An Automatic Production Equipment of Animal Hide Chew

Chen Wenjie[1], Zhou Fuyi[2], Wang Qingyan[1*]

1. College of Animal Sciences, Wenzhou Vocational College of Science and Technology, Wenzhou 325006, China; 2. Wenzhou Leakage Corrosion Hardware Products Co., Ltd., Wenzhou 325006, China

Abstract Animal hide chew is mainly hand crafted at home and abroad. This paper designed an automatic production equipment of animal hide chew. The equipment achieved the whole process automation from chicken breast smashing (meat grinding and feeding equipment), extrusion, tearing cowhide strip, rolling, wrapping chicken breast, cutting to strips, weighing and drying to packaging through automated production line, which saved a lot of manpower and material resources and leads to uniform and stable product quality.

Keywords Animal hide chew; Design; Equipment

Dog chews are specially designed in the shapes of bones, balls, circles, sticks, shoes and particles to clean the mouth of pets, including vegetable chew and animal hide chew. Pingyang area is the Asia's largest leathery dog chew base, which has much to do with the development of Wenzhou's leather industry. Animal hide chew is made by wrapping chicken breast on split leather from tanneries.

At present, there are many reports on the automatic production technology of animal hide chew accessories and various manual production processes of animal hide chews[1–2]. Animal hide chew is mainly hand crafted at home and abroad. The main production process includes cutting cowhide into strips by hand, fixing with nails, manually winding two strips of cowhide, cropping the end of cowhide roll, smashing chicken breast, wrapping chicken breast or other accessories on handmade cowhide strips, manually weighing (reducing chicken in case of overweight, otherwise supplementing chicken), *etc*. This method is time-consuming and laborious. Moreover, when the manipulator is used to simulate manual winding or other winding methods, chicken strips are easy to stick together and caked due to the winding centrifugal effect caused by fast mechanical winding. Or nonuniform formulation of auxiliary materials will have a great impact on the appearance and quality of dog chews. In view of the shortcomings of the existing technology, we designed an automatic production equipment for animal hide chew. The process is described as follows.

1 Automatic Production Line Process Design of Dog Chew

1.1 Overall structure A cowhide dog chew automatic production system comprises a cowhide strip winding machine (1), a chicken stirring device (2) and a delivery device (3). The cowhide strip winding machine (1) comprises a feeding device (11), a discharging device (12) and a winding device (13). The feeding device (11) is used to transport the cowhide strip to be winded; the winding device (13) is used to wind the cowhide strip; and the discharging device (12) is used to undertake and deliver the cowhide roll. The chicken stirring device (2) comprises a feeding section (21), a stirring section (22), a discharging section (23), and a delivery section (24). The feeding section (21) is used to inject the ground chicken and seasonings; the stirring section (22) is used to stir the chicken and seasonings; and the discharging section (23) is used to extrude the chicken breast. The delivery section (24) is arranged below the discharging section (23) and is used to rotate and deliver the cowhide roll so that the chicken breasts fall on the cowhide roll. The delivery device (3) is to convey shaped dog chews.

1.2 Partial structure of cowhide strip winding machine The feeding device (11) comprises two sets of flexible parts (111) and a driving unit (112) to rotate flexible parts (111), and a moving gap is reserved between the two sets of flexible parts (111) for the cowhide strips to pass through.

Each set of flexible parts (111) is set with multiple flexible monomers along its

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*Corresponding author.

conveying direction. A drive unit (112) comprises a drive motor (113), a rotating band (114) and several rotating wheels (115), which are connected with flexible monomers and have linkage setting with the rotating band (114).

The discharging device (12) is composed of discharge roller (121), and the winding device (13) comprises a winding shell (131) and several winding up rollers (132). The winding shell (131) is provided with a discharge port, and the discharge roller (121) is arranged in the discharge port, leaving a discharge gap with the winding shell (131). The winding up rollers (132) are arranged along the circumferential direction of the discharge roller (121).

Both the flexible monomer and winding up roller (132) are made of silica gel and are arranged in a spring winding structure. The silicone material is specifically a food-grade silicone cowhide clamp.

1.3 Partial structure of chicken stirring device The feeding section (21) includes a meat grinder (211), several flavor seasoning boxes (212) and a control end (213). The meat grinder (211) and flavor seasoning boxes (212) are connected with the stirring section (22). The control end (213) is used to control the injection volume of chicken and seasonings. The discharging section (23) includes a chicken breast control valve.

The delivery section (24) comprises a clamping part (25), a rotating part (26) and a conveying part (27). The clamping part (25) is used to clamp the cowhide rolls; the rotating part (26) is used to drive the rotation of clamping part (25); and the conveying part (27) is used to drive the movement of rotating part (26).

1.4 Partial structure of delivery device The delivery device comprises a conveyor belt, a cutting unit, a weighing unit, a weight increasing unit and a counting unit. The cutting unit includes a cutter and an infrared rangefinder arranged on the chicken stirring device (2). The transfer manipulator is used to transfer the discharging device (12) to the position of delivery section (24).

