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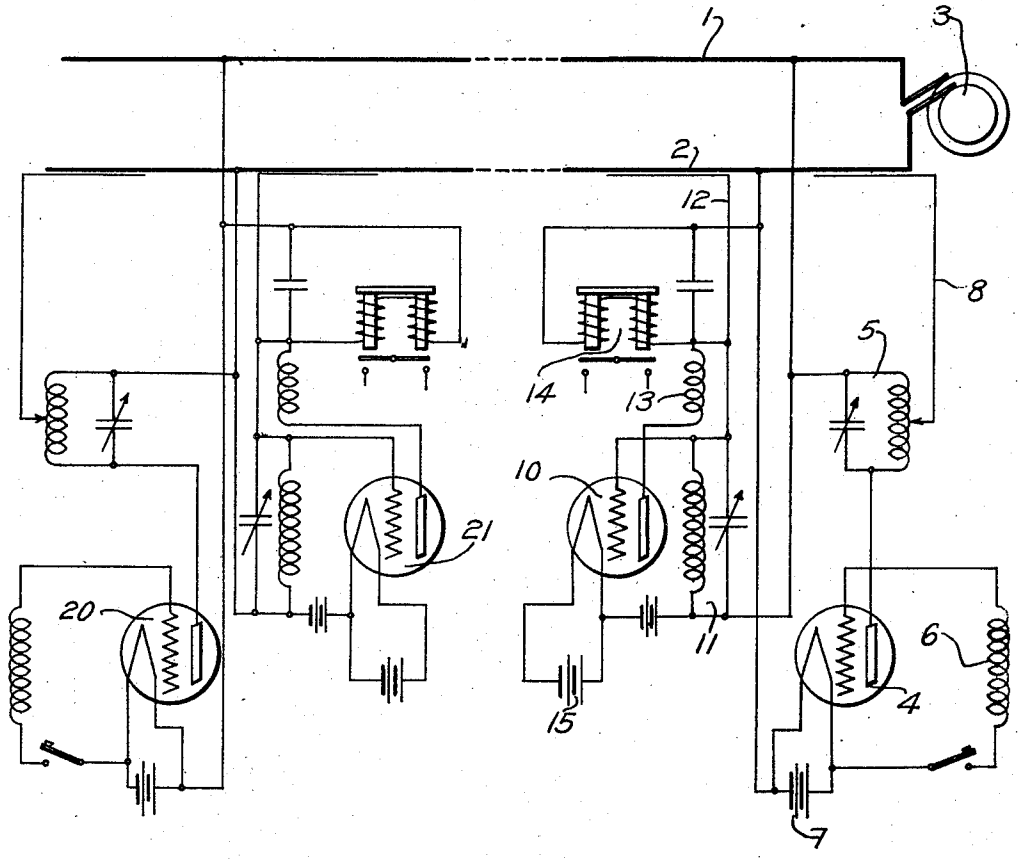
HIGH FREQUENCY SIGNALING SYSTEM

Filed March 31, 1926



WITNESSES:

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BY
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UNITED STATES PATENT OFFICE

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HIGH-FREQUENCY SIGNALING SYSTEM

Application filed March 31, 1926, Serial No. 98,759, and in Great Britain March 31, 1925.

This invention relates to signaling by means of high-frequency electric energy and it has for its object to make possible the simultaneous transmission and reception of two signals at the same frequency over the same channel.

According to this invention, a high-frequency transmitting and receiving system is supplied with energy from an alternating-current system and the transmitter is arranged to be operative upon one half-cycle and the receiver to be operative on the other half-cycle. In a complete system comprising two transmitting and receiving systems, the alternating-current supply sources are synchronized or may be common and one transmitter and its associated receiver remote from it are arranged to be in operation during one half-cycle and the other transmitter and receiver are arranged to be operative during the other half-cycle.

The preferred method of rendering the transmitters and receivers operative or inoperative as hereinbefore set forth consists in the employment of thermionic valves in the transmitters and receivers having the anodes thereof supplied with energy from an alternating-current system. A thermionic valve is only operative when the anode is positively electrified with respect to the cathode. Each transmitter or receiver is operative therefore only during the half cycles which make the anode positive.

It will be appreciated that since the receivers are only intermittently operative, the signal if received audibly upon an ordinary receiver for high-frequency signals, will be accompanied by a note or hum of frequency depending upon that of the alternating-current system which would interfere to some extent with the effective reception of the signal.

The accompanying drawing illustrates, by way of example, a complete signaling system in one of its simplest forms employing two signal transmitting and receiving apparatus which are energized from a common alternating-current supply circuit which also constitutes a carrier channel for the high-frequency signals.

