switching loss thereof.

[0012] Embodiments of the present invention seek to solve such problems as described above, and to make it possible to perform the current detection without extending the period of maintaining the vector pattern longer than the period while the vector pattern should be maintained originally, thereby avoiding increases of the output distortion and the switching loss.

Means for Solving the Problems

[0013] An inverter control device (6) according to the present invention controls a voltage source inverter (4) that converts a DC voltage (Vdc) into three-phase AC voltages (Vu, Vv, Vw).

[0014] The voltage source inverter (4) includes three current paths connected in parallel to one another between first and second DC bus lines (LH, LL) to which the DC voltage is applied, in which the potential of the first DC bus line (LH) is higher than that of the second DC bus line (LL). Each of the current paths includes: a connecting point (Pu, Pv, Pw); an upper arm-side switch (Qup, Qvp, Qwp) that is connected between the first DC bus line and the connecting point of said current path and flows a current from the first DC bus line to the connecting point at a time of conduction of the upper arm-side switch; a lower arm-side switch (Qun, Qvn, Qwn) that is connected between the connecting point of said current path and the second DC bus line and flows a current from the connecting point to the second DC bus line at a time of conduction of the lower arm-side switch; an upper arm-side diode (Dup, Dvp, Dwp) connected in antiparallel to the upper arm-side switch; and a lower arm-side diode (Dun, Dvn, Dwn) connected in antiparallel to the lower arm-side switch.

[0015] Then, a first aspect of the control device includes: a switching signal generation unit (38) that generates a switching signal (Sup, Svp, Swp, Sun, Svn, Swn) that causes any one of the upper arm-side switches and the lower arm-side switch to conduct

exclusively of each other in each of the current paths while maintaining conduction/nonconduction of the upper arm-side switch in one cycle (T0) of a triangular wave (C5, C6) on the basis of comparison between the triangular wave (C5, C6) and a plurality of voltage commands included in first and second voltage command groups; and a voltage command generation unit (34) that generates the first and second voltage command groups.

[0016] In the one cycle, the triangular wave exhibits a minimum value (Cmin) twice, a first maximal value (Cmax1) once, and a second maximal value (Cmax2) once.

[0017] The first voltage command group corresponds to the switching signal in which, in a first section including a first point of time (0°) when sums of periods while the upper arm-side switches (Qwp, Qvp) in a pair of the current paths conduct in the one cycle are equal to each other at zero, a period (V0) while the upper arm-side switches in all of the current paths are nonconductive in the one cycle is adjacently sandwiched by a pair of periods (V4) while all of the upper arm-side switches in the pair of the current paths are nonconductive and other of the upper arm-side switch conducts.

[0018] The second voltage command group corresponds to the switching signal in which, in a second section exclusive of the first section and including a second point of time (60°) when sums of periods while the upper arm-side switches (Qvp, Qup) in a pair of the current paths conduct in the one cycle are equal to each other at non-zero, a period (V7) while the upper arm-side switches in all of the current paths conduct in the one cycle is adjacently sandwiched by a pair of periods (V6) while all of the upper arm-side switches in the pair of the current paths conduct and other of the upper arm-side switch is nonconductive.

[0019] Desirably, the inverter control device further includes: a signal wave generation unit (32) that outputs a first signal wave group (Vu1*, Vv1*, Vw1*) and a second signal

wave group (Vu2*, Vv2*, Vw2*), each of which includes a first signal wave (Vu1*, Vu2*) indicating a first ratio, to the one cycle, of a first sum of periods while the upper arm-side switch (Qup) in a first one of the current paths conducts in the one cycle, a second signal wave (Vv1*, Vv2*) indicating a second ratio, to the one cycle, of a second sum of periods while the upper arm-side switch (Qvp) in a second one of the current paths conducts in the one cycle, and a third signal wave (Vw1*, Vw2*) indicating a third ratio, to the one cycle, of a third sum of periods while the upper arm-side switch (Qwp) in a third one of the current paths conducts in the one cycle.

[0020] The voltage command generation unit generates the first voltage command group and the second voltage command group on the basis of the first signal wave group and the second signal wave group, respectively. The first to third signal waves included in the second signal wave group take values obtained by subtracting, from 1, values in which phases are shifted by 180 degrees from the first to third signal waves included in the first signal wave group, respectively.

