April 18, 1939. W. J. SCHNELL 2,154,778

RADIO TUNER

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FIG. 1.

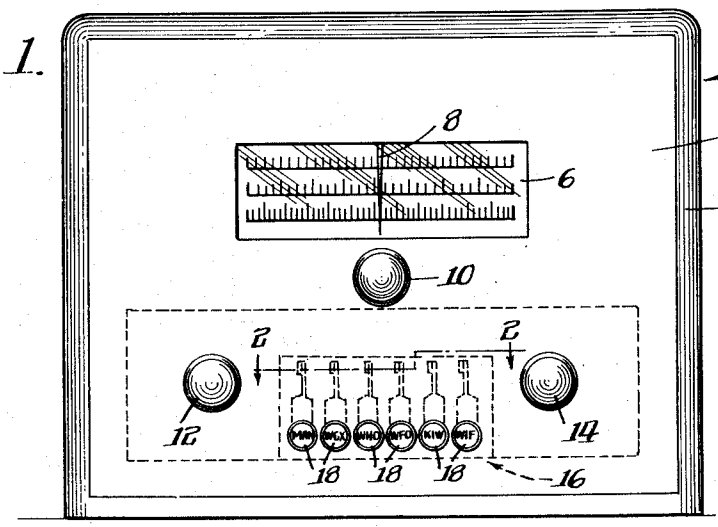
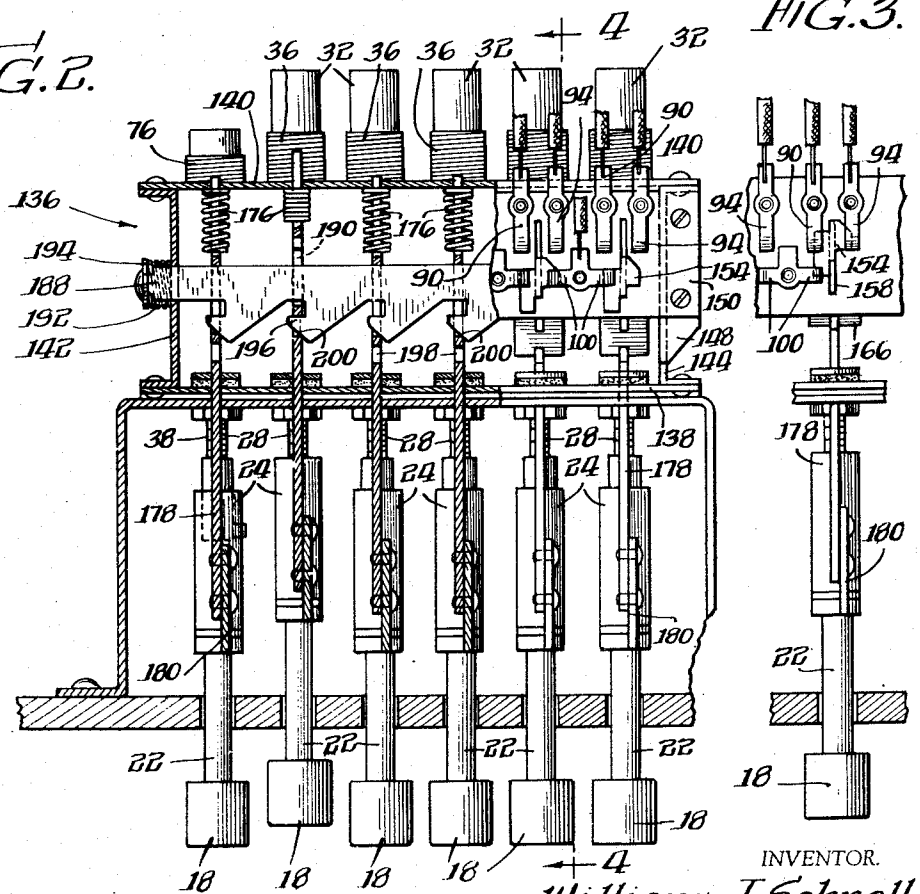


FIG. 3.

FIG. 2.



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FIG. 4.

