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Excitation of autonomous synchronous machines by solar panel

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ABSTRACT: This article considers the question of how to excite autonomous synchronous machines by a solar panel. As you know, the rotor of a synchronous machine is powered by direct current from various energy sources. Solar panels generate direct current. The task of using solar panels as a source for exciting autonomous synchronous machines.

KEY WORDS: Synchronous, machine, rotor, solar panel, excitation, electromagnet, winding, system, source, direct current, battery, power, energy.

I. INTRODUCTION

All electrical engineers are aware that the excitation of synchronous machines can be due to electromagnetic effects or a permanent magnet. In the case of electromagnetic excitation, a special DC generator is used, which feeds the winding, in connection with its main function, this device has taken the name of "the exciter". It is worth noting that the excitation system is also divided into two types according to the method of exposure - direct and indirect. The direct excitation method implies that the shaft of a synchronous machine is connected directly by mechanical method to the exciter rotor. The indirect method assumes that in order to make the rotor rotate, another engine is used, for example, an asynchronous electric machine.

II. SIGNIFICANCE OF SYSTEM

The direct method of excitation has received the greatest distribution today. However, in cases where it is assumed that the excitation system works with powerful synchronous electric machines, independent excitation generators are used, to the winding of which current is supplied from another DC source, called under the exciter. Despite all the cumbersomeness, this system allows for greater stability in operation, as well as finer installations of the characteristics. In this system, a special direct current generator (DCG), called a exciter, is used as a source.
Excitation systems are divided into two types - direct and indirect. In direct excitation systems, the exciter armature is connected to the shaft of the synchronous machine. In indirect excitation systems, the exciter is driven by a motor that is powered by from tires of own needs or auxiliary generator. The auxiliary generator can be connected to the shaft of the synchronous machine or work autonomously. Direct systems are more reliable, since in emergency situations in the power system, the exciter rotor continues to rotate with the rotor of the synchronous machine, and the field winding is not immediately de-energized.

III. METHODOLOGY

The power of the exciter is usually equal to 0.3-3% of the power of synchronous machines. It is driven from the shaft of the synchronous machine. The excitation current of a large synchronous machine IB is relatively large and amounts to several hundred and even thousands of amperes. Therefore, it is regulated using rheostats installed in the excitation circuit of the exciter. The excitation of the exciter is carried out according to the scheme of self-excitation. Valve excitation systems can be built at high power and are more reliable than electrical machines. There are three types of valve excitation systems: self-excitation, independent and brushless.

In a system with self-excitation, the energy for excitation of a synchronous machine is taken from the armature winding of the main generator, and then converted by a static converter PU (thyristors converter) into direct current energy, which enters the excitation winding. The initial excitation of the generator occurs due to the residual magnetization of its poles.

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In an independent valve excitation system, the energy for excitation is obtained from a special exciter GN, made in the form of a three-phase synchronous generator. Its rotor is located on the shaft of the main generator. The alternating voltage of the pathogen is rectified and supplied to the field winding. A variation of the independent valve excitation system is a brushless excitation system. In this case, the anchor of the AC exciter with a three-phase winding is placed on the shaft of the main synchronous machine.

Permanent magnet synchronous machines. A feature of these machines is that they use permanent magnets to create a magnetic field of excitation. Permanent magnets are most often placed on the rotor, making the machine non-contact. Permanent magnet synchronous machines are widely used as small power generators and micromotors. The advantages of machines with permanent magnets are the simplicity of design, the absence of a sliding contact, high efficiency and less heating due to the absence of losses in the winding: excitation and sliding contact. The great advantage of these machines is also the lack of a direct current source for their excitation.

