

Aug. 21, 1934.

F. X. RETTENMEYER

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RADIO RECEIVING SYSTEM

Filed Nov. 28, 1931

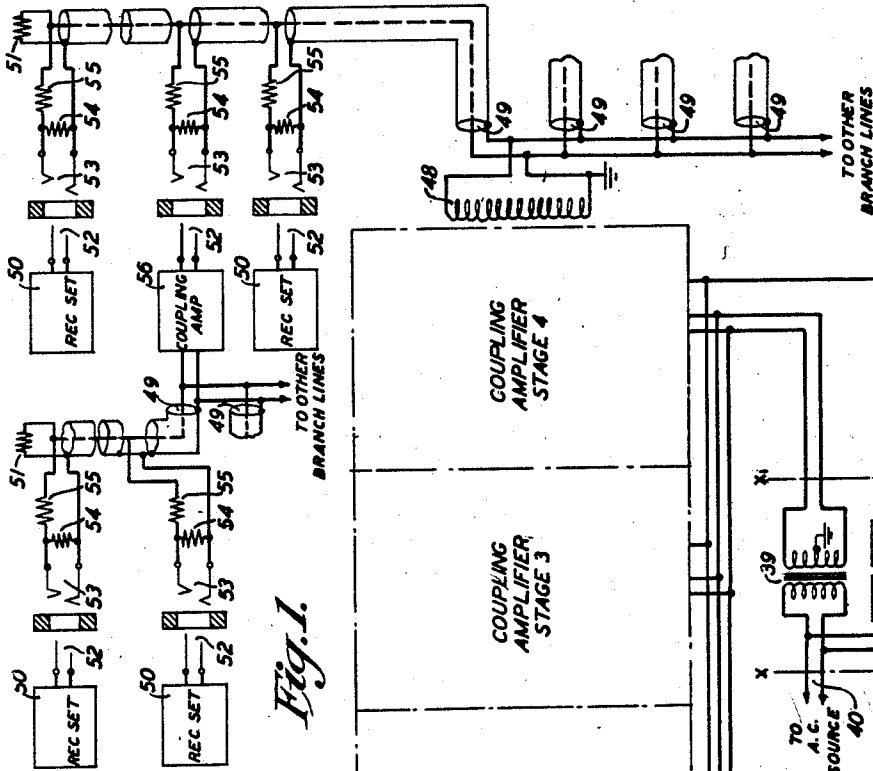


Fig. 1.

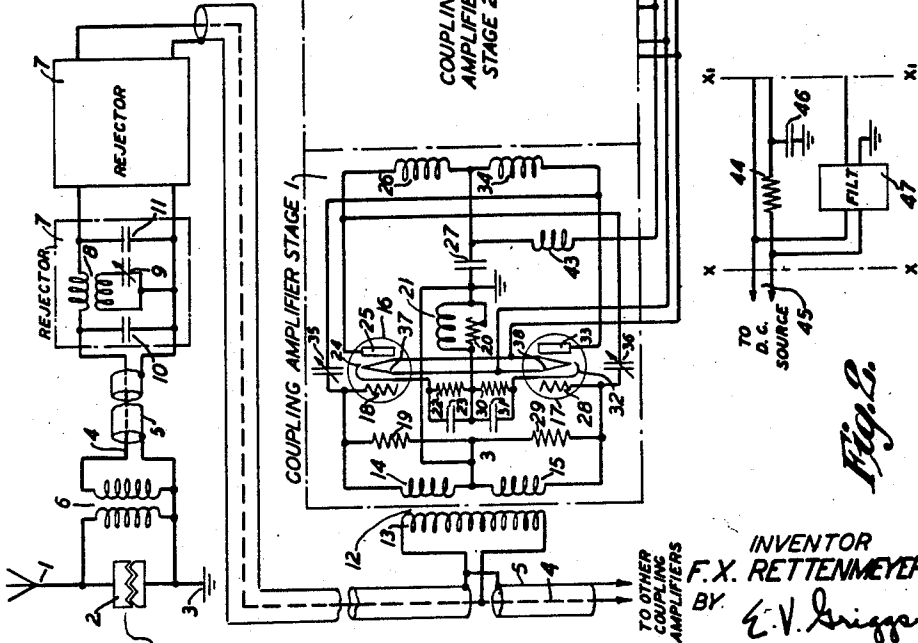


Fig. 2.