Effects of the Invention

[0021] In accordance with the inverter control device according to the present invention, it is made possible to perform the current detection without extending the period of maintaining the vector pattern longer than the period while the vector pattern should be maintained originally, whereby the increases of the output distortion and the switching loss are avoided.

[0022] Objects, features, aspects and advantages of the present invention will be more obvious by the following detailed description and the accompanying drawings.

Brief Description of Drawings

CLAIMS

1. An inverter control device that controls a voltage source inverter that converts a DC voltage into three-phase AC voltages,

wherein

said voltage source inverter includes three current paths connected in parallel to one another between first and second DC bus lines to which said DC voltage is applied, in which the potential of the first DC bus line is higher than that of the second DC bus line,

each of said current paths includes:

a connecting point;

an upper arm-side switch that is connected between said first DC bus line and said connecting point of said current path and flows a current from said first DC bus line to said connecting point at a time of conduction of the upper arm-side switch;

a lower arm-side switch that is connected between said connecting point of said current path and said second DC bus line and flows a current from said connecting point to said second DC bus line at a time of conduction of the lower arm-side switch;

an upper arm-side diode connected in antiparallel to said upper arm-side switch; and

a lower arm-side diode connected in antiparallel to said lower arm-side switch,

said device includes:

a switching signal generation unit that generates a switching signal that causes any one of said upper arm-side switches and said lower arm-side switch to conduct exclusively of each other in each of said current paths

while maintaining conduction/nonconduction of said upper arm-side switch in one cycle of a triangular wave on the basis of comparison between said triangular wave and a plurality of voltage commands included in first and second voltage command groups; and

a voltage command generation unit that generates said first and second voltage command groups,

said triangular wave exhibits a minimum value twice, a first maximal value once, and a second maximal value once in said one cycle,

said first voltage command group corresponds to said switching signal in which, in a first section including a first point of time when sums of periods while said upper arm-side switches in a pair of said current paths conduct in said one cycle are equal to each other at zero, a period while said upper arm-side switches in all of said current paths are nonconductive in said one cycle is adjacently sandwiched by a pair of periods while all of said upper arm-side switches in the pair of said current paths are nonconductive and other of said upper arm-side switch conducts, and

said second voltage command group corresponds to said switching signal in which, in a second section exclusive of said first section and including a second point of time when sums of periods while said upper arm-side switches in a pair of said current paths conduct in said one cycle are equal to each other at non-zero, a period while said upper arm-side switches in all of said current paths conduct in said one cycle is adjacently sandwiched by a pair of periods while all of said upper arm-side switches in the pair of said current paths conduct and other of said upper arm-side switch is nonconductive.

2. The inverter control device according to claim 1, further comprising: a signal

wave generation unit that outputs a first signal wave group and a second signal wave group, each of which includes a first signal wave indicating a first ratio, to said one cycle, of a first sum of periods while said upper arm-side switch in a first one of said current paths conducts in said one cycle, a second signal wave indicating a second ratio, to said one cycle, of a second sum of periods while said upper arm-side switch in a second one of said current paths conducts in said one cycle, and a third signal wave indicating a third ratio, to said one cycle, of a third sum of periods while said upper arm-side switch in a third one of said current paths conducts in said one cycle,

wherein said voltage command generation unit generates said first voltage command group and said second voltage command group on the basis of said first signal wave group and said second signal wave group, respectively, and

said first to third signal waves included in said second signal wave group take values obtained by subtracting, from 1, values in which phases are shifted by 180 degrees from said first to third signal waves included in said first signal wave group, respectively.

3. The inverter control device according to claim 2, wherein

said plurality of voltage commands included in said first voltage command group are:

a first voltage command that takes a first value obtained by subtracting, from said first maximal value, a product of a first multiplier and said first signal wave of said first signal wave group;

a second voltage command that takes a second value obtained by subtracting, from said first maximal value, a product

of said first multiplier and said second signal wave of said first signal wave group;

a third voltage command that takes a third value obtained by subtracting, from said first maximal value, a product of said first multiplier and said third signal wave of said first signal wave group;

a fourth voltage command that takes a fourth value obtained by adding, to said minimum value of said triangular wave, a product of a second multiplier and a first subtracted value obtained by subtracting, from 1, said first signal wave of said first signal wave group;

