Jan. 6, 1925. 1,521,685

B. P. HAMILTON

CARRIER TELEGRAPH CIRCUITS

Filed Oct. 21, 1920

Fig. 1

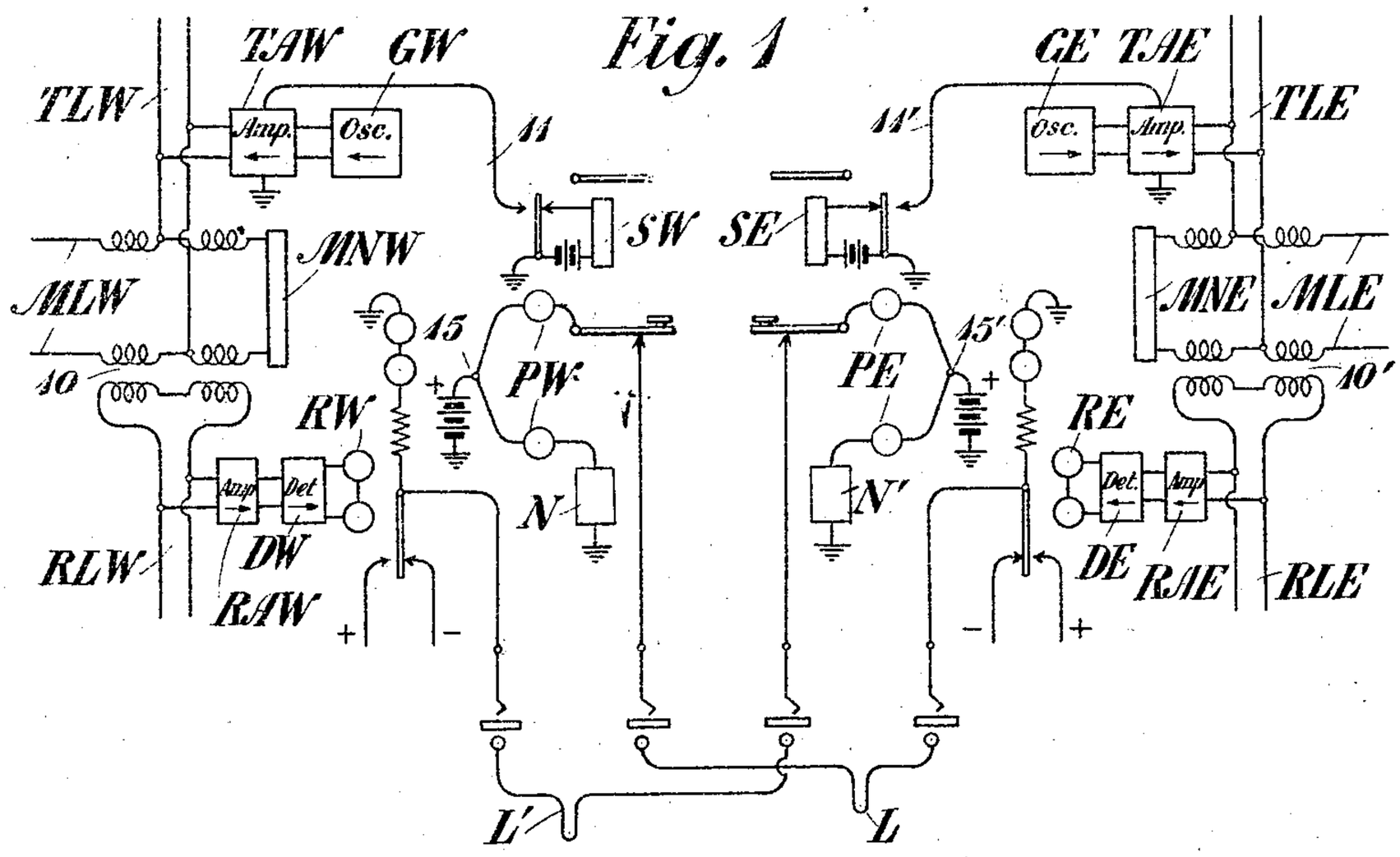


Fig. 2

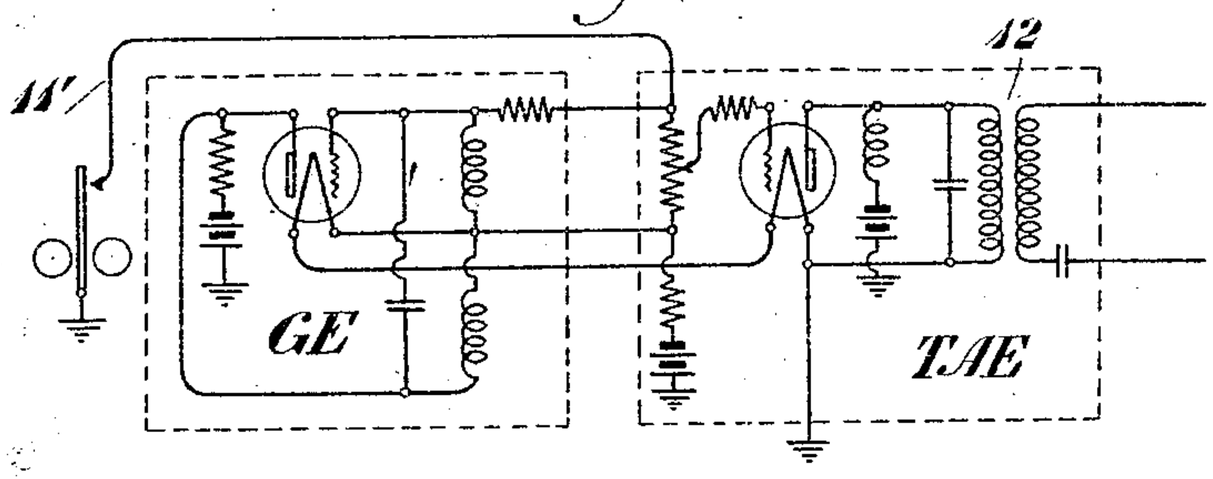
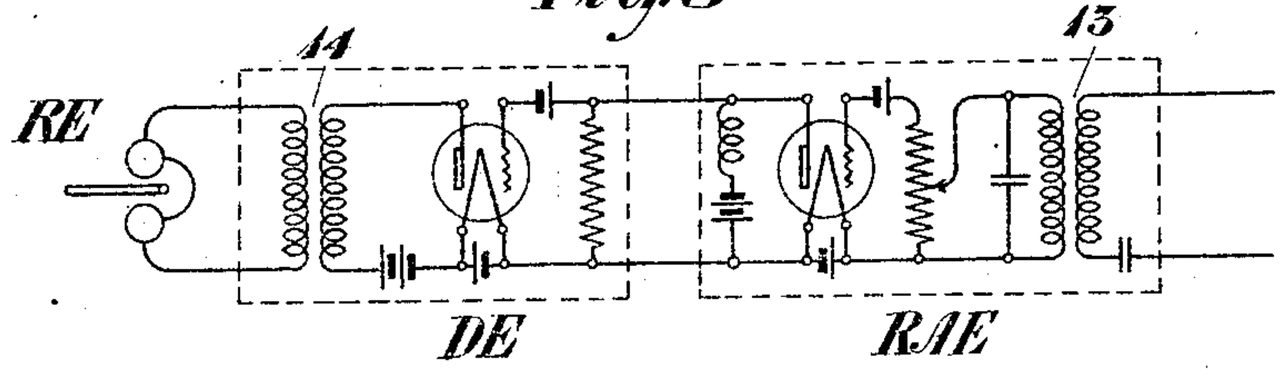


Fig. 3



INVENTOR
B. P. Hamilton
BY
ATTORNEY

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UNITED STATES PATENT OFFICE.

BAXTER P. HAMILTON, OF BROOKLYN, NEW YORK, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

CARRIER TELEGRAPH CIRCUITS.

Application filed October 21, 1920. Serial No. 418,487.

To all whom it may concern:

Be it known that I, BAXTER P. HAMILTON, residing at Brooklyn, in the county of Kings and State of New York, have invented certain Improvements in Carrier Telegraph Circuits, of which the following is a specification.

This invention relates to signalling systems, and more particularly to systems in which telegraph signals are transmitted by means of carrier currents.

One of the objects of this invention is to provide a mechanical repeater for interconnecting two line sections for the transmission of telegraph signals in such manner that the system may be operated on a full duplex basis.

Another object of the invention is to provide a repeater for interconnecting two carrier line sections of a carrier telegraph system adapted for full duplex operation, the repeater arrangement being such that signals of carrier frequency are translated into low frequency telegraph signals and after passing over a local circuit, retranslated to carrier frequency.

