Regular Paper

Development of Die Cushion Device for Press with Frictional Force

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Abstract

A frictional force is generated by sliding between metal portions of a shaft part and a hole part having an interference, and such a frictional force is used as a die cushion force of a press. In this way, a die cushion device can be downsized. In addition, since the frictional force calculated from the interference δ matches the actual measured frictional force in a test, it is possible to acquire the desired frictional force by managing a dimension of the interference. We conducted a reciprocal sliding experiment for 600,000 times and could consequently acquire the constantly stable frictional force and constantly stable temperature transition of sliding portions. Furthermore, no wear was found in an outer diameter of the shaft part and an inner diameter of the hole part after the experiment. Therefore, we were able to prove high durability and long life of the die cushion device.

Keywords: Frictional Force, Surface Treatment, Die Cushion Device, High Durability, Interference Fit Sliding

1. Introduction

1.1 Background of press processing

In recent years, the reduction of greenhouse gas has been promised to deal with global warming, and weight reduction of the car body structure is indispensable, in the automobile industry, as a measure to improve fuel efficiency.

In order to reduce weight of the car body structure, each automobile manufacturer focuses on the development to expand the adoption ratio of ultrahigh-tensile-strength steel.

The role of the die cushion device in the conventional press sheet forming is to prevent wrinkling during forming, and a press machine is equipped with the pneumatic or hydraulic die cushion device in general.

In those devices, cushion force, arrangement of cushion pins and other specification are determined as a part of the press machine specification.

This means that it is hardly possible to change the specification to realize high precision forming of ultrahigh-tensile-strength steel, which requires high die cushion force.

1.2 Current issues

A pneumatic die cushion cylinder is usually placed in a pressed frame [1], and a pneumatic pressure thereof during use is 0.5 to 1 MPa. In order to improve the capacity of the die cushion at this pneumatic pressure, the pneumatic cylinder having a large effective cross-sectional area is required. As a result, rigidity of the pressed frame that requires a space for accommodating the cylinder in a large outer shape is lowered, which possibly degrades dimensional precision of a product and possibly causes a wrinkle or a crack on a formed part.

Fig. 1 illustrate a difference in a wrinkle prevention effect that is exhibited in the actual forming process due to different magnitudes of the die cushion force [2,3].

The blank holder in (a) pushes the flange portion of the material

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