

April 27, 1937.

W. VAN B. ROBERTS

2,078,412

TUNING INDICATOR ARRANGEMENT

Filed Oct. 21, 1933

Fig. 1

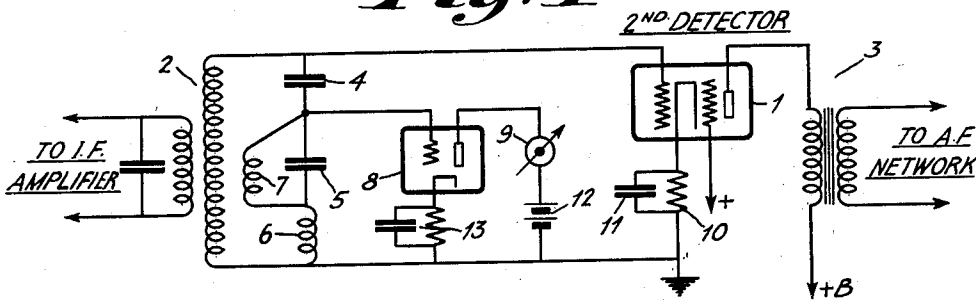


Fig. 2

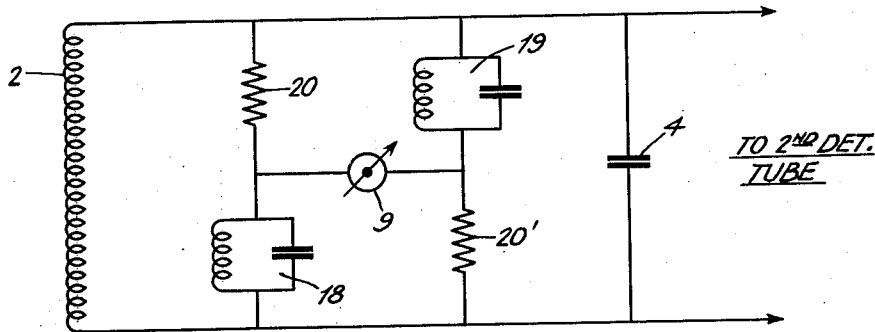
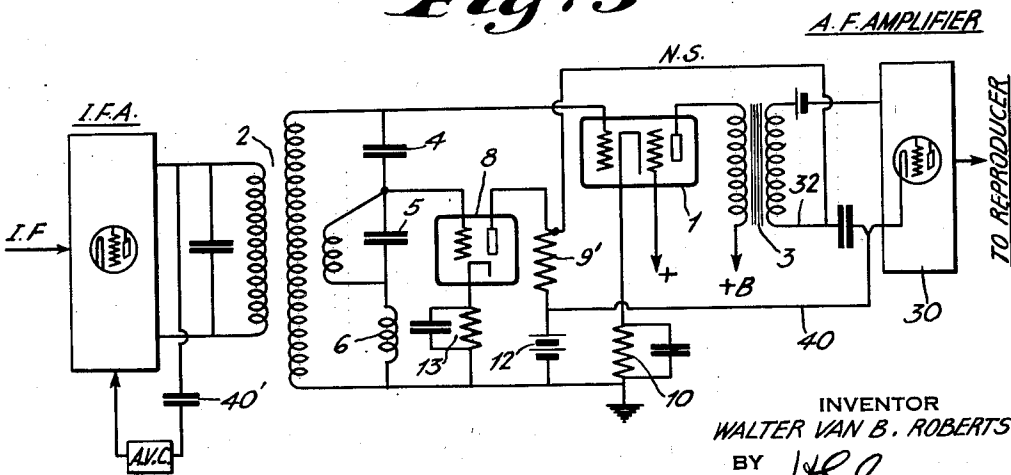


Fig. 3



INVENTOR
WALTER VAN B. ROBERTS
BY *H. B. Swer*
ATTORNEY

UNITED STATES PATENT OFFICE

2,078,412

TUNING INDICATOR ARRANGEMENT

Walter van B. Roberts, Princeton, N. J., assignor
to Radio Corporation of America, a corporation
of Delaware

Application October 21, 1933, Serial No. 694,546

10 Claims. (Cl. 250—20)

My present invention relates to resonance response devices for radio receivers, and more particularly to receiver tuning indicator arrangements.

