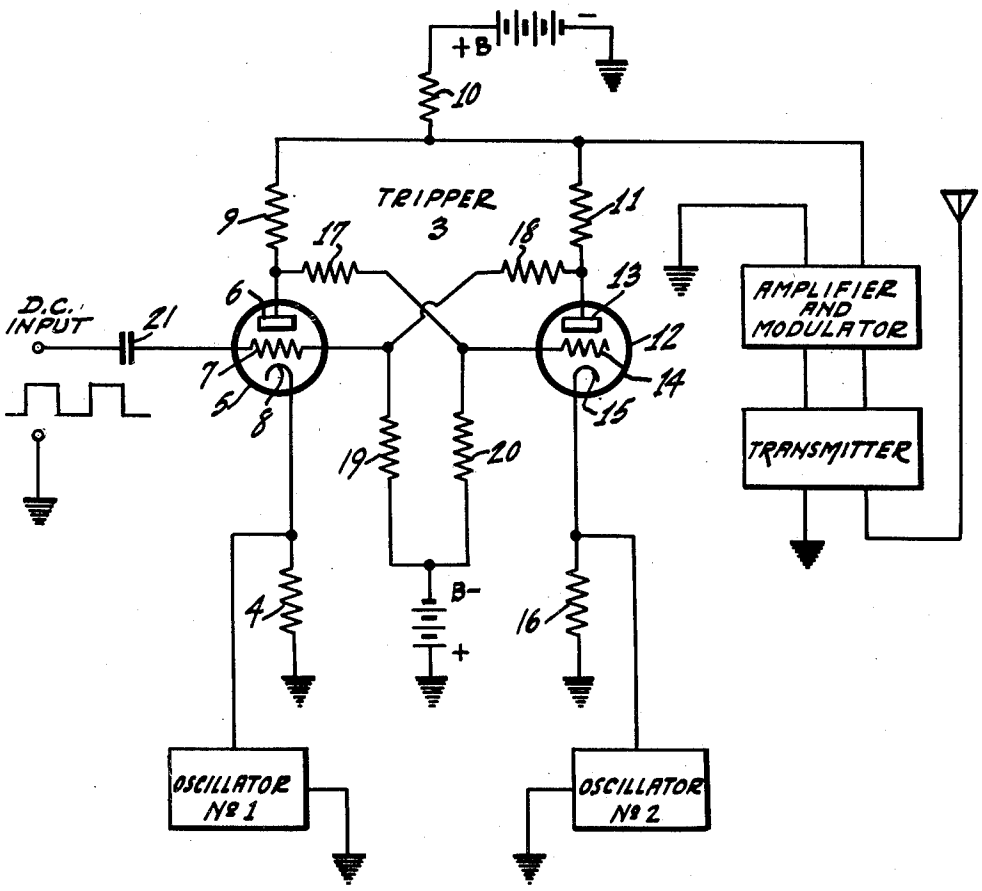
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FREQUENCY SHIFT KEYER

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FREQUENCY SHIFT KEYER

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1 Claim. (Cl. 250—27)

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This application relates to means for producing oscillations, the frequency of which depends on the strength of direct current or on the polarity of pulse energy.

The invention is obviously of wide use in the radio and allied art since, by its use, oscillating voltages or current whose frequency is determined by the direct current strength or pulse polarity are obtainable.

My invention is particularly applicable to frequency shift telegraph systems, and in the description which follows reference to such use is given by way of example.

In frequency shift telegraphy systems (also referred to as spaced wave telegraphy systems) signalling is carried on with oscillations of two frequencies alternately present. One frequency may be referred to as the mark frequency and the other the space frequency. These systems have characteristic of "on" "off" telegraphy systems but in many respects may be treated as frequency modulation systems, since oscillations of a frequency which changes in accordance with changes in signal levels are used. At the receiver the energy, i. e., mark and space oscillations, are subjected to a frequency selection of discriminating action and rectified to derive current or voltage characteristic of the signals at the transmitter.

The general object of my invention is improved production of oscillatory energies of different frequencies, alternately produced, by means of direct current voltages or pulses of reversible polarity.

A more specific object of my invention is improved production of oscillations representing marking signals and alternately produced oscillations representing spacing signals in a telegraphy system. The produced oscillations may be of any frequency such as, for example, of tone frequency. They may be sent to the receiver directly but are preferably used to modulate higher frequency oscillations which are used to carry the signal to the receiver.

Briefly, the above objects and others, which will appear from the description which follows, are attained in accordance with my invention by the use of a locking circuit somewhat similar to that disclosed in Finch U. S. Patent #1,844,950, dated Feb. 16, 1932, to which is applied the outputs of two oscillators differing in frequency. The locking circuit comprises two tubes or tube sections with the grids and anodes cross-coupled so that when one tube conducts the other is blocked and vice versa. When one section of

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the locking circuit conducts, output from one oscillator is amplified and the output of the locking circuit is of one frequency. When the other section conducts, output from the other oscillator is amplified and the output of the locking circuit is of the second frequency. The locking circuit is controlled by a direct current potential applied to one grid. If the direct current potential is a signal and has one value representing mark and a second value representing space, when the signal is on mark, frequency #1 is obtained, and when on space, frequency #2 is obtained.

