

Nov. 24, 1936.

R. A. FOX

2,061,699

RADIO SIGNALING SYSTEM

Filed July 31, 1933

3 Sheets-Sheet 2

Fig. 2.

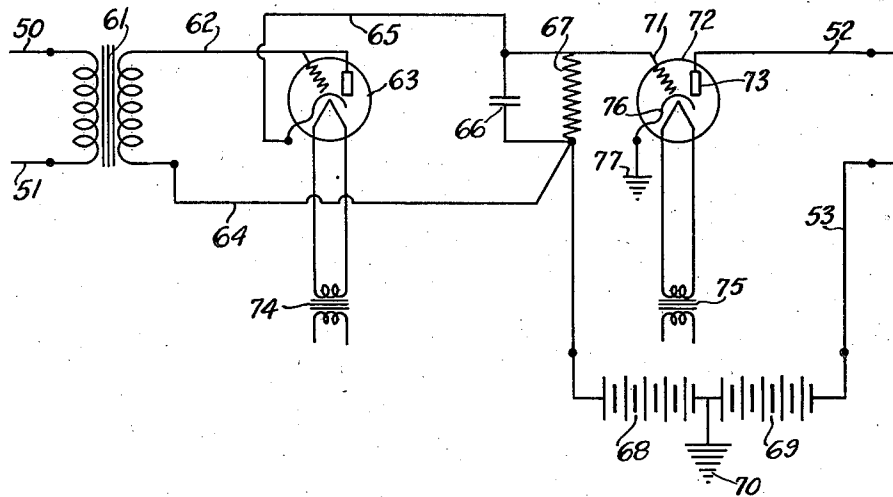
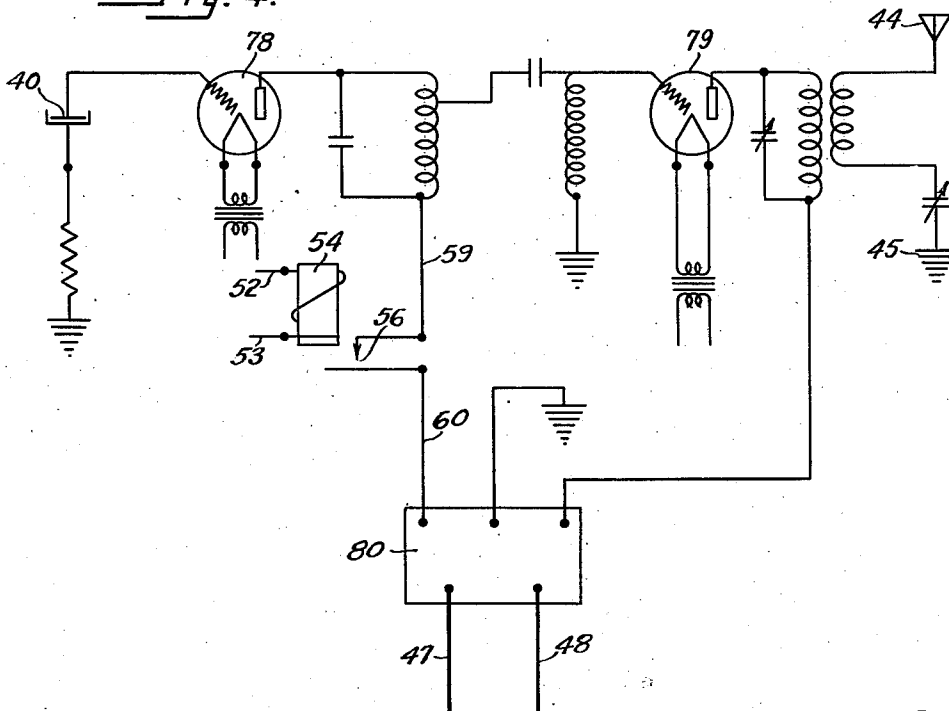


Fig. 4.



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Nov. 24, 1936.

