

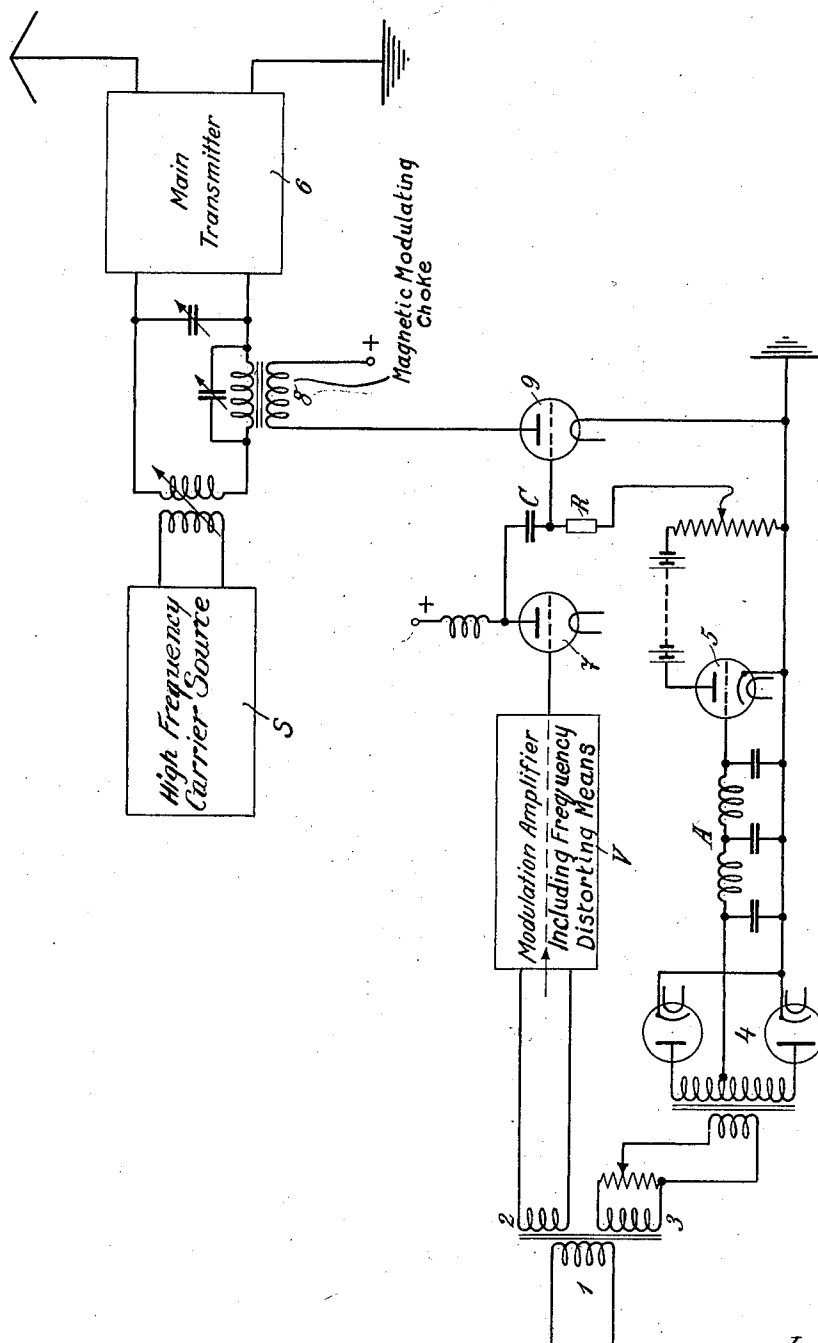
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METHOD OF MODULATING HIGH FREQUENCY TRANSMITTERS

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METHOD OF MODULATING HIGH FREQUENCY TRANSMITTERS

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There are known methods of modulation wherein the amplitude of the carrier current is changed but wherein the mean value of the carrier current is maintained constant. It has been further proposed to change also the mean value of the carrier current on modulation in such a manner that it is low in case of small modulation whereas it attains the mean value of the normal modulation in case of highest modulation in order in this way to effect savings of energy. Such a change of the mean value of the carrier current may be effected by a displacement of the working point on the modulation characteristic. The displacement of the working point is carried out by a direct current derived from the modulating current, which is displacing the working point to the lower limit in case of small modulation amplitudes and to the upper limit in case of higher ones.

In arrangements of this kind, however, it has proved that the time constant for displacing the working point must be of a definite relatively small value in order to avoid a disadvantageous overmodulation that might occur in the first moment of the modulation amplitude increasing. The displacement of the working point—as already mentioned hereinbefore—is effected by a continuous current derived from the modulating frequencies. For smoothing the continuous current there are required smoothing—or so-called flattening members. These members comprise a certain time constant. As the modulation is applied to the transmitter without delay, care must be taken that no differences of time occur between the displacement of the working point and the arrival of the modulation in the transmitter. If the modulation would reach the transmitter quicker than at any moment when the music for instance was just becoming louder an overmodulation would happen if the continuous current effecting the displacement of the working point arrived later. The working point is then not displaced whilst the modulation amplitudes are already great enough. What is valid in respect of the smoothing circuits is also valid in respect of the remaining circuits which comprise a time constant whether they are disposed in the modulation amplifier or the so-called coupling circuits, i. e. in the circuits wherein the displacing device and the modulation devices are coupled.