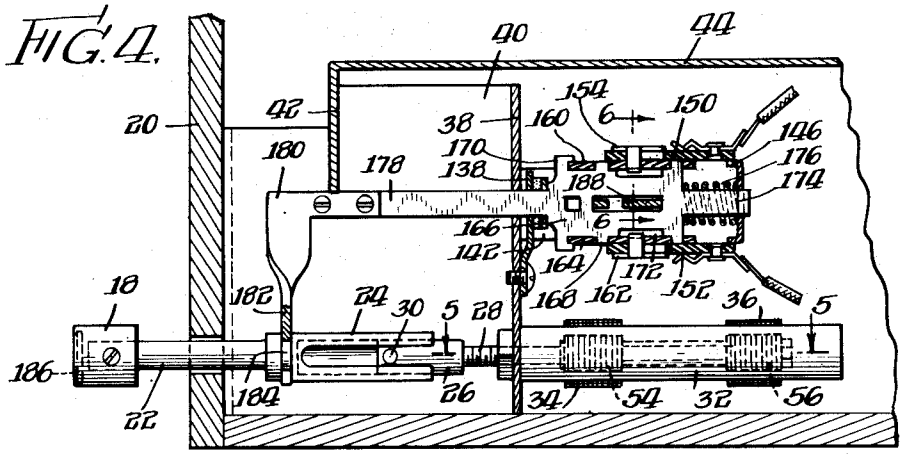


FIG. 5.

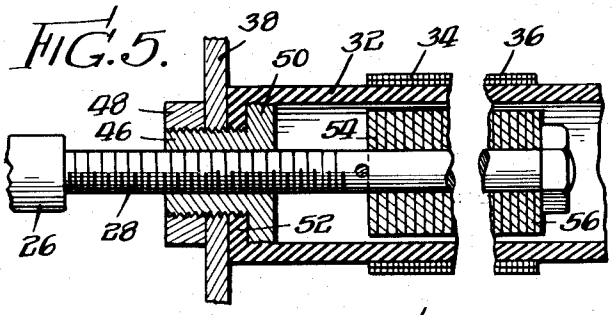


FIG. 6.

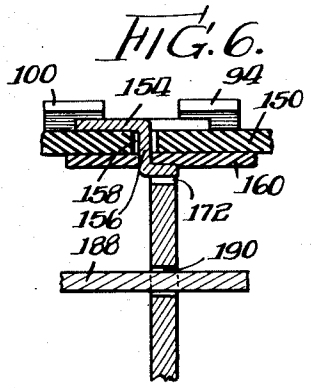


FIG. 7.

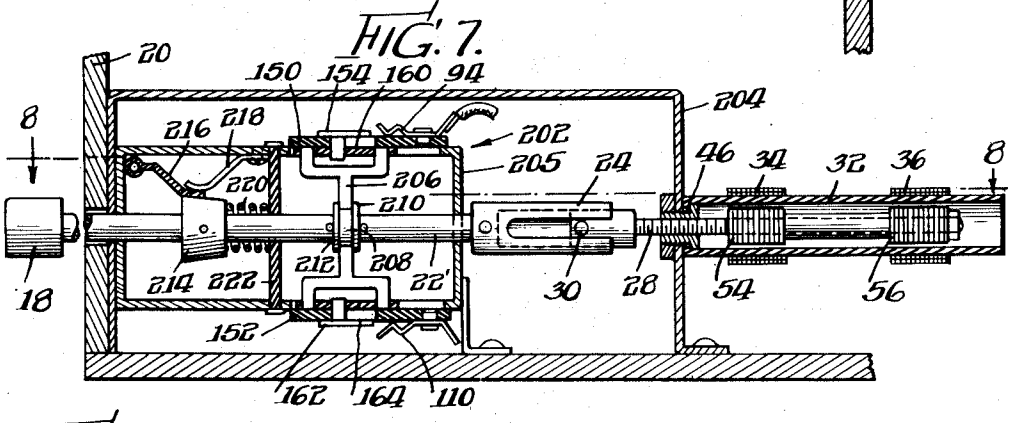
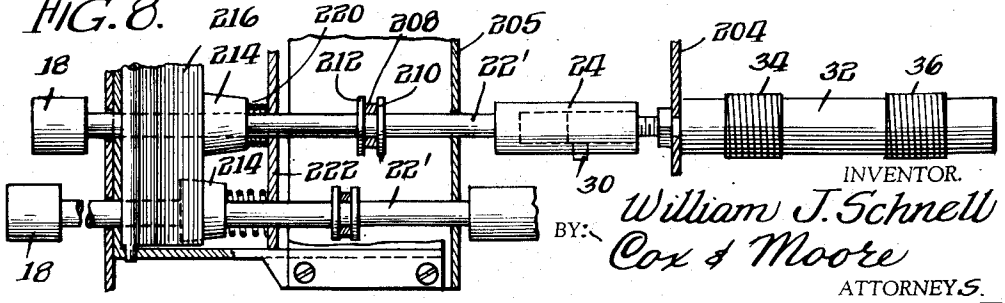


FIG. 8.



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FIG. 9.

