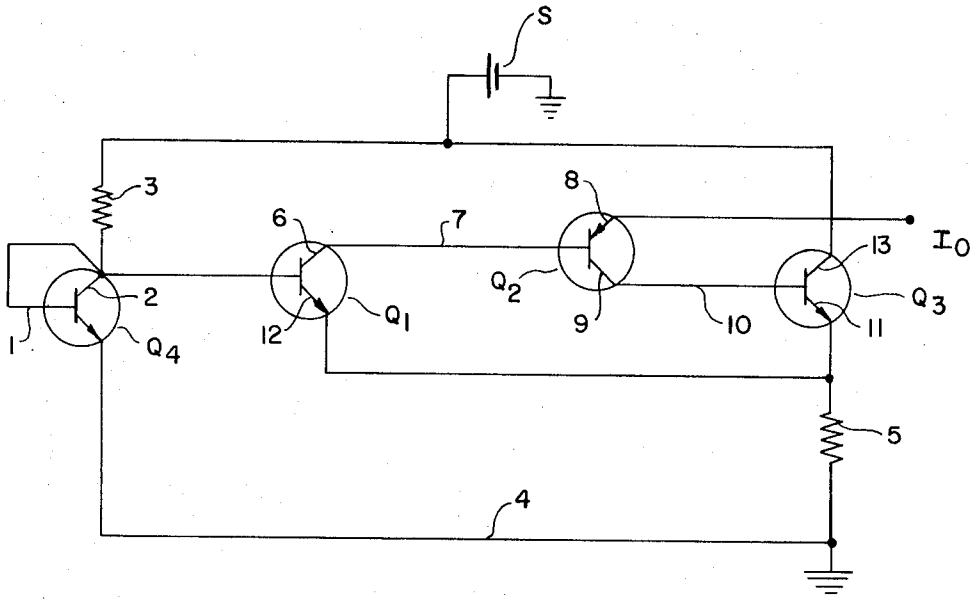
Oct. 27, 1970 D. E. PERLMAN 3,536,986

LOW LEVEL CONSTANT CURRENT SOURCE

Filed Dec. 18, 1968



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United States Patent Office 3,536,986 Patented Oct. 27, 1970

3,536,986

LOW LEVEL COSTANT CURRENT SOURCE

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Filed Dec. 18, 1968, Ser. No. 784,758
Int. Cl. G05F 1/56; H02J 1/04
U.S. Cl. 323—4 4 Claims

ABSTRACT OF THE DISCLOSURE

A low level current source has resistances which are small enough so that the circuitry can be manufactured as a monolithic integrated circuit.

BACKGROUND OF THE INVENTION

Field of the invention

This invention relates to constant current sources and more particularly to constant current sources which are adaptable for supplying currents on the order of less than one microampere.

Description of the prior art

In the prior art it has been very expensive to manufacture a low level constant current source as an integrated circuit because the values of the circuit resistors were too high. Constant current sources which have been designed with resistors having low enough values to be economically fabricated as integrated circuits have either not been able to supply a low enough output level or have had poor regulation.

SUMMARY OF THE INVENTION

It is therefore an object of the invention to substantially obviate the above disadvantages and to provide a low level constant current source which exhibits good regulation and which can be economically fabricated as an integrated circuit by virtue of its having no high value resistances.

The above and other objects of the invention are attained by providing a stage of amplification to increase the flow of current through the feedback resistance so that the amount of current flowing through the feedback resistance is enough so that the feedback resistance can be of a much lower value in order to provide the same voltage drop with a low resistance value that previously was available in the prior art only with a high resistance value.

BRIEF DESCRIPTION OF THE DRAWING

The invention will be better understood when reference is made to the following specification taken with the accompanying drawing wherein:

The sole figure shows a schematic diagram of one embodiment of a constant current source according to the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawing there is shown a unidirectional current device such as NPN transistor Q_4. The control or base terminal **1** of transistor Q_4 is electrically connected to the collector terminal **2** of transistor Q_4 so that transistor Q_4 operates substantially as a diode. The emitter terminal of transistor Q_4 is electrically connected to common terminal **4** which is grounded. The collector of transistor Q_4 is connected through resistor **3** to the positive terminal of a voltage source S. The collector terminal of transistor Q_4 is connected to the control terminal of a unidirectional current control device such as the base of

NPN transistor Q_1. The circuitry thus far described keeps a substantially constant voltage on the base of transistor Q_1 during variations in voltage of the source S since the voltage drop across transistor Q_4, when the latter is connected as a diode, stays substantially constant over a wide range of current values.

The collector terminal **6** of transistor Q_1 is coupled to the control termnial of a unidirectional current control device such as the base terminal **7** of PNP transistor Q_2. The emitter terminal of transistor Q_2 is coupled to the constant current output terminal I_0 while the collector terminal **9** of transistor Q_2 is coupled to the control terminal of a unidirectional current control device such as the base terminal **10** of NPN transistor Q_3. The emitter terminal **11** of transistor Q_3 and the emitter terminal **12** of transistor Q_1 are coupled together to resistor **5**. The collector terminal **13** of transistor Q_3 is also coupled to the positive terminal of the voltage source.

The current which flows at output terminal I_0 is constant since, if there is any tendency for the output current to increase, the base current of transistor Q_3 will tend to increase thus increasing the voltage drop across resistor **5** which effectively lowers the base voltage on transistor Q_1 which in turn decreases the base current of transistor Q_2 therefore bringing the output current back to its constant value.

When the above circuit is fabricated as a monolithic integrated circuit all of the semi-conductors will have near identical temperature coefficients. Therefore, they will track with each other almost exactly and will tend to compensate for temperature variations.

In order to calibrate the output current flowing at output terminal I_0, the only adjustment needed is to vary the value of resistor **5**.

The above circuit has been described as being particularly efficacious when manufactured as a monolithic integrated circuit since it can be easily and inexpensively fabricated as such. However, it is at once apparent that the circuit could be fabricated using discrete components in order to provide a high accuracy constant current source.

The invention has been described in detail with particular reference to a preferred embodiment thereof, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention.

I claim:

1. A constant current source adapted to be energized by a voltage source, said current source comprising:

(a) an input terminal adapted to be connected to the voltage source;

(b) first, second, and third unidirectional current control devices each having a collector, emitter, and a control electrode;

(c) a fourth unidirectional current control device;

(d) a common terminal;

(e) said input terminal being coupled to the control electrode of said first device and to said common terminal through said fourth device;

(f) a resistance;

(g) the collector of said first device being coupled to the control electrode of said second device, the emitter of said first device being coupled to the emitter of said third device and to said common terminal through said resistance:

(h) an output terminal adapted to be connected to a load, said output terminal being coupled to the emitter of said second device;

(i) the collector of said second device being coupled to the control electrode of said third device, the collector of said third device being coupled to said voltage source, so that the current through said re-

sistor is equal to the sum of the currents through said first and third devices.

2. A constant current source as in claim 1 wherein said first and third devices are NPN transistors, and said second device is a PNP transistor, and wherein each of said control electrodes is a base.

3. A constant current source as in claim 1 which is fabricated as an integrated circuit.

4. A constant current source as claimed in claim 1 wherein said fourth device is an NPN transistor having base, emitter, and collector electrodes, said base electrode being connected to said collector electrode.

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U.S. Cl. X.R.

307—297; 323—22, 38