

TITLE OF INVENTION

ELECTRIC POWER CONVERSION DEVICE

FIELD OF THE INVENTION

5 The present invention relates to an electric power conversion device composed of semiconductor switching devices.

BACKGROUND OF THE INVENTION

10 In the variable speed drive, a system using an electric power conversion device, that is, a system of converting an alternating current from a commercial power source to a direct current by a diode rectifier circuit or a PWM converter and furthermore driving a
15 motor at a variable frequency via an inverter from smoothed DC power is general.

 When a load to be driven becomes a large capacity and the voltage cannot be increased, it is necessary to increase the current and raise the capacity of the
20 conversion device and in such a case, a plurality of semiconductor switching devices composing the electric power conversion device (here, an IGBT will be explained as an example) are often used in a parallel connection state. In the conversion device using
25 semiconductor switching devices, it is a problem to

reduce the wire inductance to suppress the voltage increase during switching and when the semiconductor switching devices are connected in parallel, suppress the imbalance of the partial charge of current.

5 On the other hand, in patent literatures (PTLs) 1 and 2, the aforementioned problem is solved by laminating the conductor plate connected to the positive pole of the first semiconductor module and the conductor plate connected to the negative pole of the
10 second semiconductor module to form opposing portions and by laminating the conductor plate connected to the negative pole of the first semiconductor module and the conductor plate connected to the positive pole of the
15 second semiconductor module to form opposing portions.

15 In PTL 2, as a snubber circuit for suppressing the voltage increase of the semiconductor switching device, the so-called RCD snubber circuit composed of a series body of a snubber capacitor and a snubber diode and a
20 discharge resistor for discharging the snubber capacitor is supposed. Therefore, due to the time lag of switching of the parallel connected IGBT, even if a
25 difference appears in the voltage of the snubber capacitor between the parallel circuits, a reverse current is prevented by the snubber diode, so that no oscillating current is generated.

The aforementioned RCD snubber circuit requires a diode and a resistor, thus the conversion device can be hardly miniaturized, so that there is a system of connecting only a capacitor to both terminals of the switching device (called a clamp capacitor).

PRIOR TECHNICAL DOCUMENT

PATENT DOCUMENT

PATENT DOCUMENT 1: Japanese Patent Laid-Open
Publication No. 2007-151286

PATENT DOCUMENT 2: Japanese Patent Laid-Open
Publication No. 2010-98846

SUMMARY OF THE INVENTION

When the aforementioned clamp capacitors are used, the clamp capacitors are connected in parallel by the wire conductor plates, so that an LC circuit of a minute resistance is formed and when a difference appears in the capacitor voltage, there are possibilities that an oscillating current may be generated. If the inductance of the circuit between the parallel connected clamp capacitors is high, the oscillating current when a voltage difference appears between the clamp capacitors cannot be suppressed, so that the inductance of this circuit needs to be reduced.

In the PATENT DOCUMENTs 1 and 2, the inductance of the circuit formed between the clamp capacitors is not considered and the reduction of the inductance is insufficient.

5 The problem to be solved by the present invention is to reduce the wire inductance of the circuit formed between the terminals of the semiconductor switching devices connected in parallel in the electric power conversion device.

10 To solve the aforementioned problem, the present invention, in an aspect thereof, is an electric power conversion device formed by parallel-connecting a plurality of semiconductor modules with two semiconductor switching devices connected in series
15 between the DC terminals, that is, an electric power conversion device including the first semiconductor module and second semiconductor module which are connected in parallel between the DC terminals, the first conductor plate connected to the first terminal
20 of the first semiconductor module, the second conductor plate connected to the first terminal of the second semiconductor module, and the third conductor plate connected to the second terminals of the first and second semiconductor modules and having a structure
25 that the first to third conductor plates are laminated

to form opposing portions, wherein the first connection terminal for electrically connecting the first conductor plate to the second conductor plate and the second connection terminal for electrically connecting the second conductor plate to the first conductor plate are arranged so as to be brought closer to each other than the distance between any terminals of the first to third conductor plates.

