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THE THYRISTOR CONVERTERS' PREVENTIVE PROTECTION

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The thyristor converters have already been found the wide application in the various electro – technological installations, which are needed the energy batching constancy at the loading variations. Such loadings examples can be served the ion nitriding furnaces, the electroarc vaporizers for the metal deposition and so on. The transistor and condensing converters of bridge – type are usually applied for the powers, which are more, than 15 kwt.

The protection system of such converter is contained the voltage sensor on the direct current diagonal of the thyristor bridge, having connected with the pick – off signal comparator and to the reference voltage signal, and the above – mentioned comparator is connected with the control input of the thyristor switch off [1] through the pulse – duration selector in series connection, and the switching on pulse former.

The insufficient protection reliability from the overloads at the thyristors' switching disturbance is the general shortcoming of the above – mentioned converters.

The new protection diagram, having eliminated this shortcoming, has already been developed in [2], and it has been presented in the Fig.1. The diagram is contained the thyristor bridge 1 – 4 with the dispensing capacitor 5 in the alternating current diagonal, having connected in series with the loading 6, and the thyristor current switch off 7. The loading 6 jointly with the common – anodes of the thyristor bridge 1 – 4, e.g. with the thyristors anodes 1 and 4, and it has been shunted by the first bypass diode 8. The loading 6 jointly with the thyristor current switch off 7 has been shunted by the second bypass diode 9, having connected with the anode and the power supply minus $U_п$. The standard control system 10 has been connected by its outlets to the corresponding control inputs of the thyristor bridge 1 – 4 and the thyristor current switch off 7. The protection system has been made in a form of the triple – wound transformer 11, the first winding 12 of which has been included between the power supply plus $U_п$ and the common – anodes of the thyristor bridge 1 – 4, and that the number of turns of the second winding 13 is twofold, than the number of turns of the first winding 12, and all these windings have been included from the opposite sides towards to each other. The centerpoint of the second winding 13 is divided the whole indicated winding into the first and the second half – windings with the same number of turns, and it has been formed one of the conclusions of the alternating current diagonal of the thyristor bridge 1 – 4. The third winding 14 of the above – mentioned transformer 11 has been connected with the switching off pulse former 15, the outlet of which has been connected with the control input of the thyristor current switch off 7.

The suggested diagram is being functioned by the following way.

The current of the power supply $U_п$ must be passed through the first winding 12 and the whole of the second winding 13 of the triple – wound transformer 11, at the switching breakdown, for example, at the simultaneous unblanking of the thyristors 1 and 3. This current will not be exceeded the magnetization current, e.g. the short circuit will be, practically, locked out, while the triple – wound transformer 11 is being saturated. It is quite enough to choose the parameters of the triple – wound transformer 11 such ones, in order the time of its saturation would be quite equal to the break time of the thyristor current switch off 7, on which the disconnection signal is being got from the third winding 14 through the switching off pulse former 15 in the emergency operation. And the similar situation takes its place at the short circuit through the thyristors 2 and 4. In this case, the magnetization current is being passed only through the first winding 12 of the triple – wound transformer 11. For all this, we note, as the turnoff time of the thyristor current switch off 7 is not much (e.g. only tens of microseconds), then the dimensions of the triple – wound transformer 11 are too small, and its further connection into the power circuit of the thyristor and condensing converter is not quite the drawback. At each disconnection of the thyristor current switch off 7, the demagnetization of the triple – wound transformer 11 takes its place at the return of the electromagnetic energy of the loading into the power supply plus $U_п$, e.g. the triple – wound transformer 11 is being applied by the full hysteresis loop, but the suggested protection is quite non – inertial, and it is also limited the current at the insignificant level.

Thus, the diagram (Fig.1) has been permitted to be excluded the comparator, having had in the analogous converters, and, the main thing, the pulse – duration selector and, the next best thing, to provide the operation velocity and the protection high – level reliability. And all the more, the suggested in [2] solution is provided the preventive character of the protection: the current is not, practically, being increased at the switching breakdown of the thyristor bridge.

