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CONTROL APPARATUS FOR RADIORECEIVERS

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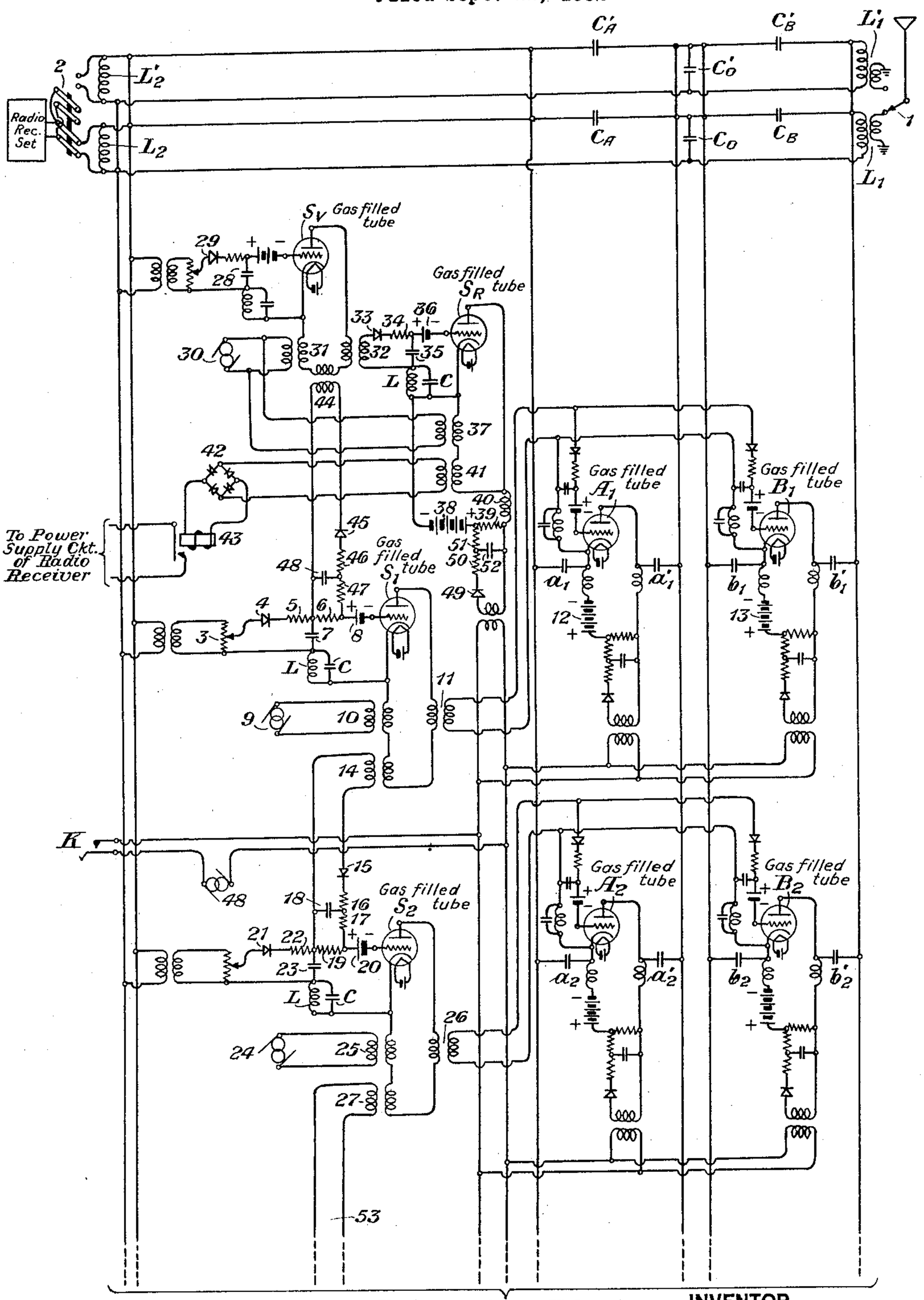

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CONTROL APPARATUS FOR RADIORECEIVERS

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This invention relates to arrangements for automatically controlling and adjusting the operation of a translating device. Devices with which the arrangements of the invention might readily be used are, for example, radio receiving sets, automatic power plants, and constant speed control of motors.

When the arrangements of the invention are utilized, for example, for the automatic control and adjustment of a radio receiver set a plurality of tuned circuits will be provided, each tuned slightly below resonance for the frequencies of various stations desired. These tuned circuits are connected by any desired selective means to the radio receiver set. The tuning is then automatically adjusted in accordance with the arrangements of the invention by the operation of a combination of gas-filled discharge tubes until the predetermined signal level is obtained. At this point the combination of gas-filled tubes will operate the power supply for the radio receiver set. The circuit is then held operated at this level until a different station selection is made or until switching means are operated. Other features, objects and advantages will appear more fully from the detailed description thereof hereinafter given.

