

July 4, 1939.

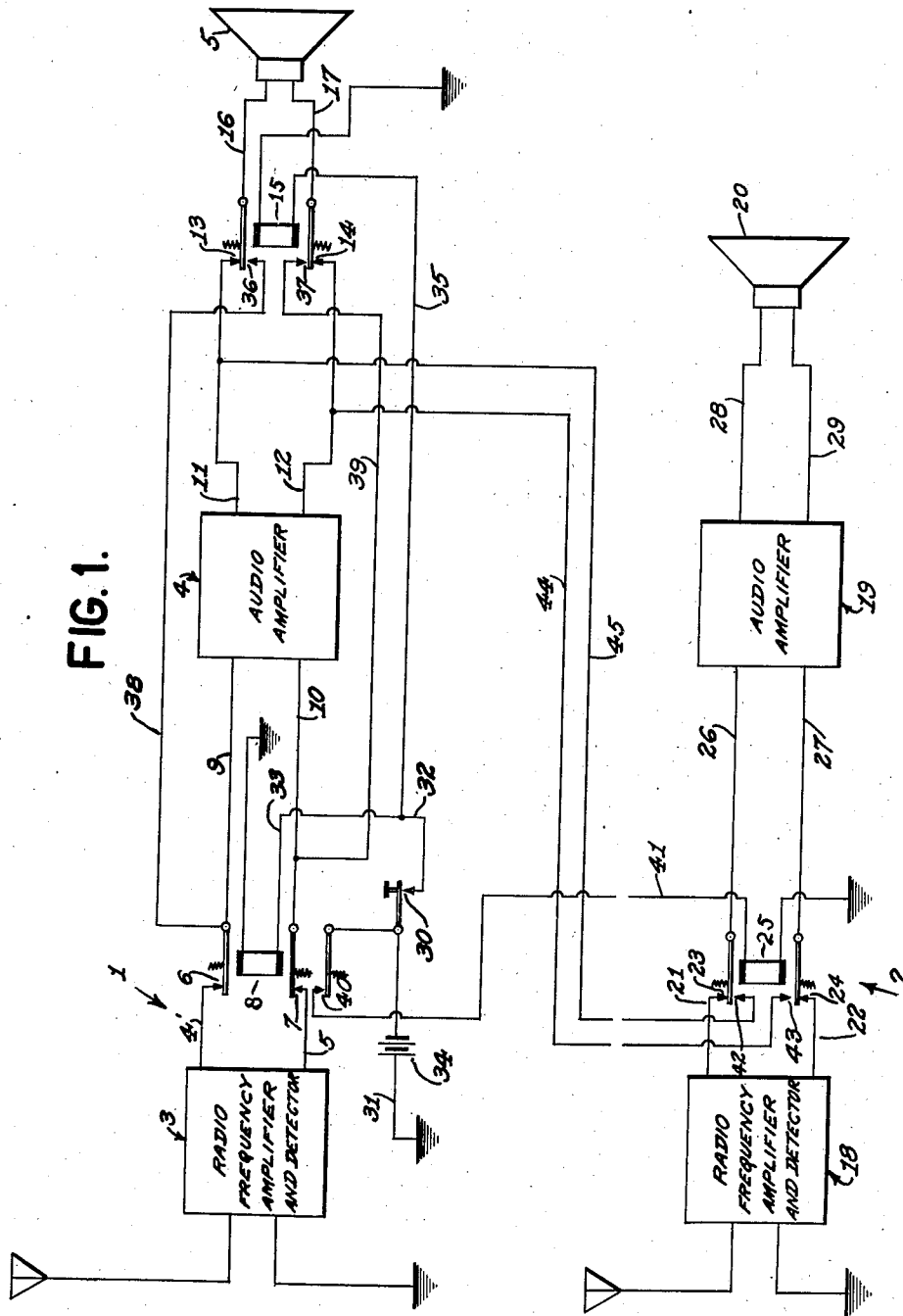
K. E. STOCKTON ET AL

2,164,960

COMBINED RADIO RECEIVING AND INTERCOMMUNICATION SYSTEM

Filed Feb. 27, 1937

3 Sheets-Sheet 1



