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RADIO RECEIVING AND DISTRIBUTING SYSTEM

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2 Sheets-Sheet 1

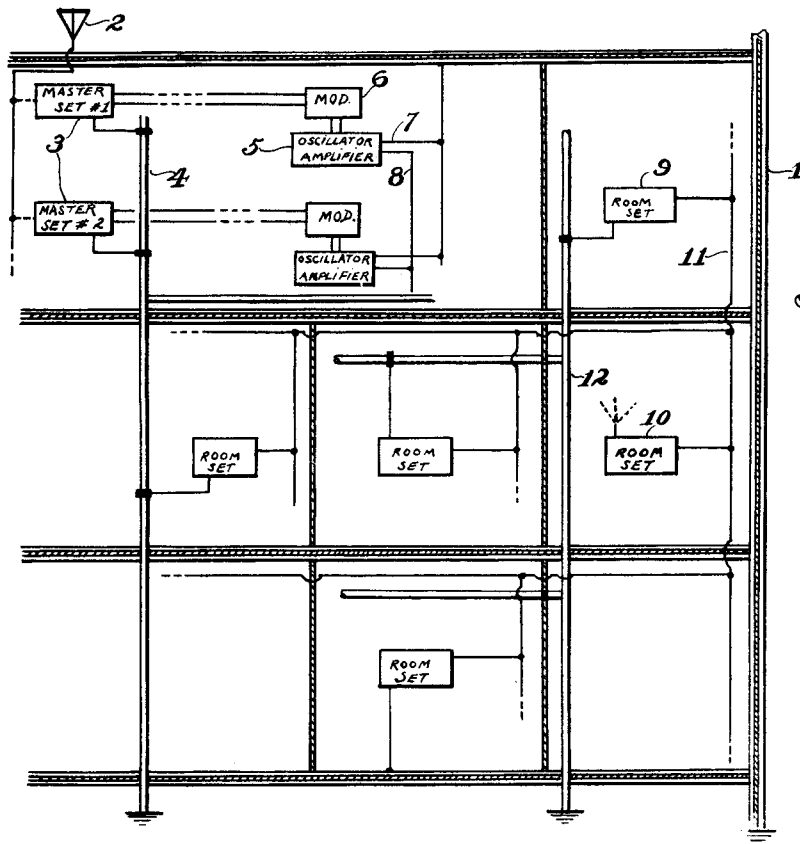


Fig. 1.

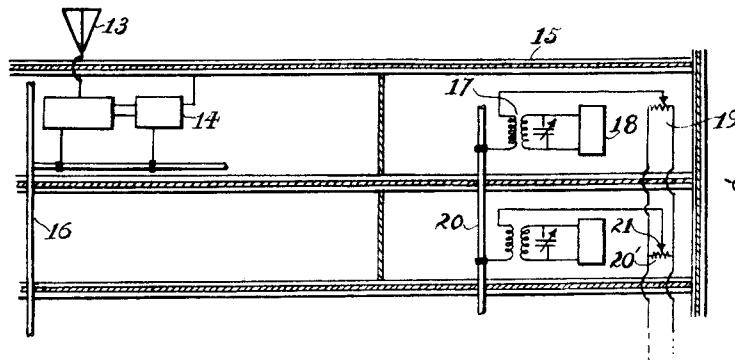


Fig. 2.