a fifth voltage command that takes a fifth value obtained by adding, to said minimum value, a product of said second multiplier and a second subtracted value obtained by subtracting, from 1, said second signal wave of said first signal wave group; and

a sixth voltage command that takes a sixth value obtained by adding, to said minimum value, a product of said second multiplier and a third subtracted value obtained by subtracting, from 1, said third signal wave of said first signal wave group,

said switching signal:

in a first period while said triangular wave departs from said minimum value, passes via said first maximal value and reaches said minimum value one more time, causes said upper arm-side switch in said first current path to conduct when said triangular wave is larger than said first voltage command, causes said upper arm-side switch in said second current path to conduct when said triangular wave is larger than said second voltage command, and causes said upper arm-side switch in said third current path to conduct when said triangular wave is larger than said third voltage

command, and

in a second period while said triangular wave departs from said minimum value, passes via said second maximal value and reaches said minimum value one more time, causes said upper arm-side switch in said first current path to conduct when said triangular wave is larger than said fourth voltage command, causes said upper arm-side switch in said second current path to conduct when said triangular wave is larger than said fifth voltage command, and causes said upper arm-side switch in said third current path to conduct when said triangular wave is larger than said sixth voltage command,

both of said first multiplier and said second multiplier are non-negative, and

a sum of said first multiplier and second multiplier is equal to or less than a resulting value obtained by subtracting a double of said minimum value from a sum of said first maximal value and said second maximal value.

4. The inverter control device according to claim 2, wherein

said plurality of voltage commands included in said second voltage command group are:

a first voltage command that takes a first value obtained by adding, to said minimum value of said triangular wave, a product of a first multiplier and a first deducted value obtained by subtracting, from 1, said first signal wave of said second signal wave group;

a second voltage command that takes a second value obtained by adding, to said minimum value, a product of said first multiplier and a second deducted value obtained by subtracting, from 1, said second signal wave of said second signal wave group;

a third voltage command that takes a third value obtained by adding, to said minimum value, a product of said first multiplier and a third deducted value obtained by subtracting, from 1, said third signal wave of said second signal wave group;

a fourth voltage command that takes a fourth value obtained by adding, to said minimum value, a product of said first deducted value and a second multiplier;

a fifth voltage command that takes a fifth value obtained by adding, to said minimum value, a product of said second deducted value and said second multiplier; and

a sixth voltage command that takes a sixth value obtained by adding, to said minimum value, a product of said third deducted value and said second multiplier,

said switching signal:

in a first period while said triangular wave departs from said minimum value, passes via said first maximal value and reaches said minimum value one more time, causes said upper arm-side switch in said first current path to conduct when said triangular wave is larger than said first voltage command, causes said upper arm-side switch in said second current path to conduct when said triangular wave is larger than said second voltage command, and causes said upper arm-side switch in said third current path to conduct when said triangular wave is larger than said third voltage command, and

in a second period while said triangular wave departs from said minimum value, passes via said second maximal value and reaches said minimum value one more time, causes said upper arm-side switch in said first current path to conduct when said

triangular wave is larger than said fourth voltage command, causes said upper arm-side switch in said second current path to conduct when said triangular wave is larger than said fifth voltage command, and causes said upper arm-side switch in said third current path to conduct when said triangular wave is larger than said sixth voltage command,

both of said first multiplier and said second multiplier are non-negative, and

a sum of said first multiplier and second multiplier is equal to or less than a resulting value obtained by subtracting a double of said minimum value from a sum of said first maximal value and said second maximal value.

5. The inverter control device according to either one of claims 3 and 4, wherein

said DC voltage is obtained by a current source converter that commutates when said triangular wave takes said minimum value, and

a sum of said first multiplier and said second multiplier is equal to the resulting value obtained by subtracting a double of said minimum value from a sum of said first maximal value and said second maximal value.

6. The inverter control device according to either one of claims 3 and 4, wherein

said DC voltage is obtained by exclusively adopting a rectified voltage obtained from a rectifier circuit and a boosted voltage obtained from a booster circuit that boosts said rectified voltage, and

when said triangular wave takes said minimum value, whether or not to adopt said boosted voltage for said DC voltage is switched.