OPIC
Office de la propriété intellectuelle du Canada

CIPO
Canadian Intellectual Property Office

(12) (19) (CA) **Brevet-Patent**

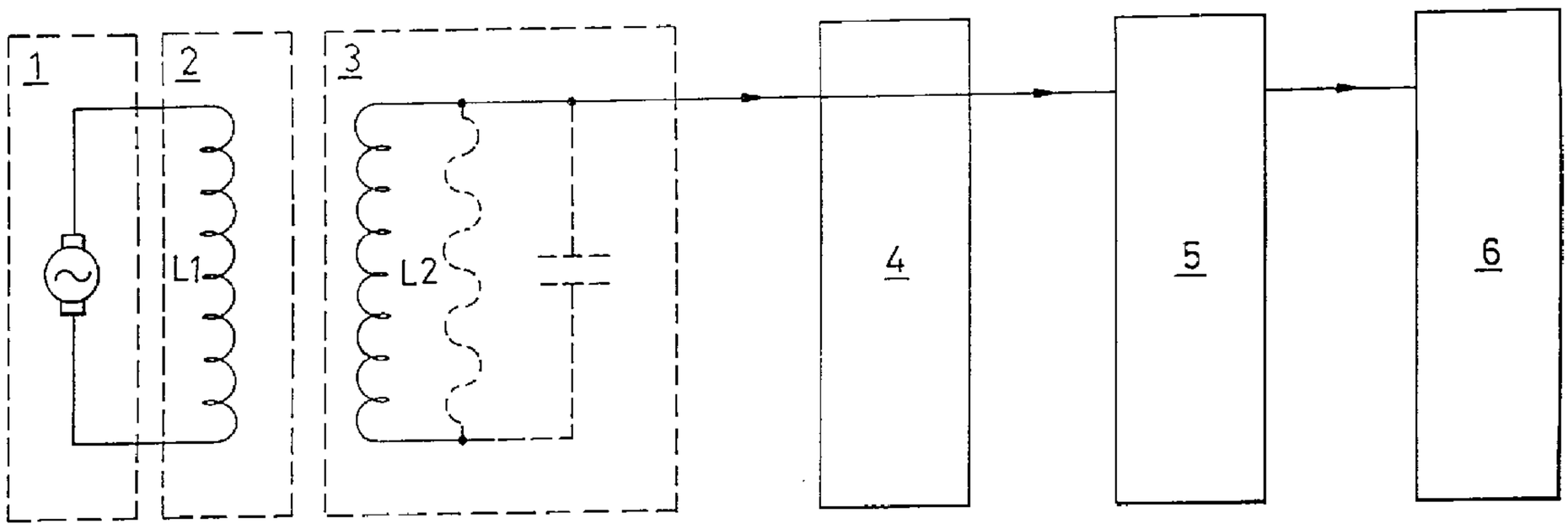
(11) (21) (C) **2,135,299**
(86) 1993/05/10
(87) 1993/11/25
(45) 2000/01/18

(72) Avramenko, Stanislav, RU
(72) Avramenko, Konstantin, RU
(73) Uniline Limited, GB

(51) Int.Cl.[6] H02J 17/00
(30) 1992/05/08 (5036137) RU

(54) **INSTALLATION ET METHODE DE TRANSMISSION ELECTRIQUE PAR CIRCUIT UNIFILAIRE**

(54) **APPARATUS AND METHOD FOR SINGLE LINE ELECTRICAL TRANSMISSION**



(57) This invention relates to the field of electrical technology, and relates particularly to a method for the continuous transformation of electrical energy with its subsequent transmission from an initial source (transformer) to a consuming device, and also to an apparatus for the implementation of this method of transformation and the supplying of power to electrical devices through a transmission line which does not form a closed circuit, ie consists of a single conducting wire. This invention therefore provides a method and associated apparatus for supplying power to an electrical device(s), including generation and subsequent transmission thereof to a receiving device via a transmission line, the method being characterised by the transformation of the electrical energy which is generated into the energy of oscillation of a field of free electrical charges such as the displacement current or longitudinal wave of an electrical field, the density of which charges varies in time, and the transmission of the energy via a transmission line which does not form a closed circuit comprising a single-wire transmission line and, where necessary, its transformation into the electromagnetic energy of conduction currents.

