

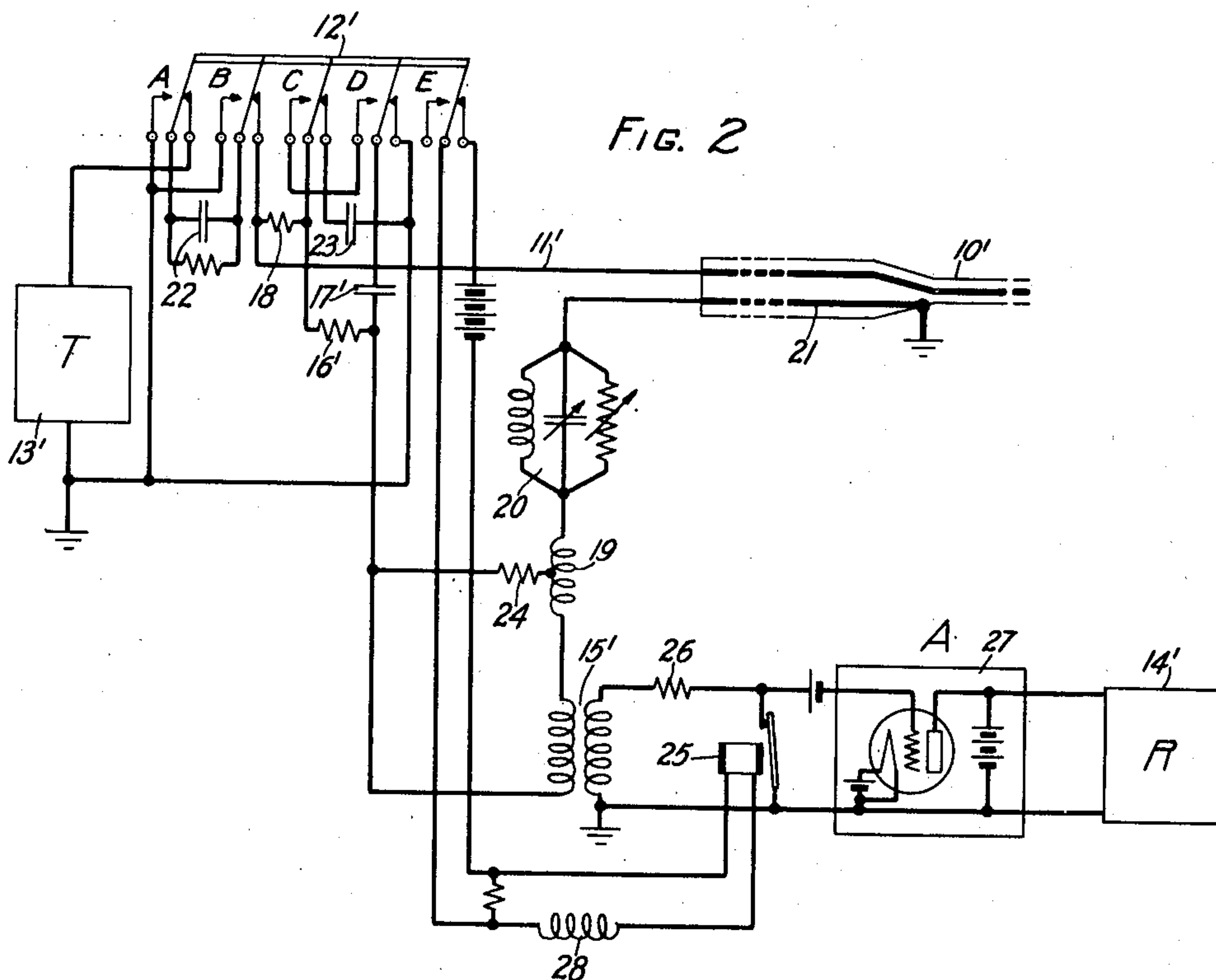
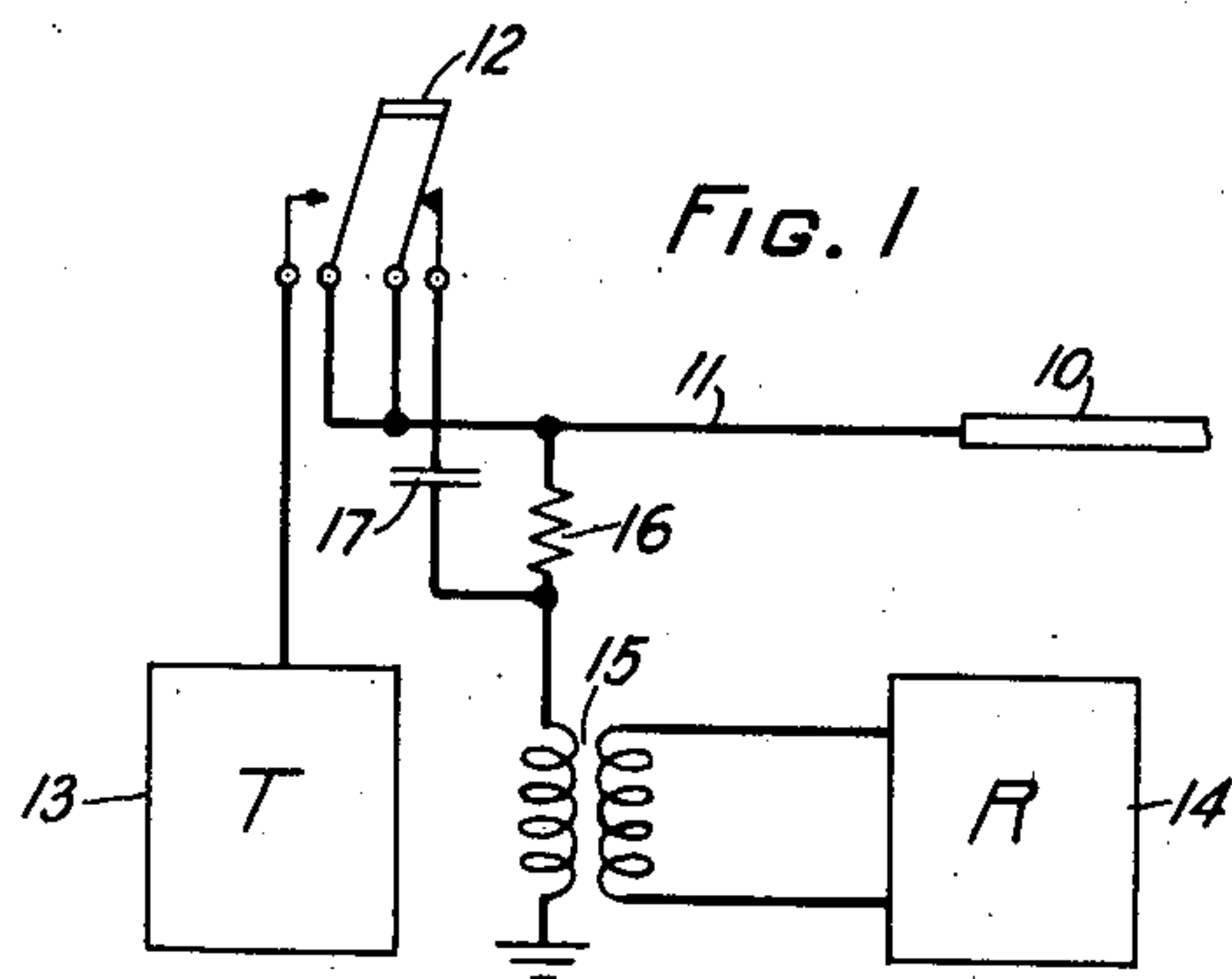
July 2, 1929.

