Structural improvement and application of cigarette packets pusher for YB65A rigid strip packaging machine

Yun Ding [1], Zhengwei Li [1], Xiaobo Lv [2], Jingxun Liu [1,*], Wenjie Li [1], Peng Ren [1]

[1]Shenzhen Tobacco Industrial Co., Ltd., Shenzhen 518109, Guangdong, China

[2]Yuxi cigarette factory of Yunnan Hongta Group Co., Ltd., Yuxi 652699, Yunnan, China

*Corresponding author: liujx@haorizi.cn

Abstract: The side baffle of the pusher plate of YB65A packaging machine is used to blocks and locates the cigarette pack. During the production, the cigarette pack contacts the side baffle surface of the pusher plate, causing obvious scratches on the surface of the cigarette pack, reducing the quality of the cigarette packs and causing potential quality hazards. To solve this problem, the distance between side baffle and cigarette packs is increased by redesigning the key parts of the pusher. The application results show that the scratches on the surface of cigarette pack have been solved, the production quality of cigarette pack has been improved.

Keywords: YB65A type rigid strip packaging machine, cigarette packets pusher plate, side baffle.

1. Introduction

The YB65A rigid strip packaging machine is one of the auxiliary machines of the ZB25/ZB45 packaging unit [1]. It is a domestic cigarette packaging equipment of the PACK (CT) type of the Italian GD company, and it is also one of the mainstream models of medium-sized special-shaped cigarettes in the industry [2]. In the production process, after the cigarette packs are pushed out of the turntable of the packer, the cigarette packs need to be turned into a vertical arrangement, and then pushed forward by the cigarette pusher to complete the packaging of the carton paper. In order to prevent the cigarette packets pusher from hitting the cigarette packs in the passage, a cigarette packets shield is designed on the left side of the cigarette packets pusher. successful completion of the process. In actual production, it was found that the side of the cigarette pack was in contact with the surface of the cigarette packets baffle plate, and the pressure was huge, and obvious scratches were produced on the surface of the cigarette pack during the retreating process of the push plate, causing serious quality problems.

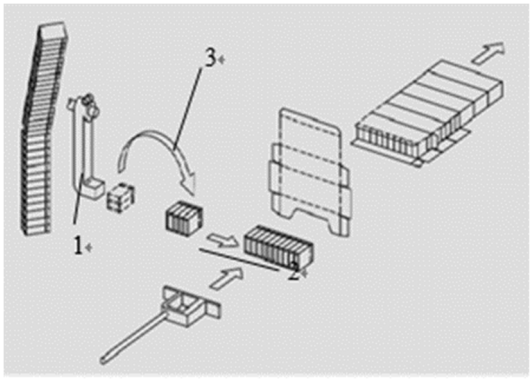
In recent years, a large number of technical transformations have been carried out on the YB65A rigid strip packaging machine. Zhang Weifeng, Chen Qinghui, etc. developed a new type of movable cigarette packets pusher power supply device, which solved the deformation and damage of the movable cigarette packets pusher and the misalignment of the bevel gear during the production process, and improved the effective operation rate of the equipment [3]; Lu Yuzhen, Ma Li, etc. The rigid strip packaging machine has problems such as long box size and not easy to carry when packing medium cigarettes in two or five flat packs. A small cigarette pack turning device is designed to change the two to five flat packs into vertical packaging to solve the above problems. At the same time, the operating efficiency of the equipment is also improved [4]; Shen Minliang and Liu Shengping designed a new type of rejector device, which changed the integral rejector plate of the YB65A rigid strip packaging machine to a split type, which reduced the failure rate of the reject device and avoided the failure rate of the reject device. The small box of cigarettes wrapped in the carton flows into the next process to ensure the quality of the product [5]; Yang Bencai and Zhang Wei designed a long-side positioning device in the middle of the long-side folding of the carton of the YB65A type rigid packaging machine, which solved the problem of the folding pressure of the carton packaging paper. Folding and positioning failure due to reasons such as traces and paper, etc., the device has accurate positioning, simple structure and convenient disassembly, which improves the operating efficiency of the unit [6]. However, there are few reports on the improvement of the scratches on the surface of the cigarette pack caused by the excessive pressure between the push plate

and the cigarette pack. Equipment maintenance personnel have also made a lot of attempts to solve this hidden quality problem, such as changing the thickness of the cigarette packets shield, adding lubricating materials between the contact surface of the cigarette packets shield and the cigarette pack, or changing the length of the arrangement channel of the small pack of cigarette packs, etc. Neither can fundamentally solve the problem of scratches on the surface of the cigarette pack. Therefore, the improvement of the equipment is aimed at solving the quality hidden danger of scratches on the surface of cigarette packs and improving the production quality of cigarette packs.

