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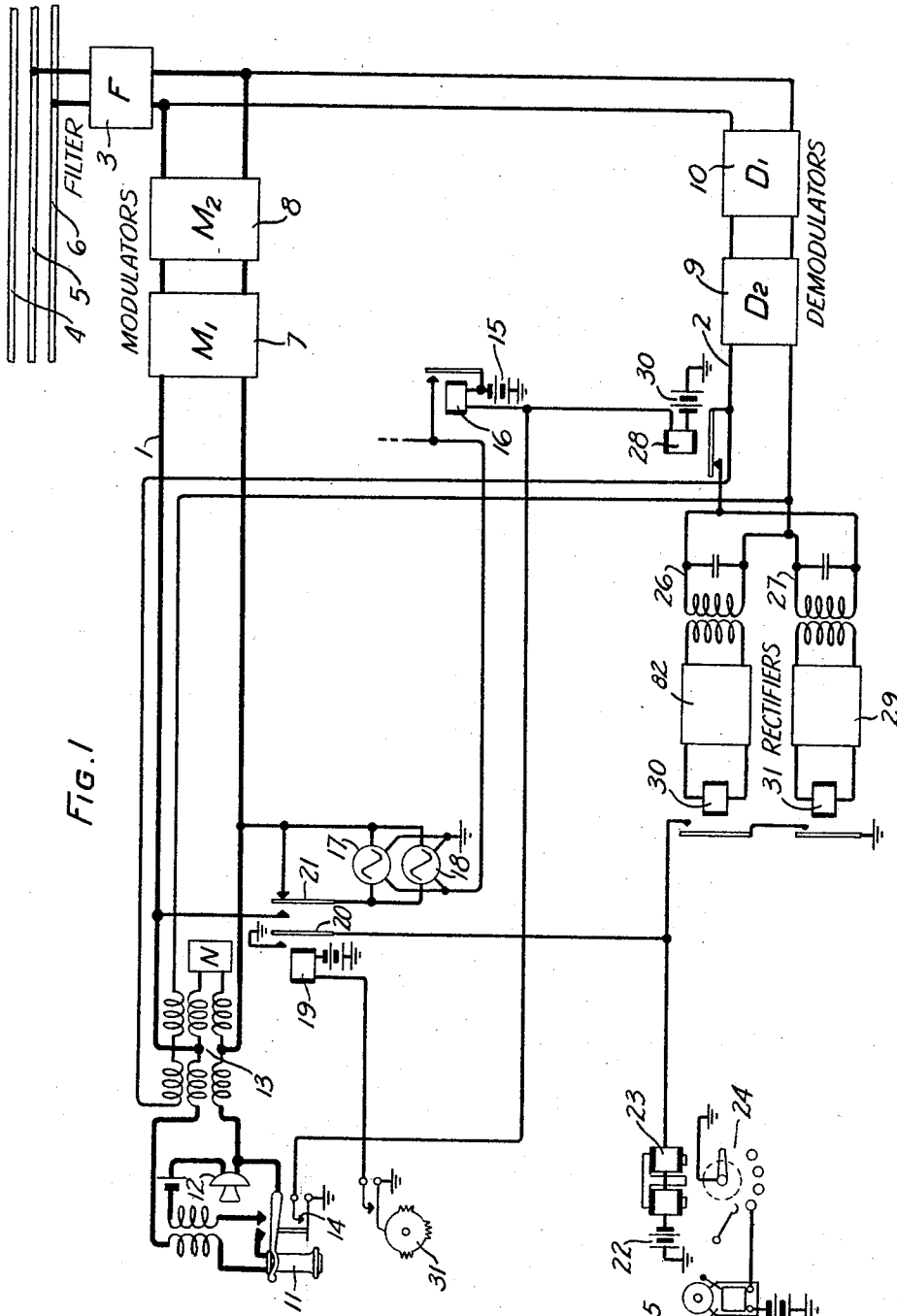
R. D. GIBSON

