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Design and Analysis of Flat Washer Stamping Compound Mold

Wu Wei

(Jiangxi Technical College of Manufacturing, Nanchang,330095)

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Abstract. Due to the simple shape of the flat washer parts and the low precision requirements, they are widely used and versatile in the mechanical industry and are therefore suitable for mass production. In order to facilitate the excretion of waste, this paper adopts flip-chip composite punching to eliminate the need for manual removal of waste, which not only saves time, but also saves a lot of labor and improves productivity. According to the stamping die process principle and flat washer structure, the structure of the flip washer is used for punching and elastic discharge. The designed composite die is verified by the production practice. The structure is simple and practical, and the stamping process is stable and reliable.

Introduction

With the continuous development of our country's industry, higher and higher requirements are placed on the mold. Therefore, the demand for the development of precision, large-scale, complex, long-life molds will exceed the total development speed. The precision will be higher and higher. The accuracy of precision molds was generally 5 microns 10 years ago. Now it has reached 2-3 microns, and a 1-micron precision mold will also be available. Multi-functional composite molds will be further developed. In addition to stamping and forming parts, the new multi-functional composite molds are also responsible for assembling tasks such as over-pressing, tapping, riveting, and locking. The performance requirements for steel materials are getting higher and higher. This paper discusses flat washers with low precision and designs a solution that is more in line with modern technology, improving product productivity and utilization.

Stamping Features

The processing of cold stamping parts is usually no longer processed by cutting, or only a large number of cutting operations are necessary. Hot stamping parts have lower machining accuracy and appearance than cold stamping parts, but they are still better than castings and forgings, and they have less machining.

Introduction to the processing of various stamping parts

Stamping is an efficient production method. It accepts composite molds, especially multi-position progressive molds. It can complete multiple stamping processes on a single press and complete the process of unwinding, leveling, blanking, forming, and finishing active production. The production obedience is high, the rest conditions are good, and the production capital is low. As usual, it can produce hundreds of pieces per minute.

Stamping is mainly classified according to process, which can be divided into two major categories: dispersion process and forming process. The dispersion process is also referred to as blanking. Its goal is to allow stamping parts to be spread along the positive surface line from the sheet material, and at the same time to guarantee the quality requirements of the dispersed sections. The goal of the forming process is to make the sheet plastically deform without breaking the blank and produce a workpiece of the desired shape and size. In actual production, each process is a combination of multiple processes used on one workpiece. Punching, bending, shearing, drawing, bulging, spinning, and rectification are several important stamping processes.

Analysis of Flat Gasket Process

Flat washers are usually thin pieces of various shapes to reduce friction, prevent leaks, isolate, prevent loosening, or distribute pressure.Flat washer style is shown in Figure 1. This material is used in many materials and structures to perform a variety of similar functions.

Figure1.Flat Washers

For example, parts: T=2mm material: 10 steel batch: 300,000/year

1. More determined form of the mold structure

Use five rows or seven rows to enter the mold, punch the holes and blank the material. This is very efficient and saves material. as shown in Fig. 2.

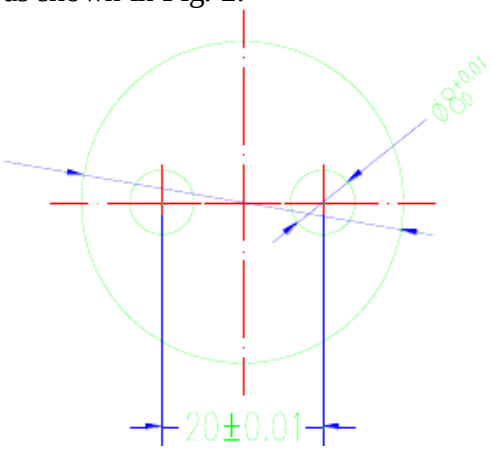

Figure 2.Structural Design

2. Determination of Process Plan

The shape of the product is simple and symmetrical. The precision requirements of the parts and the production lot meet the requirements of the blanking process. Therefore, punching and blanking compound molds are used for processing.

3. Process Design

Layout plot : Determine the minimum overlap value based on material thickness a1=2mm between workpieces.