2. Problem Analysis

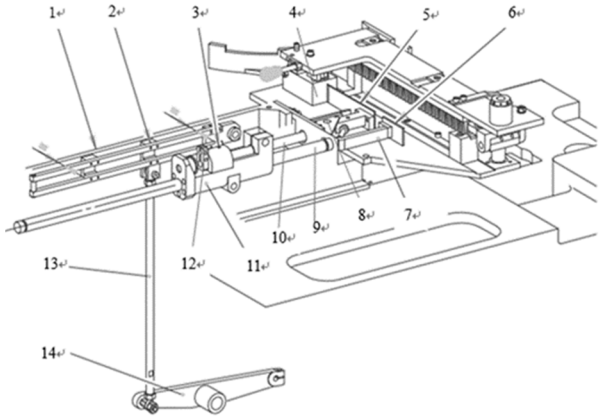
2.1. Working principle

Figure 1 shows the schematic diagram of the packaging process of the YB65A rigid strip packaging machine. After the cigarette pack is packed with the outer transparent paper, the refiller turntable is pushed out. At the same time, the carton paper in the paper library is sucked by the suction mechanism and sent to the roller conveying channel, and then enters the vertical conveying channel under the action of the guide wheel and the track, and then the cigarette pusher pushes the cigarette pack group and the carton wrapping paper into the carton for forming. The channel completes the box packaging, and then the box enters the transparent paper packaging machine to complete the transparent paper packaging outside the box, and finally sends it to the carton sealing machine for sealing and storage.



1. Pack refilling device 2. Cigarette pusher 3. Cigarette pack turning channel

Fig. 1 Schematic diagram of packaging process of YB65A rigid strip packaging machine



1. Box 2. Connection block 3. Slide rail 4. Cigarette pack 5. Movable pusher 6. Fixed pusher 7. Fixed arm 8. Side baffle 9. Push rod 10. Fixed shaft 11. Slide seat 12. Swing block 13. Pull rod 14. Swing arm

Fig. 2 Schematic diagram of the cigarette packet push plate structure

As shown in Figure 2, the cigarette packets pushing device of the box is divided into two parts: fixed and movable. It is mainly composed of a fixed cigarette packets pushing plate (5), a movable

cigarette packets pushing plate (6), a side baffle (8), and a push rod (9).), fixed shaft (10), sliding seat (11), swing block (12), slide rail (3) and other parts.

The sliding seat (11) is connected with the fixed shaft (10) and the push rod (9) to make the movable cigarette pushing assembly realize forward and backward actions, and the cigarette pack (4) is continuously transported to the cigarette pushing plate (5, 6), in order to avoid scratching the cigarette pack when the pusher is retracted, the pusher is designed to be composed of a fixed pusher (6) and a movable pusher (5). Rotate to the right to avoid the cigarette pack during the process. The cigarette packets pusher assembly is connected to the slide rail (3) through the swing block (12). The slide rail track is parallel to the cigarette packets pusher assembly when the cigarette packets pusher plate advances to the push position. At this time, the movable cigarette packets pusher plate is in the unfolded state. , push 10 packs of vertically arranged cigarette packs into the bar; when the pusher plate advances to the push-up position, the swing arm (14) drives the pull rod (13) and the connecting block (2) to lift the slide rail and swing the block Clockwise rotation, through the meshing action of the inner drive shaft and the inner sector gear and helical gear, the movement direction is changed, so that the movable cigarette pusher rotates to the right, and is retracted from the unfolded state to avoid scratching the cigarette pack during the retreat process; When the cigarette board returns to the ready position, the swing arm drives the pull rod and the connecting block to make the slide rail fall back to the parallel state. At this time, the oscillating block rotates counterclockwise. Similarly, the movable cigarette pusher rotates to the left, from the retracted state. Expand it for the next push.