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1,719,477

TELEGRAPH SYSTEM

Filed April 26, 1928



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TELEGRAPH SYSTEM.

Application filed April 26, 1928. Serial No. 272,879.

This invention relates to signaling systems, and more particularly to terminal apparatus of a submarine system adapted for changing at desired times the direction of transmission over a cable over which messages are transmitted in one direction at a time.

The object of the invention is to increase the speed of switching between sending and receiving intervals.

In submarine cable telegraph systems provided with direction control switching mechanisms, such as disclosed and claimed in Patent No. 1,601,941, issued to A. A. Clokey on October 5, 1926, the transmitting and the receiving apparatus are alternately connected to the cable for intervals of predetermined duration. Systems of such character are those which are arranged for simplex operation and the intervals for transmitting may be longer or shorter than those for receiving according to the direction of the heavier traffic. A minimum loss of cable time at the periods of reversal is desirable and a feature in which the systems now employed may be improved is a reduction in the length of time required after each transmitting interval for permitting the earth currents that are practically always present in the cable, to reach normal value. This length of time is required because of the high inductance of the input transformer connected in the receiving amplifier whereby the earth currents are caused to take a long time to build up before they reach a steady value in the transformer primary winding subsequent to a transmitting interval. Connecting the amplifier to the input transformer before the steady value is reached might result in a direct current bias which would cause a distortion in the incoming signals and therefore sufficient time has to be allowed before each receiving interval to permit the earth currents to reach a steady value in the transformer primary winding.