The invention may be more fully understood from the following description together with the accompanying drawing in which is shown a circuit diagram embodying a preferred form of the invention.

In the drawing is shown in diagrammatic form one embodiment of the invention as applied to automatic tuning of a radio receiver set. A tuned circuit is provided for each station which it is desired to receive, and so adjusted that the capacity must be increased to tune the circuit to resonance with the station frequency. A series of tubes, A_1, B_1, A_2, B_2, etc., control the connection of small capacities in parallel with the tuning capacities, successive increments of capacity being added upon the operation of successive switching tubes S_1, S_2, etc., until the signal level is sufficient to operate the final tube, S_R, controlling the power supply for the receiver tube circuits. The switching tubes S_1, S_2, etc., are thereupon disabled so that no additional capacities are added. When a different station is selected, the removal of the signal voltage from the tuned circuit and the operation of the "off" key returns all the tubes to the normal condition. The detailed operation is as follows:

A tuned circuit comprising inductances L_1 and L_2 and capacities, C_O, C_A and C_B is connected to the antenna circuit by the selective means shown here diagrammatically as switch 1. The circuit is also selectively connected to the radio frequency receiver set through switches 2 at the same time. By means of these switches the radio receiver and the antenna may be connected to other tuned circuits as shown in the drawing. Capacities C_A and C_B are so adjusted for the particular station desired that the circuit is tuned to a somewhat higher frequency than that of the station, and capacity must be added to each in order to approach resonance with the station frequency. In this detuned condition the voltage across coil L_2 will, in general, not be sufficient to give satisfactory output from the receiver and will not cause operation of tube S_V which has its input circuit adjusted to cause ionization in the tube only at the desired signal level. If tube S_V does not operate, the radio receiver power supply remains unoperated by tube S_R. Tube S_1, however, has its input circuit adjusted to operate on a very low voltage across coil L_2 and this voltage is applied through potentiometer 3 to the rectifier circuit consisting of rectifier 4, resistances 5 and 6, and condenser 7. Through the action of the rectifier, condenser 7 is charged through resistance 5, the voltage across this condenser being applied between the grid and cathode of tube S_1 in series with and opposing battery 8. When the resultant grid potential reaches the ionizing value, an arc is established between the anode and cathode of tube S_1 and voltage is applied from source 9 through transformers 10 and 11 to the input rectifier circuits of tubes A_1 and B_1. Arcs are then established in these tubes, thus connecting condensers a_1 and a_1', and b_1 and b_1' in parallel, respectively, with condensers C_A and C_B. The anode potentials for tubes A_1 and B_1 are provided respectively by batteries 12 and 13. When the arc is established in tube S_1, voltage is also applied through transformer 14 to the input rectifier circuit of tube S_2 consisting of rectifier 15, resistances 16, 17 and 19, and condenser 18. The charge built up in condenser 18 causes direct current to flow through resistances 17 and 19. The voltage drop across resistance 19 is applied between the grid and cathode of tube S_2 in series with and opposing the voltage of battery 20. The resultant grid potential, however, is not made sufficiently positive by this drop to cause tube S_2 to ionize. When the additional capacities are added to condensers C_A and C_B through the operation of tubes A_1 and B_1, the circuit is tuned more closely to resonance with the incom-

ing signal and the voltage across coil L_2 is increased to such a value that tube S_2 is ionized by the additional voltage built up across condenser 23 through the action of rectifier 21. Upon the operation of tube S_2, voltage is applied from source 24 through transformers 25 and 26 to the input rectifier circuits of tubes A_2 and B_2 in the same manner as described for tubes S_1, A_1 and B_1. Voltage is also applied through transformer 27 over leads 53 to the rectifier circuit of the tube succeeding S_2, as described in connection with rectifier 15 and tube S_2. Upon the operation of tubes A_2 and B_2, condensers a_2 and b_2, a_2' and b_2' are also connected in parallel with condensers C_A and C_B, tuning the circuit still more closely to resonance with the incoming signal and increasing the voltage drop across coil L_2 sufficiently to cause the operation of the tube succeeding S_2. The number of tubes similar to S_2 may be as many as are necessary to give the desired range of tuning.

