Nov. 24, 1936. W. D. LOUGHLIN 2,062,032

RADIO RECEIVER

Filed Sept. 29, 1933 4 Sheets-Sheet 1

Fig. 1.

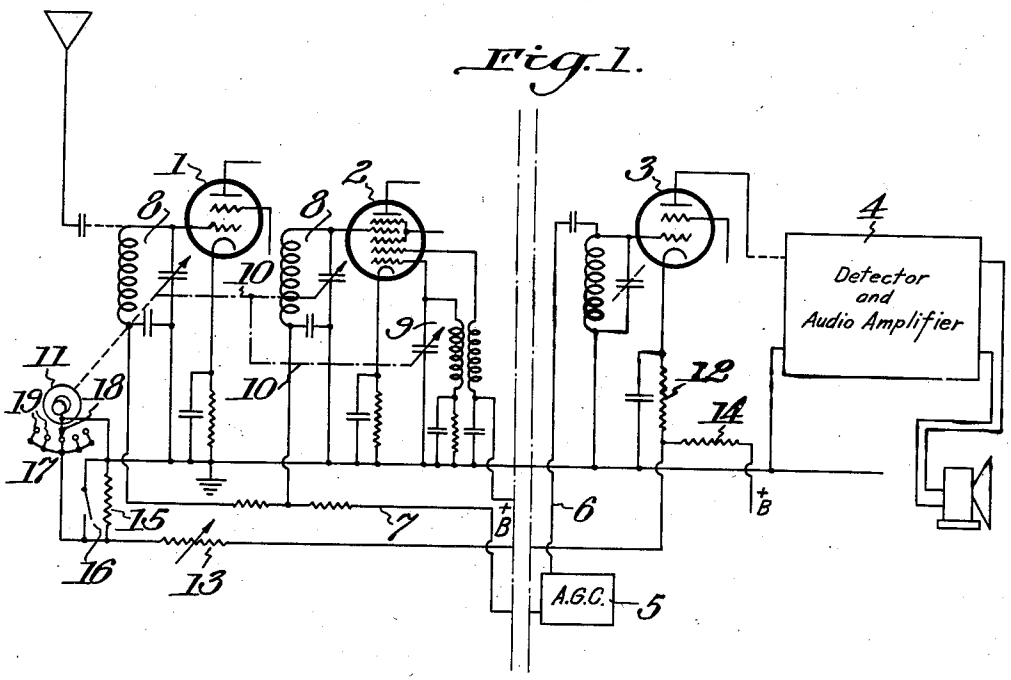


Fig. 2.

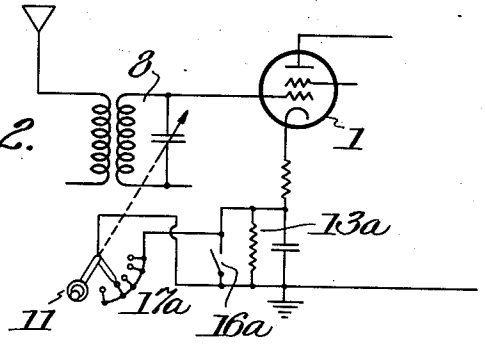
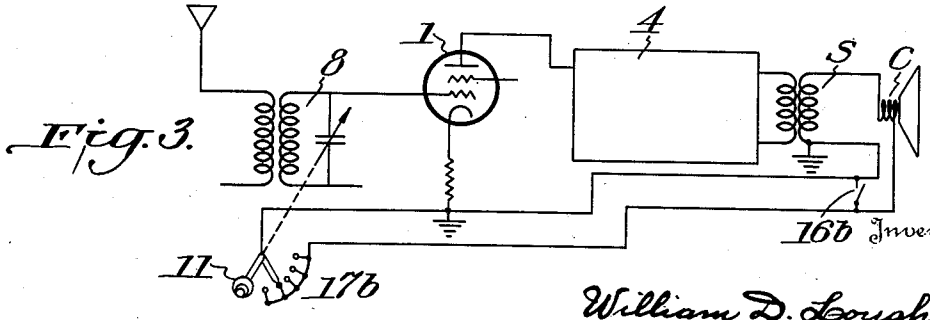


Fig. 3.



