Oct. 28, 1924. 1,513,450

L. ESPENSCHIED

HALF DUPLEX MORSE CARRIER SYSTEM

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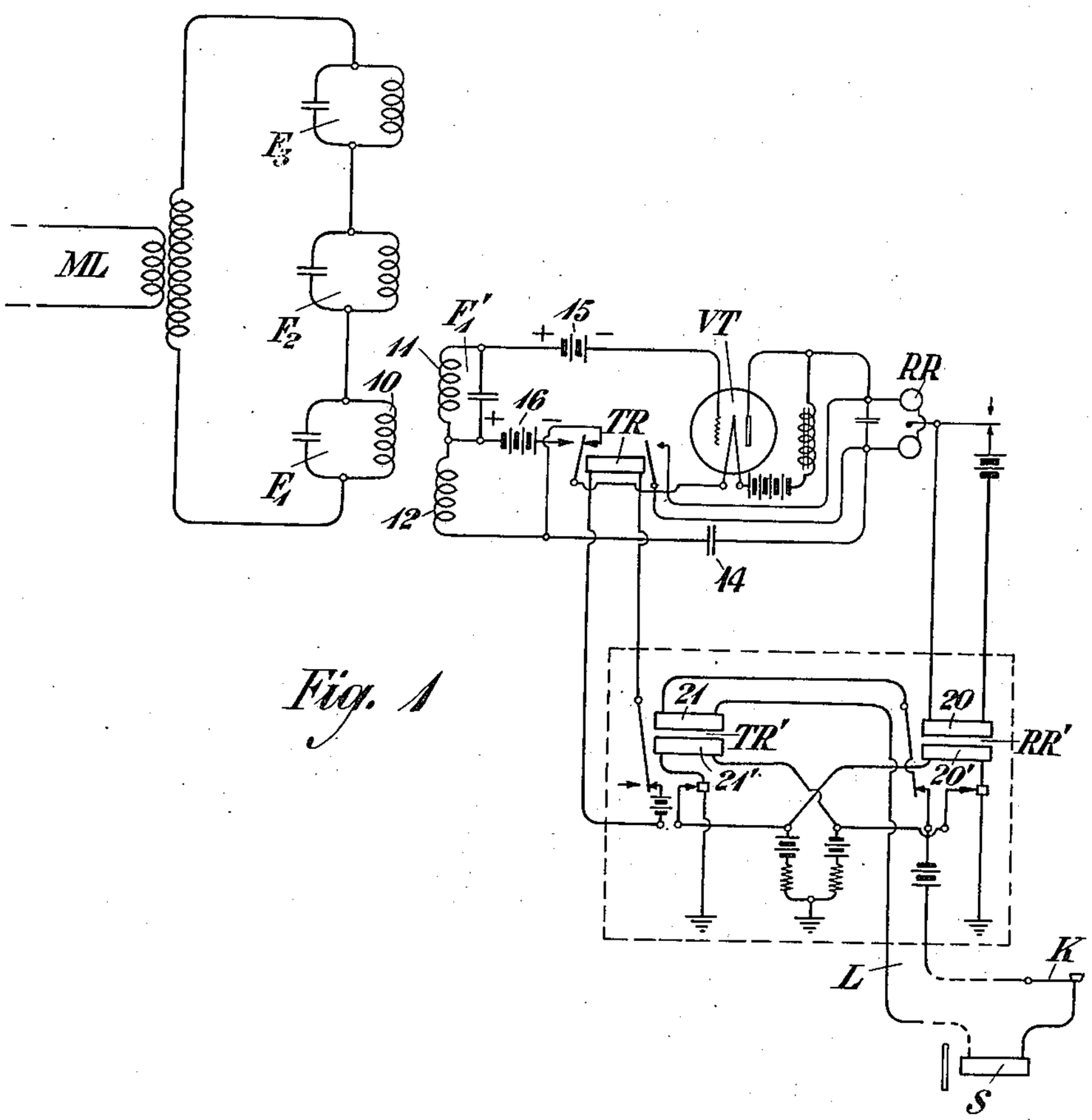

