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(54) HIGH VOLTAGE POWER SUPPLY FOR ELECTROSTATIC PRECIPITATOR

HOCHSPANNUNGSENERGIEVERSORGUNG FÜR EINEN ELEKTROSTATISCHEN ABSCHIEDER

ALIMENTATION EN COURANT HAUTE TENSION POUR PRÉCIPITATEUR ÉLECTROSTATIQUE

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Description

FIELD OF THE INVENTION

[0001] This invention relates to a high voltage (HV) power supply system energizing a number of fields of an electrostatic precipitator (ESP), said system comprising individual DC power supplies for each field fed from a common HV DC-bus built with a three-phase HV transformer-rectifier (T-R); wherein said individual power supplies are able to deliver a variable DC-voltage by means of a HV switching device built with power semiconductors with turn-off capabilities.

BACKGROUND OF THE INVENTION

[0002] Electrostatic precipitators are used for collection and removal of particulate from a gas stream in industrial processes. The concentration of particles in the gas stream can be reduced significantly by charging the particles, via the discharge electrodes of the electrostatic precipitator, generating negative charge carriers to become attached to the particles in the gas stream, and by applying a high electrical field so that the charged particles are forced towards the positive anode of the ESP, the so-called collecting plates, thereby removing the charged particles from the gas stream. The collected particles form a dust layer on the collecting plates, which is removed periodically by means of mechanical rapping devices.

[0003] The ESP's have been traditionally energized by single-phase transformer-rectifiers (TR sets). In his case, the performance of an electrostatic precipitator can be impaired when treating low resistivity and fine dust particles because a high current is needed and often this is impossible to reach. The reason is that a correspondingly high voltage has to be applied to the particular ESP field and because of the capacitive nature of an ESP field a high voltage ripple is generated. This high peak voltage causes sparking inside the ESP field limiting the current below the value that is desired. Therefore it is an advantage in such cases to apply a smooth DC-voltage where the difference between the peak and the mean value is only few kilovolts. This is not possible to obtain with traditional TR-sets.

[0004] When treating medium and high resistivity dust particles the ESP performance is impaired by the occurrence of back-corona.

[0005] Back-corona means that positive ions are generated by the breakdown of the dust layer, which neutralizes the beneficial negative ions generated by the discharge electrodes, which are used for charging the dust particles negatively. The result is a decreased voltage applied to the electrostatic precipitator and re-entrainment of the dust particles back to the gas stream due to small eruptions on the dust layer.

[0006] In this case a more pulsating voltage is beneficial and traditional power supplies operating in the so-

called intermittent energization mode are used. But in this case, the best solution is the so-called pulse systems generating narrow HV pulses in the microsecond range. Here the only problem is the price of these units, and they not are economical in all cases.

[0007] In present electrostatic precipitators one solution has been the use of HV switch mode power supplies (SMPS). These power supplies are independent units energizing each field of the ESP. As described for instance in WO 00/16906, the three-phase mains voltage is rectified and filtered and then converted to an AC voltage by a bridge inverter operating at low voltage level (500-600 VDC) and high switching frequency (25-50 kHz). This AC voltage is then raised to the required high level by a transformer and then rectified by a bridge rectifier and applied to an ESP field.

[0008] There also exist the more expensive solution based in the use of pulse systems, which are especially effective in coping with high resistivity and fine dusts. These units comprise two independent power supplies, one for generating a smooth base voltage and the other for generating narrow HV pulses (about 100µs) that are superimposed on the base voltage. EP 0 268 934 B1 describes a pulse system with a pulse transformer with a primary and secondary winding, a power source connected to a storage capacitor and a thyristor with reverse diode connected to the primary winding of the transformer. A second voltage source supplies a base voltage to an electrostatic precipitator field coupled to the secondary winding of the transformer by means of a coupling capacitor.

[0009] WO 2006 045311 also describes a pulse system where the switching device and the storage capacitors have exchanged place and the switching device is an IGBT.

[0010] All the described power supplies are independent units including their own HV transformer-rectifier and are energized from an industrial AC line. This is the usual solution employed in energizing each field of present precipitators.

[0011] The SMPS units are effective in coping with low resistivity dusts, but its complexity results in an increased price and reduced reliability. The HV transformer working at high voltage and switching frequency can be often a problem. Because the size of these units is small due to the high operating frequency, the losses may cause temperature problems in the HV components submerged in transformer oil. These problems also limit the attainable rated current and voltage of these units.

[0012] The present invention on the contrary, is based on a common HV DC-bus comprising a reliable and proven three-phase rectifier having the current capacity of energizing 3-4 ESP fields. This solution is economically attractive because the price of such a transformer-rectifier (TR) does not increase proportionally with the rated current (i.e. a 2000 mA TR-unit does not cost twice as much a 1000 mA unit).

OBJECT AND SUMMARY OF THE INVENTION

[0013] It is therefore an object of the invention to provide a power supply for ESP's that is able to generate the same voltage waveforms as a SMPS unit, but with less complexity. It is moreover an object of the invention to reduce the electrical losses in the individual units and thus reducing the thermal problems in the main components and the cost and increasing the reliability. This object is achieved by the combination of features in accordance with claim 1, i.e. when the individual power supplies do not include HV transformers as the DC voltage to be applied to an ESP field is taken from the common DC-bus. By regulating this constant voltage by means of a HV switching device, it is rendered possible to apply a smooth DC voltage to the ESP fields or a more pulsating voltage if this is required by the high resistivity of the treated dust particles. The switching device could be made of any appropriate power semiconductor capable of being turned off, e.g. IGBT's, MOSFET's, etc.

