# MAIN WAYS TO ACHIEVE ENERGY SAVINGS IN ELECTRIC POWER PLANTS

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**Annotation.** ***When we tried to make the power factor close to cosφ=1, we did not have a waste. The use of capacitor devices plays an important role in the compensation of reactive power in the shop, and then to determine the total power, it is necessary to calculate the electrical load of the enterprise.***

**Keywords:** ***Transformers, measuring transformers, compressors, capacitors, accumulators, duty, we need to calculate the line length and make a clear choice.***

It is known that about 60-70% of the electricity generated worldwide is consumed by electric motors of various mechanisms and equipment. Almost 50% of the world's electricity is generated by AC and DC power plants.

That is why it is important to ensure energy efficiency through automated power plants and to train competitive personnel in this field.

At present, the following are the main ways to save energy through automated electrical equipment:

1. Correct selection of the motor power of the electric motor by improving the motor selection method depending on the actual change in the load of the production mechanism, because if the motor power is less than the load power, the motor inefficiently changes energy and and the power wasted in the transmission line is greatly increased.

2. Replacement of automated electric motors of production mechanisms with energy-saving electric motors with increased FIC and power factor values due to increase in active mass (copper and iron);



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3. Switching from non-adjustable speed controls to speed control power saving, which saves resources (water, heat, etc.) not only in the automated power system, but also in the production mechanism.

4. Development and creation of special technical solutions that ensure minimum energy consumption in the event of variable loads in non-adjustable electric motors, as well as in the case of changes in the coordinates of electric motors in controlled automated electric motors as required by the process.

The choice and implementation of one of the above ways to save energy depends on the specific conditions created by the technological mechanism, each of which has its own advantages and disadvantages.

Given the energy crisis and rising energy prices, a way to save a significant portion of the energy required by improving power management is of particular importance. The most promising way is the fourth way, which will save 30-40% of energy by improving the automated electric control algorithm.

Therefore, the main focus should be on the theoretical issues and computational methods of energy-saving automated electrical engineering due to the radical improvement of the control algorithm and the development of new systems of automated electrical engineering that provide the least energy consumption at the expense of optimal (optimal) control. It is known that the largest consumers of electricity in all countries are mainly alternating current electric motors, especially asynchronous motor electric motors, which convert almost half of the electricity generated worldwide into mechanical energy. The operation of the main part of these motors with low load or at values much smaller than the nominal leads to a significant reduction in the FIC and sos of the electric motors. This has a significant impact on the world's consumption of electricity and heat. Therefore, the object of analysis is mainly an automated electric motor with an asynchronous motor.

But it is also useful to consider ways to optimally control alternating current.

Schematic diagram of an alternating current and an electric current that ensures the equality of alternating and excitation power losses. Given the minimum power consumption of the engine in the operating mode, we write the following equation: $k_{v*} / M_*^2 / \hat{O}_*^2 = (\mathrm{k}_{Q*} + \mathrm{k}_{P*}\omega_*^{\beta})\hat{O}_*^2$,

the following definitions have been adopted here:

$$k_{v*} = \Delta \mathrm{P}_{vH} / \Delta \mathrm{P}_{\sum H}; k_{c*} = \Delta \mathrm{P}_{c.\acute{\imath}.} / \Delta \mathrm{P}_{\sum \acute{\imath}}; \mathrm{k}_{P*} = \Delta \mathrm{P}_{P.H} / \Delta \mathrm{P}_{\sum H};$$

$$k_{Q*} = \Delta \mathrm{P}_{Q.\acute{\imath}} / \Delta \mathrm{P}_{\sum \acute{\imath}}; \mathrm{k}_{M*} = \Delta \mathrm{P}_{M.H} / \Delta \mathrm{P}_{\sum H}; I_{Q*} = \mathrm{I}_Q / \mathrm{I}_{Q.\acute{I}}; \mathrm{I}_* = I_{Ya} / \mathrm{I}_{Ya.\acute{I}}.$$

The left side of the equation represents variable power dissipation and the right side represents constant power dissipation without taking into account mechanical power dissipation. Power losses on the right side of the equation can also be called excitation power losses because they consist of magnetic losses in steel and electrical losses in the drive shaft.


