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1,724,938

CARRIER WAVE TRANSMISSION

Original Filed July 25, 1923

Fig.1

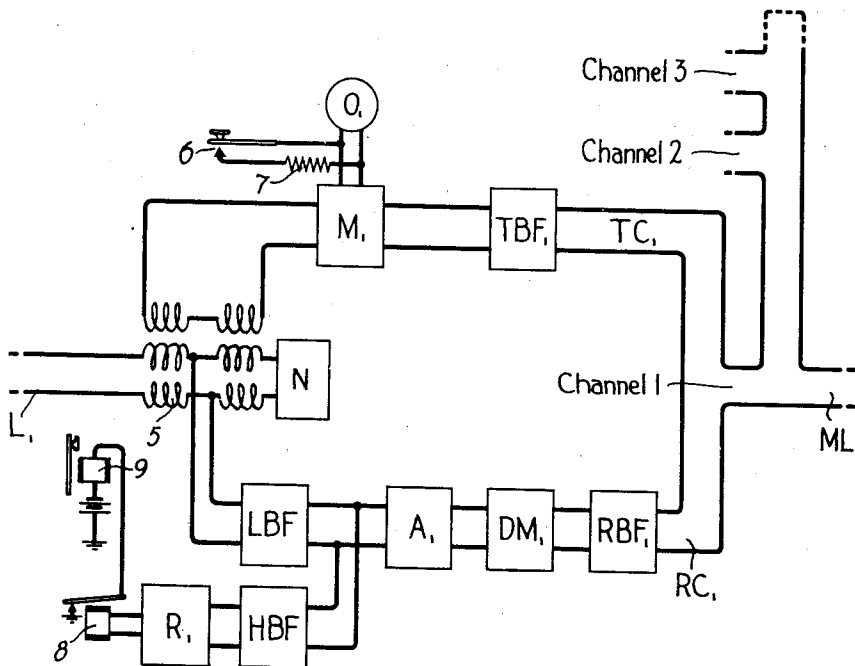


Fig. 3

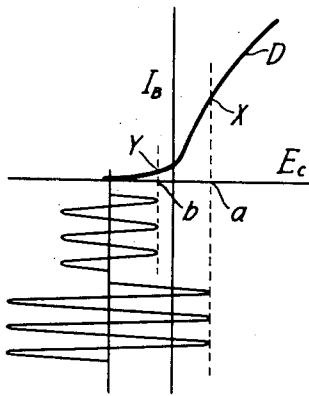
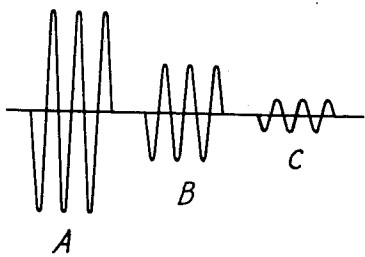


Fig.2



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CARRIER-WAVE TRANSMISSION.

Original application filed July 25, 1923, Serial No. 653,629. Divided and this application filed November 20, 1926. Serial No. 149,779.

This invention relates to carrier wave transmission, and is a division of application, Serial No. 653,629, filed July 25, 1923, patented December 21, 1926, No. 1,611,350.

5 An object of the invention is to increase the number of signaling channels in a multiplex carrier signaling system within a given frequency range.

10 Another object of the invention is to provide a novel method of and apparatus for transmitting telephone and telegraph signals simultaneously on the same carrier wave.

According to this invention, a multiplex 15 carrier wave telephone system has associated with one or more channels thereof telegraph transmitters for changing the magnitude of the carrier current in the telephone channels and receiving apparatus to 20 enable the telegraph signals to be received without affecting the operation of the carrier telephone apparatus.

In the drawings:

25 Fig. 1 is a diagrammatic illustration of a multiplex carrier telephone and telegraph system embodying the invention;

Fig. 2 shows curves representing the magnitude and form of the carrier and voice side band waves in the system of Fig. 1; and

30 Fig. 3 shows the operating characteristics of the rectifiers employed in the system of Fig. 1.

In Fig. 1 there is illustrated the west terminal of a multiplex carrier telephone and 35 telegraph system connected to the high frequency transmission line ML. The usual east terminal, which is identical to the west terminal shown in the drawing, is omitted for the sake of simplifying the showing.

40 The telephone channels employ different carrier frequencies, those used for transmission in one direction being grouped in a different frequency range from those employed for transmission in the opposite direction. 45

The multiplex carrier telephone and telegraph system illustrated has three or more telephone channels upon each of which may be superimposed a telegraph channel arranged for two-way operation, the telegraph channels employing the same carrier frequencies. Since the channels are alike

except for the constants of some of the apparatus thereof, due to the different frequencies employed, it will be unnecessary to 55 describe more than one such channel.

