

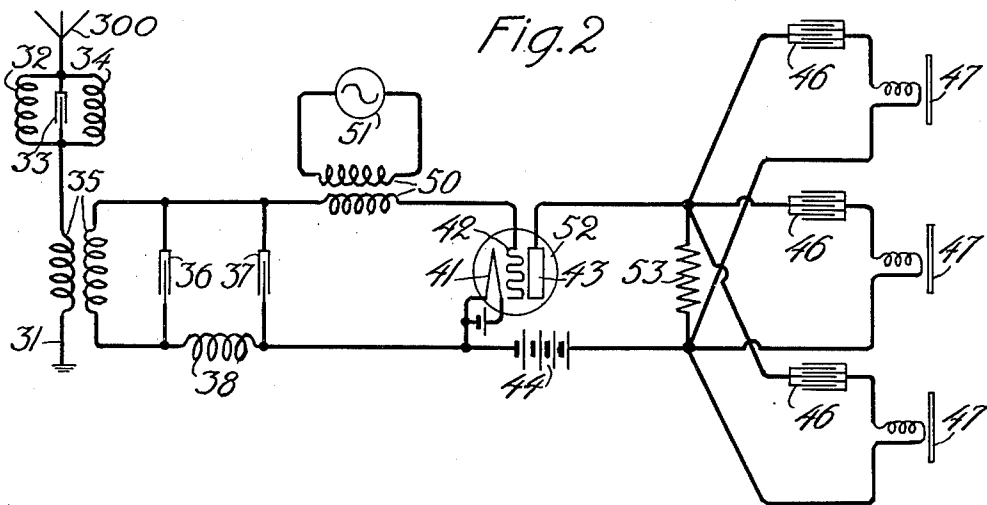
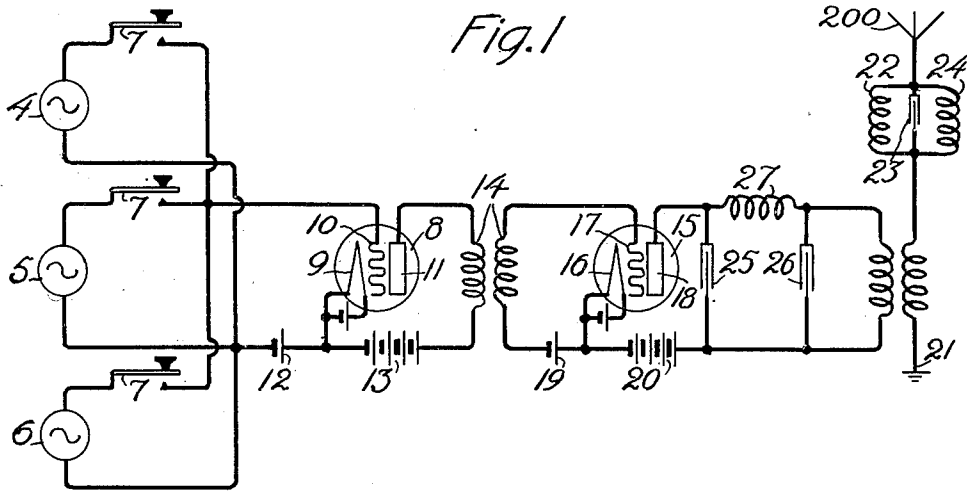
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CARRIER WAVE TRANSMISSION

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by *W. Griggs* Atty

UNITED STATES PATENT OFFICE.

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CARRIER-WAVE TRANSMISSION.

Original application filed November 2, 1920, Serial No. 421,764, Patent No. 1,465,932, dated August 28, 1923. Divided and this application filed October 21, 1922. Serial No. 595,909.

To all whom it may concern:

Be it known that I, EDWIN H. COLPITTS, a citizen of the United States, residing at East Orange, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Carrier-Wave Transmission, of which the following is a full, clear, concise, and exact description.

This invention relates to the transmission and reception of carrier waves for signaling or other purposes and more particularly to multiplex telegraphy whereby a plurality of messages are transmitted simultaneously from one or several stations and may be received simultaneously at a common receiving station.

One of the objects of the invention is to overcome the difficulties encountered in making and breaking, for signaling purposes, circuits carrying large power. A further object is to avoid, in multiplex radio signaling systems, the duplication of apparatus of large size for the production of power of different frequencies. These objects are obtained by using a plurality of generators of high frequency oscillations of low power, controlling the power from these generators in accordance with signals to be transmitted and then amplifying this controlled and modulated power.

