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Choice For Electric Power Unit Smoke Exhausts №1 Tolimarjon Thermal Electric Power Plant

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***Abstract* —** *Producing volatile gases and particles during the combustion of natural gas in the furnace of a thermal power station and necessity of using smoke exhauster with variable-frequency asynchronous drive in their transportation and features of its functioning are considered.*

Keywords — power unit; exhaust gases; thermal power plant; frequency-controlled asynchronous electric drive; energy-efficient induction machine;

Introduction

The choice of the electric smoke pump drive for the power unit No. 1 of the Tolimarjan TPP should be made taking into account the world experience, which recommends that for the effective operation of boiler units, a smoke pump should be used to ensure complete combustion of natural gas in the draft system of the power unit.

The capacity of the current power unit of the Talimarjan TPP is 800 MW. For proper operation of the furnace of boiler units and ensuring complete combustion of natural gas, an important role in the traction-blast system of the power unit is played by the smoke pump, which contributes to the release of burned gases and particles into the atmosphere.

The temperature of the exhaust gases behind the boiler is within 150-500 C^0. Additional heating surfaces (economizers and air heaters) allow it to be lowered at natural draft to 150 – 180 C^0, and at artificial – even lower. However, we can not allow the temperature of the outgoing gases to fall below the dew point, since the water vapors present in the gases begin to condense. The formation of moisture is unacceptable due to rapid metal corrosion of economizers, air heaters, smoke pumps, and chimneys [1].

It should be noted that when burning $1m^3$ of natural gas, about $2m^3$ of water vapor (more than 1.5 kg) is formed. The temperature at which water vapor begins to condense from the outgoing gases depends on (Fig. 1).

When the dew point is 55-61 C^0, to prevent condensation, the temperature of the exhaust gases in front of the chimney is usually maintained at least 100-120 C^0. If burning contact economizers are installed behind the boilers, which condense all the moisture contained in the combustion products, their temperature is reduced to 35 – 45 C^0. This allows you to use conventional fans instead of smoke pumps.

Rarefaction in the furnaces of industrial furnaces and boilers of high power, which provide a large resistance to the movement of gases, is created by means of smoke pumps. They are also installed in cases when there are devices behind the units that utilize heat (economizers, air heaters, recuperates, etc.).

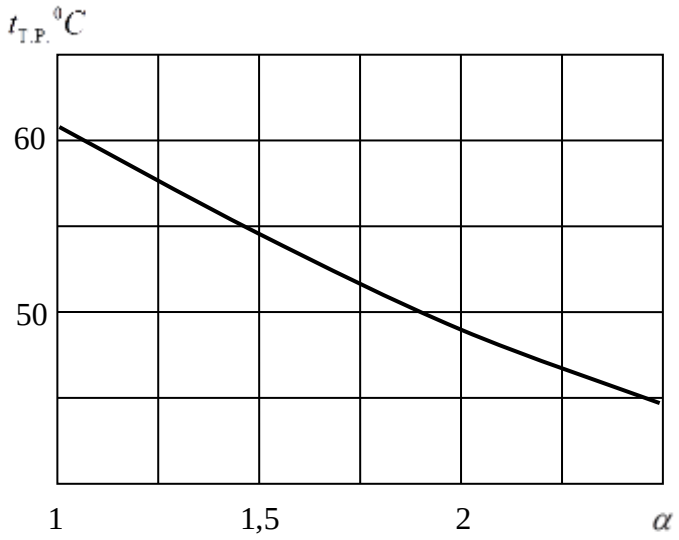


Fig. 1. Dependence of the dew point of outgoing gases $t_{T.P.}$ on α

The vacuum in the unit equipped with a smoke pump can be adjusted in various ways (Fig. 2):

1. The gate on the pressure side of the smoke pump;

2. Special guide device with rotary blades,
installed on the suction pipe of the smoke exhaust;

3. With fluid couplings, connecting shafts exhaust fan and motor, and provide the ability to change the speed of the exhaust fan at a constant speed of rotation of the electric motor;

4. Application of frequency-controlled asynchronous electric drive for regulating the speed of the smoke pump.

The first method requires the highest energy consumption for the operation of the smoke pump, the second-about 20% less, the third-50% less, and the fourth-the most economical method with the lowest energy costs [2].

The use of frequency-regulated asynchronous electric drive to smoke exhauster allows to solve the problem of matching the operating parameters and energy consumption of Tahoe-blowing mechanisms with the changing nature of the load boilers, efficient process automation, can save up to 70% of the electricity going on actuation of smoke, saves fuel by optimizing the joint work of fan and smoke exhauster. Smooth start of electric drives and full protection of the electric motor allow to increase the repair period, reduce the accident rate of equipment.

In addition, the use of a frequency-controlled asynchronous electric drive for controlling the smoke pump provides [2,3]:

- complete elimination of current overload of the motor and elimination of belt slippage;
- reduction of electricity consumption by 10-50% due to the rejection of regulation by gates;
- automatic maintenance of pressure and discharge in the air ducts when changing the operating modes of the equipment;
- elimination of the need to restart the entire process after short-term power outages due to shock-free re-activation of the rotating motor ("pick-up" function");
- possibility of precise dosage and increase of the efficiency of burning processes.