As illustrated, a plurality of telephone channels, 1, 2 and 3 are connected to the transmission line ML. Telephone channel No. 1 includes a transmitting channel TC₁ 60 and a receiving channel RC₁, which are conjugately related to a low frequency telephone line L₁ by means of a transformer 5 and a balancing network N. The telephone line L₁ usually extends to and terminates at 65 a telephone switchboard (not shown).

The transmitting channel TC₁ includes a modulator M₁ and a transmitting band filter TBF₁. The modulator M₁ may be of any well-known type such, for example, as the 70 electronic valve modulator of the three-electrode type disclosed in Fig. 42 of an article entitled "Carrier current telephony and telegraphy" by Messrs. Colpitts and Blackwell, published in the Transactions of 75 the American Institute of Electrical Engineers, vol. 40, 1921. Carrier current of the frequency assigned to this channel is supplied to the modulator M₁ from a high frequency source O₁. 80

The transmitting band filter TBF₁ may be of the type disclosed in U. S. patents to Campbell, Nos. 1,227,113 and 1,227,114, issued May 22, 1917. This band filter is designed to pass currents of the carrier frequency assigned to this channel and currents of frequencies within either the upper 85 or lower side band thereof and to suppress currents of all other frequencies.

In order that the telegraph channel may 90 be superimposed upon this telephone channel, there is associated therewith a telegraph transmitting key 6 which, during the operation thereof, is adapted to intermittently shunt an impedance element 7, which 95 may take the form of a non-inductive resistance, across the leads from the source of high frequency current O₁. Thus, during the intermittent operation of the transmitting key 6, the amplitude of the carrier current supplied to the modulator M₁ is alternately reduced from and restored to its 100 normal value. Consequently, the telephone signal modulated carrier current output

from the modulator M_1 is intermittently changed in amplitude during the transmission of telegraph signals.

The relative amplitudes of the carrier frequency when the transmitting key 6 is open and closed are shown in Fig. 2. This figure also shows the amplitude of the voice or telephone side band currents.

The receiving channel RC_1 includes a receiving band filter RBF_1 , a demodulator DM_1 , an amplifier A_1 , a low frequency band filter LBF , a high frequency band filter HBF , a rectifier R_1 and a telegraph receiving relay 8 which controls the usual telegraph sounder 9.

The receiving band filter RBF_1 is of the type disclosed in the Campbell patents, supra. It is designed to pass currents of the carrier frequency assigned to this channel and of the frequencies within either the upper or lower side band thereof and to suppress currents of all other frequencies.

The demodulator DM_1 and the amplifier A_1 may be of any well-known types such, for example, as those disclosed in Fig. 42 of the Colpitts and Blackwell article, supra.

The low frequency band filter LBF is of the type disclosed in said Campbell patents. It is designed to pass currents within the voice frequency range between about 200 and 2000 cycles frequency and to suppress currents of higher frequencies as well as the telegraph signals below 200 cycles. The high frequency band filter HBF is designed to pass currents of the carrier frequency assigned to this channel and of frequencies within both or one of the telegraph side bands and to suppress currents of all other frequencies. Thus, these two filters separate the received telephone and telegraph signals.

The rectifier R_1 may be of any well-known type such, for example, as that disclosed in Fig. 42 of the Colpitts and Blackwell article, supra.

The operation of the system, in so far as transmission and reception of telephone signals are concerned, is well known. Therefore, no description thereof will be given.

Fig. 2 shows a set of curves representing the magnitudes of the transmitted waves of different frequencies. Curve A shows the magnitude of the carrier waves when the telegraph key 6 is open, curve B the magnitude of the carrier waves when the telegraph key is closed, and curve C the magnitude of the voice side band waves.

Fig. 3 shows the characteristic curve of the rectifier R_1 . The curve D is plotted with input voltages E_c as abscissæ against rectified currents I_b as ordinates. When the telegraph key 6 is open, the input voltage α impressed upon the rectifier causes rectified current of magnitude α to flow; and when the telegraph key is closed, the input voltage β

impressed upon the rectifier causes rectified current of magnitude Y to flow.

The operation of the telegraph channel superimposed upon the telephone channel and employing the same carrier frequency may be explained by reference to Fig. 3. When the telegraph key 6 is open, the normal amount of carrier current is flowing to the line and the amount of rectified current through the telegraph receiving relay 8 at the distant station is sufficient to hold its contact closed, thereby maintaining the circuit of the sounder 9 closed. When the telegraph key 6 is closed, the amount of carrier fed to the line is reduced as indicated in Fig. 2, and the amount of rectified current through the receiving relay 8 at the distant station is reduced to such an extent that the relay can no longer hold up its armature. The circuit of the sounder 9 is therefore opened. When the telegraph key 6 is again opened, the amount of rectified current through the receiving relay 8 at the distant station increases and it thereupon closes its contact, causing the energization of the sounder 9.

