements. This particular connection of lamp 97 is not necessary, but it has the practical advantage that the lamp burns with substantially constant brilliancy without regard to the position of rheostat arm 89 (except when the time control is

off). It is usually desirable to shunt the signal lamp 97 by a resistance 198, so that the timing mechanism will not be put out of commission if the lamp should suddenly burn out. The movable switch arm 71 and one of the contacts 68 on the pivoted switch frame 63 are connected to the service main 189. A pair of terminals 199 is supposed to lead to the radio receiver for connecting the same in the power supply system when plug 187 is inserted. The contacts 68' 10 mounted on the pivoted switch member 63 are shown separately in Fig. 15 to avoid confusion in the arrangement of the circuit lines. The radio terminals 199 are connected to the power mains by conductors 200 and 201, and the switch contacts 68' are inserted in series in conductor 201. Branch wires 202 are connected to conductor 201 in shunt to contacts 68' and lead to a suitable hand switch 203, which is supposed to be mounted on the radio cabinet for turning the set on and off independently of the control box. In other words, if the switch frame 63 in the control box is in "off" position, a person may still operate the receiver by closing the hand switch 203. Conversely, if the hand switch 203 is open, a person may operate the receiver through the control box by moving the finger piece 13 to "on" position.

The operation of the radio receiver through the control box 10 is like this: We shall assume that the timing knob 21 is in "off" position 24 and that the finger piece 13 is in "on" position, so that the switch 63 is closed to connect the radio receiver to the power mains. Let us further suppose that the operator wants to tune in station D. The button 14 is moved along the slot 12 until the pointer 17 is in line with the indicating mark "D" of the selected station. When the button 14 is pushed in, the circuit of motor 133 and clutch coil 155 is closed through the following connections: Service main 188, conductor 190, through the motor windings and clutch coil 155, conductor 151, across the two switch bars 46 and 46' which are now connected by contact piece 37, conductor 52, closed switch 166—167, conductor 194, and across the closed switch contacts 68 to the return lead 189. The energized solenoid coil 155 shifts the clutch ring 142 to connect shafts 137 and 139. The energized motor 133 drives the tuning shaft 113 through the automatic reversing mechanism previously described. The reduction of speed in these transmission connections is such that the tuning shaft moves at the required slow speed.

When the rotary contact arm 181 touches contact 174*d* on disk 172, the magnet coil 161 is energized through the following connections: Circuit main 188, coil 161, conductor 53, across bar 47 and contact 48*d*, which are now connected by contact piece 38, conductor 59*d* and contact 174*d*, arm 181, brush 184, conductor 194, and across the closed contacts 68 to return main 189. The energized coil 161 rocks the lever 164 to open the switch contact 166, so that the circuit of motor 133 and clutch coil 155 is instantly opened, and the condenser shaft 113 stops in tuning position for the selected station D. As soon as the operator hears the broadcast through the loud-speaker of the radio set, he releases the push button 14 which instantly snaps back to normal position. The release of button 14 breaks the circuit of coil 161, so that the switch contacts 166—167 in the motor circuit are again closed. This, however, does not close the motor circuit, 75

because the terminal bars 46 in the control box are disconnected when the button is released. There is no need to trace the circuits for each station, because the operation of the mechanism is the same for any station, except that the tuning shaft is stopped when the rotary contact arm 181 engages with the particular contact 174 that represents the station indicated by push button 14. For example: if the push button is moved to select station G, the circuit of motor 133 is broken when the contact arm 181 touches contact 174g. This applies to all the other stations. Attention is called to the fact that the timing shaft 113 stops instantly on the release of key 14, because not only is the motor stopped, but the shaft 139 is disconnected from shaft 137 by clutch ring 142. Therefore, continued rotation of the motor shaft through its own momentum after the circuit is opened, has no effect on the tuning position of shaft 113.