Fig. 1

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By his Attorney

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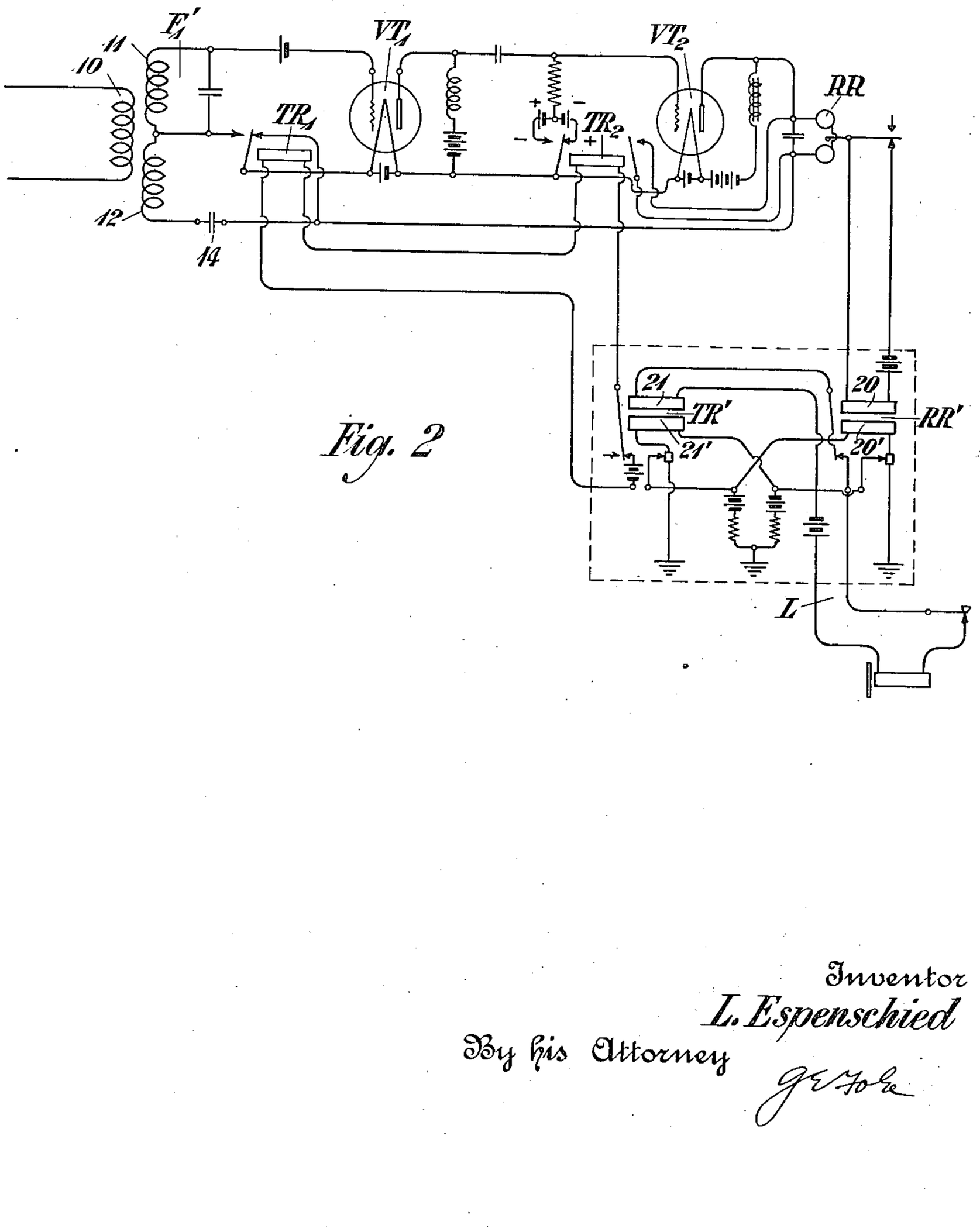

Fig. 2

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UNITED STATES PATENT OFFICE.

LLOYD ESPENSCHIED, OF QUEENS, NEW YORK, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

HALF-DUPLEX MORSE CARRIER SYSTEM.

Application filed August 11, 1921. Serial No. 491,509.

To all whom it may concern:

Be it known that I, LLOYD ESPENSCHIED, residing at Queens, in the county of Queens and State of New York, have invented certain Improvements in Half-Duplex Morse Carrier Systems, of which the following is a specification.

This invention relates to signaling systems, and more particularly to multiplex signaling systems employing carrier currents for transmission purposes.

One of the purposes of this invention is to produce a simple terminal apparatus for half-duplex Morse operation over carrier channels. A salient feature of the terminal arrangement is that the same vacuum tube is employed both as a receiving detector and as an oscillation tube for sending signals. Switching arrangements are provided for determining whether the tube shall function in the one capacity or the other, and these switching arrangements are under the control of an ordinary Morse repeater set, so that the functioning of the tube may be controlled from the subscriber's loop and signals may be repeated to the subscriber's loop.

