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MULTIPLEX SIGNALING SYSTEM

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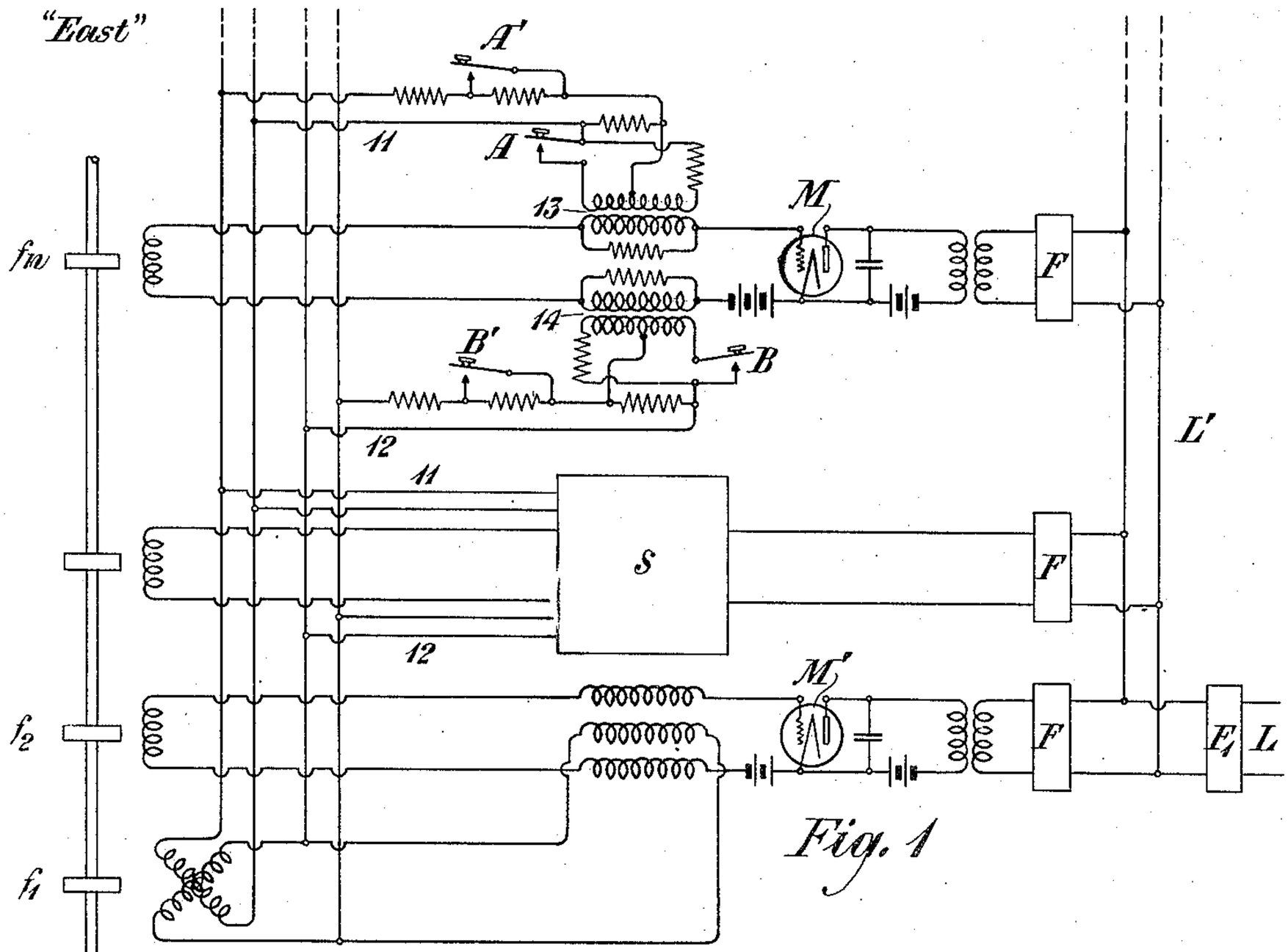

