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RESERCH OF REACTIVE POWER CONSUMPTION OF SINGLE-PHASES ASYNCHRONOUS MOTOR ENERGY SUPPLIED BY SOLAR PANELS (DEBSEUZ PROJECT ACTIVITY)

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Abstract: This scientific article was supplemented with the results of research solutions obtained within the framework of the project 101128871-ERASMUS-EDU-2023-CBHE "Development of the targeted Educational program for Bachelors in Solar Energy in Uzbekistan" (DEBSEUz, 2023-2026 y.y.). Global demand for renewable energy sources is increasing day by day, including environmentally friendly, easy to install and maintain, and taking into account the fact that the sun shines more than three hundred days a year it is great to provide the energy produced by solar panels to the consumers of manufacturing enterprises and households it is noted that in this regard, the implementation of on-grid and off-grid systems for providing consumers with continuous energy, the introduction of systematic control and management methods of the quality indicators and quantity of generated electricity , and their practical application are considered to be the main issues. More than 55-60 percent of the generated electricity are using by one -and three-phase asynchronous motors, which are considered as consumers, providing these electrical devices with high-quality electricity , controlling the consumption of reactive power that creates a magnetic field and current in asynchronous motors research of electromagnetic current converters, which allow for the evaluation of reactive power and electric current asymmetry and non-sinusoidal indicators, remote measurement of these quantities with appropriate devices, control and conversion to a standard signal, are considered urgent issues.

Key words: Asynchronous motor, electromagnetic current converter, stator weddings, reactive power, symmetrical, non-sinusoidal, converter, electromagnetic, solar panels, batteries, sensitivity.

Introduction

If will paid attention to the whole world's experience in talking about the advantages of solar energy sources, according to the calculations of international organizations, due to economic development, the demand for energy will increase by 50 percent by 2030 compared to the beginning of our century, and the total need 23, which is 27 billion tons of conventional fuel [1].

It is known from the analyzes and research that at the moment, a number of scientific research works are being carried out to control and manage the reactive power consumption of asynchronous motors, which are considered the main consumers of electricity produced by the production enterprises of republic and the solar panels installed in the houses of the residents, but these problems have not been sufficiently studied for asynchronous motors powered by a phases of solar energy source [2-5].

Allows to accurately and reliably change and control magnetic currents. The research scheme of a three-phase asynchronous motor supplied from a single-phase power supply nets is presented in Fig.1.

