

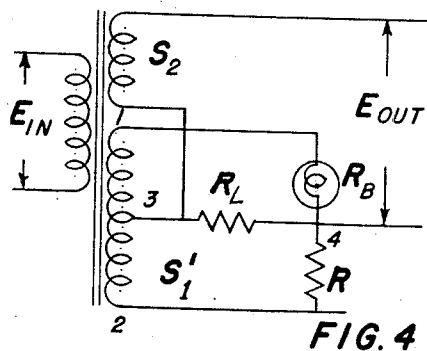
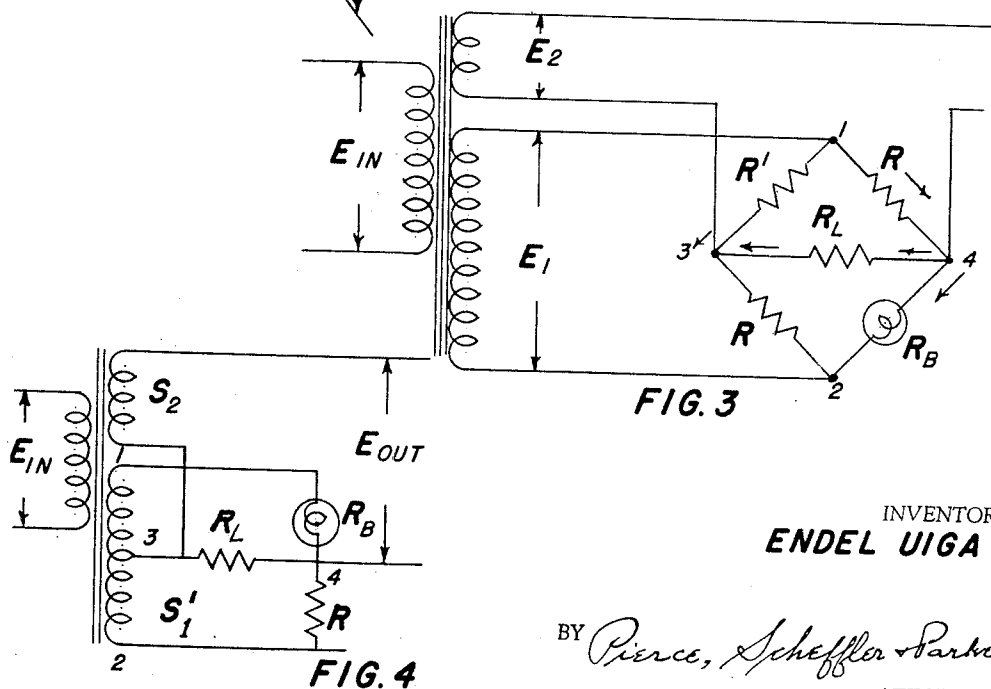
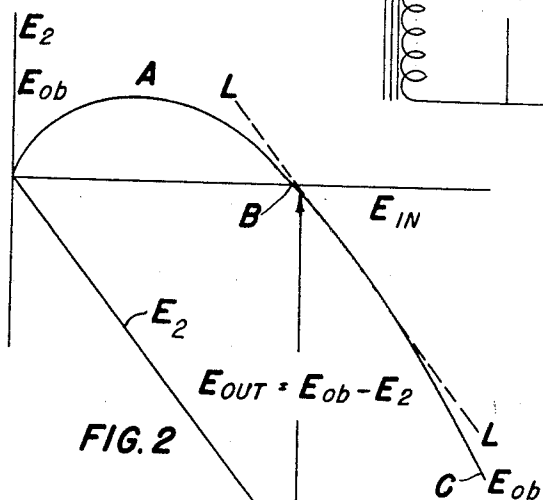
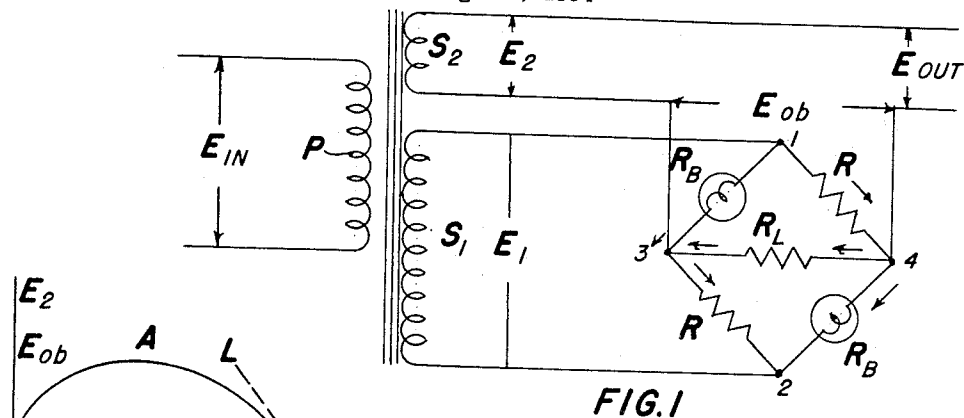
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VOLTAGE STABILIZER CIRCUIT