[0014] The common DC-bus comprises a three-phase transformer with a primary and a secondary winding, where the primary winding of the transformer is connected to the mains voltage and the secondary winding is connected to a three-phase bridge rectifier; finally the output voltage passes a LC-filter, where the capacitor acts as an energy reservoir for the individual power supplies. Series inductances are connected in series with the primary side in order to limit the in-rush current and improve the power factor and thus reducing the current harmonics.

[0015] The common DC-bus thus provides steady negative voltages in the range of 60-110 kV, depending on the rated voltage of the power supply selected. The selection depends on the plant process, the electrode configuration, etc.

[0016] The individual power supply for each electrical field of the ESP consists of a power semiconductor based switch in series with an inductance for limiting the current when the switch is closed. When the switch is opened an alternative current path is needed and this is provided by a HV diode connected between the switch and ground. The mean voltage delivered to the individual ESP fields is controlled by varying the duty cycle of the switch, i.e. the so-called ON and OFF-time. The switch is operated at a high frequency in the range of for example 15-50 kHz.

[0017] In another preferred embodiment of the system, the mean output current is automatically controlled by a PI-controller included in the control unit. The current feedback signal is delivered by an optical based current transducer. The voltage applied to the ESP field is measured by a voltage divider and this kV-signal is also used by a spark detector which is necessary for detecting the break-down of the gas normally occurring in ESP's.

[0018] In another preferred embodiment, the switching device is arranged to be turned off as soon as the spark detector detects the occurrence of a spark. Thus the load current, the so-called ESP current commutates to the HV

diode and the switching device is not subjected to any surge current.

[0019] Furthermore, during the sparking interval, which lasts typically for some milliseconds, the switching device is only exposed to a voltage equal to the voltage of the common DC-bus. These 2 conditions makes possible to build a cheaper switching device as this is not exposed to any voltage and current surges of importance.

[0020] According to a preferred embodiment of the invention, each individual power supply further comprises a firing circuit for the switching device. Preferably, the firing pulses are transferred from the control unit via infrared light. This link in practice is made using a PC board with infrared (IR) light emitting diodes (LED's) placed close to the modules comprising the switching device. In these individual modules is mounted a photo-diode as receiver followed by an IGBT-driver for applying the firing pulses to the gates of the IGBT's.

[0021] It is preferred that the system according to the invention comprises a snubber circuit connected in parallel to the switching device and the anti-parallel rectifier device. The reason is the stray inductance of the cable connection between the switch and the HVDC-bus. The snubber circuit limits the rate of rise of the voltage across the switching device (dv/dt) when it is turned off; hereby, a protection of the switching device is provided.

[0022] In an alternative, preferred embodiment of the invention, the reservoir capacitor can be fully or partially moved into the individual power supplies. It can be advantageous in some case where there is a long distance between the individual units and the common three-phase HV transformer-rectifier. Thus, possible overvoltages are avoided and a commercial standard three-phase HV transformer-rectifier can be utilized.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] The invention will be explained more fully below in connection with preferred embodiments and with reference to the drawings, in which:

Figure 1 is a block diagram of the HV power supply system according to the invention;

Figure 2 is a block diagram of one individual power supply

Figure 3 is the alternative embodiment of the invention where the reservoir capacitor is moved and distributed evenly inside the individual power supplies.

Figure 4 shows diagrams of waveforms of the firing signal applied to the gates of the switching device, the voltage applied to the ESP field (u_{OUT}) and the output current (i_{OUT}) delivered to this load, in case of normal operation.

Figure 5 shows diagrams of waveforms of the volt-

age applied to the ESP field (u_{OUT}), the current and the voltage across the switching device, in case of a spark;

[0024] Throughout the drawings, like elements are denoted by like reference numbers.

DESCRIPTION OF PREFERRED EMBODIMENTS

[0025] Figure 1 is a block diagram of the pulse system according to the invention. Shown is a common HVDC power supply 1, hereinafter referred to as DC-bus, and individual DC power supplies 8, arranged to energize an electrostatic precipitator 12. The DC-bus 1 is fed from an industrial three-phase mains 7 and comprises a HV transformer 3, a diode bridge 4, a series inductance 5 and a reservoir capacitor 6. The output voltage U_{dc} is negative because negative corona is normally used in electrostatic precipitators. Linear chokes 2 are connected in series with the primary of the HV transformer 3 for limiting the inrush-current when voltage is applied for first time to the common DC-bus and for limiting the surge current in case of short-circuits. As an example only 3 precipitator fields (A, B, C) are shown, but in practice they can be more or less, depending on the particular application.

