Jan. 10, 1939. N. MONK 2,143,163

CARRIER COMMUNICATION SYSTEM

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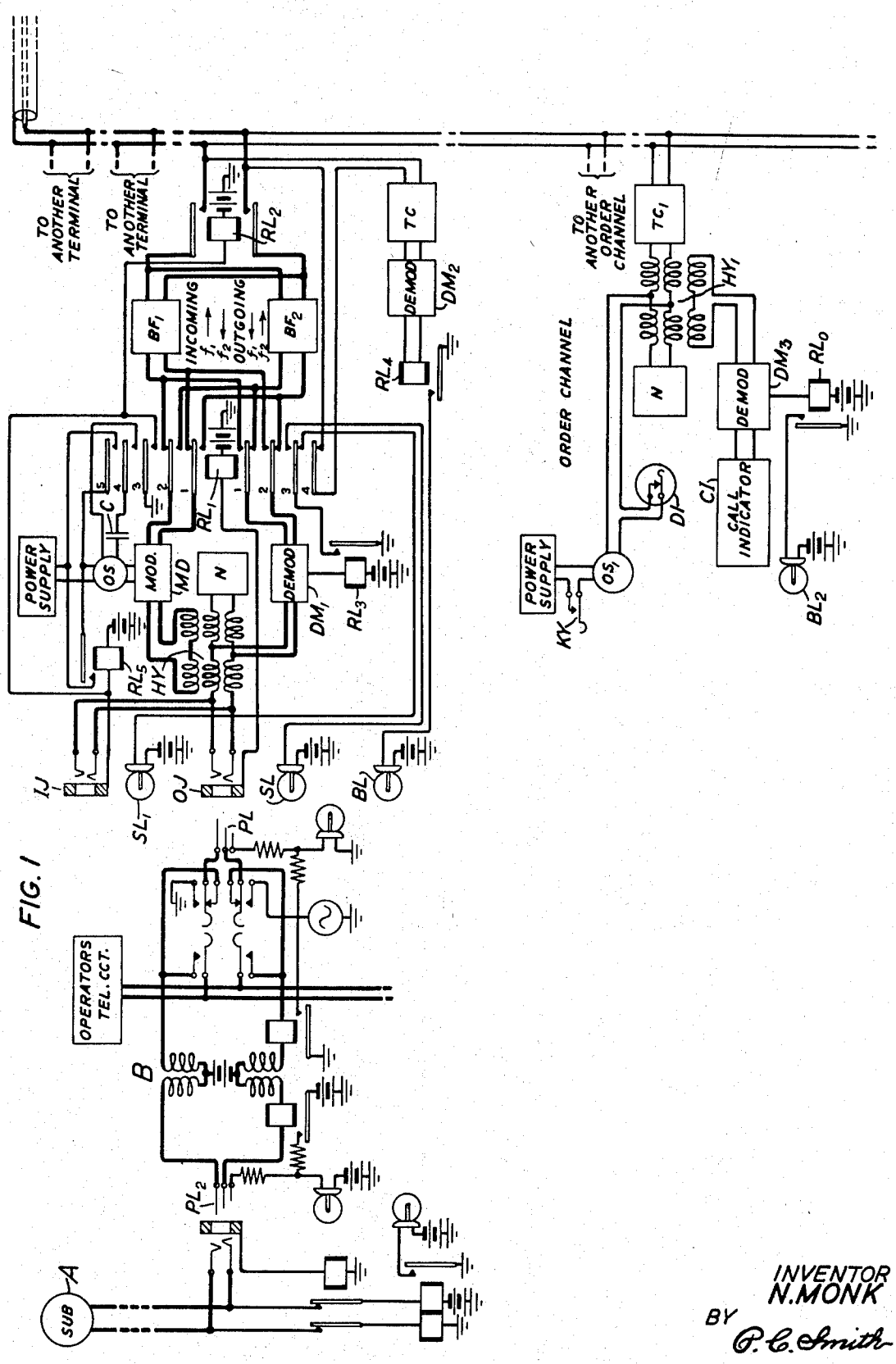

FIG. 1

INVENTOR
N. MONK
BY
P. C. Smith
ATTORNEY

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CARRIER COMMUNICATION SYSTEM