1,896,487

CALLING CIRCUIT

Filed April 18, 1930

2 Sheets-Sheet 1



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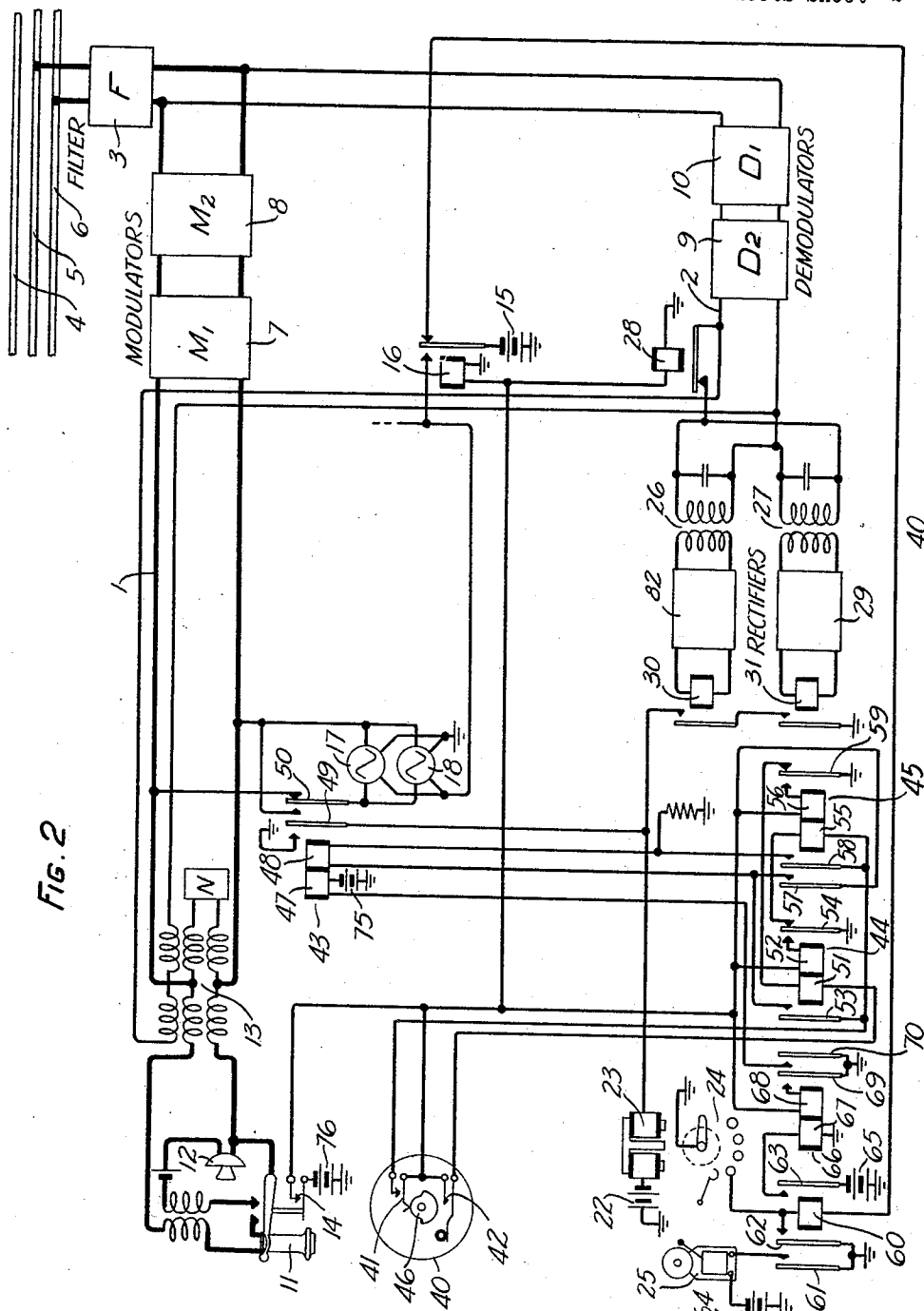


FIG. 2

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CALLING CIRCUIT

Application filed April 18, 1930. Serial No. 445,275.

This invention relates to calling circuits for communication systems and particularly to selective calling circuits for power-line carrier-current communication systems.

5 One object of the invention is to provide a power line carrier-current communication system that shall effect selective calling of a distant station by a code signal of carrier-current modulated with impulses of current
10 having more than one frequency within the voice frequency range.

Another object of the invention is to provide a power line carrier-current communication system having a plurality of signal
15 stations connected thereto that shall effect selected calling between stations by transmitting a code signal of carrier-current modulated with impulses of two currents within the voice frequency range and that shall in-
20 sure against operation of the calling selectors at the signal stations during communication between stations.

In a power-line carrier-current communication system of the type disclosed in the
25 patent to C. N. Nebel 1,733,553 dated October 29, 1929, communication is effected in opposite directions between stations by currents within the same frequency range. In a system of this type it is desirable to have the
30 impulses of currents employed for selectively calling a station to be within the same frequency range as the currents employed for communication between stations. It is desirable to have the communicating and call-
35 ing currents within the same frequency range by reason of the transmission limitations of a power line.