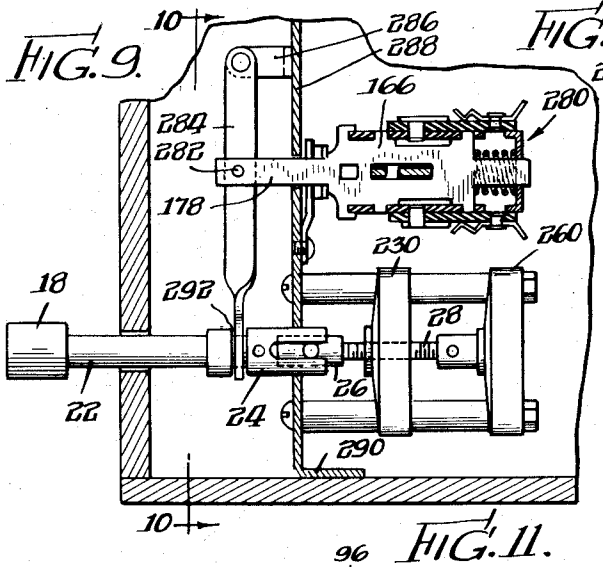


FIG. 10.

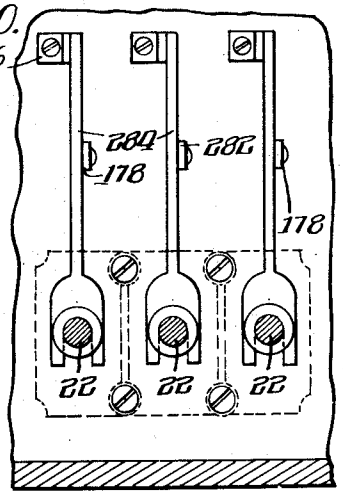


FIG. 11.

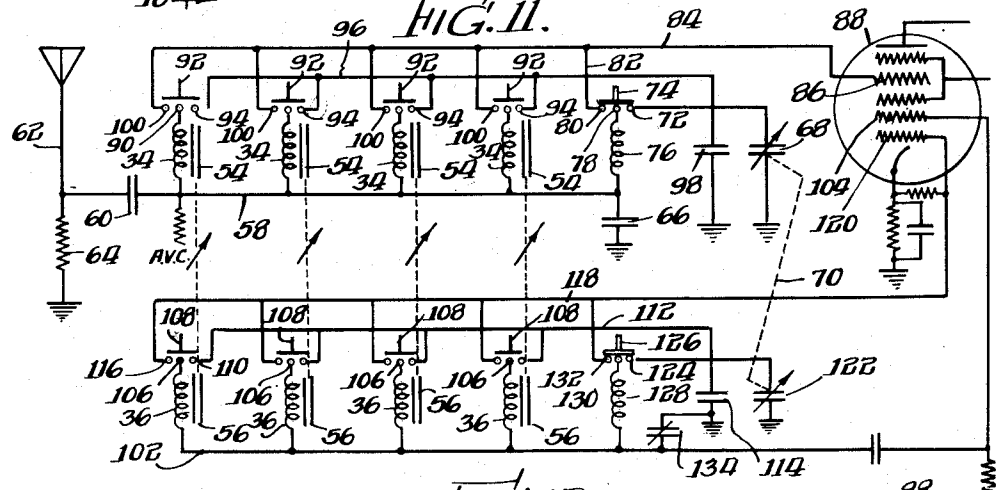
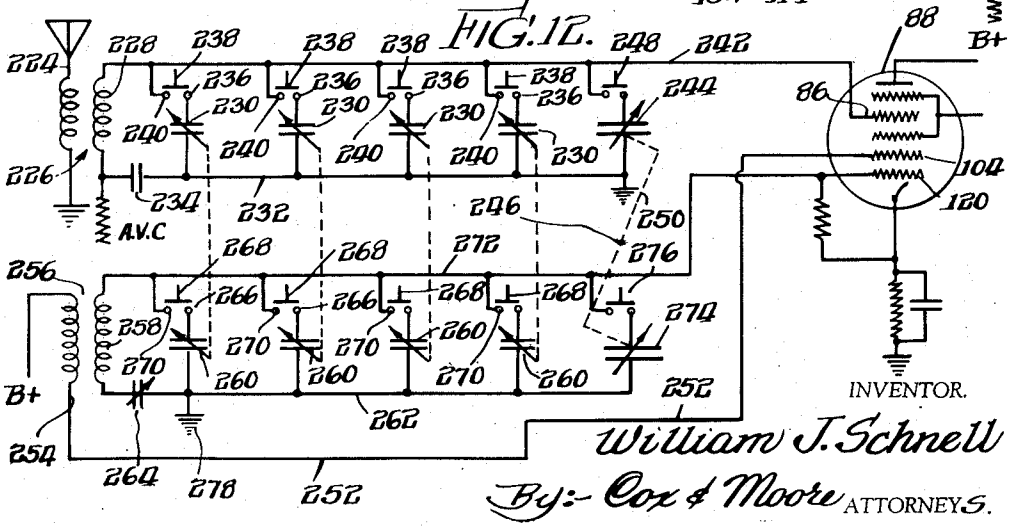


FIG. 12.



