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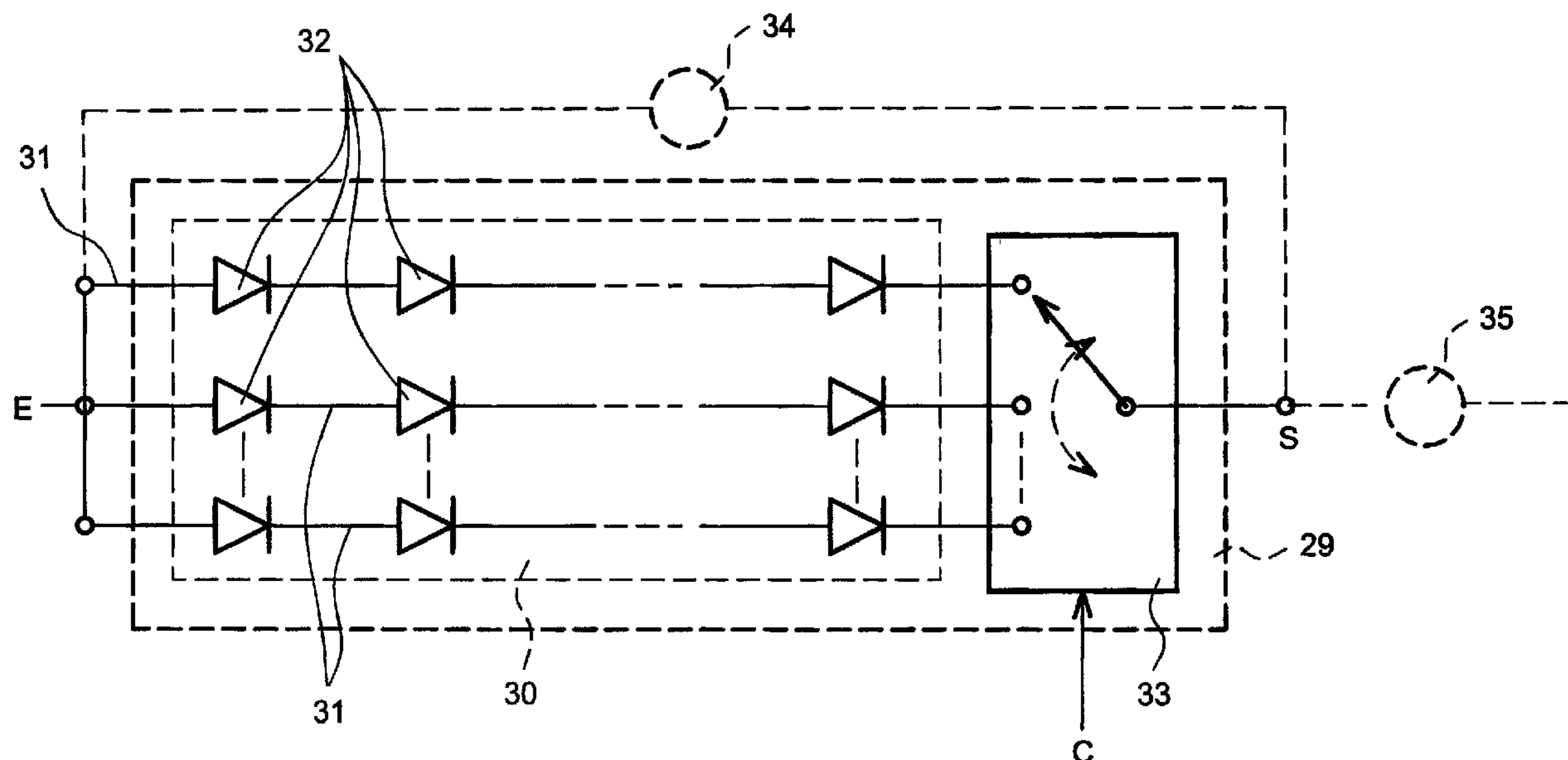
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(54) Titre : PROCESSUS DE GESTION D'UN DISPOSITIF DE SIGNALISATION LUMINEUSE, ET DISPOSITIF
UTILISANT CE PROCESSUS, PARTICULIEREMENT POUR L'AVIONIQUE

(54) Title: PROCESS FOR MANAGEMENT OF A LIGHT SIGNALING DEVICE, AND A DEVICE USING THIS PROCESS,
PARTICULARLY FOR AVIONICS



(57) Abrégé/Abstract:

This invention relates to a process for management of a light signaling device related to the operating state of a system comprising several lights each comprising several branches of several light elements, that includes a step for dynamic management of redundancy if a branch of a light should fail. This invention also relates to a device making use of this process.



