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ANALYSIS OF OPERATING MODES OF AUTOTRANSFORMERS

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Annotation
In this article, the operation mode of autotransformers is discussed and considered with the help of relevant examples.

Keywords: autotransformer, technology, production, method.

INTRODUCTION

An autotransformer is a special type of transformer in which primary and secondary windings are combined without galvanic isolation of the circuits.

If voltage U_1 is applied to the primary winding of an auto-transformer with the number of turns Z_1, then on the secondary winding of the transformer with the number of turns Z_2 we get the voltage U_2 according to the coefficient:

$$J = \frac{U_1}{U_2} = \frac{Z_1}{Z_2}$$

where J is the transfer coefficient of the autotransformer, U_1,U_2 are the primary and secondary voltages, Z_1,Z_2 are the number of turns of the primary and secondary windings.

MAIN PART

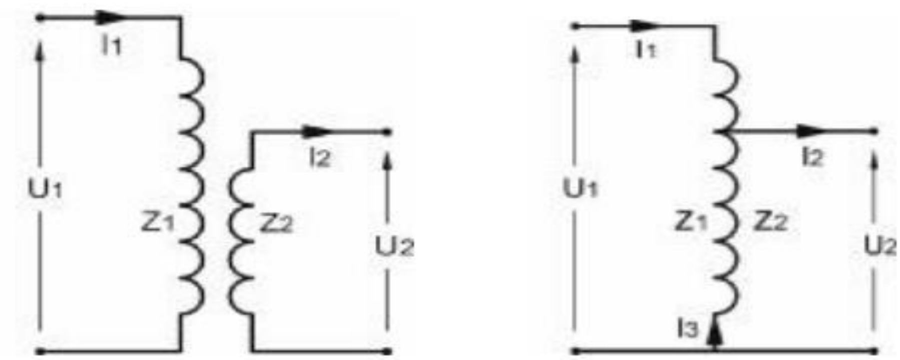

Fig.1 Transformer and autotransformer diagrams.

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In a transformer, power is transferred from the primary winding to the secondary winding by means of a magnetic field. The transfer of energy in an autotransformer is accompanied by the phenomena of transformation and conduction.

Conductivity results from the direct combination of the secondary and primary windings of an autotransformer.

Fig.2 Three-phase autotransformer type EA3.

To accurately describe the operation of an autotransformer, its rated power draw is represented by the following relationships:

Intrinsic power S_{WA} of the autotransformer, transferred to the secondary winding only by transformation

$$S_{WA} = (U_1 - U_2)I_1 = S_{PRZECH}\left(1 - \frac{1}{\vartheta}\right)$$

Transfer power S_{PA} of an auto-transformer transferred to the secondary winding by conduction

$$S_{PA} = U_2 \cdot I_1 = S_{PRZECH}\frac{1}{\vartheta}$$

The sum of self and transmit powers gives the transmit power, which is the output power of the autotransformer

$$S_{PRZECH} = U_1 \cdot I_1 \approx U_2 \cdot I_2$$

One way to start induction motors is to start at low voltage. The voltage is reduced to limit the starter current. The starting method using a starter autotransformer is

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used, in particular, in high power drives, where switching from star to delta of the stator winding is technically difficult.

Fig.3 Three-phase starter autotransformer type EA3R.

Autotransformer starting is fundamentally similar to star-delta ignition. However, in the case of an autotransformer, it is possible to arbitrarily reduce the voltage during motor start-up so that the current from the network does not exceed a predetermined value.

If necessary, starter autotransformers are made with several outputs.

When starting the motor from the power supply network with voltage U through an auto-transformer with a transfer ratio □, the voltage in the stator winding U_{RS} is:

$$U_{RS} = \frac{1}{\vartheta} \cdot U$$

Then the motor winding current U_{RS} is equal to the secondary current of the autotransformer I_2 and reaches the value:

$$I_{RS} = I_2 = \frac{1}{\vartheta} \cdot I_P$$

where U is the mains voltage, I_P is the initial starting current when the motor is supplied with the rated voltage.

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