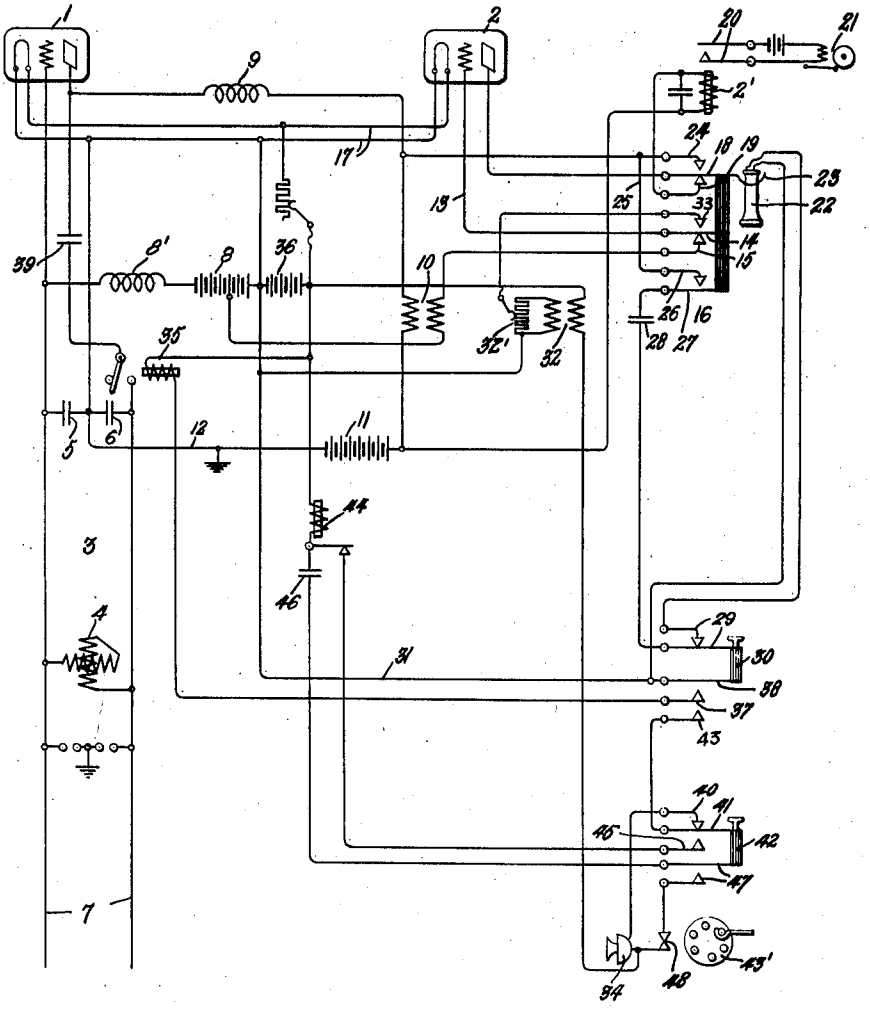
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SIGNALING SYSTEM

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SIGNALING SYSTEM

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My invention relates to signaling systems and more particularly to systems which are adapted for simplex operation, that is, systems which are adapted for alternate transmission and reception of signals.

Since in systems of the above type, transmission and reception of signals take place alternately a substantial economy, both in initial cost of the apparatus and in the operation thereof, may be effected if, in so far as possible the same apparatus, including the electron discharge devices employed in the system, be utilized during both the transmitting and receiving periods. Accordingly one of the purposes of my invention is to provide improved means whereby the apparatus, and particularly the discharge devices, may be used for both transmission and reception of signals. Another purpose of my invention is to provide a system of the type indicated in which efficient operation of the apparatus may be had during both transmission and reception. A further purpose of my invention is to provide means whereby this may be accomplished with a minimum of annoyance to the operator, resulting from switching operations necessary to effect the desired connections.

The novel features which I believe to be characteristic of my invention will be set forth with particularity in the appended claims. My invention itself, however, both as to its organization and method of operation, together with further objects and advantages thereof may best be understood by reference to the following description taken in connection with the accompanying drawing in which the single figure represents an embodiment of my invention.

Referring to the drawing, 1 and 2 represent electron discharge devices, both of which are illustrated as of the three element type. As will be later described the device 1 operates as a detector during reception and as an oscillation generator during transmission. During reception of calling signals the device 2 operates as a rectifier to currents which are produced in the output circuit of device 1 and supplies direct current impulses to a calling relay 2′. During reception of voice waves this device is idle and during the transmission period this device operates as a modulator of oscillations produced by the device 1.

