Jan. 17, 1939. L. W. PARKER 2,144,380

INTERCOMMUNICATING SYSTEM AND METHOD

Original Filed Oct. 21, 1936 2 Sheets-Sheet 1

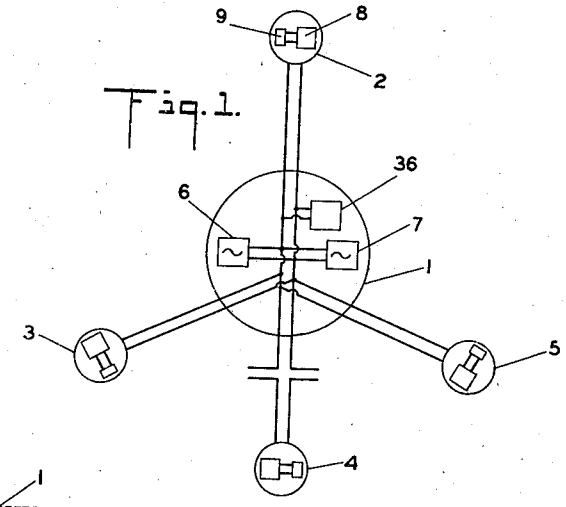


Fig. 1.

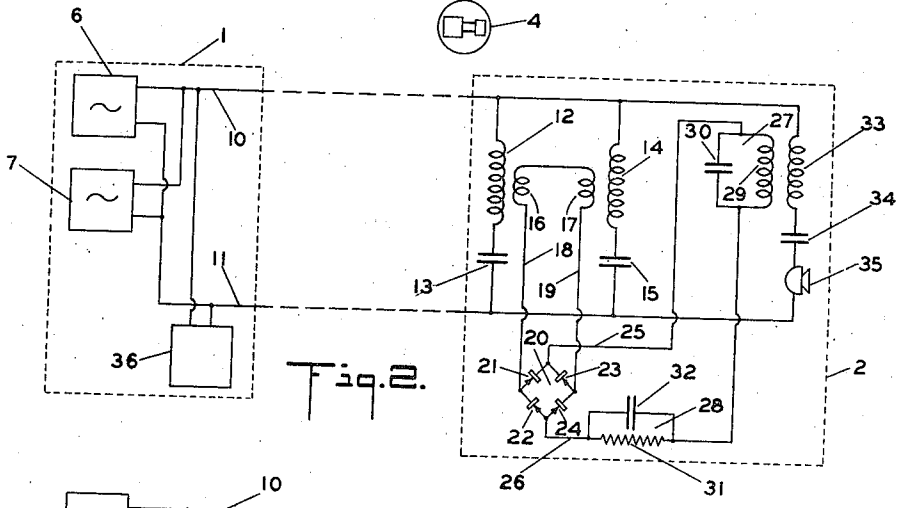


Fig. 2.

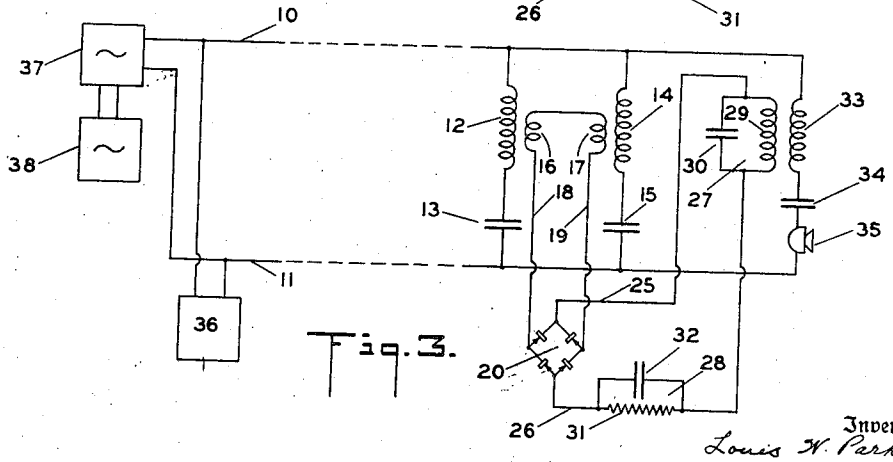


Fig. 3.