In the present invention calling circuits
40 are disclosed for a power line carrier-current communication system of the type disclosed in the above mentioned Nebel patent. Calling between stations on the power line is effected by carrier-current modulated with
45 impulses of current of two frequencies within the voice frequency range. In the preferred modification of the invention two calling oscillators are provided at each station having frequencies within the voice frequency range, as for example, one oscillator may
50 develop current having a frequency of 900

cycles and the other oscillator may develop current having a frequency of 1500 cycles. Normally the two calling oscillators are de-energized and disconnected from the power line. The two oscillators during calling of
55 a distant station are connected according to a code signal to a transmitting channel of the type disclosed in the above mentioned Nebel patent having two modulators and transmit-
60 ting only one side band of the output from the second modulator. Upon removal of the receiver from the switchhook at a calling station the two oscillators are energized but are not connected at this time to the transmitting
65 channel. Upon operation of a selector key, means is provided for intermittently connecting the two oscillators to the transmitting channel in accordance with the code signal to be transmitted. The code signal of im-
70 pulses of current of two frequencies supplied to the transmitting channel are modulated by the two modulators in the transmitting channel in the manner disclosed in the above mentioned patent to C. N. Nebel. The se-
75 lector key also controls the local selector at the calling station to give the calling operator an indication of the code signal transmitted.

Each of the stations connected to the power line is provided with a receiving channel of the type disclosed in the patent C. N. Nebel.
80 The receiving channel is provided with two demodulators for demodulating the received modulated current to obtain voice frequency currents. In the present invention two recti-
85 fiers and two tuned circuits are connected in parallel to the output circuit of the second demodulator. The two tuned circuits are respectively tuned to the frequencies of the two calling oscillators. Each of the rectifiers as-
90 sociated with the tuned circuits control a relay and the two relays jointly control the operation of a selector magnet. The selector magnet operates a local selector. In order to operate a selector magnet and the local
95 selector at a called station it is necessary to receive a code signal of impulses of current having two different frequencies. The tuned circuits connected to the receiving channel at a called station in each case being tuned to the
100 same frequency as the calling oscillators at a

calling station. In a system of this type it is apparent that the currents employed during communication between two signal stations will not be able to simultaneously transmit voice frequency currents through the two tuned circuits for operating the selector magnet and the selector in accordance with any code signal.

Each of the stations is provided with means for disconnecting the two tuned circuits from the receiving channel. Such means is preferably operated upon removal of the receiver from the switchhook.

In the accompanying drawings Figure 1 is a diagrammatic view of calling circuits constructed in accordance with the invention; and

Fig. 2 is a diagrammatic view of a modified calling circuit.

Referring to Fig. 1 of the drawings a signal station comprising a transmitting channel 1 and a receiving channel 2 is connected by a coupling filter 3 to a power line comprising conductors 4, 5 and 6. The transmitting channel is provided with two modulators 7 and 8 and the receiving channel is provided with two demodulators 9 and 10. The modulators 7 and 8 and the demodulators 9 and 10 are similar in construction and operation to the modulators and demodulators shown in the above mentioned patent to Nebel.

An operator's telephone set comprising a receiver 11 and a transmitter 12 is connected to the transmitting channel 1 and the receiving channel 2 by means of a hybrid coil 13. The receiver controls the switchhook which operates an auxiliary switch 14. The switch 14 upon the removal of the receiver from the switchhook completes a circuit from a battery 15 through a filament relay 16. The filament relay 16 completes circuits not only for energizing calling oscillators 17 and 18 but also for heating the various thermionic tubes (not shown) which are utilized at the station. A complete description of the operation of energizing the various thermionic tubes upon removal of the receiver from the switchhook is given in the above mentioned patent to Nebel.

The two calling oscillators 17 and 18 which are controlled by a pulsing relay 19 are provided for transmitting a code signal of impulses of two currents within the voice frequency range. Carrier current is modulated with the impulses from the oscillators 17 and 18 by means of the modulators 7 and 8. Preferably, the oscillators 17 and 18 are of the thermionic type. The pulsing relay 19 is provided with two switch members 20 and 21. Switch member 21 serves to connect the oscillators 17 and 18 across the transmitting channel 1 when the relay 19 is in an operative position. Switch member 20 completes a circuit from battery 22 through the selector magnet 23. The selector magnet 23 operates a selector 24 for completing a circuit to operate a call

bell 25. Preferably the selector 24 is of the type disclosed in the patent to J. C. Field, #1,343,256, dated June 15, 1920.