ABSTRACT OF THE DISCLOSURE

This invention relates to a process for management of a light signaling device related to the operating state of a system comprising several lights each comprising several branches of several light elements, 5 that includes a step for dynamic management of redundancy if a branch of a light should fail.

This invention also relates to a device making use of this process.

PROCESS FOR MANAGEMENT OF A LIGHT SIGNALING DEVICE, AND
A DEVICE USING THIS PROCESS, PARTICULARLY FOR AVIONICS

DESCRIPTION

Technical field

This invention relates to a process for management of a light signaling device and a device making use of this process, particularly for avionics.

5 State of prior art

In order to simplify the description, the following presentation is restricted to an implementation of the invention for avionics, as an example.

10 At the present time, many light type signaling indicators such as light emitting diodes are used in aircraft cockpits to keep pilots and possibly maintenance operators informed about the operating states of different systems present in these aircraft.

15 Loss of information output by this type of indicator, mainly during operation, can be difficult or even dangerous.

Therefore, pilots regularly need to make regular checks that these indicators are in good working
20 condition by using a test command which effectively lights up a predetermined set of indicators, for example indicators in the ceiling panel. The pilots then need to replace the defective lights on line.

Thus, as illustrated on figure 1, a control button
25 12 causes simultaneous lighting of all these lights in a signaling set composed of several lights 10

controlled by signals SV1, SV2, SV3 through diodes 11, and enables the pilot to easily identify a light that remains off.

5 This type of set has many disadvantages, and particularly :

- high consumption during the test, particularly when these lights are incandescent bulbs,
- impossibility of detecting a light that failed after the test,
- 10 - the efficiency of the test depends on the operator's vigilance.

Replacing incandescent bulbs by light emitting diodes has made it possible to extend the life of this type of indicator.

15 It is also known how to use lights each composed of several light emitting elements 20 in a serial/parallel circuit, as shown on figure 2. A failure of an element 20 then does not cause failure of the light, but simply reduces the brightness. This type
20 of device is not really tolerant to failures, but it does have a degraded operating mode in the case of a failure.

The purpose of the invention is a process for management of a light signaling device related to the
25 operating state of a system capable of overcoming the disadvantages of devices according to prior art by guaranteeing correct operation, even in the presence of some failures.

Presentation of the invention

This invention relates to a process for management of a light signaling device related to the operating state of a system comprising several lights each comprising several branches of several light elements in which there is a step for dynamic management of redundancy if a branch of a light should fail.

Advantageously, the process comprises a permanent automatic test step of all lights.

During the test step, the following steps are carried out for each light :

- if the light is on, its correct operation is checked by testing the current consumed and the voltage present at its terminals,
- if the light is off, it is energized for a duration of the order of a few microseconds and its current / voltage parameters are measured at this instant.

During the dynamic management step, the different branches of each light are illuminated alternately at a scanning frequency of the order of a few kilohertz, the current / voltage parameters being checked in each scanning. A branch is no longer energized if a fault is observed in the branch. However, if all branches are in fault but there is at least one branch that is not in open circuit, this (these) branch(es) may be requalified as being functional.

If a fault is observed in at least one branch, the cyclic ratio for lighting other branches without a fault is modified so that the overall brightness of the light remains unchanged.

This invention also relates to a light signaling device making use of the said process comprising at least one light, and means of detecting a failure in this or these lights, in which each light comprises m
5 branches in parallel each composed of n light emitting diodes in series and means of selecting a branch, where m and n are integer numbers such that $m \geq 2$ and $n \geq 1$.

Advantageously, each light comprises :

- 10 - a light emitting set composed of m branches of n light emitting diodes connected in series and in the same direction, the first m ends of each branch being connected together, their second ends being connected to the different inputs of a selector,
- 15 - this selector that connects a selected branch to the output, as a function of a control order.

This device advantageously comprises the following circuits associated with each light :

- 20 - a current generator that supplies powers for this light,
- a control module that controls the selector and a switch,
- this switch that is connected between the selector output and the current generator input.

25 Advantageously, each light and its control module and its switch are included in a single box.

The invention may advantageously be used in avionics.

Thus, in the process according to the invention, a
30 permanent automatic test of all lights in the cockpit of an aircraft are tested and the pilot thus no longer

need to carry out this task. This type of continuous test avoids the pilot failing to detect a hidden failure. Furthermore, the redundant structure of the lights enables immediate dynamic management if there is
5 a failure of this first redundancy without any visible repercussion by the pilot, and therefore without any additional work for him.