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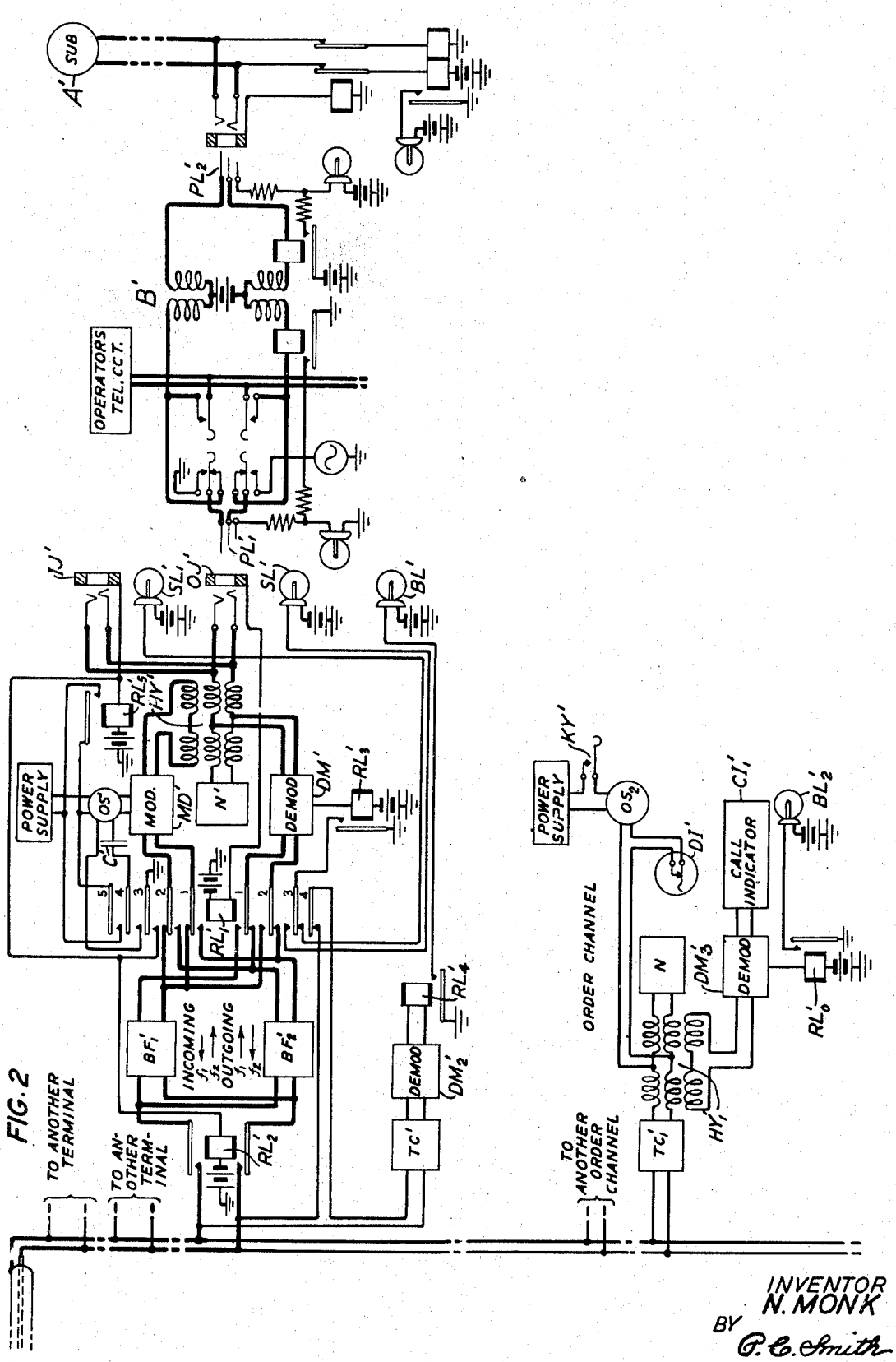

FIG. 2

INVENTOR
N. MONK
BY
P. C. Smith
ATTORNEY

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CARRIER COMMUNICATION SYSTEM

Newton Monk, New York, N. Y., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

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6 Claims. (Cl. 179—27)