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INTERCOMMUNICATING SYSTEM AND METHOD

Original Filed Oct. 21, 1936 2 Sheets-Sheet 2

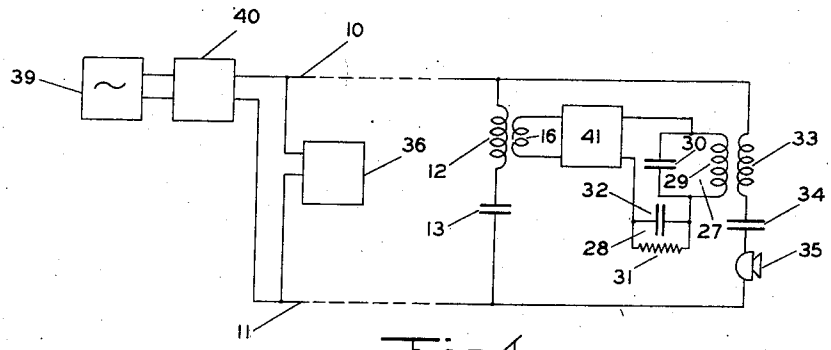


Fig. 4.

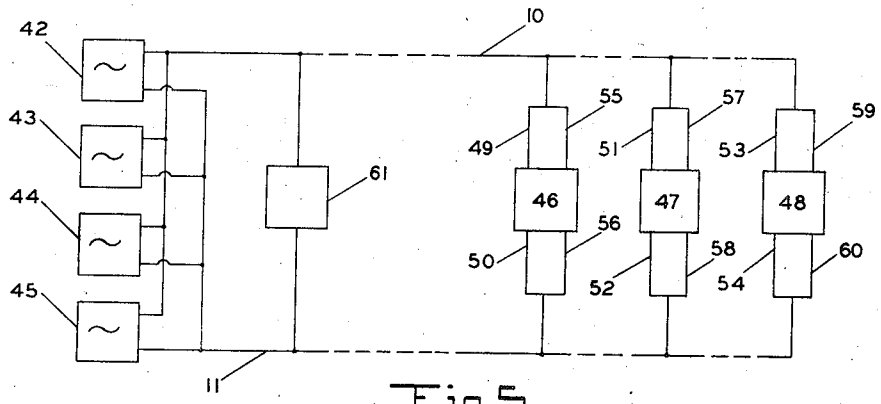


Fig. 5.

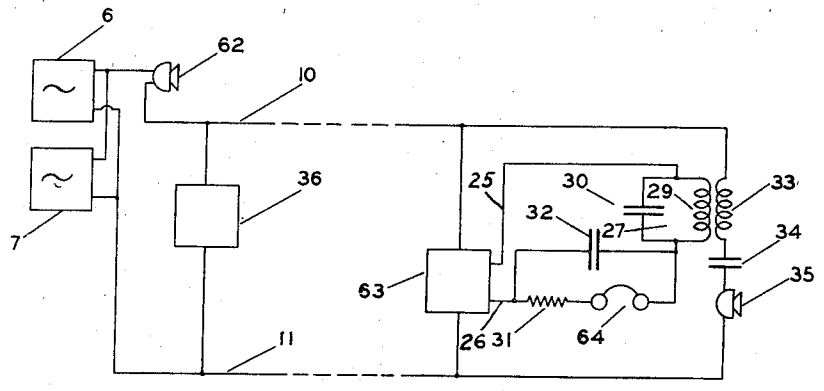


Fig. 6.