Two tuned circuits 26 and 27 are connected to the receiving channel 2 by means of a relay 28. The relay 28 is operated by the auxiliary switch 14 upon removal of the receiver 11 from the switchhook. Tuned circuit 26 is connected to a rectifier 82 by a transformer and tuned circuit 27 is connected to a rectifier 29 by a transformer. The rectifiers 82 and 29, respectively, control the operation of two relays 30 and 31. The two relays 30 and 31 have their switch members connected in series for completing a circuit from the battery 22, through the selector magnet 23.

If the operator desires to call a distant station he first removes his receiver from the switchhook. Upon removal of the receiver from the switchhook the switch 14 completes a circuit from the battery 15 for operating the filament relay 16 and a circuit from the battery 30 for operating the relay 28. Filament relay 16 energizes the calling selectors 17 and 18. The relay 28 opens the circuit connection between the tuned circuits 26 and 27 and the receiving channel 2. A selector key 31 of the type shown in the patent to J. C. Field #1,354,814 dated October 5, 1920, is operated in accordance with the code signal required to call the distant station. The pulsing relay 19 is operated to connect the oscillators 17 and 18 jointly to the transmitting channel according to the code signal. Carrier current is modulated with the impulses from the oscillators 17 and 18 by the modulators 7 and 8 and one side band of the second modulation operation is transmitted over the power lines as disclosed in the above mentioned patent to Nebel. The relay 28 serves to prevent operation of the relays 30 and 31 by the impulses which are transmitted from the oscillators 17 and 18. However, the switch member 20 which is operated by the pulsing relay 19 serves to operate the selector magnet 23 in accordance with the code signal being transmitted.

At the called station the modulated code signal is demodulated by the demodulators 9 and 10. The voice frequency currents having the same frequency as the currents from the oscillators 17 and 18 are selected by the tuned circuits 26 and 27. Such currents are rectified by the rectifiers 82 and 29 for operating the relays 30 and 31. The relays 30 and 31 operate the selector magnet 23 in accordance with the code signal for completing the circuit through the selector to operate the bell 25. The selector 24 at the called station is operated by the 17th impulse and the 18th impulse serves to release the selector. Upon removal of the receiver from the switchhook at the called station the relay 28 is operated, but by this time the code signal has been completely received and no harm

is done by disconnecting the tuned circuits 26 and 27 from the receiving channel. The pulsing relay 19 at both the calling and called stations are released so that the oscillators 17 and 18 are not connected to the transmitting channel at either station.

Referring to Fig. 2 of the drawings a modified calling circuit is illustrated which is provided with means for transmitting carrier-current modulated with two currents within the voice frequency range, the same as the circuit shown in Fig. 1 of the drawings. Similar parts in Fig. 2 of the drawings will be indicated by like reference characters. A telephone dial switch 40 having pulsing contacts 41 and off normal contacts 42 is provided for controlling the operation of a pulsing relay 43 by means of an off-normal relay 44 and a control relay 45. The control of the pulsing relay by a telephone dial switch is very similar to the control means disclosed in the application of H. B. Arnold and L. B. Cooke, Serial No. 445,077, filed April 17, 1930. The dial switch is provided with a cam member 46 which operates the pulsing contacts 41 at just half the speed, such contacts are operated by the usual figure 8 shaped cam member. With a dial switch so constructed the pulsing contacts may be left in open or closed position and accordingly means must be provided for insuring that the pulsing relay 43 is always deenergized when conversation takes place between the calling and called station. Furthermore, means must be provided to insure the transmitting of a correct code signal irrespective of the initial position of the pulsing contacts.

The pulsing relay 43 comprises two coils 47 and 48, and two switch members 49 and 50. Switch member 50 controls the connection of the oscillators 17 and 18 to the transmitting channel 1 and switch member 49 controls the operation of the selector magnet 43. The off-normal relay 44 comprises coils 51 and 52 and two switch members 53 and 54. The control relay 45 comprises two coils 55 and 56 and three switch members 57, 58 and 59.

