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(54) Title: DRIVER DEVICE AND DRIVING METHOD FOR DRIVING A LOAD

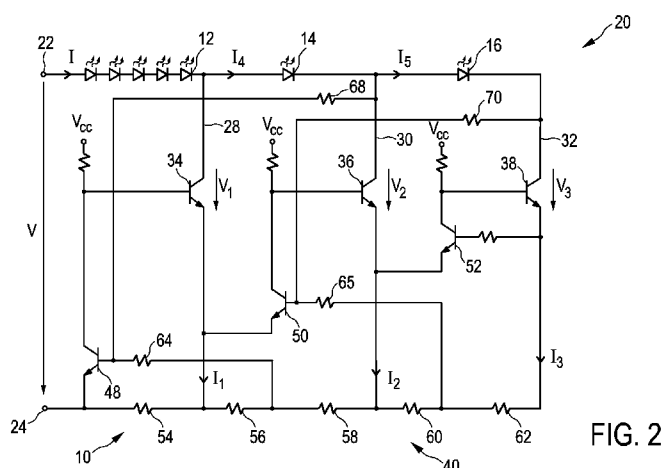


FIG. 2

(57) Abstract: The present invention relates to a driver device (10) for driving a load (12, 14, 16), in particular an LED assembly having two or more LEDs. The driver device comprises input terminals (22, 24) for receiving a variable input voltage (V) from an external power supply (26) for powering the load. The driver device further comprises a plurality of load assemblies (12, 14, 16) connected in series to each other, and a plurality of current paths (28, 30, 32) each connected to one of the load assemblies for electrically connecting the respective load assembly to one of the input terminals, wherein each of the current paths includes a current control device (34, 36, 38), the current control devices being configured to connect subsequently one-by-one a defined number of load assemblies electrically in series to the input terminals dependent on an absolute value of the input voltage. A control unit (40) is connected to the current control devices for controlling an electrical current (I1, I2, I3) in the respective current path, and configured to control a load current drawn from the external power supply inversely proportional to the number of load assemblies connected in series to the input terminals, the control unit comprising a plurality of control devices (48, 50, 52) each associated to one of the current control devices for controlling the current control devices and comprising a plurality of current detection devices (54-62) for detecting the current in each of the plurality of current paths, wherein each of the control devices is configured to control

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the current control devices on the basis of at least one current measured by one of the current detection devices in one current path, and wherein at least one of the control devices associated to one current path is configured to control the respective current control device also on the basis of a current measured in another current path.

Driver device and driving method for driving a load

FIELD OF THE INVENTION

The present invention relates to a driver device and a corresponding driving method for driving a load, in particular an LED assembly having two or more LEDs. The present invention further relates to a light apparatus comprising a plurality of lighting elements, in particular a plurality of LED assemblies having two or more LEDs.

BACKGROUND OF THE INVENTION

In the field of LED light sources, it is generally known to directly connect the LEDs to an external voltage source supplying a varying supply voltage. The supply voltage is usually a low frequency AC voltage such as mains voltage or an output voltage of a transformer transforming the mains voltage to a lower AC voltage. The varying supply voltage is usually converted or rectified to a pulsating DC voltage for driving the LEDs. The external power supply may also be converter in general or an energy buffer e.g. a capacitor.

Since the LEDs have a fixed forward voltage, the LEDs are usually connected in series to each other in a string with a certain number of taps to adapt the operated string length to the varying supply voltage. Hence, the amount of operated LEDs in the LED string is reduced for lower supply voltages and increased for higher supply voltages. The light output of the LED strings depends on the amount of operated LEDs in the string so that the light output usually varies according to the variation of the supply voltage. If the supply voltage is the rectified mains voltage, the light output varies accordingly so that a flickering light is emitted. In order to reduce the flickering of the emitted light WO 2012/168827 proposes to add a control voltage to modulate the LED current depending on the actual length of the LED string, however, the control unit increases the technical effort and the costs of the driver device in general.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide an improved driver device and a corresponding driving method for driving a load, in particular an LED assembly having

two or more LEDs, providing a reduced light output flicker with low technical effort. Further, it is an object of the present invention to provide a corresponding light apparatus.

According to one aspect of the present invention, a driver device for driving a load, in particular an LED assembly having two or more LEDs, is provided comprising:

- 5 - input terminals for receiving a variable input voltage from an external power supply for powering the load,
 - a plurality of load assemblies connected in series to each other,
 - a plurality of current paths each connected to one of the load assemblies for electrically connecting the respective load assembly to one of the input terminals, wherein
 - 10 each of the current paths includes a current control device,
 - a control unit connected to the current control devices for controlling an electrical current in the respective current path,
- wherein the current control devices are adapted to connect a defined number load assemblies electrically in series to the input terminals dependent on an absolute value of the input
- 15 voltage, and wherein the current control devices are adapted to control a load current drawn from the external power supply inversely proportional to the number of load assemblies connected in series to the input terminals.