2135299

ABSTRACT

APPARATUS AND METHOD FOR SINGLE LINE ELECTRICAL TRANSMISSION

This invention relates to the field of electrical technology, and relates particularly to a method for the continuous transformation of electrical energy with its subsequent transmission from an initial source (transformer) to a consuming device, and also to an apparatus for the implementation of this method of transformation and the supplying of power to electrical devices through a transmission line which does not form a closed circuit, ie consists of a single conducting wire. This invention therefore provides a method and associated apparatus for supplying power to an electrical device(s), including generation and subsequent transmission thereof to a receiving device via a transmission line, the method being characterised by the transformation of the electrical energy which is generated into the energy of oscillation of a field of free electrical charges such as the displacement current or longitudinal wave of an electrical field, the density of which charges varies in time, and the transmission of the energy via a transmission line which does not form a closed circuit comprising a single-wire transmission line and, where necessary, its transformation into the electromagnetic energy of conduction currents.

2135299

METHOD AND APPARATUS FOR SINGLE LINE ELECTRICAL TRANSMISSION

Field of Technology

This invention relates to the field of electrical technology, and relates particularly to a method for the continuous transformation of electrical energy with its subsequent transmission from an initial source (transformer) to a consuming device, and also to an apparatus for the implementation of this method of transformation and the supplying of power to electrical devices through a transmission line which does not form a closed circuit, ie consists of a single conducting wire.

Background Art

There exists a means for the transmission of electrical energy along a conducting wire which does not form a closed circuit ie, a single conducting wire. It is based on the discovery in 1729 by the English physicist Stephen Grey of the phenomenon of electrical conductivity. The essence of this phenomenon consists in the fact that electricity may be transmitted from one body to another along a metal conductor or a length of yarn, and that the electrical charge is distributed over the surface of the conductor.

[Yu. A. Khramov, "Physicists: A Biographical Reference Book," Moscow, "Nauka", 1983 (in Russian); "Dictionary of Scientific Biography," New York, Charles Scribener's Sons, 1970-1978].

As to closed circuits, a well known means for the supplying of power to electrical devices has existed since the creation in 1799 by the Italian scientist Alessandro Volta of the first source of prolonged electrical current (Volta's column). This means is based on the transmission of electrical energy generated in the initial source to the consuming device directly through a transmission line consisting of two conducting wires

which together with the source and the load form a closed circuit.

[Yu A Khramov, "Physicists: A Biographical Reference Book", Moscow, "Nauka", 1983 (in Russian); M I Radovsky, Galvani and Volta, Moscow-Leningrad, 1941 (in Russian); G. Polvani, "Alessandro Volta," Pisa, 1942].

There exists another important type of closed circuit that represents a means for the supply of power to electrical devices based on the discovery made by M Faraday and J Henry of the phenomenon of electromagnetic induction (published by M Faraday in 1831, and on the invention by P N Yablochkov in 1876 of the electrical transformer. The essence of this means consists in the transformation of the current or the voltage of electrical energy generated in the initial source and the transmission line to the consuming device.

[M Faraday, Experimental Research in Electricity, Moscow-Leningrad, Publishing House of the Academy of Sciences of the USSR, 1947-1959 (in Russian); Yu A Khramov, "Physicists: A Biographical Reference Book", Moscow, "Nauka", 1983 (in Russian); "The Large Soviet Encyclopedia", Third Edition, Bol 26 Moscow, "Soviet Encyclopedia", 1977 (in Russian)].

As to wireless means, there exists a means for the supplying of power to electrical and radio devices by using an electromagnetic field. This means is based on G Hertz's experimental proof in 1888 of the existence of electromagnetic waves, the discovery of which was forecast by J Maxwell in 1865. The means essentially consists in the transformation of electrical energy from the initial source into an electromagnetic field which is radiated into space and received by the consuming device.

["Dictionary of Scientific Biography", New York, Charles Scribener's Sons, 1970-1978; Yu A Khramov, Physicists: A Biographical Reference Book. Moscow, "Nauka", 1983 (in Russian); J K Maxwell, "Selected Works on Electromagnetic Field Theory", Moscow, "Gosizdat", 1954 (in Russian)].

There also exists an electrical device for the transmission of the energy of free electrical charges from the initial source by means of a non-conducting ribbon. This is the so-called high voltage electrostatic generator, which was designed and constructed by the American physicist Van de Graaf between 1929 and 1933. In this device electrical charges are sprayed from needles under high voltage on to a moving ribbon and transferred to an insulated metal dome, where they accumulate. The charges may be sprayed on to the ribbon and collected from it; the ribbon and the dome may be negatively or positively charged.

[K E Swarts, "The Uncommon Physics of Common Phenomena, Vol 2.", Translated from the English by E I Butikov and A S Kondratiev, Moscow, 1987 (in Russian); Yu. A. Khramov, "Physicists: A Biographical Reference Book," Moscow, "Nauka", 1983 (in Russian)].