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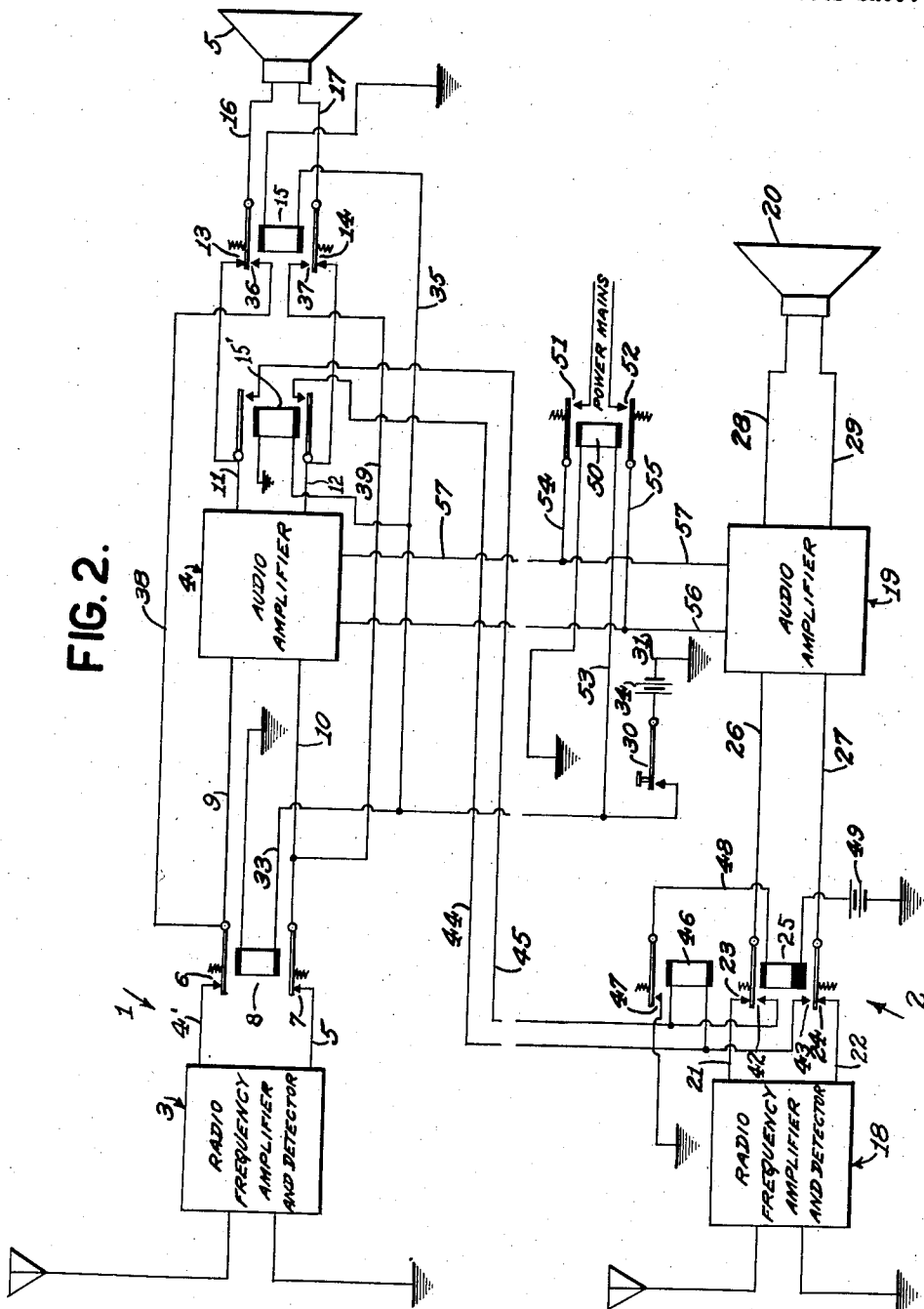
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3 Sheets-Sheet 3

FIG. 3.