According to another aspect of the present invention, a driving method for driving a load, in particular an LED assembly having two or more LEDs, it is provided comprising the steps of:

- 20 - receiving a variable input voltage at input terminals from an external power supply for powering the load,
- connecting a defined number of load assemblies electrically in series to each other between the input terminals dependent on an absolute value of the input voltage by
- 25 means of a plurality of current paths each connected one of the load assemblies,
- controlling the electrical current in the current paths by means of the current control devices in the current paths, and
- controlling the load current drawn from the external power supply by means of the current control devices inversely proportional to the number of load assemblies connected
- 30 in series to the input terminal.

According to still another aspect of the present invention a light apparatus is provided comprising a plurality of lighting elements, in particular a plurality of LED assemblies having two or more LEDs, and a driver device of this kind for connecting the light apparatus to an external power supply for driving the lighting elements.

Preferred embodiments of the invention are defined in the dependent claims. It shall be understood that the claim method has similar and/or identical preferred embodiments as the claimed device and as defined in the dependent claims.

The present invention is based on the idea to automatically adapt the number of operated load assemblies connected electrically in series to the input terminals on the basis of the input voltage and to adapt the current drawn from the external power supply on the basis of the amount of operated load assemblies. The load current drawn from the external power supply is set inversely proportional to the number of operated load assemblies so that the load current increases if the amount of operated load assemblies is decreased and the load current is decreased if the number of operated load assemblies is increased. Therefore, the variation of the power consumption and the respective power emission in particular the light emission, due to the variation of the operated load assemblies can be compensated by the inversely proportional set of the load current drawn from the external power supply so that a nearly constant power consumption and power emission, in particular nearly constant light emission can be achieved. Since the number of operated load assemblies is utilized for adapting the load current drawn from the external power supply, the technical effort for controlling the whole driver device is reduced.

In a preferred embodiment, the current control devices are adapted to connect the load assemblies subsequently one-by-one in series between the input terminals dependent on the absolute value of the input voltage. This is a possibility to adapt the amount of connected load assemblies to the input voltage, so that the load can be adapted to the input voltage in general.

In a preferred embodiment, the control unit comprises a plurality of control devices each associated to one of the current control devices for controlling the current control devices. This is a possibility to control the current in the current paths individually, since one control device is associated to each of the current paths.

In a preferred embodiment, the control unit comprises a plurality of current detection devices for detecting the current in each of the plurality of current paths. This is a possibility to detect the amount of operated load assemblies with low technical effort.

In a preferred embodiment, the each of the control devices is adapted to control the current control devices on the basis of at least one current measured by one of the current detection devices. This is a possibility to combine the current detection in the current paths with the control of the current control devices with low technical effort, so that the current control in general can be provided with low technical effort.

In a preferred embodiment, at least one of the control devices associated to one current path is adapted to control the respective current control device on the basis of a current measured in another current path connected to another at least one load assembly. This is a possibility to automatically adapt the load current drawn from the external power supply to the amount of operated load assemblies with low technical effort.

In a preferred embodiment, at least one of the control devices is adapted to control the respective current control device on the basis of a current measured in the same current path and a current measured in another current path. This is a possibility to set the load current inversely proportional to the number of activated load assemblies.

In a preferred embodiment, one of the current detection device measuring the current in the same current path and one current detection device measuring the current in another current path are each associated to the at least one control device. This is a possibility to control the current control devices of the current paths with low technical effort.

In a preferred embodiment, the current control devices are controllable transistors in particular bipolar or MOSFET transistors. This is a possibility to activate and deactivate the current paths which form a current tap for the load assemblies and to control the current in the respective current paths with low technical effort. The transistors are preferably used in a linear mode to control the current in the respective path.

In a preferred embodiment, the current control devices are adapted to switch the respectively connected controllable switch off, if a current is detected in a current path connected to a subsequently neighbored load assembly. This is a possibility to deactivate all current paths which are not necessary to operate the defined number of load assemblies and to activate merely one current path to operate the respective number of load assembly, so that a leakage current is minimized and the efficiency is increased.

In a preferred embodiment, the control devices are voltage controlled and the current detection devices are electrical resistors providing a respective control voltage to the control devices. This is a possibility to reduce the technical effort, since the technical effort for the respective devices is low.

In a preferred embodiment, the load assemblies are LED assemblies comprising one or more LEDs. This is a possibility to provide a light unit having a low power consumption and wherein the amount of operated load assemblies can be automatically adapt to the variation of the input voltage.

As mentioned above, the variation of the power consumption of the load can be compensated, since the current drawn from the external power supply is inversely

proportionally adapted to the number of activated or operated load assemblies, which is determined on the basis of the variation of the input voltage. Hence, the load, in particular LED strings can be adapted to a varying input voltage like a rectified mains voltage and a corresponding varying of the power consumption and the power emission can be reduced.

5 Hence, in the case of LED assemblies, a flickering of the emitted light can be reduced with low technical effort. Further, since the activated load assemblies are detected by means of current detection devices measuring the current in the respective current path, the technical effort for controlling the load current in the current paths can be efficiently reduced.

