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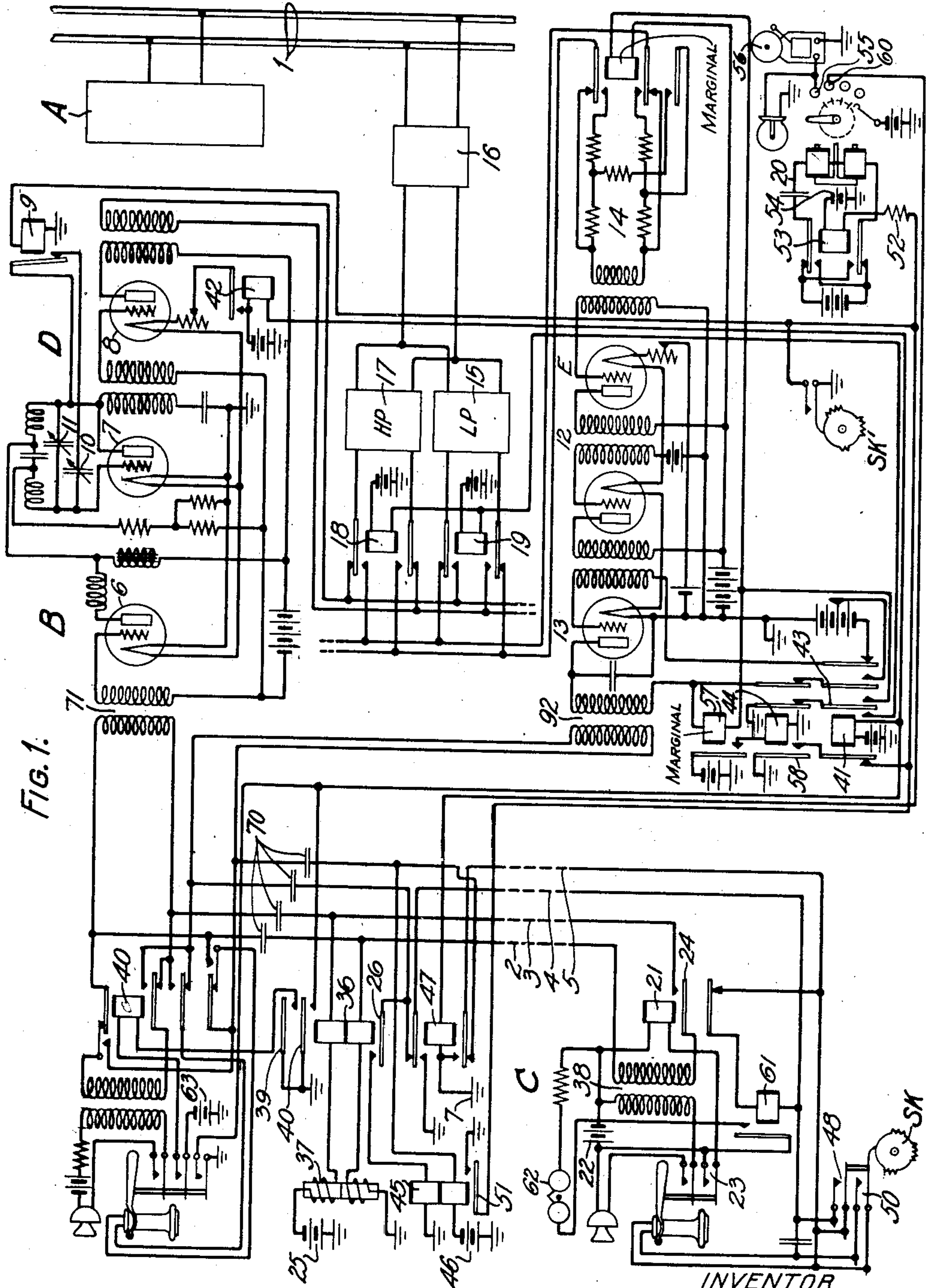
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1,717,083

