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ULTRASONIC MOTOR

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ABSTRACT:

We know that, motor is the mechanical device which produced motion,it is the arrangement of coil and the magnet which converts electric energy into mechanical energy and now ultrasonic motor are next generation motor. The angular velocity of the property of this motor depends on driving frequency, input voltage, the constant surface and friction coefficient between the stator and rotor.Piezoelectric element will expand and contract when we applied a voltage with a resonance frequency in KHz. Piezoelectric motor have some very nice characteristics compared to induction motors and in general they are characterized by a high torque at low angular velocity silent operation high positioning precision.In this motor piezoelectric element attached on a stator, the piezoelectric element will expand and contract causing high torque weight ratio highly accurate speed and position control at absence of noise . It has ability of certain material to generate an electric charge in response to applied mechanical stress.An ultrasonic motor is a type of electric motor formed from the ultrasonic vibration of a component like rotor, stator. In ultrasonic motor the stator and rotor are coupled.Someform of piezoelectric material, lead zirconate titanate and occasionally lithium niobate or other single-crystal materials. In the USM the two types of waves are used travelling and standing and they are also divide intounidirectional and bidirectional.standing wave and traveling wave are also passed in USM.

KEY WORDS: *Ultrasonic Motor, Piezoelectric material, piezoelectric effect, travelling wave, zirconate ttitanate*

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1. INTRODUCTION:

In 1980 the words first ultrasonic motor was invented which utilized the piezoelectric effect in ultrasonic frequency. Electromagnetism is always been the driving force behind electric motor technology. The ultrasonic motor used piezoelectric effect and hence no magnetic interference.

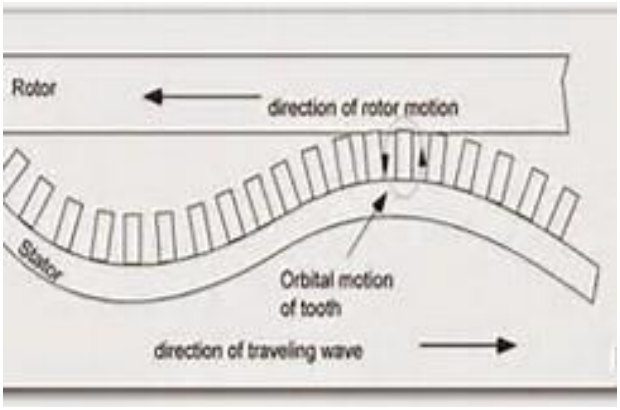

Fig1: Internal structure of USM

In this motor effect in the ultrasonic frequency range to provide its motive force resulting in a motor with a usually good low speed, and high torque,and power to weight characteristicsin this motor the travelling mechanical wave in this piezoelectric ring,aring type slider is contact with the surface of elastic body can be driven.

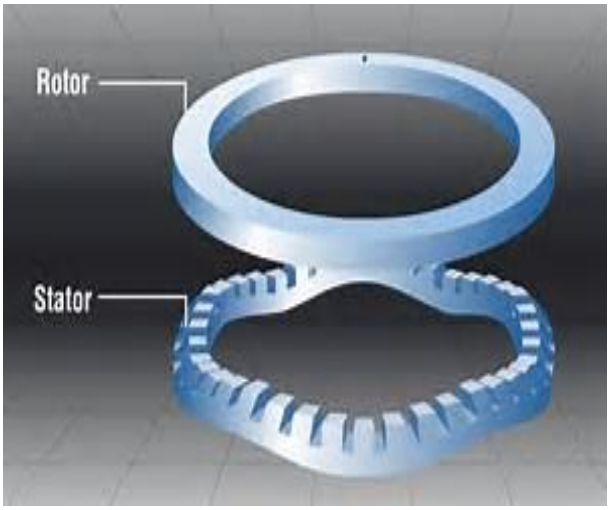

Fig.2

2. CONSTRUCTION OF USMS:

Construction of the Ultrasonic motor is simpler than EM type motors. Fewer assembly parts mean fewer moving parts and consequently less wear. The number of components required to construct an USM is small thereby minimizing the number of potential failure points.