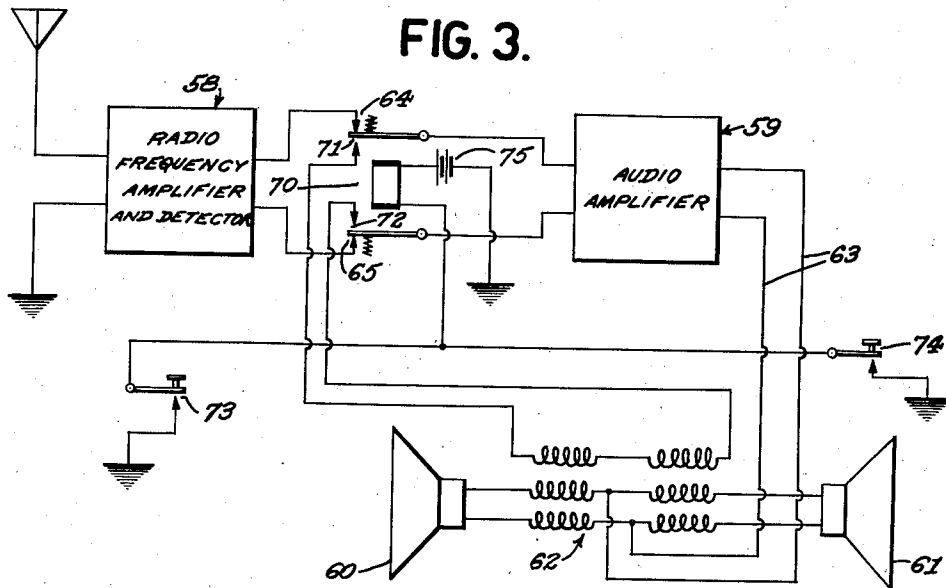
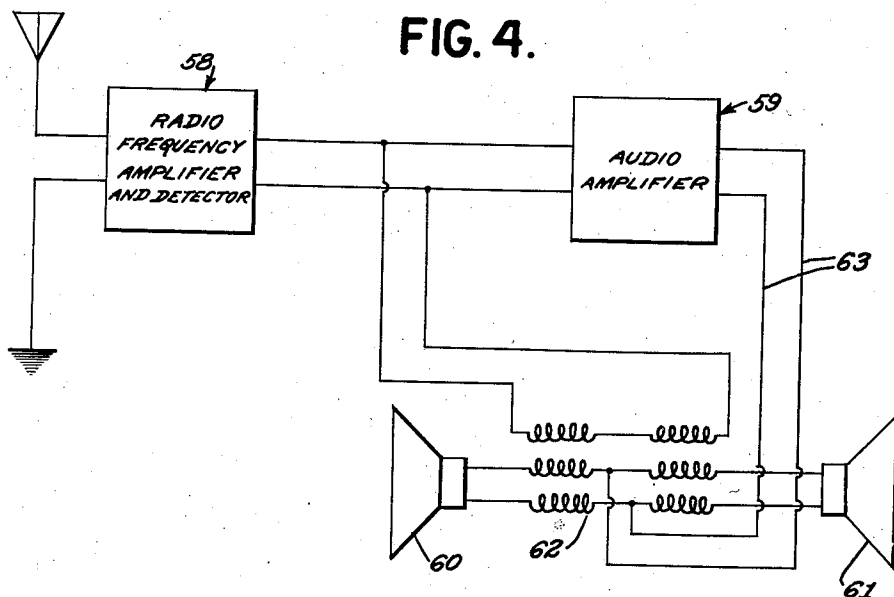


FIG. 4.