2.2. Existing problems

Ideally, there is a distance of about 5mm between the side baffles of the cigarette pusher and the cigarette packs in the conveying channel, which can block the cigarette packs and prevent the side baffles from contacting the surface of the cigarette packs and scratching the cigarette packs. In actual production, it is found that when the cigarette push plate assembly completes a cigarette pack push action and returns, its side baffles are in contact with the cigarette pack surface, as shown in Figure 3, causing obvious scratches on the cigarette pack surface, resulting in great quality hidden danger. In the production of Medium diameter cigarette products, different from the "two-five arrangement" of ordinary cigarette products, the front side of the cigarette pack contacts the side baffle, so the problem of such scratches is more obvious.

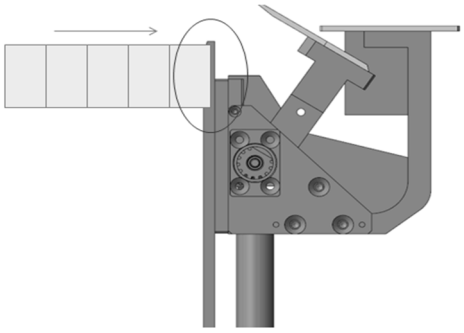


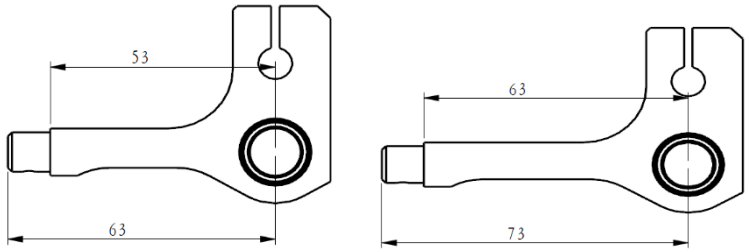
Fig. 3 Schematic diagram of the contact between the cigarette pack and the side baffle

3. Ways to improve

The YB65A rigid strip packaging machine has added a cigarette packet turning channel, which nearly doubles the distance that the cigarette packet pusher pushes the cigarette pack. In the process of long-distance pushing, the cigarette packs pushed from the left side is easily toppled, resulting in a cigarette collision failure. Therefore, during the retracting process of the cigarette pusher, the left baffle must hold the cigarette packets and prevent it not to be dumped. This requires that the distance between the side baffle of the cigarette pushing plate and the pushing plate of the cigarette packet turning channel is an integer multiple of the cigarette bag width, otherwise the cigarette pack and the side baffle of the rod box will be scratched and cause quality problems. In fact, the distance

between the side baffle of the cigarette packet pusher plate and the cigarette pack pusher of the turning channel is difficult to meet the above requirements.

In order to solve the above technical problems, a solution to improve the cigarette pushing plate is put forward. Based on the structural characteristics of the push plate assembly, some parts of the push plate assembly are redesigned. As shown in Figure 4 (a) and (b), which are the engineering drawings before and after the improvement of the swing block. It can be seen from the figure that the distance between the swing block mounting hole and the left edge is increased from 63 to 73mm, and the distance between the swing block mounting hole and the step edge is increased from 53 to 63mm.



(a) (b)

Fig. 4 Improved engineering drawing of swing block

After changing the size of the swing block, the rotation angle of the movable cigarette packets pusher will change under the condition that the stroke of the draw rod remains unchanged. As shown in Figure 5, before the improvement, it can be obtained that the maximum swing angle of the movable cigarette packets pusher is 38 degrees. Since the bevel gear of the cigarette packets pusher is 1:1 transmission, the swing angle of the swing block is the same as the swing angle of the movable cigarette packets pusher, that is, the movement of the cigarette packets pusher. The maximum swing angle of the front swing block is also 38 degrees.

