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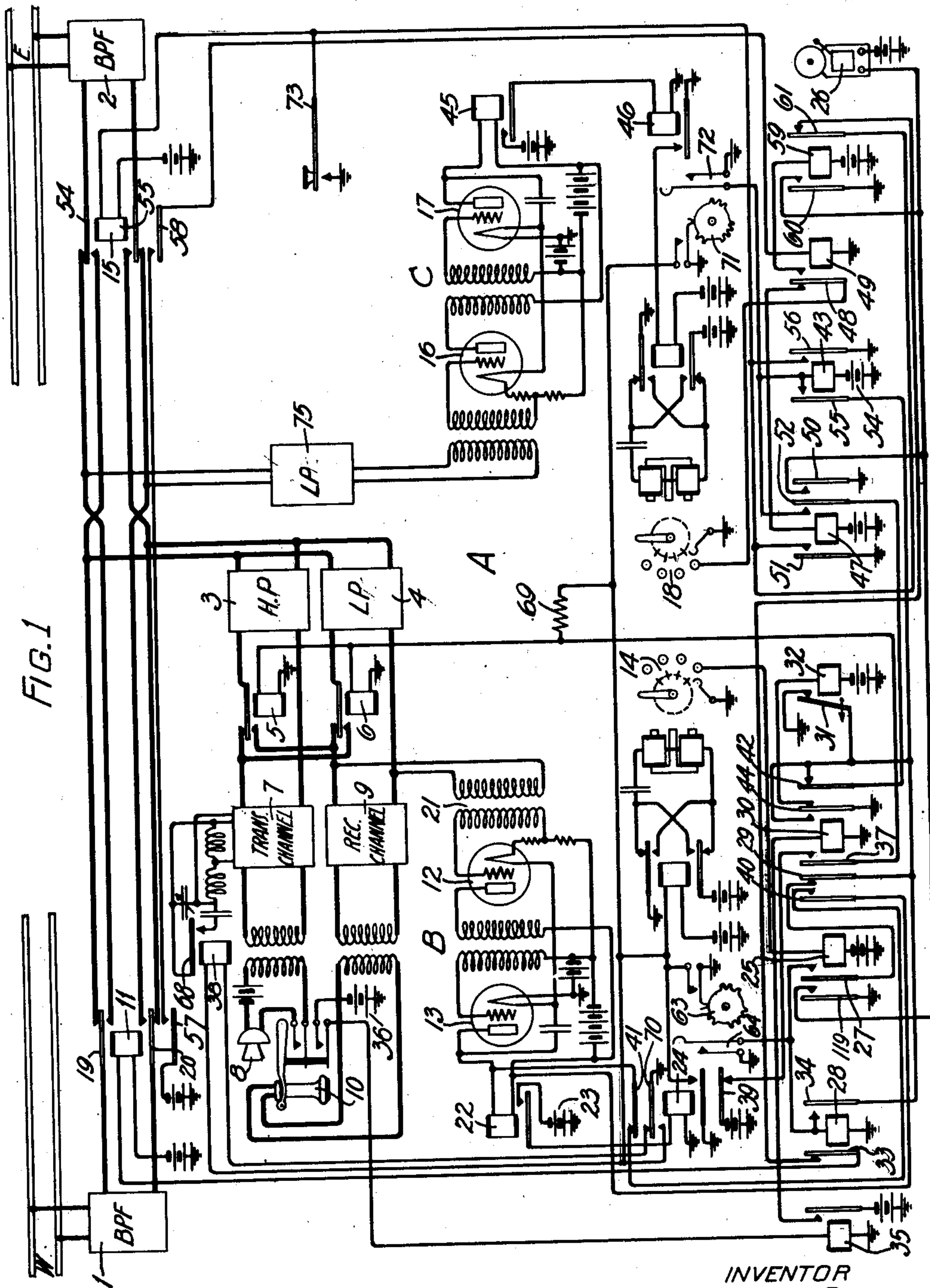
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POWER LINE CARRIER WAVE SIGNALING SYSTEM