The present invention, in another aspect, is an electric power conversion device formed by parallel-connecting a plurality of semiconductor modules with two semiconductor switching devices connected in series between the DC terminals, that is, an electric power conversion device including the first semiconductor module and second semiconductor module which are connected in parallel between the DC terminals, the first conductor plate connected to the first terminal of the first semiconductor module, the second conductor plate connected to the first terminal of the second semiconductor module, and the third conductor plate connected to the second terminals of the first and second semiconductor modules and having a structure that the first to third conductor plates are laminated to form opposing portions, wherein the connection terminal of a leading portion to be connected to one of

the DC terminals for electrically connecting the first conductor plate and the second conductor plate is arranged between two connection terminals which are a leading portion to be connected to another one of the DC terminals from the third conductor plate.

According to a preferred aspect of the present invention, the wire inductance of the circuit formed between the terminals of the semiconductor switching devices connected in parallel can be reduced.

Therefore, when the clamp capacitors are structured by directly connecting a capacitor between the terminals of the first semiconductor module and between the terminals of the second semiconductor module, the oscillating current when a voltage difference appears between the parallel connected clamp capacitors can be suppressed.

The other objects and characteristics of the present invention will be made clear in the Embodiments described below.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view showing the conductor plate structure of the electric power conversion device according to Embodiment 1 of the present invention,

Fig. 2 is an exploded perspective view of the

laminated conductor plate of Embodiment 1 of the present invention,

Fig. 3 is a perspective view showing the comparison of the conductor plate structure for explanation of the effects of the present invention,

Fig. 4 is a perspective view showing a mounting structure example of the clamp capacitor of the present invention,

Fig. 5 is a perspective view showing the conductor plate structure of the electric power conversion device according to Embodiment 2 of the present invention,

Fig. 6 is an exploded perspective view of the laminated conductor plate of Embodiment 2 of the present invention,

Fig. 7 is a perspective view showing the conductor plate structure of the electric power conversion device according to Embodiment 3 of the present invention,

Fig. 8 is an exploded perspective view of the laminated conductor plate of Embodiment 3 of the present invention,

Fig. 9 is a perspective view showing the conductor plate structure of the electric power conversion device according to Embodiment 4 of the present invention,

Fig. 10 is an exploded perspective view of the laminated conductor plate of Embodiment 4 of the

present invention,

Fig. 11 is a perspective view showing the conductor plate structure of the electric power conversion device according to Embodiment 5 of the present invention,

5 Fig. 12 is a perspective view showing the conductor plate structure of the electric power conversion device according to Embodiment 6 of the present invention,

Fig. 13 is a schematic block diagram of the drive system of the elevator to which the present invention is applied; and
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Fig. 14 is a parallel constitution diagram of the semiconductor modules composing the main circuit of the elevator shown in Fig. 13.

15 DESCRIPTION OF THE PREFERRED EMBODIMENTS

Fig. 13 is a schematic block diagram of the drive system of the elevator to which the present invention is applied.

DC power which is rectified by a converter 1 from a power source (here, a three-phase power source is used) 20 and is smoothed by a smoothing capacitor 3 is converted to AC power of a variable frequency and a variable voltage by an inverter 2 and is supplied to a drive motor 9 of the elevator to drive the elevator.
25 Namely, the motor 9 rotates a rope pulley 91 and drives a riding cage 92 and a balance weight 93 which are

hanged by a rope 94 to move up and down.

To reduce the harmonics to the power source and increase the voltage, between the power source 81 and the converter 1, a reactor 82 is often connected.

5 Further, in addition to it, a filter circuit is generally connected, though it is not related directly to the present invention, so that it is not shown in the drawing.

The converter 1 is composed of three-phase legs 11
10 to 13 and in each phase, parallel bodies of a semiconductor switching device (here, an IGBT is explained as an example) and a circulation diode (referred to as FWD), for example, 1101 and 1102 are structured as a pair of upper and lower sides. The IGBT
15 and FWD are composed of separate semiconductor chips, though here, they are codes as one parallel body (for example, 1101). The inverter 2 is also similarly composed of three-phase legs 21 to 23.

