

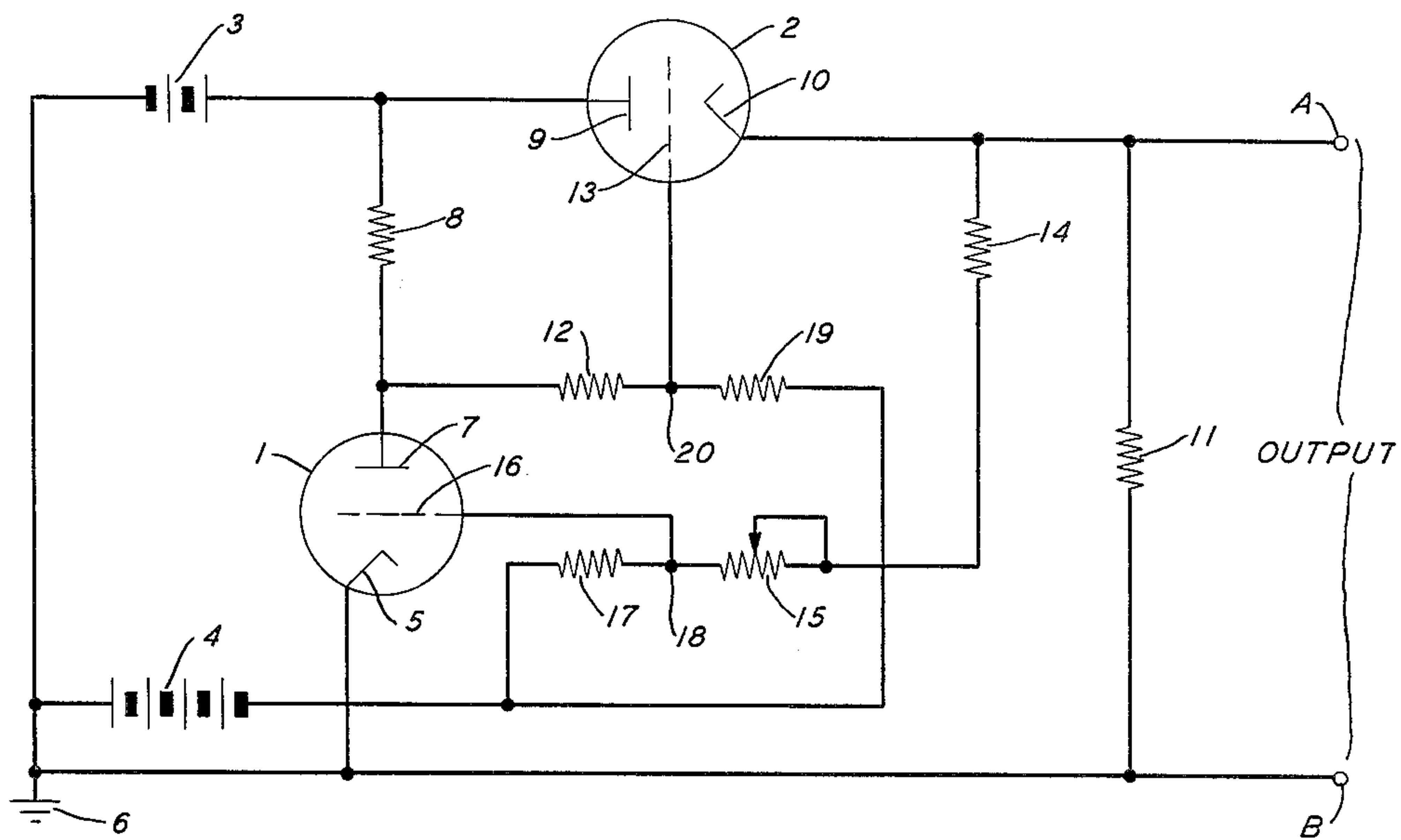
Aug. 2, 1955

E. J. HENLEY

2,714,701

VOLTAGE REGULATION CIRCUIT

Filed Dec. 8, 1951



INVENTOR
E. J. HENLEY
BY *Stoddard*
ATTORNEY

1

2,714,701

VOLTAGE REGULATION CIRCUIT

Edward Joseph Henley, Chicago, Ill., assignor to American Telephone and Telegraph Company, a corporation of New York

Application December 8, 1951, Serial No. 260,651

2 Claims. (Cl. 323—22)

This invention relates to voltage regulation circuits and, more particularly, to a stabilized potential generator.

It is an object of this invention to provide improved means for reducing the percentage of fluctuations in the magnitude of the output potential produced by a voltage regulation circuit.

Another object of this invention is to provide improved self-regulating means for compensating for voltage irregularities in the power supplied to a voltage regulation circuit.

These and other objects of the invention are accomplished in a voltage regulation circuit of the two-stage feedback amplifier type by means which include coupling the cathode of each tube to ground. Other of these means comprise operating the grid of the first tube at essentially zero voltage so as to permit the grid to be connected to a tap near the cathode end of a voltage divider coupled between the cathode of the second tube and the bias supply source. This circuit design causes only a small percentage of any voltage fluctuation in the electric energy from the bias supply source to be applied to this grid. In addition, the grid of the second tube is coupled to a tap on a voltage divider having one end connected to the anode of the first tube and its other end connected to the bias supply source. Due to this circuit configuration, a portion of any voltage fluctuation that may appear in the electric energy from the bias supply source will be applied to the grid of the second tube in such a phase relationship as to oppose that portion of the voltage fluctuation which is applied to the grid of the first tube. Thus, a considerable improvement in the stability of the output potential is obtained. These and other features of the invention are more fully discussed in connection with the following detailed description of the drawing which is a schematic circuit diagram of a voltage regulation circuit embodying the present invention.

