

Nov. 8, 1949

R. F. KOCH

2,487,760

SINGLE BUTTON TUNING CONTROL FOR RADIO SETS

Filed April 4, 1946

4 Sheets-Sheet 1

Fig. 1.

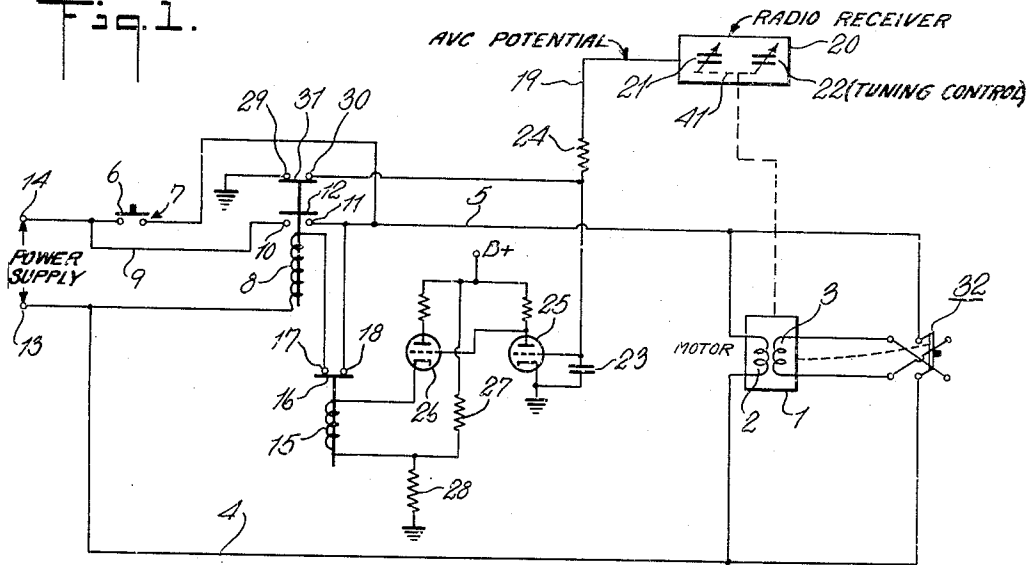


Fig. 2.

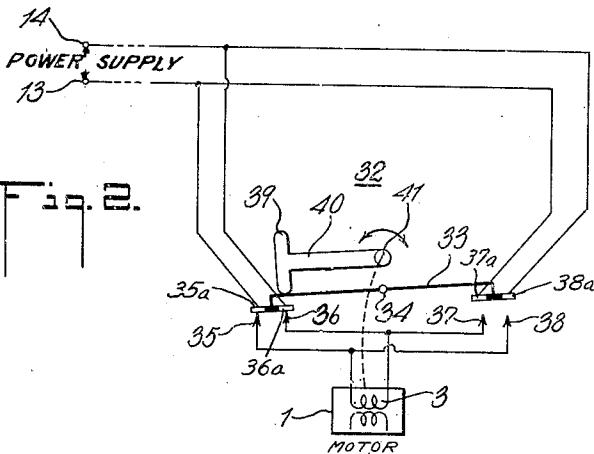
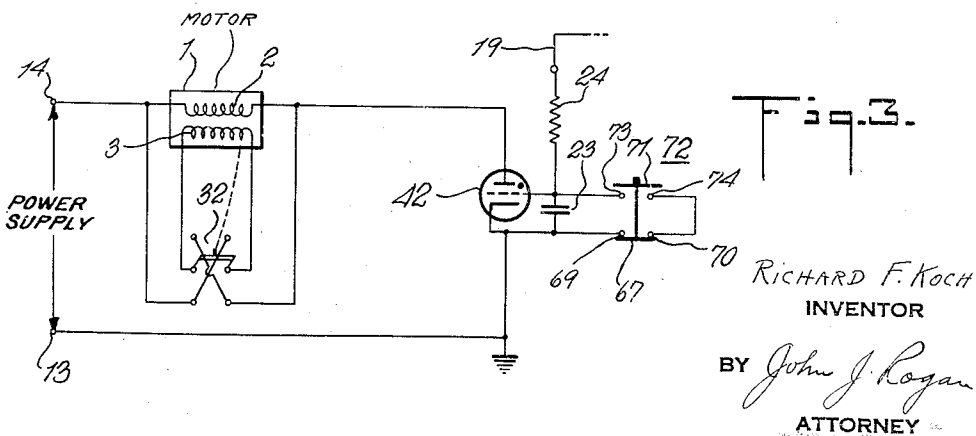


Fig. 3.