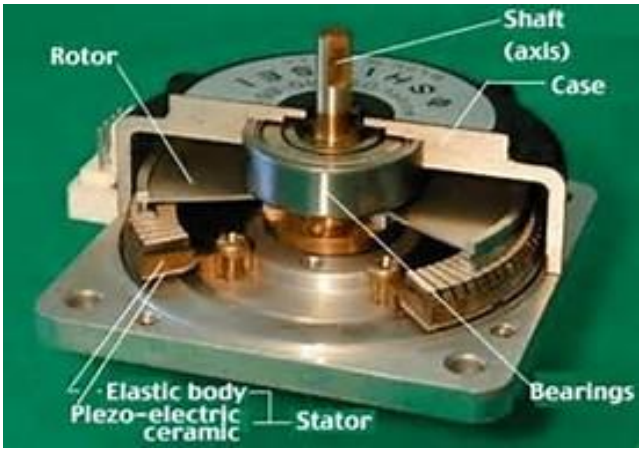

Fig.3

Constructionally, ultrasonic motor a stator and rotor are coupled. On the side of stator piezoelectric material is glued on. The piezoelectric element is the element that generates the ultrasonic vibrations. When high frequency voltage is applied the ultrasonic vibration is generated.On the other side of stator,comb tooth are set up.The rotor is pressed tightly against the side of stator.

3.WORKING OF USMS:

When the supply is switches on the actuator starts vibrating owing to coverts piezoelectric effect .the change in physical quantity like strain force stress and acceleration can be measured can converting this into electrical energy.The stator and rotor are placed so closed to each other that their surface almost grazes upon each other .

The vibration is induced into the stator of the motor and it is used for conveying the motion to the rotor and also to modulate the friction force. In this motor, the travelling wave generating elastic curling wave on the stator. The piezoelectric material which is attached to the stator is expanding and contracting wave.

Piezoelectric motors use the converse piezoelectric effect of piezoelectric sensors in which deformation or vibration of the piezoelectric material produced an electric charge.

It produced linear or rotary motion also in this motor we apply the ultrasonic frequency range which is from 20KHz to 10MKh and is not audible to normal human being.

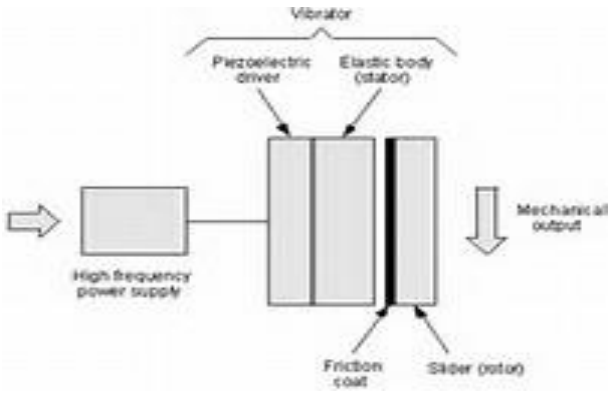

Fig5: Working of USM

The ac voltage is applied to the vibrator expanding and contracting move occur an elastic curling waves are generated on the elastic angular wave. The vibration is produced into the stator of the motor .It is used to conveying the motion of the motor and also modulate the frictional force.

The superposition of multiple standing wave create a travelling wave.The vibration velocity is simply the time derivative of vibration displacement in a structure and is not (directly) related to the speed of the wave propagation within the structure .In this motor vibration of only of few nanometer in magnitude such device required construction to meet the necessary reasons to make use of the motion within the stator.

4. CHARACTERISTICS OF USM:

The USM has non-linear characteristics due to friction driving force. In the fig., the characteristics are show between load torque and speed. At low torque, curve is likely linear whereas at high torque curve is non-linear. The fig shows that rotational speed decreases when torque increase, and torque is increases when load between stator and rotor is increases.

