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Material Technology Development Applied to Rotary Engine at Mazda

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ABSTRACT

New material and processing technologies were developed for main components of the rotary engine to establish its reliability and durability.

The components discussed in this paper are the rotor housing, side housing, and sealing elements. Also described are the material and processing technologies which resolved problems about their strength, rigidity, wear, etc.

INTRODUCTION

The Wankel type rotary engine (called merely RE in the remainder of this paper), undergoing all kinds of driving experience as an automobile engine, has continued to grow and mature for nearly two decades.

It can be said that material technologies, among others, have contributed much to the RE's reliability and durability.

The considerable difference of the RE in construction and operation from the conventional piston engine (called just CE hereafter) necessitated development of new technologies in materials and processing. The results of the development work are presented in this paper.

ROTOR HOUSING

The rotor housing, which is equivalent to the CE's crankcase and cylinder head assembly, is operated under severe thermal and mechanical conditions. Especially during the expansion stroke it is exposed constantly to combustion gas of high temperature and pressure. Fig. 1 shows temperature distribution over the circumferential trochoid wall at 5000 rpm WOT for an aluminum alloy and cast iron.

The cast iron shows greater durability in terms of strength, rigidity and thermal expansion at high temperature, but it is inferior in heat conductivity. In the case of cast iron, the trochoid surface on which the apex seal slides becomes too hot to retain a lubricating oil film, as will be noted from Fig. 1.

Thus an aluminum alloy was employed for good heat conductivity with much effort expended to develop better materials, structure, and surface treatment.

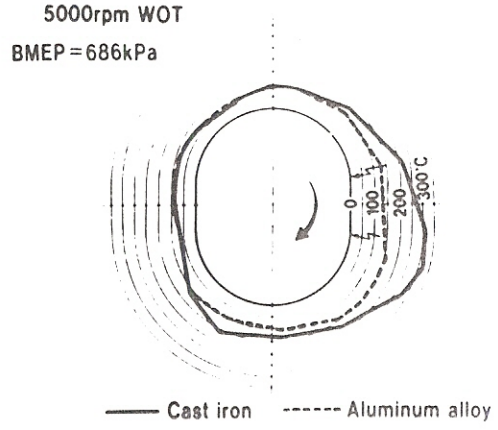

Fig.1 Comparison of temperature distribution

STRUCTURE OF ROTOR HOUSING - The rotor housing, restricted on both sides by tension bolts through the side housings, is subjected to heating and cooling. This makes it susceptible to cracks due to thermal fatigue, originating at the shooting hole of the spark plug under very severe operating condition. In addition, being clamped tightly between the side housings, the rotor housing could suffer axial compressive deformation with possible durability problems.

Development work for materials having increased durability against thermal fatigue in particular was conducted using a thermal fatigue tester. Aluminum alloy specimens (permanent mould) were given cyclic thermal loads ranging from 20 - 250°C until the rotor housing cracked and broke, and evaluation was made based on the number of cycles registered until the breakage occurred. An example of the test result is shown

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