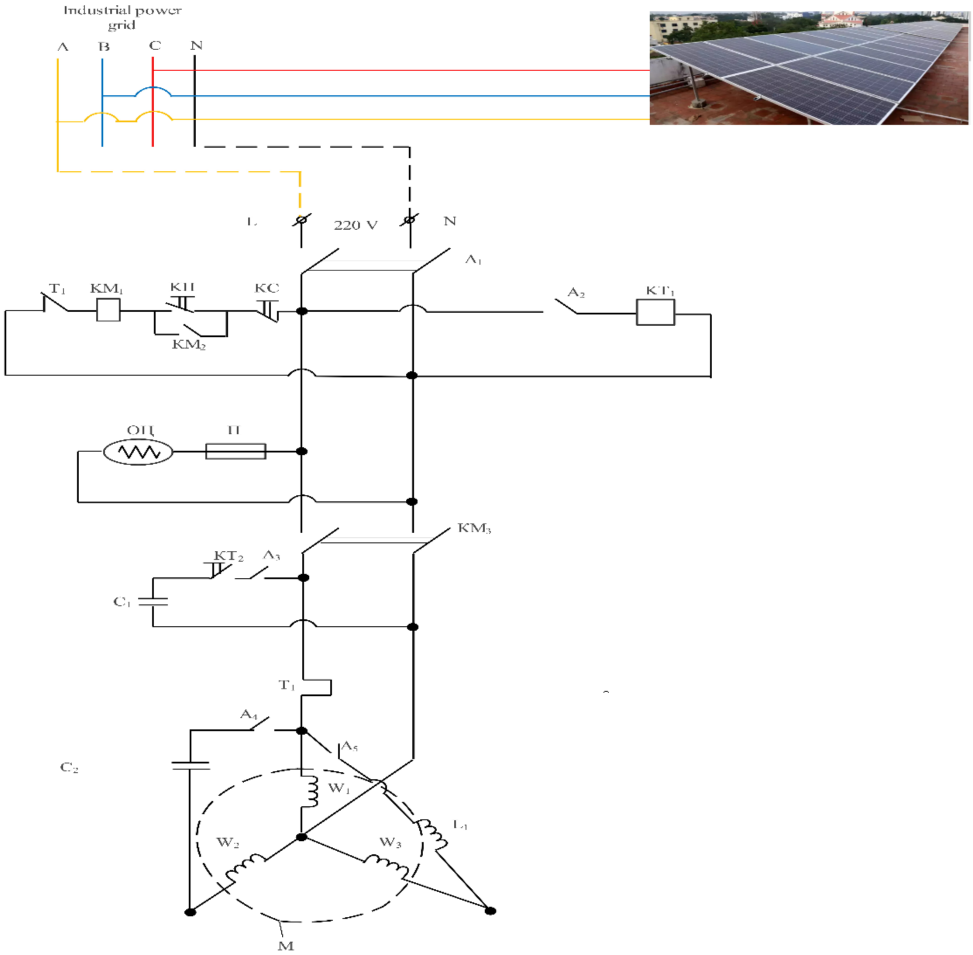

Fig. 1. Research scheme of an asynchronous motor supplied from a single-phase power supply nets

L- one phase of a three-phase power supply nets, N- neutral, A_1,A_2,A_3,A_4,A_5- automatic magnetic circuit breakers, КП- launch button, КС- stop button, КМ1,КМ2- magnetic starters, T_1-thermal relay, KT_1- time relay, C_1- reactive power source (static capacitor battery) C_1 va L_1-capacitive and inductive elements that shift the angle between current and voltage, phase W_1, W_2, W_3- asynchronous motor stator coils, ОЦ- Oscillograph, П- soluble preservative, M- asynchronous motor.

The principle of placement of the measuring rings of the transformer, which is designed to control and evaluate the symmetrical and non-sinusoidal indicators of the primary current flowing from the stator winding of the asynchronous motor reactive power, and which supplies the secondary signal in the output voltage indicator, is presented in the Fig. 2 [6]:

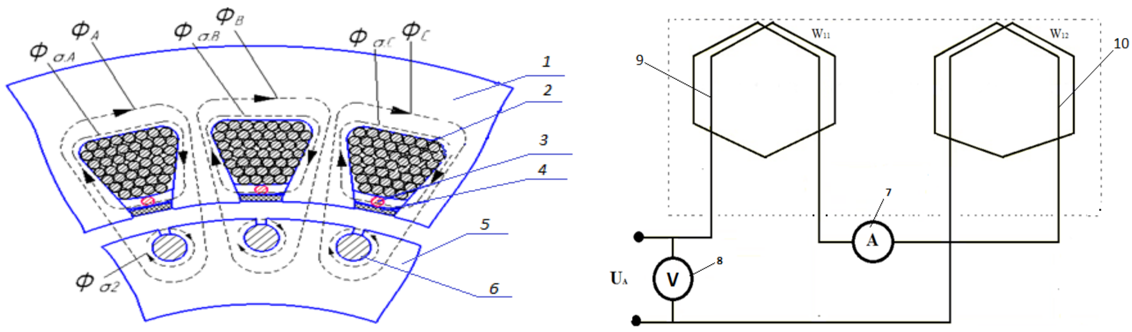

Fig. 2. A scheme that establishes the principle of signal generation based on the placement of sensitive elements in the form of a secondary coil between the stator slots of an asynchronous motor

1 - stationary part of asynchronous motor - stator, 2 - stator coils, 3 - secondary voltage generating coil - location of the sensitive measuring element, 4 - insulating paper, 5 - rotating part of the rotor, 6 - rotor coils, 7 - ammeter, 8 - voltmeter, 9-10 - secondary voltage generating coils - connection diagram of sensitive elements.

W_1 winding consist of two independent winding sections W_{11} and W_{12} installed for each phase, is the common measuring winding A phase primary current flowing from the stator windings of the asynchronous motor secondary voltage (for A phase) U_a, changes to a signal of the form When an asynchronous motor is connected to the network, the output voltage U_a, in the measuring circuit for one phase is determined as follows [7]:

$$U_a = \left(4{,}44 \cdot f \cdot W_{1A} \cdot \frac{I_A}{R_\mu}\right) W_1$$

Here *f* is the network frequency,
W_{1A} is the number of stator windings of the asynchronous motor in phase A
$W_1 = W_{11}$-W_{12} – the number of measuring coils placed in one phase (phase A).

