(19) DANMARK

(10) **DK/EP 3985221 T3**

Patent- og Varemærkestyrelsen

(12) Oversættelse af europæisk patentskrift

(51) Int.Cl.: ***E 06 B 9/68 (2006.01)***

(45) Oversættelsen bekendtgjort den: **2023-02-13**

(80) Dato for Den Europæiske Patentmyndigheds bekendtgørelse om meddelelse af patentet: **2023-01-11**

(86) Europæisk ansøgning nr.: **20202342.0**

(86) Europæisk indleveringsdag: **2020-10-16**

(87) Den europæiske ansøgnings publiceringsdag: **2022-04-20**

(84) Designerede stater: **AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**

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(54) Benævnelse: **STRØMFORSYNINGSKREDSLØB**

(56) Fremdragne publikationer:
EP-A1- 2 784 923
EP-A1- 3 255 770
EP-B1- 3 255 770
FR-A1- 2 861 513
FR-A1- 2 874 465
FR-A1- 3 004 034
FR-B1- 2 874 465
US-A- 5 856 916

Description

The invention relates to a power supply circuit. It in particular relates to the power supply for DC motors whose direction of rotation differs depending on the polarity of the DC voltage applied. As a rule, the DC voltage required here is generated by rectification from the AC mains voltage. The AC mains voltage can, for example, effectively be 100 V or 110 V or 220 V or 230 V. Its frequency can be 50 Hz or 60 Hz. The required DC voltage can, for example, be 48 V or 24 V or 12 V or other values, preferably below 50 V. One area of use is the drive of blinds which are opened, i.e. rolled up, or closed, i.e. unrolled, by electric motors. The opening takes place with the one direction of rotation of the driving electric motor and with the one polarity of the applied DC voltage; the closing takes place with the other direction of rotation of the electric motor and accordingly with the other polarity of the applied DC voltage. The electric motor can be integrated into a chain drive or another transmission.

For example, for the mentioned drive of blinds, but also in many other applications, it is desirable to operate electric motors with voltages significantly below the mains AC voltage since safety regulations are then less stringent and the motors, their supply lines and the installation environment can be designed more simply than if the mains AC voltage is used and has to be conducted. If, moreover, DC voltage is used instead of AC voltage, the direction of rotation of the drive can be influenced by means of the setting of the voltage polarity of the DC voltage, and thus directly via the supply lines, and does not require any further signaling and wiring towards the motor for this purpose.

Fig. 6 shows a known circuit for a supply of a blind drive. The mains AC voltage terminals N, the neutral conductor, and L1, one of the phases of a three-phase system, are shown at the bottom left. The phase L1 can be led via a path L_open or L_closed, which is selectable by means of a switch, to a terminal of a primary side of a power supply. The other input terminal of the primary side is connected to the neutral conductor N. Depending on the circumstance whether the power is supplied to the primary side via L_open or L_closed, a relay K2 is operated at the primary side that switches a DC voltage generated at the secondary side of, for example, 24 V between the two possible polarities at the outputs. Furthermore, a further relay K1 is provided to switch the phase connection of the input terminal of the primary coil between the two lines L_open and L_closed at the primary side. The power supply as a whole is dimensioned such that a DC voltage of a suitable amplitude is produced at the secondary side.

Said DC voltage is initially available in one polarity. The relay-actuable switch can then pass the DC voltage in the two possible polarities through to the output terminals of the power supply.

The disadvantage of this design is that it is bulky and thermally critical. On the one hand, relays are required that have to meet the comparatively high safety standards for the AC mains voltage so that even the relays are comparatively large. On the other hand, if the transformation takes place at mains frequency, i.e. 50 Hz or 60 Hz, the transformer with its iron core must then have a large and thus voluminous and heavy design at this comparatively low frequency in order to achieve an acceptable efficiency. Due to the relatively high power loss in the transformer at mains frequency, the heat development in the coil is considerable there. The use of a power supply unit leads to higher-frequency electromagnetic emissions which have to be suppressed by countermeasures. The known circuits are therefore not suitable for the mounting in the wall, i.e., for example, in flush-mounted sockets, either from a thermal point of view or with regard to their size. Instead, they have to be mounted in a surface-mounted socket or remote from the wall installation in switch boxes, which results in an increased cabling effort.

FR 2874465 A1 describes a power supply circuit comprising a rectifier having three parallel diode bridges. EP 2784923 A1 describes an electric drive comprising chokes in an AC circuit. EP 3255770 A1 describes a three-phase power supply with chokes in each phase.

It is the object of the invention to provide a power supply circuit which can generate DC voltage of a selectable polarity from AC voltage and which is comparatively small in size and thermally uncritical.

This object is satisfied by the features of claim 1.

Preferred embodiments are described by the dependent claims.

A power supply circuit has a power supply unit which is supplied with alternating electrical power from an AC voltage input and to which the alternating electrical power is supplied in one of the two power circuit lines, which are selectable by the user by means of a switch, via a first input terminal or via a second input terminal via one or the other of two alternatively selectable supply lines. The input circuit can be closed via a third input terminal. Depending on

which of the two selectable supply lines is used for the power supply at the primary side, the polarity of the DC voltage generated by the power supply unit is set at the secondary side.

The power supply unit has a full-wave rectifier with parallel diode bridges at the primary side. The two alternatively selectable supply lines are in this respect connected to their respective own diode bridge, in particular to their respective center terminal, so that there are a total of three parallel diode bridges (two-way rectifiers) which are connected in parallel with their corresponding end terminals. At least one of the selectable supply lines has a first signal tapping. In accordance with the signal which can be tapped in this way, a polarity signal is generated which is passed through to the secondary side and is used there to set the polarity of the DC voltage output.

Since the two selectable supply lines are fed via separate diode bridges into the primary-side bridge rectification, at least one of the two or both can be used for signal tappings since the signal at the one selectable line does not communicate to the other selectable line. In this way, the polarity signal can be generated depending on via which of the two alternatively selectable supply lines the mains alternating power is supplied. In the power train of the overall circuit, the selection of the connection of the power makes no difference. The selection serves for the signaling to be able to select one of the two polarities and indirectly thereby, for example, one of the two running directions of an electric motor without requiring further switches via the circuit of the alternating power.

By using a power supply unit, the transformation from mains voltage to lower voltage can take place at significantly higher frequencies than mains frequency. Therefore, the transformer can be made smaller and it has a lower power loss. Therefore, construction sizes are achievable which can be mounted in two standardized flush-mounted sockets or, depending on the case, even in one flush-mounted socket.

To avoid feedback effects of the primary-side switching in the power supply unit on the supply lines and ultimately on the house installation, a current-compensated choke is provided which has a separate coil or inductance for each of the three lines upstream of the full-wave rectifier. The three coils can be coupled such that the two coils in the two selectable lines are wound together into a coil chamber. The coil in the fixedly connected line is preferably separately wound in an axially adjacent contiguous manner. The choke can have a core around which the

coils are wound. The three coils preferably have approximately equal inductances. They are connected and electromagnetically coupled to one another such that the high-frequency signal components with frequencies above the mains frequency, which in each case arise during the switching of the power supply unit, approximately cancel one another out. In this way, feedback effects of the switching activities of the power supply unit into the supply lines are largely avoided.

A first capacitor can be provided between the first input terminal and the third input terminal. A second capacitor can be provided between the second input terminal and the third input terminal. Together with the inductances, the capacitors can be dimensioned in accordance with the switching frequency of the power supply unit so that a further effective suppression of the propagation of switching noise is provided.