Filed March 15, 1928

2 Sheets-Sheet 1



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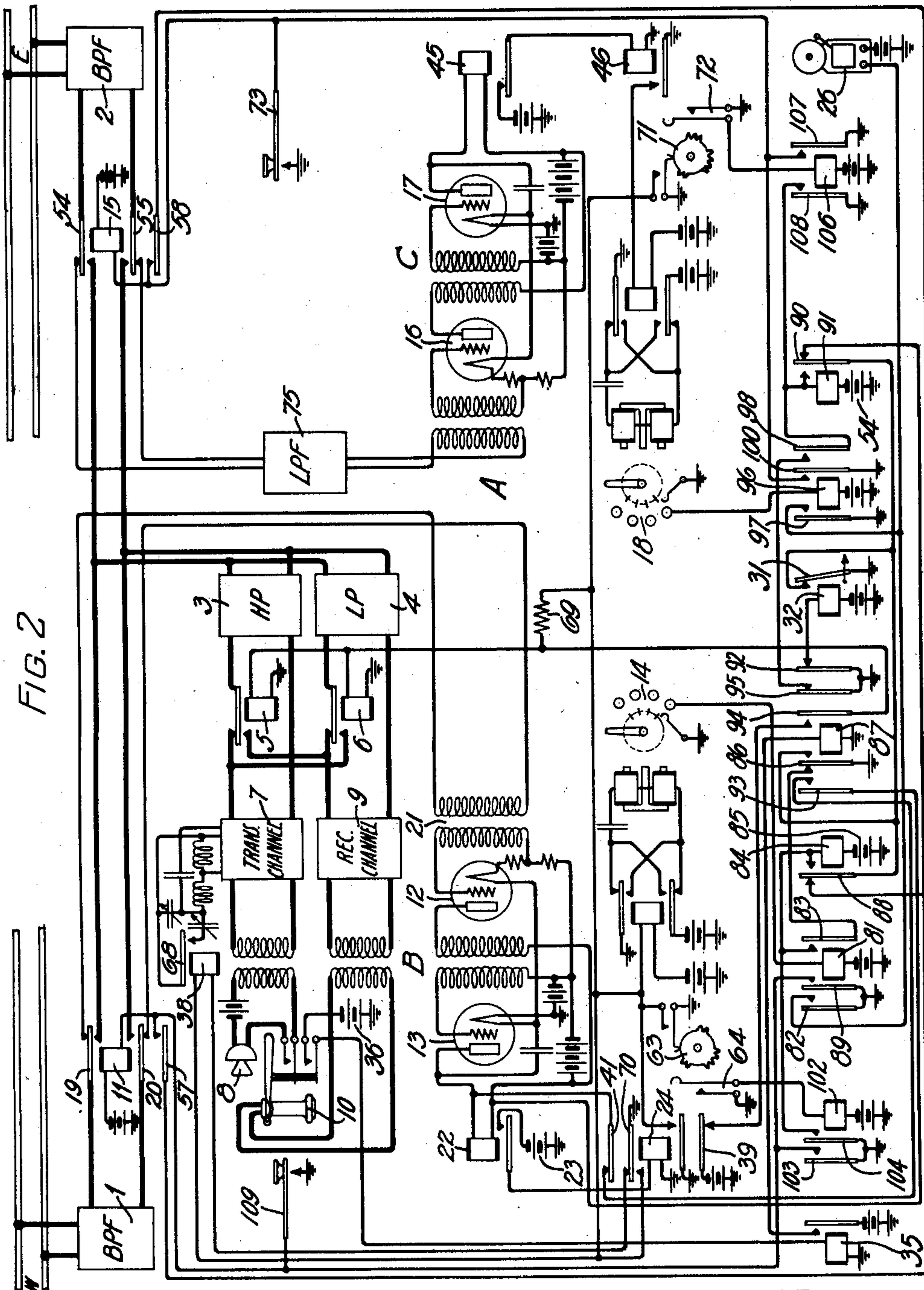
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POWER-LINE CARRIER WAVE SIGNALING SYSTEM.

Application filed March 15, 1928. Serial No. 281,787.

This invention relates to communication systems operated over power lines carrying high voltage power currents and particularly to communication systems employing high frequency waves which are superimposed upon the power currents traversing the power lines.

One object of the invention is to provide a single carrier current terminal station adapted to be automatically connected to either one of two independent power lines each having a number of signal stations connected thereto whereby calling and communication may be selectively effected between the terminal station and the signal stations on either of the power lines.

Another object of the invention is to provide a single carrier current signal terminal station having two signal apparatus arrangements connected respectively to two independent power lines each having a number of signal stations connected thereto and one carrier current apparatus adapted to be connected to either one of the power lines, said signal apparatus arrangements serving to transmit and receive calls between the terminal station and the signal stations and said carrier current apparatus serving to provide means for communication between the terminal station and the signal stations on the power lines.

A further object of the invention is to provide a carrier current communication system of the above indicated character having one terminal station connected to two independent power lines with means to permit communication between signal stations on one power line when the other power line is connected to the terminal station, to give an indication at the terminal station when in use that an operator at a signal station on the power line disconnected from the carrier current apparatus is calling, and to transmit a busy signal to the calling station on the power line disconnected from the carrier current apparatus when the terminal station is in use.

In some instances two independent power lines have a common terminal station and each power line has a separate and independent carrier current telephone system. The

providing of an independent carrier current terminal station for each of the power lines is very expensive and moreover only one terminal station can be used by the terminal operator at one time. The present invention provides means for the terminal operator to call and communicate over either power line from a single terminal carrier current station.

