

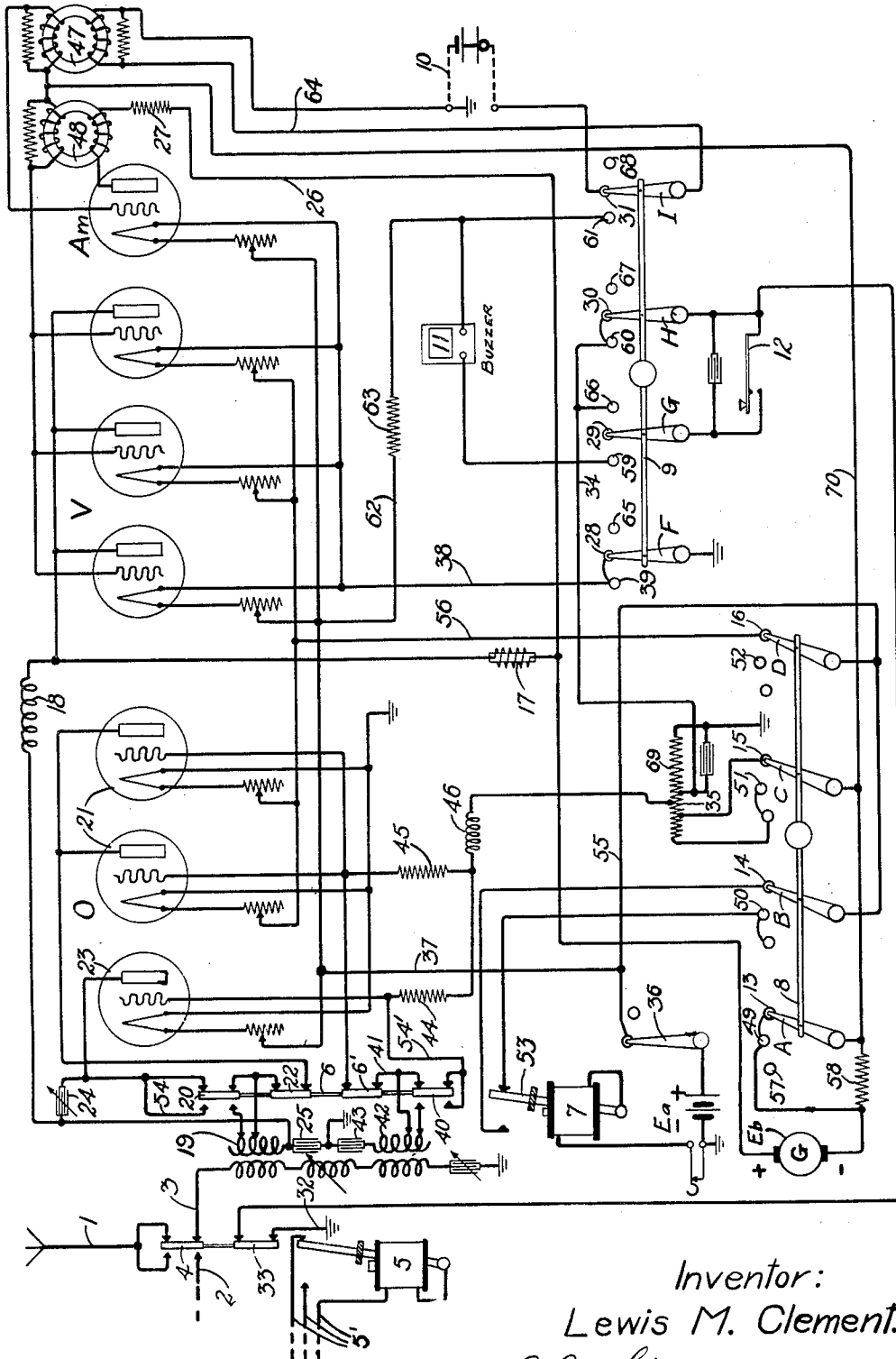
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TRANSMISSION SYSTEM

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TRANSMISSION SYSTEM

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This invention relates to signaling systems and more particularly to radio systems capable of being operated to transmit a variety of signals and also capable of transmitting each species of signal with various degrees of power.

