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DESIGN OF KELP AUTOMATIC DRYING AND HARVESTING MECHANISM

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ABSTRACT

Based on the current kelp drying, the lack situations of mechanical harvesting management, two kelp drying mechanisms are designed in this paper. And based on the two schemes of natural drying of kelp, two different kinds of automatic harvesting and bundling mechanism for kelp were designed. The mechanical automation technology was applied in the drying and later collection of kelp to realize the continuous automatic processing and efficient production process of kelp. In the design processing, mechanical technology and 3D Modeling software UG are used to design the mechanism of automatic clamping, binding and cutting kelp. The transmission mechanism and the movement coordination of each component are designed. The working principle of the two mechanisms are introduced, by comparing the different characteristics of the two schemes, the applicable circumstances of different schemes are given. The design of natural drying and harvesting mechanism of kelp in this paper, can reduce labors, improve work efficiency, and optimize the work.

1. Introduction

present, Nowadays, there is a very large area of kelp farming in China, while the drying of kelp is generally done manually. Using the traditional way, workers are not only toilsome, but also inefficient at work, and the benefits are low [1, 2]. At present, there is no mechanism in the market that can realize the automatic drying and harvesting of kelp. To reduce labor, improve work efficiency, and further expand the scale of kelp farming, this paper puts forward two kinds of kelp automatic drying mechanism and automatic harvesting, different harvesting mechanism can be applied to different drying scheme; all can realize automatic clamping, cutting and seaweed strapping of the entire process.

The design of automatic harvesting mechanism can be divided into two parts: the clamp cutting part and the automatic strapping part. The clamp cutting part requires the cutting action occurs after the kelp is clamped, and achieve a better cutting effect. The design request of the automatic strapping part is relatively lower; it just needs to tie up the kelp after the clamping action. In order to achieve continuous strapping of kelp, this paper introduces a similar stapler program [3]. As long as a part of the strapping mechanism is designed to resemble a stapler, the continuous supply of the wire needed for the strapping is used to achieve continuous strapping.

2. THE INTRODUCTION OF AUTOMATIC KELP DRYING MECHANISM

According to the characteristics of kelp growth, this paper proposed two kinds of kelp automatic drying program: one is a double track drying mechanism, as shown in Figure 1. It has the advantages of small occupied area, simple structure and large air-drying capacity. But the kelp does not have enough drying area when getting moved for a circle. The other is a single track drying mechanism, as shown in Figure 2, it ensures the kelp has a long drying time, and the kelp has not too much light interference to each other, but the amount of the kelp drying is based on the area of the mechanism.

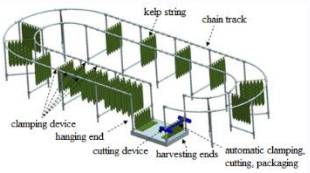


Figure 1: Double Track Drying Mechanism

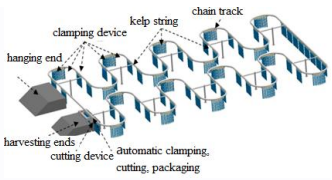
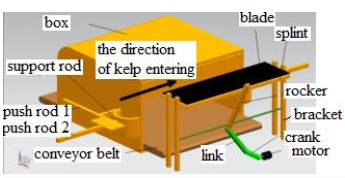


Figure 2: Single Track Drying Mechanism

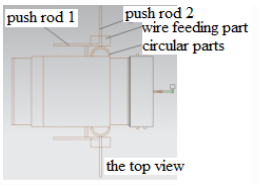
3. SCHEME DESIGN OF AUTOMATIC CUTTING MECHANISM OF KELP DRYING

Based on the above two cases, this paper shows two proposals that can cooperate with the drying mechanism for the sake of realizing the automatic clamping, cutting and binding of kelp. One solution is suitable for the situation of Figure 2, and the two mechanisms are not fixed, so disassembled conveniently, and can achieve the desired effect. The second is suitable for both of the drying mechanisms in Figure 1 and Figure 2, and it is easy to be disassembled conveniently as well. Three dimensional graphs of the two design schemes are presented below.