In carrying out the invention the terminal station is provided with two signal apparatus arrangements respectively associated with the two power lines. The signal apparatus provides means whereby the terminal operator may selectively call any signal station located on either power line and be called by any of the signal stations. The carrier current communicating apparatus is automatically connected to the power line having the calling station connected thereto. Moreover means are provided for preventing the idle power line carrier system from interfering with communication between the other carrier current system and the terminal station while permitting communication between the signal stations on the system disconnected from the terminal station. In case an operator on the idle power line calls the terminal station when it is in communication with a signal station on the other power line, an indication is given at the terminal station that an operator on the disconnected power line is calling. The term "idle power line" is used to indicate a power line disconnected from the carrier current apparatus at the terminal station. Furthermore, a busy signal is transmitted from the terminal station to the calling station on the power line disconnected from the terminal station.

In the accompanying drawing, Fig. 1 is a diagrammatic view of a carrier current signaling system constructed in accordance with the invention.

Fig. 2 is a modification of the system shown in Fig. 1.

Referring to Fig. 1 of the drawing, a terminal station A is shown connected to a west power line W and to an east power line E. The station A is connected to the power line W through a band pass coupling filter 1 and

is connected to the power line E through a band pass coupling filter 2. The two power lines W and E are assumed to be disconnected from each other and to carry high tension power currents of low frequency for power purposes. It is also assumed that various carrier current signal stations are connected to each of the power lines W and E. The carrier current apparatus at the terminal station connected to the power lines may be of the type disclosed in the application of W. V. Wolfe, Serial No. 664,147, filed September 22, 1923, patented July 24, 1928, No. 1,678,133, or of the type disclosed in the application of W. V. Wolfe, Serial No. 166,664, filed February 8, 1927.

In the system under consideration two carrier current frequencies are utilized in communicating between any of the stations on power lines W and E and the terminal station A. The calling station transmits at one frequency to a called station and receives at a higher frequency current from a called station. This is true whether a station on the power lines W and E or the terminal station is the calling station. Moreover impulses of the lower frequency are utilized for calling purposes between any of the stations on the power line and the terminal station.

The carrier current apparatus at the terminal station A comprises a high pass filter 3 and a low pass filter 4 which are respectively controlled by the relays 5 and 6. A transmission channel 7 is provided between the transmitter 8 and the filters, and a receiving channel 9 is provided between the receiver 10 and the filters. Normally the relays 5 and 6 are deenergized so as to connect the transmitting channel 7 to the high pass filter 3 and to connect the receiving channel 9 to the low pass filter 4. In such a condition the station A will receive at the lower frequency current and transmit at the higher frequency current. The transmission channel 7 is preferably similar to the transmitting channel disclosed in the application of W. V. Wolfe, Serial No. 166,664, and embodies an oscillator and suitable modulating and amplifying apparatus. A complete description and illustration of such apparatus is deemed unnecessary. The receiving channel 9 may include suitable amplifying and demodulating apparatus similar in construction to the receiving channel disclosed in the application of W. V. Wolfe, Serial No. 166,664.

Two signal apparatus arrangements B and C are provided at the terminal station A for connection to the power lines W and E. The signal apparatus B, which is normally connected to the power line W by means of a relay 11, comprises a suitable amplifying thermionic tube 12 and a detector thermionic tube 13. The detector tube 13 and apparatus

to be more fully described hereinafter, controls a selector 14. The signal apparatus C, which normally is connected to the power line E by means of a relay 15, comprises an amplifying thermionic tube 16 and a thermionic rectifier 17. The rectifier tube 17 and apparatus to be more fully described hereinafter, controls a selector 18. A low pass filter 75 is shown in circuit with the signal apparatus C between the band pass filter 2 and the amplifier tube 16. This low pass filter is added merely as a selective device and may be dispensed with if so desired inasmuch as only low frequency impulses will be transmitted to the signaling apparatus C.

In the system under consideration the relay 11 when deenergized connects the carrier current communication apparatus and the signal apparatus B to the power line W. The relay 15 when released connects the signal apparatus arrangement C to the power line E. Upon operation of the relays 11 and 15, as will be hereinafter set forth, the carrier current communication apparatus is connected to the power line E.

Call received from power line W (Fig. 1).

It is assumed a calling station on the power line W transmits a predetermined code of the lower frequency impulses for calling the terminal station A. The lower frequency impulses are received at the terminal station through the band pass filter 1, switch members 19 and 20 of the relay 11, low pass filter 4, transformer 21, amplifying device 12 and rectifier 13 for operating a relay 22. The relay 22 completes a circuit from a battery 23 for operating a relay 24 in accordance with the received impulses. The relay 24 controls the selector device 14 for completing a circuit to operate a relay 25. The relay 25 operates a switch member 119 for completing a circuit through the call bell 26. A second switch member 27 is operated by the relay 25 for completing a circuit to operate a relay 28. The circuit for operating the relay 28 extends from battery through the energizing coil of the relay 28, switch member 27, switch member 29 of a relay 30 and switch member 31 of a slow acting relay 32 to ground. Upon operation of the relay 28 a switch member 33 is operated to insure against any operation of the relay 11 during the receipt of a call by terminal station A from a station on the power line E. A switch member 34 is operated by the relay 28 for completing a locking circuit for such relay through the switch member 31 of the relay 32.