RICHARD F. KOCH
INVENTOR

BY John J. Logan
ATTORNEY

Nov. 8, 1949

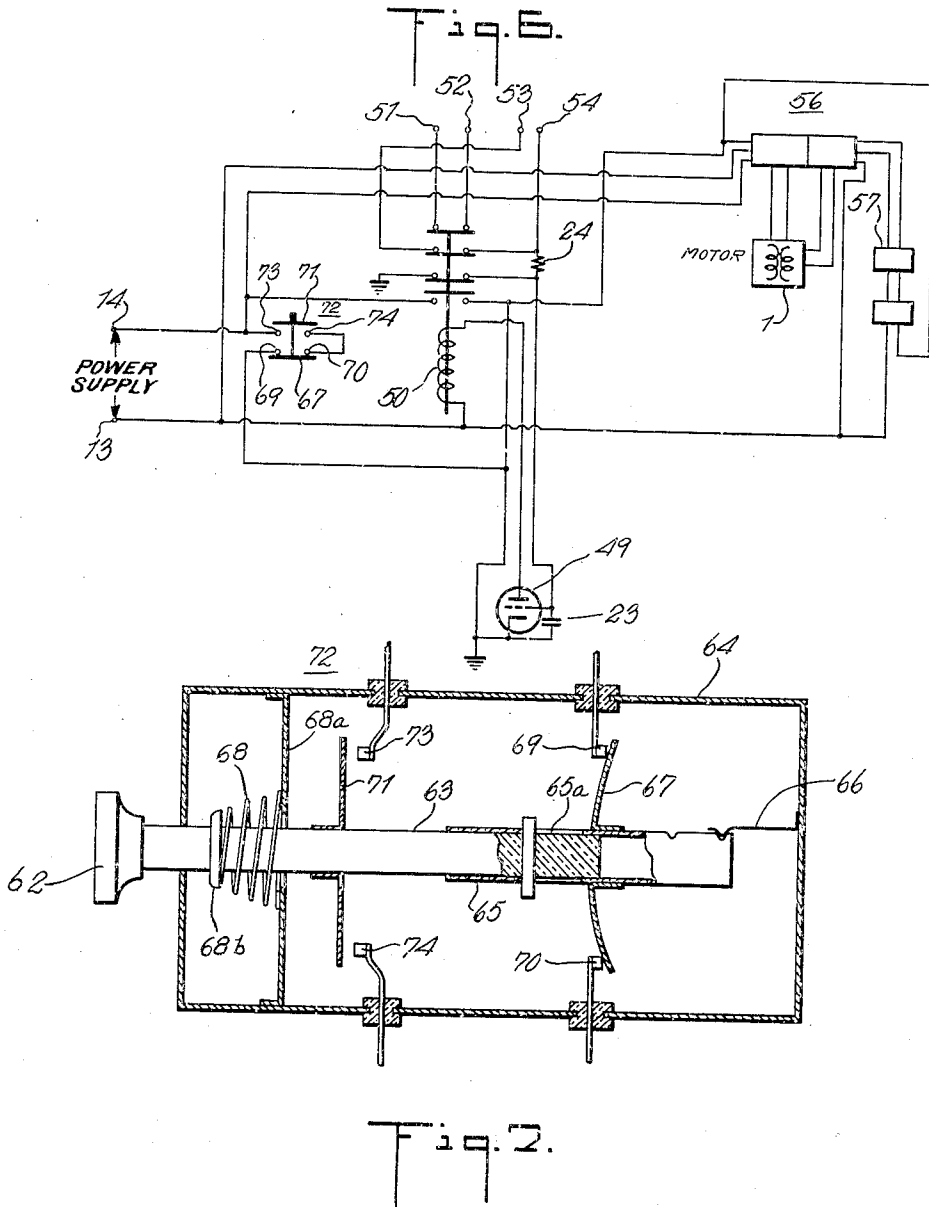
R. F. KOCH

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SINGLE BUTTON TUNING CONTROL FOR RADIO SETS

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4 Sheets-Sheet 2



RICHARD F. KOCH
INVENTOR

BY *John J. Rogan*
ATTORNEY

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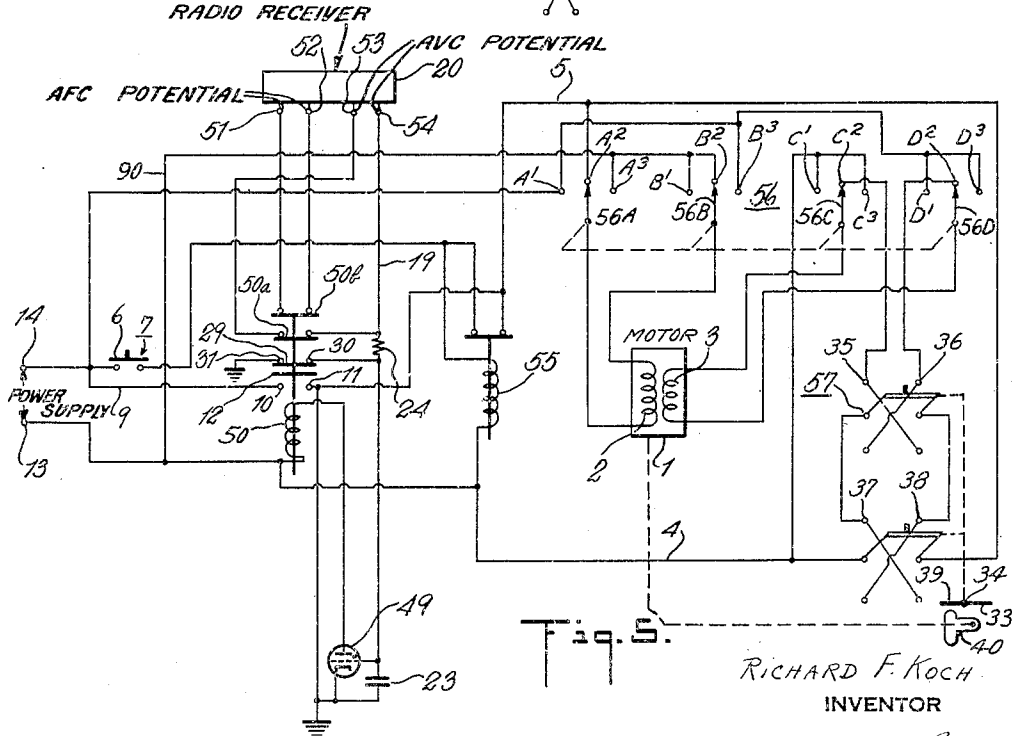
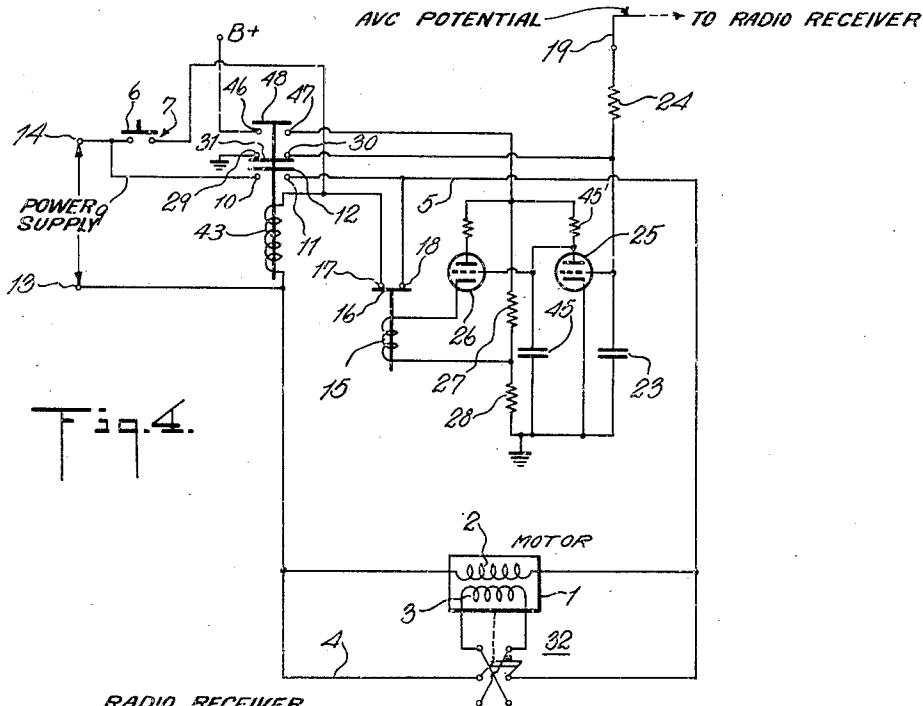
R. F. KOCH

