

March 10, 1942.

G. BUCKY ET AL

2,275,610

LOUDSPEAKER SYSTEM

Filed Jan. 23, 1941

3 Sheets-Sheet 1

Fig. 1.

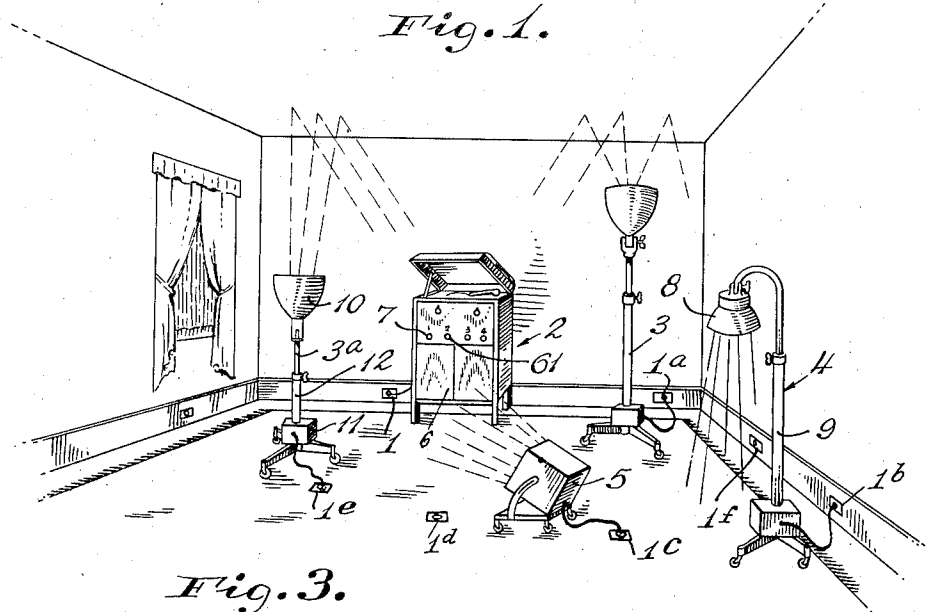


Fig. 3.

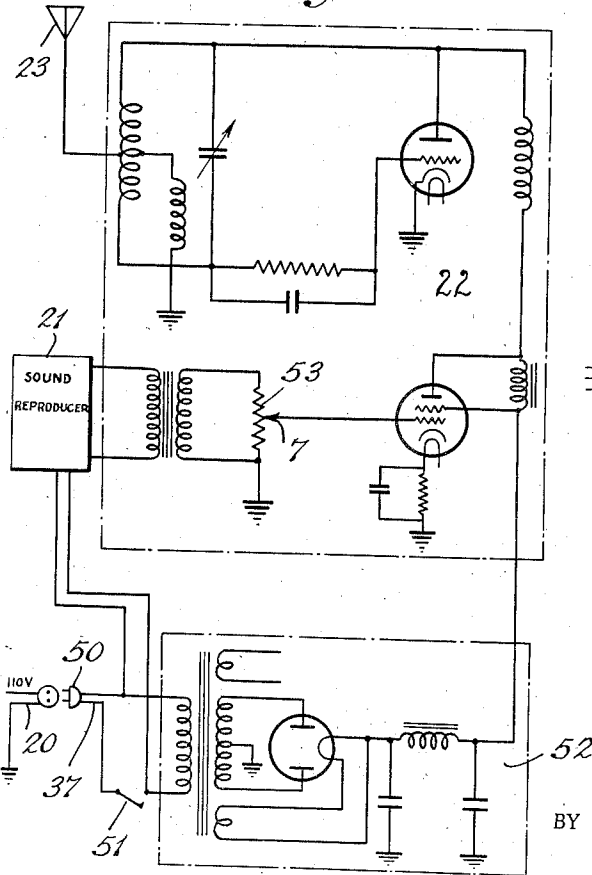
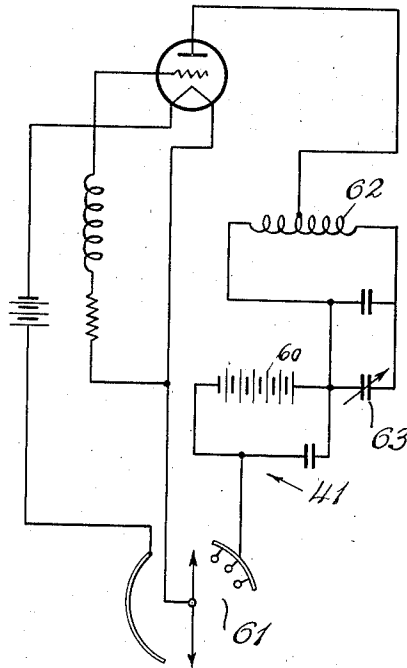