Other and further features of the invention will be clear from the following description, when read in connection with the accompanying drawing, Figure 1 of which illustrates the invention as applied to a single tube which functions both as a detector and as an oscillator, while Fig. 2 illustrates the invention as applied to two tubes, one of which functions as an amplifier and the other as a detector when receiving, while both tubes function to generate oscillations when transmitting.

Referring to Fig. 1, ML designates a main transmission line terminating in selective circuits F_1, F_2, F_3, etc., the selective circuit arrangements being adapted to associate the main line with terminal carrier channels. The carrier apparatus associated with but one of the selective devices is illustrated, but it will be understood that similar apparatus will be provided for each channel. The apparatus associated with the selective device F_1 includes a vacuum tube VT of the usual three-element type. A tuned circuit or other selective device F_1' is included in the grid circuit of the vacuum tube. This tuned circuit is coupled with the tuned circuit or selective device F_1 and renders the vacuum tube selective of the received carrier frequency when receiving, and serves to determine the frequency of the vacuum tube when functioning as an oscillator, as will be described later. The output circuit of the vacuum tube VT includes a polar receiving relay RR for controlling the circuit of the operating magnet of a loop controlling relay RR'. The polar relay RR operates upon the attenuating current component of the received signal and its armature is unbiased so that it will rest upon either contact when no signal impulses are received.

The tuned circuits F_1 and F_1' are coupled together through windings 10 and 11 of a transformer, and a third winding 12, arranged in inductive relation ~~to the~~ windings 10 and 11, is connected in the plate filament circuit. The plate circuit may, if desired, include a blocking condenser 14 to prevent the direct current from the plate battery from flowing through the relay RR or into the feed-back connection. A transmitting relay TR is provided, this relay being controlled by the transmitting relay TR' of the loop repeater, as will be described later. The transmitting relay TR is normally energized and in this condition establishes a connection from the filament through windings 12 and 11 in series to the grid of the vacuum tube VT. The grid circuit includes the usual grid battery 15, which applies such a potential to the grid circuit as to enable it to function as a detector. When the transmitting relay TR is deenergized in response to signals from the loop, it establishes a connection from the filament to the junction point between the windings 11 and 12 through an auxiliary battery 16. The winding 11 is now included in the grid circuit and the winding 12 in the plate circuit, so that a feed-back connection is established. Battery 16 is also connected in series with the battery 15, so that the potential now applied to the grid is such that the tube functions most efficiently as an oscillator. The extra contact upon the relay TR short circuits the receiving relay RR to prevent it from chattering in response to the oscillations generated.

The loop L includes a transmitting key K, a sounder controlling relay S, and the winding of the magnet 21 of the loop transmitting relay TR'. The relays TR' and RR' are each provided with auxiliary magnets

21′ and 20′, respectively, these auxiliary magnets functioning as holding magnets to prevent false operation of the relays, as will be described later. The windings of the holding magnets are normally short-circuited when the operating windings of the relays are energized, the magnet 21′ being short-circuited by a contact of the relay RR′, and the magnet 20′ being short-circuited by a contact of the relay TR′. The relay RR′ controls the circuit of the loop L through its armature, and the relay TR′ controls the circuit of the transmitting relay TR through its armature.

Under normal conditions, when the key K is not operated to transmit signals, the circuit of the loop L is closed and the winding 21 of the relay TR′ is energized. The winding 20 of the loop controlling relay RR′ is also energized when signals are not being received, and under these conditions the winding of magnet 21′ is short-circuited by the contact of relay RR′ and the winding of magnet 20′ is short-circuited by the contact of relay TR′. Relay TR′ holds the transmitting relay TR energized and the windings 11 and 12 of the vacuum tube circuit are serially included in the grid circuit, so that the vacuum tube is in condition to function as a detector. The short circuit about the winding of relay RR is also held open by relay TR. If signals are received with the circuits in this condition, the polar receiving relay RR is operated in response to the alternating component of the detected signals to open the circuit of the winding 20 of the loop controlling relay RR′. As the winding 20′ of this relay is short-circuited, the armature of the relay falls off and opens the loop circuit to operate the loop sounder. As the armature of the relay RR′ falls off, it opens the circuit of the magnet 21 of the loop transmitting relay TR′, but at the same time the short-circuit about the winding of the holding magnet 21′ of the relay TR′ is removed, so that the holding magnet prevents the armature of the relay TR′ from being retracted to repeat the received signal back to the main line ML.