This invention relates to an improved communication system, and more particularly to a communicating system of the type in which carrier waves or oscillations, either free or guided, are employed as the medium for conveying energy for effecting the operation and control of electric signaling, controlling and communicating apparatus located at separate points in the system. The invention especially relates to a system in which carrier currents, in the form of high frequency waves guided upon wires, are used as the medium of electrical connection between the electrical apparatuses and devices located at different points in the system. These carrier currents are assigned such frequencies that they are non-interfering with one another, so that each carrier serves as a separate and distinct connecting medium superposed upon the line or conductor over which the carrier is transmitted. Each of the carriers is modulated in accordance with the voice currents or other signaling or controlling currents that are to be carried. The carriers thus modulated are transmitted over the toll or long distance line or any other common medium such as, for example, a coaxial cable, and are passed through individual receiving arrangements each of which is selective to one carrier frequency to the exclusion of the others and each of which serves to reproduce, from the modulated carrier, the voice or signal current with which the carrier was modulated at the distant station.

The apparatus which is used to transmit and receive by means of any one high frequency wave as distinguished from that which is used for transmitting and receiving by means of a wave of a different frequency is commonly known as a high frequency channel or frequency selective channel.

In the type of carrier communicating system to which the present invention particularly relates, a common medium having associated with it a number of toll stations or offices is provided at each station or office with such high frequency channel terminal apparatus as is necessary to give each station access for calling and communicating purposes to the high frequency channels thus superposed upon the common medium. Where, in this type of system, there are three or more stations associated with the common medium, each station is provided with means whereby it may call any of the other stations, preferably through the medium of a high frequency calling channel and may establish conversational connection with the called station through the medium of any one of the other high frequency channels that is not at the same time elsewere in use.

It is the object of the invention to provide a system in which a frequency selective communicating channel associated with the line is made available for use between any two of a number of stations on the line; in which a frequency selective channel, when in use, is guarded against intrusion; in which any one of a plurality of frequency selective channels is made available for intercommunication between any two of a plurality of stations connected with the line with which the high frequency channels are associated; in which means are provided for enabling any one of the stations simultaneously to employ for use all of the channels, or as many as are not in use for communication between other stations; in which each station has means for applying to the line a plurality of different frequency waves to each of which each distant station of the line is responsive so that each station may select any other station on the line; in which a special calling high or other frequency channel is employed for effecting the selection of a particular called station, the wanted subscriber in that station and the particular frequency selective channel selected at the calling station and over which the talking connection is to be established; in which the selection of the different stations through the medium of the special calling channel is accomplished by the interruption of the calling high frequency channel by a series of dial pulse codes which designate the wanted station, the subscriber's number and the frequency selective channel over which communication is to take place; in which the completion of a connection with the identified channel at the calling station causes the operation of a supervisory signal at the calling station to indicate that the connection has been established; in which all other stations are prevented from using the special calling channel while it is in use by any one of them; and in which the condition of use or disuse of a selective communicating channel at each of the two stations that are using it is automatically indicated at every other station.

The foregoing are some of the principal objects that the system of the present invention attains. The foregoing and other features are all included in the present embodiment of the invention, but are capable of separate use where it may be desirable to include only part of the features that are herein disclosed.

In addition, the system of the invention in the preferred form in which it is disclosed embodies

a number of other features incidental to those mentioned above and incidental to its use as part of a comprehensive system providing for intercommunication between toll or other stations. The manner in which the above objects and features are attained and realized will be explained in the following description of the preferred form of the invention and the constructions and combinations for which the objects are attained will be more particularly defined in the appended claims.

The scope and purpose of the invention may be obtained from a consideration of the following description taken in connection with the attached drawings in which

Fig. 1 shows, schematically, the combined outgoing and incoming outlet or terminal of my invention located at one office and

Fig. 2 shows, schematically, a similar combined outgoing and incoming outlet or terminal located at another office, each of said terminals and, necessarily, each of said offices, being connected to the same common transmission medium such as, for example, a pair of coaxial conductors.