The pole changer at the secondary side is connected downstream of the rectifier at the secondary side and has semiconductor switches which are connected such that they can at least set the two possible polarities at the two output terminals, i.e. selectively +/- or -/+. They can also be settable to "open" corresponding to "completely off". At least four semiconductor switches are preferably provided, of which a respective one can apply or disconnect a respective one terminal of the secondary-side rectifier to or from a respective output terminal and can be suitably controlled together.

Primary side and secondary side are preferably galvanically isolated from one another. In the power train, this takes place by the transformer in the power supply unit. In the signal strand, this takes place by wireless couplers, in particular optocouplers. The polarity signal is in particular fed to the pole changer from the first signal tapping via at least one optocoupler. The semiconductor switches of the pole changer can be switchable in accordance with the polarity signal, in particular between on = low impedance and off = high impedance.

In the forward signal branch from the primary side to the secondary side, the signaling of the polarity signal an take place successively via two wireless couplers. A first wireless coupler, in particular an optocoupler, can be located right next to the first signal tapping and can tap from there a signal whose amplitude has been suitably set and can forward said signal wirelessly. The signal generated in this way can be digitally usable and can actuate a flip-flop whose output supplies the polarity signal which is then fed to the pole changer via the further

optocoupler already mentioned. If a signal tapping is provided at a respective one of the two selectable supply lines, they can be guided separately via their respective own optocouplers and can then in each case actuate the set input or the reset input of the flip-flop mentioned.

The first optocoupler in the signal flow before the flip-flop separates the high voltage side at the input from the signal side. The second optocoupler after the flip-flop separates the primary side from the secondary side.

A feedback branch can be provided from the secondary side to the primary side, for example, to regulate the output DC voltage by intervention at the primary side and/or for stop detection and switch-off detection. A DC signal tapping can be applied to the output of the secondary-side rectifier and feeds back an analog signal to the primary side (feedback). The analog signal can be guided via a wireless coupler, in particular an optocoupler. At the primary side, the feedback (feedback) signal can be used for regulating the power supply unit, for instance, for regulating the pulse width of the chopper of the power supply unit. It can be a case of pulse width modulation. The regulation difference to a predefinable or fixedly set desired value can be generated and can then be entered into a suitably written regulator which then generates switching pulses of a suitable width for the chopper in accordance with a suitably implemented characteristic curve. The pulse frequency of these pulses can be fixed. The pulse width can be settable. However, instead of a regulation with feedback, a simpler feedforward control without DC voltage feedback can also be provided for voltage regulation.

The power supply circuit can be installed in a housing that is shaped and adapted for the installation into a standardized flush-mounted socket or into a double flush-mounted socket. The flush-mounted sockets can be those that are designed in accordance with a standard, for example, as double sockets (device junction boxes), e.g. with a nominal diameter of 55 mm, or a norm. The housing can have suitable shapes and waistings to enable the installation of the required components. The input-side switch for the selection "open" or "closed" or, technically speaking, for the selection of the polarity of the DC voltage to be output can be placed externally (over the plaster) onto the housing and, if necessary, can be fastened thereto or can be installed in its own surface-mounted sockets or flush-mounted sockets and can be connected via lines.

Embodiments of the invention will be described in the following with reference to the drawings. There are shown:

Fig. 1	a block diagram of the power generation circuit;
Fig. 2	an extended block diagram of the input side of the power generation circuit;
Figs. 3A to 3D	representations relating to a choke;
Fig. 4A	a circuit diagram of the primary side of the power generation circuit;
Fig. 4B	a circuit diagram of the secondary side of the power generation circuit;
Fig. 5	features of the housing; and
Fig. 6	prior art.

Fig. 1 shows a block diagram of the power generation circuit. It comprises a power supply unit which is supplied with alternating power and to which the alternating electrical power is selectably supplied in one of the two circuit lines via one or the other of two alternatively selectable supply lines. Depending on which of the lines is used for the power supply at the primary side, the polarity of the generated DC voltage is set at the secondary side.

Fig. 1 is a block diagram of the entire circuit. Fig. 2 is a more detailed block diagram of the input side of the circuit. An AC voltage source is designated by 2 and can, for example, be regarded as the building connection of a typical building supply, i.e. an AC voltage of 230 V or 110 V at 50 Hz or 60 Hz. Other AC voltage sizes are also possible, however. The voltage source can be a phase L1 or L2 or L3 of a three-phase connection with respect to the neutral conductor N. The voltage source 2 can be a voltage source controlled in the house installation, for instance, in accordance with the KNX standard or the EIB standard.

The source can have two supply terminals 2-1 and 2-2. For example, they can be lines of the neutral conductor N running into a flush-mounted socket, preferably at the terminal 2-2, and of a phase L (e.g. L1 of the three-phase system L1-L2-L3-N), preferably at the terminal 2-1. However, the reverse assignment is also possible: N to 2-1, L to 2.2. The power supply circuit has three input terminals 8-1, 8-2 and 8-3. Via a switch 8, the first supply terminal 2-1 can be selectively connected to the first or second input terminal 8-1 or 8-2 during operation. This can be a fixed connection during the operation. The third input terminal 8-3 can be fixedly connected to the second supply terminal 2-2. The switch 8 can also have a third open switch

position in which the supply terminal 2-1 is not connected to an input terminal, i.e. no power is supplied.

The switch 8 can be of a mechanical design and can be a commercially available switch of the necessary nominal voltage (e.g. 230 V), if necessary, also with a completely open position. However, the switch 8 can also be electronically designed by means of suitably controllable semiconductor switches. This control can then have a manually or automatically executable keying and a corresponding signal shaping with which, for instance, "open" can be set switched on in accordance with the one polarity with the first input terminal 8-1, "closed" can be set switched on in accordance with the other polarity with the second input terminal 8-2, and "off" can accordingly be set switched on with no power with no input terminal. Unlike the previously described user-actuable switches, the switch 8 can also be part of an automatic control or remote control and can thus be automatically actuable. The switch 8 can be designed in accordance with the KNX standard or the EIB standard and/or can be switchable and/or operable and/or remote controllable. It is also possible to provide an automatically actuable switch (also KNX, EIB) functionally in parallel with a user-actuable switch.

A primary-side full-wave rectifier 5 has a bridge rectifier 21. It has three diode bridges 21 and at least one smoothing capacitor 24. The three diode bridges are connected in parallel with their anode ends 23-1 and their cathode ends 23-2 and are connected to one each of the input terminals 8-1, 8-2 and 8-3 with their center terminals 22-1, 22-2 and 22-3. A choke 10 each can be disposed between the input terminals 8-1, 8-2 and 8-3 and the diode bridges such that a respective coil 25-1, 25-2, 25-3 is disposed between one input terminal 8-1, 8-2, 8-3 each and one center terminal 22-1, 22-2, 22-3 each. The three coils 25 are electromagnetically coupled to one another and can be wound around a coil core.

What is not shown in Figs. 1 and 2 are two filter capacitors 401-1, 401-2 which can each be connected between the third input terminal 8-3 and one each of the first input terminal 8-1 and the second input terminal 8-2.

The coils 25 of the choke 10 can each have an inductance of greater than 10 mH or greater than 20 mH or greater than 25 mH. It can be below 1 mm or below 40 µm or below 35 µm. The capacitors 401 can each have a capacitance of greater than 10 or 20 or 50 nF, respectively. It can be less than 500 or 200 or 100 nF, respectively. It can be 68 or 100 nF. The tuning of the

coils 25 and the capacitors 401 can be such that they have resonant frequencies well above the mains frequency and that they are tuned to the switching frequency of the subsequent power supply unit. The resonant frequency can be greater than 500 Hz or 1 kHz or 2 kHz in each case and can be less than 10 kHz or 5 kHz in each case. It can be 3 kHz, preferably ±20% or ±10%.