3 represents an oscillatory circuit comprising an inductance 4 and condensers 5 and 6. This oscillatory circuit is connected to conductors 7 which comprise a part of a signal circuit extending to remote signal apparatus or to a suitable antenna system as desired. The condenser 5 which comprises a portion of the oscillatory circuit is permanently connected between the grid and cathode of the discharge device 1. Thus oscillations produced in the circuit 3 in response to high frequency currents received from a remote point are impressed upon the grid of the discharge device 1. The oscillatory circuit 3, however, is unassociated, either inductively or conductively, with the anode of the device 1 at this time and during the entire reception period. In this way the possibility of oscillations being produced in the oscillator during reception by action of device 1, is eliminated. The side of the oscillatory circuit opposite the grid connection may be connected to the anode by the contacts of relay 35 during transmission as will later be described.

A source of potential 8 is connected through choke coil 8′ between the cathode and grid of device 1, whereby the grid is maintained at a fixed negative potential with respect to the cathode. This bias potential is of magnitude such that the device 1 operates as a detector during reception. It has been found that with this fixed bias upon the grid efficient operation may be had during both transmission and reception and that the necessity for switching means to connect, grid leak and condenser combinations, of different magnitude for the different functions is avoided.

The anode circuit of device 1 comprises the usual radio frequency choke coil 9, primary winding of coupling transformer 10, source of potential 11, conductor 12, cathode conductors 17 and space between the cathode and anode of the device 1. The secondary winding of the transformer 10 is connected to the grid of the discharge device 2 through

a circuit comprising conductor 13, contacts 14 and 15 of switch 16, secondary winding of the transformer 10, a portion of source of potential 8, cathode conductors 17 and cathode of the device 2. The negative potential impressed upon the grid of device 2 by the source 8 is such that this device also operates as a rectifier of alternating current produced in the anode circuit of the device 1. The anode circuit of the device 2 comprises contacts 18 and 19 of the switch 16, relay 2′, source of potential 11, conductor 12 and the cathode conductors 17.

As thus described high frequency currents which are received in the oscillatory circuit 3 from a remote point are impressed upon the grid of the discharge device 1 and rectified. Currents flowing in the output circuit of the device 1 resulting from demodulation of the received high frequency wave are supplied through the transformer 10 to the grid of the device 2. These currents are rectified by the device 2 and supplied to the relay 2′. 20 represents contacts upon the relay 2′ which are utilized to control any suitable type of signal device 21 which may comprise a bell, relay, selector switch, or the like.

As thus arranged the system is in the normal "stand-by" condition. It will be seen that the receipt from the signal circuit 7 of modulated currents having the frequency to which the tuned circuit 3 is adapted to respond will produce operation of the bell 21, informing the operator of a received call.

The operator upon hearing the bell will remove the receiver 22 from its supporting hook 23. The receiver hook 23 is biased, by means not shown, to the position opposite to that shown in the drawing and when the receiver is removed therefrom it assumes the mentioned opposite position and thereby effects the following connections. The anode circuit of the device 2 is connected by means of contacts 18 and 24 to the anode of the device 1 through the choke coil 9, the anodes of these devices then being both connected through the primary winding of the transformer 10 and the source of potential 11 to the cathode conductors. The circuit of the relay 2′ is broken at contact 18 and operation of the signal device 21 is interrupted. The anode of the device 1 is also connected through the radio frequency choke coil 9, conductor 25, contacts 26 and 27 of switch 16, blocking condenser 28, contacts 29 on switch 30, receiver 22, conductor 31 to the cathode conductors 17. Thus in this position of the switch 16 signals are supplied directly from the anode circuit of the device 1 to the receiver 22 and the system is in condition for reception of voice waves or other signal current by which the received carrier wave is modulated.

Since the device 2 is idle during this condition of the receiving circuit, connections thereto are prepared by the contacts of the switch 16 such that this device assumes the modulating function when the operator desires to speak. It will be seen that the secondary of the microphone transformer 32 with its potentiometer 32′, which may be utilized for volume control purposes, its connected in a circuit leading from the cathode conductors 17 through contacts 33 and 14 on the switch 16 to the grid of the device 2.