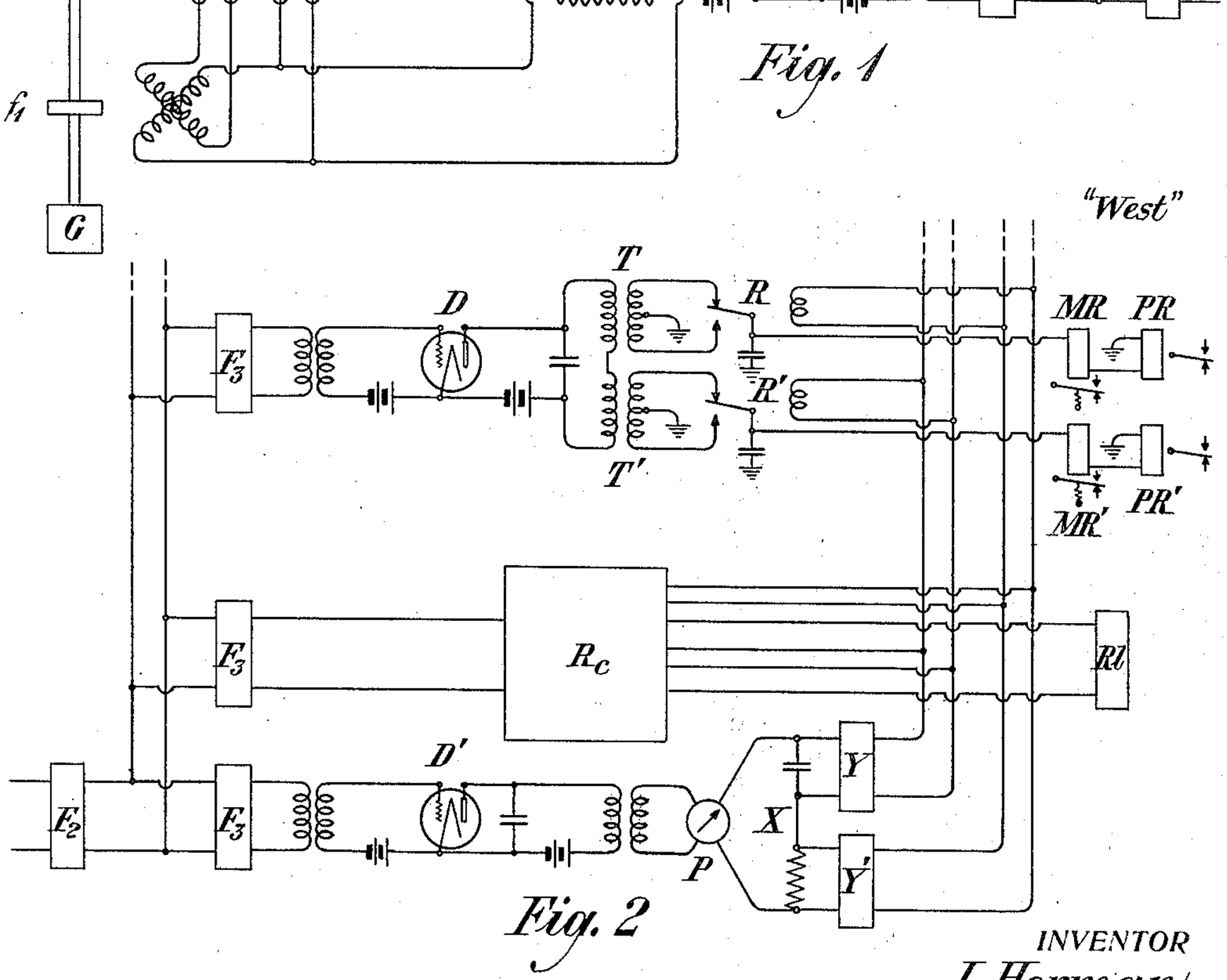

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MULTIPLEX SIGNALING SYSTEM.