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2,144,380

INTERCOMMUNICATING SYSTEM AND METHOD

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14 Claims. (Cl. 179—84)

This invention relates to intercommunicating systems and more particularly to an improved method of intercommunication between a central station and one or more distant stations.

A principal object of the invention is to provide a system of intercommunication between a central station and one or more outlying stations wherein the signalling energy generating equipment is located entirely at the central station. As a result of this it is possible to provide satisfactory communication from outlying points to a central station in situations where it would be impossible or impractical to locate the usual signal energy generating devices at the outlying points. The upkeep and surveillance of the signal energy generating equipment is therefore confined to the central station. Such a system can be used for example to provide intercommunication between the bridge of a vessel and a plurality of outlying points on the vessel, e. g., engine room, life-boat stations, wheel-house, etc., even though the usual ship's generator should fail. Furthermore the communication can be achieved in any emergency over the existing metallic media of the ship, thus obviating the running of special signal conductors to all the important points of the vessel.

Another object of the invention is to provide a system of selective signalling between a plurality of outlying stations and a central station, by employing different signal frequencies but without requiring the relatively complicated wiring connections and apparatus usually employed for this purpose.

A feature of the invention relates to a central station intercommunicating system wherein a sustained alternating current of a given frequency or frequencies, is transmitted from the central station to one or more outlying stations where it is translated into an alternating current of a different frequency to serve as a carrier of signals back from the outlying stations to the central station.

Another feature relates to a system of intercommunication between an outlying station and a central station whereby at the outlying station a signal modulated carrier frequency current may be transmitted to the central station employing no moving generating equipment, oscillator generators or the like at the outlying station.

Another feature relates to novel circuit arrangements at a distant station for receiving signal energy of one frequency from a central station and converting it locally at the distant station into signal energy of a different frequency for retransmission back to the central station.

A further feature relates to a system of intercommunication which is well adapted to provide two-way communication between a central point and a plurality of outlying points which may or may not be mobile, e. g., between an executive's office and various departments in a factory, office building, school, hospital or the like; or in construction operations between headquarters and various points of operation which are mobile or semi-permanent in character, such as elevators or supply trains, and without the necessity of running special signal conductors to the various points. It will be seen also that this system is particularly well-suited to provide communication between a director's booth and the various points on a "movie location."

A still further feature relates to the novel organization, arrangement and relative connection of parts which go to make up a reliable, simple and efficient system of communication between a plurality of outlying stations and a central station.

Other features and advantages not specifically enumerated will be apparent after a consideration of the following detailed descriptions and the appended claims.

While the invention will be disclosed herein as applied to one form of intercommunicating system it will be understood that this is done merely for purposes of explaining the inventive concept and not by way of limitation. Likewise while the various methods are shown in diagrammatic or schematic form, only sufficient apparatus is disclosed in detail as to enable a thorough and complete understanding of the invention to be attained. It will be clear to those familiar with the art of intercommunication that various changes in the type and details of the various parts and apparatus represented schematically may be made without departing from the spirit and scope of the invention. Accordingly in the drawings,

Fig. 1 is a schematic diagram of a typical intercommunicating system for purposes of explaining the invention.

Fig. 2 is a schematic wiring diagram showing the details of one of the outlying stations of Fig. 1.

Fig. 3 is a modification of Fig. 2.

Figs. 4 and 5 are further modifications of Fig. 2.

Fig. 6 shows the system of Fig. 2 modified for two-way communication.

Referring to Fig. 1 the numeral 1 represents any suitable central station such as a ship's bridge, a director's office or the like. The numerals 2, 3, 4 and 5 represent a plurality of distant stations or points from which communication is to be had with the central station. The stations 2, 3 and 5 are shown connected with the central station by a two-wire line, such as a telephone line, a telegraph line or the like, while station 4 is coupled to the central station by a space inductive link such as radio antennae or the like. The invention is not necessarily limited to the use of special signalling lines such as telegraph or telephone lines for connecting the various stations and therefore the two conductors shown connecting the stations in Fig. 1 may be the existing metallic media or adjuncts of a building structure or they may represent any known form of signalling channel either wires or wireless. For example one conductor may be the neutral wire of a three-wire electric light or power system, and the other conductor may be the grounded framework of the building in which the central station and the various outlying stations are located.

