Jan. 17, 1928. 1,656,839

G. A. SOMERSALO

MEANS FOR PREVENTING RETRO ACTIVE EFFECTS IN AUDION AMPLIFIER CIRCUITS

Filed Feb. 11, 1926

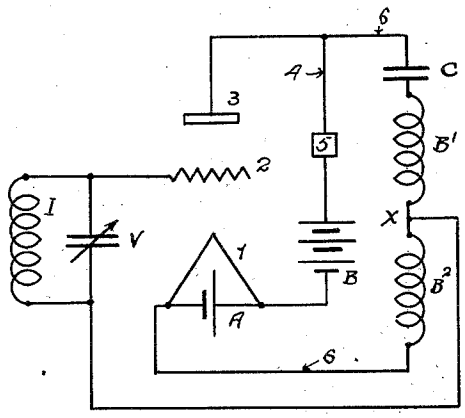

Fig. 1.

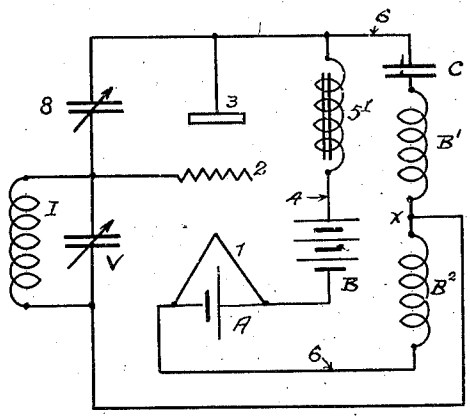

Fig. 2.

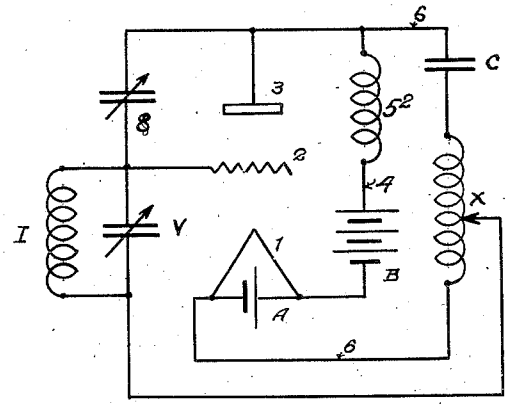

Fig. 3.

INVENTOR

GEORGE A. SOMERSALO

BY

ATTORNEYS

Patented Jan. 17, 1928. 1,656,839

UNITED STATES PATENT OFFICE.

GEORGE A. SOMERSALO, OF NEW YORK, N. Y.

MEANS FOR PREVENTING RETROACTIVE EFFECTS IN AUDION AMPLIFIER CIRCUITS.

Application filed February 11, 1926. Serial No. 87,607.

This invention relates to the amplification of electric currents of minute intensities such as experienced in the reception of radio telephonic and telegraphic signals by means of audion tubes of the three-electrode type, and more particularly to the provision of means for neutralizing, balancing, or otherwise compensating for the inherent capacity coupling between the input and output electrodes of the audion tubes of the amplifier.

It has long been known that when audion tubes are energized and the filament and grid electrodes connected to a source of alternating signal energy, and the filament and plate electrodes connected to a suitable output circuit, that the variations in the output circuit are fed back into the input circuit, due to the inherent capacity coupling existing between the electrodes contained in the input and output circuits. These current variations fed back into the input circuit may, and frequently do, cause oscillations which, in amplifiers, are particularly objectionable since they interfere considerably with the reception of the incoming signals and frequently rise to such magnitudes as to completely incapacitate the amplifier.

The present invention embodies the underlying principles set forth in my copending application Serial No. 18,019, filed March 24, 1925, in accordance with which this inherent capacity coupling is balanced by a direct connection between the input and output circuits at points of equal potential, so that the variations in the output circuit cannot be reproduced in the input circuit. The underlying principles of that invention are described and claimed in my copending application just mentioned. The present invention deals with a special arrangement in the layout of the balanced network, and the thought which underlies the present improvement is the use of parallel paths for the output circuit, for the reasons hereinafter set forth.

In the accompanying drawings—

Figs. 1, 2 and 3 are diagrams of a single stage of an audion amplifier, in each of which diagrams the output circuit includes parallel paths, but the circuit differing in details in the several figures.

Referring more particularly to the drawings, filament, grid and plate electrodes are indicated respectively by the references 1, 2 and 3. The filament 1 is energized by the battery A and the plate 3 by the battery B. The output circuit between the plate and filament comprises parallel paths, of which one, indicated by the reference 4, contains impedance 5 in series with the battery B; while the second, indicated by the reference 6, contains (Fig. 1) two inductance coils in series, viz B′, B^2, one end of the coil B^2 being connected to the filament 1, and the opposite end of the coil B′ being connected to the plate 3 through an interposed blocking condenser C.

The input circuit comprises an input coil I, one end of which is connected to the grid 2, and the other, or low potential, end of which is directly connected to the junction point X between the series windings B′ and B^2. A variable condenser V for tuning, may be bridged across the input coil.

The impedance 5 in the path 4 of the output circuit may be of any suitable character, and I have so indicated in Fig. 1 by a diagrammatic representation of this element. It may, for example, be a choking coil, such as 5′ (Fig. 2), or it may be an ordinary inductance coil 5^2 as indicated in Fig. 3; or it may be a high resistance. I prefer, however, to use either a choking or an ordinary inductance coil since a lower demand upon the plate battery B is made thereby.

The blocking condenser C is of high capacity, say .006 microfarad, and its function is to prevent high direct current voltage from reaching the grid.