10 BRIEF DESCRIPTION OF THE DRAWINGS

These and other aspects of the invention will be apparent from and elucidated with reference to the embodiment(s) described hereinafter. In the following drawings

Fig. 1 shows a schematic block diagram of a driver device for driving a load,

Fig. 2 shows a diagram illustrating one detailed embodiment of the driver

15 device of Fig. 1, and

Fig. 3 shows a timing diagram illustrating the input voltage, the current in the load assemblies and the power consumption of the load.

DETAILED DESCRIPTION OF THE INVENTION

20 Fig. 1 shows a driver device generally denoted by 10. The driver device 10 is connected to a plurality of load assemblies 12, 14, 16, which are preferably formed as LED assemblies 12, 14, 16, each comprising at least one LED for emitting light. The driver device 10 and the LED assemblies 12, 14, 16 form a light unit generally denoted by 20.

The driver device 10 comprises input terminals 22, 24 for connecting the
25 driver device 10 to an external voltage source 26 and for receiving an input voltage V. The input voltage V is a variable voltage in general. The external voltage source 26 is preferably mains voltage providing an alternating voltage, wherein the alternating mains voltage is rectified by a rectifier (not shown) in order to provide the input voltage V as a pulsating DC voltage to the input terminals 22, 24.

30 The load assemblies 12, 14, 16 are connected in series to each other and connected directly to the input terminal 22 in order to form a string of load assemblies. The driver device 10 comprises a plurality of current paths 28, 30, 32 which are each connected to one of the load assemblies 12, 14, 16, respectively, for connecting the load assemblies 12, 14, 16 to the input terminal 24. Since the load assemblies 12, 14, 16 are connected in series to

each other and each connected to the current paths 28, 30, 32, the length of the string of driven load assemblies can be set by controlling the current in the current paths 28, 30, 32. The length of the string of load assemblies 12, 14, 16 is controlled on the basis of an absolute value of the input voltage V, wherein the length of the string of load assemblies 12, 14, 16 is increased for higher values of the input voltage V and reduced for lower values of the input voltage V. The driver device 10 comprising the current paths 28, 30, 32 for controlling the length of the string of driven load assemblies 12, 14, 16 is a tapped linear driver which adapts the load in general to the input voltage V.

Each of the current paths 28, 30, 32 comprises a current control device 34, 36, 38 for controlling a current I1, I2, In in the respective current path 28, 30, 32. The driver device 10 further comprises a control unit 40 for controlling each of the current control devices 34, 36, 38 in order to set the respective currents I1, I2, In. The control unit is electrically connected between the current control devices 34, 36, 38 and the input terminal 24. The control unit 40 controls each of the current control devices 34, 36, 38 by means of a control signal 42, 44, 46. The control unit 40 is adapted to determine each of the currents I1, I2, In and/or a voltage V1, V2, Vn-1, Vn at each of the current paths 28, 30, 32 or between each of the load assemblies 12, 14, 16 and the input terminal 24. The current control devices 34, 36, 38 further controls the currents I1, I2, In in the respective current paths 28, 30, 32 to a constant value.

For the case that the load assemblies 12, 14, 16 are LED assemblies having one or more LEDs, the length of the string of load assemblies 12, 14, 16 is automatically adapted to the absolute value of the input voltage V, since the respective load assemblies 12, 14, 16 are activated or driven if the forward voltages of the respective LEDs are exceeded. Since the voltages V1, V2, Vn-1, Vn and the currents I1, I2, In of the current paths are detected by the control unit, the control unit 40 determines which of the load assemblies 12, 14, 16 are activated or driven or in other words determines the length of the string of driven load assemblies 12, 14, 16. Dependent on the amount of load assemblies 12, 14, 16 operated dependent on the absolute value of the input voltage V, the control unit 40 activates the current paths 28, 30, 32 so that the respectively operated load assemblies 12, 14, 16 are connected in series to each other. Further, dependent on the amount of activated or operated load assemblies 12, 14, 16, the control unit 40 controls the current I1, I2, In in the respectively activated current path 28, 30, 32 in order to set or control the load current I in general.

Usually, the power consumption of the load assemblies 12, 14, 16 and the respectively emitted light depends on the amount of driven load assemblies 12, 14, 16 connected in series to each other. The control unit 40 is adapted to control the currents I_1 , I_2 , I_n and therefore the load current I inversely proportional to the amount of load assemblies 12, 14, 16 activated or operated dependent on the input voltage V and electrically connected in series to each other. Hence, the load current I is increased when the amount of load assemblies 12, 14, 16 is reduced and the load current I is reduced if the amount of load assemblies 12, 14, 16 is increased. Since a reduced amount of LEDs usually have a reduced power consumption and a reduced light emission, the light units 20 emits a flickering light dependent on the input voltage V . Since according to the invention the load current I is controlled inversely proportional to the amount of activated or operated load assemblies 12, 14, 16, the variable power consumption and the variable light emission can be compensated so that a nearly constant power consumption and a nearly constant light emission can be achieved.