At the central station 1 there are located two sources 6, 7 each source being designed to generate an alternating electric current of a frequency different from that generated by the other. Preferably the sources 6 and 7 generate high frequency electric currents of sustained sinusoidal wave form, and preferably, although not necessarily the two sources are connected in parallel. The outputs of the two sources 6 and 7 are applied to the transmission networks or links leading to the various outlying stations. At each of the outlying stations there is provided a pick-up unit 8 consisting of circuit units such as inductances, condensers, rectifiers and the like, whereby the received electric energy is translated into carrier energy of a different frequency which is impressed back upon the same link leading from the central station. In circuit with each translating unit is a signalling device 9 such as a microphone, telegraph key or the like for varying the amplitude of the outgoing translated carrier. At the central station a suitable signal reproducing device 36 is located.

Referring to Fig. 2 a typical circuit arrangement is disclosed. At the main or central station 1 there are provided the two sources 6 and 7 for generating sustained alternating currents of different frequencies. Any well-known form of alternating current generator may be employed for this purpose preferably capable of generating substantially sinusoidal alternating current. The generators are connected in parallel to the two conductors 10, 11 which may be the conductors of a telephone pair, a radio antenna of any known type, or any two metallic adjuncts of an existing structure such as the grounded frame-work of the building in which the generators are located, and the neutral wire of a three-wire power or lighting system. If desired the conductors 10 and 11 may be the conductors of a two-wire power or lighting circuit. Connected across non-equipotential points of the network is a tuned circuit consisting of an inductance 12 and a condenser 13, the condenser-inductance combination being adjusted to resonate at the frequency of one of the generators at the central station, for example the generator 6. Connected in parallel with the first tuned circuit is another similar tuned circuit consisting of the inductance 14 and the condenser 15 which have been adjusted to resonate at the frequency of generator 7. Coupled to inductance 12 is an inductance 16, and coupled to inductance 14 is a similar inductance 17. While the drawing shows the inductances 16 and 17 as separate inductances, it will be understood that a single inductance symmetrically coupled to the inductances 12 and 14 may be employed. The conductors 18, 19 leading from the terminals of the inductances 16, 17 are connected to a suitable rectifying arrangement designated generally by the numeral 20. Preferably, although not necessarily, this rectifying arrangement consists of two full-wave rectifiers connected in bridge formation as shown. Merely for purposes of explanation, the rectifying arrangement is shown as consisting of four half-wave rectifiers 21, 22, 23 and 24. These rectifiers may be of any well-known type but preferably are of a type not requiring separate power supply. Thus crystal, contact type rectifiers, chemical or electro-chemical rectifiers may be employed. It will be understood that the conductors 18, 19 instead of being coupled to the tuned circuits by inductive coupling, may be coupled in any other manner well-known in the art, e. g. by means of resistors, resistor-condenser combinations, chokes, or choke-condenser combinations, so long as energy of the two frequencies is efficiently appied to the rectifier arrangement.