To realize a large capacity of the electric power
20 conversion device, the semiconductor switching devices may be connected to each other in parallel.

Fig. 14 is a parallel constitution diagram of the semiconductor modules composing the main circuit of the drive system of the elevator to which the present
25 invention is applied.

In the example shown in the drawing, a semiconductor module 111 having a pair of upper and lower sides (1111 and 1112) of the IGBT and FWD built-in and a semiconductor module 112 similarly having 1121 and 1122 built-in are connected in parallel. Further, to the respective semiconductor modules 111 and 112, clamp capacitors 41 and 42 for suppressing the voltage increase during switching are connected.

In Fig. 14, to suppress the voltage increase during switching, the inductance of a round circuit L1 composed of a smoothing capacitor and a semiconductor module which are not drawn needs to be reduced. Further, for realization of uniformity of the partial charge of current of the semiconductor modules 111 and 112, the inductances of both modules need to be uniform, which has been achieved in the constitution of the PATENT DOCUMENT 1.

On the other hand, as described before, if the inductance of a circuit L2 between the parallel connected clamp capacitors 41 and 42 is high, the oscillating current when a voltage difference appears between the clamp capacitors 41 and 42 cannot be suppressed. Therefore, the inductance of the circuit L2 needs to be reduced.

In the PATENT DOCUMENTS 1 and 2, in the IGBT

parallel circuit shown in Fig. 14, regarding the circuit (the dashed line L1 shown in Fig. 14) including a smoothing capacitor not drawn, the reduction in the inductance is realized and the inter-parallel inductance is uniformed, though the inductance of the circuit (the dotted line L2 shown in Fig. 14) connected of the clamp capacitors 41 and 42 is not considered and the oscillating current when a voltage difference appears between the clamp capacitors 41 and 42 cannot be suppressed.

For example, in the constitution of the conductor plate of PTL 1 shown in Figs. 11, 12, and 14, the circuit (the dotted line L2 shown in Fig. 14) between the parallel clamp capacitors is connected to a conductor plate PC via a conductor plate connection a3 from a connection a2 of a conductor plate CP1 from a DC positive pole terminal P1, is connected to a connection b3 of a conductor plate CP2 by the conductor plate PC, and is connected to another clamp capacitor by a connection b2 of the conductor plate CP2. The negative pole of the capacitor, because terminals c2 and c3 of a DC negative pole conductor plate N are connected to each other with the conductor plate N, and the inductance of this portion is low, though the connections a3 and b3 between the conductor plates CP1

and CP2 are separated from each other, is not suitable for reduction in the inductance of the circuit (the dotted line L2 shown in Fig. 14) connected of the clamp capacitors 41 and 42. Similarly, in the constitution shown in Figs. 23 and 24 of the PATENT DOCUMENT 1, the portion connected to the conductor plate CP1 and the portion connected to the conductor plate CP2 are separated from each other, so that the negative pole of the capacitor is not suitable for reduction in the inductance of the circuit connected of the clamp capacitors.

Hereinafter, the embodiments of the present invention for reducing the wire inductance of the circuit formed between the terminals of the parallel connected semiconductor switching devices will be explained with reference to the accompanying drawings. Further, in each drawing and each embodiment, the same numeral is assigned to each same or similar component and the explanation therefor will be omitted.

{Embodiment 1}

Fig. 1 is a perspective view showing the conductor plate structure of the electric power conversion device according to Embodiment 1 of the present invention and Fig. 2 is an exploded perspective view of the laminated conductor plate thereof.

Similarly to the PATENT DOCUMENT 1, an embodiment that the semiconductor modules 111 and 112 in which the positive pole P1 and a negative pole N1 are arranged in line on one side are arranged so that the terminals approach each other and are connected in parallel is indicated.

