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Research, Design and Manufacture of Seal-Binding Automechanism for 6-Pronged Plastic Seals

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ABSTRACT

In this paper, the author presents the result on researching, designing and manufacturing a seal-bing mechanism for 6-pronged plastic seals to apply in laser engraving lines of logos, barcodes, codes ... with automatic 6-pronged plastic seals. Unlike the conventional clamping machenism that require two clamping and rotating mechanisms for twisting, this seal-binding mechanism is designed to integrate and connect the clamping mechanism to the rotating mechanism, therefore, the structure is compact and effective. The seal-binding mechanism is implemented during the process of collecting seals, if achieved, 10 seals will clamp and twist the wire to bind seals each bundle with each bundle of 10 seals in 14 seconds, the number of twisted turns when binding from 4 to 5 turns. In order to ensure a reliable and stable working process, the twisting machenism is designed and used with a sensor to count the number of turns, the angle of twist to release the clamp. These processes are programmed by PLC for control.

KEYWORDS: *Automechanism, automatic wire-twisting, plastic seal, PLC control*

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1. INTRODUCTION

In the process of production, transportation, storage of goods, 6-pronged plastic seals are widely used becaue of its the superiority as follows.

Fig.1. 6-pronged plastic seals

- Limiting losses during the transport.
- Transparency in the delivery process from production warehouses - delivery staff - consumers.
- Easy in brand management and recognition
- Increase the reliability and professionalism in the eyes of customers

However, these plastic seals promote their superiority only when they are laser engraved with logos, barcodes, codes ... of the company in the process of use. Meanwhile, some enterprises are using labor to engrave and collect plastic seals manually with low productivity and toxic working environment.

The wire- twisting mechanism to bind seals into each bundle with a fixed number is a decisive mechanism in the line of engraving seals.

In fact, the wire- twisting mechanism is also widely used in industry and in life, especially in automated devices.

Figure 2, 3 are a picture of clamping and rotating terminals to create a twist when making twisting brushes. In this mechanism, two clamping and rotating mechanisms are implemented by independently controlling two different mechanisms [1].

Fig.2. Twisting brush [1]

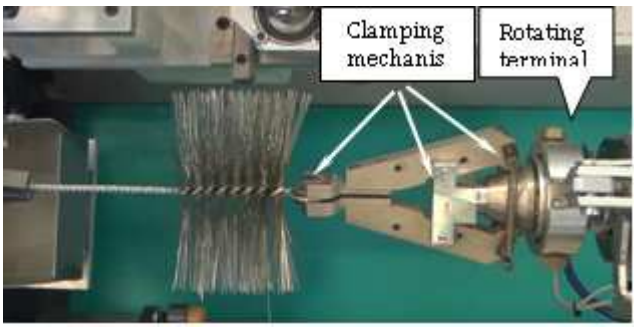

Fig.3. Clamping terminal to make twisting brushes [1]

Similar to the twisted barbed wire machine, it has similar structure with the clamping terminal which has a tight clamping mechanism and rotating mechanism operated independently (independently controlled by two different mechanisms).

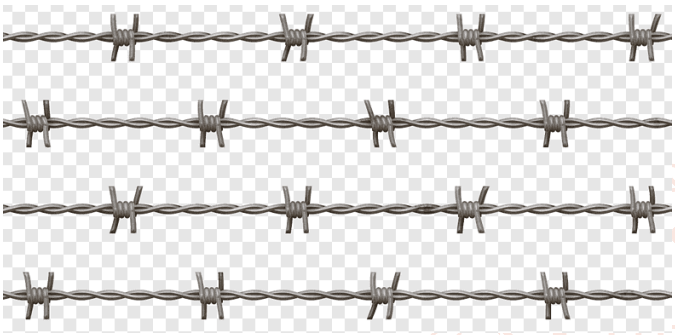

Fig.4. Twisted barbed wire [2]

