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Prototype and estimation for an ultrasonic motor using a transmission rod with a stator and a rotor at the both ends

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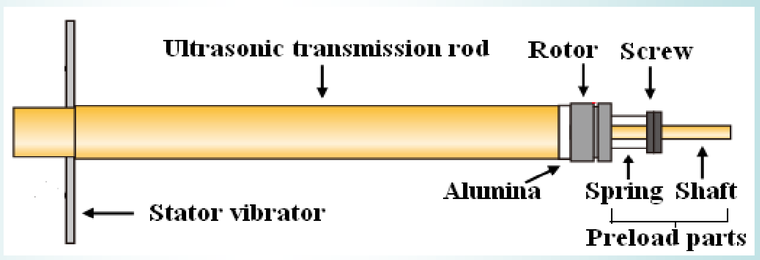
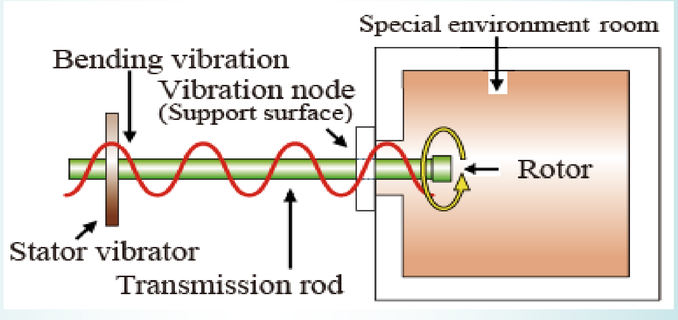
Purpose

◎ To develop an ultrasonic motor being able to use in special environment.
◎ To realize the ultrasonic motor, an ultrasonic motor using a transmission rod with a stator and a rotor at the both ends (ROD-USM) is proposed.

ROD-USM

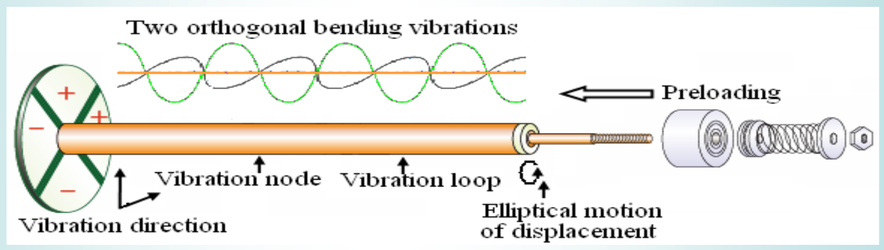


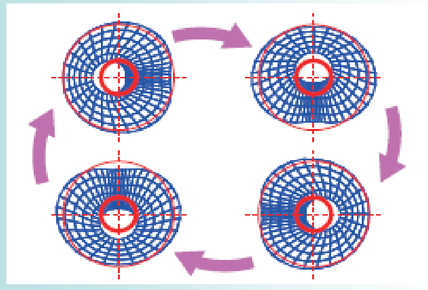
Prototype of ROD-USM



Operation in the special environmental room

Operation principle



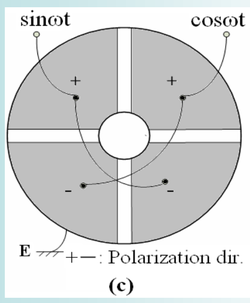


Mode rotation of two degeneration ((1,1))-((1,1))' modes.

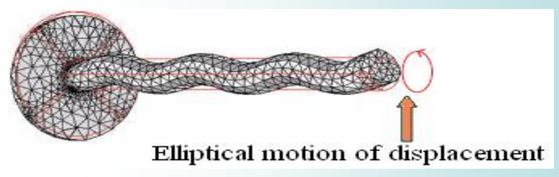
Two orthogonal nonaxisymmetric modes – ((1,1))-((1,1))7 – of an annular plate is used.

The vibrator is amounted at the rod end and the rotor is pressed at the other end.

Two orthogonal bending vibrations are excited in the rod.



