УДК621.317.38+620.9.62

ENERGY SAVING IN UNCONTROLLABLE ELECTRIC DRIVES

O.P. Burmistenkov, PhD, Professor
Kyiv National University of Technology and Design
S.A. Demishonkova, Ph.D.
Kyiv National University of Technology and Design

Keywords: energy conservation, alternative energy sources, environmental issues.

Power engineering is the basis of economic development, the driving force of production. From a philosophical point of view - energy is a quantitative measure of the interaction and movement of all kinds of matter. Energy is not created out of nothing and does not disappear; it can only be transformed from one form to another. So energy obeys the law of energy conservation and it preservation is impossible, so we can only speak about efficient ways of generating and using energy. However, the term of energy saving is widely used in scientific and technical literature and results usually in reduction of useless losses. Analysis of the losses in the production, distribution and consumption shows that the main component of losses (90%) is in the sphere of consumption.

The rate of energy consumption increases worldwide, so at the present stage of civilization the most burning issue of energy efficiency.

The world is facing two problems: how to get cheap electricity and how to effectively use it? This article analysed the energy sources used in industry, transport and household and identified possible ways of savings it while using.

Energy sources can be divided into two types: permanent and non-renewable. In non-renewable sources energy production based on the burning of coal, oil, gas and atomic energy.

Non-renewable energy sources - are those deposits of substances that naturally formed and accumulated in the bowels of the planet, and therefore able in certain circumstances to liberate accumulated energy. These energy sources include fossil fuels: coal, oil, natural gas, peat, oil shale, nuclear fuel. Organic fuel formed mainly from plant matter. Millions of years in the bowels of the earth continued the disintegration process of plants and animals remains that once been using solar energy.

Permanent energy sources include solar energy received at HES, etc. Technology of reception and converting energy from these sources fulfilled fairly well, but these energy sources are sorely lacking and need new sources of energy.

The effect of energy conservation in every element of the electromechanical system conveniently traced on the example of functional energy structural scheme of unmanageable electric drives.

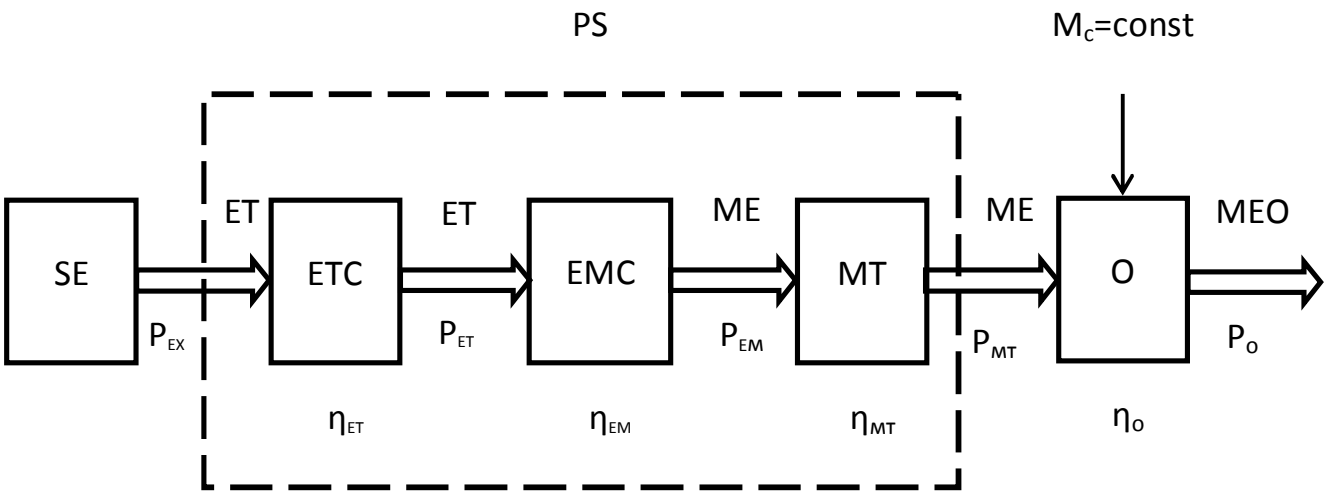

Figure 1 – functional energy structural scheme of unmanageable electric drives.

where ET and ME – flows of electrical and mechanical energy; SE – a source of energy; ETC – electro-technical converter; EMC – electromechanical converter; MT – manual transmission; O – technological object.