Referring more particularly to the terminal in Fig. 1, the apparatus of this terminal includes an outgoing jack OJ through which a connection can be established between a calling subscriber such as subscriber A and the common medium by way of a cord medium B or other suitable means, an incoming jack IJ for completing a connection from a distant office over the common medium to a called subscriber, such as subscriber A, over the cord medium B or other suitable means, a hybrid coil HY terminating in the usual balancing network N, a modulator MD with its associated oscillator OS, a demodulator DM, two band filters BF_1 and BF_2 and a relay RL_2 which permits the apparatus of the terminal to be connected to the common medium under the control of the operator, as more completely described hereinafter. A relay RL_1 is provided for reversing the connections between the filters BF_1 and BF_2 and the modulator MD and demodulator DM for outgoing connections. This relay, that is, relay RL_1, changes, at the same time, the frequency of the oscillator OS. Other relays and signal lamps are also included, as shown, for the purpose of supervising the connection.

Referring, now, to the terminal in Fig. 2, which represents the apparatus at the completing office, the organization of the terminal is exactly the same as that of Fig. 1 since the terminal of my invention can be used either for originating or completing a connection. In order to illustrate and describe the extension of a connection between two offices connected by the same medium and through the same terminals, the equipment at the originating office has been duplicated at the terminating office and apparatus elements in the completing terminal of Fig. 2 corresponding to those in the outgoing terminal of Fig. 1, have been given identical but primed designations to establish, respectively, their distinction and their identity.

According to my invention, each central office accessible by way of the common medium is provided with a number of terminals of the kind illustrated in Fig. 1 or 2 and each of such terminals utilizes one frequency for transmitting and one for receiving. The terminals at each office are normally arranged to transmit and receive on the same pair of frequencies in the same order but, in setting up a connection, the transmitting and receiving frequencies are reversed at the outgoing office. Communication is then established with another central office by selecting an idle pair of frequencies and its associated terminal and identifying for the wanted central office the particular frequencies or channels selected.

In setting up an outgoing connection, an idle terminal is first selected by observing the busy lamp BL associated with jack OJ, which lamp will be dark if the terminal is not in use, as more completely described hereinafter. The plug PL of a cord B, the other end of which is connected to the calling subscriber's loop and, therefore, to subscriber A, is then inserted into jack OJ of the terminal selected. Upon insertion of the plug PL into the outgoing jack OJ, a circuit is completed extending from ground through the calling cord lamp and cord sleeve, sleeve of the jack OJ, winding of relay RL_1, battery, ground. Relay RL_1 operates and, at upper and lower contact sets 1 and 2, reverses the connections between the modulator MD and demodulator DM and the filters BF_1 and BF_2, thus arranging the terminal to transmit on the frequency f_2 and to receive on the frequency f_1. Through upper contact 4, relay RL_1 also changes the frequency of the oscillator OS which is associated with the modulator MD to the frequency f_2, the condenser C having a capacity sufficient to alter the oscillation frequency of the oscillator OS from frequency f_1 to frequency f_2 while through contacts 5, relay RL_1 further closes the power supply to oscillator OS. In addition, relay RL_1 completes an obvious circuit for relay RL_2 through upper contact 3, thus connecting the terminal to the common medium. Relay RL_1, at its lower No. 3 contacts, further closes a partial path from the contact of relay RL_3 to supervisory lamp SL which, when relay RL_3 operates as a result of receiving the carrier frequency from the called office as described hereinafter, completes the circuit to said lamp to indicate that communication has been established with said office. Relay RL_1, at its lower No. 4 contacts, further breaks the circuit from the common medium to the filter or tuned circuit TC which passes the frequency f_2 only, thereby preventing the busy lamp BL from functioning by preventing the operation of relay RL_4 through the demodulator DM_2.

With the operation of relay RL_1 which has resulted in reversing the connection of the two filters BF_1 and BF_2 and the closure of the oscillator OS and power supply thereto, frequency f_2 is transmitted over the common medium in a path extending from upper No. 1 front contacts of relay RL_1, through one side of modulator MD, upper winding of hybrid coil HY, through other side of modulator MD, upper No. 2 front contacts of relay RL_1, one side of band filter BF_2, upper contacts of relay RL_2, one conductor of the common medium, through the tuned circuit TC' at the incoming office which is tuned to respond to frequency f_2, lower No. 4 contacts of relay RL'_1 thereat, other conductor of the comon medium, lower contacts of relay RL_2 at the outgoing office, other side of the band filter BF_2 back to the upper No. 1 front contacts of relay RL_1. The circuit TC' responds to the frequency f_2, operates the demodulator DM'_2 in the well-known manner which, in turn, causes the operation of relay RL'_4 connected to said demodulator. Relay RL'_4, on operating, completes a circuit to the lamp BL' lighting said lamp for

indicating that the terminal OJ' at the incoming office should not be used for an outgoing call. Similar operations will, of course, take place at all offices except the originating office which have a terminal of the kind illustrated and operating on frequencies f_1 and f_2 so that the terminals will not be used for originating outgoing connections.