Fig. 3^a



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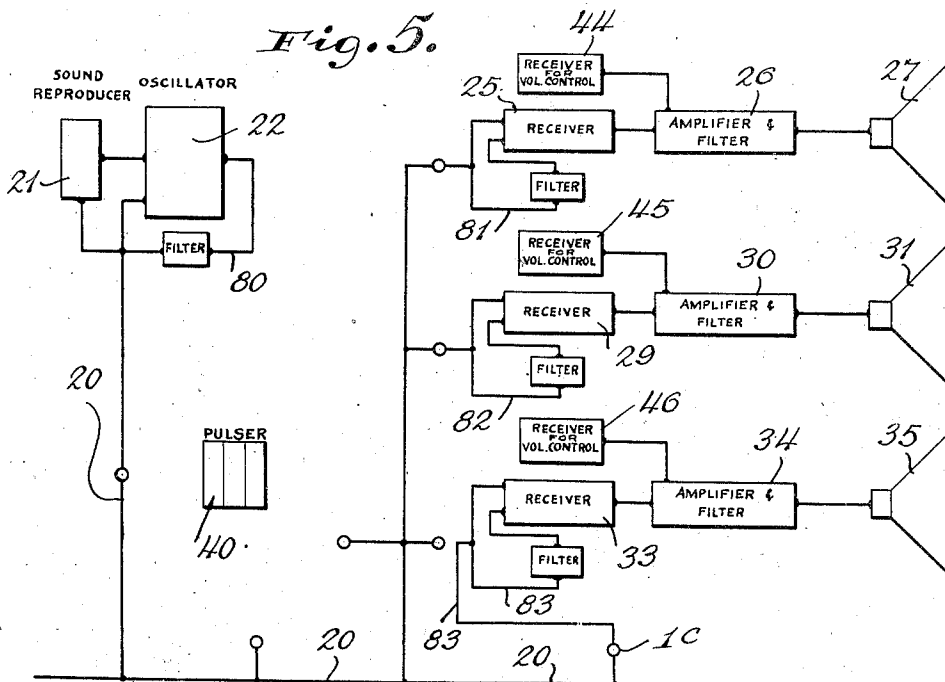
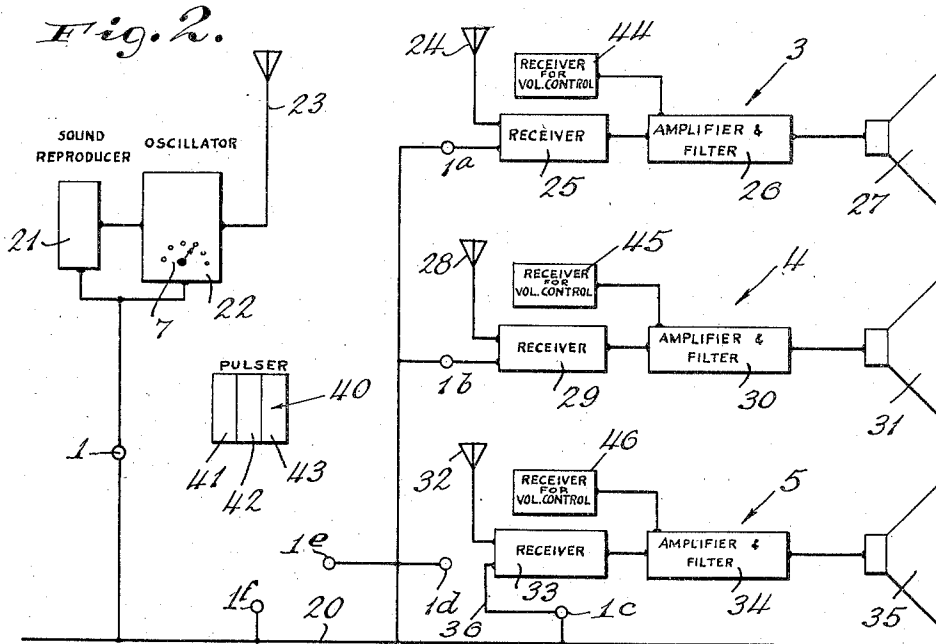
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3 Sheets-Sheet 2



