Aug. 4, 1931. J. W. HORTON 1,816,905

COMMUNICATION SYSTEM

Filed Feb. 21, 1929 2 Sheets-Sheet 1

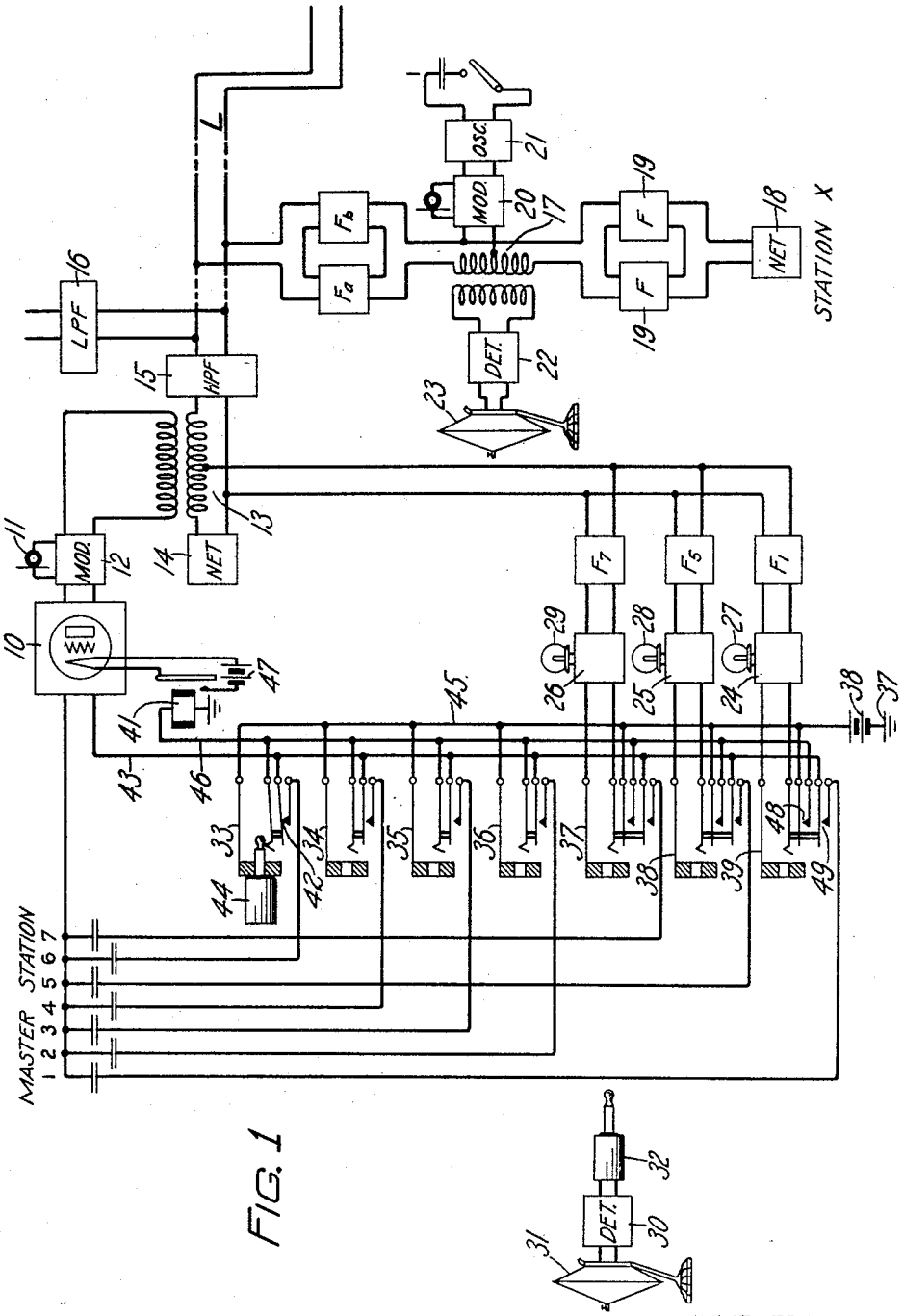

FIG. 1

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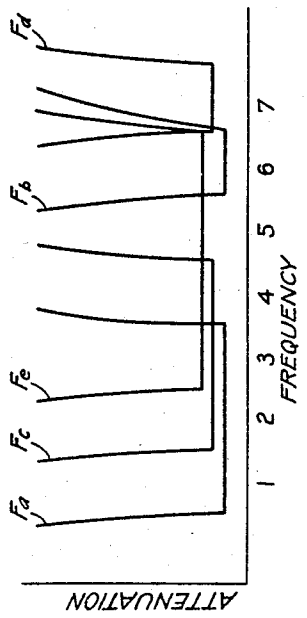

