Nov. 18, 1941. O. O. PULLEY 2,263,276

MODULATED CARRIER WAVE TRANSMITTER

Filed Feb. 3, 1940

Fig. 1

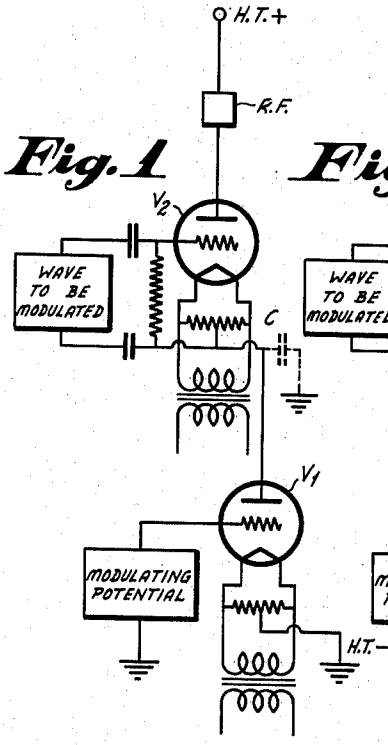


Fig. 2

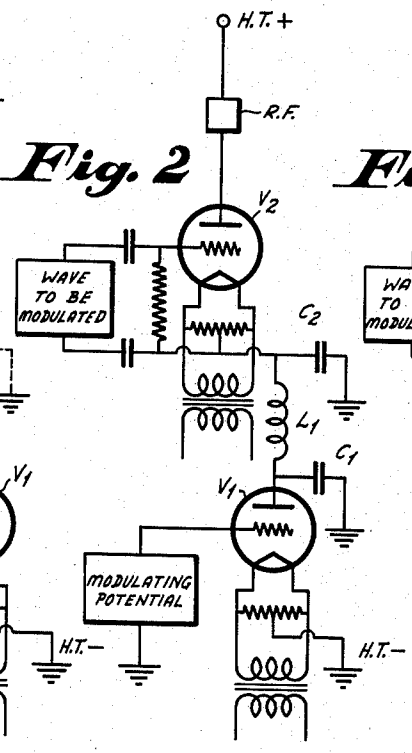


Fig. 3

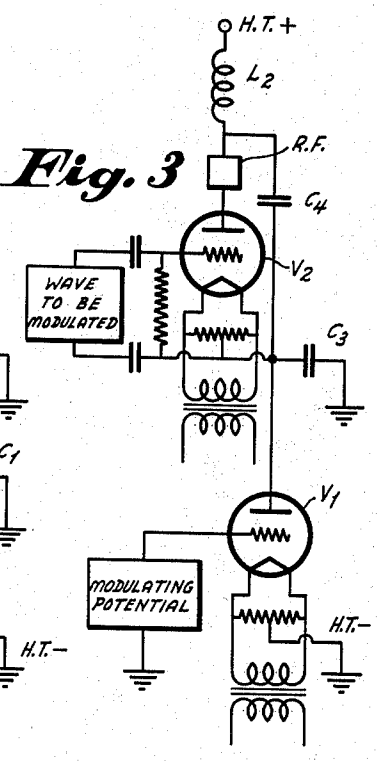


Fig. 4

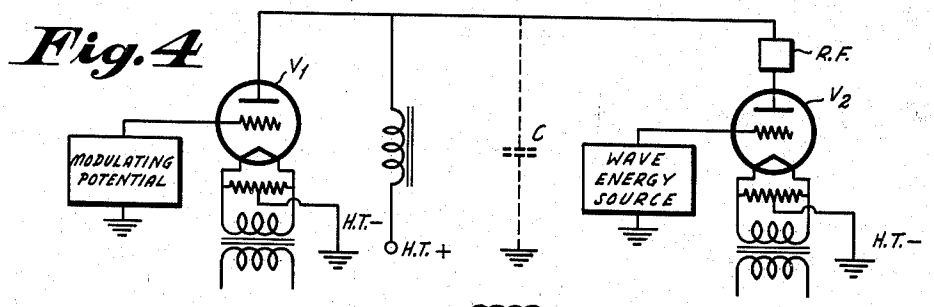
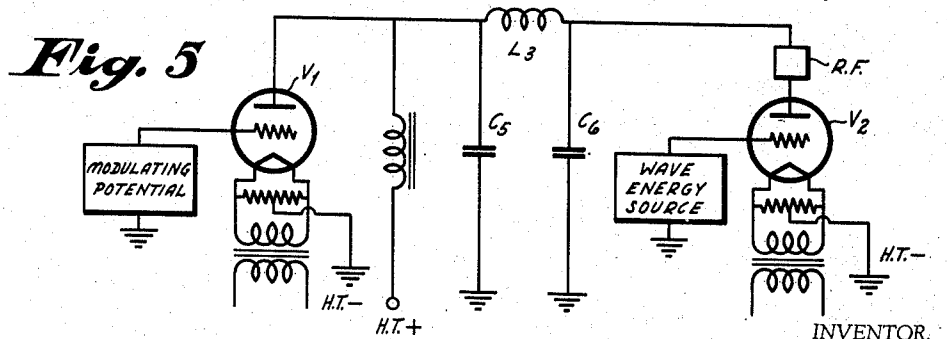


