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Examiner

May 7, 1935. F. X. RETTENMEYER 2,000,190

RADIO RECEIVING SYSTEM

Filed Aug. 23, 1931

For Apartment House distribution

FIG.2

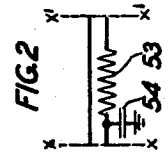


FIG.3

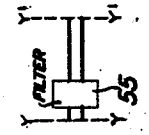
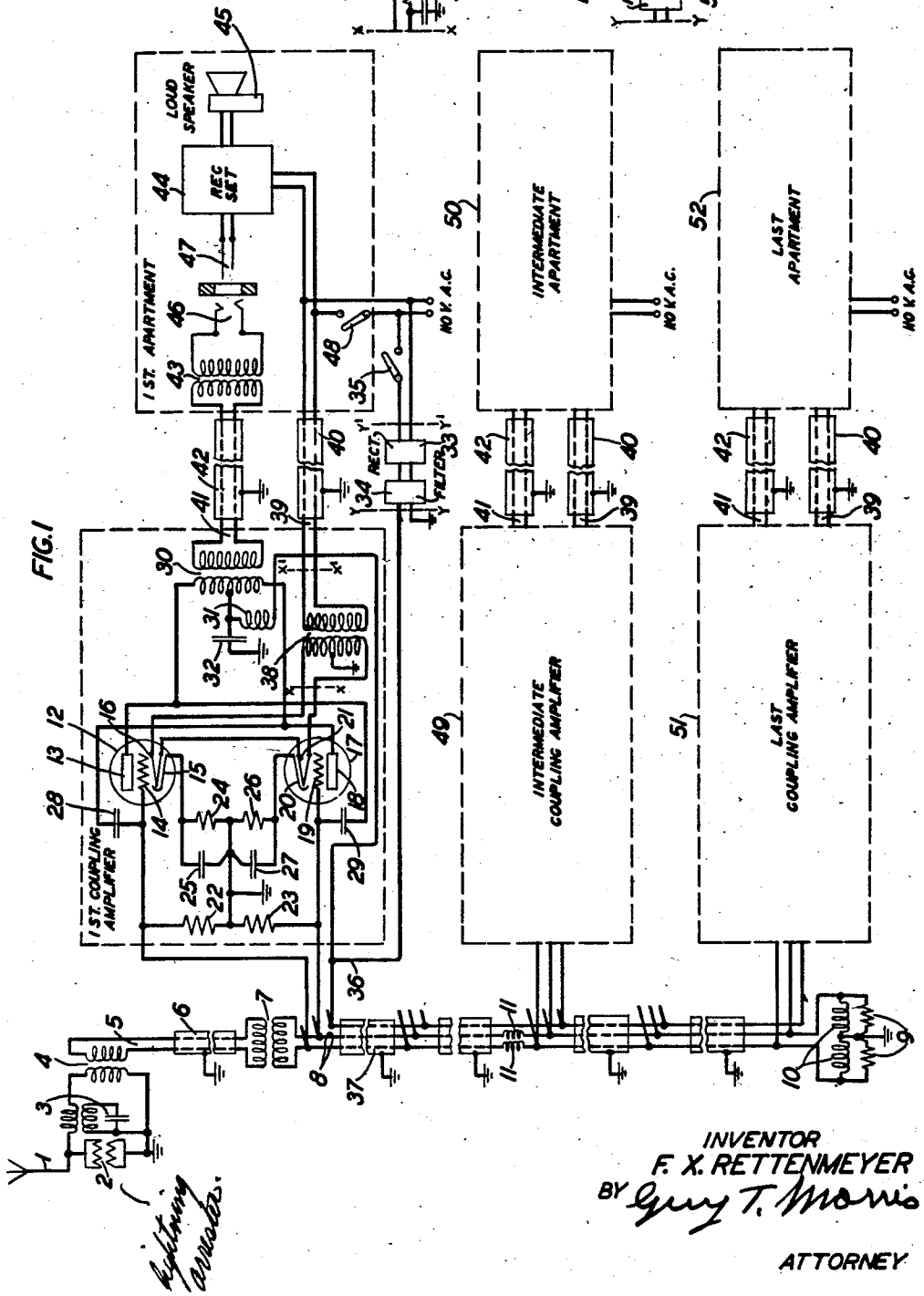


FIG.1



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RADIO RECEIVING SYSTEM

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5 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 different broadcast listeners desire to simultaneously receive different programs.

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 these systems the problems of eliminating interaction between the several receivers and of preventing energization of the antenna by waves produced in the receivers as in superheterodyne receiving sets have not been satisfactorily overcome. Moreover, considerable difficulty has been experienced in efficiently transmitting the energy absorbed by the antenna to the various receivers and in preventing undesired absorption by the transmission system connecting the antenna to the receivers.

It is one object of this invention to couple an antenna to several receivers in a more efficient manner than has heretofore been achieved.

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

It is a further object of this invention to eliminate, substantially, even-order modulation products in a radio receiving system.

It is still another object of this invention to prevent waves produced in a radio receiver from energizing the associated antenna.