Brief description of the drawings

10 Figures 1 and 2 illustrate two devices according to prior art.

Figures 3 and 4 illustrate the device according to the invention.

15 Figure 5 illustrates an advantageous embodiment of the device according to the invention.

Detailed description of particular embodiments

The light signaling device according to the invention comprises at least one light 29 like that
20 shown on figure 3 that comprises :

- a light emitting set 30 composed of m branches 31 of n light emitting diodes (LED) 32 (where $m \geq 2$ and $n \geq 1$), the n diodes in each branch being connected in series and in the same
25 direction, the first m ends of these branches 31 being connected together to the input E, their second ends being connected to the different inputs of a selector 33,
- this selector 33, which connects one of the
30 selected branches 31 to the output S, as a function of a control order C.

A voltage measurement device 34 connected between the input E and the output S of the light determines the voltage at the terminals of this light. A current measurement device 35 connected to the output of the
5 light 29 provides information about the intensity of the current that passes through it.

As shown on figure 4, the power supply for the light 29 is provided by a current generator 40. A control module 41 controls firstly the selector 33
10 through a line 43 and secondly a switch 42 through a line 44. This control module 41 contains a memory that stores the functional or non-functional state of each branch 31. The control signal for this module 41 transported on an outside command line 45 is a
15 conventional order given to a light (On/Off). A report line 46 provides information about the state of this light 29, to external devices for example for alarm or maintenance purposes.

The process according to the invention carries out
20 a dynamic test of all lights 29, for example the lights in an aircraft cockpit, such as :

- if a light is on, it is easy to check that its operating condition is correct by regularly testing the current consumed and the voltage
25 present at these terminals,
- if a light is off, the same measurement principle is used and this light is energized for a short period. This light is then energized for a duration of the order of a few
30 microseconds which is not perceptible to the human eye, while respecting nominal control

values. The current / voltage parameters of this light are measured at this instant.

The process according to the invention also dynamically manages redundancy of each light which
5 consist of using selector 33, and alternately selecting the different branches 31 of this light at a sufficiently high scanning frequency (of the order of a few kHz) so that it cannot be perceived by the human eye.

10 The current/voltage parameters of the light will be checked during each scan. If a fault is observed, the branch concerned is no longer energized and the cyclic lighting ratio for the other branches is modified so that the overall brightness of the light
15 remains unchanged.

Thus, the process according to the invention avoids total loss of the light. Also, even when the light is not on, the process according to the invention continues its dynamic test by carrying out a short
20 control of the different branches. As soon as a first branch is lost, a preventive maintenance message can be produced without the pilot being informed about it.

Thus, operation is as follows considering the two possible states of a light (light off or light on) :

25

- light off:

No order reaches the external control line 45. The control module 41 opens and closes the switch 42 to supply power for the light 29 by sufficiently short
30 pulses, for example of the order of a few microseconds

and at intervals such that the light 29 appears off to an observer.

Each pulse is switched in sequence by selector 33 to one of the branches 31. It is used to measure the voltage at the terminals of this branch and the current that passes through it.

Two failure cases can be detected (there are only two failure modes for a light emitting diode, namely short circuit and open circuit) :

- 10 - a zero current : the circuit is open and the branch can no longer operate. It is considered as being non-functional
- 15 - a voltage lower than the nominal voltage ; at least one diode is short circuited. Whether or not the branch is considered as being functional depends on the ratio between the number of diodes in good condition and the number of diodes in the branch, which is equal to the ratio between the measured voltage and the nominal voltage. The manufacturer or the user decides on the drop of efficiency at which a branch must be declared as being non-functional.
- 20

This type of "light Off" operating mode enables the control module 41 to determine which functional branches may be used in "light on" mode, before giving any order to switch the light on.

- light On

A light on order arrived on the external control line 45. The control module 41 closes the switch 42 to energize the light 29 continuously. The selector 33

controlled by the signal C cyclically energizes the functional branches 31 one after the other.

For each energized branch 31, two failure cases may be detected :

- 5 - a zero current : the circuit is open and the branch can no longer operate. It is considered as being non-functional
- 10 - a voltage lower than the nominal voltage ; at least one diode is short circuited. Whether or not the branch is considered as being functional depends on the ratio between the number of diodes in good condition and the number of the diodes in the branch, which is equal to the ratio between the measured voltage and the
- 15 nominal voltage.