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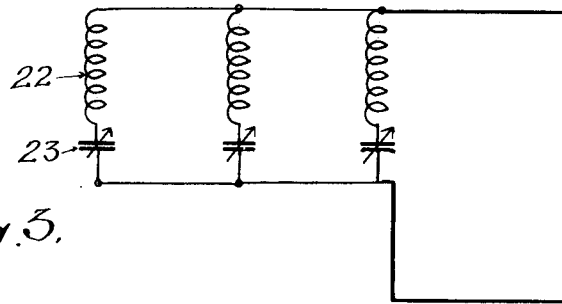
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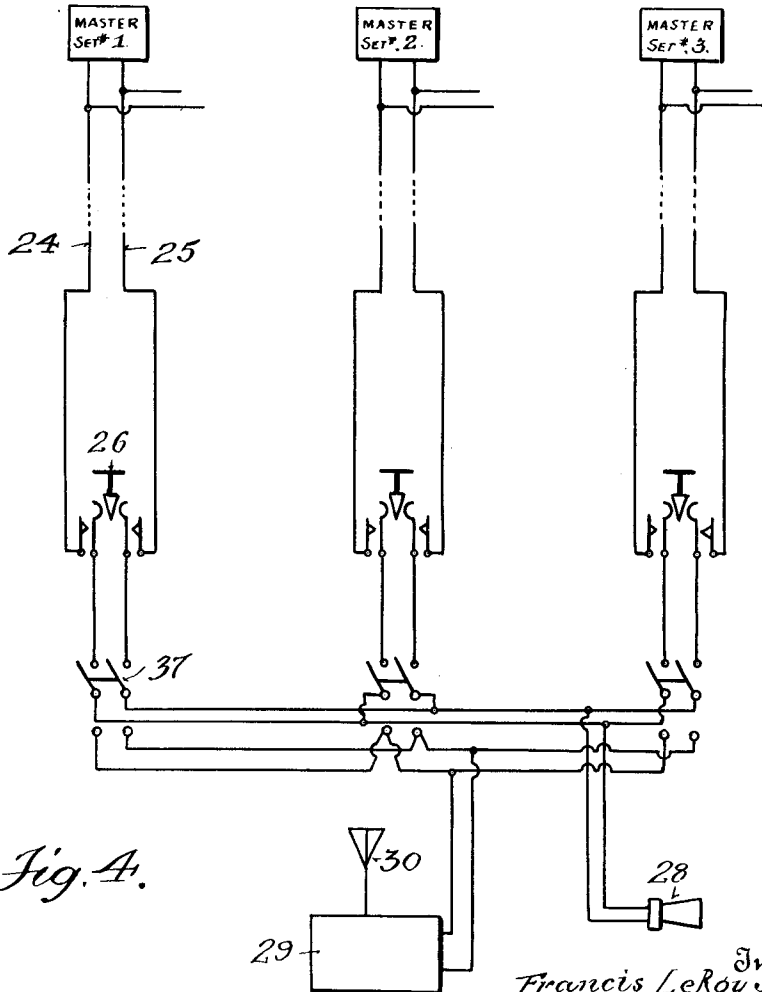
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*Fig. 3.*



*Fig. 4.*

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# UNITED STATES PATENT OFFICE

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## RADIO RECEIVING AND DISTRIBUTING SYSTEM

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6 Claims. (Cl. 250—15)

This invention relates to transmission systems and with particularity to systems for redistributing radio messages or programs.

An object of the invention is to provide a system of intercepting and redistributing radio signals in which one type of antenna system is employed for reception of the original signals and a different type is used for reception of the redistributed waves.

A further object of the invention is to provide a system of distributing radio signals which is particularly well adapted for apartment houses, hotels, or the like, and without necessitating complicated transmitting and receiving apparatus.

A feature of the invention pertains to means for redistributing within a building wherein the usual building structure and adjuncts may be employed to form complete loop antenna systems.

A further feature pertains to means for retransmitting radio signals within a building wherein two portions of the building structure are used as a transmitting loop antenna, and another two portions are used as a receiving loop antenna, thus obviating the erection and maintenance of special antenna systems for this purpose.

A further feature pertains to means for distributing radio programs to the rooms in a hotel, apartment or other building, by employing a master receiving set at one part of the building, and using the building framework, water pipes, steam pipes, and the usual wiring such as electric light, telephone, etc. for distributing the programs to the several rooms or locations within the building, under control of the master set.

A still further feature relates to a switching and monitoring system for controlling the distribution of radio programs within a building.

It is well known that in large buildings the metal framework is usually detrimental to good broadcast reception, and in order properly to receive the programs, special or highly efficient antenna systems and receiving sets must be employed. In the case of apartment houses, hotels, or the like, where there may be a great number of listeners-in, it is manifestly impractical and prohibitive in cost to provide each occupant with a separate outdoor antenna. Likewise, while each set might be equipped with a so called "loop" or indoor antenna, it is necessary, especially because of the steel building structure, floors, etc., to provide highly sensitive receiving sets.

The above and other disadvantages are overcome by the present invention since a single master set alone is required for the entire building for each broadcast program desired, and relatively

inexpensive individual receiving sets may be employed throughout the building.

For the purpose of illustrating one phase of the invention, there is shown in Fig. 1 a schematic representation of a building having individual receiving sets distributed throughout and common master receiving sets.

Fig. 2 is a modification of Fig. 1.

Fig. 3 is a schematic diagram showing the manner of proportioning the characteristics of the output and antenna circuits according to another phase of the invention.

Fig. 4 is a wiring diagram of one form of "monitoring" equipment.