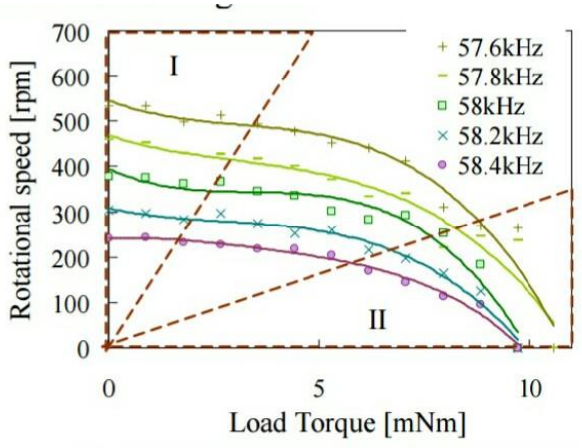

Fig4: T-N characteristics of USM

In the below fig., shows the output torque vs applied voltage magnitude. Its show that output torque appears to be proportional to magnitude of the sinosoidal voltage.

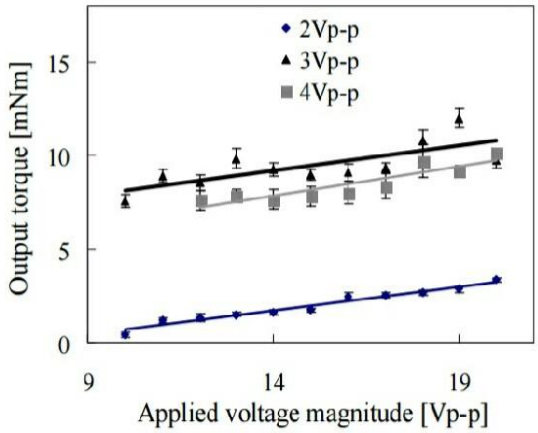

Fig6: Output torque vs applied voltage magnitude

5. FEATURES & MERITS OF ULTRASONIC MOTORS:

- These are small in size and are excellent in response.
- These have low speed of ten to several hundred rpm and high torque, and hence reduction gears are not required.
- These consist of high-holding power, and even if the power is turned off, they don't need brake and clutch.
- They are small, thin and have less weight compared to other electromagnetic motors.
- These motors don't contain any electromagnetic material and they do not generate electromagnetic waves. So, these can be used even in high magnetic field areas as these are unaffected by the magnetic field.
- These motors don't have any gears, and an inaudible frequency vibration is used for driving these motors. So, they do not generate any noise and their operation is very quiet.
- Accurate speed and position control are possible with these motors.
- The mechanical time constant for these motors is less than 1ms and the speed control for these motors is step less.
- These motors have very high efficiency, and their efficiency is insensitive to their size.

6. DEMERITS OF ULTRASONIC MOTORS:

- A high-frequency power supply is required.
- As these motors operate on friction, durability is very less.
- These motors have drooping speed-torque characteristics.

7. APPLICATIONS OF ULTRASONIC MOTORS:

- Used for the autofocus of camera lens.
- Used in compact paper handling devices and watch.
- Used for drying and ultrasonic cleaning.
- Used as the best motors known to offer high potential for miniaturization of equipment's.

- Used in MRI magnetic resonance imaging scanning in medicine.
- Used to control the disk heads of computer like floppies, hard disk and CD drives.
- Used in many applications in the fields of medicine, aerospace and robotics.
- Used to automatically control Rolling screen.

8. CONCLUSION:

Ultrasonic motor uses piezoelectric ceramics .The waves drive the comb of the piezoelectric ring whenapplied, the piezoelectric comb will expand or contract corresponding to the traveling wave form and the rotor

ring which is pressed against these combs start rotating. These motors are very advantageous. It is in great demand in the area automation and iniaturization. These motors are low cost. In ultrasonic motor electromagnetic interference is not there.

ACKNOWLEDGEMENT

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