

Circuit arrangement for power supply to a load.

The invention relates to a circuit arrangement for supplying a load from a DC voltage source as defined in the preamble of the main Claim.

Such a circuit arrangement is known from US-PS 3,710,229. It is assumed therein that a load is to be supplied with the output voltage E_{out} . This is achieved from a DC voltage source (+VDC, -VDC) via a switch bridge of four power switches Q1, Q2, Q3, Q4. The power switches here connect the load to be connected to the voltage E_{out} to the DC voltage source with alternating polarity, as is shown in Figs. 2 to 4 of US-PS 3,710,229. For this purpose, the known circuit arrangement comprises an AC voltage reference source 16 which supplies a sinusoidal reference voltage V_{ref} whose frequency and amplitude correspond to the desired frequency and amplitude of the output voltage E_{out} . This sine reference is supplied to a comparator 22 which renders the power switch Q1 permanently conductive during the positive half wave of the sine reference and the power switch Q2 permanently conductive during the negative half wave of the sine reference via a driver circuit 24.

The circuit arrangement of US-PS 3,710,229 also comprises a differential amplifier 30 whose one input receives the sine reference and whose second input receives the output voltage which is to be supplied to the connected load and which is taken off from the switch bridge Q1-Q4 through a transformer T and smoothing elements L1, C1. The differential amplifier 30 forms the difference between the output voltage E_{out} and the sine reference V_{ref} . This difference is integrated in an integrator 32.

US-PS 3,710,229 further discloses a comparator 34 in which the signal representing the integral of the voltage difference provided by the integrator 32 is compared with two threshold voltages V_H and V_L . The power switch Q3 is switched ON when the output signal of the integrator 32 reaches the upper threshold V_H , whereas the power switch Q4 is switched ON when the output signal of the integrator reaches the lower threshold V_L , see US-PS 3,710,229, column 3, ll. 26-32. The power switches Q3 and Q4 thus operate independently of the power switches Q1 and Q2

according to the prior art, cf. column 3, ll. 34-36, and Figs. 3 and 4. The output signal of the integrator 32 fluctuates between the threshold voltages V_H and V_L in Fig. 6. A voltage gradient is generated in this manner - as is shown in Fig. 2 of US-PS 3,710,229 - in a kind of pulse width modulation through positive and negative pulses of the output voltage E_{out} , which gradient after smoothing is to correspond closely to the sine reference V_{ref} . This is indeed the object of the device according to US-PS 3,710,229, cf. column 1, second paragraph.

US-PS 3,700,960 discloses a circuit arrangement for operating a tubular metal halide lamp. This circuit arrangement should eliminate the non-uniformity of the light emission of such a lamp over its length, which is caused especially by cataphoresis and non-uniform operating temperatures, in that a DC component whose value and polarity are controlled, is superimposed on the discharge current of the lamp. For this purpose, an arrangement is proposed, in which the lamp is supplied from a direct voltage source under the control of a control circuit, in which semiconductor elements are used as polarity reversal switches. The time during which the current flows in one polarity is determined by the direction and the degree of non-uniformity of the lamp radiation. For this purpose, a pair of photosensors measuring the light quantity are arranged at opposite ends of the lamp. The signals emitted by them are supplied to a differential amplifier, which is in the form of a zero passage detector. The output signal of this differential amplifier controls driver circuits by which the transistor power switches are switched.

The known circuit arrangement requires a rather complicated construction, in particular owing to the photosensors. Moreover, due to the fact that foreign light of different intensity is incident upon the photosensors, there is a risk of a non-compensated control error and hence of an undesired direct current.

The invention has for its object to provide a simple circuit arrangement for accurately adjusting and controlling a given direct current component through a load.

According to the invention, this object is achieved in a circuit arrangement of the kind mentioned in the opening paragraph by means of the characteristic features as defined in the main Claim.