According to one feature of this invention the means employed for preventing interaction between the receivers and undesired energization of the antenna comprises a plurality of neutralized push-pull radio frequency amplifiers, one of which is inserted between each receiver and the antenna system.

According to another feature of the invention the energization of each receiver and its associated coupling amplifier is controlled by the listener by means of a single switch, and the energy for the anode circuits of the space discharge tubes in several of the coupling amplifiers is obtained from a common source of energy.

In one embodiment of the invention an antenna which is aperiodic over the broadcast range and associated with a wave trap for suppressing undesired local interfering signals of a given frequency is connected to a low impedance balanced line. The line is loaded at proper intervals and terminated in its surge impedance. Several coupling amplifiers are connected across the line and each is associated with a commercial type receiver by means of a plug and jack in the individual apartment. The switch that controls the receiver also controls the associated coupling amplifier which, with the other coupling amplifiers, is located preferably outside of the apartment. Several coupling amplifiers located on the same or different floors are supplied with anode potential from a common power unit.

The invention will be better understood from the following description taken in connection with the drawing in which;

Fig. 1 illustrates a multiple channel radio receiving system arranged for alternating current operation and having a neutralized push-pull coupling amplifier associated with each receiving set;

Figs. 2 and 3 show the equipment to be substituted in the system of Fig. 1 for alternative direct current operation.

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. A wave trap comprising a tuned circuit 3 is transformer-connected to antenna 1 and connected also to ground. The antenna 1 is inductively connected by means of radio frequency transformer 4 to a transmission line 5 which is shielded by the grounded sheathing 6 and terminated in the primary winding of radio frequency transformer 7. The secondary winding of transformer 7 is connected to the line 8 which is terminated in its surge impedance comprising a resistance 9. Resistance 9 is shunted by inductance 10, the function of which will be pointed out later and the center points of the resistance and inductance are grounded thus balancing the line. Inductance 10 has a high impedance for radio frequency currents and substantially zero impedance for direct current. Numerals 11 designate loading coils inserted in the conductors of line 8 at proper intervals.

Several coupling amplifiers each associated with a receiving set are bridged across the transmission line 8. Each coupling amplifier comprises a heater type space discharge tube 12 having an anode 13, control electrode 14, cathode 15 and heater filament 16 and another similar type tube 17 having an anode 18, control electrode 19, cathode 20 and heater filament 21, the input and output circuits of the tubes being arranged for push-pull operation in the well known manner. Reference numerals 22 and 23 designate resistances

connected in the input circuits of tubes 12 and 17, respectively, and in series with each other, the common connection being grounded. Numerals 24 and 25 designate, respectively, a grid biasing resistance and a condenser connected in shunt thereto, the shunt arrangement being included in the input and output circuits of tube 12. A similar shunt arrangement comprising grid leak resistance 26 and condenser 27 is included in the input and output circuits of tube 17. The control electrode 14 of tube 12 is connected to the anode 18 of tube 17 through a neutralizing condenser 28, and the control electrode 19 is connected to anode 13 through a neutralizing condenser 29. Numeral 30 represents a transformer one half of the primary winding of which is included in the output circuit of tube 12, the other half of said winding being included in the output circuit of tube 17. The center point of this primary winding is connected to the power unit to be described below through radio frequency choke coil 31 and to ground through radio frequency pass condenser 32.

The power unit for supplying energy to the anodes of tubes 12 and 17 comprises a rectifier 33 and a filter 34. The unit is connected by means of switch 35 to the 110 volt alternating current supply. Conductor 36 connects the power unit to the several amplifiers and, together with the conductors of line 8, is shielded between the amplifiers by means of the grounded sheathing 37. The filaments 16 and 21 of tubes 13 and 17, respectively, are associated with the 110 volt alternating current supply by means of transformer 38 and line 39. The midpoint of the secondary winding of transformer 38 is grounded and line 39 is shielded by the grounded sheathing 40.

Reference numeral 41 designates a transmission line which is shielded by grounded sheathing 42 and which connects the secondary winding of the output transformer 30 in the coupling amplifier to the primary winding of transformer 43 located in the subscriber's apartment. The secondary winding of transformer 43 is associated with a radio receiving set 44 and loud speaker 45 in the subscriber's apartment by means of jack 46 and plug 47. Reference numeral 48 designates a switch which controls the radio receiving set and also the energization of the filaments of the tubes in the coupling amplifier. A loud speaker is shown on the drawing but it is obvious that other equipment as, for example, television apparatus may be used in place thereof.

The amplifier and the subscriber's equipment just described are typical of several such amplifiers and equipments which are connected across line 8, the rectangular blocks 49 and 50 representing, respectively, another such amplifier and subscriber's equipment. The blocks designated 51 and 52 also represent still another such amplifier and equipment. As a practical matter at least several hundred coupling amplifiers and associated receivers may be successfully employed in this system. The coupling amplifiers 49 and 51 are connected to the receiving equipments 50 and 51, respectively, by means of shielded transmission lines similar to those shown between the first coupling amplifier and the first subscriber's equipment.

