April 13, 1937. E. A. LAPORT 2,076,787

VARIABLE CARRIER SYSTEM

Filed Dec. 24, 1935

FIG. 1

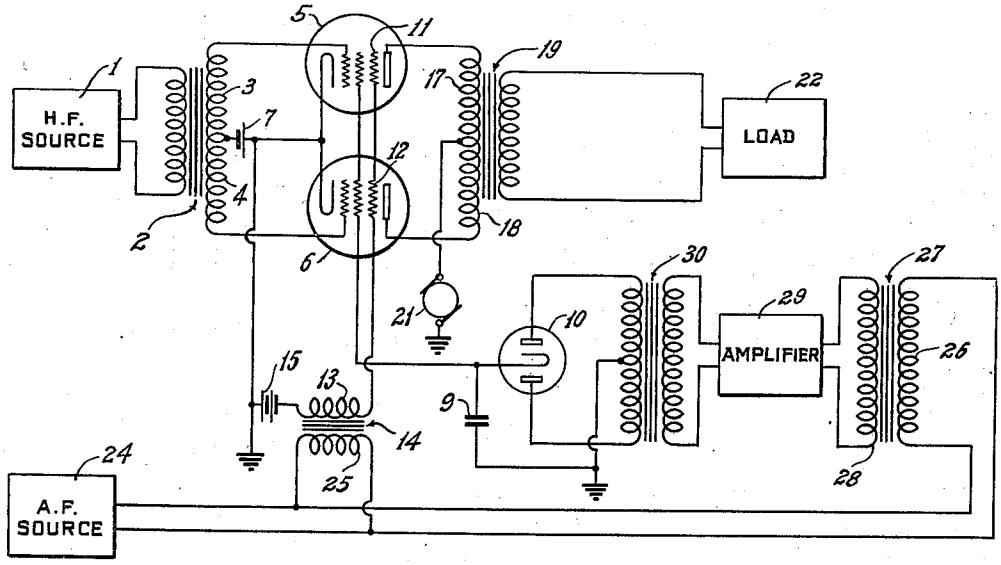
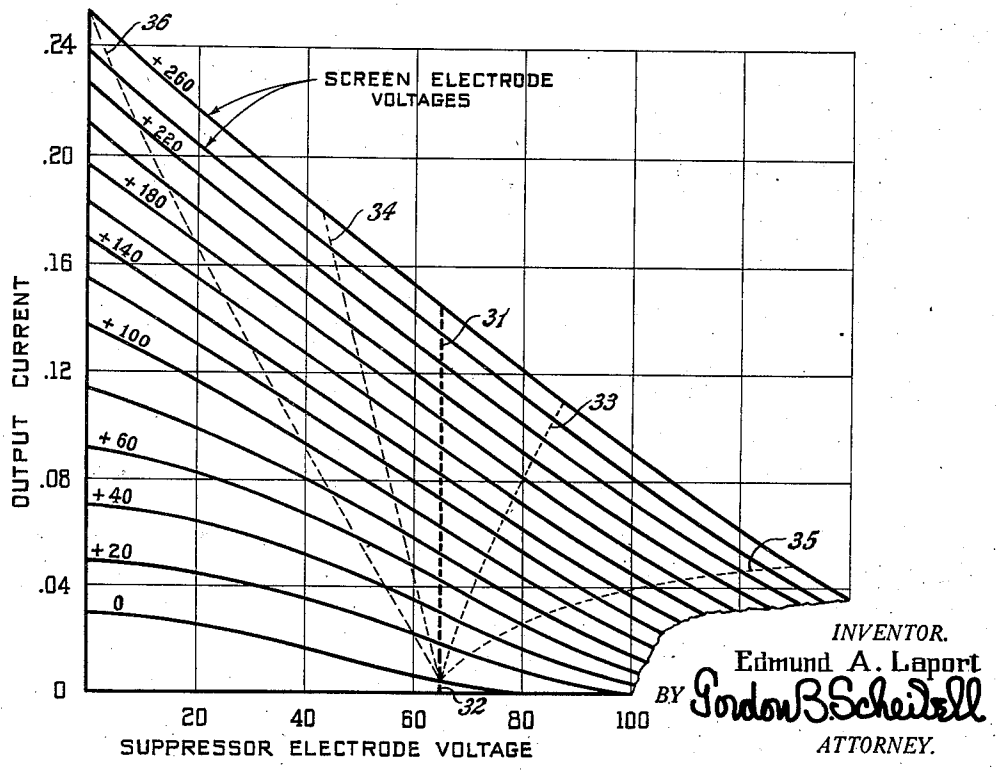


FIG. 2



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VARIABLE CARRIER SYSTEM

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3 Claims. (Cl. 179—171)

This invention pertains in general to radio transmission systems and specifically relates to the transmission of modulated high frequency energy.

