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A Stamping Die That Reduces Machining Allowances

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Abstract. In the field of high-voltage three-phase asynchronous motor manufacturing, stator punching piece, rotor punching piece is a necessary part, rotor punching piece through the stacking, casting aluminium, wear shaft, manufactured into cast aluminium rotor, cast aluminium rotor machined with a lathe and then manufactured into a rotor, made from the cast aluminium rotor into a rotor, there will be a machining allowance, the size of the machining allowance determines the efficiency of the production, in order to improve the efficiency of the production, reduce machining allowances, when manufacturing stator punches and rotor punches,special stamping dies are required to ensure that processing allowances are reduced and production efficiency is increased.

Keywords. Rotor punch, stamping mould, machining allowance, improve efficiency.

1. Introduction

High-voltage three-phase asynchronous motors have higher voltage and higher power to meet the needs of different industrial fields. High-voltage three-phase asynchronous motors are important power equipment in industrial production, play an important role in the field of energy conversion, and also play an important role in the field of scientific research and so on. The structure of high-voltage three-phase asynchronous motor mainly includes stator, rotor and bearings. The stator mainly includes stator core, stator winding, seat and other parts; the rotor mainly includes rotor core, rotor winding, shaft and other parts, the stator core consists of stator punches and other components, the rotor core consists of rotor punches and other components. Therefore, stator punches and rotor punches are indispensable parts in high-voltage three-phase asynchronous motors. stator punches and rotor punches can't be made without the stamping die, many companies tend to do single slot stamping dies in order to shorten the stamping die manufacturing cycle and save costs, a single slot stamping die is placed on a high-speed press to manufacture stator punches and rotor punches; stator punches are laminated and other processes to make stator cores, rotor punches are laminated, cast, and threaded into a cast aluminum rotor, cast aluminum rotors are processed and made into rotors, the process flow for making the rotor is shown in figure 1.

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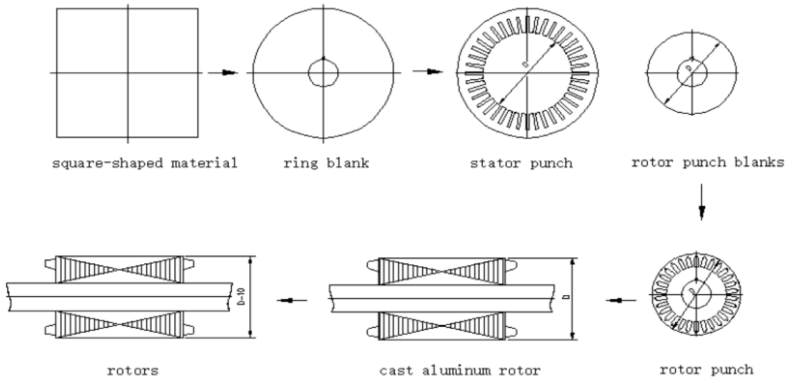

Figure 1. Rotor production process

From figure 1 process flow, it can be known that the steps of rotor process are as follows, ① make silicon steel sheet square material, ② make silicon steel sheet square material into ring billet, ③ make ring billet into stator punch and rotor punch blank, ④ make rotor punch blank into rotor punch, ⑤ make rotor punch into cast aluminum rotor after stacking, casting, and piercing the shaft, ⑥ make cast aluminum rotor into rotor by machining.

In the production of rotor process steps, from step ③ to ⑥, the diameter from D to D-10, this corresponds to a machining allowance of 10 mm for the rotor, 10mm machining allowance, which directly leads to lower productivity; from the production of rotor process steps, we found that the processing amount of 10mm, resulting in the formation of step ③, in order to improve productivity, you can use the stamping die that reduces the amount of machining allowance, with this stamping die[1], the stamped rotor punch, after stacking, casting aluminum, threading the shaft, machining and other processes, the rotor machining allowance can be reduced to improve production efficiency.