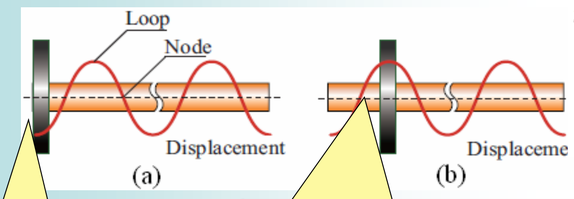
Driving method for exciting two orthogonal modes.

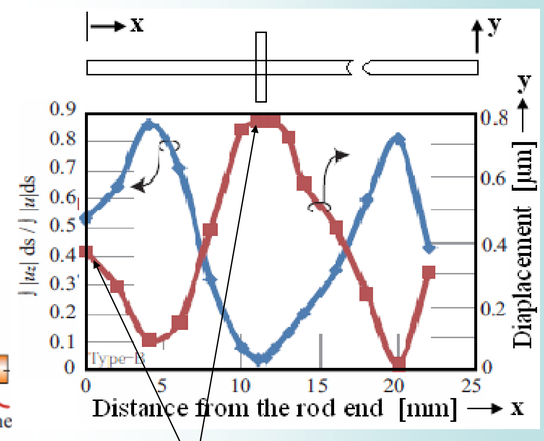


Mode simulation of the vibrator and the rod, and elliptical motion formed at the rotor side end.

Design and estimation

Displacement of the rotor side end (y) changes by the mounting position of the stator.



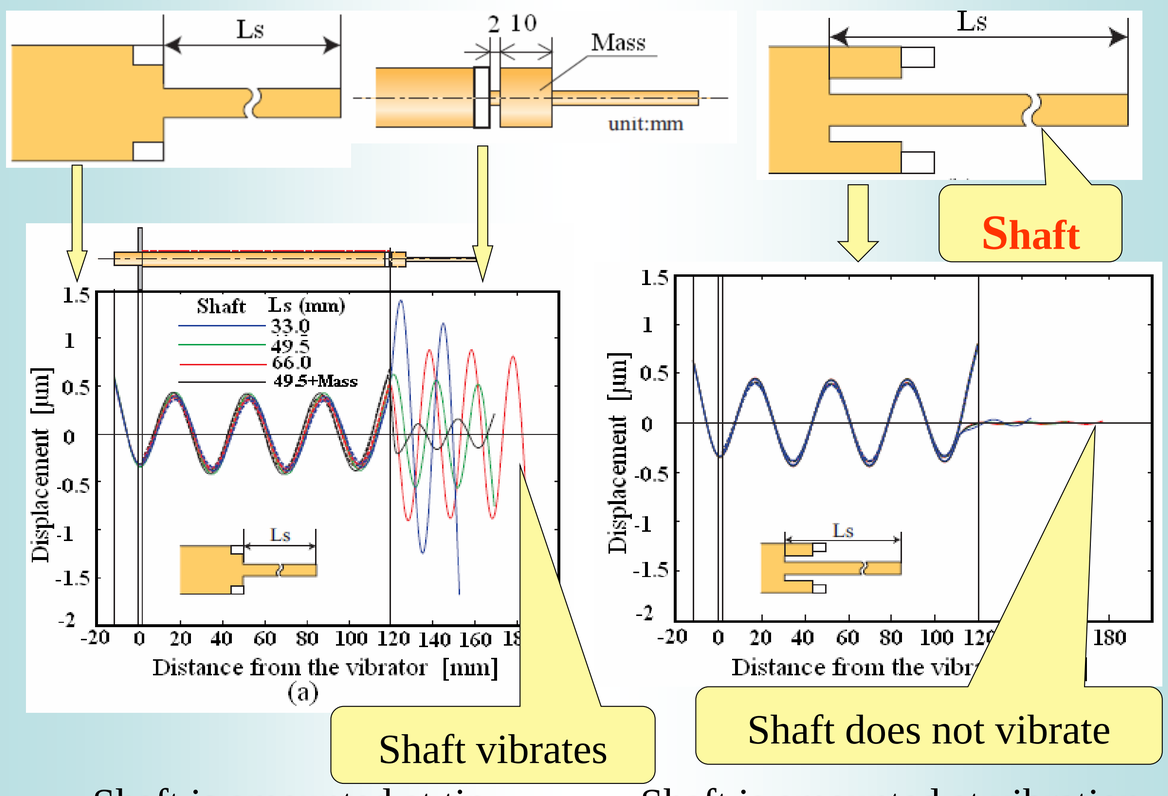


Rod end

Loop position of the bending mode

Each displacement y becomes 2 times.

