

End-effector Employing Parallel Mechanism for Scanning Electrical Discharge Machining

Background and problem

- Additional time to make form of electrode
- Problem on mechanical strength of electrode with

Solution

- Skipping electrode production by scanning electrical discharge machining with cylindrical electrode

Advantages

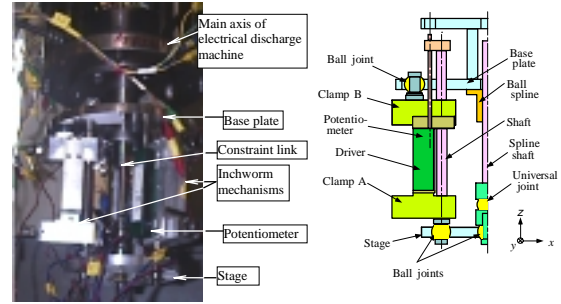
- Parallel mechanism with higher frequency response than quill of general electrical discharge machine in linear mode
- High machining accuracy
- Wide working range by hybrid mode

Results

- 3 degrees of freedom (rotation about x and y axis and translation in z direction)
- Compensation of electrode wear

Applicable fields

- Micromold fabrication
- Machining complicated shape without electrode making process

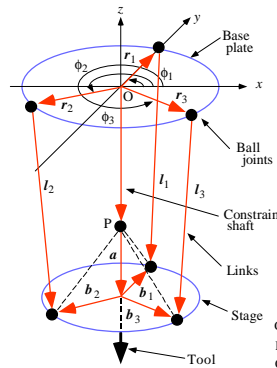


Appearance

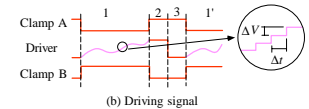
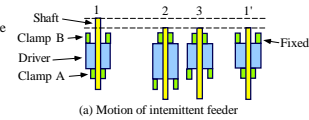
Structure

Specifications

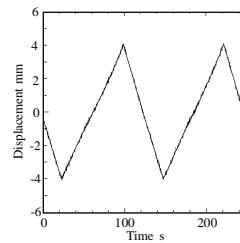
Dimensions	$\phi 182 \times 228$ mm
Weight of whole device	6 kg
Weight of stage	2 kg
Degrees of freedom	3 (along z, and around x and y)
Inclination around x and y	10 deg.
Stroke along z	30 mm
Positioning accuracy by step mode	30 μ m
Frequency range by linear mode	200 Hz



Geometrical arrangement

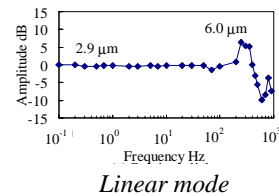


Intervals of reference position: 0.5 mm
Movement per step: 10 μ m
Driving frequency: 100 Hz



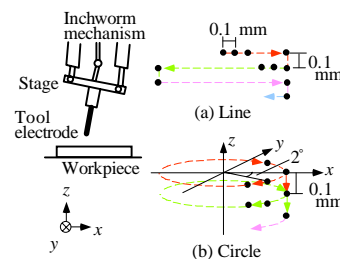
Step mode

Controlling link length by hybrid mode

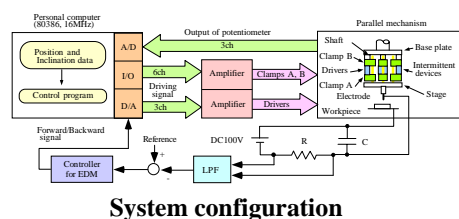


Linear mode

Motion of stage

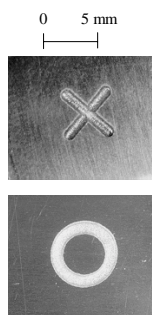


Tool path



System configuration

URL: <http://www.toyota-ti.ac.jp/Lab/Kikai/5k60/>



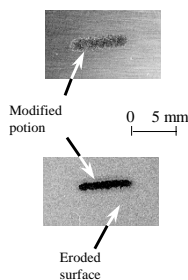
Cross

Length: 5 mm
Depth: 0.58 mm
Width: 1.10 mm
Angle error: 0.8 deg.
Machining time: 30 min.

Circle

Diameter: 5 mm
Depth: 1.28 mm
Roundness: 0.142 mm (inner)
0.126 mm (outer)

Error of center: 0.043 mm
Machining time: 70 min.



Surface modification with Silicon

Before and after erosion with hydrochloric acid for 10 hours