FIG. 2

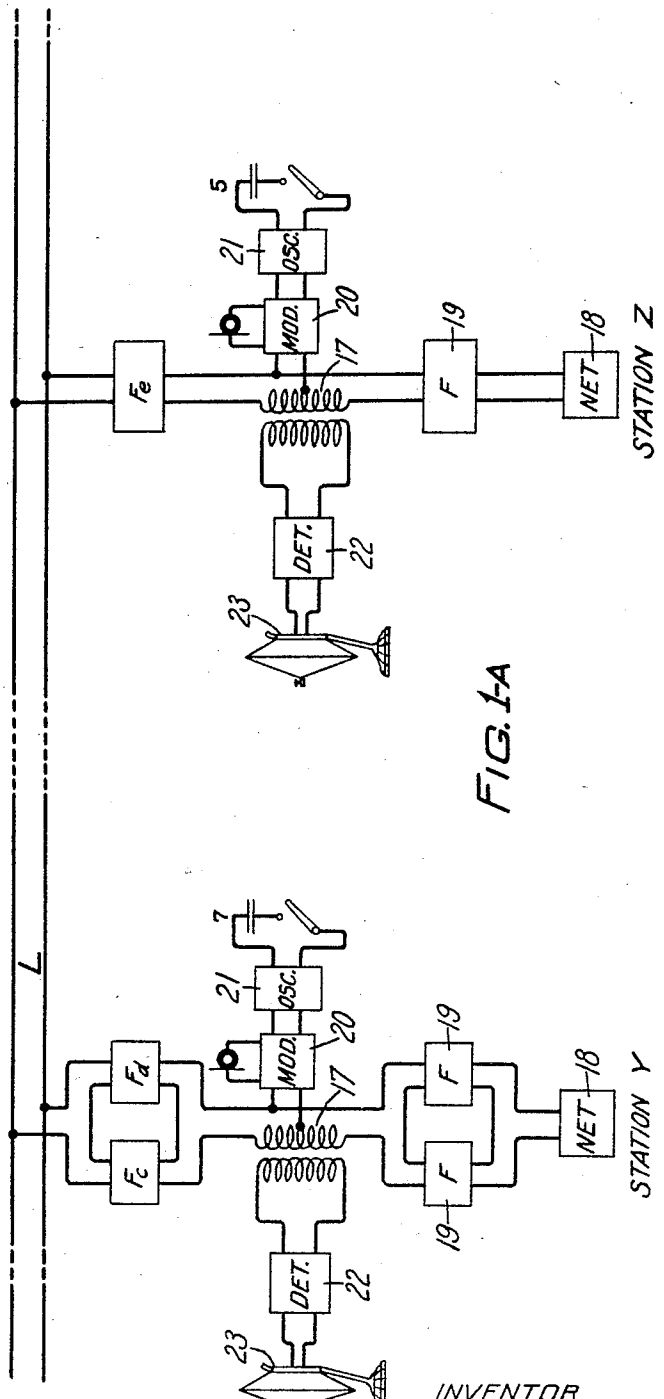

FIG. 1-A

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Patented Aug. 4, 1931

1,816,905

UNITED STATES PATENT OFFICE

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COMMUNICATION SYSTEM

Application filed February 21, 1929. Serial No. 341,597.

This invention relates to communication systems and more particularly to a system in which individual or simultaneous communication with a selected group of stations may be had.

An object of the invention is to permit a group of stations on a power line or other transmission line to communicate with a master station individually to the exclusion of one another or for the master station to communicate with one, two or any number of the other stations in any combination.