If it is desired to transmit signals, the key K is operated to open the loop, thereby deenergizing the winding of the magnet 21 of the loop transmitting relay TR′. As the winding of magnet 21′ is short-circuited, the armature of the relay TR′ is caused to fall off and deenergize the transmitting relay TR. The short-circuit about the winding of the holding magnet 21 of the loop controlling relay RR′ is removed at the same time, so that the relay RR′ is locked up to prevent the opening of the loop independently of the key K, in case the receiving relay RR should happen to respond to the transmitted signals. The receiving relay RR is however prevented from operating by the shunt circuit closed by relay TR. The transmitting relay TR when deenergized connects the filament to the junction point of the windings 11 and 12, so that the circuit of the vacuum tube VT is changed from a detecting circuit to an oscillating circuit. The tube then generates oscillations at a frequency determined by its tuned circuit F_1' and these oscillations are transmitted to the main line ML so long as the key K is held open. In this manner groups of oscillations representing dots and dashes may be transmitted to the main line.

A modified form is illustrated in Fig. 2, in which two tubes are provided, one normally functioning as an amplifier and the other as a detector, and the circuits being so arranged that when signals are to be transmitted, the two tubes will function in tandem as a generator of oscillations. In the diagram of Fig. 2, VT_1 designates the tube which normally functions as an amplifier and VT_2 designates a tube which normally functions as a detector. The plate circuit of the tube VT_2 has associated therewith a polar receiving relay RR similar to that described in connection with Fig. 1 for actuating the loop controlling relay RR′ of the mechanical repeating arrangement in the same manner as in Fig. 1. Two transmitting relays TR_1 and TR_2 are provided, these transmitting relays being controlled by the relay TR′ in the loop circuit to transmit signals. Normally the relays TR_1 and TR_2 are energized, the former maintaining a connection from the filaments of the two tubes through the condenser 14 and the windings 12 and 11 in series to the grid of the tube VT_1. A connection is at the same time maintained from the filaments of the two tubes through the winding of the polar relay RR. to the plate of the tube VT_2. The relay TR_2 maintains a connection from the grid of the tube VT_2 to the filament through a polarizing battery of such potential and polarity as to apply a potential to the grid of the tube VT_2 which will render it most efficient as a detector. With the circuit arrangement in this condition, high frequency oscillations will be amplified by the tube VT_1 and detected by the tube VT_2 whereby the attenuating component of the detected signal actuates the polar receiving relay RR which will repeat the signals through the relay RR′ of the repeater to the loop L in a manner similar to that described in connection with Fig. 1.

Relays TR_1 and TR_2 are so arranged that when they are deenergized the former breaks the connection from the filaments of the two tubes to the grid of the tube VT_1 and to the plate of the tube VT_2 previously described, and connects the two filaments to the junction point of the windings 11 and 12. A feed-back connection is now established from

the plate of the tube VT_2 through the condenser shunting the receiving relay RR, through the condenser 14 and the winding 12 and over the contact of the relay TR_1 to the filaments of the tubes VT_1 and VT_2. The energy from the plate circuit of the tube VT_2 will, therefore, be transmitted back through the winding 12 and through the inductive connection between the windings 11 and 12 will be impressed upon the grid circuit of the tube VT_1. This energy will be amplified by the tube VT_1 and then impressed upon the grid circuit of the tube VT_2 to be again amplified and impressed upon the feed-back circuit, so that the combination of tubes functions as a generator of oscillations. The relay TR_2 when deenergized short circuits relay RR and shifts the connection between the filament and grid of the tube VT_2 so as to change the polarizing battery connection in such a manner as to apply a potential to said tube of such polarity and value as to render the tube most efficient as an amplifier or oscillator, thereby assisting in rendering the system an efficient generator of oscillations. Signals may be transmitted by opening the loop circuit in the manner described in connection with Fig. 1, thereby causing the relays TR_1 and TR_2 to be deenergized for each dot and dash. The relays TR_1 and TR_2 function as previously described and shift the circuit connections so that oscillations are generated during each dot and dash.

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, a transmission circuit and carrier apparatus associated therewith, said carrier apparatus including a translating device which under certain conditions functions as a detector and under other conditions functions as a generator of oscillations, a subscriber's loop and mechanical repeating apparatus associated therewith, said mechanical repeating apparatus operating when said translating device functions as a detector to repeat the detected signals to the loop, and operating when signals originate in the loop to cause said translating device to function as a generator of oscillations.

2. In a signaling system, a transmission circuit and carrier apparatus associated therewith, said carrier apparatus including a vacuum tube which under certain conditions functions as a detector and under other conditions functions as a generator of oscillations, a subscriber's loop and mechanical repeating apparatus associated therewith, said mechanical repeating apparatus operating when said vacuum tube functions as a detector to repeat the detected signals to the loop and operating when signals originate in the loop to cause said vacuum tube to function as a generator of oscillations.

