E. O. SCRIVEN.

VACUUM TUBE APPARATUS.

APPLICATION FILED JUNE 27, 1918. RENEWED SEPT. 14, 1920.

1,375,739. **Patented Apr. 26, 1921.**

Fig. 1.

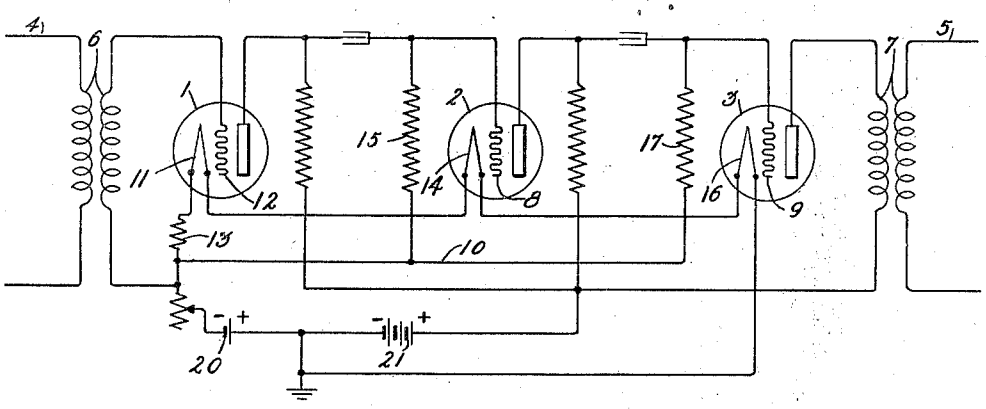
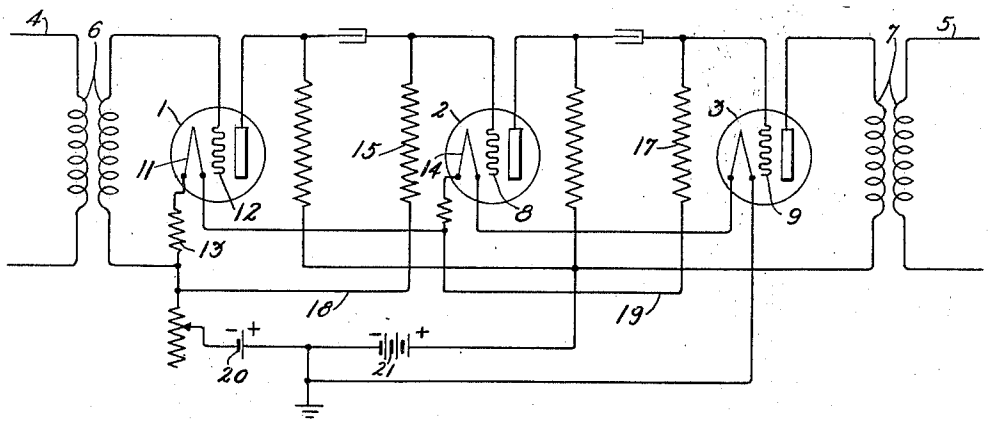


Fig. 2.



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UNITED STATES PATENT OFFICE.

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VACUUM-TUBE APPARATUS.

1,375,739. Specification of Letters Patent. Patented Apr. 26, 1921.

Application filed June 27, 1918, Serial No. 242,183. Renewed September 14, 1920. Serial No. 410,082.

To all whom it may concern:

Be it known that I, EDWARD O. SCRIVEN, a citizen of the United States, residing at New York, in the county of New York, State of New York, have invented certain new and useful Improvements in Vacuum-Tube Apparatus, of which the following is a full, clear, concise, and exact description.

This invention relates to vacuum tube circuits and has for its object to provide means whereby the grid potential of a tube is maintained at all times at a potential different from that of the filament potential, viz. negative.

In the case where a plurality of tubes are connected to act as a multi-stage amplifier it is desirable, especially in the last few tubes of a series, that the grid potential shall always be negative with respect to the filament potential. If this were not so, or if the potential of the grid were not sufficiently negative as above stated, the fluctuations of the larger amounts of energy which occur in the later tubes would cause the grid potential to become positive, thereby not only impairing the amplification efficiency of the tubes but also causing a current in the grid circuit with a consequent loss of the power in the tube itself. To accomplish this object the invention provides that the grid of a tube in the series shall be connected to the far side (negative side) of a preceding filament so that there shall be sufficient voltage drop to the grid as to cause it to be negative in potential with respect to the filament.