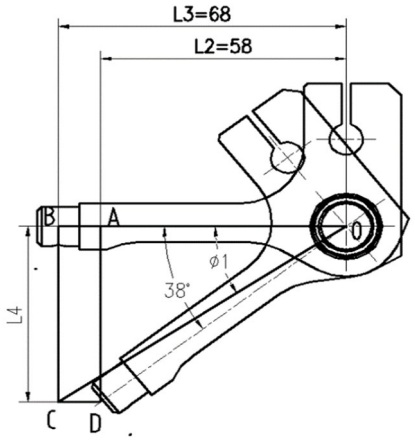


Fig. 5 Schematic diagram of improved swing angle of front and rear swing blocks

Before the improvement, the arm length of the swing block is 58mm, and the maximum swing angle of swing block is 38 degrees. So the maximum stroke of the cam can be calculated as:

$$L4=L2*\tan(38)=45.3mm \quad (1)$$

After the improvement, the stroke of the cam has not changed, and its stroke is L4=45.3mm,and the arm length of the oscillating block after the improvement is 68mm, it can be calculated that the oscillating angle of the oscillating block after the improvement is:

$$\emptyset_1=\arctan(L4/L3)=\arctan(45.3/68)=33.7^\circ \quad (2)$$

In short, the swing angle of the swing block is reduced to 33.7 degrees. Since the swing angle of the movable cigarette packets pusher is equal to the swing angle of the swing block, the swing angle of the movable cigarette packets pusher is 33.7 degrees too.

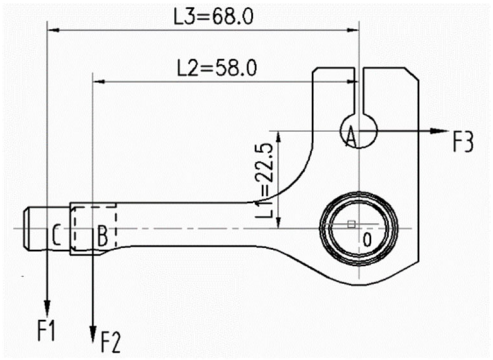


Fig. 6 Force analysis diagram of swing block

The swing block is driven by lever principle, changing the arm length of the swing block will change the stress condition of the swing block. For this reason, the force analysis of the swing block is carried out. In the force analysis diagram in Figure 6, F1 is the pulling force of the improved sliding rail to the swinging block, F2 is the pulling force of the front sliding rail to the swinging block, and F3 is the force of pin to the swinging block. F1, F2 and F3 are the interaction force and reaction force.

$$\text{Before improvement: } F2*L2=F3*L1 \tag{3}$$

$$\text{After improvement: } F1*L3=F3*L1 \tag{4}$$

For the load of the cigarette packets pusher have not changed, so:

$$F2*L2=F1*L3 \tag{5}$$

Thus it can be calculated:

$$F1=F2*L2/L3=0.85*F2 \tag{6}$$

According to the force calculation, the pulling force of the improved sliding rail to the swing block is smaller than that before the improvement. This indirectly shows that lengthening the arm length of the swing block has played a certain role in improving the stress of the entire device and the service life of the lifting cam and connecting rod.

The improved parts also include the sliding seat. The engineering drawings of the parts before and after the improvement are shown in Figure 7(a) and (b). After the improvement, the left-right distance between the central axis of the left mounting hole and the central axis of the right second mounting hole is increased from 20mm to 30mm.



(a) Before improvement (b) After improvement

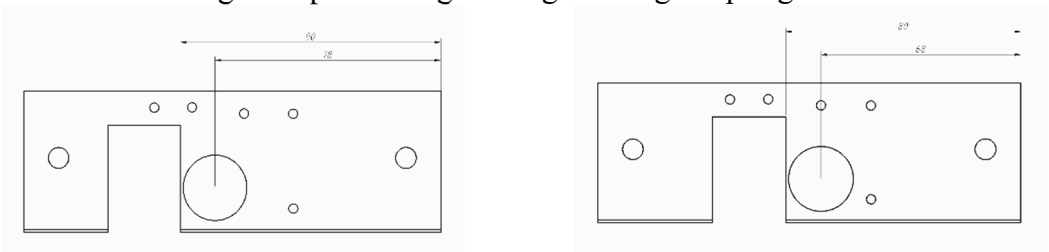
Fig. 7 Engineering drawing of sliding seat improvement

The spring base and the end baffle had been improved too. The engineering drawings of the parts before and after the improvement are shown in Figure 8 and Figure 9. After the improvement, the left and right distance between the central axis of the upper mounting hole and the central axis of the lower mounting hole is increased from 20mm to 30mm. the left and right distance between the right edge of the improved baffle and the center of the circular hole is increased from 58mm to 68mm,



(a) Before improvement (b) After improvement

Fig. 8 Improved engineering drawing of spring base



(a) Before improvement (b) After improvement

Fig. 9 Improved engineering drawing of end baffle

Figure 10 shows the assembly schematic diagram of the improved push-pull assembly. After the parts are externally processed, they are installed on the equipment for the next step of debugging, and the test verification is carried out after confirmation.