It is well known that in radio signaling there is an advantage in being able to change a transmitter quickly so as to transmit a different form of signal and likewise to be able with a particular form of signal to change the radiated power.

This invention includes improved and practical means for accomplishing either or both of these purposes. Many features of the invention are also applicable to wire or wireless teledynamic systems in which it is desirable to change the transmitted wave form or the power, and certain features are of still more general application.

In the specific embodiment of the invention disclosed herein, provision is made for transmitting speech by modulating the carrier wave to be transmitted in accordance with speech waves; for transmitting modulated continuous wave telegraph signals by modulating the waves to be transmitted with a low frequency in accordance with a code; and for transmitting continuous wave code signals. By "continuous wave" signaling as used herein is meant a method of signaling wherein waves of uniform amplitude and frequency are intermittently interrupted for the purpose of signaling.

In the specific embodiment of the invention, vacuum tubes are provided in connection with means whereby each kind of signal may be transmitted with high power oscillations derived from a plurality of tubes, medium power oscillations produced by the maximum output of one tube, or low power oscillations produced by a single tube working at reduced capacity. Movement of a single control switch having a plurality of contact blades to any one of several selected positions conditions the apparatus for transmitting the desired form of signal, while movement of another switch regulates the power. By a unique arrangement of circuits connected to the contacts and blades of these switches a desirable simplicity of circuit arrangement is produced and effective operation is secured.

When modulated waves are to be transmitted, one or more modulating tubes are energized to produce modulation of the transmitted waves, while an amplifier is energized for the purpose of increasing the energy of the modulating wave. The invention accordingly includes switching means to connect these elements in circuit when they are to be operative and to deenergize and

disconnect them from the circuit when they are not operative, thereby preventing loss of power in idle elements or interference with the functioning of the active parts of the circuit.

Among the other objects of the invention are to prevent sparking when the antenna switch is thrown from the "transmit" position; to provide simple and efficient means for reducing the power below that ordinarily generated by a single space discharge device; to provide arrangements whereby the speech input circuit and the telegraph key circuit are always ready to be operated when the function switch is moved to the proper position; and to provide means whereby the oscillator constants and the coupling of the oscillator to the antenna are automatically changed when the power is changed.

Other objects and advantageous features will be apparent to those skilled in the art after a perusal of the following description and the appended claims wherein the various novel features of the invention are set forth.

The accompanying drawing illustrates diagrammatically a radio transmission system embodying the invention.

An antenna 1 may be connected to a receiving circuit 2 or a transmitting circuit 3 by means of a transmit-receive contact controller or relay 5. The receiving circuit 2 may be of any of the well-known types, for example, one employing an electron tube detector, as shown in U. S. Patent No. 1,173,079 to Alexanderson, February 22, 1916. An oscillator O generates the waves to be transmitted. Controlling the circuits of the oscillator, in a manner hereinafter described, is an auxiliary power switch or circuit closer 6, controlled by an auxiliary power relay 7, which is in turn controlled by a manually operated power switch 8.

In the preferred form of apparatus the switch 6, carrying the contacts 40, 6', 20 and 22, is a rigid extension of armature 53, the various contacts being insulated from each other and from the armature. Associated with the oscillator are a modulator or variable impedance system V, an amplifier Am, suitable power sources Ea and Eb, a function switch 9, a speech frequency or telephone circuit 10, a buzzer 11, a telegraph key 12 and other auxiliary apparatus which will be described.

When the transmit-receive switch is in the transmitting position as illustrated, it being controlled through local or remote control by the relay 5 through the circuits 5', the system is capable of operating in several ways in accord-

ance with the positioning of the power switch 8 and the function switch 9. Relay 5 is of the type which, upon being energized, moves over to the opposite position, breaks its own circuit, and takes no more current until again energized for reverse movement. The complete circuits for operating this relay 5 are not illustrated as they form no part of the invention herein claimed. It need merely be stated that this relay is indicated in the "transmit" position with the antenna connected to the transmitting circuits. The contacts 4 and 33 are moved by the armature of relay 5. When the armature of relay 5 moves to the right, the contacts 4 and 33 move to the right and vice versa.