2. Client Need

At present, according to the customer's order requirements, we need to produce stator punching piece inner diameter D = Φ890mm, stator punching piece groove number n = 40, stator punching piece groove width h = 20mm [2], stator punching piece see figure 2, stator punches are laminated to make stator cores; rotor punches are laminated, cast in aluminum and threaded through the shaft to make a cast aluminum rotor, machining of cast aluminum rotors to obtain rotors for high-voltage three-phase asynchronous motors with rotor diameter D1 = Φ880 mm,The rotor is shown in figure 3 [3]. From the above description, it can be seen that the gap between the stator core and the rotor core is 10mm, according to the previous processing technology, In the process of making a rotor from a rotor punch, it is necessary to machine the rotor on a lathe to remove the excess machining allowance of 10 mm.

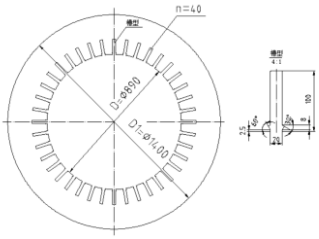

Figure 2. stator punch

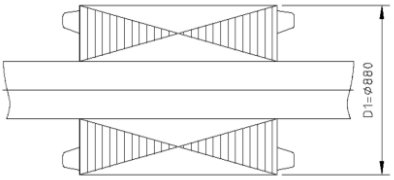

Figure 3. Rotors

3. Description of Equipment and Rotor Process Step Analysis

3.1. Current Equipment

In the high-pressure production workshop, there are 400T stamping machines and two 5T high-speed grooving machines.ordinary lathe CW621250, planer, milling machine, grinder, drilling machine. among them, 400T stamping machine, 2 sets of 5T high-speed grooving machine are used to make the punching piece; ordinary lathe CW621250, planer, milling machine, grinder, drilling machine are used to process the shaft in the rotor and other parts used in the three-phase asynchronous motor.

3.2. Rotor Process Step Analysis

① Cut the 1410mm wide silicon steel sheet coil into 1410mm×1410mm squares with a cutting machine, and the squares that have been cut, see figure 4; ② Put the square material of 1410mm×1410mm on the 400T press bed which already has a drop mold, and press the ring blank, the ring blank is shown in figure 5; ③The stamping die with reduced machining allowance is mounted on a 5T high-speed grooving machine, and the ring blank is machined into a stator punch piece and a rotor punch piece blank with the stamping die [4], see figure 6; ④ Install the existing stamping die on another 5T high-speed slotting machine to process the rotor punch blank into a rotor punch. See figure 7 [5]; ⑤ The rotor punch of figure 7 is laminated, cast aluminum, and threaded through the shaft to form a cast aluminum rotor, see figure 8; ⑥ The cast aluminum rotor of figure 8 is put on the lathe for machining and machined into a rotor, see figure 9.