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SINGLE BUTTON TUNING CONTROL FOR RADIO SETS

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4 Sheets-Sheet 3



RICHARD F. KOCH
INVENTOR

BY *John J. Rogan*
ATTORNEY

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R. F. KOCH

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SINGLE BUTTON TUNING CONTROL FOR RADIO SETS

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4 Sheets-Sheet 4

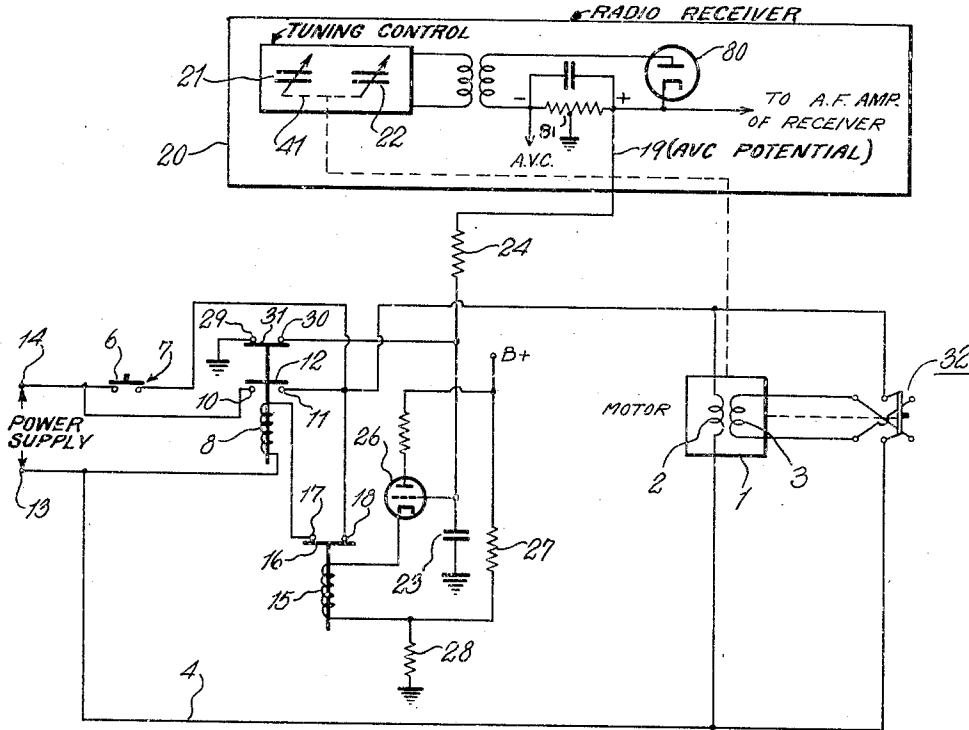


Fig. 2.

