ISSN 0040-6015, Thermal Engineering, 2013, Vol. 60, No. 8, pp. 548–553. © Pleiades Publishing, Inc., 2013.
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STEAM-TURBINE, GAS-TURBINE, AND COMBINED-CYCLE PLANTS AND THEIR AUXILIARY EQUIPMENT

The T-100-12.8 Family of Cogeneration Steam Turbines: Yesterday, Today, and Tomorrow

A. E. Valamin[a], A. Yu. Kultyshev[a, b], T. L. Shibaev[a], Yu. A. Sakhnin[a], and M. Yu. Stepanov[a]

[a] *Ural Turbine Works, ul. Frontovykh Brigad 18, Yekaterinburg, 620017 Russia*

[b] *Ural Federal University, ul. Mira 19, Yekaterinburg, 620002 Russia*

Abstract—The T-100-12.8 turbine and its versions, a type of cogeneration steam turbines that is among best known, unique, and most widely used ones in Russia and abroad, are considered. A list of turbine design versions and quantities in which they were produced, their technical and economic indicators, design features, schematic solutions used in different design versions, and a list of solutions available in a comprehensive portfolio offered for modernizing type T-100-12.8 turbines are presented. Information about amounts in which turbines of the last version are supplied currently and supposed to be supplied soon is given.

Keywords: steam turbine, district heating cogeneration, high-pressure cylinder, intermediate-pressure cylinder, low-pressure cylinder, steam admission, control stage

DOI: 10.1134/S0040601513080144

Now, when preparations to the 75th anniversary of the Ural Turbine Works are underway, we would like to touch the topic about the T-100-12.8 (T-100) turbine and its design versions, which is one of the best known, unique and most widely used cogeneration steam turbines in Russia and abroad. The first T-100-12.8 turbine was put in operation in 1961 at Mosenergo's TETs-20 cogeneration station (CSs). Turbines of the T-100 series, which were intended for use at newly constructed and expanded CSs in large and medium-size cities, were designed with a certain degree of versatility; i.e., they had fairly good efficiency both during operation at different heat loads and in purely condensing modes. The turbine has a well-developed low-potential part, a condenser group with the optimal flowrate of cooling water, and a well-developed regeneration system, due to which it became very popular. Since 1961, the Ural Turbine Works (formerly TMZ) has produced 245 turbines of the T-100 family, which were issued in different design versions in different years and commissioned at 106 CSs and district power stations (DPSs) in 13 countries around the world.

Turbines of the T-100 family have always featured high efficiency and reliability indicators and, accordingly, met almost all requirements of their customers.

The T-100 turbine is a single-shaft set consisting of high-, intermediate-, and low-pressure cylinders (HPC, IPS, and LPC) and fitted with a nozzle-type steam admission system. Live steam is supplied via steam lines to the stop valve, from which it is fed through four crossover pipes to four boxes of control valves. Control valves are manipulated by means of a cam-type distribution device, the shaft of which is driven by a servomotor through a toothed bar.

Steam passes through the HPC in a direction opposite to that in the IPC, due to which the HPC blade system is designed for leftward direction of rotation. The HPC flow path, which has a yokeless design, includes a two-row control stage and eight impulse-type stages. The first regenerative extraction of steam in the HPC is taken from its exhaust. This solution, according to which there are no steam extractions from the cylinder itself, simplifies the HPC design. Steam leaving the HPC is forwarded to the IPC via four crossover pipes.

The turbine unit does not have a steam reheat system because the gain in efficiency obtained from using steam reheating in turbines having heating or process steam extractions is smaller than in condensing turbines; nonetheless, a few draft design versions of the turbine with steam reheating have been elaborated [1, 2].

The intermediate-pressure cylinder consists of a cast-and-welded steam admission part and a welded exhaust part interconnected by a vertical flange. The cylinder comprises eight stages with all-forged disks and six subsequent stages with shrunk-on disks.

The low-pressure cylinder has a double-flow design and consists of a middle part and two exhaust parts connected to the middle part on both sides. Each of two LPC flows has two stages. Control diaphragms are installed at the flow path inlet, which serve to perform control within the required pressure range in the chamber of lower district heating extraction in the case of using single-stage heating of delivery water, as well