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J. MASSOLLE ET AL

AMPLIFIER COUPLING

Filed March 20, 1922

Fig. 1.

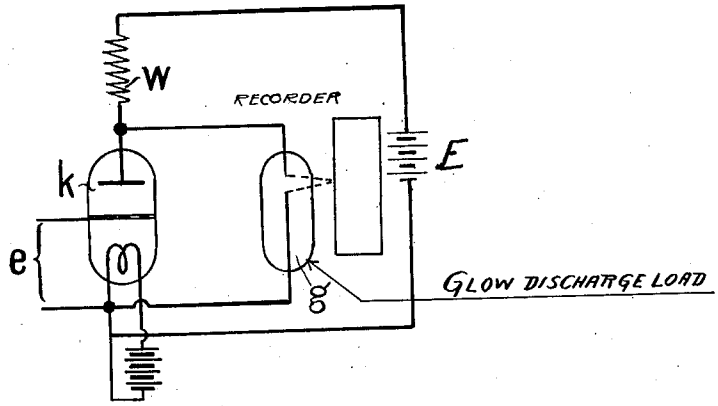
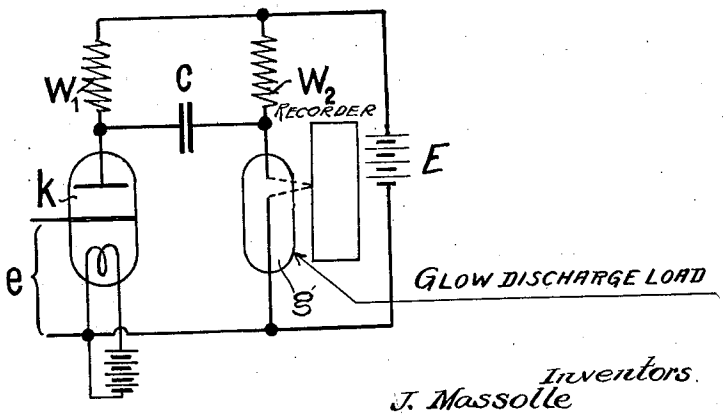


Fig. 2.



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AMPLIFIER COUPLING.

Application filed March 20, 1922. Serial No. 545,375.

To all whom it may concern:

Be it known that we, JOSEPH MASSOLLE, JOSEF ENGL, and HANS VOGT, citizens of the German Republic, and residents, respectively, the first and second of Berlin-Grunewald, the third of Berlin-Wilmersdorf, Germany, have invented a new and Improved Amplifier Coupling, for which we have filed application for patent in Germany under date of Feb. 18, 1821, and of which the following is a full, clear, and exact description.

When electrical discharge tubes, for instance thermionic amplifiers are employed in amplifying arrangements difficulty arises in connecting them to the detector, recorder or other device to be operated by the amplified currents, received by such device herein called the utilizing device, on account of the high resistance of the thermionic amplifier. Transformers may be employed as couplings, but except in the case of high frequency transformers they require as a rule very high self-inductance, with the result that the transformer owing to this inductance and to its capacity and that of the leads sets up a low frequency natural oscillation. It is therefore only possible to get proportional transformation of audible frequencies, for instance of speaking currents, by the aid of transformers of small self-inductance, the use of which involves a sacrifice of amplitude.

Resistance couplings are also known in which the utilizing device is placed in series with the thermionic amplifier. This certainly obviates the difficulties arising in transformer couplings. But because the lower part of the anode current characteristic curve of the amplifier is bent or sharply curved there will be lack of proportionality between the received current and its effect upon the utilizing device if the amplifier has to be worked near this bend of the curve. This occurs for instance when the electric undulating current received by the thermionic amplifier is to be recorded photographically by means of a glow discharge tube.

The method of connection hereinafter described obviates these defects. It consists in connecting the utilizing device in parallel with the thermionic amplifier. The accompanying drawings show two arrangements.

In Figure 1 there is a glow discharge tube g immediately in parallel with the thermionic amplifier k. In series with both of them there is a coupling resistance w which may be an ohmic resistance. The source of E. M. F. E supplies the E. M. F. necessary for the discharge circuit. Upon variations of current occurring in the amplifier k on account of variations in the input potential e, of the amplifier, corresponding but reversed alterations of current arise in the glow discharge tube g. If the various parts of the apparatus are suitably designed the conditions may be made such that the amplifier k need only work upon the straight line part of its curve of anode current.