Telephony—high power

The switch 8 is moved to close the contacts 13, 14, 15 and 16, as indicated in the drawing. The anode-cathode circuit of the oscillator tubes extends from the positive side of the generator E_b through the speech frequency choke coil 17 and the high frequency choke coil 18 to the plate oscillator coil 19 and the contact 22 to the anodes of tubes 21. A separate contact 20 serves to connect in circuit the plate of tube 23. A branch between the coils 17 and 18 is connected to the anodes of the modulating or variable impedance tubes.

Owing to the action of the coil 17 in tending to maintain the sum of the plate currents constant, variation in impedance of the modulating tubes will cause modulation of the high frequency waves produced by the oscillator. This type of system is known in the art as the "constant current modulation system."

The coil 19 and the capacity 24 in parallel, form the high frequency plate circuit of the oscillator which extends from the anodes through these elements in parallel and through the capacity 25 and ground to the filaments. The purpose of the capacity 24 is to adjust the oscillator for maximum efficiency, the frequency being regulated by varying the reactances in the antenna circuit 3.

The plate circuit of the amplifier A_m is completed through the conductor 26 which includes a resistance 27 for reducing the voltage applied to the amplifier. The "function switch" 9 closes the contacts 28, 29, 30 and 31.

The cathodes of the various tubes are grounded and have a return connection to the negative side of source E_b through the ground 32, contact 33 of the transmit-receive switch, the blade H, contacts 30 and 60, conductor 34, a part of resistance 35, contact 15, blade C, blade A, and contact 13 to the negative terminal of the source E_b . Resistance 35 is of a small value; its use is later described. The cathodes of the various tubes are energized through a circuit which extends from ground through battery E_a , the switch 36, and the conductor 37 to the positive terminals of the cathodes of the tube 23, the right hand tube of the system V, and the amplifier tube A_m .

The connection to the positive terminals of the other tubes, included in the oscillating system and the modulating system V, is through the conductor 55, switch blade D, contact 16, and conductor 56. The negative terminals of the various cathodes are grounded when the tubes are energized. The ground connection of the negative terminals of the modulator and amplifier tubes is through the conductor 38 to the contact 39 which is connected to the contact 28 and the switch blade F.

The grid input circuit of the oscillator extends from the grids of tubes 21 to the contact 6' and the grid of tube 23 through the conductor 54' and contact 40 to the conductor 41, thence through coil 42 and capacity 43 to ground. The grids are thus connected to the parallel combination of resistances 44 and 45 which together form a high resistance leak path for all the grids through the coil 46 and a portion of resistance 35 to ground through conductor 34, contacts 60 and 30 and switch blade H.

The coil 46 is included to make the leak path inductive and is preferably a coil wound upon a small wooden or other non-magnetic core. This coil preferably has small distributed capacity.

The telephone circuit 10 is connected to the transformer 47 through the blade I and the contact 31. The secondary of transformer 47 is connected to the input circuit of the amplifier A_m whose output circuit is connected by the transformer 48 to the input circuit of the modulating tube system V.

Telephony—intermediate power

For intermediate power the power switch 8 is moved to close the contacts 49, 50, 51 and 52. This acts to deenergize the tubes 21 and all but one of the modulating tubes V in the following manner. Blade B in moving from contact 14 to contact 50 causes an impulse of current through the auxiliary power relay 7. The armature 53 is thereby thrown to the left and the contacts 40, 6', 22 and 20, which are controlled by the armature 53 are also thrown to the left.

As soon as the auxiliary power relay 7 has acted it breaks its own circuit and takes no more current. Relay 7 is of the same type as relay 5. Such relays are well known in the art and for this reason the illustration of them in the drawing is diagrammatic and is not intended to show the exact details.

After the relay 7 has acted, the anodes of tubes 21 are open-circuited at the contact 22; the anode circuit of tube 23 is closed, beginning at coil 18, through coil 19 and conductor 54. The grid circuit of tubes 21 is opened at the contact 6'. The grid circuit of tube 23 is closed through conductor 54', contact 40, coil 42, and condenser 43 to ground. Resistance 45 becomes idle. The leak path for the grid of tube 23 is through the resistance 44, coil 46, a portion of resistance 35, conductor 34, and blade H to ground through the contact 33 on the transmit-receive switch.

