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ELECTROMAGNETIC COMPATIBILITY OF STARTING DEVICES FOR AC ELECTRIC DRIVES WITH POWER SUPPLY NETWORK

The paper considers a problem of the influence of starting devices on the power network and peculiarities of their selection with regard to electromagnetic compatibility.

Key words: *starting devices, asynchronous motor, electromagnetic compatibility.*

Introduction

Electromagnetic compatibility with the power supply network should be a basic argument in the choice of type and parameters of a starting device for AC electric drive. This fact is especially important for high-power electric drives since not every starting device can operate in any network.

In this regard, two main factors can be distinguished:

1. On the one hand, in CIS countries the policy was carried out for decades, which was directed towards splitting power in the networks of industrial enterprises. This means that there is influence of disturbances in the network on variable electric drives and reverse influence of variable electric drives on adjacent electrical receivers.

2. In Russia and in the majority of CIS countries a more rigid Standard on the network voltage quality [1] is applied as compared with the International Standard [2]. These Standards limit normal and maximum permissible voltage variations. The given research is devoted to the investigation of the conditions of electromagnetic compatibility of energy supply system with starting devices and power supply network.

Results of the research

In order to comply with the Standards, starting devices should meet the following requirements:

– electrical drive should be started under limit deviations of the network voltage;

– starting device should not cause network voltage deviations exceeding normally permissible deviations.

Considering the influence of the network voltage deviations on the electric drive, it is necessary to take into account both variations of the voltage vector modulus in the load node and supply voltage distortion.

Most probable could be disturbances due to variations of the voltage vector modulus in the load node caused both by overloads in the network and by direct starting of powerful AC motors. From the entire list of the Standard requirements to starting devices we distinguish the following most significant requirement: under low network voltage the motor start should occur.

Let us consider supply voltage distortion, which is caused both by operation of the electrical drive system itself and by adjacent receivers. As a rule, for voltage supply to electric drives with starting devices a separate bus section is used. In this case this section could be considered to be an autonomous system, for which the voltage quality requirements of the Standard are not applicable. Then considerable voltage distortions could be observed. Let us, for example, discuss starting of the asynchronous motor of a conveyor using SIEMENS 3RW40 softstarter with the power of 40 KW. Fig. 1 shows voltage shape of phases A and B during starting process. Significant voltage distortions are evident. These voltage distortions influence the electric drive through the starting device. Therefore, one more requirement to starting devices is as follows: the possibility of network-supplied operation under high content of upper harmonics in the voltage [3].