Another object of the invention is to associate local subscribers' circuits or loops with a repeater arrangement of the character just described so that repeated signals will be received by the loops and signals may be transmitted from the loops through the repeater to the carrier circuits.

Other and further objects of the invention will be clear from the following description when read in connection with the accompanying drawing, Figure 1 of which is a circuit diagram of one embodiment of the invention, and Figs. 2 and 3 of which show detailed circuit arrangements of certain features of the transmitting and receiving apparatus employed in connection with the invention.

Referring to Fig. 1, MLE and MLW designate main line sections over which carrier currents may be transmitted. A carrier transmitting circuit TLE and a carrier receiving circuit RLE are associated with the main section MLE through a balanced transformer arrangement 10′, an artifical network MNE being provided to balance the main line section MLE. In a similar manner, a carrier transmitting circuit TLW and a carrier receiving circuit RLW are associated through the transformer 10 with the main line section MLW, and a balancing circuit MNW is provided to balance said main line section. Each transmitting circuit, TLE and TLW, will in practice have associated therewith a plurality of carrier transmitting channels. But one channel is illustrated as being associated with each circuit. The channel associated with the transmitting circuit TLE comprises a generator GE and a transmitting amplifier TAE. These elements may be of any well known construction, but are preferably of vacuum tube construction as illustrated in Fig. 2. As shown in this figure, the vacuum tube amplifier TAE includes a tuned circuit 12, for rendering the channel selective to the carrier frequency assigned thereto, it being understood that each channel will operate upon a different carrier frequency. The oscillator GE, by means of its feed-back coupling, generates oscillations of the desired frequency, such oscillations being transmitted to the input circuit of the amplifier TAE. The short-circuit connection 11′ may be closed to the grid circuit of the amplifier TAE, and when this short-circuit connection is closed, the oscillations from the generator GE are diverted through the short-circuit and are not transmitted through the amplifier TAE. By opening and closing the short-circuit connection 11′, the carrier frequency transmitted to the circuit TLE may be interrupted. A similar channel comprising an amplifier TAW and an oscillator GW is shown as being associated with the transmitting circuit TLW. These elements will be identical in construction with the elements GE and TAE.

A plurality of receiving channels will in practice be associated with each of the circuits RLE and RLW. For the purposes of illustration, but one channel is shown associated with the circuit RLE comprising an amplifier RAE, a detector DE and a polar receiving relay RE. The amplifier RAE and detector DE may be of any well known character, but are preferably of the vacuum tube type illustrated in Fig. 3. The amplifier RAE is provided with a tuned circuit 13 in its input circuit in order to render the channel selective to the frequency assigned thereto. Since the detector DE is a direct current device, so far as its output circuit is concerned, and it is desired to

operate the receiving relay RE as a polar relay, a transformer 14 is interposed between the output circuit of the detector DE and the polar relay RE so that said relay will be operated by the alternating current component of the detected signal. A similar channel is shown associated with the circuit RLW, said channel comprising a receiving amplifier RAW, a detector DW and a polar receiving relay RW, similar in construction to that shown in Fig. 3. In order that signals received by the receiving relay RE may be repeated to the transmitting channel including the oscillator GW, a loop L is provided, said loop being placed at one end by means of a balancing circuit N and having associated therewith a polar transmiting relay PW, one winding of which is included in the loop circuit and the other winding in the balancing circuit N. Battery of one polarity is connected to the junction point 15 of the upper windings of the polar relay PW and the other end of the loop is normally connected to battery of opposite sign over the normal contact of the receiving relay RE. The alternate contact of said receiving relay leads to battery of the same sign as that connected to the junction point 15. The loop will include sounders or transmitting keys (not shown) for receiving and transmitting signals.

A similar loop L′ is provided for associating the receiving relay RW with the transmitting channel including the oscillator GE, the loop L′ is balanced at one end by means of a network N′ and has associated with it a transmitting polar relay PE, one winding of which is included in the loop, and the other winding of which is included in the balancing circuit N. Battery of one sign is connected to the junction point 15′ of the loop and balancing circuit, and the other end of the loop is connected over the normal contact of the receiving relay RW to battery of the opposite sign. Battery of the same sign is connected to the alternate contact of the receiving relay RW as is connected to the junction point 15′. The polar transmitting relays PE and PW control the short-circuit connections 11′ and 11 as well as the circuits of the sounders SE and SW.