Since the rectifiers are being supplied with two alternating currents of different fundamental frequencies, each of substantially sinusoidal wave form, there will appear in the output of the rectifier combination, namely across the conductors 25, 26, a plurality of components consisting of a direct current component, alternating components corresponding to multiples of the input frequencies, components equivalent to the sum of the input frequencies, and components equivalent to the difference of the input frequencies. The output conductors of the rectifier arrangement are connected in circuit with the tuned circuit 27 and the aperiodic circuit 28. The former preferably comprises an inductance 29 in parallel with a condenser 30, while the latter comprises a D. C. load resistor 31 in parallel with a by-pass condenser 32. The resistor 31 is preferably of such a value that it dissipates the D. C. component of the rectifier output and applies a sufficient load on the rectifier to insure proper operation thereof, while the condenser 32 is merely of sufficient capacity to provide a low impedance path for the alternating components. The inductance 29 and condenser 30 are adjusted to resonate at a frequency which is equivalent to the difference in frequency between sources 6 and 7. Coupled to inductance 29 is another inductance 33 and a series condenser 34, the said inductance 33 and condenser 34 being adjusted to resonate at the same frequency as that of the elements 29, 30. The energy in the circuit 33, 34 is applied to the connecting network 10, 11 through some suitable modulating device such as the microphone 35.

Located at some remote point where the signals impressed upon microphone 35 are to be received, for example at the central station 1, is an electrical signal reproducing device 36 which is capable of being tuned to the frequency of the circuit 27. Preferably this signal reproducing device is provided with means for demodulating or detecting the signal modulations in the received modulated wave transmitted from the outlying station 2 over the connecting network described.

Instead of employing two separate frequency generators at the central station 1 connected in parallel to the transmission network, any other arrangement for producing two differing frequency currents may be employed. Thus as shown in Fig. 3 a source 37 of sustained sinusoidal alternating currents is modulated by sustained sinusoidal currents from a source 38 of a lower or modulating frequency as compared with the frequency of source 37. It is well known that such an arrangement produces in its output, currents not only of the fundamental frequency, i. e. frequency of source 37, but also upper and lower side-band frequencies. The modulated output of source 37 is impressed upon any of the transmission networks mentioned in connection with Fig. 1, and at the outlying station 2, two out of the three frequencies are selected by means of the tuned circuits 12—13, and 14—15. For example the circuit 12—13 may be tuned to the frequency of source 37, while the circuit 14—15 may be tuned to the frequency of either the upper side-band or the lower side-band. Alternating currents of two differing frequencies are rectified in the manner already described in connection with Fig. 1, and are used as the local carrier at the outlying station for transmitting a signal therefrom, either to the central station 1 or to some other point.

Instead of employing two separate sources of alternating current at the central station, a single source may be employed, and by suitable circuits at the outlying station this frequency may be changed for transmission back to the central station. Thus as shown in Fig. 4, the source 39 may be arranged to generate an alternating current of a chosen high frequency, which is impressed upon the transmitting network after being filtered in a suitable filter 40 to suppress all the harmonics inherent in the generator 39. At the outlying station the transmission network is bridged by the circuit comprising the inductance 12 and condenser 13 which are adjusted to resonance with the fundamental frequency of the source 39. Coupled to the inductance 12 is an inductance 16 which is connected to a suitable rectifier 41 which may be of the half-wave or full-wave type. The output of rectifier 41 will contain alternating components corresponding to multiples of the frequency of source 39 and the circuit 29, 30 will be tuned to a selected one of the alternating current multiple components, for example to a frequency which is twice or three times the frequency of source 39. This selected frequency component may then be used as described in connection with Fig. 2 to transmit a signal back to the central station, filter 40 preventing the frequency component at the source 39, corresponding to the selected multiple at station 2, from being impressed upon the signal responsive device 36 which would tend to overload the latter.