3. In a signaling system, a transmission circuit and carrier apparatus associated therewith, said carrier apparatus including a translating device which under certain conditions functions as a detector and under other conditions functions as a generator of oscillations, a subscriber's loop and mechanical repeating apparatus associated with said subscriber's loop and including a relay arrangement for repeating signals originating in the loop and another relay arrangement for repeating to the loop signals detected by said translating device when functioning as a detector, said first relay operating in response to signals originating in the loop to cause said translating device to generate oscillations.

4. In a signaling system, a transmission circuit and carrier apparatus associated therewith, said carrier apparatus including a vacuum tube which under certain conditions functions as a detector and under other conditions functions as a generator of oscillations, a subscriber's loop and mechanical repeating apparatus associated with said subscriber's loop and including a relay arrangement for repeating signals originating in the loop and another relay arrangement for repeating to the loop signals detected by said vacuum tube when functioning as a detector, said first relay operating in response to signals originating in the loop to cause said vacuum tube to generate oscillations.

5. In a signaling system, a transmission circuit and carrier apparatus associated therewith, said carrier apparatus including a translating device which under certain conditions functions as a detector and under other conditions functions as a generator of oscillations, a subscriber's loop, mechanical repeating apparatus associated with said subscriber's loop and including a relay arrangement for repeating signals originating in the loop and another relay arrangement for repeating to the loop signals detected by said translating device when functioning as a detector, said first relay operating in response to signals originating in the loop to cause said translating device to generate oscillations, and means associated with said relays to prevent received signals from operating said first mentioned relay and to prevent transmitted signals from operating said second relay.

6. In a signaling system, a transmission circuit and carrier apparatus associated therewith, said carrier apparatus including a vacuum tube which under certain conditions functions as a detector and under other con-

ditions functions as a generator of oscillations, a subscriber's loop, mechanical repeating apparatus associated with said subscriber's loop and including a relay arrangement for repeating signals originating in the loop and another relay arrangement for repeating to the loop signals detected by said vacuum tube when functioning as a detector, said first relay operating in response to signals originating in the loop to cause said vacuum tube to generate oscillations, and means associated with said relays to prevent received signals from operating said first mentioned relay and to prevent transmitted signals from operating said second relay.

7. In a signaling system, a transmission circuit and carrier apparatus associated therewith said carrier apparatus including a vacuum tube, means associated with said tube for producing a normal, steady difference of potential between the grid and filament of said tube independent of signaling currents applied thereto whereby the tube normally functions as a detector, and switching means to change the normal difference in potential between the grid and filament of the tube so that the tube may function efficiently as an oscillator.

8. In a signaling system, a transmission circuit and carrier apparatus associated therewith said carrier apparatus including a vacuum tube, means associated with said tube for producing a normal, steady difference in potential between the grid and plate of the tube independent of any signaling currents applied thereto whereby the tube normally functions as a detector, and switching means for establishing a feed-back connection between the grid and plate of said tube and for changing the normal, steady potential difference between the grid and filament of the tube so that the tube will function as a generator of oscillations.

9. In a signaling system, a transmission circuit and carrier apparatus associated therewith, said carrier apparatus including a vacuum tube which normally functions as a detector, and switching means for normally establishing a connection from the filament of said vacuum tube through two windings of a transformer to the grid, said switching means being so organized that under certain conditions the filament will be connected to the junction point of the two windings so as to establish an oscillating feed-back connection between the grid and plate.

10. In a signaling system, a transmission circuit and carrier apparatus associated therewith, said carrier apparatus including a vacuum tube which normally functions as a detector, and switching means for normally establishing a connection from the filament of said vacuum tube through two windings of a transformer to the grid, said switching arrangement being so organized that under certain conditions the filament will be connected to the junction point of the two windings so as to establish an oscillating feed-back connection between the grid and plate, and said switching arrangement simultaneously operating to change the potential applied to the grid so as to render the tube most efficient as a generator of oscillations.

11. In a signaling system, a transmission circuit and carrier apparatus associated therewith, said carrier apparatus including a vacuum tube normally functioning as an amplifier and another vacuum tube normally functioning as a detector, and a switching device normally establishing a connection between the filaments of said tube and through two windings in series to the grid of the first tube, a connection being simultaneously established from the filaments of the tubes to the plate of the second tube, said switching apparatus being so organized that under certain conditions a connection may be established from the filaments to the junction point of the two windings, so that a feed-back connection is established between the plate of the second tube to the grid of the first tube, said switching arrangement also simultaneously operating to change the potential applied to the grid of the second tube to render said tube most efficient as an oscillator.

In testimony whereof, I have signed my name to this specification this 9th day of August, 1921.

LLOYD ESPENSCHIED.