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Development of a New Tooth Profile Designed for High Efficiency P/M Internal Gear Pump Rotors

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Abstract

We developed a new tooth profile designed for P/M internal gear pump rotors. The theoretical discharge volume of the new tooth profile internal gear rotors is more than 10% higher than that of the same size conventional rotors. Our new profile rotors can achieve a decrease in torque, and fuel-efficiency will also be improved.

Keywords: internal gear pump rotors, tooth profile, theoretical discharge volume, volumetric efficiency, torque

1. Introduction

P/M internal gear pump rotors are primarily used for automobile parts, especially for oil pumps. Internal gear pumps are principally used for engine lubrication, automatic transmission and continuously variable transmission.

Energy loss in engine oil pumps is estimated to be about 10%, and that of automatic transmission oil pumps is estimated to be about 20-30%. Accordingly, the demand for developing a high-efficiency oil pump rotor is growing stronger every year.

We developed a new tooth profile designed for P/M internal gear pump rotors.

2. Experimental and Results

In this report, we present our newly-developed high efficiency oil pump rotor.

The theoretical discharge volume of the new tooth profile internal gear rotors is more than 10% higher than that of the same size conventional rotors.

Table 1 indicates the difference in the theoretical discharge volume between conventional tooth profile rotors and our new tooth profile rotors. Our new tooth profile has two characteristics. First, the profile of the inner rotor has two base circles. Second, these circles are connected by an involute curve. As a consequence, the new tooth profile can obtain high tooth length and large displacement distance.

Moreover, the volumetric efficiency of the new oil pump rotor is equal to that of our standard high-efficiency oil pump rotor. Therefore, the actual discharge volume is also more than 10% higher than that of the same size conventional rotor. In other words, the rotor size can be downsized compared to conventional rotors when the required actual discharge volume is fixed.

Table 1. Difference in Theoretical Discharge Volume

	Conventional rotor	Rotor with New Tooth Profile
Image of tooth profile		
Outside diameter	ϕ 94mm	ϕ 94mm
Thickness of rotors	10mm	10mm
Theoretical discharge volume	16cm^3/rev	18cm^3/rev
Theoretical discharge volume rate, compared with conventional rotors	100%	112%

This test was performed using the same conditions, with a theoretical discharge volume of 18.6cm^3/rev and an outside diameters of outer rotors of ϕ94.

Fig. 1 indicates the difference of the volumetric efficiency and the actual discharge volume between the conventional tooth profile rotors and the new tooth profile rotors. The thickness of a conventional tooth profile rotor is 11.62mm, and the thickness of our new tooth profile rotor is 10.34mm. The solid line represents the new tooth profile rotor, while the dotted line represents the conventional tooth profile rotor.

As mentioned above, the same actual discharge volume was obtained from the new tooth profile rotors as the conventional

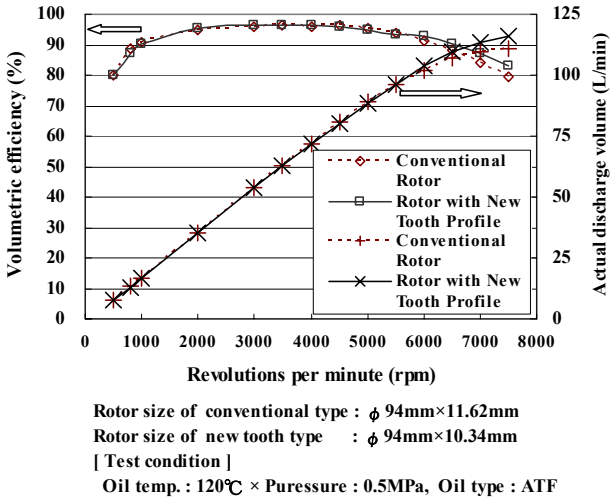

Fig. 1. Difference inVolumetric Efficiency and Actual Discharge Volume

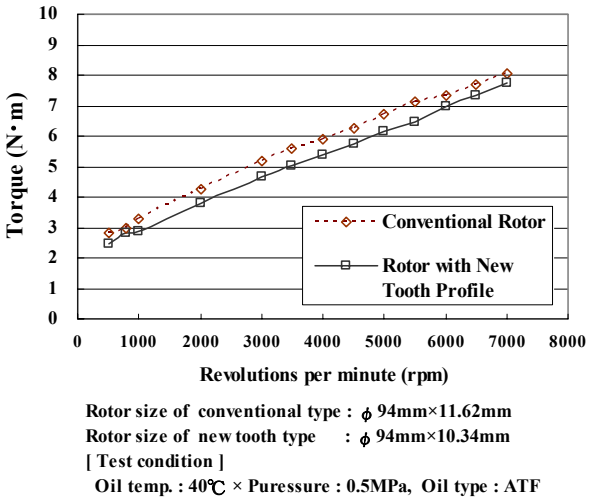

Fig. 2. Difference in Drive Torque

tooth profile rotors, even though the new tooth profile rotors are thinner than the conventional tooth profile rotors.

Fig. 2 indicates the difference between the drive torque of the conventional tooth profile rotors and the new tooth profile rotors, at oil temperature 40℃. The drive torque of the new tooth profile is less than that of the conventional tooth profile.

3. Summary

We developed a new tooth profile designed for high-efficiency P/M internal gear pump rotors. Our new profile rotors can achieve a decrease in torque, and fuel-efficiency will also be improved.