The above may be rendered somewhat clearer by the following considerations. When an amplifier tube is connected in series with the glow lamp recorder or load, the current delivered from the amplifier may, at times, be a small current corresponding to a point on the lower bend of the plate-current-grid-voltage characteristic curve of the amplifier. For the proper operation of the recorder or load the relation between voltage and current of the latter should be as constant as possible, which means that the amplifier should be operating only on the approximately-straight-line part of its characteristic. This is true in our construction just described for the following reasons. The resistance of the grid-cathode path of the amplifier, k, diminishes, as the potential, e, between grid and cathode of the same increases, or becomes less negative. Therefore, the current through the tube will increase as the input potential, e, increases or becomes less negative, and accordingly the current through the recorder, g, in parallel with the tube, will decrease. Similarly as the potential, e, decreases or becomes more negative the current through the tube decreases and the current through the recorder increases. The small tube current corresponds, or may correspond, to points on the bend of the characteristic, which is to be avoided. The corresponding comparatively large current through the recorder will, with proper design, be beyond the range of sound or other energy which is to be recorded by the glow tube, g, and therefore the amplifier will only be operating effectively on the straight line portion of its characteristic and the relation between the

voltage and current of the recorder or load will be quite constant.

This arrangement is modified in Figure 2 by the introduction of a condenser c between the amplifier and the utilizing device. If the utilizing device is a glow discharge tube it is then necessary to connect it through a second resistance w_2 to a source of E. M. F. which should be such that an average discharge current flows in the glow discharge tube g. As is shown in Fig. 2, the source of E. M. F. may be a source E which is common to both amplifier and glow discharge tube, it not, however, being essential that a single source be used. For the received current, resistances w_1 and w_2 are then in parallel and so also are amplifier k and recorder g. To avoid substantial losses condenser c must be made so large that its impedance for alternating currents is small compared with the impedance of the remainder of the circuits.

In place of the glow discharge tube any other utilizing devices may be connected in similar fashion in parallel with the amplifier, or if several amplifiers are used in parallel with the last of them.

The arrangement of Fig. 2 also, of course, permits operation of the amplifier on the flat or straight-line part of the characteristic. In this arrangement the current flowing through the recorder does not have the same dependency on the current through the amplifier as in the first case. By regulating the two resistances, w_1 and w_2, the amplifier may be worked on any desired part of its characteristic, and the bottom bend thereby avoided.

We claim:—

1. In an amplifier coupling, the combination of a thermionic amplifier, a luminous gas discharge recorder, having only two terminals, means connecting the same with the plate and filament of said amplifier, conductors carrying varying potential to said amplifier only, connected to the filament and grid thereof, a source of potential and connections therefrom to the plate and filament of said amplifier and to the terminals of said device to deliver current to the same in parallel.

2. In an amplifier coupling, the combination of a thermionic amplifier, an electrical recording device, having only two terminals, conductors of low ohmic resistance, connecting the same with the plate and filament of said amplifier, for operation of said device in accordance with the output of said amplifier, conductors carrying varying potential to said amplifier only, connected to the grid and filament thereof, an external resistance connected in series with said amplifier, a source of potential and connections therefrom for delivering current to said amplifier through said resistance, and to the terminals of said device, in parallel.

3. In an amplifier coupling, the combination of a thermionic amplifier, an electrical recording device, having only two terminals, means connecting the same with the plate and filament of said amplifier, for operation of said device in accordance with the output of said amplifier, conductors carrying varying potential to said amplifier only, connected to the grid and filament thereof, a resistance connected in series with said amplifier, a resistance in series with said device, a condenser in the connection between said amplifier and one of the terminals of said device, a source of potential and connections therefrom for delivering current to said amplifier and device, through said resistances, in parallel.

4. In an amplifier coupling, the combination of a thermionic amplifier, a luminous gas discharge device, having only two terminals, means connecting the same with the plate and filament of said amplifier, for operation of said device in accordance with the output of said amplifier, conductors carrying varying potential to said amplifier only, connected to the grid and filament thereof, a resistance connected in series with said amplifier, a resistance in series with said device, a condenser in the connection between said amplifier and device, a source of potential and connections therefrom for delivering current to said amplifier and device, through said resistances, in parallel.

5. In an amplifier coupling, the combination of a thermionic amplifier, a recorder having only two terminals, and comprising a source of light, means connecting the same with the plate and filament of said amplifier for operation thereof to vary the intensity of said light in accordance with the output of said amplifier, conductors carrying varying potential to said amplifier only, connected to the grid and filament thereof, a resistance connected in series with the plate of said amplifier, a source of potential and connections therefrom for delivering current to said amplifier through said resistance, and to said source of light, in parallel.

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