In the preceding description, we have assumed that the time control is off, so that the thermostat bar 74 remains stationary and performs no other function than that of a stationary contact piece for the pivoted switch frame 63. Let us now assume that the timing knob 21 has been moved to an operative position along the time scale 23. When the rheostat arm 89 is in position 89a, practically all the resistance 80 is in circuit, so that the current through coil 77 is a maximum. This means that the thermostat bar 74 is heated very rapidly, so that the main switch 63 is opened after a minimum interval of time, which is conveniently represented on the timing scale of the control box by the numeral "1". This does not necessarily mean one minute, but rather the briefest interval during which the radio set will remain in operation after the pointer of knob 21 has been moved to the first division on the timing scale. As the arm 89 is gradually turned clockwise to cut out more and more resistance, the current through coil 77 is correspondingly decreased. Consequently, it takes longer for the thermostat bar 74 to become heated high enough to operate switch 63. When the pointer 22 of the timing knob 21 is at the highest point on the scale, the rheostat arm 89 is in position 89b to cut out almost all the resistance 80, so that only a weak current flows through coil 77. The heating effect of the coil now accumulates so slowly that it takes a maximum interval of time to heat the thermostat bar 74 to switch-operating temperature. When the pointer 22 is in line with the "off" mark (see Fig. 1), the extension 84' of shell 84 (see Fig. 2) opens the switch arm 84a, so that the circuit of heating coil 77, resistance 80 and lamp 97 is broken.

The electrical conductors that connect the remote control box 10 with the radio receiver are enclosed in a single cable 204 (see Fig. 2). If it is not desired to have the full house-lighting voltage in the cable, the switch contacts 68' may be connected in a relay circuit of low voltage for closing the main switch 203 in the radio cabinet when the relay is energized. The other conductors in the cable need not carry the full voltage of the house-lighting system, because only a low voltage is required to operate the heating coil 77 and the signal lamp 97 in the control box, and to operate the electric motor 133 and coils 155 and 161 in the radio cabinet. The circuit connections for controlling the volume of reproduction by knob 20 have been omitted, because they form no part of my invention and are furthermore understood by those skilled in the art.

I have only considered it necessary to indicate a rheostat 205 in Fig. 2 under the control of volume knob 20. The cover part of control box 10 may be of suitable color and design, and the same applies to the hand-operable parts 14, 19, 20 and 21. The signal lamp 97 may be mounted independently of timing knob 21, but the arrangement shown is believed to enhance the attractiveness of the box as a whole. In a simplified form of my invention the timing mechanism may be omitted. The control box may also be mounted on the radio cabinet itself for automatic tuning without remote control. It should be noticed that the receiver is always in condition to be tuned by hand in the usual way, because shaft 130 is normally disconnected from the motor-driven shaft 137.

If the resistance 80 is made of metallic wire, it will of course give off heat, but this will not appreciably affect the thermostat bar 74. In any case, however, the timing scale 23 can be calibrated to compensate for any heating effect of resistance 80. It should be noted that the scale 23 need not be accurate to the exact minute, for only an approximation of time is necessary for practical purposes. The controlling resistance 80 may also consist of carbon or graphite, or of any other practical material. Furthermore, the chamber 56 may have ventilating holes, preferably at the sides.

Although I have shown and described certain specific constructions, I want it understood that my invention is not limited to the details set forth. Changes and modifications will probably occur to others within the scope of the invention as defined in the appended claims.

I claim as my invention:

1. In radio tuning apparatus, a remote control box adapted to be operatively connected with a radio receiver, a switch in said box for closing the circuit of said receiver, means independent of said power switch and selectively operable for tuning in any one of a plurality of stations, a rotary knob mounted on said box, a time index associated with said knob, and thermostatic means controlled by said knob for automatically opening said switch after a predetermined interval, this interval being varied by the adjustment of said knob in relation to said index.

2. A radio receiver having variable tuning mechanism which includes a rotary member movable to any one of a plurality of angular positions representing each a certain station, in combination with a remote control box operatively connected with said mechanism and having means for selectively controlling said mechanism to stop said member in tuning position for anyone of said stations, a hand-operable switch in said box for turning the receiver on and off, thermostatic means in said box for automatically opening said switch after a certain lapse of time, an adjustable finger piece on said box, and means controlled by said finger piece for affecting the operation of said thermostatic means to vary said time interval.

3. A radio receiver having variable tuning mechanism which includes a rotary member movable to any one of a plurality of angular positions representing each a certain station, in combination with a remote control box operatively connected with said mechanism and having means for selectively controlling said mechanism to stop said member in tuning position for any one of said stations, a hand-operable switch

in said box for turning the receiver on and off, adjustable thermostatic means in said box for automatically opening said switch after a certain lapse of time, and hand-operable means for rendering said thermostatic means inoperative to affect the closed and open positions of said switch.

