Design of Decontamination Device for Punching Sheet of Motor Rotor Core

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Abstract. In the stamping process of the iron core, the residual iron filings and oil stains on the surface are difficult to completely remove even through the cleaning process, and the cleanliness is difficult to reach the standard, which directly affects the product quality. Some manufacturers use manual auxiliary cleaning methods with high cost, low efficiency and uncontrolled product quality. Develop an automated decontamination device to improve product quality, shorten production cycle, and reduce labor costs. The decontamination device adopts a decontamination, absorption, antifouling, storage fouling multi-stage purification process to achieve the goal of meeting product cleanliness.

Keywords: Motor Rotor Iron Core Punching, Decontamination Process, Automation, Cleanliness

1. Introduction
At present, the punching of the motor rotor core is mainly completed by stamping. In the stamping process of the iron core, the residual iron filings and oil stains on the surface are difficult to completely remove even through the cleaning process, and the cleanliness is difficult to reach the standard, which directly affects the product quality [1-2]. Some manufacturers adopt manual auxiliary cleaning methods with high cost, low efficiency, and uncontrolled product quality. Therefore, it is urgent to carry out the design of efficient decontamination devices.

In order to cater to International Industry 4.0 and Made in China 2025, various manufacturers are pursuing lean production, improving product quality and reducing production costs. For this reason, the original method of dust removal of iron core punching has been successively replaced by various manufacturers with automated and semi-automated production methods.

For the current development, our country is in the stage of industrial optimization, and the traditional enterprise development model no longer adapts to the current social development. In order to change the traditional production model of my country's industrial enterprises, it is required to realize automated production [3]. Many companies are continuously increasing investment in automation technology to realize the transformation and upgrading of corporate development. According to the actual situation of the enterprise, the design scheme of the automatic production line...
of the motor rotor core punching and dust removal is developed, so as to improve the product quality, shorten the production cycle, reduce the labor cost, and truly realize the automation of production [4].

2. The Decontamination Principle

2.1. Design Parameters of Decontamination Device
During the stamping process, iron scraps and oil stains on the surface of the iron core punching sheet are difficult to completely remove even through the cleaning process. The quality of the iron core punching piece directly affects the technical performance of the product, so the quality requirements for the iron core punching piece are also very high, such as the dimensional accuracy requirements and cleanliness requirements of the iron core punching piece [5-6]. The designed motor rotor iron core punching and decontamination device has the following requirements: 1. Product cleanliness must reach (1) The maximum residue mass is less than 0.4mg (2) The maximum residue length is less than 0.6mm; 2. The production cycle is 12 pieces /minute; 3. Ensure the safety of operators.

2.2. Decontamination Process and Overall Design
The decontamination device designed in this paper adopts a multi-stage purification process of decontamination-absorption-anti-pollution-storage, and designed an integrated decontamination device based on high-pressure gas dust removal, as shown in Figure 1. The high-pressure gas source is filtered and the gas that meets the product cleanliness standards is stored in the gas storage tank; the iron core punching piece to be dusted is placed on the fixed bracket, the screw drives the rotating chassis to move, and the iron to be decontaminated The core punch is placed in the designated area; the lifting system drives the high-pressure gas in the blow head gas tank to absorb dirt. This process is mainly realized by vacuum cleaner; the dust cover is mainly used for personnel protection and preventing secondary pollution to ensure product cleanliness; on the workpiece The blown off dirt will be stored in the dust removal tank to prevent pollution to the work; finally, the iron core punching sheet is purified.

![Decontamination process and equipment](image-url)
2.3. Design of Main Parts of Decontamination Device

2.3.1 Rotating Table Design. According to the production cycle and the actual size and shape of the product, it is designed to rotate and lift, and the 12 motor rotor cores are simultaneously decontaminated. The rotating table consists of a fixed bracket, a rotating bottom plate, a turntable and a shaft sleeve, as shown in Figure 2. In order to achieve no dead-angle cleaning for the motor rotor core punching sheet, it is designed to rotate the motor rotor core punching sheet when the blowing system is working. When the blowing system is working, it moves from top to bottom. The blowing blows off the pollutants on the surface of the parts, and then vacuuming is carried out below to collect the pollutants in the dust storage tank. In order to effectively realize the collection of dirt, the turntable is designed as a cone. According to the design of the fixed bracket and the turntable and the working mode of the blowing system, considering the installation of the actual product, the effective connection between the fixed bracket and the turntable is realized by rotating the bottom plate. In the early design process, due to the use of rotary air blowing, it is necessary to use the shaft sleeve to cooperate with the turntable, and finally achieve the purpose of deep cleaning.