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RADIO RECEIVING SYSTEM

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6 Claims. (Cl. 250—9)

This invention relates to multiple channel radio receiving systems and more particularly to systems of this type for use in hotels, apartment houses and other places where a number of broadcast receivers are located in a single building.

In large hotels and apartment houses it is usually impracticable and often impossible to provide individual antennas for the various receivers installed in the building and many systems in which a single antenna is associated with several receivers are now in use. In such systems, the interactions between the several receivers and the energization of the common antenna by waves produced in the receivers, as in the case of superheterodyne receiving sets, often prevent satisfactory reception by the receivers connected to the system.

The disturbing effects mentioned above have been substantially eliminated in the system disclosed in my copending application Serial No. 559,847, filed August 28, 1931, by means of individual unilateral amplifiers inserted between each receiver and the common antenna. This system is especially suitable and economical for buildings having a relatively small number of radio receiving sets. For buildings having an extremely large number of sets, as for example 3000, it appears desirable for reasons of economy to employ unilateral amplifiers each common to a large number of sets. The common amplifier should preferably be arranged to prevent interactions between the sets and undesired antenna energization and also to suppress certain frequencies originating in the amplifier itself.

It is one object of this invention to associate an antenna with a relatively large number of radio receivers in a more efficient and more economical manner than has heretofore been achieved.

It is another object of this invention to prevent interactions between the receivers associated with a single antenna.

It is a further object of this invention to prevent interactions between receivers associated through a common coupling device with a single antenna.

It is still another object of this invention to suppress substantially, in multi-channel systems employing a common amplifier, undesired frequency components originating in the common amplifier.

According to one feature of the invention interactions between receivers associated with the same coupling amplifier are substantially eliminated by means of attenuators inserted between said receivers.

In one embodiment of the invention an antenna aperiodic over the broadcast range is connected through several rejector or wave trap sections, each of which may be adjusted to attenuate the same or different undesired broadcast waves, to one or more four stage push-pull radio frequency amplifiers. Each amplifier is untuned and cross-neutralized and provided with feed-back means for eliminating even order modulation products which are not completely balanced out by the push-pull output arrangement. An amplifier containing such a feedback means is disclosed and claimed in the copending application of C. W. Green, Serial No. 4659, filed January 26, 1925, and assigned to applicant's assignee. A relatively large number of receiving sets are bridged through separate attenuators across the transmission lines extending from the output of the amplifiers. Other amplifiers, each common to a plurality of receivers, may also be bridged through individual attenuators across the transmission line.

The invention will be more fully understood from the following description taken in connection with the drawing, in which like reference numerals denote elements of similar function, and in which:

Fig. 1 illustrates a receiving system constructed in accordance with the invention and arranged for alternating current operation; and

Fig. 2 illustrates a direct current power unit which may be substituted for the alternating current unit shown in Fig. 1.

Referring to Fig. 1, reference numeral 1 designates an antenna which is aperiodic over the broadcast range and numeral 2 denotes a lightning arrester connected between the antenna and the ground 3. The antenna is inductively associated with a concentric transmission line of low impedance comprising inner conductor 4 and outer grounded conductor 5 by means of transformer 6 and this line is connected to several common coupling amplifiers only one of which is illustrated on the drawing. The electrical characteristics of transformer 6 are, preferably, such as in effect transform the antenna impedance into an impedance equivalent to that of the line so that a maximum transfer of energy is effected. Included in the line between the common antenna and the first amplifier are wave traps or rejectors 7 each of which comprises a transformer 8 having a primary included in series with conductor 4 of the line and a secondary connected to the other conductor 5 of the line, an adjustable condenser 9 connected across the secondary winding, and two condensers 10 and 11. The primary windings function also as loading coils for the line. Condenser 10 is bridged across the line on one side, and condenser 11 is bridged across the line on the other side, of the primary winding of transformer 8. The rejectors may each be tuned by means of the adjustable condensers 9 so

