

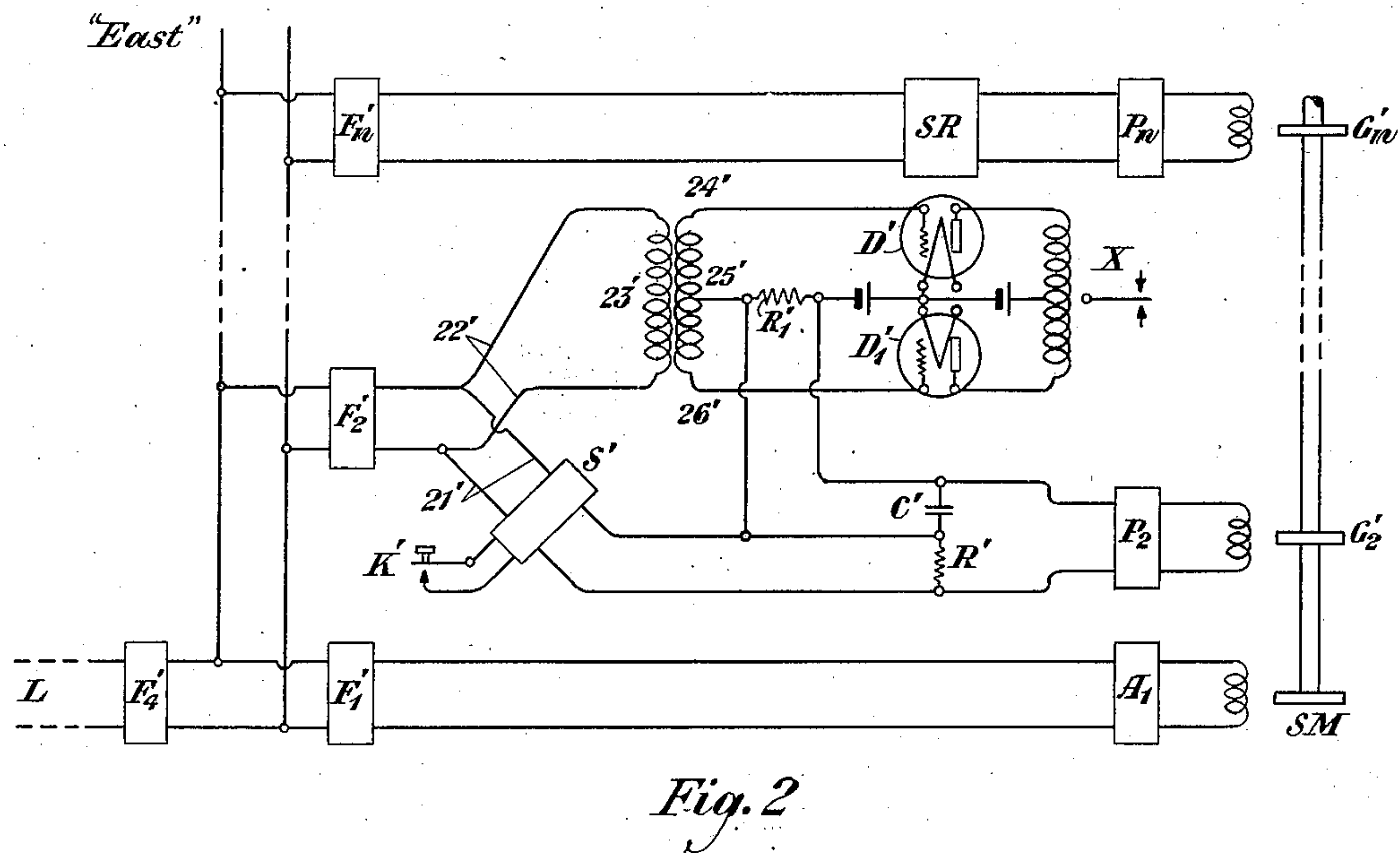
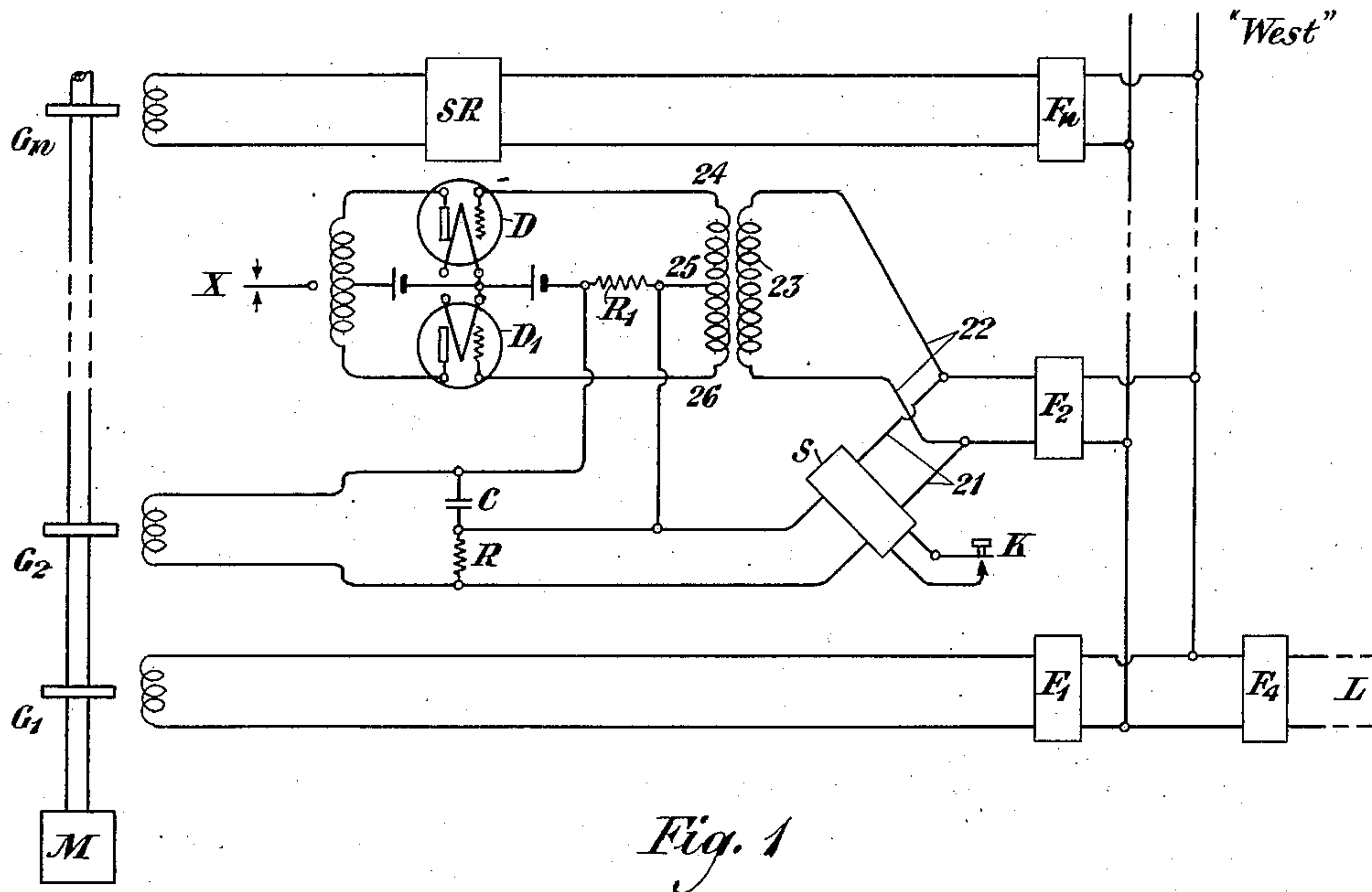
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H. A. AFFEL