By properly proportioning the resistances 44 and 45 a suitable value of leak resistance will be included in circuit when several tubes are operating and a suitably higher value when only a single tube is operating. The cathode circuits of tubes 21 and the idle tubes V will be opened when the blade D moves off of the contact 16, since their only connection with the positive terminal of source E_a is through switch 36, conductor 55, blade D, contact 16, and conductor 56.

When the element 6 is moved to the left a number of additional turns of the coils 19 and 42 are included in circuit. The resulting increased inductance of these coils is more suitable when only a single tube is operating. The coupling of these coils with the antenna is also changed.

Telephony—low power

For transmitting at low power the switch 8 is moved to close contact 57. This causes to be included in the anode-cathode circuit of each tube

which is operating the resistance 58. This resistance is of such value that it cuts down the plate current to the desired value. No other change in the circuit connections takes place. To again transmit with intermediate or high power the power switch is moved back to the appropriate position. When blade B passes to contact 14 the auxiliary power relay is caused to move to connect all the tubes in circuit.

Telegraphy—buzzer modulated.

For transmitting continuous high frequency waves modulated at an audible frequency by means of the buzzer 11, the power switch 8 may be moved to any of the three available positions in the same manner as for transmitting telephony. Instead of including the telephone circuit 10 in operative relation, the function switch 9 is moved to close the series of contacts 39, 59, 60 and 61.

When blade I is moved from contact 31 the telephone circuit 10 is open-circuited. Closing the contact 39 effects no change in the circuit. Closing the contacts 59 and 61 energizes the buzzer 11 in the following manner; from ground, through battery E_a , switch 36 through conductors 37 and 62, resistance 63, thence through two paths one of which extends through buzzer 11, contact 59, blade G, and key 12 to ground through contact 33 on the transmit-receive switch. When this path is closed by the operation of the key 12 the buzzer will be excited, thereby impressing its oscillations upon the amplifier A_m through the transformers 47 and 48 by means of the circuit through contact 61, blade I, conductor 64 and primary of transformer 47 to ground.

Continuous wave telegraphy

Transmission of continuous waves at any of the three different powers may be accomplished by moving the power switch to the appropriate position, thereby controlling the auxiliary power relay, these parts functioning in a manner similar to that hereinbefore described for telephony. The function switch 9 is moved to close the series of contacts 65, 66, 67 and 68. When blade F is moved to the idle contact 65 the cathode circuits of the modulating tubes V and the amplifying tube A_m are open.

When blade G engages with contact 66 a shunt circuit to ground around the series resistance 69 in the space current circuit of the tubes is prepared which may be closed by the key 12. This circuit extends from the left end of resistance 69 through conductor 34, contact 66, blade G, and key 12 to ground, through contact 33 on the transmit-receive switch.

When the key 12 is open the resistance 69 is included in the grid-leak circuit of the oscillator O. By this means the resistance 69 is also included in the space current path of the tubes. The grids of the oscillator tubes are connected to that terminal of resistance 69 which is negative with respect to the grounded terminal, the latter being connected to the oscillator cathodes. A high negative potential is thus impressed upon the grids. This negative potential is sufficiently high to reduce the space current to a small value or to zero with the result that the oscillations are caused to cease immediately after the resistance 69 is included in circuit. Moreover, resistance 69, when included directly in the space current circuit, decreases the value of the space current, thus tending to prevent oscillations. Upon closing

key 12 the resistance 69 is short-circuited and trains of oscillations will be produced.

When blade H is moved to the idle point 67 from the point 30 the conductor 34 is opened and the key 12 is placed in the circuit 34, 66, and G to ground at 32. Blade I contacts with the idle point 68 thereby open-circulating both the buzzer and telephone circuits. The key 12 is thus equally available for transmitting either buzzer modulated or continuous waves and is properly included in circuit without further action on the part of the operator than that of moving the function switch 9 to its appropriate position.

When transmitting telephony or buzzer modulated waves it will often be desirable for the operator to throw the transmit-receive switch from the transmitting to the receiving position when the oscillator O is active. This will tend to cause an arc to be drawn from contact 4 owing to the high potentials and large currents existing in the antenna. The shunt circuit around the resistance 69 to ground extends through the contact 33 on the transmit-receive switch so that immediately when the transmit-receive switch starts to move from the transmitting position, the resistance 69 will be included in the space current path as well as in the leak path of the oscillator.

