

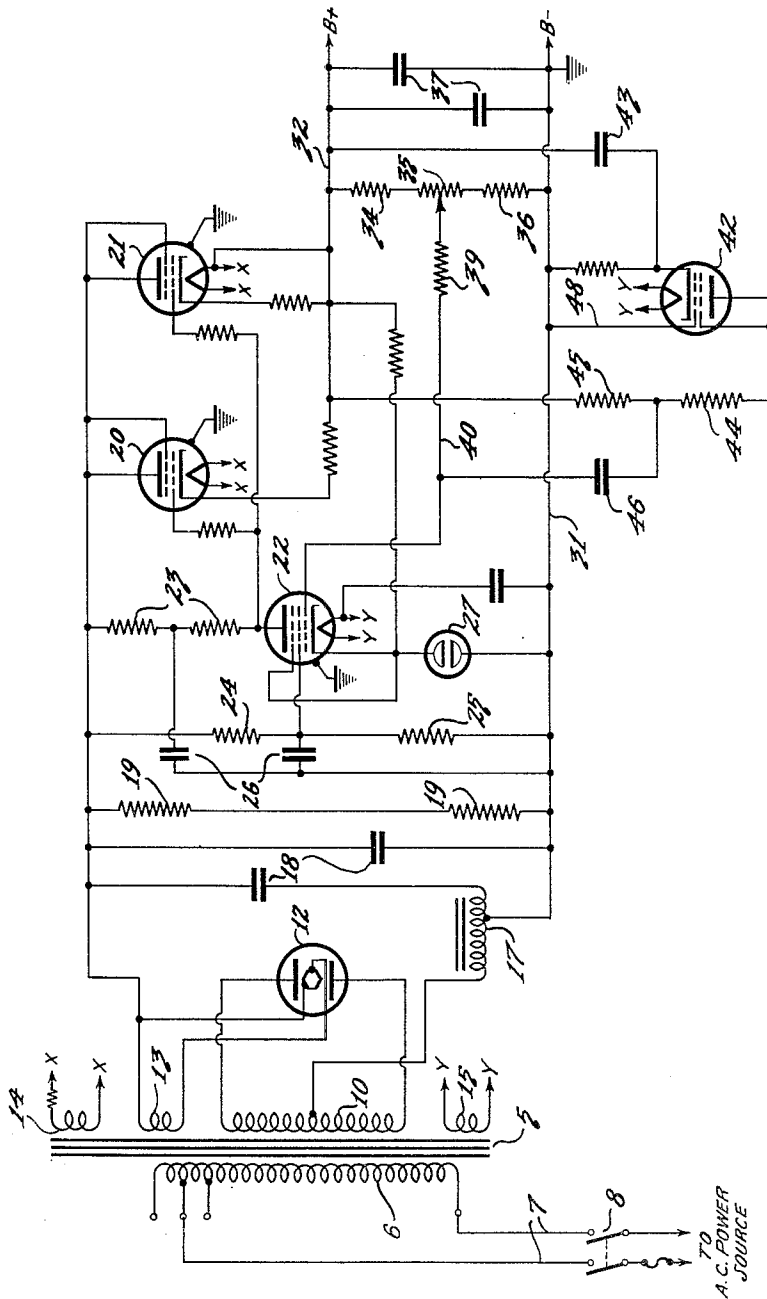
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REGULATED POWER SUPPLY

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REGULATED POWER SUPPLY

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This invention relates to power supply circuits, and particularly to a regulated rectifier circuit wherein variations in the load current on the rectifier produce minimum variations in the output voltage thereof.

Regulated power supply circuits of different types are known, regulation being provided by a feedback arrangement which varies the impedance or resistance between the rectifier and load. Systems for stabilizing the light output of lamps wherein parallel feedback circuits are used, one for the relatively slow current variations, and another for the relatively rapid current variations, have also been suggested, as shown by Reiskind U. S. Patent No. 2,360,012 of October 10, 1944. The present invention is directed to a regulated power supply in which two regulating feedback paths are provided, one for the slow current changes, and the other for the rapid current changes, such as the hum components, which permit the power supply not only to have good regulation, but to improve its hum filtering ability and also provide a desirable time constant by eliminating resistors and condensers formerly used for filtering.

The hum voltage feedback path utilizes a grounded grid amplifier in which the output is in phase with the input, thus avoiding the use of another amplifier tube to maintain the proper phase relations, the impedance of the output of the power supply being held low to improve the regulation ability thereof. By preventing rapid output voltage changes caused by rapid load current changes, while providing adequate hum reduction, the regulator circuit of this invention is particularly useful for power supplies for noise reduction amplifiers and compressors used in sound recording and in radio broadcasting.

The principal object of the invention, therefore, is to facilitate the regulation of electrical power supplies.

Another object of the invention is to provide an improved power supply unit which permits rapid load current changes, while providing constant output voltage and adequate filtering.

A further object of the invention is to provide a regulated power supply circuit in which the regulation is provided by parallel feedback paths, one for slow current variations, and another for rapid current or hum voltage variations.

A still further object of the invention is to provide a regulated power supply having a pair of feedback circuits for improving regulation and for reducing hum.

Although the novel features which are believed

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to be characteristic of this invention will be pointed out with particularity in the appended claims, the manner of its organization and the mode of its operation will be better understood by referring to the following description read in conjunction with the accompanying drawings, forming a part hereof, in which the single figure is a schematic circuit drawing of a regulated power supply embodying the invention.