According to the present invention the input transformer is maintained continuously in connection with the cable through the low frequency elements of the input network, thereby providing a path between the cable and the sea-earth return for allowing the earth potentials on the cable to become balanced, i. e. the earth currents reach a steady value during the time that the cable is connected for sending. In order to prevent the outgoing signaling currents from entering

the input transformer, the high frequency elements of the input network are disconnected from the cable during the transmitting intervals. By this method practically no time is required during the switching interval, or at the beginning of the receiving interval, for discharging earth potentials or bringing the earth currents to a steady value through the transformer winding and therefore the input transformer is free to inductively transmit without bias the incoming signals immediately following a transmitting interval.

The invention is described in detail in the following description in which reference is made to the accompanying drawing. Fig. 1 represents the invention in its simplest form, and Fig. 2 illustrates a more complex embodiment of it applied to a particular terminal apparatus arrangement.

Referring to Fig. 1, only those parts of the terminal apparatus are shown which are necessary for explaining the idea involved in the invention, all elements required for refining or shaping the signal being omitted. Cable 10 is shown terminating in conductor 11 which is connected to switching apparatus 12. The switching apparatus may be manually or automatically operated, as desired, to alternately connect cable 10 to the transmitting apparatus 13 and receiving apparatus 14 for intervals of equal or unequal duration in accordance with the requirements of traffic. The receiving apparatus is connected to cable 10 through input transformer 15, the connection being established over two parallel paths, one being through resistance 16 which is maintained closed continuously and the other extending through condenser 17 which is controlled by switching apparatus 12 and is closed only during the receiving intervals. The resistance 16 which is the low frequency element of the input network allows the earth potentials on the cable to attain a steady value in the transformer primary winding during both the transmitting and receiving intervals and therefore no delay is required for this operation during the switch-over period. The condenser 17 which is a high frequency element of the input network provides a path for the incoming signals, and with the earth current at a steady value in the transformer primary winding when the signals arrive, the signals are repeated to the re-

ceiving apparatus 14 without any direct current bias. In order to protect the transformer from the local transmitted signals, condenser 17 is disconnected from the cable during the transmitting intervals.

Fig. 2 shows how the invention can be applied to a submarine cable telegraph system wherein cable 10' terminates in conductor 11' which is connected to switching apparatus 12'. The switching apparatus alternately connects cable 10' to the transmitting apparatus 13' and receiving apparatus 14' and is arranged to automatically operate in a manner such as is disclosed in Clokey Patent No. 1,601,941, supra. The primary winding of an input transformer 15' is maintained in continuous connection with the cable 10' in a circuit extending from cable 10', conductor 11', resistance 18, resistance 16', primary winding of transformer 15' magnetic shunt 19, anti-resonant circuit 20 and sea-earth return 21 and thereby the direct or very low frequency currents caused by the earth potentials on cable 10' are allowed to flow through the transformer primary winding continuously. A high frequency element 17', referred to herein as the receiving condenser, is connected to the cable only during the receiving interval and provides a path to the input transformer for the incoming signaling currents.

When the terminal apparatus is connected for transmitting signals to cable 10' switching apparatus 12' is in the position shown and a circuit is closed from transmitting apparatus 13', right hand contact of switch A, sending condenser 22, right hand contact of switch B, conductor 11', to cable 10'. The high frequency components of the transmitted currents are prevented from reaching the input transformer 15' by the disconnection of the receiving condenser 17' from the cable and connection in its stead of condenser 23 which provides a shunt path to earth for the small part of the transmitted current which flows from conductor 11', through resistance 18 and over the right hand contacts of switch C. The low frequency components, which are allowed to flow through resistance 18, continue through resistance 16', thence over magnetic shunt resistance 24 and the transformer primary winding in parallel, magnetic shunt inductance 19, anti-resonant circuit 20 and to the sea-earth return 21. During each transmitted impulse, the cable 10' acquires a charge which affects the steady value of the earth potentials at opposite ends of the cable, but by means of the continuously connected path between the transformer primary winding and the cable, this charge is allowed to discharge almost immediately. In order to prevent this discharge from affecting the receiving apparatus, a short circuit is provided across the transformer secondary winding.

This short circuit is maintained closed during the transmitting intervals by relay 25 which in turn is maintained operated by a circuit closed at the right hand contact of switch E. The local receiving apparatus is thereby prevented from responding to waves impressed on the primary of transformer 15' during transmission. The transformer secondary circuit includes resistance 26 which is sufficiently high to allow the earth currents to reach a steady value in the primary winding as quickly as possible. The resistance 26 is low in comparison to the high impedance of the vacuum tube amplifier 27 when the transformer is connected to the receiving apparatus 14'.

