

FLEXIBLE MACHINING FOR NON-CYLINDER PISTON PINHOLE BASED ON GMM

PENG ZHAI^{1,2}, CHENGRUI ZHANG¹, TIANLIANG HU¹, XIUSHENG CHEN¹
XINLIANG WANG³ AND JIANBO YU³

¹School of Mechanical Engineering
Shandong University
Jinan 250061, P. R. China
zp1197@163.com; crzhang@sdu.edu.cn; tlhu@mail.sdu.edu.cn; cxs001cn@yahoo.com.cn

²School of Information Engineering
Shandong University at Weihai
Weihai 264209, P. R. China

³Shandong Binzhou Bohai Piston Co. Ltd
Binzhou 256602, P. R. China
yjb@jinhe-yt.com

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ABSTRACT. To bear more loads for heavy truck pistons, the shape of heavy truck piston pinhole is often designed as Non-cylinder form. Current methods can not meet the needs for precision machining on Non-cylinder piston pinhole(NCPPH). A novel mechanism based on Giant Magnetostrictive Materials(GMM) is presented. New models are established for the servo mechanism, GMM and magnetizing force of the control solenoid to characterize the relationship between the control current of the solenoid and the displacement of the GMA(Giant Magnetostrictive Actuator). Special designed CNC system is employed to control the GMA system. Some boring experiments are performed. It is demonstrated that the novel mechanism can meet the needs to perform fine machining on NCPPH effectively.

Keywords: Giant magnetostrictive material (GMM), Piston, Pinhole, Flexible machining

1. Introduction. To bear more loads for heavy truck pistons, the shape of piston pinhole is often designed as the new shape of NCPPH, the shape of NCPPH can be described as: the form of cross section is oval, and the ovality can decrease or increase according to the position along the axis of NCPPH; and the lengthways section form is a B-spline curve. The tolerance of NCPPH form is only $1.5\mu m$, the tolerance of the diameter is only $3\mu m$, and the roughness of the surface is Ra0.4. So, the shape of NCPPH is dimensional and at high precision [1].

Traditional methods can only perform machining on a certain shaped piston pinhole, oval or trumpet, and can not perform machining on the more sophisticated future NCPPH; A method based on electromagnetic actuator was discussed in [2], a revolving electromagnetic actuation mechanism composed of electromagnetic stator and electromagnetic rotor was developed, some simulation about the loci of the rotor center vs different control currents were performed. It may be a promising method for the machining of non-circular shaped piston pinhole.

A new method based on GMM is presented, some tests about NCPPH were performed, the satisfied results demonstrated that: it will be an effective method for NCPPH.