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Saving Energy and Resources through Electric Power Consumers Management

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ABSTRACT: This article discusses the characteristics of electric motors in the production plants and the characteristics of their electrical power consumption in different loads, and the method of electric motors management based on these characteristics. As a result, the use of electric energy in accordance with the load, correct distribution of voltage from phase to electric motor stator, timely prevention of stator defects, the friction of rotating parts of the electric motor, re-magnetization of steel parts and to prevent occurrence of the evolution of currents, the timely detection of the failures of the bearings in the upstream part was achieved.

KEYWORDS: electric drive, energy resources, energy efficiency, electric motors, improving of electric energy efficiency, modes of operation, mathematical modeling, quantity of heat, management of power consumption.

I.INTRODUCTION

Nowadays, it is important to increase the efficiency of electricity consumers by reducing extra amount of electric energy which was produced by plants and saving energy and energy resources in all the countries of the world. One of the most important aspects of energy efficiency in developed countries is energy saving policy in the production and consumption of electricity, including the creation of highly effective techniques and technologies, the development of methodologies for evaluating electricity consumption at the production enterprises, optimizing the cost of electricity , production of the process of the electricity consumption management system, developing a complex management system for electricity consumption the impact of the complex and technical factors, to determine the level of consumption of electrical energy production and technological factors, special attention is paid to improving the methods of determining the level of the connection.

II.ENERGY EFFICIENCY

In this area , one of the important tasks is to develop balance of energy , forecasting of electricity consumption, and limit of planning methods , taking into account the quality indicators of the produced products, including the use of energy resources and increase of electricity efficiency. At present, research projects aimed at reducing the energy efficiency of industrial enterprises and increasing the efficiency of their energy supply are among the leading research centers and higher education institutions of the world, including the National Mining Institute (Ukraine), Moscow State Mining University (Russia), MP Azimuth (Russia) The extensive research in countries such as California Institute of Technology, Tokyo Technology Institute (Japan), Ontario (Canada), Indian Institute of Technology Mumbai (India), Tashkent State Technical University (Uzbekistan) [1] . In world practice the methods of computing (analysis) of electric power consumption in the machine-building plants, analysis, automatic control of technological equipment, methods of creating a mathematical model and algorithm of electric power consumers are developed. They are recommended to increase the efficiency of production by reducing the energy consumption of machine-building factories. The features of increasing the efficiency of electric energy consumers were studied by a number of scientists, including Nekrasova AS, Sinyanka Yu.V., Melexina V., Melent'eva LA, Klyueva Yu.B., Matthaus G, Tyukhmatiyev V.M and others. It has increased energy efficiency on the basis of managing the operating mode of electric energy consumers at the manufacturing enterprises. The basic principles and laws and the possible statistical approach in the stabilization of the cost of electric energy are the number of scientists, including A.P. Pishchur, V.M. Gunin, L. Koptsev, G.V. Nikiforov and others.

The method of distribution of consumed energy and the development of mathematical models and algorithm of consumers of electric power, as well as the study of the number of scientists including M. Karpenko, Suzganova E.Yu ,

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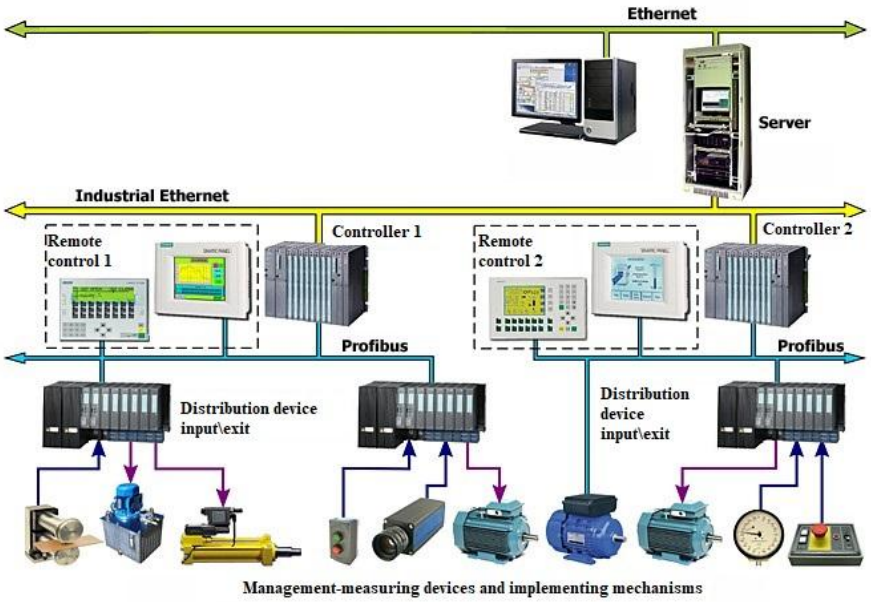
Zang L, Frost.R and other scientists [3] . However, in these studies, taking into consideration the quality of products manufactured by the machine-manufacturing factories, increasing the energy efficiency by saving energy, the efficiency of machines and mechanisms in the production and processing of machinery, and the mathematical models taking into account the factors affecting the energy consumers energy-efficient consumers by improving management and management capacity in efficiency is poorly understood. At present, the machineries of machine-building factories are the main work force of the plant.