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Patented July 4, 1939

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UNITED STATES PATENT OFFICE

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COMBINED RADIO RECEIVING AND INTERCOMMUNICATION SYSTEM

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Application February 27, 1937, Serial No. 128,114

8 Claims. (Cl. 179—1)

This invention relates to communication systems and pertains more particularly to systems of this character which are adapted to utilize parts of standard radio receiving apparatus, while at the same time leaving said apparatus in condition for use in receiving radio signals.

It is an object of our invention to provide means whereby two radio receiving sets, such for example, as might ordinarily be used in separate rooms of a private home, may be used as a means of inter-communication between the two points at which the sets are located.

A further object is to provide means whereby two or more loud speakers connected to a common radio amplifier may be used both to reproduce a radio or other program and also to transmit sound between the two points at which the loud speakers are located.

In accordance with our invention two standard radio receivers are provided, these being located at different points at which it is desired to receive radio programs and between which it may be desired to carry on a conversation. These sets may be, for example, located in the master's and servants' quarters of a house and in this case it will ordinarily be sufficient to arrange the apparatus, following our invention, in such way that a radio program being received by one or both of said receivers, may be interrupted and a spoken order be transmitted from the master's receiver to the servants' receiver. In other instances it may be desirable not to interrupt the received program but merely to superimpose the master's voice on the program being received in the servants' quarters. Or it may be desired to provide for two way communication between the two receivers.

In fulfilling any one of these conditions circuits are provided so that a loud speaker of one receiver is used as a microphone for transmitting voice currents to the audio-frequency amplifier of the other receiver. Or according to a modification of our invention, by the use of a hybrid coil arrangement, inter-communication between two points may be carried on by the aid of two loud speakers connected to the output of a single radio receiver or public address system. In this case, the single amplifier of voice frequency acts to amplify the voice currents transmitted from either of the loud speakers to the other while at the same time, if desired, also amplifying the radio program or other signals which are being transmitted thereto from a remote point.

Additional features of our invention involve the provision of control circuits, including relays, whereby upon actuation of a switch which is provided for the purpose of inter-connecting the radio receivers to operate as an inter-communication system, the energizing current is supplied from the power source to the receivers to render

them operative. In carrying out this phase of the invention the circuit arrangement may be such, that in response to the operation of the inter-communication control switch, the energy will be supplied to only the radio receiver adjacent to the inter-communication switch or to the receiver remote from the inter-communication switch, or to both of these receivers.

Referring to our invention in somewhat more detail it may be pointed out in a general way, that radio receivers usually consist of a radio frequency amplifying stage, a detecting stage and an audio frequency amplifying stage, the output of the latter supplying a loud speaker. The loud speaker is usually of the moving coil type and fairly well adapted to act as a dynamic type microphone. However any type of loud speaker adapted to operate as a microphone may be used. In order that intercommunication between the points at which two such receivers are located may be carried out, it is necessary in accordance with our invention, to provide switching means whereby the loud speaker of the first receiver may be disconnected from the output of the audio frequency amplifier thereof and be connected to the input instead while, at the same time, the output of the amplifier just mentioned is connected to the input of the audio frequency amplifier of the second receiver. By this rearrangement of circuits any words spoken into the loud speaker at the first receiver will be reproduced in the loud speaker at the second receiver. Following this arrangement it will be noted that the voice currents generated by the first loud speaker, which is being used as a microphone, will be twice amplified, once in the amplifying stage of the first receiver and a second time in the amplifying stage of the second receiver. This need not necessarily be so, but will in many instances be found desirable in order to obtain sufficient sensitivity of pick-up with a suitable volume of output at the loud speaker of the second receiver. However, in certain instances the sound reproduced at the second loud speaker may be sufficiently loud if the voice currents from the first loud speaker are amplified by passing through only one of the amplifying stages of the two receivers. And this effect may be obtained either by connecting the output of the audio amplifier of the first receiver directly to the loud speaker of the second receiver, or on the other hand by applying the voice currents generated by the first loud speaker directly to the input of the audio frequency amplifier of the second receiver. It is preferred, however, to use both amplifiers since by this means a sufficient volume of sound will be obtained, no additional cost of equipment being involved since both amplifying stages are available.

