INTERNATIONAL JOURNAL OF ADVANCED RESEARCH & INNOVATION

IMPROVEMENT OF THE CONTROL SYSTEM FOR ASYNCHRONOUS ELECTRIC DRIVES IN VENTILATION UNITS

A.A. Khamzaev, M.Z. Usmonov, D.A. Atamurodov

Associate Professor of the Department of "Mining Electromechanics"

Assistant of the Department of "Mining Electromechanics"

Master's student in the field of "Electrification and Automation of Mining Works"

Abstract

The article examines the directions for improving the efficiency of asynchronous electric drives used in industrial ventilation units. Methods for modernizing the control system aimed at reducing energy consumption, increasing reliability, and improving the dynamic characteristics of the drive are presented. Recommendations for the implementation of frequency-regulated electric drives and microprocessor control systems are provided.

Keywords: numerical program control, frequency controllers, two-speed asynchronous electric motor, gas volume, capacitive sensor, air fan.

Introduction

Asynchronous electric motors are widely used in the composition of ventilation units of various industries - thermal power plants, metallurgy, mining enterprises, and in the ventilation systems of industrial premises. Traditionally, such motors are connected directly to the network, which leads to limited speed control capabilities, increased energy consumption, and reduced equipment service life.

Modern requirements for energy efficiency and reliability of industrial systems necessitate the improvement of control systems for asynchronous electric drives of

ventilation units. One of the main directions in the continuous development of production enterprises at the present time is the acceleration of scientific and technological progress, increasing the production of electricity and increasing its efficiency, and ensuring the competitiveness of products. This requires large-scale automation of technological equipment, increasing its productivity and accuracy in startup. In addition to achieving high productivity, it is also necessary to achieve energy savings. Taking all this into account, in the boiler houses of thermal power plants (thermal power plants), water is converted into steam and transferred to turbines [2]. To convert water into steam, when heating boiler houses, methane gas or fuel oil is used. Ventilators (VV) are installed on both sides of the boiler room. The purpose of this fan is to remove unburned gases or carbon monoxide gases released as a result of fuel oil combustion into the atmosphere; these fans are started using a two-speed short-circuited rotor asynchronous motor. At the same time, the fan's operating mode depends on the amount of carbon monoxide, which, in turn, is related to the problem of automatic speed control during the engine production process[1]. Depending on the readings of the gas sensor, which measures the volume of unburned gas or carbon monoxide formed as a result of fuel oil combustion, it is required to change the speed regulation of the fan motor in automatic mode.

Analysis of existing management systems

The classical control scheme for a fan electric drive involves directly connecting the motor to a fixed rotational speed network. In this case, air flow regulation is carried out by mechanical throttles,

which is accompanied by significant energy losses.

The main shortcomings of the traditional system are:

- lack of smooth rotation speed regulation;
- high starting current (5-7 times higher than the nominal);
- increased wear of mechanical elements;
- low power factor;
- uneven load on the network

Thus, existing control circuits require the implementation of modern automation and regulation tools.

Methodology

Regulating the speed of this motor leads to a reduction in workforce and low switching consumption. The application of numerical software control in TPP technology leads to the need to construct a numerical model of technological processes, which, in turn, leads to the widespread use of mathematical methods and numerical calculations [3-5]. Originating on the basis of certain sciences (engineering technology, mathematics, physics, cybernetics, computer science), the installation of a numerical program for starting electric motors has gained independent status today. The use of numerical software management not only corresponds to the technological process but also requires the implementation and provision of software management (DB) [3-5].

