May 31, 1932. C. W. HOUGH 1,861,183

RADIO RECEPTION SYSTEM

Original Filed July 10, 1925 3 Sheets-Sheet 1

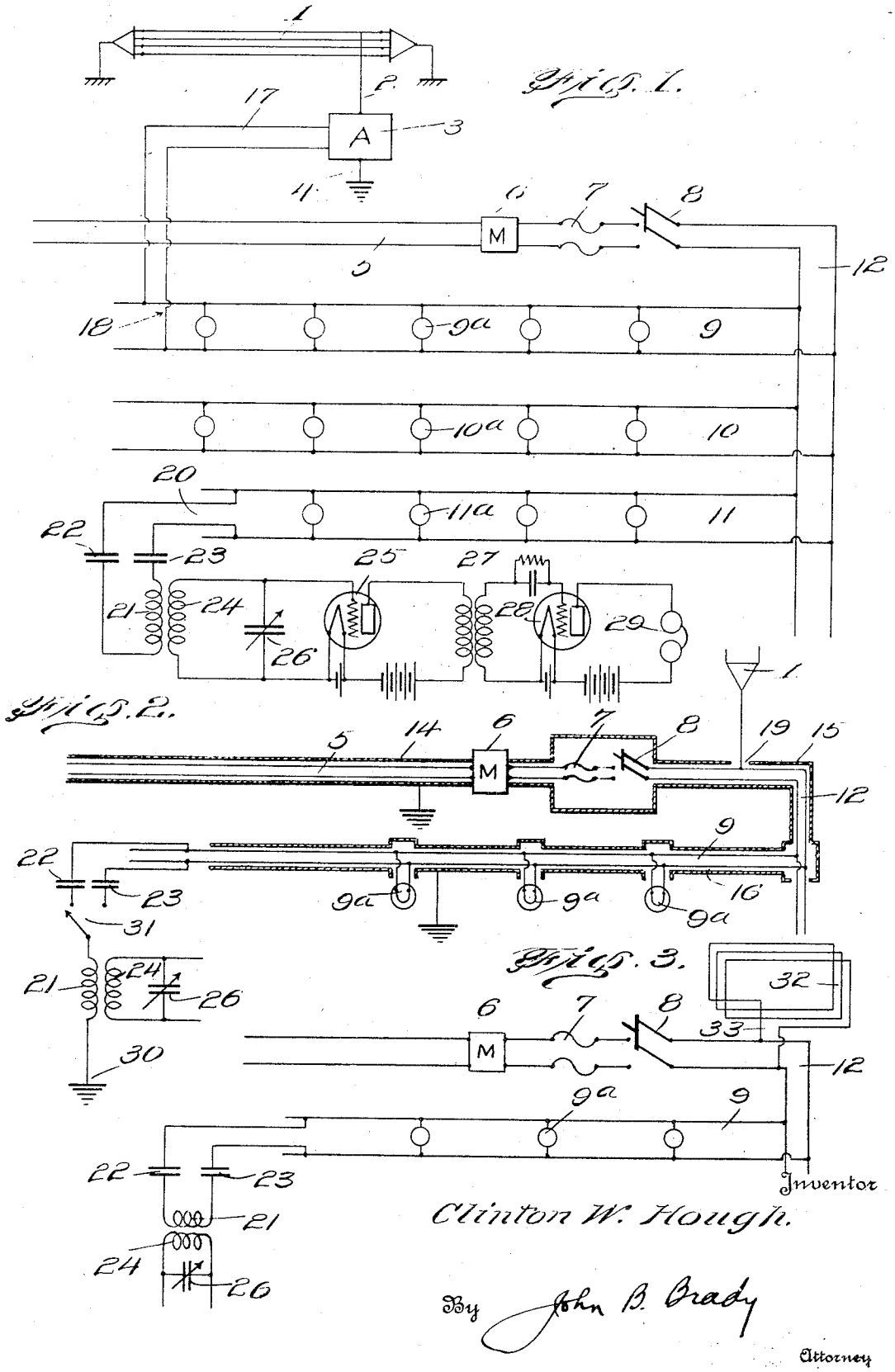


Fig. 1.