[0026] The reference number 8 denotes one of the individual DC power supply energizing one ESP field according to the invention. This power supply consists basically of a semiconductor switching device 9 comprising a number of power semiconductors in series, where its collector terminal is connected via a series inductance 11 to the corresponding ESP field. From the connection point of the collector terminal of the switching device 9 to the series inductance 11 is connected the anode of a HV diode 10 comprising a number of Si diodes in series. This HV diode 10 works as an alternative path for the output current when the switching device 9 is turned off. The cathode of the HV diode 10 is connected to ground. Figure 1 also shows that the output voltage U_{dc} of the DC-bus 1 is connected to the emitter terminal of the switching device 9.

[0027] Figure 2 shows the DC power supply used for energizing one field of an electrostatic precipitator 13. This is fed from the negative pole of the common DC-bus 1, the positive pole being connected to ground. The switching device consists of a large number of semiconductor modules connected in series based on power semiconductors with turn-off capabilities like IGBT's, power MOSFET's, etc. The emitter terminal of the switching device is connected to the common DC-bus and the collector terminal of the switching device is connected via a series inductance 11 to the ESP field 13. To the point off coupling (A) between the collector terminal and the series inductance 11 is connected the anode terminal of a HV diode, acting as alternative current path in the time intervals when the switching device 9 is turned off. The cathode terminal of the HV diode 10 is connected to ground.

[0028] Because of the parasitic inductance of the cable connection between the common DC-bus 1 and the DC power supply, the snubber circuit 21 is connected in parallel with the switching device 9 for limiting the rate of rise of the voltage when this is turned off.

[0029] The control unit 16 receives feedback signals from the DC power supply by measuring of the output current (mA) and the voltage applied to the ESP field (kV). These signals are obtained by means of a current transducer 15 and a voltage divider 14, respectively. The control unit 16 sends a firing signal 17 to the switching modules via infra-red light emitting diodes mounted in a common PC board 18. This infra-red light 19 is received by a firing unit 20 built in each switching module comprising mainly a photo-diode and an IGBT-driver. Then the firing signal with the required amplitude and duration is applied to the gate of the power semiconductor, e.g. an IGBT.

[0030] The switching device 9 is normally operated at a constant frequency whose period is equal to the ON-time (t_{ON}) plus the OFF-time (t_{OFF}). The duty cycle is defined as the ON-time divided by the period ($t_{ON} / (t_{ON} + t_{OFF})$).

[0031] When the switching device 9 is closed (t_{ON}), then the voltage at its collector terminal (point A) is equal to the DC voltage delivered by the DC-bus (U_{DC}). When the switching device 9 is opened (t_{OFF}) then the voltage at point A is equal to the voltage drop across the HV diode 10, which is ideally zero. So the voltage at point A is ideally a square wave varying between U_{DC} and 0V. Then the mean voltage at point A is equal to the voltage U_{DC} multiplied by the duty cycle of the switching device 9. Because the mean voltage across the series inductance 11 is zero, then the mean output voltage applied to the ESP field (point B) is also equal to U_{DC} times the duty cycle. In other words the mean output voltage (U_{OUT}) and consequently the mean output current (I_{OUT}) can be varied by varying the duty cycle.

[0032] Figure 3 shows an alternative embodiment of the invention, where the reservoir capacitor 6 of the common DC-bus 1 is moved into the individual power supplies 8. This may be necessary in case of long distances between the common DC-bus and the individual power supplies increasing the parasitic inductances in the system, thus increasing the risk of overvoltages across the switching device 9.

[0033] Figure 4 shows, as example, the waveforms of the firing signal (u_{GATE}), the output current (i_{OUT}) and the output voltage (u_{OUT}) applied to one ESP field. In **this particular example** the common DC-bus has a rated voltage of 80 kV, the switching frequency is 20 kHz, and the load is represented by a 60 nF capacitor in parallel with 100 k Ω . Then the rated output mean current is 800 mA. The series inductance 11 has a sufficient high value that assures that the output current can flow continuously through it (few [H]). The duty cycle D is chosen to be 0.75.

[0034] During the ON-time 26 the switching device 9 is closed and the output current increases linearly 28.

During the OFF-time 27 the switching device is open and the output current decreases linearly 29. After one period (50 μ s) of the switching frequency 25 the sequence is repeated. Because of the duty cycle $D=0.75$ and the DC-bus voltage 34 is 80 kV, the mean output voltage 33 is $0.75 \times 80 = 60$ kV and the mean output current 32 is $60 \text{ kV}/100 \text{ k}\Omega = 0.6 \text{ A}$. The peak value 30 of the output current is below the rated value 31 (0.8 A) indicating the low current intensities the switching device has to withstand in this application example.

[0035] Because of the capacitive nature of the load 13 and the relatively high switching frequency, the output voltage is very smooth 33. In practice a ripple of few kilovolts could be expected.

[0036] Figure 4 shows only one application example. Because of the rated current and voltage values of the DC power supply depends strongly of the particular application of the electrostatic precipitator, both lower and higher rated values should be used in practice.

[0037] Figure 5 shows, as example, the waveforms of the output voltage (u_{OUT}) applied to the ESP field 13, the output current (i_{OUT}), the current (i_{switch}) through the switching device 9 and the voltage (u_{switch}) across the switching device 9, in case of a spark.