As a conductor plate for wiring, there exist, as a conductor plate on the positive pole side, a first conductor plate 51 connected to the DC positive pole terminal P1 and a second conductor plate 52 connected to the DC positive pole terminal P2. As a conductor plate on the negative pole side, there exist a conductor plate 53 connected to the DC negative pole terminal N1 and a DC negative pole terminal N2. These three conductor plates are laminated via an insulated portion not drawn in the order of 51, 53, and 52 from this side.

Firstly, the first conductor plate 51 includes a terminal 511 directly connected to the DC positive pole terminal P1 of the semiconductor module 111 and a terminal 512 to be connected to a terminal 611 of a conductor plate 61 connected to the positive pole of the smoothing capacitor 3.

Further, the second conductor plate 52 includes a terminal 521 directly connected to the DC positive pole

terminal P2 of the semiconductor module 112 and a terminal 522 to be connected to a terminal 612 of the conductor plate 61 connected to the positive pole of the smoothing capacitor 3.

5 Furthermore, the third conductor plate 53 includes a terminal 531 directly connected to the DC negative pole terminal N1 of the semiconductor module 112 and a terminal 532 directly connected to the DC negative pole terminal N2 of the semiconductor module 112.

10 The situation of these terminals can be clearly confirmed by the exploded perspective view of Fig. 2.

 Here, the terminal 512 of the first conductor plate 51 to be connected to the terminal 611 of the conductor plate 61 connected to the positive pole of the
15 smoothing capacitor 3 and the terminal 522 of the second conductor plate 52 to be connected to the terminal 612 of the conductor plate 61 connected to the positive pole of the smoothing capacitor 3 are arranged in the neighborhood of the center so as to approach
20 each other. Namely, the relationship between an interval d1 and an interval d2 shown in Fig. 1 is $d1 < d2$.

 The connection of the terminals 512 and 611 and the connection of the terminals 522 and 612 are all a DC
25 positive pole and on the other hand, the terminals 533

and 534 are connected to the DC negative pole via the conductor plate 62 at different potentials, so that an insulated distance needs to be secured. Further, the terminals 512 and 522 are at the same potential, so that no insulated distance is necessary. Therefore, as mentioned above, compared with the interval d2 of the connections at the different potentials, the interval d1 of the connections at the same potential may be shorter. Due to the same potential, the interval d1 may be zero, though there exist the negative pole conductor plate 53 and the insulated portion between the conductor plates, so that the connections at the same potential do not exist on the same plane. Therefore, the portion of the conductor plate 61 connected to the terminals 512 and 522 needs to be divided and in consideration of manufacture errors, a separation of several millimeters enables easy manufacture.

Fig. 3 is a perspective view showing the comparison of the conductor plate structure for explanation of the effects of Embodiment 1 of the present invention.

Fig. 3(A) shows Embodiment 1 of the present invention, and Fig. 3(B) shows a comparison example with Figs. 12 and 14 of the PATENT DOCUMENT 1 applied to, and Fig. 3(C) shows a comparison example with Figs. 23 and 24 of the PATENT DOCUMENT 1 applied to.

The portion with the interval of the positive poles connected in the circuit L2 between the clamp capacitors shown in Fig. 14 is shown with a dashed line. Further, regarding the connection between the negative poles, in every case, the negative poles are connected via the conductor plate 53 on the negative pole side. In the comparison examples shown in Figs. 3(B) and 3(C), the terminals 512 and 522 are arranged away from each other and the area enclosed by the circuit L2 is widened, while in Fig. 3(A), due to approaching of the terminals 512 and 522, the inductance can be reduced.

As mentioned above, according to Embodiment 1 of the present invention, due to the reduction in the inductance between the parallel connected clamp capacitors, the oscillating current can be suppressed. Further, in the comparison example shown in Fig. 3(C), the two conductor plates 51 and 52 connected to the positive pole side are different in shape, while in Embodiment 1 of the present invention, they can be formed in the same shape.