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VOLTAGE STABILIZER CIRCUIT

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This invention relates to voltage regulator or stabilizer circuits and more particularly to resistive networks for developing an alternating output voltage which remains substantially constant over a wide range of input voltage variation.

It is known that the output characteristic of a resistive bridge comprising constant resistors and certain non-linear resistors is a curve of a quasi-sine form for alternating input voltages from zero up to the value at which the bridge balances and that then the output voltage reverses phase and increases approximately linearly with increasing input voltage values. Such bridges have been used for voltage regulation over the narrow range of input voltages straddling the peak of the quasi-sine curve since considerable change in the input voltage in this region is accompanied by a lesser change in the output voltage. It has also been proposed to operate such bridges in the region beyond bridge balance and to "buck" the bridge output with a second input voltage which varies linearly at a rate equal to the approximately linear rate of bridge output in this voltage region.

Objects of the present invention are to provide stabilizer or voltage regulator circuits of the latter type which afford a closer approximation to a constant output voltage over a wider range of input voltages than has been possible in the past. An object is to provide a voltage regulator circuit of constant and non-linear resistors which includes a linear resistor shunted across the bridge output terminals to decrease the rate of change of the non-linear resistances, thereby to obtain a more nearly linear relation between the bridge input and output voltages.

These and other objects and the advantages of the invention will be apparent from the following description when it is read with the accompanying drawing in which:

Fig. 1 is a circuit diagram of a voltage regulator embodying the invention;

Fig. 2 is a curve sheet showing the variation of the output voltage of a non-linear bridge with increasing input voltage;

Fig. 3 is a fragmentary diagram of a regulator network which includes a modified form of bridge circuit; and

Fig. 4 is a circuit diagram of another form of the invention.

In Fig. 1, the bridge side arms comprise non-linear resistors R_B alternating with constant or temperature-invariant resistors R in a closed ring having input terminals 1 and 2, and output terminals 3 and 4. Resistors R_B may be tungsten filament lamps, carbon filament lamps, ballast resistors or the like having a resistance which is a function of only the RMS value of the current through the resistor, and having an initial (cold condition) resistance differing from the constant resistance R but approaching it when the input voltage is applied. Resistors such as Thyrite, etc., whose resistance value is not dependent on the RMS current or voltage applied to the bulb, but only on their momentary value are not adapted for use in this type of bridge.

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An input voltage E_{in} across the primary P of a closely coupled transformer develops a voltage E_1 across a secondary S_1 which is connected to the diagonally arranged input terminals 1 and 2 of the bridge. In this circuit arrangement it is known that the resulting voltage E_{ob} across the output terminals 3 and 4 varies with the input voltage as shown by curve E_{ob} of Fig. 2. The bridge output first increases with the input voltage to a maximum at A and, from this point, it decreases to zero at point B when the resistances of the bulbs R_B are equal to and balance the bridge resistors R so that the output voltage is zero. On further increase of the input voltage the bridge is unbalanced in the opposite sense and the output voltage changes phase and increases constantly from point B to point C.