3.1 Scheme 1



(a) the Three Dimensional Graph



(b) the Top View

Figure 3: The Structure Graph of Scheme 1

Using the 3D modeling software UG, the 3D model of scheme 1 is established, as shown in Figure 3(a) [4,5]. This scheme is mainly composed of clamping cutting mechanism, strapping mechanism and the box. The right side is the cutting part, including the motor, the active crank,

the connecting rod, the rocker, and the splint on the rocker. The splint is equipped with a blade for cutting the kelp; the motor provides power to drive through the connecting rod, driving the movement of the driven rocker, while pushing the splint back and forth; there is a sliding slot on the splint so that the splint can move around the bracket to achieve the purpose of clamping kelp. The bracket is mainly supporting for the whole clamping cutting mechanism.

The left side is the box body and the strapping mechanism, as shown in Figure 3(a). As shown in the top viewport in Figure 3(b), push rod 1, push rod 2, wire feeding and half-arc components constitute automatic strapping mechanism, after the splint clamping, the strapping mechanism began to work, first of all, push rod 1 movement to the right after arrived at the specified location, both the front and behind push rod 2 began to relative motion, make the two closed circular parts, parts wire feeding and half arc components constitute institutions similar to the stapler, the wire parts began to exercise after the two half-arc parts closures, promote the movement of the wire in the arc parts, so as to complete the function of automatic strapping. The cutting motion is carried out by the blade after the strapping action. And then all the parts are returned to the original position after the clamping, cutting and strapping actions are completed. After the kelp is cut, the belt will automatically fall into the transport belt in the box, and the conveyor will be transported to each packing box to realize the final packing.

As shown in Figure 3(a), the kelp go into the device from the left side (shown in bold black arrow), through the sensor to stop at a specified location, at this time the motor starts to rotate to drive the active rod moving, pushing the splint to move. When the splint clamps the kelp sensed by the sensor, the motor stops rotating, then the strapping mechanism and cutting blade began to move. The two push rods 1 and 2 of the strapping mechanism push the semicircular solid parts into the appropriate position with sliding, and then the two semicircular solid parts begin to move relatively to each other. After reaching the designated position, they strap the kelp automatically. When the strapping and the cutting is completed, the induction motor starts to move with the connecting rods to achieve the retraction of the blade, the retraction of the splint and the retraction of the strapping part, so that the kelp is dropped onto the conveyor belt and transported by the conveyor.

The overall construction of this scheme is relatively simple and easy to operate. The only thing we need to do is coordinating the time of each component's movement [6]. The power requirements of the clamping and cutting mechanism are not very high. The motion cycle diagram is shown in Figure 4.

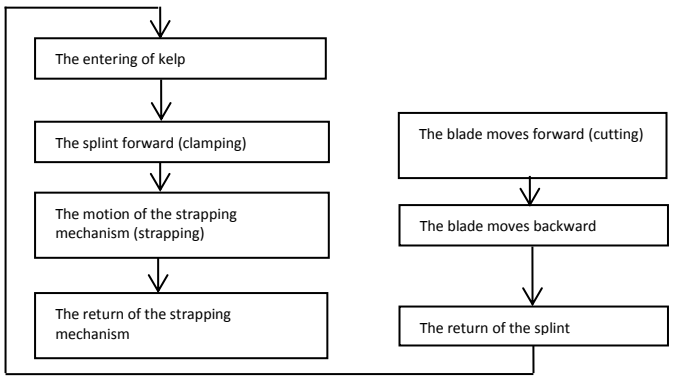
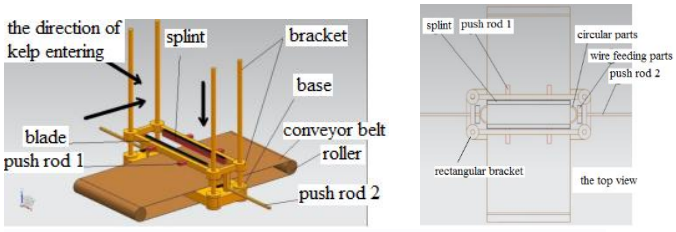