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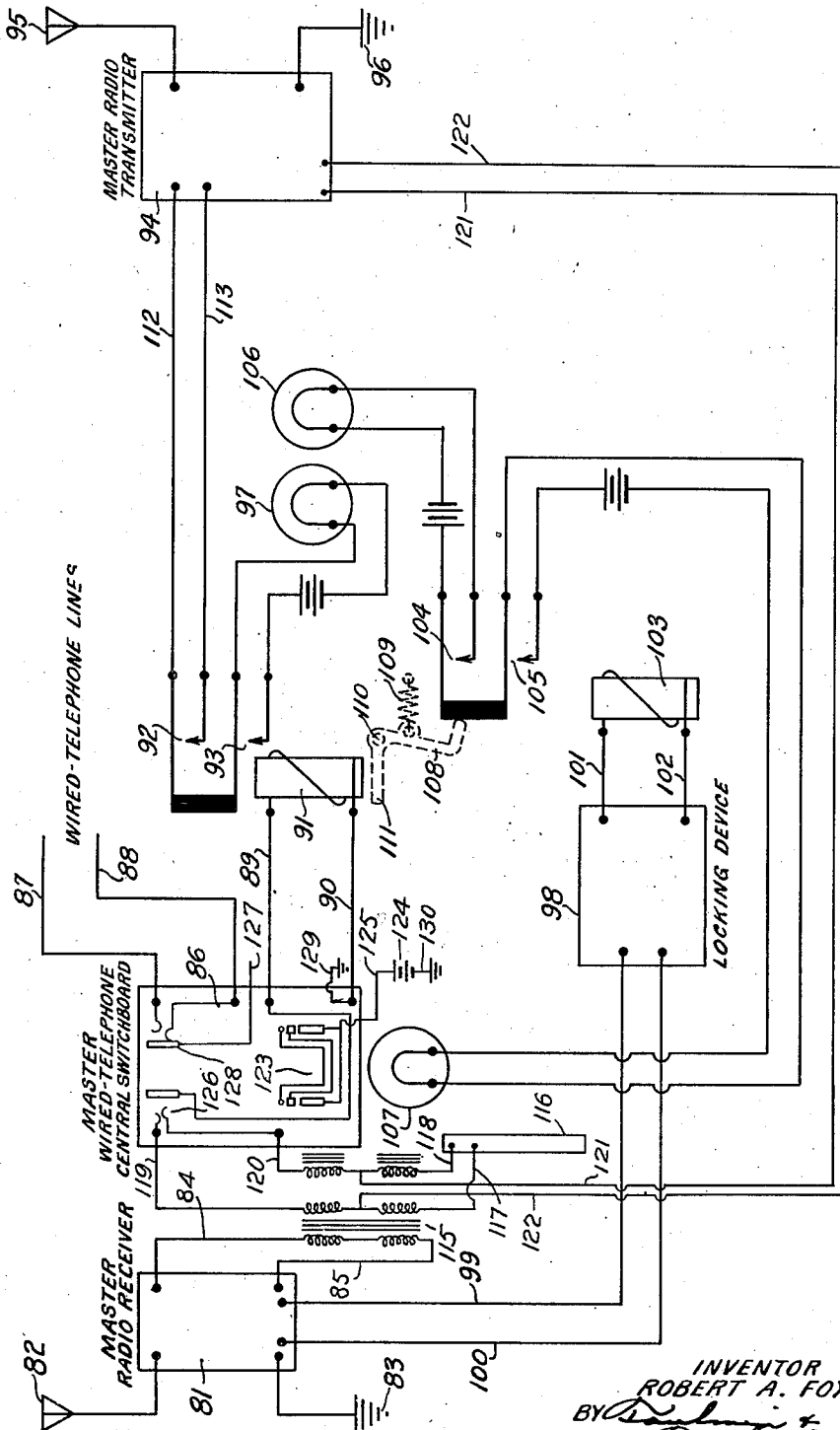
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Fig. 3.



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RADIO SIGNALING SYSTEM

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Application July 31, 1933, Serial No. 682,979

18 Claims. (Cl. 250—9)

This invention relates to radio signaling systems and, in particular, to such systems, which employ a master station and a plurality of subsidiary stations, as in the case of a shore station and a plurality of ship stations.

An object of my invention is to provide a radio signaling system wherein a master radio station may transmit to and receive from any one of a plurality of subsidiary stations, the remaining ones thereof being automatically excluded from receiving an intelligible version of the messages being exchanged.

Another object is to provide such a radio signaling system wherein all the remaining stations are rendered inoperative, both as to transmitting and receiving, except for the reception of a busy signal, until the interchange of messages between the master station and the working subsidiary station has been concluded.

Another object is to provide such a radio signaling system wherein indicating means are provided to show the remaining stations that the master station is already in communication with another subsidiary station.

Another object is to provide such a radio signaling system wherein the master receiving station is provided with means for joining wired telephone lines thereto, to permit the direct transfer of radio telephone messages to wired telephone lines and systems.

Another object is to provide a radio signaling system wherein a radio transmitter is automatically brought into operative condition when the transmitter mouth piece is raised from its rest, and automatically made inoperative when replaced on its rest.

Another object is to provide a radio signaling system wherein the signals sent out between the master station and a subsidiary station operate busy tone devices in the remaining subsidiary stations.

Another object is to provide a radio signaling system wherein the busy tone is made of such character not only to warn the station that another station is already working, but also to interfere with the actual message to such an extent as to prevent its intelligible reception.

Another object is to provide a radio signaling system having devices for rendering the busy tone device inoperative if it is not already in operation when the operator raises the transmitter mouth piece from its rest.

Another object is to provide such a radio signaling system having means for alternately rendering either the radio transmitter or the radio receiver inoperative when one of them is in use.

Another object is to provide a radio signaling system having means to operate a warning signal to call the operator's attention to the pres-

ence of a signal, yet having means incorporated therewith to render the signal audible as a call signal yet unintelligible as a message signal.

Another object is to provide a radio signaling system wherein means are provided so that a voice speaking into the transmitter mouth piece causes the transmitter circuit to be automatically closed and the receiving circuit automatically locked out of use.

Another object is to provide a radio signaling system combining radio telephone and wired telephone systems wherein the reception of vocally-modulated radio signal waves operates warning signals, the warning signal circuit being automatically locked in closed circuit position until the operator heeds the signals and properly connects the wired telephone lines to the radio set.

In the drawings:

Figure 1 is a diagrammatic representation of the circuit employed in a subsidiary station, arranged according to one form of my invention.

Figure 2 is a diagrammatic representation of the circuit employed in the locking device.

Figure 3 is a diagrammatic representation of the circuit employed in the master station, arranged according to my invention.

Figure 4 is a diagrammatic representation of a radio transmitting circuit showing how and where a lockout switch may be placed in accordance with my invention.