As above described, the oscillations will at once cease when resistance 69 is included in the space current path, since the grids of the oscillator tubes are made highly negative because of the potential drop across the resistance 69. The generation of oscillations is checked so quickly that, by the time the switch is moved far enough to cause an arc of appreciable magnitude, the delivery of power to the antenna by the oscillator will cease. The arcing action is, therefore, reduced to a minimum without the inclusion of additional apparatus other than the contact 33, the resistance 69 serving to perform this additional useful function.

The space current of the tubes always has its return path to the negative side of the source E_b through the resistance 35, one of the contacts 15 or 51 and the blade C. The conductor 70 leads from the blade C to the grids of the amplifying and modulating tubes. The cathodes are connected through ground to a more positive point on resistance 35. A suitable negative working potential is thus impressed upon these grids.

Since the plate current varies with the number of tubes in circuit, the contacts 15 and 51, leading to different points of the resistance 35, are provided so that the proper potential difference between the grids and the cathodes of the tubes will result, irrespective of the number of tubes in operation. This adjustment is made when the apparatus is constructed and needs no attention on the part of the operator, the proper circuit being closed automatically by movement of the power switch 8.

One form of the invention having been described in detail, the novel features believed to be inherent therein are defined in the appended claims. The invention is not to be regarded as limited otherwise than as indicated by the scope of the claims.

What is claimed is:

1. In a radio system an oscillation generator comprising a plurality of associated electric discharge devices, grid, anode and cathode circuits therefore, a power control switch, means controlled by said switch for inactivating a portion of the discharge devices while maintaining at least one of the devices activated, and means

simultaneously controlled by said switch for effecting changes in the grid, anode and cathode circuits to permit the efficient operation of the device remaining activated.

2. In a system of space discharge devices having control elements, a leak path for said elements, a power control switch for varying the number of said devices connected in circuit, and means controlled by said switch for varying the control element leak path in accordance with the number of said devices included in circuit.
3. In a transmission system, a signaling conductor, a system of thermionic devices connected thereto by means of a high frequency circuit, a power switch for controlling the number of devices connected to said circuit, and means automatically operating when the number of said devices is changed to change said circuit to a condition suitable for operating with the changed number of devices.
4. In a transmission system, a power control switch having a plurality of positions and an auxiliary power control switch having a less number of positions, means whereby said auxiliary switch is automatically made to assume one position for one position of said control switch and another position for a plurality of other positions of said control switch, and means whereby each position of said control switch transmits high frequency waves of power different from any other position.
5. In a transmission system, a plurality of electric discharge devices, a power control switch having one position corresponding to a circuit condition for operating one number of said devices, and a plurality of other positions corresponding to a circuit condition for operating another number of said devices, means operated by a change from one to another of said other positions to change the circuit of said devices without changing their number, and means at each position of said power control switch to cause the transmission of high frequency waves at a power level different from that at another position.
6. In a transmission system, a power device, an additional power device each of said devices having an anode-cathode circuit, a grid leak circuit and a cathode circuit, and means for controlling said devices comprising a member for controlling said anode-cathode circuits, a second member for controlling the connection between said power device and said additional power device, a third member for controlling the grid leak circuit of said power device, and a fourth member for controlling the energization of the cathode circuit of said additional power device.
7. In a transmission system, power radiating means, a plurality of electric discharge devices for supplying power thereto, circuits for said devices, a main power control switch, and an auxiliary power control switch, said main power control switch having elements to control the connections of the circuits of said devices to operate at a plurality of power levels and to simultaneously control the operation of said auxiliary switch to adjust the power radiating means for operation at the respective power levels.
8. In a transmission system, a source of carrier waves, a buzzer, a modulating device, a telegraph key and a function switch, said function switch being associated with means whereby in one position it connects said buzzer with said source through said modulating device whereby said waves may be modulated in accordance with

a code by said key, and in another position said waves may be interrupted in accordance with a code by said key.