The amplitude of the side band frequencies (as indicated in Fig. 2) is low compared to the difference between the amplitudes of the carrier frequencies when the telegraph key is open and closed. Consequently, there is no interference between the simultaneously transmitted telephone and telegraph signals.

The invention set forth herein is, of course, susceptible of various other modifications and adaptations not specifically shown but included within the scope of the appended claims. For example, the invention is not limited to telephone transmission in the narrow sense of that term, since the variable waves with which the carrier current is modulated may represent something other than speech such as the characteristics of a picture to be electrically transmitted.

What is claimed is:

1. In a carrier wave transmission system, the method of simultaneously transmitting signals of different character which comprises slowly varying a characteristic of the carrier waves in accordance with signals of one character and changing the magnitude of said carrier waves having a characteristic varied in accordance with signals of another character between definite fixed limits to produce signals of another character which are distinguished according to the amplitude of the carrier wave.

2. The method of transmitting telegraph signals and speech or similar signals simultaneously which comprises varying the amplitude of carrier waves in accordance with the speech or similar signal waves and changing the amplitude of said carrier waves modulated with the signal waves between definite fixed values in accordance with the

telegraph signals to produce signals that are distinguished by the change in amplitude of the carrier wave.

3. In a carrier wave transmission system, 5 the method of signaling which comprises transmitting a plurality of carrier waves of different frequencies each modulated in accordance with speech, varying the amplitude of each of said carrier waves to transmit 10 signals of another character, and reproducing said last mentioned signals at a receiving station in accordance with the amplitude of the carrier wave.

4. A carrier wave transmission system 15 comprising a source of carrier waves, means for slowly varying the amplitude of waves from said source to transmit signals of one character, means for simultaneously varying the amplitude of waves from said source 20 between definite fixed limits to transmit signals of another character, and means controlled by the amplitude of the carrier wave for reproducing said last mentioned signals at a receiving station.

5. A carrier wave transmission system 25 comprising a source of sustained carrier waves at the transmitting terminal, means for modulating waves from said source to transmit signals of slowly varying character, 30 means for simultaneously abruptly varying the amplitude of waves from said source to transmit signals of another character, means at the receiving terminal for combining said modulated waves with waves of carrier frequency to derive said first mentioned signals, the means for separately detecting said 35 second mentioned signals.

6. A carrier wave transmission system 40 comprising means for transmitting a plurality of carrier waves of different frequencies each modulated in accordance with speech, means for causing a variation in the amplitude of each of said modulated carrier waves to transmit telegraph signals, means 45 for detecting the speech components of said waves, and means for separately detecting said telegraph signals.

7. A carrier wave transmission system 50 comprising a source of sustained carrier waves, means for modulating waves from said source in accordance with signal waves, and means for simultaneously causing a reduction in the amplitude of the modulated carrier wave to transmit telegraph spacing 55 signals.

8. A carrier wave telephone and telegraph 60 transmission system comprising a source of sustained carrier waves, means for modulating waves from said source in accordance with telephone signal waves, and means for reducing the amplitude of the carrier waves from said source supplied to said modulat-

ing means so as to transmit telegraph spacing signals which are distinguished according to the amplitude of the carrier waves. 65

9. A carrier wave transmission system comprising a source of sustained carrier waves, a modulator for modulating waves from said source in accordance with signal waves, an impedance, and means for intermittently connecting the impedance in shunt 70 with said carrier frequency source to intermittently decrease the amplitude of the carrier wave currents in accordance with telegraph signals. 75

10. A carrier wave transmission system comprising a source of sustained carrier waves, a modulator, means for impressing waves from said carrier source upon said modulator, a source of low frequency signal 80 waves, means for impressing waves from said last mentioned source upon said modulator, and means for abruptly varying the magnitude of the carrier wave as supplied to said modulator in accordance with a signal. 85

11. A multiplex carrier telephone and telegraph system comprising a high frequency transmission line over which a plurality of high frequency waves, each modulated in accordance with telephone and telegraph signals are to be transmitted, a plurality of transmitting channels connected to the line and each including modulating means for transmitting a different wave modulated in accordance with telephone signals, selective 90 means connecting the transmitting channels to the line and preventing interference between the channels, and means associated with each transmitting channel for changing the amplitude of the carrier wave of the frequency assigned thereto and modulated with the telephone signals to transmit telegraph signals. 100

12. A carrier telephone and telegraph system comprising a high frequency transmission line over which a high frequency wave modulated in accordance with telephone and telegraph signals is to be transmitted, a transmitting channel connected to the line and including modulating means for transmitting carrier waves modulated in accordance with telephone signals, means associated with the transmitting channel for changing the amplitude of the modulated carrier wave to transmit telegraph signals, a receiving 110 channel connected to the line, demodulating means in the receiving channel, and means associated with the demodulator to selectively receive the transmitted telephone and telegraph signals. 120

In witness whereof, I hereunto subscribe my name this 11th day of October A. D., 1926.

JACOB S. JAMMER.