It has been proposed, as shown in Fig. 1, to provide the input transformer with an additional secondary winding S_2 having a number of turns so related to the turns of secondary S_1 that the rate of increase of its voltage E_2 is equal to the mean slope $L-L$ of section B—C of the bridge output voltage curve E_{ob} , and to buck this voltage E_2 against the bridge output to obtain a network output voltage E_{out} which is approximately constant over a range of input voltage.

While this expedient provides voltage regulation over a wider range of input voltage than does the bend A of curve E_{ob} , the prior arrangements have lacked accuracy since the section B—C of voltage curve E_{ob} is not linear and parallel to voltage curve E_2 . The curvature may be varied to some extent by the choice of the tungsten filament lamps which are employed as the non-linear resistors R_B but it has not been possible to obtain a truly linear characteristic with presently available non-linear resistors.

In accordance with the invention, a closer approach to linearity of the bridge output voltage E_{ob} is obtained by connecting a constant load resistor R_L between the output terminals 3 and 4 of the bridge. Resistor R_L has no effect at bridge balance since no current flows through it under that condition. With an increase of the input voltage, however, a current indicated instantaneously by the arrows in Fig. 1, flows through R_L and is thus bypassed around the non-linear resistors R_B , thereby reducing their effective resistances below the values that they obtain in the prior systems which do not include this loading resistor shunted across the bridge output terminals. The net effect of the loading resistor R_L is to flatten the section B—C of curve E_{ob} into closer approximation to the line $L-L$ over a greater range of input voltage E_{in} .

The non-linear bridge may be modified, as shown in Fig. 3, by replacing the non-linear resistor R_B of arm 1—3 by a fixed resistor R' of the same value as resistors R .

Another variation, as shown in Fig. 4, comprises a transformer secondary winding S' , with a center tap 3 constituting one of the bridge output terminals. The second output terminal 4 is connected to the opposite ends or bridge input terminals 1 and 2 of secondary winding S' by a non-linear resistor R_B and a constant resistor R respectively, and to bridge terminal 3 by a loading resistor R_L . One end of an additional secondary S_2 is connected to the bridge output terminal 3 and its opposite end, with bridge output terminal 4, constitute the output terminals of the voltage regulator system.

I claim:

1. A voltage regulator of the type including a bridge with resistive side arms of constant and non-linear resistances, said bridge having output terminals and input terminals across which an alternating voltage of variable magnitude may be impressed, and means connecting in series with the output voltage of said bridge an alternating voltage of an instantaneous polarity opposite to and varying at substantially the mean rate of bridge output voltage

at input voltages above the critical value required to balance said bridge; characterized by the fact that a constant loading resistor is connected between said bridge output terminals.

2. A voltage regulator comprising a bridge having pairs of output terminals and a pair of input terminals across which an alternating voltage of varying magnitude may be impressed, side arms connected in ring form between said terminals and comprising fixed and non-linear resistors, a fixed resistor connected between said output terminals, an input transformer having a secondary winding connected across said pairs of input terminals, and a further transformer secondary winding connected in series with said bridge output terminals to buck the output voltage developed by said bridge.

3. A voltage regulator as recited in claim 2, wherein said non-linear resistor comprises a tungsten filament lamp.

4. A voltage regulator comprising a transformer having a primary winding across which an input voltage may be impressed and a secondary winding with a center tap

constituting a bridge output terminal, a second bridge output terminal connected to said center tap by a constant resistor, a constant resistor and a non-linear resistor connected between said second bridge output terminal and the respective ends of said center-tapped secondary winding, and means for bucking the voltage developed across said bridge output terminals with a voltage varying with the impressed input voltages at substantially the same rate as said bridge output voltage, said bucking means comprising an additional transformer secondary winding having one end connected to said center tap, the other end of said additional secondary winding and said second bridge output terminal constituting the regulator output terminals.

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