In addition, electrical cables are always manufactured in the twisted form shown in Figure 5

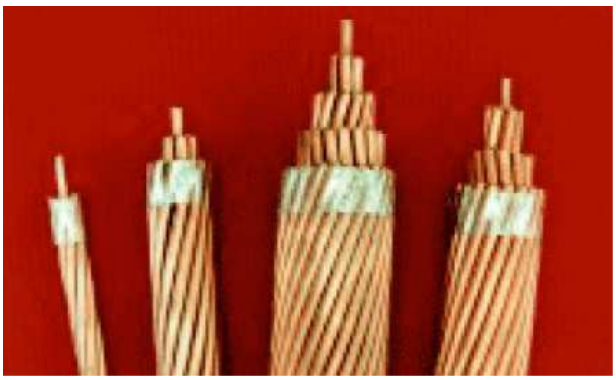

Fig.5. Electric wire with a twisted structure [3]

From the references above, the author and others have designed the sealing mechanism described in the following sections

2. DESIGN OF 6-PRONGED PLASTIC SEALING AUTOMECHANISM

2.1. Design parameters

Input parameters for the process of designing a machine include:

- Binding time: 14 seconds.
- The number of seals in each bundle: 10 seals
- Number of twisted turns: 4÷5 turns.
- The seal bundle is tight, seals are not dropped from the bundle.

From the above design requirements, the author has built the principle diagram of the machenism described in Figure 6 and Figure 7.

* The working principle consists of three steps: clamping wire, twist ing wire and releasing wire.