It is believed to have been proposed to provide a means for the supply of power to electrical devices via a single-wire transmission line, demonstrated by N Tesla in the late nineteenth century.

[John O'Neill: Electrical Prometheus, Moscow, "History of Technology" 1944 (in Russian)); B N Rzhonsnitsky, "Nikola Tesla", Moscow, "Molodaya Gvardiya", 1959 (in Russian); G K Tsverava, "Nikola Tesla", Leningrad, "Nauka" 1974 (in Russian)].

It is believed there is a trace mentioned by John O'Neill of one more distinctive means for electrical transmission but description of this trace did not have details and was not confirmed by any original document.

Objects of The Invention

An object of the present invention is to provide an increase of the coefficient of efficiency of transmission from an initial source to a consuming device in electrical technology, and also a simultaneous reduction in the metal content of the transmission line.

Summary of The Invention

According to a first aspect of the present invention there is provided a method of supplying power to an electrical device(s), including generation and transformation of electrical energy and subsequent transmission thereof to a receiving device(s) via a transmission line, the method being **characterised by** the transformation of the electrical energy which is generated into the energy of oscillation of a field of free electrical charges such as the displacement current or longitudinal wave of an electrical field, the density of which charges varies in time, and the transmission of the energy via a transmission line which does not form a closed circuit comprising a single-wire transmission line and, where necessary, its transformation into the electromagnetic energy of conduction currents.

Thus, the invention provides transformation of electrical energy generated in an initial source into energy of oscillation of a field of free electrical charges (the displacement current or longitudinal wave of the electrical field), which energy is transmitted to a consuming device via a conductor of the transmission line which does not form a closed circuit and, where necessary, transformed into the electromagnetic energy of closed circuit conductive currents.

The oscillations of the field of free electrical particles occur either by means of the reciprocating (cyclical) displacement of a concentrated electrical charge in space, or by means of a periodical change in density (and/or polarity) of the free electrical charges on a particular surface (in a particular volume).

According to a second aspect of the present invention there is provided an apparatus for the implementation of the method of the first aspect, the apparatus providing an initial source of electrical energy, a transforming device, a transmission line and a receiving device, the apparatus being characterised by the provision of a variable density generator of free

electrical charges, the output of which is connected by means of a conductor of a transmission line which does not form a closed circuit to a receiving device, either directly or via a blocking capacitor, and further to any conductive body possessing an equivalent (natural) capacity adequate to ensure the normal functioning of the receiving device.

Thus, the invention provides a variable (alternating) density generator of free electrical charges, which flow under the influence of coulomb forces along a conductor of the transmission line which does not form a closed circuit to the site of a device which consumes electrical energy.

A possible variant of the generator is a generator at the outlet of which not only the density of the free electrical charges but also their polarity may be varied.

The outlet of the generator is connected to a conductor of the transmission line which does not form a closed circuit either directly or via a blocking capacitor.

In addition, the generator of oscillations of the electrical field of free charges may be constructed in a similar fashion to a generator of displacement current (travelling longitudinal waves of an electrical field), by using a sequential resonance circuit in the form of two interconnected inductors such that the equivalent inductance of the resonance circuit is provided by their resultant inductance, and the equivalent capacity of the resonance circuit is provided by the equivalent (natural) capacity of the interconnected inductors.

To supply power to electrical devices which consume alternating current, the output of the conductor of the transmission line which does not form a closed circuit may be connected:

to one of the input terminals of the receiving device, while the device's other input terminal is either earthed or connected to any conductor

possessing a natural (equivalent) capacity adequate to provide for the normal working of the receiving (consuming) device;

to an accommodating device employing a conversion circuit consisting of two interconnected inductors, such that the receiving device (load) is connected to the two ends of the first inductor, the output of the conductor of the transmission line which does not form a closed circuit is connected to one end of the second inductor, and the other end of the second inductor connected to any conductor with an equivalent (natural) capacity and inductance selected in order to provide for the nominal power consumption of the receiving device (load).

To supply power to devices consuming direct current, the conductor of the transmission line which does not form a closed circuit may be connected to an adjustment circuit in the form of:

a diode system, such that the output of the conductor of the transmission line which does not form a closed circuit is connected to the common point of the anode of the first diode and the cathode of the second diode, while the cathode of the first diode and the anode of the second diode are the output points for connection to the receiving device, either directly or with a capacitor connected in parallel;

a transformer circuit consisting of two interconnected inductors such as to rectify alternating current (voltage) directed to the receiving device from the first inductor.