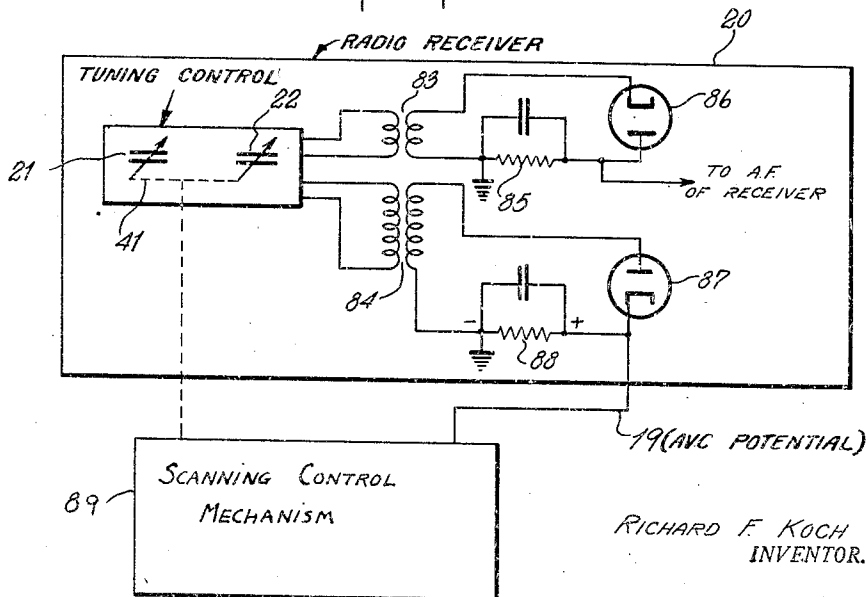


Fig. 3.

RICHARD F. KOCH
INVENTOR.

BY John J. Rogan

ATTORNEY

UNITED STATES PATENT OFFICE

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SINGLE BUTTON TUNING CONTROL FOR
RADIO SETSRichard F. Koch, Cedarhurst, N. Y., assignor of
fifty per cent to John F. Rider

Application April 4, 1946, Serial No. 659,471

15 Claims. (Cl. 250—40)

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The present invention relates to automatic tuning controls for radio apparatus, and more particularly to a novel tuning arrangement for successively tuning in a multiplicity of wavelengths within any particular frequency band.

In ordinary broadcast transmissions and in the absence of program data at any given time, it is necessary to sample the content of all programs being broadcast at that time in order to select any particular desired program. However, to tune a receiver manually through each of a plurality of station frequencies constitutes a tedious and time-consuming operation, and is accompanied by lack of assurance that all stations which the receiver is normally adapted to serve, have been sampled. Push-button tuning of the type wherein each button is associated with a particular frequency is not a complete solution of this difficulty. Generally, the number of buttons provided in the conventional type of tuning does not equal the number of stations on the air in any given band, and if the receiver is mounted in a motor vehicle or other moving medium, such tuning becomes unsatisfactory.

Accordingly, it is an object of the present invention to accomplish the tuning of a radio device through all of the available frequencies in a particular frequency band by a simple operation requiring a minimum of critical supervision and yet assuring reasonably complete coverage of the band.

This, and other objects of the invention which will become apparent as the description progresses, are attained by the provision of a single push-button and associated circuit, said circuit being adapted to repeat a cycle of operations on each successive actuation of the single push-button to cause a sharp tuning of the apparatus to the next or adjacent frequency. When this step-by-step tuning or "scanning" reaches the end of the frequency band, a novel arrangement is provided for automatically reversing the direction of the scanning.

Included in said circuit is a driving means or motor adapted to actuate the adjustable tuning means of the apparatus. This driving means is controlled during a tuning cycle by potentials produced in the usual ancillary control circuits of the apparatus, such as the AVC (i. e. automatic volume control potential) or AFC (i. e. automatic frequency control potential). The fact that such controls have different potentials when the apparatus is in an untuned condition than when it is tuned, is taken advantage of according to the invention so that the driving means is actuated

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when the apparatus is untuned and stops when a sharp tuning is accomplished.

A feature of the invention is means for delaying the application of the control potentials to the scanning motor, in such a manner that at the beginning of each tuning cycle the AVC or other control potentials are not applied to the motor circuit until a delay has occurred of sufficient duration to prevent the retaining action of such potentials from affecting the tuning to a new wavelength.

The various novel features of the invention will be better understood by reference to the accompanying drawing, in which,

Fig. 1 illustrates schematically one form of the invention, wherein AVC potentials are utilized to control the tuning.

Fig. 2 shows a reversing switch which may be used in the circuit of Fig. 1.

Figs. 3 and 4 show further modifications of the circuit of Fig. 1.

Fig. 5 illustrates schematically another form of the invention, wherein both AVC and AFC potentials are employed to control the tuning.

Fig. 6 is a modification of the circuit arrangement of Fig. 5, wherein one relay is eliminated by a novel construction of the push-button; and

Fig. 7 shows the push-button assembly adapted for use in the arrangements of Figs. 3 and 6.

Figs. 8 and 9 show schematically two alternative methods of deriving the scanning control voltage from a radio receiver set.

In accordance with the invention, the scanner has but a single push-button, but by means of this one control any station may be tuned in, within the frequency and sensitivity range of the radio receiver of which the scanner is a part. When the radio receiver is first turned on, it may not be tuned to any station, or it may be tuned to an undesired station. Pressing the button of the scanner will cause the scanner to retune the set to the nearest station above or below the first frequency setting. If this station should be undesired, pressing the button again will select the next station, and so on. When the end of the band is reached, the scanner automatically reverses its direction, and will select stations one by one as its button is pressed, until it reaches the other end of the band and reverses again. In this manner all the stations in the band (within range of the set) can be tuned in by means of a single extremely simple operation.

Referring to Fig. 1, there is shown a motor 1 which is adapted to serve as the driving means for the adjustable tuning members such as those

of a radio receiver. Motor 1 may be of any well-known type having for example a field winding 2 and a reversing armature winding 3. Windings 2 and 3 of the motor are connected to a suitable A. C. or D. C. potential supply by conductors 4 and 5 and by contact arm 6 of push-button 7 when the latter is depressed. Depression of push-button 7 energizes relay 8 which then closes a parallel circuit over conductor 9, fixed contacts 10, 11, and armature 12 of relay 8, conductor 5, winding 2, to conductor 4. Conductors 4 and 9 are connected to A. C. or D. C. terminals 13, 14. This circuit continues closed when the button 7 is released to its initial position, so that it is not necessary to keep the button depressed during the entire tuning operation.