The mounting position of the shaft depends on the vibration of the shaft.



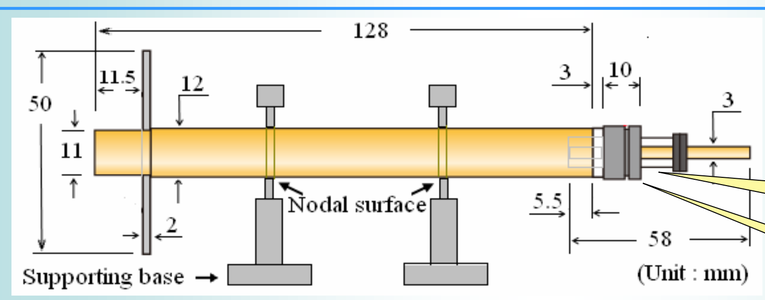
Shaft vibrates

Shaft does not vibrate

Shaft is amounted at tip of the rod end.

Shaft is amounted at vibration loop of the bending mode.

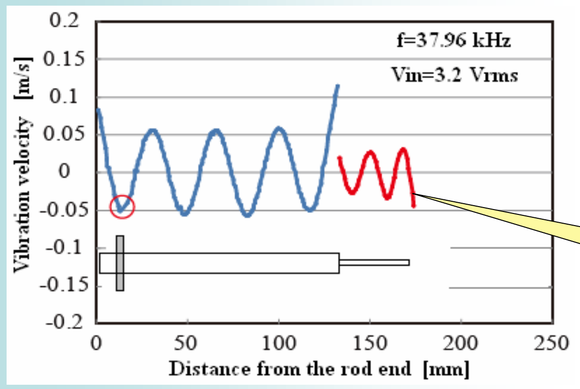
Trial motor construction and measurement



Trial motor construction

Spring

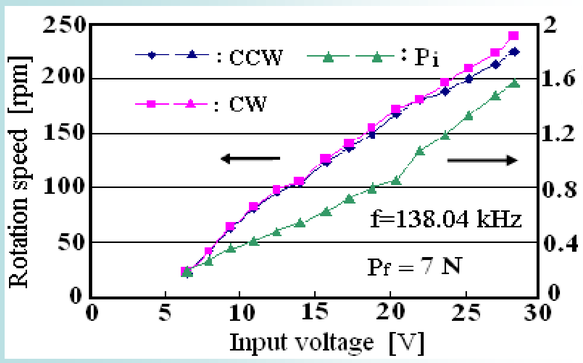
Rotor



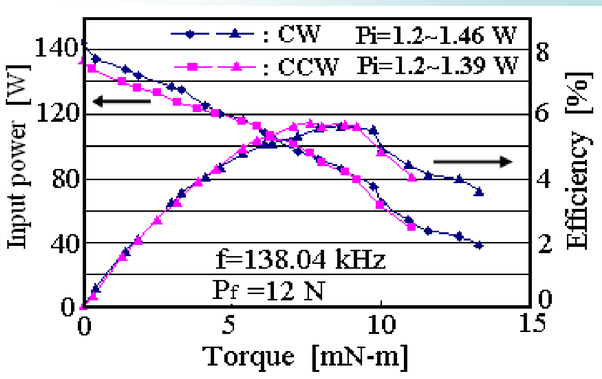
Vibration velocity on the surfaces of rod and shaft

Rod vibrates in 7th bending vibration mode.

Shaft vibration amplitude relatively is small.



Rotation characteristics versus input voltage.



Load characteristics.

Conclusions

A new structure of ultrasonic motor (ROD-USM) is proposed.

Effective mounting positions of the vibrator and the shaft were proved.

The motor operation of the new construction was confirmed.

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