

Development of a low-vibration new type internal combustion engine by using Z-Mechanism and potential applications of this mechanism

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The most recognized industrial machinery that supports our life is the reciprocating engine. Most of the current internal combustion engines (ICE) are reciprocating engines, and the number of new cars sold worldwide is 72.66 million in 2020, making them the largest amount of industrial machinery that support our daily lives. The mechanism of an ordinary internal combustion engine consists of (1) piston, (2) connecting rod and (3) crankshaft and is called a piston-crank mechanism in kinematics. This mechanism was put to practical use in the Industrial Revolution and has been used in various machines such as internal combustion engines, compressors, and pumps. The basic motion of this mechanism is quite simple: thermal energy is applied to the piston to generate linear motion, which is transmitted by the connecting rod to the crankshaft, which converts it into rotational motion for output. However, the piston-crank mechanism has had several problems since it was invented, and humankind has faced and attempted to solve these problems for more than 240 years.

The recent shift to quieter electric motors has brought to the fore the tendency to focus on mechanism-brought vibrations, which until recently have not been regarded as a problem. As a result, the reduction of vibration in industrial machinery has become an urgent issue.

The authors have proposed two unique mechanisms called Z-Mechanisms (As shown Fig.1) that can eliminate such mechanism-brought vibrations by changing some parts [1].

These mechanisms perform mutual conversion between linear and rotary motion while suppressing vibrations and are applicable to machines using pistons and cranks. This paper describes the extremely low-vibration performance of an internal combustion engine manufactured as an application machine using this new mechanism and the potential application for energy generation.

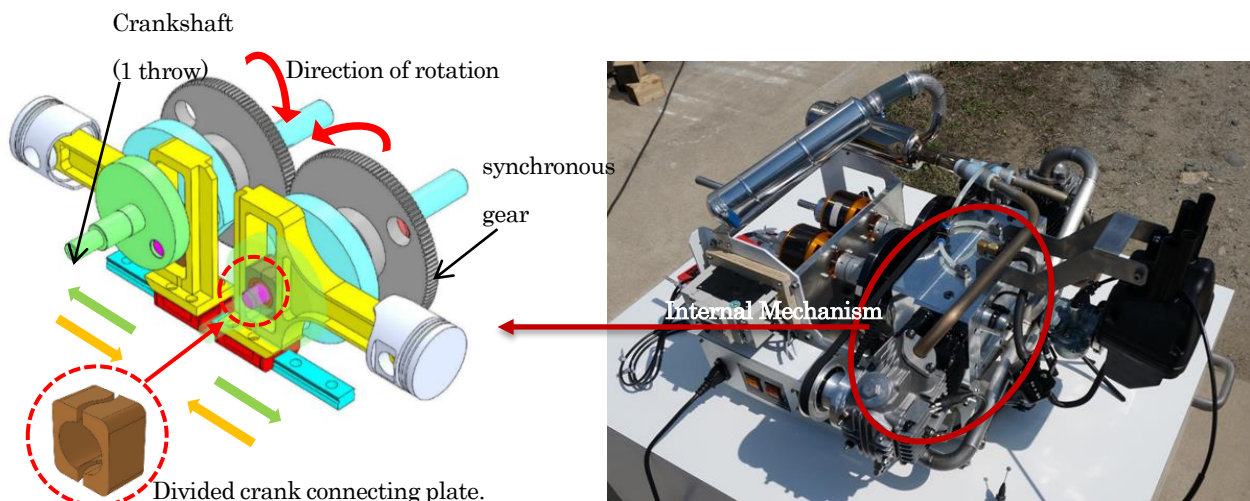


Fig1 Oblique view of Z-Mechanism (Mirror arrangement type) and manufactured ICE

References

- [1] Y. Yoshizawa et al., “Development of a low-vibration new structure engine by using the XY-separate crank mechanism (Second Report)”, *Society of Automotive Engineers of Japan Autum Congress 2017*. 20175200, pp. 1111–1115, (2017).