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Structural Improvement of Multiple-Cavity Dry Scroll Vacuum Pump

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Dry scroll vacuum pump (DSVP) has been widely used in many industries with its inherent advantages of outstanding pumping capacity, low power consumption, low vibration and noise and oil free performance in the cavity, resulting in the increasing demand for DSVP. The huge fund has been invested to study DSVP by many research institutes and vacuum equipment manufacturers. However, it is difficult to improve the performance of DSVP, limiting its application. This paper aims to improve the performance and widen the scope of application of DSVP to provide efficient and clean vacuum environment for more industrial areas and the multiple-cavity dry scroll vacuum pump (MCDSVP) was researched in detail. According to the mechanical theory of scroll, the calculation method of MCDSVP was put forward and established, and then compared with the single cavity structure. It was found that the suction speed of multi-chamber was increased by 76.4%, the peak load located in bearing was reduced by 88.8% and the friction loss was reduced by 58.3% compared with that of single chamber under the same comparison standard, which proved the design superiority of MCDSVP. Then taking the four-chamber as an example, the steady-state deformation and stress of the four-chamber dynamic and fixed scroll with gas load, thermal load and multi-field coupling were studied with ANSYS Workbench, respectively. Through the thermo-mechanical coupling analysis of the multi-cavity vacuum pump under the condition of assembly, the optimal radial clearance of each scroll body is 0.06 mm in the four-chamber scroll pump, which provide theoretical guidance for the design and study of the bilateral scroll vacuum pump.

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