CARRIER SIGNAL SYSTEM

Filed Feb. 29, 1928

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

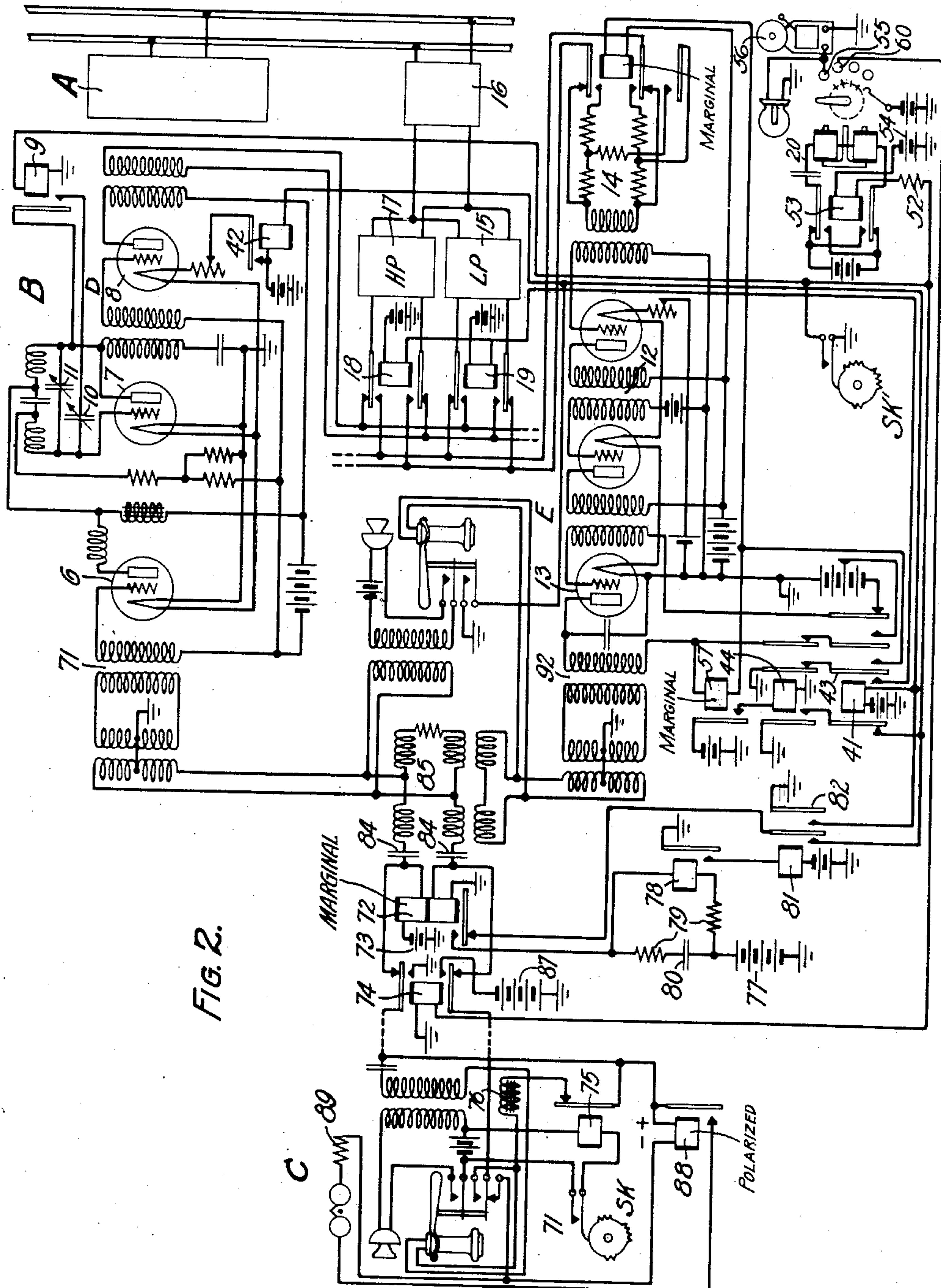


FIG. 2.

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Patented June 11, 1929.

1,717,083

UNITED STATES PATENT OFFICE.

HENRY B. ARNOLD, OF NEW YORK, N. Y., ASSIGNOR TO BELL TELEPHONE LABORATORIES, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

CARRIER SIGNAL SYSTEM.

Application filed February 29, 1928. Serial No. 257,864.