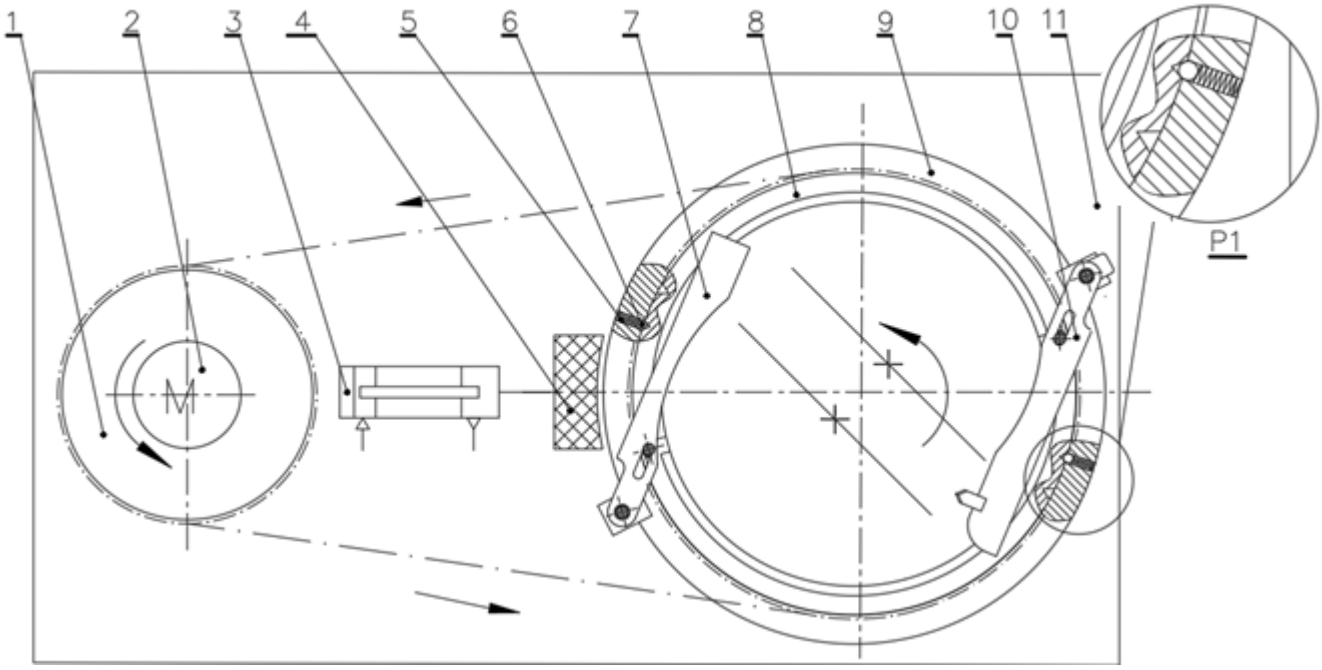

Fig.6. Principle diagram of wire-twisting mechanism in the open mode

1. Sprocket; 2. Motor; 3. Cylinder; 4. Brake; 5. Spring; 6. Ball; 7. Winding bard 1; 8. Inner ring shaft; 9. Outer ring disc; 10. Winding bard 2; 11. Support.

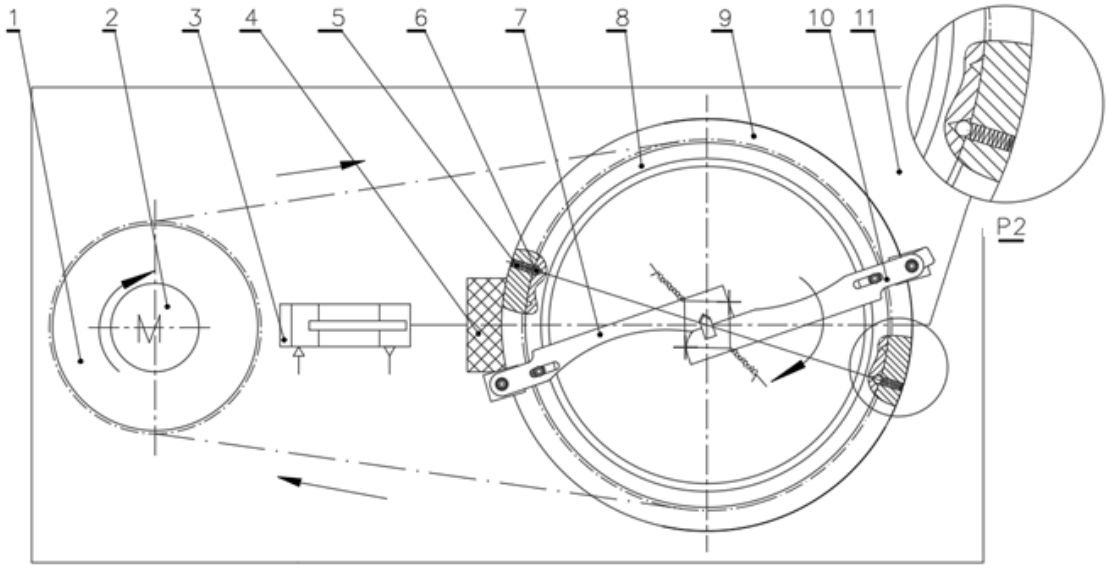

Fig.7. Principle diagram of wire-twisting mechanism in the wire-twisting mode

Step 1: Clamping wire: The piston 3 pushes the brake 4 at the brake position into the outer disc 9 and at the same time, the motor 2 rotates counterclockwise to make the sprocket 1 rotate, and the inner disc 8 rotates accordingly. Thus, the outer disc stands still, the inner disc rotates at a 10-degree angle until the concave position P1 at the inner ring moves to the ball 6, the spring 5 will push the ball 6 into the concave position P1 of the inner disc, simultaneously two clamping bars 7 and 10 are closed to clamp the wire. At this time, the outer disc will attach to the inner disc through the ball 6 and spring 5 (Figure 7). Then, the brake 4 will be released

Step 2: Twisting wire: The motor 2 continues to run in a counterclockwise direction, the piston 3 pulls the brake 4 that had been released from the outer disc 9, causing the outer disc 9 to rotate along the inner disc 8 and twist the wire until the number of twisted turns is 5 turns, the seal is bound tightly at the end of step 2. The spring 5 and ball 6 are responsible for mounting the outer disk to rotate along in the inner disc and for keeping the clamping bar from opening.