In order to avoid the disadvantages of such an overmodulation the smoothing devices disposed behind the rectifier by means of which the rectified low frequency modulation is converted

into a continuous current have been constructed with a time constant of a definite relatively small magnitude. The same constructions come true in connection with the coupling elements between the modulation amplifier and the proper modulation tube provided that the displacement of the working point and the modulation of the transmitter are effected in the same circuit of the transmitter.

Care must be taken that the change of modulation and of the working point respectively are effected on the characteristic approximately at the same time.

As the time constant is decisive for the transmission of the range of frequencies and as the transmission of the low frequencies becomes worse when the time constant is small, the invention proposes to employ coupling elements having a time constant of a relatively small magnitude and to compensate the drop of the low frequencies caused thereby in a prestage of the modulation amplifier by means of a corresponding predistortion.

The effect of the invention is explained with the aid of a form of construction shown in the drawing.

The low frequency modulation is introduced at 1 and takes two different routes from there. One of these, designated 2, extends through the modulation amplifier V, a usual low frequency amplifier, to the terminal tube of this amplifier 7, whilst the other route (3) leads to the rectifier 4 and over a smoothing device A and a reversing tube 5 to the modulating tube 9. Between the terminal tube 7 of the modulation amplifier and the proper modulation tube 9 there are disposed the coupling elements C and R. The real displacement of the working point is effected in modulating choke 8 connected in the grid circuit of the main stage 6 of the transmitter, which is controlled by the controlling transmitter or high frequency carrier source S. The modulation tube 9 influences the modulating choke 8, disposed in the grid circuit of the main stage 6, by means of which the change in mean amplitude of the carrier is accomplished. By means of tube 9 not only is the modulating signal delivered to the main transmitter but also the displacement of the working point is effected by changing the continuous current flowing in one winding of the modulating choke corresponding to the change of the grid bias and thus of the plate current of tube 9. The displacement of the working point of the main stage depends upon the grid bias of tube 9.

The displacing of the working point is effected by the fact that the alteration of the grid bias of the tube 9, causes an alteration of the anode direct current, which in turn produces an alteration of the magnetization of the coil 8. The alteration of this direct current magnetization of the coil 8 causes a modification of the high frequency impedance of the circuit connected in advance of the transmitter 6, therefrom results the alteration of the amplitude of the carrier frequency transmitted from the control sender 5 to the sender 6 so that it varies with the value of the modulation amplitude.

The dimensioning of condenser C and resistance R which is decisive for the time constant according to the invention is so made that a small time constant may be obtained therefor which also inherently results in greater attenuation of the low frequencies. For balancing this drop of the amplitudes of the low frequencies a predistortion is carried out in one of the prestages of the modulation amplifier V.

The time constant of the coupling elements C and R is added to the time constant essentially determined by the filter device A. The time constant of these coupling elements is essentially given by the capacity C and the resistance combination

$$R_c = R + \frac{R_{ak7} + R_{gk9}}{R_{ak7} \cdot R_{gk9}}$$

R_{ak7} showing the constant anode-cathode-resistance of tube 7 and R_{gk9} being the grid-cathode-resistance of tube 9 dependent upon the variable working point.

For dimensioning the resistance R and the capacity C the lowest frequency to be transmitted is decisive besides the voltage—or power adaptation to the tube 7. The lower the frequencies to be transmitted the greater must be the product $C \cdot R_c$, but on the other hand the time constant $T = C \cdot R_c$ shall be as small as possible.

The latter requirement can be accomplished only if, as mentioned heretofore, a drop of the amplitudes of low frequencies is admitted in these coupling elements and the balance therefor is effected at another point.

What is claimed is:

1. A modulating system comprising a high frequency carrier source, a low frequency signal source, means having a modulation characteristic, a multi-stage amplifier for amplifying the low frequency signal, means for causing the amplified low frequency signal to modulate the high fre-

quency carrier at a point on said characteristic, means for displacing said point on said characteristic in accordance with the mean amplitude of the low frequency signal, means including a low time constant circuit coupling said second and third means to said modulating means, said low time constant causing a distortion of the low frequency signal and means for predistorting the low frequency signal in a complementary sense prior to the final low frequency amplification stage.

2. In a radio transmitter which comprises a device having a modulation characteristic, a coupling circuit having a time constant, means for applying a high frequency carrier to said device, a source of low frequency signals, a signal channel including said circuit for applying said signals to said device to effect modulation of said carrier by said signals at a point on said characteristic, means for producing control voltages in dependence on the mean value of said signals, and a control channel including part of said circuit for applying said voltages to said device to displace said point of effective modulation on said characteristic, the method of compensating for the distortion of the signals due to unequal drops in amplitude thereof occasioned by the time constant of the said coupling circuit which comprises predistorting said signals in a complementary sense ahead of said coupling circuit.

3. A radio transmitter which comprises a device having a modulation characteristic, means for applying a high frequency carrier to said device, a source of low frequency signals, a first channel for applying said signals to said device to effect modulation of said carrier by said signals, means for producing control voltages in dependence on the mean value of said signals, and a second channel partially coinciding with said first channel for applying said voltages to said device to control the mean amplitude of said carrier, a signal transmitting and amplifying circuit comprising a predistorting and amplifying device in said first channel, the portion of said first channel which coincides with said second channel being proportioned so as to have a low time constant whereby frequency discrimination between different components of the signals results, and the predistorting and amplifying device being adapted to introduce an equal and opposite frequency discrimination.

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