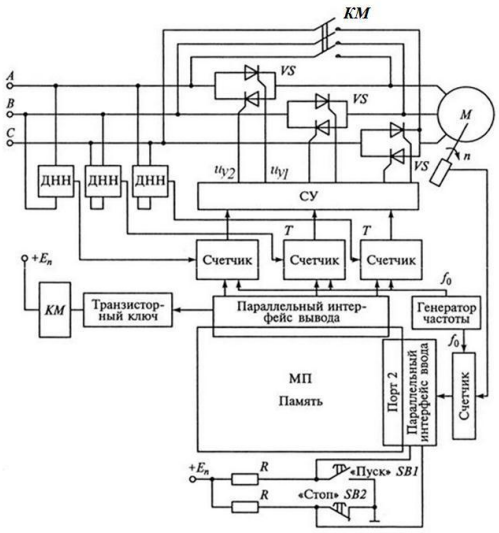

Fig. 1. Simplified motor start-up microcontroller circuit

For MPs to interact with the external world, memory devices for storing programs and intermediate calculation results, information input-output devices, etc., are necessary. The set of these devices is called a microprocessor device (MPD) (Figure 1). Taking all this into account, in the boiler houses of thermal power plants (TPPs), water is converted into steam and transferred to turbines. To convert water into steam, when heating boiler houses, methane gas or fuel oil is used. Air-blowing fans are installed on the two sides of the boiler room. The purpose of this air-blowing unit is to remove unburned gases or carbon monoxide gases released as a result of fuel oil combustion into the atmosphere; these fans are started using a two-speed short-circuited rotor asynchronous motor. At the same time, the fan's operating mode depends on the amount of carbon monoxide, which, in turn, is related to the problem of automatic speed control during the engine manufacturing process [3-5].

The most promising direction for improving ventilation electric drives is the use of frequency-regulated electric drives based on voltage inverters and microprocessor control systems.

Frequency regulation provides:

1. smooth starting and stopping of the engine;

2. optimization of energy consumption;

3. Reduction of mechanical loads on the shaft and bearings;

4. the ability to automatically maintain the required air flow rate;

5. increasing the overall reliability of the system.

For the implementation of such systems, microcontrollers capable of performing algorithms

of vector control or control by a scalar law (U/f = const) are used.

3. The proposed modernized system

The proposed management system includes:

1. Short-circuited rotor asynchronous motor.

2. Frequency Transducer with Pulse Width Modulation (PWM).

3. Control controller with PID speed and torque controller.

4. Current, speed, and temperature sensors.

5. Automatic Dispatch Control System (SCADA) Communication Interface.

The system provides an adaptive change in the frequency and amplitude of the power supply voltage depending on the required fan performance. The control algorithm implements the principle of optimal energy consumption at a given load.

Conclusions

Improving the control system of asynchronous electric drives of ventilation units is an important direction in increasing the energy efficiency of industrial enterprises. The use of microprocessor-controlled frequency-regulated electric drives significantly reduces energy costs, increases equipment reliability, and ensures optimal ventilation system operation.

Further research can be aimed at developing intelligent algorithms for adaptive regulation and integrating control systems with digital platforms of the Internet of Things.

In the output control range from 0.5 nominal to nominal, it is proposed to switch the frequency converter to a low-speed winding. While maintaining the energy characteristics, this will improve

the operating conditions of the electric motor, reduce the frequency regulation range (less regulated operating mode), and increase the equivalent efficiency of the exhaust fan. Switching the windings of a two-speed electric motor when powered from a frequency converter allows for extending the service life of expensive electrical equipment, ensures efficiency due to resource saving, and increases the reliability of the boiler's draft mechanisms.

REFERENCES

1. И.П.Копылов, Электрические машины, Москва, 2000 г.-607 ст
2. А.А. Хамзаев, Внедрение современной техники и технологии для регулирования скорости высокомощного двух скоростного электромотора в автоматическом режиме, Международный научный журнал «Молодой учёный». № 28 (132).-5ст
3. Хамзаев А.А. Применение современной техники и технологии для регулирования скорости высокомощного двух скоростного электромотора в автоматическом режиме. научно-технический и производственный журнал горный вестник,узбекистана, апрель-июнь 2017,2, №69, ст 96-99
4. Buri, T., Akbar, K. Development of Technical Solutions for the Improvement of the Smooth Starting Method of High Voltage and Powerful Asynchronous Motors. *AIP Conference Proceedings*., 2023, 2552, 040018.
5. Usmonov, M. Z., & Saidova, L. F. (2024). Determination of rational parameters of the lever. Web of Scientists and Scholars: Journal of Multidisciplinary Research, 2(2), 72-76.