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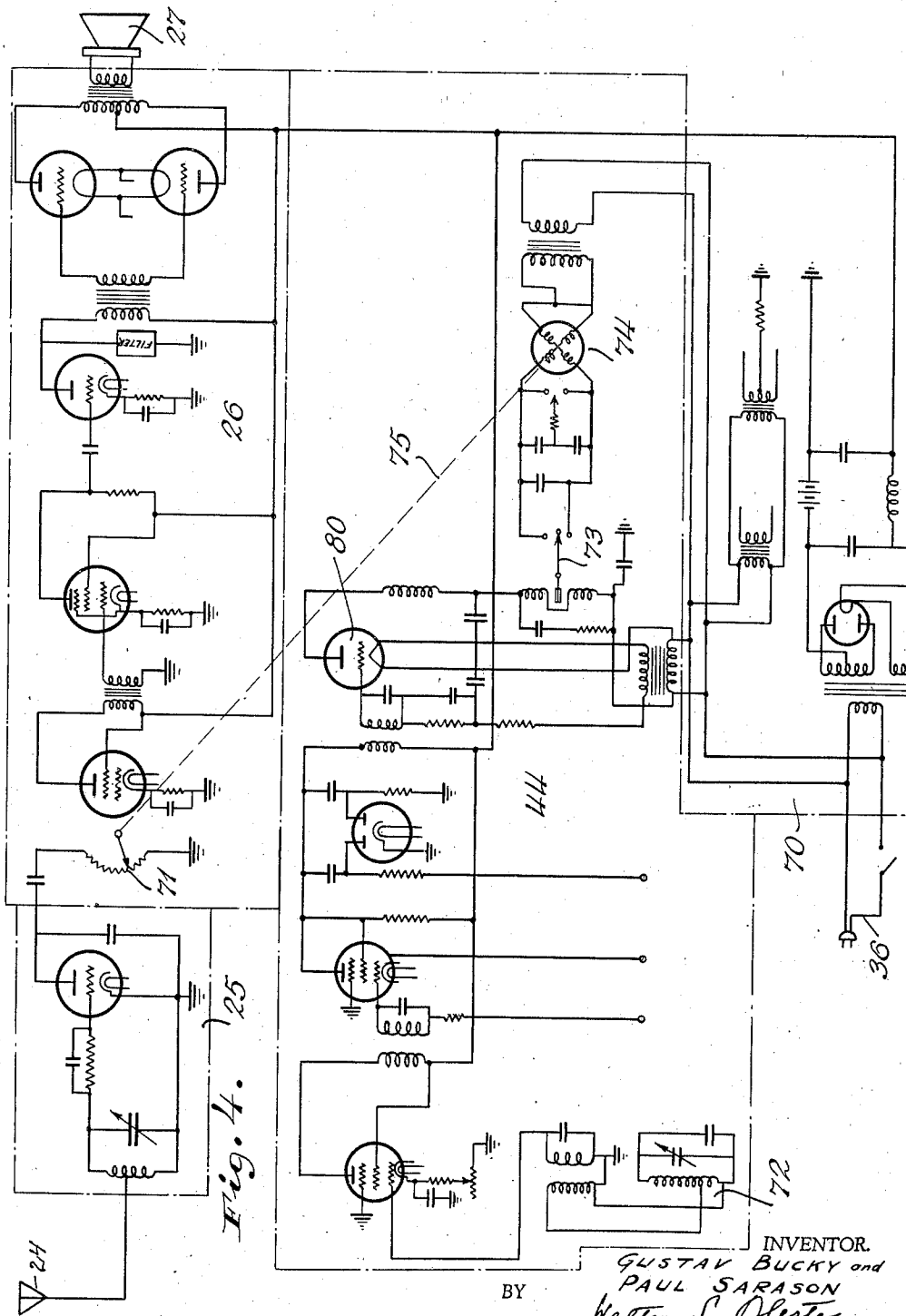
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LOUDSPEAKER SYSTEM