MULTIPLEX TELEGRAPHY

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INVENTOR
H. A. Affel
BY *gr 408*
ATTORNEY

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HERMAN A. AFFEL, OF MAPLEWOOD, NEW JERSEY, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

MULTIPLEX TELEGRAPHY.

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An object of my invention is to provide a new and improved method of multiplex carrier current signaling. Another object of my invention is to provide a duplex carrier current telegraph system in which discrimination between the messages in the two directions is based on a difference of phase. Another object of my invention is to provide for receiving a carrier current message by the homodyne method and transmitting on the same frequency 90 degrees displaced from the received homodyne current, so that the transmitted message does not interfere with the received message. These and other objects of my invention will become apparent on consideration of an example which I have chosen for illustration in the accompanying drawings and which I now proceed to describe in the following specification.

The invention will be defined in the appended claims and it will be understood that the following description relates to the particular embodiment here presented by way of example.

In the drawings, Figure 1 is a diagram of the station at one end of a line operating according to my invention, and Fig. 2 is a diagram of the station at the other end of such line.

At the station "West" shown in Fig. 1, the constant speed motor M drives the alternating current generators G_1 , G_2 and G_n of respective different frequencies. These generators may be several armatures on the same shaft. The current from one of these generators G_2 goes to a phase splitter comprising the resistance R and the condenser C in series. Accordingly, from the terminals of the resistance R and from the terminals of the condenser C, two currents may be drawn off 90 degrees apart in phase. One of these currents is controlled by the sending key K which operates a reversing device S, changing the phase 180° ; from this the current goes through the conductors 21 to the band filter F_2 , and thence through another filter F_4 to the line L.

