

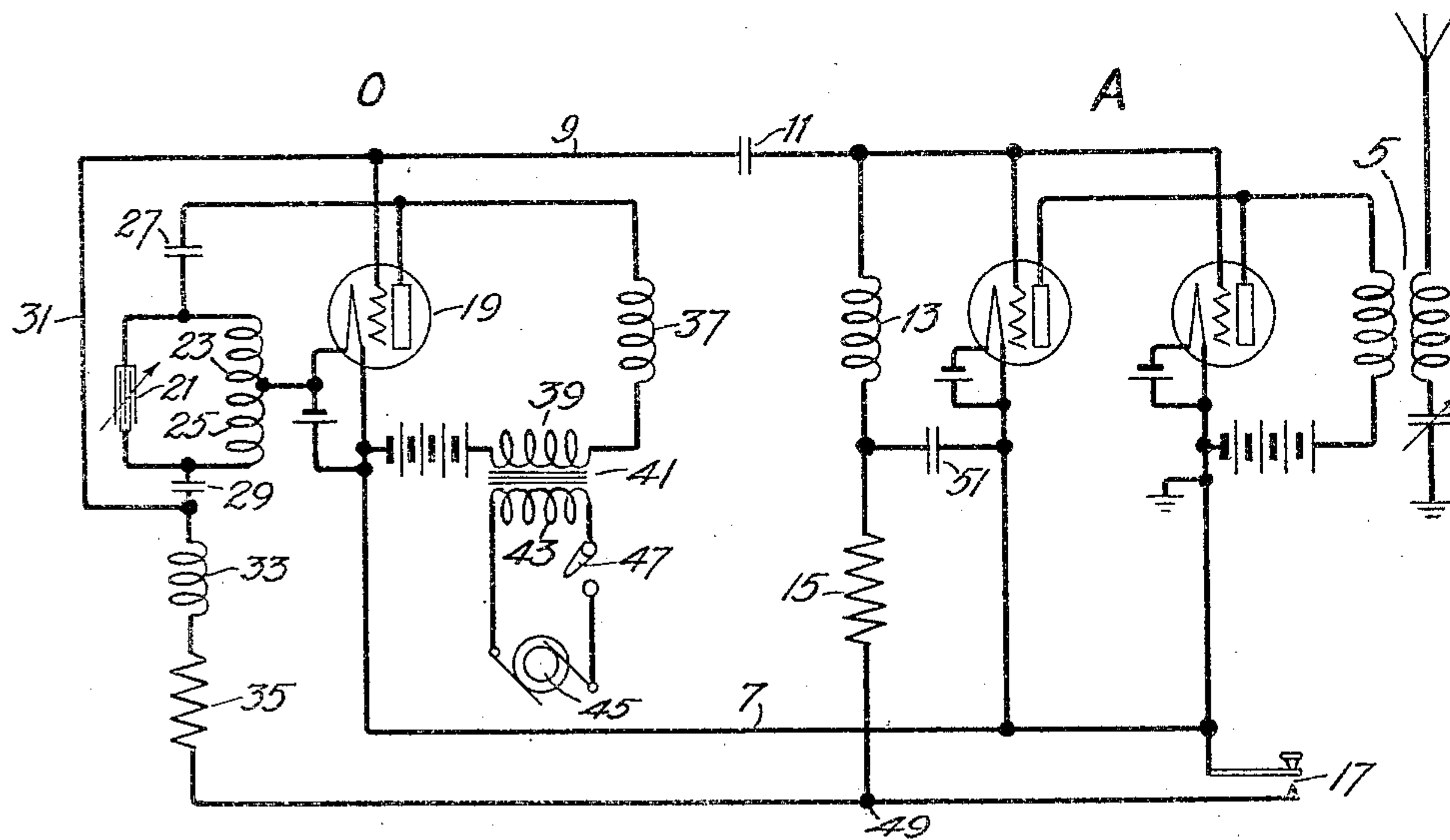
Feb. 14, 1933.