Fig. 2.

Fig. 3.

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RADIO RECEPTION SYSTEM

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Fig. 4.

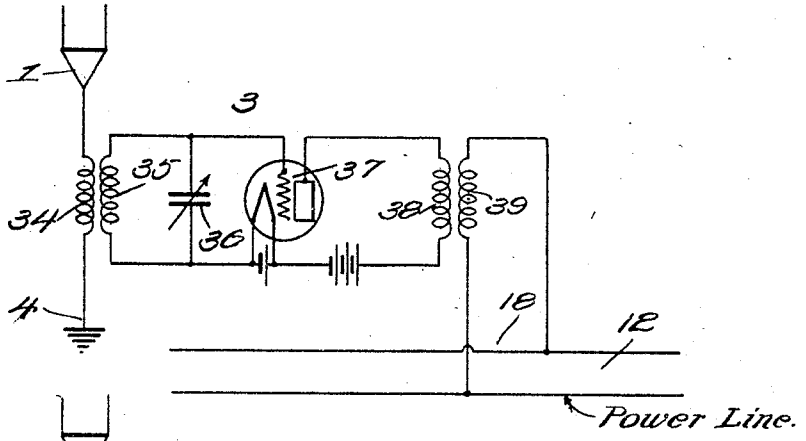


Fig. 5.

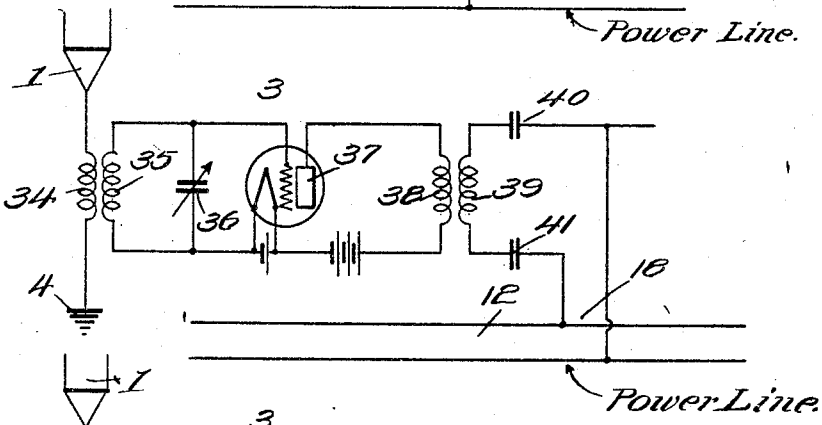


Fig. 6.

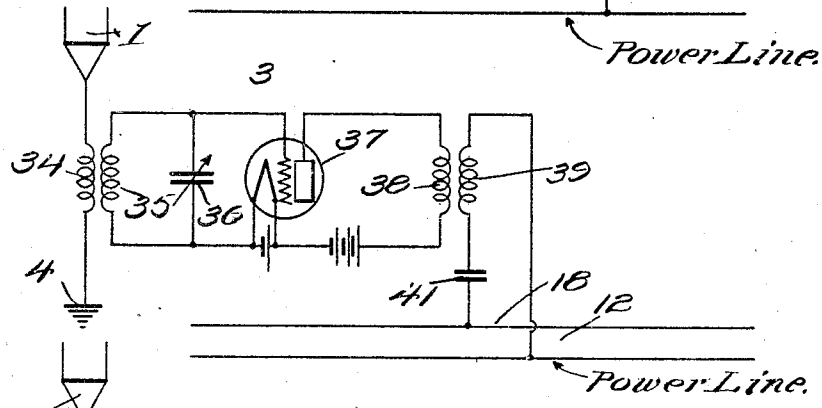
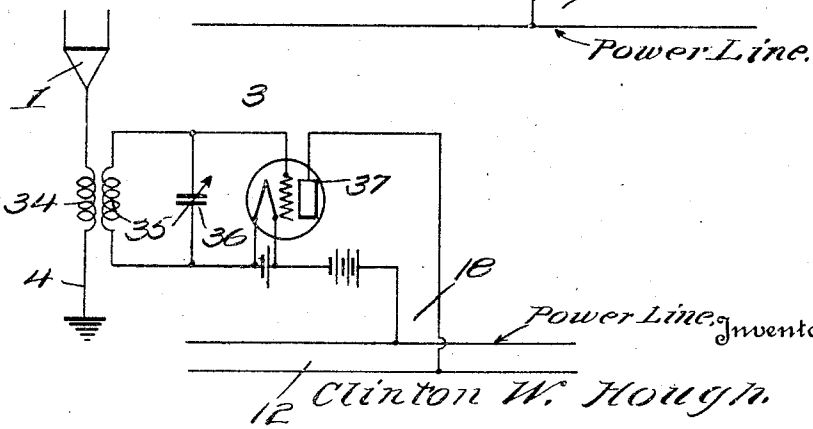