In the drawings illustrative of the invention, Figure 1 shows three tubes having their grids connected to a common wire leading to the far side of the first filament of the series; Fig. 2 shows a circuit in which the grid of each tube is connected to the far side of the filament of the tube next preceding.

As shown in the drawing, with particular reference to Fig. 1, a plurality of tubes 1, 2 and 3 are shown connected between an incoming line 4 and an outgoing line 5 by suitable transformers 6 and 7.

The grids 8 and 9 of tubes 2 and 3 are connected by a common wire 10 to the first tube 1. The requisite negative potential relation for grid 12 of tube 1 is provided by the drop from battery 20 through resistance 13 to filament 11. Since the first tube handles relatively small amounts of power, the potential difference between grid 12 and filament 11 need not be very great. This may be of the order of .1 volt. In tube 2 the requisite potential for grid 8 is similarly obtained by the drop from battery 20 through resistance 13, filament 11 to filament 14. This drop may be of the order of 10 volts. Likewise in tube 3 the requisite drop for grid 9 is obtained over the following circuit: from battery 20, resistance 13, filaments 11 and 14 to filament 16. This drop may be of the order of 20 volts. It will be noted that the drop to grids 8 and 9 is obtained by passing through all the preceding filaments in each case. Resistances 15 and 17 are provided in the circuit of grids 8 and 9, respectively, and are of the order of 100,000 ohms. In accordance with this circuit, therefore, the potential relation between the filaments and grids in the tubes, as above set forth, increases along the series of tubes and thus enables increasingly larger amounts of energy to be handled by the tubes without causing appreciable current to flow in the grid circuit and impair the efficiency of amplification.

In Fig. 2 is represented a circuit wherein a series of tubes 1, 2 and 3 may be used as an amplifier of modulated waves. For this purpose it is not necessary that the potential difference between grid and filament in succeeding tubes be increased by so much as in the former circuit as shown in Fig. 1. Therefore it is only necessary in this case to connect the grid of tube 3, as shown, to the far side of the preceding filament in tube 2. In this case the grid of tube 1 is connected as described with reference to Fig. 1. In tube 2 the grid 8 is connected through resistance 15 to wire 18, to the far side of filament 11 of tube 1. Grid 9 of tube 3 is connected through resistance 17 to wire 19 to far side of filament 14 of tube 2. By this arrangement the same principle is employed but the voltage drops to the grids are not so great as shown in Fig. 1, because of the needs of the particular adaptation of the device. The usual "A" and "B" batteries are designated as 20 and 21, respectively.

It is evident then that the negative poten-

tial desired for a grid is obtained from the drop in potential across the terminals of the filaments of the preceding tube or tubes.

What is claimed is:

1. A vacuum tube apparatus comprising a plurality of tubes arranged in a series and each having a cathode and a grid, and means for applying to the grid of one of said tubes the potential across the cathode of another tube.

2. A vacuum tube apparatus comprising a plurality of tubes arranged in a series and each having a cathode and grid, and means for applying to the grid of one of said tubes the potential across the cathode of a preceding tube.

3. A vacuum tube apparatus comprising a plurality of tubes arranged in a series and each having a cathode and grid, and means for applying to the grid of one of said tubes the potential across the cathode of the tube next preceding.

4. A vacuum tube apparatus comprising a plurality of tubes arranged in a series and each having a cathode and a grid, and means for causing the difference in potential between the grid and cathode in succeeding tubes to increase along the series.

5. A vacuum tube apparatus comprising a plurality of tubes arranged in a series and each having a cathode and a grid, and means for applying to one grid in the series the potential across the cathode of the first tube of the series.

6. A vacuum tube apparatus comprising a vacuum tube having a filament and grid, means for heating the filament, a resistance between the filament and said means, a second tube having a filament and grid, and connecting means whereby the potential of the grid in the second tube is made dependent upon the drop across the preceding filament and said resistance.

In witness whereof, I hereunto subscribe my name this 24th day of June A. D., 1918.

EDWARD O. SCRIVEN.