It is possible to have a degraded operating mode in which all branches are declared to be non-functional but in which there is at least one branch which is not in open circuit. In this case, the branch(es) in question may be requalified as being functional, and the light emits less light than during its nominal operation.

Any failure detection can be followed by sending a signal on the report line, that will be sent to an operator and/or any maintenance system.

In one advantageous embodiment like that illustrated on figure 5, the light 29 and its control module 41 and the switch 42 are integrated in a single box 50 with two power supply lines 51, to present the external appearance of an almost conventional light.

CLAIMS

1. Process for management of a light signaling device related to the operating state of a system comprising at least one light comprising a plurality of branches of several light elements and means for selecting one of the plurality of branches, said means being between said branches and an output, the process comprising:

 providing a power supply to the at least one light with a current generator;

 controlling the means for selecting one of the plurality of branches;

 storing a functional or non-functional state of a selected branch; and

 providing information about the state of the light to at least one external device.

2. Process according to claim 1, further comprising a permanent automatic test step for all lights in the system.

3. Process according to claim 2, in which during said test step, the following steps are carried out, for each light:

 if the light is on, a correct operation thereof is checked by testing a current consumed and a voltage present at terminals thereof,

 if the light is off, it is energized for a duration of the order of a few microseconds and current and voltage parameters thereof are measured.

4. Process according to claim 1, in which different branches of the at least one light are illuminated alternately during a dynamic management step, at a scanning frequency of the order of a few kilohertz, current and

voltage parameters being checked during each scan.

5. Process according to claim 4, wherein a branch is no longer energized if a fault is observed in the branch.

6. Process according to claim 4, wherein, if there is a fault in all branches, and there is at least one branch that is not in open circuit, this at least one branch is requalified as being functional.

7. Process according to claim 4, wherein, if there is a fault in at least one branch, a cyclic ratio during which remaining branches not in fault are illuminated is modified so that an overall brightness of the at least one light remains unchanged.

8. Light signaling device making use of the process according to any one of claims 1 to 7, comprising at least one light, and means of detecting a failure in said at least one light, wherein each one of said at least one light comprises m branches in parallel each composed of n light emitting diodes in series and means of selecting a branch, where m and n are integer numbers such that $m \geq 2$ and $n \geq 1$.

9. Light signaling device according to claim 8, wherein each one of said at least one light comprises,

a light emitting set composed of m branches of n light emitting diodes connected in series and in a same direction, first m ends of said branches being connected together, second ends thereof being connected to different inputs of a selector, said selector connecting a selected branch to an output, as a function of a control order.

10. Light signaling device according to claim 9, also comprising for each one of said at least one light:

a current generator that powers each light; and
a control module that controls the selector and a switch, and that contains a memory in which the state of each branch is stored, said switch being connected between the output from the selector and the input to the current generator.

11. Light signaling device according to claim 10, wherein each light, the control module thereof and the switch thereof are integrated into a single box.