When the terminal apparatus is connected for receiving signals through cable 10', switching apparatus 12' is automatically moved to its opposite position thereby disconnecting the transmitting apparatus and connecting the receiving condenser 17' to the cable through the left hand contacts of switches C and D and resistance 18. The operating circuit for relay 25 is opened at switch E and the relay deenergizes thereby opening the short circuit across the transformer secondary circuit. The transformer is now prepared to repeat the incoming signals without any direct or very low frequency current bias because the earth currents in the cable have reached a steady value in the primary winding. At the end of a receiving interval when the switching apparatus 12' is operated to its transmitting position, the operating circuit for relay 25 is again closed but the relay does not operate immediately because of the retard coil 28 being included in the operating circuit. This delay is effected in order that the last impulse in the preceding receiving interval may reach the receiving apparatus.

In this manner a large accumulation of charge on the cable during transmitting intervals is avoided and the earth currents reach a practically steady value in the transformer primary winding during the transmitting period.

What is claimed is:

1. In signaling by means of a signaling system, comprising a line subject to disturbing earth potentials and having a transmitter and a receiver at a terminal, a mechanism for alternately causing said transmitter to transmit over the line and the receiver to receive over the line, the method of preventing potential differences due to earth currents from disturbing the receiving apparatus upon changing from transmission to reception, characterized in this, that the receiving apparatus is maintained in continuous connection with said line through a path conductive to earth currents during transmission.
2. In signaling by means of a signaling system, comprising a line subject to disturb-

ing earth potentials, and having a transmitter and a receiver at a terminal, mechanism for alternately causing said transmitter to transmit over the line and the receiver to receive over the line, the method of preventing potential differences due to earth current from disturbing the receiving apparatus upon changing from transmission to reception which consists in maintaining the receiving apparatus connected to the line through a path conductive to earth currents at all times.

3. A signaling system, comprising a line subject to disturbing earth potentials, a transmitter and a receiver at a terminal, mechanism for alternately causing said transmitter to transmit over the line and the receiver to receive over the line, and means arranged in continuous connection between said line and said receiver to allow disturbing earth potentials to reach steady values during transmission.

4. A signaling system comprising a line subject to disturbing earth potentials, a transmitter and a receiver at a terminal, automatic mechanism for alternately causing said transmitter to transmit over the line and the receiver to receive over the line, and an input network arranged in continuous connection between said line and said receiver to allow the disturbing earth potentials to reach steady values during transmission.

5. In a signaling system comprising a line, subject to disturbing earth potentials, a transmitter and a receiver at a terminal, automatic mechanism for alternately causing said transmitter to transmit over the line, and a receiver to receive over the line, and an input network comprising elements arranged in continuous connection between said line and said receiver and elements arranged to be connected between said line and said receiver only during the receiving intervals, said first mentioned elements allowing the disturbing earth potentials to reach a steady value at all times and said second mentioned elements being connected to the line only during receiving intervals to receive only incoming signals.

6. A signaling system comprising a line subject to disturbing earth potentials, a transmitter and a receiver at a terminal, automatic mechanism for alternately causing said transmitter to transmit over a line and a receiver to receive over a line, an input

network comprising resistance and capacity elements arranged to be connected between said line and said receiver, said resistance being effectively connected between said line and said receiver to allow the earth potentials to reach a steady value and said capacity elements being connected only during the receiving intervals to receive the incoming signals.

7. A signaling system comprising a line subject to disturbing earth potentials, a transmitter and a receiver at a terminal, automatic mechanism for alternately causing said transmitter to transmit over the line and a receiver to receive over the line, a transformer connected between said line and said receiver, means effective at all times for allowing the earth potentials to reach a steady value in the primary winding of said transformer, means effective only during receiving intervals for allowing the incoming signals to be repeated through said transformer, and means effective during transmitting intervals for preventing the discharge of excessive earth potentials from being repeated to said receiver.

8. A signaling system comprising a line subject to disturbing earth potentials, a transmitter and a receiver at a terminal, automatic mechanism for alternately causing said transmitter to transmit over the line and a receiver to receive over the line, a transformer having a primary circuit including said line and a secondary circuit including said receiver, an amplifier in said secondary circuit, an input network comprising a low frequency path effective at all times for allowing the earth current to reach a steady value in the primary winding of said transformer and a high frequency path effective only during receiving intervals for allowing the incoming signals to operate said amplifier and said receiver, means for shunting said amplifier during the transmitting intervals and a resistance in said secondary circuit high enough in impedance to allow current to vary in said primary circuit when said amplifier is shunted but low in comparison to the input impedance of said amplifier when said amplifier is not shunted.

In witness whereof, I hereunto subscribe my name this 23rd day of April, 1928.

WILLIAM A. KNOOP.