Nov. 16, 1937. W. BUSCHBECK 2,099,294

CARRIER WAVE MODULATION AND SUPPRESSION

Filed Oct. 8, 1936

Fig. 1

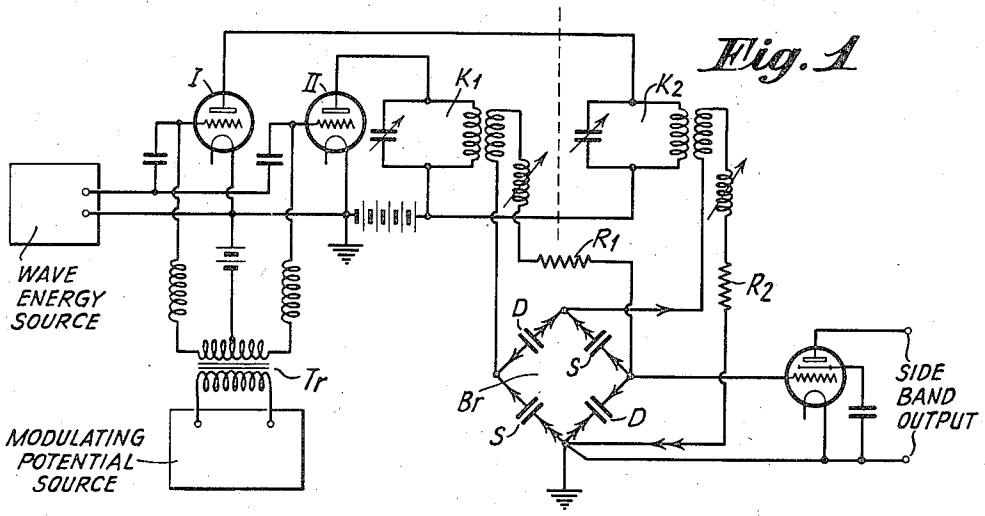


Fig. 2

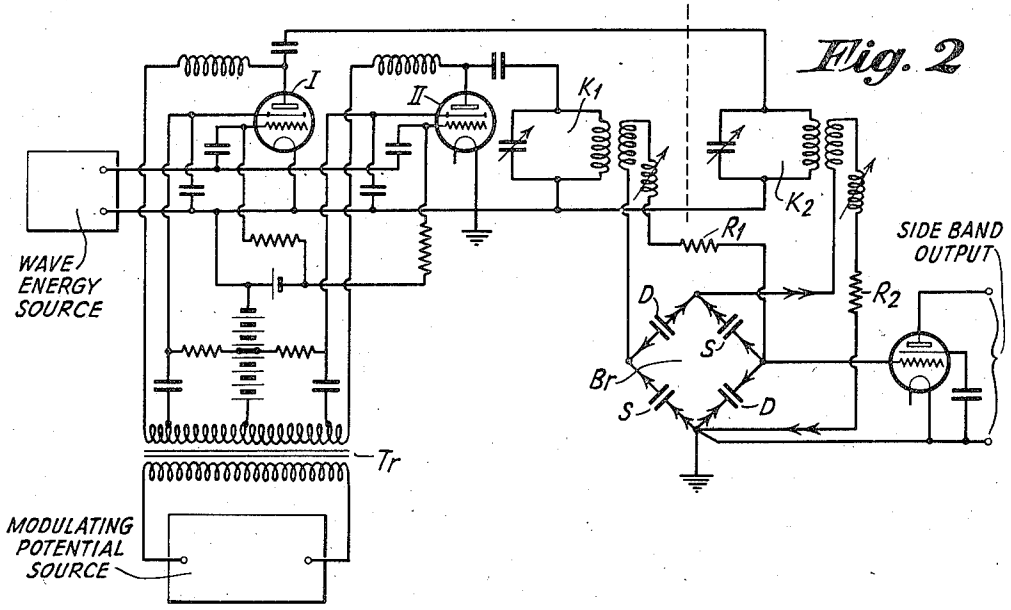
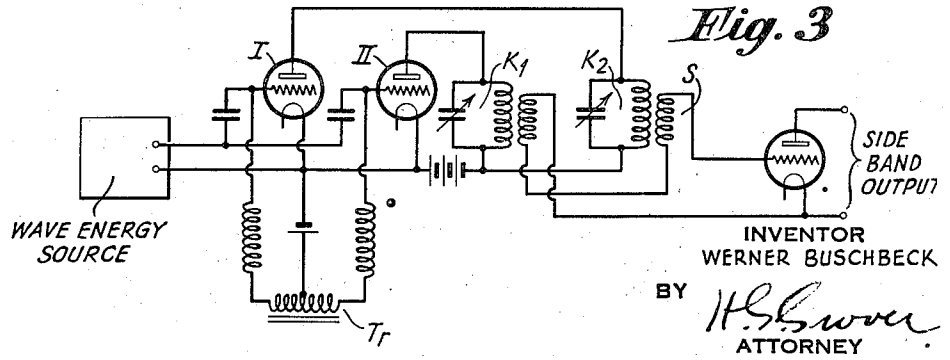


Fig. 3



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CARRIER WAVE MODULATION AND SUPPRESSION

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5 Claims. (Cl. 179—171)

The known and often used method of Carson for the suppression of the carrier wave in a modulated transmitter, which method provides for differential coupling of two tubes which are controlled cophasal for high frequency and in phase opposition for low frequency (see Zenneck-Rukop, Figure 645, page 708) whereby said tubes influence a common output circuit, presents great difficulties, due to this latter point, concerning the insuring of rectilinear modulation characteristics. It is known that there is required above all for the purpose of obtaining grid or plate modulation characteristics having a linear course, a constant external resistance having a high value compared to the limiting resistance of the tube. But these requirements cannot be realized in the type of construction known in the prior art for the reason that the external resistances vary back and forth from practically zero (in unmodulated state) to the maximum value possible (in the case of great modulation depth) due to the coupling caused by the output circuit common to both tubes which work in opposite relationship. The external resistance is equal to zero in the un-modulated state since a current flows in the oscillation circuit without creating an ohmic counter-electromotive force therein.