12. Use of the light signaling device according to any one of claims 8 to 11 in avionics.

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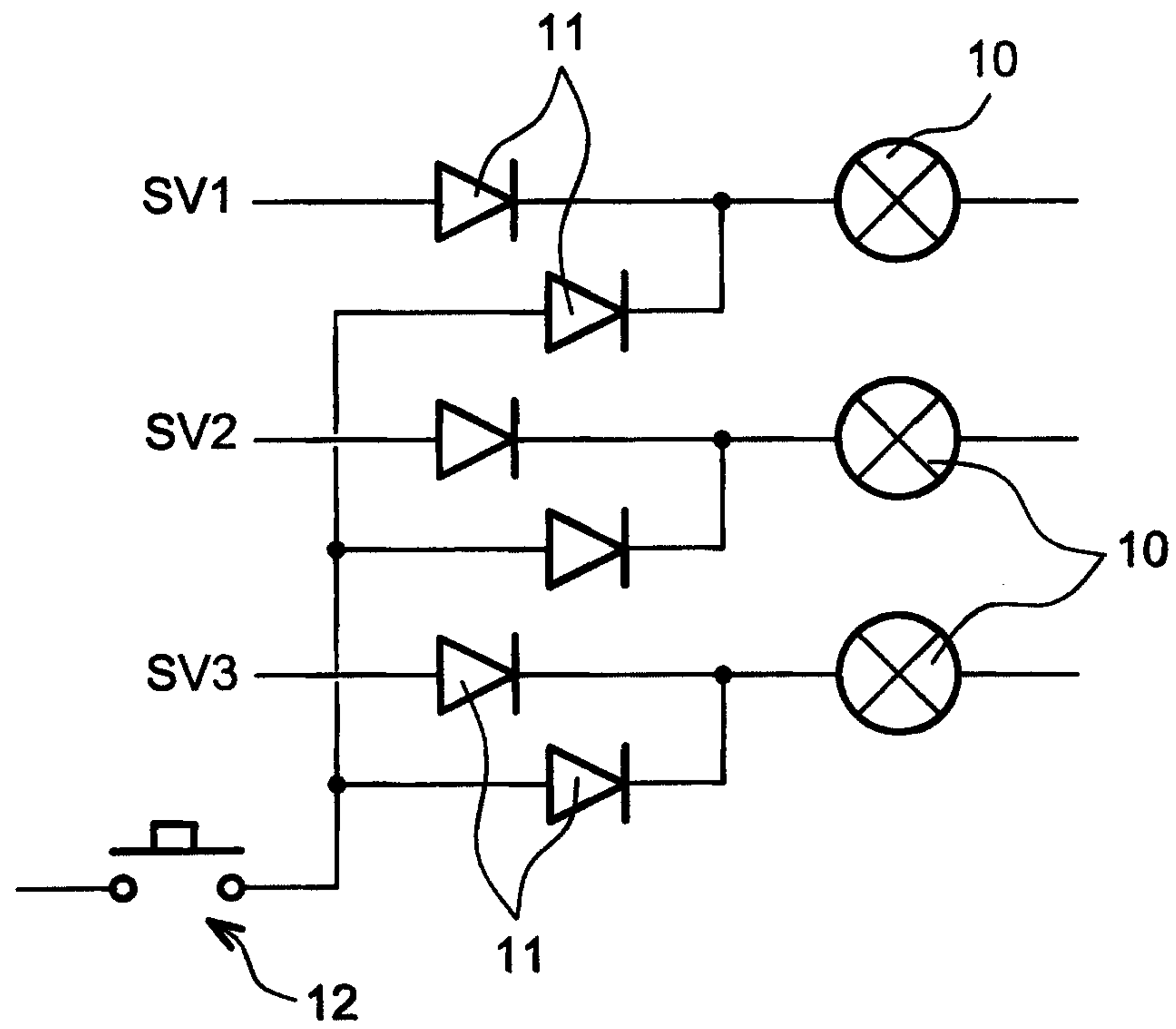