[0038] In this particular example the common DC-bus still has a rated voltage of 80 kV, the switching frequency is 20 kHz, and the load is represented by a 60 nF capacitor in parallel with 100 k Ω . The duty cycle $D = 0.75$ as in Figure 4. The output voltage before the spark 40 is 60kV and the spark 41 occurs at $t = 51 \text{ ms}$. Then the output voltage drops to zero and remains there. The duration of the spark is supposed to be 1 ms, so at $t = 52 \text{ ms}$ the short-circuit at the output disappears and the output voltage can increase again 42.

When the control unit 16 detects the spark 41, it blocks the firing pulses 17 to the gates of the switching device 9 and the output current starts decreasing slowly 43. After the spark and because the short-circuit of the load has disappeared 42, the output current starts decreasing faster down to zero 44. In this example the gate pulses are blocked during a typical interval of 10 ms.

[0039] The current through the switching device (i_{switch}) follows the output current during the ON-time 26 and is zero during the OFF-time 27. Then it remains at zero 46 after the spark, because the gate pulses are blocked. The voltage across the switching device (u_{switch}) oscillates between 0 and the rated voltage 48. After the spark 41 it remains at this level (80 kV). So, neither the peak voltage across the switching device 47, nor the peak value of the current through the switching device 45 exceeds the rated values of the power supply. During the occurrence of the spark, the peak voltage across the switching device remains at the rated voltage of the DC-bus ($U_{DC} = 80 \text{ kV}$) and current through the switching device stays below the rated value of the power supply 31 (0.8 A).

[0040] The operation mode described by Figures 4 and 5 gives a very smooth output voltage. In case of a more

pulsating voltage is desired to be applied to an ESP field, then blocking times in the range of milliseconds should be introduced in the operation of the switching device 9. So when the switching device 9 is turned on and off with an appropriate duty cycle, the output voltage will increase more or less linearly and during the blocking period of the switching device the output voltage will decrease exponentially. This is not illustrated by a figure, because the principle can easily be understood without a drawing.

[0041] For example, if the switching device 9 in steady-state conditions is operated at $D = 0.75$ and this operation is allowed during 3 ms and then the switching device is turned off during 7 ms, then the output voltage will have a pulsating waveform with a period of 10 ms. This waveform is very alike to the one generated by traditional single-phase transformer-rectifier unit energized from a 50 Hz line. (For instance, see EP 0 268 467).

Claims

1. A high voltage DC power supply system for energizing one or more fields of an electrostatic precipitator (12), said system comprising:

one or more individual high voltage DC power supplies (8), one for each field of the precipitator (12);

a high voltage DC-bus (1) having a negative and a positive pole and consisting of a three-phase transformer-rectifier (3, 4) and a L-C filter (5, 6); the high voltage DC-bus (1) being common for said one or more high voltage DC power supplies,

said system being arranged to be coupled to said electrostatic precipitator (12); **characterized in that**

the one or more power supplies (8) comprises a switching device (9), an inductance in series (11) and a high voltage diode (10),

said switching device (9) has an emitter and a collector terminal, the first being connected to the negative pole of the DC-bus (1) and the second one to the series inductance (11),

where the anode terminal of said high voltage diode (10) is connected to the collector terminal of said switching device (9) and the cathode terminal is connected to ground,

the other terminal of said series inductance (11) being the output terminal, adapted to be connected to the precipitator field (13).

2. A system according to claim 1, wherein said switching device (9) is built by using MOSFET's.
3. A system according to any of claims 1 to 2, **characterized in that:**

said positive pole of the high voltage DC-bus (1) being connected to ground; said high voltage power supplies (8) are adapted to be energized from the negative pole of said common DC-bus (1); the output HV terminal of the high voltage DC power supply (8) is connected to the discharge electrodes of said precipitator field (13).

4. A system according to any of claims 1 to 3, **characterized in that** said switching device (9) comprises a large number of modules in series and is arranged to be turned on and off at a relatively high switching frequency in order to generate a smooth output voltage that can be varied by varying the duty cycle.
5. A system according to any of the claims 1 to 4, wherein the switching device (9) can be operated with a combination of duty cycle control and the introduction of blocking periods in the millisecond range, in order to apply a more pulsating voltage in one or more precipitator fields (13).
6. A system according to any of the preceding claims, wherein said filter capacitor (6) is adapted to be moved fully or partially inside the individual DC power supplies (8) fed from the common DC-bus (1).
7. A system according to any of the claims 1 to 4, further comprising a control unit (16) that is adapted to block, after the detection of a spark (41), the firing pulses to the gates of the switching device (9) for a time interval in the millisecond range, thus avoiding the occurrence of current surges.

Patentansprüche

1. Hochspannungs-Gleichstromversorgungssystem zum Zuführen von Energie für ein oder mehrere Felder eines elektrostatischen Abscheiders (12), wobei das System umfasst:

eine oder mehrere individuelle Hochspannungs-Gleichstromversorgungseinrichtungen (8), eine für jedes Feld des Abscheiders (12), einen Hochspannungs-Gleichstrombus (1), der einen negativen und einen positiven Pol hat und aus einem Dreiphasen-Transformator-Gleichrichter (3, 4) und einem LC-Filter (5, 6) besteht, wobei der Hochspannungs-Gleichstrombus (1) für die eine oder die mehreren Hochspannungs-Gleichstromversorgungseinrichtungen gemeinsam ist, wobei das System so ausgelegt ist, dass es mit dem elektrostatischen Abscheider (12) gekoppelt ist, **dadurch gekennzeichnet, dass** die eine oder mehreren Stromversorgungseinrichtungen (8) eine Schaltungsvorrichtung (9), eine Reihen-

