Modulation « «

At the present time, amplitude modulation is universally employed for voice transmission, although experiments with frequency modulation show interesting possibilities. In amplitude modulation, the amplitude of the radiated wave is varied in accordance with the sound waves impressed on the microphone. There are a number of methods of accomplishing amplitude modulation. Plate modulation is by far the most popular system due to the efficiency and ease of adjustment. In this system, the plate voltage of a Class C amplifier tube is varied at audio frequencies. Since the power output of a Class C amplifier is directly proportional to the plate voltage, the carrier is modulated by the process.

In grid modulation, the audio voltage is applied in series with the grid bias. The audio power required is much less than for plate modulation, but the amplifier tube must be operated at low efficiency, resulting in much lower carrier power than from a similar tube plate modulated. A grid modulated stage is critical in adjustment of bias, R.F. excitation, audio voltage and amplifier load.

In the new R.F. pentodes, it is possible to apply the modulating voltage to a separate grid, called the suppressor. The adjustment of audio and R.F. excitation voltages are more independent of each other making the system less critical than control grid modulation. The efficiency is low in both types of grid modulation.

In plate modulation of a screen grid tube, or pentode, unless the screen and plate are simultaneously modulated, the percentage of modulation will be quite low. Simultaneous modulation can be accomplished by connecting a resistor from the plate terminal of the modulation transformer secondary to the screen, the resistor dropping both audio and D.C. voltage to proper values. The undesirable feature is that a considerable percentage of both the audio and D.C. power is wasted in the dropping resistor.

It is possible to conserve this power by using a special output transformer having two individual windings, one for modulating the plate, and the other the screen. The D.C. voltage for the screen can then be obtained from the low voltage supply for the oscillator or buffer.

Downward Modulation

One of the most frequent troubles with phone transmitters is "downward modulation." The antenna current, instead of rising slightly under modulation, decreases. The usual cause is insufficient R.F. excitation to the modulated amplifier. If we analyze an extreme case, the reason is quite apparent. Let us suppose that all electrons given off by the filament or heater are drawn to the plate with no modulation. When the audio voltage is applied, the plate voltage increases on the positive half of the audio cycle, but the R.F. output cannot increase, because all electrons are already reaching the plate at the lower voltage. On the negative half of the audio cycle, the plate voltage of the R.F. amplifier is being reduced and, of course, less electrons are drawn to the plate, with a consequent reduction in R.F. output. The average R.F. output under these conditions will be less under modulation than without it. If the grid of the modulated amplifier is driven more positive, more electrons will be pulled away from the filament and will be drawn to the plate on the positive half of the audio cycles, consequently, with sufficient excitation the R.F. output will increase under modulation.

Another cause of "downward modulation" is oscillation in the modulated amplifier tube. The circuit may be stable without modulation, but the changing plate voltage causes the circuit to oscillate. The cure is to properly neutralize the amplifier, or to use shielding if oscillation is caused by stray coupling between circuits.

Less frequent causes are improper bias, and too tight coupling to the load circuit. The remedies are obvious for these two conditions.