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RADIO RECEIVER

Filed Sept. 29, 1933 4 Sheets-Sheet 2

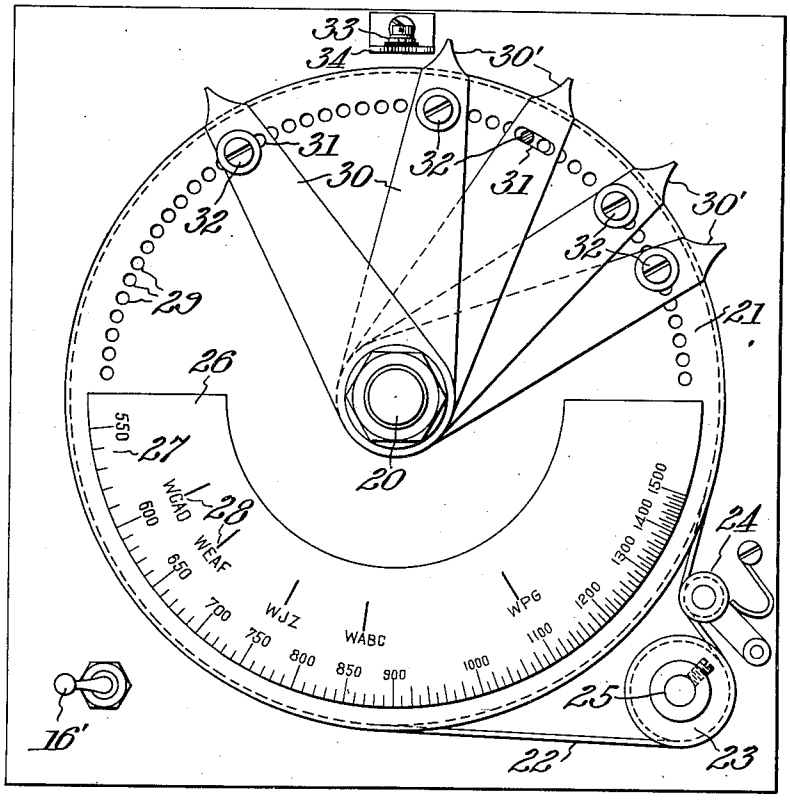


Fig. 4.

Fig. 5.

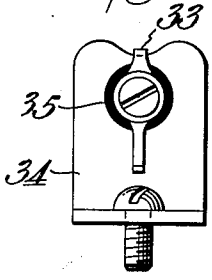
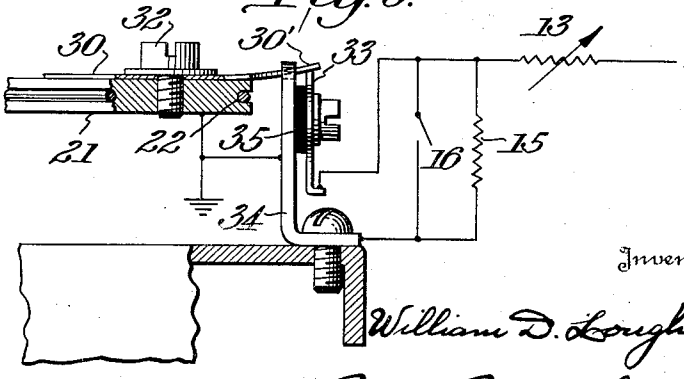


Fig. 6.



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Nov. 24, 1936. W. D. LOUGHLIN 2,062,032