Fig. 7.



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Fig. 8.

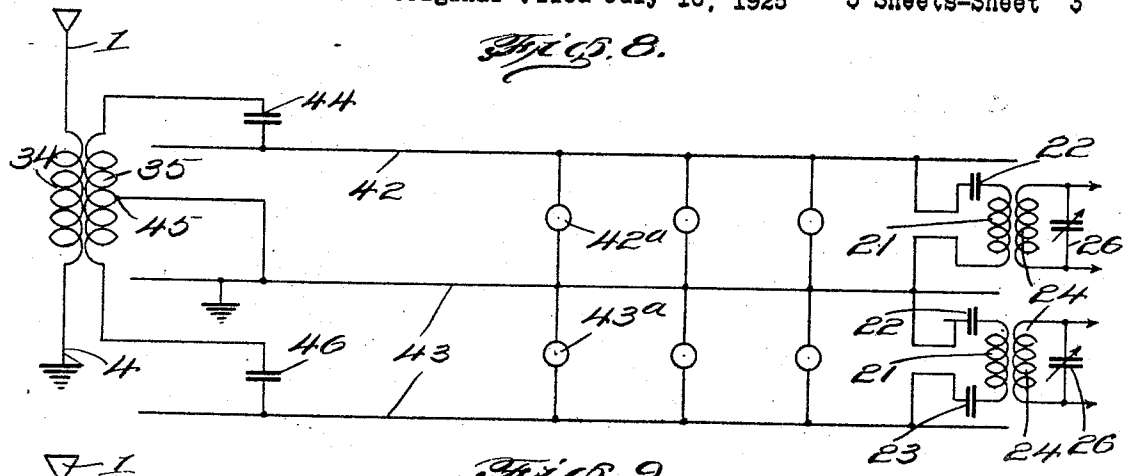


Fig. 9.