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UNITED STATES PATENT OFFICE

2,154,778

RADIO TUNER

William J. Schnell, Berwyn, Ill., assignor to Electrical Research Laboratories Inc., Chicago, Ill., a corporation of Illinois

Application June 16, 1938, Serial No. 214,007

9 Claims. (Cl. 250—40)

This invention relates to an "automatic" radio tuner, and particularly to a radio tuner of the push button type.

It is an object of applicant's invention to provide a simple, compact and relatively inexpensive tuning device, preferably of the push button type, which is readily and precisely adjustable for the selection of desired broadcasting stations.

It is another object of applicant's invention to provide in a radio tuner a plurality of selectively energizable electrical tuning elements or impedances, and to provide means for controlling the selective energization of said tuning elements or impedances which last mentioned means shall be individually adjustable exteriorly of the radio receiver selectively to vary the impedance of said tuning elements so that the selected tuning element will, whenever energized, tune the receiver to the desired station.

A more specific object of applicant's invention is to provide a tuning device comprising a plurality of inductances or condensers wherein means is provided for selectively energizing said inductances or condensers to tune the radio receiver to a selected broadcast station, and wherein the selected control means is adjustable exteriorly of the receiver or from the front panel of the receiver by manual manipulation and without the use of any tool or device to individually adjust or pre-set the impedance values of said inductances or condensers.

Other and further objects and advantages of the invention will be apparent from the following description when taken in connection with the accompanying drawings, wherein:

Fig. 1 is a view in elevation of a radio receiver embodying the invention.

Fig. 2 is a fragmentary horizontal section taken substantially along the line 2—2 of Fig. 1.

Fig. 3 is a view of a portion of Fig. 2, but with the elements in a different position of operation.

Fig. 4 is a fragmentary sectional view taken substantially along the line 4—4 of Fig. 2.

Fig. 5 is an enlarged fragmentary horizontal section on the line 5—5 of Fig. 4.

Fig. 6 is an enlarged fragmentary section along the line 6—6 of Fig. 4.

Fig. 7 is a fragmentary section similar to Fig. 5, but showing a modification.

Fig. 8 is a fragmentary horizontal section taken substantially along the line 8—8 of Fig. 7.

Fig. 9 is a fragmentary section similar to Figs. 4 and 7, but showing a second modification.

Fig. 10 is a vertical section along the line 10—10 of Fig. 9.

Fig. 11 is a schematic diagram of the electric circuit for the forms of Figs. 1 to 6 and Figs. 7 and 8.

Fig. 12 is a schematic diagram of the circuit for the forms of Figs. 9 and 10.

As shown in Fig. 1, the radio receiver 2 comprises the usual cabinet 4 having a tuning dial 6 over which moves a pointer 8 controlled by the usual manually operable knob 10 which also, in the usual manner, controls the tuning adjustment of the conventional gang tuning condenser. The receiver also comprises the usual tone and volume adjusters 12 and 14 respectively and in addition an automatic tuner 16 for automatically adjusting or tuning the receiver to any desired one of a plurality of selected broadcast stations. The automatic tuner 16 preferably comprises a plurality of push buttons 18 located exteriorly of the front panel 20 of the radio receiver and carried by slidably and depressibly mounted bars or rods 22 extending through said front panel into the interior of the receiver.

Each rod 22 interiorly of the receiver is provided with a bifurcated portion or member 24 formed integrally with or rigidly fastened to the rod. The bifurcated member or portion 24 is provided with a central opening preferably circular in cross section, to receive a sleeve or collar 26 carried by or secured to the end of a threaded rod 28. The bifurcated member or portion 24 is slidable upon the sleeve or collar 26 which, therefore, acts as a guide for said member, and the sleeve is provided with a pin 30 received between the furcations of the bifurcated member or portion 24 so that the sleeve 26 and rod 28 may be rotated by rotation of the push button 18 and the rod 22. A tube 32, which may be of insulatory material, carries circumferentially thereof spaced induction coils or inductances 34 and 36. The tube 32 is secured to a supporting wall or flange 38 of a bracket 40 welded or otherwise fastened to the front wall 42 of the usual receiver chassis 44. This securing of the tube 32 to the wall or flange 38 is accomplished by a sleeve 46 exteriorly threaded to receive a nut 48 clamping the sleeve against the wall or flange 38 and having an enlarged head 50 abutting the inwardly extending annular end flange 52 of the tube 32.

