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DESIGN AND NUMERICAL AND EXPERIMENTAL INVESTIGATIONS OF THE NON-CONVENTIONAL CENTRIPETAL RADIAL BLOWER FOR SPECIAL PURPOSES

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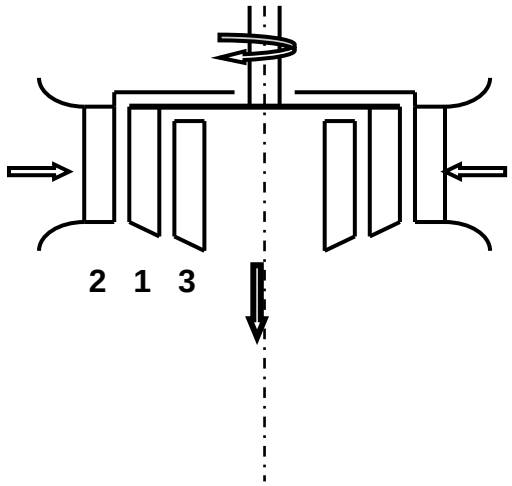
A design and investigations of the single-stage centripetal blower to be used in a vacuum furnace for high pressure gas quenching (HPGQ) technology are presented. The blower task is to cool (a closed-loop cycle operation with nitrogen or helium as a cooling medium under pressures up to 2.5 MPa) steel elements of various shapes and mass at high rate. A schematic view of the blower is shown in Fig.1.

The blower under consideration can be an alternative to classical radial blowers used in vacuum furnaces. From the design viewpoint, both types of blowers are built as ”power packs” and are subject to significant limits as far as dimensions and technological processes are concerned.

Centripetal radial blowers have been described in literature, starting with the publications by Petermann (1948). In Poland, the investigations of such machines have been presented in (Górnisiewicz 1966).



1. Impeller
2. Centripetal guide vanes
3. Centripetal outlet guide vanes

Fig. 1. Schematic view of the radial centripetal blower

Within the project No. 1482/T02/2006 of the Ministry for Higher Education, a blower prototype (denoted as A) was built in the 1:1 scale and subject to aerodynamic investigations which showed unsteady operation of the flow system. On the basis of unsteady 3D flow calculations (ANSYS CFX code, SST turbulence model), next three blading models were built (referred to as B, C, D, respectively). A common problem for all blading systems A-D is a very narrow useful operating range and a hysteresis of the characteristics at the surge threshold. The inner efficiency of those designs did not exceed 47%. Eventually, the final

blading system E, characterized by a presence of rear centripetal guide vanes, which allowed for an elimination of the hysteresis loop and widened a useful operating range, was developed. The inner efficiency increased up to 52%.

The experimental investigations including fast-variable pressure measurements showed a good conformity of the experiment and the results of unsteady numerical calculations.

References

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