

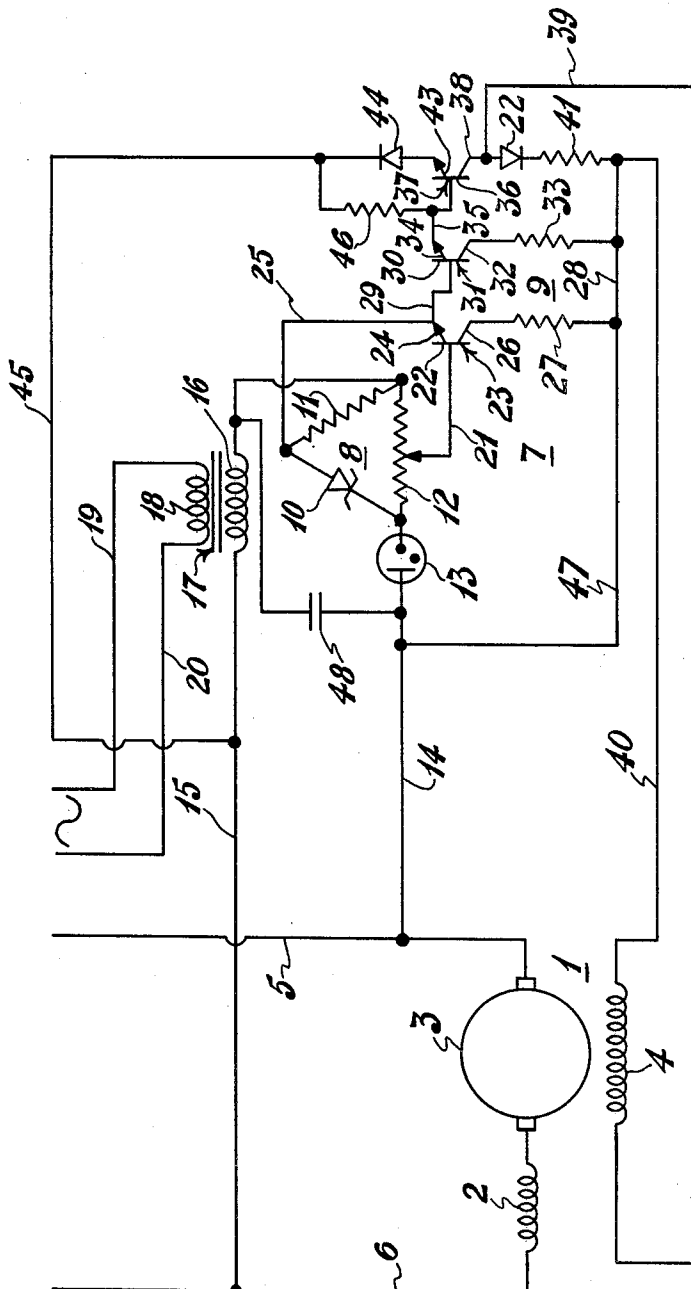
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TRANSISTORIZED VOLTAGE REGULATOR

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TRANSISTORIZED VOLTAGE REGULATOR

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3 Claims. (Cl. 322—28)

The present invention relates to voltage regulators and more particularly to a transistorized voltage regulator for a D.C. generator.

Heretofore, it has been the practice to employ a D.C. amplifier mode of operation for a transistorized voltage regulator for a D.C. generator as no A.C. voltage is available at the terminals of a D.C. generator. This mode of operation has the disadvantage of relatively large losses in the transistors, thereby limiting the power output available from the transistor amplifier, or the ambient temperature capability, or a combination of both.

The present invention provides a transistorized regulator in which the transistor amplifier is modulated by an A.C. voltage impressed on the D.C. voltage input to a reference bridge. The A.C. voltage may be from an external alternating voltage source or from a transistor multivibrator energized from the D.C. generator.

It is an object of the invention to provide a novel voltage regulator for a D.C. generator.

Another object of the invention is to provide an improved transistorized voltage regulator for a D.C. generator.

Another object of the invention is to provide an improved voltage regulator in which losses are kept to a minimum.

Another object of the invention is to provide an improved voltage regulator for a D.C. generator having a fast response.

The above and other objects and features of the invention will appear more fully hereinafter from a consideration of the following description taken in connection with the accompanying drawing, wherein one embodiment is illustrated by way of example.

In the drawing, the single FIGURE is a schematic diagram of a system embodying the invention.