When the operator at the terminal station A removes his receiver 10 from the switch-hook upon receipt of a call, a circuit is completed for operating a relay 35 from a battery 36. The relay 35 effects operation of the relay 30. The relay 30 operates the

switch member 29 to break the above described energizing circuit for the relay 28. The relay 28 is not released at this time inasmuch as the locking circuit therefor is completed through the switch member 34. A switch member 37, operated by the relay 30, performs no useful function at this time inasmuch as a circuit for the relays 5, 6 and 38 which would be completed thereby is held open by the switch member 39 of the relay 24. It is essential to maintain the relays 5 and 6 deenergized during the receipt of a call from a distant station so that terminal station A transmits by means of higher frequency impulses and receives by means of lower frequency impulses. The switch member 40 is operated by the relay 30 for completing a shunt circuit around the relay 22 when the terminal station A is operated as a calling station. The terminal station is now assumed to be operated as a called station and the relay 24 is operated to open the shunt circuit around the relay 32 by means of a switch member 41. A switch member 42 is operated by the relay 30 for insuring against locking a relay 43 in operative position in case a call is received from the power line E. The function and operation of the relay 43 will be set forth in detail when a call over the power line E is considered. A switch member 44 is operated for opening the normally closed energizing circuit for the slow acting relay 32. The switch member 44 not only opens the energizing circuit for the relay 32 but completes a holding circuit for the relay 28. Inasmuch as the relay 32 is slow acting the locking circuit for the relay 28 is completed through the switch member 44 prior to the release of the switch member 31 by the relay 32. It is apparent that the releasing of the relay 30 by returning the receiver 10 to the switchhook will return all circuits to normal position. With the circuits in the position above set forth the terminal station A transmits by means of the higher frequency current and receives by means of the lower frequency current whereas the distant calling station on the power line W transmits by means of lower frequency current and receives by means of the higher frequency current.

If a call is received by the terminal station A from a station on the power line E while communicating with a station on the power line W, the call bell 26 is operated to notify the operator at station A that a station on the power line E is calling and a busy signal is given to the calling operator on the power line E. The lower frequency impulses transmitted by the calling station on the power line E in the form of a code to call the operator at station A are received through the band pass filter 2, low pass filter 75 and the signal apparatus C for operating a relay 45. The relay 45 operates a relay

46 which in turn operates the selector 18. The selector 18 completes a circuit for operating a relay 47. The circuit for operating the relay 47 extends from ground through the switch element of selector 18, switch member 48 of relay 49 and coil of relay 47 to battery and ground. The relay 47 operates a switch member 50 for completing a circuit to operate the call bell 26 and a switch member 51 for completing a circuit to operate the relay 15. At this time it may be noted that the switch member 51 which operates the relay 15 cannot effect operation of the relay 11 inasmuch as the switch member 33 is operated by the relay 28. Accordingly a call from the station on the power line E cannot interfere with communication between the terminal station A and a station on the power line W. The operation of the relay 15 connects the power line E through the band pass filter 2 to the carrier current circuit between the power line W and a terminal station. Thus, the calling operator on the power line E may listen in on the conversation with the terminal station and receive notice that the terminal station A is in communication with another station. The operation of the switch member 52 by the relay 47 does not complete a locking circuit for the relay 43 at this time inasmuch as the switch member 42 of the relay 30 is operated. As soon as the switch member of the selector 18 drops back the relay 47 is released to release the relay 15 and disconnect the station on the power line E from the circuit between the terminal station and a calling station on the power line W. It may be noted that the release of the relay 15 permits communication between any of the carrier current stations on the power line E.

Call received from east line (Fig. 1).

It is assumed a calling station on the power line E transmits a code of the lower frequency carrier current impulses for operating a selector at the terminal station A. The lower frequency current impulses are received through the band pass filter 2, switch members 54 and 55 of the relay 15 and low pass filter 75 for operating the signal apparatus arrangement C and the relay 45. The relay 45 operates the relay 46 which in turn operates the selector 18 for completing a circuit to effect operation of the relay 47. The relay 47 operates the switch member 51 for completing circuits to effect operation of relays 11 and 15. The operation of such relays disconnects the carrier current communication apparatus from the power line W and connects it to the power line E. The switch member 52 operated by the relay 47 completes a circuit for operating the relay 43. The circuit for operating the relay 43 extends from grounded battery 54, through relay 43, switch member 52, switch member

42 and switch member 31 of relay 32 to ground. Upon operation of the relay 43, a switch member 55 is operated for completing a circuit through the relay 43 independent of the switch member 52 controlled by the relay 47. A switch member 56 is operated by the relay 43 for completing a holding circuit through the relays 11 and 15. The relay 47 also operates a switch member 50 for completing a circuit to operate call bell 26. The relay 47 is released upon return of the selector 18 to normal position but the relays 43, 11 and 15 are held in operated position.