When alternating power is supplied to the circuit by connecting one of the input terminals 8-1 or 8-2 to the supply terminal 2-1 by means of the switch 8, power is guided via the left diode bridge 21-1 and 21-4 or via the middle diode bridge 21-2 and 21-5, depending on whether the input terminal 8-1 or 8-2 is connected, but in any case via the right diode bridge consisting of diodes 21-3 and 21-6. The pulsating DC voltage thus produced is smoothed by means of the capacitor 24 and, if necessary, further devices so that a sufficiently constant DC voltage G is produced at the output of the diode bridges 21 connected in parallel.

To detect via which of the selectable terminals 8-1 or 8-2 power is supplied as a selection for one of the polarities of the DC voltage to be generated, at least the supply line between the first input terminal 8-1 and the first center terminal 22-1 has a signal tapping 27-1. From the user's point of view, the selection of one of the terminals 8-1 or 8-2 corresponds to the selection for "open" or "closed" in the case of blind controls. Due to the separate diode bridge of the two selectable supply lines from the two input terminals 8-1 and 8-2, the potential at the one selectable supply line is not communicated to the other selectable supply line so that it can be detected, via a potential measurement, via which of the selectable supply lines power is supplied. In Fig. 1, the signal tapping 27-1 is shown between the input terminal 8-1 and the choke 10. However, it can also be disposed between the choke 10 and the center terminal 22-1 of the diode bridge, as shown in Fig. 2. As shown in Figs. 1 and 2, both of the selectable supply lines preferably each have a signal tapping 27-1 and 27-2.

The DC voltage applied at the smoothing capacitor 24 is chopped into a pulse-like DC voltage Z via a chopper 9. The chopper can be operated in the manner of a pulse width modulator with a constant pulse frequency, but a settable pulse width. The pulse frequency can be significantly higher than the mains frequency. It can be above 1 kHz or above 2 kHz or above 5 kHz or above 10 kHz. The overall design can be such that with a pulse width which is between 40% and 60% of the period duration, preferably 50% of the switching frequency, the DC voltage desired in terms of magnitude is produced at the output of the secondary-side rectifier and such that the DC voltage value can then actually be adjusted by regulating the pulse width.

However, other regulation strategies are also conceivable, for instance, a constant pulse width with a settable switching frequency. In the event of lower demands for the accuracy of the secondary-side DC voltage, its value can also be settable only by the feedforward control.

The transformer 4 receives the chopped DC voltage at its primary side 4-1 and transforms it into an AC voltage of a lower amplitude in accordance with the winding ratio. The transformer 4 can be connected in accordance with the principle of the flyback converter. This means that when the transistor is switched on, energy is stored from the primary side in the winding and is output at the secondary side during the blocking phase. The winding ratio between the primary side 4-1 and 4-2 is suitably selected. The secondary coil 4-2 feeds the AC voltage present at its connections into a secondary-side rectifier 6. The secondary-side rectifier can have a bridge rectifier, in particular a full-wave rectifier, or it can have a switching rectifier. Furthermore, a smoothing is provided, for example by means of capacitors connected in parallel, so that a sufficiently smoothed DC voltage is applied at the terminals 6-1 and 6-2 at the output of the rectifier 6.

A feedback branch 15 can be provided which feeds back a value corresponding to the DC voltage as an analog value in order, where possible, to generate a regulation difference after a comparison with a desired value in the subtractor 16, which regulation difference can be converted in a regulator 18 into a suitable pulse width for controlling the chopper 9 or, if necessary, into a pulse frequency. The feedback signal R in the feedback branch 15 can pass through an analog wireless coupler 14, in particular an optocoupler. The galvanic isolation of the primary side from the secondary side is then maintained.

The output voltage of the secondary-side rectifier 6 runs into a pole changer 7 whose output 3 has two output terminals 3-1 and 3-2. The pole changer is adapted to apply the DC voltage, which it receives, in a selectable one of the two possible polarities, i.e. plus either to 3-1 or 3-2 and minus accordingly to the respective other terminal. This can take place via a switching network of switches. These can be electronic switches that can be switched on and off electronically, i.e. can be switched between low impedance and high impedance. The switches can have field-effect transistors or bipolar transistors. The block diagram of Fig. 1 schematically shows switches, e.g. anti-parallel free-wheeling diodes and the like, in the pole changer 7. In the implementation by means of semiconductor switches, however, two switches are usually not installed, but rather four individual on and off switches which can each

establish or interrupt one of the desired connections. The semiconductor switches switch in accordance with the polarity signal which is supplied to the switches suitably set in amplitude and timing.

The polarity signal P is generated in accordance with the signal at least from the first signal tapping 27-1. In one embodiment, only one signal tapping 27-1 can be provided. The polarity can be a priori at a preset value which is switched to the other polarity when a certain signal S1 arrives from the first signal tapping 27-1 or possibly fails to arrive.

However, both selectable supply lines from 8-1 and 8-2 preferably each have their own signal tapping 27-1, 27-2 whose signals S1, S2 together serve to generate the polarity signal P. After a suitable signal shaping, for instance an amplitude setting by voltage dividers and/or rectification, one of the signal tappings can, for example, act on the set input and the other can act on the reset input of a flip-flop 12 at whose output 12-3 the polarity signal is then stably applied until it is switched over by a signaling from the other signal tapping.

The power lines from the first input terminal 8-1 and from the second input terminal 8-2 are guided via separate diode bridges 21-1, 21-4 and 21-2, 21-5. The potentials in these lines are therefore decoupled from one another so that they can be detected independently of one another and can thus serve for the signaling as described. In the power train of the overall circuit, the selection of the connection of the power from 2-1 to 8-1 or 8-2 is meaningless. The selection serves for the signaling via the signal tapping 27-1 and, if applicable, 27-2 to be able to select one of the two polarities and indirectly thereby, for example, one of the two running directions of an electric motor without requiring further switches and signalings towards the motor beyond the switching of the alternating power.

At least one optocoupler or wireless coupler 13 is provided in the path of the polarity signal P to maintain the galvanic isolation. Fig. 1 shows it after the output 12-3 of the flip-flop 12. The output of the wireless coupler 13 is connected to the control input of the pole changer 7 and can thus effect the desired switchover. The polarity signal P is preferably a digital signal which can stably adopt two values in accordance with the two desired polarities.

The two signals S1 and S2 are preferably also guided from the signal tappings 27-1, 27-2 via wireless couplers/optocouplers 11-1 and 11-2 which can have the further necessary signal

shaping switching elements, for example, voltage division and/or rectification. If they are provided, the wireless coupler 13 can be omitted at the output of the flip-flop.

The switching off of the motor when the driven mechanism, for example a blind drive, has reached a stop can take place in a technical regulation aspect in that current changes are evaluated at the stop and this is processed in a technical regulation aspect such that the power supplied is regulated to zero at the input side, i.e. in the case of pulse width modulation to a pulse width of zero corresponding to a switch 9 that is always switched off. Switched off here means a switch set to high impedance. The switch 9 can be a power transistor, in particular a field effect transistor or a bipolar transistor. The switching off can also take place by means of suitable stop switches or manually.

The choke 10 has the three coils 25-1, 25-2 and 25-3. They are electromagnetically coupled to one another. They serve to filter out the feedback effects of the switching of the power supply unit to the supply lines beyond the voltage supply circuit. The three choke coils 25-1, 25-2 and 25-3 are adapted to generate reactive voltages in the event of switching noise, said reactive voltages at least partly, and preferably largely, compensating one another. They are adapted so that all three have substantially the same impedances; their impedances cannot differ by more than 20% or 10% or 5% or 2% of the value of the largest inductance. Then, either the two coils 25-1 and 25-3 or the two coils 25-2 and 25-3 are simultaneously flown through by the switched current. The generated reactive voltages in the high-frequency range can then cancel one another out at least partly and preferably to a large extent so that an undesired feedback effect on the supply lines is largely suppressed and the circuit is in compliance with EMC regulations such as norms. The suppression of feedback effects can be further improved if capacitors are provided between the common supply line and each of the selectable supply lines.