9. In a radio transmission system, a thermionic device, a transmit-receive switch having terminals for connecting said thermionic device to the antenna for the transfer of wave energy thereto, a leak path adapted for connection to said thermionic device, means controlled by the beginning of movement of said transmit-receive switch from transmitting position to include a resistance in said leak path, and means controlled by continuing movement of said switch to disconnect said device from said antenna.

10. A space discharge tube, appropriate circuits connected thereto for the generation of oscillations, a work circuit, a switch for connecting and disconnecting said work circuit to and from said generator, a control element in said generator, a control path connected to said element, and means controlled by and operated at the initiation of the disconnecting movement of said switch for affecting said path in a manner to cause cessation of generating action.

11. In combination, an antenna, a signal receiving circuit and a signal transmitting circuit, and a switch for alternately connecting the receiving and transmitting circuits to said antenna, said signal transmitting circuit comprising a signaling element, a thermionic device having a control circuit, a resistance element in said control circuit, a current path connected in shunt to said resistance element when said switch is in the transmitting position, and an alternative current path connected in shunt to said resistance by the operation of said signaling element.

12. In a vacuum tube system, a vacuum tube having an anode, a cathode and a grid, a source of anode-cathode current, a ground connection for the cathode, a ground connection for the negative terminal of the source of anode-cathode current, an element having a high resistance, and signal means for effectively connecting and disconnecting the high resistance element in the ground connection of the negative terminal of the anode-cathode current source.

13. In a space discharge system, a plurality of discharge devices having control elements, a source of polarizing potential for said control elements, a control means for varying the number of said control elements included in circuit, and means operated thereby upon changing the number of said devices to change said source, to a condition suitable for operating with the changed number of devices.

14. In a space discharge system, a plurality of discharge devices, a current path therefor, a plurality of devices whose grid potentials are derived from said current path, control means for changing the number of said devices connected in operative relation, and means controlled by said control means for varying the grid polarizing action of said path.

15. In combination, an antenna, a radio receiving circuit, a radio transmitting circuit comprising a thermionic device having a control element, a transmit-receive switch for alternately connecting said receiving and transmitting circuits to said antenna, and means operated by the initial movement of the transmit-receive switch from the transmitting position to negatively polarize said control element.

16. In a radio system, an antenna, a receiving circuit, a transmitting circuit, a transmit-receive switch for alternately connecting said antenna

to the receiving and transmitting circuits, an electric discharge device in said transmitting circuit, said device having a cathode, an anode and a control element, an anode-cathode circuit for said device, a resistance element, connections from said resistance element to said control element, and means controlled by said transmit-receive switch for connecting said resistance element in said anode-cathode circuit.

17. In a signaling system a space discharge device connected to a transmission circuit for the transfer of energy thereto, a signaling circuit closing device, a resistance, a control element in said discharge device connected to a point on said resistance, a space current source, means controlled by said circuit closing device to cause said source to establish said point at a sufficiently high negative potential to stop the transfer of energy to said transmission circuit.

18. A space discharge device, appropriate circuits connected thereto whereby said device generates oscillations, a resistance, a control element in said device, a space current circuit for said device, connections for including said resistance in said space current circuit whereby said control element is negatively charged, and means for closing a path in shunt to said resistance.

19. A space discharge device, including a control element, a space current circuit for said device, a control element circuit for said device, a resistance, means for including said resistance in the space current and control element circuits of said device whereby said control element is made more negative and the external resistance of said space current circuit is increased, and signal transmitting means for closing a path in shunt to said resistance.

20. In a vacuum tube transmission system comprising vacuum tubes having anodes, grids and filaments, a resistance in the anode-cathode circuit, a current supply source for said circuit, a connection from the grid to the terminal of said resistance which is electrically adjacent the negative terminal of said current supply source, said resistance being short-circuited when said system is operating, and means for connecting said resistance in circuit to render said system inoperative.

21. In a vacuum tube system, a grid-filament circuit, an anode-filament circuit, a resistance common to said circuits and a signaling element for closing a circuit of low impedance around said resistance during signaling periods.

22. A discharge device having an anode, a cathode and a control grid, a grid-cathode circuit, a cathode-anode circuit coupled to said grid-cathode circuit, and a resistance in said cathode-anode circuit and said grid-cathode circuit, said resistance being of such value that the normal anode-cathode current necessary to permit the generation of oscillations if the grid were normally polarized, produces such a value of negative grid potential as to prevent the generation of oscillations.