In carrying out the invention, it is preferable

that means likewise be provided for disconnecting the audio frequency stages of the receivers from their respective radio frequency and detecting stages, whereby interference from an incoming radio program will be prevented. While this operation is preferable in order that ease of communication may result, still communication may be carried on even though the radio program is still permitted to come through the radio frequency amplifying stages and the detector stages into the audio frequency amplifying stages and the loud speaker of the second receiver. The former method of operation has the additional advantage that if the second radio receiver is being used for the reception of the program the interruption of the program will call attention to the fact that intercommunication is desired.

According to a further modification of our invention, intercommunication between two points at which different loud speakers of a common radio receiving set are located, may be carried on. In this modification of our invention, hybrid coils are used to interconnect the two loud speakers with one another as well as with the output and the input of the audio frequency amplifying stage of the receiver. In this instance the audio frequency amplifying stage just mentioned serves to amplify the speech, whether it is transmitted from the first loud speaker to the second or from the second to the first. In carrying out this phase of the invention, it is not necessary that the radio frequency program be interrupted during intercommunication between the two loud speaker points, although such interruption is desirable in order that clear conversation may be carried on with a minimum of difficulty. In the event that a radio program is being received or a public address being broadcast, it is merely necessary for a person adjacent one loud speaker to wait for a lull in the program so that he may make himself heard with ease at the other loud speaker. Or attention may be attracted by merely tapping on the diaphragm or housing of one loud speaker, which will cause a distinctive sound to be made by the other loud speaker.

In many instances of the use of two loud speakers, one will be connected directly to a radio receiving set and form a part thereof in the usual way, while the other loud speaker will be located at a remote point, for example, in another room. One person of the two carrying on a conversation will, therefore, ordinarily be near to the control mechanism of the receiving set and therefore will be able to detune the receiver so that it no longer picks up a program over the radio aerial which will interfere with the conversation to be carried on between the two loud speaker points. However, if desirable, push buttons or switches may be located adjacent to each of the loud speakers, whereby through associated circuit connections the audio frequency amplifying stage may be disconnected from the detector and radio frequency stage of the receiver, thereby isolating the circuit for use as an intercommunication system. In this case also, remote control means may be provided adjacent to each of the loud speakers, whereby the audio frequency amplifier may be connected to the power mains or other source of electrical supply.

The above mentioned and further objects and advantages of our invention and the manner of obtaining them will be more fully set forth in

the following description taken in conjunction with the accompanying drawings.

In the drawings, Fig. 1 illustrates one embodiment of our invention wherein two radio receivers are used as an intercommunication system. Fig. 2 represents a modification of the structure shown in Fig. 1, wherein a voice current relay is provided for controlling the circuit of the second receiver, and Fig. 3 illustrates a still further modification of our invention, wherein a single radio receiver serves by means of a hybrid coil connection, both to reproduce at two loud speakers a radio program and to permit conversation between the two loud speakers. Fig. 4 illustrates a further modification of our invention.

Referring more particularly to the drawings, reference numeral 1 indicates generally a first radio receiver and 2 a second radio receiver. The first radio receiver has a radio frequency amplifying and detecting stage 3, an audio frequency amplifying stage 4 and a loud speaker 5. In normal use radio signals picked up by the antenna and ground connection pass through the radio frequency amplifying and detecting stage 3 and then travel through conductors 4' and 5 and the back contacts 6 and 7 of relay 8, and conductors 9 and 10 into the input of the audio frequency amplifier 4. The output of the audio frequency amplifier is in turn connected through conductors 11 and 12, the back contacts 13 and 14 of relay 15, and conductors 16 and 17 with the loud speaker 5.