Fig. 5



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MODULATED CARRIER WAVE TRANSMITTER

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In Australia February 16, 1939

3 Claims. (Cl. 179—171.5)

This invention relates to improvements in modulated carrier wave transmitters wherein a signal applied to a valve or bank of valves, hereinafter called the modulator, varies the carrier frequency output of an oscillator comprising a further valve or bank of valves, hereinafter called the high frequency (H. F.) valves, in accordance with the amplitude of said signals.

The invention will now be particularly described with reference to two well-known systems of amplitude modulation, viz., the "series" and the Heising systems; but it will be understood that the invention may be applied also to other systems of modulation.

In the said "series" system of modulation the internal impedance of the modulator is connected in series with the high frequency valve or valves, across the high tension supply. The modulator valve may be connected either on the high tension side or on the earthed side of the H. F. valve. The present invention is hereinafter explained more particularly with reference to the case wherein the modulator valve is on the earthed side of the H. F. valve.

It is found in practice that a relatively high capacity leakage exists between portions of the H. F. valve circuits and earth, for example, between the secondary and primary windings of the filament transformer and between the filament leads and earth.

This capacity to earth may be so large as to afford a low reactance to the higher modulation frequencies and hence to constitute a reactance shunt across the load of the modulator.

In the aforesaid Heising system of modulation the modulator is in shunt to the H. F. valve and both valves are fed with high tension voltage through a common choke. Unwanted capacities exist across the modulator, including in this case the self capacity of the choke, the anode-filament capacities of the modulator and H. F. valves, and radio frequency by-pass condensers. In like manner such capacities form a reactive shunt across the modulator. At high modulation levels the non-linearity of the modulator-loads caused by these capacities results in distortion and the appearance of a form of rectification which reduces the negative peaks of modulation.

The object of the present invention is to provide improved modulation systems wherein the above disadvantages are obviated.

According to the invention unwanted capacities shunting the modulator in known modulation systems are compensated by the combination with the associated circuits of said modulator of reactance components the values of which are so chosen that the resultant load on the modulator is essentially a constant resistive impedance.

In describing my invention reference will be made to the attached drawing wherein:

Figs. 1 and 4, respectively show diagrammatically a modulation system of the series modulation type and a modulation system of the parallel modulation type;

Figs. 2 and 3 each illustrate my novel means for compensating undesirable capacities in modulation circuits of the series modulation type wherein leakage may take place; while

Fig. 5 illustrates my novel means for compensating inherent capacities in a modulation system of the parallel type wherein leakage which causes distortion may exist.

Fig. 1 illustrates a well-known system of series modulation wherein modulating potentials are applied to the input of the modulator V1 which is in series with the H. F. valve V2 across the H. T. supply. In this instance the modulator is included in the negative H. T. or earth lead to V2. Variations in impedance of V1, due to modulation potentials applied to its grid, give rise to corresponding variations of potential applied to the anode of the H. F. valve with consequent variations in output supplied to the succeeding radio frequency circuits R. F.

The R. F. circuits are represented here as being in series with the valve V2 in the H. T. lead, but it will be readily appreciated that such R. F. circuits could be shunt fed without departing from this invention.

Since the circuits of the H. F. valve V2 are at a high potential with respect to earth, stray capacity leakage to earth is likely to occur therein and such capacity may be represented by the lumped capacity C between earth and the junction of the anode of modulator V1 with the filaments of H. F. valve V2. This capacity is seen to be shunted across the modulator V1 and therefore adds a reactive component to the load thereof.

Figs. 2 and 3 illustrate two methods, according to the invention, whereby the stray capacity C of Fig. 1 may be compensated.

In Fig. 2 the stray capacity is distributed into two sections, C1 associated with the modulator anode and C2 with the filaments of the H. F. valve V2. An inductance L1 is interposed between the two capacities to form a "pi" type filter network. The capacities may be the stray existing capacities augmented, if necessary, by lumped capacities. At the highest modulation

frequency their reactance should be less than the load impedance of the modulator, and the two aforesaid sections should be approximately equal.