Figs. 3A, 3B and 3C show embodiments of the choke 10 with the choke coils 25-1, 25-2 and 25-3. Fig. 3A schematically shows a possible winding scheme. 25-3 symbolizes the coil in the fixedly connected supply line from the third input terminal 8-3. The two coils 25-1 and 25-2 in the two selectable supply lines from the first terminal 8-1 and the second input terminal 8-2 can be wound together. All the coils can have the same number of windings. A coil core 31 of a suitable material can be disposed in the interior of the coils. The third coil 25-3 and the jointly wound first coil 25-1 and second coil 25-2 are disposed adjacent to one another on the coil core. However, they can also be disposed in a radially layered manner. Each coil has its own

connections and can thus be separately switched on electrically. The first coil 25-1 has the connections 26-1 and 26-4 and the second coil 25-2 has the connections 26-2 and 26-5. The third coil 25-3 has the connections 26-3 and 26-6.

Fig. 3B shows a coil body such as can be used to manufacture the choke 10. The coil body 32 can have a smaller chamber 33 and a larger chamber 34. The coil 25-3 can be wound into the smaller chamber 33 in the fixed supply line. The coils 25-1 and 25-2 wound together can be wound into the larger chamber 34. The coil takes place with suitable wires of a suitable cross-section. The number of windings of each of the coils can be over 20 or over 50 or over 90. It can be below 250 or below 150.

Fig. 3C shows a perspective representation of the possible embodiment of the choke 10. The choke core 31 is shown which occupies the coil interior and which can also close the magnetic circuit at the outside around the coils. The choke can have downwardly projecting connection legs by means of which it can be inserted and soldered into a circuit board. The perspective representation shows the two connections 26-3 and 26-6 of the third coil 25-3. Of the first coil 25-1 and the second coil 25-2, only the respective one connection leg 26-1 and 26-2 can be recognized. The other connections are not recognizable, but are present.

Fig. 4A shows a complete circuit diagram of the primary side of the power supply circuit. It is to be understood together with the circuit diagram of Fig. 4B which shows the secondary side of the power supply circuit.

The circuit diagrams of Figures 4A and 4B show many switching elements in combination with one another. This is not to imply that embodiments necessarily have to have this combination as shown. Part aspects can be designed differently and built differently or can be omitted.

The primary side of the circuit has its own DC power supply which has AC voltage supplied to it from an auxiliary coil 403 of the transformer 4 and which half-wave rectifies the AC voltage with the diode 404 and smooths it with the capacitor 405. It is then available at the primary side as Vcc.

The preferably integrated circuit IC 406 forms part of the control or regulation 17 for the switch 9 of the chopper. From IC 406, 17, the semiconductor switch 9 receives control pulses of the desired frequency and width. In this way, the primary coil 4-1 receives a keyed, pulsating DC voltage which appears as an AC voltage beyond the DC component at the transformer 4. The switch 9 can be a power transistor, in particular a field effect transistor or a bipolar transistor. The circuit 406 can be a standard circuit, for instance, a flyback converter configuration or an LLC configuration.

The wireless couplers 11-1 and 11-2 are provided together here, which, as stated, is not absolutely necessary. They have voltage divider chains 408 for the amplitude setting and initially parallel capacitors 409. The dimensioning can be such that they generate digitally usable signals at their output, a center terminal of the output-side voltage dividers 410.

It is assumed that the supply of the AC voltage in the operation of the circuit can only take place via one of the input terminals 8-1 or 8-2. Therefore, only one of the wireless couplers 11-1 and 11-2 can also provide a corresponding signal.

In the embodiment shown, a flip-flop which has a set input and a reset input is designed with a plurality of logic gates 411. The set input 11-1 is in communication with the output of the one wireless coupler 11-1 and the reset input 11-2 is in communication with the output of the other wireless coupler 11-2. The flip-flop can be configured as an integrated circuit. The use of a flip-flop makes it possible to avoid the incorrect switching of the polarity when the mains voltage is switched off, as is the case, for example, when a relay connected to one of the two phases is used for the switching.

The output of the gate 411 at the bottom right forms the output 12-3 of the flip-flop which is given to the third wireless coupler 13 so that the polarity signal P can be transferred to the secondary side in a galvanically decoupled manner.

The primary side has a ground line 402 which is formed by the anode ends of the diode chains and to which the different components can be connected as necessary. The switch 9 of the chopper is disposed between the ground line 402 and the cathode ends of the diode bridges. Fuses 412 can be provided in the incoming lines. They can be designed as lead fuses to provide an overcurrent protection. Furthermore, thermistors 413 can be provided as overload protection

and can form a further overcurrent protection. The auxiliary coil 403 can also be connected to the primary-side ground line 402.

Fig. 4B shows the circuit at the secondary side. The secondary coil 4-2 is connected to the secondary-side rectifier 6 which is designed as a switching rectifier. It would easily produce a pulsating DC voltage. By means of smoothing capacitors 414, said pulsating DC voltage is smoothed to a sufficiently stable DC voltage value. The DC voltage value produced in this manner is available as a V_{DC} value with respect to the secondary-side ground 415.

The DC voltage V_{DC} is in particular supplied to the pole changer 7. Said pole changer 7 furthermore receives a digital signal from the wireless coupler 13 to apply the DC voltage V_{DC} present at its input in a constant polarity to its output terminals 3-1 and 3-2 in one of the two selectable possible polarities. The pole changer 7 can be designed as an integrated circuit which includes the required semiconductor switches and further circuit components in an integrated manner, in particular for the formatting and time control of the switching signals of the individual transistors.

The secondary-side DC voltage V_{DC} can be fed back by means of a correlated signal via a feedback branch 15, in particular with a wireless coupler 17 which can wirelessly feed the signal back analogously to the primary side, where the signal can be used by feeding it to the IC 406 or the control/regulation 17. The regulator 17 can also be configured as an integrated circuit. Since a settability of the DC voltage to be generated is often not necessary, an explicit desired value specification and the difference formation with a possibly settable desired value can be omitted if the regulator 17 is otherwise suitably designed in its characteristic curve with respect to the feedback value. The regulation characteristic curve is implemented in the integrated circuit 406. Said integrated circuit 406 can work in an analogous manner or can have a small digital circuit.

A secondary-side ground 415 and a primary-side ground 402 can be connected to one another via so-called "Y capacitors" connected in series, wherein the center of the Y capacitors can be connected to the building grounding.

Fig. 5 shows features of the mechanical design. 505 is the housing of the power supply circuit. It can receive the components described. It can have ventilation openings or ventilation slots

506, e.g. at oppositely disposed housing sides, so that air can circulate for cooling. However, the actual switch 8 for selecting the first input terminal 8a or the second input terminal 8b for supplying the power can be provided separately and can be additionally attached and is then connected by means of separate lines. It is not shown in Fig. 5. 501 is a double flush-mounted socket which is based on or shaped to follow a standard for individual flush-mounted sockets such as can be recessed into housing walls in building installations. A specification here can, for example, be DIN-49073 or corresponding standards of other countries. Figure 5 shows the socket in the not yet installed state. 502 are fastening structures for fastening the installations in the socket. In the embodiment shown in Figure 5, the housing 505 is shaped so that it can be inserted into a double flush-mounted socket that follows a standard shape and can be fastened there. However, depending on the power required, smaller designs are also possible which can fit into a single flush-mounted socket.