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Therefore, the minimum power dissipation condition of the motor can be written as: $\Delta P_{v*} = \Delta P_{Q*}$,

$$\Delta P_{v*} = k_{v*} M_*^2 / \Phi_*^2 = I_*^2 k_{v*};$$

$$\Delta P_{Q*} = \hat{O}_*^2 (k_{Q*} + k_{P*} \omega_{\bullet}^{\beta}) = I_{Q*}^2 (k_{Q*} + k_{P*} \omega_*^{\beta}).$$

Figure 1 shows a schematic diagram of an electrical circuit that ensures equal excitation and constant power dissipation.

The power control circuit of the electric drive circuit has an armature-controlled rectifier (ARC) and an excitation motor-controlled rectifier (ACC). Separate current meters (MVDs) are connected to the motor armature and drive chains. These current gauges measure the square of the current in the circuit. A functional converter (FO'1) and a multiplier were used to determine the power dissipation in the engine steel. The signal to FO1 is taken from the speedometer (TO). Variable power dissipation and excitation power dissipation are compared at the inlet of the regulator (R) to ensure their equality. If it is necessary to take into account the nonlinearity of the motor magnetization characteristic, then an additional functional converter (FO’2) is added to the circuit diagram, which represents the nonlinearity of the magnetic flux depending on the excitation current.

Adjustment system that calculates the optimal excitation current of the electric drive. The optimum magnetic flux for an electric motor at a given speed and load is determined by the following equation:

$$\hat{O}_{\hat{\imath}pt\,*}^2 = \check{E}_* \sqrt{\frac{k_{v*}}{k_{Q*} + k_{P*} \omega^{\beta}}}.$$

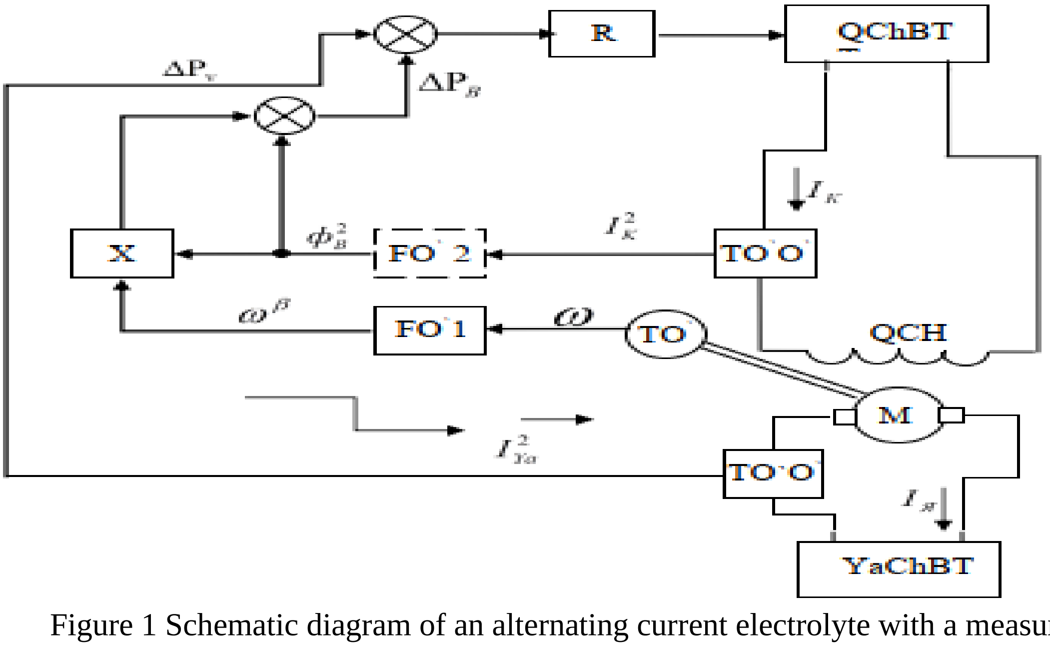


Figure 1 Schematic diagram of an alternating current electrolyte with a measuring transducer that converts the value of currents into squares


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For the linear part of the motor magnetization characteristic, this expression represents the law of adjustment of the excitation current for a given load moment and speed of the motor. A schematic diagram of an electric drive that implements this law is shown in Figure 2.