It is often desirable to indicate the exact resonance point of a radio receiver while the receiver is being tuned to receive a given signal frequency. This is particularly desirable in the case of receivers employing automatic volume control, inasmuch as the action of the volume control device renders it comparatively difficult for the average broadcast receiver operator to accurately tune the receiver. Again, a simple and effective resonance indicator has great value in receivers in general.

Accordingly, it may be stated that it is one of the prime objects of the present invention to provide an indicator in a radio receiver to indicate when a signal is accurately in tune with a receiving circuit, and particularly to give the same indication of exact tuning regardless of the strength of the signal.

Another important object of the present invention is to control the amplification of the signal in such fashion that full output from the loud speaker occurs relatively suddenly as the tuning is brought to exactness. In this way, a visual indicating means is dispensed with, as the circuits will, of necessity, be in exact tune when the loud speaker output is maximum.

Still another object of the present invention is to provide a radio receiver with a mechanism for automatically rendering the receiver insensitive except at the point of exact tuning, thus making it possible to obtain accurate tuning by ear alone, even though automatic volume control means is employed, it being pointed out that such volume control means ordinarily makes such tuning by ear impractical.

Still another object of the present invention may be said to reside in the provision of a visual tuning indicator device in a tunable high frequency circuit of a radio receiver, the indicator device giving the same indication of exact tuning regardless of the strength of the signal.

Still other objects of the present invention are to improve generally the simplicity and efficiency of resonance indicators for radio receivers, and to particularly provide tuning indicator arrangements for radio receivers which are not only reliable in operation, but economically manufactured and assembled in radio receivers.

The novel features which I believe to be characteristic of my invention are set forth in particularity in the appended claims. The inven-

tion itself, however, both as to its organization and method of operation will best be understood by reference to the following description, taken in connection with the drawing, in which I have indicated diagrammatically several circuit organizations whereby my invention may be carried into effect.

In the drawing:

Fig. 1 shows a second detector circuit embodying the present invention,

Fig. 2 shows a modification of the arrangement shown in Fig. 1,

Fig. 3 shows still another modification of the present invention.

Referring now to the accompanying drawing, wherein like reference characters in the different figures represent similar circuit elements, there is shown in Fig. 1, in diagrammatic manner, one form of the present invention, as applied to the second detector network of a superheterodyne receiver. The second detector tube, of the screen grid type, is designated by the numeral 1, and has its signal grid and cathode connected to a network tuned to the operating intermediate frequency of the receiver. The transformer 2 has its primary and secondary maintained fixedly tuned to the intermediate frequency in the usual manner, and it is to be understood that the tuned primary is connected to the intermediate frequency amplifier of the receiver. The circuits preceding the intermediate frequency amplifier need not be shown, since they may comprise any of the circuits customarily employed by those skilled in the art. The anode of the tube 1 is connected to the primary of the audio frequency transformer 3, and it will be understood that the secondary of the latter is to be connected to one or more stages of audio frequency amplification, and/or a reproducer such as a loud speaker of the electrodynamic or electromagnetic type.

The tuned secondary circuit of the transformer 2 includes the tuning condenser 4, and in series therewith is arranged a pair of reactances 5 and 6 arranged in series with each other and with the condenser 4. The reactance of the pair of reactances 5 and 6 is zero at intermediate frequency. A radio frequency choke coil 7 is connected in shunt with the condenser 5, and the function of this choke 7 is to provide a direct current path across the reactance 5. An auxiliary tube 8 has its input electrodes connected across the series path including condenser 5 and inductance 6, a meter 9 being connected in the plate circuit of tube 8.