In the drawing, the voltage regulation circuit is represented as including a two-stage feedback amplifier constituted by two triodes 1 and 2, the first functioning as a conventional amplifier and the second as a cathode follower. These triodes 1 and 2 are operated by potentials from two sources 3 and 4, the source 3 supplying a positive potential of 140 volts and the source 4 supplying a negative bias potential of 380 volts. It is to be understood that these voltage values, as well as the values of other circuit elements described hereinafter, are set forth for the purpose of explaining the principles and features of operation of this invention by describing a particular embodiment of the invention which has operated satisfactorily, and that the invention is not limited to these specific values. It is also to be understood that the potential sources 3 and 4, which are indicated in the drawing by the symbol for a battery, may actually be any convenient source, such as the output from an alternating current rectifier operated by a conventional commercial source of electric power.

The amplifier 1 has its cathode 5 connected to ground 6 and its anode 7 coupled through a 0.1 megohm resis-

2

tor 8 to the supply source 3. Normally, this causes a positive potential of approximately 45 volts to be applied to the anode 7. The cathode follower tube 2 has its anode 9 connected to the supply source 3 and its cathode 10 connected through a 1,000-ohm load resistor 11 to ground 6. The output terminals A and B of the voltage regulation circuit are connected across the load resistor 11 for supplying a utilization circuit of any suitable type with electric energy of an assigned potential, such as five volts. The amplifier 1 drives the cathode follower 2 over a path extending from the anode 7 of tube 1 through a 0.22 megohm resistor 12 to the grid 13 of tube 2. Negative feedback is provided over a circuit from the cathode 10 of tube 2, through a 4,700-ohm resistor 14, and then through an adjustable 5,000-ohm resistor 15 to the grid 16 of tube 1. The grid 16 is also connected through a 0.47-megohm resistor 17 to the supply source 4 and normally has a negative bias of about 0.2 volt.

The resistors 17, 15, and 14 constitute a voltage divider connected between the supply source 4 and the cathode 10 of tube 2. It is to be noted that the tap 18 which connects the grid 16 to this voltage divider 17—15—14 is located at a point which has a 0.47-megohm resistance between it and the bias source 4, but no more than 9,700 ohms resistance between it and the cathode 10. Since the grid 16 is thus connected near the cathode end of the voltage divider 17—15—14, only a small percentage of any voltage fluctuation in the electric energy from the bias source 4 will be applied to the grid 16. This serves to reduce the percentage of fluctuations in the magnitude of the output potential appearing across the terminals A and B of the voltage regulation circuit.

In order to provide self-regulating means for compensating for voltage changes in the bias supply source 4, one end of a 1.8 megohm resistor 19 is connected to the resistor 12 and its other end is connected to the supply source 4. Thus, the two resistors 12 and 19 constitute a voltage divider having one end connected to the anode 7, and its other end connected to the source 4. Since the grid 13 is connected to a tap 20 on this voltage divider 12—19, a portion of any voltage fluctuation that may appear in the electric energy from the bias source 4 will be applied to the grid 13 of the tube 2 in such a phase relationship as to oppose that portion of the voltage fluctuation which is applied to the grid 16 of the tube 1. This is due to the fact that the phase of a voltage fluctuation applied to the grid 16 is reversed by the tube 1 and appears in opposite phase at the anode 7 which then applies it through the resistor 12 to the grid 13.

This greatly reduces voltage fluctuations appearing across the output terminals A and B and results in a substantial improvement in the stability of the output potential from the voltage regulation circuit. For example, a variation of 50 volts in the electric energy from the bias source 4 will produce a variation of approximately one volt in the potential applied to the grid 16 of the tube 1 and a variation of about three volts in the potential applied to the grid 13 of the tube 2 and a resulting variation of approximately only 0.3 volt in the output potential across the terminals A and B.

It is to be understood that this invention has been described above with reference to a specific voltage regulation circuit for the purpose of explaining its principles and features of operation, and that the invention is not to be restricted to this particular embodiment but is to be limited only by the claims appended hereto.

What is claimed is:

1. A voltage regulator comprising a source of voltage to be regulated, a load circuit, a first thermionic tube having cathode, anode and grid electrodes and being connected with its anode-cathode path in series between said source and said load circuit, a second thermionic tube

3

having cathode, anode and grid electrodes, a first resistor coupling the anode of said second tube to the grid of said first tube for controlling the operation of said first tube, a source of bias voltage for said second tube, a second resistor coupling said source of bias voltage to the grid of said second tube, input connections from said load circuit to the grid of said second tube, and a third resistor for applying to the grid of said first tube from said source of bias voltage a voltage of the same polarity as that supplied therefrom to said second tube so that fluctuations in the voltage of said bias source tend to cancel out in their effects on the voltage across said load circuit.

2. A voltage regulation circuit in accordance with claim 1 and including in said load circuit a load resistor having one end connected to the cathode of said first tube and its other end to one terminal of each of said sources of voltage, said second resistor having one end connected to

4

said bias source and its other end connected to the grid of said second tube, and a fourth resistor having one end connected to the grid of said second tube and its other end connected directly to the cathode of said first tube, said fourth resistor being separate and distinct from said load resistor, the resistivity of said second resistor being several times greater than the resistivity of said fourth resistor.

References Cited in the file of this patent

UNITED STATES PATENTS

2,206,123	Rinia	July 2, 1940
2,210,394	Braden	Aug. 6, 1940
2,268,790	White	Jan. 6, 1942
2,470,895	Marlowe	May 24, 1949
2,554,977	Chapin	May 29, 1951