In the armature chain of an electric drive, the speed of the motor is controlled by a speed regulator (RT). The input to the RTez is given the difference between the given value of the velocity and the real values. In the motor drive chain, the energy drive is optimized. The optimum value of the current in the drive circuit is determined by the current regulator (RT). A computing device (HQ), such as a microprocessor, determines the optimal value of the excitation current by processing certain coefficients and moment M and velocity values based on given mathematical expressions. The torque of the motor is determined by multiplying the proportional values of the armature current and the excitation current.

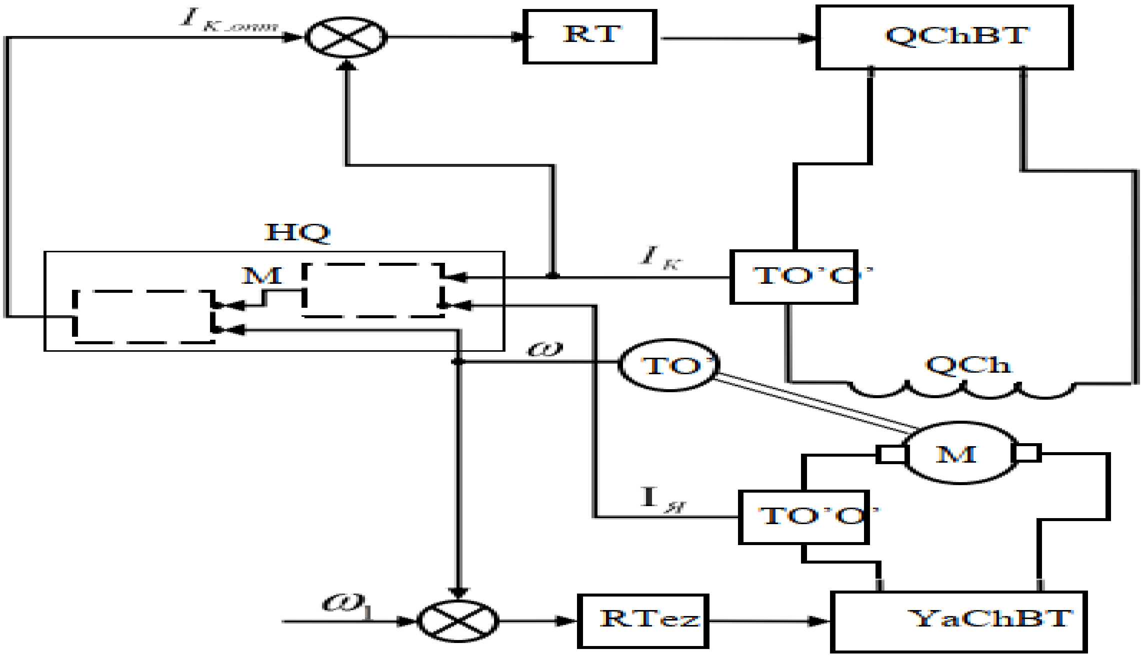


Figure 2 Schematic diagram of an alternating current electric circuit containing a device for calculating the optimal value of the excitation current

A system that operates a DC motor with a minimum power dissipation when the motor torque changes. If the torque of the electric field varies with velocity, then the scheme in Figure 2 can be simplified. For example, for an electric fan, the torque is as follows:

$$M \approx \omega_*^2.$$

In this case, the optimal value of the magnetic flux is determined by the following equation:

$$\hat{O}_{\hat{i}pt*} = \omega_* \sqrt{\frac{\mathrm{k}_{\mathrm{v}*}}{k_{Q*} + \mathrm{k}_{\mathrm{P}*}\omega^{\beta}}},$$

ya’ni moment faqatgina tezlikka bog`liq bo‘lib qoladi.