Several important distinctions in the present network over that of my prior application are thus apparent. Whereas in my prior network a direct connection between the grid and filament is made through an interposed resistance, and the connection between the output coil and the input coil is made through a circuit containing a blocking condenser which prevents the flow of direct current therethrough, the present network establishes the direct current circuit between the grid and filament through portion of the output coil, while the blocking condenser is shifted to a point in the output circuit between the connection X and the plate. Again, while in my prior network the direct current is impressed upon the plate 3 through a connection from the bat-

tery B and the complete output coil, I have now established the connection between the battery and plate through the path 4, which is arranged in parallel to portion of the output path 6.

These differences result in a markedly improved layout. The elimination of the high resistance between the grid and filament is important. This resistance is objectionable for several reasons. For example, it may cause some rectifying effect. And again commercial resistances such as are suitable for this use are not very dependable in practice.

The new location of the blocking condenser prevents use of the output path 6 (on the input side of the blocking condenser C) as the path for the direct current from battery B to the plate electrode. This direct current connection is now afforded by the parallel path 4.

While I have shown in Figs. 1 and 2 the output inductance in the form of two coils B′ and B² connected in series, it is perfectly obvious, as illustrated in my above mentioned application, that the point X may be located intermediate the ends of the single coil as shown in Fig. 3 of the present application.

An external adjustable balancing condenser 8 may be arranged between the grid and either the plate or filament electrodes. Its location depends primarily upon the ratio of the inductances B′ and B², or approximately upon the ratio of their turns. This will be apparent from the following:

If c_p represents the plate grid capacity and c_t represents the grid filament capacity, the actual balance occurs when

$$\frac{c_p}{c_t} = \frac{L_2 + M}{L' + M}$$

in which L_2 and L' represent self-inductances of coils B′—B² respectively, and M the mutual inductances. Or otherwise explained

$$\frac{c_p}{c_t} \text{ approximately equals } \frac{N_2}{N'}$$

in which N equals the number of turns in the respective coils B′ and B².

The present system thus embodies all of the advantages in a network technically more efficient.

With the understanding that only the advantages of the present network are claimed herein, and that claims to the broader invention are maintained in my earlier application, I claim,

1. In an audion amplifier network, grid and plate electrodes, input and output circuits connected therewith, a filament electrode common to both circuits, the plate-filament circuit including parallel paths, one for direct current and the other for alternating current, each path including means for blocking the flow of a different type of current, and the alternating current path including a plurality of electro-magnetically coupled coils, connected in series to one end of the filament and having the ratio of their equivalent impedances substantially equal to the ratio of actual capacities between the plate-grid electrodes on the one hand, and the grid-filament electrodes on the other hand, the grid filament circuit being connected at one end to the grid electrode and at the other end to the electro-magnetically coupled coils at their junction.

2. In an audion amplifier network, grid and plate electrodes, input and output circuits connected therewith, a filament electrode common to both circuits, the plate filament circuit including parallel paths, one for direct current and the other for alternating current, each path including means for blocking the flow of a different type of current, and the alternating current path including a plurality of electro-magnetically coupled coils connected in series to one end of the filament, and having the ratio of their turns substantially equal to the ratio of the capacities between the plate-grid electrodes on the one hand, and the grid-filament electrodes on the other hand, the grid filament circuit being connected at one end to the grid electrode and at the other end to the electro-magnetically coupled coils at their junction.

3. In an audion amplifier network, grid and plate electrodes, input and output circuits connected therewith, a filament electrode common to both circuits, an adjustable condenser connecting the grid with the plate electrode, the plate filament circuit including parallel paths, one for direct current and the other for alternating current, each path including means for blocking the flow of a different type of current, and the alternating current path including a plurality of electro-magnetically coupled coils connected in series to one end of the filament and having the ratio of their turns substantially equal to the ratio of the actual capacities between the plate-grid electrodes on the one hand, and the grid-filament electrodes on the other hand, the grid-filament circuit being connected at one end to the grid electrode and at the other end to the electro-magnetically coupled coils at their junction.

4. In an audion amplifier network, grid and plate electrodes, input and output circuits connected therewith, a filament electrode common to both circuits, an adjustable condenser connected between the grid and plate electrodes, the plate-filament circuit including parallel paths, one for direct current and the other for alternating current, each path including means for block-

ing the flow of a different type of current, and the alternating current path including a plurality of electro-magnetically coupled coils, connected in series to one end of the filament and having the ratio of their equivalent impedances substantially equal to the ratio of actual capacities between the plate-grid electrodes on the one hand, and the grid-filament electrodes on the other hand, the grid filament circuit being connected at one end to the grid electrode and at the other end to the electro-magnetically coupled coils at their junction.

5. In a balanced audion amplifier network, an alternating current plate-filament circuit including output inductance and a blocking condenser, a grid-filament circuit including portion of said inductance, a source of direct current potential and a connection therefrom to the plate electrode, said connection including means for preventing the passage of radio frequency current, both the grid-filament circuit and the direct current path to the plate excluding said blocking condenser.

6. In a balanced audion amplifier network, an alternating current plate-filament circuit including output inductance and a blocking condenser, a grid-filament circuit including portion of said inductance, a source of direct current potential and a connection therefrom to the plate electrode, said connection including means to prevent the passage of radio frequency current, said direct current path between plate and filament and the portion of the inductance included in the grid-filament circuit being on opposite sides of the blocking condenser.

7. In an audion amplifier network, grid and plate electrodes, input and output circuits connected therewith, a filament electrode common to both circuits, the plate-filament circuit comprising two parallel paths, one for direct current and the other for alternating current, each path including means for blocking the flow of a different type of current, the alternating current path including an inductance, and the grid-filament circuit being connected at one end to the grid electrode and at its other end to an intermediate point in said inductance.

In testimony whereof I have signed my name to this specification.

GEORGE A. SOMERSALO.