As a result of the primary current flowing through the stator winding, the main Ф1 and scattered magnetic fluxes Фσ1 are generated and are expressed as follows:

$$\Phi_{\sigma 1} = \frac{L_\sigma I_1}{w_1}$$

$$\Phi_{\sigma 1} = \frac{L_{\sigma 1.8} I_1}{W_{11}}$$

The stray magnetic flux crosses the measuring coil and creates an output voltage in it, and to study this voltage, its research model is formed as follows:

$$\text{Ua} = \sqrt{2}\pi f w_1 \frac{L_\sigma I_A}{w_A}$$

In laboratory conditions, when the load is changed in phase A of a 250 kVA asynchronous motor, the results of the output signal of the measuring element in the measuring devices are presented in Fig. 3.

Fig. 3. The process of receiving a signal from an asynchronous motor and its measuring circuit provided by the energy source produced by solar panels in CAYSLAB laboratory devices

When the asynchronous motor operates from a single-phase network, the output signals from the electromagnetic current converter are measured on the basis of the static descriptions of the graph theory, the number of windings of the sensitive element is proportional to the output signals, and when choosing the sensitive element rings, the stator windings of the asynchronous motor are selected based on the size of the grooves (grooves). Measuring sensitive element rings are required to be fast, accurate, reliable, and have a compact geometric size, while also being able to provide a standard voltage of 5 V [8-14].

The result

The theoretical and practical results of the static description of the output voltage of the electromagnetic current converter for a single-phase asynchronous motor obtained from the results of the research can be seen. The static description of phase A and output voltage of the current transformer placed between the stator wedges and the insulating wedge of the asynchronous motor is presented in Fig. 4.

$$\Delta U_{A\,out} = \frac{U_{pract} - U_{theor.}}{U_{pract}} = \frac{3{,}85 - 3{,}84}{3{,}85} 100\% = 0{,}2\%$$

The static description of the asynchronous motor was obtained using the CAYSLAB device, and the theoretical values and practical results of the appearance of output signals provided the following asymmetry index:

$$\Delta U_{symmetrical\ size} = \frac{\Delta U_{Aout} + \Delta U_{Bout} + \Delta U_{Cout}}{U_{prakt}} =$$

$$= \frac{0,2 + 0,5 + 0,04}{3} 100\% = 0.7\%$$

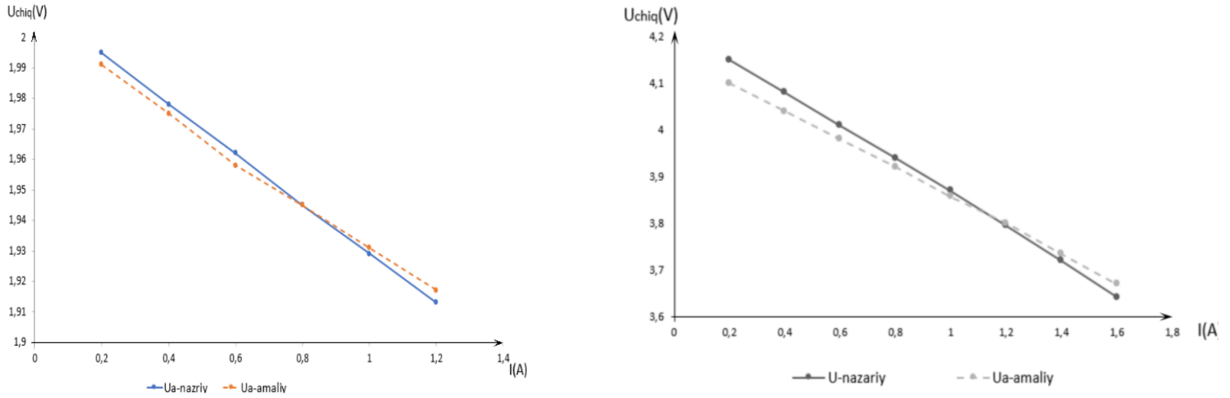

Fig. 4. Static characteristics of the A phase and output voltage of the current transformer placed between the stator wedges and the insulating wedge of the asynchronous motor: a) - output description of the circuit with a capacitor battery, b) - output description of the circuit without a capacitor battery

Discussion

From the obtained results, it can be seen that the developed three-phase current electromagnetic transformer has the advantages of high accuracy, high reliability, compact form and accurate, complete and fast delivery of information compared to classical current transformers. application in asynchronous motors used in households gives positive results.