Arrangement of subsidiary station

Referring to the drawings in detail, Figure 1 shows the arrangement of a combined receiving and transmitting circuit in a subsidiary station, according to my invention. It will be understood that the master station and the subsidiary stations may be located entirely on land, entirely on the sea, or partly on land and partly on the sea or in the air. The arrangement of a master station on land and subsidiary stations on ships at sea is chosen as a convenient illustrative arrangement.

In Figure 1, the subsidiary station is shown as possessing a radio receiver 1 of any suitable type, having a receiving antenna 2 and a ground connection 3. The plate circuit of one of the vacuum tubes in the radio receiver 1 has leads which are brought out through the lines 4 and 5 to the operating coil of a relay 6 placed in series therewith (Figure 1). The grid of this vacuum tube is biased to such a point that no plate current will flow in the absence of radio signal waves; that is, that the presence of radio frequency input voltage is necessary to be applied to the grid of this vacuum tube from the radio frequency amplifier circuit of the radio receiver 1 in order to upset this grid bias and cause a flow of plate current to take place.

The relay 6, when thus energized, closes the normally-open switch 7. The latter joins the power line 8 with the power line 9 through the normally-closed switch 10 of the relay 11 by way of the operating coil of the relay 12 (Figure 1). When the operating coil of the relay 12 is thus energized by the energization of the relay 6, it opens its normally-closed switch 13 which otherwise connects the operating coils of the relays 11 and 14 to the power lines 8 and 9 by way of the hook switch 15. The latter is kept normally open by the action of the hook switch plunger 16 which is pressed downward by the weight of the hand telephone 17. When the hand telephone 17 is raised, the plunger 16 rises under the influence of its coil spring 18, allowing the switch 15 to close and thus close the circuit energizing the operating coils of the relays 11 and 14 when the switch 13 remains in its normally-closed position, as it does when the operating coil of the relay 12 remains unenergized.

The relay 11 also contains and actuates the normally-open switch 19 placed in series with the power line 9 shortly before the latter enters the converter 20, and beyond its connection with the line energizing the operating coils of the relays 6, 11, 12 and 14.

When the switch 19 is closed by the energization of the relay 11, power current of the direct or continuous type is admitted to the converter 20 from the power lines 8 and 9 leading from the ship's generator lines 21 and 22 or from the ship's emergency battery lines 23 and 24. Whether the generator lines 21 and 22 or the battery lines 23 and 24 shall furnish current to the power lines 8 and 9 is controlled by the relay, whose operating coil is connected between the generator lines 21 and 22 through the double-throw relay switches 26 and 27. When the ship's generators are supplying current at a normal voltage, the operating coil of the relay 25 is energized to such an extent that the movable blades of the switches 26 and 27 are pulled toward the relay coil, thus causing current to be supplied to the power lines 8 and 9 by the generator lines 21 and 22 respectively. If, however, the ship's generator voltage drops below a predetermined amount, as in the case of generator failure, the coil of the relay 25 is not sufficiently energized to hold the plates of its double-pole switches toward it (as in Figure 1) and releases them, causing current to be thenceforth supplied from the battery lines 23 and 24 instead of from the generator lines 21 and 22.

The relay 12 also actuates the switch 28 which in turn operates the busy tone signaling device 29 which is likewise energized from the power lines 8 and 9. The busy tone signaling device 29 transmits its signals along the lines 30 and 31 through the band pass filter 32 to the ear phone 33 of the hand telephone 17. The band pass filter 32 is of such nature as to filter off all frequencies above and below those necessary for the transmission of speech such as, for example, below 200 and above 3000 kilocycles. This prevents any energy from reaching the ear phone 33 that will create noise or interference with the reception of voice frequencies.

The busy tone signaling device 29 is likewise connected to one pole each of the double-throw relay switches 34 and 35 which are actuated by the relay 14. The opposite poles of the relay switches 34 and 35 are connected through the low-pass filter 36 to the signaling device 37. The latter may be of the loud speaker type or else

may consist of a bell or buzzer. When a bell or buzzer is used at 37, the low-pass filter 36 becomes unnecessary. When a loud speaker is employed, however, the low-pass filter 36 removes all frequencies that are required for intelligible speech, but passes a band of frequencies sufficient to cause a signaling tone in the loud speaker at 37. In their normal positions with the operating coil of the relay 14 unenergized, the switches 34 and 35 connect the output lines 38 and 39 of the radio receiver 1 to the signaling device 37. If, however, the relay 14 is energized, its switches 34 and 35 are thrown to the opposite poles connecting the audio output of the radio receiver 1 to the telephone receiver 33 and busy tone 29.

The hand telephone 17 contains a telephone transmitter 40 of any suitable type, such as a microphone type, connected by the lines 41 and 42 to the radio transmitter 43 of the subsidiary station. The radio transmitter 43 has its transmitting antenna 44 and ground connection 45. The transmitter 43 is controlled by the hook switch 46 which is likewise actuated by the plunger 16 of the hand telephone 17 in the same manner as the hook switch 15 previously described. Accordingly, when the hand telephone 17 is raised from its rest, the hook switch 46 is closed, placing the radio transmitter 43 in an operative condition, provided that the other relay switches are properly closed.

The direct or continuous current from the power lines 8 and 9 passes through the converter 20 and therein becomes alternating current; this proceeds by the lines 47 and 48 into the transmitter 43.