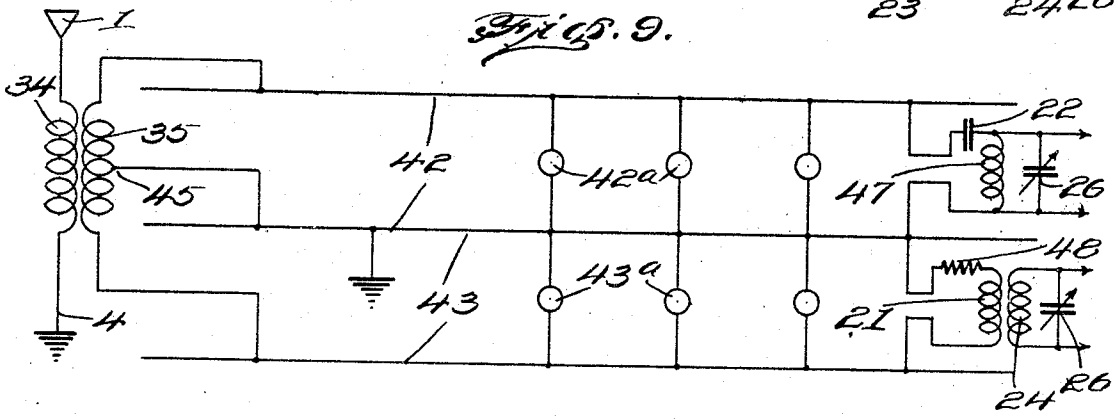
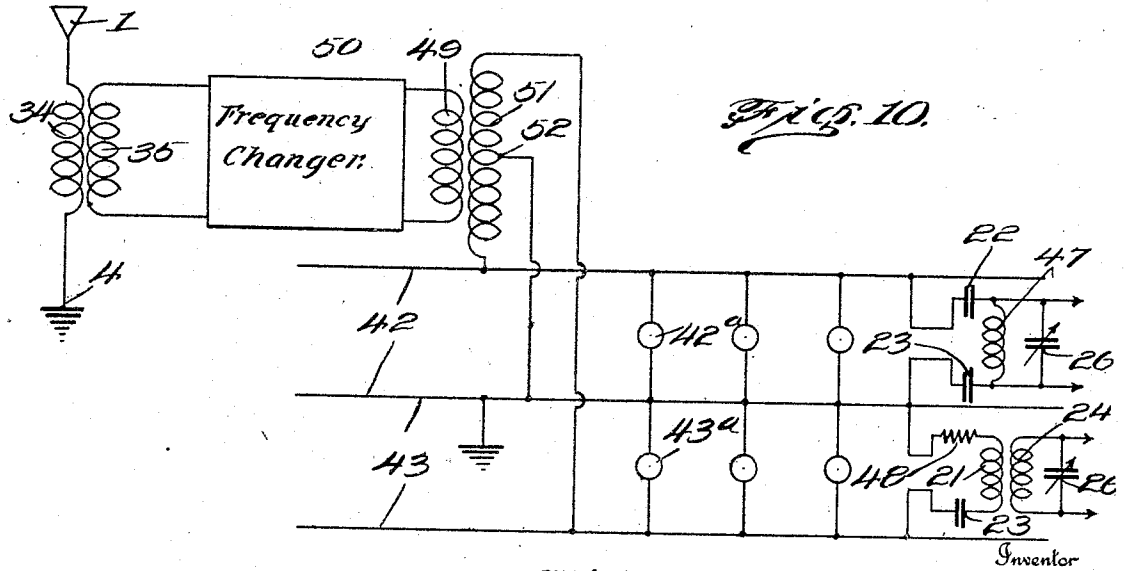


Fig. 10.



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Patented May 31, 1932 1,861,183

UNITED STATES PATENT OFFICE

CLINTON W. HOUGH, OF NEW YORK, N. Y., ASSIGNOR, BY MESNE ASSIGNMENTS, TO WIRED RADIO, INC., OF NEW YORK, N. Y., A CORPORATION OF DELAWARE

RADIO RECEPTION SYSTEM

Application filed July 16, 1925, Serial No. 42,691. Renewed May 8, 1931.

My invention relates broadly to systems for the reception of radio signals and more particularly to a system for the operation of a multiple number of receiving sets from a common radio frequency energy feed system.

One of the objects of my invention is to provide a radio frequency energy feed system, where radio frequency currents may be supplied to a plurality of receiving sets through a common line wire system.

Another object of my invention is to provide means for feeding radio frequency currents which are received by a space radio receiving system over the power lines in a concentrated area in such manner that radio receiving sets may be connected into the line wire system at desired points for reproducing the radio signals.

Still another object of my invention is to provide circuit arrangements for the connection of radio receiving apparatus to various points in a line wire system by which radio frequency currents are conveyed from a space radio receiving set to the line wire system.