In line with this invention this condition is remedied by providing means whereby the two differential tubes or tube groups, modulated in phase opposition, are de-coupled from each other in their plate connections as to this external resistive effect. To obtain twin-circuit arrangements, mutually uninfluenced, per tube I use separate plate oscillating circuits and a common bridge oscillating circuit the transmission of the side band frequencies being established by means of suitable coupling with the bridge wherein constant circuit attenuation is maintained.

The de-coupling of the circuits is suitably accomplished through a bridge arrangement. As is known, in double-fed bridge circuit schemes, the bridge branches (arms) located opposite each other carry either the sum or difference of the currents. The next following stage is now connected or coupled to one of the two bridge branches which carries the difference of the currents produced by the two tubes. Just which one of the bridge branches carries at that time the sum or difference of the currents depends solely on the polarity of the bridge. Hence it is immaterial in this case whether the two differential tubes are imparted a cophasal or push-pull excitation, the latter being in many cases preferable because a symmetrical load is placed on the control stage.

In describing my invention reference will be made to the attached drawing wherein Figures 1, 2, and 3 each show modifications of my suppressed carrier modulator. Figures 1 and 2 use the bridge arrangement to decouple the modulator outputs while Figure 3 accomplishes this result without the bridge circuit.

Figure 1 shows an embodiment by way of example of the idea of the invention for grid potential modulation. Unessential details have been omitted. The two tubes I and II are excited cophasally by high frequency energy from a source of control potential such as an oscillator. The grids of I and II can also be modulated in phase opposition by low frequency from a transformer Tr. The output electrodes of the tubes I and II each feed independent oscillation circuits K_1 and K_2 respectively which in turn are coupled to a bridge arrangement Br the arms of which may for instance consist of capacities S and D. It is assumed that the coupling of K_1 and K_2 to the bridge is adjusted for cophasal operation. In that case, for any instant the direction of the currents produced by the two tube groups can be indicated, as shown by arrows. The next following stage is coupled to the bridge arm carrying the difference currents flowing in the arms D. Dissymmetries, for instance of the secondary side of transformer Tr or of the characteristics of the two tubes may be equalized easily by the coupling adjustment of the bridge to the oscillation circuits K_1 and K_2, small phase errors may be eliminated in all cases by a subsequent tuning of the output circuits. Thus, the carrier wave may be removed in an exact manner, which represents a great improvement in the one-side-band telephony as far as subsequent filter circuits are concerned.

Since the output resistance of the modulated tubes I and II is constant and of exactly measurable value, I obtained very linear operating characteristics, hence the tubes can be modulated to a high degree and thus their permissible output utilized to a great extent. Furthermore, insuring actually rectilinear modulation characteristic curves means that the carrier wave vanishes not only in non-modulated state or for any exactly established degree of modulation, but in fact for any desired degree of modulation below the allowable maximum limit the carrier output still remains negligibly small.

Particularly rectilinear modulation characteristics are insured in case of plate modulation of

screen grid tubes with simultaneous modulation of the screen grid. Figure 2 shows such an arrangement which otherwise corresponds to Figure 1.

It is also feasible to make use of other known types of modulation.

Figure 3 illustrates an arrangement wherein the de-coupling is accomplished without the use of a bridge. In this modification each tube I and II is supplied with a separate plate oscillation circuit K_1, K_2. The circuits are so arranged that no appreciable current flows in the coupled circuit S. This is especially the case in long waves since in that case only a small wattless current flows through the grid to filament capacity of the output tube. In Figure 3 the input circuits may be formed exactly the same as in Figures 1 or 2.

I claim:

1. In a modulation system of the carrier wave suppression type comprising a pair of electron discharge tubes of the multiple-electrode type and means for impressing wave energy to be modulated on like electrodes thereof and modulating energy on like electrodes thereof, a bridge circuit having four arms, a coupling between the output electrodes of one of said tubes and opposed points on said bridge, a coupling between the output electrodes of the other of said tubes and other opposed points on said bridge and an output circuit coupled to one arm of said bridge.

2. In a modulation system of the carrier wave suppression type comprising a pair of electron discharge tubes each having a control grid, a cathode, an anode, and auxiliary electrode and means for impressing wave energy to be modulated on said control grids and modulating energy on said anodes and auxiliary electrodes, a bridge circuit having four arms, a coupling between the anode and cathode of one of said tubes and opposing points on said bridge, a coupling between the anode and cathode of the other of said tubes and other opposed points on said bridge, and a utilization circuit coupled to one arm of said bridge.

3. In a modulation system of the carrier wave suppression type comprising a pair of electron discharge tubes each having input and output electrodes and means for impressing wave energy to be modulated on the input electrodes thereof and modulating energy on like electrodes thereof, tuned circuits connected with the output electrodes of each of said tubes, a bridge circuit having four arms, means coupling one of said tuned circuits to opposed points on said bridge, means coupling the other of said tuned circuits to other opposed points on said bridge, and an output circuit coupled to one arm of said bridge.

4. A system as recited in claim 1 wherein the arms of said bridge each include capacitive reactance.

5. A system as recited in claim 2 wherein each arm of said bridge circuit includes capacitive reactance.

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