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THERMIONIC TUBE AMPLIFIER

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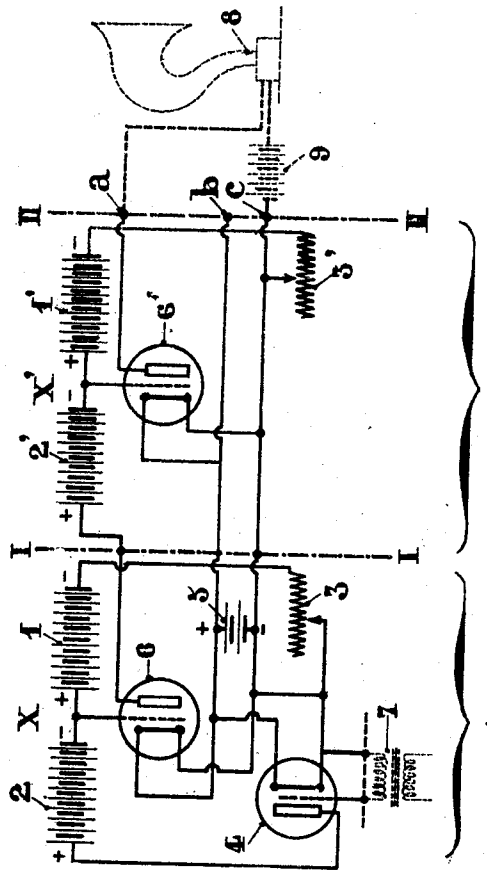

Fig. 1

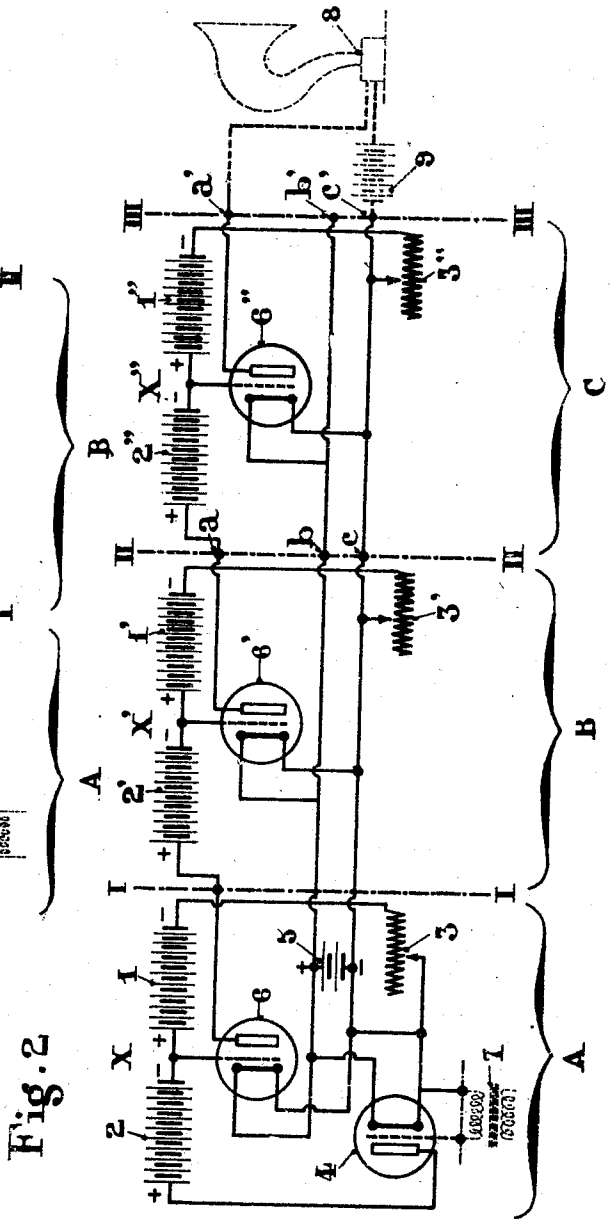

Fig. 2

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THERMIONIC TUBE AMPLIFIER

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Amplifying devices consisting of thermionic tubes are already well known which are arranged in the form of a differential bridge or a Wheatstone bridge and of which the two symmetrical branches of the bridge are composed either of compensating resistances or compensating sources of current, for example accumulator batteries arranged in series, the diagonal of the bridge (diagonal which extends from the common point of the batteries) being formed by the grid filament circuit of a thermionic valve, which permits of amplified control of the variations of any suitable resistance included in one of the two symmetrical branches of the said bridge.