Summary

Research results show that energy and power losses of asynchronous motors are significantly increased during overloading and when the the affected by temperature, especially after repair, as a result of a sharp increase in its non-symmetry and non-sinusoidal indicators. increase is observed. Considering that asynchronous motors are the most common in practice, measuring and controlling the amount of reactive power consumed by them, controlling three-phase currents through an electromagnetic converter can be a solution to this problem.

The fact that the static description of the current transformer is straight line, it has advantages such as simplicity, accuracy, and compactness over other types of signal transformers, and it is useful in solving problems in the field of practical application with the workability and suitability of the working environment.

References

1. I.X.Siddikov S.S A’zamov D.D Karimjonov Chemical technology control and management 2023, №4 (112) pp.21-27/ /https://ijctcm.researchcommons.org/journal/vol 2023/iss4/4/.
2. Siddiqov Ilhom Xakimovich, Denmuxammadiyev Aktam mavlonovich, A’zamov Saidikrom//Namangan muhandislik texnologiyalari ilmiy texnik jurnal volume 8.ins se 1, 2023. // http://niet.uz/index.php/nj/article/view/46.
3. D D Karimjonov[1]*, I X Siddikov[2], S S Azamov[1], and R Uzakov[1] IOP Conference Series: Earth and Environmental Science // 1142 (2023) 012023 IOP Publishing doi:10.1088/1755-1315/1142/1/012023, article online.
4. Siddiqov Ilhom Xakimovich, Denmuxammadiyev Aktam mavlonovich, A’zamov Saidikrom Saidmurodovich Science and innovation international scientific journal volume

2 issue 3 march 2023. uif-2022:8.2 //issn: 2181-3337. scientists.uz// https://cyberleninka.ru/article/n/ research of energy consumption-control of renewable energysource-byconsumers.

5. Azamov S.S., Tozhiboev Zh.B. Renewable energy source of power supply systems with expired reactive power and management of elementary improvemen Просвещение и познание 2022. № 9 (16) научно-методический журнал ст-3-7
6. International scientific-practical conference “Prospects for the develop-ment of digital energy systems, problems and solutions for obtaining renewable energy-2023”// http://jurnal.jizpi.uz/index.php/JOURNAL/article/view/39.
7. Siddikov Ilkhomjon Khakimovich, Boikhanov Zailobiddin Urazalai oglu, A’zamov Saidikrom Saidmurodovich Modeling of the asymmetrical quantities of asynchronous motors reactive powers supply on the basis of current transducers //Andijan Institute of Mechanical Engineering scientific-technical journal of mechanical engineering page-143-152.
8. Siddikov I.X Boykhanov Z. U. Karimjonov DD “Elements And Devices For Monitoring And Control Of Energy Efficiency”. The American Journal of Engineering and Technology (ISSN – 2689-0984) Published: September 29, 2020 | Pages: 136-148.
9. Siddikov IX, Boykhanov Z. U, Maksudov MT, Uzokov. R. Features production of reactive power on systems of electrical supply with renewable energy sources. Academicia: an international multidisciplinary research journal vol. 10, issue 6, June 2020 PaGES: 292-29
10. I.X.Siddikov D.D Karimjonov, Abdumutal Abdikarimovich Abdigapirov Research of three-phases current’s transducers of filter-compensation devices for control reactive power’s consumption of asynchronous motor. //Chemical Technology, Control and Management Chemical Technology, Control and

Management (ISSN 1815-4840), E-ISSN 2181-1105. 2023, №1(109) pp.35-45.
11. Siddikov I.X Boykhanov Z. U. Karimjonov D.D "Elements And Devices For Monitoring And Control Of Energy Efficiency". The American Journal of Engineering and Technology (ISSN – 2689-0984) Published: September 29, 2020 | Pages: 136-148.
12. Siddikov IX, Boykhanov Z. U, Maksudov MT, Uzokov. R. Features production of reactive power on systems of electrical supply with renewable energy sources. Academicia: an international multidisciplinary research journal vol. 10, issue 6, June 2020 PaGES: 292-29.
13. Ilhomjon Xakimovich Siddikov, A'zamov Saidikrom Saidmurodovich, Boixanov Zaylobiddin Urazali ogli, Uzakov Raxmonjon Analysis of power dissipation in a triangle connection of single-phase asynchronous motor supplied from solar energy source. https://doi.org/10.5281/zenodo.10091694
14. Аъзамов Саидикром Саидмуродович, Анализ управления и контроля рассеяния реактивной мощности однофазного асинхронного двигателя, вырабатываемой Солнечными панелями. DOI: 10.32743/UniTech.2023.115.10.16107.