A locking device 49 is provided whereby the radio receiver 1 is automatically rendered inoperative when the radio transmitter 43 is used or vice versa, for safety purposes. The input lines 50 and 51 of the locking device 49 are connected to the lines 41 and 42 leading from the hand telephone transmitter 40 to the radio transmitter 43 (Figure 1). The output lines 52 and 53 from the locking device 49 lead to the operating coil of a relay 54 in series therewith. The relay 54 controls a pair of normally-open relay switches 55 and 56. The relay switch 55, when closed by the energization of the relay 54, directly connects the receiving antenna 2 to the receiving ground 3 through the lines 57 and 58, thus rendering the radio receiver 1 inoperative at that time. The closing of the relay switch 56 by the same means closes the circuit between the lines 59 and 60 (Figures 1 and 4). The radio transmitter 43 (Figures 1 and 4) is of any type suitable for the particular conditions encountered. Figure 4 shows a conventional transmitting circuit, and is illustrated in detail merely to show where the switch 56 of the relay 54 may be placed in order to control the operation of the radio transmitter 43. The major parts of the transmitting circuit are the microphone mouth piece transmitter 40, the master oscillator vacuum tube 78 and the modulated amplifier vacuum tube 79. The rectifier 80 converts the alternating current from the lines 47 and 48 into the various direct current voltage necessary for the operation of the circuit. The output lines of the radio transmitter are connected respectively to the transmitting antenna 44 and the ground connection 45.

Thus the energization of the operating coil of the relay 54 closes the switch 56 which permits current to flow from the rectifier 80 to the balance of the circuit, placing the radio

transmitter 43 in an operative condition, provided that the other externally operated switches are closed as previously described.

It will be obvious to those skilled in the radio art that the switch 56 may be placed to make or break the circuit in other lines of the transmitter circuit than the lines 59 and 60, the latter being chosen merely for illustrative purposes.

Locking device circuit

The circuit contained within the locking device 49 is shown in Figure 2. The lines 50 and 51 leading from the transmitter mouth piece lines 41 and 42 respectively are connected to the primary winding of the transformer 61. The secondary lead 62 thereof is connected to the grid and plate of the rectifying vacuum tube 63, the other secondary lead 64 and the line 65 leading from the electron discharge member of the vacuum tube 63 are interconnected by the fixed condenser 66 and the resistance 67. Beyond these the line 64 leads to the minus terminal of the C battery 68, thus providing a bias for the grid of the rectifying tube 63. The positive pole of the C battery 68 and the negative pole of the B battery 69 are grounded as at 70, and the positive pole of the B battery 69 is connected to the output line 53.

Beyond the resistance 67, the line 65 is connected to the grid 71 of the relay control vacuum tube 72, the plate 73 of which is connected to the output line 52.

The filaments of the vacuum tubes 63 and 72 are lighted by current from transformers 74 and 75 communicating with the power lines of the circuit. The electron discharge element 76 of the relay control vacuum tube 72 is grounded, as at 77. The output lines 52 and 53 of the locking device 49 may be connected to any suitable apparatus, such as to the operating coil of the relay 54 (Figure 1).

Arrangement of master station

The master station (Figure 3) contains a master radio receiver 81 whose input lines are connected to a receiving antenna 82 and ground 83 respectively. The output lines 84 and 85 from the master radio receiver 81 are connected to the master wired-telephone central switchboard 86 of any suitable type. The central switchboard 86 is connected to the wired-telephone lines 87 and 88, whereby the radio telephone messages intercepted by the master radio receiver 81 may be transferred directly to the wired-telephone system and thence to any telephone subscriber. The master wired-telephone central switchboard 86 is likewise connected by the lines 89 and 90 to the operating coil of a relay 91 having paired switches 92 and 93 operated simultaneously by the energization of the operating coil of the relay 91, which occurs when the switchboard operator at the master central switchboard 86 manually plugs in the call coming from the master radio receiver 81. The closing of the normally-open switch 92 places the master radio transmitter 94 in an operative condition by closing the circuit between the lines 112 and 113 leading thereto in a manner analogous to the action of the switch 56 (Figure 4). The master radio transmitter likewise has a transmitting antenna 95 and ground connection 96. The switch 93, when closed, operates the warning signal 97, here shown as a green lamp bulb, in order to warn the radio technical

operator of the master station that the master radio transmitter 94 is now in circuit and ready for use.

The master radio receiver is similarly connected to the locking device 98 through the lines 99 and 100, in a manner analogous to that already described for the subsidiary radio receiver 1 and locking device 49. The two locking devices 49 and 98 are of similar construction and arrangement. The output lines 101 and 102 of the locking device 98 are connected to the operating coil of a relay 103. The latter, when energized, closes the normally-paired switches 104 and 105, the former operating a warning signal 106, here shown as a red lamp bulb. The red bulb 106 serves to warn the radio technical operator that signals are being received by the master radio receiver 82 so that he may have the master radio transmitting circuit in readiness for immediate operation when the switchboard operator plugs in the call on the master central switchboard 86. The switch 105 when closed by the energization of the relay 103 operates the warning signal 107, here shown as a lamp bulb of any suitable color. The warning signal 107 is placed near the master central switchboard 86 to warn the operator thereof that signals are being received by the master radio receiver 81.

The relay 103 is of the lock-up type. The latching action thereof is accomplished by any suitable means, the means shown diagrammatically in Figure 3 being a lever 108 urged into latching engagement with the paired switches 104—105 by the coil spring 109 and pivotally mounted as at 110. When the energization of the relay 103 pulls the paired switch arms of the switches 104 and 105 downward, the latching lever 108 slips into position and prevents the return thereof. This holds the switches 104 and 105 in closed circuits and thus operates the warning signals 106 and 107 continuously.