This latter branch of the bridge may be formed by a resistance offered by the anode filament circuit of a thermionic valve or a valve having a number of electrodes of which the grid is subjected to variations in potential determined by the variation of a resistance which constitutes for example:

Resisting coils.—Imperfect di-electrics. Selenium cells or photo-electric cells. Ionization chambers.

The present invention has for its subject improvements applied to the devices above referred to. These improvements do not consist in using the variations of the anode current of a triode mounted in the diagonal of the bridge (which variations can actuate a controlling apparatus), but on the contrary consists in utilizing the variations of the resistance of the anode filament circuit of this triode which, for this purpose, is mounted in such a manner that its anode circuit is included in a branch of a second bridge arranged in cascade with the preceding bridge.

Under these conditions the anode filament circuit of this triode forms one of the branches of the second bridge which is also provided with a triode arranged in the diagonal branch, the anode circuit of this triode being adapted to be connected either to a controlling apparatus or arranged in cascade in a branch of a third bridge similar to the second bridge and so on.

In the accompanying drawing there are illustrated solely by way of example differential bridge devices with amplifying triodes, these devices being arranged in accordance with the present invention.

Figure 1 illustrates diagrammatically a device with two differential bridges arranged in cascade.

Figure 2 illustrates diagrammatically a device with three differential bridges arranged in cascade.

The device illustrated in Figure 1 has a first differential bridge A, which comprises two balanced batteries 1 and 2 of an electro-motive force respectively equal to E and E′.

The negative pole of one of these two batteries (the battery 1) is connected to a suitable adjustable compensating resistance 3. The positive pole of the battery 2 is connected to the anode of the controlling triode 4 of which the filament is connected to the common heating battery 5 which supplies the filaments of all the triodes of the device.

The grid of the differential triode 6, of which the grid filament circuit forms the diagonal branch of the bridge, is connected to the equi-potential point X formed by the common point of the two batteries 1 and 2. The filament of the triode 6 supplied by the battery 5, is connected to the resistance 3 and the filament of the controlling triode 4.

The differential triode of the bridge A also forms a branch of the succeeding differential bridge B, the resistance of the anode filament circuit of this triode being arranged in cascade in the branch of the bridge in question which is indicated by the chain dotted lines I—I and II—II. This second differential bridge is formed by the batteries 1′ and 2′ connected to the equi-potential point X′, and the compensating resistance 3′ which balances the resistance of the anode filament circuit of the differential triode 6 of the first bridge A. The grid filament circuit of the differential triode 6′ forms the diagonal of this new bridge.

In the example illustrated in Figure 1, the grid of the controlling triode 4 receives the variations of potential which it is desired to control at the points *a* and *c* after amplification. This device may serve, for example and as indicated by broken lines, for amplify-

ing modulated currents at an audible frequency, which currents act upon the grid of the controlling triode through the medium of an input transformer 7. Between the points a and c (anode circuit of the differential triode 6′) are included the loud speaker 8 and the anode battery 9.

The compensating resistances 3 and 3′ are brought to such a value that the equilibrium of each bridge is obtained in accordance with the equation:

$$\frac{R}{E} = \frac{\rho}{E'}$$

in which equation ρ indicates either the resistance of the anode filament circuit of the controlling triode 4, or the resistance of the anode filament circuit of the differential triode 6 which is due to the control triode opposite the point B (for this determined heating of their filaments and a determined potential of their grids, this potential may be zero).

In the diagram illustrated in Figure 2 there is illustrated a device provided with a supplementary bridge C identical with the intermediate differential bridge B and indicated (in the diagram) between the chain dotted lines II—II and III—III. This third bridge is formed by batteries 1″ and 2″ connected at the equi-potential point X″ and of the compensating resistance 3″, which balances the resistance of the anode filament circuit of the differential triode 6′ of the preceding bridge B.