The housing has the dimensions and external shape required for the installation into a socket, for example, also waistings 504. In the embodiment shown, the terminals 8K corresponding to the input terminals 8-1, 8-2 and 8-3 and, if necessary, further terminals, in particular a housing grounding and/or protective conductors, are provided at the left longitudinal end. The terminals 3K of the DC voltage terminals 3, 3-1, 3-2 can be disposed at the other end and in a non-visible manner in the representation shown. The respective external lines can extend from empty tubes in the wall, for example, through openings 503 into the socket and can then be connected there to the terminals 8K or 3K. Fig. 5 at the bottom shows the power supply circuit in the housing 505 in the installed state in the double flush-mounted socket 501. The switch 8 can then be disposed elsewhere, e.g. in its own flush-mounted socket or surface-mounted, and can connected by means of suitable cables which, for instance, run in the wall. If the switch 8 is of an electronic design, it is, however, also possible to integrate it into the circuit described and to provide the control panel as accessible from the outside for this purpose.

Reference numeral list

1	power supply circuit
2	AC voltage source
2-1, 2-2	first, second supply terminal
3	DC voltage output
3-1, 3-2	first, second DC voltage terminal
4, 4-1, 4-2	transformer, primary coil, secondary coil
5	full-wave rectifier
6	rectifier
7	pole changer
8	switch
8-1, 8-2, 8-3	first, second, third input terminal
9	chopper
10	choke
11	wireless converter
12	flip-flop
13	wireless converter
14	wireless converter
15	return
16	difference formation
17	control, regulation
21	bridge rectifier
21-1 - 21-6	diodes
22-1, 22-2, 22-3	center terminals
23-1, 23-2	anode terminal, cathode terminal
24	smoothing capacitor
25-1, 25-2, 25-3	first, second, third coil
26-1 - 26-6	coil connections
27-1, 27-2	first signal tapping, second signal tapping
31	coil core
32	choke body
33	first chamber

34	second chamber
401-1, 401-2	capacitors
402	primary-side ground
403	auxiliary coil
404	diode
405	capacitor
406	controller, regulator
408	voltage divider
409	capacitor
410	output-side voltage divider
411	logic gate
412	fuse
413	thermistor
414	smoothing capacitor
415	secondary-side ground
416, 417	y capacitors
418	grounding
501	flush-mounted socket
502	fastening device
503	cable inlets
504	waisting
505	housing
506	ventilation slots

Patentkrav

1. Strømforsyningskredsløb med

- en vekselspændingsindgang, der har
  - en første og en anden indgangstilslutning (8-1, 8-2), som alternativt valgbart kan tilsluttes til en vekselspændingskildes (2) første forsyningstilslutning (2-1),
  - en tredje indgangstilslutning (8-3), som kan tilsluttes til vekselspændingsforsyningens (2) anden forsyningstilslutning (2-2),
- en switch-mode strømforsyning (5) med en helbølgeensretter (5, 21 - 24) til den fra indgangstilslutningerne (8-1, 8-2, 8-3) indgående vekselspænding, en chopper (9), en transformator (4) med en primær spole (4-1) og en sekundær spole (4-2) og en til den sekundære spole tilsluttet ensretter (6) med to jævnspændingstilslutninger (6-1, 6-2), og
- en polvender (7) tilsluttet til jævnspændingstilslutningerne (6-1, 6-2) med to udgangstilslutninger (3-1, 3-2), der er udformet til at anlægge den jævnspænding, som modtages fra jævnspændingstilslutningerne (6-1, 6-2) på udgangstilslutningerne (3-1, 3-2), i en polaritet der kan vælges i overensstemmelse med et polaritetssignal (P),

hvor helbølgeensretteren (5, 21 - 24) har tre parallelforbundne diodekæder (21-1 til 21-6) med hver to endetilslutninger (23-1, 23-2) og med hver en midtertilslutning (22-1, 22-2, 22-3), hvoraf den første (22-1) står i forbindelse med den første indgangstilslutning (8-1), den anden (22-2) med den anden indgangstilslutning (8-2) og den tredje (22-3) med den tredje indgangstilslutning (8-3),

hvor et første signaludtag (27-1) til et første signal (S1), i overensstemmelse med hvilket polaritetssignalet (P) genereres, er tilvejebragt mellem den første indgangstilslutning (8-1) og den første midtertilslutning (22-1),

og hvor en drossel (10, 25, 26) med tre elektromagnetisk koblede spoler (25-1, 25-2, 25-3) er tilvejebragt, hvoraf den første (25-1) er koblet mellem den første indgangstilslutning (8-1) og den første midtertilslutning (22-1), den anden (25-2) mellem den anden indgangstilslutning (8-2) og den anden midtertilslutning (22-1) og den tredje (25-3) mellem den tredje indgangstilslutning (8-3) og den tredje midtertilslutning (22-3).

2. Strømforsyningskredsløb ifølge krav 1, hvor den første og den anden spole (25-1, 25-2) og fortrinsvis også den tredje spole (25-3) i deres induktans ikke adskiller sig indbyrdes med mere

end 20 % eller 10 % eller 5 % eller 2 % af værdien af den største induktans.

3. Strømforsyningskredsløb ifølge krav 1 eller 2, hvor den største induktans har en værdi mellem 20 mH og 40 mH.

4. Strømforsyningskredsløb ifølge krav 1, 2 eller 3, med en første kondensator (401-1) mellem første indgangstilslutning (8-1) og tredje indgangstilslutning (8-3) og en anden kondensator (401-2) mellem anden indgangstilslutning (8-2) og tredje indgangstilslutning (8-3).

5. Strømforsyningskredsløb ifølge et af kravene 1 til 4, hvor den første spole (25-1) og den anden spole (25-2) er viklet forenet i et første område (34), og hvor den tredje spole (25-3) er viklet i et andet område (33), der ligger an til det første område i aksial eller radial retning.

6. Strømforsyningskredsløb ifølge ethvert af de foregående krav, med et andet signaludtag (27-2) mellem den første indgangstilslutning (8-2) og den anden midtertilslutning (22-2) for et andet signal (S2) i overensstemmelse med hvilket polaritetssignalet (P) genereres.

7. Strømforsyningskredsløb ifølge ethvert af de foregående krav, hvor mindst det første signaludtag (27-1) har en første trådløs kobler (11-1), i særdeleshed en første optokobler, og fortrinsvis har signalformningselementer på indgangssiden og/eller udgangssiden.

8. Strømforsyningskredsløb ifølge ethvert af de foregående krav, hvor mindst det første signaludtag (27-1) er tilsluttet mellem den første midtertilslutning (22-1) og den første spole (25-1) eller mellem den første spole (25-1) og den første indgangstilslutning (8-1).

9. Strømforsyningskredsløb ifølge ethvert af de foregående krav, hvor polvenderen (7) har flere halvlederkontakter, som kan kobles til og fra i overensstemmelse med polaritetssignalet (P).

10. Strømforsyningskredsløb ifølge ethvert af de foregående krav, med en flipflop (12), som kan styres i overensstemmelse med det første og evt. det andet signal (S1, S2) og kan levere polaritetssignalet (P) til sin udgang.

11. Strømforsyningskredsløb ifølge krav 10, hvor der er tilsluttet en tredje trådløs kobler (13), i særdeleshed en tredje optokobler, mellem udgangen (12-3) på flipflop'en (12) og polvenderen

(7).

12. Strømforsyningskredsløb ifølge ethvert af de foregående krav, med en returgren (15) for tilbageføring af et tilbagekoblingssignal (R) genereret i overensstemmelse med ensretterens udgangsvariabel fra ensretterens (6) udgang til chopperen (9), hvor returgrenen kan have en fjerde trådløs kobler (14), i særdeleshed en fjerde optokobler, og hvor en regulator (17, 406) til styring af chopperen (9) kan være tilvejebragt fortrinsvis i overensstemmelse med tilbagekoblingssignalet (R).

