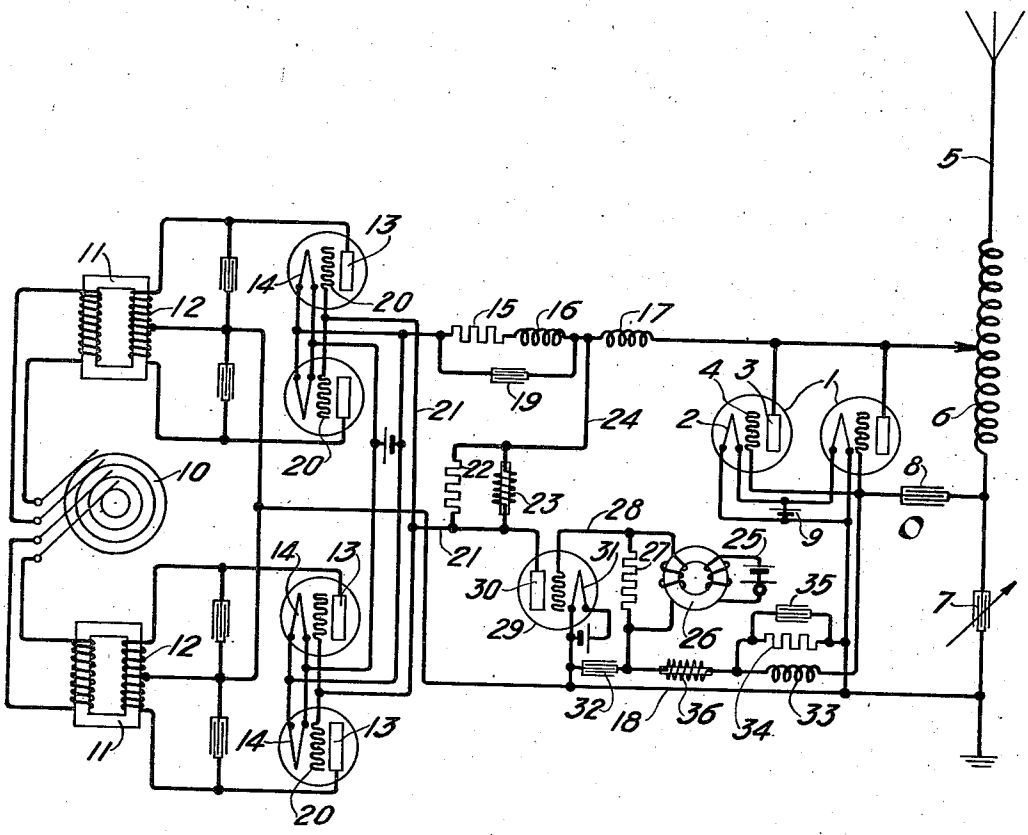
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J. C. GABRIEL

WAVE MODULATING

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WAVE MODULATING.

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To all whom it may concern:

Be it known that I, JOHN C. GABRIEL, a subject of the King of Great Britain, having taken 1st papers U. S. A., residing at New York city, in the county of New York, State of New York, have invented certain new and useful Improvements in Wave Modulating, of which the following is a full, clear, concise, and exact description.

This invention relates to systems for and methods of producing modulated waves and more particularly to systems utilizing space discharge devices and adapted to produce modulated oscillations for high frequency transmission. The invention is herein illustrated in a radio system.

One important feature of the invention consists in the provision of means for connecting a signaling wave controlled device to a modulating device in two ways, each of which produce modulation and which together cooperate to modulate more effectively. The signal controlled device operates directly on the modulating device and also indirectly thereon through the agency of an intermediate variable impedance device or system of variable impedance devices. In the preferred form the intermediate variable impedance system comprises several discharge tubes arranged to rectify several phases of alternating current and impress the combined rectified current on the modulating device, more briefly styled, the modulator. As a result of the unidirectional conductivity of the variable impedance tubes the current is variably rectified in accordance with the signals and the resulting waves into which the rectified current is translated are correspondingly modulated in amplitude. Due to the direct action of the signal controlled device, which is preferably arranged in parallel with respect to the modulator, a further modulation or variation in amplitude of the waves results. In the preferred form the modulator comprises an oscillation generator of the type having appropriate tuned circuits connected to a heated electron emitting filamentary cathode, an anode, and an impedance controlling element of a space discharge device. In accordance with this system a variable impedance signal controlled device very effectively controls the production of the modulated waves.

For a detailed description reference is made to the accompanying drawings which comprise a circuit diagram of a radio telephone transmitting system involving the various features of the invention.