As a result, fuel consumption is reduced by 3-10% at the same boiler capacity [4].

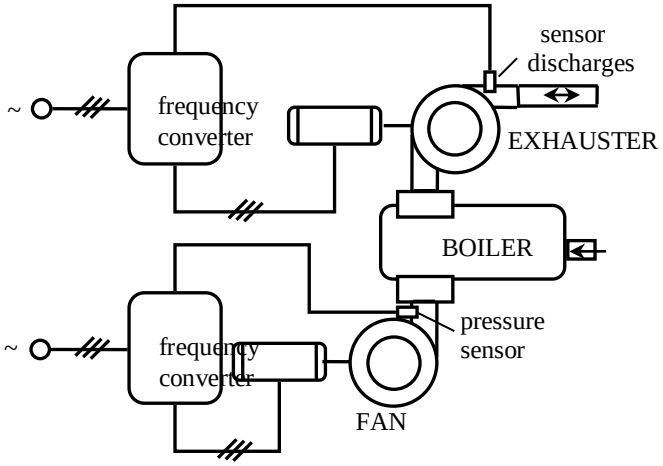
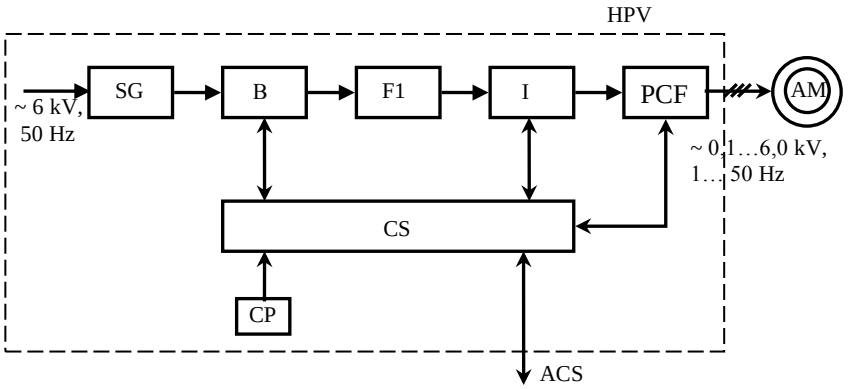


Fig. 2. Reduced technological scheme of thermal power plant

We will use a modern frequency-controlled asynchronous electric drive with a high-voltage frequency Converter of the HPV type for driving the smoke pump to save energy in the electric drive of the smoke pump in dynamic and static modes of operation, (Fig. 3).

Frequency-regulated asynchronous electric drive of smoke exhauster has the following power components: LCH – line chokes, designed to current limit short-circuit, reducing the speed of switching and limits the reverse current of the thyristors; In – controlled three-phase bridge rectifier intended for rectification of the mains voltage, the voltage in the DC link and the implementation of soft start the motor, the rectifier is assembled from high-voltage thyristors; F1 – filter DC voltage (F1); I – a three-phase bridge inverter designed to convert rectified voltage to AC with the required frequency and voltage values, the inverter valves are built on the basis of series-connected IGBT modules with protective circuits; PCF – a power compensating filter designed to filter the output step voltage and current of the inverter; CS – a control system with a control panel



(PU).

Fig. 3. Functional diagram of the frequency-controlled asynchronous electric drive of the smoke pump based on HPV

The frequency-controlled asynchronous electric drive functions as follows. The mains voltage is rectified in the rectifier B and smoothed out in the intermediate filter F1. Sinusoidal (average) voltage is formed in the HPV using an inverter and pulse width modulation (PWM). PWM ripples are smoothed out by the PCF filter, so the voltage at the HPV output is sinusoidal. The content of higher harmonics in it is not higher than in the mains voltage (no more than 5 %) and the engine in steady mode works as when powered from the mains - without additional losses. In transient modes, the voltage amplitude and frequency are formed on the principle of vector control, ensuring the optimal motor mode during start-up when the speed (performance) set point changes. The set point value can be set either from a local remote control or remotely from an automated system.

Conclusions.

The main power element of a high-voltage frequency-controlled asynchronous electric drive is a high-voltage HPV frequency Converter, it consists of a rectifier assembled from high-voltage thyristor valves and an Autonomous inverter built on the basis of series-connected IGBT modules.

Main nominal technical characteristics of HPV:

- rated power, 6000 kW;
- supply voltage (three-phase, variable), 6300 V;
- power supply frequency, 50+ 2% Hz;
- supply voltage for own needs , (three-phase with neutral, variable) 380 V;
- rated output voltage, 6000 B;
- output voltage frequency, 5 ... 50 Hz;
- efficiency factor, 95 %;

The operating mode is long-term and the cooling method is air.

Thus, using a smoke pump for an unregulated asynchronous electric drive, using a frequency-controlled asynchronous electric drive, it will be possible to save electricity by about 25% of the power consumption of the smoke pump.

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