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 this invention is to provide a power line carrier signaling system having a number of signal stations connected to a power line and an extension station connected to one of the signal stations by unexposed conductors which serve for calling and signalling so that selective calling and communication may be effected between the extension station and the signal stations.

Another object of my invention is to provide a power-line carrier telephone system of the above indicated character having an extension station connected to one of the signaling stations on the power line that shall provide means whereby the extension station may call and communicate with the associated signal station or operate apparatus at the associated signal station to selectively call and communicate with any other signal station.

In power-line carrier-current telephone systems now in service, a number of signal stations are connected to a power line carrying low frequency power currents so that high frequency carrier waves may be used to transmit signals over the power line.

The application of W. V. Wolfe, Serial No. 664,147, filed September 22, 1923, Patent 1,678,133, patented July 24, 1928, discloses a carrier wave signaling system whereby telephoning over high voltage power lines may be effected with safety to the operators and the signaling apparatus. In that system, any of a plurality of signal stations may freely call and converse with any other station on the line. Calling is accomplished, for example, by transmitting impulses on the lower of two carrier frequencies, a selector at the called station responding to a predetermined code of impulses. Each station is provided with a high pass and a low pass filter for passing waves of one frequency and suppressing waves of the other frequency. The high pass filter at each station is normally connected to the outgoing channel and the low pass filter is normally connected to the incoming channel. A relay arrangement is employed to interchange the filters with re-

spect to the incoming and outgoing channels whereby the station originating a call transmits on the lower of the two frequencies and receives on the higher frequency.

The signal stations in systems similar to those disclosed in the Wolfe application are located adjacent to the power line. In many cases, however, it is desirable to communicate over the power line from a point located away from the power line. A dispatcher, for example, may desire a station located at his home or the officials of the power company may desire stations at offices located away from the power line.

The present invention provides means whereby an extension station located away from the power line is so connected to a signal station on the power line as to permit calling and conversing between the extension station and any of the signal stations connected to the power line. The extension station is provided with means for controlling the carrier current apparatus at the associated signal station selectively to call and converse with the signal stations connected to the power line, and to call and converse with the signal station associated therewith. Furthermore, a signal station connected to the power line may selectively call and converse with any other signal station on the power line and call and converse with the extension station or the signal station associated with the extension station.

The extension station may be connected to the associated signal station either by a two wire circuit or by a four wire circuit. The extension circuits are not exposed to the influence of the power lines so that direct current control of the apparatus at the associated signal station from the extension station may be effected over the connecting wires used for signaling and reduce the amount of control apparatus required. Moreover, the communication between the extension station and the associated signal station may be effected by means of audio-frequency waves.

In the system having a four wire connection between the extension station and the associated signal station, one pair of the connecting wires serves to connect the receiver at the extension station to the receiving channel at the associated station and the other pair of connecting wires serves to connect the transmitter at the extension station to the transmitting channel at the associated signal

station. In case conversation takes place between the extension station and the associated signal stations, means are provided automatically to reverse the two pairs of connecting wires at the associated signal station upon removal of the receivers at the extension station and the associated signal station from their switchhooks.

In the accompanying drawings Figure 1 is a diagrammatic view of a power line communication system constructed according to the invention and having a four wire connection between an extension station and a signal station on the power line.

Fig. 2 is a diagrammatic view of a modification of the system shown in Fig. 1 and discloses a system having a two wire connection between the extension station and a signal station on the power line.

Referring to Fig. 1 of the drawings, a power-line carrier-current communication system is shown comprising a power line 1 having carrier current signal stations A and B connected thereto. It is to be understood that other similar carrier current signal stations are connected to the power line at distant points. Each signal station is equipped with terminal apparatus substantially similar in arrangement and function to that shown at station B. The station B has some additional apparatus for control from an extension station. An extension station C is connected to the signal station B by means of four conductors 2, 3, 4 and 5.

The signal station B comprises a transmitting channel D and a receiving channel E. The transmitting channel D comprises a modulator 6, an oscillator 7, and an amplifier 8. The frequency of the current generated by the oscillator 7 is controlled by a relay 9 which in the operated position connects a condenser 10 in shunt to a condenser 11 in the oscillator circuit. Thus in the operated position of the relay 9, the oscillator 7 produces a frequency lower than when the relay is in the released position.