The discharge tubes 1 are of a well known type each comprising a suitably evacuated vessel containing a cathode 2, an anode 3, and an impedance controlling element 4. Several tubes arranged in parallel are shown for producing more high frequency power than one tube is capable of handling. Each electrode is connected to a tuned antenna circuit 5 comprising inductance 6 and capacity 7. The connection of the grid or impedance controlling element is through the usual stopping condenser 8. These elements are connected to a filament heating source 9 and a space current source hereinafter described. The above described elements constitute an oscillation generator 0 of a well known type for producing in the antenna circuit high frequency oscillations.

The energy for supplying the space current to the oscillator is derived from two phases of a quarter phase generator 10. These phases are connected respectively to the primaries of transformers 11 whose secondaries 12 are divided into halves, each half having connected thereacross a space current path which lies between the anode 13 and the cathode 14 of a plurality of rectifying devices similar to device 1. The path of the rectified current resulting from any phase may be traced as follows: beginning at secondary 12, to an anode 13, the corresponding cathode 14, resistance 15, inductance coil 16, inductance coil 17, anode 3, cathode 2, and conductor 18 returning to the point of beginning. The several rectified phases will be combined in the circuit containing the tubes 1 to form a continuous uni-directional current. The condenser 19 is connected around resistance 15 and coil 16. This condenser allows variations of the speech or signaling frequency to pass around coil 16 which may be adjusted with respect to the capacity of the condenser 19 so that the circuit 15, 16, 19 is resonant to the harmonic which results from combining the four phases derived from the four halves of the secondaries 12. The amplitude of this harmonic will be reduced by this resonant circuit. The coil 17 is a high frequency inductance coil designed to offer a high impedance to the high frequency current generated by the oscillator 0. Resistance 15 serves to impress a desired

negative working potential upon the control elements 20 due to the drop of potential across the resistance caused by the uni-directional current flowing therethrough. The grids 20 are connected to this resistance through a circuit comprising a conductor 24, the resistance 22 and coil 23 in parallel, and the conductor 21.

Microphone circuit 25 represents any suitable source of signaling waves such as a telephone line connected to the primary of the transformer 26. Across the secondary of this transformer is connected the resistance 27 which serves to impress the signaling variations on the grid circuit 28 of an amplifying tube 29 whose space current circuit may be traced as follows: beginning at the anode 30 through resistance 22, conductor 24, coil 16, resistance 15, cathodes 14, anodes 13, secondaries 12, and conductor 18 to the cathode 31. This circuit includes the resistance 22 which is also included in the grid circuit, that is, the circuit between the grids and the cathodes of the rectifying tubes. Waves applied to the input circuit 28 cause corresponding variations of current through the resistance 22 and thereby vary the potential of the grids 20 with respect to their associated cathodes 14. This causes the impedance of the rectifying tubes to vary in accordance with the impressed signaling waves thereby causing a corresponding variation in amplitude of the rectified current. Coil 23 serves as a low resistance path for direct current supplied to the tube 29 but as a high impedance to the speech variations which are thereby caused to pass through the resistance 22. Thereby the resulting variation in amplitude of the rectified current will cause corresponding variations in the amplitude of the high frequency waves produced by the oscillator 0. However, the tube 29 is connected to the oscillator 0 in such a manner as to cause a further variation of the waves. This is due to the fact that the space current path of the tube 29 is connected in parallel with respect to the tubes 1. When signaling waves act upon the device 29 so as to decrease its impedance the impedance of the rectifying tubes is increased. At this instant therefore the amplitude of the unidirectional current supplied to the device 1 is decreased. It is still further decreased, however, by the fact that additional current flows through the device 29 at this instant because of its lowered impedance. The grid of tube 29 derives its working potential from the tubes 1 since it is connected to the side of the leak resistance 34 next to the grids 4. When speech currents make tube 29 of low impedance, the impedance of the rectifying tubes becomes large, and the oscillations generated by tubes 1 become smaller. At this time the leak current through resistance 34 becomes smaller and therefore the impedance of tube 29 becomes still smaller, owing to its decreased negative grid potential which results from the decreased drop across the resistance 34. Any tube in the system may have additional tubes connected in parallel with it to increase the power capacity.

A condenser 32 in the input circuit of tube 29 serves to insulate the grid of this tube from the space current circuits. Inductance coil 33 and resistance 34 form a leak path connecting the grid 4 of the device 1 with the cathode 2. A condenser 35 is advantageously connected around the resistance 34. Inductance coil 36 is designed to prevent signaling frequency variations applied to the grid circuit 28 from reacting directly upon the grid circuit of the device 1.

One form of the invention having been described, the novel features believed to be inherent therein are defined in the appended claims.

What is claimed is:

1. A space discharge system comprising a source of current, a space discharge device supplied thereby, and a second space discharge device connected to said source and to said first mentioned device by means acting upon said source tending to vary the total current supplied thereby and simultaneously to vary in an inverse manner the proportion of the supplied current applied to said first mentioned device.