The signal input circuit in Figure 3 includes a hybrid circuit 115 with an artificial balancing line 116 connected thereto by the lines 117 and 118. The hybrid circuit itself is connected to the master radio receiver 81 by the lines 84 and 85, and is connected to the master wired telephone central switchboard 86 by the lines 119 and 120 (Figure 3). The hybrid circuit finally is connected to the master radio transmitter by the signal input lines 121 and 122.

The master central switchboard 86 includes a cord circuit 123 connected to a battery, or other source of current 124, by the line 125. The lines 119 and 120 are interconnected with the line 89 through the jack switch 126. The lines 87 and 88 are connected to one another and to the supervision line 127 by the jack 128. The line 90, leading from the master switchboard 86 to the relay 91, is grounded by means of the line 129, and the opposite side of the battery 124 is grounded by the line 130.

When the switchboard operator at the master central switchboard 86 heeds the warning and connects the switchboard so that it energizes the relay 91, the latter attracts the portion 111 of the latching lever 108, moving the whole and unlatching the paired switches 104 and 105, thus disconnecting the warning signals 106 and 107.

Upon the completion of a manual connection by the telephone operator at the master central switchboard 86, through the operation of the cord circuit 123, the relay 91 is energized and applies power to the transmitter in the manner described in more detail below. While an in-

terchange of messages is taking place, however, the hybrid circuit 115 transmits speech from the wired telephone lines 87 and 88 to the transmitter. When speech is fed from the master radio receiver 81 to the hybrid circuit 115 it is transmitted to the wired telephone lines 87 and 88, but is balanced out and not transmitted by the lines 121 and 122 to the master radio transmitter 94.

10 *Operation in subsidiary station communication with master station*

Let it first be assumed that none of the subsidiary stations is in communication with the master station, and that the particular radio channel is clear, to which these stations are tuned. Let it also be assumed that one of the subsidiary stations is to place a call to the master station at this time when the channel is not busy. The operator of the subsidiary station removes the telephone hand set 17 from the cradle (Figure 1.) As soon as the plunger 16 rises, the hook switches 15 and 46 make contact, closing their respective circuits.

25 The closing of the hook switch 15 causes the operating coils of the relays 11 and 14 to become energized, the former closing the normally-open relay switch 19 which closes the circuit between the power lines 8 and 9 and the converter 20 which in turn provides current for operating the radio transmitter 43. The same energization of the relay 11 opens its normally-closed relay switch 10, thus preventing the energization of the relay 12. The latter is thus henceforth unable to open the normally-closed switch 13 and thus interfere with the operation of the radio transmitter 43. The relay 12 is also thereby prevented from closing the switch 28 and operating the busy tone signaling device 29. Meanwhile the energization of the relay 14 simultaneously with that of the relay 11 shifts the relay switches 34 and 35, thereby connecting the audio output lines 38 and 39 from the radio receiver 1 to the telephone hand set ear phone 33 and disconnecting them 45 from the signaling device 37.

After lifting the telephone hand set 17 from its cradle, the operator listens for the busy tone; hearing none, he calls the master station with such pre-arranged signals as have been previously decided upon. As soon as the current variations set up in the lines 41 and 42 by the action of the voice upon the microphone in the hand set transmitter 40 reach the locking device 49 by way of the lines 50 and 51, the latter pass through the transformer 61 (Figure 2) and through the rectifying tube 65. The direct current emerging from the rectifying tube 65 charges the condenser 66. Before any current variations due to speech came into the circuit, the condenser 66 discharged through the resistance 67 without any effect upon the system, hence the relay 54 remained unenergized and its switches 55 and 56 consequently open. The current variations from the speech, however, impose an additional charge 65 upon the condenser 66 which upsets the grid bias of the C battery 68 on the grid 71 of the relay control vacuum tube 72, thus giving rise to a flow of B battery current through the plate circuit because of the lowered resistance to the electron flow within the relay control tube 72. The flow of plate current energizes the operating coil of the relay 54, thus closing the relay switches 55 and 56. The former by-passes the receiving antenna 2 directly to the ground 3 (Figure 1), whereas the 75 latter places the radio transmitter in an opera-

tive condition by connecting the lines 59 and 60 within the radio transmitter 43 (Figure 4).

The condenser 66 of the locking device 49 (Figure 2) is of sufficient capacity to accumulate an adequate charge which operates to keep the relay 54 energized between words, and its switches 55 and 56 consequently closed. If, however, there is a greater pause than normal between words, the condenser 66 becomes completely discharged and the relay 54 de-energized, thus opening its switches 55 and 56. This action disconnects the receiving antenna 2 from its by-pass connection through the lines 57 and 58 to the ground 3 and places the radio receiver 1 in an operative condition (Figure 1). The same action opening the relay switch 56 of the relay 54 breaks the circuit of the radio transmitter 43 and places the latter in an inoperative condition.

Having called the master station, the operator listens in the ear phone 33 for the answering call of the master station. When this call comes in over the receiving antenna 2, its waves are amplified by the initial radio frequency stages of the radio receiver 1, and thus amplified upset the grid bias of the vacuum tube to which the leads 4 and 5 are connected, thus causing plate current to flow through them into the operating coil of the relay 6, energizing it and closing the normally-open relay switch 7. The relay switch 10 of the relay 11 still remains open, however, from the energization of the latter, hence the busy tone signaling device 29 cannot operate. The message thus passes from the output lines 38 and 39 of the radio receiver through the switches 34 and 35 to the head set ear phone 33 and is heard by the operator. Messages can thus be interchanged between the operator and the master station, the transmitter being at once connected and the radio receiver disconnected whenever the operator talks into the hand set transmitter microphone 40, by reason of the action of the locking device 49 previously described.