A principal object of the invention is to receive the plurality of signals separately and without confusion, and to this end use is made of a source of high frequency oscillations at the receiving station, which oscillations combine with the received oscillations representing each signal to give a definite beat frequency. Oscillations of this beat frequency can then be readily selected from oscillations of other beat frequencies resulting from interfering oscillations or from other incoming signal oscillations.

Referring to the drawings: Fig. 1 shows a transmitting station; Fig. 2 shows a receiving station to be used in conjunction with such a station as is shown in Fig. 1. In the drawing, 4, 5 and 6 represent generators of high frequency low power oscillations. These generators may be of any suitable type, such as dynamos, mercury vapor oscillation generators or thermionic oscillation generators of well-known type. Each of these generators is provided with a signal-

ing key 7 and all are connected in parallel to the input circuit of a thermionic amplifier 8. This amplifier has the usual input electrodes, 9 and 10, consisting of a cathode which may be a hot filament and an impedance control element, and the usual output electrodes 9 and 11, 11 representing the usual plate electrode. A battery 12 is placed in the input circuit as shown to determine the potential of the control element or grid 10, and a battery 13 is placed in the output circuit for supplying the power necessary for said output circuit. The output circuit of this amplifier is connected by means of the transformer 14 to the input circuit of a power amplifier 15. This power amplifier, which in general will consist of a plurality of tubes connected in parallel, is here shown diagrammatically and has the usual cathode 16, grid 17 and plate 18. The input circuit includes the battery 19 and the output circuit includes the battery 20. The manner of connection and operation of this power amplifier is fully set forth in patents to Arnold 1,129,942 and 1,129,943.

To the output circuit of this power amplifier is inductively connected the radiating antenna system comprising the elevated conductor 200, which is connected to ground at 21.

In order to improve the efficiency of radiation, it has been found desirable to give this radiating antenna a number of degrees of freedom agreeing with the number of messages to be transmitted. The increase in the number of degrees of freedom is obtained by making this antenna system more complex, and one method for doing this is shown in Figure 1, in which 22, 23 and 24 designate reactances connected in parallel to each other and in series to the elevated conductor 200. In view of these degrees of freedom imparted to the radiating system it is possible to tune the antenna to each and all of the frequencies to be used for signaling. In this case it is also desirable to give the output circuit of the power amplifier an equal number of degrees of freedom, one method for accomplishing which is shown by inserting the condensers 25, 26 and the inductance 27, in the manner shown.

At the receiving station a similar antenna system is used consisting of the elevated

conductor 300, earth connection 31 and reactances 32, 33, 34. Inductively connected to this antenna system by means of the transformer 35 is a circuit tuned to the frequencies of the signals to be received, the necessary degree of freedom being supplied in the same or similar manner as to the sending station—namely, by means of the condensers 36, 37, and the inductance 38.

The receiving circuit having the several degrees of freedom is connected to the input terminals of a detector or demodulator 52, preferably of the highly evacuated three-element electric discharge type to constitute an input circuit therefor. Inductively connected to this input circuit by means of a transformer 50 is a source 51 of oscillations differing in frequency from the oscillations transmitted from sources 4, 5 or 6. Connected in the output circuit of detector 52 is a high impedance 53 to which a plurality of receiver circuits are connected in shunt. Each receiver circuit includes a condenser 46 and a translating device 47.

The operation of the system is as follows: Generators 4, 5 and 6, adjusted to generate oscillations of a certain definite frequency, differ the one from the other: for example—these may be 100,000, 99,600, 99,200 and so forth. Upon the closing of one or more of the signaling keys 7, oscillations of the frequencies of the corresponding generators will be impressed upon the input circuit of the amplifier 8. This amplified power will then be impressed upon the input circuit of the power amplifier 15, that is, all the power high frequency oscillations of different apparatus will be radiated simultaneously from the antenna. Upon being received at the receiving station these oscillations will combine with the locally generated oscillations, which oscillations have a definite frequency of say 100,200, and the combination of these locally generated oscillations, with the oscillations from any one generator of the transmitting station, will give oscillations which have a certain beat frequency given by the difference between the two frequencies in question. If, for example, the generator 4 has a frequency of 99,600 and signals are sent from this generator, then there will be impressed upon the input circuit of the detector 52, two different high frequency oscillations which differ in frequency by 600 cycles, and the resulting beat frequency oscillations which are set up in the output circuit of the detector will have a frequency of 600 cycles.

