

## **Use of fuel-free energy plants based on turbo expander-generator sets for the production of heat, cold and electricity**

Over the last two decades, in industrialized countries, effective installations have been actively created and are being implemented that convert the energy of fossil fuels into electricity and heat. To increase the technical and economic performance of such facilities, new, unconventional methods are needed. Their application would lead to a significant increase in the technical and economic indicators of power equipment, as well as to improve its environmental friendliness.

A variant of solving this problem at industrial facilities that use natural gas as fuel is the EGS - expander-generator sets. In these devices first an expander convert the energy of the flow of natural gas into mechanical energy, and then in the generator - into electrical energy. In this case, it is possible in principle, together with electricity, to obtain heat energy at different temperature levels (high-temperature for heating, low-temperature for use in refrigeration and air-conditioning systems).

The EGS consists of an turbo-expander, an electric generator, heat exchangers for gas heating, regulating and shut-off fittings, a control and automation system and automation.

Currently, EGS is used at gas control points (GRP) and gas distribution stations (GDS), where due to the throttling of the gas flow, a technological reduction of the gas pressure occurs. The analysis showed that with the use of technological differences in the transported gas, EGS generate electricity with better thermal efficiency than that produced by existing gas turbine and steam turbine units. However, at the same time, combustion of fuel occurs, leading to air pollution.

The method of operation of the EGS, allowing this unit to function without burning fuel, as well as a technical solution for implementing the proposed method, were proposed and patented in 1999. In the proposed model, the gas entering the expander is heated by a heat pump, which operates on energy, which is generated by the generator of the EGS. Such a technical solution allows to ensure the normal operation of the EGS by using low-potential energy without burning fuel. The source of such energy can be both secondary energy resources and thermal energy of the environment.

Another fuel-less unit is based on heating the gas entering the expander, due to the operation of the so-called air heat pump, which combines an air compressor and an air turbine. This technical solution is also patented.

The work of both the heat and air heat pump in both units is provided by the electricity generated by the generator of the EGS. Due to this, the useful electrical capacity of the plants decreases - that is, the power that can be transferred to consumers.

Creation of a fuel-free installation based on the device and the principle of operation of the expander-generator set is possible in the case of a choice of the operating mode with the gas heating at the expander exit. However, in this case, the gas leaving the expander will have such a low temperature that it can not meet the operating conditions ( $-80$  -  $-100$  ° C). In addition, with such a technical solution, the gas before the expander would have to be throttled, losing a significant part of the potential of its pressure. Proceeding from this, such installations will most likely not be widely used. Of more interest are fuel-free plants based on EGS, in which the gas that enters the expander is heated by heat with a temperature so low that it can not be used to heat the gas to the temperature required by the operating conditions ( $+80$  to  $+100$  ° C). Transforming facilities are used to increase the potential for such heat.

To date, on the basis of expander-generator sets, two types of fuelless plants have been developed. The first model consists of a EGS and a traditional heat pump, in which the working medium is refrigerants - substances having a low boiling point. The second model operates on a so-called air heat pump, in which the working body is ordinary atmospheric air. Each of the options has a number of advantages and disadvantages. However, both these models of installations are inherently fuel-less, that is, their work takes place without burning fuel.

#### References:

1. Use of fuel-free energy plants based on turbo expander-generator sets for the production of heat, cold and electricity  
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