Operation in attempted interruption by second subsidiary station

While the above interchange of messages is taking place between one of the subsidiary stations and the master station, let it be assumed that another subsidiary station desires to send a message to the master station: the second subsidiary station operator raises his hand set 17 and listens for the busy tone. Meanwhile the signals from the two intercommunicating stations come in over the receiving antenna 2 of the second subsidiary station, which is a duplicate of the circuit shown in Figure 1. This time the radio signals have energized the operating coil of the relay 6 in the manner previously described, and the current has passed through the normally-open relay switch 7 closed thereby through the normally-closed relay switch 10 to and through the operating coil of the relay 12, the relay 11 having not yet been energized.

The energization of the relay 12 in this way opens the normally-closed switch 13, thus preventing subsequent energization of the relays 11 and 14, and at the same time closing the normally-open relay switch 28. The latter sets the busy tone signaling device in operation, creating an audible tone in the ear phone 33. This tone not only warns the second subsidiary station operator that another subsidiary station is already using the radio channel, but also assists in preventing intelligible reception of the messages by sound by the other station. The continued de- 75

energization of the relay 14 leaves its switches 34 and 35 in the position shown in Figure 1, connecting the audio output lines 38 and 39 to the signaling device 37 through the low-pass filter 36.

The second subsidiary station operator may thus hear signals being interchanged by reason of the tones emitted by the signaling device 37, but will not be able to understand their meaning.

By thus preventing the energization of the relay 11 and the consequent closing of its normally-open switch 19, the second subsidiary station transmitter 43 is thereby kept from receiving power current through the line 9, and is accordingly locked out of operation while the first subsidiary station is working, and at the same time the busy tone signaling device 29 is locked in operation. The second subsidiary station is thus warned that the channel is busy and also is prevented from attempting to transmit messages over the same channel until the line is free.

Operation in master station calling a particular subsidiary station

Assuming that the above interchange of messages has ceased, let it now be assumed that the master station has a message for a particular subsidiary station. The master station places its radio transmitter 94 in operation and calls the subsidiary station by sending out a predetermined signal peculiar to that subsidiary station. As soon as it has transmitted this signal several times, it shuts off its transmitter and listens for the answer of the called station. The calling signal from the master station is received by all of the subsidiary stations since all of their receivers are tuned to the same wave length or frequency. When the signals from the master station come in through the radio receiver 1 (Figure 1), they are amplified by the radio frequency and audio frequency circuits of the radio receiver 1 and pass through the low-pass filter into the signaling device 37, where the call signal is made audible. The operator of the particular station called raises his telephone handset 17 and thus locks in his own receiving and transmitting circuits and when the shore answers, it locks out the transmitting circuits of the other subsidiary stations and causes their busy tone signaling devices to operate in the manner previously described. The operation thenceforth proceeds as before.

Operation in master radio station

The master radio station (Figure 3) receives the subsidiary station signals through the master radio receiver 81. The signals pass through the output lines 99 and 100 into the locking device 98, which is arranged and operated in substantially the same way as the locking device 49 previously described. The signals cause the locking device 98 (Figure 3) to energize the operating coil of the relay 103 in a manner analogous to that described above for the relay 54 (Figure 1). Thus energized, the relay 103 closes the paired switches 104 and 105 (Figure 3), and the latching lever 108 slips in behind these switches and holds them in a closed position. As a result of this, the warning light 107 glows on the master central switchboard 86 and the red warning light 106 glows at the technical operator's desk. These warnings show that a signal is being received, and the technical operator immediately makes sure that the master radio transmitter 94 is in readiness to transmit. Mean-

while the switchboard operator 86 receives the call and plugs it in to the appropriate wired telephone lines 87 and 88. As the switchboard operator plugs in the call, the same action causes the working coil of the relay 91 to be energized, as previously described, closing the normally-open switches 92 and 93 and withdrawing the latching device 108, allowing the switches 104 and 105 to open when the relay 103 is de-energized. The closing of the relay switch 92 places the master radio transmitter in an operative condition, and the closing of the relay switch 93 operates the green warning signal 97 at the technical operator's desk, notifying him that the transmitter is about to be operated. The master radio transmitter 94 is then operated in the usual manner and the subsidiary station communicated with in the way described above.

In this manner the master radio station can communicate with any one of a plurality of subsidiary radio stations, and the others will be prevented, not only, from transmitting signals during the progress of the intercommunication, but will also be prevented from listening in on the conversation or reading the messages. In this way a measure of secrecy is accomplished. It will be obvious that the master radio station may likewise tune its receiver or another receiver and transmitter in the station to communicate with a different plurality of subsidiary stations in a manner substantially the same as that described above.

It will be understood that I desire to comprehend within my invention such modifications as may be necessary to adapt it to varying conditions and uses.

Having thus fully described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. In combination, a telephone receiver and transmitter, a radio transmitter connected to the telephone transmitter, a telephone switch controlled by the removal of the telephone receiver and transmitter, means controlled by said switch for connecting the radio transmitter to a source of sending power current, a radio receiver adapted to be brought in circuit with the telephone receiver upon the lifting thereof, a signaling device connected to the radio receiver, means upon the connecting of the radio receiver with the telephone receiver for rendering the signaling device inoperative, a busy tone device connected to the source of sending power current, the telephone receiver and the radio receiver, and means upon lifting the receiver for preventing the operation of said busy tone device if it is not already in operation.