13. Strømforsyningskredsløb ifølge ethvert af de foregående krav, hvor polvenderen (7) er udformet til at indtage mindst to koblingstilstande svarende til de to polariteter, og kan være udformet til at indtage en tredje koblingstilstand, hvor dens udgang (3) ikke får tilført nogen spænding fra ensretteren (6).

14. Strømforsyningskredsløb ifølge ethvert af de foregående krav, med et kabinet (505), der er udformet med henblik på indbygning i en eller to tilstødende standardiserede planforsænkede stikdåser.

15. Strømforsyningskredsløb ifølge ethvert af de foregående krav med en omskifter (8), ved hjælp af hvilken alternativt den første indgangstilslutning (8-1) eller den anden indgangstilslutning (8-2) eller ingen af de to kan forbindes med den første forsyningstilslutning (2-1).

Fig. 1

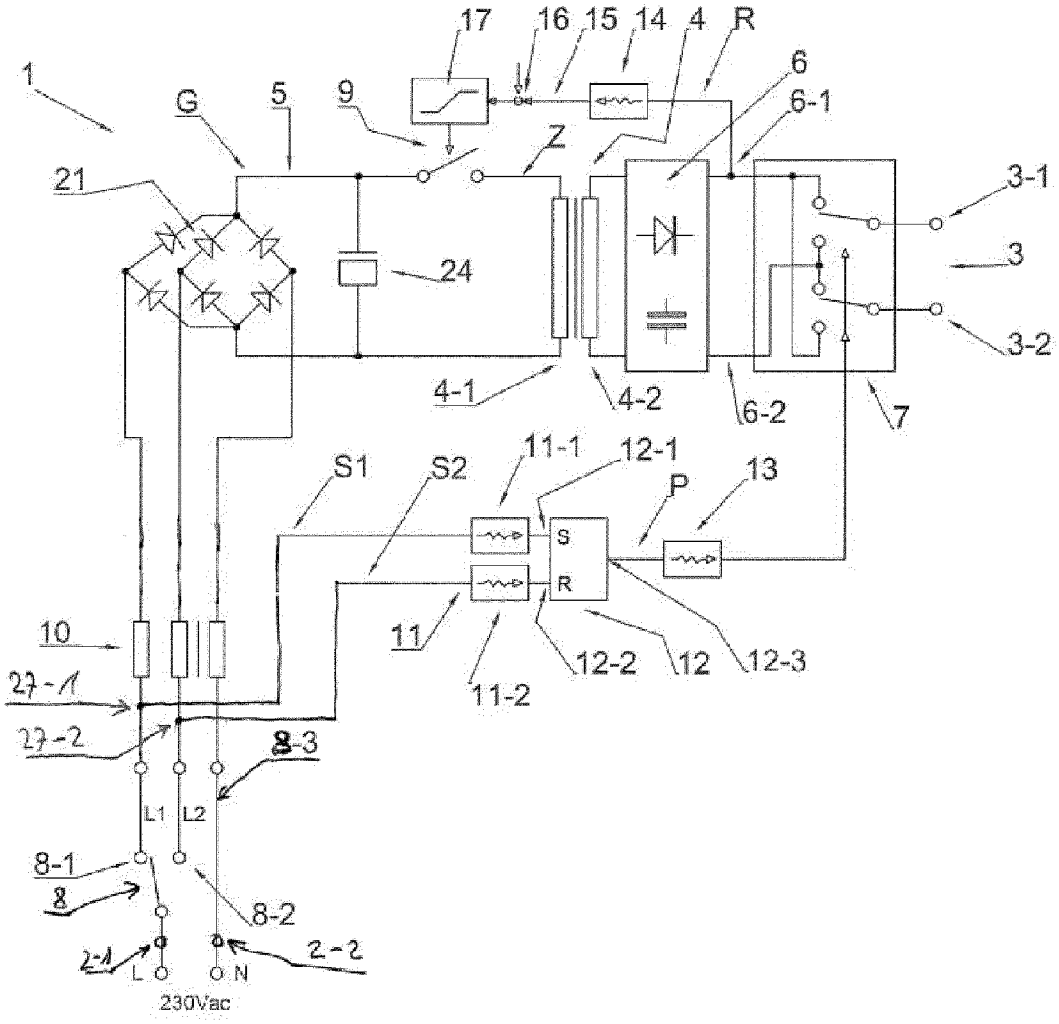

17
16
15
14
4
R
1
G
5
9
6
6-1
Z
21
24
3-1
3
3-2
4-1
4-2
6-2
7
S1
S2
11-1
12-1
P
13
S
R
10
11
12-2
12
12-3
11-2
27-1
27-2
8-3
L1
L2
8-1
8
8-2
2-1
2-2
L
N
230Vac

Fig. 2

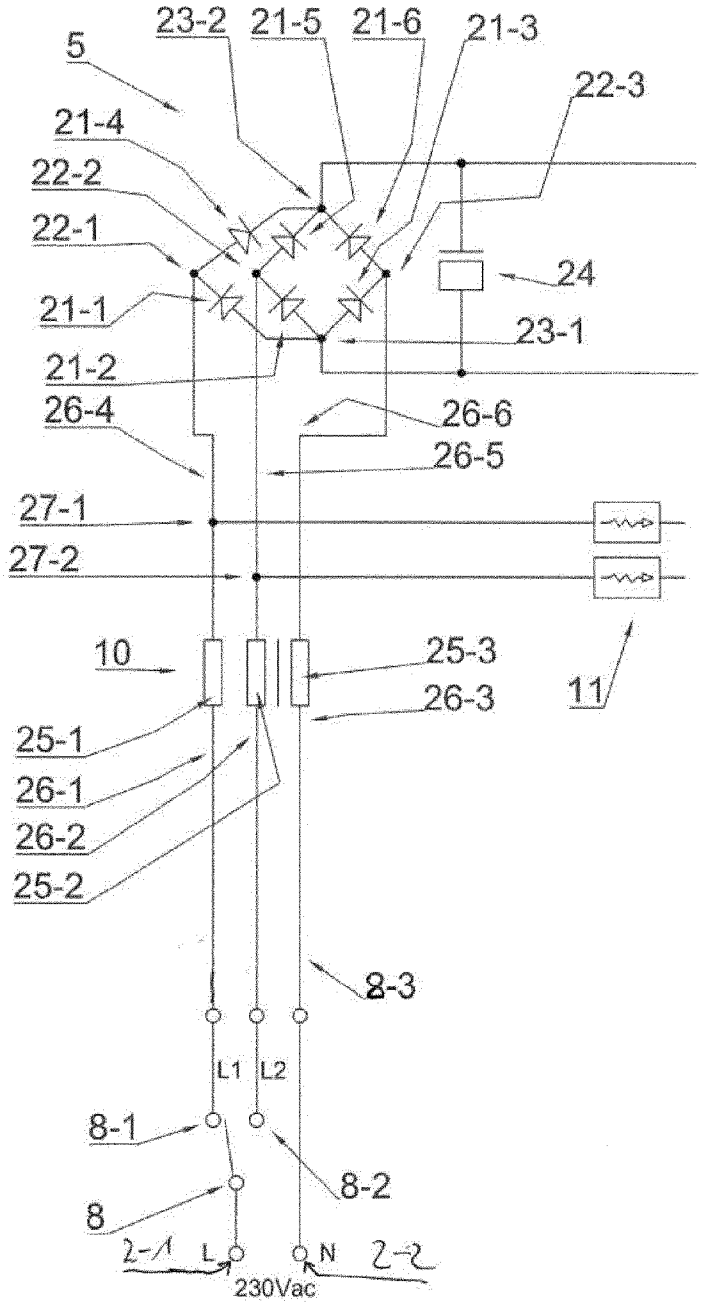

23-2
21-5
21-6
21-3
5
22-3
21-4
22-2
22-1
24
21-1
23-1
21-2
26-4
26-6
26-5
27-1
27-2
10
25-3
26-3
11
25-1
26-1
26-2
25-2
8-3
L1
L2
8-1
8-2
8
2-1
L
N
2-2
230Vac