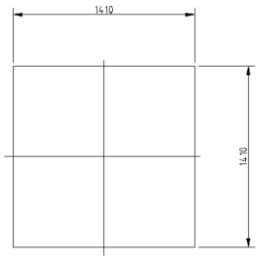

Figure 4. Square-shaped material

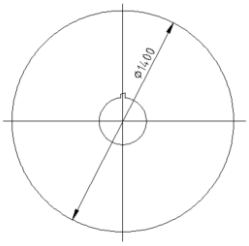

Figure 5. Ring blank

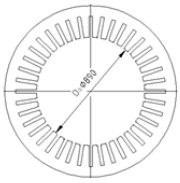

Figure 6(a). Stator punch

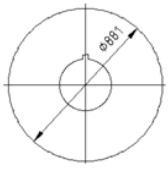

Figure 6(b). Rotor punch blanks

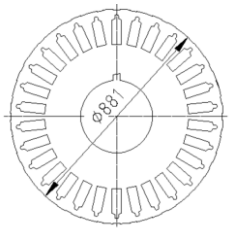

Figure 7. Rotor punch

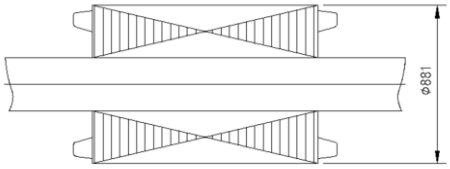

Figure 8. Cast aluminum rotor

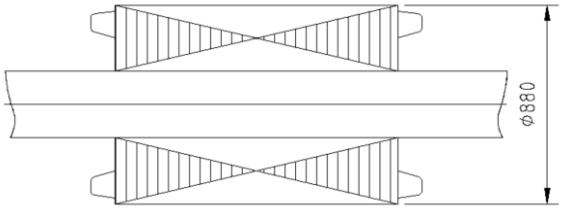

Figure 9. Rotors

In step ③ of the rotor process, a stamping die that reduces the machining allowance is used ,stamping dies that reduce machining allowances have separation punches added during the die design process,so that in figure 6, the diameter of the rotor blank is Φ881mm[6][7].

4. The Process of Designing a Stamping Mould with Reduced Machining Allowance

4.1. Design of Stamping Dies with Reduced Machining Allowance - separation punch and slot punch, see figure 10 and figure11 respectively:

Separating punch and slot punch are mounted on the punch fixing plate, separation punch and slot punch carry out continuous punching and stamping operation together, so as to make separation of silicon steel sheet material, so as to obtain the required stator punch and rotor punch blank semi-finished. Design separation punch, slot punch, material selection Cr12, after heat treatment, the hardness reaches HRC58 ~ 62. nominal size of separation punch and slot punch is the same as the nominal size of the lower die, leaving a gap of 0.03 ~ 0.06mm between the two [8]; the appropriate gap can improve the quality of punching, reduce burrs and collapse, prolonging the life of the mold.

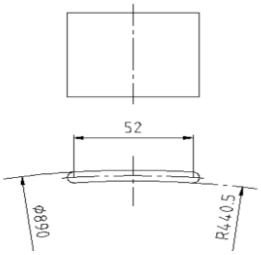

Figure 10. Separation punch

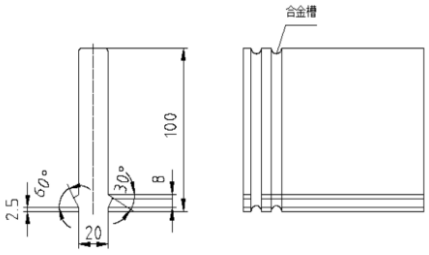

Figure 11. Slot punch

4.2. Design a Stamping Die that Reduces Machining Allowance - lower mold, see figure 12:

The material of the lower mold is Cr12, after heat treatment, the hardness reaches HRC58~62[9][10]. When designing the lower mold, we have to make sure that the dimensions of figure 10 are correct and reasonable, 360/80°, 444, 360/40°, Φ890, Φ881, (3.14×890-40×20)/40+2 dimensions are the main dimensions for the design of the lower mold, and we will introduce the meanings of each dimension respectively.

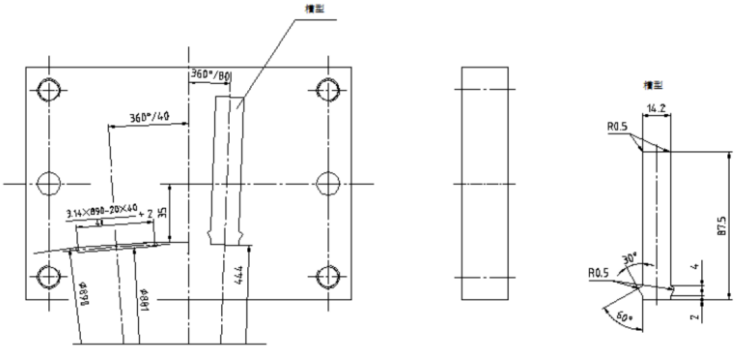

Figure 12. Lower mold

①Dimension 444, 360/40°

In 5T high-speed punching machine, if the stator punching piece of the groove type

all punching, need to punch 40 times, in order to make the force center of the 5T high-speed grooving machine and the center of the punch press co-linear, so the lower die of the grooving type is offset by a certain angle position, the angle is 360/40°; Dimension 444, ensuring that the stator punch is completely separated from the rotor punch blank after punching..