An additional object of my invention is improvement of locking tube circuits. This improvement resides in provision of cathode biasing resistances which provides negative bias between the grids and cathodes. These bias resistances also serve as input impedances to which currents or potentials to be keyed through the locking tubes may be applied.

In describing my invention in detail reference will be made to the attached drawings in which the single figure illustrates by circuit connections and block diagram an arrangement for producing oscillations of one frequency in the presence of direct current potential which may represent marking conditions and oscillations of a second frequency in the presence of direct current potential which represents spacing conditions. The tubes 5 and 12 with resistances 9, 11, 17, 18, etc., provide a tripping or locking circuit similar in some respects to that disclosed in Finch U. S. Patent #1,844,950. In my improved system, however, cathode resistances 4 and 16 are included as shown to raise the cathodes 8 and 15 positive with respect to ground potential.

Oscillation generator 1 and oscillation generator 2 have outputs coupled respectively to the resistances 4 and 16 in the cathode return circuits of tubes 5 and 12 respectively.

The anodes 6 and 13 of the tubes are coupled by resistances 9 and 11 and common resistance 10 to the positive terminal of a source of direct current the negative terminal of which is connected to ground. The negative terminal of another source of D. C. is connected to the grids 7 and 14 of the respective tubes 5 and 12 by resistances 19 and 20, and the positive terminal of this source is connected to ground. The anodes 6 and 13 are cross-coupled to the grids 14 and 7 by resistances 17 and 18 respectively.

The connections, element value and D. C. source are such that if plate current commences to flow

in say tube 5 while tube 12 is conducting, the potential drop in resistance 9 applies a less positive potential to the grid 14 to reduce current in the tube 12 and the effect builds up until all current is tripped through tube 5 and tube 12 is cut off. This condition remains until negative potential on the grid 7 reduces the current through tube 5, thereby raising the voltage at plate 6. A portion of this change in voltage is coupled into grid 14 by resistor 17 and is sufficient to raise the grid voltage above cutoff so that current flows through tube 12, and by the action described above trips all current through tube 12 and cuts off tube 5.

The oscillators in 1 and 2 may be of any appropriate type provided that they possess the required features, i. e., sufficient output of about constant frequency and of the desired frequency. Preferably the two oscillators are to have the same amplitude of output. The outputs should be of different frequencies and the frequency separation should be such as to permit separation of the oscillations at the receiver. The oscillators may be of the tuned circuit or of the R. C. type. The frequencies of the oscilaltors 1 and 2 may be as desired. In the example given they are of tone frequency, one representing mark and the other space.

The invention consists of two constant frequency oscillators 1 and 2 and a locking circuit 3. Resistors 4 and 16 are placed in the cathodes 8 and 15 of tubes 5 and 12 to provide grid bias when the tubes are conducting and to provide a means of coupling the tones from oscillators 1 and 2 into the locking circuit. Resistors 17 and 18 are the usual coupling resistors, resistors 9 and 11 are the D. C. plate load resistors and 19 and 20 are the grid resistors. D. C. telegraph signals are shown coupled to grid 7 through capacitor 21. The output is obtained across resistor 10.

When tube 5 conducts, the alternating voltage across resistor 4 is amplified and appears across resistor 10. A portion of this voltage is coupled through resistor 17 to grid 14, but the locking circuit is so arranged that when the tubes are cut off, these alternating current variations are of insufficient amplitude to bring the tubes' grids above cutoff and allow current to flow in the tubes and hence the alternating current tones cannot control the locking circuit. The same is true when tube 12 conducts.

If the signal applied to grid 7 becomes negative, tube 5 will be cut off, as described hereinbefore, current is tripped to tube 12, and tube 12 will

begin to conduct in the usual manner. Now tube 12 will amplify the voltage from source 2 across resistor 16 and oscillations of the frequency of oscillator 2 will appear in the output. When the direct current potential fed to the grid 7 swings positive tube 5 conducts and tube 12 is cut off. Then oscillations from source 1 applied to resistance 4 are amplified in tube 5 and appear at the output. Thus, when the telegraph signal is on mark we obtain say oscillations of the frequency of source 1, and when the telegraph signal is on space we obtain oscillations of the frequency of say source 2, and we thus have a frequency shift keyer.

The direct current potential at the junction of resistors 9, 10 and 11 will remain constant over an entire cycle of the locking circuit since the two sections of the locking circuit are chosen to be symmetrical. The impressed keying rate therefore does not appear in the output of the device.

What is claimed is:

In a frequency shift telegraphy system, two tubes each having electrodes including an anode, a cathode, and a control grid, an impedance connected to the anode of each tube, a separate unbypassed resistance connecting the cathode of each tube to ground for maintaining the cathode of each tube above ground with respect to alternating current and direct current potentials, said separate resistances also serving to provide negative bias on the control grids of the respective tubes, resistances cross-coupling the anodes and control grids of the tubes so that when one tube draws current the potential drop in the impedance coupled to its anode is supplied to the grid of the other tube which is cut off thereby and vice versa, a source of oscillations of a first frequency coupled to the cathode of one tube, a source of oscillations of a second frequency coupled to the cathode of the other tube, a source of control potential the magnitude of which varies in accordance with signals coupled between the grid of one tube and ground and an output circuit coupled to the anodes of said tubes by a common load impedance.

JAMES R. WEINER.

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The following references are of record in the file of this patent:

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