A feature of the invention resides in using band pass filters capable of passing different portions of the frequency spectrum, at different stations of a group connected to a power line or the like. The bands of frequencies passed by the filters at the respective stations partially overlap in a predetermined manner to permit communication between the master station and the line stations in the combinations above set forth.

A better understanding of the invention may be had by reading the following description together with the accompanying drawings, of which Figs. 1 and 1A when placed side by side represent a power line or other type of transmission line to which a master station may be connected for communicating with a plurality of stations placed at intervals along the line, and Fig. 2, a diagram of the transmission ranges of the filters used at the various stations.

In Figs. 1 and 1A, a system is shown in which a master station may communicate with three stations, X, Y and Z connected at intervals along a power line L or the like, individually or in any desired combination.

In order to provide for this type of service with three stations, it is necessary to have seven different frequency channels at the master station. The manner in which selectivity is obtained at the various substations is shown by referring to the filter characteristics in Fig. 2. From this figure, it may be seen that the band pass filter F_a includes three of the frequency bands at the master station, namely bands 1, 2 and 3.

The band pass filter F_c is displaced one band from F_a and includes bands 2, 3 and 4. The filter F_e is displaced one band from F_c and transmits four bands, namely, 3, 4, 5 and 6. A fourth filter F_b transmits one band 6, in common with filter F_e, while another filter F_d transmits band 7 exclusively.

It can now be seen that by placing two filters F_a and F_b at station X, filters F_c and F_d at station Y and F_e at station Z, the master station may communicate with station X to the exclusion of stations Y and Z by using the frequency band 1, with station Y to the exclusion of stations X and Z by using the frequency band 7 and with station Z to the exclusion of the stations X and Y by using the frequency band 5, since these bands are passed exclusively by filters at these stations, respectively. By using the frequency band 2, the master station may communicate with stations X and Y to the exclusion of station Z, since this band is common to filters F_a at station X and F_c at station Y. Similarly the master station may communicate with stations Y and Z to the exclusion of station X by using the band 4 which is common to the filters F_e and F_c located respectively at stations Z and Y. Likewise the master station may communicate with station X and station Z to the exclusion of station Y by using the band 6 which is common to the filters F_e at station Z and F_b at station X. The master station may communicate simultaneously with all three stations by using the band 3 since this band is common to all three filters F_a, F_c and F_e.

Since each of the stations has an exclusive frequency band in common with the master station, two-way communication may be had over this band if proper sending means are located at these stations and provision made for differentiating and receiving incoming signals at the master station.

The master station is associated with the line L through the hybrid coil 13 which together with the balancing network 14 aids in separating the incoming and outgoing signals in well-known manner. The sending apparatus at the master station comprises an oscillator 10 which may be of any well-known type, as for instance, that disclosed in Patent 1,356,763 to R. V. L. Hartley, issued October

26, 1920, and a modulator 12 in which the carrier frequency from the oscillator is modulated with the signaling frequency from the microphone 11 to produce a band for transmission to the stations.

A plurality of frequency determining circuits 1 to 7 are associated with the oscillator, one only of which, as determined by the frequency band desired to be used, is connected with the oscillator at one time. Four of these circuits, namely, 2, 3, 4 and 6 are employed in one-way communication to the stations in various combinations as heretofore described, while three of them, namely, 1, 5 and 7, are employed in connection with the channels for two-way communication of the master station with the individual stations.

A plurality of jacks 33 to 39 are provided whereby the desired selecting, calling and answering of the various stations may be accomplished and the proper frequency determining circuits may be associated with the oscillator. Four of the jacks, namely, 33 to 36, are used in calling line stations from the master station. These jacks have two pairs of contacts for connecting a frequency determining circuit to the oscillator and a source of energy to the oscillator. For instance, if it is desired to call stations X and Z, a plug 44 is inserted in the jack 33, which connects the frequency determining circuit 6 to the oscillator. This completes the circuit from the ground at 37 through the battery 38, lead 45, plug 44, lead 46 and the relay 41 to ground. Upon completion of this circuit, the relay 41 attracts its armature to complete a circuit from the source of electrical energy 47 which supplies current to the filament of the oscillator. At the same time, a circuit is completed from the oscillator through the frequency determining circuit 6, contacts 42 of the jack 33, through the lead 43, back to the oscillator. Similarly, in initiating other calls, by plugging in the jacks 36, 35 and 34, respectively, frequency determining circuits 2, 3 and 4 are connected to the oscillator.