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3 Sheets-Sheet 3



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LOUDSPEAKER SYSTEM

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4 Claims. (Cl. 250—6)

The present invention relates to a loudspeaker system in which a plurality of loudspeakers are operated in a particular room or space from a common sound reproducing unit, e. g. as described in U. S. Letters Patent 2,179,840.

In the named patent it has been explained that a plurality of loudspeakers of different ranges of frequencies are required in order to attain best tonal effects, and that the correct position of such loudspeakers, and the level and direction in which their sound beams are emitted should be ascertained by trial according to the acoustic qualities of the particular room or space in which the sound reproduction is intended to be performed. According to this well-known system each loudspeaker is connected to the common sound reproducing unit by an individual current-conducting cable whose length must be maintained constant in order to avoid variation of the output resistance of the respective amplifier. The large number of these cables and their considerable length constitute a severe drawback in certain instances particularly if large halls are to be equipped with such system. On the one hand, each unit will permit only a limited number of loudspeakers being connected thereto so as to exclude in practice the application of more loudspeakers than originally provided; on the other hand, the manipulation of the great bulk of cables is very cumbersome when the loudspeakers are shifted from one place to another in the testing of their most efficient location. It may even become practically impossible or at least very annoying to dispose the connecting cables between the sound reproducing unit and the loudspeakers.

The present invention contemplates to avoid the mentioned drawback and to provide a system in which no movable cable connections between the sound reproducing unit and the loudspeakers are required. The invention consists in a system of the mentioned type in which the sound reproducer, such as a pick-up of a record player, a microphone, a sound track or similar device is connected with an oscillator and each of the loudspeakers is connected with an individual amplifier wherein transmission from the oscillator to the loudspeakers occurs by radio energy. The system according to the invention offers appreciable advantages in that the mentioned cable connections of the well-known system are dispensed with, that an unlimited number of loudspeakers may be used and energized by the same oscillator, and that the number of loudspeakers for each range of frequency may

be varied according to the tonal qualities of the room in which the system is used whereby an entirely arbitrary modulation of the sound effects may be attained. According to a modification of the invention, the oscillations produced by the oscillator will be transmitted to the loudspeaker-receiver sets through the power lines of the network supplying the individual apparatus with the required current in the manner of the well-known so-called wired wireless method.

The invention, furthermore, comprises means for a remote control collectively and/or individually of the loudspeakers from a central station as to their volume of tone. Further objects and details of the invention will be apparent from the description given hereinafter and the accompanying drawings illustrating an embodiment thereof by way of example. In the drawings:

Fig. 1 is a view of a room in which a plurality of loudspeakers has been arranged according to our invention.

Fig. 2 is a schematic diagram of the system according to the invention.

Fig. 3 is a circuit diagram of a transmitter which may be used in the system of Fig. 2.

Fig. 3a is a circuit diagram of a transmitter for the individual volume control of one of the loudspeakers.

Fig. 4 is a circuit diagram of a receiver-loudspeaker set with individual volume control, and Fig. 5 is a diagram of a modified system in which transmission is effected by wired wireless.

