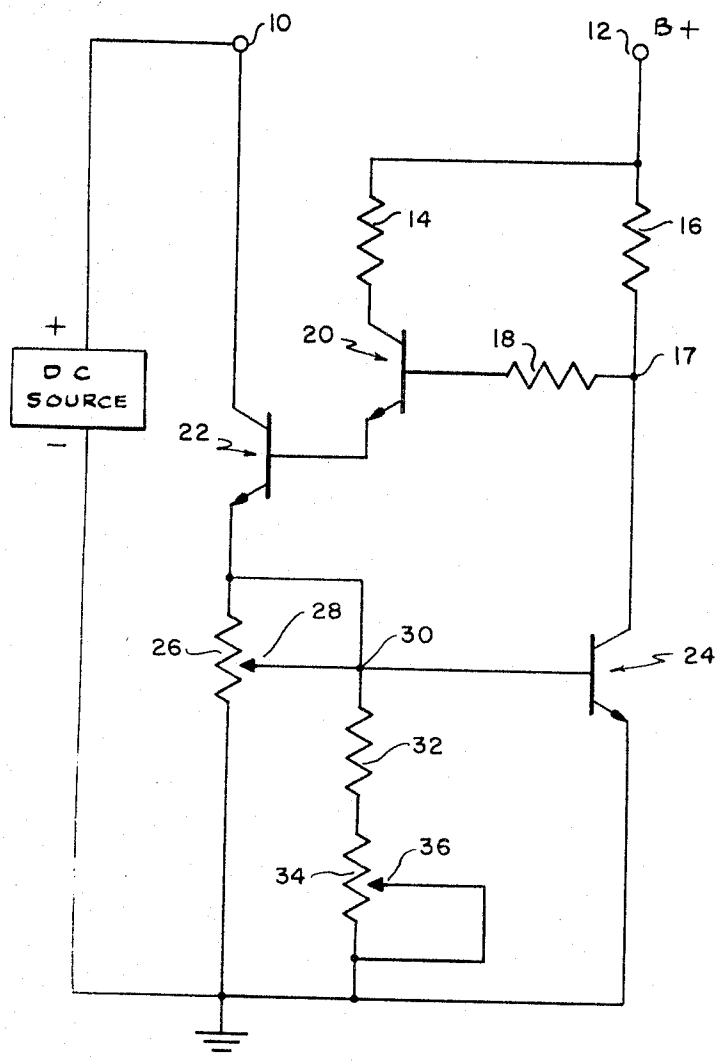
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CONSTANT CURRENT SINK CIRCUIT

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CONSTANT CURRENT SINK CIRCUIT

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ABSTRACT OF THE DISCLOSURE

A solid state circuit providing an automatically variable load for a battery under test as the terminal voltage of the battery varies from a maximum to a minimum value. The circuit employs an external source of constant voltage and a variable setting for the current to be drawn. The load comprises a first section having a transistor and a second section having variable resistors, voltage sensing and current control means to vary the impedance of the first section of the load.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

The present invention relates to a constant current sink circuit and more particularly to a constant current sink for drawing a constant current discharge from a battery.

The testing of batteries frequently requires that a constant current be drawn from the battery under test so that the total capacity of the battery can be determined by a multiplying the current discharge level times the time the discharge is maintained. One prior art method of achieving this constant current discharge was shunting the battery with a manually operated rheostat. A constant current was maintained by manually adjusting the rheostat to reduce the load as the terminal voltage of the battery decreased. Obviously this method has several deficiencies, the most important of which are inaccuracy and the requirement of constant attention by personnel.

A second method used to discharge batteries at constant current is force discharging with a power supply. However, this method requires an accurately regulated high capacity power supply with the capability of forcing a constant current from the battery terminals and dissipating the energy from the battery. Power supplies that have these requirements are extremely expensive and still do not provide results as accurate as is desired.

Summary

The general purpose of this invention is to provide a load circuit that has all of the advantages of similarly employed circuits and has none of the above-described disadvantages. To attain this, the present invention provides a unique constant current sink circuit which does not require an adjustment once an initial selection of discharge current is made. The load circuit comprises two sections, the first section having a transistor and the second section a plurality of resistors, a voltage sensing transistor and current controlling resistors, a transistor and a source of constant B^+ voltage to vary the impedance of the first section. The desired discharge current level is selected by adjusting the current controlling resistors for a coarse and a fine adjustment. The circuit then needs no further attention until the battery is discharged.

It is therefore an object of the present invention to provide a constant current sink circuit.

It is another object of the present invention to provide a constant current sink circuit for use in battery testing.

It is still another object of the present invention to provide a constant current battery discharge device with superior regulation characteristics.

It is a further object of the invention to provide a constant current battery discharge circuit of reduced cost.

It is a still further object of the invention to provide a constant current sink circuit employing an external source of constant voltage.

It is another object of the invention to provide a constant current sink circuit having transistor circuitry and being adjustable for various discharge rates.

Other objects and many of the attendant advantages of the invention will be readily appreciated as the same becomes better understood by reference to the following detailed description of an embodiment thereof when considered in connection with the accompanying drawing wherein the figure is a schematic diagram of an embodiment of the constant current sink circuit of the invention.

It should be noted that although the description which follows places emphasis on the use of the device of the invention in the art of battery testing, that the circuit of the device is useful in any application where it is desired to present a variable load to a circuit element to draw a constant current from that element.