②Dimension 360/80°,Φ890,Φ881,(3.14×890-40×20)/40+2

Dimensions Φ890, Φ881, on the one hand, to ensure that the inner diameter of the stator punching piece conforms to the drawing, and on the other hand, to ensure that the dimensions of the rotor punching piece blanks; 360/80°, (3.14×890-40×20)/40+2 ensures that there is no lower die size for the grooved part of the punch, where the lower die is fitted with the cutter. These two dimensions ensure that the cutter is correctly fitted on the one hand, and that the stator punches are completely separated from the rotor punches on the other hand.[11].

4.3. Designing a Stamping Die that Reduces Machining Allowances - lower die holder see figure 13:

The lower die holder is an important part of the stamping die, its main function is to support and fix the various parts of the lower die. The lower die holder is the part of the lower die in contact with the press table, usually in the form of a plate, which is directly fixed to the table or pad of the press. When designing the lower die holder, it is necessary to ensure the correctness and reasonableness of the dimensions in figure 13, so that on the one hand, the parts can be assembled smoothly, and on the other hand, the punched scrap, through the slots 1 and 2, will have enough space to be introduced into the scrap box[12] .

4.4. Design a Stamping Die with Reduced Machining Allowance - stripper Plate, see figure 14:

The stripper plate is one of the indispensable parts of the mold, the main role of the stripper plate is to detach the workpiece from the mold, to prevent the workpiece and the mold from sticking together, thus improving productivity and product quality;stripper plate material made of No. 45 steel, the production of which needs to be considered with the separation of punches, groove punches gap, the gap is generally 0.4mm~0.5mm, this gap avoids deformation of stator and rotor blanks.

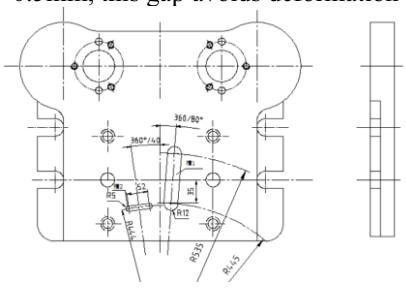

Figure 13. Lower Die Holder

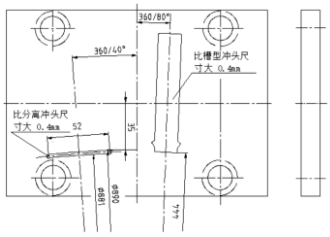

Figure 14. Stripper plate

4.5. Designing a Stamping Die with Reduced Machining Allowance - The punch fixing plate see figure 15:

The punch fixing plate, through its design and installation, ensures that the separating punch and slot punch maintain the correct position and perpendicularity during the stamping process, so as to ensure the precision and quality of the stator punch and rotor punch blanks; the processing should be carried out in accordance with the dimensions of the drawings, and the slot punches and separating punches should be poured into the punch fixing plate with alloy aluminum after processing and molding, so as to ensure that the slot punches and separating punches have a fixed positional relationship.

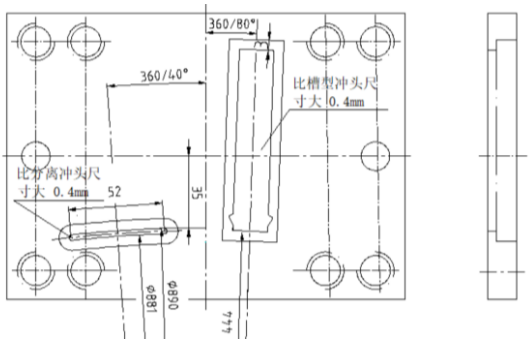

Figure 15. Punch fixing plate

4.6. Design of a Stamping Die with Reduced Machining Allowance - upper die holder see figure 16:

The main role of the upper die holder is to install the guide sleeve and punch fixing plate and other parts, to ensure the assembly requirements of the mold, so that when the mold is working, the upper die holder moves up and down along the guide pillar smoothly, without blocking phenomenon, so as to ensure that the mold can work normally. The upper die holder, on the one hand, is connected with the punch fixing plate, and on the other hand, it is connected with the 5T high-speed slotting machine.