Step 3: Releasing wire: When the number of twisted turns is sufficient, the seal is bound tightly. Piston 3 pushes the brake 4 to brake into the outer disc, motor 2 rotates clockwise, the chain mechanism 1 will pull the inner disc to rotate accordingly: The inner disc rotates about 10 degrees, the outer disc stands still, making ball 6 move from concave position P2 and return to concave position P1, at the same time, clamping bars 1 and 2 open to release the wire, the winding process is ended. Especially, the wire-twisting machenism on the clamping mechanism is integrated and generated from the rotating motion, thus it is compact during the mechanical fabrication.

2.2. Peparation of a drawing to manufacture and assemble the machenism

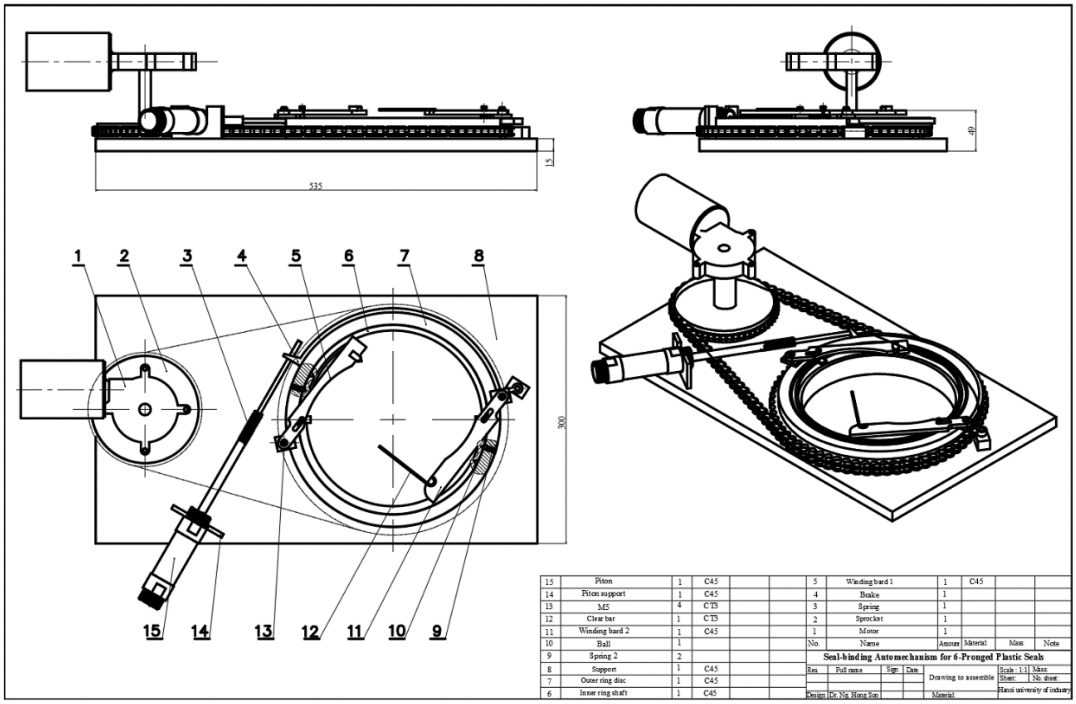

Fig.8. Drawing to assemble the automatic seal-winding machenism

From the principle diagram above. The author and others have built detailed drawings for each part, then continued to assemble and 3D simulate the machenism to evaluate and adjust the shape of parts (if necessary). In the next step, the author and others have established a technological process of manufacturing and assembling parts [4,5,6,7] into a machenism as shown in Figure 8.