The inductivity or inductive value of the coils or inductances 34 and 36 is varied or adjustably controlled by integrally connected magnetic cores 54 and 56 rigidly secured to the rod 28 within the tube 32. The sleeve 46 also provides a stationary nut compelling the rod 28 to move axially when rotated so as to vary the relative alinement

of the cores 54 and 56 with their respective coils 34 and 36, and for this purpose the sleeve 46 is internally threaded to receive the external threads of the rod 28. As shown in Fig. 11, there are a plurality of coils or inductances 34 and 36, each pair having the inductive values of its constituent coils controlled by a separate push button 18. One end of each coil 34 (Fig. 11) is connected in common by a wire 58, in which is interposed a condenser 60 of the order of .01 of a microfarad, to the antenna lead 62 which lead is grounded through a resistor 64 of the order of 25,000 ohms. One side of a grounded condenser 66 of the order of .002 of a microfarad is connected to the common wire 58. One unit 68 of the manually adjustable gang condenser 70 is connected to the contact 72 of a switch 74 controlling the energization of a fixed inductance or coil 76. One end of the coil 76 is connected to the contact 78 of the switch 74 and the other end of said coil is connected to the common wire 58. A third contact 80 of the switch 74 is connected by a lead 82 to a common wire 84 connected to the signal control grid 86 of a combined amplifier and oscillator vacuum tube 88. The switch 74 is controlled in a manner later to be described by one of the push buttons 18 and when the coil 76 is energized, the condenser unit 68 is simultaneously connected therewith and to the control grid 86 so that the receiver may be manually tuned by manipulation of the control knob 10.

The other end of each of the coils 34 is connected to a contact 90 of a switch 92, there being one switch 92 for each of the coils 34 and each of said switches being controlled by one of the push buttons 18. The contacts 94 of the switches 92 are connected in common by a wire 96 to one side of a fixed condenser 98 which is grounded at its other side. The other contacts 100 of the switches 92 are connected in common by the common wire 84 to the control grid 86 of the amplifying, oscillating tube 88.

One end of each of the coils 36 is connected by a common wire 102 to the anode electrode 104 of the oscillating section of the tube 88 through a condenser 105 of the order of .002 microfarad. The other end of each coil 36 is connected with the contact 106 of a switch 108 controlled simultaneously with the switch 92. The contact 110 of each switch 108 is connected by a common wire 112 to one side of a fixed condenser 114 which is grounded at its other side. The contact 116 of each switch 108 is connected by a common wire 118 to the control grid 120 of the oscillator section of the tube 88. A second unit 122 of the manually adjusted gang condenser 70 is connected to the contact 124 of a switch 126 controlled simultaneously with the switch 74 by its associated push button 18. A fixed inductance or coil 128 is connected at one end to the common wire 102 and at its other end to the contact 130 of the switch 126. The third contact 132 of the switch 126 is connected to the common wire 118. A separately adjustable compensating condenser 134 is grounded at one side and its other side is connected to the common wire 102.

The output of the tube 88 may be fed in any conventional fashion to the succeeding tubes of the receiver. The usual automatic volume control (A. V. C.) may be connected to the common wire 58 and the source of plate potential for the oscillating section of the tube may be connected to the common wire 102 between the anode 104 and the condenser 105.

All of the switches 92, together with switches 74 and 126, are mounted as a unit upon a support 136 (Fig. 2). The support 136 comprises front and rear plates 138 and 140 respectively and side plates 142 and 144 respectively forming a frame or housing for the switches. The rear frame plate 140 is provided with inwardly turned upper and lower flanges 146 (Fig. 4) and the side frame plates 142 and 144 are provided with laterally bent flanges 148 (Fig. 2), the flanges 146 and 148 forming supporting and attaching surfaces for receiving upper and lower insulating plates or srips 150 and 152 respectively. The contacts 90 and 94 are arranged in pairs on the outer surface of the upper insulating plate 150 and the contacts 100 for adjacent ones of the coils 34 are formed as a single blade secured to the upper surface of the plate 150 between adjacent pairs of the contacts 90 and 94. The contacts 106 and 110 are arranged in pairs and secured to the lower surface of the lower insulating plate 152 in the same manner as the contacts 90 and 94 are secured to the upper plate. The contacts 116 are secured to the lower surface of the insulating plate 152 and are disposed in a manner similar to the disposition of the contacts 100 on the plate 150. A movable switch blade 154 is adapted to connect each pair of contacts 90 and 94 to the adjacent contact blade 100. The contact blade 154 comprises a headed portion adapted to bridge the space between the contacts 90 and 94 and an elongated portion in constant engagement with the switch blade 100 and adapted to bridge the space between this blade 100 and the contact blade 90 when the blade 154 is moved to its upper position in Figs. 2 and 3 or to its righthand position in Fig. 4. The switch blade 154 comprises in addition a depending leg or flange 156 (Fig. 6) extending through a guide slot 158 in the insulating plate 150 and through an opening provided in an insulating plate or strip 160 which is mounted for slidable movement relative to the plate 150. The lower end of the depending leg or flange 156 is bent over into clamping engagement with the lower surface of the slide plate 160 so as to securely fasten the movable switch blade 154 to said slide plate. A similar switch blade 162 likewise mounted for slidable movement on the plate 152 is similarly secured or fastened to an insulating and slidable plate 164 identical to the slide plate 160. The plates or strips 160 and 164 are carried by a slide bar 166 to which they are attached by lugs 168 passing through the strips 160 and 164 and by clips 170 bent over the end edges of said strips into clamping engagement therewith. Notches 172 are formed in the opposite edges of the slide bar 166 (Fig. 4) to receive the inturned ends of the depending flanges of the switch blades 154 and 162, there being sufficient clearance between the walls of these notches and said inturned ends to prevent engagement between the slide bars and the movable switch blades. The slide bar 166 is formed with a reduced end portion 174 received in a guide opening in the rear frame plate 140, and a coiled spring 176 is interposed between said rear frame plate and the enlarged body portion of the slide bar 166. The opposite reduced end portion 178 of the slide bar 166 extends forwardly through guide openings in the front frame plate 144 and the supporting plate 38, and at its forward edge is secured an L-shaped operating bar 180 having a bifurcated end portion 182, the furcations of which are received in an annular groove 184 formed in the rod 22

