

## Design and Implementation of High-speed Rail Body Blast Cleaning Equipment

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### Abstract

Now, there are some defects in the industry's cleaning of high-speed rail cars and similar large welded parts. The design is based on the subject, considering the future development of the design, in view of the existing research on the basis of the jet shot blasting machine. Which focuses on solving the following two problems: 1. the process of high speed car body cleaning requires manual participation and low production efficiency. 2. nozzles need manual hand hold, the surface of the high speed car body is not completely cleaned, the quality can not be guaranteed. The above two problems have been successfully solved by the design of the high speed iron body shot peening machine. In view of the above problems, the design of special equipment for high-speed rail car body surface cleaning - high-speed rail car body shot peening machine. The equipment has realized the high efficiency, high quality and low cost cleaning of the high speed car body. Compared to the previous manual operation, the equipment adopts mechanical arm specially designed to replace the manual, so the equipment for high speed rail vehicle and similar large welding parts cleaning to achieve a high degree of mechanization, automation, avoids the cleaning process of the artificial participation. At the same time no pit design makes the device has the advantages of low cost, easy maintenance. For the shot blasting room, the use of rock wool sandwich color steel plate reduces the noise pollution in factories and responds to the call of the state.

### Keywords

High iron car body; shot peening machine; surface cleaning of high speed car body.

### 1. The title of the background

Now industrial cleaning of high-speed rail body there are some shortcomings. This design considers the future of the design and is based on the design of the existing blast-cleaning machine. Which focus on solving the following two issues:

1. The process of high-speed rail car body cleaning needs manual participation and the production efficiency is low.
2. Nozzles need to be hand-held, the surface of high-speed rail body cleaning is not complete, the quality can not be guaranteed.

How to quickly and efficiently clean the surface of a high-speed railcar body has gradually become a concern of the relevant enterprises. This article is for this problem, designed a special high-speed rail body handling equipment - high-speed rail body shot peening machine. In order to achieve high-speed rail car body, high efficiency, high quality, low-cost mechanization, automated clean-up.

### 2. Research status

China started in the 50s of the last century with regard to spray (throwing) pills. It started late, and it mainly emulated the technology of the former Soviet Union. By the seventies, China's spray (throwing) pill technology gradually with independent research and development capabilities. Since the 1980s, as the demand for shot blasting cleaning industry in various sectors of society has gradually become broader, the technology of shot blasting and shot blasting has also been developed and perfected, and the industries of metallurgy and mining, machinery manufacturing and aviation

have been gradually expanded. At this stage, with the introduction of national policies, shot blasting technology mainly develops in the direction of energy saving, environmental protection and economy, and gradually integrates with new technologies. With the use of new materials, the shot blasting technology tends to be increasingly automated, intelligent, mechanized and large-scale. Even so, China's shot blasting technology still has a certain gap with developed countries. At present, the advanced large-scale numerical control shot peening equipment needed for domestic production still needs to be imported from abroad.

### **3. High-speed rail body shot peening machine design**

#### **3.1 High-speed rail body shot peening machine the main components and functions**

This article designed peening cleaning machine has shot peening room, gate, scraper recovery device, hoist device, screw conveyor, pill residue separation, shot peening robot arm and other devices. The main components of their functions are described as follows:

##### **(1) Clean room**

The clean room is the main working area of the high-speed rail vehicle body shot peening equipment. The overall structure is welded welded. In order to automate the blasting process, mechanization, clean room with a gantry-type carriage and a robotic arm on the train. In the peening cleaning room, all the parts that are likely to be in contact with the steel shot ejected from the shot peening machine are protected by a protective plate made of a special material, and the parts of the mechanical arm are protected by rubber to protect the inner wall of the cleaning room and the inner part of the structure Will not be destroyed by steel balls.

##### **(2) Door**

This cleaning machine has doors on both sides so that the body can be machined in and out, improving work efficiency. Two outside the door, an increase of clean-up area of the shot peening room, but also reduces the size of the equipment, another from a security point of view, the upper door installed limit switch, only when the cleaning room door completely closed before starting Shot peening.

##### **(3) Shot blasting robot arm device**

The part is suspended by the gantry-type traffic, and can do some horizontal movement on the road, while the mechanical arm can be vertical telescopic, vertical rotation, horizontal swing three movements, can greatly enhance the shot peening Clean up the coverage, improve the quality of shot peening. In the high-speed rail body to be cleaned into the shot peening equipment, cleaning room door completely closed, the shot peening robot arm under the control of the computer, according to a predetermined trajectory to be cleaned of high-speed rail body shot blasting.

In this paper, the design of high-speed rail body shot peening machine, the use of Venturi-type nozzle, the hose connector for the selection, the use of jacket quick connector connection. The peening hose connected in this way has no change in the flow cross-section at the joint, and the joint does not directly contact with the projectile flowing at high speed, reducing the wear of the joint, and has a great life compared with the plug-in connection improve.

##### **(4) Scraper recovery device**

Scraper recovery device designed in this paper is used to clean up the indoor scattered shots and rust and other mixtures collected. When the equipment is running, the projectile shot by the shot peening machine, after cleaning up the rust on the surface of the vehicle body, falls down to the ground with a mixture of rust and the like and falls into the scraper recovery device through the grating, and the scraper recovery device passes Reciprocating cycle, the projectile and iron slag and other mixture collected together, so that the rapid recovery of the projectile recycling.