Energy characteristics of each the scheme element characterized by its coefficient of performance (COP) η and power, which is the input. Efficiency coefficient describes the energy loss in the corresponding elements that can be expressed as:

$$\Delta P_x = (1-\eta_x)\cdot P_{x\text{EX}};$$

where $P_{x\text{EX}}$ – Power supplied to the input element X.

In electromechanical systems with unmanageable electric drive usually constant dimension of load moment Ms = const. Then energetic elements equality of the analysed system will look like:

$$P_{ET} = P_{EX}\cdot\eta_{ET};$$
$$P_{EM} = P_{ET}\cdot\eta_{EM};$$
$$P_{MT} = P_{EM};$$
$$P_O = P_{MT}\cdot\eta_0.$$

Solving equations obtained together there can be obtained an equation, that determines the power of the system output:

$$P_0 = P_{EX} = P_{EX}\cdot\eta_{EMC};$$

where, $\eta_{EMC} = \eta_{ET}\cdot\eta_{EM}\cdot\eta_{MT}\cdot\eta_0$ – Efficiency of uncontrolled electromechanical system consisting of the efficiency of all the system elements.

Assuming that Efficiency of the object is constant, or close to it, the energy loss in the system will only depend on the efficiency of its constituent elements.

The value of the nominal efficiency of individual elements included in the structure of the electromechanical system depends on the type, capacity and some features of modern system components and specified in the relevant technical documents.

We use the efficiency values for the most common elements in considered systems, the efficiency of electrical transformer (based on modern thyristors) – 0.96; efficiency of the electromechanical transducer (highest efficiency has asynchronous electromotor with short circuit rotor) – 0.8; Efficiency of mechanical transmission (cylindrical Tooth gearings) – 0.96 and calculate the output power of the object:

$$P_0 = 0,96 \cdot 0,8 \cdot 0,96 \cdot \eta_0 \cdot P_{EX} = 0,74 \cdot \eta_0$$

This shows the percentage of energy lost in elements that connect the power source and the object. If in the last equation consider Efficiency of object it is possible to determine the full energy losses and identify ways to reduce losses. So for the object type centrifugal fans - the efficiency is 0.5, here:

$$P_0 = 0,37 \cdot P_{EX}$$

Thus, more than 50% of the energy is lost on its way from the power source to the object, and the bulk of the of losses falls on the processes taking place in the object.

Reducing energy loss in electromechanical system can be achieved using elements with high efficiency, reducing the number of elements in the system (such as using gearless drive) and improving manufacturing processes in the object.

Similarly, we can analyse the energy loss when used for lighting the streets and houses, when used in household appliances for cooking, its heating and cooling, etc. and identify ways to reduce energy losses.

World population should change their views on the use of non-renewable energy sources, as their deposits are exhausted, and its intensive use is dangerously polluting. The easiest way to reduce pollution is to use energy efficiently.

Even more promising way to save the environment is reducing the use of non-renewable sources of energy and increased use of renewable energy sources.

References

1. Krasnok AE, Maksimov Y.S., Denysyuk AI, PA Belov, AE Miroshnichenko, Symovskyy CR, YS Kyvshar: Optical nanoantennas// Successes of physical sciences. - 2013 - Vol 183, number 6. - pp. 561-589.

2. Energy Strategy of Ukraine till 2030. - Access mode: http://mpe.kmu.gov.ua/control/uk/archive/