necting through several rejector or wave trap sections, each of which may be adjusted to attenuate the same or different undesired broadcast waves, to one or more four stage push-pull radio frequency amplifiers. Each amplifier is untuned and cross-neutralized and provided with feed-back means for eliminating even order modulation products which are not completely balanced out by the push-pull output arrangement. An amplifier containing such a feedback means is disclosed and claimed in the copending application of C. W. Green, Serial No. 4659, filed January 26, 1925, and assigned to applicant's assignee. A relatively large number of receiving sets are bridged through separate attenuators across the transmission lines extending from the output of the amplifiers. Other amplifiers, each common to a plurality of receivers, may also be bridged through individual attenuators across the transmission line.

as to reject waves of the same frequency or different frequencies. Only two rejectors are illustrated but obviously any number may be employed.

5 The common coupling amplifier is inductively connected to the concentric transmission line comprising conductors 4 and 5 by means of an input transformer 12 having a primary winding 13 and secondary windings 14 and 15. The amplifier illustrated comprises four similar stages, the block diagrams designated Stage 2, Stage 3 and Stage 4 each representing equipment and a circuit arrangement similar in design to that included within the blocked diagram designated 10 Stage 1. These stages are inductively coupled in a manner well known at the present time. Obviously any number of stages may be employed. Although not specifically illustrated, the tubes included in the last stage may, of course, be of 15 the low anode-cathode impedance type commonly referred to as power type tubes.

Referring to the detailed circuit arrangement of Stage 1, reference numerals 16 and 17 designate space discharge tubes having their input and output circuits arranged for push-pull operation. The input circuit of tube 16 includes control electrode 18, secondary winding 14, resistance 19 connected across winding 14, feedback arrangement comprising resistance 20 and 20 low frequency pass coil 21, a grid bias arrangement comprising resistance 22 and high frequency pass condenser 23, and cathode 24. The output circuit of this tube may be traced from anode 25 primary winding 26 of an output transformer, the secondary of which is included in 30 Stage 2, high frequency pass condenser 27, feedback arrangement mentioned above, the grid bias arrangement also mentioned above, and cathode 24.

40 Similarly, the input circuit of tube 17 includes control electrode 28, input transformer winding 15, resistance 29 connected across winding 15, the feed-back arrangement, mentioned above, a grid bias arrangement comprising resistance 30 and high frequency pass condenser 31, and cathode 32; and the output circuit of this tube may be traced from anode 33, primary winding 34 of an output transformer, the secondary of which is included in Stage 2, condenser 27 the 50 feed-back arrangement mentioned above, the grid bias arrangement comprising resistance 30 and condenser 31, and cathode 32. Reference numeral 35 designates a cross-neutralizing condenser connected between the control electrode 18 of tube 16 and the anode 33 of tube 17; and numeral 36 designates a cross-neutralizing condenser connected between control electrode 28 of tube 17 and anode 25 of tube 16.

It will be observed that the feed-back arrangement comprising resistance 20 and coil 21 is common to the input and output circuits of both tubes 16 and 17. This is an important feature of the invention, and as explained below it functions to eliminate certain frequencies in the tubes.

65 The filaments 37 and 38 of tubes 16 and 17, respectively, are connected through transformer 39 comprising a power unit to line 40 which is associated with an alternating current source of energy as, for example, a 110 volt A. C. generator not shown on the drawing. Reference numeral 41 designates a rectifier having its input terminals connected to the line 40 and its output terminals connected to filter 42, the high potential output terminal of filter 42 being connected through radio frequency choke coil 43 to anodes 25 and 33 75

through transformer windings 26 and 34, respectively. The other output terminal of the filter is connected to ground. In a similar manner the anodes and filaments of the tubes in Stages 2, 3 and 4 are connected to the rectifier and filter just described. If power tubes are employed in the last stage, the high positive potential for the anodes may be obtained from the filter 42 over a separate conductor not shown on the drawing.