Similarly receiver 2 has a radio amplifying and detecting stage 18, an audio amplifying stage 19 and a loud speaker 20. Under normal conditions radio signals picked up by the antenna and ground connections pass through the radio frequency amplifying and detecting stage and then by way of wires 21 and 22 through the back contacts 23 and 24 of relay 25, and conductors 26 and 27 into the input of the audio frequency amplifying stage 19. The output of this amplifying stage is in turn connected through conductors 28 and 29 to the loud speaker 20.

When it is desired to carry on a conversation from loud speaker 5 to loud speaker 20, the key or switch 30 is closed, thereby energizing the winding of relay 8 through conductors 31, 32 and 33, battery 34, and the ground return. At the same time, the winding of relay 15 is energized through the conductor 35 and its associated ground connection. By this action the two back contacts of relay 8 are broken as well as the two back contacts of the relay 15. Simultaneously the front contacts 36 and 37 of the latter relay are closed thereby connecting the loud speaker 5 over conductors 38 and 39 with the input of audio frequency amplifying stage 4.

While this operation is taking place the front contacts 40 of relay 8 are closed thereby energizing the winding of relay 25 through conductor 41 and its associated ground connection. This results in the breaking of the back contacts 23 and 24 of the relay 25 and the closing of the front contacts 42 and 43 thereof, this operation forms a connection from the output of audio frequency amplifying stage 4 over conductors 44 and 45 with the input of audio frequency amplifying stage 19.

After this series of switching arrangements has been completed the desired conversation can be carried on by speaking directly into the loud speaker 5, which then acts as a dynamic microphone, picks up the sound, passes it to the input

of the audio amplifier 4, then through the audio amplifier 19 and into the loud speaker 20 which reproduces the sound.

If desired, the key 30 may also be made to close through suitable relay connections, the energizing circuits of the radio receivers 1 and 2 whereby the audio frequency amplifying stages, if not already in use for radio receiving purposes will be rendered operative for intercommunication purposes. As has been explained hereinabove, while it is desirable that the radio frequency and detecting stage of the reproducing receiver be disconnected from the audio amplifier during the use thereof as part of an intercommunication system, this operation may be dispensed with, the voice currents generated by the loud speaker 5 then being superimposed upon the radio program which is reproduced by the loud speaker 20.

Fig. 2 discloses a system similar to that in Fig. 1, except that the contacts 40 of relay 8 have been removed and the relay 25 has been placed under the control of a voice current operated relay 46 which is bridged across the wires 44, 45 leading to the contacts of a relay 15', which upon energization closes a circuit to the output of the audio-frequency amplifier 4.

An additional modification of the system of Fig. 1 has also been made. A relay 50 having contacts 51 and 52 has been provided for supplying the energizing current to the amplifiers 4 and 19 responsive to the closing of switch 30. Upon closure of this switch direct current energy is supplied over wire 53 from battery 34 to the relay 50, thereby closing contacts 51 and 52 thereof. This results in the application of current from the power means to the amplifiers 4 and 19 through conductors 54, 55, 56 and 57. At the same time energy is also supplied to the winding of relay 15' thereby closing its contacts.

With the switch 30 closed when a sound wave is picked up by the loud speaker 5, the currents produced are amplified in the stage 4 and then impressed on the wires 44 and 45 thereby causing the operation of relay 46 with the resultant closing of contacts 47 and the energizing of the relay 25 which is preferably of the slow release type, by way of wire 48 and its associated battery 49, and the ground connection. The amplifying stage 19 then acts to amplify the voice currents and reproduce them in loud speaker 20 in the same manner as described in connection with Fig. 1. As explained above, relay 25 is preferably of the slow release type and therefore a momentary reduction of amplitude or cessation of sound adjacent the loud speaker 5, which is acting as a microphone, will not cause the release of the relay 25, this relay staying energized for a short period of time after the relay 46 opens its contact 47. While a slow release relay will ordinarily be found sufficient to prevent undesirable deenergization and reenergization of the amplifier 19 and resultant clicks or other interference in the reproduced sound, other well known equivalent delay arrangements may be used in place of the slow release feature of relay 25 to insure, if desirable, a still longer connection of the amplifier 19 after cessation of sound adjacent to the loud speaker 5.