This last-mentioned circuit continues to supply power to the motor until it is broken by deenergization of relay 8, at which time the armature 12 thereof is disengaged from contacts 10, 11. Deenergization of relay 8 occurs in response to the operation of relay 15 which at its armature 16 and contacts 17 and 18 controls the operating and locking circuits of relay 8.

Relay 15 is controlled by the potentials over conductor 19 which carries a portion of the AVC (automatic volume control) or similar potentials from the radio receiver 20, the tuning controls of which are schematically represented at 21, 22. Although variable condensers are shown, other variable tuning elements may be used. When a new station is tuned in, the AVC voltage increases rapidly in the negative direction in the well-known manner, and charges condenser 23 through resistor 24. Also included in the control circuit of relay 15 is a first discharge tube 25, the control grid of which is excited negatively by this rapidly increasing AVC voltage; and a second discharge tube 26, the control grid of which becomes more positive than its quiescent value under these conditions so as to overcome the cathode bias produced on the cathode of tube 26 by voltage divider and resistors 27, 28, thus allowing current to flow through the winding of relay 15. In response to this current, relay 15 opens the contacts 17, 18, and relay 8 is deenergized thus breaking the motor power circuit and stopping the motor.

When the contacts 10, 11, of relay 8 are opened, condenser 23 is shorted to ground through contacts 29, 30 and armature 31, thus allowing the discharge tube control circuit to assume its quiescent condition, whereupon the contacts 17, 18, of relay 15 are again closed, and the tuner or scanner is ready for a new cycle.

The action of the control circuit is delayed so as to permit a tuning cycle to commence, by delaying the action of the AVC potential. When the scanning cycle starts, the AVC voltage over conductor 19 is highly negative, assuming of course that the receiver is initially tuned to a station, and the grid of tube 25 will start to go negative. However, because of the fact that the AVC voltage is in a condition of transition from negative to positive when the receiver is being detuned, the grid of tube 25 goes only very slightly negative and then swings in the positive direction, during detuning, so that relay 15 does not release until a new station is tuned in.

A switch 32 is connected to winding 3 of the motor for reversing the direction of tuning when the end of a band has been reached. Fig. 2 shows this switch in greater detail. Arm 33 is pivoted at 34 and is provided at each end with dual spaced contacts 35a, 36a, 37a, 38a, adapted to engage cooperating contacts 35, 36, 37, 38 lead-

ing to winding 3. Arm 33 is caused to oscillate on its pivot 34 by pressure imparted by head 39 mounted on arm 40 which is mounted so as to be moved as a unit with the movable shaft 41 of the tuning elements 21, 22. Elements 21, 22, are adapted to tune through a complete frequency band and their drive can be angularly moved through an arc of 180° or any other desired angle corresponding to the band to be covered. It is to be understood of course that the particular structure of this switch is shown merely by way of example.

Fig. 3 shows a simplified form of the circuit of Fig. 1. Instead of using relays, a grid-controlled tube 42 is connected in series with windings 2 and 3 of motor 1. The AVC potentials applied over conductor 19 to the grid of tube 42 render the latter conductive to plate current during a tuning operation, and non-conducting when a tuned condition is arrived at. Preferably, although not necessarily, tube 42 is of the gas-filled or Thyatron type. When the tube 42 is conducting, current flows through the motor circuit and drives the motor. When a tuned condition has been reached, the tube becomes non-conducting, stopping the flow of current to the motor. There is also provided a delay circuit comprising resistor 24 and condenser 23 as in Fig. 1. The reversing switch 32 is also similar to switch 32 of Fig. 1. However, the main tuning push-button switch 72 (Fig. 7) is provided with two sets of contacts 69-70 and 73-74. Associated with contacts 69 and 70 is the contact armature 67, and associated with contacts 73 and 74 is contact armature 71. The switch is so arranged that the armature 71 makes contact with 73 and 74 before armature 67 breaks contact with 69 and 70. However, on the return-to-normal of the switch, the armature 67 closes with contacts 69 and 70 after armature 71 breaks with contacts 73, 74. The normal position of the switch is shown in Figs. 3, 6 and 7. When button 62, which actuates the switch, is depressed, the grid of tube 42 is momentarily grounded, thus rendering tube 42 conductive as to plate current and closing the windings 2 and 3 of the motor. When the button is completely depressed, the contacts 69 and 70 are opened but the tube 42 remains conductive. This condition continues until the negative AVC potential is applied over conductor 19 as above described to cut off the plate current of tube 42.

In the modification of Fig. 4, which is similar to Fig. 1, a delay device comprising condenser 45 and resistance 45' is employed to prevent the immediate application of B-plus potential to the tube 25, to avoid a premature opening of relay 15. It will be noted that relay 43 (corresponding to relay 8 of Fig. 1) has an extra contact set 46, 47, 48, which controls the B-plus supply. This arrangement eliminates the drain of the tubes 25 and 26 on the B-plus supply during quiescent periods. Parts of Fig. 4 which function the same as those of Fig. 1, bear the same designation numerals. In this embodiment, the elements 23 and 24 may be omitted.

Fig. 5 illustrates several refinements and the use of a single grid-controlled tube 49 to replace tubes 25 and 26 of Fig. 1. The grid circuit of tube 49 is the same in principle as that of tube 25 of Fig. 1. When the grid of tube 49 becomes sufficiently negative under control of the AVC voltage over conductor 19, the grid will gain control of the tube to interrupt the current through the winding of relay 50, thus deenergizing that relay. Tube 49 may be any suitable type of elec-

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tron tube, either of the gaseous or high vacuum type. However, a hard tube will not cut off as sharply here as a gas tube.