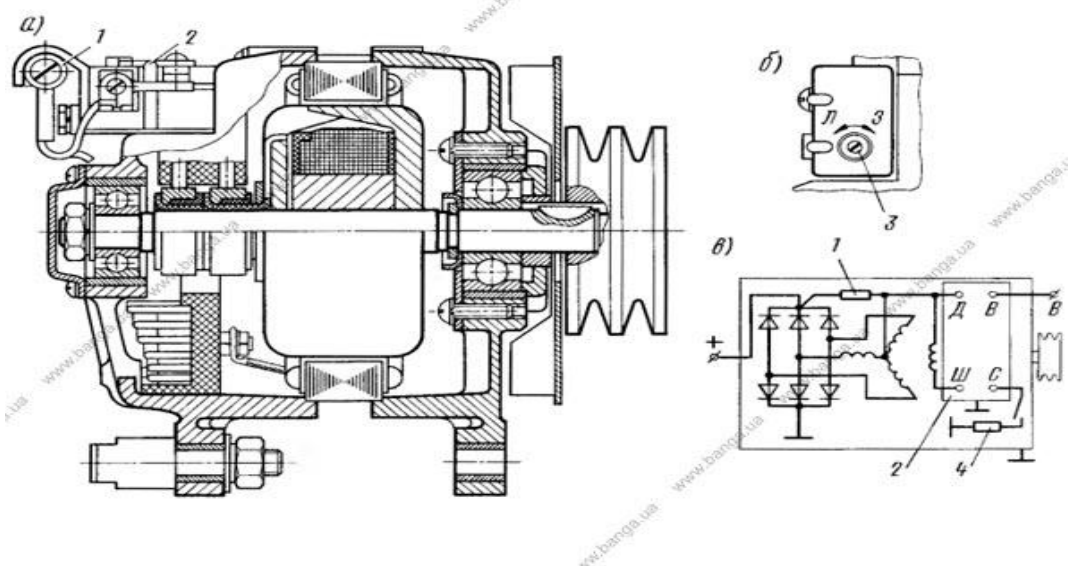

Fig. 1. Generator set G272: a — device of the generator set; b — rear view of the voltage regulator; c — electrical circuit; 1 — recharge resistance; 2 — voltage regulator Я120M; 3 — seasonal adjustment switch; 4 — seasonal adjustment resistance

The table shows the technical characteristics of the generator:

Generator type	G272
Rated voltage, V Rotation frequency (at a temperature of 25 ± 10 ° C, voltage of 28 V and independent excitation), rpm, at a load current, no more than:	28
10 A	1500
20 A	2000
Maximum power of return current, A	30
The intensity of the excitation current, A, no more	1,72
Pressure force of brush springs (with compression of a spring up to 17.5 mm), gf	190—250
Stator winding	
Wire mark	PEV-2 or PETV
Number of winding phases	3
» coils in each phase	6
» turns in coils	20
Phase resistance at a temperature of +20 ° C, Ohm	0,34...0,36
Rotor winding	
Wire mark	PEV-2 or PETV

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Number of turns	1200
Winding resistance at a temperature of + 20 ° C, Ohm	16,0—17,0
Rectifier block	
Type	BPV 24-45
Maximum reverse voltage, V	150
The strength of the maximum rectified currents,	45
Voltage drop, V, no more	0,7
Current strength at which voltage drop is measured, A	10

IV. EXPEREMENTAL RESULTS

Our country has a lot of sunny days, which allows us to focus on the conversion of solar energy, as a source of primary energy. In recent years, the development of the creation of photovoltaic solar energy converters based on silicon cells with electric power accumulators, followed by conversion to alternating voltage.

In Uzbekistan, 300 sunny days a year. An unconventional excitation system for synchronous machines can be used in countries where there are many sunny days, using a solar panel. Autonomous synchronous machines include synchronous engines of mine compressor units, open-pit and agricultural pumping units, open-pit excavators, for the excitation of diesel electric generators by a geologist for exploration and military industries.

The solar panel excitation system of autonomous synchronous machines can be used for synchronous generators and motors. The goal is to develop an unconventional excitation system for synchronous machines using solar energy. The main disadvantage of such unconventional excitation is the expensive cost of solar panels and batteries.

As you know, on the windings of synchronous machines you need to constantly supply current. In this proposed circuit, a solar panel is used for the field winding with a direct current source, while turning on both contacts, the solar panel charges the battery. In cases of lowering the power of the solar panel, the excitation system is powered by a battery. The task of the invention is the use of new non-traditional excitation systems for stand-alone synchronous machines using solar energy.

The objective of this proposed scheme is to direct the rotor winding of a synchronous machine from the solar panel to a direct current that feeds the field winding, the solar panel is the causative agent. At the same time, the solar panel charges the battery, which serves as a reserve source of the field winding. A resistor controls the excitation current of synchronous machines. The Almalyk branch of TashSTU has assembled an excitation stand for a synchronous 1500 W excitation generator with a solar panel, a diagram of which is shown in the figure 5.

