

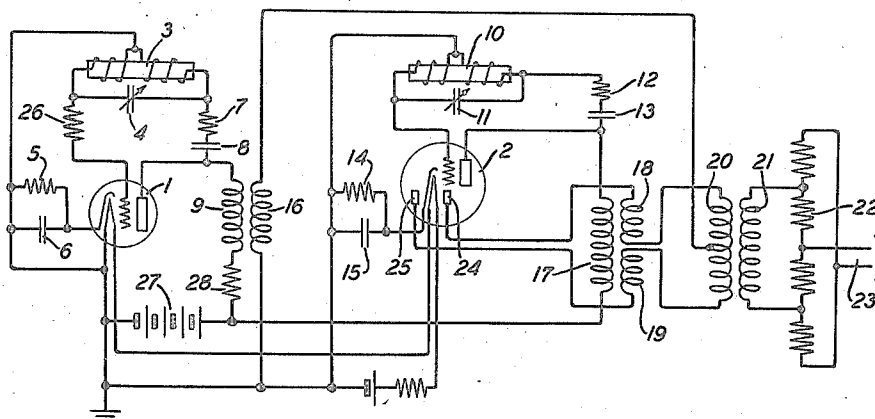
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GENERATOR OF INTERRUPTED WAVE

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GENERATOR OF INTERRUPTED WAVE

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This invention relates to a generator of an interrupted wave and more particularly a circuit organization comprising a means for periodically interrupting the output of a vacuum tube carrier oscillator without reaction, or other effect, on the vacuum tube in its primary function of carrier generation.

It is an object of the invention to achieve the above results with a maximum of simplicity and economy of plant consistently with the efficient performance of such results.

The objects of the invention are effectuated in a circuit substantially all of whose elements are used in common for generating a carrier wave, especially of the order of a voice frequency, and interrupting said carrier wave at a relatively low frequency, such as at the rate of 20 cycles a second. Compactness and simplicity, as well as superior performance are achieved by using a certain five-element tube that has been employed before for quite different functions. This tube comprises, besides the usual three elements, on account of which the tube resembles conventional three-element amplifier or detector tubes, two additional anodes which, in combination with the common cathode, are called "Diodes". The anodes of these diodes are physically as remote as practicable from the remaining elements, although using the common cathode of the tube as the terminating element of the discharge path. The three first-mentioned electrodes are used with the aid of conventional external circuit elements, in the generation of the carrier wave, the diodes functioning to complete interrupter paths. The output circuit for the carrier wave passes through these interrupter paths, and since this output circuit must necessarily also carry the interrupting current, there is an intimacy between the low frequency interrupting wave and the oscillator which tends to cause the low frequency wave to react on the tube and correspondingly vary its operation as an oscillator as by plate-modulating its oscillations as they are generated. The invention therefore further involves an association between said output circuit, space discharge path, oscillator tube and low frequency source whereby the low frequency current in its passage through the output circuit functionally organizes said output circuit so as to be balanced with respect to the output electrodes of the oscillator, while the carrier current similarly flowing through said output circuit organizes it in such a way as to be effective with relation to the output electrodes con-

stituting a part of the circuit for said output current.

The above features of the invention as well as others more fully hereinafter appearing are exemplified by the circuits and structure set forth in the following description and illustrated in the accompanying drawing the single figure of which presents an embodiment of the invention in a favored aspect.

Referring now to the drawing two conventional oscillators are shown, one generating a carrier frequency and the other generating a lower frequency than the first. The two are interconnected in such a way that the two anodes and the cathode of vacuum tube 2 act as an interrupter to connect the output of the higher frequency oscillator to the load circuit at the frequency of the lower oscillator.

The oscillator which generates the lower frequency, say 20 cycles per second, comprises vacuum tube 1, a tuned feed back circuit composed of an inductance 3 and a variable capacity 4 and an output transformer consisting of windings 9 and 16. The higher frequency generator, generating say 1000 cycles per second, comprises the grid, plate and cathode elements of vacuum tube 2, a tuned feed back circuit composed of inductance 10 and variable capacity 11 and an output transformer consisting of windings 17, 18 and 19. The output transformers of the two oscillators and the coupling transformer to the load are so connected that the higher frequency is applied to the load only during the positive half cycles of the lower frequency oscillator by means of the two anodes 24 and 25 of vacuum tube 2.

In more detail it will be seen that vacuum tube 1 is connected in an oscillatory circuit in which the plate is connected to the grid through condenser 8, resistances 7 and 26 and a tuned element composed of inductance 3 and tuning condenser 4. The natural period of this combination can be adjusted by means of variable condenser 4, and by altering the grid voltage at this frequency corresponding oscillations are produced in the plate circuit which includes transformer winding 9. This plate circuit is traced from the positive side of plate battery 27, resistance 28, transformer winding 9, the plate and cathode elements of vacuum tube 1, to the negative side of plate battery 27 through resistance 5 shunted by condenser 6. The voltage drop in resistance 5 is used to bias the grid to a negative value in the usual manner. The output appears on the winding 16 of the output transformer.

In a similar way the grid, plate and cathode 55

elements of vacuum tube 2 are used to generate a carrier frequency current. The plate is connected to the grid through condenser 13, resistance 12 and a tuned element composed of inductance 10 and tuning condenser 11. The natural period of this combination can be adjusted by means of variable condenser 11, and by altering the grid voltage at this frequency corresponding oscillations are produced in the plate circuit which includes transformer winding 17. This plate circuit is traced from the positive terminal of plate battery 27, transformer winding 17, the plate and cathode elements of vacuum tube 2 to the negative terminal of battery 27 through resistor 14 shunted by condenser 15, the voltage drop in the resistor 14 being utilized to bias the grid to a negative potential in the usual manner.