RADIO RECEIVER

Filed Sept. 29, 1933 4 Sheets-Sheet 3

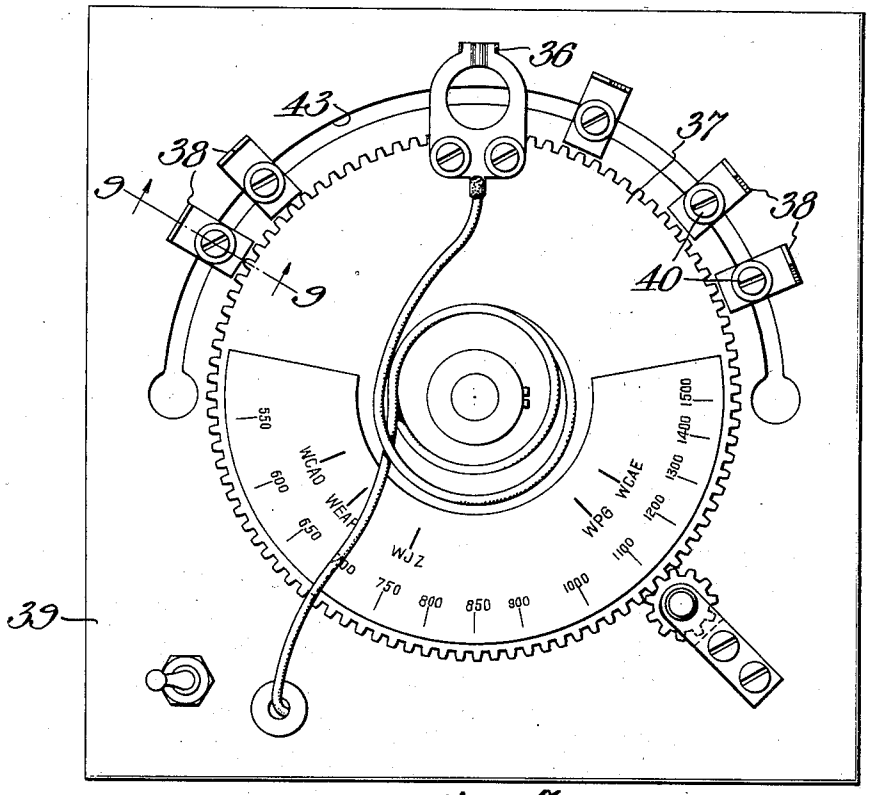


Fig. 7.

Fig. 8.

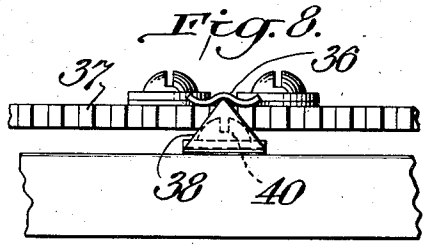


Fig. 9.

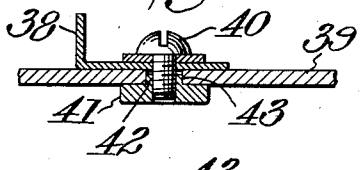
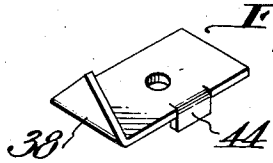


Fig. 10.

Fig. 11.



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RADIO RECEIVER

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Fig. 12.

