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The Development of Sintered Planetary Carrier for Automatic Transmission

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1. Introduction

A planetary gear set in automatic transmission consists of three members-sun gear, ring gear, and planetary carrier which holds the planetary gears in proper relation with the sun and ring gear. Planetary carrier plays an important role in driving system and needs to have a good stiffness.
Usually conventional planetary carrier consisted of welded two stamped steel plates with machining inside/outside diameters, six drilling, turning and honing. In order to reduce the cost and improve the stiffness, sintered planetary carrier is developed.
In the PM-technique metal powders are compacted two parts. The two parts are sinter-brazed together into one unit. Microscopic analyses are performed on the sinter-brazed parts. As single sintered component, rupture torques and fatigue strengths are measured compared with steel plate by using rig tester. Finally the durability of sintered planetary carriers is confirmed in actual automatic transmission test.

2. Experimental Method

Planetary carrier is made out of Fe-2.0Cu-0.8C structural sintered materials and is compacted two parts to a density of 6.8 g/㎤. The designs of two parts, boss and flange, are optimized through FEM analysis. These are sintered and brazed together into one unit at 1130-1160℃ for 30 minutes in endothermic gas atmosphere.
In order to measure the rupture torques for sintered components torque-out tests are carried out by using rig tester. And also to compare with the fatigue strengths in sintered and steel plate components, fatigue tests are carried out by using magnetic resonance fatigue tester. Test mode is tension/compression and mean loads are -5.0KN and -3.5KN for sintered and steel plate components respectively.
Sintered planetary carriers are performed to durability tests for 800 cycles on the automatic transmissions for passanger vehicles.

3. Results and Discussion

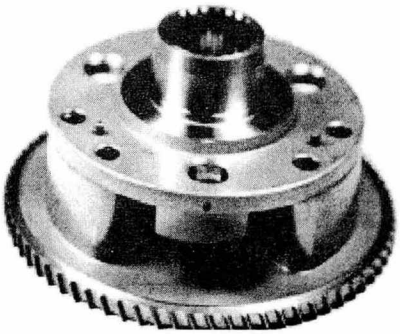
Metallography on the brazed parts, boss and flange, shows continuous microstructure and the distribution of hardness is even from HRB 65 to HRB 75.
From the results of torque-out test the maximum rupture torque of sintered parts is around 23% higher than that of steel plate parts and the rupture occurred around in the necks not in the brazed parts. And also fatigue strengths of sintered parts are higher than that of steel plate parts.

planetary carrier	max. rupture torque kgf · m	fatigue strength KN
steel plate	159	-3.5±3.0
sintered	195	-5.0±4.5

4. Conclusion

Sintered planetary carrier shows the higher maximum rupture torque and fatigue strengths compared with steel plate and its cost has been significantly reduced above 30% due to the reduction of machining processes.
The development of sintered planetary carrier have extended the applications of general sinter-brazed parts into complicated structural automobile parts.

steel plate planetary carrier



sintered planetary carrier