Referring now to Fig. 1 of the drawings, the room illustrated in that figure is provided with a plurality of current outlets 1, 1a, 1b, 1c, 1d, 1e, 1f fixed to the room walls and/or floor and connected to a source such as e. g. the general 110 volt net of a community. The outlets are so distributed as to permit apparatus positioned in any part of the room to be connected to a selected one of the outlets by a conveniently short length of cable. The wiring connecting the outlets to the net is not shown as it may be covered by the surface lining of the walls. The apparatus supplied with current from the outlets comprises according to the invention a sound reproducing and transmitting unit 2, and a plurality of movable loudspeaker sets. The unit 2 is connected to the outlet 1 and includes a sound reproducing device such as a record player, microphone, or analogous device, a radio transmitter, and a general volume control. In the embodiment of Fig. 1, the unit 2 is arranged in a cabinet 6. The switch for the general volume control is indicated

at 7. A plurality of loudspeakers is provided, at least one for each of a desired number of frequency ranges which are so selected that the entire band of acoustic frequencies is covered. For example, there are loudspeakers for three different ranges of frequency with the loudspeaker sets 3 and 3a for the high range, the set 4 for medium and the set 5 for low. Each of the sets is connected to one of the outlets 1a, . . . 1f which is most conveniently located according to the selected position of the pertaining set in the room. Each set comprises a receiver tuned on the transmitter of the unit 2, a filter according to the respective range of frequency, amplifier, and the loudspeaker proper. All the mentioned parts may be bodily connected as shown at 8 and carried by a standard 9 as in the case of the set 4, or the loudspeaker 10 may be spaced from the receiver, filter and amplifier part 11 as on the standard 12 of set 3a, or the parts may be arranged with respect to each other in any other suitable manner allowing the set to be moved as a unit. The individual loudspeakers may be so directed as to emit the sound upward as in the set 3, or downward as in 4, or in an inclined direction as in the set 5.

Now, it will be clear that the sound reproducing and transmitting unit 2 may be positioned at any desired part of the room, that the various loudspeaker sets may be shifted from place to place, and that the unit and the sets may be connected by an only short cable to the nearest outlet 1, 1a, . . . or 1f. By varying the position including the beam direction of the individual loudspeaker sets that position can be found where the best acoustic effect will be attained. The transmission of energy from the unit 2 to the loudspeaker sets takes place by radio waves, preferably by very short waves so that no cable connection between said unit and said sets is required. This makes it possible to use any desired number of loudspeakers for each range of frequency as it is illustrated by the two loudspeakers 3 and 3a in the higher frequency range. The provision of more than one loudspeaker set in a particular range of frequency may be desirable owing to the acoustic peculiarities of the room equipped with the system according to the invention. We have also found that an increase of the number of loudspeakers of a particular range is a very efficient means for increasing the tone volume in the latter. In other words, whereas the general volume control mentioned in connection with the transmitter unit is of equal effect as to all ranges of frequency, an individual range control may be obtained by a variation of the number of the loudspeakers in the respective ranges relatively to each other.

The schematic diagram of Fig. 2 shows the general arrangement of the circuits. The unit 2 comprising the sound reproducer 21, the oscillator 22 and radiator 23 is connected to the outlet 1 of the power network 20 so as to take from the latter the current required for operating the unit. The loudspeaker sets 3, 4, and 5 are similarly connected to the outlets 1a, 1b, and 1c respectively. Set 3 comprises an antenna 24, a receiver 25, an amplifier and filter 26, and the loudspeaker proper 27. The corresponding parts of the sets 4 and 5 are denoted by the consecutive numerals 28 to 35. The sets 3, 4, and 5 differ from each other only by the filters and the loudspeakers, the filters being so designed as to fit the ranges of frequency for which they are respectively destined and the loudspeakers

are of such type, e. g. electro-magnetic or dynamic as best suitable for their particular tonal range. Thus, the waves produced in the sound reproducer 21 excite the oscillator 22 which in turn energizes the radiator 23 wherein the output energy may be controlled by the general volume control switch 7. The radiations will be received by the receivers 25, 28, 33 via their respective antennas 24, 28, 32 then amplified and filtered at 26, 30, and 34 so that the loudspeakers 27, 31, and 35 will be operated. Now, it will be apparent that any one of the loudspeaker sets, for instance 5, may be moved to a desired other position after the short connecting cable 36 has been disconnected from the outlet 1c, and, then, may be plugged into the nearest other outlet, e. g., 1d without causing any alteration of the conditions of operation. Similarly, the unit 2 may be bodily shifted to another place, and there plugged into the nearest current outlet, e. g., 1f. Free outlets such as 1d and 1e may be used for connecting thereto additional sets of loudspeakers, be it in order to increase the length of the total frequency band covered by the sets 3 to 5, be it to increase the tone volume of a particular range of frequency as disclosed hereinbefore in discussing Fig. 1, or be it in order to vary the distribution of the sources of the sound waves emitted.