Referring now to the drawing, numeral **10** indicates the terminal between which ground and the battery or other DC source under test is connected, and the terminal is in turn connected to the collector of NPN-type transistor **22**. The emitter of transistor **22** is connected to the series parallel combination of resistors **26**, **32** and **34** which is in turn connected to ground. Terminal **12** is connected to a source of constant voltage such as a regulated B^+ and through resistors **14** and, **16** and **18** respectively, to the collector and base of NPN-type transistor **20**. The emitter of transistor **20** is connected to the base of transistor **22**. The collector of NPN-type transistor **24** is connected at point **17** between resistors **16** and **18** and the emitter thereof to ground. The base of transistor **24** is connected to terminal **30** which in turn is connected to the sliding tap on resistor **26**. Resistor **34** is also adjustable by means of a sliding tap **36**.

The circuit can be described as comprising a load having two sections, the first section being the transistor **22** and the second section the variable resistors **26**, **32** and **34**, a voltage sensing means (transistor **24**), and current control means (including transistor **20**, resistors **14**, **16** and **18** and the source of constant voltage) to vary the impedance of the first section of the load (transistor **22**).

The operation of the circuit will be described in use as a constant discharge of a battery (nominally rated at 40 volts) being discharged to a 1.5 volt level. It will be understood that the use of the device of the invention is not limited to such an application but in fact has utility in any application where there is a requirement for a constant current discharge from a source of voltage. The positive terminal of the battery under test is connected between terminal **10** and ground and a source of constant regulated voltage is applied between terminal **12** and ground. The desired discharge current level is selected by adjusting tap **28** on resistors **26** for the coarse adjustment and tap **36** on the resistor **34** for the fine current adjustment. The circuit then needs no further attention until the battery is completely discharged. During discharge the current through resistors **16** and **18** supplies bias current to the base of transistor **20** thereby causing it to conduct, drawing current through resistor **14** from the source of constant voltage. This current is in the base circuit of transistor **22** which turns it on and causes current to flow from collector to emitter of transistor **22** and to develop a voltage across the parallel series combination of resistors **26** and **32** and **34**. This voltage is applied to the base of transistor **24** to turn it on, causing the

voltage at point **17** to decrease, and by current division, decrease the current available to the base of transistor **20**. Since the transistor **20** controls the base current to transistor **22**, a point of equilibrium is reached. Any change in current through transistor **22** produces a corresponding change in the current available to the base of transistor **22**, thereby holding that current constant. The resistors **26**, **32** and **34** work together with transistor **24** to form a feedback loop which provides a base voltage on transistor **20** that is a function of the collector to the emitter current of transistor **22**, so that the discharge current from the battery is independent of battery voltage.

While the circuit has been described as employing NPN-type transistors it is to be understood that other electronic devices capable of controlling current may be used in a similar manner, such as, PNP-type transistors and vacuum tubes.

In a typical circuit where transistor **22** is a Westinghouse 164–04 transistor the circuit is capable of dissipating 200 watts while maintaining a 5 ampere discharge rate with less than a 1% variation.

It will be noted that there are several alternatives to the method used to set the discharge current. For example, fixed resistors on a gang switch could be employed rather than the series parallel combination of resistors shown, to set the discharge current in preselected steps. Additionally instead of employing a constant voltage source (in this case 28 volts) a variable source of regulated voltage could be employed to set the level of the discharge current by varying the primary bias to transistor **22**.

Obviously many other modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. A constant current sink circuit for drawing a constant current from a voltage source regardless of source voltage variations comprising:

a load having first and second sections, said load being connected to said voltage source;

means for sensing a voltage drop across at least a part of said second section of said load; and

current control means comprising a transistor and an independent source of regulated voltage, said transistor being biased by current from said independent source of regulated voltage, and said transistor being responsive to said sensed voltage for causing variation of the impedance of said first section of said load;

whereby current from said voltage source is maintained at a substantially constant level.

2. The circuit of claim **1** wherein said means for sensing a voltage comprises a transistor having a base;

said base being maintained at a potential equal to the voltage drop across said second section of said load.

3. The circuit of claim **2** wherein said first section of said load comprises:

a transistor having a base, bias to said base being controlled by said current control means.

4. The circuit of claim **3** wherein the level of said constant current may be varied.

5. The circuit of claim **4** wherein the level of said constant current may be varied by at least one variable resistance element in said second section of said load.

6. The circuit of claim **4** wherein the level of said constant current may be varied by means for varying the voltage level of said regulated voltage.

7. A constant current sink circuit for drawing a constant current from a voltage source regardless of variations of the voltage of said source, said circuit comprising:

a first transistor having a base, collector and emitter, said collector being connected to said voltage source;

a series-parallel combination of resistances having a first end connected to the emitter of said first transistor and a second end connected to ground thereby forming a series load circuit across said voltage source, said series-parallel combination of resistances comprising at least one potentiometer having a center tap;

a second transistor having a base, collector and emitter, said base being connected to said center tap, said second transistor being adapted to sense a voltage drop across said series-parallel combination of resistances and said base being maintained at a potential equal to said voltage drop;

a source of regulated voltage connected through a resistance to the collector of said second transistor; and

a third transistor having a base, collector and emitter, said base being connected through a resistance to the collector of said second transistor, said emitter being connected to the base of said first transistor and said collector being connected to said source of regulated voltage,

whereby said second transistor senses a voltage drop across said series-parallel combination of resistances, and varies the current through said third transistor which is also biased by current from said source of regulated voltage thereby maintaining current flow through said first transistor at a constant level.

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