The arrangement according to the present invention, therefore, does not measure the voltage but the current. This is important especially for loads having non-

linear current-voltage characteristics, for which a circuit arrangement according to US-PS 3,710,229 would be wholly unsuitable if the object is, as it indeed is in the present invention, to achieve an accurate adjustment of a given DC component. It is also an object of US-PS 3,710,229 to apply a certain voltage waveform to the load. In the circuit arrangement according to the invention, by contrast, the consecutive current integrals of the currents flowing through the load in different directions are compared with a reference value in a simple manner and thus equalized with one another or given an adjustable desired difference, whereby a corresponding, permanent DC component can be accurately set. The switch-over of the reference value to the other one of two given values upon the occurrence of each switching signal in accordance with a preferred embodiment achieves that the current integrals assume a value for one polarity of the current through the load which is different from the value assumed by the current integrals for the other polarity of the current through the load. In the prior art, by contrast, where two threshold voltages are mentioned, these are two constant thresholds between which the integral of the voltage difference fluctuates. This means, however, that in the integration of both positive and negative values of the voltage difference the same distance between the two thresholds will always be covered so that - expressed in the terms of the present invention - the same corresponding reference value (*i.e.* the difference between V_H and V_L) is always the criterion for the integration of the positive and the negative values. A switch-over of the reference values as in the present invention would involve a change in V_H or V_L in dependence on the rise or fall of the curve of the output signal of the integrator 32 in Fig. 6 of US-PS 3,710,229; this, however, is not mentioned in the cited Patent nor is it rendered obvious thereby.

In the circuit arrangement according to the invention, a direct measurement of the current through the load therefore takes place, measuring errors from a light measurement, as in the arrangement according to US-PS 3,700,960 being excluded from the beginning. The control in the circuit arrangement according to the invention is moreover effected by a charge integration with the same integration stage for both polarities of the current. As a result, further error sources are excluded. With a reference value constant during the whole operation of the circuit arrangement according to the invention, the electric charge flowing through the load is therefore adjusted on average exactly to zero so that from the beginning a cataphoresis cannot occur, even upon the occurrence of inevitable manufacturing tolerances of the

construction of the circuit. A balancing of the circuit arrangement necessary in the subject matter of US-PS 3,700,960 then also becomes superfluous.

Moreover, the circuit arrangement according to the invention can be used for an arbitrary load and not only for supplying a metal halide lamp, as that according
5 to US-PS 3,700,960.

By the adjustment of the reference value, the period duration in which the direct voltage source can be connected to the load in alternating polarity can further be determined. By the choice of different reference values for the different polarities of the current through the load, the flow of charge can moreover be controlled in a simple and
10 precise manner so that on average a (pulsatory) direct current flows. Preferably, the reference value can be switched upon the occurrence of the switching signal each time to the other of two given values. The adjustment described then takes place by programming of these reference values.

More particularly in the case of a load having an arbitrarily non-linear
15 current-voltage characteristic curve, an exactly proportioned DC component can intentionally be applied in this manner independently of the direct voltage source available. In the special case, this DC component disappears.

It should be noted here that European Patent Application 361 389 discloses a circuit arrangement for converting direct current energy into alternating
20 current energy, which comprises a circuit for eliminating a DC component. The output signal is then measured by a DC/AC converter circuit and this measurement signal is compared in a calculation circuit with a reference signal, a first output control signal being obtained. This first output control signal is processed in the circuit arrangement for eliminating the DC component and a second output control signal is then obtained.
25 The DC/AC converter circuit is controlled through a pulse conversion circuit by the second output control signal.

In this circuit arrangement, the second output control signal is therefore formed independently of the operating properties of the pulse conversion circuit, of the DC/AC converter and of the load supplied through a transformer. Asymmetries present
30 in these stages are not eliminated by the circuit and continuously lead to a DC component in the load or in the transformer preceding it.