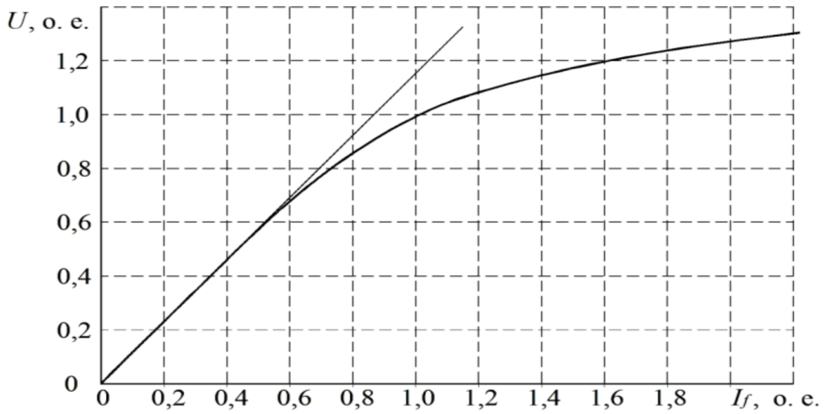

Fig. 2. Idling characteristic of a synchronous generator.

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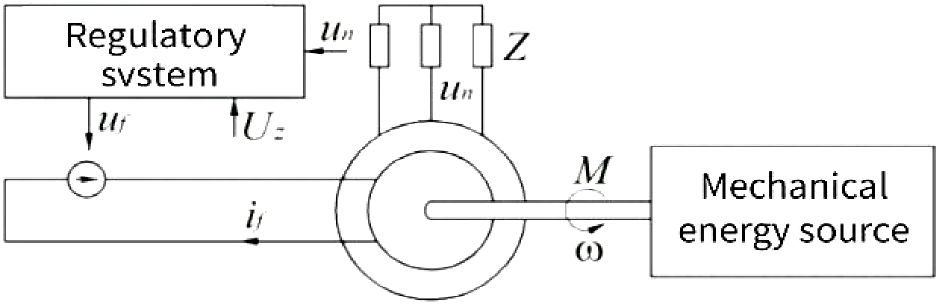

Fig. 3. Model diagram of a synchronous generator.

Figure 5 shows the investigated scheme of excitation of synchronous machines by a solar panel

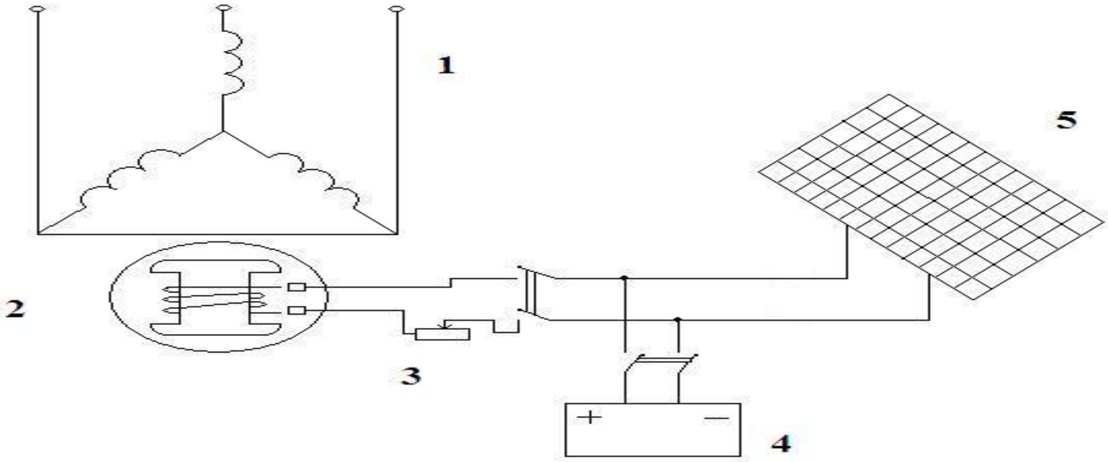

Fig. 4. 1-stator winding 2-field winding 3-stop 4-battery 5-solar panel

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