Berilgan tezlikni o‘zgartirmasdan ushlab turilib, motorning minimum quvvat isrofi rejimida ishlashini amalga oshiruvchi elektr yuritma sxemasi 3,a – rasmda keltirilgan. Berilgan tezlikni o‘zgartirmasdan ushlab turish, yakor zanjiri kuchlanishini tezlik rostlagichi (RTyez) orqali rostlash hisobiga amalga oshiriladi.



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The function of the functional converter (FO) is to determine the optimal value of the excitation current at a given speed. The motor is for the linear part of the magnetization characteristic $I_{Q.\hat{\imath}pt*} = \hat{O}_{\hat{\imath}pt.*}$ . For the nonlinear part of the motor magnetization characteristic, the value of the excitation current must be corrected by a functional variable. The description of the change in the optimum value of the motor excitation current ( $I_{Q.\hat{\imath}pt}(\omega)$ ) for a mechanically powered electric motor with a fan is shown in Figure 3, b.

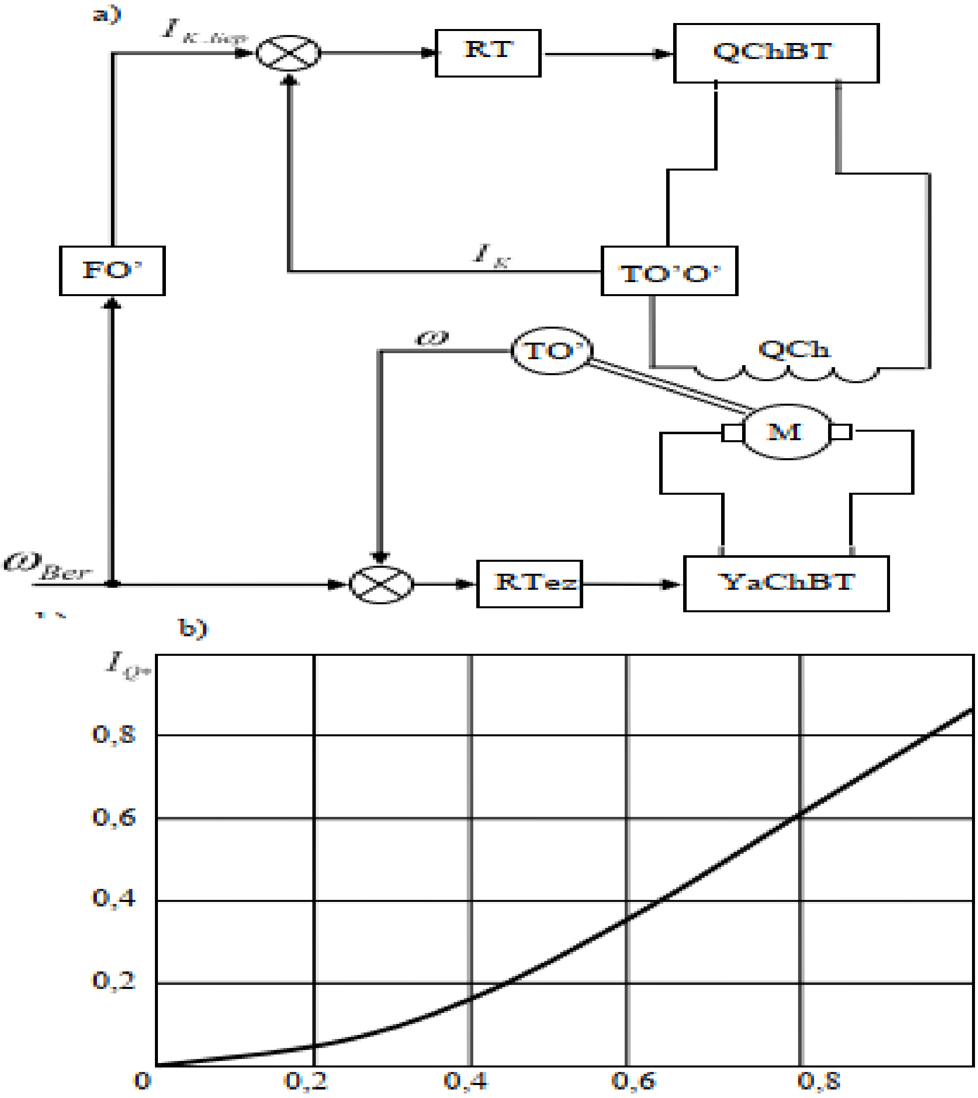


Figure 3 DC current of the fan-loaded mechanism: a - system diagram; b is the velocity-dependent characteristic of the optimal excitation current