#### (5) Screw conveyor

Spiral conveyor is driven by the motor spiral section, the scraper recovery device to collect the projectile and iron slag and other mixtures transported to the lower end of the hoist for pellet separation.

There are several types of helicoidal surface in screw conveyors: solid surface, ribbon, and vane. According to different conveying materials using different helical surface type, for the viscosity of the smaller, more dry powder or granular materials, the use of solid surface spiral surface. [8] Therefore, according to the design requirements to select the solid surface.

#### (6) Lifting device

The cleaning machine designed in this paper uses a belt-driven bucket elevator that is blanked by gravity and subsequently separated by a pellet separator.

Bucket elevator used in this paper is a tape centrifugal lift, compared to the chain hoist, the device is easy to manufacture, easy to overhaul during use. Compared with some large-angle lifting devices, the equipment has the advantages of small floor area for transporting materials and saving the factory construction land; the outer cover of the hoist is closed and has a good tightness in working work, and the device is reduced Pollution of the environment. The disadvantage is the use of belt conveyors. Compared to chain conveyors, slippage may occur.

#### (7) Pill residue separation device

The pellet separation device separates the projectile and the iron slag and other mixtures promoted by the lifting device, removes the iron slag and the damaged projectile, and recycles the projectile again for the equipment of the shot peening process.

Because of the peening cleaning device designed in this paper, the shot peening is adopted and the air compressor is used to provide the power. Therefore, the wind separation device is still used on the separating device, so that the motive power can be reduced. In addition, in the air separation plant, the conventional separator has a simple structure and is capable of separating rust, scale and the like from the pellet mixture. Therefore, the selection of ordinary wind separator device.

#### (8) Dust removal device

The device is used to clean the interior of the chamber as a result of shot peening dust generated during the cleaning chamber, clear the chamber to clean the suspension of sand and sand mixture.

As the peening device designed in this paper is designed to use shot peening and air compressor to provide power, so the ventilation and dust removal device is still used in the separation device, so that the motive force can be reduced. Also in the ventilation dust removal device, the dust in the projectile completely meet the requirements of the cleaning equipment designed in this study, without the need for recycling dust. Therefore, a device that normally removes dust from the projectile is selected.

### **3.2 High-speed rail body shot peening machine working principle and process**

This design of high-speed rail car body cleaning equipment is the body surface rust layer to be cleaned. Through the pressure provided by the air compressor, the projectile is sprayed out at a high speed, hitting the surface of the body to be processed to achieve the cleaning effect.

High-speed rail body cleaning machine processing flow: The high-speed rail body to be processed is towed by the tractor through the open door on one side and moves along the guide rail of the clean room to a designated position. Subsequently, the opened door is closed and the driving spray Pill robotic arm shot blasting according to a predetermined trajectory, the projectile uniformly hit the surface of the high-speed rail body, in order to remove the rust layer and the surface scale, while cleaning the bottom of the scraper recovery unit open, the projectile and rust mixture Collected concentrated, transported to the lifting device through the screw conveyor, the projectile and rust mixture and then upgraded into pellet separation device for separation, reusable recyclable projectile.

### 3.3 High-speed rail body shot peening machine features

This design of high-speed rail car body cleaning equipment comprehensive domestic and foreign advanced technology, is a set of high-quality, high automation, low noise cleaning equipment, has the following characteristics:

- (1) To achieve a high degree of mechanization, reducing the manual process of cleaning up the participation.
- (2) To achieve a high coverage rate to clean up, greatly avoiding the clean-up corner.
- (3) Using advanced blast cleaning technology, with high production efficiency and labor productivity
- (4) The equipment is reliable in operation, there is no need to build a pit, the equipment cost is reasonable, the operation is smart and convenient, and the maintenance is simple.
- (5) The working environment has been improved, which is in full compliance with the state's policies and regulations regarding the degree of environmental pollution in factories.

### 3.4 High-speed rail body shot peening machine scope of application

This design of high-speed rail body cleaning equipment is designed specifically for the high-speed rail body cleaning machine. The cleaning machine of this paragraph uses an air compressor to power the projectile and sprays the projectile into the high-speed rail car body to be processed in the shot blasting room for cleaning purposes. It is suitable for high-speed rail car body, similar to the thickness of the body of high-speed rail car body is not less than 2mm, or for the size of the precision of small metal surface cleaning.

## 4. Conclusion

In this design, in response to the existing problems:

- (1) The clean-up process of the high-speed rail body requires manual participation and the production efficiency is low.
- (2) The nozzle needs to be hand-held, and the surface of the high-speed rail car body is not completely cleaned, and the quality cannot be guaranteed.

Made the following work:

- (1) Using mechanical arm instead of artificial, to achieve a high degree of automation.
- (2) Scraper recycling device, no pit design, reducing production costs.

The design of this project has basically completed the requirements of the project and can satisfy the shot blasting of high-speed rail car bodies and solve the problems that existed before.

However, this article still has further optimization work;

- (1) Reduce the size of the house
- (2) This equipment can be used to clean medium-sized castings and increase their availability.

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