The selector 24 operates a relay 60 having three switch members 61, 62 and 63. Switch member 61 completes a circuit from a battery 64 for operating the bell 25. The switch member 62 completes a holding circuit from the battery 15 for the relay 60. The switch member 63 completes a circuit from battery 65 for operating a relay 66. The relay 66 is provided with two operating coils, 67, 68 and two switch members 69 and 70. The switch member 70 serves to complete a circuit from battery 75 through the coil 47 of the pulsing relay 43 to disconnect the oscillators 17 and 18 from the transmitting channel at the called station during conversation. The switch member 69 completes a holding circuit through the coil 68 of the

relay 66 when the receiver at the called station is removed from the switchhook.

If the operator desires to call a distant station he first removes his receiver from the switchhook and operates the auxiliary switch 14. Thereupon, the filament relay 16 and the relay 28 are operated. The filament relay 16 energizes the oscillators 17 and 18 and the relay 28 disconnects the tuned circuits 26 and 27 at the calling station from the receiving channel 2.

Assuming the pulsing contact 41 of the dial switch to be in open position and the dial switch to be operated to transmit a code signal, a circuit is completed by the off normal contacts 42 for operating the off-normal relay 44. The circuit completed by the off-normal contacts may be traced from battery 76 through the switch 14, off-normal contacts 42, coil 51 of the off-normal relay 44, switch member 59 of the control relay 45 and ground return to the battery 76. The off-normal relay 44 is operated and a holding circuit is completed by the switch member 54 through the coil 52 and the auxiliary switch 14. The pulsing contacts 41 of the dial switch operate the pulsing relay 43 by a circuit which may be traced from the battery 76 through the auxiliary switch 14, pulsing contacts 41, switch member 53 of the off-normal relay 44, coil 48 of the pulsing relay 43 and ground return to the battery 76. Upon completion of this signal the pulsing contacts 41 are closed to insure the operation of the pulsing relay 43 so as to disconnect the oscillators 17 and 18 from the transmitting channel 1. The selector magnet 23 is operated by the switch member 49 of the pulsing relay in order to operate the selector at the called station and give the operator at such station an indication of the signal being transmitted.

At the called station the modulated impulses comprising the code signal are demodulated by the demodulators 9 and 10. The circuits 26 and 27 which are tuned to the same frequency as the oscillators 17 and 18 select the code signal impulses which are transmitted to the rectifiers 82 and 29 for operating the relays 30 and 31. The relays 30 and 31 effect the operation of the selector magnet 23 which, in turn, operates the selector 24 for operating the relay 60. The relay 60 completes a circuit for operating the called bell 25. The switch member 62 as before set forth completes a holding circuit for the relay 60 from a battery 15 through the switch member of the filament relay 16. The switch member 63 completes a circuit from the battery 65 for operating relay 66. The switch member 70 of the relay 66 completes a circuit for operating pulsing relay 43 to insure the disconnection of the oscillators 17 and 18 from the transmitting channel at the called station. The switch member 69 completes a holding circuit for the

relay 66 when the receiver is removed from the switchhook.

When the operator at the called station removes his receiver from the switchhook a circuit is completed from the battery 76 for operating the filament relay 16 and the relay 28. The filament relay 16 opens the holding circuit through the relay 60 to stop operation of the call bell 25. The relay 66 and the pulsing relay 43 are not released at this time by reason of the holding circuit through the relay 66 which is completed by the switch member 69 and the auxiliary switch 14. Upon completion of conversation between the two stations the replacing of the receiver on the switchhook at the called station breaks the holding circuit for the relay 66 to return all parts to normal position. The return of the receiver to the switchhook at the calling station breaks the holding circuit through the off-normal relay 44 to return all parts to normal position.

If the pulsing contacts 41 are initially in closed position and the operator desires to call a distant station, he first removes his receiver from the switchhook and a circuit is completed for operating the control relay 45. The circuit for operating the control relay may be traced from the battery 76, through the auxiliary switch 14, pulsing contacts 41, coil 55 of control relay, switch member 54 and ground return to the battery 76. The pulsing relay 43 is not operated this time inasmuch as the pulsing contacts 41 of the dial switch 40 established a shunt circuit across the coil 48 of the pulsing relay 43. The shunt circuit across the coil 48 may be traced from one terminal of the coil through switch member 58, pulsing contacts 41 of the dial switch and switch member 57 to the other terminal of the coil 48. Upon separation of the pulsing contacts the shunt circuit across the coil 48 is opened and such coil is energized from the battery 76. The energizing circuit for the coil 48 of the pulsing relay may be traced from the battery 76, through the switch 14, switch member 57, coil 48 and ground return to the battery 76. Upon completion of the code signal the pulsing contacts 41 of the dial switch are held in open position to insure the operation of the pulsing relay 43 to disconnect the oscillators 17 and 18 from the transmitting channel 1.