In the signal station under consideration, which is more fully described in the above mentioned application of W. V. Wolfe, a calling station transmits at one carrier frequency and receives at a higher carrier frequency. The called station receives at the low carrier frequency and transmits at the higher carrier frequency. Normally, each station is positioned to receive at low frequency and to transmit at high frequency. The frequency of the current at the calling station is controlled by means of the above mentioned relay 9.

The receiving channel E at station B comprises an amplifier 12 and a rectifier 13. Normally the receiving channel E is connected to the power line 1 through a gain control device 14, a low pass filter 15 and a coupling filter 16. The transmission channel

D is normally connected to the power line through a high pass filter 17 and the coupling member 16. The filters 15, 16 and 17 may be designed in accordance with the principles set forth in the patent to C. A. Campbell, No. 1,227,113, dated May 22, 1917. Two relays 18 and 19 are provided for interchanging the connections of the filters 15 and 17 to the receiving channel and the transmission channel when the station is operating as a calling station. A selector 20 of the type shown in patents to J. C. Fields No. 1,200,095 dated October 6, 1916 and No. 1,343,256 dated June 15, 1920, is provided for operating a calling signal either at the carrier current station B or at the extension station C.

Call from extension station (Fig. 1).

In calling a distant station from the extension station C the receiver at the extension station is removed from the switchhook for completing a circuit to operate a relay 21 at the extension station. The relay 21 is energized from a battery 22 through a switch member 23 controlled by the switchhook. Relay 21 operates the switch member 24 for completing a circuit from battery 25 through a relay 36. The circuit for relay 36 extends from battery 25 through one winding of a retard coil 37, one winding of the relay 36, switch member 24, secondary winding of the transformer 38, lower winding of the relay 36, lower winding of the retard coil 37 and ground to the battery 25. The relay 36 operates one switch member 39 for preparing a circuit to operate a relay 40. The relay 40 is only operated when the extension station C calls the associated carrier current signal station B. In the case under consideration we are assuming the extension station is calling a distant carrier current signal station. A second switch member 40 is operated by the relay 36 for completing a circuit to operate a relay 41 and a relay 42. The relay 42 serves to connect battery to the filaments of the tubes included in the transmission channel D. The relay 41 operates one switch member 43 for completing a circuit through an armature of a relay 44 to operate the relays 18 and 19 that control the connections of the high pass filter 17 and the low pass filter 15 to the transmission channel D and the receiving channel E. Thus the relays 18 and 19 are operated to connect the transmission channel D to the power line 1 through the low pass filter 15 and to connect the receiving channel E through the high pass filter 17 to the transmission line 1. The relay 36 also operates a switch member 26 for preparing a circuit to operate a pulsing relay 45.

A selector key SK at the extension station C is operated in accordance with the code signal desired to transmit to the distant station. The key SK closes a circuit for pulsing a relay 45. The circuit for operating the pulsing

relay 45 extends from a battery 46 through the lower winding of relay 45, lower switch member of a relay 47, switch member 48 operated by the key SK, upper switch member operated by the relay 47, switch member 26 operated by the relay 36, the upper winding of the pulsing relay 45 and ground to battery 46. A second switch member 50 is operated by the key SK while the code is being transmitted to prevent transmission of the code signal to the receiver at the extension station. The pulsing relay 45 operates a switch member 51 for controlling the relay 9 which in turn controls the frequency of the carrier current generated by the oscillator 7 in the transmission channel D. The relay 9 is normally operated by means of a circuit extending from ground through the coil of the relay 9, resistance 52, relay 53 and battery 54 to ground. The relay 9 is a low current relay and is operated by very little current whereas the relay 53 is a high current relay and takes considerable current to effect operation thereof. Thus, normally the battery 54 supplies sufficient current through the coil of the relay 53 and the resistance 52 to effect operation of the relay 9 but not to effect operation of the relay 53. When switch member 51 of the relay 45 is operated a shunt circuit is connected around the coil of the relay 9 to release this relay and also to effect operation of the relay 53. The relay 9 and the relay 53 are released and operated in accordance with the operation of the pulsing relay 45 which is controlled by the key SK. The relay 9 controls the transmission of impulses of the lower frequency current which is transmitted over the power line to the various signal stations. The relay 53 controls the operation of the selector 20 and if a code signal had been transmitted for calling the associated signal station B a circuit would have been completed through the contact member 55 for operating the call bell 56 at the signal station B.