23. A space discharge device having a cathode, an anode, and a grid or control electrode, a grid-cathode circuit, a cathode-anode circuit, a space current source connected in the cathode-anode circuit, and a resistance common to said circuits of such value that said source is unable to drive sufficient current between said cathode and anode to enable said device to operate.

24. The method of rendering substantially inoperative an electric discharge device having a control element and a space current circuit including a source of potential, which method com-

prises producing a negative potential from the normal flow of current in the space current circuit, impressing that negative potential upon the control element to reduce and tend to block the flow of space current, producing from the reduced flow of space current a stable negative potential, and impressing the stable negative potential on the control element to maintain the flow of space current at a low value.

25. A radio signaling system comprising an antenna earth system, a plurality of audions having plate, grid and filament electrodes associated therewith, a circuit connecting said plate electrodes to each other and to said filament electrodes, a circuit connecting said grid electrodes to each other, a circuit connected between said grid electrodes and said filament electrodes and including therein a resistance, and means for varying said resistance by and in accordance with signals.

26. A radio signaling system comprising an antenna earth system, a plurality of audions having plate, grid and filament electrodes associated therewith, a circuit connecting said plate electrodes to each other and to said filament electrodes, a circuit connecting said grid electrodes to each other, a circuit connected between said grid electrodes and said filament electrodes and including therein a resistance, and means for varying said resistance by and in accordance with signals, and means for associating said audions with said antenna earth system.

27. A radio signaling system comprising an antenna earth system, a plurality of audions having plate, grid and filament electrodes associated therewith, a circuit connecting said plate electrodes to each other and to said filament electrodes, a circuit connecting said grid electrodes to each other, a circuit connected between said grid electrodes and said filament electrodes and including therein a resistance, and means for varying said resistance by and in accordance with signals, and means included in said plate and grid circuits for associating said audions with said antenna earth system.

28. A radio signaling system comprising an antenna earth system, a plurality of audions having plate, grid and filament electrodes associated therewith, a circuit connecting said plate electrodes to each other and to said filament electrodes, a circuit connecting said grid electrodes to each other, a circuit connected between said grid electrodes and said filament electrodes and including therein a resistance, and means for varying said resistance by and in accordance with signals, and means included in said plate and grid circuits for associating said audions with said antenna earth system and with each other.

29. The method of operating an electron discharge device having an electron emitting cathode, an anode and a controlling grid with circuit connections connected thereto for the production of high frequency oscillations which consists in supplying current thereto through a resistance device, varying the value of the resistance of said device between a low and a comparatively high value, and simultaneously producing a high negative potential on the grid of the electron discharge device.

30. In combination a thermionic oscillation generator and a thermionic modulator having their plates connected in parallel, and means, including a resistor in the plate circuit of said modulator, for controlling the grid potential in the generator,