By the aid of the relay 50 it is possible to render the entire system of stations 1 and 2 operative to transmit sound from loud speaker 5 to loud speaker 20 upon closure of the key 30 whether or not the radio receivers have previously been energized. In the modified circuit ar-

angement shown in Fig. 2, it will be noted that the key 30 has been moved to a position adjacent the receiver 2, although it could be located adjacent to the receiver 1, as shown in connection with Fig. 1.

One use to which the arrangement of Fig. 2 may well be put is to provide a communication or monitoring system between the nursery and living room of a private home. In this case the key or switch 30 being adjacent the receiver 2 in the living room, the circuit to the control relays may be closed at any time when it is desired to listen for sounds in the nursery. This key may be kept constantly closed so that while a radio program may still be reproduced by receiver 2, this program will be interrupted by operation of the relay 46 whenever an infant cries out or any other sound occurs in the nursery. Manifestly, this circuit arrangement has many other uses in the alarm field and the example given is merely for the purposes of illustration.

Fig. 3 shows a further embodiment of our invention wherein a single receiver is utilized for intercommunication between a plurality of points. In this figure reference numeral 58 indicates a radio frequency amplifying and detecting stage and 59 an audio frequency amplifying stage. Two loud speakers 60 and 61 are illustrated, these being connected to the output of the audio frequency amplifying stage 59 by way of the intermediate point of hybrid coil 62, and conductors 63. Under normal conditions a radio program may be picked up by the antenna and ground connection, then amplified and detected in stage 58, passed through the back contacts 64 and 65 of relay 70, amplified at audio frequency in stage 59 and reproduced on both loud speakers 60 and 61. When it is desired to communicate from a position adjacent one loud speaker to the other loud speaker, a local circuit is closed which energizes the relay 70 and closes the front contacts 71 and 72 thereof, thereby connecting the input of the audio frequency amplifying stage 59 to the series winding of the hybrid coil 62. The energization of the relay 70 may be brought about by means of either keys 73 and 74 located adjacent the loud speakers 60 and 61, respectively. Upon closure of either of these keys the relay 70 is energized by means of battery 75 and the ground return circuit.

In most instances one of the loud speakers will either be located closely adjacent to or be incorporated in the radio receiver while the other loud speaker will be on an extension line located at a remote point, for example, in another room of a house. In this case the relay 70 and the operating keys 73 and 74 may be dispensed with, the series winding of the hybrid coil then being connected permanently across the input of the amplifying stage 59 while the latter is still connected to the output of the radio frequency amplifying and detecting stage 58. The reason for this is that even if the receiver is being used to reproduce a radio program and intercommunication between the two loud speakers is desired, a person within the range of the loud speaker adjacent to the radio receiver will be able to operate the receiver controls, to detune the circuits thereof so that the radio program is no longer picked up in sufficient volume to disturb the two-way interconnection between the loud speakers. If a person approaches the extension loud speaker remote from the receiver, it will be necessary merely for him to wait for a lull in the program to announce that he wishes to communicate with

a person at the other loud speaker and at the same time request that the radio receiver be detuned to eliminate the program. Or, attention may be obtained by tapping on the diaphragm of the extension loud speaker or otherwise making a distinctive sound which will be recognized at the loud speaker adjacent to the receiver.

While we have shown two loud speakers interconnected by means of a single hybrid coil it will be obvious to one skilled in the art that a greater number of loud speakers may also be incorporated in the system by means of additional hybrid coil connections, while at the same time assuring the desired two-way communication between any two loud speakers without interruption of a received radio program. Or, if desired, control keys may be provided adjacent to each loud speaker, as shown in Fig. 3.

Fig. 4 shows the circuit of Fig. 3 with the relay and its associated connections removed. In this case, as described above, the receiver may be used for the reception of programs while at the same time being constantly in readiness for intercommunication between the two loud speakers.