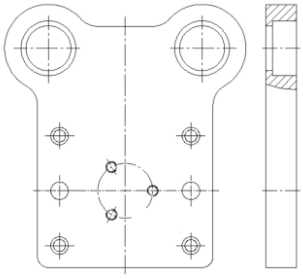

Figure 16. upper die holder

4.7. Remaining Attachments

The rest of the accessories include guide pillar, guide seat, guide sleeve and elastic rubber. See figure 17: Among them, the guide pillar and guide seat are mounted on the lower die holder; the guide sleeve is mounted on the upper die holder; the guide pillar, guide seat and guide sleeve form a sliding positioning device to ensure that the

positional relationship between the separating punch, the slotting punch and the lower die remains unchanged. In this stamping mold, the elastic rubber is installed between the punch fixing plate and the stripping plate as an unloading part. unloading is a very important part of this mold to ensure production efficiency and product quality. The rubber has a certain degree of elasticity, which can be used to eject the product from the mold after stamping is completed, which is convenient and quick.

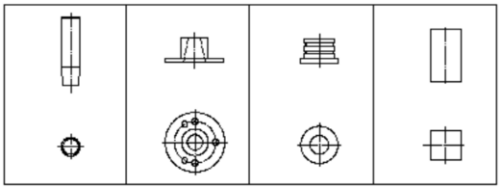

Figure 17. Guide pillar guide seat guide sleeve elastic rubber

4.8. Assembly Drawing

After all the parts are done, use bolts, pins, alloy aluminum, etc. to connect all the parts in sequence according to the assembly drawing, assembling a stamping die that reduces machining allowance,see figure 18.

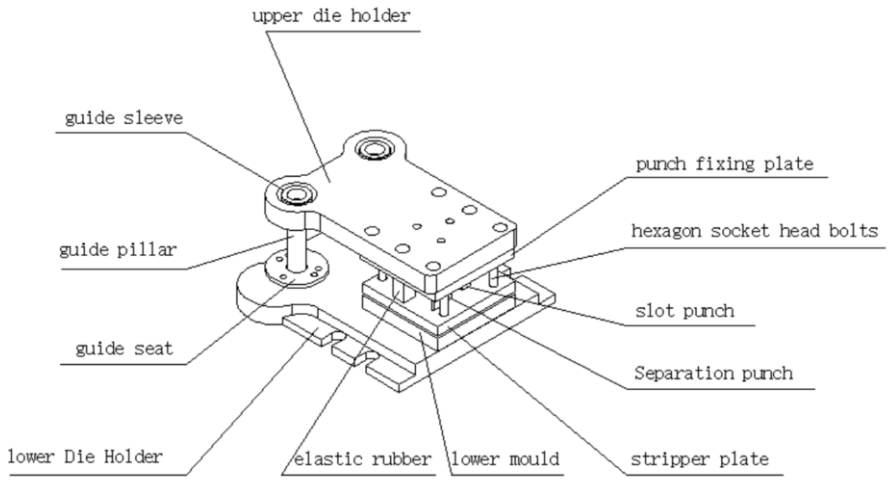

Figure 18. Assembly plan

5. Conclusion

The dimensional accuracy and surface quality of the parts processed by the stamping molds with reduced machining allowances are in accordance with the requirements of the drawings. In terms of dimensional accuracy, there is no excessive burr, size inconsistency, deformation and other defects; in terms of surface quality, there is no surface scratches, pockmarks, wrinkles and other defects; in short, by reducing the machining allowance of stamping molds, not only reduces the amount of machining allowance, improves productivity, and completes the quality of the part requirements.

Acknowledgements

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