

Sept. 13, 1927.

G. M. WRIGHT

1,642,526

MEANS FOR SUPPLYING POWER TO THERMIONIC VALVES

Filed Aug. 17, 1926

Fig. 1

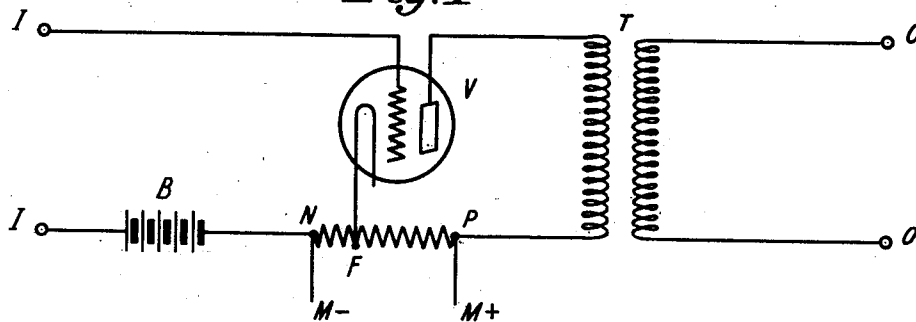


Fig. 2

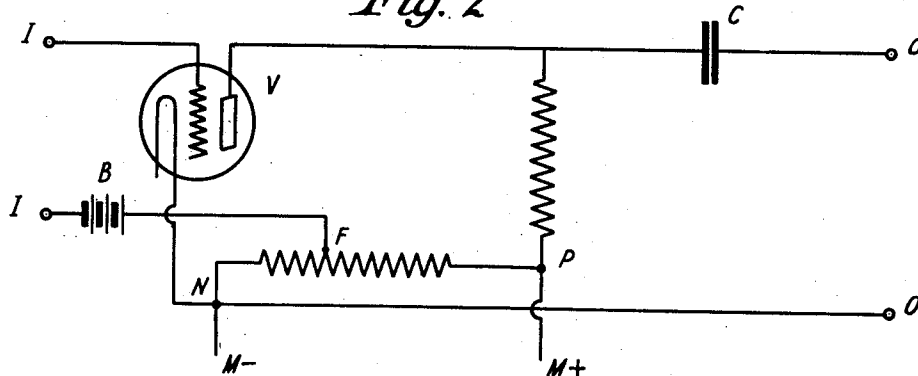
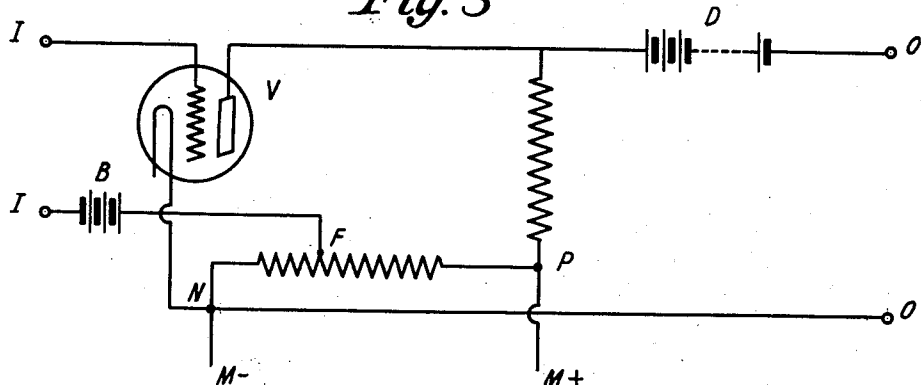


Fig. 3



INVENTOR.

GEORGE MAURICE WRIGHT

BY

Isa f Adams
ATTORNEY.

UNITED STATES PATENT OFFICE.

GEORGE MAURICE WRIGHT, OF CHESTERFIELD, ENGLAND, ASSIGNOR TO RADIO CORPORATION OF AMERICA, A CORPORATION OF DELAWARE.