85 If it is desired to operate the amplifier from a direct current instead of alternating current source, the apparatus shown between the lines XX and X₁ X₁ in Fig. 2 may be substituted for that shown between the lines similarly designated in Fig. 1. In Fig. 2, numeral 44 designates a resistance having one terminal connected to filaments 37 and 38 and the other connected to one conductor of line 45 which is associated with a direct current source of energy as, for example, a 110 volt D. C. generator. Reference numeral 46 95 designates a radio frequency by-pass condenser having one terminal grounded and numeral 47 designates a filter which performs a function similar to that of filter 42 in Fig. 1.

The secondary winding 48 of a transformer, 100 the primary windings of which are associated with the output circuits of the tubes in the last coupling amplifier stage, is connected to a plurality of branch concentric transmission lines 49. Since these lines are associated with similar equipment, the apparatus associated with only one line will be described in detail. Referring to the branch line 49 shown at the top of the drawing the numerals 50 designate receiving sets connected across the line. The line 49 is terminated in 110 a resistance 51, this resistance being approximately equal to the surge impedance of the line. The receiving sets are conveniently associated with the branch line by means of plugs 52 and jacks 53. Included between each receiving set 115 50 and the branch line is an attenuator comprising a shunt resistance 54 and a series resistance 55. An auxiliary coupling amplifier 56 similar to the amplifier described above is also associated with the branch line by means of a plug 52 and a jack 53 through an attenuator similar to that just described. The output of this auxiliary amplifier is associated with a plurality of branch lines and a plurality of receivers are connected by means of plugs and jacks each through a separate attenuator to each of these last mentioned lines as illustrated on the drawing. The receiving sets may, of course, be arranged to receive sound and/or television programs or the like.

120 In the operation of the receiving system described above filaments 37 and 38 and anodes 25 and 33 of the tubes 16 and 17, respectively, of all amplifier stages are energized either by means of the alternating current power unit comprising transformer 39, rectifier 41 and filter 42, or by 135 means of the direct current unit shown in Fig. 2.

Waves of all frequencies within the broadcast range to be received are absorbed by the aperiodic antenna 1 and inductively transferred by means of transformer 6 to the concentric line 140 comprising conductors 4 and 5. The outer conductor 5 functions in one sense as a shield for the inner conductor 4. The concentric line minimizes reradiation of the transmitted energies and prevents, to some extent, absorption of pick-up 145 waves. Lightning and heavy static discharges are conducted to ground through lightning arrester 2.

If waves from one or more local, or powerful, broadcasting stations are especially annoying they may be attenuated or rejected substantially, 150

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if it is so desired, by proper manipulation of the tuning condensers 9 included in the rejectors. The waves not completely rejected comprising various frequencies within the broadcast range
 5 to be received are supplied to the input terminals of the amplifier, amplified, and then transmitted over the lines 49 to the input terminals of the several receivers 50, and also to the auxiliary amplifier 56 and associated receivers 50.

10 The operation of the push-pull amplifier is obvious to those skilled in the art and, therefore, will not be explained in detail. In this connection, however, certain important features of the amplifier should be noted. First of all the grid
 15 biasing arrangements function to impress the proper biasing potential on the control electrodes of tubes 16 and 17. The adjustable neutralizing condensers 35 and 36 which prevent substantially, the flow of energy from the output to the input
 20 circuits of the tubes in each stage, function to eliminate interactions between the receiving sets associated with different common amplifiers and also to prevent substantially the energization of the common antenna by waves produced in the
 25 receivers, one or more of which may be of the superheterodyne type.