The jacks 37 to 39 having an extra pair of contacts are answering jacks and are similarly associated with the frequency determining circuits 1, 5 and 7 employed in the two-way channels. The additional pairs of contacts enable a receiving device which may be a loud speaker 31 and a detector 30 to be connected to the incoming branches of the two-way channels. As mentioned above, three band pass filters, namely, F_1, F_5 and F_7 each of which passes one of the bands of frequencies that a line station has exclusively in common with the master station, are provided to differentiate between the incoming signals. Associated with each of these incoming paths is a relay device 24, 25 or 26 which operates to give a signal to an attendant to indicate which of the line stations is calling. These indicating signals may be lamps 27, 28 and 29 asociated with the relay circuits or any other type of indicating means which it may be desired to use. When the plug 32 is inserted in one of the jacks as for instance 39, a through circuit is provided from the station X to the receiver 31. At the same time contacts 48 and 49 are closed, connecting the frequency determining circuit 1 to the oscillator and completing the circuit through the relay 41 which operates to energize the oscillator.

Since the line L may be a power line or the like, a high pass filter 15 is provided which readily passes the signaling bands but excludes the low frequency power from the signaling circuits, while at the same time a low pass filter 16 excludes the signaling currents from the power apparatus, or other low-frequency circuits that may be associated with line L.

The band pass filters F_a and F_b at station X, F_c and F_d at station Y and F_e at station Z in addition to determining the frequency bands which are transmitted to and from the line stations also exclude the low frequency power in the line L from the signaling circuits. Each line station is equipped with a hybrid coil 17 similar to that at the master station to aid in separating the incoming and outgoing signals. Sending and receiving apparatus comprising the oscillator 21, modulator 20, detector 22 and the loud speaker 23 similar to that of the master station is also provided. Proper balancing of the line impedance is obtained by means of the networks 18, and the filters 19 which simulate the discriminating filters associated with the respective stations.

Since each line station, however, may communicate only with the master station, one sending frequency only is provided at these stations, which is determined by the channel which the line station has in common with the master station. Thus the sending frequency at station X is in the frequency band 1, that at station Y in the frequency band 7, and that at station Z in the frequency band 5.

In order to operate the system, the attendant at the master station determines which of the stations or combination of stations he desires to communicate with. He then plugs into the jack which will cause the oscillator to generate the frequency which is in the channel that is exclusive to that station or group of stations. The signals from the microphone 11 modulate the carrier frequency generated by the oscillator 10 to produce a band which is transmitted to and detected at the stations, as determined by the band filter located thereat.

If the attendant at one of the line stations desires to communicate with the master station, the oscillator thereat which has a frequency in a band excluded from the other line stations is started. This frequency is

transmitted to the master station where it is directed into its proper channel by one of the band pass filters F_1, F_5 or F_7. The signal lamp associated with that channel operates and indicates to the attendant at the master station which of the line stations is calling. The receiving apparatus is plugged into the proper jack, starting the oscillator 10 which generates waves of the same frequency as those at the line stations. The system is then in condition for two-way operation with this station.

For instance, if the attendant at the station X desires to call the master station he closes a switch which may be arranged to start the oscillator 21 as well as to connect the frequency determining circuit 1 thereto. The frequency generated is transmitted to the master station where it is selectively passed by the filter F_1 to operate the signal lamp 27, thus apprising the attendant at the master station that station X is calling. The attendant at the master station inserts the plug 32 in the answering jack 39 thereby permitting the signals from station X to be received and at the same time starting the oscillator 10 at the frequency which permits exclusive communication with station X. When the attendant at the latter station receives an answer from the master station he is aware that he may proceed to communicate with it.

Although two or more of the stations may desire to communicate with the master station simultaneously, interference is prevented at the master station by the attendant who has it in his power to select the station with which he desires to communicate. However, the fact that other stations are attempting to communicate with the master station is indicated to the attendant by means of the signal lamps associated with those channels so that upon the termination of the conversation with one station, another staiton may be picked up by plugging into its associated jack.