The relay 11 operates a switch member 57 and the relay 15 operates a switch member 58 for completing a circuit to operate the relay 49. The relay 49 operates the switch member 48 so that a relay 59 is operated if the selector 18 is operated by a calling station on the power line W when the terminal station A is in communication with a calling station on the power line E. It may be noted that the operation of the relays 11 and 15 connects the signal stations on the power line W to the signal arrangement C. The operation of the terminal station upon receipt of a call from a signal station on the power line W when in communication with a station on the power line E is set forth hereinafter.

When the operator at station A removes the receiver 10 from the switchhook the relay 35 is operated to effect operation of the relay 30. The relay 30 operates at this time in a manner similar to the operation above described when the call was received from a station on power line W.

Switch members 40, 29, 37 and 42 perform no useful function at this time. The switch member 44 completes a holding circuit for the relay 43, and opens the circuit of the relay 32. Upon completion of the conversation between terminal station A and the calling station on the power line E the return of the receiver to the switchhook deenergizes the relay 35 which in turn releases the relay 30. The relay 30 releases the relay 43 which in turn releases the relays 11, 15 and 49.

If a call is received by the terminal station A from a station on the power line W when in communication with a station on the power line E, the call bell 26 is operated to notify the operator at station A that a station on the power line W is calling and the calling operator on the power line W is given an indication that the terminal station A is in use. The lower frequency impulses transmitted by the calling station on the power line W for operating the selector at the terminal station A are received through the band pass filter 1, switch members 19 and 20 of relay 11, low pass filter 75 and the signal apparatus arrangement C for operating the

relay 45 in accordance with the received code. The relay 45 operates relay 46 which in turn operates the selector 18 for completing a circuit through the relay 59. At this time the relay 49 is operated so that the switch member 48 connects the selector to the relay 59. Relay 59 operates switch member 60 for completing a circuit to operate the call bell 26. The relay 59 also operates a switch member 61 for releasing the relay 11. Upon release of relay 11 the switch members 19 and 20 connect the calling station on the power line W to the carrier current communication circuit between the calling station on the power line E and the terminal station A, so that the calling operator on the power line W may listen in on the conversation and be given an indication that the terminal station A is in communication with a signaling station on the power line E. Upon return of the selector 18 to normal position the relay 59 is deenergized to operate the relay 11.

Call from terminal station to line W
(Fig. 1).

When making a call from the station A to a station on the power line W the receiver 10 is first moved from the switchhook and then a key 63 is operated to transmit a code according to the station desired to be called on the power line W. The key 63 may be of any suitable type such as the master impulse transmitting device disclosed in U. S. Patent 1,354,814 to J. C. Field issued October 5, 1920. Upon removal of the receiver from the switchhook the relay 35 is operated for operating the relay 30. Inasmuch as the relay 24 is not operated at this time the operation of the switch member 40 by the relay 30 serves to short-circuit the relay 22 and prevent operation of the relay 22 or the relay 24 thereafter. The switch member 29 performs no useful function at this time. A switch member 64 which is operated whenever a code is transmitted by the key 63 completes a circuit for operating the relay 28. The relay 28 operates the switch member 33 so as to insure against operation of the relay 11 during communication with a station on the power line W. The switch member 34 operated by the relay 28 completes a holding circuit through the armature 44 of the relay 30. The switch member 37 of the relay 30 completes a circuit for operating the relays 5, 6, and 38. The relays 5 and 6 interchange the connections of the transmitting channel 7 and the receiving channel 9 to the filters 3 and 4. The relay 38 controls an oscillator in the transmitting channel 7 as more fully described in the application of W. V. Wolfe Serial No. 166,664. In the closed position of the relay 38 the switch member 68 thereof adds capacity to the oscillator (not shown) and included in the transmitting channel 7.

By increasing the capacity in circuit with the oscillator a lower carrier frequency is transmitted as disclosed in the applications of W. V. Wolfe Serial Nos. 664,147 and 166,664. In the released position of the relay 38 the capacity in the circuit of the oscillator is reduced to raise the carrier frequency transmitted.

The key 63 is operated to transmit a code of impulses to the line W according to the station it is desired to call. The relay 38 at this time is operated by a circuit which extends from grounded battery through the switch member 39 of the relay 24, switch member 37 of the relay 30, a resistance 69, relay 38 and a switch member 70 of the relay 24 to ground. However, the key 63 intermittently connects a shunt circuit around the relay 38 in accordance with code desired to transmit to a distant station. Thus, normally with the relay 38 operated, a lower frequency carrier current is used in the transmission channel and upon each release of the relay 38 a higher frequency carrier current is developed. The higher frequency carrier cannot be transmitted through the low pass filter 4 and accordingly a code of lower frequency current impulses is transmitted from the station A to the called station on the power line W. This feature is fully described in the above mentioned two applications of W. V. Wolfe.

Call from terminal station to power line E (Fig. 1).