Further, in Figs. 1 to 3, with respect to the conductor plates 61 and 62, the positive pole side conductor plate 61 is arranged above the other, though even if the negative pole side conductor plate 62 is inversely arranged above the other, the effect will not

be changed. Further, in the examples shown in Figs. 1, 2, and 3(A), the first terminal 512 is arranged on the lower right side of the drawing, and the second terminal 522 is arranged on the upper left side of the drawing, though even if the arrangement of both terminals is inversely interchanged, the area of the circuit L2 can be reduced and the inductance can be reduced exactly similarly.

Fig. 4 is a perspective view showing a mounting structure example of the clamp capacitors of the present invention. A mounting example of the clamp capacitors 41 and 42 which are omitted in the previous explanation to easily understand the terminals of the semiconductor modules and conductor plate shape is shown. The clamp capacitors 41 and 42 are directly connected to the semiconductor modules 111 and 112 as shown in the drawing, thus a reduction in the inductance is realized. Further, in the previous examples, as shown in Fig. 14, the case that the clamp capacitors 41 and 42 are connected is a prior condition for the explanation. However, the IGBT itself has an electrostatic capacity in the off state and when the switching timing is shifted, there are possibilities of generation of an oscillating current during that period. To prevent this oscillating current, the inductance

needs to be reduced and even when no clamp capacitors are connected, the present invention is effective.

Embodiment 1 aforementioned is an electric power conversion device formed by parallel-connecting a plurality of semiconductor modules (111, 112, ---) with two semiconductor switching devices connected in series between the DC terminals, that is, an electric power conversion device including the first semiconductor module (111) and the second semiconductor module (112) which are respectively connected in parallel between the DC terminals (P1, P2 - N1, N2), the first conductor plate (51) connected to the first terminal (P1) of the first semiconductor module (111), the second conductor plate (52) connected to the first terminal (P2) of the second semiconductor module (112), and the third conductor plate (53) connected to the second terminals (N1, N2) of the first and second semiconductor modules (111, 112) and having a structure that the first to third conductor plates (51 to 53) are laminated to form opposing portions, wherein the first connection terminal (512) for electrically connecting the first conductor plate (51) to the second conductor plate (52) and the second connection terminal (522) for electrically connecting the second conductor plate (52) to the first conductor plate (51) are arranged so as to

be brought closer to each other (the interval d1) than the distance between any terminals of the first to third conductor plates (51 to 53).

Further, in other words, in an electric power conversion device having a structure that the first to third conductor plates (51 to 53) are laminated to form opposing portions, the first conductor plate (51) and the second conductor plate (52) are connected electrically and the connection terminal (512 and/or 522) which is a leading portion to be connected to one of the DC terminals is arranged between two connection terminals (533, 534) which are a leading portion to be connected to another one of the DC terminals.

{Embodiment 2}

Fig. 5 is a perspective view showing the conductor plate structure of the electric power conversion device according to Embodiment 2 of the present invention and Fig. 6 is an exploded perspective view of the laminated conductor plate thereof. Here, the conductor plates 53 and 62 on the negative pole side have the same structure as that of Embodiment 1 shown in Figs. 1 and 2. The positive pole side has a structure that the first connection terminal 512 and the second connection terminal 522 directly make contact with each other and are electrically connected to each other and

furthermore are directly connected to the connection terminal 611 of the conductor plate 61.

By use of such a constitution, the area enclosed by the circuit between the clamp capacitors can be reduced much more, so that the effect of the induction reduction is great.

On the other hand, as shown in Fig. 6, the conductor plates 51 and 52 on the positive pole side have the same shape, though the connection needs to be bent and attention needs to be paid to the insulation security in the neighborhood of the connection.

{Embodiment 3}

Fig. 7 is a perspective view showing the conductor plate structure of the electric power conversion device according to Embodiment 3 of the present invention and Fig. 8 is an exploded perspective view of the laminated conductor plate thereof.

The respect that the connection terminals 512 and 522 directly make contact with each other and thereby are electrically connected to each other is the same as that of Embodiment 2. Here, the connection terminal 533 on the negative pole side is not divided to be kept as one place.