Related Calculation of Gasket Compound Mold

1. Calculate the punch pressure:

(1) Punching force

$F=KLt\tau b=1.3\times2\times3.14\times(20+4+4)\times2\times353=161385(N)=161.4KN$

(F—Punching force, L---Punching peripheral length, t—Material thickness,τb---Shear strength of materials (see Table 4-12), K-coefficient)

(2) Unloading

Force:$Fx=KxF=161.4\times0.05=8KN$

(3) Pushing

Force:$Ft=nKtF=161.4\times2\times0.055=17.7KN$

(Kx,Kt---Discharging force, thrust coefficient) refer to Table 3—19

(4) Determination of press nominal pressure:

When elastic discharging device and punching mold are adopted,

FZ=F+Fx+Ft=161.4+8+17.7=187.1KN

2. Stampings calculation

（1）Primary press: The type is a mechanical open fixed press.

（2）Calculate convex and concave die edge dimensions

Die and Die edge size: In the actual mold manufacturing process, whether it is blanking or punching, they are accustomed to do the punches marked with the size and tolerances (easy processing), and then prepare the die edge of the specified gap. This is a common practice, especially in the processing of progressive die and the use of electric discharge wire cutting punches and dies.

Progressive die has both the punching edge, but also blanking edge, and even bending, deep drawing and various forming cavity. According to the single processing method, if the blanking edge is the reference, the punching edge is a non-reference. This will inevitably result in a drawing, some edges marked with dimensional tolerances, and some edges are not marked with dimensional tolerances. Obviously, it is unreasonable. Especially in the machining using wire electric discharge, it must be done that all edges are marked with dimensions and tolerances, or they are not marked. Due to the high position and size requirements between the cutting edge of the progressive die and the cutting edge, it is necessary to mark a number of positions and dimensions. Therefore, the general practice is to convert the size of the blanking die into a punch die, that is, only mark each. The size of the punch and its tolerances are matched with the cutting edge of the die, so that the double-sided gap can be ensured, and only the edge of the die is marked on the drawing.

Overall Mold Design and Component Design

1. Mold Type Selection

Template material:

According to the product's shape is simple, precision is not high, punching thickness is less than 3mm (“Die Design Guide” Table 3-5), requiring good wear resistance, quenching deformation, long life characteristics (“Practical stamping technology manual”, Table 9-2), punch and die material selection Cr12Mo4V, convex and concave die material selection 9Mn2V, upper and lower die plate material for the commonly used Q235, for the rest of the non-standard material, 45 steel is selected.

2. Positioning Method Selection

Select template size:

(1) Select the template thickness: Select the thickness of the plate by experience, the upper mold plate is 30mm, the lower mold plate is 30mm, the plate is 8mm, the punch plate is 10mm, the stripper plate is 10mm, the concave plate is 25mm (die Height H=Kb=0.28×90=25.2mm≥15mm, combined with this mold, so take H=25mm).

(2) Select the template size: The width of the template is basically calculated according to the standard of “Punching Technology and Die Design”. According to the empirical method, the size of the upper and lower die plate can be selected as 150mm×150mm×30mm.

(3) Selection of standard parts: The standard parts used in this auxiliary mold include dies, guide posts, guide bushes, screws, pins, and super glue.

(4) Determine the height of the punch: The punch is an embossing effect on the surface of the iron during the manufacturing process of the mold, or concave or convex. The design of punch and die is as follows:

① Punch: circular punch, roughing on the lathe to keep unilateral 0.1 grinding, pay attention to the end hit the center hole, and then high-frequency quenching, turning grinding machine each step outside the circle to meet the drawing tolerances, then the end grinding center hole’s location.

② Dies: The holes of the mounting pin are machined by using cast iron, and then the profile is milled out. Before quenching, the tapped holes, φ15 pig iron holes, and thread cutting holes are machined. After the screws are screwed, they are quenched to prevent cracks. After quenching, the hardness is HRC 60 to 64. With wire cutting, excess material can be saved for use.

③ Boss: Due to its cylindrical shape, it can be machined by turning, and then it can be

machined with mounting screw holes, φ8 pig-holes, and wire-cutting thread holes. Screws are then screwed and finished and then quenched. Treatment, hardness HRC56 ~ 60, after quenching grinding with cylindrical grinding machine finishing, and finally die hole using wire cutting.

Conclusion

Flat washer stamping dies have been used since they were put into production, using the structure of flip-chip composite punching production and elastic unloading, which greatly simplified the die structure. This paper analyzes the technical properties of gaskets, analyzes and compares the gasket forming solutions, and designs punching and falling composite molds to reduce the number of processes. Then, it discussed the mold work process and design points. Through actual production verification, this set of molds has significantly improved the production efficiency. The reasonable mold structure ensures the shape and dimensional accuracy of the gasket. Its structure is simple and practical, and the stamping process is stable and reliable, and its application is extensive.

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