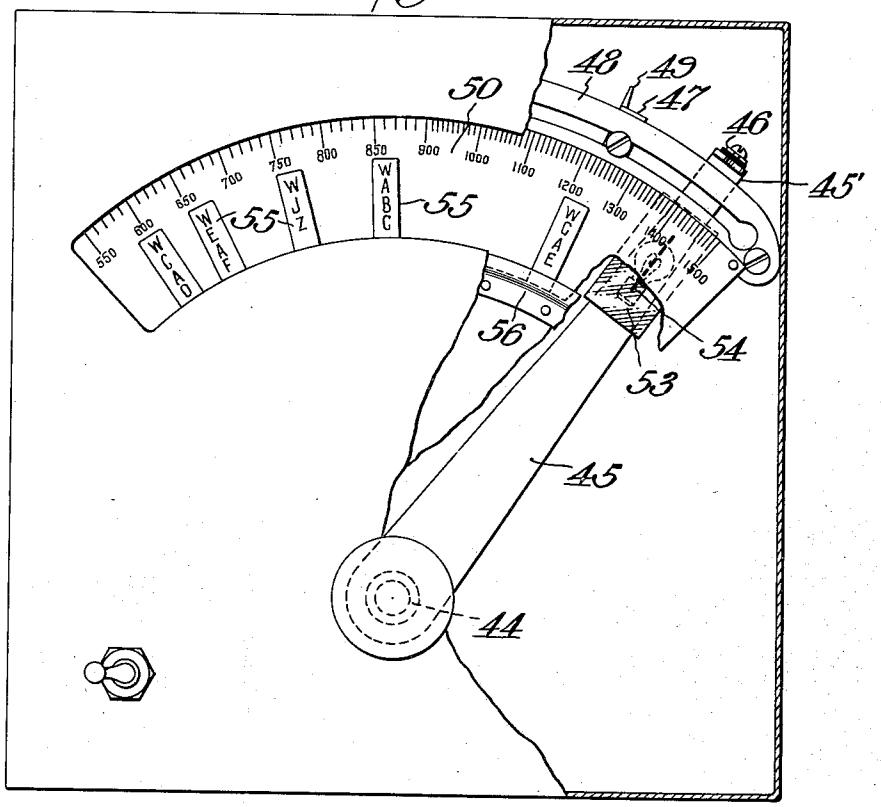

Fig. 13.

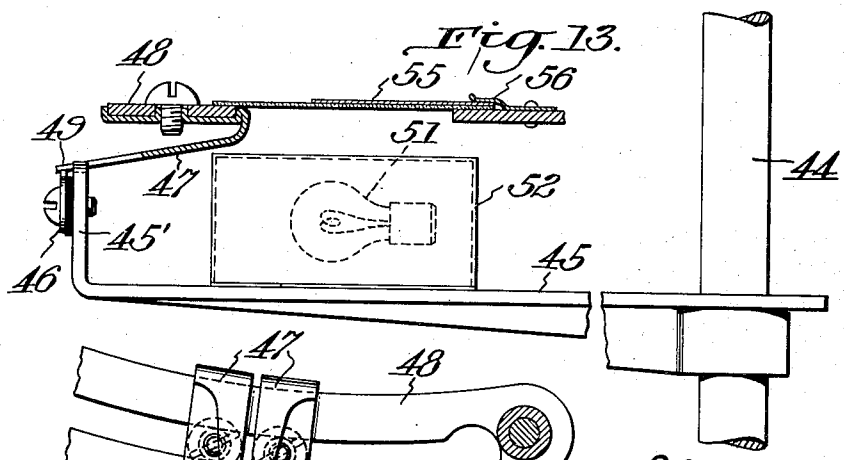

Fig. 14.

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Patented Nov. 24, 1936

2,062,032

UNITED STATES PATENT OFFICE

2,062,032

RADIO RECEIVER

William D. Loughlin, Mountain Lakes, N. J., assignor, by mesne assignments, to Radio Corporation of America, New York, N. Y., a corporation of Delaware

Application September 29, 1933, Serial No. 691,541

10 Claims. (Cl. 250—20)

This invention relates to radio receivers and more particularly to novel circuit arrangements and constructions for facilitating the tuning and improving the fidelity of reproduction.

The high sensitivity of modern radio receivers makes it possible to receive strong signals from local or distant stations when the receiver is tuned to a frequency which may differ materially from the frequency of the desired signal. In the case of automatic gain control receivers, it frequently happens that the listener will not tune to resonance by means of the tuning meter, but will leave the controls in any position which brings in the desired station. A failure to tune to resonance results in reproduction which is noisy, due to the unnecessarily high gain, and is distorted by the cutting of the side bands of the carrier. Another characteristic of modern automatic gain control receivers is the disagreeable phenomenon known as "inter-carrier noise" which results from the high amplification of incoming radio impulses produced when the adjustable amplifier is not tuned to a carrier of sufficient strength to operate the automatic gain control. A similar manifestation is the unpleasant "blasting" and disturbance which may accompany the receiver tuning between widely spaced reception channels, caused by the rapid passage through the resonance points of a series of strong unwanted transmissions.

Various mechanical systems have been proposed for setting the tuning control to any one of a plurality of pre-selected positions by the aid of keys or push buttons. Such systems are comparatively expensive and are difficult to maintain in exact adjustment. For the suppression of "inter-channel noise", i. e., the disturbance produced when tuning through frequencies in which there is no transmission, various special tubes and circuits have been proposed, all of which require the use of additional parts and are only partially effective in their action. No expedient has been proposed for prevention of "blasting" by unwanted signals during the tuning process, except the clumsy expedient of a manually operated muting switch operated independently of the tuning control by means of a push-button on the front of the receiver. This device, although widely used, affords no assistance in locating a wanted signal, in fact its use is confusing to the operator and actually makes tuning more difficult, since the operator must simultaneously adjust both the tuning control and the muting switch, with a high degree of manual coordination, to produce satisfactory results.