Further details of the apparatus will be clear from a description of the operation, which is as follows:

Normally, when signals are not being transmitted, the carrier frequency is transmitted in both directions over each of the line sections. If signals are transmitted from a distant station associated with the line section MLE, the carried frequency incoming from the line section MLE and passing through the amplifier RAE to the detector DE, is interrupted. Each time an interruption occurs, the armature of the polar receiving relay RE is shifted to its alternate contact, thereby connecting positive battery to the loop L so that both ends of the loop L are connected to positive battery and no current flows in the loop. The sounders in the loop, therefore, respond to the interruptions of the carrier frequency. The current flow through the upper winding of the polar relay PW (which is normally twice as great as that through the lower winding) ceases to flow when both ends of the loop are connected to the same pole of the battery, and consequently, the lower winding of the polar relay PW becomes effective to shift its armature, thereby opening the circuit of the sounder SW and closing the short-circuit connection 11. The closing of the short-circuit connection 11, by short-circuiting the amplifier TAW, interrupts the transmission of the carrier frequency from the oscillator GW to the main line section MLW, and the signals received from the line section MLE are therefore repeated to the line section MLE. Signals originating in the loop L may be transmited to the line section MLW by opening and closing the loop by means of the sending key. The opening of the loop interrupts the current flow through the upper winding of the polar relay PW so that said relay becomes effective to transmit the signals as carrier frequencies in the manner already described.

Signals incoming from the main line section MLW as interruptions of the normal carrier frequency transmitted through the amplifier RAW to the detector DW, will be repeated through the lop L′ and the polar transmitting relay PE to the main line section MLE in a manner similar to that described for transmission in the opposite direction. Signals may also be transmitted to the line section MLE by interrupting the loop L′.

It will be obvious that the general principles herein disclosed may be embodied in many other organizations widely different from those illustrated without departing from the spirit of the invention as defined in the following claims.

What is claimed is:

1. In a signaling system, two transmission line sections over which carrier currents may be transmitted, a repeater apparatus for interconnecting said line sections, said repeater apparatus comprising carrier transmitting channels and carrier receiving channels associated with each line section, means associated with each receiving channel for translating carrier currents into telegraph signals, means associated with each carrier transmitting channel for translating low frequency telegraph signals into carrier currents, of the same frequency as those received, and separate low frequency circuits in-

terconnecting the receiving channel of each line section with the transmitting channel of the opposite line section.

2. In a signaling system, two transmission line sections over which carrier currents may be transmitted, a repeater apparatus for interconnecting said line sections said repeater apparatus comprising carrier transmitting channels and carrier receiving channels associated with each line section, means associated with each receiving channel for translating carrier currents into telegraph signals, means associated with each carrier transmitting channel for translating low frequency telegraph signals into carrier currents, of the same frequency as those received, and separate local telegraph loops for interconnecting the receiving channel of each line section with the transmitting channel of the opposite line section.

3. In a signaling system, two transmission line sections over which carrier currents may be transmitted, a repeater apparatus for interconnecting said line sections, said repeater apparatus comprising carrier transmitting channels and carrier receiving channels associated with each line section, means associated with each receiving channel for translating carrier currents into low frequency signals, said means including receiving relays, separate low frequency circuits for interconnecting the receiving channel of each line section with the transmitting channel of the opposite line section, balancing circuits for each low frequency circuit, a transmitting polar relay for each low frequency circuit having windings in the low frequency circuit and the corresponding balancing circuit, said relays controlling the transmission of carrier currents from the transmitting channels to the line sections. a source of current connected to the junction point of the windings of each polar relay, and oppositely poled sources connected to the opposite ends of the low frequency circuits over contacts of the receiving relays.

4. In a signaling system, a pair of transmission line sections over which carrier currents may be transmitted, a repeater apparatus for interconnecting said line sections, said repeater apparatus comprising carrier transmitting channels and carrier receiving channels associated with each line section, means associated with said carrier receiving channel for translating carrier currents into low frequency signals, said means including receiving relays, separate loop telegraph circuits for interconnecting the carrier receiving channel of each line section with the transmitting channel of the opposite line section, balancing circuits for each loop, polar transmitting relays for each loop having windings in the loop and corresponding balancing circuits, said polar relays controlling the transmission of carrier currents from the transmitting channels to the line sections, telegraph transmitting and receiving apparatus in each loop, sources of current connected to the junction points of the windings of said polar relays and oppositely poled sources connected to the other ends of each loop circuit over contacts of the receiving relays.

In testimony whereof, I have signed my name to this specification this 18th day of October 1920.

BAXTER P. HAMILTON.