induktanz (11) und eine Hochspannungsdioden (10) umfasst,

die Schaltungsvorrichtung (9) einen Emitter und einen Kollektoranschluss hat, wobei der Erste mit dem negativen Pol des Gleichstrombusses (1) und der Zweite mit der Reiheninduktanz (11) verbunden ist,

wobei der Anodenanschluss der Hochspannungsdioden (10) mit dem Kollektoranschluss der Schaltungsvorrichtung (9) verbunden und der Kathodenanschluss mit der Erde verbunden ist, wobei der andere Anschluss der Reiheninduktanz (11) der Ausgangsanschluss ist, der dazu ausgelegt ist, mit dem Abscheiderfeld (13) verbunden zu sein.

2. System nach Anspruch 1, bei dem die Schaltungsvorrichtung (9) unter Verwendung eines MOSFETs gebaut ist.
3. System nach irgendeinem der Ansprüche 1 bis 2, **dadurch gekennzeichnet, dass** der positive Pol des Hochspannungs-Gleichstrombusses (1) mit der Erde verbunden ist, die Hochspannungs-Stromversorgungseinrichtungen (8) dazu ausgelegt sind, von dem negativen Pol des gemeinsamen Gleichstrombusses (1) unter Strom gesetzt zu werden, wobei der Ausgangs-Hochspannungsanschluss der Hochspannungs-Gleichstromversorgungseinrichtung (8) mit den Entladungselektroden des Abscheiderfeldes (13) verbunden ist.
4. System nach irgendeinem der Ansprüche 1 bis 3, **dadurch gekennzeichnet, dass** die Schaltungsvorrichtung (9) eine große Anzahl von Modulen in Reihe umfasst und dazu ausgelegt ist, mit einer relativ hohen Schaltfrequenz an- und ausgeschaltet zu werden, um eine gleichmäßige Ausgangsspannung zu erzeugen, die durch Variieren des Arbeitszyklus variiert werden kann.
5. System nach irgendeinem der Ansprüche 1 bis 4, bei dem die Schaltungsvorrichtung (9) mit einer Kombination aus Arbeitszyklussteuerung und der Einführung von Blockierzeiten im Millisekundenbereich betrieben werden kann, um in einem oder mehreren Abscheiderfeldern (13) eine pulsierende Spannung anzulegen.
6. System nach irgendeinem der vorhergehenden Ansprüche, bei dem der Filterkondensator (6) dazu ausgelegt ist, vollständig oder teilweise innerhalb der von dem gemeinsamen Gleichstrombus (1) gespeisten individuellen Gleichstromversorgungseinrichtungen (8) bewegt zu werden.
7. System nach irgendeinem der Ansprüche 1 bis 4, das weiterhin eine Steuereinheit (16) aufweist, die

dazu ausgelegt ist, nach der Feststellung eines Fun-
kens (41) die Zündimpulse zu den Gates der Schalt-
vorrichtung (9) für ein Zeitintervall im Millisekunden-
bereich zu blockieren, um das Auftreten von Strom-
stößen zu vermeiden.

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Revendications

1. Système d'alimentation continue haute tension pour
alimenter un ou plusieurs champs d'un précipitateur
électrostatique (12), ledit système comprenant :

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une ou plusieurs alimentations continues haute
tension (8) individuelles, une pour chaque
champ du précipitateur (12) ;

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un bus continu haute tension (1) ayant des pôles
négatif et positif et consistant en un transforma-
teur-redresseur triphasé (3, 4) et un filtre L-C (5,
6) ; le bus continu haute tension (1) étant com-
mun aux dites une ou plusieurs alimentations
continues haute tension,

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ledit système étant agencé pour être couplé au
dit précipitateur électrostatique (12) ; **caracté-**

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risé en ce que
lesdites une ou plusieurs alimentations (8) com-
prennent un dispositif de commutation (9), une
inductance en série (11) et une diode haute ten-
sion (10),

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ledit dispositif de commutation (9) comporte une
borne d'émetteur et une borne de collecteur, la
première étant connectée au pôle négatif du bus
continu (1) et la deuxième à l'inductance série
(11),

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dans lequel la borne d'anode de ladite diode
haute tension (10) est connectée à la borne de
collecteur dudit dispositif de commutation (9) et
la borne de cathode est connectée à la masse,
l'autre borne de ladite inductance série (11)
étant la borne de sortie, conçue pour être con-
nectée au champ de précipitateur (13).

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2. Système selon la revendication 1, dans lequel ledit
dispositif de commutation (9) est réalisé en utilisant
un transistor MOSFET.

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3. Système selon l'une quelconque des revendications
1 à 2, **caractérisé en ce que** : ledit pôle positif du
bus continu haute tension (1) est connecté à la
masse ; lesdites alimentations haute tension (8) sont
conçues pour être alimentées à partir du pôle négatif
dudit bus continu commun (1) ; la borne haute ten-
sion de sortie de l'alimentation continue haute ten-
sion (8) est connectée aux électrodes de décharge
dudit champ de précipitateur (13).