One of the objects of my invention consists in providing a radio transmission system having means for producing modulated high frequency energy with the level of the carrier frequency varied in accordance with the level of the modulation energy.

A further object of the invention comprises providing a variable carrier transmission system having a transmitter with a source of high frequency oscillations modulated by a source of modulation energy to produce carrier and side band modulated high frequency energy, the high frequency energy in the range of the carrier being varied in magnitude in accordance with the level of the modulation energy.

These and other objects will be apparent from the following, reference being had to the accompanying drawing in which:

Fig. 1 is a diagrammatic representation of one embodiment of the invention; and

Fig. 2 is a graphical representation of relative dynamic zones of the operating characteristics which are employed in the system of Fig. 1.

This invention contemplates a radio transmission system for transmitting modulated high frequency energy to a radio receiver whereby the high frequency energy in the carrier frequency range is supplied to the receiver only in proportion to the magnitude of the modulation energy. That is, low values of modulation energy or audio signal will be transmitted by carrier frequency energy of low magnitude whereas modulation energy of a high level will be transmitted by carrier frequency energy of a corresponding high level. In accordance with the invention, plural electrode tubes are employed in a balanced circuit energized by a high frequency source and an audio frequency source for producing modulated high frequency energy. Further connections are provided for controlling the tubes from a rectifier-amplifier system which is controlled, in turn, by the audio frequency modulation source.

Referring to the drawing in detail, a high frequency source 1 is connected to the primary winding of transformer 2 having secondary windings 3 and 4. This high frequency source comprises means known in the art for producing sustained high frequency oscillations of a frequency suitable for carrier frequency transmission purposes. A pair of pentode electron tubes 5 and 6, of which the Type 59 is an example, are provided with their control electrodes respectively connected to the windings 3 and 4 in a balanced arrangement as shown. A source of biasing voltage 7 is provided in circuit with the midpoint of windings 3 and 4 and the cathodes of the tubes 5 and 6.

The screen electrodes of the tubes 5 and 6 are connected in parallel with a rectifier tube 10. Suppressor electrodes 11 and 12 are connected through the secondary winding 13 of a transformer 14 and thence through a source of biasing voltage 15 to the ground potential cathodes of the tubes 5 and 6. The anodes of the tubes 5 and 6 are respectively connected to primary windings 17 and 18 of a transformer 19. The midconnection of these windings 17 and 18 includes a connection to a source 21 which supplies constant, positive anode potential. The secondary winding of transformer 19 includes a connection to a load 22. The load 22 is representative of any form of utilization circuit, such as a wired radio or space radio transmitting arrangement.

An audio frequency source 24 is provided with connections to the primary winding 25 of transformer 14. The source 24 is representative of any suitable means for providing modulation or signalling energy including voice currents suitable for program purposes. This source 25 also includes a connection to the primary winding 26 of a transformer 27 having a secondary winding 28. Secondary winding 28 includes a connection directed through an electron tube linear amplifier 29 and thence through a balanced transformer 30 to the double wave rectifier unit 10.

The positive terminal of the rectifying circuit comprising transformer 30 and double diode 10 is connected to the screen electrodes of pentodes 5 and 6. Condenser 9 serves as a smoothing filter, so that the screen potential variations are reduced to syllabic or modulation envelope form. The rectifier output is dissipated in the screen circuit, the latter constituting the rectifier load circuit of sufficiently high impedance so as to give a virtually linear relation between plate voltage applied to the two plates of the diode 10 and screen current. The circuit is designed to provide for adequate power capacity in the amplifier 29 and rectifier 10 to fully energize the screen circuit within the desired ranges of operation.