B

Brief Description of the Drawings

In order to provide a better understanding of the invention, there follow specific examples of its construction with references to the drawings attached, in which:

Fig 1 shows a block diagram of a first embodiment of an apparatus according to the present invention;

Fig 2 shows a schematic diagram of a second embodiment of an apparatus according to the present invention, employing a sequential resonance circuit;

Fig 3 shows a power supply diagram for receiving devices operating on alternating current;

Fig 4 shows a power supply diagram for receiving devices operating on direct current.

Description of First Embodiment

The first embodiment of the invention provides apparatus adapted for use in a method of supplying power to electrical devices, including the generation and transformation of electrical energy with its subsequent transmission to a receiving device via a transmission line, the method being distinguished by the fact that the electrical energy generated is transformed into the energy of oscillation of a field of free electrical charges (the displacement current or longitudinal wave of an electrical field), the density of which charges varies in time, and this energy is transmitted via a conductor of the transmission line which does not form a closed circuit and, where necessary, transformed into the electromagnetic energy of conductive currents.

Referring to Fig 1, there is illustrated an apparatus for initial source of electrical energy 1, a transformer (of current, voltage or frequency) 2, an

alternating density generator of free electrical charges 3, which charges flow under the influence of coulomb forces along a transmission line or conductor 4, through a consuming device 5, to any conductive body 6, which has an equivalent (natural) capacity sufficient to provide for the normal working of the consuming device 5.

Description of Second Embodiment

Referring to Fig 2, in addition, the apparatus may be constructed on the basis of a generator of displacement current (longitudinal wave of an electrical field), using a sequential resonance circuit (Fig 2) in the form of two interconnected inductors L1 and L2 such that an equivalent inductivity Leq of the resonance circuit is provided, in the simplest case of idle running, by the resultant inductivity L1 and L2, and the equivalent capacity is provided by the resultant (natural) capacity of the resonance circuit.

To supply power to electrical devices operating on alternating (variable) current, the output of the conductor of the transmission line which does not form a closed circuit 4 is connected either:

to one of the input terminals Bx 1 of the receiving device 5 (Fig 3), and the other input terminal Bx 2 of the receiving device is either earthed or connected to any conductive body 6 possessing an equivalent (natural) capacity adequate to ensure the normal working of the receiving device 5; or

to an accommodating device, employing a transformer circuit (Fig 3) consisting of two interconnected inductors L3 and L4, such that the two ends Bx3 and Bx4 of the inductor L3 are connected to the receiving device 5, while one end of the ends Bx5 of the second inductor L4 is connected to the output of the conductor of the transmission line which does not form a closed circuit 4, and the other end Bx6 of the inductor L4 is connected to any conductive body 6, with an equivalent (natural)

capacity selected in order to provide the nominal power consumption of the receiving device 5.

To supply power to electrical devices operating on direct current, the output of the conductor of the transmission line which does not form a closed circuit 4 is connected to an accommodation circuit in the form of either:

a diode circuit (Fig 4) such that output of the conductor 4 is connected to the common point of the anode of the first diode VD1 and the cathode of the second diode VD2, while the cathode of the first diode VD1 and the anode of the second diode VD2 are the outlets 01 and 02 to be connected to the receiving device 5, either directly or with a capacitor connected in parallel; or

a transformer circuit (Fig 4) employing two interconnected inductors L5, L6, such that the receiving device 5 is connected to the inductor L5 via a rectifying circuit.

The method for supply of power to electrical devices and the apparatus for the implementation of this method, according to the invention, possess a high degree of reliability due to the absence of complex electronic or mechanical assemblies. They permit the use of inexpensive mass-produced radio-electronic components and their working cycle is automatically regulated to a high degree.

Use of the invention will make possible a sharp reduction in the costs involved in transmitting electrical energy over long distances, and a sharp reduction in the losses of Joulean heat from transmission lines.

The invention is intended for the creation of a highly efficient means for the transformation and transmission of electrical energy, and also for the creation of both permanent and mobile devices for the transmission of electrical energy from an initial source to a consuming device via a transmission line which does

not form a closed circuit, ie a single-wire transmission line.

The invention may be used conjointly with various power-engineering and technological processes which involve the use of super-high voltage electrical and electromagnetic fields, electron beams and super-long wave radio communications, when it will make possible a sharp reduction in the dimensions and weight of equipment as compared with the means traditionally employed.