If the terminal station A desires to call a signal station on the power line E the receiver 10 is removed from the switchhook and a key 71, which is similar to the key 63, is operated in accordance with the code to call the desired station. Upon operation of the key 71 a contact member 72 is operated and maintained in operation during the transmission of the code for completing a circuit from ground through the relay 43.

The relay 43 completes a locking circuit for itself through a switch member 44 of the relay 30. Prior to the operation of the key 71, the removal of the receiver from the switchhook has operated relay 35 which in turn has operated relay 30. Relay 30 operates a switch member 44 for deenergizing the slow operating relay 32 but at the same time completes a holding circuit for the relay 43. The other switch members of the relay 30 operate in the manner above described in considering a call from terminal station A over power line W. The relay 43 operates the switch member 56 for completing circuits to operate the transfer relays 11 and 15. The transfer relays operate in the manner above described in considering a call from a station on the power line E. Such relays connect the carrier current

apparatus to the power line E and connect the signal apparatus arrangement C to the power line W.

Before making a call on either the power line W the operator at the terminal station A may determine whether or not some of the signal stations on the power line W are in use by merely removing his receiver from the switchhook and listening in. The same operation may be effected with respect to the signal stations on the power line E. However, the operator must at this time operate the key 73 to complete a circuit for operating the relays 11 and 15. The relays 11 and 15 transfer the connection of the carrier current apparatus at the terminal station A from the power line W to the power line E.

Terminal station in Fig. 2.

Referring to Fig. 2 of the drawings a system is illustrated wherein the two signal apparatus arrangements are normally connected to the power lines W and E and the carrier current apparatus is automatically connected to the power line having the calling station connected to it. Inasmuch as substantially the same apparatus is used in the system shown in Fig. 2 as in the system shown in Fig. 1, similar parts in the system of Fig. 2 have been designated by like reference characters.

Call received from line W (Fig. 2).

It is assumed a code of lower frequency impulses are transmitted from a station on the power line W for calling the terminal station A. The impulses from the calling station are received at station A through the coupling filter 1, switch members 19 and 20 of relay 11, and signal apparatus B for operating the relay 22. The relay 22 energizes relay 24 in accordance with the received impulses for operating the selector 14. The selector 14 completes a circuit for operating a relay 81. The relay 81 operates a switch member 82 for completing a circuit to operate the call bell 26. A second switch member 83 of the relay 81 completes a circuit for operating a relay 84. The circuit for operating the relay 84 extends from a grounded battery 85 through the coil of the relay, switch member 83, and switch member 86 of a relay 87 to ground. The relay 84 establishes a locking circuit for itself through a switch member 88 operated thereby. Such locking circuit extends through the switch member 31 of the relay 32. A third switch member 89 operated by the relay 81 closes a circuit for operating the relay 11. The relay 11 serves to connect the power line W to the high pass filter 3 and the low pass filter 4 of the carrier current apparatus. The relay 11 operates

the switch member 57 for establishing a holding circuit which extends through an armature 90 of a relay 91. In connection with the operation of the relay 84 by the relay 81, it should be noted that the switch member 88 which completes a holding circuit for the relay 84 also serves to prevent locking of the relay 15 in operative position when the terminal station A is talking with a calling station on the power line W.

Upon taking the receiver 10 from the switchhook a circuit is completed from the battery 36 for operating the relay 35. The relay 35 in turn operates the relay 87. A switch member 92 is operated for breaking the normally closed energizing circuit for the relay 32. Relay 32 is slow in operating and before the locking circuit completed through the armature 31 thereof for the relay 84 is opened, the switch member 86 of the relay 87 completes a second locking circuit for relay 84. A switch member 93 is operated by the relay 87 for establishing a shunt circuit around the relay 22. Such shunt circuit extends through the switch member 41 which is operated by the relay 24. At this time the relay 24 is in operative position and accordingly switch member 41 prevents the closing of the shunt circuit by the relay 87. A switch member 94 is operated by the relay 87 for preparing an energizing circuit of the relays 5, 6 and 38 through a switch member 39 of the relay 24. Inasmuch as the relay 24 is operated, the switch member 39 prevents the operation of the relays 5, 6, and 38 at this time. A switch member 95 is operated by the relay 87 for preventing operation of the relay 91 when the station A is in communication with a signal station on the power line W.

In case a station on the power line E signals the terminal station A when the terminal station is in communication with a signal station on the power line W, the terminal station is given a signal that a party on the power line E is calling and the calling station on the power line E is given a busy signal. The code of low frequency impulses transmitted from the calling station on power line E are received through the coupling filter 2, switch members 54 and 55 of the relay 15, low pass filter 75, and signal apparatus C for operating the relay 45. The relay 45 operates the relay 46 which in turn operates the selector 18. The selector 18 completes a circuit for operating a relay 96. The relay 96 operates switch member 97 for completing a circuit to operate the call bell 26. A switch member 98 operated by the relay 96 performs no useful function at this time inasmuch as the switch member 95 of the relay 87 prevents the completion of a holding circuit through the relay 91. The switch member 100, which is operated by the relay 96, completes a circuit for operating

the relay 15. The relay 15 connects the calling station on the power line E to the carrier current channel between the terminal station A and the station in service on the power line W so that the calling party on the line E may listen in on the conversation and thus be notified that the terminal station A is in service. Upon the return of the selector 18 to normal condition, the relays 96 and 15 are released.