R. A. HEISING

1,897,050

ELECTRIC WAVE TRANSMISSION

Filed Feb. 27, 1926



Inventor:
Raymond A. Heising
by J. E. Roberts Atty.

UNITED STATES PATENT OFFICE

RAYMOND A. HEISING, OF MILLBURN, NEW JERSEY, ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK

ELECTRIC WAVE TRANSMISSION

Application filed February 27, 1926. Serial No. 91,206.

The invention relates in one aspect to operation of electric space discharge devices, and in another aspect to telegraphy, and aims for simplicity and efficiency in operating such devices and in sending telegraph signals.

It further aims to stabilize systems of electric space discharge devices, and especially to prevent undesired oscillations in the devices.

In accordance with one aspect of the invention a single key in a single keying location in a telegraph signal transmitting circuit suffices for keying both sustained and audio-frequency modulated waves. The keying of the sustained waves sends signals for use in interrupted continuous wave telegraphic transmission, and the keying of the modulated wave sends signals for use in tone telegraph transmission. In a preferred specific form of this aspect of the invention, sustained and modulated waves from an oscillation generating and audio-frequency modulating means are amplified by an electric space discharge amplifier, and the signaling key is inserted in the circuit between the cathodes of the oscillator and the amplifier and their grid leak resistances. Consequently opening the key interrupts the grid leak paths of the oscillator and the amplifier, with the result that negative potential accumulating on the oscillator grid causes oscillations to become weak or to cease and, because of the conductive connection of the grids of the oscillator and the amplifier through their grid leak resistances, reduces or stops the flow of the amplifier space current.

Thus, in the space current circuit of the amplifier, as well as in that of the oscillator, substantially no energy is consumed during the periods in which no signal waves are transmitted. Closing the key causes the oscillator to generate the sustained wave for transmission, and, if the source of audio-frequency modulating waves is actively connect-

ed in circuit, causes generation of an audio-frequency modulated wave for transmission. The generation of these waves continues as long as the key is closed, such periods corresponding to the signal elements represented by transmission of signal waves. Because of the position of the key in the circuit, any current traversing the key contacts is small.

In order to avoid undesired oscillations in the amplifier when the key is closed, the circuit for discharging the accumulated negative charges on the grids of the amplifier is preferably given a time constant greater than that of the circuit for discharging the accumulated negative charges on the grid of the oscillator.

The single figure of the drawing represents a system for practicing the invention.

In the drawing the antenna 5 is fed from an electric space discharge power amplifier A, the grids and cathodes of the amplifier being fed from the grid and cathode of an oscillator 0 through conductors 7 and 9. The blocking condenser 11 is included in conductor 9 between the grid of the oscillator and the grids of the amplifier.

The amplifier comprises one or two or more electric space discharge tubes connected in parallel, two being shown in the drawing. For the tubes of the amplifier there is provided a grid leak path extending from the grids through a high frequency choke coil 13, a high resistance 15 and a telegraph signaling key 17 to the filaments.

The oscillator 0 is of the general type disclosed in Hartley Patent 1,356,763, October 26, 1920, which includes an electric space discharge tube 19 and an oscillation circuit comprising condenser 21 and inductances 23 and 25. A blocking condenser 27 in a connection between the oscillation circuit and the anode or plate of tube 19, prevents passage of direct current from the plate or filament batteries of the tube through inductance 23. A blocking condenser 29 is in-

serted in a conductor 31, connecting the oscillating circuit to the grid of the tube 19. A grid leak path for the tube extends from the grid through the conductor 31, a high frequency choke coil 33, a high resistance 35, the key 17 and the conductor 7 to the cathode of the tube. The condenser 29 prevents passage of direct current from the filament battery of the tube through elements 7, 17, 35, 33 and 25. The plate circuit of the oscillator includes, in series with the plate circuit battery, a high frequency choke coil 37 and the secondary winding 39 of an audio-frequency transformer 41, which has its primary winding 43 energized from an audio-frequency source of electromotive force 45 through a circuit comprising a switch 47. The coil 37 impedes high frequency current which might traverse the distributed capacity of a low frequency transformer coil or choke coil and compels all high frequency space currents from the plate to pass through the tuned circuit to the filament. The condenser 29 and grid leak resistance 35 cause the grid of the tube to be maintained at an appropriate negative potential with respect to the filament. The high frequency choke coil 33 prevents energy dissipation due to the flow of high frequency current through the grid leak resistance 35, as explained in Heising Patent 1,452,339, April 17, 1923.