or in the forward end of the bifurcated member 24.

The front face of each push button 18, except one, is recessed as at 186 (Fig. 4) to receive a tab or disk carrying suitable indicia, such as the call letters of the broadcast station for which the particular push button may be, as subsequently set forth, adjusted to tune the receiver.

The switch blades or contacts 72, 78, 124 and 130 are secured to the insulating plates 150 and 152 in a manner similar to the contacts 90, 94, 106 and 110, and the contacts 80 and 132 are secured to said plates in a manner similar to the contacts 100. The switch blades 74 and 126 are formed similarly to the switch blades 154 and 162 and are similarly mounted for slidable movement upon the plates 150 and 152.

The remaining push button 18 is connected, in the same manner as the other buttons are connected, to the switches 92 and 108 and to the switches 74 and 126. This push button is also provided with a recess to receive a marking tab indicative of its function, viz., to energize the tuning device.

A common latch lever or bar 188 extends through enlarged slots 190 in all of the slide bars 166 and through alined slots in the side frame plates 142 and 144. A coiled spring 192 interposed between the side plate 142 and a washer 194 bolted to the left end of the latch bar 188 normally urges said latch bar to the left as seen in Fig. 2. The latch bar 188 is provided with a plurality of latch fingers 196, one for each of the slide bars 166 and each adapted to engage a slot 198 in the associated slide bar to retain said slide bar in its rearwardly depressed position. Each latch finger 196 is formed with a cam surface 200 having camming engagement with the forward edge of the slot or opening 198.

The adjustment and operation of this form of the invention is as follows: The adjustable core elements 54 and 56 provide means for adjustably varying the permeability of the cores of the coils 34 and 36. In order to adjust a push button for the selection of a desired station, said push button is first depressed to connect the selected coils 34 and 36 to the control grids 86 and 120 and to the fixed condensers 98 and 114. The depressed push button 18 is then rotated to rotate the rod 22 and through the bifurcated member or portion 24 causes rotation and axial movement of the rod 28. The axial movement of the rod 28 varies or adjusts the core elements 54 and 56 axially of the coils 34 and 36 and by varying the permeability of the cores, varies the impedance of said coils whereby the tuning circuits, of which the selected coils 34 and 36 form constituent parts, are adjustably pre-set in frequency so that this push button and its operated elements will when operated effect the tuning of the receiver to the desired broadcasting station. Each of the push buttons 18, other than the push button associated with and controlling the switches 74 and 126, is adjusted in like manner to pre-set their associated controls to the desired ones of a selected group of broadcasting stations. When it is desired to use an already adjusted button for the selection of a different station, it is merely necessary to repeat the adjusting operation previously described.

In the form of the invention shown in Figs. 7 and 8, the switch unit 202 is mounted within a housing 204 to the rear wall of which is secured the tube 32 in the same manner as said tube is secured to the plate 38 of the form of the invention shown in Figs. 1 to 6. The operating rod 22' is connected by the same bifurcated member or portion 24 to the threaded rod 26 which controls the permeability setting of the adjustable core elements 34 and 36. The operating rod 22' is in this form of the invention, however, relatively extended and passes through alined guide openings in the opposite end walls of the switch frame 205. The insulating slide plates or strips 160 and 164 are directly connected to the rod 22' by means of a saddle member 206 having a cylindrical center portion 208 fitting over the rod 22' and confined between the annular flange 210 and a collar 212. The opposite ends of the saddle 206 are bifurcated to form attaching lugs received within the slide plates 160 and 164 which are held against inward movement by the movable switch blades 154 and 162 slidably supported upon the insulating mounting plates 150 and 152.