It will be noted that the carrier current output of vacuum tube 2 which appears on transformer winding 17 will be transmitted to load transformer winding 20 whenever the upper terminal of winding 18 is connected to the lower terminal of winding 19 and that these terminals are connected to the two anodes 25 and 24 of vacuum tube 2. It will also be noted that the output of the lower frequency oscillator appearing on transformer winding 16 is connected between the cathode of vacuum tube 2 and the two anodes just referred to. During the half cycle of the lower frequency wave when the upper terminal of transformer winding 16 is more positive than the lower terminal, anodes 24 and 25 are positive with respect to the cathode of vacuum tube 2. This will be apparent by tracing the circuit from the upper terminal of transformer winding 16, to the mid-point of transformer winding 20 thence by two paths, the first through the upper part of transformer winding 20 and transformer winding 18 to anode 25 and the second through the lower part of transformer winding 20, and transformer winding 19 to anode 24. The cathode of vacuum tube 2 is connected to the lower winding terminal of transformer winding 16 through resistance 14 shunted by condenser 15.

During the positive half cycle, therefore as soon as coil 16 has generated a voltage higher than the voltage drop in resistance 14 which opposes it, anodes 24 and 25 become positive with respect to the cathode of vacuum tube 2 and due to the electron flow the resistance between each anode and the cathode becomes of low value. Two paths are now completed through vacuum tube 2, one being traced from the mid-point through the lower part of transformer winding 20, transformer winding 19, anode 24 and the cathode of vacuum tube 2, resistance 14 shunted by condenser 15, transformer winding 16 to the mid-point of transformer winding 20. The other path is traced from the mid-point through the upper part of transformer winding 20, transformer winding 18, anode 25 and the cathode of vacuum tube 2, resistance 14 shunted by condenser 15, transformer winding 16 to the mid-point of transformer winding 20. As explained previously the closure of these balanced circuits completes the output circuit of the higher frequency oscillator and the higher frequency is transmitted through transformer winding 21 to the load circuit 23 through network 22 which is provided so that fluctuations in the load circuit 23 will not alter the frequency rate of the oscillators.

When the instantaneous value of voltage during the positive half cycle of the lower frequency

oscillator falls below that of the voltage drop across resistor 14 and during the negative half cycle the resistance between anodes 24 and 25 and the cathode of vacuum tube 2 is greatly increased so that the two balanced circuits traced above are effectively open. Under this condition there is no transfer of energy from the higher frequency oscillator to the load.

From the foregoing it is apparent that the higher frequency oscillator is connected to and disconnected from the load at the frequency of the lower frequency oscillator thereby producing in the load circuit a carrier frequency modulated at a frequency lower than the carrier. It should be noted also that the relative directions of the lower frequency currents in windings 18 and 19 is such that the carrier frequency is modulated by interruption only, that is, these currents have a balanced relation such as to prevent impression of an induced voltage on transformer winding 17 and hence on the plate of the tube. Were it not for this there would tend to be a plate modulation effect undesirably complicating the intended operation of the circuit.

What is claimed is:

1. A modulator circuit comprising in combination, an electric discharge device having an anode, a cathode and a control element together with at least one auxiliary anode element adapted to cooperate with said cathode to constitute discharge paths but positioned so that said discharge paths are relatively remote from the discharge path specific to said first anode and control element, external circuits associated with said cathode, first anode and control element to constitute, with them, a generator of carrier current, an output circuit for said carrier current which includes said auxiliary discharge paths, and means for impressing an alternating interrupting potential across said auxiliary discharge paths so as to interrupt the output carrier current at a corresponding frequency.

2. A modulator like that specified in the next preceding claim in which a pair of auxiliary anode elements are used, with circuit means whereby the carrier current flows through the two auxiliary discharge paths in series and the interrupter current flows through said discharge paths in parallel.

3. The modulator circuit of claim 1 in which a pair of auxiliary anode elements are used, and said interrupter potential impressing means is constituted by a circuit comprising said discharge paths in parallel and in series with a source of opposing, adjustable, biasing potential, said output circuit being so related to said discharge paths that the carrier current flows therethrough in series.

4. A modulator circuit comprising in combination, an electric discharge device having an anode, a cathode and a control element, together with two auxiliary anode elements adapted to cooperate with said cathode to constitute discharge paths but positioned so that said discharge paths are relatively remote from the discharge path specific to said first anode and control element, external circuits associated with said cathode, first anode and control element to constitute, with them, a generator of carrier current, an output transformer for said generator having a primary winding connected to said first anode and cathode, and a secondary winding connected to said auxiliary elements and including a means coupling said transformer to an energy utilization circuit, and means for impressing a modulating

potential between said cathode and the electrical mid-point of said secondary winding whereby said potential may interrupt the carrier output current at its own frequency without reaction on the primary winding of said transformer or hence on the carrier current generator elements of said discharge device.

5. The modulator circuit of the next preceding claim including additionally a source of adjust-

able negative biasing potential between said cathode and said auxiliary elements in the modulating potential circuit for predetermining the threshold values of said modulating potentials beyond which discharge occurs through said discharge paths to correspondingly vary the condition of the carrier current circuit.

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