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ADAPTIVE ELECTROSTATIC SEIZING DEVICE

Shulgov,Vladimir

Belarusian State University of Informatics and Radioelectronics (BSUIR)

ABSTRACT

This paper presents the design and control circuit of the electrostatic seizing device of robotics. The device makes it possible to fix and handle flats conductive or semi-conductive parts on the basis of their approximate weight..

1. INTRODUCTION

To handle flat objects of different weight or objects, the weight of which varies in the handling process, the gripping devices providing the fixation force corresponding to the object weight are necessary.
To solve the tasks assigned, the device shall be capable of recognizing the objects of different weights, geometrical dimensions, material, surface roughness, etc. by means of its own sensor systems.
The objective of this paper consists in the development of the design and control circuit of the electrostatic gripping robotics device making it possible to fix and handle flat conductive or semi-conducting parts in accordance with their approximate weights.

2. DESIGN OF THE DEVICE

The design of the gripping device is presented in the figure. The working head of the device 1 comprises the aluminium base made of aluminium alloy AMg-4m (Al is the base, Mg – 4%). The base surface is machined to R_a = 0.008 µm. The dielectric layer of Al_2O_3 2 with the thickness of 30-100 µm is formed on the base surface by anodizing. Further, the base is subjected to repeated anodizing (re-anodizing) for the purpose of increasing the thickness of the Al_2O_3 barrier layer and electrical strength (breakdown voltage) of the oxide. The external annular electrode 3 for applying the potential to the part to be fixed is manufactured of titanium BT1-0. Both electrodes are mounted on the insulating base 4 made of polytetrafluorethylene (analogue: Teflon). The technology of manufacturing the device is presented in [1].

3. CONTROL CIRCUIT

The working head of the head (not shown in the figure) is equipped with a touch (slippage) sensor that makes it possible to determine the moment of contact or separation of the workpiece. The touch sensor confirms also the fixation of the part or gives the command for iterative increase of the operating voltage, should a slippage signal be received.

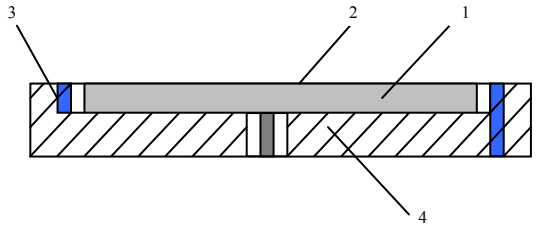

Figure: Design of the working head of the device

The sensor of the device has a core which sinks by gravity onto the object to be gripped. In case of slippage, the position of the core changes relatively to the solenoid winding of the oscillating circuit that causes the variation of its inductance, resonance frequency and amplitude of forced oscillation.
The control circuit consists of a computing device (either microprocessor or microcomputer), interfacing device and controllable high-voltage source. The computing device specifies the high voltage to be applied to the electrode of the seizing device via the interfacing device according to the approximate weight of the part.
The small-sized stabilized high-voltage power supply unit forms the supplying voltage from 100 V to 4000 V with the maximum current in the load of up to 40 mA. The power supply unit can be also controlled via interface RS232/RS485/USB. The program of communication with a PC is available. The output voltage can be switched off by the external signal.

4. PARAMETER OF THE DEVICE

The developed adaptive electrostatic gripping device has the following parameters: adhesion pressure: 0.1 MPa; operating voltage: up to 4000 V; current consumption (DC): up to 40 mA; dielectric coating thickness: 30-100 µm.
This device has passed the testing at the Progress multistation assembly for the articles of integrated optics and optoelectronics (the works were performed jointly with the Research and Technological Institute of Optical Instrument Engineering, Moscow, Russia).

5. REFERENCES

V. Shulgov,“Anodic aluminium oxide as dielectric covering in electrostatic seizing devices of robotics“, 52 IIWK/Technische Universität Ilmenau, 10 – 13 Sept. 2007.