MEANS FOR SUPPLYING POWER TO THERMIONIC VALVES.

Application filed August 17, 1926, Serial No. 129,857, and in Great Britain August 15, 1925.

This invention relates to improved means for supplying the high tension power for a thermionic valve from an ordinary power supply circuit or the like.

5 In many cases it is desirable for practical reasons to supply power from direct current generators or public supply mains, as, for example, to valves in central telegraph offices or to the valves of broadcast receivers.

10 When, however, power is supplied to the anode circuits of thermionic valves from ordinary power supply circuits, difficulties arise from two main causes:—

(1) The fairly large semi-permanent 15 changes in the supply voltage which occur from time to time owing to variations in the load on the feeders. These changes tend to affect the anode supply to the valves and may put the direct current bridges in a tele- 20 graph office out of adjustment.

(2) The ripples superimposed on the steady direct current voltage, which ripples are caused by commutation and by the arma- 25 ture teeth in the generators supplying the circuit. Such ripples give rise to a hum in audio circuits or in broadcast receivers.

According to the present invention potential is so applied from a power circuit or the like to the anode and to the grid of a 30 thermionic valve, that when a change in the electromotive force applied to the anode occurs, there will be a change of opposite effect in the electromotive force applied to the grid, the proportions between the electromotive 35 forces applied being such that the effective output of the valve remains substantially constant.

In one form of construction, suitable for use in a transformer coupled amplifier, the 40 terminals of the power supply are shunted by a resistance, and the positive terminal is connected through the primary of the inter-valve transformer to the anode of the valve. At a point along the resistance, a connection 45 is taken to the filament of the valve and the grid circuit connection is made to the negative terminal of the power supply. The usual biasing battery may be included in series with the input terminal. The tapping 50 point for the filament connection is such that it divides the resistance into two parts, so that the required compensating voltage is applied to the grid. I have found that this compensation is obtained when the part of 55 the resistance adjacent the anode is approxi-

mately m times that adjacent the grid, where m is the magnification factor of the valve.

With this arrangement so long as the valve is working on the substantially straight part of its characteristic curve any change in the 60 voltage applied to the anode will be compensated for by a change of opposite effect in the voltage applied to the grid, so that the effective output of the valve, which in this case is the anode current, remains sub- 65 stantially constant.

In a modification, suitable for use in a resistance coupled amplifier, the grid circuit connection is made to the tapping point upon the resistance, and the filament and anode 70 circuit connections are made each to one end of the said resistance and to the negative and positive terminals of the power supply respectively. With this arrangement I have 75 found the required compensation to be obtained and the effective output of the valve (in this case the anode voltage) to remain substantially unaffected by variations in the power supply when the part of the resistance 80 adjacent the anode is $R\alpha$ times that adjacent the filament, where R is the series resistance of the anode circuit of the valve, and α the slope of the grid volts-anode current characteristic.

If desired, the tapping point for the fila- 85 ment and resistance may be made movable, that is to say, the shunt resistance may be the winding of a potentiometer.

In case of the transformer coupling, preferably the resistance is of low value com- 90 pared with the valve impedance, so as to avoid undesirable reactions between the anode and grid circuits.

Any potential dividing arrangement may be used in place of the resistance hereinbe- 95 fore referred to. A convenient method, in the case where the supply is from a local motor generator or the like, is to provide an extra brush resting on the commutator there- of, which brush serves as the filament tapping 100 point. This arrangement avoids the losses which occur when resistances are used.

It may be desirable to provide condensers in shunt across the tapping points of the 105 resistances or the like. When such condensers are used, their impedances should be in the before-mentioned ratio.

The arrangements hereinbefore described are suitable for use with direct current sup- 110 ply from an ordinary power circuit. If al-

ternating current power supply only is available, such arrangements may conveniently be employed in conjunction with rectifiers.