The current control devices 34, 36, 38 may be formed as controllable current sources to set the respective current I_1 , I_2 , I_n and may be formed as bipolar transistors as described in the following.

The light unit 20 shown in Fig. 1 may have an arbitrary length and may have any amount of load assemblies 12, 14, 16 as indicated in Fig. 1.

Fig. 2 shows a detailed block diagram of an embodiment of the driver device 10. Identical elements are denoted by identical reference numerals, wherein here merely the differences are described in detail.

The load assemblies 12, 14, 16 are formed by LED assemblies, wherein the first LED assembly 12 comprises five LEDs and the second and third LED assembly 14, 16 each comprise one LED. The LED assemblies 12, 14, 16 are connected in series to each other and the series connection of the load assemblies 12, 14, 16 is connected to the input terminal 22. The current paths 28, 30 are each connected to a node between the LED assemblies 12, 14 and 14, 16, respectively, and the current path 32 is connected to the LED assembly 16. Hence, the current paths 28, 30, 32 each form a tap within the string of LED assemblies 12, 14, 16 in order to connect a defined number of LED assemblies in a string to the input terminals dependent on the absolute value of the input voltage V . The current paths 28, 30, 32 form a tapped linear driver for the LED assemblies 12, 14, 16.

The current control devices 34, 36, 38 are formed by transistors 34, 36, 38, in particular bipolar transistors wherein a control contact of the transistors 34, 36, 38 is each

connected to an auxiliary supply voltage VCC, which switches the transistors 34, 36, 38 on. The control contact of the transistors 34, 36, 38 is further connected to the control unit 40 in general for controlling each of the transistors 34, 36, 38 as described in the following.

The control unit 40 comprises a plurality of control transistors 48, 50, 52 which are each associated to one of the current paths 28, 30, 32 and each connected to the control contact of one of the transistors 34, 36, 38. The control transistors 48, 50, 52 connect the control contacts of the transistors 34, 36, 38 to the input terminal 24 so that the electrical potential of the control contacts can be reduced by the transistors 48, 50, 52 and the transistors 34, 36, 38 can be controlled by the control transistors 48, 50, 52.

The control unit 40 further comprises sense resistors 54, 56, 58, 60, 62 which are connected in series to each other and which are connected to the current paths 28, 30, 32, respectively. Two of the sense resistors 54–62 are each associated to the control contact of the control transistors 48, 50 in order to control the control transistors 48, 50, wherein merely one sense of the resistors is associated to the last control transistor 52, which is associated to the current path 32. The control contacts of the control transistors 48, 50 are connected via a resistor 64, 65 to a node between two of the sense resistors 56, 58, 60, 62 which are connected in series between the current paths 28, 30 and 30, 32, respectively. Hence, the voltage dropping across two of the sense resistors 54–60, which are associated to different current paths 28, 30, 38 control the control transistors 48, 50 so that the control transistors 48, 50 are controlled on the basis of the respective currents I1, I2, I3 of two of the current paths 28, 30, 32.

The control contacts of the control transistors 48, 50, 52 are in this particular embodiment connected via a resistor 68, 70 to the respectively neighbored current path 30, 32 in order to provide an additional control voltage to the respective control transistors 48, 50.

These connections are merely optional to improve the performance of the circuit.

The control contact of the control transistor 52 is merely connected to the transistor 38 and only one of the sense resistors 62 is associated to the control contact of the control transistor 52, since this control transistor 52 is connected to the last current path 32 which has no further neighbor current path.

At the beginning of the operation of the driver device 10, the positively varying input voltage V increases until the absolute value of the input voltage V exceeds the forward voltage of the LEDs of the LED assembly 12 and the current I1 in the first current path 28 starts to flow. Due to the auxiliary supply voltage VCC, the transistor 34 is conductive and the current I1 flows through the LED assembly 12, the transistor 34 and the

sense resistor 54. The current I1 increases and the voltage dropping across the sense resistor 54 increases which switches the control transistor 48 in a conductive state which controls the transistor 34 and controls the current I1 to be constant. The magnitude of the current I1 is set by a base emitter voltage of the control transistor 48 and by the resistance of the sense resistor 54. The influence of the sense resistor 56 is low, since the current in this resistor is negligible.

When the absolute value of the input voltage V further increases and reaches a value above the sum of the forward voltages of the LED assemblies 12 and 14, the current I2 starts to flow, since the transistor 36 is conductive due to the auxiliary supply voltage VCC.

The current I2 flows through the resistors 54, 56, 58 and provides an additional control voltage to the control transistor 48, which drops across the sense resistor 56. This additional voltage dropping across the sense resistor 56 reduces the control voltage at the control contact of the transistor 34 so that the transistor 34 is switched off and the current path 28 is deactivated. Hence, the sense resistor 56 safely shuts the transistor 34 down and reduces the current I1 to zero. Hence, the additional LED assembly 14 is automatically added to the string of LED assemblies when the input voltage V increases. The connection of the control contact of the control resistor 48 via the resistor 68 aid switching the control transistor 48 off by means of increasing voltage between the LED assembly 14 and the transistor 36.