In the meanwhile, the outgoing operator selects an idle "order" channel indicated by the associated dark lamp BL_2 and energizes this channel for the period required by operating key KY which connects a power supply to the oscillator OS_1. The carrier frequency transmiteed to the medium through the hybrid coil HY_1 and the tuned circuit TC_1 affects the tuned circuit TC'_1 at the incoming office which, in turn, induces a current of a similar frequency in the circuit including the lower winding of hybrid coil HY'_1 at the incoming office, the demodulator DM_3, the circuit being completed in the call indicator CI. The demodulator DM_3 closes a circuit for relay RL'_0 which, in turn, closes an obvious circuit for lamp BL'_2 to indicate to the incoming operator that the associated order channel is busy. Similar operations take place at every other office which has an order wire channel operating at the same frequency.

The operator at the calling office next advises the operators at all of the incoming offices of the details of the call, that is, the particular incoming office desired, the identification of the terminal over which the call is being established and the number of the wanted subscriber in the desired office. This she does by interrupting the order channel circuit by means of a dial DI in accordance with an impulse code which designates each of the items necessary to the operator at each incoming office. These interruptions, in the form of high frequency pulses, are transmitted over the common medium, are passed through the tuned circuit TC'_1 at the incoming office as well as all other offices having order wire channels responding to the same frequency, and are demodulated through the demodulator DM'_3 at each of said offices to cause the operation of an impulse responding device in the call indicator that sets a series of switches or other equivalent means into position to give a numerical display of the various items of information transmitted by the dial impulse codes. Obviously, while the "order channel" circuit is here illustrated as operating at a high frequency over the common medium, it would be possible to employ various other order channel arrangements such as, for instance, voice frequency call circuits operating on individual pairs extending between the different offices; or carrier frequency circuits also operating over individual pairs extending between the different offices. In the latter case, however, the opposite directional call circuits between any two offices might be operated over the same physical pair, or more than one call circuit might be set up between any two offices over a single physical connection.

The operator at an incoming office, upon noting the display of her office number, the number of the terminal and the called subscriber's number upon the call indicator CI, inserts the plug PL'_1 of a cord into the inward jack IJ' of the designated terminal and connects the plug PL'_2 at the other end of the cord into the jack of the called subscriber A'. The insertion of the plug PL'_1 into the jack IJ' closes an obvious circuit for relay RL'_2 extending from the grounded sleeve of the plug thus causing its operation and the consequent connection of the terminal to the common medium. At the same time relay RL'_5 operates in parallel with relay RL'_2 and closes the power supply circuit to the oscillator OS' which operates to produce a current of frequency f_1. A talking connection is then completed between the incoming office and the outgoing office from subscriber's line A' through cord medium B' over the hybrid coil HY', modulator MD', upper Nos. 1 and 2 back contacts of relay RL'_1, band filter BF'_1 passing frequency f_1 (transmitting), demodulator DM'_1, lower Nos. 1 and 2 back contacts of relay RL'_1, band filter BF'_2 passing frequency f_2 (receiving), contacts of relay RL'_2, over the common medium to the calling office, contacts of relay RL_2, pass band filter BF_1 to receive frequency f_1, lower Nos. 1 and 2 front contacts of relay RL_1, demodulator DM_1, or pass band filter BF_2 to transmit frequency f_2, upper Nos. 1 and 2 front contacts of relay RL_1, modulator MD, the hybrid coil HY, cord medium B to subscriber A. When frequency f_1 is received at the calling office from the called office immediately upon the operation of oscillator OS', said current of frequency f_1 passes through the demodulator DM and causes the operation of relay RL_3 which now completes the previously described circuit to the supervisory lamp SL to indicate to the outgoing operator that the connection to the wanted subscriber has been established at the incoming office. When frequency f_2 is received at the called office in the demodulator DM'_1 relay RL'_3 operates and closes the circuit of supervisory lamp SL'_1 extending from ground over the contact of relay RL'_3, the lower No. 3 back contact of relay RL'_1 through the lamp to battery to indicate to the incoming operator that the connection over the communication channel has been completed.