The invention is illustrated in the accompanying drawing, in which Figure 1 is a diagram of a transformer coupled amplifier, according to the invention; Figure 2 is a diagram of a resistance capacity coupled amplifier and Figure 3 is a diagram of a resistance battery coupled direct current amplifier.

Referring to Figure 1, V is a thermionic valve and I the input terminals, whereby the impulses to be amplified are applied between the grid and filament of the said valve. T is an output transformer, whose secondary is connected to output terminals O. M+ and M- are the positive and negative terminals of the power supply, which is connected across the ends of a resistance NFP, the part PF of which is included in the anode circuit of the valve, the part NF being included in the grid circuit thereof. B is a grid bias battery. I have found that satisfactory compensation is obtained when the parts NF, FP, of the resistance are so proportioned that

$$\frac{NF}{FP} = \frac{1}{m},$$

where m is the magnification constant of the valve.

It will be seen that when fluctuation, say, an increase of anode potential, occurs, a compensating fall of grid voltage is occasioned, so that the anode current remains substantially constant.

In Figure 2, those parts corresponding to parts shown in Figure 1 are indicated by like reference letters. C is a coupling condenser.

The arrangement shown diagrammatically in Figure 3 is suitable for use as a direct current amplifier, and is generally similar to that shown in Figure 2, except that the capacity C (of the said Figure 2) is replaced by a battery D, whereby the grid of the succeeding valve (not shown) can be adjusted to the correct potential.

I have found that in this case satisfactory compensation results are obtained when

$$\frac{NF}{FP} = \frac{1}{Ra},$$

when R is the anode series resistance and a is the slope of the grid voltage-anode current characteristic of the valve.

It will be seen, in this case, that if an increase in anode potential occurs, a compensating rise of grid voltage is occasioned, so that the anode potential to negative end of filament remains substantially constant.

The invention is also applicable to amplifiers of the so-called "choke coupled" or "inductive resistance coupled" type.

Having described my invention, what I claim is:

1. Means for supplying current from a power circuit to a resistance coupled thermionic tube having cathode, anode and grid electrodes, including a resistance shunting the terminals of the power supply, and a connection from said resistance to the grid of the tube, said connection dividing the resistance in such a manner that one part is included in the anode circuit of said tube and the other part included in the grid circuit, the ratio of the resistance of the grid circuit to that in the anode circuit being equal to the reciprocal of the anode series resistance multiplied by the slope of the grid voltage-anode current characteristic of the tube.

2. The method of maintaining the anode potential of a resistance coupled thermionic valve substantially constant when the valve is receiving its power from direct current generators subject to fluctuations, consisting in inserting resistances in the anode and grid circuits of the valve, the ratio between said resistances being equal in value to the anode series resistance multiplied by the slope of the grid voltage-anode current characteristic of the valve by any change occurring in the electromotive force applied to the anode will produce a corresponding change in the electromotive force applied to the grid.

3. In an amplifier arrangement having an output circuit, a series resistance in the output circuit, means for supplying current from a power circuit to said amplifier arrangement, a resistance shunting said power supply, the cathode of the amplifier and the output circuit being connected to the terminals of the shunt resistance, and the grid of said amplifier being tapped off from said shunt resistance at a point intermediate of its terminals, said resistance being divided in such manner that the ratio of the portions included in the input and output circuits is equal to the reciprocal of the anode series resistance multiplied by the slope of the grid voltage-anode current characteristic of the amplifier.

4. The method of maintaining the potential difference between the anode and filament of an impedance coupled thermionic valve substantially constant when the valve is supplied with a resistance shunted fluctuating source of direct current which consists in including portions of the resistance in the input and output circuits of the valve in such a manner that the ratio of the portions included in the input and output circuits is equal to the reciprocal of the anode series resistance multiplied by the slope of the grid voltage-anode current characteristic of the thermionic valve.

GEORGE MAURICE WRIGHT.