An object of the present invention is to provide a radio receiver having an improved tuning system that insures quiet operation and high fidelity.

An object of the invention is to provide a radio receiver which presents simultaneously the three following desirable characteristics: (1) simplified tuning to a substantial number of predetermined stations; (2) elimination of that noise output which is caused by the absence of radio carriers at tuning points between those of the desired stations; (3) elimination of that noise output which is caused by the presence of undesired modulated radio carriers at all tuning points between those of the desired stations.

A further object is to provide a receiver of the customary single-control type, and an electrical switch system associated with the control element, the receiver circuits being so designed that the audio output is substantially or completely suppressed for all settings of the control element which do not correspond to substantially exact tuning for some one of a plurality of selected stations. More particularly, an object is to provide a receiver which is normally biased to suppress transmission, a switch which may be manually operated to remove the high bias that blocks transmission, and a tuning control which includes switch mechanism for automatically removing the high bias when the control is positioned to adjust the receiver to exact resonance with a selected carrier channel.

These and other objects and advantages of the invention will be apparent from the following specification when taken with the accompanying drawings, in which:

Figs. 1, 2, and 3 are fragmentary circuit diagrams illustrating typical embodiments of the invention;

Fig. 4 is a plan view of a tuning dial and muting switch system suitable for use in systems such as shown in Figs. 1–3;

Fig. 5 is an end elevation of the stationary contact of the automatic switch;

Fig. 6 is a side elevation, with parts in section, of the switch; the circuit elements associated therewith being shown diagrammatically;

Fig. 7 is a plan view of another form of tuning dial and muting switch system;

Fig. 8 is a fragmentary end elevation of the switch of Fig. 7;

Fig. 9 is a section on line 9—9 of Fig. 7;

Figs. 10 and 11 are perspective views of parts of the adjustable contacts;

Fig. 12 is a plan view of a further embodiment of the invention;

Fig. 13 is a fragmentary view, with parts in transverse section, of the automatic muting switch, dial and tuning shaft of the Fig. 12 construction; and

Fig. 14 is a bottom view illustrating a pair of adjustable contacts and a portion of their supporting member.

For purposes of illustration, the invention will be described as incorporated in a superheterodyne receiver but it is to be understood that it is useful with any type of tuned receiver or transmission system.

In the fragmentary circuit diagram, Fig. 1, the reference numeral 1 identifies the tube of a carrier wave amplifier which works into the combined detector-oscillator tube 2, the resulting beat frequency being amplified in a suitable intermediate frequency amplifier which has a final stage, including tube 3, which works into a second detector and audio amplifier 4. The receiver preferably includes an automatic gain control unit 5 which is connected in parallel with the input circuit of tube 3 by a lead 6, the rectified output of the unit 5 being returned by lead 7 to the control grids of tubes 1 and 2 to maintain an approximately constant radio voltage level at the input to tube 3.

The condenser elements of the tuned circuits 8 of tubes 1, 2, and of the oscillator network 9 are preferably sections of a gang tuning condenser or are otherwise connected, as indicated by the broken lines 10, for simultaneous adjustment by the customary single control member 11.

In accordance with this invention, the control element of a muting system is so associated with some movable member of the tuning system as to block or substantially reduce the transmission of signals from all but certain preselected stations. As shown in Fig. 1, the circuit elements for suppressing the reception from undesired stations are associated with a manual output or room level control which is described and claimed in the copending application of Paul O. Farnham, Serial No. 671,772, filed May 18, 1933. As described in that application, the room level is controlled by a manual regulation of a direct current bias applied to a radio amplifier tube having a radio input voltage that is maintained approximately constant by an automatic gain control system.

The cathode circuit of the radio amplifier 3 includes a fixed bias resistor 12 of such value that, when connected directly between the cathode and ground, the tube is self-biased for its normal or maximum gain. As described in the said application, a manual control of the gain is provided by connecting an adjustable resistance 13 between the resistor 12 and ground, and connecting the junction of resistances 12, 13 to a source of direct current voltage, indicated as +B, through a high resistance 14. When resistance 13 is set at zero, the control grid bias is determined solely by the fixed resistor 12 but, as the effective value of resistance 13 is increased, the bias is increased negatively by the potential drop established across the resistance 13 by current flow from the source +B, thus reducing the stage gain.