In a further embodiment, the circuit arrangement according to the invention comprises a half-wave lengthening stage for increasing the time interval of the

occurrence of the switching signal in an optional time period immediately after the circuit arrangement has been put into operation. This stage is advantageous with a load which takes up a very high initial current when put into operation. Such a high current occurs, for example, upon the ignition of a high-pressure gas discharge lamp and a
5 correspondingly high measurement value is integrated by the integration stage. Thus, the reference value is attained more rapidly; the period duration of the current through the load decreases. In many cases, this is undesirable, for example during the operation of a high-pressure gas discharge lamp, which is coupled to an ignition circuit, which in turn was proportioned for a given period duration of the current flow. By the half-wave
10 lengthening stage, the time intervals of the occurrence of the switching signal are now favourably enlarged with respect to the value they would have to assume only on account of the current through the load. Thus, an optimal period duration can be adjusted for the current through the load. The time interval in which the half-wave lengthening stage is operative can be chosen in accordance with the requirements.

15 According to a further embodiment of the invention, the reference values can be increased by the half-wave lengthening stage in the time period after the circuit arrangement has been put into operation. This can preferably be effected by a switch-over of an arrangement supplying the reference values. The time period required by the integration stage for integrating the measurement value to the reference values is
20 lengthened by the increase in the reference values. However, the same effect is also attained by a corresponding switch-over of the integration time constants in the integration stage.

The last-mentioned switch-over possibility is preferably obtained in that the integration stage comprises an RC low-pass filter whose capacitance can be
25 connected in parallel with an additional capacitance in the time period after the circuit arrangement has been put into operation.

In another advantageous embodiment of the invention, a forced switch-over stage for forcibly reversing the polarity of the current through the load is provided if the time interval of the occurrence of the switching signal exceeds a given value. The
30 forced change-over stage becomes operative in the case in which the current through the load assumes excessively low values, for example in the case of a defect or a current interruption in the load. In this case, the period duration of the current through the load determined by the integration stage would become very long because the integrated

measurement values attain the reference values only after a very long time duration.

The switch bridge then remains in a given state for a correspondingly long time.

Depending on the supply of the switch bridge and the control circuit, in such a case the associated supply voltage can decrease to such an extent that the operation of the circuit

5 arrangement is adversely affected. The period duration, in which the direct voltage source can be connected to the load in alternating polarity, must then be given an upper limit. This is achieved in that after the termination of the corresponding time duration the forced switch-over stage causes a forced reversal of the polarity of the current through the load, independently of the value instantaneously supplied by the integration
10 stage.

Further advantageous embodiments of the circuit arrangement according to the invention will become apparent from the dependent Claims.

An embodiment of the invention is shown in the drawing and is described more fully hereinafter.

15 In the drawing:

Figure 1 shows a circuit arrangement according to the invention for supplying a load,

Figures 2 and 3 show time diagrams clarifying two modes of operation of the circuit arrangement shown in Figure 1, and

20 Figure 4 shows in greater detail a control circuit for the use in a circuit arrangement shown in Figure 1.

In the circuit arrangement shown in Figure 1, the example of a load having a non-linear current-voltage characteristic curve is a gas discharge lamp 1, which is arranged in series with an ignition circuit 2. A terminal of the ignition circuit 2 is
25 connected to a terminal of the gas discharge lamp 1, while a further terminal of the ignition circuit 2 is connected to the other terminal of the gas discharge lamp 1. Such ignition circuits are known in principle and therefore are not described in detail hereinafter.

The combination of the gas discharge lamp 1 and the ignition circuit 2 is
30 inserted with the connection between the further terminal of the ignition circuit 2 and the terminal of the gas discharge lamp 1 on the one hand and with a third terminal of the ignition circuit 2 on the other hand as a transverse branch into a switch bridge, which consists of switch elements 3,4 in a first branch and 5, 6 in a second branch

shown diagrammatically. The switch elements 3, 4, 5, 6 are represented as mechanical switches, it is true, but in practice they take the form of semiconductor switching elements, for example MOS transistors. Each of the switching elements 3, 4, 5, 6 is switched by an associated driver stage 7, 8, 9 and 10, respectively, i.e. passed to the
5 conducting or the non-conducting state.