The grid of the oscillator is conductively connected to the grids of the amplifier through a path comprising conductor 31, choke coil 33, grid leak resistance 35, grid leak resistance 15 and choke coil 13. The key 17 when closed connects the filaments of the oscillator and the amplifier to this path at a point 49 between the grid leak resistances 35 and 15. Thus when the key is closed the grid leak circuits of both the oscillator and the amplifier are complete and consequently the oscillator generates oscillations and the amplifier amplifies the electrical variations transmitted to it from the oscillator. When the key 17 is opened, it opens the grid leak circuits of both the oscillator and the amplifier. Therefore the oscillator blocks, and because the oscillator grid is conductively connected to the amplifier grids through elements 31, 33, 35, 15 and 13, it blocks the tubes of the amplifier also. The generation of oscillations and the amplification of the wave from the oscillator, in response to the closing of switch 17, and the blocking of the oscillator and the amplifier upon the opening of the key, occur regardless of whether or not the switch 47 is closed to cause the oscillator wave to be modulated.

When switch 47 is closed, audio-frequency power from generator 45 is superimposed upon the plate power supply of the oscillator, and accomplishes audio-frequency modulation of the sustained superaudible wave

generated by the oscillator. This method of modulation, and means for practicing the method, is claimed in U. S. patent to Hartley No. 1,592,934, July 20, 1926.

Thus, to operate the system for transmitting signals in interrupted continuous wave telegraphy, the keying of the signals is performed by closing and opening key 17, and switch 47 may be either open or closed; and to operate the system for transmitting signals in tone telegraphy, the switch 47 is maintained closed and the keying of the signals is performed by closing and opening key 17.

Preferably a condenser 51 connects the amplifier filaments to the junction of choke coil 13 and grid leak resistance 15 to insure that the time constant of the circuit for discharging the accumulated negative charges on the grids of the amplifier is greater than that of the circuit for discharging the accumulated negative charges on the grid of the oscillator. Then upon the closing of the key 17 the amplifier will remain inoperative until oscillations have built up in the oscillator. This overcomes any tendency of the amplifier to be shock excited into oscillations by the oscillator. As soon as the oscillations in oscillator 0 have built up to normal value, those oscillations determine the oscillation frequency for the system as a whole and there is no longer danger that the power amplifier will oscillate. Thus there are prevented deleterious effects which might be caused by oscillation of the power amplifier, such as, for example, (1) danger of injury to the amplifier tubes due to highly energetic oscillation of those tubes, and (2) ineffectiveness of key 17 to exert the desired control over waves transmitted from the amplifier. The preferable value for the time constant of condenser 51 and resistance 15 is a value between the keying period and the audio-frequency period. Although the condenser 51 is not always essential in the circuit it usually improves the operation of the system.

The space current sources which, for the sake of simplicity, are separately indicated in the plate circuit of the oscillator and the plate circuit of the amplifier, are intended to represent any suitable means for supplying space current to the oscillator and the amplifier, and may be a battery or other source of direct current common to the oscillator and the amplifier.

What is claimed is:

1. The method of operating an electric space discharge tube having a cathode and an electric space discharge device connected to said tube for influencing the output wave of said tube, which comprises causing transmission through said device to be blocked intermittently in accordance with a tele-

graphic code by accumulation of electrons from said cathode of said tube.

2. A method of operating an electric space discharge oscillator having a cathode and a space discharge device having an impedance control element and being connected in tandem relation to said oscillator, which comprises causing the space current through said device to be blocked intermittently in accordance with a telegraphic code by accumulation of electrons on said element from said oscillator cathode.