In accordance with this invention, the control resistance 13 is not connected directly to ground, but is connected through a resistance 15 that is shunted by a manual muting switch 16 and by the automatic switch 17 that is associated with the tuning control. The value of the resistance 15 is so chosen that for zero adjustment of the manual control resistance 13, the potential drop across resistance 15 establishes such a high negative bias on tube 3 that the transmission through tube 3 is blocked or, if desired, is reduced to a comparatively low level.

When the muting switch 16 is closed, the receiver functions in the usual manner and carrier wave signals will be received throughout the entire range of adjustment of the tuning control. When switch 16 is opened, signals wil be reproduced only when the contact 18 that moves with the tuning control 11 engages some one of the contacts 19 to short circuit the biasing resistance 15. By adjusting the contacts 19 to correspond to the tuning adjustments for those local stations or distant stations which consistently furnish a strong carrier wave signal at the receiver, the reception of signals will be restricted to the preselected stations and the receiver may be tuned from one selected station to another without disturbance from intervening stations which provide low receiver input voltages. Furthermore, good quality of reproduction may be insured by so designing the switch 17 that the contacts open when the tuning controls are moved but slightly from those adjustments which correspond to an accurate tuning to resonance at the frequency of one of the selected stations.

It will be apparent that the switch system could control another portion of the receiver circuit to effect a similar muting action, and that the particular muting circuit employed will determine whether the switch system should be open or closed to permit reception. One advantage of the described arrangement is that the control of transmission by a direct current bias simplifies the circuit construction when the invention is applied to remote control tuning systems.

As shown in Fig. 2, the muting system may be associated with one or more of the radio frequency amplifier tubes 1 by including relatively high resistance 13*a* in the cathode circuit of the controlled tube or tubes. The resistance 13*a* may be short-circuited by the manually controlled switch 16*a* or by the automatic switch 17*b*. When switch 16*a* is open, the tube or tubes 1 are given such a high negative bias by the potential drop across resistance 13*a* that there is little or no transmission of signals by the radio amplifier. When the tuning control is adjusted to receive signals from a preselected favorite station, the biasing resistance is shorted by switch 17*a*, thus restoring normal transmission through the receiver.

As shown schematically in Fig. 3, the muting system is not applied to the radio circuits of the receiver but to the loud speaker or reproducer. It is customary to connect the operating coil C of the loud speaker directly across the secondary S of the output transformer and to ground the low potential terminal of the secondary. In accordance with the invention, the low potential terminal of the coil C is not returned directly to the secondary but may be connected to the same either through the manual switch 16*b* or through the automatic switch 17*b*.

One switch construction that has proved satisfactory is illustrated in Fig. 4, and it will be noted that this particular construction reverses the relative arrangement of the contact arm 18 and adjustable contacts 19 that is shown diagrammatically in Fig. 1. The shaft 20, which may be the shaft of the gang tuning condenser or may be suitably connected thereto, carries a disk 21 that has a peripheral groove for receiving a cable 22 that passes over a small driving pulley 23 and a

tensioning puley 24. The shaft 25 to which the pulley 23 is secured extends to the exterior of the casing (not shown) of the receiver cabinet or remote control unit to receive an appropriate knob for the manual adjustment of the shaft 20. A sector is cut from the disk 21 to expose a translucent dial 26 which carries a printed scale 27 of kilocycle graduations and upon which a set of markings 28 may be penciled to identify the tuning adjustments of the preselected stations. The dial 26 extends along about one-half of the circumference of the disk 21, and the remainder of the disk is provided with a sem-annular series of tapped openings 29 for receiving the screws by which the adjustable contacts 30 may be secured to the disk. The contacts 30 take the form of radial arms or strips that are angularly adjustable about the shaft 20 and have elonagted slots 31 of such length, with respect to the spacing of adjacent tapped openings 29, that the contact strip may be clamped in any desired position of angular adjustment by screws 32. The single contact 33 that cooperates with the several contact strips is mounted upon a supporting strap 34 but is insulated therefrom by a washer 35. The strap 34 is positioned adjacent the edge of the disk 21 and parallel to the shaft 20, and the contact 33 is preferably located on the side of strap 34 which is away from the disk. The upper end of the contact 33 projects slightly beyond the plane of the disk and is in radial alinement with a guide depression formed at the central portion of the end of the strap 34. The edges of the strap 34 are rounded off to permit the resilient tips 30' of the contact strips to ride over the same and into the central depression. As best shown by the fragmentary views, Figs. 5 and 6, the relative width of the depression is so related to the width of the projecting tip 30' of a contact strip 30 that the tip 30' is accurately positioned at the center of the depression when it engages the projecting end of the fixed contact 33. The dial 21 and tuning shaft 20 are thus yieldingly arrested in the exact position which corresponds to an accurate adjustment to resonance at a particular preselected carrier frequency.