The two branches consisting of the series arrangements of the switch elements 3, 4 and 5, 6, respectively, to each of whose junction points the combination of the gas discharge lamp 1 and the ignition circuit 2 is connected, are combined in parallel with each other to form the switch bridge and are connected to a DC voltage
10 source 14 through an adjustable current-limiting resistor 11 and a measuring resistor 13 forming part of a device 12 for measuring a current through the gas discharge lamp 1. The DC voltage source 14 is represented as a battery, but may also be constituted by a switch mode power supply or a combination of an energy storage and such a switch mode power supply.

15 The ignition circuit 2 is constructed so that during operation, when the gas discharge lamp 1 is ignited, no or only a negligibly small current is passed parallel to the gas discharge lamp 1. In a switching state in which, for example, the switch elements 3 and 6 are conducting and the switch elements 4 and 5 are non-conducting, or conversely, the current flowing through the gas discharge lamp 1 then corresponds at
20 least substantially exactly to the current through the measuring resistor 13. Due to the described switching states of the switching elements 3 to 6, moreover, the current through the gas discharge lamp 1 can be optionally passed in both directions.

The device 12 for measuring the current through the gas discharge lamp 1 comprises besides the measuring resistor 13 further a measuring amplifier 15 having
25 two inputs, each of which is connected to a relevant terminal of the measuring resistor 13. The measuring amplifier 15 is preferably constructed as a differential amplifier which delivers at its output 16 a measurement value in the form of a voltage which is directly proportional to the current through the gas discharge lamp 1, subject to the resistance value of the measuring resistor 13.

30 The measurement value of the output 16 of the measuring amplifier 15 is supplied to an integration stage 18 contained in a control circuit 17 and is integrated in this stage as a function of time. At an output 19, the integration stage 18 delivers an integrated measurement value, which continuously increases when current is flowing

through the measuring resistor 13.

The integrated measurement value is supplied to the inverting input of a comparison stage 20, to whose non-inverting input is further supplied a reference value by a reference value generator 21. The integrated measurement value and the reference value are preferably transmitted and processed, as is the measurement value at the output 16, in the form of a voltage (in the analog form). In a variation of the arrangement shown in Figure 1, when the device 12 for measuring the current, the integration stage 18 and the comparison stage 20 are constructed in a corresponding manner, measurement and reference values may also be processed in the form of digital signals.

The comparison stage 20 delivers at its output 22 a switching signal if the integrated measurement value corresponds to the reference value, that is to say that it increases until it reaches this value. The switching signal of the output 22 is supplied to a signal-producing stage 23, which supplies a reset signal through a reset lead 24 of the integration stage 18. As a result, the integration stage 18 is reset to an initial state in which the integrated measurement value at the output 19 assumes a defined initial value, for example zero. With the subsequent current flow through the measuring resistor 13, starting from this initial stage, the measurement values at the output 16 of the device 12 are again integrated until the integrated measurement values at the output 19 again reaches the reference value and a new switching signal is delivered by the comparison stage 20, which signal causes a new reset signal to be obtained at the reset lead 24.

Furthermore, two control signals of opposite polarity, i.e. complementary control signals, are supplied by the signal-producing stage 23 to two control leads 25, 26 which are connected to the driver stages 7, 10 and 8, 9, respectively. The switch elements 3 and 6 and 5 and 4, respectively, are alternately switched by the control signals to the conducting and to the non-conducting state, and conversely, through the driver stages 7 to 10. When, for example, a control signal having a high level is applied to the control lead 25, the switching elements 3, 6 become conducting through the driver stages 7, 10; correspondingly, through a control signal having a low level applied simultaneously to the stage lead 26, the switch elements 5 and 4 are passed to the non-conducting state by the driver stages 9, 8. From the direct voltage source 14, a current then flows through the current-limiting resistor 11, the switch element 3, the gas discharge lamp 1 with the ignition circuit 2, the switch element 6 and the measuring

resistor 13. In the opposite case, the current flows through the gas discharge lamp 1 via the switch elements 5 and 4 and hence has a polarity opposite to that in the first case.

