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STUDY OF POWER BALANCE OF SMALL POWER ASYNCHRONOUS MOTOR

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Abstract: In order to provide consumers with uninterrupted and high-quality electricity, as the world is increasingly relying on alternative energy sources, based on the climatic conditions of our country, extensive work is being carried out to introduce solar energy sources and further improve the existing ones in accordance with modern energy systems, and to effectively use the electricity generated by solar panels. In this regard, it is important to provide small-power asynchronous motors with solar energy sources, generate sufficient reactive power in them, and use them effectively. Small asynchronous motors supplied from small-power On-Grid or Off-Grid solar power plants are single-phase or three-phase asynchronous motors, and it is important to use these asynchronous motors with high-efficiency operating modes, providing them with a single-phase solar power source. This article provides a sufficient solution to the problems that arise in asynchronous motors through the use of capacitive and inductive elements that provide phase shifting and reactive power in single-phase and three-phase asynchronous motors, which are the most important aspects of researching the elements that generate the starting torque and provide reactive power, and increasing their efficiency.

Keywords: solar panels, asynchronous motor, starting capacitor, reactive power, magnetic flux, inverter, symmetrical currents, stator slots, rotation period.

Introduction. The most widespread and most demanding electric power consumption device in industrial production enterprises and sectors of the national economy in the world is asynchronous motors. In asynchronous motors, the main current of the magnetic field ($F_{\mu 1}$) that generates reactive power is used to generate a stray magnetic field ($F_{\mu 2}$). Providing high efficiency indicators through precise and effective control and management of reactive power consumption of single- and three-phase asynchronous motors is one of the main factors. Single-phase asynchronous motors are the most common in automatic and light industrial electric drive devices in industrial production enterprises, and are mainly widely used in double-phase rotary drive devices with a rotation period of n=3000 min/min.

Method: In industrial enterprises and the national economy, single-phase asynchronous motors are among the most energy-consuming devices for solar panels. These asynchronous motors require high-precision, reliable, compact converters to control and regulate the amount of reactive power. In single-phase asynchronous motors, in addition to the starting and working capacitor banks, there is also a starting winding. When the starting winding is provided with a winding with a smaller cross-sectional area than the working main winding, with a low reactive resistance and good active resistance, the asynchronous motor is provided with high efficiency indicators. Figure 2 shows a single-phase asynchronous motor with a phase-shifting inductive starting winding and a working capacitor bank.

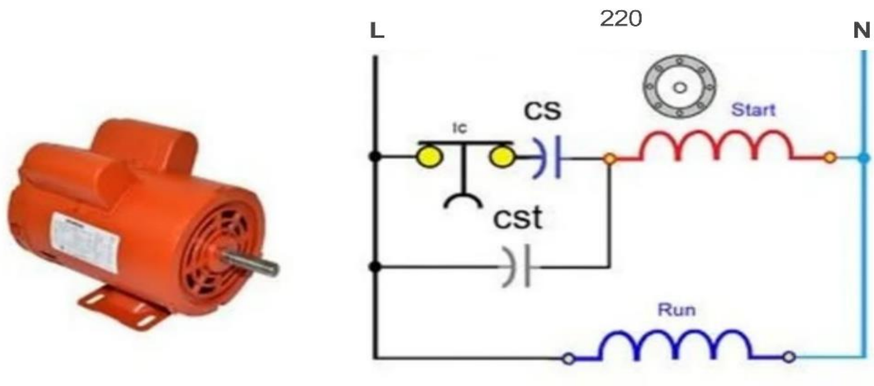


Figure 1. Connection diagram of a single-phase asynchronous motor to the network through a phase-shifting inductive coil, a starting capacitor and a working capacitor bank

The correct selection of a single-phase asynchronous motor starting and working capacitor bank allows the asynchronous motor to operate for a long time and efficiently in stable and stable operating modes. The basic formula for the capacitor capacity when selecting a working capacitor bank for the single-phase asynchronous motor under study is:

$$C=\frac{I}{2\pi f U} \qquad [F]$$

Here:

C-capacitor capacity;

I-rated current of the induction motor;

f- network frequency;

U-rated voltage of the induction motor;

Usually, induction motors require five to seven times more reactive power than their rated power during start-up, so the starting capacitor is selected larger, in this regard, it is desirable that the starting capacitor is two to three times larger than the working capacitor bank, this expression is as follows

$$C_{tush.}=2.5\cdot C_{ish.} \qquad [F]$$

When asynchronous motors are connected to the network through a capacitor bank, the voltage supplied to the stator of the asynchronous motor is shifted forward by 900 from the electric current, and the asynchronous motor starts to operate with a single-phase source. In this process, when we connect a capacitor and a phase-shifting inductive coil to the stator windings of the asynchronous motor and start it, the stator currents of the asynchronous motor are shifted forward by 900, as a result of which the asynchronous motor starts to operate in stable and stable operating modes. The selection of a phase-shifting inductive coil for an asynchronous motor is selected using the following expression:

$$L=\frac{1}{(2\pi f)^2 C} \qquad [Hn]$$

Here:

C-capacitor capacitance;

