http://www.moderntechno.de/index.php/meit/article/view/meit27-01-018
DOI: 10.30890/2567-5273.2023-27-01-018

УДК 681.7

INCREASING THE SPEED DUE TO THE IMPROVEMENT OF THE TECHNICAL CHARACTERISTICS OF THE INSTRUMENT COMPONENT OF THE STABILIZER

ПІДВИЩЕННЯ ШВИДКОДІЇ ЗА РАХУНОК ПОКРАЩЕННЯ ТЕХНІЧНИХ ХАРАКТЕРИСТИК ПРИЛАДОВОГО СКЛАДУ СТАБІЛІЗАТОРА

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Abstract. *The work is devoted to the description of experimental studies of engines used in stabilizers.*

Key words: *engine, stabilizer, speed, moving object, power amplifier.*

Introduction. The speed of the stabilizer is an important aspect, as it is its ability to quickly adapt to changing external conditions, which is relevant when considering this issue from the point of view of application in military equipment. The stabilizer of moving objects must be able to quickly respond to movements and oscillations, ensuring constant stability and elimination of deviations. Performance indicators of stabilizers of moving objects, in particular their speed, largely depend on the parameters of the electric motors used in them. However, in the known literature [1-3, etc.] these issues are not considered.

The properties of electric motors play an important role in the operation of the stabilizer, as they provide movement and respond to changes in the requirements for stabilizing the object. Some of the main properties of electric motors that affect the operation of the stabilizer include the following:

• Torque: Determines the motor's ability to transmit force to move an object or control its position. The greater the torque of the electric motor, the more effectively the stabilizer will be able to keep the object in a stable position, especially during load changes or external influences.

• Reaction Speed: Determines how quickly he can change his strength and rotation speed. To effectively stabilize an object, it is necessary for the stabilizer to be able to respond quickly to changes in motion and deflection, and an electric motor with a high response speed can help achieve this goal.

• Positioning accuracy: An electric motor can have various control systems, such as encoders or position sensors, that allow the exact position of an object to be determined. This is important for the stabilizer, as it must accurately determine and

control the position of the object to avoid its unwanted movement.

• Energy efficiency: The level of energy efficiency affects the consumption of electricity and the duration of operation of the stabilizer. More efficient electric motors allow you to reduce energy losses and provide longer autonomous operation of the stabilizer, which is especially important for portable or mobile devices.

• Control and programming: Some models of electric motors support different operating modes, parameter settings and other functions that allow the stabilizer to be flexible and adapt to different conditions and requirements.

In general, the properties of electric motors, such as torque, response speed, positioning accuracy, energy efficiency and control capabilities, directly affect the performance of the stabilizer. High-quality and optimally selected electric motors help to achieve more accurate, stable and effective stabilization of a moving object.

The task of this work is to consider the main parameters of electric motors of stabilizers and to provide appropriate recommendations for improving these parameters.

Presentation of the main research material. To evaluate the time constants of electric motors used in stabilizers, experimental studies of EDM20M, EDM02, and EDM20 engines were carried out [3].

It was found that in order to increase the speed, it is necessary to use electric motors with smaller electromagnetic and electromechanical constants and increased starting and nominal torques compared to the previously used motors.

It is advisable to increase the nominal torque to (2.6-3) Nm, and the power to (800-1000) W [2.3]. Technical characteristics of electric motors are given in Table 1 [3].

Table 1 - Comparative characteristics of electric motors [3]

Engine parameters	ЕДМ03	ЕДМ20	ЕДМ20М	ЕДМ14	ЕДМ600	БДПТ
Supply voltage	23 В	23 В	23 В	23 В	23 В	-
Bias voltage in idle mode, V	2,0	-	-	-	0,7	-
Permanent E.M.F., Vs/rad	0,052	0,053	-	0,056	0,069	-
Winding resistance, Ohm	0,22	0,125	0,125	0,45	0,07	0,067
Anchor time constant, p	$0{,}32\cdot10^{-3}$	$0{,}26\cdot10^{-3}$	-	-	$0{,}49\cdot10^{-3}$	$0{,}6\cdot10^{-3}$
Moment of inertia of the anchor, $kgms^2$	$3{,}15\cdot10^{-5}$	$3{,}2\cdot10^{-5}$	$3{,}2\cdot10^{-5}$	$4{,}7\cdot10^{-5}$	-	-
Moment of resistance, Nm	1,3	1,3	1,3	0,57	1.9	2,0
Constant load moment on the shaft, Nm/A	0,052	0,054	-	0,056	0,069	-

Continuation of Table 1						
Engine parameters	ЕДМ03	ЕДМ20	ЕДМ20М	ЕДМ14	ЕДМ600	БДПТ
Starting moment, Nm	9,33	7,5	7,48	-	13,6	-
Power, W	470	400	432	180	650	800
Rotational frequency, rev/min	3500	3000	3000	3000	3700	4000
Starting current, A	130	180	131	60	240	270
Nominal current, A	31	-	25,7	-	23,7	-
Electromechanical time constant, p	$9{,}31 \cdot 10^{-3}$	$26 \cdot 10^{-3}$	$20 \cdot 10^{-3}$	-	-	-
Electromagnetic time constant, p	$0{,}32 \cdot 10^{-3}$	-	$0{,}26 \cdot 10^{-3}$	-	-	-
Overheating in nominal mode ºC	113	-	133	-	104	-

Experimental studies have revealed the possibility of reducing the inductance of chokes in LC filters of power amplifiers while maintaining an acceptable level of pulsations created by power bridge commutators working on the active-inductive load of the armature windings of electric motors [3].

As a result of these studies, the time constant of the power amplifiers was reduced to 0.3 ms compared to 8 ms.

These refinements were introduced in the corresponding stabilizer blocks produced in series, as well as in the block working with the EDM600 engine of increased power [2, 3].

The use of collectorless DC motors [1-3] has a number of advantages over conventional collector motors:

- more validity period than collector ones;
- high speed and dynamics, positioning accuracy;
- higher efficiency;
- fast dialing of the maximum rotation speed;
- greater power;
- does not require additional cooling;
- there is no spark;
- a wide range of rotation frequency changes;
- non-contact and lack of nodes requiring maintenance;
- increased service life, high reliability and increased service life due to the absence of sliding electrical contacts;
- low overheating of the electric motor when working in modes with possible overloads;
- lower level of electromagnetic noise.

At the same time, some disadvantages of brushless DC motors should be noted:

- high cost;
- it is not possible to use them without a driver;
- problematic repair, especially when rewinding the engine.

Conclusions. Experimental studies of electric motors used in stabilizers to estimate the time constants of electric motors have been carried out.

It was established that to increase the speed, it is necessary to use electric motors with smaller electromagnetic and electromechanical constants and increased starting and nominal torques compared to the previously used motors.

It is advisable to increase the nominal torque to (2.6-3) Nm, and the power to (800-1000) W.

Experimental studies have revealed the possibility of reducing the inductance of chokes in LC filters of power amplifiers while maintaining an acceptable level of pulsations created by power bridge commutators.

As a result of these studies, the time constant of the power amplifiers was reduced to 0.3 ms compared to 8 ms. These improvements are introduced in the corresponding blocks.

It is proposed to use direct current collectorless motors, which have significant advantages over conventional collector motors.

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Анотація. *Робота присвячена опису експериментальних досліджень двигунів, що використовують у стабілізаторах.*

Ключові слова: *двигун, стабілізатор, швидкодія, рухомий об'єкт, підсилювач потужності.*

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Стаття відправлена: 26.05.2023 р.