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An object of my invention is to provide a new and improved method and suitable apparatus for utilizing a line for the simultaneous transmission of a number of messages. Another object of my invention is to provide for a system of multiplex telegraphy with discrimination by difference of phase between messages in the same frequency range. Another object of my invention is to modulate a carrier current with a relatively lower frequency current on which signal elements have been impressed by phase discrimination or magnitude discrimination or both, to transmit the carrier current modulated in this way, and at the receiving end to detect the respective signal elements. Another object of my invention is to provide in this connection for the same low frequency modulating current at the sending and receiving ends by means of transmission over a pilot channel. These and various other objects of my invention will become apparent on consideration of a specific example of practice according to the invention which I have chosen here to illustrate and describe. With the understanding that the following specification is a disclosure of this example of the invention and that the scope of the invention will be indicated in the appended claims, I now proceed to describe the structure and operation of the apparatus shown in the drawings.

In these drawings, Figure 1 is a diagram of the sending station "East" and Fig. 2 is a diagram of the corresponding receiving station "West."

At the station east the motor G drives the various generators on the same shaft therewith, each of which generates a current of respective frequency f_1, f_2 . . . f_n . . . . The voltage of frequency f_n is impressed on the grid of the vacuum tube modulator M whose plate circuit is connected through a transformer and the band filter F with the branch conductors L′ and thence through the main filter F_1 with the line L.

The generator of frequency f_1 is a two-phase generator and from the respective circuits for the two phases branch circuits 11 and 12 go to the respective three-winding transformers 13 and 14, each of which has its secondary winding in the grid circuit of the modulator M.

The currents in the branch circuit 11 of frequency f_1 are reversed in phase by closing the key A and are substantially increased in magnitude by closing the key A′, the two effects being superposable. Similarly, the currents in branch circuit 12, differing 90 degrees in phase from those in 11, are reversed by closure of the key B and substantially increased in magnitude by closure of the key B′.

The output current from the modulator M is accordingly modulated to correspond with four telegraph messages impressed by means of the keys, A, A′, B and B′. The band filter F passes a frequency range in which f_n is intermediate and as stated before, the modulated current through this filter goes on the branch conductors L′ and then through the filter F_1 to the line L.

Carrier currents of other frequencies than f_n are modulated each in the same way by means of apparatus similar to that already described and indicated symbolically by the rectangle S, and all the different carrier currents, each modulated with four messages, are superposed in the conductors L′ and tranmitted by the line L.

A single special carrier current of frequency f_2 is modulated at M′ by current of one of the two phases of frequency f_1, and this current, so modulated, is also put on the line L.

At the receiving end, the current from the line L passes through the filter F_2 and thence in multiple through the band filters F_3, which correspond respectively with the filters F, and separate the respective modulated carrier currents each carrying its four messages. The current passed by the filter F_3 shown in the upper part of Fig. 2 goes to a demodulator D, in whose output circuit are the two primary windings in series of respective transformers T and T′. As a result of the action of the demodulator D, the currents through these primary windings are of two superposed phases 90 degrees apart, each of the frequency f_1 and each reversed from time to time and varying in magnitude according to the operation of the keys A, A′, B and B′ at the sending end. Corresponding electromotive forces are impressed in the secondary circuits of the transformers T and T′ and in these secondary circuits are mechanical rectifiers R and R′.

The current from the line L of frequency f_2, modulated by the lower frequency f_1,

goes through the corresponding filter F_3 to the demodulator D′. Accordingly, the output current from the demodulator D′ will be the pure current of frequency f_1. Through the transformer shown, this current passes to a phase adjuster P and thence to a phase splitter X, from which branch circuits carry two currents 90 degrees apart and of the frequency f_1 to the respective amplifiers Y and Y′. From the output circuits of the amplifiers Y and Y′ branch conductors go to the magnets of the rectifiers R and R′ and vibrate their armatures at the frequency f_1.

Proper phase relations having been attained by the adjustment of the device P, the rectifier R rectifies the currents of one phase and the rectifier R′ rectifies the currents of the other phase 90 degrees displaced therefrom. The rectified currents from R go through a marginal relay MR and a polar relay PR in series, and similarly, the rectified currents from R′ go through a marginal relay MR′ and a polar relay PR′ in series. Accordingly, the relay PR responds only to the key A at the sending station, the relay MR to the key A′, the relay PR′ to the key B and the relay MR′ to the key B′.