When the operator desires to talk he will press and retain the button 30 in its lower position and speak into the microphone 34. By means of contacts 29 the circuit of the receiver 22 is interrupted. Relay 35 is energized through a circuit extending from the positive side of the source of potential 36 through relay 35, contacts 37 and 38 on switch 30 to the negative side of the source of potential 36. Relay 35 then actuates its armature to the right, thereby connecting the oscillatory circuit 3 between the grid and anode of the discharge device 1 through blocking condenser 39. The circuit of the transmitter or microphone 34 now extends from the positive side of the source of potential 36 through the primary winding of the microphone transformer 32, transmitter 34, contacts 40 and 41 of switch 42, contacts 43, 37 and 38 of the switch 30, all of which are in conductive engagement with each other and conductor 31 to the negative side of the source of potential 36.

Thus with the receiver 22 removed from the hook and the switch 30 pressed to its lower position, voice currents may be supplied from the transmitter through the microphone transformer 32 to the grid of the electron discharge device 2. The coupling transformer 10, the primary of which is connected in the anode circuit of both discharge devices operates as a modulation reactor to modulate the high frequency currents in accordance with the voice waves produced by the transmitter.

It will thus be seen that during the conversation the only switching means which the operator need bear in mind, or control, is the switch 30. To transmit he need merely to press the switch 30 and to receive he releases the switch 30. All of the changes in the connections of device 2 necessary to cause this device to assume the modulating function, or the rectifying function as desired are made in response to the position of the receiver hook. The only additional connections which are necessary are in the receiver circuit, the microphone circuit and the circuit of relay 35 for controlling the tube 1. These latter connections may be made by means of light contacts which may be operated by a small button mounted upon the telephone instrument and which may be controlled by the finger of the operator during the conversation.

The switch 42, which is also a small but-

ton mounted on the telephone instrument is used to complete the circuit of the ringing current generator 44, 46 through the keying contacts 48. The ringing current generator comprises an ordinary induction coil of well known construction which produces alternating currents in the circuit of blocking condenser 46, contacts 48 and the primary of the microphone transformer.

To send signals for the purpose of calling a remote party the operator will remove the receiver 22 from the hook, operate both switches 30 and 42 to their lower position and then dial the number of the called party by means of the dialing or keying device 43'. With the key 42 in the lower position, the circuit of the microphone is opened at the contacts 40 and 41 and a circuit is closed from the positive side of the source of potential 36 through the inductance coil 44 and its armature and contact, contacts 45 and 41 of the switch 42, contacts 43, 37 and 38 of the switch 30 and conductor 31 to the negative side of the source of potential 36. The coil 44 will then be energized and will attract its armature thereby interrupting its own energizing circuit, which, in turn, causes its contacts to close, this buzzer action continuing as long as the key 42 is in its lower position. Due to the inductance of the coil 44 oscillatory currents will be produced in a circuit extending from the positive side of the source of potential 36 through coil 44, condenser 46, contacts 47 of key 42, contacts 48 of the dialing device 43', primary winding of the microphone transformer 32 to the positive side of the source of potential 36. These oscillatory currents will be supplied to the grid of the discharge device 2 and, in a well known manner, will be caused to modulate the high frequency currents of the circuit 3 whenever the contacts 48 are in engagement. These contacts may be actuated in accordance with any desired code combination by the device 43'. Having effected the necessary dialing the operator will release the buttons 42 and 30 and listen for a response from the remote operator.

It will be seen that with the circuit as thus described the operator may effect the necessary connections with great facility, most of the connections being made in response to the position of the receiver hook. The receiver having been removed from the hook the only additional operation on the part of the operator, to change the circuit from its receiving condition to its transmitting condition is to press the key 30. It is preferable that the receiver 22, the transmitter or microphone, 34 and the switching devices 30 and 42 be mounted in a single unit supported by the receiver hook 23. The operator may then by means of the fingers on the hand in which he holds the receiver effect with convenience all of the desired connections.

While I have shown a single embodiment of my invention it will be understood that I do not wish to be limited thereto since many modifications, both in the circuit arrangement and in the instrumentalities employed may be made without departing from the spirit and scope of my invention as set forth in the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. In combination, a plurality of electron discharge devices, each of said devices having an anode and a cathode, means connecting said devices in cascade relation, a plurality of signal devices one of said devices being connected in the anode circuit of one of said discharge devices and means for connecting another of said signal devices in the anode circuit of a second of said discharge devices, means for supplying high frequency current received from a remote point to said second discharge device to cause desired actuation of said signal devices, an oscillatory circuit associated with said second discharge device whereby oscillations may be produced and means including said first discharge device for modulating the oscillations produced.