It will be obvious that the invention is not limited to a single pick-up unit at the outlying station, or to a single station. For example the method illustrated in Fig. 2 may be employed to receive at the central station separate messages from two or more outlying stations. Thus as shown in Fig. 5 the central station is provided with four sources 42, 43, 44 and 45 of sustained high frequency alternating current, each generating a different fundamental frequency. At suitably spaced points throughout the transmission network 10, 11 are located three pick-up units 46, 47, 48 the input circuits for each of these units being diagrammatically indicated respectively by the numerals 49—50, 51—52, 53—54; while the output circuits for impressing the output energy back upon the transmission network are designated respectively by the numerals 55—56, 57—58, 59—60. The details of the various input and output circuits may be the same as those shown in Fig. 2 and further description thereof is not believed necessary at this point. The electric signal responsive device 61 at the central station can then be resonated at will to the output frequency produced by each of the pick-up units at the outlying station or stations. As a typical example of such an arrangement, the sources 42, 43, 44 and 45 may respectively generate the frequencies, 20,000 cycles, 30,000 cycles, 40,000 cycles, and 50,000 cycles each source being provided with a suitable switching arrangement for cutting it into and out of circuit. Let it be assumed that the input circuit 49—50 of the pick-up unit 46 is responsive to 20,000 cycles and to 30,000 cycles and that the output circuit 55—56 produces a modulated signal whose carrier frequency corresponds to the difference, or 10,000 cycles. Likewise let it be assumed that the input circuit 51—52 of pick-up unit 47 is tuned to be responsive to 30,000 cycles and to 40,000 cycles, and its output circuit 57—58 to the difference, namely 10,000 cycles; and also that the input circuit 53—54 for unit 48 is tuned to be responsive to 40,000 cycles and to 50,000 cycles and that the output circuit of this unit is tuned to the difference, 10,000 cycles. Under these circumstances the signal responsive device 61 may be tuned to 10,000 cycles, and it will not be necessary to make any adjustment of the tuning of device 61. Consequently if it is desired to receive from unit 46, it is only necessary to use the sources 42 and 43. If it is desired to receive only from unit 47, sources 43 and 44 are switched into circuit; while for reception from unit 48, sources 44 and 45 are used. If all the sources 42 to 45 are employed then signals from all the distant units may be received simultaneously.

While the foregoing embodiments disclose a system of communication back from the outlying stations to the central station they are capable of being used for two-way communication. Such an arrangement is illustrated in Fig. 6. In this embodiment the two high frequency sources of different frequency 6 and 7 are connected to the transmission network through a suitable modulating device such as the microphone 62. It will be understood of course that this method of effecting the modulation is purely schematic and that any other well-known modulating method may be employed. At the remote pick-up unit the numeral 63 represents the input resonant circuit such as the circuits 12—13, 14—15, 16—17, 18—19 of Fig. 2, and also a suitable rectifier arrangement. The remaining parts bear the same numerals as the corresponding parts of Fig. 2 and perform similar functions. The main difference is that in Fig. 6 there is inserted in circuit with the load resistor 31 a telephone receiver 64. It will be understood by those familiar with the art that any modulation produced by variation of the resistance of microphone 62 in accordance with sound waves impressed thereon will produce in the output of the rectifier in unit 63, an additional component equivalent to the modulating variations, which will be reproduced in the telephone receiver 64. It will further be understood that in this case the condenser 32 will have such

a value as not to bypass the low frequency speech currents but will serve merely to pass the high frequency components used for the return carrier. It is obvious that this addition will in no way affect the operation of the system when talking in the reverse direction.

It will also be clear to those familiar with the art while the systems disclosed can be used for speech transmission, that any other type of signal device may be substituted for the microphone **35** to vary the resistance of the output circuit of the pick-up units for other types of transmission. For example a telegraph key, code signalling devices, facsimile, television and other signal devices may be employed. In like manner other types of signal devices may be substituted for microphone **62** and receiver **64**. Further while in some of the embodiments the several sources of high frequency currents have been shown connected in parallel, it is possible to use a series connection. Likewise instead of coupling these sources directly to the transmission network, they may be coupled thereto capacitively, inductively, or through a suitable corrective network, filter, bridge circuit or the like, as will be obvious to those familiar with the art. Other changes may be made in the various embodiments without departing from the spirit and scope of the invention.

This application is a division of application Serial No. 106,789, filed October 21, 1936.