At the measuring resistor 13, a current of the same polarity, corresponding to the amount of current through the gas discharge lamp 1, is constantly measured. The

- 5 measurement value is integrated in the manner described for each polarity of the current through the gas discharge lamp 1 and, when the reference value is reached, i.e. when a given charge value which has flown through the gas discharge lamp 1 is reached, the polarity of the current through the gas discharge lamp is reversed. This process is repeated for the reversed polarity, and so on. As a result, an accurately defined, i.e.
- 10 precisely measured electrical charge is constantly passed through the gas discharge lamp 1 for each polarity of the current through the gas discharge lamp. With a constant reference value not varying with time, the charge quantities for both polarities of the current through the gas discharge lamp are identical. This identical character is guaranteed also with manufacturing tolerances in the circuit arrangement and with
- 15 arbitrarily non-linear current-voltage characteristic curves of the gas discharge lamp 1. Any cataphoresis effect is thus effectively prevented without specific complicated control arrangements even for longer operating times in all cases.

- The circuit arrangement shown in Figure 1 offers within the control circuit 17 also the possibility of applying a given average direct current to the gas
- 20 discharge lamp 1 used as a load. For this purpose, the reference value generator 21 is constructed so that it can be switched over such that it can alternately supply to the non-inverting input of the comparison stage 20 two reference values that can be chosen differently. These reference values are effectively switched by the signal-producing stage 23 through leads 27, 28 branching from the control leads 25 and 26, respectively,
- 25 by means of the control signals. One of the reference values is then fixedly assigned to each of the polarities of the current through the gas discharge lamp 1, independently of the duration of the current flow, which may be variable.

- Figure 2 shows a diagram for the most important measurement values or signals and currents as a function of the time t to clarify the processing steps of the
- 30 circuit arrangement of Figure 1. Figure 2a) shows the measurement value occurring at the output 16 of the measuring amplifier 15, which value is proportional to the amount of current through the gas discharge lamp 1. This measurement value is indicated in the diagram by U_{16} . Figure 2c) shows the corresponding current I_1 through the gas

discharge lamp 1. In the time interval between the moment zero and the moment t_1 chosen here, a negative current of comparatively small current strength flows through the measuring resistor 13. Correspondingly, the measurement value U_{16} is comparatively low. The voltage U_{19} shown in Figure 2b), which represents the
5 integrated measurement value at the output 19 of the integration stage 18, then exhibits a comparatively small rise as a function of the time t .

At the moment t_1 , the integrated measurement value U_{19} reaches the reference value designated in Figure 2b) by U_{21} . As a result, a switching signal appears at the output 22 of the comparison stage 20, by which the current I_1 in the gas
10 discharge lamp 1 changes polarity. On account of the non-linear current-voltage characteristic curve of the gas discharge lamp 1, a larger positive current flows through this lamp after the moment t_1 . Correspondingly, a higher voltage is obtained for the measurement value U_{16} , which leads to a stronger rise of the integrated measurement value U_{19} starting at the moment t_1 at the value zero again. The latter again reaches the
15 unchanged reference value U_{21} at the moment t_2 . Since the rise of the integrated measurement value U_{19} is greater in the time interval between the moments t_1 and t_2 than before the moment t_1 , the time interval in which the current I_1 assumes a comparatively high positive value, is correspondingly shorter.

At the moment t_2 , the current I_1 through the gas discharge lamp 1 is
20 changed over again to the polarity described first, so that the processes in the time interval between the moment zero and the moment t_2 are repeated in the time following the moment t_2 .

In Figure 2c), the described current I_1 through the gas discharge lamp 1 changing its polarity is designated by I_{1W} . The average value of this square wave
25 alternating current is referenced I_{1G} and amounts exactly to zero.

Figure 3 shows a mode of operation of the circuit arrangement shown in Figure 1 in which the reference value U_{21} is changed over each time upon the occurrence of a switching signal at the output 22 of the comparison stage 20. In the time interval between the moment zero and the moment t_{10} , a comparatively high
30 reference value U_{21} is set. Since the measurement value U_{16} is comparatively low, the result is a long time duration before the integrated measurement value U_{19} reaches the reference value U_{21} . Correspondingly, the time interval between the moment zero and the moment t_{10} is comparatively long. In this time interval, a comparatively low current

I1 of negative polarity flows.