Referring now to the drawing, a power transformer 5 has its tapped primary winding 6 energized over conductors 7 connected by a switch 8 to any standard power source. The high voltage secondary winding 10 has its terminals connected to the anodes of a rectifier 12, while a winding 13 supplies the cathodes of the rectifier; a winding 14, the heaters of a pair of regulator tubes 20 and 21; and a winding 15, the heaters of a pair of amplifier tubes 22 and 42. The output of the rectifier is derived from the mid-tap of the secondary 10 through a choke coil 17 and across a pair of filtering condensers 18, terminating resistors 19, and the rectifier cathodes.

At 20 and 21, is a pair of triode connected pentodes, such as RCA-6L6's, connected in parallel, but in series with the rectifier output. The grid voltage for tubes 20 and 21 is obtained across a resistor 23 and derived from the plate of tube 22. Resistors 24 and 25 and condensers 26, together with an RCA-OA2 voltage regulator tube 27, maintain the cathode voltage constant on a control amplifier tube 22, such as an RCA-6J7. The rectifier output is supplied to the load over conductor 31 and conductor 32, said last named conductor having the plate-cathode resistances of tubes 20 and 21 in series therewith.

The output circuit is shunted by a potentiometer consisting of resistors 34, 35, and 36 and condensers 37, resistor 35 being variable and connected over a resistor 39 and a conductor 40 to the control grid of tube 22. Thus, should the voltage across the output terminals plus B and minus B be reduced by an increase in the load current or a decrease in the power supply voltage, the voltage applied to the grid of tube 22 varies to change the plate-cathode resistances of tubes 20 and 21 accordingly. For instance, should the current drain be high, a voltage reduction occurs between the minus B terminal and the arm of the voltage adjusting potentiometer 35. The grid of tube 22 is thus made more negative with respect to its cathode and its plate current will be decreased. This decreases the voltage drop across plate load resistor 23, and the voltage on the grids of tubes 20 and 21 becomes less nega-

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tive with respect to their cathodes. Thus, the plate-cathode resistances of tubes 20 and 21 decrease, and the decreased voltage drop across them results in an increased voltage at the terminals plus B and minus B, thereby compensating for the original voltage reduction. Since this action is instantaneous, the effect is a constant voltage output at all times. When the output voltage of the rectifier increases due to an increase in supply voltage or a reduction in the load current, the reverse action takes place.

However, it has been found that this feedback arrangement is insufficient or inadequate to provide both good regulation for relatively slow voltage changes caused by the load current variations as explained above, and, at the same time, reduce the hum or ripple voltages which are relatively very rapid variations. The reason for this difference in regulation or filtering action is caused by the presence of filter-condenser 37 across the terminals plus B and minus B which attenuate the hum or ripple voltages considerably while having no effect on the slow voltage changes. Consequently, slow voltage changes will produce relatively large control voltage variations at the grid of tube 22, while rapid voltage fluctuations as hum or ripple due to their higher attenuation caused by condenser 37 will be relatively ineffective in providing a feedback voltage.

Therefore, a tube 42 has been provided, the input thereto being over condenser 43 from the plus B terminal to its cathode, and the output being over resistors 44 and 45 and a condenser 46. It will be noted that this circuit has its grid grounded over conductor 48 so that no phase shift exists between its input and output. In the ordinary alternating current amplifier, a phase shift of 180 degrees exists between input and output voltages, and the use of such a tube would require a second tube in order to obtain the proper phase relationship for this portion of the circuit.

Where previously, a series resistor was used in the plus B conductor ahead of potentiometers 34, 35, and 36 and a series condenser connected between the power supply side of this resistor and the grid of tube 22 in order to reduce hum, a large time constant was introduced, since this condenser had to be charged through resistor 39. The present circuit eliminates these elements, thus obtaining as good, if not better filtering for ripple voltages without a time constant. This is accomplished by additionally amplifying and then impressing the hum potential on the grid of tube 22 in the same phase relation as previously obtained. Therefore, tube 22 controls the plate-cathode resistance of tubes 20 and 21 in accordance with the ripple voltages and the slow voltage variations as explained above.

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Thus, the circuit is particularly suitable for power supplies energizing noise reduction amplifiers wherein load current changes are encountered during sudden increases and decreases in the signal being recorded and in compressors and expanders in which the average plate current changes the load on the rectifier.

I claim:

1. A power supply regulator circuit having output terminals for a rectifier adapted to be connected to a load, comprising impedance means connected between said rectifier and said terminals and adapted to be varied in accordance with voltage variations at said terminals, and a pair of feedback circuits between said terminals and said impedance, one of said circuits including a shunt resistor between said terminals, a series resistor, and an amplifier, and the other of said circuits including a condenser and resistor in series across said terminals, a grounded grid amplifier having its input connected between said resistor and condenser, a condenser-resistor output circuit for said grounded grid amplifier connected to the input of said first mentioned amplifier, and a resistive circuit between said first mentioned amplifier and said impedance means.

2. A power supply regulator circuit having means for rectifying an alternating current and output terminals for said means, one of said terminals being grounded, comprising a variable impedance connected in series between said rectifying means and said terminals, a resistor element connected in shunt with said terminals, an amplifier having its output resistively connected to said variable impedance and its input to a point on said resistor element, a condenser and resistor in series connected in shunt with said terminals, an amplifier having its output capacitively connected to the input of said first mentioned amplifier and its input connected to the point of connection between said condenser and resistor, and a conductor connecting the grid of said second mentioned amplifier to said grounded terminal.

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