June 6, 1939. G. M. CHARRIER 2,161,406

OSCILLATION GENERATING AND MODULATING DEVICE

Filed April 27, 1937

Fig. 1.

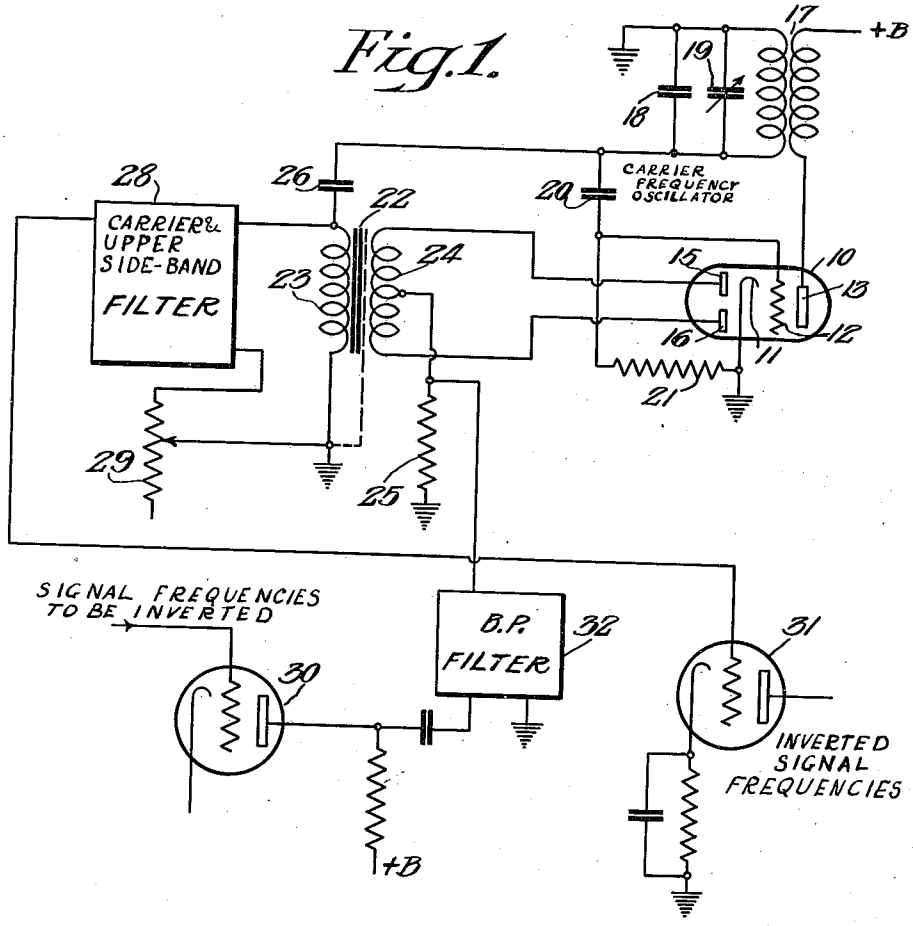
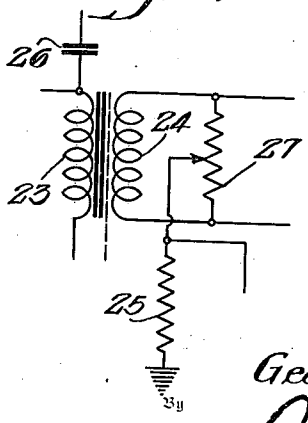


Fig. 2.



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OSCILLATION GENERATING AND MODULATING DEVICE

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Application April 27, 1937, Serial No. 139,148

3 Claims. (Cl. 179—171)

This invention relates to oscillation generating and modulating devices such as are sometimes utilized in the secret transmission of intelligence or the like, and has for its principal object the provision of an improved oscillation generating and modulating device which is less complicated than prior devices of this character. A further object is the provision of an improved method of generating and modulating impulses such as those of carrier or like frequencies.

The present invention is similar in some respects to that disclosed in my copending application, Serial No. 105,363, filed October 13, 1936, and assigned to the same assignee as the present application but differs therefrom in that the same result is achieved in a manner which is relatively simple and inexpensive.

The present invention is based on the discovery that a single electron discharge device of the diode-triode type may be made to function as a combined oscillation generator and balanced modulator of the signal suppressed type to produce a carrier which is modulated by audio or other signal impulses. To this end, the triode electrodes of the device are so interconnected as to generate the carrier impulses and the diode electrodes of the device are so interconnected as to form a balanced modulator whereby the carrier is modulated and the upper and lower side bands are made available. Although the invention is described as applied to a signal frequency inverter for use in a secret communication system wherein the lower side band or difference frequency impulses are transmitted, it is apparent that it has utility in other situations where it is desired to segregate the side bands so that they may be utilized either separately or together.

The invention will be better understood from the following description when considered in connection with the accompanying drawing and its scope is indicated by the appended claims.