Referring more particularly to Fig. 1, the numeral 1 represents the steel framework of a building such as an apartment house, hotel, or the like, having a plurality of rooms wherein the radio programs are to be received. Situated at a convenient point on the building, and preferably at a location where the broadcast waves may be most efficiently intercepted, is the usual receiving antenna 2; while this antenna is shown in the drawings as external to the building it will be understood that an indoor antenna may also be employed for reception of the broadcast waves. Located within the building, preferably near the antenna 2 are a plurality of receiving sets 3 of any well known and efficient construction. The ground connection for the master sets is made to the water pipe system 4 of the building, or other suitable ground. Associated with each master set is a source of amplified radio frequency oscillations 5, and a modulating device 6. The audio frequency output from each set 3 is connected to its respective modulator 6 whereby the radio frequency oscillations from source 5 are modulated in the well known manner. The frequencies of the respective oscillator may be fixed or adjustable, however, it is preferred to adjust each frequency so that there may be a minimum of interference with the waves to be intercepted by antenna 2. The oscillators are so positioned with respect to the receiving antenna 2 and the master sets, that there is a minimum of interference from re-radiation, electromagnetic coupling, etc. Likewise the oscillators are shielded to prevent this electrostatic or electromagnetic interference. The amplified modulated outputs of devices 5 are then impressed by means of conductors 7 and 8 upon a novel radiating loop antenna system, including the framework 1 of the building, the connection for completing the transmission loop of this system being provided by the water pipe 4. Located at various points throughout the build-

ing are receiving sets 9, 10, etc. which may be of any well known construction. In the case of apartments or hotels there may be a receiving set in each room, or if desired, the occupant of each room may be required to communicate with the management of the hotel or apartment with the purpose of supplying said occupant with a receiving set. In this latter case, since it is not likely that all the occupants of the rooms will be using receiving sets at the same time, fewer sets are required, and are used only when requested by the room occupants.

The waves which are impressed upon the framework 1 under control of the master transmitters 5 are intercepted by a magnified loop antenna system comprising the usual wiring of the building and another metallic portion of the building structure as for example the steam pipe system. In Fig. 1 of the drawings this wiring is represented by the numeral 11, and may either be the usual telephone wiring or electric light wiring. It has been found that in buildings equipped with three-wire systems or the like, that the midpoint or neutral wire of the electric light system provides the most desirable point to which the receiving set 8 may be connected, thus the wire 11 shown in Fig. 1 represents schematically this neutral wire of the lighting system. It will be understood, however, that in the case of two-wire systems the connection may be made to either wire of the system. For the purpose of completing the loop system for the room sets the steam piping 12 may be used. Because of the effective close coupling between the building framework 1 and the wiring 11, the programs which are redistributed are efficiently transmitted to the receiving sets 9, and consequently these sets may be much simpler than the usual set which is used for directly receiving broadcast waves. Instead of supplying the necessary audio amplification with each set the output of device 5, which is common to all the sets, may be sufficiently amplified to enable the individual room sets to require for example, only one stage of audio amplification. Likewise, the detector system of the room sets may also be simple, because of the efficient transmission between the loop antenna systems. If desired a common amplifier may be provided for the modulated outputs of the oscillators instead of individual amplifiers as shown in Fig. 1, and any well known type of indoor antenna may be used with the room sets.

Thus when an occupant of a room in a hotel desires to listen-in on a radio program, he communicates over the telephone, or in any other manner, with the management and requests that a room-set be forwarded to his room. All that is necessary upon the arrival of the set is to connect one of the antenna posts of the set to the wire 11, and the other antenna post to the steam pipe 12. It will be understood that instead of an actual direct connection to the lighting system, wiring may be provided from such point to a suitable outlet within the room.

Referring to Fig. 2 there is shown a modification in which the broadcast programs are intercepted by the usual antenna 13, and are amplified by a highly efficient radio frequency amplifier 14, the output of this amplifier system being impressed upon the framework 15 of the building. The ground connection for the receiving antenna 13 being provided by the water pipe 16. In each room of the building is located a receiving set comprising the usual selective means represented generally by the numeral 17, and detecting and

amplifying means, represented generally by the numeral 18. The loop antenna system for the room set is provided by the electric light or telephone wiring 19, and the steam pipe 20. The wiring system 19 may be the same as that described in connection with Fig. 1, that is, it may be the neutral wire of a three-wire system. However, in buildings which are equipped only with two-wire systems, it may be desirable to provide an effective midpoint by means of a resistance 20' and a tap 21, as will be clear to those familiar with the art. In the system disclosed in Fig. 2, it is obvious that a single master set and amplifier 14 is required for each broadcast program received, and that the occupant of each room is enabled to select any one of the broadcast programs that he desires.

It has been found preferable to redistribute the programs from the master sets at a different wave-band from that used in the broadcast range. While this redistributing wave-band may be a lower one, it has been found that a band from 1000 to 2000 meters produces the best results. However, for any particular building it is advisable to correlate the wave-band to the electrical characteristics of the building structure, so that the most efficient radiation or transmission is effected.

