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2,275,136

AMPLIFIER CIRCUITS

Original Filed Aug. 6, 1937

FIG. 1.

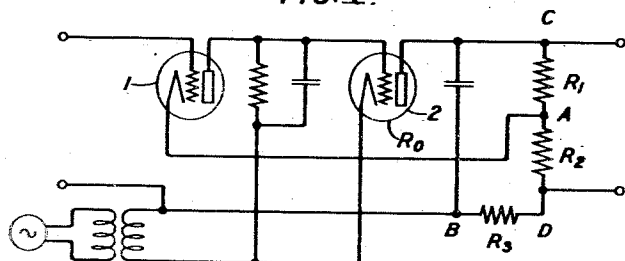


FIG. 2.

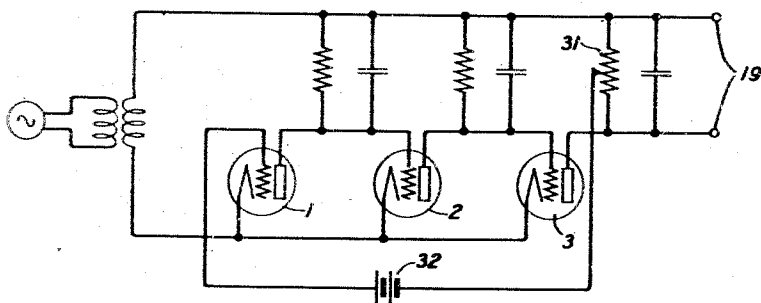
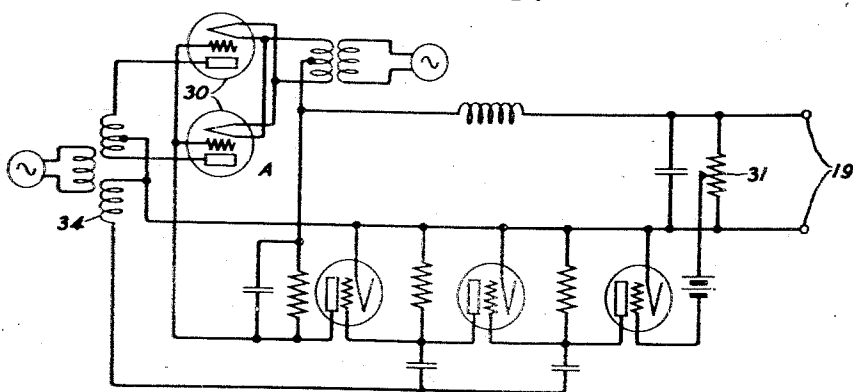


FIG. 3.



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AMPLIFIER CIRCUITS

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Original application August 6, 1937, Serial No. 157,693. Divided and this application March 13, 1940, Serial No. 323,689

4 Claims. (Cl. 175-363)

This is a division of an original application Serial No. 157,693, filed August 6, 1937, for Amplifier circuits, now Patent No. 2,207,976 of July 16, 1940.

This invention relates to amplifier circuits and more particularly to circuits making use of vacuum tube amplifiers for which the basic supply of power is an alternating current source. Still more particularly it relates to an amplifier circuit in which alternating current voltage is supplied directly to the plate circuits of tubes without the intermediate step of rectification.

In some cases I arrange the circuits so that alternate tubes have their anodes connected to one side of the alternating current power line and the other tubes have their anodes connected to the other side of the power line. In other cases I find it convenient to connect all the tubes in such manner that the anodes are connected to the same side of the alternating current power source. In both cases the intermittent supply of power to the tube gives substantially the same effect as is accomplished in a conventional direct current amplifier by a plurality of separate batteries or by batteries of opposed polarity. Circuit arrangements exemplifying this are shown in the drawings and described in detail in the specification of the above-identified parent application.

This divisional application is more specifically directed to the invention disclosed in the above-identified application with particular reference to Figs. 10 and 11 thereof.

The invention will be better understood by reference to the following specification and the accompanying drawing, in which

Fig. 1 shows a circuit arrangement for an amplifier in which anode power supply is furnished directly from an alternating current source, a gain reducing negative feedback connection of the bridge type being included; and

Figs. 2 and 3 show circuit arrangements for regulating the output of a rectifying circuit and including a direct current amplifier whose anode power supply is furnished directly from an alternating current source.

Reference to the above-noted patent No. 2,207,976 will evidence that Figs. 1, 2 and 3 herein are the same as Figs. 9, 10 and 11 thereof. Figs. 1 to 8 of the patent show various circuits in which the cathode and anode of the electron discharge devices therein are connected directly with an alternating current source. It is brought out also in the patent that to increase the stability and to improve the over-all performance of the

circuits, a variety of negative feedback connections may be included in them.

Fig. 1 illustrates an extension of the arrangements of Figs. 2, 3, 4, 5, 7 and 8 of the patent for providing feedback connection, the one here shown being that commonly known as the bridge type of feedback. In Fig. 1, R_0 represents the internal impedance of the last tube. The resistances R_0 , R_1 , R_2 and R_3 form a balanced bridge with the points AB conjugate to the points CD. Under these circumstances, the voltage between A and B is dependent upon the apparent generator voltage in the last tube and is fed back to the grid of the first tube, but this voltage between A and B is independent of changes occurring in the load circuit, all in a manner which is well known in the art.