Any other carrier current modulated in accordance with four messages, as from the sending network S, will be separated out at the receiving end by the filter F_3 and put through a demodulator and associated apparatus represented symbolically by the rectangle R*c*, and the rectified currents will go through the corresponding relays represented symbolically by the rectangle R*l*, so that the four messages will be respectively received.

It will be seen that I provide for a number of carrier currents of different frequency, such as f_n, and that I modulate each of these by means of a common lower frequency f_1, on which, in each instance, four signal trains are impressed by means of phase discrimination and magnitude discrimination. At the receiving end, separation is first effected by means of the carrier frequency and then these separated currents are demodulated, so that from each carrier frequency there is obtained only the modulating current of the common lower frequency, and in this current of lower frequency the four signal trains are respectively identified according to the phase and magnitude differences.

I claim:—

1. In a carrier current telegraph system, the method of transmitting a plurality of messages on each frequency, which consists in modulating the carrier currents each with a common lower frequency in two phases 90 degrees apart, reversing each of these phases for two signal trains and varying each in magnitude for two others, putting the carrier currents thus modulated together on a line, and at the receiving station separating them according to their carrier frequencies and demodulating and interpreting the four signal trains in the respective demodulator output currents.

2. In a carrier current telegraph system, the method of putting a plurality of messages on a line for each frequency, which consists in modulating each frequency by two currents 90 degrees apart, each of the same low frequency and each reversed in phase and varied in magnitude to correspond to four signal trains.

3. In a carrier current telegraph system, means to put carrier currents of various frequencies on a line, means to modulate each carrier current by two currents of the same low frequency and 90 degrees apart in phase, and means to vary each modulating current by phase reversal for one signal train and by magnitude change for another signal train.

4. In a carrier current telegraph system, the method of transmitting a plurality of messages on a single carrier current frequency, which consists in modulating it with a lower frequency in two phases 90 degrees apart, reversing each of these phases for two signal trains, and varying each in magnitude for two others, putting the carrier current thus modulated on a line and at the receiving station demodulating it and separating the signal trains according to the phase of the low frequency current and according to the magnitude thereof.

5. In a carrier current telegraph system, the method of transmitting a plurality of messages on one carrier current frequency, which consists in modulating the carrier current with a low frequency current in two phases 90 degrees apart, controlling one phase for one message and another phase for another message, putting the carrier current thus modulated on a line, and at the receiving end discriminating the two messages according to the difference of phase.

6. The method of transmitting two messages by means of a carrier current of a certain frequency, which consists in modulating that current with two currents of the same low frequency 90 degrees apart in phase, varying each of these low frequency currents according to a message, transmitting the carrier current thus modulated, demodulating at the receiving end and separating the messages according to phase.

7. In a carrier current telegraph system, the method of receiving messages on different phases of a low frequency modulating current applied to a high frequency carrier current, which consists in demodulating the received carrier current, and combining the effect of the demodulated current with low

frequency currents of different phases, so as to discriminate the messages according to phase.

8. The method of receiving messages carried by a carrier current modulated with message currents of the same low frequency of different phase, which consists in demodulating the received currents and sending the output through rectifiers operated at the low frequency and in different phases, respectively.

9. In a carrier current telegraph system, means to put a carrier current of a certain frequency on a line, means to modulate it by two currents of the same low frequency and 90 degrees apart in phase, and means to vary each modulating current according to a respective message.

10. In a carrier current telegraph system, means to put a carrier current of a certain frequency on a line, means to modulate it by two currents of the same low frequency and 90 degrees apart in phase, means to vary each modulating current according to a respective message, means to demodulate it at the receiving end, and means to rectify the respective currents of the two phases in order to separate the two messages.

11. In a carrier current telegraph system, means to put a carrier current of a certain frequency on a line, means at the sending end to modulate this current by two currents of the same low frequency and 90° apart in phase, means to vary each modulating current according to a respective message, means to demodulate the corresponding current at the receiving end, two mechanical rectifiers at the receiving end to which the current goes from the said demodulating means, and means at the receiving end to generate two currents 90° apart to actuate these rectifiers respectively whereby the currents of the two different phases are separated to the respective output circuits of said rectifiers and can there be applied to give their corresponding signal indications.

In testimony whereof, I have signed my name to this specification this 18th day of June 1924.

JOSEPH HERMAN.