At the moment t_{10} , the polarity of the current I1 through the gas discharge lamp 1 is changed over again by the switching signal at the output 22 of the comparison stage 20. Now a positive current I1 flows of comparatively high value so that a correspondingly high measurement value U16 and hence a comparatively strong rise of the integrated measurement value U19 are obtained. Moreover, in the present example, at the moment t_{10} the reference value U21 is changed over to a lower value. As a whole, the integrated measurement value U19 therefore reaches the reference value U21 after a considerably shorter time than in the mode of operation shown in Figure 2.

At this moment t_{20} , the polarity of the current I1 is changed over again; the time sequence of the time interval between the moment zero and the moment t_{20} is then repeated.

In Figure 3c), the direct current, resulting in this mode of operation, which is negative in this case, is designated by I1G. Its value can be adjusted arbitrarily by the choice of the two values for the reference value U21.

Figure 4 shows in greater detail a cut-out part of the circuit arrangement shown in Figure 1, more particularly of the device 12 for measuring the current through the gas discharge lamp 1 and of the control circuit 17, which also comprises an addition as compared with Figure 1. Elements already described are provided again with the same reference symbols.

The measuring amplifier 15 shown diagrammatically in Figure 1 is constructed according to Figure 4 as a differential amplifier, to whose inputs 151, 152 the voltage derived at the measuring resistor 13 is supplied through input resistors 153, 154. From the input 151, moreover, a resistor 155 is connected to earth, while from the input 152 a shunt resistor 156 is connected to the output 16 of the measuring amplifier 15. The measuring amplifier 15 is fed with energy through a current supply terminal 157, of which a supporting capacitor 158 is connected to earth.

In the arrangement shown in Figure 4, the integration stage 18 comprises an RC low-pass filter consisting of a series resistor 181 and a parallel capacitance 182. This represents a particularly simple embodiment of the integration stage 18, which can be used advantageously especially for short charging times, i.e. short time periods of the current flow through the gas discharge lamp 1. Preferably, the RC low-pass filter 181, 182 is dimensioned so that the parallel capacitance 182 - starting from the

completely discharged state - is charged also with the longest time period of the current flow through the gas discharge lamp 1 only to a small voltage value as compared with the supply voltage at the current supply terminal 157. In fact, the charge of the parallel capacitor 182 then still takes place substantially linearly with time.

- 5 In a more complicated embodiment of the circuit arrangement shown in Figure 4, the integration stage 18 may also be provided in known manner with an operational amplifier.

- The signal-producing stage 23 comprises in the arrangement shown in Figure 4 a pulse-producing stage 231, which is constituted, for example, by a
10 monostable multivibrator and delivers a voltage pulse at its outputs 232, 233 when a rising signal edge - the switching signal - occurs at its input 234 coupled to the output 22 of the comparison stage 20. The duration of this voltage pulse is determined by a resistor 235 determining the pulse duration and a capacitance 236 determining the pulse duration, by means of which the pulse-producing stage 231 is switched in known
15 manner. The voltage pulse occurring at the output 233 has negative polarity and causes a discharge of the parallel capacitor 182 of the integration stage 18 through its output 19 upon the occurrence of the switching signal through the reset lead 24 and a decoupling diode 201.

- From the output 232, the voltage pulse - polarity positive in this case, for
20 example - arrives at the switching input of a switch-over stage 237, which is preferably constructed as a bistable trigger stage and delivers at its outputs 238, 239 opposite control signals which change levels each time upon the occurrence of a voltage pulse at the output 232. These signals are conducted away as mutually complementary control signals through the control leads 25 and 26, respectively.