What I claim is:

1. The method of message-signalling from a plurality of outlying stations to a common central station which comprises generating only at the central station a plurality of pairs of alternating currents of different frequencies, transmitting the alternating currents over a transmission network to said outlying stations, selectively passing a pair of currents at one outlying station to derive therefrom an alternating current of a different frequency from any of said transmitted alternating currents, selectively passing another pair of said transmitted alternating currents at another outlying station to derive therefrom an alternating current of a frequency different from the transmitted alternating currents, at each of said outlying stations modulating only the derived currents in accordance with message signals, and impressing the signal modulated currents on said network for transmission to said central station.

2. The method according to claim 1 in which the frequency difference between each pair of transmitted alternating currents is the same.

3. The method according to claim 1 in which the frequency difference between all the transmitted alternating currents is the same.

4. The method according to claim 1 in which the frequency difference between the alternating currents of each pair is the same, and the derived currents are of the same frequency as said frequency difference.

5. The method according to claim 1 in which the derived currents are modulated at voice frequencies.

6. The method of signalling which comprises generating at a central point a plurality of pairs of alternating currents, transmitting said currents simultaneously to a plurality of separate distant signalling sources, impressing the received currents simultaneously on a plurality of pairs of tuned circuits at each of said sources, rectifying the combined output of each pair of tuned circuits to produce a local carrier current having a frequency different from the frequencies of said pairs of currents, and modulating said local carrier current in accordance with signals.

7. The method according to claim 6 in which the currents of each said pair of currents are of different frequencies with a frequency difference equal to the frequency difference of a corresponding pair of the tuned circuits at the signalling sources.

8. In a system of the character described, a central station, a plurality of pairs of alternating current generators at said station each generating a current of different frequency from the others, a plurality of outlying stations, a transmission network linking the central station with the outlying stations, means at each outlying station to pass selectively a pair of said currents to derive therefrom an alternating current of a frequency different from any of said pairs of alternating current, at each outlying station modulating only the derived current thereat in accordance with message signals, and impressing the modulated currents on said network for transmission to said central station.

9. In a system of the character described, a central station, a plurality of pairs of alternating current generators at said station, a plurality of separate distant signalling devices, a transmission network linking said central station with said devices, a plurality of pairs of tuned circuits one pair associated with each of said devices, means to impress said alternating currents on said tuned circuits, means to rectify the currents passed by each pair of tuned circuits to derive a local alternating current having a frequency different from the frequencies of said pairs of currents, and means to modulate said local alternating current in accordance with message signals.

10. A system according to claim 9 in which the currents of each of said pair of currents are of different frequencies with a frequency difference equal to the frequency difference of a corresponding pair of said tuned circuits.

11. In a system of the character described the combination of a central station, a plurality of pairs of alternating current generators at said station each generating a different frequency, a plurality of outlying signalling points, a transmission network linking said station and said points, means to selectively couple each pair of generators to said network, a pair of tuned circuits at each signalling point there being a tuned circuit corresponding in tuning to each of said generators, means coupled to each pair of tuned circuits to produce another alternating current having a different frequency from that of either of the associated tuned circuits; means to modulate said other current in accordance with signals, and means to impress the modulated current on said network.

12. A system according to claim 11 in which the frequencies of the generators at the first station are separated by the same amount, and the tuning of each pair of circuits is separated by the same amount.

13. In a system of the character described, the combination of a central station having a plurality of pairs of alternating current generators the frequency difference between each pair of generators being the same, a plurality of receiving points, a transmission network linking said generators with said receiving points, a rectifier network at each point, a tuned input circuit for each rectifier, a tuned output circuit for each rectifier, the output circuits of all the rectifiers

being tuned to said frequency difference, means to modulate said outputs in accordance with message signals, means to impress said modulated outputs on said network for transmission back to said central station, and means at said central station to selectively receive said modulated signals.

14. A system according to claim 13 in which the input circuit for each rectifier is tuned to pass only frequencies corresponding to a single pair of frequencies generated at the central station.

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