![Figure 2. Rotary table assembly](image)

2.3.2 Workpiece Handling Design. The decontamination of the rotor core of the motor is mainly divided into two stations. The first is the placement station for the workpiece to be decontaminated. This station mainly places the punch to be decontaminated on the support of the rotating table, and the other station is the dust removal station for the punch. How to realize the effective connection of the two stations and realize the conveyance of the workpiece has become a problem to be solved by the device. In the design of the rotating table, the fixed support of the workpiece and the turntable have been integrated, and this layout has restricted the choice of the handling process. In order to save costs and the cost of the design cycle, the method of moving the bottom plate is selected, and the turntable and the moving bottom plate are directly integrated and designed. This can shorten the construction period and effectively save costs. The movement mode uses the motor as the power source, the lead screw is used for movement transmission, and the light rod is used for guidance and support.

2.3.3 Vacuum Cleaner Selection. The vacuum cleaner is the core component of the motor rotor iron core punching dust removal device. Its dust collection and cleaning performance needs to meet the design requirements. The iron core punch is stamped by a punch, and the production process will produce many iron filings that are extremely difficult to clean. This requires a very high level of suction power of the vacuum cleaner. This design uses a 4500W industrial vacuum cleaner as the main cleaning device to achieve the expected cleaning effect [7].

2.3.4 Dust Cover Design. The main reasons for the design of the dust cover: (1) The motor rotor iron core flushing and decontamination device must not only ensure the cleanliness of the product, but also ensure that the cleaned dirt (mainly iron filings) will not freely scatter and cause secondary pollution
(2) Since the equipment has a large air flow rate when it is working, there is a risk of damaging operators if dirt splashing is not prevented. For personnel safety and product cleanliness requirements, a wind hood system must be adopted.

The dust cover is made of organic glass. Because there is an emergency when the equipment is working, it is necessary for the staff to debug the equipment and observe the working status of the equipment in order to understand the working status of the equipment at the first time [8]. According to the design size and working space of the rotating disk, the basic size and shape of the wind hood can be initially determined.

3. The Key Problem Solved By the Motor Rotor Iron Core Punching and Decontamination Device

The motor rotor iron core punching and decontamination device is a special decontamination equipment designed according to actual production needs during the production of iron core punching. Key issues to be solved:

(1) Effectively guarantee product quality: effectively remove iron filings and oil stains remaining on the surface of the iron core punching sheet, so that the product meets the requirements of cleanliness standards.

(2) Improve production efficiency and reduce costs: The original manual dust removal method of iron core punching is replaced by automated and semi-automatic production methods. This not only ensures product quality but also shortens the production cycle, reduces labor costs, and truly realizes the automation of production [9].

(3) Ensure clean and safe production areas: modern production companies advocate lean production and 6S management. The investment of this equipment effectively guarantees the cleanliness of the production area and the safety of operators.

4. Application Effect and Promotion Prospects

In order to verify the decontamination effectiveness of the motor rotor iron core punching decontamination device, according to the VDA19 parts cleanliness analysis standard and analysis test method, the cleanliness test of the device after decontamination is carried out, and the specific results of three consecutive tests are shown in Table 1. Show. Passed three sets of product cleanliness tests, all qualified. According to the relevant regulations of VDA19, the decontamination device meets production requirements [10].

| Number of experiments | Maximum residue mass | Maximum residue length | Comparing results |
|-----------------------|----------------------|------------------------|-------------------|
| #1                    | 0.251 mg             | 0.421 mm               | qualified         |
| #2                    | 0.282 mg             | 0.363 mm               | qualified         |
| #3                    | 0.171 mg             | 0.385 mm               | qualified         |

The motor rotor iron core punching chip decontamination device replaces the original manual method of assisting in removing product dirt, which not only improves production efficiency but also guarantees product quality. Regardless of customer requirements or actual enterprise development needs, automated and semi-automated production methods are gradually being applied to actual production. Many companies are constantly increasing investment in automation technology to achieve the transformation and upgrade of corporate development. The investment of the device realizes the improvement of product production quality, shortens the production cycle, reduces labor costs, and truly realizes the automation of production.

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