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4. Système selon l'une quelconque des revendications
1 à 3, **caractérisé en ce que** ledit dispositif de com-

mutation (9) comprend un grand nombre de modules
en série et est agencé pour être activé et désactivé
à une fréquence de commutation relativement éle-
vée afin de générer une tension de sortie lissée qui
peut être modifiée en modifiant le rapport cyclique.

5. Système selon l'une quelconque des revendications
1 à 4, dans lequel le dispositif de commutation (9)
peut être réalisé par une combinaison de commande
de rapport cyclique et de l'introduction de périodes
de blocage dans la plage des millisecondes, afin
d'appliquer une tension plus pulsatoire dans un ou
plusieurs champs de précipitateur (13).

6. Système selon l'une quelconque des revendications
précédentes, dans lequel ledit condensateur de fil-
trage (6) est conçu pour être déplacé entièrement
ou partiellement à l'intérieur des alimentations con-
tinues (8) individuelles fournies par le bus continu
commun (1).

7. Système selon l'une quelconque des revendications
1 à 4, comprenant en outre une unité de commande
(16) qui est conçue pour bloquer, après la détec-
tion d'une étincelle (41), les impulsions de déclenche-
ment des grilles du dispositif de commutation (9)
pendant un intervalle de temps dans la plage des
millisecondes, évitant ainsi l'apparition de surinten-
sités transitoires.