Operation at called station (Fig. 1).

Inasmuch as the low pass filter 15 is connected to the transmission channel D at the calling station only low frequency impulses are transmitted over the line 1. The low frequency impulses are received at the called station through a coupling filter 16 and a low pass filter which at the called station is connected to the receiving channel. The transmitting and receiving channels at all the signal stations connected to the power line are similar in construction and accordingly a brief description will be given as to the receipt of a calling signal at a distant station while referring to the carrier current signal station shown in Fig. 1 of the drawing. In the following description it is assumed the low pass filter 15 is connected to the receiving channel E and the high

pass filter 17 is connected to the transmission channel D. The impulses of low frequency current, which are transmitted through the coupling filter of the low pass filter 15 are amplified by the amplifier 12 and rectified by the rectifier 13. Such rectified impulses are of sufficient strength to effect operation of a marginal relay 57. The marginal relay in turn effects operation of the relay 44 which operates a switch member 58 for completing a circuit to operate the selector 20. The selector 20 in the manner disclosed in the above mentioned application of W. V. Wolfe completes a circuit for operating an alarm. For a more detailed description of the operation of the transmitting channel D and the receiving channel E reference may be had to the above mentioned application of W. V. Wolfe.

Call from carrier signal station (Fig. 1).

If the associated carrier current station B desires to call either a distant station or the associated extension station C the key SK' is operated in the same manner as the key SK for directly controlling the operation of the relay 9. The operation of the relay 9 by the key SK' for calling a distant station is the same as was described with reference to key SK. However, when the key SK' is operated to call the associated extension station C the selector 20 is operated for completing a circuit through the contact member 60 to effect operation of the relay 47. The relay 47 upon operation completes a circuit for operating a relay 61 which in turn completes a circuit from the battery 22 for operating the bell 62 at the extension station.

When the carrier-current signal station B calls extension C or extension station C calls the carrier-current station B communication is effected between the two stations at audio-frequency over the conductors 2, 3, 4 and 5. When the receiver at the station B is removed from its switch hook and the receiver at the extension station C is removed from its switch hook a circuit is completed from a battery 63 for operating the relay 40. Upon operation of the relay 40 it will be noted that the connection of the transmitter and the receiver to the conductors 2, 3, 4 and 5 is reversed so that the transmitter at station B is connected to the receiver at station C and the receiver at station B is connected to the transmitter at station C. Under normal conditions the transmitters at the stations B and C are positioned to be connected to the carrier current transmission channel D and the receivers are positioned to be connected to the carrier current receiving channel E.

The communication circuits between the extension station C and the transmission channel D and the receiving channel E are completed over the lines 2, 3, 4 and 5 through the condensers 70. A transformer 71 is pro-

vided for connecting transmitters at the stations B and C to the transmitting channel D and a transformer 92 is provided for connecting the receivers at the stations B and C to the receiving channel E. The relay 36 and the retardation coil 37 have balanced windings and offer a high impedance to currents of talking frequencies. Moreover, the pulsing relay 45 has balanced windings and a laminated core to offer high impedance to currents of talking frequencies and prevent interference with the communication circuits.

Calling from distant station (Fig. 1).

In case a call is received from a distant station on the power line 1 for the extension station C impulses of the lower frequency are received through the coupling filter 16, the low pass filter 15, amplifier 12 and the rectifier 13 which has its space current increased to a point sufficient to operate the marginal relay 57. The marginal relay 57 operates the relay 44 which completes a circuit for operating a selector 20. The selector 20 completes a circuit through the contact member 60 for operating the relay 47. The relay 47 starts the operation of the bell 62 in the manner above set forth in describing a call from the station B to the station C. In case the call from the distant station is for the signal station B the selector 20 completes a circuit through the contact member 55 for operating the bell 56. Upon receipt of a call at the extension station C the operator removes his receiver from the switch hook and completes a circuit through the battery 22 for operating the relay 21. The relay 21 opens the circuit of the relay 61 to stop operation of the bell 62 and also for completing the communication circuits to the transmitting channel D.