The generator G_1 generates what may be called a pilot frequency current that goes through the band filter F_1 and the filter F_4 to the line L.

At the receiving station "East" shown in Fig. 2, the current of pilot frequency from the generator G_1 goes through the filter F_4

and the band filter F_1' , is amplified by the amplifier A_1 and drives the synchronous motor SM. This motor SM drives the generators G_2' and G_n' at frequencies the same as for G_2 and G_n , respectively.

The current from the generator G_2' goes through the adjustable phase shifter P_2 and thence through a phase splitter comprising the resistance R' and condenser C' the same as the phase splitter that has been described at the station "West". The current component tapped from the terminals of the resistance R' is controlled by the key K' as described above for the key K and is put through the band filter F_2' and the filter F_4' to the line L.

This signal current determined by the key K' at station "East" passes over the line L and through the filters F_4 and F_2 and the branch conductors 22 to the primary 23 of a transformer. The design of the system is such and adjustments are made at the phase shifter P_2 and the filters F_2 and F_2' which also act as phase shifters so that the received current in the transformer secondaries 24, 25 and 25, 26 are 90 degrees out of phase with the transmitted current controlled by the key K.

The current tapped from the terminals of the condenser C to the resistance R_1 is also 90 degrees out of phase with the current controlled by the key K. The demodulators D and D' operate on the principle employing homodyne current, which is obtained in this case from the terminals of the condenser C. For effective demodulation the local homodyne current must be in phase with the received current and that condition is satisfied in the present instance, both the received current and the homodyne current being 90 degrees displaced from the transmitted current controlled by the key K. Moreover, the transmitted current controlled by the key K passing over the conductors 21 divides, part of it going to the filter F_2 and the line, and part going over the conductors 22 to the transformer primary 23. But this current in the transformer primary 23, being 90 degrees out of phase with the current from the terminals of the condenser C, is ineffective in the demodulator. The effect in a demodulator depends on the product of the two currents and this product is of most substantial and

effective value when the two currents are in phase and is ineffective when they are 90 degrees apart in phase.

Accordingly, the received currents at station "West" determined by the operation of the key K' at station "East", are not interfered with by the transmitted currents at station "West" which differ 90 degrees and are controlled by the key K.

The output circuit of the demodulator D, D₁ includes the winding of the receiving polar relay X by means of which the received message may be interpreted in dots and dashes in the usual manner.

It will be noted that the diagram shows a balanced demodulator where the locally applied homodyne current supplies the same polarity to both grids. The current received from the distant end supplies positive potential to one grid at the instant that it supplies negative potential to the other grid. Consequently, it is evident that when current is being received from the distant end, the effective magnetic flux in one winding will be increased, causing the polar relay armature to be moved to one side. When the transmitted current is reversed in phase, the relay flux is reversed, causing the armature to go to the opposite contact. It is evident, then, that reversing the phase of the transmitted current gives the effect of marking and spacing signals.

If the key K is used to open the circuit between R and F₂ instead of to reverse the phase, the signaling is accomplished by breaking the current, in which case a single tube demodulator can be used instead of the balanced arrangement shown.

Also, if the locally supplied homodyne current of the proper value is supplied to another winding of the input transformer, it will either double or neutralize the received current, making it possible to use a simple rectifier as a detector.

The box SR indicates sending and receiving apparatus similar to that which has been described in detail lying between the

generator G₂ and the filter F₂. It will be seen that a plurality of duplex carrier current generators are provided, each based on a respective carrier current frequency.

At the station "East" shown in Fig. 2, the remaining apparatus not heretofore described in detail is the same as that at station "West".

I claim:

1. The method of multiplex signaling, which consists in transmitting one way on a carrier current of a certain frequency, and transmitting the opposite way on a carrier current of the same frequency 90 degrees different in phase.

2. The method of multiplex signaling, which consists in transmitting one way on a carrier current of a certain frequency, and transmitting the opposite way on a carrier current of the same frequency, so as to receive at a phase difference of 90 degrees, and receiving by the homodyne method with locally generated current differing 90 degrees from the transmitting current, whereby the transmitting current is ineffective on the receiver because of the phase difference of 90 degrees.

3. A transmission line, means to transmit from each end on the same carrier current frequency, so that the received currents will be 90 degrees different in phase from the transmitted currents at the same end, and means to distinguish the received currents and the transmitted currents by the phase difference.

4. Means to generate currents of the same frequency 90 degrees apart, means to modulate one component for transmitting, means to receive a message in phase with the other component, and means to apply said other component, to demodulate the received current.

In testimony whereof, I have signed my name to this specification this 12th day of December 1924.

HERMAN A. AFFEL.