A further object of my invention is to provide a radio receiving system which is adapted for operation of a multiple number of receiving sets within an apartment house, or other concentrated area, where received radio currents are impressed upon the power mains for delivery to any number of individual receiving sets, which may be plugged into the electric light sockets in the lighting line at various points in the lighting system for reproducing the signaling energy.

Another object of my invention is to provide means for receiving space radio signals and changing the frequency at which said signals may be distributed over the lighting lines to any desired number of receiving sets in a concentrated area.

A still further object of my invention is to provide means whereby the lighting or power lines within a given area may be utilized for conveying radio frequency currents to any number of independent receiving sets without the detrimental shielding effects normally introduced by the conduits which enclose the conductors and the metallic outlet boxes which enclose the switches, contacts and meter forming part of the power system.

My invention will be more fully understood from the following specification and the accompanying drawings, wherein Figure 1 represents diagrammatically the arrangement of the space radio receiving system and the line wire network over which the radio frequency currents are conveyed to any number of independent receiving sets; Fig. 2 is a diagrammatic view showing the arrangement of the grounded shields normally employed in power line systems which normally preclude the utilization of such systems as pick up areas for radio frequency currents and illustrating the means which I provide for enabling the line wires to become a good conveyor of radio frequency currents; Fig. 3 is a diagrammatic view illustrating another form of pick up circuit for impressing received space radio signals upon the power line system; Figs. 4, 5, 6 and 7 show various methods of connecting the radio frequency feed system to the power lines; Figs. 8 and 9 show methods of connecting the radio frequency feed system to a three wire lighting system and illustrating the arrangement of receiving sets which may be plugged in at various points along the line; and Fig. 10 illustrates a method by which signals may be picked up at a given signaling frequency and transferred to that frequency which can be most efficiently received over the line wire circuit.

Heretofore in the art it has been proposed to utilize the electric lighting or power line as a pick up area for the radio frequency currents received in space radio signaling systems. In these systems the received radio frequency currents are often screened by the grounded metal conduits which enclose the electric lighting line and a receiving set cannot be readily coupled to the line so that it will efficiently reproduce the signaling energy. The metal conduits which enclose the conductors are substantially continuous and terminate in metallic casings and housings which contain the switches and fuses, and terminal blocks for the system. The conduit continues to each terminal block and often

has the electrical effect of extending over the socket into which the receiving set is connected. The conduit is permanently grounded and any space radio frequency energy instead of being efficiently picked up by the line wire system is normally conveyed to ground through the conduit. By my present invention, I provide means for positively picking up the space radio currents and impressing the same on the power line. This is accomplished by means of a suitable radio frequency energy collector which is connected to the line wire system for impressing radio frequency currents directly thereon.

My invention also contemplates the adaptation of a radio frequency feed system to three wire systems of power distribution and also to the change in the frequency of the energy from the signaling frequency to any desired frequency over the line wire system. That is to say, the signals may be received at that frequency which is available in the broadcasting band and then transferred to a higher or lower frequency for distribution over the line wire system for reception of the signals with maximum efficiency and minimum interference.