- 25 The mutually complementary control signals moreover arrive through the leads 27, 28 at the reference value generator 21. The latter comprises an adjustable voltage divider 211, 212 for each reference value to be adjusted. Of each of the adjustable voltage dividers 211, 212, a respective centre tap 213, 214 is connected through a switching transistor 215, 216 to a common reference value output 217. The
30 switching transistors 215, 216 are switched on alternately by the control signals from the signal-producing stage 23 through driver stages 218 and 219, respectively, which may comprise a potential shift for the control signals at the leads 27, 28 and may also be omitted in the case of suitable potentials for driving the switching transistors 215,

216. As a result a reference value appears at the reference value output 217 in the rhythm of the repolarizations of the current through the gas discharge lamp 1, alternating with the adjustments of the voltage dividers 211, 212, and is applied to the comparison stage 20, i.e. in the example of Figure 4 to its inverting input, in contrast to
5 the example of Figure 1, in which the reference value is applied to the non-inverting input of the comparison stage 20. However, this essentially does not mean a change of the mode of operation of the circuit arrangement.

In Figure 4, moreover, the output 22 of the comparison stage 20 is connected to the current supply terminal 157 through a supply resistor 202. For the sake
10 of simplicity, all further signal processing stages of the control circuit 17 are also connected to the current supply terminal 157. Of course, the individual signal processing stages may also be supplied by different supply voltage sources.

The circuit arrangement shown in Figure 4 comprises in comparison with the circuit arrangement of Figure 1 additionally a half-wave lengthening stage 40. The
15 latter comprises a pulse-producing stage 41 for forming a switching-on pulse immediately after the circuit arrangement, i.e. the control circuit 17, has been put into operation. The duration of this switching-on pulse is again defined in a usual manner by a resistor 42 connected to the pulse-producing stage 41 and determining the pulse duration and a capacitance 43 determining the pulse duration in such a manner that it
20 covers the time interval from the moment the circuit arrangement is put into operation to the moment the gas discharge lamp is reliably ignited. During this time interval, an additional capacitance 45 is connected by the pulse-producing stage 41 through a switching transistor 44 parallel to the parallel capacitance 182 of the RC low-pass filter 181, 182.

25 The period duration for the repolarization of the current through the gas discharge lamp 1 is lengthened by the half-wave lengthening stage 40 in this manner in a time interval immediately after the gas discharge lamp has been put into operation, i.e. during the ignition process. Thus, the effect is counteracted that during the ignition of the gas discharge lamp 1 a considerably higher current flows through this lamp than
30 during operation after ignition of the gas discharge. This high current at the measuring resistor 13 would lead to a strongly accelerated charging of the parallel capacitance 182 so that considerably shorter switch-over periods are obtained by the integration stage 18. In order to avoid this, according to Figure 4, the parallel capacitance 182 is

enlarged by the additional capacitance 45 in such a manner that the integration of the measurement value at the output 19 of the integration stage 18 takes place at least substantially with the same time constant during the ignition process as during operation of the gas discharge lamp 1 after ignition of the gas discharge lamp.

5 In a variation of the circuit arrangement according to Figure 4, the same result can be attained in that the half-wave lengthening stage 40, more particularly the pulse-producing stage 41 contained therein, connects an additional reference voltage generator, for example an additional voltage divider in the form of the voltage dividers 211, 212, to the reference value output 217 through the switching transistor 44 instead
10 of the additional capacitance 45 in the time interval immediately after the circuit arrangement has been put into operation. By this additional voltage divider or reference value generator, a correspondingly increased reference value is then supplied to the comparison stage so that the period duration of the current through the gas discharge lamp 1 during the ignition process again approximately corresponds to that during the
15 succeeding operation of the lamp.

The resistor 42 determining the pulse duration contained in the half-wave lengthening stage 40 is constructed so as to be adjustable in order to permit a simple adaptation of the duration of the switching-on pulse to the operation of the lamp used.