The value of L1 may be readily calculated with relation to the actual values of the capacities and the highest modulation frequency so that the resultant load on the modulator V1 is essentially a constant resistive impedance over the range of modulation frequencies.

An alternative arrangement whereby the stray capacity C of Fig. 1 may be computed is shown in Fig. 3 wherein one capacity section C3 lies between the common point of the modulator anode and the H. F. valve filaments and earth, and the other, C4, from this same common point to the anode of the H. F. valve. An inductance L2 is inserted in the H. T. supply to the H. F. valve. It is seen that this arrangement is similar in behavior to that of Fig. 2 and the same considerations apply to the choice of values of L2, C3 and C4. The choice of one of the alternative arrangements will depend on the particular design and arrangement of the transmitting equipment.

Although described with reference to systems of series modulation wherein the modulator is in the negative or earth lead to the H. F. valve, the invention is equally applicable to the case where the modulator is on the H. T. side of the H. F. valve. The invention then aims at compensating the stray capacity to earth from the modulator valve circuits.

Fig. 4 illustrates the aforesaid Heising modulation system. Variations in impedance of V1, due to modulation potentials applied thereto, give rise to corresponding variations of potential applied to the anode of the H. F. valve V2, with consequent variations in carrier output supplied to the radio frequency circuits. As before, unwanted capacities to earth exist in the circuit and may be represented by capacity C.

Fig. 5 illustrates how the capacity C of Fig. 4 may be compensated, according to the invention, by combination with the circuits of reactance components L3, C5, C6.

As in the foregoing example of series modulation, the values of L3, C5 and C6 are so chosen with reference to the highest modulation frequency that the resultant load on the modulator is essentially a constant resistive impedance over the range of modulation frequencies.

Disposing the capacity in two sections approximately equal is an essential point in all cases, otherwise, though the reactive load may be compensated, the equivalent resistive impedance alters and distortion limitation to modulation depth still exists.

I claim:

1. In a modulation system a high frequency stage including an electron discharge device having a cathode and a second electrode between which electrodes high frequency wave energy to be modulated flows, a relatively low frequency stage including a tube having a cathode and a second electrode between which modulating potentials flow, and circuit means for coupling said device to said tube to accomplish modulation of the high frequency by the modulating potentials and including means for compensating the capacity inherent between said device and circuits and ground to prevent the same from presenting a low reactance to the higher modulating frequencies including, an inductance, and means connecting the impedance of said device and said inductance and the impedance of said tube in the order given in a series circuit, and substantially equal capacities one of which includes the capacity between the electrodes of the device and ground and the other of which includes the capacity between the electrodes of said tube and ground connecting points in said series circuit on opposite sides of said inductance to ground, the reactance of said capacities at the highest modulation frequencies being less than the impedance load imposed by said device and circuit means on said tube.

2. In a modulation system a high frequency stage including an electron discharge device having a cathode and a second electrode between which electrodes high frequency wave energy to be modulated flows, a relatively low frequency stage including a tube having a cathode and a second electrode between which modulating potentials flow, and circuit means for coupling said device to said tube to accomplish modulation of the high frequency by the modulating potentials and including means for compensating the capacity inherent between said device and circuits and ground to prevent the same from presenting a low reactance to the higher modulating frequencies including, an inductance, conductors connecting said inductance and the impedances between the electrodes of said device and said tube in a series modulation circuit wherein the inductance is located between the said impedances, and substantially equal capacities one of which includes the capacity between the electrodes of the device and the other of which includes the capacity between the electrodes of the tube connecting points in said series circuit on opposite sides of said inductance to ground, the reactance of said capacities at the highest modulation frequencies being less than the impedance load imposed by said device and circuit means on said tube.

3. In a modulation system a high frequency stage including an electron discharge device having a cathode and a second electrode between which electrode high frequency wave energy to be modulated flows, a relatively low frequency stage including a tube having a cathode and a second electrode between which modulating potentials flow and circuit means for coupling said device to said tube to accomplish modulation of the high frequency by the modulating potentials and including means for compensating the capacity inherent between electrodes in said device to prevent the same from presenting a low reactance to the higher modulating frequencies including, an inductance connected between the said second electrode of said device and the said second electrode of said tube, a connection between the cathodes of the tube and device, and substantially equal capacities one of which includes the capacity between the electrodes of the device and the other of which includes the capacity between the electrodes of the tube connecting spaced points on said inductance to the cathodes of said tube and device, the reactance of said capacities at the highest modulation frequencies being less than the impedance load imposed by said device and circuit means on said tube.

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