Two wire extension circuit (Fig. 2).

Referring to Fig. 2 of the drawings a modification of the system shown in Fig. 1 is illustrated wherein the extension station C is connected to the carrier-current signal station B by means of a two-wire line. Inasmuch as the system shown in Fig. 2 uses substantially the same apparatus as shown in Fig. 1 and as the transmission channels and receiving channels are similar, like parts will be indicated by similar reference characters.

Call from extension station (Fig. 2).

In case the operator at the extension station C desires to call a distant station on the power line the receiver is removed from the switch hook and a circuit completed for operating a marginal relay 72. The circuit for operating the relay 72 extends from battery 73 through one coil of the relay 72, upper switch member of a relay 74, armature of the relay 75, retard coil 76, switch member 71 operated by the receiver switch hook, lower switch member of the relay 74 and another

winding of the relay 72 through ground to the battery 73. The normally closed circuit for the relay 72 through a polarized relay 88 does not permit sufficient current flow to operate the relay 72. The relay 72 upon operation completes a circuit from a battery 77 for operating a relay 78. The winding of the relay 78 is shunted by resistances 79 and a condenser 80 in order to permit quick operation of the relay and a slow release thereof. The relay 78 in turn operates a relay 81. The relay 81 operates a switch member 82 for completing circuits to operate the relay 42 and the relay 41. The relay 42 as above set forth in describing the system shown in Fig. 1 controls the source of heating current for the discharge devices in the transmission channel D. The relay 41 operates the switch member 43 for completing a circuit to effect operation of the filter relays 18 and 19. The filter relays interchange the connections of the filters 17 and 15 so that the transmission channel D is connected to the power line through the low pass filter, and the receiving channel E is connected to the power line through the high pass filter 17. The key SK, which is similar to the key SK at the extension station shown in the system of Fig. 1, is operated for sending selected signal impulses of low frequency current over the power line 1 to operate the selector at the distant station. The key SK operates the relay 75 which opens and closes the circuit above traced for operating the relay 72. When the relay 72 is released a shunt ground circuit is connected around the relay 9 which controls the oscillator 7 in the manner above set forth in discussing the system shown in Fig. 1 of the drawings. Normally, as above set forth, the relay 9 which is a low current relay, is operated by current supplied from the battery 54 through the relay 53 and the resistance 52. The relay 53, which requires a greater amount of current to effect its operation, is not operated by the current which effects operation in relay 9. Consequently, under normal conditions the relay 9 is in operated condition and the relay 53 is in released condition. Therefore, the shunt circuit completed by the relay 72 around the winding of the relay 9 serves to release the relay 9 to position the oscillator 7 for generating current of high frequency. Upon operation of the relay 9 the frequency of the current generated by the oscillator 7 is reduced. Consequently by operating the key SK the relay 9 is intermittently operated to transmit impulses of low frequency over the line 1 for operating the selector at the distant station. The relay 78 which is a slow release relay is not released during the intermittent operation of the relay 72 during the calling operation. Accordingly, the relays 81 and 41 are held in closed position and also the relays 18, 19 and 42. The relay 72 has a laminated core in order to offer high impedance to currents

of talking frequencies and condensers 84 are provided in the circuit between the extension circuit and the channels D and E to permit the flow of speech currents and prevent the flow of the direct current used in the control circuits. The transmission channel D and the receiving channel E are connected to the transmitter and receiver at station C for communication purposes by means of a hybrid coil 85.

If the associated carrier current signal station B is called in place of a distant carrier current signal station the selector 20 is operated to complete a circuit through the contact member 55 for operating the signal bell 56. Upon removal of the receiver from the switch hook of the carrier current station B communication between stations B and C may be effected by currents of audio-frequency.