When the absolute value of the input voltage V further increases and exceeds the sum of the forward voltages of the LED assemblies 12, 14, 16, the current I3 starts to flow since the transistor 38 is conductive due to the auxiliary supply voltage VCC. The current I3 drops across the sense resistor 60 which is associated to the control transistor 50 and controls the transistor 36 so that the current I2 is reduced to zero. The current I3 further drops across the sense resistor 62, which is associated to the control transistor 52 and controls the transistor 38 so that the current I3 is controlled to be constant. The connection of the control contact of the control transistor 50 via the resistor 70 to the LED assembly 16 aids switching the transistor 36 off since the voltage exceeding the sum of the forward voltages is provided to the control contact of the control transistor 50.

Consequently, the control transistors 48, 50, 52 are each controlled by the current I1, I2, I3 in the current paths 28, 30, 32 to which the respective control transistor is associated in order to control the current I1, I2, I3 in the current paths 28, 30, 32 to be constant. Further, the control transistors 48, 50 are controlled on the basis of a current I2, I3 of the respectively neighbored current path 30, 32 (via the sense resistors 56, 60) so that the

current paths 28, 30 can be switched off if the input voltage V exceeds the sum of the forward voltages of the respective LED assemblies as described above.

The currents I_1 , I_2 , I_3 are controlled to a value so that the respective load current I increases with a reduced number of LED assemblies connected in series to each other and being activated or driven on the basis of the absolute value of the input voltage V . Hence, the current I_1 is larger than the current I_2 which is larger than the current I_3 . By means of this inversely proportional controlling of the load current I , the power consumption of the LED assemblies in general can be set to be constant so that the light emission is nearly constant and a flickering of the emitted light can be avoided. These higher currents at a lower string length of the LED assemblies 12, 14, 16 are possible since the sense resistors 54, 56 and 58, 60 for switching the respectively associated sense resistors 48, 50 are split in separate sense resistors. This enables a constant light output independent of the supply voltage V and the string length as long as the supply voltage is high enough to supply the shortest LED string.

Fig. 3 shows a schematic timing diagram of the input voltage V , the load current I in the LED assembly 12, the current I_4 in the LED assembly 14, the current I_5 in the LED assembly 16 as shown in Fig. 2 and the total power consumption P of the light unit 20 corresponding to the light emission of the light unit 20.

The input voltage is a pulsating DC voltage, typically generated by a rectified sinusoidal input voltage and some buffering, as shown in Fig. 3. When the absolute value of the input voltage V drops down to a value between the sum of the forward voltages of the LED assemblies 12 and 14 at t_1 , merely the LED assembly 12 is activated or driven and the load current I flows through the LED assembly 12 and the current path 28. At t_2 , the input voltage V exceeds the sum of the forward voltages of the LED assemblies 12, 14, so that the current path 30 is activated and the current path 28 is switched off as described above and as shown in Fig. 3, since the current I_4 in the LED assembly 14 increases. At t_3 , the input voltage V exceeds the sum of the forward voltages of the LED assemblies 12, 14, 16 so that the current path 32 is activated and the current path 30 is switched off so that the current I_5 is increased.

As can be seen in Fig. 3, the load current I drawn from the voltage supply 26 has different absolute values dependent on the amount of activated or driven LED assemblies 12, 14, 16 and/or dependent on the length of the LED string. The load current I has the highest value in the case that merely the LED assembly 12 is activated or driven and the lowest value if all LEDs assemblies 12, 14 16 are activated. Hence, the load current is set

inversely proportional to the amount of activated LED assemblies 12, 14, 16. This leads to an increased light emission of the single LEDs of the LED assemblies so that the power consumption P of the light unit 20 in general is constant even if different amounts of LEDs are driven. This leads to a constant light emission of the light unit 20 so that a flickering of the emitted light can be avoided.

While the invention has been illustrated and described in detail in the drawings and foregoing description, such illustration and description are to be considered illustrative or exemplary and not restrictive; the invention is not limited to the disclosed embodiments. Other variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed invention, from a study of the drawings, the disclosure, and the appended claims.

In the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality. A single element or other unit may fulfill the functions of several items recited in the claims. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage.

Any reference signs in the claims should not be construed as limiting the scope.