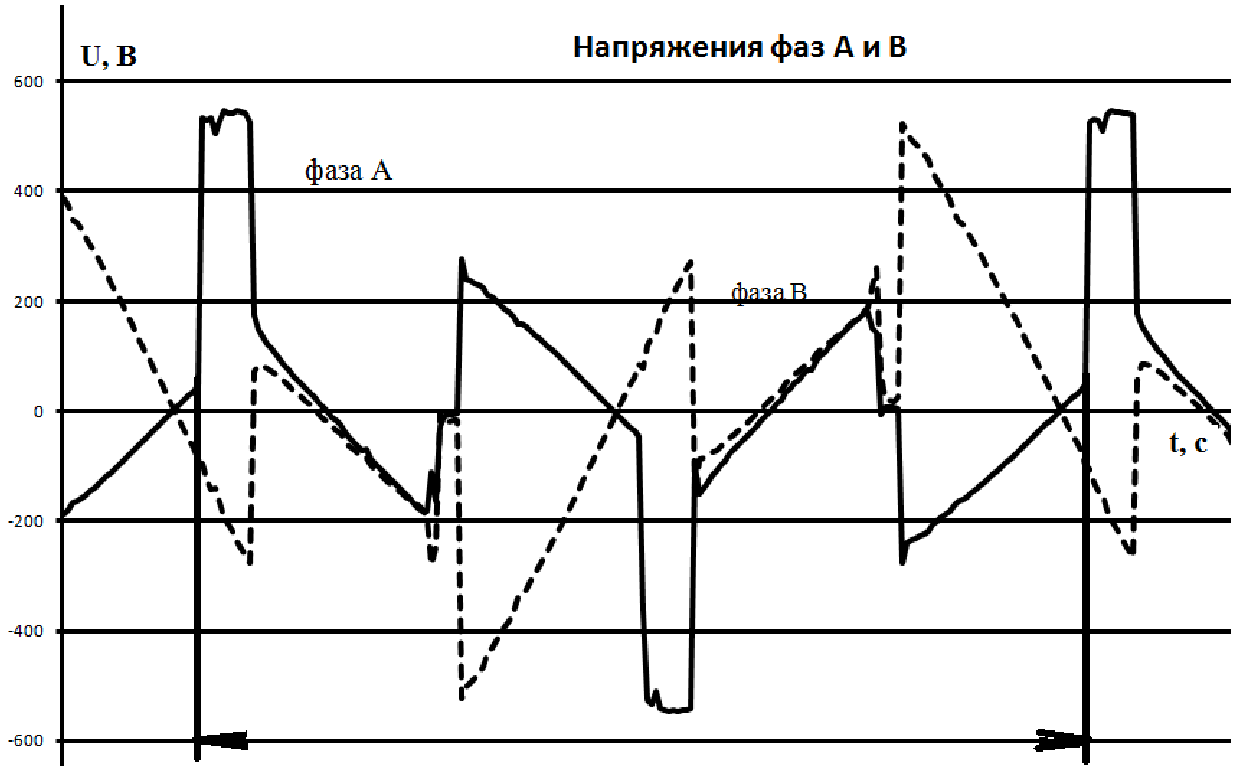

Fig.1. Voltage shape during asynchronous motor starting process

We should also note the influence of the reactive power, consumed by the electric drive. This leads to the increased losses in the network, which, in its turn, causes voltage variations in the load node. As it is evident from Fig. 2, reactive power, consumed from the network during the starting process, is two times higher than active power.

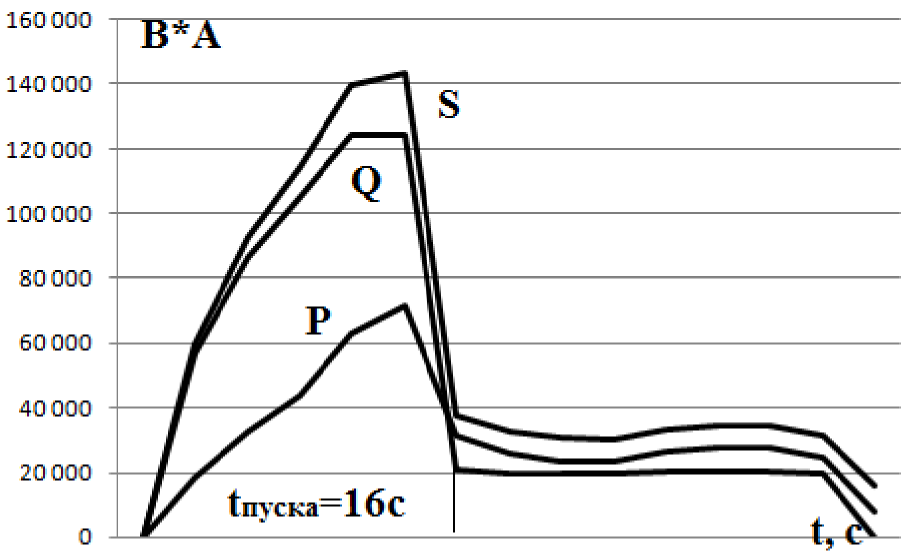

Fig. 2. Shapes of power consumed during soft starting of the asynchronous motor

In this case total power within the starting process is 140 KW. Thus, we can say that in starting modes the excess of the peak (total) power is 3.5 times higher than the power of starting device (40 KW). This, in its turn, requires that installed capacity of the starting device is minimum 1.5 times higher than that of electric drive [4].

Currents, consumed by the electric drive, differ from sinusoidal currents (Fig. 3). This causes voltage distortion at the point of common coupling. The standards normalize both the voltage distortion factor K_{UH} and voltage harmonics factors K_{Un}. Normally permissible value of distortion factor $K_{UH} = 0{,}05$.

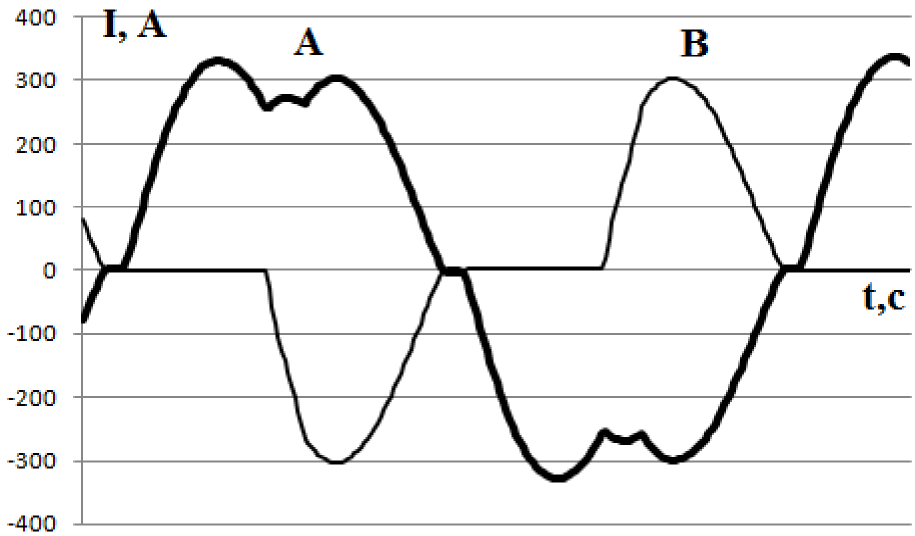

Fig. 3. Shapes of the currents during starting process

Conclusion

The conditions of electromagnetic compatibility with power supply network determine, to a great extent, the choice of type and parameters of high-power variable AC electric drive. In a number of cases these requirements influence not only the choice of an electrical power supply system, but also that of a starting device.

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