2. A space discharge system comprising a source of current, means for the production of modulated oscillations supplied thereby, and a space discharge device connected to said source and to said means by other means acting upon said source tending to vary the total current supplied thereby and simultaneously to vary in an inverse manner the proportion of the supplied current applied to said means.

3. A modulating system comprising a modulating space discharge device, a signal controlled space discharge device and a source of current for said devices, said signal controlled device being connected to said source and modulating device by means whereby it simultaneously acts to increase the current supplied by said source at the instant that it acts to increase the proportion of the supplied current furnished to said modulating device and vice versa.

4. A modulating system comprising a producer of modulated oscillations, a signal controlled device acting directly thereon to cause modulation of the oscillations in accordance with a certain wave form, a third device, and means whereby said signal controlled device acts indirectly through said third device to cause additional modulation of the oscillations in accordance with the same wave form.

5. A modulating system for signal trans-

mission comprising a space discharge oscillation generator for producing relatively high frequency oscillations, a source of low frequency modulating electrical variations acting thereon to cause modulation of the oscillations, in accordance with a given wave form, a third device, and means whereby said low frequency source acts indirectly through said third device to cause additional modulation of the oscillations in accordance with substantially the same wave form.

6. A radio transmission system comprising an antenna, a space discharge device having its input and output circuits inter-coupled and associated with said antenna for the generation of oscillations therein, a speech controlled device acting thereon to cause modulation of the oscillations, a third device and means whereby said speech controlled device acts indirectly through said third device to cause additional modulation of the oscillations in accordance with the same wave form.

7. In a signaling system, a modulating device, a source of alternating electromotive force and a rectifying device, said devices and said source being included in a series circuit, and signal controlled means for varying the impedance of said rectifying device and simultaneously acting directly upon said modulating device to vary the current flow therethrough.

8. In a signaling system, a wave modifying device for effecting changes in the amplitude of carrier frequency waves in accordance with changes of a unidirectional electromotive force impressed thereon, a source of alternating electromotive force, a rectifier for supplying unidirectional current from said source to said device, means for changing a characteristic of said rectifier in accordance with signals, and means whereby said last mentioned means acts directly upon said wave modifying device.

9. A method of producing oscillations varied in amplitude in accordance with a given wave which comprises rectifying alternating current and at the same time variably controlling the rectification so as to produce unidirectional current varying in amplitude in accordance with said wave, supplying said varying direct current to the space current path of an electron discharge oscillator, and separately acting on said oscillator in accordance with said wave.

10. In a signaling system, an electron discharge device, an anode and a cathode therefor, said anode and said cathode constituting the terminals of a discharge space, a source of alternating electromotive force, and means including a signal controlled space discharge amplifier to cause said source to impress upon the terminals of said space a unidirectional voltage which varies in accordance with signals, said space discharge amplifier having its discharge path in shunt to said space.

11. A modulating system comprising a space discharge device for producing waves modulated in accordance with waves of lower frequency, a source of current therefor, a variable impedance device in series with said space discharge device and said source, another device controlled by waves of said lower frequency operative to vary the impedance of said variable impedance device and means whereby said other device acts upon said space discharge device dependently of variations in said variable impedance device.

12. A system comprising a plurality of sources of alternating current not in phase with each other, means operable to variably impede and rectify the current from said sources, means variably operable in response to variations in said rectified current to translate the rectified current into signaling waves, and a wave controlled repeater operable to act directly upon each of said means.

13. An electron discharge system comprising three distinct groups, each consisting of at least one space discharge device, the space discharge path of two of said groups being in parallel and said parallel combination being in series with respect to the third of said groups, and a signaling device for varying the impedance of one of said paths.

14. An electron discharge system comprising three groups, each containing at least one discharge device, each group having a space discharge circuit, two of which circuits form a parallel combination in series with respect to the third such circuit, each of said groups having a plate circuit and a grid circuit, the plate circuit of one group being connected to the grid circuit of another group.

15. In a modulating system, a space discharge device for producing modulated oscillations, a circuit including said space discharge device, a variable impedance device in series with said space discharge device, a variable impedance device in shunt to said space discharge device, and a source of signaling waves for varying the impedance of both said space discharge devices in opposite phase with respect to each other.

16. The method of modulating comprising supplying energizing current to an electrical device, varying the impedance of a device in series with the current supply source in accordance with modulating waves, and varying in opposite phase relation the impedance of a device in shunt to said electrical device as viewed from the source of energizing current.

In witness whereof, I hereunto subscribe my name this 10th day of December A. D., 1920.

JOHN C. GABRIEL