In this specification where reference has been made to radio receivers, it should be clear that the same remarks apply to apparatus used in public address systems, and the like. The invention is applicable to intercommunication between different parts of private homes, stores, hotels or other locations wherein one or several audio frequency amplifiers and several loud speakers are available.

While we have described particular embodiments of our invention for the purposes of illustration, it should be understood that various modifications and adaptations thereof may be made within the spirit of the invention as set forth in the appended claims.

We claim:

1. A combined radio receiving and intercommunication system comprising two radio receivers, each having a loud speaker and at least one of said receivers having an audio frequency amplifying stage, and means comprising a switch for simultaneously disconnecting the loud speaker from one of the receivers and providing a circuit connection whereby electric currents generated by use of said loud speaker last mentioned as a microphone, are conducted to the input of the audio frequency amplifying stage of the other of said receivers.
2. A combined radio receiving and intercommunication system comprising two radio receivers each having a loud speaker and at least one of said receivers having an audio-frequency amplifying stage, and switch means for simultaneously disconnecting the loud speaker from one of the receivers and connecting it to the input of the audio frequency amplifying stage of the other of said receivers.
3. A combined radio receiving and intercommunication system comprising a first and a second radio receiver each having an audio frequency amplifying stage and a loud speaker, the latter being normally connected to the output of the said amplifying stage, and switch means for simultaneously changing the connection of the loud speaker of the first receiver from the output to the input of the amplifying stage thereof and connecting the output of said amplifying stage of said first receiver to the input of said amplifying stage of said second receiver.
4. A combined radio receiving and intercom-

munication system comprising a first and a second radio receiver each having an audio frequency amplifying stage and a loud speaker, the latter being normally connected to the output of the said amplifying stage and switch means for simultaneously energizing said amplifying stage, changing the connection of the loud speaker of the first receiver from the output to the input of the amplifying stage thereof and connecting the output of said amplifying stage of said first receiver to the input of said amplifying stage of said second receiver.

5. A combined radio receiving and intercommunication system comprising a first and a second radio receiver, each having a detector stage, an audio frequency amplifying stage and a loud speaker, connected in the order mentioned, and switch means for simultaneously disconnecting the loud speaker from the output of the amplifying stage of said first receiver and the detector from the input of the amplifying stage of said first receiver, disconnecting the amplifying stage of said second receiver from the detector stage thereof, connecting the loud speaker of said first receiver to the input of the amplifying stage thereof and connecting the output of said amplifying stage last mentioned to the input of said amplifying stage of said second receiver.

6. A combined radio receiving and intercommunication system comprising a radio receiver having a detector stage, an audio frequency amplifying stage and a loud speaker, said receiver being positioned at a first location, sound pick-up means at a second location, a line interconnecting said pick-up means and said radio receiver, and relay means responsive to currents generated by said pick-up means for disconnecting said audio frequency amplifying stage from the detector stage of said receiver, and connecting said pick-up device to the input of said audio frequency amplifying stage.

7. A combined radio receiving and intercommunication system comprising a detector stage, an audio frequency amplifying stage and a plurality of loud speakers, and hybrid coil means interconnecting said two loud speakers with the output of said audio frequency amplifying stage and with the input of said audio frequency amplifying stage, whereby voice currents generated by the use of one of said loud speakers as a microphone are introduced into the input of said audio frequency amplifying stage, and amplified currents are passed from said amplifying stage to both loud speakers.

8. A communication system comprising a first radio set including a detector, audio amplifier and loud speaker, a second radio set including a detector audio amplifier and loud speaker, a relay having normally closed contacts interconnecting said detector and amplifier of said first radio set, a second relay having normally closed contacts interconnecting said amplifier and loud speaker of said first radio set, a third relay having normally closed contacts interconnecting said detector and amplifier of said second radio set, said first relay having a normally open contact connected in an energizing circuit for said third relay, the latter having normally open contacts connected to the output of said amplifier of said first radio set, and switch means for simultaneously operating said first and second relays to an off normal position.

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