CLAIMS:

1. Driver device (10) for driving a load (12, 14, 16), in particular an LED assembly having two or more LEDs, comprising:
 - input terminals (22, 24) for receiving a variable input voltage (V) from an external power supply (26) for powering the load,
 - 5 - a plurality of load assemblies connected in series to each other,
 - a plurality of current paths (28, 30, 32) each connected to one of the load assemblies for electrically connecting the respective load assembly to one of the input terminals, wherein each of the current paths includes a current control device (34, 36, 38), the current control devices being configured to connect subsequently one-by-one a defined
 - 10 number load assemblies electrically in series to the input terminals dependent on an absolute value of the input voltage,
 - a control unit (40) connected to the current control devices for controlling an electrical current (I1, I2, I3) in the respective current path and configured to control a load current drawn from the external power supply inversely proportional to the number of load
 - 15 assemblies connected in series to the input terminals, the control unit comprising a plurality of control devices (48, 50, 52) each associated to one of the current control devices for controlling the current control devices and comprising a plurality of current detection devices (54–62) for detecting the current in each of the plurality of current paths,
 - 20 wherein each of the control devices is configured to control the current control devices on the basis of at least one current measured by one of the current detection devices in one current path, and wherein at least one of the control devices associated to one current path is configured to control the respective current control device also on the basis of a current measured in
 - 25 another current path.
2. Driver device as claimed in claim 1, wherein at least one of the control devices is configured to control the respective current control device on the basis of a current measured in the same current path and a current measured in another current path.

3. Driver device as claimed in claim 2, wherein one of the current detection devices configured to measure the current in the same current path and one of the current detection devices configured to measure the current in another current path are each
5 associated to the at least one control device.

4. Driver device as claimed in claim 3, wherein the current control devices are configured to disconnect a current path from one of the input terminals, if a current is detected in a current path connected to a subsequently neighbored load assembly.

10 5. Driver device as claimed in claim 1, wherein the current control devices are controllable transistors.

6. Driver device as claimed in claim 1, wherein the control devices are voltage
15 controlled and the current detection devices are electrical resistors providing a respective control voltage to the control devices.

7. Driver as claimed in claim 6, wherein at least one of the current detection devices comprises two electrical resistors connected in series with a current path and wherein
20 a control contact of one of the control devices in another current path is connected with a node between the two electrical resistors.

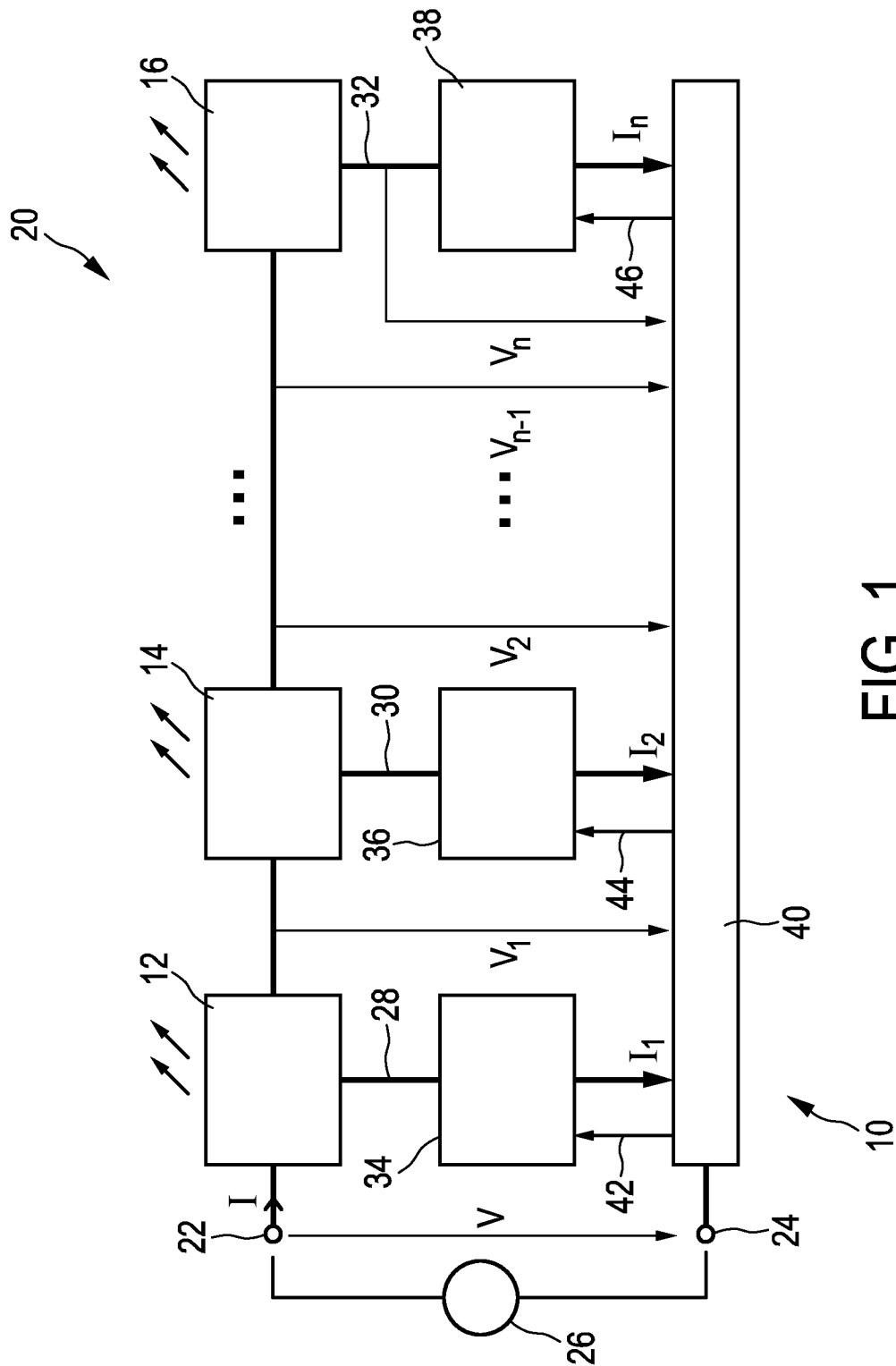
8. Driver as claimed in claim 7, wherein via a resistor the control contact of the control device is connected to the node between the two electrical resistors of the detection
25 device.