The circuits containing the translating devices are electrically tuned by means of the condensers 46 and the impedance in the circuits to one of the beat frequencies. One such circuit, for example, will be tuned to a frequency of 600, another circuit will be tuned to a frequency of say 200, and so

forth. Only that circuit then which is tuned to a frequency of 600 will take up or select signals transmitted from the generator 4. In this manner signals sent from any of the generators will be picked up by one and only one receiving circuit.

In order to increase the selectivity of the circuits containing the translating devices, it is desirable to have the translating device mechanically tuned to the frequency to be received. This may be accomplished in a variety of ways such, for example, as having a telephone receiver with a tuned diaphragm or by tuning forks, or by any other suitable and well-known expedient.

It is obvious that in case the signals received are very weak, the detector 52 may be adjusted to act also as an amplifier or that separate amplifying devices may be inserted in the circuits for this purpose.

While but three generators and receiving circuits have been shown, it is obvious that any number may be used.

In Fig. 1, a single voltage amplifier 8 has been shown which feeds by means of the transformer 14 into the power amplifier 15. It is to be understood, however, that a plurality of these voltage amplifiers 8 may be connected in series to step up to a higher voltage, in the manner described in the patents to Arnold mentioned above.

As in the ordinary case the antenna may be replaced if desired by a transmission line.

Although this invention has been described as particularly applicable to multiplex radio telegraphy, it is obvious that certain features of the invention which are covered by the appended claims are capable of application generally to energy wave transmission for signaling or selective purposes, regardless of the medium.

This application is a division of application Serial No. 421,764, filed November 2, 1920, by Edwin H. Colpitts; for multiplex radio telegraph systems, as a renewal of application Serial No. 50,172, filed September 11, 1915, Patent No. 1,465,932, August 28, 1923.

What is claimed is:

1. The method of multiplex transmission comprising modification of each of a plurality of different frequency oscillations in a manner individual thereto, simultaneous transmission of all of said modified oscillations, reception of all of said transmitted oscillations at a common station, conversion of all of said received oscillations into a composite current comprising lower frequency oscillations which differ in frequency by greater proportional amounts than the corresponding transmitted oscillations from which they are derived, selection of each of said lower frequency oscillations from the other lower frequency oscillations of the composite current to thereby distinguish

their individual modifications, and utilization of each of said selected oscillations to give a response which is characteristic of the individual modification thereof.

5 2. The method of multiplex signal transmission which comprises interrupting each of a plurality of different frequency waves of substantially constant amplitude in accordance with a message individual thereto, simultaneously transmitting all of said waves and receiving them at a common point, converting said received waves into a composite current comprising lower frequency waves which differ in frequency by greater proportional amounts than said received waves, separately selecting each of said lower frequency waves from the other lower frequency waves of the composite current to thereby distinguish the messages and causing each of said selected waves to produce indications corresponding to its individual message.

3. The method of multiplex signaling which comprises transmitting and receiving a plurality of different frequency waves each modified in accordance with an individual message, simultaneously combining all of said received waves with local oscillations of another frequency to produce a composite current comprising similarly modified waves of frequencies lower than the respective transmitted waves and having greater proportional frequency differences, separating said lower frequency waves of said composite current from each other, and causing each to produce indications corresponding to its individual message.

4. A signaling system involving the separation of different messages received as modified different frequency oscillations, characterized by means for converting such received oscillations into a composite current comprising lower frequency oscillations differing in frequency by greater proportional amounts than said received oscillations, means for separately selecting each of said lower frequency oscillations of said composite current from the other lower frequency oscillations thereof to thereby distinguish the messages, and means for separately utilizing said selected oscillations.

5. A signaling system according to claim 4, characterized by the combination of means for simultaneously supplying a plurality of message waves of different frequencies and converting means comprising means for supplying oscillations of a single frequency for combination with said waves.