It has been stated that the general tone volume can be controlled by the energy control of the unit 2, and that a volume control of an individual range of frequency can be attained by varying the number of loudspeakers in the particular range. However, it will be apparent that such individual volume control will be possible only by rather large steps. In order to attain a finer control the invention further suggests the application of a centralized transmitter acting on receivers which in turn operate means for controlling the tone volume of the loudspeakers respectively. Apparatus useful for the indicated purpose is known in the art. However, we believe that such apparatus has not been used nor suggested in an arrangement and with the result described hereinafter. The apparatus here under consideration comprises a box or other suitable housing 40 of as many transmitters as there are ranges of frequencies in the system, i. e. three in the example of Fig. 2. The three transmitters 41, 42, and 43 are preferably of the type of the well-known pulser which emits impulses of radiations. The three transmitters or pulsers are of the same design but differ in tuning so that each pulser may emit waves of a distinctive length which differs also from that of the radiations of the oscillator 23 in order to avoid interference. Each loudspeaker set is provided with a corresponding receiver 44, 45, 46 respectively, tuned on the wavelength of the co-ordinate pulser and adapted to actuate a control, e. g. a variable resistance, (see Fig. 4) of the energy passing to the pertaining loudspeaker proper. In the illustrated example the control is applied between the radio frequency detector and the amplification stage of each set. However, it is also possible to control the energy at any other suitable point of the circuit supplying energy to the loudspeaker. Thus, by manipulating any one of the pulsers, e. g. pulser 42, it can be attained that the co-ordinate volume control receiver 45 is energized to cause increase or decrease of the tone volume of the loudspeaker 31. It will be noticed that the place where the pulser set 43 is positioned

can be selected as desired; it may be combined with the unit 2 in cabinet 6 of Fig. 1, or it may be separate therefrom and placed near the unit 2 or near one of the sets 3, 4, 5, or remote from any of the named apparatus, in view of the fact that it has no material connection with the unit 2 or the sets 3, 4, 5.

Any suitable type of radio oscillator, receivers, and accessorial parts may be used in the system according to our invention. Therefore, the detailed circuit diagrams of Figs. 3, 3a, and 4 are merely shown as examples and it will be noticed that the illustrated circuits of the individual part apparatus per se are well known in the art and are not claimed as our invention. For the same reason, a detailed description of the individual circuit element appears to be unnecessary. In general, Fig. 3 of the circuit for a unit 2 shows the net line 20 with outlet, into which the plug 50 of the short cable 37 with switch 51 may be inserted so as to supply the power pack 52 with current from the net. An oscillator 22 including the variable resistance 53 is connected to the power pack 52 on the one hand, and to the sound reproducer 21 on the other hand and supplies the radiator 23 with energy so as to emit radio waves to be received by the loudspeaker sets mentioned hereinbefore. The volume of the output energy can be controlled with the aid of the variable resistance 53 whose switch 7 is shown in Figs. 1 and 2.

Fig. 3a illustrates the circuit diagram of one of the three pulsers, e. g. 41 of the pulser set 40 which serves as transmitter for the individual volume control of the loudspeakers. The power for the pulser may be taken from any suitable source. In the present case, a battery 60 is used for this purpose rather than the general net, because it makes the pulser entirely independent of any connection and, therefore, facilitates its transportation from place to place. A control switch 61 is provided which may be actuated to give the desired impulses to the co-ordinate part at the pertaining loudspeakers. Such impulses occur in the form of radiations emitted from the coil 62. For fine tuning a variable condenser 63 may be provided.