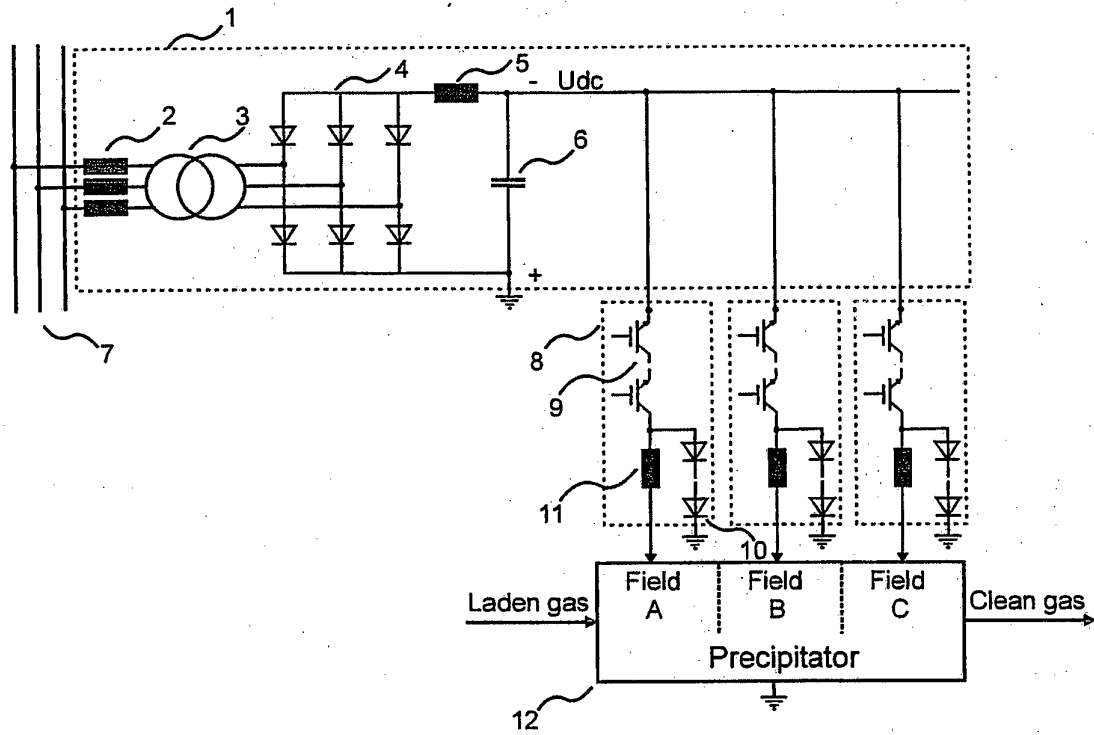


Figure 1

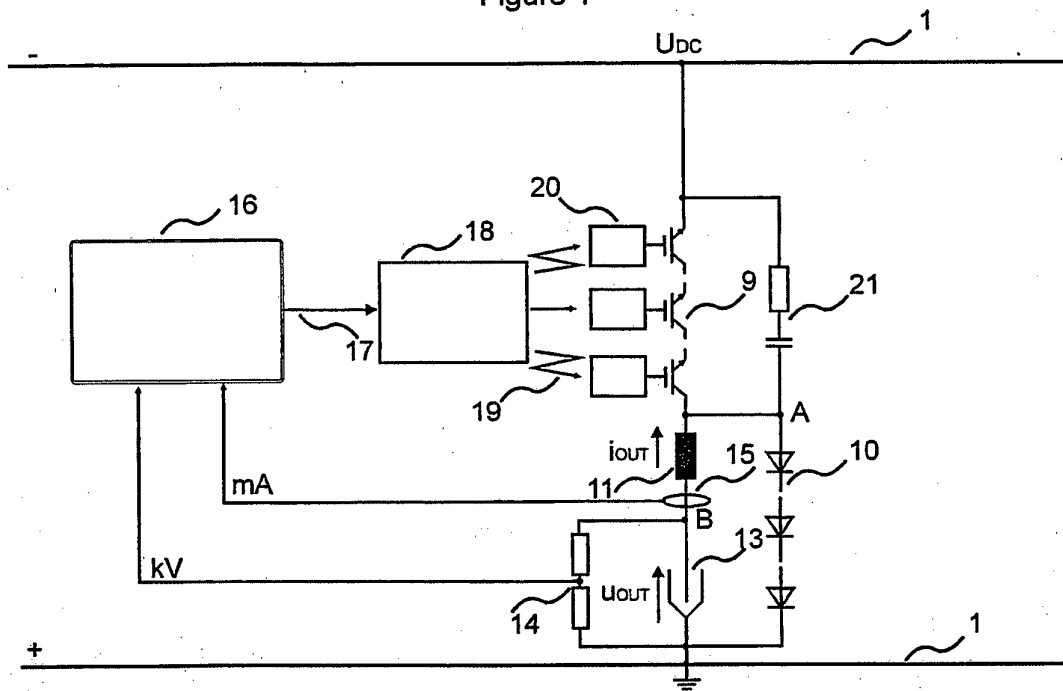


Figure 2

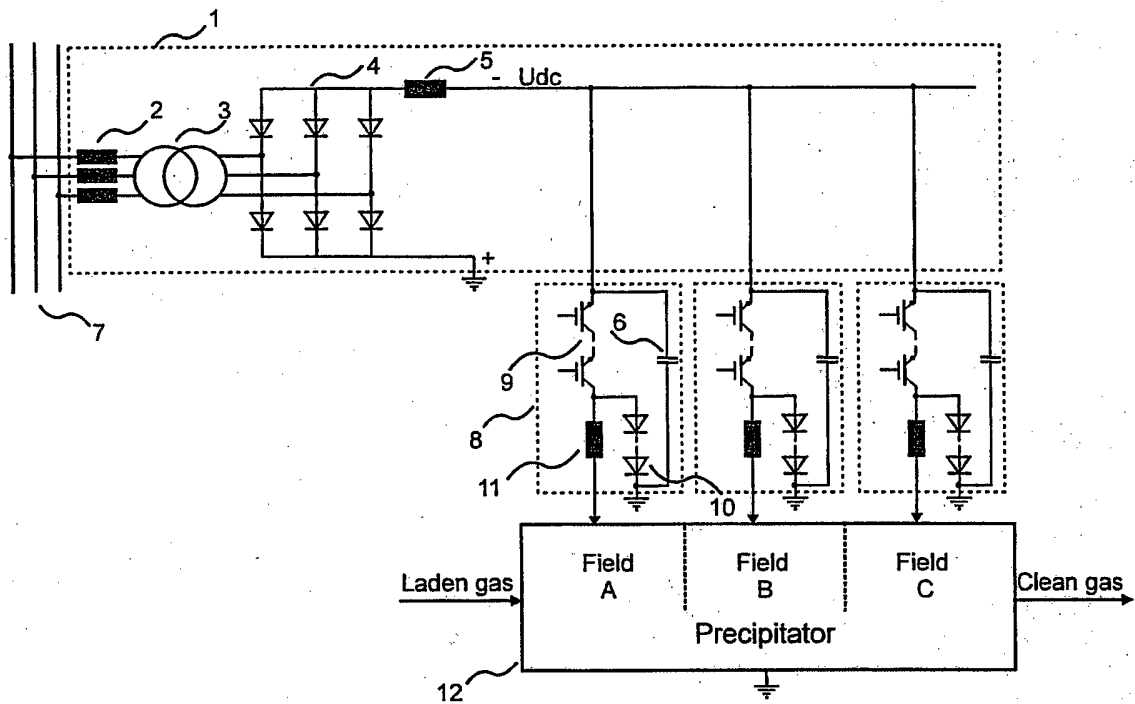


Figure 3