6. A signaling system comprising means for receiving different messages transmitted as modified different frequency oscillations, means for detecting all of said received oscillations to produce a composite current consisting of lower frequency oscillations differing in frequency by greater proportional

amounts than said modified high frequency oscillations, means for separately selecting each of said lower frequency oscillations representing an individual message from the other lower frequency oscillations of said composite current and individual translating means for utilizing said selected oscillations to produce signals.

7. A multiplex signaling system comprising a common means for simultaneously receiving a plurality of different frequency oscillations, the oscillations of each frequency being modified in accordance with a message individual thereto, means for reducing the effective frequency of all of said received oscillations to produce a composite current consisting of a corresponding plurality of lower frequency oscillations having relatively greater frequency differences than said received oscillations, means for selecting each of said lower frequency oscillations from the others and separate means for utilizing each of said selected oscillations to indicate an individual message.

8. A receiving system comprising means for receiving simultaneously a plurality of different frequency waves, means for combining oscillations therewith to produce a composite current including as components combination frequency waves having relatively larger frequency difference than said received waves and hence more readily separable, means for separating each of said combination frequency waves from the remaining components of said composite current and means for utilizing each of said separated waves to produce a separate signal.

9. A receiving system for simultaneously receiving a plurality of messages each of which is transmitted as a modification of oscillations of a frequency individual to said message comprising a receiving circuit, means for simultaneously impressing all of said different frequency transmitted oscillations thereupon, a single detector having an input circuit connected to said receiving circuit and having an output circuit, a local source of oscillations of frequency different from said transmitted oscillations also connected to said input circuit, a plurality of selective circuits connected to said output circuit, each of said selective circuits being tuned to the frequency difference of said local oscillations and the oscillations transmitted for one of said messages, and individual signal indicating means associated with each of said selective circuits.

10. In a system for receiving and detecting continuous wave signals, means for receiving wave signals, means for producing currents of audio frequencies from the received signals, a circuit upon which the currents of audio frequencies are impressed, an indicator operatively related to said circuit in such a way as to be directly affected by

currents of a desired frequency impressed upon said circuit, and means directly associated with said circuit for preventing currents of an undesired frequency impressed upon said circuit from affecting said indicator.

11. In a system for receiving and detecting continuous wave signals, means for receiving continuous wave signals, a detector, an indicator operatively related to said detector so as to be directly actuated by signaling currents of a desired frequency produced by said detector, and means associated with said detector for preventing currents of an undesired frequency produced by said detector from affecting said indicator.

12. A method of multiplex signal transmission which comprises modifying each of a plurality of different frequency waves in accordance with a message individual thereto, simultaneously transmitting all of said waves and receiving them at a common point, converting said received waves into a composite current comprising lower frequency waves which differ in frequency by greater proportional amounts than said received waves, establishing the relative frequencies of said lower frequency waves in accordance with the carrier or wave frequency of said received waves independently of their respective modifications, separately selecting each of said lower frequency waves from the other lower frequency waves of the composite current to thereby distinguish messages, and causing each of said selected waves to produce oscillations corresponding to its individual message.

13. A signaling system involving the separation of different messages received as modified different frequency oscillations characterized by means for converting said received oscillations into a composite current comprising lower frequency waves differing in frequency by greater proportional

amounts than said received oscillations, said means being capable of converting received oscillations of one frequency during the time received oscillations of a different frequency are being applied thereto, means for separately selecting each of said lower frequency oscillations of said composite current from other lower frequency oscillations thereof to thereby distinguish the messages, and means for separately utilizing said selected oscillations.

14. A signaling system involving the separation of different messages received as modified different frequency oscillations characterized by means for simultaneously converting such received oscillations into a composite current comprising as its components lower frequency oscillations differing in frequency by greater proportional amounts than said received oscillations, means for separately selecting from said composite current each of said lower frequency oscillations from the other lower frequency oscillations to thereby distinguish messages, and means for separately utilizing said selected oscillations.

15. The combination, in a receiving circuit, of a conductor for transferring incoming waves, a local source, a circuit in which waves from said conductor and said local source are combined, a detector operating on the combined waves, an output circuit for said detector, a plurality of selective means connected to said output circuit each selective of a wave of frequency produced by the combination of a frequency component of incoming waves and waves from said local source when operated upon by said detector, and individual wave responsive instrumentalities controlled by excitation of a corresponding individual one of said selective means.

In witness whereof, I hereunto subscribe my name this 18th day of October A. D., 1922.

EDWIN H. COLPITTS.