FIG. 1

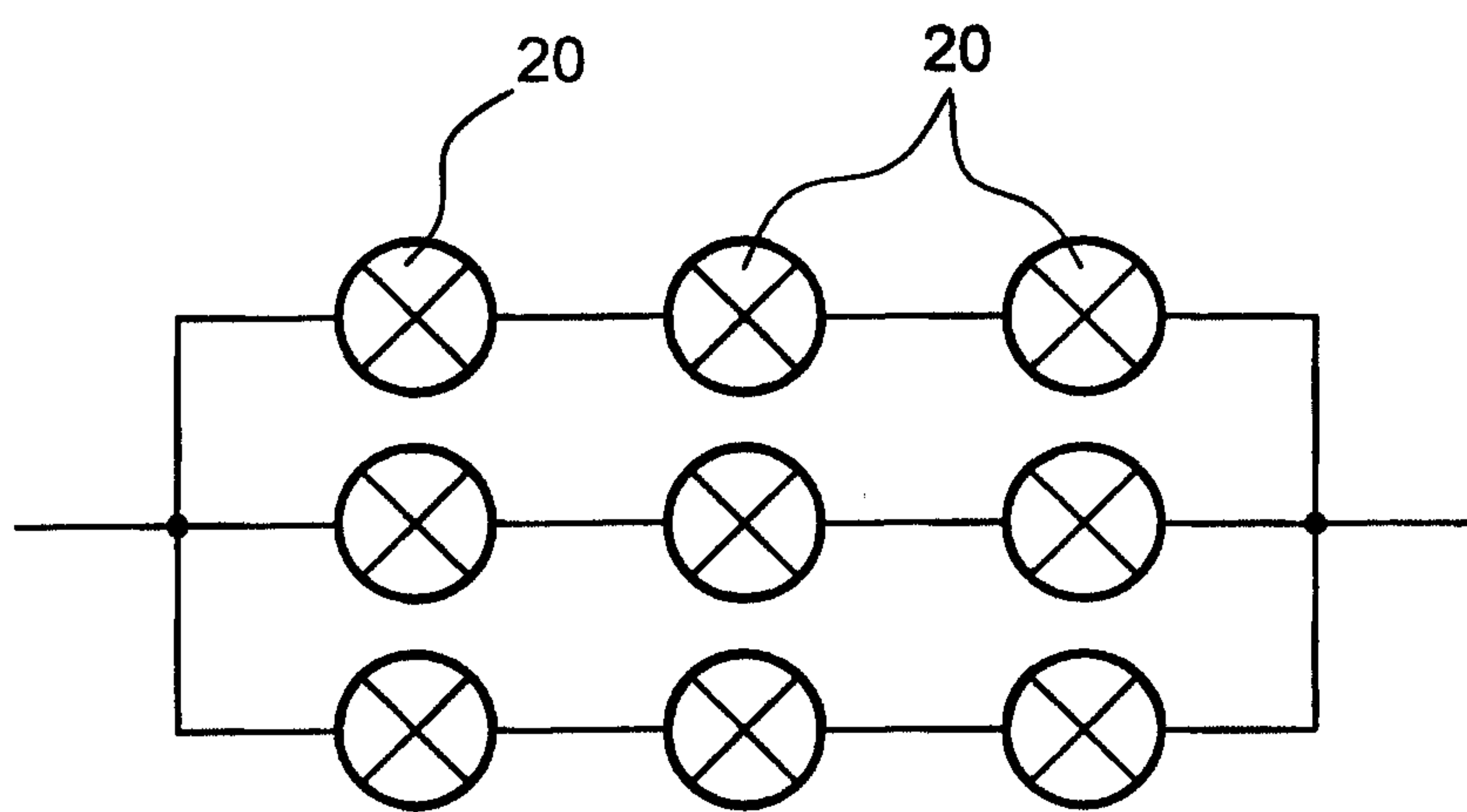


FIG. 2

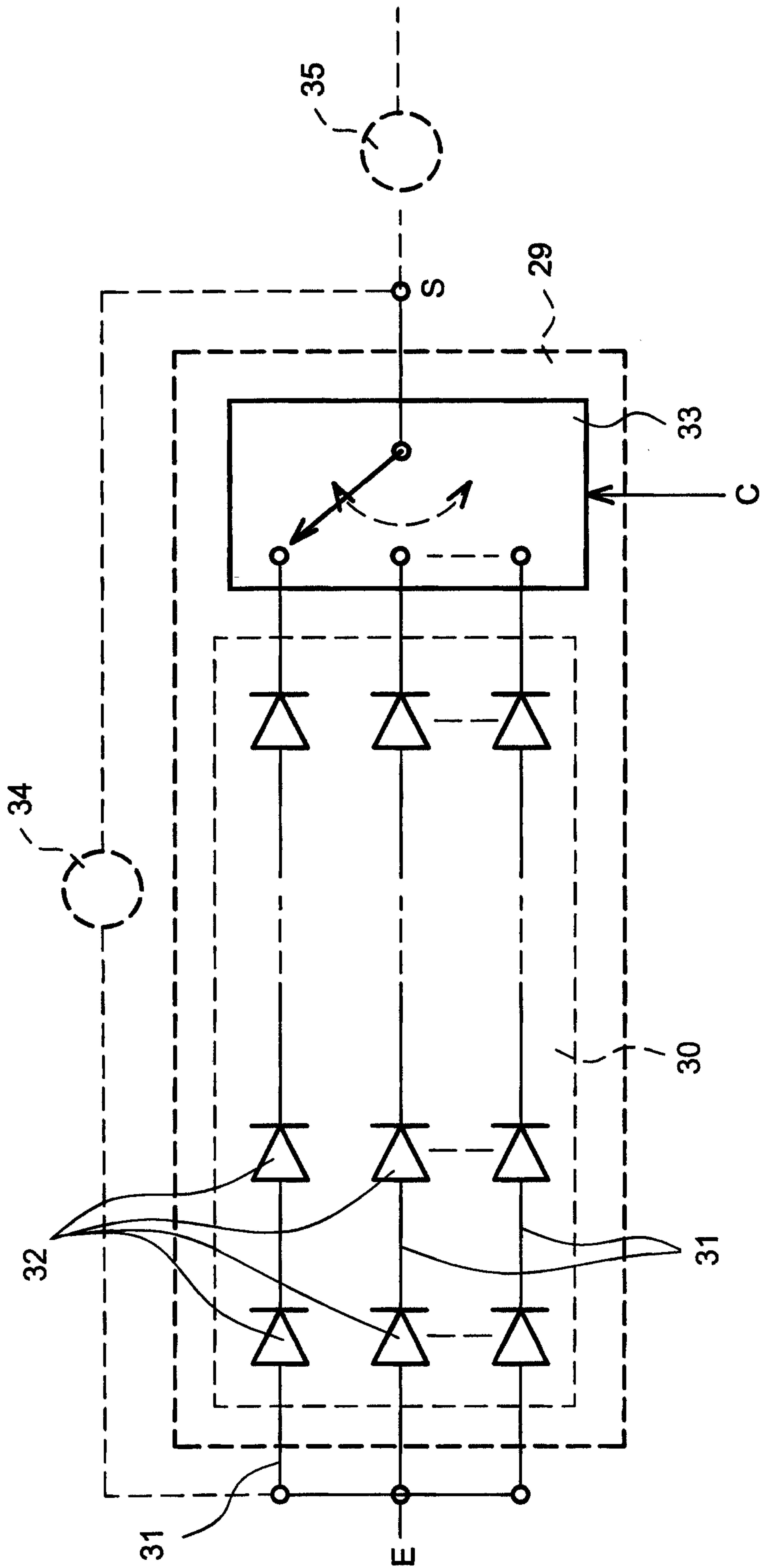