20 *Call from distant station (Fig. 2).*

If a distant station calls the extension station C impulses of the lower frequency are transmitted over the power line for operating the marginal relay 57 in the manner above set forth in describing the system shown in Fig. 1. The relay 57 operates the relay 44 which in turn operates the selector relay 53. The selector completes a circuit through the contact member 60 for operating the relay 74. The relay 74, upon operation, completes a circuit from the battery 87 for operating the polarized relay 88. The polarized relay 88 is positioned so as not to be operated by the current from battery 73 which operates the relay 72. The relay 88 closes a bell circuit at station C in series with the compensating resistance 89, across the circuit operating the relay. The bell circuit in parallel with the winding of the relay 88 permits a flow of current through the winding of the relay well above its operating value. The resistance 89 is provided to adjust the current flow through the bell circuit. When the call is answered by removing the receiver from the switch hook the circuit for operating the relay 88 is opened to stop operation of the bell. The relays 72, 78 and 81 are then operated in the manner above set forth in describing the operation of a call from the extension station. However, inasmuch as the relay 44 is held in an operated position by the current from the calling station no circuit can be completed for operating the filter relays 18 and 19. Accordingly, the extension station which is operating as a called station will transmit by means of current of the higher frequency and receive by means of current of the lower frequency.

In each of the above described systems it will be noted the extension station may call and communicate with the associated carrier current station or any other station on the power line. Moreover, any station on the

power line may selectively call any other station or the extension station as desired.

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 by the appended claims.

What is claimed is:

1. A transmission system comprising a power line adapted for the simultaneous transmission of power currents and signal waves, signal stations connected to said power line, means for one station to selectively call another station and to effect communication therewith, an extension station, conductors for connecting the extension station to one of said power line stations to permit calling and signaling over the same conductors, and means operated at said extension station through the associated signal station for selectively calling the power line stations and for communicating therewith.

2. In a transmission system, a power line for transmitting high tension power currents, signal stations connected to said power line, means at said signal stations for calling and signaling over said power line by carrier current waves, an extension station, conductors for connecting said extension station to one of said signal stations to permit calling and signaling over the same conductors, and means operated at said extension station through the associated signal station for selectively calling and signaling said signal stations connected to the power line.

3. In a transmission system, a power line for transmitting high tension power currents and carrier wave signal currents, signal stations connected to said power line, means comprising carrier current transmitting and receiving apparatus at each of said signal stations for selectively calling and for effecting communication between stations, an extension station, conductors for connecting said extension station to one of said signal stations to permit calling and signaling over the same conductors, and means at said extension station for calling and communicating with the associated signal station and for controlling the carrier current transmitting and receiving apparatus at the associated signal station to selectively call and signal the various signal stations.

4. In a transmission system, a power line for transmitting high tension power currents and carrier wave signal currents, signal stations connected to said power line, an extension station, conductors for connecting said extension station to one of said signal stations to permit calling and signaling over the same conductors, carrier current transmitting and receiving apparatus at each of said signal stations, means at each signal station for controlling said carrier current apparatus to selectively signal and effect tele-

phone communication with any other signal station, means at said extension station for operating the carrier current apparatus at the associated station to selectively call and to effect telephone communication with the other signal stations, and means for effecting telephone communication between the extension station and the associated signal station independently of the carrier apparatus at the associated signal station.

5. In a power line carrier telephone system, a power line, signal stations connected to said line and having carrier current apparatus for calling other stations and for effecting telephone communication therewith, an extension station, conductors for connecting the extension station to one of said signal stations to permit calling and signaling over the same conductors, means controlled by signal stations connected to the power line for operating the carrier current apparatus at the signal station associated with the extension station to selectively call either the extension station or the signal station associated therewith, and means operative upon removal of the receiver at the extension station from the switch hook for preparing the carrier current apparatus at the associated signal station for telephone communication between the extension station and signal stations.

6. In a power line carrier telephone system, a power line for transmitting high tension power currents and carrier wave signal currents, signal stations connected to said power line, means at said signal stations for calling and signaling over said power line by carrier current waves, an extension station, conductors for connecting the extension station to one of said signal stations to permit calling and signaling over the same conductors, direct current control means between the extension station and the associated signal station for selective calling and for preparing the circuits for telephone communication, and means for maintaining the opposite sides of circuits between the extension station and the associated signal station at nearly the same potential with respect to ground.