It will be observed that the cathode of the second detector tube 1 is connected to ground through a self-biasing resistor 10, the resistor being shunted by the radio frequency bypass condenser 11. The positive potential source 12 used for the auxiliary tube 8 has its positive terminal connected to the meter 9, while its negative terminal is connected to the grounded side of resistor 10. The cathode of tube 8 is connected to ground through a grid biasing network 13 which is similar in construction to the biasing network which includes resistor 10.

The operation of the arrangement shown in Fig. 1 is as follows:—When the receiver is so adjusted that the incoming signal is converted to a frequency exactly equal to the resonant frequency of the intermediate frequency circuits, it will produce no voltage drop across the series resonant path 5, 6, and hence no voltage input to the auxiliary tube 8. The meter 9 is adjusted so that it will indicate a predetermined normal value in such a case. If, however, the receiver is slightly mistuned, it being understood that the signal selector mechanism has not been shown to preserve simplicity of description, the current in the intermediate frequency system will not be exactly the frequency at which the reactance path 5, 6 is zero.

Therefore, the current flowing through the series resonant path will produce a voltage drop which, when applied to the input circuit of tube 8, will cause the plate meter 9 to indicate a value different from normal. The process of tuning then consists in varying the tuning selector adjustment (not shown) until the indicator 9 shows normal current in the presence of signals. Since the method of exact tuning is to bring this indication to a definite normal value, the indication of correct tuning will be the same whether a strong or weak signal is being received. In other words, the indicating needle of the meter 9 will decrease to its normal setting as the incoming signal approaches resonance with the receiver, and increase away from the normal value as the receiver is tuned away from resonance with the desired signal.

In Fig. 2 is shown a bridge arrangement modification of the arrangement of Fig. 1. In this bridge arrangement the antiresonant circuits 18 and 19 are each tuned to the intermediate frequency. The resonant circuit 18 is connected to the high potential side of the intermediate frequency circuit through a resistor 20, while a resistor 20' connects the network 19 to the low potential side of the intermediate frequency circuit. The meter 9 is connected between the low potential side of resistor 20 and the high potential side of resistor 20'.

This arrangement operates in the following manner:—When the I. F. is correct the bridge is in balance, and meter 9 reads zero. If the I. F. is not correct, the bridge is out of balance. The indicator 9 may be a D. C. instrument combined with a rectifier, or it may be of a type responsive to A. C.

In Fig. 3 there is shown the indicating method of Fig. 1 applied to an arrangement for automatically rendering insensitive the over-all action of the receiver, except at the point of exact tuning. Instead of the meter 9 being disposed in the plate circuit of the auxiliary tube 8, a high resistance 9' is inserted between the positive terminal of source 12 and the plate electrode of tube 8. The space current of tube 8 flows through the

resistance 9', and the value of the resistance 9' is so chosen that the normal plate current of tube 8 flowing therethrough produces the proper voltage for the bias of the output audio frequency amplifier tube 30. Thus, a direct current connection is shown connected between one side of resistor 9' and the low potential side of grid circuit 32 of the audio amplifier 30. The amplifier 30 is not shown in detail, since those skilled in the art are well acquainted with its specific construction, and the aforesaid direct current connection is designated "NS" to show that it is the background noise suppression connection. A direct current connection 40 is made between the cathode of amplifier 30 and the side of resistor 9' adjacent source 12.

When, however, "out of tune" signals are passing through the intermediate frequency circuit, they will, as explained previously, produce a voltage input to tube 8 which, in the case of Fig. 3, is so arranged that the plate current is increased by the application of voltage to its input circuit. Thus, the presence of mistuned signals finally results in the application of excess bias to the audio tube 30, with the result that the amplification of the audio tube is substantially reduced.

As a result, it will be found that full loud speaker output will be obtained only when the receiver is accurately in tune, and will fall off rapidly as the receiver is detuned in either direction away from the exact resonance. This makes it possible to obtain accurate tuning by ear alone, even though automatic volume control means are employed. Such automatic volume control means is conventionally represented by the circuit designated "AVC", and it is to be understood that the volume control energy is derived from the input network of the second detector tube 1, and the signal energy is impressed on the automatic volume control device through a coupling condenser 40'. The direct current control potential output of the AVC network is, of course, applied to the grid, or grids, of the radio frequency and intermediate frequency amplifiers of the receiver. Such an arrangement is well known to those skilled in the art and need not be described in any further detail. It is only necessary to point out that automatic volume control means ordinarily makes tuning by ear impractical, because the sound output from the speaker possesses no sharply defined maximum at the point of accurate tuning when such automatic volume controls are used alone.