The control circuit of Fig. 5 derives control potentials from the AVC and AFC circuits of the radio receiver 20 which may be of the frequency modulation type. Terminal 51 is connected to the reactance (frequency-control) tubes of the receiver, and terminal 52 is connected to the AFC discriminator. Terminals 53 and 54 are connected to the AVC controlled tubes and the AVC rectifier, respectively, in the receiver. However, the AVC and AFC circuits are disconnected at the armatures 50a and 50b during tuning of the scanner to increase the accuracy of the circuit's operation. Relay 55, which is not essential to the operation of the circuit of Fig. 5, may prevent the tuner from passing a station if the button is held down too long. With this relay in the circuit the button must be released and repressed after each new station is reached, if still another station is desired. This requires that relay 50 (corresponding to relay 8 of Fig. 1) operate more rapidly than relay 55.

In certain cases it may be desirable to have the receiver tuned continuously over its frequency band without automatically stopping it at any particular station. The push button 6 and its associated mechanism as above described controls the automatic stopping of the tuning mechanism of the receiver at each successive station as it is received. Accordingly, the arrangement shown in Fig. 5 not only permits the automatic stopping but also permits the continuous scanning of the received spectrum. For this purpose, there is provided a four-gang switch 56 comprising four switch arms 56A, 56B, 56C, 56D. Each contact arm has associated therewith a set of three fixed contacts A¹, A², A³; B¹, B², B³; C¹, C², C³; D¹, D², D³. When the contact arms are in engagement with the respective contacts A², B², C², D², the system operates as above described to automatically stop the tuning mechanism of the receiver as each successive station is reached. Should it be desired to continuously scan the received frequency band in one direction without the above-described automatic stopping, the switch 56 may be operated to move the contact arms 56A, 56B, 56C, 56D, on to their corresponding contacts A¹, B¹, C¹, D¹. In this position the power circuit is completed directly from the terminal 13 via conductor 4, contact C¹, arm 56C, motor winding 3, arm 56D, contact D¹, and thence directly to the power supply terminal 14. A circuit is also closed from the power supply terminal 13, conductor 90, contact B¹, arm 56B, motor winding 2, arm 56A, contact A¹, to supply terminal 14. The motor will therefore be rotated in the desired direction. If the scanning of the band is to be in the opposite direction the switch 56 is operated to close the arms 56A, 56B, 56C, 56D, on their respective contacts A³, B³, C³, D³. It will be observed that when the automatic stopping is desired, switch 56 is closed on its middle contacts A², B², C², D², and the end limit switch 57 which may be identical with switch 32 (Fig. 2) comes into play.

Fig. 6 illustrates a modification of the circuit shown in Fig. 5, wherein the push-button switch assembly 72, having the extra set of contacts 69, 70, and contact arm 67, performs the function of relay 55 of Fig. 5, thus eliminating the need for such relay.

A detailed view of a push-button assembly which may be used in the circuit of Fig. 6 is

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shown in Fig. 7. This push-button switch assembly is so constructed that the make contacts will close before the break contacts open, on pressing the button 62, and when the button is released the break contacts will remain open until after the make contacts have opened. A shaft 63 of insulating material is mounted for linear movement in a suitable casing 64. A protruding end of said shaft 63 is provided with the button 62. A portion of said shaft within casing 64 is surrounded by a cylindrical member 65, in a pin and slot engagement to permit a small relative motion of shaft 63 relative to member 65. However, when shaft 63 is depressed a distance greater than the length of the slot, said shaft carries member 65 with it. A detent spring 66 is adapted to engage suitable notches on member 65 to permit said member to stay-put either in a depressed or a released condition. When button 62 is released, shaft 63 first moves to the left under control of a compression spring 68 which is located between the fixed partition 68a and the collar 68b, the latter being attached to the shaft 63. The partition 68a is fastened interiorly to the housing 64 in any suitable manner and has a central enlarged opening through which the shaft 63 can freely pass a short distance independently of member 65, because of the pin and slot engagement, while spring 66 holds member 65 in the depressed condition. After shaft 63 has moved to the left the length of the slot, it pulls member 65 with said shaft as shown in Fig. 7, and shaft 63 and member 65 thus return to their original positions. Contact arm 67 is mounted on member 65 for engagement with contacts 69, 70, respectively, the latter contacts being appropriately supported within casing 64. The contact arm 67 may be flexed against the contacts 69, 70, when the button 62 is in a released position as shown in Fig. 7, at which time electrical contact exists between arm 67, and contacts 69, 70, whereas contact arm 71 is not in contact with the associated contacts 73, 74. However, a depression of button 62 results in contact between said arm 71, and contacts 73, 74, while contact continues to be maintained between arm 67, and contacts 69, 70. The arm 67 and contacts 69, 70, remain in electrical connection until the shaft 63 has been displaced linearly a distance greater than the length of the slot in member 65, after which said member will be carried along with shaft 63. At such time, further linear movement of shaft 63 will result in a break between arm 67, and contacts 69, 70. In this illustration the contacts 73, 74, should be spring-mounted to permit shaft 63 to continue its linear movement after contact between arm 71, and contacts 73, 74 is made, and until the contact between arm 67 and contacts 69, 70, is broken.