Each of the rods 22' is provided with a frusto-conical cam 214 engaged by a pivoted latch bar or strip 216 common to and extending transversely of all of the operating rods 22'. A spring strip 218 engages the latch bar 216 and normally urges it into latching engagement with the forward face of a depressed cam 214. A coiled spring 220 interposed between a partition wall 222 and a rear face of the cam normally urges the associated rod 22' to its forward position. It will be evident that upon depression of the selected rod 22' of the form shown in Fig. 7, the associated switch contacts 90, 94, 106, 108, 110 and 116 will be operated to connect the selected coils 34 and 36 to the tube 88 and the fixed condensers 98 and 114, and the cam 214, when in its rearward depressed position, will be engaged by the free edge of the latch bar 216 and held in said depressed position. Upon depression of another rod 22', the cam 214 associated therewith will cause the latch bar 216 to pivot vertically to release the cam 214 associated with the previously depressed rod and the spring 220 will cause said last mentioned rod to move forward into normal position.

It will be seen from the foregoing description that in the forms of the invention shown in Figs. 1 to 8 and 11, applicant has provided an automatic permeability tuner embodying a plurality of pre-settable tuning circuits in combination with a manually adjustable tuning circuit and wherein means, such as a plurality of push buttons, are provided for not only determining the selective connection of a pre-settable tuning circuit to the signal input of the tube 88, but also for adjusting the core elements of the coils forming constituent parts of the pre-settable tuning circuits.

In the form of the invention shown in Figs. 9, 10 and 12, the adjustable tuning impedances comprise trimmer condensers of the compression adjustable type. As shown in Fig. 12, the antenna 224 is coupled by a transformer 226, the secondary 228 of this transformer constituting the fixed inductance common to each of the pre-settable tuning circuits for the amplifier portion of the oscillator tube 88. One side of each of the adjustable condensers 230 is connected in common by a wire 232 in which is interposed a condenser 234, preferably of fixed value to one terminal of secondary 228. The other side of each of the condensers 230 is connected to a contact 236 of a switch 238, the other contact 240 of each of the switches being connected in common by a wire 242 to the other terminal of the secondary winding 228 and to the control grid 86 of the

amplifying section of the tube 88. The adjustable unit 244 of the manually adjustable gang condenser 246 is connected to the common wire 232 and by a switch 248 to the common wire 242. The common wire 232 is preferably grounded as at 250.

The anode electrode 104 of the oscillator section of the tube 88 is connected by a wire 252 through the primary 254 of the transformer 256 to the positive side of the B-supply source. The secondary 258 of the transformer 256 constitutes the fixed tuning inductance for the oscillator section. One side of each of the trimmer condensers 260 is connected in common by wire 262, in which is interposed an adjustable condenser 264 to one terminal of the secondary 258. The other side of each of the condensers 260 is connected to the contact 266 of a switch 268, and the other contact 270 of each of these switches is connected in common by a wire 272 to the other terminal of the secondary 258 and to the control grid 120 of the oscillator section of the tube. The adjustable unit 274 of the manually adjustable gang condenser 246 is connected to the common wire 262 and by a switch 276 to the common wire 272. The common wire 262 is preferably grounded as at 278.

As shown in Figs. 9 and 10, the trimmer condensers 230 and 260 are of the compression adjustable type and are arranged in pairs for common control by the threaded rod 28 which, similarly to the form of the invention shown in Figs. 1 to 6, is provided with a sleeve or collar 26 slidably received in the bifurcated member or portion 24 carried by or fastened to the rod 22 which latter carries at its outer end the push button 18. The switch unit 280 for selectively controlling the energization of the condensers 230 and 260 is similar in all respects to the controlling switch unit in the form of the invention shown in Figs. 1 to 6 with the exception that one of the fixed contacts of each of these switches is eliminated. The contact which is eliminated may be said to correspond to the contact 94 of the form shown in Figs. 1 to 6. The slide bar 166 which controls the switch unit 280 has its forwardly extending reduced end portion 178 pivotally connected as at 282 intermediately the ends of a lever 284 pivoted at its upper end to a bracket 286 carried by the front wall 288 of a bracket 290. The lower end of the lever 284 is twisted so as to lie in a plane perpendicular to the axis of the rod 22 and is bifurcated at its lower edge, the furcations thereof being received in an angular groove 292 in the bifurcated member or portion 24.

The adjustment and operation of this form of the invention will be apparent from the description hereinabove set forth in respect to the forms of the invention shown in Figs. 1 to 8.