In order that there may be a minimum of interference between the several programs which are impressed upon the building transmission loop it has been found necessary properly to proportion the electrical constants of the output resonators of devices 5 with respect to the building structure. For example as shown in Fig. 3 characteristics of the output resonators are represented by the respective inductance 22 and condenser 23. It has been found that the characteristic of the building loop antenna system is predominately an inductance one and that the best results are obtained when the inductance of the output resonators is very much higher than that of the building loop antenna system.

In one large hotel building in which the above described system was installed it was found that the waves impressed upon the building structure from the master transmitting sets were substantially entirely restricted to the volumetric unit of space defined by the building limits. As a matter of fact, actual tests showed that there was substantially no radiation exteriorly of the building. Probably one explanation for this result is that the building framework, together with the piping system acts as a large loop, as represented schematically in Fig. 3, while the building wiring and another piping system acts as a receiving loop. Because of the inductance characteristics of the building structure in conjunction with the resonators 22, 23, the transmitting loop as a whole possesses substantially no radiating efficiency. However, since the receiving loops are in such close proximity to the transmitting loop, there is sufficient power transmitted through the system to operate the receiving apparatus. It is a well known fact in transmission systems that where the resonator operates into the line at surge impedance, there is substantially no reflection and consequently no radiation. However, it is to be understood that the present invention is not to be limited to any particular theory of operation, it having been found that the use of the building frame work and a building adjust such as a piping system forming one loop, and the building wiring forming a portion of the receiving loop, that practical results can be attained without ra-

diating any of the power outside of the building proper.

Referring to Fig. 4 there is shown one type of monitoring system which may be used to check the programs as they are transmitted from the building structure, with the programs as they are received by the master sets. For this purpose the output circuit of each master set is connected by means of conductors 24, 25, to the normally open contacts of a key 26, there being one of these keys for each of the master sets. Associated with each key 26 is a double pole double throw switch 37, which in one position connects the associated master set with the monitoring reproducer 28. The switch 37 in its other position connects the reproducer 28 with the output circuit of the monitoring receiving set 29, which may be provided with a loop antenna 30, or may be connected to the building wiring and piping systems as described in connection with Fig. 1.

Thus, for example, assuming that a program is being received by master set No. 1 and it is desired to check the programs as redistributed under control of such master set the key 26 is operated to close the associated contacts and the switch 37 is thrown to its upper position wherein the reproducer 28 is connected directly to the first master set. The attendant then throws switch 37 to its lower position and the reproducer 28 is connected directly in circuit with the monitoring receiving set 29. If the attendant finds that the programs as received on the monitoring set are not at the required level, he may change the adjustment of the master set by any suitable volume control, until the desired level in the monitoring set is reached. Similar switches are provided for each of the other master sets. It will be understood that while each master set is connected directly to its associated key 26, that any well known remote control means may be provided for controlling the effectiveness of the master set.

For example the contacts of key 26 when closed may serve to operate a relay at the master set which either short circuits or opens the output of said set.

While specific apparatus has been described for carrying out the invention, it will be understood that in its broad aspects the invention is not limited thereto, the main objects being the provision of a distributing system for apartment houses, hotels, or the like utilizing existing apparatus, and requiring inexpensive individual receiving sets.

What is claimed is:

1. In combination a metallic framework serv-

ing as the supporting structure of a building, a master radio receiving set within the building, an oscillator within the building, means for modulating said oscillator with the signals from said master set, a first metallic adjunct of the building, means for impressing said modulated oscillations on said framework and adjunct for purposes of transmission within the building, and means including a power wiring system and said adjunct connected to the signal input of a radio receiving set for intercepting waves radiated from said framework.

2. The combination according to claim 1 in which the neutral wire of a three-wire power system is connected to said receiving set.

3. In combination a metallic framework serving as the supporting structure of a building or the like, means for applying modulated high frequency oscillations to said framework for purposes of transmission within the building, a plurality of radio receiving sets, and an antenna system for said receiving sets including the electric light wiring system of said building.

4. A system for distributing radio programs within a building and substantially confining useful radiation within the limits of said building, the combination of a distributing radiating antenna comprising the metallic framework of the building, an intercepting receiving antenna including the electric light wiring of the building, and a plurality of radio receiving sets having their signal input terminal connected to said wiring.

5. Means for redistributing radio signals within a building comprising a master receiving set, a radiating system including the building framework and one of the building piping systems, said radiating system being energized under control of said master set, and a receiving system including the power wiring of the building and another piping system.

6. In a system for redistributing radio programs within a building the combination of a master receiving set, means for modulating a carrier wave in accordance with the output of said set, means for impressing said modulated carrier on the building framework, monitoring means including a radio receiving set and a sound reproducer, switching means for connecting said reproducer to said master set in one position and in another position to connect said reproducer with said monitoring set whereby the output of said master set may be compared with the programs as radiated from the building structure.

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