Fig. 3A

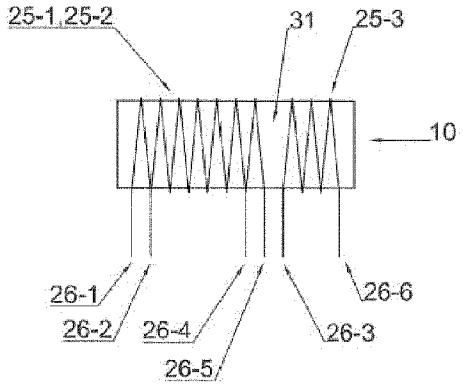


Fig. 3B

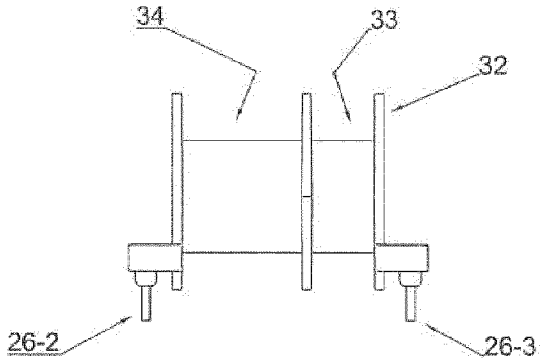


Fig. 3C

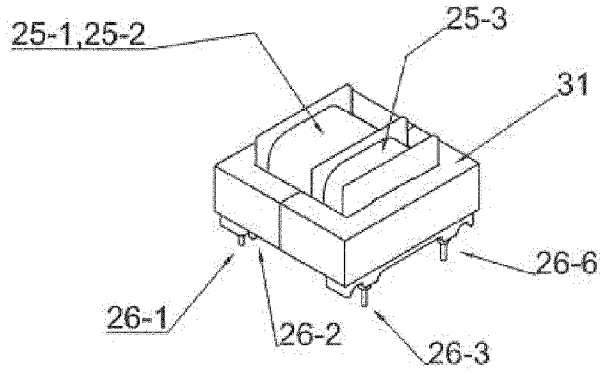


Fig. 4A

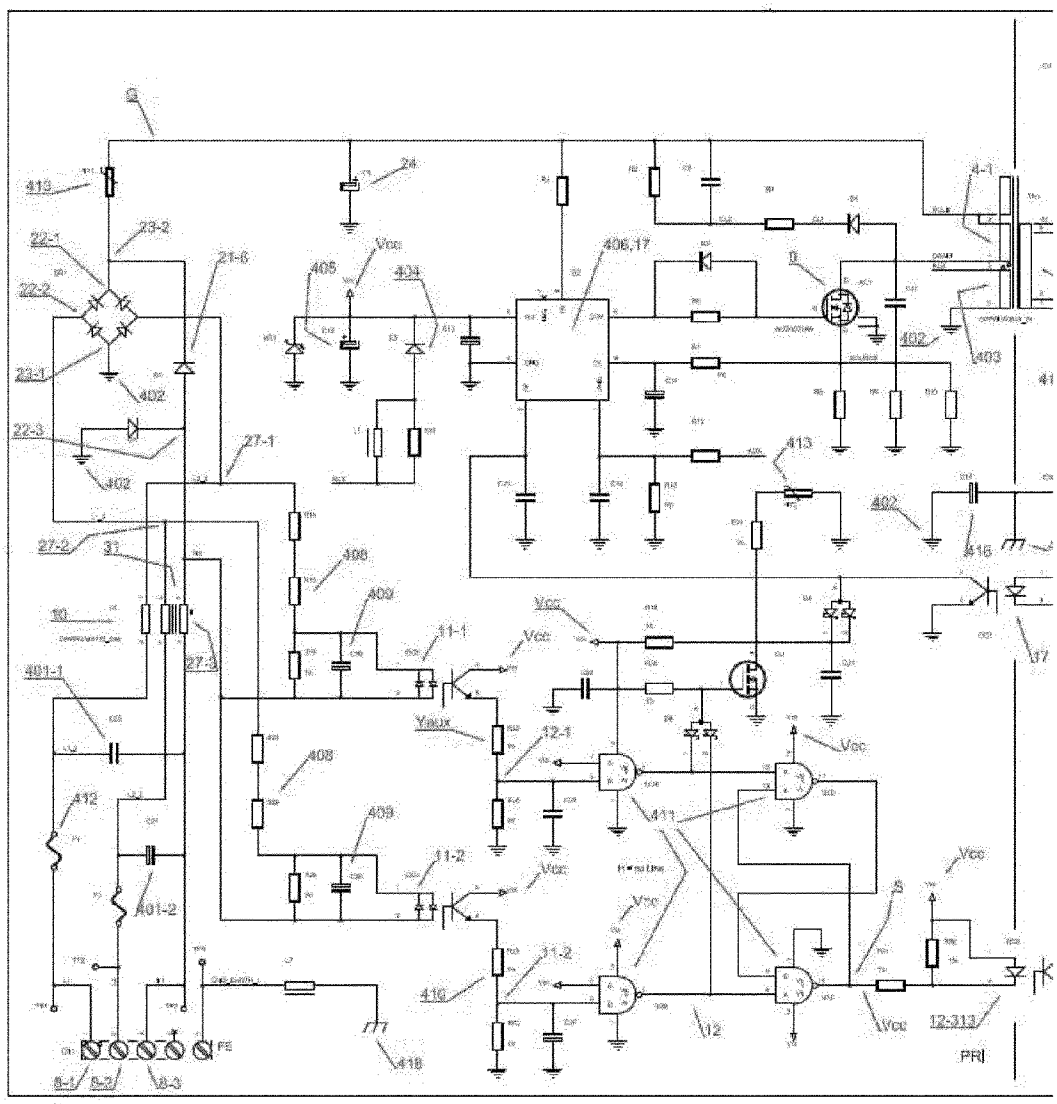

Q
413
23-2
22-1
21-6
22-2
23-1
402
22-3
27-1
27-2
31
10
27-3
401-1
412
401-2
8-1
8-2
8-3
FS
405
Vcc
404
406,17
403
413
409
11-1
Vout
408
409
11-2
410
418
12-1
411
12
12-313
PRI