Figure 4 further shows a forced switch-over stage 50 which comprises a
20 timer 51, which in the present embodiment is constructed in accordance with the pulse-producing stages 41 or 231. The timer 251 is controlled at its input 52 by the voltage pulse at the output 232 of the pulse-producing stage 231. Upon the occurrence of this voltage pulse, a low voltage level is produced at the output 53 of the timer 51, which voltage level is maintained as long as the time interval between two voltage pulses
25 arriving at the input 52 does not exceed a given value. For adjusting this value, the timer 251 is connected in known manner to a resistor 54 determining the time and a capacitance 55 determining the time. If on the contrary the time interval between two voltage pulses becomes too long, the output 53 is switched to a high voltage level. Through a decoupling diode 56 and a series resistor 57, this voltage level is switched to
30 the output 19 of the integration stage 18 and there leads to a comparatively rapid charging of the parallel capacitance 182. Thus, the voltage applied to the parallel capacitance 18 now reaches the reference value very rapidly so that the comparison stage 20 emits a switching signal.

When the time interval between two switching signals at the output 22 is exceeded, the time period of the flow of current through the gas discharge lamp 1 is therefore limited by the forced switch-over stage 50. This case applies particularly with an excessively low current through the gas discharge lamp 1, for example, when the lamp has reached the end of its life, has become defective or has been removed. In the extreme case, only the ignition circuit 2 would then be traversed by a current, which without the use of the forced switch-over stage 50 would lead to very long time periods for the switch-over of the switch bridge 3 to 6. Such long time periods can lead in given cases to difficulties with the current supply especially of the switch elements 3 and 5 in the form of transistors. Moreover, the necessity of long time periods would adversely affect the dimensioning of the switch bridge 3 to 6.

CLAIMS :

1. A circuit arrangement for supplying a load (1) from a direct voltage source (14) through a switch bridge (3 to 6), by which the DC voltage source (14) can be connected with alternating polarity to the load (1), comprising a control circuit (17) for controlling the switch bridge (3 to 6), which control circuit comprises an integration stage (18), a comparison stage (20) for supplying a switching signal (to 22), and a signal-producing stage (23) for reversing the polarity of a current (I1) through the load (1) when the switching signal (at 22) occurs, characterized by a device (12) for measuring a current (I1) through the load (1) and supplying a corresponding measurement value, and characterized in that the integration stage (18) is constructed for integrating the measurement value, the comparison stage (20) for comparing the integrated measurement value with a reference value (from 21) and for supplying the switching signal (to 22) when these values correspond to each other, and the signal-producing stage (23) for resetting the integration stage (18) to an initial state upon the application of the switching signal (to 22).
- 15 2. A circuit arrangement as claimed in Claim 1, characterized in that the device (12) for measuring the current (I1) through the load (1) comprises a measuring resistor (13) which is included in the connection line between the switch bridge (3 to 6) and the DC voltage source (14).
3. A circuit arrangement as claimed in Claim 2, characterized by a measuring amplifier (15) with two inputs, each of which is connected to a respective connection point of the measuring resistor (13).
- 20 4. A circuit arrangement as claimed in Claim 1, 2, or 3, characterized in that the reference value (from 21) can be switched over to the other one of two given values upon each occurrence of the switching signal (at 22).
- 25 5. A circuit arrangement as claimed in Claim 1, 2, 3, or 4, characterized by a half-wave lengthening stage (40) for increasing the time interval of the occurrence of the switching signal (at 22) in a time period that can be chosen immediately after the circuit arrangement has been put into operation.



6. A circuit arrangement as claimed in Claim 5, characterized in that the reference values (from 21) can be increased by the half-wave lengthening stage (40) in the time period after the circuit arrangement has been put into operation.
7. A circuit arrangement as claimed in Claim 5, characterized in that the
5 integration stage (18) comprises an RC low-pass filter to whose capacitance (182) an additional capacitance (45) can be connected in parallel in the time period after the circuit arrangement has been put into operation.
8. A circuit arrangement as claimed in any one of the preceding Claims, characterized by a forced switch-over stage (50) for forcedly reversing the polarity of
10 the current (I1) through the load (1) when the time interval between the occurrences of the switching signal (at 22) exceeds a given, adjustable value.