Referring to Fig. 2, the solid lines show the relationships between output current into a load circuit, screen potential and suppressor potentials. The data here represented are obtained in connection with the circuit of Fig. 1, with a constant

anode potential, a constant control electrode bias and constant high frequency excitation voltage for the control electrode. Other similar families of curves would be obtainable for other values of anode potential, control bias potential and high frequency excitation energy. From Fig. 2 it can be seen that for zero screen potential, the output current becomes zero at approximately 80 suppressor volts. A suitable value of the suppressor bias is chosen from these data for zero, or nearly zero load current when the screen potential is zero, and bias source **15** is adjusted to this value. Such a choice is indicated by dotted line **31**. It will be noted that this line traverses the several screen-voltage output-current curves at very nearly the middle of their most linear portions. In the operation of the system modulation voltages are applied to the suppressor electrodes, and maximum degree of linearity is effected between output current and suppressor voltage.

In accordance with the invention, when there is no modulation energy from source **24**, and the screen voltage from rectifier **10** retains a virtually linear relationship with modulation voltage applied to the suppressor electrodes **11** and **12**, an adjustment is made which brings the screen-voltage suppressor-voltage operating zone within the boundaries of the lines **33** and **34** with point **32** as the static origin. By changing this adjustment, the suppressor-voltage variations may be made to occupy the much larger zone of operation between lines **35** and **36**, or any intermediate area. In program operation, the screen voltage varies at the syllabic or envelope rate, while the suppressor voltage follows the instantaneous program signal variations precisely. For this reason, preliminary circuit adjustment is made, using a constant signal from source **24**, to bring the operation of the circuit within the zone of lines **33** and **34**, and when typical program signals are supplied from source **24**, the instantaneous suppressor voltage variations may swing out to the limits of the zone lying between lines **35** and **36** without distortion due to overmodulation.

Bias source **7** is adjusted to a value which brings the anode current of electron tubes **5** and **6** to nearly zero when full operating anode and screen electrode potentials, as well as proper operating value of suppressor bias voltage from source **15**, are applied in the absence of excitation from source **1**. Following this, excitation from source **1** is applied until an operating voltage which has a peak value at least equal to that of bias voltage **7** has been reached. The circuit is then in condition to perform in accordance with Fig. 2.

The foregoing provides a system for the production and transmission of modulated high frequency energy in the form of modulation side band frequencies with a carrier frequency, the level of the carrier frequency being variable in accordance with the magnitude of the modulation energy available for transmission purposes. Although there has been disclosed a preferred form of the system, it will be understood that various modifications and changes can be made without departing from the intended scope of the invention. I do not, therefore, desire to limit myself to the foregoing except as may be pointed out in the appended claims.

What I claim as new and original and desire to secure by Letters Patent of the United States is:

1. A variable carrier transmission system comprising, a pair of electron tubes each including a cathode, a control electrode, a screen electrode, a suppressor electrode and an anode, a balanced input circuit included between the control electrodes and the cathodes of said tubes, means for supplying sustained high frequency oscillations to said input circuit, a modulation circuit included between the suppressor electrodes and the cathodes of said tubes, a source of modulation energy for energizing said modulation circuit, a balanced output circuit included between the anodes of said tubes, a load circuit energized by said output circuit, a double wave rectifier system operatively energized solely by said modulation energy and connected with said screen electrodes for impressing unidirectional potentials upon the same, a smoothing condenser so included in said rectifier system as to reduce the potentials applied to said screen electrodes to syllabic envelope form and a circuit extending between said source of modulation energy and said rectifier system for supplying modulation energy thereto, said high frequency source and said source of modulation energy operating said tubes to produce modulated high frequency energy with modulation side band frequencies and a carrier frequency, and said rectifier system controlling said tubes through rectified modulation frequency voltages applied to said screen electrodes to vary the output energy level of said carrier frequency in accordance with the envelope form of said modulation energy.

2. The system in accordance with claim 1 in which said rectifier system includes an amplifier for amplifying the modulation energy from the level available for said suppressor electrodes to a higher level available for rectification to energize said screen electrodes.

3. The system in accordance with claim 1 in which said screen electrodes are connected in parallel and in which said suppressor electrodes are also connected in parallel.

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