When the voltage across coil L_2 has been increased by the operation of tubes S_1, S_2, etc., and reaches a value which is satisfactory for the operation of the receiver, tube S_V is operated by the voltage built up across condenser 28 through the action of rectifier 29. When this tube operates, voltage is applied from source 30 through transformers 31 and 32 to the rectifier circuit consisting of rectifier 33, resistances 34, and condenser 35, causing the operation of tube S_R. Anode potential for tube S_R is provided by battery 38 through resistance 39 and coil 40. Tube S_R thus is not self-quenching and remains operated until the "off" key K is closed. Voltage from source 30 is also applied through transformers 37 and 41 to the rectifier circuit 42 and relay 43, which closes the power supply circuit for the radio receiver. When tube S_V is operated, voltage is also applied through transformer 44 to the rectifier circuit associated with tube S_1, consisting of rectifier 45, resistances 46, 47 and 6 and condenser 48. This rectifier is so connected that the voltage drop produced across resistance 6 is of the same polarity as battery 8 and places a high negative potential between grid and cathode of tube S_1, which is thus quenched and remains so as long as tube S_V is operated. Since the anode potentials of tubes A_1 and B_1 are provided by batteries, these tubes remain operated even through the input from tube S_1 is removed. The grid potential provided by the voltage drop across resistance 19 in the input rectifier circuit of tube S_2 is also removed when tube S_1 is quenched and this causes tube S_2 to be quenched since this tube is adjusted to require a large grid potential, most of which is provided by the voltage drop across resistance 19. The voltage built up across condenser 23 is not alone sufficient to ionize tube S_2, even with the voltage level across coil L_2 necessary to cause operation of tube S_V. The quenching of tube S_2 causes the quenching of the succeeding tubes in a similar manner. Tubes A_2 and B_2 and succeeding tuning tubes remain ionized for the same reason as tubes A_1 and B_1, plate potential being provided by batteries in each case.

When it is desired to turn off the receiver or to tune to another station, the selective means is operated which transfers switches 1 and 2 to another similarly tuned circuit and removes the signal voltage across coil L_2 of the circuit considered above. At the same time key K is operated either separately or as part of the selective operation and voltage from source 48 is applied simultaneously to the rectifier circuits associated with the anode circuits of tubes S_R, A_1, B_1, A_2, B_2, etc. Rectifier 49 in the anode circuit of tube S_R charges condenser 52 through resistance 50 and direct current flows through resistances 51 and 39, producing a voltage drop across resistance 39 which opposes the voltage of battery 38. When the resultant anode potential becomes less than that required to sustain ionization, depending upon the gas employed in the tube, S_R is quenched and relay 43 is released, removing power supply from the receiver. Quenching of tubes A_1, B_1, A_2, B_2, etc., occurs in a similar manner and the auxiliary tuning condensers a_1, b_1, a_1', b_1', etc., are disconnected from condensers C_A and C_B, restoring the tuned circuit to the normal condition.

If the signal voltage across coil L_2, at the time the circuit is connected between the antenna and radio frequency tube V, is strong enough to cause operation of tube S_V immediately, this tube operates and prevents the operation of tube S_1 by virtue of the high negative potential produced across resistance 6. Since S_1 is not operated, S_2 and succeeding tubes will not be operated, as explained above, and no auxiliary condensers will be connected across C_A and C_B. Tube S_R will be operated and applies power to the receiver at once by operation of relay 43.

While this invention has been described in connection with the circuit arrangements shown, it is understood that other circuit modifications may be employed without detracting from the scope of the appended claims. Tubes of various types, such as those including additional electrodes, called collectors, not physically connected to the operating electrodes, may be of advantage in separating the tuning circuits from the operating circuits.

What is claimed is:

1. Radio receiving apparatus comprising an incoming circuit, a receiving set connected to said circuit, a power supply for said receiving set, elements of capacity and inductance included in said incoming circuit and so adjusted that said circuit will be tuned slightly below resonance for a known incoming radio frequency, a series of gas-filled discharge tubes connected across said incoming circuit and adjusted to be progressively operated by variations in the voltage drop across said inductance element of said known incoming radio frequency, means controlled by said gas-filled discharge tubes for connecting additional elements of capacity in parallel with said first mentioned elements of capacity, and means operated by the voltage drop across said inductance of said known incoming radio frequency when said incoming circuit is tuned to resonance with said incoming frequency for operating said power supply for said receiving set and for disabling said set of gas-filled discharge tubes.

2. A translating device, a receiving circuit connected thereto including reactance elements so adjusted that said circuit will normally be tuned below resonance for an arbitrary frequency, a series of gas-filled discharge tubes connected across said receiving circuit and adjusted to be progressively operated by received currents of said arbitrary frequency as said circuit is tuned closer to resonance for said arbitrary frequency, means controlled by said gas-filled tubes for connecting additional reactance elements in parallel with certain of said reactance elements to change the tuning of said receiving circuit, and means operative when said circuit is tuned by said last

mentioned means to resonance for said arbitrary frequency for operating said translating device.