The proposed apparatus, which may be termed a "monovibrator", may consist of two inductively connected much layed coils in accordance with the scheme of a consecutive resonance circuit. As a rule, the secondary coil consists of up to some tens of thousands of turns of thin isolated wire with the windings wound one to another in many layers on a dielectric former. Disposition of the primary coil in respect to the secondary one doesn't matter much. What does matter is an inductive link which determines potential transmitted from the primary to the secondary coil. The monovibrator may or may not have a ferromagnetic core. The ferromagnetic core influences the width of the working frequency bandwidth - it broadens it.

High working output voltage is the result of a high coefficient of transformation, as the primary coil usually contains a couple of dozens of turns for working frequencies ranging from 1kHz to a couple of hundred kHz. A preferred working frequency is 5kHz.

With the characteristics, specified in claim 3, the load of the monovibrator when running idle acquires capacitance character which means that it is reactive. The magnitude of an active constituent of a monoconductive line with the consecutive resonance is rather low and its incoming resistance is approaching zero. That is why with a rather powerful primary source the consecutive resonance makes it possible to transmit more power through the monoconductive line in case there is an outtake of this power at the other line terminal, which is opposite to the primary source of power.

C

Reaction of the monoconductive line of any length can always be compensated by regulated within frequency range primary source (generator, converting devices), thus providing consecutive resonance in the line itself with all the magnitudes of incoming and outgoing characteristics arising therefrom.

Currently there are different schemes of automatic frequency regulation of generators of alternating electromotive power depending on changing inductive-capacitant parameters of conductive lines.

The method and apparatus of the present invention deos not have the drawbacks of previously known single line systems.

C

Claims

1. A method of supplying power to an electrical device(s), including generation and transformation of electrical energy and subsequent transmission thereof to a receiving device(s) via a transmission line, the method being **characterised by** the transformation of the electrical energy which is generated into the energy of oscillation of a field of free electrical charges such as the displacement current or longitudinal wave of an electrical field, the density of which charges varies in time, and the transmission of the energy via a transmission line which does not form a closed circuit comprising a single-wire transmission line and, where necessary, its transformation into the electromagnetic energy of conduction currents.

2. A method of supplying power to an electrical device(s) as claimed in claim 1, **characterised in that** the oscillation of the field of free electrical particles occurs by means of reciprocating (cyclical) displacement of a concentrated charge in space.

3. A method of supplying power to an electrical device(s) as claimed in claim 1, **characterised in that** the oscillation of the field of free electrical particles occurs by means of a periodical change in density and/or polarity of the free electrical charges on a particular surface/in a particular volume.

4. An apparatus for the implementation of the method of claim 1, wherein the apparatus provides an initial source of electrical energy, a transforming device, a transmission line and a receiving device, the apparatus being **characterised by** the provision of a variable density generator of free electrical charges, an output of which is connected by means of a conductor of a transmission line which does not form a closed circuit to

a receiving device, and further to any conductive body possessing an equivalent (natural) capacity adequate to ensure the normal functioning of the receiving device.

5. An apparatus as claimed in claim 4, **characterised in that** the output of the generator is connected by means of the conductor of the transmission line which does not form a closed circuit to the receiving device either directly or via a blocking capacitor.

6. An apparatus as claimed in either of claims 4 or 5, **characterised in that** the generator is a generator at the outlet of which not only the density of the free electrical charges but also their polarity may be varied.

7. An apparatus as claimed in claim 4, **characterised in that** the generator of the field of free electrical charges, such as displacement current or longitudinal wave of an electrical field, employs a sequential resonance circuit in the form of two interconnected inductors (L1) and (L2), such that the equivalent inductance (Leq) of the resonance circuit is provided, in the simplest case, by the resultant inductance (L1 + L2), and the equivalent capacity adequate to ensure the normal functioning of the receiving device.

8. An apparatus as claimed in claim 7, **characterised in that** for the supply of power to electrical device(s) operating on alternating current the output of the conductor of the transmission line which does not form a closed circuit is connected to one of the input terminals of the receiving device, while the device's other input terminal is either earthed or connected to a conductor possessing a natural (equivalent) capacity adequate to provide for the normal working of the receiving (consuming) device.

C

9. An apparatus as claimed in claim 7, **characterised in that** for the supply of power to electrical devices operating on alternating current, the output of the conductor of the transmission line which does not form a closed circuit is connected to an accommodating device which employs a transformer circuit consisting of two or more interconnected inductors, such that the two ends of one of these inductors are connected to the receiving device, while one of the ends of the other inductor is connected to the output of the conductor of the transmission line, and the other end of this inductor is connected to any conductive body possessing an equivalent (natural) capacity adequate to ensure the normal functioning of the receiving device.