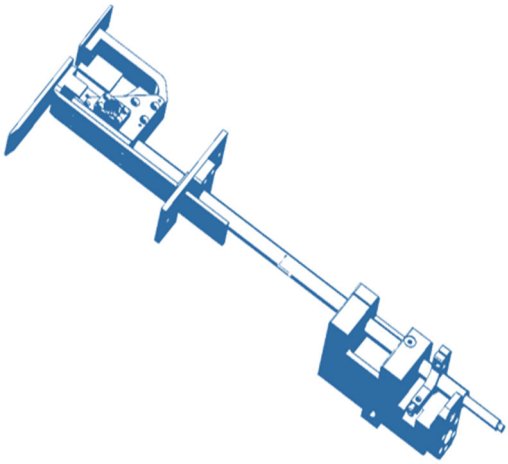


Fig. 10 Schematic diagram of the assembly of the improved push cigarette packets component

4. Apply the effect

4.1. Experimental Design

Equipment: YB65A rigid strip packaging machine

Test method: The production speed is 20 pieces/min (200 packs/min), and 3 operators work continuously in one shift (8h).

4.2. Data analysis

As can be seen from Table 1, YB65A rigid strip packaging machine no longer has the problem of scratching the cigarette pack during the production process, and meets the requirements of the enterprise quality inspection standard after the improvement.

Table 1. Statistics of scratches on the surface of cigarette packs of the YB65A rigid packaging machine after improvement

	before improvement		after improvement	
Test time	Output /box	Number of scratches on the surface of the cigarette pack/pack	Output /box	Number of scratches on the surface of the cigarette pack/pack
Day 1	158.2	6952	172.3	0
Day 2	145.3	6265	153.2	0
Day 3	124.7	5325	124.7	0
Day 4	135.6	5708	161.1	0
Day 5	110.8	4540	168.9	0
mean	134.9	5758	156.0	0

Note: The test time is from March 15 to March 20, 2021 before the improvement; from April 12 to April 16, 2021 after the improvement.

5. Conclusion

The cigarette packets push plate of the YB65A rigid packaging machine is improved and designed. By redesigning the sliding seat, swing block, spring base and box end baffle and other parts, the distance of cigarette packets push plate and cigarette packets is increased, which solves the problem in production. The test results show that the equipment runs stably, the quality of the cigarette pack can meet the quality inspection requirements of the enterprise.

References

[1] Yang Bencai,Zhang Lu.Reconstruction of the carton paper conveying system of YB65A rigid strip packaging machine[J].Tobacco Science & Technology,2012(01):23-25.

[2] Lu Honglin, Chen Tao, Liu Xiang, Xiao Huayu. Improvement of special-shaped packaging of YB65 carton packaging machine[J].Tobacco Science & Technology,2021,54(04): 100-106.

[3] Zhang Weifeng, Chen Qinghui. Development of a new type of YB65 movable cigarette packets pusher power supply device[J].Internal Combustion Engines & Parts,2017(22):16-17.

[4] Lu Yuzhen, Ma Li, Lu Xiaobo, Dao Ronggui, Zhou Bo, Zhang Jinwu, Wu Jie.The design of the small box cigarette packet turning device of the YB65A rigid strip packaging machine[J].Tobacco Science & Technology,2019,52(08): 95-100.

[5] Shen Minliang, Liu Shengping. Improvement of the ejector of YB65A rigid strip packaging machine [J].Equipment Management and Maintenance,2020(04):95-97.

[6] Yang Bencai, Zhang Lu. The design and application of the mid-section positioning device for the long-side folding of the YB65A rigid strip packaging machine[J].Tobacco Science & Technology,2012(12):30-32.