EXPERIENCE GAINED IN THE ASSEMBLY AND IN THE
STARTUP AND ADJUSTMENT OF THE GPA-Ts-16
GAS PUMPING AGGREGATE, EQUIPPED WITH
A LUBRICANT-FREE BLOWER

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The increase in the capacity of gas pumping aggregates (GPA) leads to large stresses on the bearings, an increased loss of capacity due to friction, an increased consumption of lubricants, complications in the design, and an increased metal requirement for the lubricating system. Besides this it is known from the experience gained in the exploitation of centrifugal compressors (CC), incorporated in GPA, that 40% of all stoppages due to breakdowns are caused by some disturbance in the lubrication system of the bearings and seals. The efficiency of centrifugal compressors can be improved by the following technical solutions: the installation of the rotor shaft in electromagnetic bearings (MB), hermetic sealing of the shaft by means of contact-free (dry) gas seals, the use of a membrane (dry) coupling which transmits the torque from the driving motor to the CC.

The additional expenses for the inclusion of a CC with electromagnetic bearings, contact-free seals, and a membrane coupling are compensated by an increased reliability, a reduced consumption of lubricants, a decrease in the dimensions and the mass, and by an extended period between overhauls by reduced leakages of gas and by a reduced contamination of the gas by the lubricating oil.

The use of MB is expedient in high-speed CC with medium and large capacities; the savings achieved are the largest in this case [1-3]. Friction losses are significantly smaller in MB than in roller or journal bearings. The power $P_p$ spent by radial bearings of different types as function of the rotor speed is shown in Fig. 1 (mass of rotor 1000 kg, diameter of MB 150 mm, of hydrodynamic and roller bearings 100 mm).

The present article offer the results of the testing of an improved lubricant-free blower, built into a GPA-Ts-16 gas pumping aggregate. The MB system includes a pressurization system for the explosion-proofing of electrotechnical equipment by creating an excess pressure in the MB shells and to prevent penetration of the natural gas into the shells. At all operating

![Fig. 1. Power $P_p$ spent by radial bearings of different types as function of the rotor speed $n$: 1) roller bearing; 2) hydrodynamic journal bearing; 3) active magnetic bearing.](image)

modes of the GPA the bearing compartments were first made explosion-proof by the supply of pressurized air from a VV-2/1-1.01 turbocompressor (power required 0.25 W, output 0.033 m³/min). However, it was decided then to use air at the steady operation modes of the GPA, taken from the driving motor. The air passes through a cooling system, installed in the aspiration compartment of the GPA. During cold months the system can operate through a line, bypassing the cooler. In the startup and shutdown periods of the GPA the pressurizing system is supplied from a compressor, installed separately. The change of the pressurization from one system to the other is carried out automatically, triggered by a signal from a pressure relay which is adjusted directly according to the air pressure in the bearing compartments.

In the first tests the air is taken from the pressurization system of the GPA-Ts-16 with the MB at several points (on the air supply pipeline, after the adjustment valve, on the pipelines immediately before the bearing compartments, on the runoff gas pipelines after the second seal). This made it possible to control visually from the readings of pressure gauges the correct adjustment of the electrical system. The system of pressurization of the bearing compartments performs one more important task: the cooling of the MB cavity. Due to the small clearances the maximum heating occurs in the moving part. Perforations through the axial bearing were therefore made for the supply of additional air to the bearing disk. A scheme showing the passage of air in the pressurization of the bearing compartments is presented in Fig. 2.

The construction of the MB includes security bearings, intended to prevent the direct contact between the mobile and stationary parts of the MB. The security bearings (Fig. 3) contain two sets of ball bearings, operating in the radial and axial planes; the air gap against the shaft is 0.25-0.35 mm. The security bearings are designed for short loads and are not suited for prolonged operation at the nominal speed and the design load.

For the reliable operation of the centrifugal compressor the security and electromagnetic bearings must be strictly aligned; this is achieved by fixing a special device in the place of the bearing 1, which simulates the radial bearing of the magnetic drive, and by checking its alignment with the radial stators. The radial gap must be within 0.9-1.1 mm. The clearance between the stator part and the outer cage of the security bearing is eliminated by the spacer 2 (see Fig. 3). Prior to installing the security