The system shown in Fig. 1 may be operated from a 110 volt direct current supply in which case the apparatus shown between the lines XX—X'X' and YY—Y'Y' in Fig. 1 are replaced by the apparatus illustrated in Figs. 2 and 3, respectively. In Fig. 2 reference numeral 53 designates a resistance and numeral 54 designates a condenser, one terminal of which is connected to the amplifier terminus of the resistance. Condenser 54 provides an alternating current path to ground. In Fig. 3 numeral 55 designates a filter.

The system described above operates in the following manner: Assuming that switches 35 and 48 are closed, energy for heating the filaments 16 and 21 of tubes 12 and 17, respectively, in the amplifier is supplied from the 110 volt source through transformer 38 shown in Fig. 1 or resistance 53 shown in Fig. 2; and positive potential for the anodes of the same tubes is obtained over conductor 36 from the alternating current power unit comprising rectifier 33 and filter 34 shown in Fig. 1 or the direct current unit comprising filter 55 shown in Fig. 3, dependent upon the type of current available. When switch 48 is closed the receiving set 44 is also energized. The various receiving sets and associated amplifiers may of course be operated simultaneously.

Waves of substantially all frequencies in the broadcast band are absorbed by the aperiodic antenna 1. The wave trap associated with the antenna is adjusted so as to eliminate a particular signal as, for example, a strong local undesired signal. The absorbed energy is then transferred by means of transformer 4 to lines 5 and 8 and conducted to the input circuits of the untuned coupling amplifier. The loading coils 11 of line 8 function to minimize the energy loss in transmission and the surge impedance 9 effectively eliminates wave reflections. The sheathing 37 minimizes the amount of undesired energy absorbed by line 8; and since the line is balanced, that is, since the impedance to ground for each conductor is substantially similar, no current flows in the conductors of line 8 as a result of the small amount of undesired energy picked up by line 8. Inductance 10 being a path of practically zero impedance for direct current functions to prevent, in the event of a short circuit between the anode and control electrodes of any coupling amplifier tube, a high direct potential from being impressed on the control electrodes of the tubes in the remaining amplifiers.

The coupling amplifiers being untuned amplify all broadcast frequencies in the manner well known at present although their main function is that of a unilateral amplifier between the associated receiving set and the remaining portion of the system comprising the antenna and the other receiving sets. In other words, the neutralizing condensers 28 and 29 in each amplifier effectively prevent the return of energy from the amplifier output circuit, and hence from the associated receiver, through the anode-control electrode capacity of the tubes to the amplifier input circuit and so prevent interference between the various receivers. In addition, these condensers prevent waves produced locally in the associated receiver, as in the case of superheterodyne receivers, from energizing the common antenna 1. The balanced or push-pull arrangement of the radio frequency amplifier tubes functions in accordance with this invention to suppress even-order modulation products including those derived from interaction of two or more incoming signals and harmonics thereof and also even harmonics of the desired signal. The receiving set 44 may be tuned to any broadcast station. The radio receiving set and associated coupling amplifier are deenergized by opening switch 48.

Although the invention has been described in connection with certain specific means for pre-

venting interaction between the receiving sets and for eliminating even-order modulation products it is to be understood that the invention is not to be limited to these specific means. Moreover, it is obvious that other types of tubes, as for example, those having an element which functions both as a filament and a cathode may be successfully employed in place of the heater type tube shown in Fig. 1 without exceeding the scope of the invention.

What is claimed is:

1. In combination, an antenna, a plurality of receiving sets connected thereto, and a plurality of neutralized push-pull amplifiers at least one of which is included between each of the said sets and the antenna.

2. In a radio receiving system, an antenna, a balanced transmission line associated with said antenna, said line being terminated in a resistance shunted by an inductance having a negligible resistive value, a plurality of cross neutralized push-pull amplifiers each of which is bridged across said line and energized from a source connected to an intermediate point in said inductance, and a radio receiving set connected to each amplifier.

3. In a radio receiving system, an antenna aperiodic over a band of frequencies, a transmission line connected thereto, a plurality of amplifiers bridged across said line, each amplifier comprising two space discharge tubes having input and output circuits arranged for push-pull operation and two neutralizing condensers, the input circuit of each tube being connected to the output circuit of the other tube through one of the said condensers, a plurality of energized receiving sets each of which is connected to a different amplifier.

4. In a multiple channel radio receiver, an antenna common to a plurality of receiving sets, said antenna being aperiodic over a plurality of frequencies, a balanced loaded transmission line connected to said antenna and terminated in a resistance equal to its surge impedance, an inductance having substantially zero resistance connected in shunt to said resistance, a plurality of neutralized push-pull amplifiers each of which is bridged across said line, a radio receiving set connected to each amplifier, and a source of energy, one terminal of said source being connected to an intermediate point in said inductance and the other terminal being connected to said amplifiers and receiving sets.

5. In combination, a plurality of amplifiers, each comprising two space discharge tubes connected in push-pull, a different resistance connected between the control electrodes of the tubes in each amplifier, a common inductance having a negligible resistive value connected in shunt to said resistances, a source of direct current energy having one terminal connected to the anodes of said tubes and its other terminal connected to an intermediate point of said inductance.

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