3. A receiving circuit including reactance elements so adjusted that said circuit will normally be tuned below resonance for an arbitrary frequency, a second receiving circuit including reactance elements so adjusted that said circuit will normally be tuned below resonance for another arbitrary frequency, a translating device, switching means for operatively connecting said translating device to either of said receiving circuits, a series of gas-filled discharge tubes connected across all of said receiving circuits and adjusted to be progressively operated as either of said circuits when receiving its respective frequency and connected to said device is tuned closer to resonance for its respective frequency, means controlled by said gas-filled discharge tubes for connecting additional reactance elements in parallel with certain of said reactance elements to change the tuning of said circuits, and means operative when either of the circuits operatively connected to said device is tuned to resonance for its respective arbitrary frequency for operating said translating device.

4. A radio receiving device, a receiving circuit including reactance elements so adjusted that normally said circuit will be tuned below resonance for an arbitrary incoming radio frequency, switching means for operatively connecting said circuit to said receiving device, a gas-filled discharge tube connected to said receiving circuit and adjusted to operate on a signal level existing when said circuit is tuned to resonance for said arbitrary frequency, a second gas-filled discharge tube connected to said receiving circuit and adjusted to operate on a substantially lower signal level than said first tube, means controlled by said second tube for connecting additional reactance elements in parallel with certain of said first mentioned reactance elements to increase the signal level in said receiving circuit, a third gas-filled discharge tube connected to said receiving circuit and adjusted to operate on a higher signal level than said second tube but below the level on which said first tube operates, means controlled by said third tube for connecting additional reactance elements in parallel with certain of said first mentioned reactance elements to further increase the signal level in said receiving circuit, means controlled by said second tube when operated for reducing the level at which said third tube will operate by an amount sufficient to cause said third tube to operate when the signal level in said receiving circuit is raised by the operation of said second tube, and means controlled by the operation of said first tube for operating said radio receiving device.

5. A radio receiving device, a receiving circuit including reactance elements so adjusted that normally said circuit will be tuned below resonance for an arbitrary incoming radio frequency, switching means for operatively connecting said circuit to said receiving device, a gas-filled discharge tube connected to said receiving circuit and adjusted to operate on a signal level existing when said circuit is tuned to resonance for said arbitrary frequency, a second gas-filled discharge tube connected to said receiving circuit and adjusted to operate on a substantially lower signal level than said first tube, a set of gas-filled discharge tubes operated by the operation of said second tube for connecting additional reactance elements in parallel with certain of said first mentioned reactance elements to increase the signal level in said receiving circuit, a third gas-filled discharge tube connected to said receiving circuit and adjusted to operate on a higher level than said second tube but below the level on which said first tube operates, a set of gas-filled discharge tubes operated by the operation of said third tube for connecting additional reactance elements in parallel with certain of said first mentioned reactance elements to further increase the signal level in said receiving circuit, means controlled by said second tube when operated for reducing the level at which said third tube will operate by an amount sufficient to cause said third tube to operate when the signal level in said receiving circuit is raised by the operation of said second tube, a fourth gas-filled tube operated by said first tube and switching means for operating said radio receiving device controlled by the operation of said fourth tube.

6. A radio receiving device, a receiving circuit including reactance elements so adjusted that normally said circuit will be tuned below resonance for an arbitrary incoming radio frequency, switching means for operatively connecting said circuit to said receiving device, a gas-filled discharge tube connected to said receiving circuit and adjusted to operate on a signal level existing when said circuit is tuned to resonance for said arbitrary frequency, a second gas-filled discharge tube connected to said receiving circuit and adjusted to operate on a substantially lower signal level than said first tube, a set of gas-filled discharge tubes operated by the operation of said second tube for connecting additional reactance elements in parallel with certain of said first mentioned reactance elements to increase the signal level in said receiving circuit, a third gas-filled discharge tube connected to said receiving circuit and adjusted to operate on a higher level than said second tube but below the level on which said first tube operates, a set of gas-filled discharge tubes operated by the operation of said third tube for connecting additional reactance elements in parallel with certain of said first mentioned reactance elements to further increase the signal level in said receiving circuit, means controlled by said second tube when operated for reducing the level at which said third tube will operate by an amount sufficient to cause said third tube to operate when the signal level in said receiving circuit is raised by the operation of said second tube, a fourth gas-filled tube operated by said first tube, switching means for operating said radio receiving device controlled by the operation of said fourth tube, means controlled by the operation of said first tube for extinguishing said second and third tubes, switching means and circuits controlled thereby for extinguishing said fourth tube and the sets of tubes operated by said second and third tubes, and means for adjusting the circuits of said first tube so that it will become extinguished when the signal level in said receiving circuit falls below the level existing when said circuit is tuned for resonance to said arbitrary incoming frequency.

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