NETWORK SWITCHING OF THE INVERTER IN FREQUENCY CONVERTER

Magazinnik L.T.

The Ulyanovsk State Technical University, Ulyanovsk, e-mail: tai@ulstu.ru

Switching processes in d.c.frequency inverter with properties of a direct frequencyconverter are considered. It is shown , that the application of the frequency converter described will allow to simplify the power scheme and the control system essentially.

Keywords: frequencyconverter, inverter

Adjustable frequency converters are widely used in electric drives and electrotechnologies.

In [1-2] a frequency converter with a power scheme practically identical to a three-phase bridge scheme of a frequency inverter with independent voltage and current inverters is presented. Thyristor switching is natural (in the network) as in the proper frequency converter but there is bilateral communication between the loading and the network, i.e. the mode of recuperation of energy into the network is possible and the frequency range is approximately the same as in a «classical» frequency inverter.

Thus, the obvious advantage of the frequency inverter being suggested is the simplicity of its power scheme: two thyristor bridges instead of six bridges employed in a «classical» frequency inverter of a similar ripple.

However, some drawback are present: first, double energy transformation (as in all direct current frequency inverters), which is not so essential considering small losses in thyristors; and second, three single-phase saturated transformers are included into the rectifier power supply circuit.

Hence, the decision on the frequency inverter competitiveness in in comparison with the usual ones is possible only taking into account the key parameters of the switching transformers already mentioned and intended for specified loadings. In the article the switching processes in frequency inverters employing direct current and network switching with reference to use as the loading for asynchronous short-circuited engines («4 A», 380 V) are described.

When analyzing switching processes in the scheme we accept the following assumptions:

1. Inductance of a choke in the rectified current circuit $L_d \to \infty$, so the current in the interswitching intervals constant;

2. Switching transformers haves cores with an «ideal» rectangular hysteresis loop.

Comparisonof the calculation results of switching transformers relative capacity

and volt second integral allows us to conclude that the latter is a determining one, i.e. the switching transformers «capacity» in this case does not exceed 5% of capacity of the installation as a whole –at the rated loads and 10% – at possible double overloads.

In a «classical» frequency inverter without a transformer there are reactors limiting current (air or core-type). In the frequency inverter under consideration switching transformers can be used reactors limiting current and they are quite commensurable with reactors (as for as the mass and dimensions are concerned). At the same time the number of thyristors in the frequency inverter being described is three times as less. Hence, the design and the control system can be simplified (the number of control channels is less). The whole installation turns out much more compact than the traditional frequency inverter and its application for low-voltage asynchronous engines («4 A») is justified, especially for the drives working in a start-stop mode, in a mode of variable rotation frequencies accompanied by «delays» at transitions to smaller rotation frequencies, i.e. when a mode of recuperative delay takes an essential part of time in the running drive cycle (problems of the realization of a recuperation mode in frequency inverters with independent inverters are well-known).

Noteworthy, that at low frequencies modulation of switching delay angle α can be carried not to get the quasisinusoidal current in the engine windings.

The application of a frequency inverter with the above mentioned type of inverter switching can appear rather effective, e.g. both in over-synchronous valve cascade where switching transformers are used only in the vicinity of a transition across the synchronous frequency of the engine rotation [1] and in synchronous frequency-adjustable electric drives for acceleration up to the rotation frequency when switching due to the e.m.f. of an engine is already possible. However, the recommendation given demands both circuit studies and further quantitative analysis but this problem is beyond the frameworks of the article.

References

1. Magazinnik L.T., Magazinnik G.G. An over synchronous valve cascade. Patent R.F., № 2073309. 10.02.97 Bul. № 4.

2. Magazinnik L.T. A discrete adjustable frequency inverter for a.c. drives «Problems of Power Engineering» // High School Bul. – 2004. – № 5-6. – P. 48-55.