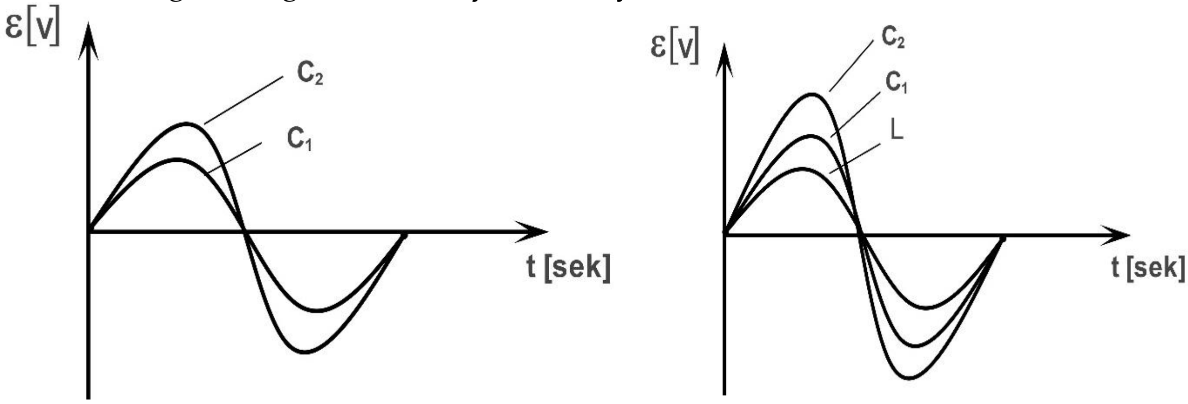
f- network frequency;

The experimental stand conducted on the current converter device under investigation for the control and regulation of the reactive power of an asynchronous motor is shown in Figure 2.

Picture 2.

A single-phase asynchronous motor and an experimental device powered by solar panels were tested.

Result: Single-phase asynchronous motors are powered by two starting and working capacitor banks when providing reactive power. From the description in Figure 1, it can be seen that when a single-phase asynchronous motor is powered by only an internal capacitor bank, the torque generated by the starting and working capacitor banks is twice as good as when it is powered by the reactive power provided by the capacitor bank, resulting in a higher efficiency of the asynchronous motor.



Picture 3. Description of the torque at the time of starting a single-phase asynchronous motor with a starting and working capacitor bank. ε[V]-electromotive force, C_2-working capacitor bank, description generated, C_1-starting capacitor bank, description generated, t(sekc)-rotation period time.

If we conclude from the description given in Figure 2 that the reactive power losses that occur during the start-up of single-phase asynchronous motors and the output voltage of the proposed electromagnetic converter device are exactly the same, when the asynchronous motor is connected to the network through the phase-shifting inductive winding and the working capacitor battery, the asynchronous motor starts to operate at the passport indicators, at the values given in the design, and even with higher efficiency operating modes.

The studied single-phase asynchronous motors of the DOL-34H type are widely used in light industry and the national economy in our country and the world today. The number of stator windings of this type of asynchronous motor is z=24, symmetrically wound and arranged in accordance with the stator windings, and using the electromagnetic current converter device, which is located between the insulating wedge and the air gap, to control and manage the waste of reactive power, economic efficiency was achieved by reducing the rapid failure of this type of asynchronous motor device, as well as the waste of electrical energy generated by solar panels by 1.5%. A schematic view of the electromagnetic current converter device used is shown in Figure

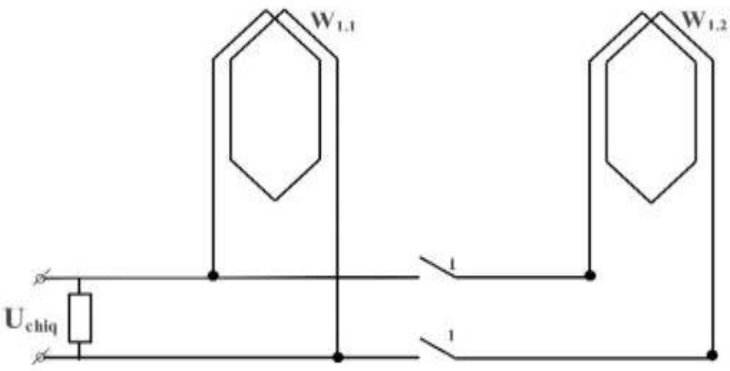


Figure 4. The procedure for placing the alternator pulley on the stator slots of a single-phase asynchronous motor

An asynchronous motor powered by solar panels from a single-phase power grid has the following disadvantages in measuring, controlling and controlling reactive power: current transformers have magnetic core saturation after the 19th harmonic, and other disadvantages.

Conclusion: An asynchronous motor powered by solar panels can fully meet the requirements of modern reliable, high-precision, low-power, and economical measuring devices for monitoring and controlling reactive power consumption.

The method under study allows asynchronous motors powered by solar panels to operate in nominal, starting, and overload modes, thereby preventing the burning of the inventory device, ensuring stable and stable operating modes of the asynchronous motor, and also preventing the burning of the asynchronous motor, and also making efficient use of electrical energy.

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