As indicated by the fragmentary circuit diagram included in Fig. 6, the contact strips 30 are all grounded on the chassis, as is the supporting strap 34, and the contact 33 is connected to the junction of the manual control resistance 13 and the muting resistance 15. The control knob 16' of the switch 16 may be mounted on the sub-panel or chassis in such position that it will be exposed at a convenient point when the tuning apparatus is housed in a cabinet.

The contact strips 30 may be accurately adjusted to their several positions by first closing the switch 16 and then carefully tuning the receiver to exact resonance with one of the desired carrier frequencies. The clamp screw 32 is then loosened or removed, and the contact strip is moved angularly about shaft 20 to bring the projecting resilient tip 30' into the depression of the strap 34.

After setting the series of contact strips 30, the muting switch may be opened to provide "silent tuning" of the receiver to any desired one of the selected stations.

The relative arrangement of the contact arm and the adjustable contacts of the automatic muting switch may be reversed, as is illustrated in Figs. 7 to 11, inclusive. In this form of the invention, a single resilient contact 36 is mounted on the tuning dial 37 for cooperation with a plurality of contacts 38. As shown in Fig. 8, each of the contacts 38 has a relatively sharp tip and the movable contact 38 has a cooperating central depression which facilitates the adjustment of the tuning control to exact resonance with a preselected station. The several contacts 38 rest upon the upper wall of the chassis or a sub-panel 39 and are clamped in any desired position by screws 40 and nuts 41 which have integral non-circular projections 42 for sliding engagement in the arcuate slot 43 in the chassis wall 39. The contacts 38 preferably carry projections 44 which extend into the slot 43 to maintain the radial alinement of the contacts 38 with respect to the axis of the dial 37.

In the form of the invention shown in Figs. 12 to 14, the shaft 44 which adjusts the tuning control of the receiver is provided with an arm 45 that carries an insulated contact 46, the contact 46 projecting slightly above a central depression in the flanged end 45' of the arm 45. The general arrangement and shape of this movable contact is substantially the same as that of the stationary contact 33 which is illustrated in Fig. 5. A plurality of resilient contact members 47 are adjustable along and may be clamped in desired positions on the slotted strap 48 and each contact member has a tapered resilient finger positioned in the path of movement of the contact 46 and its supporting member 45'. As illustrated in Fig. 14, each contact finger 49 is in radial alinement with an edge of its associated member 47 but all contacts are not at the corresponding edge of the contact members. This construction permits a very close setting of adjacent contact fingers 49 when two of the favorite stations which are to be received are transmitting on closely adjacent channels. The dial 50 is of the full-vision type and preferably carries a scale of kilocycle graduations at its outer edge. The tuning adjustment of the receiver is indicated by a pilot lamp 51 that is mounted within a frame or box 52 on the arm 45, the upper wall 53 of the box being translucent and having a central black line 54 (or a slot) which casts a shadow on the dial 50. The favorite station which the operator has selected by making the required adjustments of the contact fingers 49 may be identified on the dial by transparent or translucent slips 55 which are marked with the call letters of the particular stations and which are yieldingly held in place by a resilient clamping strip 56 that extends over the inner edge of the dial 50.

It will be apparent that the invention is not restricted to the particular types of transmission networks and tuning circuits herein disclosed. The physical construction of the automatic switching system, and the particular location and design of the elements for suppressing transmission are subject to wide variation without departure from the spirit of my invention as set forth in the following claims.