10. An apparatus as claimed in claim 4, **characterised in that** for the supply of power to receiving devices operating on direct current, such devices are connected to the output of the conductor of the transmission line by means of an accommodating devices in the form of a diode circuit such that the common point of the anode of the first diode and the cathode of the second diode is connected to the output of the conductor of the transmission line, while the cathode of the first diode and the anode of the second diode are the outlets to be connected to the receiving device, either directly or with a capacitor connected in parallel.

11. An apparatus as claimed in claim 4, **characterised in that** for the supply of power to receiving devices operating on direct current, such devices are connected to the output of the conductor of the transmission line by means of an accommodating device in the form of a transformer circuit employing two

interconnected inductors, such that the receiving device is connected to one of the inductors via a rectifying circuit.

12. An apparatus as claimed in claim 7, **characterised in that** the two interconnected inductors (L1, L2) comprise two inductively connected coils in accordance with the scheme of a consecutive resonance contour, the second coil (L2) comprising a plurality of turns of isolated wire with the turns wound round a dielectric former.

13. An apparatus as claimed in claim 12, **characterised in that** the inductors have a ferromagnetic core.

14. An (electrostatic) generator for use in the apparatus of any one of claims 4 to 13.

15. A receiving device for use in the apparatus of any one of claims 4 to 13.

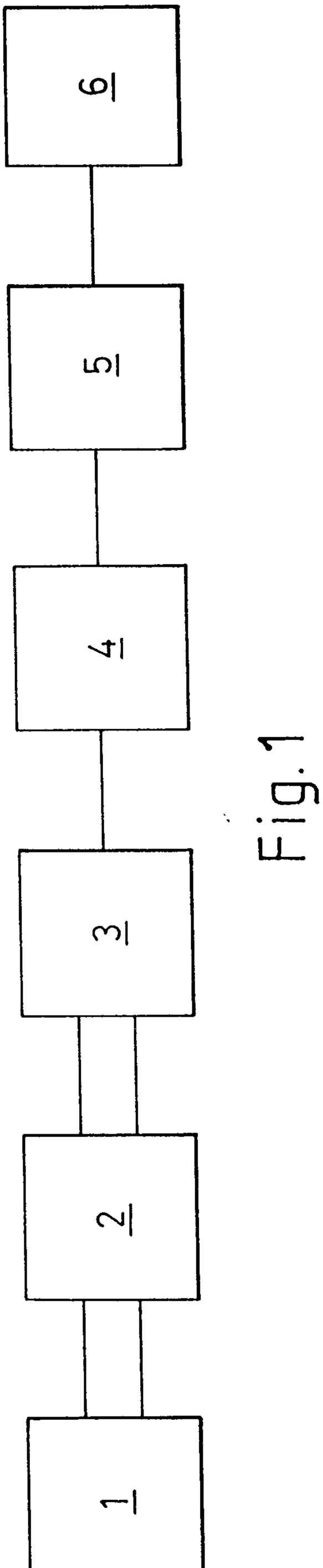


Fig. 1

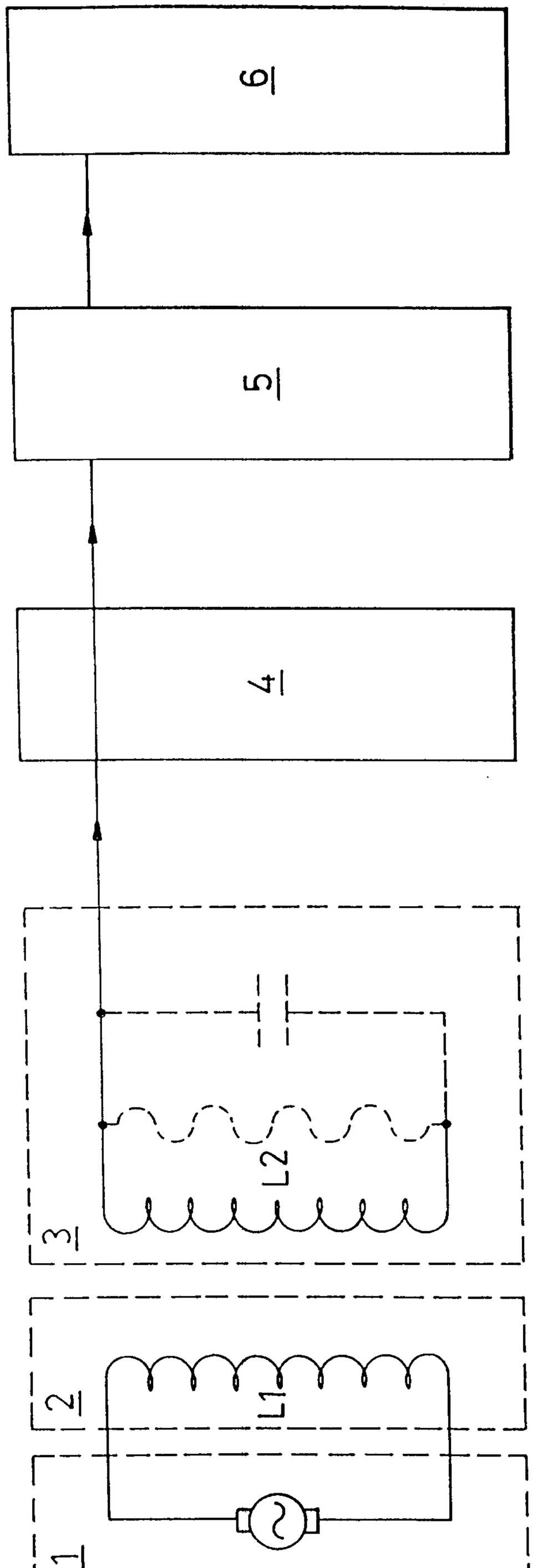


Fig. 2

Gowling, Strathy & Henderson

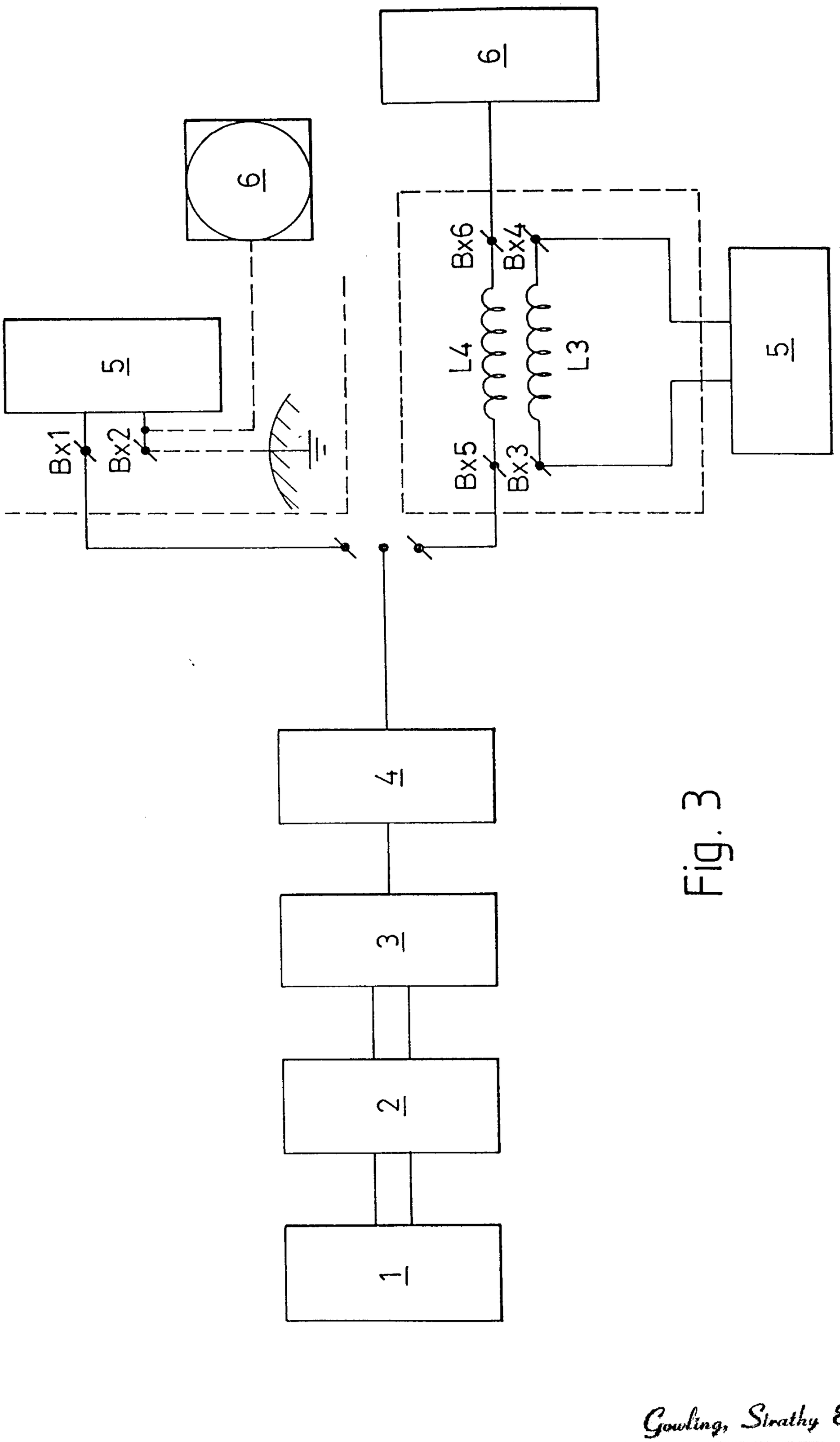


Fig. 3

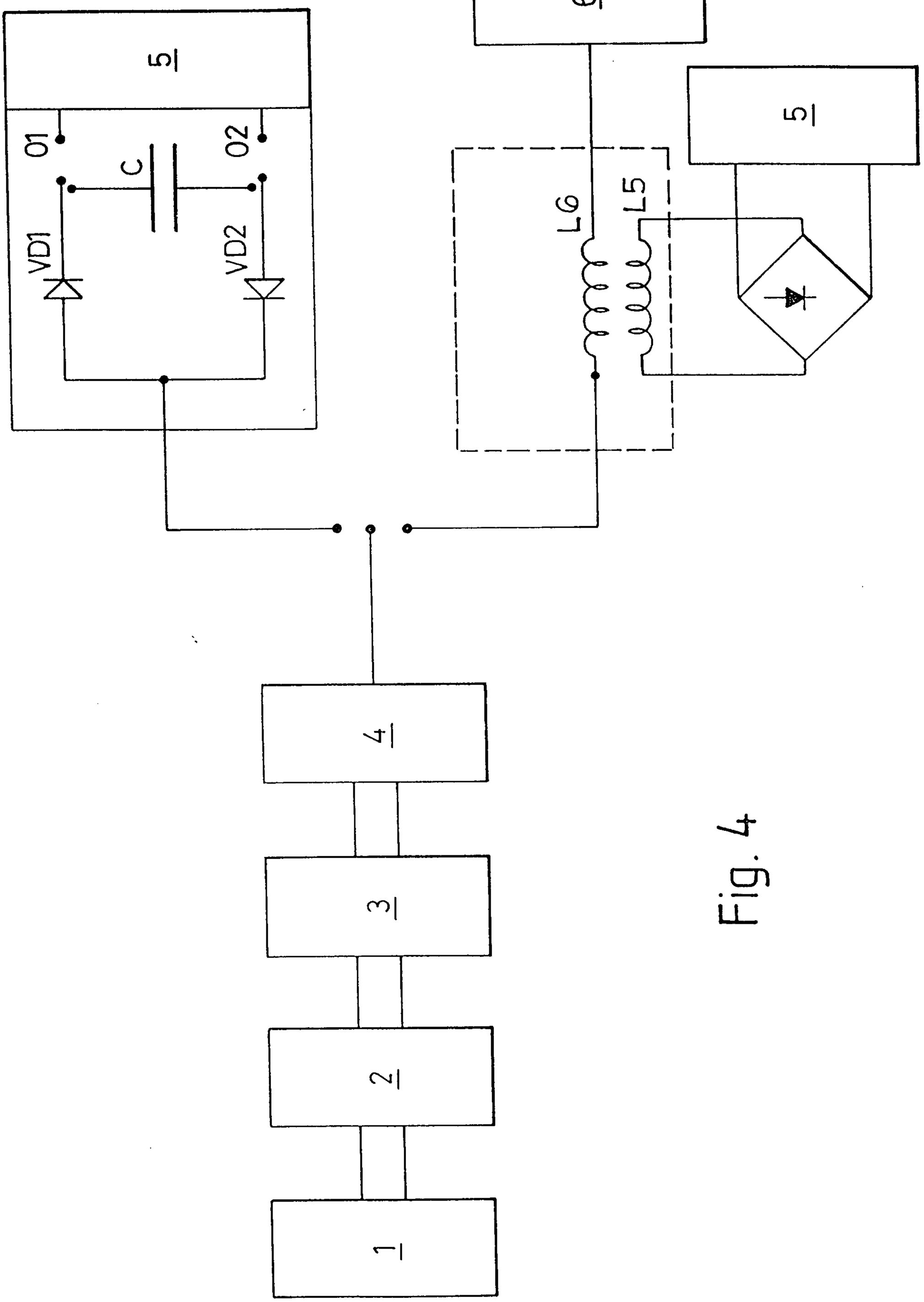


Fig. 4

Gowling, Strathy & Henderson