Therefore, one vacant space is sufficient for insulation security of each connection terminal, so

that the width of the conductor portion of the connection terminal can be widened. However, the connection terminal 533 becomes close to the DC negative pole terminal N1 and becomes remote from another DC negative pole terminal N2, so that there are possibilities that the current flowing to the smoothing capacitor 3 via the conductor plate 62 on the negative pole side may become non-uniform.

This Embodiment 3 is an electric power conversion device formed by parallel-connecting a plurality of semiconductor modules (111, 112, ---) with two semiconductor switching devices connected in series between the DC terminals, that is, an electric power conversion device including the first semiconductor module (111) and the second semiconductor module (112) which are respectively connected in parallel between the DC terminals (P1, P2 - N1, N2), the first conductor plate (51) connected to the first terminal (P1) of the first semiconductor module (111), the second conductor plate (52) connected to the first terminal (P2) of the second semiconductor module (112), and the third conductor plate (53) connected to the second terminals (N1, N2) of the first and second semiconductor modules (111, 112) and having a structure that the first to third conductor plates (51, 52, 53) are laminated to

form opposing portions, wherein the DC first terminals (512, 522, 611) for electrically connecting the first conductor plate (51), the second conductor plate (52), and one of the DC terminals and the DC second terminals (532, 621) connected to another one of the DC terminals from the third conductor plate (53) are arranged in line at intervals in an almost parallel direction to the plane to which the first to third conductor plates (51 to 53) are opposite.

{Embodiment 4}

Fig. 9 is a perspective view showing the conductor plate structure of the electric power conversion device according to Embodiment 4 of the present invention and Fig. 10 is an exploded perspective view of the laminated conductor plate thereof.

Here, the semiconductor module 11 composing one phase of the converter 1 shown in Fig. 13 and the semiconductor module 21 composing one phase of the inverter 2 are assumed as one unit, and the three units compose three phases, and the unit of one phase in this case is shown. Further, the semiconductor modules 11 and 21 have a standard structure that the positive pole terminals P1 and P2, the negative pole terminals N1 and N2, and the AC terminal AC are arranged in a row at the center of the module.

The intervals between the positive poles and the negative poles of the semiconductor modules are connected in parallel, though the alternating current is connected separately and the switching operations are not performed simultaneously. When the clamp capacitors are connected between the positive poles and the negative poles, if any of the semiconductor modules is switched, the voltage of the capacitor connected to the module is changed, so that between the clamp capacitor and another clamp capacitor, there are possibilities that an oscillating current may be generated. To early suppress the oscillating current, the inductance needs to be reduced. Therefore, similarly to Embodiment 1, the connection terminals 512 and 522 are arranged close to each other.

{Embodiment 5}

Fig. 11 is a perspective view showing the conductor plate structure of the electric power conversion device according to Embodiment 5 of the present invention.

This Embodiment 5 has a constitution that the four semiconductor modules 111, 112, 113, and 114 are connected in parallel. The two-row parallel connection is the same constitution as that of Embodiment 1 and the conductor plates 61 and 62 have a structure corresponding to the four-row parallel connection. Also

in this case, the constitution is such that the connections 512 and 522 approach each other and there exists the entirely same constitution in the lower right portion, so that the inductance can be reduced similarly to the previous Embodiments.

{Embodiment 6}

Fig. 12 is a perspective view showing the conductor plate structure of the electric power conversion device according to Embodiment 6 of the present invention.

Also in this embodiment, the four semiconductor modules are connected in parallel, though the positive pole P1 of the semiconductor module 111 and the positive pole P3 of the semiconductor module 113 are connected with the same conductor plate 51. Similarly, though hidden in the drawing, the positive pole P2 of the semiconductor module 112 and the positive pole P4 of the semiconductor module 114 are connected with the same conductor plate 52. Further, the negative poles N1, N2, N3, and N4 of the four semiconductor modules are connected to the one conductor plate 53. In Fig. 11, the divided conductor plates are unified, thus the inductance between the parallel connections can be reduced more.