The circuit shown in Fig. 4 is one which may be used in one of the loudspeaker sets, e. g. 3. In this figure, the main parts of Fig. 2 are separated from each other by dash and dot lines and denoted with the same reference numerals. The entire set may be connected to the net by means of the short cable 36 attached to the power pack 70 which delivers current to the receiver, i. e. a radio frequency detector 25, the latter being excited by radiations through antenna 24, and further to the amplifier 26 with filter so as to operate the loudspeaker 27. A variable resistance 71 serves to control the tone volume of the latter. In the receiver 44 for actuating the variable resistance 71, the impulses radiated from the pertaining pulser are received at 72 and amplified and so transformed with the aid of a means such as an RCA thyratron tube 80 that the switch 73 is moved in the one or the other direction so as to admit power to the reversible motor 74 whose shaft is mechanically connected to the movable part of the variable resistance 71 as indicated by the dash line 75. Thus, it will be clear that by manipulating switch 61 in Fig. 3a, the tone volume of the loudspeaker 27 can be controlled. If no individual volume control is required, the pulser 41 and the entire part denoted by 44 can be dispensed with and only the parts

indicated in Fig. 3 and the parts 70, and 24 to 27 of Fig. 4 for each loudspeaker set are required.

If, as mentioned, the wired wireless method is applied, the system in general is the same as hereinbefore described with the difference, however, that suitable filter circuits 80, 81, 82, and 83 will be substituted for the radiator 23 and antennas 24, 28, 32 of Figs. 2 and 4 respectively and connected to the power net 20. This is illustrated in Fig. 5.

What we claim is:

1. Sound reproducing system comprising a transmitting unit, a plurality of receiving sets at least one for each of a plurality of differently selected portions of the range of audio frequencies, the sum of which covers the entire range of audio frequencies, said unit comprising a sound reproducer, a short wave radio transmitter including a radiator and means for controlling the energy supplied to said radiator, each of said receiving sets comprising short wave receiving means tuned on the wavelength of said transmitter and including an antenna to receive radiations from said radiator, a filter according to that portion of the range of audio frequencies for which the set is destined, an amplifier and a loudspeaker, a plurality of outlets of current from an external source, said outlets being provided within the room equipped with the system, and means for detachably connecting said unit and said sets individually to selected ones of said outlets.

2. Sound reproducing system comprising a transmitting unit, a plurality of receiving sets at least one for each of a plurality of differently selected portions of the range of audio frequencies, the sum of which covers the entire range of audio frequencies, said unit comprising a sound reproducer, a short wave radio transmitter including a radiator and means for controlling the energy supplied to said radiator, each of said receiving sets comprising short wave receiving means tuned on the wavelength of said transmitter and including an antenna to receive radiations from said radiator, a filter according to that portion of the range of audio frequencies for which the set is destined, an amplifier and a loudspeaker, a plurality of outlets of current from an external source, said outlets being provided within the room equipped with the system, means for detachably connecting said unit and said sets individually to selected ones of said outlets, and centralized radio remote control means for controlling the tone volume of the receiving sets of each of said frequency ranges individually.

3. A system as claimed in claim 2 wherein said remote control means comprises a movable pulser unit having as many differently tuned and individually operable pulsers as there are receiving sets of different frequency ranges, each pulser being co-ordinate to one of said ranges, and a means in each of said transmitter sets operative to control the energy supplied to the pertaining loudspeaker, and responsive to the impulses received from the co-ordinate pulser.

4. Sound reproducing system comprising a transmitting unit, a plurality of receiving sets at least one for each of a plurality of differently selected portions of the range of audio frequencies, the sum of which covers the entire range of audio frequencies, said unit comprising a sound reproducer, and a radio transmitter including means for controlling the energy output of said transmitter, each of said receiving sets comprising receiving means tuned on the wavelength of

said transmitter, and a filter according to that portion of the range of audio frequencies for which the set is destined, an amplifier and a loudspeaker, a plurality of outlets of current from an external power network, said outlets being provided within the room equipped with the system, means for detachably connecting said unit and said sets individually to selected ones of said outlets, so as to supply said unit and said sets with currents, a circuit between the output 10

side of said transmitter and respective connecting means, said circuit including means for impressing oscillations caused by said transmitter on said net, and individual circuits between said receivers and their respective connecting means, said circuits including means to transmit impressed oscillations from said net to the receivers.

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