A schematic diagram of the searchable automatic control system of the electric drive, which is free from these shortcomings, is shown in Figure 4a. The power meter (QOO), which measures the total active power consumed by the motor armature and drive shafts, and its value is:

$$P_1 = P + \Delta P_{\Sigma} = M\omega + \Delta P_{\Sigma} .$$

If and, then the value of depends only on the magnetic flux, and its minimum value is determined by the minimum power dissipation. Figure 4, b shows


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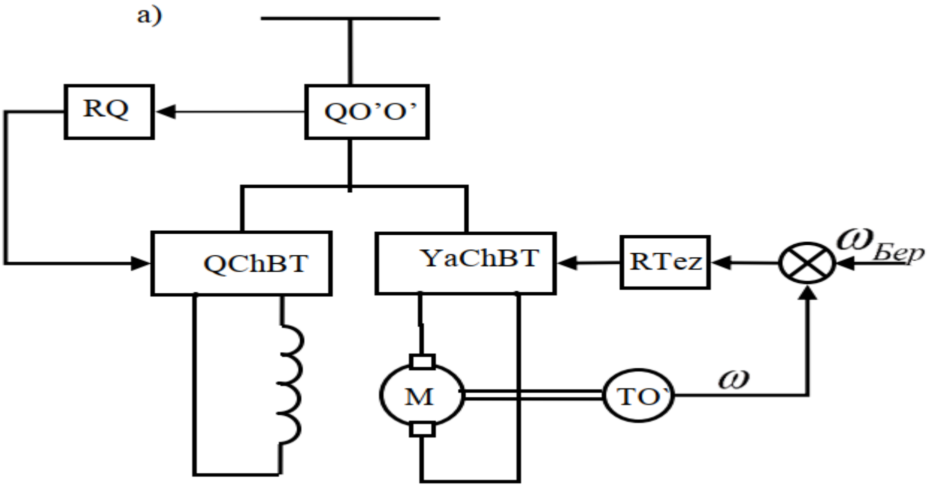
a description of the magnetic flux of the active power consumed by a P71 stationary motor.

It is known that the differential of any continuous function changes its sign at the extreme value. The regulator in the drive belt seeks the minimum value of the power consumed by keeping the power differential over time at zero.

The advantage of such an adjustment system is that the setting of the minimum value of the power consumption sought does not depend on the performance and operating conditions of the power supply, but the level of accuracy is not high, because the minimum value of the power characteristic is not very clear (4, b - see picture). In addition, such search adjustment systems cannot be used for electric motors where the torque or speed is constantly changing

a)




during operation.

b)

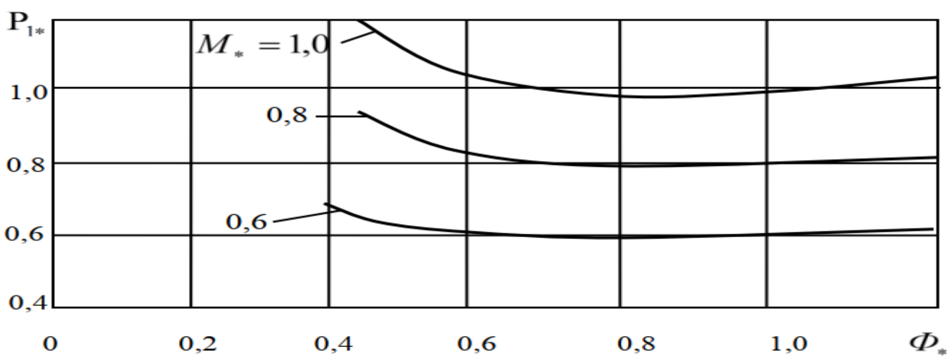



Figure 4 Search system that provides the minimum power dissipation mode of AC power: a - system diagram; b is a description of the dependence of the power consumed on the magnetic flux.

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