Referring to the drawing,

Figure 1 is a wiring diagram of a signal frequency inverting system illustrating one practical application of the invention, and

Figure 2 illustrates a modified detail of the system of Figure 1.

The system of Figure 1 includes an electron discharge device 10 which is provided with triode electrodes comprising a cathode 11, a grid 12 and an anode 13 and with diode electrodes comprising the cathode 11 and a pair of anodes 15 and 16. Associated with the triode electrodes 11, 12 and 13 for operation as a carrier frequency oscillation generator in the audio frequency range are an oscillation transformer 17, timing capacitors 18 and 19, a grid coupling capacitor 20 and a grid leak resistor 21. Associated with the diode electrodes 11, 15 and 16 for operation as a balanced modulator are a push-pull connected balanced transformer 22 including magnetically coupled windings 23 and 24 and an impedance device, such as a resistor 25, which is connected between ground and a mid-point terminal of the push-pull connected transformer winding 24 and has applied to it the signal impulse to be inverted. The peak potential of this signal impulse must be less than the peak potential of the carrier frequency impulse. An oscillation coupling capacitor 26 is connected to the output circuit of the triode oscillator in series with the winding 23 of the transformer 22.

With these connections, carrier frequency impulses supplied through the coupling capacitor 26 and the transformer 22 are rectified by the diodes 15—16, these rectified carrier impulses are modulated by the signal impulses applied to the resistor 25 and the resultant, consisting of both side bands and the carrier, is made available at the terminals of the transformer winding 23. It will be apparent that substantially the same sequence of operation will follow if the capacitor 26 is connected to the transformer winding 24 or if the signal impulses are applied to the mid-point of a resistor 27 (Fig. 2) which is connected in shunt with the transformer winding 24, the provision of this resistor having the advantage of better balance and cleaner inversion.

The upper and lower side band impulses appearing at the terminals of the transformer winding 23 may obviously be utilized either together or separately for any customary or desired purpose. If only the lower or difference frequency side band is desired, which is the inverted signal frequency, there is connected in the oscillator-modulator output circuit a low pass filter 28 which prevents transmission of the carrier and upper side band impulses. Additional attenuation of the undesired impulses may be produced by a resistor 29 connected in the filter input circuit.

In the illustrated signal frequency inverting system, the signal impulse to be inverted is derived from the output circuit of an audio frequency stage 30 through a band pass filter 32 and the lower or difference frequency side band is applied to the input circuit of an audio frequency stage 31. The output of 31 may be used to modulate a radio

frequency carrier or transmitted in secrecy over land lines, or the like. Under these conditions, the signal frequencies are inverted as exemplified by the following table:

Signal frequency	Carrier frequency	Sum frequency	Difference frequency
300	4000	4300	3700
500	4000	4500	3500
1000	4000	5000	3000
2000	4000	6000	2000
3000	4000	7000	1000
3500	4000	7500	500
3700	4000	7700	300

Thus 300 cycles per second becomes 3700 cycles per second and 3700 cycles input produces a 300 cycle output and the other frequencies are correspondingly inverted. It will be observed that the carrier frequency is higher than the upper limit of the signal frequency.

Radio frequency carrier currents which have been modulated by currents of inverted signal frequency, may be received by a conventional radio receiver and demodulated, but the demodulated signal currents produce audio signals which are unintelligible because of the frequency inversion. These demodulated currents may be inverted to reproduce the original signals. The inverter at the receiver is essentially the same as the signal inverter at the transmitter except that the band pass filter **32** is omitted as will be readily understood without detailed explanation.

I claim as my invention:

1. The combination of an electron discharge device provided with triode and diode electrodes, means including an oscillatory circuit interconnected with said triode electrodes for generating carrier frequency impulses, means including a transformer having a center-tapped secondary winding connected to said diode electrodes for applying said impulses out of phase to said diode electrodes, means for applying modulating impulses to the center-tap terminal of said transformer and means for passing one side band resulting from said modulation and eliminating the carrier and other side band.

2. The combination of an electron discharge device provided with triode and diode electrodes, means including an oscillatory circuit interconnected with said triode electrodes for generating carrier frequency impulses, means including a transformer winding having a mid-point connection for applying said impulses out of phase to said diode electrodes, and means for simultaneously applying modulating impulses having a substantially lower potential than said carrier frequency impulses to the mid-point terminal of said transformer.

3. A combined oscillation generator and balanced modulator of the suppressed signal type including an electron discharge device having triode and diode electrodes, means interconnected with said triode electrodes for generating audio frequency carrier currents, a transformer having a primary and a center-tapped secondary winding, means including said transformer for impressing said carrier frequency currents out of phase between said diode electrodes, a source of voice frequency currents having a maximum frequency less than that of said carrier currents, means including said center tap for impressing said currents in phase on said diode electrodes, whereby said carrier is modulated by said voice frequency currents to produce upper and lower sidebands but suppressing said voice frequency currents.

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