7. In a transmission system, a power line for transmitting high tension power currents and carrier wave signal currents, sig-

nal stations connected to said power line, an extension station having a two wire receiver connection and two wire transmitter connection to one of said signal stations, means comprising carrier current transmitting and receiving apparatus at said signal stations for effecting selective calling and telephone communication between the signal stations, means for signal stations on the power line to call and effect telephone communication with the extension station through the signal station associated therewith, and means at the extension station to selectively call and effect telephone communication with said signal stations.

8. In a power line carrier telephone system, a power line, signal stations connected to said line and having carrier current apparatus for calling other stations and for effecting telephone communication between stations, an extension station having a two wire receiver connection and a two wire transmitter connection to one of said signal stations, means operative upon removing the receiver at the extension station from the switch hook for preparing the carrier current apparatus at the associated signal station to relay a selective call from the extension station to other signal stations and to permit telephone communication therethrough to other signal stations, and means for operating said carrier current apparatus to effect selective calling between the signal stations and the extension station.

9. In a power line telephone system, a power line, signal stations connected to said line and having carrier current apparatus for calling other stations and for effecting telephone communication between stations, an extension station having a two wire receiver connection and a two wire transmitter connection to one of said signal stations, means controlled from the extension station for calling and for effecting telephone communication with the signal stations, and means for automatically reversing the transmitting and receiver circuit connections between the extension station and the associated signal station when the receivers at the two stations are both removed from the switch hooks.

In witness whereof, I hereunto subscribe my name this 28th day of February, 1928.

HENRY B. ARNOLD.

DISCLAIMER

1,717,083.—*Henry B. Arnold*, New York, N. Y. CARRIER SIGNAL SYSTEM. Patent dated June 11, 1929. Disclaimer filed February 6, 1930, by the assignee, *Bell Telephone Laboratories, Incorporated*.

Hereby enters this disclaimer to the said claims of said Letters Patent which are in the following words to wit:

"1. A transmission system comprising a power line adapted for the simultaneous transmission of power currents and signal waves, signal stations connected to said power line, means for one station to selectively call another station and to effect communication therewith, an extension station, conductors for connecting the extension station to one of said power line stations to permit calling and signaling over the same conductors, and means operated at said extension station through the associated signal station for selectively calling the power line stations and for communicating therewith.

"2. In a transmission system, a power line for transmitting high tension power currents, signal stations connected to said power line, means at said signal stations for calling and signaling over said power line by carrier current waves, an extension station, conductors for connecting said extension station to one of said signal stations to permit calling and signaling over the same conductors, and means operated at said extension station through the associated signal station for selectively calling and signaling said signal stations connected to the power line.

"3. In a transmission system, a power line for transmitting high tension power currents and carrier wave signal currents, signal stations connected to said power line, means comprising carrier current transmitting and receiving apparatus at each of said signal stations for selectively calling and for effecting communication between stations, an extension station, conductors for connecting said extension station to one of said signal stations to permit calling and signaling over the same conductors, and means at said extension station for calling and communicating with the associated signal station and for controlling the carrier current transmitting and receiving apparatus at the associated signal station to selectively call and signal the various signal stations.

"4. In a transmission system, a power line for transmitting high tension power currents and carrier wave signal currents, signal stations connected to said power line, an extension station, conductors for connecting said extension station to one of said signal stations to permit calling and signaling over the same conductors, carrier current transmitting and receiving apparatus at each of said signal stations, means at each signal station for controlling said carrier current apparatus to selectively signal and effect telephone communication with any other signal station, means at said extension station for operating the carrier current apparatus at the associated station to selectively call and to effect telephone communication with the other signal stations, and means for effecting telephone communication between the extension station and the associated signal station independently of the carrier apparatus at the associated signal station.

"5. In a power line carrier telephone system, a power line, signal stations connected to said line and having carrier current apparatus for calling other stations and for effecting telephone communication therewith, an extension station, conductors for connecting the extension station to one of said signal stations to permit calling and signaling over the same conductors, means controlled by signal stations connected to the power line for operating the carrier current apparatus at the signal station associated with the extension station to selectively call either the extension station or the signal station associated therewith, and means operative upon removal of the receiver at the extension station from the switch hook for preparing the carrier current apparatus at the associated signal station for telephone communication between the extension station and signal stations."

[*Official Gazette February 25, 1930.*]