As is well understood at the present time the even order modulation products of the fundamental waves supplied to the common amplifier
 30 are for the most part balanced or canceled in the primary winding of the output transformer included in each push-pull amplifier stage. These modulation products include even harmonics of the fundamental waves desired to be amplified
 35 and sum and/or difference frequency waves resulting from modulation of waves received from two or more stations, or modulation of harmonics thereof, which last mentioned waves are commonly called "phantom station" waves since
 40 they do not exist in the ether. Because of the impossibility of matching tubes and other apparatus, a perfect balance is seldom ever obtained and certain voltages resulting from the unbalanced modulation products appear across the
 45 terminals of the feed-back arrangement comprising resistance 20 and coil 21, which arrangement as stated above, is common to the output and input circuits of both tubes. Since the control electrodes of both tubes are associated with
 50 the same terminal of the feed-back arrangement these voltages are automatically impressed across the input electrodes of both tubes in similar phase or polarity so that the resultant currents in the output circuits are for all practical
 55 purposes balanced. This balancing or suppression of undesired frequencies originating in the tubes is of primary importance and its function is to prevent the distortion common in multi-channel systems in use at the present time which employ
 60 common amplifiers.

Interactions between the receiving sets 50 associated with the same common amplifier, and between the sets 50 and the auxiliary coupling amplifier 56 also associated with the same common amplifier, are prevented by means of the
 65 attenuators. As between any two sets, or as between a receiving set and an auxiliary amplifier, two attenuators and a portion of the concentric line are included and, as a result, the
 70 interfering waves originating in any one set are greatly attenuated before reaching the other set or the auxiliary amplifier.

In view of the above description, it is apparent that, in accordance with this invention, an exceedingly large number, as many as 4000 receive-

ing sets, may be associated with a single antenna in a multi-channel system utilizing a minimum of equipment in such a manner that program distortion and disturbing effects commonly existent in such systems are substantially eliminated.

Although the invention has been described in connection with one specific arrangement, it is to be understood that it is not to be limited to such an arrangement. Obviously, other arrangements, as for example, one in which the rejectors and attenuators and other component parts are substantially different from those described herein, may be successfully employed in practicing the invention without exceeding its scope.

What is claimed is:

1. In combination, an antenna, a plurality of receivers connected thereto, a push-pull amplifier, and means including said amplifier for eliminating the unbalanced portion of the second order modulation output components, said amplifier being included between said antenna and said receivers.

2. In combination, an antenna, a plurality of receivers connected thereto, a push-pull amplifier, means including said amplifier for eliminating the unbalanced portion of the second order modulation output components, and means for neutralizing the plate-grid capacities of the tubes in said amplifier, said amplifier being connected between said antenna and said receivers.

3. In combination, an antenna, a rejector for attenuating certain waves, a push-pull amplifier including a feedback impedance common to the amplifier input and output circuits, at least eight receivers, said rejector being included between the antenna and the amplifier, and said amplifier being included between the rejector and said receivers.

4. In combination, an aperiodic antenna, a low impedance concentric line comprising two coaxial conductors, means connecting said antenna and line, said means adapted to transform the antenna impedance into that of the line, at least eight receivers, a push-pull amplifier, and an impedance included in the common branch of the input and output circuits of said amplifier, said amplifier being included between said line and said receivers.

5. In combination, an antenna, a push-pull amplifier comprising two tubes, means for impressing the unbalanced even order modulation voltage in the output of said amplifier on the grids of said tubes in similar phase, at least eight impedances, and, a plurality of receivers, said amplifier being included between said receivers and the antenna, and a different impedance included between each receiver and the amplifier.

6. In a multi-channel system, an aperiodic antenna, an amplifier each stage of which comprises two tubes arranged for neutralized push-pull operation, an impedance included in the common branch of the input and output circuits of said tubes, a concentric line comprising two conductors having a common center, a rejector for attenuating certain waves included in said line, said line being connected between the antenna and the input of the amplifier, a second concentric line connected to the output of the amplifier and terminated in its surge impedance, a plurality of attenuators, and at least eight receiving sets each connected through a different attenuator to a different point in said second line.

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