4. A radio receiver having variable tuning mechanism which includes a rotary member movable to any one of a plurality of angular positions representing each a certain station, in combination with a remote control box operatively connected with said mechanism and having means for selectively controlling said mechanism to stop said member in tuning position for any one of said stations, a hand-operable switch carried by said box for turning the electric power on and off, a thermostat bar in said box for automatically opening said switch after a certain lapse of time, a heating coil for said bar, and manually adjustable means carried by said box for regulating the current through said coil to vary said time interval, said last-mentioned means being operable to cut said heating coil out of circuit and thereby render said thermostat bar inoperative in relation to said switch.

5. In combination with a radio receiver having tuning mechanism, a remote control box operatively connected with said mechanism, said box having a single finger piece adjustable in a substantially rectilinear path to any one of a plurality of positions, each of which represents a certain station, a slidably supported spring blade mounted wholly within said box for supporting said finger piece so that it can be pushed in, switch mechanism controlled by said finger piece when the same is pushed in, and means whereby the pushing-in operation of said finger piece automatically causes said switch mechanism to control said tuning mechanism so as to tune in the particular station represented by the rectilinear position of said finger piece, said resilient means automatically raising said finger piece to normal position when it is manually released.

6. In combination with a radio receiver having tuning mechanism, a remote control box operatively connected with said mechanism, said box having a straight slot on top, a single finger piece projecting through said slot and mounted to slide in either direction to any one of a plurality of positions, each of which represents a certain station, means whereby said finger piece is depressible, said finger piece being normally in raised position, a series of switch contacts in said box representing each a selected station, switch means operated by said finger piece to engage one of said contacts when the finger piece is pushed down, means whereby the engagement of said switch means with a selected contact automatically operates said mechanism to tune in the station represented by the engaged contact, and a slidably supported spring blade mounted entirely within said box for automatically raising said finger piece to normal position when it is manually released.

7. In combination with a radio receiver having tuning mechanism, a control device operatively connected with said mechanism, said device having a pair of parallel supports, a spring member slidably mounted on said supports, a push button connected to the center of said spring member for sliding the same to a selected position, said spring member normally holding said button raised, and normally open switch mechanism adapted to be closed when said button is depressed in any adjusted position.

8. In combination with a radio receiver having tuning mechanism, a control device operatively connected with said mechanism, said device having a bowed leaf spring slidably supported at its ends, a push button connected to the central portion of said spring for sliding the same, said spring normally holding the button in raised position, a station indicator associated with said button, and normally open switch mechanism adapted to be closed when the button is pushed in to bring in the selected station.

9. In combination with a radio receiver having tuning mechanism, a control device operatively connected with said mechanism, said device having a station indicator comprising a series of marks representing each a selected station, a push button movable bodily along said scale and normally held in raised position, a pointer movable with said button to select a desired station, operating circuits controlled by said button when the same is pushed in, and means for preventing inward operative movement of said button unless said pointer is substantially in line with a station mark on said indicator, said last-mentioned means permitting free sliding movement of the push button in normal raised position.

10. In combination with a radio receiver having tuning mechanism which includes an electric motor, a remote control box operatively connected with said mechanism, said box being provided with a push button which is slidable to a plurality of selected positions, each position representing a certain station, a motor switch in said box adapted to be closed when said button is depressed in any one of its positions whereby said tuning motor is energized, a plurality of station-selecting switches in said box adapted to be individually closed by the depressed button to stop said motor in selected tuning position, there being a selecting switch for each position of the button, spring means within said box for normally holding the button raised in any position to keep all of said switches open, said spring means automatically raising the push button to circuit-opening position when the button is released, and means for mounting said button to permit free sliding movement thereof in normal raised position.

11. In radio tuning apparatus, the combination of a hand-operable switch member for closing the power circuit for the receiver, a finger piece for moving said switch member to closed and open positions, means independent of said power switch and selectively operable for tuning in any one of a plurality of stations when said switch member is in closed position, means for automatically moving said member to open position after a predetermined lapse of time, whereby the selected station is cut out, and a hand-operable member independent of said finger piece and station-selecting means for varying said time interval and for rendering said automatic switch-operating means inoperative.