Two conductors 1 and 2 are fed with alternating current from an alternating-current generator 3. The transmitter at one station consists of a thermionic valve 4 connected to a tuned circuit 5 to which is inductively coupled a reaction coil 6 which is connected in the grid circuit so as to cause oscillations to be maintained in the circuit 5 when the anode of the valve is positively electrified. The end of the tuned oscillatory circuit remote from the anode of the valve 4 is connected to the conductor 1 while the cathode of the valve is connected to the conductor 2. The cathode of the valve is supplied with energy for the purpose of heating it from a battery 7. The oscillatory circuit is electrostatically coupled to the line conductors 1 and 2 in any usual manner by means of a conductor 8.

The receiving apparatus comprises a thermionic valve 10 having a tuned grid circuit 11 which is coupled to the line conductors 1 and 2 in any usual manner through a conductor 12. The anode circuit of the valve 10 contains a reaction coil 13 and a polarized relay 14 which may be shunted by a condenser, as shown. The anode of the valve 10 is connected through the reaction coil 13 and polarized relay 14 to the conductor 2 while the cathode of the valve is connected to the conductor 1. The cathode of the valve 10 is arranged to be heated by energy from a battery 15.

The valve 10 with its associated circuits is so arranged that, upon the energization of grid circuit 11 by a signal, the valve is set into oscillation and remains in an oscillating state until such time as the potential of the anode in respect to the cathode falls sufficiently to quench the oscillations. When the valve 10 is in a state of oscillation, the anode current, which passes through the relay, is greatly increased to actuate the relay 14 which may be connected to operate any desired signalling or control apparatus in the usual manner.

It will be appreciated that the anode of the receiving valve 10 is only positively electrified with respect to the cathode to allow the receiver to be operative during such times as the anode of the transmitting valve 4 is

negatively electrified with respect to the cathode thus rendering the transmitter inoperative. Accordingly, the operation of the transmitter 4 exerts no influence upon the receiver 10.

Another precisely similar system comprising a transmitter 20 and a receiver 21 is disposed at a remote point along the conductors 1 and 2. The connections of the remote system however are such that the anode of the transmitting valve 20 is connected through its oscillatory circuit to the conductor 2 and the cathode to the conductor 1 so that the valve 20 is inoperative when the valve 4 is operative. Likewise, the anode of the receiving valve 21 is connected through a reaction coil and relay to the conductor 1 and the cathode is connected to the conductor 2 so that the valve 21 is operative during the times when the transmitting valve 4 is operative and inoperative when valve 10 is operative.

Although, in the system described, the transmitters are at opposite ends of the circuit, they may be both located at the same end or one of them at intermediate point, with the receivers at any point remote from the associated transmitters.

It will be appreciated that the direct connections as shown from the anodes and the cathodes of the valves to the conductors 1 and 2 would be impracticable upon high-voltage circuits. Transformers would be interposed ordinarily in these connections for the purpose of transforming the voltage to values suitable for supplying the anodes of the receiving and transmitting valves, respectively. The principles of operation remain unchanged. Moreover, the cathodes of the valves may readily be heated by alternating current obtained from the conductors 1 and 2 by means of transformers. In order to simplify the drawings and description and to make the operation clearer, such transformers have not been shown or described since they are well-known and form no part of the invention.

While one embodiment of the invention as applied to high-frequency signaling over conductors, and in which a common source of alternating electric potential is made use of for two apparatus has been described, it is obvious that the invention may be used for wireless communication of signals and that means, such as a synchronizing carrier wave, may be employed to hold two separate sources of alternating electric potential in synchronism with one another. The common or synchronized sources of electric potential may have any desired frequency. While in the circuits described an audible or a subaudible frequency is assumed, the invention is not limited to the use of such frequencies. Moreover the precise circuit arrangement described may be modified in many ways without departing from the scope of the invention.

I claim as my invention:

1. The combination with an alternating-current distribution circuit, of means for impressing a plurality of high-frequency signaling currents upon said circuit substantially simultaneously comprising a plurality of thermionic oscillators having their anode-cathode circuits connected across said distribution circuit in reverse order whereby the operation of said oscillators is effected only during alternate half-cycles of the voltage of said distribution circuit.

2. The combination with an alternating-current distribution circuit, of means for alternately impressing two high-frequency signaling currents upon said circuit only during the positive and negative half cycles of the voltage thereof, respectively, said means comprising two thermionic oscillators and means electrically connecting said oscillators to said circuit whereby the anodes of said oscillators are rendered alternately positive and negative with respect to the cathodes thereof and with respect to each other.

3. A high-frequency signaling system comprising an alternating-current distribution circuit, a pair of thermionic oscillators, a pair of thermionic receivers respectively tuned with respect to said oscillators, and electrical connections between the thermionic devices and said circuit whereby the anode of each oscillator and its corresponding receiver is rendered alternately positive and negative with respect to the cathode thereof and opposite in polarity with respect to the anodes of the other oscillator and receiver.

In testimony whereof I have hereunto subscribed my name this tenth day of March, 1926.

ERNEST WILLIAM BRAENDLE.