WHAT IS CLAIMED IS:

1. An electric power conversion device formed by parallel-connecting a plurality of semiconductor modules with two semiconductor switching devices
5 connected in series between DC terminals, comprising:

a first semiconductor module and a second semiconductor module which are connected in parallel between said DC terminals,

10 a first conductor plate connected to a first terminal of said first semiconductor module,

a second conductor plate connected to a first terminal of said second semiconductor module, and

15 a third conductor plate connected to second terminals of said first and second semiconductor modules, and having:

a structure that said first to third conductor plates are laminated to form opposing portions, wherein:

20 a first connection terminal for electrically connecting said first conductor plate to said second conductor plate and a second connection terminal for electrically connecting said second conductor plate to said first conductor plate are arranged so as to be brought closer to each other than a distance between
25 any other terminals of said first to third conductor

plates.

2. An electric power conversion device formed by parallel-connecting a plurality of semiconductor modules with two semiconductor switching devices
5 connected in series between DC terminals, comprising:

a first semiconductor module and a second semiconductor module which are connected in parallel between said DC terminals,

10 a first conductor plate connected to a first terminal of said first semiconductor module,

a second conductor plate connected to a first terminal of said second semiconductor module, and

15 a third conductor plate connected to second terminals of said first and second semiconductor modules, and having:

a structure that said first to third conductor plates are laminated to form opposing portions, wherein:

20 a connection terminal of a leading portion to be connected to one of said DC terminals for electrically connecting said first conductor plate and said second conductor plate is arranged between two connection terminals of a leading portion to be connected to another one of said DC terminals from said third
25 conductor plate.

3. The electric power conversion device according to Claim 1 or 2, further comprising a smoothing capacitor connected between said DC terminals, wherein:

5 said connection terminal of said leading portion to be connected to one of said DC terminals for electrically connecting said first conductor plate and said second conductor plate is connected to a terminal of a leading conductor plate to one end of said smoothing capacitor,

10 said third conductor plate includes third and fourth connection terminals to a leading conductor plate at another end of said smoothing capacitor,

15 said first to fourth connection terminals are arranged in line at intervals on a surface almost parallel to a surface to which said first to third conductor plates are opposite, and

20 an interval between said first connection terminal and said second connection terminal is narrower than an interval between said connection terminals and said third or fourth connection terminal.

4. The electric power conversion device according to Claim 3, wherein:

25 said interval between said first connection terminal and said third connection terminal is almost equal to said interval between said second connection

terminal and said fourth connection terminal.

5. The electric power conversion device according to Claim 1 or 2, wherein:

5 said first connection terminal and said second connection terminal are overlapped and connected together so as to make direct contact each other.

6. An electric power conversion device according to Claim 1 or 2, wherein:

10 said first conductor plate and said second conductor plate are in the same shape.

7. An electric power conversion device formed by parallel-connecting a plurality of semiconductor modules with two semiconductor switching devices connected in series between DC terminals, comprising:

15 a first semiconductor module and a second semiconductor module which are respectively connected in parallel between said DC terminals,

 a first conductor plate connected to a first terminal of said first semiconductor module,

20 a second conductor plate connected to a first terminal of said second semiconductor module, and

 a third conductor plate connected to second terminals of said first and second semiconductor modules, and having:

25 a structure that said first to third conductor

plates are laminated to form opposing portions,
wherein:

5 a DC first terminal for electrically connecting
said first conductor plate, said second conductor plate,
and one of said DC terminals and a DC second terminal
to be connected to another one of said DC terminals
from said third conductor plate are arranged in line at
intervals in an almost parallel direction to a surface
to which said first to third conductor plates are
10 opposite.

8. The electric power conversion device according
to any one of Claims 1, 2, and 7, wherein:

15 said first and second conductor plates are
connected to positive poles of said DC terminals and
said third conductor plate is connected to a negative
pole of said DC terminals.

9. The electric power conversion device according
to any one of Claims 1, 2, and 7, wherein:

20 a capacitor is connected directly between said
terminals of said first semiconductor module and
between said terminals of second semiconductor module.

10. The electric power conversion device structured
by combining several ones of Claims 1, 2, and 7.