Figure 4: The Motion Cycle Diagram

3.2 **Scheme 2**



(a) the Three Dimensional Graph (b) the Top View

Figure 5: The Structure Graph of Scheme 1

Using the 3D modeling software UG, the 3D model of scheme 2 is established, as shown in Figure 5(a) [7]. This scheme mainly consists of the clamping part, the strapping part and the frame. The clamping section mainly consists of splint, push rod 1, push rod 2 and blade. Push rod 1 to push the next two splints relative motion, when two splints press the lever 1 stop motion, the blade begins to cut. As shown in Figure 5(b) the top view, push rod 2, wire feeding mechanism and arc mechanism together form an automatic strapping mechanism, its structure is similar to plan 1, after the splint to tighten, push rod 2 began to push the relative motion of the two half-arc parts, clamping, wire feeding parts began pushing for half arc parts within the wire, the principle of using stapler complete automatic strapping. The whole clamping, cutting, strapping mechanism is attached to the rectangular bracket, which is moving along the four brackets. When the cutting and strapping motions are completed, the kelp falls to the conveyor belt to complete the expected overall cutting. After the clamping, cutting and strapping, the components return to the original position.

When the kelp from the front, left or above into the device (as shown in the bold arrow in Figure 5(a)), through the sensor, when the kelp reached the specified location the rectangular bracket begins to rise, through the sensor to the designated location. At this time the two clamping plates of the clamping device begin to move in opposite directions. When clamping, the automatic strapping mechanism begins to move and the blade begins to cut. When the cutting and tying is completed, the strapping device, the clamping device and the blade are evacuated sensed by the induction sensor, and the kelp is dropped to the conveyor belt, and the parts are returned to the original position after all the operations have been completed.

The overall structure of this scheme is more complicated, and the matching requirements of parts are higher, but its applicability to the drying mechanism is well, and it does not need to be connected with the drying rod, so it is easy to disassemble. The motion cycle diagram is the same as the scheme one.

3.3 **The Applicability of the Two Programs and Comparison**

Scheme 1: When faced with the situation shown in Figure 2 above, the model 1 is suitable. The body of model 1 is relatively cumbersome, the movement of the link is relatively high, and the timing requirements of the coordination of the various components are not high, as long as the function can be completed. Model 1 does not need to be fixed with the drying mechanism shown in Figure 2, so that the removal is more convenient, the shape request of the drying mechanism is not high as well, only need to ensure that the kelp into the model can be in a suitable location.

Scheme 2: When facing the situation shown in Figure 1 or 2 above, the model two can achieve the desired function, the institutions of model two are relatively lightweight, but the specific cooperation with the various components are relatively high. To the cutting effect, there is no difference between the two. Model 2 does not need to be fixed with the drying device, easy to disassemble, and the shape of the drying mechanism is not complicated, just to ensure that the location of the kelp can be suitable.

4 CONCLUSION

Based on the current problem of kelp drying, firstly two kinds of kelp automatic drying mechanisms are put forward, and then two kinds of automatic harvesting mechanisms corresponding to the kelp drying mechanisms are put forward in this paper. According to the two schemes of kelp automatic drying mechanism, the design of kelp clamping, cutting and strapping mechanism is introduced. According to the model three-dimensional diagram, the working principle and structure features are showed. The overall structure of model 1 is relatively simple, and the volume is relatively large, covers an area of large, but the stability is good and can reduce the vibration, thereby enhancing the cutting effect. The construction of model 2 is more complex, covers an area of smaller, but also can achieve the desired cutting effect. The applicability of the two institutions to the kelp drying equipment is relatively high, and they both do not need to be fixed with the drying mechanism, easy to disassemble, can achieve the kelp automatic clamping, cutting and strapping, can greatly reduce the labor intensity, improve the work efficiency.

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