12. In radio tuning apparatus, the combination of a pivoted switch arm, a finger piece for moving said switch arm to closed and open positions, means independent of said switch arm and selectively operable for tuning in any one of a plurality of stations when said switch arm is in closed position, means for automatically swinging said arm to open position after a predetermined lapse of time, whereby the selected station is cut out, and a manually operable member for varying said time interval.

13. In radio tuning apparatus, the combination

of a hand-operable switch member in the power circuit for the receiver, a finger piece for moving said switch member to closed and open positions, means independent of said switch member and selectively operable for tuning in any one of a plurality of stations when said switch member is in closed position, thermostatic means for automatically moving said member to open position after a predetermined lapse of time, whereby the selected station is cut out, and a rotary hand knob for controlling the operation of said thermostatic means to vary said time interval.

14. In radio tuning apparatus, the combination of a hand-operable member in the power circuit for the receiver, a finger piece for moving said member to close and open said circuit, means independent of said member and selectively operable for tuning in any one of a plurality of stations when said member is in circuit-closing position, means for automatically moving said member to circuit-breaking position after a predetermined lapse of time whereby the selected station is cut out, and a second hand-operable member for controlling the operation of said means to vary said time interval.

15. In radio tuning apparatus, the combination of a hand-operable switch member in the power circuit for the receiver, a finger piece for moving said switch member to closed and open positions, means independent of said power switch and selectively operable for tuning in any one of a plurality of stations when said switch member is in closed position, thermostatic means for automatically moving said member to open position after a predetermined lapse of time whereby the selected station is cut out, and hand-operable means for controlling the action of said thermostatic means to vary said time interval.

16. In combination with a radio receiver having tuning mechanism, a device operatively connected with said mechanism for controlling the same to select any desired station, said device comprising a spring-pressed push button movable to any one of a plurality of station-selecting positions, switch means operated by said button when the latter is depressed in any one of said positions, and means for locking said button against being pushed in when it is not in correct station-selecting position, said locking means permitting free movement of the push button in normal position to any station-selecting position.

17. In combination with a radio receiver having tuning mechanism, means for controlling said mechanism to tune in any desired station, a hand-operable switch for turning the receiver on and off, said controlling means being separate from said power switch and operable independently thereof, adjustable thermostatic means for automatically opening said switch after a certain lapse of time, whereby a tuned-in station is cut out, hand-operable means for rendering said

thermostatic means inoperative, so that a selected station remains in tune until said switch is manually opened, a signal lamp which is lighted when said thermostatic means is in operation, and switch means for automatically opening the lamp circuit when the thermostatic time control is off.

18. In combination with a radio receiver having tuning mechanism, a device operatively connected with said mechanism for controlling the same to select any desired station, said device comprising an insulating base carrying a pair of parallel terminal bars, a series of separate contacts carried by said base, each contact representing a certain station, a common contact bar associated with said station contacts and mounted on said base substantially parallel with said terminal bars, a support slidable transversely of said bars and carrying a pair of insulated switch members, one of said switch members being in line with said pair of terminal bars and the other switch member being in line with said station contacts and associated contact bar, spring means for normally holding said support in such position that said switch members are out of engagement with said bars and contacts, and a push button for sliding said support to any selected position and pushing it inwardly to move said switch members into circuit-closing position.

19. A radio receiver having variable tuning mechanism which includes a rotary member movable to any one of a plurality of angular positions representing each a certain station, in combination with a remote control box operatively connected with said mechanism and having means for selectively controlling said mechanism to stop said member in tuning position for any one of said stations, a hand-operable switch carried by said box for turning the receiver on and off, thermostatic means in said box for automatically opening said switch after a certain lapse of time, and manually adjustable means carried by said box for controlling the action of said thermostatic means to vary said time interval.

20. A radio receiver having variable tuning mechanism which includes a rotary member movable to any one of a plurality of angular positions representing each a certain station, in combination with a remote control box operatively connected with said mechanism and having means for selectively controlling said mechanism to stop said member in tuning position for any one of said stations, a hand-operable switch carried by said box for turning the receiver on and off, adjustable thermostatic means in said box for automatically opening said switch after a certain lapse of time, and an adjustable finger piece mounted on said box for rendering said thermostatic means incapable of affecting the closed and open positions of said switch.

ADOLPH A. THOMAS.