The operation at the called station when the pulsing contacts of the dial switch are initially closed is the same as that before described when the dial switch was considered with the pulsing contacts initially in open position. Upon completion of the conversation between the called and calling station, the replacing of the receivers upon the switchhooks open the auxiliary switch 14 for releasing the control relay 45 and the relay 60 to return all parts to normal position.

Modifications in the systems and in the ar-

range and location of parts may be made within the spirit and scope of the invention and such modifications are intended to be covered by the appended claims.

What is claimed is:

1. In a signal system, a power line having a plurality of signal stations connected thereto, calling selectors at the signal stations, two calling oscillators at each station, said oscillators developing currents having frequencies within the voice frequency range, means for energizing said calling oscillators at a calling station upon removal of the receiver from the switchhook, means for transmitting a code signal of carrier current modulated with impulses from each of said oscillators at a calling station to call a distant station, control means connected to the line at a called station comprising two circuits each including a filter, a rectifier, and a relay and responsive only to said code signal transmitted from the calling station for operating the selector at the called station, and means for disconnecting said control means from the line upon removal of the receiver from the switchhook.

2. In a signal system, a transmission line having a plurality of signal stations connected thereto, and means for effecting selective calling between stations by code signals of carrier current modulated with two currents of audio frequency comprising calling selectors at said stations, a plurality of relay means connected to the line at each station, means at a called station for demodulating a received code signal of modulated current impulses to operate said relay means, each of said relay means responsive to impulses of audio frequency current of a particular frequency different from the frequency of the impulses operating the other relay means, means controlled by the joint operation of the relay means at a station to effect operation of the associated selector, and means at each station for disconnecting the relay means from the line upon removal of the receiver from the switchhook.

3. In a signal system, a transmission line having a plurality of signal stations connected thereto, means at a calling station for transmitting code signals of carrier current modulated with two currents of audio frequency to a called station, calling selectors at said stations, transmitting and receiving channels at each station, a plurality of relay means connected to the receiving channel at each station, means at a called station for demodulating a received code signal of modulated current impulses to operate said relay means, each of said relay means responsive to impulses of current of a particular audio frequency different from the frequency of the impulses required to operate the other relay means, means at a calling station for transmitting a code signal of impulses of currents of different frequencies to operate the relay

means at a called station, means controlled by the joint operation of the relay means at a called station to effect operation of the associated selector, and means at each station for
5 disconnecting the relay means from the receiving channel upon the removal of the receiver from the switchhook. 70

4. In a signal system, a power line having a plurality of signal stations connected thereto, calling selectors at said stations, means
10 at a calling station to simultaneously transmit to a called station code impulses of carrier current modulated with two voice frequency currents, means at the called station
15 to demodulate the received calling code signal, selective means comprising filters for separating the code impulses of the two voice frequency currents transmitted from the calling station, rectifiers respectively connected
20 to the output circuits of said filters, and means comprising two relays respectively connected to said rectifiers for jointly operating the selector at the called station. 75 80 85

5. In a signal system, a power line having a plurality of signal stations connected thereto, calling selectors at said stations, two calling oscillators at each of said stations, each
25 of said oscillators developing a frequency within the voice frequency range, each station having a transmitting channel for modulating carrier current with voice frequency
30 current and a receiving channel for demodulating received modulated current, means at a calling station for energizing the calling oscillators upon removal of the receiver from
35 the switchhook, means for simultaneously connecting the two calling oscillators to the transmitting channel in accordance with a code signal to transmit carrier current modulated with impulses from the two oscillators,
40 two filters at the called station respectively selective of the frequencies of the two calling oscillators at the calling station and connected in parallel to the receiving channel, a
45 rectifier and relay in the output circuit of each of said filters, means jointly operated by said relays for operating a calling selector at the called station upon receipt of the transmitted code signal, and means for disconnecting
50 said filters from the receiving channel upon removal of the receiver from the switchhook. 90 95 100 105 110 115

6. In a signal system, a power line having a plurality of signal stations connected
55 thereto, means at said stations for transmitting code signals of carrier current modulated with impulses of two voice frequency currents for selective calling purposes, means at said stations for demodulating received code signals, means comprising filters
60 connected to said demodulators for separating the impulses of the two voice frequency currents, two separate relay means operated by the received impulses of the two voice frequency currents for operating a calling selec- 120 125 130

In witness whereof, I hereunto subscribe my name this 17th day of April, 1930.

ROBERT D. GIBSON.