Upon completion of the call, the carrier supply is removed from the medium at the outgoing office by the removal of the cord plug PL from the jack OJ thus causing the release of relay RL'_3 at the incoming office and the extinguishing of lamp SL'_1. The operator then removes the plug PL' from the jack IJ' and the terminal is in a condition to be employed for another connection.

It is obvious from the above description that a connection using the same terminals could be established in the reverse direction, that is, originating at the office represented by the equipment in Fig. 2 and terminating at the office represented by the equipment in Fig. 1. The two terminals, however, are perfectly symmetrical in every respect and no further description appears to be necessary beyond stating that the description already given will suffice to describe such a connection if the designations of the apparatus are interchanged.

What is claimed is:

1. In a high frequency communicating system, the combination with a plurality of high frequency stations, of means at each station for transmitting on one high frequency wave and receiving on another high frequency wave of a communicating channel, means controlled at a calling one of said stations for utilizing said first high frequency wave to call the remaining stations, a high frequency calling channel having a selective branch at each station, means for energizing said calling channel at said calling station, means at the calling station for transmitting the designation of a wanted station over said high frequency calling channel when energized, wave selective means at each station responsive to the frequency of the calling channel to indicate at each station the wanted one of said stations, and

means at the wanted station for establishing a communicating relation between said calling station and said wanted station through the medium of said communicating channel.

2. In a carrier wave communicating system, the combination with a common medium having a number of stations connected thereto, of means at each station for producing and applying to said medium a common signaling high frequency, a plurality of trunks associated with said medium and available for use at each of said stations, each of said trunks being capable of producing and responding to a definite pair of high frequency waves, means responsive to the initiation of a call at one of said stations by the selection of one of said trunks for selecting a corresponding trunk at each of the other stations which is capable of producing and responding to the same pair of high frequency waves, and other means responsive to said common signaling high frequency for designating at each station the wanted station and the identification of the trunk selected, to complete the connection.

3. In a high frequency communicating system, the combination with a plurality of stations, of means at each station for producing and applying to said medium a common signaling high frequency, a plurality of frequency selective channels available for use at each of said stations, a signal for each channel at each station, means under control of a calling one of said stations for selecting one of said channels and for causing the operation of said signal associated with that channel at each of the remaining stations, other means responsive to said common signaling high frequency for identifying at each station a wanted station and the selected one of said channels, and means under the control of said wanted station for causing the operation of the signal associated with the selected channel at the calling station.

4. In a carrier wave communicating system, the combination with a common medium and a plurality of stations connected thereto, of means at each station for producing and applying to said medium one of two frequencies of a communicating channel for calling an outward station, means for producing and applying to said medium the other frequency of said communicating channel for answering said calling station from said outward station, means for producing and applying to said medium a separate calling frequency modulated by dial interruptions in accordance with a code which designates said outward station and a called line terminating therein, and means at each station responsive to said interrupted calling frequency for indicating at each outward station the designated outward station and the desired called line.

5. In a high frequency communicating system, the combination with a plurality of high frequency stations connected to a common medium, of means at each station for transmitting over one of the frequencies of a communicating channel and receiving on another frequency of said communicating channel when said station is called, means to reverse the sense of direction of the two frequencies at said communicating channel when said station is calling, means for producing and applying to said medium another calling frequency modulated by dial interruptions in accordance with a code which designates another station and a called line terminating therein, and means at each station responsive to said interrupted calling frequency for indicating at each outward station the designated outward station and the desired called line.

6. In a carrier wave communicating system, the combination with a common medium and a plurality of stations connectible by any one of a plurality of communication channels thereover, of means at each station for selecting a communication channel and for producing and applying to the selected channel one of two frequencies allocated thereto for calling an outward station, means for producing and applying the other of the frequencies of a selected channel for answering a calling station from any outward station, means for producing and applying to said medium a separate calling frequency modulated by dial interruptions in accordance with a code which designates the outward station wanted, the number of the called line terminating therein and the selected communication channel, and means at each station responsive to said interrupted calling frequency for indicating at each outward station the designated outward station, the desired called line and the communication channel to be used in answering the call.

NEWTON MONK.