Referring to the drawings in detail, reference character 1 designates an antenna system which I provide for picking up radio frequency signaling energy. The antenna system may connect through the conductor 2 with a suitable amplification system 3, the radio frequency pick up circuit being completed through ground connection 4. The power lines have been indicated at 5 leading through meter 6, fuses 7 and main switch 8 to the distribution line 12 and to branch circuits 9, 10 and 11. The branch circuits have been indicated as having lamps 9*a*, 10*a* and 11*a* fed therefrom. The power line conductors 5, distribution circuit 12 and branch circuits 9, 10 and 11 are normally encased in grounded metal conduits represented at 14, 15 and 16 which serve to normally shield the power lines against radio frequency currents. By my invention I provide means for impressing upon the distribution circuit 12 the radio frequency energy existent upon the antenna system 1. The output circuit 17 from the amplifier 3 may be connected to the branch circuit 9 as indicated at 18 by which radio frequency currents are led throughout the power line system. As represented in Fig. 2, the antenna 1 may be connected directly to one of the power lines in the distribution circuit 12 as represented at 19. The receiving sets may be plugged into any of the lighting sockets in the lighting system, connections being taken through leads from the socket at 20 as indicated in Fig. 1 to a series circuit including the primary inductance 21 and coupling condensers 22 and 23. The receiving set may be of any desired construction, and may be coupled through a secondary winding 24 with the primary winding 21. The receiving circuit illustrated in Fig. 1 consists of a radio frequency amplifier 25 having its input circuit tuned by means of condenser 26 with the output circuit of the radio frequency amplifier 25 connected through coupling circuit 27 with detector circuit 28 for the operation of a suitable responsive device 29. In Fig. 2, I have illustrated a modified method of connecting the receiving circuit to the line where switch device 31 may be utilized to connect the receiving circuit with the line through either coupling condenser 22 or 23. The primary inductance 21 is connected to ground 30 so that radio frequency energy existent on the antenna 1 is conveyed through the primary inductance 21 to ground and transferred to the secondary circuit comprising inductance 24 and variable capacity 26. In Fig. 3, I have indicated a radio frequency energy pick up circuit in the form of a loop collector 32 which impresses radio frequency energy across the distribution circuit 12 to connections 33. The loop collector provides a sufficient load to prevent short circuiting of the distribution system. In Figs. 4–7, I have represented various methods of connecting the radio frequency energy collecting system with the line. The antenna 1 and ground 4 may connect to the amplification system 3 through coupling coils 34 and 35 tuned by means of condenser 36 to the desired receiving frequency. A suitable amplifier including any number of electron tubes designated at 37 may be connected in the circuit. The output circuit of the amplifier 37 may include an inductance 38 coupled with an inductance 39 which may be inductively connected to the power distribution line 12 at 18 as represented in Fig. 4. The inductance 39 may be connected to the power distribution line 12 through coupling condensers 40 and 41 as represented in Fig. 5. Fig. 6 shows a method of connecting the radio frequency feed system to the power distribution line 12 where only a single condenser 41 is included in the circuit. Fig. 7 shows a method of impressing the radio frequency currents upon the power distribution line by a conductive connection in the output circuit of tube 37 to the line wire system.

In Figs. 8 and 9 I have shown the radio frequency feed system associated with a three wire system. The incoming signaling energy which is impressed upon the antenna ground circuit 1—4 is transferred inductively to windings 34 and 35 through the three wire power distribution system having lines 42 and 43. A midtap connection 45 is provided in the secondary inductance 35 and energy impressed upon both sides of the three wire system through condensers 44 and 46 and connections to the line. The line wire system is shown as having load 42*a* and 43*a* in

the form of incandescent lamps with connections of the radio receiving apparatus through a single capacity coupling 22 or the pair of condensers 22 and 23.

In Fig. 9, I have shown direct connections from the radio frequency feed system to the three wire power distribution circuit. The receiving circuits may be coupled to the line by a reactance circuit 47 or a regulating resistance 48 may be connected in series with the primary winding 21 as has been represented. In Fig. 10, I have illustrated the interposition of a frequency changer between the antenna ground system 1—4 of the radio frequency collecting circuit and the power distribution circuit by which the incoming signaling energy may be transmitted to the receivers with greatest efficiency. The output circuit of the frequency changer connects to primary inductance 49 which transfers energy through secondary winding 51. A mid-tap connection 52 is provided in the secondary inductance 51 from which leads are taken to the power distribution circuit. I have illustrated the reactance coupling of the radio receiver at 47 with condensers 22 and 23 disposed in series with the line. I have also shown resistance 48 disposed in one side of the line leading to primary coupling coil 21 with the condenser 23 disposed in the other side of the line connecting coupling coil 21.