An amplifier of the type described in the above-identified patent is particularly applicable to control circuits such as those for automatic volume control, rectifier output regulation, battery charging, alarm signal operation, etc. In the automatic volume control circuit as applied to many radio receiving sets the negative bias applied to various tubes should be proportional to, but many times as large as the negative voltage developed at the detector, and the circuits described above are peculiarly well adapted to supply this. In the regulation of rectifiers or generators some standard voltage may be used as a reference. The direct current amplifier of my invention would be used to drive the grids of the rectifier tubes or the field of the generators so that the rectifier or generator output current is proportional to the difference between the terminal voltage and the reference voltage. An illustration of this is given in Fig. 2 in which the group of amplifiers 1, 2 and 3 are arranged in tandem in substantially the manner indicated in Figs. 6 and 7 of the above-identified patent. The tube or tubes serve as a rectifier to deliver direct current power at the terminals 15 from the alternating current power supply. Across the direct current power line is bridged a volt coil 31, and a feedback connection from a suitable point thereon goes to the grid of tube 1. In this feedback grid circuit there is also included a reference voltage from a source 32. If the voltage amplification in this circuit after feedback is, say, 100, and if we use as the input or reference voltage 32 a 1.5 volt dry cell, then the output across the terminals 19 is 150 volts and in so far as the negative feedback has made the amplification ratio independent of time, load, supply voltage, etc., this output voltage

will also be independent of those variables. It will be observed that the source of reference voltage 32 need not deliver any appreciable current and may, therefore, consist of small cells designed for long shelf life. For more precise regulation some of the well-known standard voltage cells can be used.

Still another particular illustration of the application of my invention is shown in Fig. 3 in which the upper part A of the figure represents a conventional rectifier supplying direct current power to the terminals 19. The rectifier tubes 30 have grid control. Due to variations in the load or in the alternating current supply the voltage across the terminals 19 will, in general, be subject to fluctuations. To protect against this, there is provided as shown in the lower part of Fig. 3 a direct current amplifier feeding part of its output back to the grids of the rectifier tubes in the portion A. Any variations in the voltage across the terminals 19 are effective, through the volt coil 31, to operate on the grid of the first in the train of direct current amplifier tubes. The particular circuit of Fig. 3 is applicable to high vacuum rectifying tubes, each tube comprising three elements, one of which is a control grid, such as are well-known in the art. It is, however, evident that any type of rectifier tube may be used so long as these rectifier tubes are subject to control. Thus, they may be replaced by gaseous rectifiers of the hot cathode or ignitron type, if these are at the same time provided with suitable alternating current excitation of the grids. In this Fig. 3 a separate secondary winding 34 is shown as providing power for the plate circuits of the direct current amplifier. This, however, is a matter of convenience and the necessary alternating current voltage could be obtained by tapping from the main high voltage winding.

While this invention has been described in terms of three-electrode tubes, this is for the sake of simplicity. It is understood that any or all of these tubes may be replaced by tubes of other types such as screen grid tubes or pentodes. The substitution of these will be obvious to those skilled in the art.

What is claimed is:

1. In a circuit for converting alternating current power into direct current power, a rectifier circuit comprising rectifier tubes with control grids, means for regulating the voltage delivered by the rectifier which comprises a train of vacuum tube amplifiers connected in tandem, the

plate circuits thereof being supplied directly from the alternating current source, the grid of the first tube being controlled by a volt coil across the load circuit, and the output of the train of tubes being connected to control the voltage of the grids of the rectifier.

2. In a circuit for converting alternating power into direct current power, a rectifier circuit comprising rectifying tubes with control electrodes; means for regulating the voltage delivered by the rectifier circuit, said means comprising a plurality of vacuum tubes connected in tandem, the anode circuits of said vacuum tubes being supplied directly with alternating current, and said vacuum tubes having control grids; means at the output of said rectifier circuit across which the rectifier circuit output voltage is developed; and means for applying a portion of said voltage to the control grid of the initial tube of said tandem-connected tubes, the output of the final tube of said tandem-connected tubes controlling the potential on the control electrodes of the rectifying tubes.

3. In a circuit for converting alternating current power into direct current power, a rectifier circuit comprising rectifier tubes with control electrodes, and means for regulating the voltage delivered by the rectifier circuit, said means comprising a direct current amplifier, supplied with alternating current from the source of alternating current power to be rectified and having an input control grid whose potential is determined by the voltage developed at the rectifier circuit output, the output voltage of the amplifier being applied to the control electrodes of the rectifier tubes.

4. A circuit for converting alternating current power into direct current power having a substantially constant voltage, comprising rectifying means including a tube having cathode, anode and control electrode, the alternating current to be converted being impressed on said cathode and anode; impedance means across which is developed the output voltage of said tube; and a direct current amplifier deriving its anode circuit power as alternating current from the source of alternating current, obtaining its input control potential from a portion of the voltage developed across said impedance means, and delivering its output to the rectifying means to regulate the potential of the control electrode of said tube.

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