III.RESULTS AND DISCUSSIONS

The main unit of these devices is their electrical installation. Today, in all countries of the world, 45% of electricity consumed by manufacturing enterprises. More than 25% of the electricity is consumed by the enterprise for the consumption of electricity and the remaining 20% is spent on other technological units of the enterprise. Hence, these indicators show that the main electricity consumers of the enterprise are electric locomotives. At present, there is increase in electricity scarcity due to the partial erosion of electricity in production enterprises.
The main part. Mechanisms and mechanisms of production are mainly driven by three-phase asynchronous electric motors. We know that the most delicate element of the engine is its isolation material which is covering its shavings. The engine's normal level of heat determines according to the quality and type of the material. If the temperature of the electrostatic precipitates exceeds normal temperatures, it indicates that excessive electricity is consumed. As a result of engine heating, not only excessive energy is consumed, but also excessive overload overheats the motor and its slopes are quickly disrupted, as a result the working period of motor finishes. In order to avoid such problems, it is necessary to improve automated control of electric motors and moderate them and monitor the electric motors via the computer. To do this, we need to connect these equipment directly to the computer to determine the operating modes and various characteristics of the electric motors (Figure 1). As a result, by controlling the work schedules of all electrical installations in the production enterprises, we can achieve energy consumption and energy savings and the efficient use of electricity.



Picture 1. The structure of electrical equipment control over the computer.

The following settings of electric guides can be controlled by the computer.
P_n- rated power;
U_n - nominal voltage;

I_n - nominal current;

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Cosα - force coefficient;
T-temperature;
Q - Amount of heat;
n - Nominal rotational speed.
Therefore, the main cause of electric heating is the followings:
- failure to select electrics in accordance with the delivered load;
- the voltage distribution of the stress from the phases for electrical conductors operating on phase-to-phase current as a result of symmetric operation;
- power loss in stator waster;
- rubbing of parts and re-magnetization of steel parts and energy savings generated by the stimulation of them;
- distance change between the burner bearings.
In the course of the engine's operation, its various components (bearing body, steel magnetic system, copper wax and insulating material) are heated at different temperatures. Therefore, the calculation of the engine heating is very complicated.
In practice, the motor is considered to be the same material with an equivalent thermal capacity. Accordingly, the differential equations of the heat balance of the engine can be calculated as follows:

$$Qdt = A\tau dt + cd\tau, \qquad (1)$$

where Q the total amount of gasses within the unit of time due to power loss of the material equivalent to the motor, $\frac{cal}{s}$

$$Q = 0{,}24\ \Delta P\ t = 0.24I^2Rt \qquad (1.1)$$

where 0.24 - the equivalent coefficient to convert the electric energy to heat energy; I - loading of the electric drive; R - resistance of the patient; t- is the amount of heat released [4].
Thus, the intensity of separation from the engine is proportional to the square of the load current. By identifying these indicators, we can detect the amount of heat released by the electric motor when it is hot, and then find the electricity we spend on. In the formula 1.1 - the amount of heat dissipated to the environment every second from its surface, τ- when the temperature difference between the outside temperature of the motor temperature is 1^0 degree $\frac{cal}{s*grad}$ or $\frac{J}{s*grad}$; c - the amount of heat needed to raise the motor temperature to 1^0 degree $\frac{cal}{grad}$ or$\frac{J}{grad}$; t- time, s. The engine's heat is described by the progress $\tau = f(t)$. This reference (1.1) defines the expression as follows:

$$dt = \frac{cd\tau}{Q - A\tau}$$

from that

$$t = -\frac{c}{A}\ln(Q - A\tau) + k$$

At the same time k- integral continuity=0 will be $\tau = \tau_0$ determined as follows:

$$k = \frac{c}{A}\ln(Q - A\tau_0)$$

By putting the value of k , the following expression is taken:

$$t = -\frac{c}{A}ln\frac{Q - A\tau}{Q - A\tau_0}$$

(1.5), by solving the equation τ the following is generated

$$t = \frac{Q}{A}\left(1 - e^{\frac{tA}{c}}\right) + \tau_0 e^{-\frac{1}{T}}$$

Here $\frac{Q}{A} = \tau_t$ and $\frac{c}{A} = T_q$ are the equations that interpret the engine's heating process

$$\tau_0 = \tau_t\left(1 - e^{-\frac{t}{T}}\right) + \tau_0 e^{-\frac{t}{T}}$$

where τ_t - the temperature of the engine in the steady state of operation; τ_t - Time constant of heat. By entering this formula into a computer, the result is that we detect the temperature change in the entire operation of the electric motor without the thermostat. Detecting the operating temperature of the motor, which parameter fluctuations are exceeding

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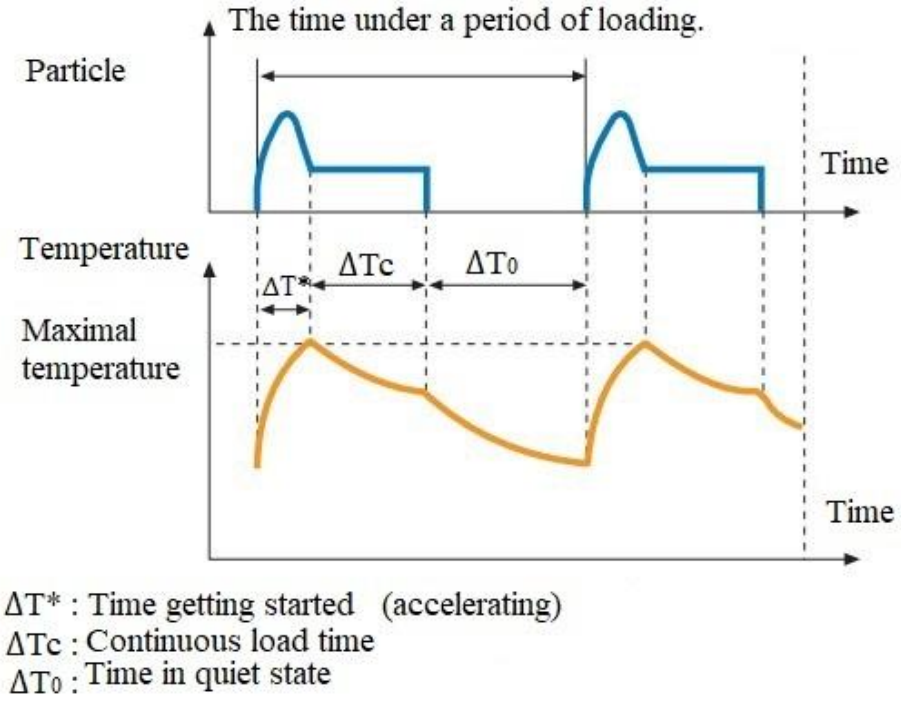
the temperature, immediately prevent this problem. Preventing this kind of heat from cooling the electric motor, as a result, prevents the electric motor from burning, and saves electrical energy.
The heating of the engine is described by the $\tau = f(t)$ connection.



If the engine is powered by a frequent start-up and interruption, then in the transitional modes, the power from the crankcase and the amount of heat released from it will depend on the electric motor controlling system.

IV. CONCLUSION

In other words, the main working bodies of machinery and mechanisms in the manufacturing enterprises are their electric motors.
If we manage business processes of these working bodies, the result is:
- Consumption of electricity in accordance with the load;
- The correct distribution of the voltage from the phase to the motor stator;
- timely prevention of stroke problems;
- friction of rotating parts of electric motor, re-magnetization of steel parts and prevention of occurrence of currents in them;
- we find timely detection of malfunctions of bearing heads in the electric motors

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