Referring now to the drawing, a D.C. generator is indicated generally by the numeral 1 and has a series field winding 2, armature 3 and shunt field winding 4. The armature 3 has the usual commutator and the output therefrom is connected by conventional brushes to output conductor 5 and through the series winding 2 to output conductor 6.

A voltage regulator indicated generally by the numeral 7 includes a reference bridge 8 and an amplifier 9. The reference bridge has a silicon zener diode 10 in one leg, a resistor 11 in an adjoining leg and a tapped resistor 12 forming the other legs thereof. One input of the bridge 8 is connected by a gas diode 13 and conductor 14 to the output line 5. The other input of the bridge 8 is connected by conductor 15 and secondary winding 16 of a transformer 17. In addition to the secondary winding 16, the transformer 17 has a primary winding 18 connected by conductors 19 and 20 to a suitable source of alternating current (not shown).

One output terminal of the bridge is connected by conductor 21 to base 22 of a transistor 23 which forms the first stage of the amplifier 9. In addition to the base 22,

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the transistor 23 has an emitter 24 connected by conductor 25 to the other output terminal of the bridge 8 and a collector 26 connected by resistor 27 to conductor 28. The emitter 24 of the transistor 23 is also connected by conductor 29 to base 30 of a transistor 31 which forms the second stage of the amplifier 9. In addition, the transistor 31 has a collector 32 connected by conductor 33 to the conductor 28 and an emitter 34 connected by conductor 35 to base 36 of a transistor 37.

The transistor 37 forms the third stage of the amplifier 8 and has a collector 38 connected by conductor 39 to one side of the shunt field winding 4 of the generator 1. The other side of the winding 4 is connected by a conductor 40 to the conductor 28. A resistor 41 and rectifier 42 are connected across the conductors 39 and 40. Also, the transistor 37 has an emitter 43 connected by a rectifier 44 and conductor 45 to the output line 6. A resistor 46 is connected from the conductor 45 to the conductor 35. The conductor 28 is connected by conductor 47 to the input conductor 5. A capacitor 48 may be connected across the bridge 8.

In operation, the sensing bridge is connected across the output of the generator with a portion of the output voltage dropped across the gas diode. An alternating current is impressed upon the input of the bridge. The capacitor connected across the bridge shapes the alternating current into a saw-toothed wave form. The reference bridge is balanced and so arranged that a line voltage increase gives a decrease in output and a decrease in line voltage gives an increase in output.

The output of the reference bridge is a saw-toothed approximation with an average D.C. level inversely proportional to the generator line voltage. This output is applied to the transistor amplifier which is designed to be well overdriven by the saw-toothed wave form. The output of the amplifier is approximately a square wave. Any change in the input voltage changes the width of the square wave output. Extreme line voltage changes, such for example as transients, cause sufficient change in the applied D.C. level to turn the first stage completely "on" or "off" depending on whether an undervoltage or over-voltage occurs.

The output of the first stage of the amplifier is applied to two additional stages, each being designed to be slightly overdriven. Thus, each stage is either in an "on" or "off" condition, thereby keeping the power dissipation of each stage to a minimum.

Although only one embodiment of the invention has been illustrated and described, various changes in the form and relative arrangement of the parts, which will now appear to those skilled in the art, may be made without departing from the scope of the invention.

What is claimed is:

1. A voltage regulator for a D.C. generator having an excitation winding and an output winding comprising a reference bridge, circuit means connecting the input of said reference bridge to the output of said generator, said reference bridge being connected to provide an output inversely proportional to the input deviating from a predetermined value, a transistor circuit adapted to be driven to an "on" or "off" condition, means including an alternating current impressed on the input of said bridge to modulate the output thereof to control said transistor circuit, other circuit means connecting said transistor cir-

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cuit for energization from said generator output, and means connecting the output of said transistor circuit across said excitation winding.

2. The combination as set forth in claim 1 in which the output of said transistor circuit is a square wave in which changes in the input voltage changes the width of the square wave.

3. The combination as set forth in claim 1 and including a capacitor connected across the input of said reference bridge to change the alternating current to a saw-toothed wave form.

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References Cited in the file of this patent

UNITED STATES PATENTS

2,740,086	Evans et al. -----	Mar. 27, 1956
2,751,550	Chase -----	June 19, 1956
2,767,365	Guggi -----	Oct. 16, 1956
2,809,339	Guggi -----	Oct. 8, 1957
2,866,944	Zelina -----	Dec. 30, 1958
2,886,763	Zelina -----	May 12, 1959
2,892,143	Sommer -----	June 23, 1959