The Design of Small-Metals Collector in Workshop

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Abstract. A small appliance for collecting the small metals scattered in factories and workshops. This collector has rotary drum structure and uses the permanent magnet to absorb small metals. The design of the one action removal system helps collected metal parts is removed automatically instead of desquamated by hand. Part structure of this appliance can be combined by increasing the working width to satisfy different market demands in various conditions. The tests indicate that this appliance with simple structure, convenient operation and low cost has great market demand and application value.

1. Introduction

Production department, the place to produce and process enterprise's products and realize value increment, presents inner image of an enterprise. It is the center for an enterprise to realize profits. Modernized enterprises emphasize on management of production department a lot, which is one of significant contents in the whole production of an enterprise. Production department management plays an essential role in improving product quality, decreasing poor product cost and increasing production efficiency. It is an important link to realize scientific, systematic and efficient management inside the enterprise.

There are usually many small metal pieces scattering on the assembly bench and the ground, even iron filings, such as screw, nut and so on. If these small metal pieces are not collected in time, it will influence production environment seriously. It will even result in mixing metal pieces in equipment accidentally, which will lead to serious security accident. Besides, if these metal pieces are not recovered in time, it is not a small waste. According to an investigation, currently production department usually adopts the way of artificial cleaning or magnetic adsorption and then manual cleanup, which is an inconvenient way for collection and wastes time and energy [1]. Therefore, in order to largely improve effective management of enterprise’s production department, fully utilize resources, promote productivity and increase profits, it is necessary to design a tool satisfying collection of metal pieces.

2. Design requirements of collector

According to collector’s characteristics of collection, a full investigation is made to decide design requirements of collector, which is shown as following:

(1) Collector should save energy and time and can improve collection efficiency.
(2) Collector has a simple structure and low production cost, and is in light weight and easy to use.
(3) Collector’s structure can realize “one click” unloading. After collection, there is no need to detach screws or iron filings one by one.

(4) Collector has a flexible structure and application of extension. By adding cumulated groups number, it expands collection width and increases volume and intensity of magnet, which enables it to collect screws and metal pieces with bigger size and volume.

3. Overall structure and operation principle of collector

Based on the above design requirements, Figure 1 shows the structure of screw collector designed in this paper, which is mainly consisted of hand shank, roller bearing, left cover, magnet base, magnet, drum, knob, spring and bearing clip.

![Figure 1. Structure diagram of screw collector.](image1)

1 hand shank, 2 roller bearing, 3 left cover, 4 magnet base, 5 magnet, 6 drum, 7 knob, 8 spring, 9 bearing clip

When manual holding the hand shank of collector and pushing forward, left cover, magnet base, magnet, drum and knob together make a whole and rotate around roller bearing. At this time, poles of magnet expose. Small metal pieces like screws, nuts and iron filings will be adsorbed quickly in to sulciform space constituted by magnet and drum when collector meets them. Figure 2 presents adsorption principle of metal piece collector.

![Figure 2. Adsorption principle diagram.](image2)

When sulciform space is completely occupied by metal pieces like screws, adsorption becomes difficult and rolling starts to be strenuous. Now it is the time to detach screws and iron filings in order to start collection again. This collector can realize “one click” unloading and does not need to detach screws one by one. It only needs to fix the outer drum and rotate the knob 45 degrees clockwise or anticlockwise until it is not able to rotate. Magnetic poles’ hiding enables metal pieces like screws to
separate from magnetic poles, which makes it easy to collect screws in the container. Figure 3 shows the unloading principle of metal piece collector.

4. **Key components design of collector**

Key components of collector mainly include magnet base, drum and assembly of drum and knob. This collector designs 4 magnet bases, which is connected through its own pins. As the diagram showed in Figure 4, the structure of magnet base adopts axial cumulation to make interlock connections. The collector designs 4 drums, which is also linked through its own pins. Figure 5 presents assembly diagram of drum, which also adopts axial cumulation to make interlock connections. Inside, left cover and magnet base, and magnet base and knob use pins to build connections. Elongation slot design is adopted between left cover and magnet and between drum and knob.

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Figure 3. one action removal principle diagram.

Figure 4. Structure diagram of magnet carriage.

Figure 5. Rotary drum assembling drawing.
Figure 6 displays the assembly diagram of drum and knob. Exerting torsion can realize relative motion. Magnet is pressed into magnet base. Spring offers axial preload to make axial backlash. Bearing clip and roller bearing is riveted in the end, which plays a role of axial spacing.

![Assembly Diagram of Drum and Knob](image1)

**Figure 6.** Assembling drawing between rotary drum and knob.

5. Extension of application

As an important design approach and core technology of flexible design and mass customization, modular design realizes user oriented design and customized design through different combinations of functional modules, which is widely applied in industries like machine tool, reducer, computer, household electrical appliances and furniture. This collector designs a structure of “one click” unloading to simplify operation. It is not limited to be used in metal piece collection of small handhold worktop, and also can make extension of application. At this time, applying modular design theory, extending collector’s handle shank and the part of roller and magnet base axially, and adding cumulated groups number will increase collection width, diameter of roller and magnet, and magnet’s volume and intensity. In other words, it can collect screws or iron pieces with larger volume and size, which is displayed in Figure 7. In this situation, it can be used to collect screws and iron filings in garages or small parking lots, which effectively avoid damage of car tires, alleviate cleaner’s work and improve cleaning efficiency.

![Extension of Application](image2)

**Figure 7.** Enlarge width to use.
6. Conclusion
The metal piece collection created and designed in this paper has obtained national patent. With a simple structure, convenient operation and reliable work, it is in prototype production in one company now. The standalone cost is only about 100 Yuan, which possesses strong practicability. According to experiment results, collector can collect small metal pieces, like screws in factory workshop, which meets established design requirements. It will make volume production and has a wide market prospect.

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