Extended research and investigation has shown that it is impractical to receive short waves over a line system at a distant point and excite a plurality of receivers with sufficient amplitude to secure volume reception. A line system responds better to signaling energy of relatively long wavelength. Accordingly, short wave signaling energy is picked up as set forth herein and impressed upon a power distribution line at a point which is closely adjacent the points of take off by a plurality of receiving sets. In this way the actual path of travel of the electromagnetic waves over the power distribution circuit is relatively short. In order however to efficiently transmit the signaling energy over the power distribution circuit at longer wavelengths than the wavelength at which this energy is transmitted through space, I may employ to advantage the frequency changer illustrated in Figure 10 for increasing the wavelength or lowering the frequency of the signaling energy to a value at which it may be efficiently transmitted over the power line system to the plurality of receiving sets.

It will be understood that the system described herein may be employed throughout certain city areas, communities and buildings, such as apartment buildings, where a large number of receiving sets may be plugged into the line at various points for reproduction of the radio signaling energy. It will be appreciated that by this method received radio frequency energy may be impressed upon the line wire system at relatively large amplitude and then delivered to receiving sets which do not require considerable amplification for reproduction of signals at relatively large amplitude. In this way the receiving sets used by the various subscribers may be relatively inexpensive in construction in that only a small number of tubes is required for satisfactory reception. It will be further seen that by reason of the ability of the system to be operated at desired frequencies, the signaling frequency is dependent only upon the available wavelength band for after the radio frequency energy is collected the frequency may be properly chosen for impression upon the power line system.

While I have described my invention in certain particular embodiments, I desire that it be understood that modifications may be made and that I intend no limitations upon the invention other than those imposed by the scope of the appended claims.

What I claim and desire to secure by Letters Patent of the United States is as follows:

1. In a system for distributing signaling energy over a three wire power distribution network, the combination of an antenna system, a receiving set having its input circuit connected to said antenna system, the output circuit of said receiving said set being connected to each of the wires of said three wire power distribution network for the purpose of impressing signaling energy received by said antenna system upon said power distribution network, means connecting a plurality of sound reproducing means to said network whereby the signaling energy impressed upon said network may be reproduced, part of said sound reproducing means being connected to the neutral wire and another wire of said three wire network, and another part of said sound reproducing means being connected to the neutral wire and the other wire of said three wire network.

2. In a system for distributing intelligence within a structure having a three wire power distribution network therein, the combination with the power distribution network of an antenna system, a receiving set connected to said antenna system for receiving wave signaling energy, the output circuit of said receiving set being connected to each wire of said three wire power distribution network for impressing signaling energy upon said network for distribution through said structure, said network being substantially shielded from electromagnetic waves by metallic walls within which it is housed, and a plurality of signal reproducing devices coupled to said network at spaced intervals throughout said structure whereby signaling energy impressed upon said network may be reproduced at spaced intervals throughout said structure, each of said reproducing devices

being connected to two wires of the three wire power distribution network.

3. In a radio signal distribution system for receiving sets within a localized area, a master receiving and retransmitting set comprising means for changing the frequency of the received signals to a lower frequency suitable for wired radio transmission through armored conductors or metallic conduits, means for impressing the output of said retransmitting set on metallic conductors within the area, said metallic conductors being simultaneously serviceable as power or lighting circuits and a plurality of receiving sets connected to said metallic conductors.

4. In a radio signal distributing system for a building, a master receiving set, means for changing the frequency of the received radio signals to a frequency suitable for wired radio transmission, a plurality of separate receiving sets located within said building, a power and lighting service network of conductors within metallic conduits and means for retransmitting signals from said master set through said network to said plurality of separate receiving sets.

5. The method of receiving radio-frequency signals and distributing correlative wired-radio signals through a network of armored cable or power and lighting conductors housed in metallic conduits, to a plurality of receiving sets which consists of amplifying the received signals, translating the radio-frequency signals into oscillations of a lower frequency, impressing said oscillations upon said network and receiving said oscillations at said plurality of receiving sets.

6. The invention set forth in claim 4 in which said power and lighting service network comprises a three wire system both sides of which together with the neutral wire are used for retransmitting said signals.

CLINTON W. HOUGH.