Call received from power line E (Fig. 2).

If a call is received by the terminal station from a station on the power line E, a code of lower frequency impulses is received through the band pass filter 2 and the signal apparatus C for operating the selector 18. The selector 18 operates the relay 96 which in turn completes a circuit through the switch member 97 for operating the call bell 26 and completes a circuit through the switch member 100 for operating the relay 15. The relay 15 connects the carrier current apparatus at terminal station A to the power line E. The switch member 58, operated by the relay 15, establishes a holding circuit for the relay through the switch member 88 of the relay 84 and the switch member 31 of relay 32. The third switch member 98, operated by the relay 96, completes a circuit for operating the relay 91. The relay 91 operates a switch member 90 for insuring against holding the relay 11 in operative position during communication between the terminal station and a calling station on the power line E. The switch member 90 also establishes a holding circuit for the relay 91 through the switch member 31 of the relay 32. Upon removing the receiver 10 from the switchhook a circuit is completed for operating the relay 35 which in turn operates the relay 87. The relay 87 operates the switch member 92 for opening the holding circuit of the relay 32 and operates the switch member 86 for establishing a new holding circuit for the relays 91 and 15. The switch member 93 performs no useful function at this time.

It is apparent that all the circuits completed for service during a communication between the terminal station and a calling station on either the power line E or the power line W are under the control of the receiver switchhook and the relay 87. Accordingly, upon the return of the receiver to the switchhook all circuits are returned to normal position by release of the relay 87.

If a station on the power line W calls the terminal station, when the terminal station is in communication with a station on the power line E, the call bell 26 is operated to notify the terminal operator that a station on the line W is calling and the calling station on the line W is notified that the terminal station is in operation. The lower

frequency impulses transmitted from the calling station on the line W are received through the coupling filter 1, switch members 19 and 20 of the relay 11 and the signal apparatus B for operating the selector 14. The selector 14 operates relay 81 which in turn operates the call bell 26 and the relay 11. The relay 11 connects the called station on the power line W to the carrier current communication channel between the terminal station and the station in service on the power line E for permitting the operator at the calling station to listen in on the conversation. Upon the return of the selector 14 to normal position, the relays 81 and 11 are released so that the power line W is in condition for communication between any two signal stations thereon.

20 *Call from terminal station to line W.*

In calling a station on the power line W the terminal operator removes his receiver from the switchhook and operates the key 63 in accordance with the code required for calling the desired station. The removal of the receiver from the switchhook completes a circuit for operating the relay 35 which in turn operates the relay 87. The relay 87 operates the switch member 93 for establishing a shunt circuit around the relay 22 to insure against operation of the relays 22 and 24 at this time. The switch member 86 operated by the relay 87 prepares a holding circuit for the relay 84. The switch member 94 of the relay 87 completes a circuit through the switch member 39 of the relay 34 for operating the relays 5, 6 and 38. The relays 5 and 6 interchange the connections of the filters 3 and 4 so that transmission from the terminal station is effected by means of the lower frequency carrier current. The relay 38 is operated to control the oscillator (not shown) and generate current of the lower carrier frequency. When the key 63 is operated for transmitting a code of impulses over the power line W, a switch 64 is closed for operating a relay 102. The relay 102 operates a switch member 103 for operating the relay 11. The relay 11 establishes a holding circuit through the switch member 57. The relay 102 also operates a switch member 104 for completing an energizing circuit through the relay 84. The relay 84 upon operation completes a holding circuit through its switch member 88 and a switch member 86 of the relay 87. The relay 87 controls all operative circuits in the same manner as above set forth in describing the receipt of a call by the terminal station from one of the signal stations on either of the power lines. Accordingly upon the return of the receiver to the switchhook the relay 87 is released to return all circuits to normal position.

A call from terminal station to line E (Fig. 2).