FIG. 3

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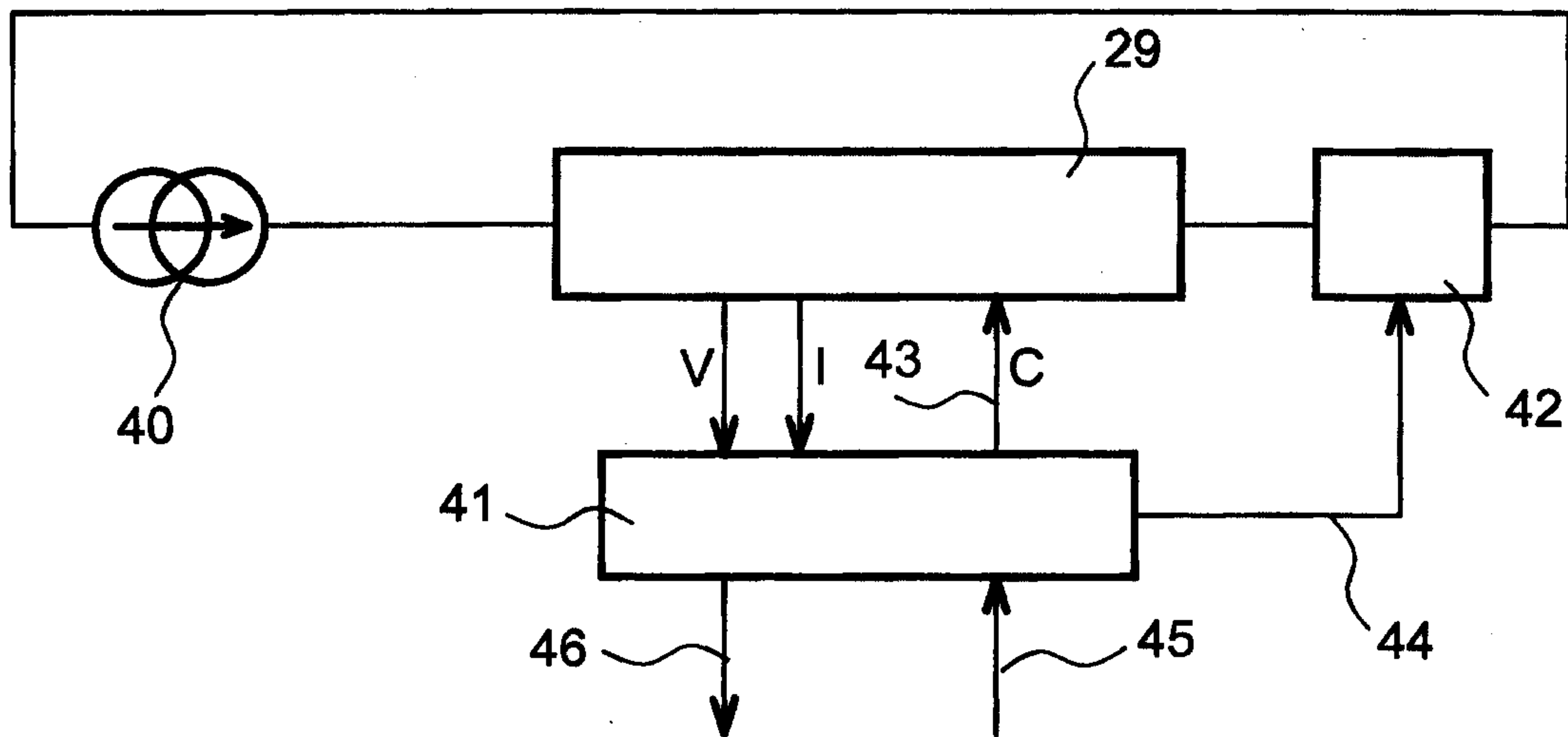