31. A radio-telephone oscillator comprising an antenna, a ground connection, a condenser and an inductor serially connected between said antenna and said ground connection, a vacuum tube having a cathode, an anode and a control electrode, a circuit exterior to the tube from said anode to said cathode, a second circuit exterior to the tube from said control electrode to said cathode, a ground connection for said cathode, a second inductor coupled to said first-named inductor, a second condenser serially connected with said second inductor in said anode circuit, a third condenser in shunt to said second inductor, a third inductor coupled to said first-named inductor and connected in said control electrode circuit, a fourth condenser in series therewith in said circuit, a resistor in shunt to said fourth condenser, and means for varying the electrical constants of the circuit thus constituted, substantially as described.
32. An electric discharge device for generating oscillations, said device having a cathode, an anode and a control element, a cathode-anode circuit for said device, a resistance element connected in said cathode-anode circuit, a connection from said resistance element for applying a negative potential to said control element, and a key for controlling the negative potential supplied to said control element by said resistance.
33. In a wave transmitter, a signaling conductor, a high frequency circuit, a system of electric discharge devices connected to said conductor by means of said circuit, means for producing in said system of electric discharge devices a plurality of waves of different wave forms, a function switch for selecting that one of said means for producing the desired wave to be transmitted, a power switch for controlling the number of said devices connected to said circuit with whatever wave form is at any time selected by said function switch, and means automatically operated when the number of said devices is changed to change said high frequency circuit to a condition suitable for operating with the changed number of devices.
34. An electric discharge device, appropriate circuits connected thereto whereby said device generates oscillations, a resistance element, a space current circuit for said device, connections for including said resistance element in said space current circuit, and means for opening and closing a path in shunt to said resistance.
35. In combination, an antenna, a radio receiving circuit, a radio transmitting circuit comprising an electric discharge device having a cathode and a control element, switching means for alternately connecting said receiving and transmitting circuits to said antenna, and means operative when said switching means is operated to connect the antenna to the receiving circuit for impressing a negative potential on said control element.
36. In combination, an antenna, a radio receiver, a radio transmitter, a switch for alternately connecting said antenna to said receiver and transmitter, an electric discharge device for said transmitter, an anode-cathode circuit for said device, a source of current, connections for supplying current from said source to said anode-cathode circuit, a resistance element, and means controlled by said switch for including said resistance element in said anode-cathode circuit when said antenna is connected to said receiver and for effectively disconnecting said resistance
- from said anode-cathode circuit when said antenna is connected to said transmitter.
37. In combination, an antenna, a radio receiver, a radio transmitter including an electric discharge device circuit for producing waves of amplitude suitable for radiation, means for alternately connecting said antenna to said receiver or said transmitter, and means controlled by the alternately connecting means for reducing the amplitude of said waves to an amplitude lower than said amplitude suitable for radiation and greater than zero when said antenna is connected to said receiver.
38. A transmission and receiving system comprising an antenna ground system, an electron tube oscillator, a radio receiving circuit including an electron tube detector and a responsive device, switching mechanism for alternately establishing connection between said antenna ground circuit and said oscillator or with said radio receiving circuit, and means rendered effective simultaneously with the actuation of said switching mechanism for changing the amplitude of the oscillations developed by said oscillator when said oscillator is connected in circuit with said antenna ground system or when said antenna ground system is connected with said receiving circuit.
39. A transmission and receiving system comprising a radio frequency energy transmitting and collecting circuit, a transmitter including an electron tube oscillator having an input circuit and an output circuit, means for limiting the amplitude of the oscillations developed by said electron tube oscillator, a radio receiving system, and means for alternately establishing connection between said radio frequency energy collecting or radiating circuit and said oscillator and said receiving circuit, said means operating to simultaneously control said aforementioned means for reducing the amplitude of oscillations developed by said oscillator when said radio frequency energy collecting or radiating circuit is connected with said receiving circuit.
40. A signal transmission and reception system comprising a radio frequency energy collecting or radiating circuit, an electron tube system having input and output circuits arranged for the production of high frequency oscillations, a resistor arranged in the output circuit of said electron tube system, a signal receiving circuit, means for alternately establishing connections between said radio frequency energy collecting or radiating circuit, said oscillator and said receiving circuit, said means operating to shunt said resistor when said radio frequency energy collecting or radiating circuit is connected with said oscillator.
41. In a high frequency signaling system employing an electron discharge device having an anode, a cathode and a grid, a source of potential for said anode, a resistance permanently connected between said grid and the negative side of said source of potential, a connection between said cathode and the negative side of said source of potential, means for controlling the operation of said electron discharge device comprising a contact making key inserted in said last mentioned connection, one side of said key being connected both to the negative side of said source of potential and to said grid, and the other side of said key being connected to the cathode, and a parallel combination of resistance and capacitance connected in parallel with said key.
42. In a high frequency signaling system em-

playing electron discharge devices each of said devices having an anode, a cathode and a grid, a source of potential for said anodes, a permanent connection between said grids and the negative side of said source of potential, a connection between said cathodes and the negative side of said source of potential, means for controlling the operation of said signaling system comprising a contact making key inserted in said last mentioned connection, one side of said key being connected to the negative side of said source of potential and to said grid, and the other side of said key being connected to the cathode, and means associated therewith and adapted to maintain a definite negative potential on said grids and across said key when said key is open, said means comprising a parallel combination of capacitance and resistance connected in parallel with said key.

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