While I have indicated and described several systems for carrying my invention into effect, it will be apparent to one skilled in the art that my invention is by no means limited to the particular organizations shown and described, but that many modifications may be made without departing from the scope of my invention, as set forth in the appended claims.

What I claim is:—

1. In a high frequency signalling system, a resonant circuit tuned to a desired signal frequency, a path in said circuit series resonant to the desired signal frequency, an electron discharge device having its input electrodes connected to the series resonant path, and a visual current indicator in the plate circuit of said device.

2. In a system as defined in claim 1, said series resonant path including a condenser and coil in series, and said resonant circuit including a tuning condenser connected to said path.

3. In combination with an electron discharge

tube, a tuned circuit connected between the input electrodes of the tube, the said tuned circuit including a coil and a condenser, a reactive network disposed in said tuned circuit, a visual current indicator connected to said network, the constants of said network being so chosen that a predetermined minimum current indication of said indicator corresponds to exact resonance of said tuned circuit with a desired signal frequency.

4. In an arrangement as defined in claim 3, said network including a pair of reactances of opposite sign which are series resonant to the desired signal frequency, said current indicator being connected to one of said reactances.

5. In a radio receiver, a radio frequency amplifier, a detector following said amplifier, a resonant coupling network between said amplifier and detector, the network being tuned to a desired signal frequency, a reactive path series resonant to said signal frequency connected in said coupling network, an electron discharge tube having its input electrodes connected across said reactive path, an impedance in the anode circuit of said tube, a direct current connection between one side of said impedance and the grid of an audio frequency amplifier connected to the output of said detector, a direct current connection between the other side of said impedance and the cathode of said audio frequency amplifier, and means for automatically controlling the gain of said radio frequency amplifier.

6. In a radio receiver, an electron discharge tube provided with a resonant input circuit between its input electrodes, a tuning condenser connected in said input circuit, a reactive path connected in said input circuit, a tube having its input electrodes connected across said reactive path, and a visual current indicator in the anode circuit of said last named tube, the constants of said reactive path being so chosen that said current indicator indicates a pre-determined minimum indication when the frequency of the signal currents applied to said resonant input circuit is such as to produce substantially no voltage across said reactive path.

7. In combination with a source of high fre-

quency signals, a resonant network including a coil and a condenser, said network being resonant to at least one desired frequency, a signal utilization network connected across the resonant network, a path, series resonant to the desired frequency, connected between the coil and condenser, a space current device connected across said path for indicating the resonance condition of said first network, and means in the space current path of the device responsive to changes in space current flow of the latter.

8. In an arrangement as defined in claim 7, said responsive means comprising a visual current indicator.

9. In a high frequency signalling system, a resonant circuit tuned to a predetermined signal frequency, a path in said circuit tuned to said predetermined frequency and including the series connection of a coil and a condenser, a radio frequency choke coil connected in shunt to said condenser, a vacuum tube having its input electrodes connected across the outer ends of said first named coil and condenser and a visual current indicating means connected to the output circuit of said tube.

10. In a radio signalling system, the combination of a detector having an input and an output circuit, an amplifier having a control grid circuit coupled to said output circuit, said detector input circuit being resonant to a desired signal frequency and including the series connection of a coil and a condenser which together have a resonance frequency equal to the desired signal frequency, an electron discharge tube having a cathode, a control grid and a plate, connections between said cathode and control grid and the outer ends of said coil and condenser, a circuit connecting the plate and cathode of said discharge tube and including a resistor, a conductive connection between a point on said resistor and the control grid of said amplifier tube and a conductive connection between a second point on said resistor and the cathode of said amplifier tube.

WALTER VAN B. ROBERTS.