Although this invention has been described in connection with one specific embodiment and a limited number of stations, nevertheless it is capable of broad interpretation and application to many stations, and is to be limited therefore only by the scope of the appended claims.

What is claimed is:

1. In a communication system, means for communicating with a plurality of stations in different combinations, and means comprising filters having overlapping transmission bands for determining said combinations.

2. In a communication system, means for transmitting signals over a line in a plurality of signal channels, receiving means connected at intervals along said line, and different selective circuits associated with each of said receiving means having in part common and in part individual frequency ranges, all of said selective circuits aiding to permit simultaneous reception at various combinations of said stations, and exclusive reception at each one thereof individually.

3. In a communication system, means for transmitting signals over a line in a plurality of signal channels, receiving stations connected at intervals along said line, and a plurality of selective circuits having overlapping transmission bands distributed among said stations for enabling selective communication with said stations singly or in groups.

4. In a transmission system, a transmission line, means for providing a plurality of signal channels for transmitting signals over said line, receiving stations connected at intervals along said line, selective means at each of said stations for communicating over different groups of said channels, some of which channels are common to certain of said selective means and individual to others, and means for communicating exclusively with said stations or with any combination of them as determined by the transmitting channel selected.

5. In a transmission system, a transmission line, a master station connected thereto for transmitting signals to a plurality of stations along the line, means at said master station for providing a plurality of signaling channels, filtering means at said line stations for permitting communication over some of said signal channels but not over others, said filters having transmission ranges partially overlapping so that each station may receive in a channel exclusive to itself or in common with the others, individually or in any combination, the station or combination of stations receiving signals being determined by the channel selected for use at said master station.

6. In combination a transmission line, a master station connected thereto for transmitting signals to a plurality of stations along the line, a plurality of carrier channels at said master station, means for generating carrier frequencies for communicating in each of said carrier channels, means for modulating said carrier frequency signals to produce a plurality of frequency bands, receiving means connected at said master and said line stations, a plurality of band-pass filters at said line stations, each of said stations having a portion of the transmission region of its filter means capable of transmitting the signal band from one channel to the exclusion of the other stations, one portion capable of transmitting a signal band from another channel in common with all of said stations, and other portions capable of transmitting a signal band from still other channels common to one each of the other stations, and transmitting means at each of said line stations for communicating with

the master station within its exclusive frequency band.

7. In combination, a transmission line, a master station connected thereto for transmitting signals to a plurality of stations, transmitting and receiving means at said stations, means at said master station for transmitting in a plurality of channels, said means comprising an oscillator and a plurality of frequency determining circuits, means at each of said line stations for communicating with said master station in a different one of said channels, different combinations of said stations being capable also of receiving signals from said master station in other of said channels, band-pass filters at said line stations having transmission bands passing signals from different groups of said channels, the signals from some of said channels, however, being received in common by said stations, and means at said master station for selecting the signaling channel which permits transmission to the desired station or combination of stations.

8. In a communicating system, a master station and a plurality of line stations, individual two-way signaling channels associated therewith for permitting exclusive communication between said master station and each of said line stations, one-way signaling channels also associated with said stations for permitting the simultaneous communication of said master station with all of said stations or any combination thereof, filtering means at each of said line stations for exclusively transmitting signals in one of said two-way channels, said means also transmitting signals in a channel common to all of said other stations, and signals in separate channels common to each one of said other stations.

9. In a communication system, a master station and a plurality of line stations, individual two-way signaling channels associated therewith for permitting exclusive communication between said master station and each of said line stations, one-way signaling channels also associated with said stations for permitting the simultaneous communication of said master station with all of said stations or any combination thereof, filtering means at said master station for differentiating between the incoming signals in said two-way channels, indicating means at said master station associated with the incoming channels for indicating when said channels are in operation, and filtering means at each of said line stations for exclusively passing signals in one of said two-way channels, said means also passing signals in a channel common with all of said other stations and signals in separate channels common to each one of said other stations.

10. A communication system in accordance with claim 9 in which means are provided at the master station for simultaneously associating receiving apparatus with an incoming channel when its indicator apprises of its operation and preparing the transmission means at the master station for answering in the same channel.

In witness whereof, I hereunto subscribe my name this 18th day of February, 1929.

JOSEPH W. HORTON.