2. In combination, a telephone receiver and transmitter, a radio transmitter connected to the telephone transmitter, a telephone switch controlled by the removal of the telephone receiver and transmitter, means controlled by said switch for connecting the radio transmitter to a source of sending power current, a radio receiver adapted to be brought in circuit with the telephone receiver upon the lifting thereof, a signaling device connected to the radio receiver, means upon the connecting of the radio receiver with the telephone receiver for rendering the signaling device inoperative, a busy tone device connected to the source of sending power current, the telephone receiver and the radio receiver, means upon lifting the receiver for preventing the operation of said busy tone device if it is not already in operation, and means of alternately ren-

dering the radio transmitter and radio receiver inoperative when one of them is operating in the transmission or reception of signals.

3. In combination, a radio transmitter adapted to emit electro-magnetic waves, a telephone transmitter connected to the radio transmitter, a telephone receiver, a telephone switch, a radio receiver adapted to receive electro-magnetic waves and connected to said telephone receiver, a busy tone device connected to the telephone receiver and the radio receiver, means set in operation by attempted reception of signals with said radio receiver for temporarily disabling said busy tone device, and means set in operation by the electro-magnetic waves from the prior operation of another radio transmitter for rendering said busy tone device operative to interfere with the intelligible reception of signals by said radio receiver.

4. In combination, a radio transmitter, means of applying and transmitting energy thereto, a telephone transmitter connected to the radio transmitter, a telephone receiver, a telephone switch, a radio receiver connected to the telephone receiver, a busy tone device connected to the telephone receiver and the radio receiver, means for rendering said busy tone device inoperative, said parts being so arranged that when the telephone is put into circuit with the radio transmitter and receiver the busy tone device will be prevented from operating if not already operating yet will be permitted to continue operating if already operating whereby the telephone receiver will be prevented from receiving any other signals than the busy tone signals from the busy tone device, and means after the busy tone device is rendered inoperative for alternately rendering the radio transmitter and radio receiver inoperative when one or the other is operating during the period of voice transmission or reception respectively.

5. In combination, a radio transmitter, means of applying and transmitting energy thereto, a telephone transmitter connected to the radio transmitter, a telephone receiver, a telephone switch, a radio receiver connected to the telephone receiver, a busy tone device connected to the telephone receiver and the radio receiver, means for rendering said busy tone device connected to the telephone receiver and the radio receiver, means for rendering said busy tone device inoperative, said parts being so arranged that when the telephone is put into circuit with the radio transmitter and receiver the busy tone device will be prevented from operating if not already operating yet will be permitted to continue operating if already operating whereby the telephone receiver from receiving any other signals than the busy tone signals from the busy tone device, means after the busy tone device is rendered inoperative for alternately rendering the radio transmitter and radio receiver inoperative when one or the other is operating during the period of voice transmission or reception respectively, means connected to the radio receiver for receiving call signals prior to the operation of the telephone receiver, and means for rendering the signaling device inoperative upon rendering the telephone receiver operative.

6. In combination, a telephone receiver and transmitter and telephone switch; a radio transmitter having a power supplying circuit and power switch; a power connecting relay, a radio receiver, a signaling device connected thereto, a signaling device switch for disconnecting the

signaling device and connecting the radio receiver to the telephone receiver, a busy tone device connected to the telephone receiver, to the radio receiver and to the power circuit; a busy tone relay and switch for rendering the busy tone device inoperative or operative, and a conversion relay for rendering the switch device inoperative and connecting the radio receiver to the telephone receiver.

7. In combination, a telephone receiver and transmitter and telephone switch; a radio transmitter having a power supplying circuit and power switch; a power connecting relay, a radio receiver, a signaling device connected thereto, a signaling device switch for disconnecting the signaling device and connecting the radio receiver to the telephone receiver, a busy tone device connected to the telephone receiver, to the radio receiver and to the power circuit; a busy tone relay and switch for rendering the busy tone device inoperative or operative, a sensitive relay and switch for controlling the connecting of the busy tone device with the radio receiver, and a conversion relay for rendering the switch device inoperative and connecting the radio receiver to the telephone receiver.

8. In combination, a telephone receiver and transmitter and telephone switch; a radio transmitter having a power supplying circuit and power switch; a power connecting relay, a radio receiver, a signaling device connected thereto, a signaling device switch for disconnecting the signaling device and connecting the radio receiver to the telephone receiver, a busy tone device connected to the telephone receiver, to the radio receiver and to the power circuit; a busy tone relay and switch for rendering the busy tone device inoperative or operative, a sensitive relay and switch for controlling the connecting of the busy tone device with the radio receiver, a conversion relay for rendering the switch device inoperative and connecting the radio receiver to the telephone receiver, and a radio transmitter and receiver lock-out mechanism whereby when one is operating the other is rendered inoperative.

9. In combination, a telephone receiver and transmitter and telephone switch; a radio transmitter having a power supplying circuit and power switch; a power connecting relay, a radio receiver, a signaling device connected thereto, a signaling device switch for disconnecting the signaling device and connecting the radio receiver to the telephone receiver, a busy tone device connected to the telephone receiver, to the radio receiver and to the power circuit; a busy tone relay and switch for rendering the busy tone device inoperative or operative, a sensitive relay and switch for controlling the connecting of the busy tone device with the radio receiver, a conversion relay for rendering the switch device inoperative and connecting the radio receiver to the telephone receiver, a radio transmitter and receiver lock-out mechanism whereby when one is operating the other is rendered inoperative, a signaling device filter and a telephone receiver filter.