FIG. 4

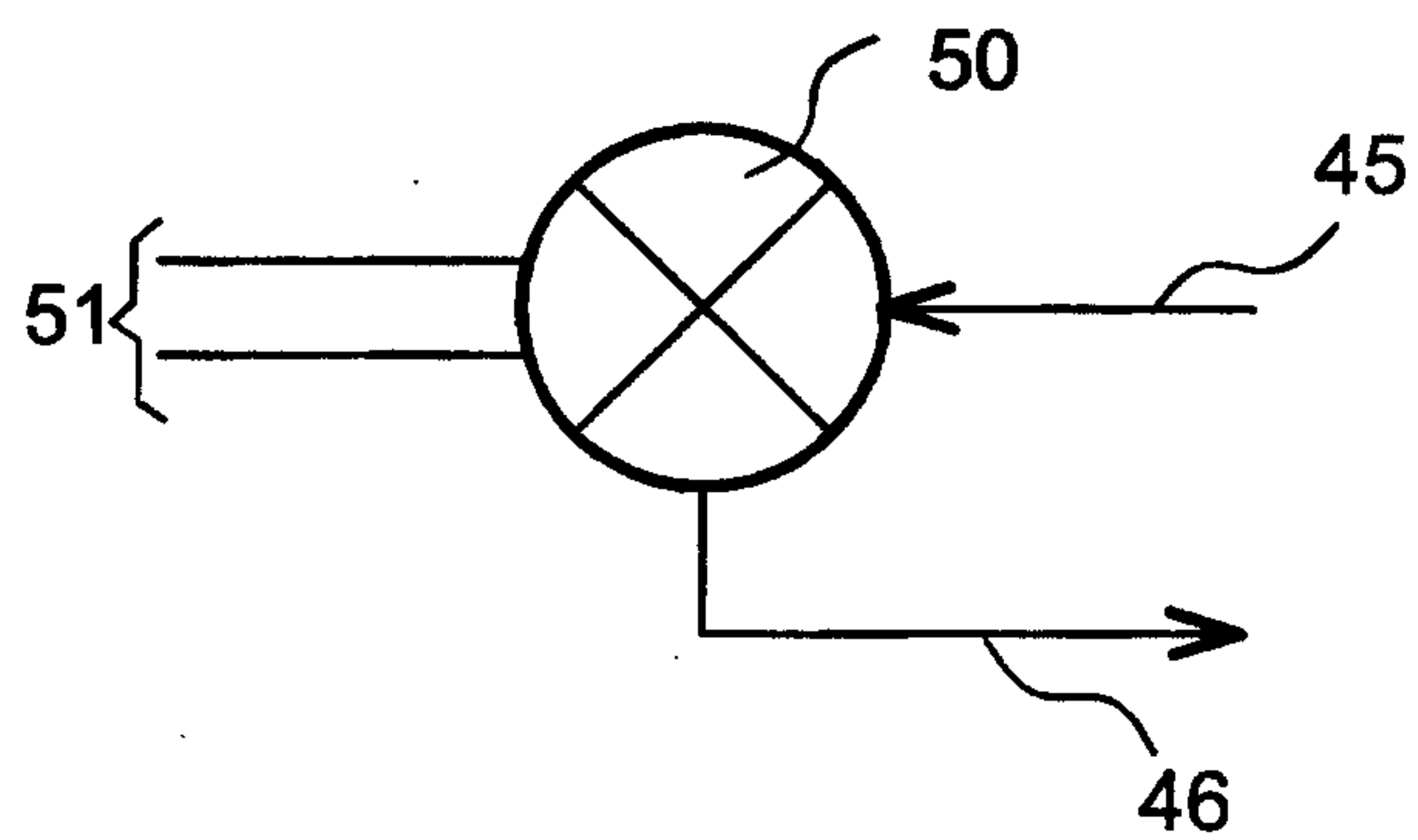


FIG. 5

