

# PATENT SPECIFICATION

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343,250

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## COMPLETE SPECIFICATION.

### Improvements in or relating to Thermionic Amplifying Systems.

We, ARCTURUS RADIO TUBE COMPANY, a Company incorporated under the laws of the State of Delaware, United States of America, of 260, Sherman Avenue, Newark, New Jersey, United States of America, Assignees of SAMUEL RUBEN, a citizen of the United States of America, of 801, Riverside Drive, City and State of New York, United States of America, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to an electric circuit arrangement and more particularly it relates to a circuit arrangement for radio frequency amplification, with means provided for preventing the maintenance of the self-oscillations due to the coupling between the various resonant circuits comprising the amplifying system.

The object of this invention is the provision of means for preventing self-oscillations.

In the prior art, to prevent self-oscillations under resonance conditions in tuned radio frequency amplifier systems, various means have been employed, such as by the introduction of a resistance in the output circuit of the amplifying tubes and the application to the input circuit of the amplifier tube, either inductively or capacitively, a negative feedback potential of a value sufficient to neutralize the effect of the coupling in the tube or in the circuits causing self-oscillation.

It has also previously been proposed to provide a thermionic valve with a grid divided into two parts, one of the parts being arranged in the electron discharge path and the other grid being arranged outside the electron discharge path.

According to our invention we employ a vacuum tube of special design which more efficiently accomplishes the desired result. This tube functions through the usual three elements, a filament, a grid and a plate and an additional grid element in the same electrical field as is the other grid, but much smaller in size. The larger or controlling grid functions and is connected as in the usual three element type

[Price 1/-]

of tube but the minor grid is so connected in the amplifying system as to have an effect on the electronic emission of the tube opposite to the effect produced by the other grid, the larger grid being connected in a tuned input circuit. While it is preferable to inductively couple this second grid with the plate circuit, it can be capacitively coupled in a way commonly known in the art.

To more completely describe this invention, reference is made to the accompanying drawings of an embodiment of the invention, in which Fig. 1 illustrates a vacuum tube of a design suitable for operation in the circuit illustrated, and Fig. 2 shows a multi-stage, tuned radio frequency circuit utilizing this tube.

Referring more particularly to Fig. 1, which shows a vacuum tube similar to that forming the subject matter of our pending application No. 39,446/29, in glass bulb 1, are the filamentary cathode 2, anode 3, grid 4 for the control of the electron stream by the application of a potential from the tuned input circuit, and a second grid 5, of about one-tenth the physical size of grid 4. Grid 5 is inductively connected with respect to grid 4 to supply a potential for preventing self-oscillation under resonant circuit conditions. The filament 2 having leads at 2<sub>b</sub>, is supported by arm 2<sub>s</sub> mounted on rod 2<sub>a</sub> by glass bead 2<sub>c</sub>. The anode is mounted on rods 2<sub>a</sub> and 3<sub>a</sub>, the latter being also a lead for the anode. Rods 4<sub>a</sub> and 4<sub>b</sub> support the control grid 4, 4<sub>b</sub> being employed also as a lead; the smaller grid is mounted on rod 5<sub>a</sub> and lead 5<sub>b</sub>.

In Fig. 2, at L and L<sub>1</sub> are inductances for coupling the antenna and ground circuit with the input circuit grid 4 and filament 2 and with the circuits for the first amplifying tube, C being a variable condenser for tuning L. The plate 3, of the tube is connected to the output inductance L<sub>2</sub> which is coupled to inductances L<sub>3</sub> and L<sub>4</sub>.

L<sub>3</sub> is an inductance that is connected with the smaller grid 5, to which is inductively fed-back a suppressing potential which prevents feed-back oscillations; and L<sub>4</sub> is a tuned inductance which is con-

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connected to the input circuit of the second amplifying tube. As the amplification can be extended beyond to as many stages as desirable, the specific description of the rest of the amplifying system is omitted because the operation of each succeeding stage is identical. The output circuit of the last radio frequency stage is coupled to a detector tube  $T_3$ , which has the usual accessories, such as a grid leak condenser  $R$ , in the grid circuit and a by-pass condenser  $C_4$ , in the plate circuit, to which can be connected any audio frequency translating device, such as a telephone receiver  $P$ , or if desirable, to an audio frequency amplifying system.

Batteries  $B$ ,  $B_1$  and  $B_2$  are employed respectively to energize the filaments of the several tubes, to supply a potential between the cathode and anode of the final tube and both  $B_1$  and  $B_2$  supply a potential between the cathode and anodes of the tubes, other than the detector.

The value of the negative feed-back inductance  $L_2$  in the first stage or  $L$  and  $L_1$ , in their respective stages, is such as to be just sufficient to prevent self-oscillation or resonance, this being controlled by the degree of coupling and inductance of the circuit.

The operation of the circuit in respect to the tuned circuits and the usual elements of the tube is similar to the commonly known radio frequency amplifying system and the new elements, such as the small grid of one tube and its cooperating inductance negatively related to the input circuit allows more efficient operation with the undesirable oscillating conditions or the use of loss-imposing devices such as are known in the present art.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. An amplifying system particularly for use in radio frequency amplification, comprising an electron discharge tube having a cathode, an anode and two grids, one grid being of substantially smaller dimensions than the other grid, and being so connected in the system as to have an effect on the electronic emission of the tube opposite to the effect produced by the other grid, while the larger grid is connected in a tuned input circuit.

2. An amplifying system particularly for use in radio frequency amplification, according to claim 1 in which the grid of smaller dimensions is connected in an output circuit.

3. An amplifying system as claimed in claim 1 or 2, in which the smaller grid is coupled, preferably inductively, to the plate circuit.

4. The improved amplifying system particularly for use in radio frequency amplification, substantially as hereinbefore described and illustrated with reference to Fig. 2 of the accompanying drawings.

Dated the 24th day of December, 1929.

For ARCTURUS RADIO TUBE COMPANY,

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*[This Drawing is a reproduction of the Original on a reduced scale.]*