In case the terminal station A desires to call a station on the power line E the key 71 is operated in accordance with the code required to call the desired station. Prior to the operation of the key 71, the terminal operator removes his receiver from the switchhook. The removal of the receiver from the switchhook operates relays 35 and 87. The relay 87 operates the relays 5, 6 and 38 in the same manner as above described in considering a call from the terminal station to a station on the power line W. A switch 72, which is operated by the key 71, completes a circuit for operating relay 106. Relay 106 operates a switch member 107 for completing a circuit to operate relay 15. Relay 15 connects the carrier current apparatus at the terminal station to the power line E. The switch member 58, which is operated by the relay 15, establishes a holding circuit for the relay through a switch member 88 of the relay 84 and the switch member 31 of the relay 32. This last traced calling circuit is later completed through the switch member 86 of the relay 87. A switch member 108 is operated by the relay 106 for completing a circuit to operate the relay 91. The relay 91 establishes a holding circuit through its switch member 90 and switch member 86 of relay 87. Thus the relay 87 which is controlled by the receiver switchhook controls the operation of relays 5, 6, 38, 15 and 91 and the return of the receiver to the switchhook serves to deenergize the relay 87 and return the apparatus to normal position. Before making a call on either the power line E or the power line W the terminal operator may first desire to listen in on both of the power lines to see whether or not stations thereon are in service. If the terminal operator desires to call a station on the power line E a key 73 is operated for completing a circuit to energize the relay 15. The relay 15 serves to connect the terminal station carrier current apparatus to the power line E so that the terminal operator may listen in on any conversation between stations on line E. In like manner if the terminal operator desires to call a station on the power line W a key 109 is operated for completing an energizing circuit for relay 11. Relay 11 connects the carrier current apparatus at the terminal station to the power line W so that the terminal station operator may listen in on any conversation between stations on the power line W.

Modifications in the systems and in the arrangement and location of parts may be made within the spirit and scope of the invention and such modifications are intended to be covered in the appended claims.

What is claimed is:

1. A carrier current power line signaling system comprising two independent power lines each having signal stations connected thereto, a terminal station associated with the power lines, means controlled from a signal station on one of said power lines automatically to connect the terminal station to the associated power line and exclude the signal stations on the other power line, and means to give a busy signal to a calling station if the terminal station is in use.
2. A carrier current power line signaling system comprising two independent power lines each having signal stations connected thereto, a terminal station associated with the two power lines, means for a station on one power line to communicate with the terminal station and exclude stations on the other power line, means at the terminal station when communicating with one power line to indicate a call from the idle power line, and means to give a busy signal to a calling station if the terminal station is in use.
3. A carrier current power line signaling system, comprising two independent power lines each having signal stations connected thereto, a terminal station associated with said power lines, two signal apparatus arrangements at said terminal station respectively associated with said two power lines for making and receiving calls over the power lines, one carrier current communicating apparatus adapted to be selectively connected to either of said power lines by a calling station on the power line, and means for preventing the connection of said carrier current apparatus simultaneously to both of said power lines and for preventing stations on one power line from interfering with calling and communication between the terminal station and stations on the other power line.
4. A carrier current power line signaling system, comprising two independent power lines each having signal stations connected thereto, a terminal station having one carrier current communicating apparatus adapted to be connected to either of said power lines and two signal apparatus arrangements, respectively connected to said power lines, and means including said carrier apparatus, said signal apparatus arrangements for signaling signal stations on either said power lines and for effecting exclusive conversation therewith, for indicating at the terminal station when an operator on the other line desires to communicate therewith, and for giving a calling station on the other power line a busy signal when the terminal station is in use.
5. A carrier current power line signaling system comprising two independent power lines having stations connected thereto, a terminal station having two signal apparatus arrangements connected to the respective power lines and one carrier current communicating apparatus adapted to be selectively connected to the power line connected to the calling station, and means at the terminal station when in communication with a signal station on one power line to indicate a call from a signal station on the idle power line.
6. A carrier current power line signaling system comprising two independent power lines having signal stations connected thereto, a terminal station having two signal apparatus arrangements normally connected to the respective power lines and one carrier current communicating apparatus normally disconnected from the power lines, and automatic means operated upon receipt at the terminal station of a call for connecting the carrier current apparatus to the power line connected to the calling station.
7. A carrier current power line signaling system comprising two independent power lines having signal stations connected thereto, a terminal station having two signal apparatus arrangements normally connected to the respective power lines for receiving and transmitting calls and one carrier current communicating apparatus normally disconnected from the power lines, automatic means for connecting the carrier current apparatus to the power line connected to the calling station upon receipt of a call at the terminal station, and means to transmit a busy signal to a signal station on an idle power line when the terminal station is in use.
8. A carrier current power line signaling system comprising two independent power lines having signal stations connected thereto, a terminal station having two signal apparatus arrangements normally connected to the respective power lines for receiving and transmitting calls and one carrier current communicating apparatus normally disconnected from the power lines, automatic means for connecting the carrier current apparatus to the power line connected to the calling station upon receipt of a call at the terminal station, and means at the terminal station when in communication with a signal station on one power line to indicate a call from a signal station on the idle power line.
9. A carrier current power line signaling system comprising two independent power lines having signal stations connected thereto, a terminal station having two signal apparatus arrangements normally connected to the respective power lines for receiving and transmitting calls and one carrier current communicating apparatus normally

disconnected from the power lines, automatic means upon receipt at the terminal station of a call for connecting the carrier current apparatus to the power line connected to the calling station, means at the terminal station when in communication with a station on one power line to indicate a call from a station on the idle power line, and means to transmit a busy signal to a calling signal station on an idle power line when the terminal station is in use. 10

In witness whereof, I hereunto subscribe my name this 13th day of March, 1928.

REGINALD M. PEASE.