It will be seen from this description that in the form of the invention shown in Figs. 9, 10 and 12, applicant has provided an automatic tuner of the trimmer condenser type embodying a plurality of pre-settable tuning circuits in combination with a manually adjustable tuning circuit and wherein means, such as a plurality of push buttons, are provided not only to determine the selective connection of a pre-settable tuning circuit to the signal member of the tube 88, but also for adjusting the capacities of the trimmer condensers forming constituent parts of the pre-settable tuning circuits.

Further modifications and changes may be made in the form, construction and arrangement of the parts without departing from the spirit of the invention or sacrificing any of its attendant advantages, and the right is hereby reserved to make all such changes as fairly fall within the scope of the following claims.

The invention is hereby claimed as follows:

1. In a tuning device for a radio receiver or the like having an amplifier, a plurality of individually tuned circuits, a plurality of separate means for connecting each of said tuned circuits to said amplifier to tune the receiver to a desired station, means for selectively controlling said connecting means, and means operated by said control means for varying the tuning of a selected one of said tuned circuits.

2. In a tuning device for a radio receiver or the like having an amplifier, a plurality of individually tuned circuits comprising inductances each having an adjustable core element to vary the permeability of the core of said inductance whereby to vary the impedance of said inductance, a plurality of separate means for connecting each of said tuned circuits to said amplifier to tune the receiver to a desired station, means for selectively controlling said connecting means and means operated by said control means for selectively adjusting the core element of a selected one of said tuned circuits.

3. In a tuning device for a radio receiver or the like having an amplifier, a plurality of individually adjustable condensers, a common inductance connected to said amplifier, a plurality of separate means for connecting each of said condensers to said inductance and to said amplifier to tune the receiver to a desired station, means for selectively controlling said connecting means, and means operated by said control means for adjusting the selected condenser.

4. In a tuning device for a radio receiver or the like having an amplifier, a plurality of individually tuned circuits, a plurality of separate means for connecting each of said tuned circuits to said amplifier to tune the receiver to a desired station, a plurality of push buttons, one for each of said connecting means, for controlling said connecting means, and a plurality of separate means each operatively connected to one of said push buttons for varying the tuning of a selected one of said tuned circuits.

5. In a tuning device for a radio receiver or the like having an amplifier, a plurality of individually tuned circuits comprising a plurality of inductances each having an adjustable core element to vary the permeability of the core of said inductance whereby to vary the impedance of said inductance, a plurality of separate means for connecting each of said tuned circuits to said amplifier to tune the receiver to a desired station, a plurality of push buttons, one for each of said connecting means, for controlling said connecting means, and a plurality of separate means each operatively connected to one of said push buttons for adjusting the core element of the selected impedance.

6. In a tuning device for a radio receiver or the like comprising an amplifier, a plurality of individually adjustable condensers, an inductance connected to said amplifier, a plurality of separate means for connecting each of said condensers to said inductance and to said amplifier to tune the receiver to a desired station, a plurality of push buttons, one for each of said connecting means, for controlling said conecting means, and a plurality of separate means each

operatively connected to one of said push buttons for adjusting the selected condenser.

7. In a tuning device for a radio receiver or the like, the combination of a plurality of pre-settable tuning circuits, an adjustable tuning circuit, a plurality of switches for selectively rendering said pre-settable tuning circuits effective to tune the receiver to a desired one of a selected group of broadcast stations, an additional selectively operable switch, for rendering said adjustable tuning circuit effective to tune the receiver to any broadcast station, a plurality of push buttons, one for each of the switches, for controlling said switches, and a plurality of adjusters operatively controlled by said push buttons for selectively varying the setting of said pre-settable tuning circuits.

8. In a radio receiver or the like having a radio amplifier and an oscillator operatively associated therewith, the combination of individually tuned pairs of tuning circuits, a plurality of separate means for connecting each pair of said circuits to said amplifier and to said oscillator, one of the connected pair of circuits being connected to the amplifier and the other to the oscillator to tune the receiver to a desired broadcast station, means for selectively controlling said connecting means, and means operated by said control means for simultaneously varying the tuning of each tuned circuit of the selected pair of said circuits.

9. In a tuning device for a radio receiver or the like, the combination of a plurality of pre-settable tuning circuits, an adjustable tuning circuit, a plurality of switches for selectively rendering said pre-settable tuning circuits effective to tune the receiver to a desired one of a selected group of broadcast stations, an additional selectively operable switch, for rendering said adjustable tuning circuit effective to tune the receiver to any broadcast station, a plurality of push buttons, one for each of the switches, for controlling said switches, a plurality of adjusters operatively controlled by said push buttons for selectively varying the setting of said pre-settable tuning circuits, automatically operable means for latching the operated switch in its operated position and means operatively connected to said latching means for releasing said latching means upon operation of a different selected one of said push buttons.

WILLIAM J. SCHNELL.