The differential triode 6″ is arranged in a similar manner to the differential triode 6′ in the preceding example. The anode filament circuit of the differential triode 6″ could also form a branch of a further differential bridge arranged in cascade at the points a', b', c' at the outlet from the bridge C and so on.

The diagrams illustrated in the accompanying drawings are given (as regards the number of bridges arranged in cascade and the application of the device) only by way of example and not in a limiting sense, the device being adapted to be provided with any suitable number of bridges arranged in cascade and be used for various applications without departing from the scope of the invention.

We claim:—

1. A thermionic tube amplifying device comprising in combination two batteries in series forming two symmetrical branches of a Wheatstone bridge, a thermionic tube having a plurality of electrodes, the anode filament circuit of said tube forming a third branch of the said bridge, an adjustable compensating resistance forming a fourth branch of said bridge, a second thermionic tube having a plurality of electrodes, the grid filament circuit of said second tube forming the diagonal of said bridge and being located between the common point of the two batteries and the common point of the other two branches of said bridge, and means for varying the potential of the grid of the first mentioned tube, the anode of the first mentioned tube being connected to the positive pole of one of the batteries, the anode filament circuit of the second mentioned tube forming one of the branches of a second bridge otherwise constituted in the same manner as the first mentioned bridge.

2. A thermionic tube amplifying device comprising in combination two batteries in series forming two symmetrical branches of a Wheatstone bridge, a thermionic tube having a plurality of electrodes, the anode filament circuit of said tube forming a third branch of the said bridge, an adjustable compensating resistance forming a fourth branch of said bridge, a second thermionic tube having a plurality of electrodes, the grid filament circuit of said second tube forming the diagonal of said bridge and being located between the common point of the two batteries and the common point of the other two branches of said bridge, and means for varying the potential of the grid of the first mentioned tube, the anode of the first mentioned tube being connected to the positive pole of one of the batteries, the anode filament circuit of the second mentioned tube forming one of the branches of a second bridge otherwise constituted in the same manner as the first mentioned bridge, and a third bridge arranged in cascade with the second mentioned bridge, the third mentioned thermionic tube forming a branch of the third mentioned bridge.

3. An amplifying device comprising a plurality of Wheatstone bridges arranged in cascade, the first of said bridges consisting of two batteries arranged in series and forming two symmetrical branches thereof, a thermionic tube having an anode filament circuit forming the third branch of said bridge, a compensating adjustable resistance forming the fourth branch of said bridge and a second thermionic tube having a grid filament circuit forming the diagonal of said bridge which is located between the common point of said batteries and the common point of the said third and fourth branches, said second mentioned thermionic tube having an anode filament circuit forming a branch of the second bridge, said second bridge including two batteries each of which forms a branch of said second bridge, an adjustable compensating resistance forming the fourth branch of said second bridge, and a third thermionic tube forming the diagonal of said second bridge and being located between the common point between the two branches and the common point of the anode filament circuit of the second mentioned tube and of the second mentioned resistance, and means for varying

the potential of the grid of the first mentioned thermionic tube.

4. An amplifying device comprising a plurality of Wheatstone bridges arranged in cascade, the first of said bridges comprising two batteries each of which forms a branch of said bridge, a thermionic tube having an anode filament circuit and a grid filament circuit, the anode filament circuit forming a third branch of said bridge, an input transformer included in said grid filament circuit, an adjustable compensating resistance forming the fourth branch of said bridge, a second thermionic tube having an anode filament circuit and a grid filament circuit, the grid filament circuit constituting the diagonal of said bridge and being located between the common point between the branches formed by the two batteries and the common point formed between the anode filament circuit of the first mentioned thermionic tube and the compensating resistance, each of the remaining bridges consisting of two batteries each of which forms a branch thereof, an adjustable compensating resistance forming a third branch, the fourth branch being formed by the anode filament circuit of the thermionic tube of which the grid filament circuit constitutes the diagonal of the preceding bridge, and a thermionic tube having an anode filament circuit and a grid filament circuit, the grid filament circuit forming the diagonal of said bridge, said diagonal extending between the common point of the branches formed by the two batteries and the common point of the branches formed by the last mentioned resistance and the anode filament circuit of the thermionic tube of which the grid filament circuit forms the diagonal of the preceding bridge, and a heating battery common to all the filaments of the thermionic tubes in the various bridges.

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