3. A system comprising an electric space discharge oscillator, an electric space discharge amplifier for amplifying waves from said oscillator, said oscillator and said amplifier each having a control element, means for producing from waves traversing the system biasing potentials for said control elements and common signal keying means operatively associated with said first means to block said oscillator and said amplifier.

4. A system comprising an electric space discharge tube for transmitting electric variations, an electric space discharge device for amplifying variations transmitted from said tube, said tube and said device each having an impedance control element and an electron emitting cathode, means for preventing electrons discharged from said cathodes to said impedance control elements from blocking transmission through said tube and said device, means whereby said preventing means may be disabled intermittently in accordance with a telegraphic code, and common means for supplying blocking potentials to said control elements of both said tube and said device when the preventing means is disabled.

5. A system adapted for transmitting tone telegraph signals and interrupted continuous wave telegraph signals, said system comprising means for generating continuous waves and modulating said waves at a frequency in the audible frequency range, an electric space discharge amplifier associated with said generating means, said generating means and said amplifier each having an anode, a cathode and a grid, means conductively connecting said grids, and signaling means whereby said last mentioned means may be conductively connected to said cathodes in accordance with a telegraphic code.

6. A signal transmitting system comprising two electric space discharge devices connected in tandem relation each having a cathode and a control electrode, a conductive path connecting the cathode of each tube to the control electrode of that tube, said paths being partly common, and a signal responsive switch in said common portion of said paths.

7. A system comprising an electric space discharge oscillator, an electric space discharge amplifier for amplifying waves from said oscillator, said oscillator and said am-

plifier having grids and cathodes, individual grid leak paths for said oscillator and said amplifier, common means for interrupting said paths, and means for rendering the time constant of discharge of said paths for negative charges accumulated on said grids greater in the case of the amplifier than in the case of the oscillator.

8. A system in accordance with claim 7, in which are comprised high resistances individual to said paths, said means for rendering said time constants different comprising a condenser in shunt relation to the space path between the grid and the cathode of the amplifier, with respect to one of said resistances.

9. A system comprising an electric space discharge oscillator, means for producing audi-frequency modulation of said oscillations, an electric space discharge amplifier associated with said oscillator and said modulating means, individual grid leak circuits for said oscillator and said amplifier, a key for keying said circuits in accordance with a telegraph code, and impedance for giving the time constant of the grid circuit of said amplifier a value between the keying period and the audi-frequency period.

10. In a transmitting system, means to generate continuous carrier waves and tone-modulated carrier waves alternatively, means to amplify the generated waves, and a signal responsive circuit closer connected to the generating and amplifying means and operative for either continuous or tone modulated waves to intermittently interrupt the generation of the waves and disable the amplifying means.

11. In combination a space discharge device for transmitting waves, a second space discharge device for transmitting waves received from the first device, each device having space discharge electrodes and a grid or control element, means individual to said devices normally producing a biasing potential for the respective grids, a switch for rendering the first device inoperative to transmit waves and means controlled by said switch for applying to the grid of the second device a biasing potential from the biasing potential producing means individual to the first device.

12. In combination, a space discharge device for generating oscillations, a space discharge device associated therewith for amplifying the oscillations, each device having a grid or control element, a grid-leak path for each device for biasing the respective grid, said paths being in part common, and means to give the grid leak path of the amplifying device a different time constant from that of the oscillation generating device for reducing the alternating potential impressed on the grid of the amplifying device via the grid leak connections.

13. In a high frequency signaling system,
an oscillation generator, a high frequency
amplifier connected to amplify the oscilla-
tions produced by said oscillation generator,
5 a control circuit for said oscillation genera-
tor, a control circuit for said high frequency
amplifier and a common means comprising a
single pair of contacts for controlling both of
said control circuits.

10 In witness whereof, I hereunto subscribe
my name this 26th day of February, A. D.
1926.

RAYMOND A. HEISING.

15

20

25

30

35

40

45

50

55

60

65