Oct. 6, 1942. W. VAN B. ROBERTS 2,298,099

MODULATION

Filed March 25, 1941

Fig. 1.

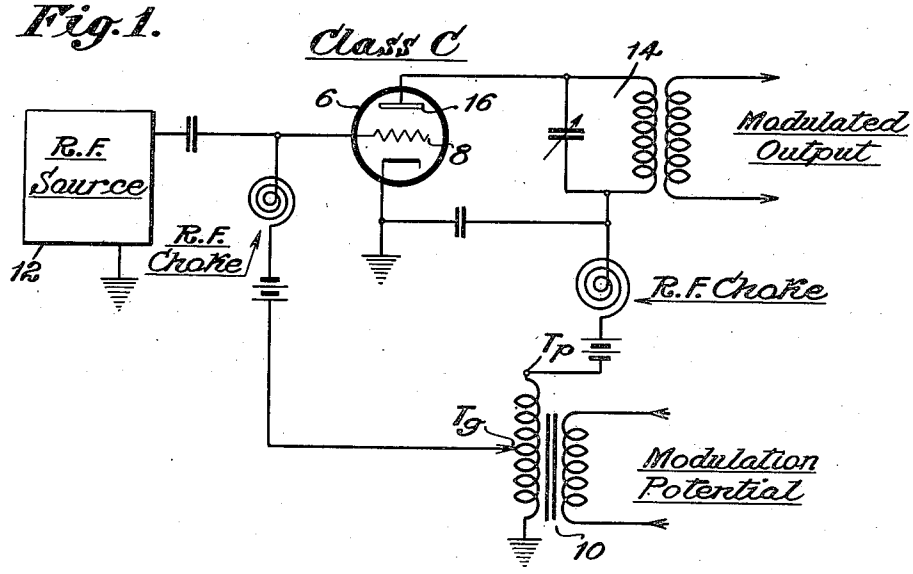
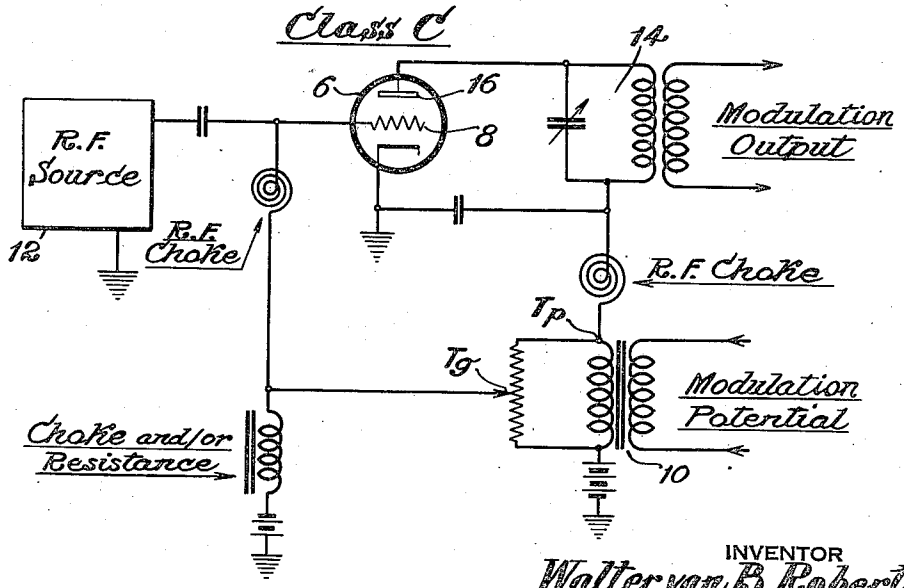


Fig. 2.



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MODULATION

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1 Claim. (Cl. 179—171.5)

The present invention relates to amplitude modulation of a carrier wave generally. The object of the present invention is to improve the efficiency of operation of a modulated class "C" amplifier, when modulated by audio frequency power which is insufficient to modulate the stage fully by simple plate modulation.

It is known that grid modulation requires relatively little modulating power, but that the amplifier stage operates at low efficiency when grid-modulated. On the other hand, the stage operates at high efficiency when plate-modulated, but requires a relatively large amount of modulating power. In many cases the modulating power available is insufficient to fully modulate the amplifier stage by simple plate modulation. In accordance with the present invention, in such a case the available modulating power is arranged to be supplied chiefly to the plate circuit of the modulated stage, while a small proportion of the modulating power is simultaneously and cophasally applied to the grid circuit of the modulated stage. The proportioning of the power to the plate and grid circuits is so adjusted that the total available modulating power is utilized when the stage is modulated 100%. In this way, the efficiency of the class "C" stage is made as high as is possible with the limited amount of audio power available.

The proportioning of the modulating power between the plate and grid circuits may be adjusted as follows. For example, the entire modulating power may be applied to the plate circuit initially, with the result that less than 100% modulation is obtained. Then a small fraction of the modulating voltage is applied to the grid circuit, and the percentage modulation is observed to increase. The modulating voltage applied to the grid is then further increased, and the percentage modulation noted. By continuing this process, the modulation will ultimately be brought up to 100%. It will be understood, of course, that after each of the aforesaid adjustments the class "C" stage will be readjusted to give the maximum power output possible, without exceeding the desired anode dissipation, and the transformation ratio of the modulation transformer feeding the audio power into the plate circuit of the class "C" stage will be readjusted to maintain an approximate impedance match between the source of audio power and the class "C" plate circuit load. As a rough guide, it may be noted that at 100% modulation the class "C" plate circuit resistance, into which the modulation transformer must work, is equal to twice the audio power available, divided by the square of the direct current component of class "C" plate current. This relation permits an approximate setting of the modulation transformer ratio.

The invention will be understood somewhat better by reference to the drawing, in which Figure 1 represents one embodiment of the invention, and Figure 2 represents a modification, which is preferred in practice.

Referring to Figure 1, the class "C" stage is tube 6 seen to be plate modulated by a modulation transformer, having plate tap T_p and a grid tap T_g. These two taps are adjusted by the trial method described above, until 100% modulation is obtained, together with full utilization of the audio power available. The grid 8 of the tube 6 is excited by radio frequency energy to be modulated from source 12 while the modulated output appears in tuned circuit 14 connected with the anode 16.

Figure 2 differs from Figure 1 in that the plate direct current source may be grounded, while the choke feed and condenser coupling arrangement in the grid circuit permits a grid bias source to be grounded.

It will be understood that there are various ways in which substantially all of the audio frequency power available may be impressed upon the amplifier plate circuit, while sufficient audio frequency voltage is simultaneously impressed on the grid circuit to bring the modulation up to 100%. My invention, therefore, is limited only in accordance with the following claim.

I claim:

In a modulation system, an electron discharge device having a control grid, a cathode, and an anode, a source of wave energy to be modulated coupled to said control grid and cathode, an alternating current output circuit coupled to said anode and cathode, sources of direct current potential connected to the electrodes of said device to bias the same for class C operation, a source of modulating potentials of considerably less power than that required to accomplish 100% anode modulation of said device and of more power than that required to accomplish 100% grid modulation of said device, a modulation circuit coupling said source of modulating potentials to said anode and cathode for applying substantially all of the modulation power to said anode, said anode modulation circuit including a transformer having a primary winding coupled to said source of modulating potentials and a secondary winding coupled with said anode and cathode, and a circuit coupling said source of modulating potentials to said grid and cathode to apply a portion of said modulation power to said grid and cathode sufficient to produce full modulation of said device, said grid modulation circuit including a portion of said secondary winding coupled between said control grid and cathode.

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