Aug. 5, 1930. J. WEINBERGER 1,772,374

SIGNALING SYSTEM

Filed May 3, 1923

Fig. 1

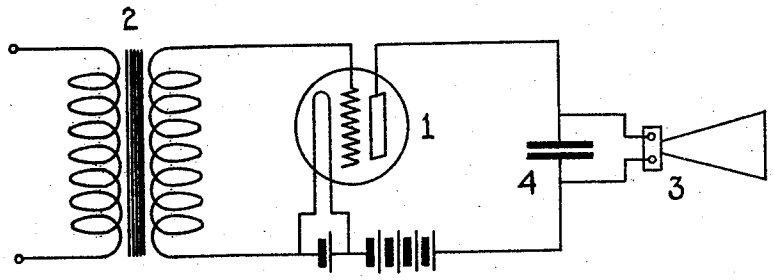


Fig. 2

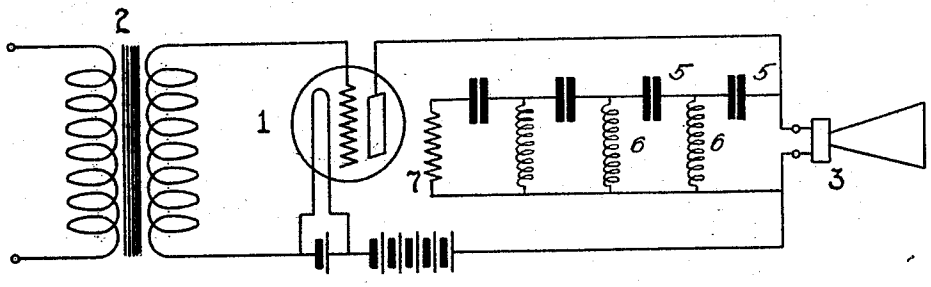
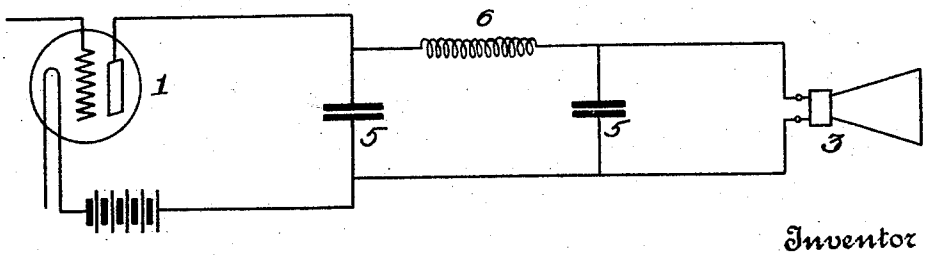


Fig. 3



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UNITED STATES PATENT OFFICE

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SIGNALING SYSTEM

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The object of this invention is to provide audio frequency vacuum tube amplifier circuits, used in combination with a loud speaker (or similar electro-acoustic device) which produce an improved quality of performance of the system.

It is well known that the grid voltage-plate current characteristic of a vacuum tube is, in general, not a straight line but a curve. Over a small portion of this curve it may be regarded as a straight line, and alternating voltages impressed on the grid may be substantially reproduced in undistorted form by currents in the plate circuit, provided such voltages are small relative to the entire range of the characteristic curve.

When the voltage impressed on the grid becomes appreciable, relative to the total voltage which would be required to swing the plate current from zero to maximum, the effect of the curvature of the characteristic is to give rise to harmonics in the plate current. That is, if a voltage having a frequency of 800 cycles be impressed on the grid of a tube, of appreciable amplitude, the current in the plate circuit will contain this fundamental frequency plus numerous harmonics thereof (1600, 2400, 3200 cycles and so on) in increasing proportion to the fundamental as the amplitude of the voltage impressed on the grid is increased. Should the tube be used as an amplifier to feed a loud speaker, these harmonics will produce objectionable shrillness in the sounds emitted by the loud speaker.