Fig. 4B

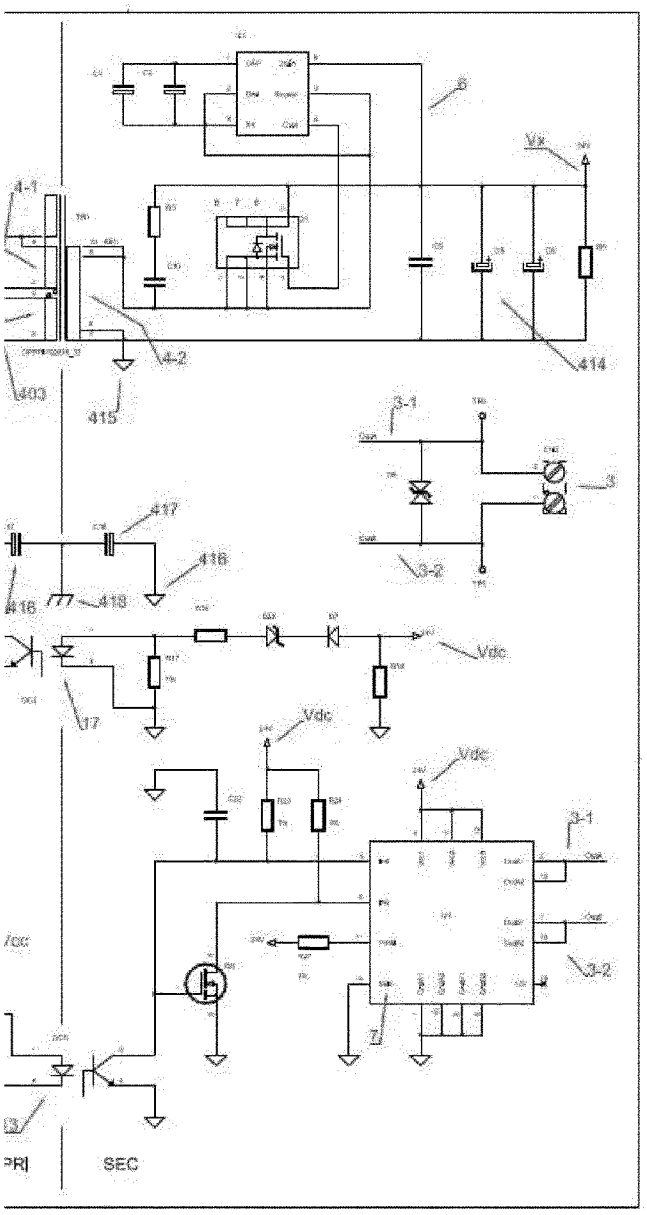


Fig. 5

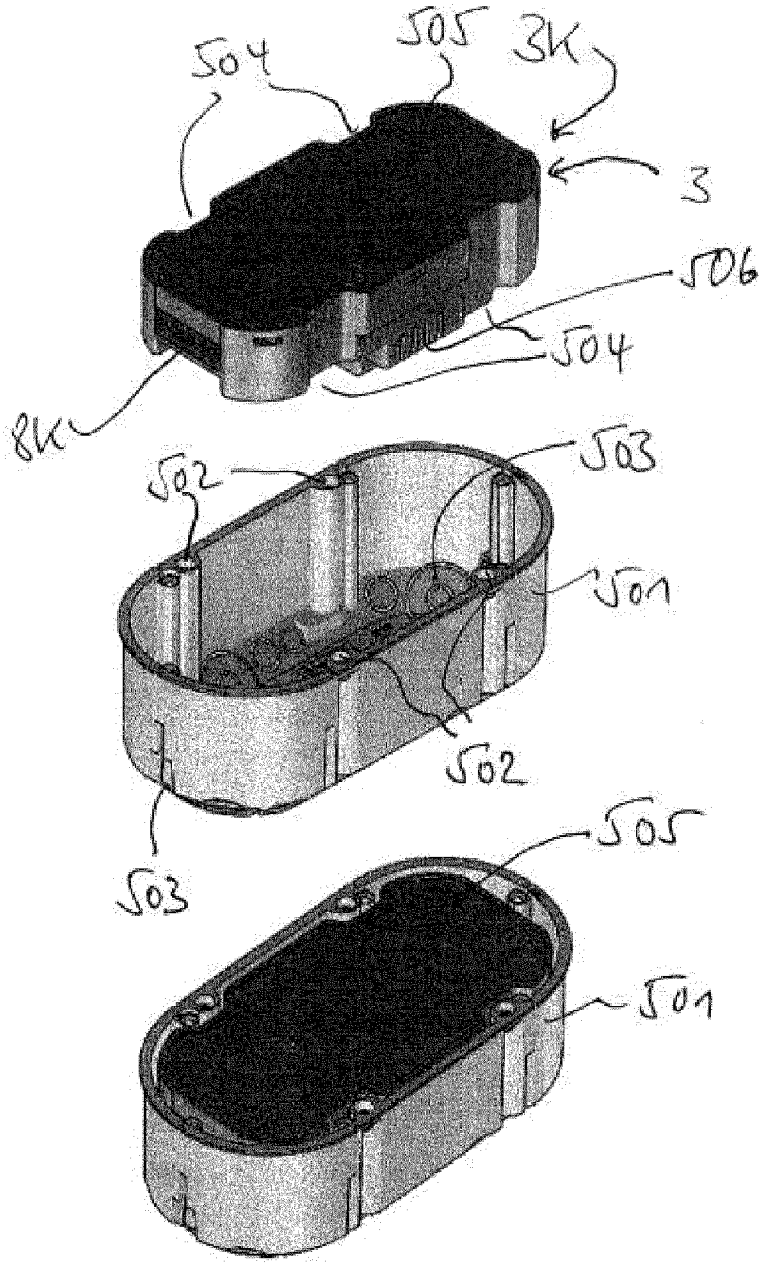
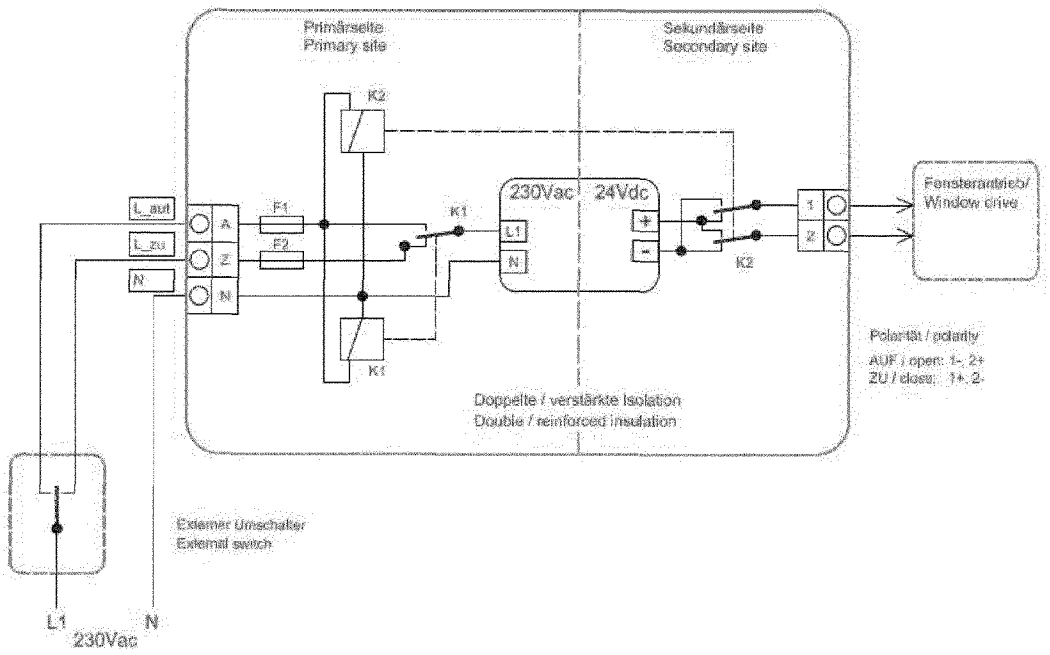


Fig. 6


Primärseite
Primary site
Sekundärseite
Secondary site
K2
K1
230Vac
24Vdc
L_auf
L_zu
N
A
Z
N
F1
F2
L1
N
+
-
1
2
K2
Fensterantrieb/
Window drive
Polarität / polarity
AUF / open: 1-, 2+
ZU / close: 1+, 2-
Doppelte / verstärkte Isolation
Double / reinforced insulation
Externer Umschalter
External switch
L1
N
230Vac