

# Self-adaptive Lubrication Characteristics of Conical Flow Distribution Pairs of Ball-piston Hydraulic Pumps

**ABSTRACT:** On the basis of the wide application of end-face distribution and axial distribution in hydraulic pumps, a conical distribution method applied to ball piston pumps is proposed, and the dynamic variation law of the distribution axis under impact load is studied.

According to its structure principle, the lubrication model is deduced, and the force analysis of the distributor axis is carried out. The dynamic model of the distributor axis with two degrees of



freedom in the axial and radial direction is established.

By solving the dynamic equation numerically, the changing rule of the position of the distribution axis with impact load is obtained. It is found that the eccentricity of the distribution axis relative to the cylinder block and the distribution clearance can establish a new equilibrium state in a relatively short time after fluctuation.

The ability of the distributor shaft to restore stability without external force reflects the self-adaptive lubrication characteristics and ensures the reliability of the ball piston pump.

**Key words:** [hydraulic pump](#); conical valve pair; lubrication characteristics; self-adaptation; dynamic characteristics

Ball piston pump is a new type of radial hydraulic pump. It drives the ball piston to and fro in the cylinder bore by the eccentric action of cylinder block and action ring, thus realizing the process of oil absorption and pressure.



Compared with the traditional axial piston pump, under the same performance index, the axial dimension of the ball piston pump decreases greatly, occupies less space and has high power density; has fewer components, simple and compact structure and high reliability; the variable mechanism is simple and reliable, which can realize stepless change of displacement in a certain range. Therefore, the ball piston pump is an important component of high performance vehicle transmission system, especially. It has wide application prospects in continuously variable transmission and steering of military tracked vehicles.

During the working process of ball piston pump, the distributor shaft needs to discharge high-pressure oil on one side and inhale low-pressure oil on the other side, which causes the unbalanced force on both sides. When the working pressure is high, the unbalanced force is very large, and it can not be satisfied by dynamic pressure support.

In this environment, combined with the structural design experience of the cylindrical valve pair, the conical valve pair is composed of a conical cylinder block 4 supported on bearing 6 and a fully floating conical valve distribution shaft 2. The valve distribution surface between the two pairs is machined into a parallel conical surface.

Because of the compression force of the discharge hole 8, the conical distributor axis compresses the conical cylinder along the axis, and the distribution force is unbalanced. In order to avoid the metal contact between the conical cylinder body and the conical distributor axis, throttling damping is installed in the conical distributor axis to communicate the high-pressure balanced oil tank 1 and the low-pressure balanced oil tank 2.

At the same time, the high-pressure runner is distributed on the upper and lower sides, and the low-pressure runner is distributed on the left and right sides, thus eliminating the torque of the distribution shaft about the axis and avoiding deflection.