The undesirable effect thus produced may be greatly alleviated by the use of the circuits diagrammatically shown by way of example in Figs. 1, 2 and 3.

Figure 1 shows one simple method of carrying out this invention. It is my object therein to provide an element connected to the loud speaker, in this case a condenser, which will tend to progressively short-circuit the loud speaker for the higher frequencies, and thus progressively allow less and less current due to harmonics to flow through the loud speaker, the higher the frequency of these harmonics. In this figure, 1 is a vacuum tube amplifier, 2 an input transformer for audio frequencies, 3 a loud speaker and 4 a condenser connected in parallel therewith. The value of this condenser is best found by trial, and varies with the particular loud speaker used. I have found, however, that for vacuum tubes having an output impedance (or internal resistance) of the order of 20,000 ohms, the best condenser is approximately determined by making it of such value that its reactance is equal to the reactance of the loud speaker at a frequency of about 1200 cycles. For example, with a loud speaker having an inductance of 4 henries, a suitable condenser would be about 0.005 microfarads. Higher or lower values of capacity may be used without departing from the spirit of the invention, which consists in the connection of an electrical element in a vacuum tube loud speaker circuit for the purpose of selectively adjusting the current passed through the loud speaker at different frequencies.

An improved method of carrying out the invention is to use a more complex net work, such as a filter, in parallel or in series with the loud speaker, which will produce an effect only above a certain frequency. In music, (and also in speech) the fundamental frequencies most employed lie ordinarily below about 2000 cycles. Harmonics of these frequencies, present in the original sound, give it its quality. However, it is in general the harmonics having frequencies considerably above 2000 cycles, which, when generated by an amplifying tube, give rise to the objectionable shrillness. If a high pass filter is made which passes relatively little in the range of frequencies below 2000 cycles, but progressively more in the range above this, and connected in parallel to the loud speaker, the same results may be secured as in the case of the simple condenser shunt (Figure 1) without eliminating any frequencies below 2000 cycles. A circuit in which this is done is shown in Figure 2. Here the numbers have the same significance as in Figure 1, while the high pass filter composed of inductances 6 and condensers 5, and terminated by an impedance 7 (to improve the performance of the filter) replaces the condenser 4 of Figure 1. It is obvious that a

low pass filter in series with the loud speaker may be designed so as to produce the same result as a high pass filter in parallel. Fig. 3 discloses this type of a filter.

The scope of the invention is not limited to the combination of a vacuum tube amplifier with a loud speaker only, but to the combination thereof with any output circuit from which it is desired to progressively keep higher harmonic currents which may be produced due to distortion by the vacuum tube.

Having described my invention, what I claim is:

1. The method of converting electrical undulations into audible signals which comprises sufficiently amplifying said electrical undulations to produce harmonics of said undulations in addition to said undulations, filtering said harmonics from said amplified undulations and converting said amplified undulations into sound vibrations.

2. In the art of electrical reproducing, the method of improving the quality of sound vibrations produced which comprises over-amplifying the electrical undulations to be reproduced, said over-amplification resulting in the production of amplified electrical undulations and harmonics of said undulations, separating said harmonics from said amplified undulations, and converting said amplified undulations into sound vibrations.

3. In a radio receiving system having a vacuum tube audio frequency amplifier constructed and arranged to produce harmonics in its normal operation, a loudspeaker device connected to said amplifier, the said harmonics producing undesirable noises in the loudspeaker, a filtering means connected across the terminals of said loudspeaker, said filtering means being designed to absorb said harmonics, whereby to eliminate the noises produced in said loudspeaker by said harmonics.

4. In a radio receiving system having a vacuum tube audio frequency amplifier constructed and arranged to produce harmonics in its normal operation, a loudspeaker device connected to said amplifier, the said harmonics producing undesirable noises in the loudspeaker, a filtering means connected across the terminals of said loudspeaker, said filtering means being designed to absorb said harmonics, whereby to eliminate the noises produced in said loudspeaker by said harmonics, and an impedance connected across said filtering means.

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