3. DEVELOPMENT OF CONTROL PROGRAM AND TEST FOR VERIFICATION

Based on the principle diagram of the machenism described in section 2 and the requirements on controlling the machenism, the author and others have built a flowchart to control the seal-winding mechanism described in Figure 9, then built a program to control the machenism by PLC. Figure 10 is an interface for the program of entering parameters of the wire-winding machenism [8], [9].

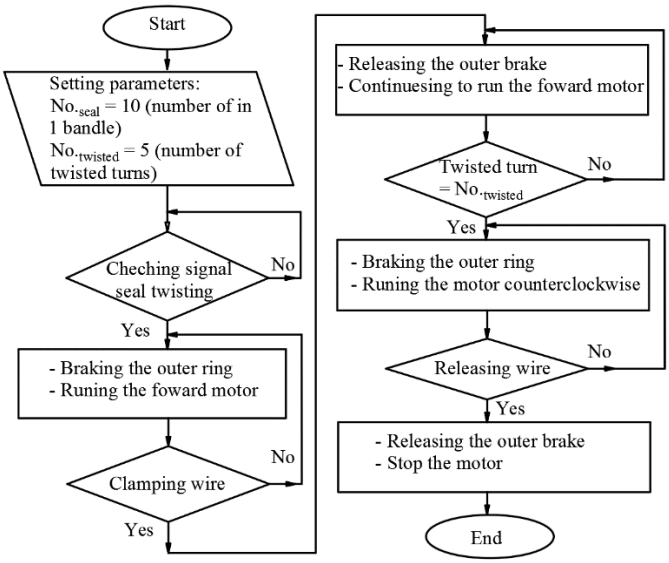

Fig.9. Flowchart for mechanism control

Fig.10. Interface for the program of entering parameters of the wire-winding machenism

The interface for the program of entering parameters of wire-winding program includes the following parameters:

- Motor speed: 1200 rp/m.
- Number of seals in a bundle: 10 seals
- Number of twisted turns: 5 turns.

The seal-winding machenism is connected to the seal laser-engraving line. Of which the seal-winding mechanism is a process of collecting and binding seals of the line. When testing with the control parameters entered in Figure 11, the bound device is sealed as required by the design, with the mortor speed of 1200 rpm, the test result shows that the binding time is 12.20 seconds (passed accoring to the design requirement of 14 seconds)

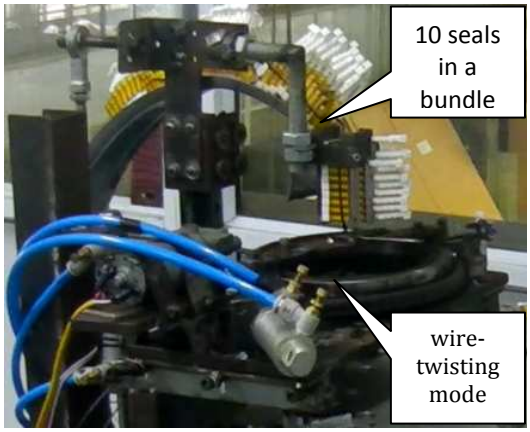

Fig.11. Test the seal-binding mechanism

4. CONCLUSION

Therefore, the 6-pronged plastic sealing machenism has been implemented in accordance with the design process: Designing the diagram, building a detailed drawing, building an assembly drawing(2D and 3D), simulating movements for calibration (if necessary), developing a procedure of detailed technology and processing, developing a control program, connecting the control and testing for verification.

The sealing mechanism has a wire-clamping mechanism that is produced from a rotating mechanism, thus the mechanical structure is compact.

The process of testing products evaluates that the criteria against the design requirements are all achieved, only for the binding time, the result is less than nearly 2 seconds.

The sealing mechanism mentioned above can be applied to manufacture devices with different wire-twisting mechanisms due to the simple principle and compact structure.

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