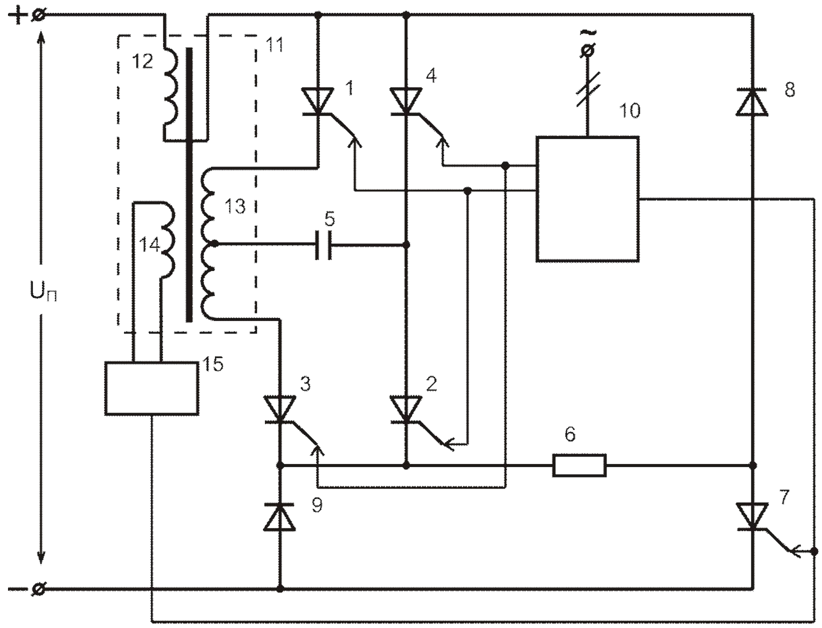

Fig.1.

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WIDENING FREQUENCY PASS-BAND OF A HALF-BRIDGE CONVERTER AND INCREASING ITS PROTECTION AGAINST THROUGH-FAULTS

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Single-phase half-bridge converters are being widely used in different secondary power sources, for example, in some inverter welding transformers [1]. Such converters contain a half-bridge in its power part; a diagonal of the bridge’s direct current is connected with power source U_p via a choke [2]. The choke is a typical unit in the structure of the common converters and reduces the steepness of current build-up in transistors during through-faults, i.e. when transistors are being triggered simultaneously. But, while reducing the steepness of current build-up, the choke cuts at the same time, the frequency pass-band of the converter. That is why its inductance should be relatively small, which in its turn lowers the protection level during through-faults. All these deficiencies were eradicated in the developed appliance [3], scheme see on pic.1.

The device works as follows.

As in the common half-bridge single-phase converters, the output of control system 13 is a common pulse-width modulator that sends antipodal signals to transistors 1 and 2. Pulse duration of these impulses depends on the signals (current, voltage); frequency in modern converters that supply, for example, welding transformers, reaches 100 kHz.

Let assume, that power source U_p is on, and capacitors 8, 9 are charged each till about 0,5 U_p voltage. Then the first signal from the output of control system 13 reaches, for example, transistor 1, causing transistor 1 to trigger, and capacitor 8 discharges to load 10. Through winding 11 and winding 6 of transformer 5 flows equal current. As the windings have the same number of loops and opposite ones, they form a bifilar and do not bring reactance to load circuit. Capacitor 9 is being charged at the time. If the load is enough for capacitor 8 to discharge fully, then by the end of the converter’s operation half-cycle, the capacitor 9 will receive the voltage U_p. during the triggering of transistor 2, bifilar is formed by windings 11 and 7 of transformer 5.

So, when the converter is in the operating mode, transformer 5 does not cause reactance in the load circuit, and the maximal converter frequency is limited only by parameters of transistors 1 and 2. As the magnetic flow of transformer 5 is zero during con-