10. In combination in a radio telephone transmitting and receiving set, a radio telephone transmission circuit, a radio telephone receiving circuit, a busy tone circuit, means responsive to the attempted reception of signals to prevent the operation of said busy tone circuit, and means set in operation by the electro-magnetic waves from the prior operation of another radio transmitting circuit for rendering said busy tone cir-

cuit operative to interfere with the intelligible reception of signals by said first-mentioned radio receiving circuit whereby all other signals except the busy tone signal will be made unintelligible by the action of said busy tone circuit.

11. In combination in a radio telephone transmitting and receiving set, a radio telephone transmission circuit, a radio telephone receiving circuit, a busy tone circuit, means responsive to the attempted reception of signals to prevent the operation of said busy tone circuit, means set in operation by the prior operation of another radio transmitting circuit for rendering said busy tone circuit operative to interfere with the intelligible reception of signals by said first-mentioned radio receiving circuit, whereby all other signals except the busy tone signal will be made unintelligible by the action of said busy tone circuit, and means associated with the receiver and transmitter and responsive to the operation of the one for locking the other temporarily out of operation whereby to prevent the accidental simultaneous operation of both receiver and transmitter.

12. In combination in a combined radio and wire system of communication, a master radio transmitter and receiver, a wire telephone terminal station connectible thereto and to wire telephone lines, a plurality of subsidiary radio transmitters and receivers associated therewith and tuned to substantially the same wave length as said master transmitter and receiver, and devices responsive to the prior operation of one subsidiary transmitter adapted to prevent the intelligible reception of signals by the other subsidiary stations.

13. In combination in a combined radio and wire system of communication, a master radio transmitter and receiver, a wire telephone terminal station connectible thereto and to wire telephone lines, a plurality of subsidiary radio transmitters and receivers associated therewith and tuned to substantially the same wave length as said master transmitter and receiver, devices responsive to the prior operation of one subsidiary transmitter adapted to prevent the intelligible reception of signals by the other subsidiary stations, and devices similarly responsive to indicate the busy condition of the system to said other subsidiary stations.

14. In combination in a combined radio and wire system of communication, a master radio transmitter and receiver, a wire telephone terminal station connectible thereto and to wire telephone lines, a plurality of subsidiary radio transmitters and receivers associated therewith and tuned to substantially the same wave length as said master transmitter and receiver, devices responsive to the prior operation of one subsidiary transmitter adapted to prevent the intelligible reception of signals by the other subsidiary stations, devices similarly responsive to indicate the busy condition of the system to said other subsidiary stations, and means associated with each receiver and transmitter and responsive to the operation of the one for locking the other temporarily out of operation whereby to prevent the accidental simultaneous operation of both receiver and transmitter.

15. In combination in a combined radio and wire system of communication, a master radio transmitter and receiver, a wire telephone terminal station connectible thereto and to wire

telephone lines, a plurality of subsidiary radio transmitters and receivers associated therewith and tuned to substantially the same wave length as said master transmitter and receiver, devices responsive to the prior operation of one subsidiary transmitter adapted to prevent the intelligible reception of signals by the other subsidiary stations, devices similarly responsive to indicate the busy condition of the system to said other subsidiary stations, means associated with each receiver and transmitter and responsive to the operation of the one for locking the other temporarily out of operation whereby to prevent the accidental simultaneous operation of both receiver and transmitter, a signaling device associated with each radio telephone receiver for indicating the presence of incoming signals to the operator while idle, and means for shutting off the signaling device when the radio telephone receiver is put into operation for reception of signals.

16. In combination, a master radio-telephone transmitter and receiver, and a group of subsidiary radio-telephone transmitters and receivers tuned to substantially the same wave length as said master transmitter and receiver arranged for inter-communication by voice-modulated electro-magnetic waves; and means set in operation by the reception of the electro-magnetic waves from the inter-communication between one subsidiary station and the master station for positively rendering the other subsidiary transmitters inoperative.

17. In combination, a master radio-telephone transmitter and receiver, and a group of subsidiary radio-telephone transmitters and receivers tuned to substantially the same wave length as said master transmitter and receiver arranged for inter-communication by voice-modulated electro-magnetic waves; means set in operation by the reception of the electro-magnetic waves from the inter-communication between one subsidiary station and the master station for positively rendering the other subsidiary transmitters inoperative, means similarly set in operation to render the other subsidiary receivers incapable of reproducing intelligible signals, and means similarly set in operation for indicating the busy condition of the system to said other subsidiary receivers.

18. In combination in a combined radio and wire system of communication, a master radio transmitter and receiver a wire telephone switchboard connectible thereto and to wire telephone lines, means set in operation by the closing and opening of the circuit between the master radio receiver and said switchboard for placing said master radio transmitter in an operative and inoperative condition respectively, a plurality of subsidiary radio telephone transmitters and receivers adapted to communicate with said master station, and means set in operation by the reception of the electro-magnetic waves from the intercommunication between one subsidiary station and the master station for positively rendering the other subsidiary transmitters temporarily inoperative and for rendering the other subsidiary receivers temporarily incapable of reproducing intelligible signals.

CERTIFICATE OF CORRECTION.

Patent No. 2,061,699.

November 24, 1936.

ROBERT A. FOX.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 6, first column, line 58, claim 5, after the word "receiver" insert --will be prevented--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 17th day of September, A. D. 1940.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.