9. Driver as claimed in claim 6, wherein via an additional electrical path, the additional electrical path comprising a resistor, the control contact of the control device of at least one current path is connected to another current path.

30 10. Driver device as claimed in claim 1, wherein the load assemblies are LED assemblies comprising one or more LEDs.

11. Driver device as claimed in claim 10, wherein the LEDs are connected in series to each other so that a current path is activated if the input voltage exceeds a threshold voltage of the respectively connected load assembly.

- 5 12. Light apparatus (10) comprising a plurality of lighting elements (12, 14, 16), in particular a plurality of LED assemblies having two or more LEDs, and a driver device (10) as claimed in claim 1 for connecting the light apparatus to an external power supply (26) for driving the lighting elements.



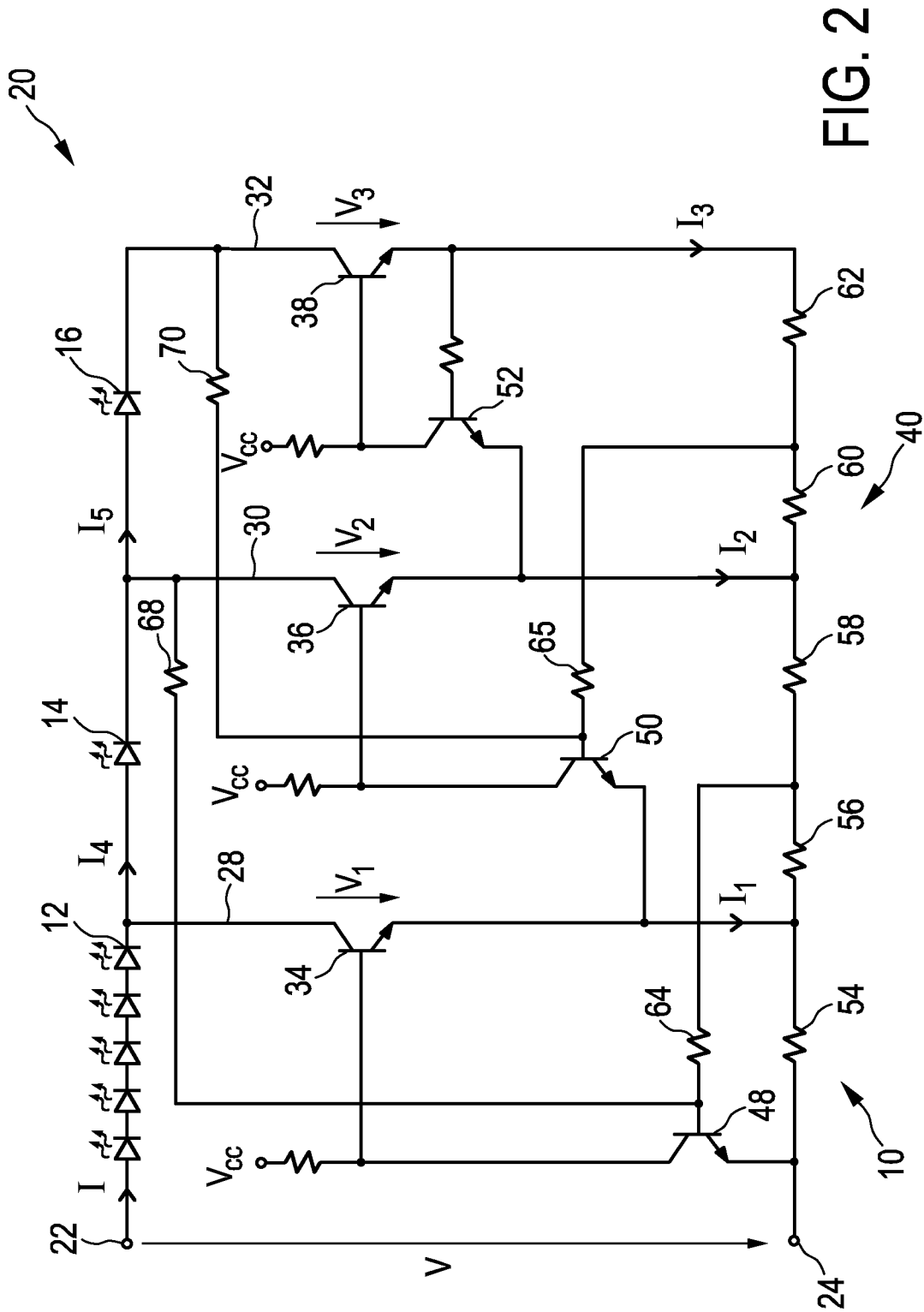


FIG. 2

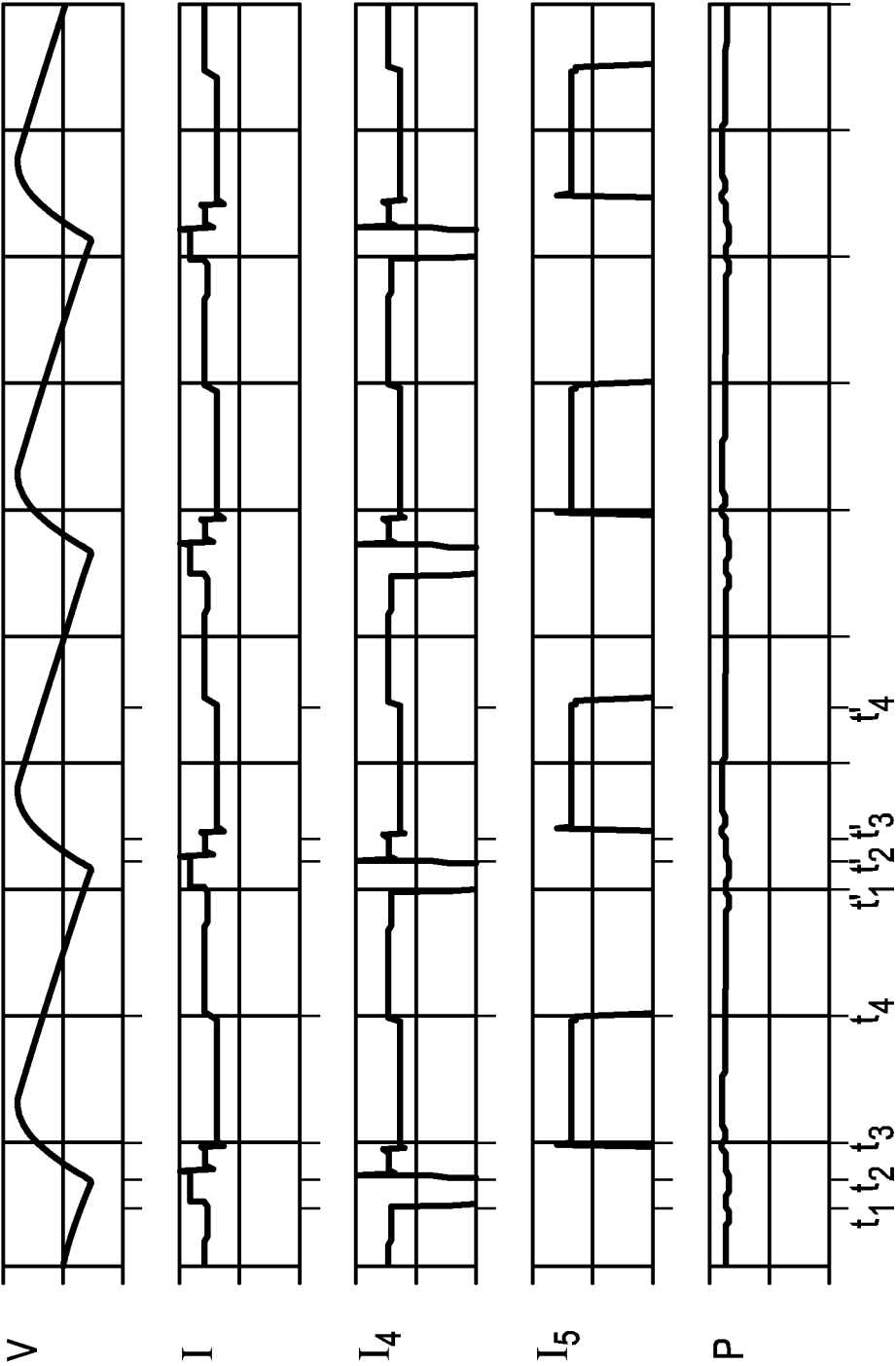


FIG. 3

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2015/056415

A. CLASSIFICATION OF SUBJECT MATTER
INV. H05B33/08
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H05B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2012/313541 A1 (EGAWA SHUNJI [JP] ET AL) 13 December 2012 (2012-12-13) paragraphs [0003], [0060] - [0098]; figures 1-5 -----	1-12



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

15 June 2015

Date of mailing of the international search report

22/06/2015

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2015/056415

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2012313541 A1	13-12-2012	CN 102792778 A	21-11-2012
		EP 2542033 A1	02-01-2013
		JP 5550716 B2	16-07-2014
		US 2012313541 A1	13-12-2012
		WO 2011105630 A1	01-09-2011