While in the foregoing, reference has been made to an AVC potential of the receiver for controlling the scanning cycle, it will be understood that any other equivalent voltage normally present in a radio receiver, the magnitude of which is proportional to the accuracy of tuning to a received wave length, may be employed. Furthermore, it is not necessary that this scanning control voltage be a negative voltage. For example, there is shown in Fig. 8 a system wherein the radio receiver 20 has an intermediate frequency stage, the usual detector 80 and a detector load resistance 81. The resistance 81 is grounded at its midpoint and the AVC lead is taken off the negative end in the usual way. The positive

end of this resistor 81 is then connected to scanning control conductor 19 and thence through resistor 24 as described above in connection with Fig. 1 for example. Since this control voltage over conductor 19 is a positive voltage, it is not necessary to use two tubes such as tubes 25 and 26. The tube 25 may therefore be deleted and the scanning control voltage over conductor 19 may be applied to the control grid of tube 26, it being understood that the resistance 24 and condenser 23 provide the necessary delay in the action of this scanning control voltage so as to permit the beginning of operation of the motor 1 when the button 6 is depressed. The remaining elements of Fig. 8 which bear the same designation numerals as the corresponding elements of Fig. 1, function in the same manner.

Instead of using a single midtap resistor to provide the positive scanning control voltage, as shown in Fig. 9, the intermediate frequency stage of the radio receiver 20 may feed two intermediate frequency transformers 83, 84. Transformer 83 is the usual intermediate frequency transformer of the radio receiver and is relatively broadly tuned to cover the necessary side bands of the signal. The output of this intermediate frequency stage is detected in the usual detector 85 and the signals across the load resistor 85 are applied to the audio frequency portion of the receiver. The intermediate frequency transformer 84 is very sharply tuned to the intermediate frequency of the receiver and is connected to a rectifier 87 in circuit with a load resistor 88, the negative terminal of which is grounded. The positive terminal of this resistor 88 is then connected to the scanning control conductor 19 which functions therefore as described above in connection with Fig. 8. The scanning control mechanism proper is indicated schematically by the block 89 and may be identical with the corresponding control elements of Fig. 8.

While I have indicated and described several arrangements for carrying my invention into effect, it will be apparent to one skilled in the art that my invention is not thereby limited, but that modifications may be made therein without departing from the scope of my invention, as set forth in the appended claims.

What is claimed is:

1. A system for tuning radio apparatus successively to a series of wavelengths within a predetermined band, comprising a driving means in power-transfer engagement with an adjustable tuning member of the apparatus, control means for said driving means, said control means comprising a plurality of switching devices, means for actuating said switching devices, one of said means comprising a single push-button operable in connection with one of said switching devices to initiate each tuning operation, another of said means comprising an automatic control circuit, a control voltage correlated with the tuned or tuning condition of said apparatus, means for applying said voltage to said automatic control circuit and including a time delay arrangement for delaying the application of said control voltage for the purpose described, said control circuit being adapted to actuate another of said switching devices in response to the magnitude of said voltage during a tuned condition to stop said driving means, and still another of said means operable in connection with still another of said switching devices for reversing the direction of travel of said adjustable tuning member on reaching each limit of said band.

2. A tuning arrangement for a radio receiver comprising driving means in power-transfer relation to an adjustable tuning member of said apparatus, means for limiting to one direction the travel of said adjustable tuning member through a predetermined frequency band, means for reversing the direction of said travel at both limits of said band, a single manually operable control switch, means responsive to the operation of said switch for initiating said travel of said tuning member, and means for automatically stopping said travel in response to a tuned condition, the last-mentioned means including a circuit for developing a voltage whose magnitude corresponds to the tuned and detuned condition of said receiver with respect to a received radio signal, a relay to which said voltage is applied, and a delay arrangement for delaying the application of said voltage to said relay for the purpose described.

3. A tuning arrangement for a radio apparatus comprising driving means in power-transfer relation to an adjustable tuning member of said apparatus, means for limiting to one direction the travel of said adjustable tuning member through a predetermined frequency band, means for reversing the direction of said travel at both limits of said band, said means comprising at least one reversing switch, means for actuating said reversing switch, the last-mentioned means comprising a member mounted for travel with said adjustable tuning member and adapted to engage said switch at the limits of travel across said frequency band, means for initiating said travel of said tuning member, and means for automatically stopping said travel in response to a tuned condition, the last-mentioned means including a network for developing a voltage whose magnitude corresponds to the tuned and detuned condition of said receiver with respect to a received radio signal, a relay to which said voltage is applied, and a delay arrangement for delaying the application of said voltage to said relay for the purpose described.

4. A tuning arrangement for a radio receiver and the like, comprising driving means in power-transfer relation to an adjustable tuning member of the receiver, means for limiting to one direction the travel of said adjustable tuning member through a predetermined frequency band, means for reversing the direction of said travel at both limits of said band, means for initiating said travel of said tuning member, the last-mentioned means comprising a single control member, a holding means for continuing said travel when said control member is released, and means for stopping said travel in response to tuning conditions, the last-mentioned means including a network for developing a voltage whose magnitude corresponds to the tuned and detuned condition of said receiver with respect to a received radio signal, a relay to which said voltage is applied, and a delay arrangement for delaying the application of said voltage to said relay for the purpose described.

5. A tuning system for a radio receiver and the like, comprising driving means in power-transfer relation to an adjustable tuning member of the receiver, means for limiting to one direction the travel of said adjustable tuning member through a predetermined frequency band, means for reversing the direction of said travel at both limits of said band, means for initiating said travel of said tuning member, and means for stopping said travel in response to a tuned condition, the last-

named means comprising a switching device adapted to stop said driving means when opened, a control voltage for said switching device, said voltage varying in magnitude in accordance with the extent of de-tuning of said receiver, a control circuit for supplying current to said switching device to stop said tuning member when said control voltage is of a magnitude corresponding to maximum sharpness of tuning of said receiver, said control circuit including a time delay network for the purpose described.