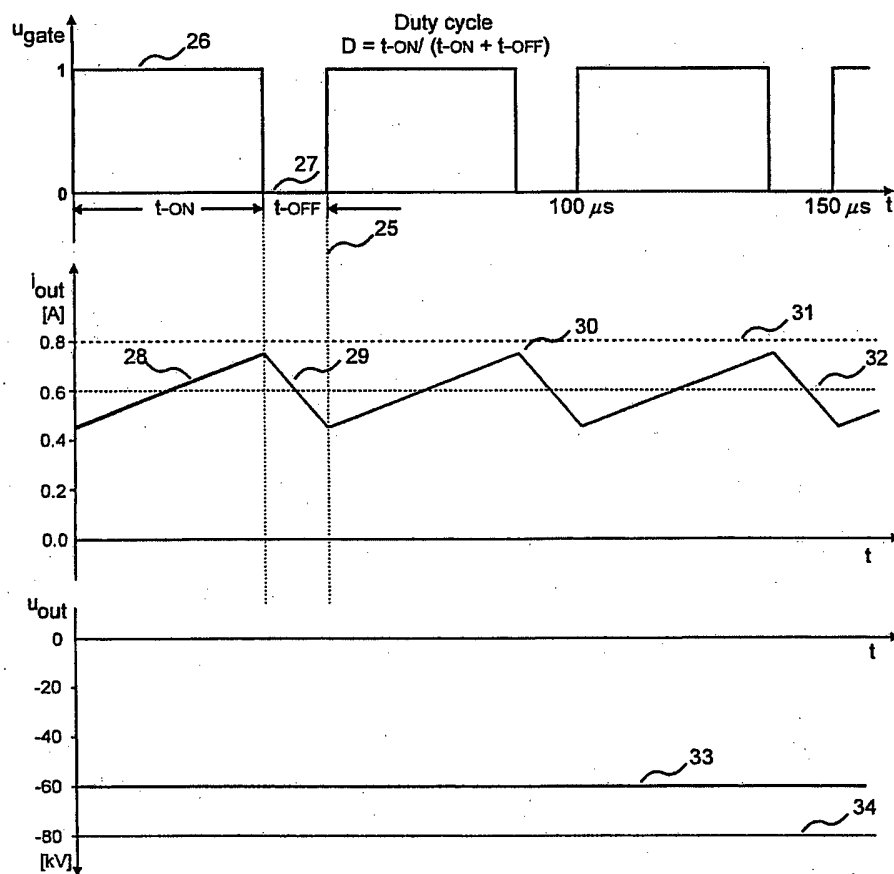


Figure 4

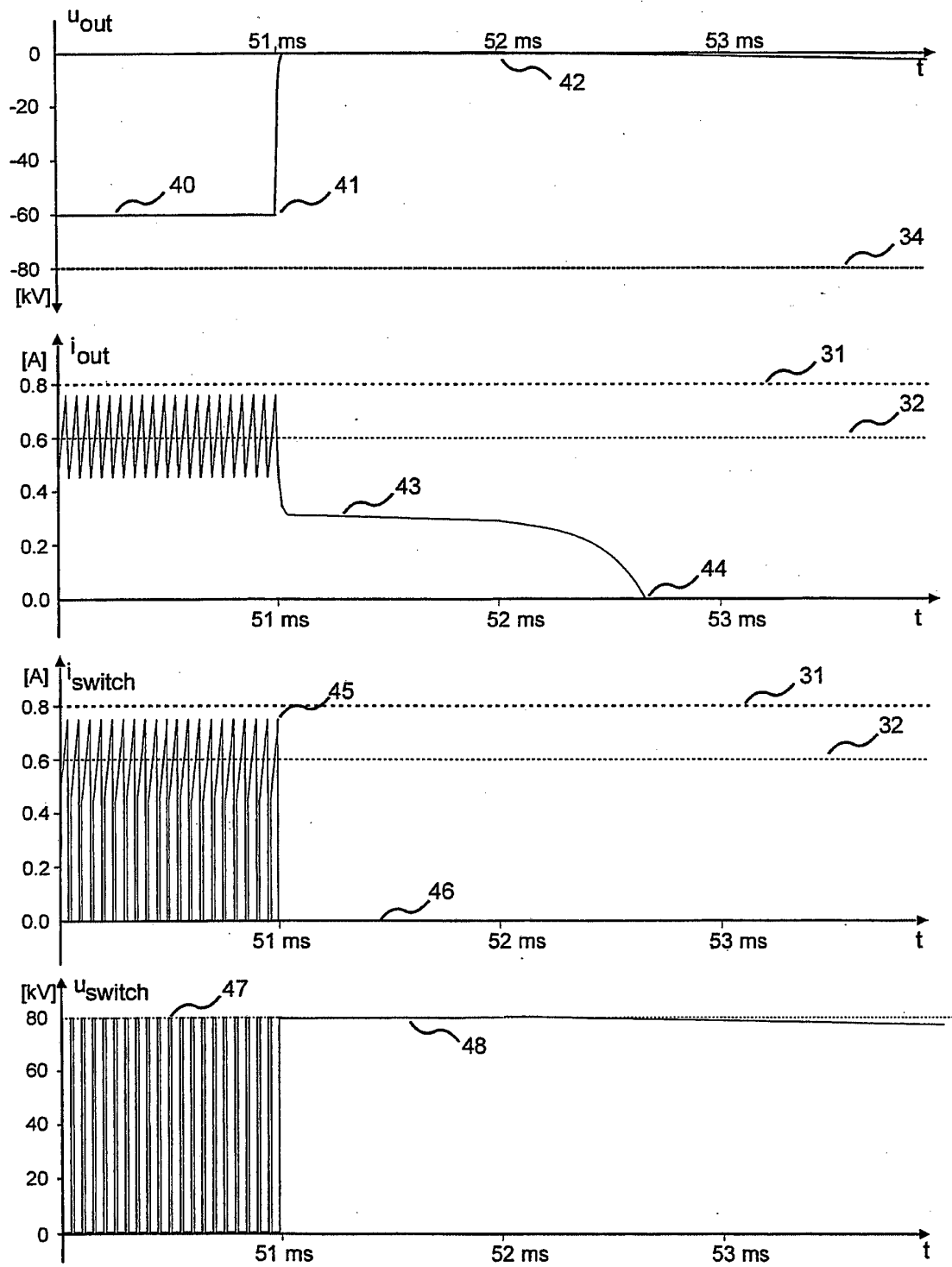


Figure 5

REFERENCES CITED IN THE DESCRIPTION

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