2. In combination, a plurality of electron discharge devices, each of said devices having an anode, a cathode and a grid, means including an inductance device connected in the anode circuit of one of said devices and in the grid circuit of a second device whereby said devices are connected in cascade relation, a signal device connected in the anode circuit of said second device, means for supplying current received from a remote point to the grid of said first device to cause actuation of said signal device, an oscillatory circuit, means for connecting said oscillatory circuit to the grid and anode of said first device whereby oscillations may be produced and means including said second discharge device and said inductance device for modulating said oscillations.

3. In combination, a plurality of cascade connected electron discharge devices, an oscillatory circuit connected to the grid and cathode of one of said discharge devices, said oscillatory circuit being normally unassociated with the anode of said device, said last mentioned discharge device being arranged to rectify high frequency currents supplied to said oscillatory circuit from a remote point, a signal device, means including a second of said discharge devices for rectifying current produced in the anode circuit of said first device and for operating said signal device in response thereto, means for conductively connecting said oscillatory circuit between the grid and anode of the first device whereby high frequency current may be produced and means including said second discharge device for modulating said oscillations in response to signal current.

4. The combination in a high frequency signaling system, an electron discharge device having an anode, a cathode, and a grid, an oscillatory circuit connected to the cathode and grid of said discharge device, said discharge device being arranged to rectify high frequency current supplied to said circuit, said oscillatory circuit being normally unassociated with the anode of said device, means for impressing a fixed negative potential on said grid, a signal device, means for connecting said signal device in the anode circuit of said discharge device, means for connecting said oscillatory circuit between said grid and anode whereby oscillations may be produced by said discharge device and means for modulating said oscillations in response to signal current.

5. In a signal system, an oscillatory circuit, a signal device, a plurality of normally cascade connected electron discharge devices, each of said discharge devices having an anode, a cathode and a grid, said oscillatory circuit being normally connected to the grid and cathode of one of said devices and unassociated with the anode of said device, means including said cascade connected discharge devices for rectifying current supplied from a remote point to said oscillatory circuit and for operating said signal device in response thereto, a second signal device, a transmitter, a common switching means for connecting the output of said one of said devices to said second signal device and for connecting the anodes of said devices together and additional switching means for connecting said transmitter to the grid of another of said devices and for connecting said oscillatory circuit between the grid and anode of said first discharge device whereby high frequency currents modulated in response to currents produced by the transmitter may be produced in said oscillatory circuit for transmission to a remote point.

6. The combination in a high frequency telephone system, a pair of electron discharge devices, an oscillatory circuit connected to the grid and cathode of one of said discharge devices whereby oscillations in said circuit are impressed upon said grid, a signal device, means including the other of said discharge devices for rectifying currents produced in the anode circuit of said first device and for supplying direct current to said signal device in response thereto, a transmitter, a second signal device, a transformer, means responsive to the position of the receiver hook for connecting said second signal device in the output circuit of said first discharge device, for connecting the anodes of said devices together and for connecting the secondary of said transformer to the grid of said other discharge device and additional switching means for connecting said oscillatory circuit between the grid and anode of said first device and for connecting said transmitter to the primary of said transformer whereby high frequency current modulated in accordance with currents produced by said transmitter are produced in said oscillatory circuit.

7. In combination, a pair of electron discharge devices, an oscillatory circuit connected to the grid and cathode of one of said devices, means for impressing a fixed bias potential upon the grid of said device, a signal device, means including a transformer having its primary winding connected in the anode circuit of said one device whereby said discharge devices are connected in cascade relation to supply current to said signal device, a second signal device, common means for connecting said second signal device in the anode circuit of said one discharge device and for connecting the primary of said transformer in the anode circuit of both of said devices, a transmitter, means for conductively connecting said oscillatory circuit between the grid and anode of said one discharge device and for connecting said transmitter in the grid circuit of the other discharge device whereby high frequency current produced in said oscillatory circuit is modulated in accordance with current produced by said transmitter.

8. In combination, a pair of electron discharge devices, each of said devices having an anode, a cathode and a grid, a signal circuit including an oscillatory circuit connected to the grid and cathode of one of said discharge devices, a signal device connected in the anode circuit of the other discharge device, an inductive coupling between the anode of said first device and the grid of the other device whereby said signal device is operated in response to current supplied from a remote point to said oscillatory circuit, a second signal device, and switching means whereby said coupling means is connected in the anode circuit of said second discharge device, said second signal device is connected in the grid circuit of the second discharge device and said oscillatory circuit is connected between the grid and anode of said first device whereby high frequency currents produced in said oscillatory circuit by said first device are modulated in response to operation of said second signal device and supplied to said signal circuit.

In witness whereof, I have hereunto set my hand this 21st day of June, 1928.

WILLIAM A. TOLSON.