6. A tuning system for a radio receiver and the like, comprising driving means in power-transfer relation to an adjustable tuning member of said receiver, means for limiting to one direction the travel of said adjustable tuning member through a predetermined frequency band, means for automatically reversing the direction of said travel at both limits of said band, means for manually initiating said travel of said tuning member, and means for automatically stopping said travel in response to tuned conditions of said tuning member corresponding to successive frequencies to be tuned-in, the last-mentioned means including a network for developing a voltage whose magnitude corresponds to the tuned and detuned condition of said receiver with respect to a received radio signal, a relay to which said voltage is applied, and a delay arrangement for delaying the application of said voltage to said relay for the purpose described.

7. In a radio receiver, means for tuning said receiver in sequence to all frequencies within normal range of the receiver and within a predetermined frequency band, means for limiting to one direction the tuning across said band, means for automatically reversing the direction of said tuning across said band at both sides of said band, means for manually initiating the tuning of the receiver to a station frequency succeeding that to which it had been previously tuned, and means for automatically stopping the tuning means when the receiver is tuned to said adjacent succeeding frequency, the last-mentioned means including a network for developing a voltage whose magnitude corresponds to the tuned and detuned condition of said receiver with respect to a received radio signal, a relay to which said voltage is applied, and a delay arrangement for delaying the application of said voltage to said relay for the purpose described.

8. A tuning system for a radio receiver comprising a driving means in power-transfer relation to an adjustable tuning member, a power supply source for said driving means, means for limiting to one direction the travel of said adjustable tuning member across a predetermined frequency band, means for reversing the direction of said travel at both side limits of said band, manually operable switch means for initiating said travel of said tuning member, and a control circuit for said driving means for controlling said travel in response to tuning conditions, a current supply for said control circuit, said current supply varying in magnitude in accordance with the sharpness of tuning to a station frequency, means effective after operation of said manually operable switch means and substantially independent of the duration of operation of said switch for delaying the application of said current supply to said control circuit to permit release from a previously tuned condition, a switching device adapted to be actuated by said control circuit for opening and closing the power supply to said driving means, cir-

cuit connections to maintain said switching device closed during an untuned condition of said tuning member to actuate said driving means, and circuit connections controlled by said delaying means to open said switching device to stop said driving means when a tuned condition is reached.

9. Apparatus for scanning the frequency spectrum to which a radio receiver or the like can be tuned, comprising an adjustable tuning element in the receiver, motive means for moving said tuning element, a single manually operable switch for causing the operation of said motive means when the receiver is to be tuned from one frequency to a succeeding frequency, a first circuit controller initially operated by said switch, a second circuit controller for controlling the first controller to maintain said first controller operated independently of said switch, and means including said second controller for automatically stopping said motive means at said succeeding frequency under control of an in-tune voltage derived from said receiver independently of the previous operation of said switch.

10. Apparatus according to claim 9 in which said single control member is in the form of a push-button which is common to all the frequencies to which the receiver is to be tuned, and the means for automatically stopping said motive means includes at least one grid-controlled electron tube whose plate current controls the power supply to said motive means, said tube having a connection from its control grid to the source of said in-tune voltage whereby the plate current of said tube corresponding to an in-tune condition of the receiver causes said power supply to be disconnected from said motive means, and the means for automatically stopping said motive means also includes a time delay network connected to the grid of said electron tube and to which said in-tune voltage is applied.

11. Apparatus according to claim 2 in which said means for automatically stopping said travel includes a pair of grid-controlled tubes one of which has its control grid supplied with said in-tune voltage, the other of said tubes being plate current conductive when the receiver is tuned to a received frequency subsequent to the operation of said single control switch, means responsive to a succeeding operation of said single control switch to change the bias on said second tube to cause plate current cutoff, and means responsive to said plate current to prepare a stopping circuit for said driving means when said receiver is tuned to the succeeding frequency.

12. Apparatus for scanning the frequency spectrum to which a radio receiver or the like can be tuned, comprising a motor for driving a tuning element of the receiver, a normally open power circuit for said motor, a single operating key having normally open contacts in said power circuit, a relay having normally open contacts in said power circuit, a grid-controlled electron tube normally biased to permit the flow of plate current when said key is operated and having its plate current controlling the operation of said relay, means for producing a voltage controlled by the tuned and untuned conditions of said receiver for controlling said plate current, and a time delay network to which said voltage is applied for the purpose described.

13. Apparatus according to claim 12 in which a second relay is provided having normally closed contacts in said power circuit, said second relay having an energizing circuit completed through

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the contacts of the operating key, said second relay being arranged for energization in response to the operation of said key to cause the control of said power circuit to be independent of said key, after the initial operation of said key, during each successive tuning operation of said apparatus.

14. Apparatus for scanning the received frequencies to which a radio receiver or the like can be tuned, comprising a motor for driving a tuning element of the receiver, a single key for controlling the tuning of said receiver to all the frequencies in said spectrum, a grid-controlled tube separate from the radio receiver for controlling the power circuit of said motor, said key having a first set of normally open contacts which when closed apply a momentary potential to said grid-controlled tube to cause it to continuously pass plate current independently of the operation of said key and independently of the amplitude of the received frequency to which the receiver is tuned, and a connection from the control grid of said tube to the radio receiver for applying to said control grid a negative potential correspond-

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ing to the in-tune condition of the receiver whereby the plate current of said tube is interrupted under control of said grid when the receiver is in an in-tune condition.

15. A tuning arrangement according to claim 2 in which separate switch means are provided for disabling said automatic stopping means and for causing said driving means continuously to tune the receiver through its tuning range independently of said single manually operable control switch.

RICHARD F. KOCH.

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