I claim:

1. In a radio receiver, the combination with a radio frequency amplifier comprising at least one electronic tube, means for tuning the amplifier over a band of carrier frequencies which includes a plurality of transmission channels, and a reproducer, of a circuit including switch means adjustable to closed and open positions, respectively, to permit normal transmission or to block substantially all over-all transmission through the amplifier and reproducer and means connecting said switch means to said tuning means for actuation simultaneously and with said switch

means including relatively movable contacts positioned to close only when the tuning means is accurately set to one of a plurality of preselected spaced positions corresponding to a tuning of the amplifier to resonance at a plurality of preselected channels, said circuit comprising means for biasing the electronic tube to suppress transmission therethrough and said switch comprising means for short-circuiting the biasing means when the tuning means is set to one of the plurality of positions.

2. In a radio receiver, a radio frequency system including a tunable amplifier, an audio frequency system including an amplifier, means adjustable to tune said first amplifier over a frequency band, means normally biasing one of said amplifiers substantially to block transmission therethrough, cooperating switch means for rendering said biasing means inoperative, one of said switch means being a movable contact and the other comprising a plurality of adjustable contacts, and means for actuating one of said switch means synchronously with adjustments of said adjustable tuning means.

3. A radio receiver as claimed in claim 1 wherein the switch means is closed when the amplifier is tuned to the preselected frequency and said cooperating elements constitute means restricting closure of the switch means to an adjustment of said tuning means corresponding to substantially less than a single channel width.

4. In a radio receiver, the combination with a radio amplifier, means for tuning said amplifier over a band of transmission channels, an audio system including a detector and a reproducer, means for automatically controlling the gain of said amplifier to suppress fluctuations of the reproducer output with changes in the radio input to said amplifier, and suppression means operable synchronously with said tuning means to render the receiver inoperative except when said amplifier is tuned to resonance at the carrier frequency of a desired channel, said suppression means comprising means normally biasing said amplifier to suppress transmission therethrough, and switching means for rendering said biasing means inoperative.

5. In a radio receiver, the combination with a radio amplifier including means manually adjustable to tune said amplifier over a band of frequencies, a detector, an audio amplifier, and a reproducer; of indexing means facilitating the accurate adjustment of said amplifier to resonance at preselected frequencies, said indexing means comprising an element having a recess in the edge thereof, a plurality of resilient fingers having ends adapted to be seated in said recess, and means for effecting relative movement of said element and said fingers in synchronism with the adjustments of said tuning means, said fingers being adjustable to and fixed in positions which effect a seating of some one finger end in the recess of said element when said tuning means adjusts said radio amplifier to resonance at one of said preselected frequencies, said amplifier being normally biased so as to block transmission therethrough and means for rendering the biasing means inoperative when one of the finger ends is seated in the recess of said element.

6. A radio receiver as claimed in claim 5, wherein said means for effecting relative movement of said element and said fingers includes a member secured to and adjustable with said tuning means, a fixed support adjacent said member, means mounting said element on said fixed support, and means for securing the several fingers in desired positions of adjustment on said member.

7. A radio receiver as claimed in claim 5, wherein said tuning means includes a variable reactor having a portion thereof carried by a rotatable shaft; and said means for effecting relative movement of said element and said fingers includes a disk secured to said shaft, means mounting said element with the grooved edge thereof adjacent the periphery of said disk, and means for securing the several fingers to and in desired angular relation on said disk.

8. A radio receiver as claimed in claim 5, wherein said means for effecting relative movement of said element and said fingers includes a member secured to and adjustable with said tuning means, a fixed support adjacent said member, means mounting said element on said member, and means for securing the several fingers in desired positions of adjustment on said fixed support.

9. A radio receiver as claimed in claim 2 wherein the switch means includes cooperating indexing elements yieldably locking said switch means and tuning means in those positions which correspond to a tuning of the amplifier to the preselected carrier frequencies.

10. A radio receiver as claimed in claim 2 wherein the amplifier comprises a plurality of cascaded tubes, in combination with means automatically varying the gain of certain of said tubes as an inverse function of the strength of received signals.

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