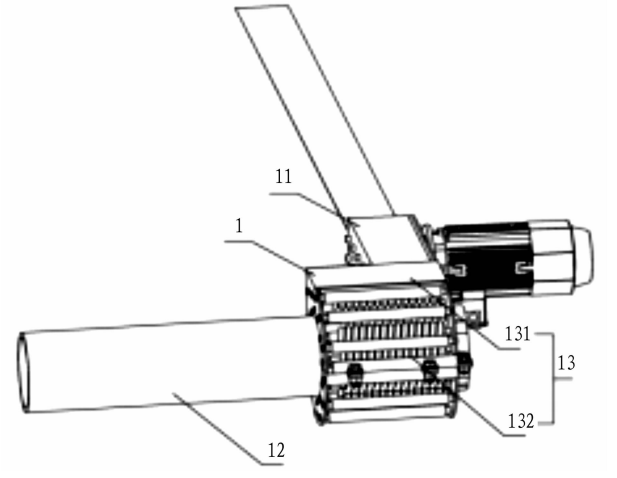
2 Specific Implementation Mode

2.1 Implementation mode of cowhide strip winding machine As the cowhide strip to be winded is placed at the feeding device (11), the cowhide roll is formed through the winding device (13) and moved to the discharging device (12), and then shifted to the delivery section (24) by manual transfer or manipulator transfer or other delivery methods, so as to complete the preliminary operation of cowhide roll (Fig.1).

After the scrap leather is removed by automatic cowhide slitting machine, the standard cowhide strips are moved into the winding device (13) from the moving gap (5) through the delivery device (3).

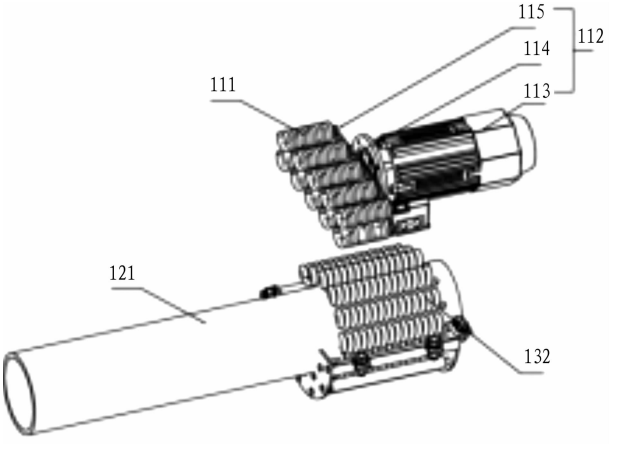
The drive motor (113) drives the rotation of the rotating wheel (115), and the whole set of flexible parts (111) is rotated through the rotating band (114), so as to deliver cowhide rolls to the winding operation. With the gradual transfer of rear cowhide rolls, the front cowhide rolls are wound around the discharge roll (121) through the winding up roller (132) until they protrude from the discharge gap and continuously move forward along the discharge roll (121).

As shown in Fig.2, with the design of spring winding structure, the winding direction of the winding up roller (132) is the delivery direction of cowhide rolls, and the cowhide rolls are gradually trans-



Note: 1. Cowhide strip winding machine; 11. Feeding device; 12. Discharging device; 13. Winding device; 131. Winding shell; 132. Winding up roller.

Fig.1 Three-dimensional structure diagram of cowhide winding machine



Note: 111. Flexible parts; 112. Drive units; 113. Drive motor; 114. Rotating band; 115. Rotating wheel; 121. Discharge roller.

Fig.2 Internal structure diagram of cowhide winding machine

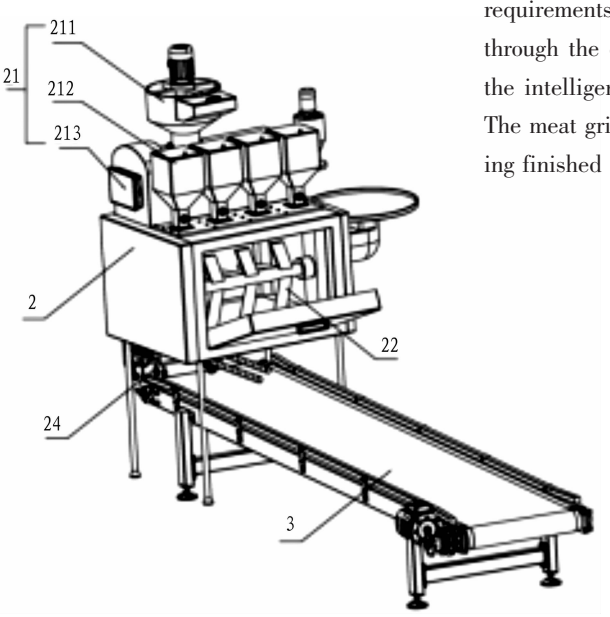
ferred along the winding up roller (132) from the entrance position to the discharge gap position, so the winding up roller (132) and flexible monomers all have guiding effects.

2.2 Implementation mode of chicken stirring device Quantitative chicken breast and specified flavor seasonings are injected through the feeding section (21), stirred fully and evenly through the stirring section (22), and then extruded through the discharging section (23), making them fall on the cowhide roll at a uniform speed. At the same time, the delivery section (24) gradually drives the cowhide roll to rotate and move, so that the chicken is evenly spread on the cowhide roll until the cowhide roll moves to the terminal and lands on the delivery device (3), thus completing the first stage of the production process of dog chew.

As shown in Figs.3-4, the (nutrient solution) flavor seasoning box (212) is provided with a variety of seasonings with different flavors. According to the food requirements, the flavor ratio is adjusted through the control end (213) to achieve the intelligent control of dog chew taste. The meat grinder (211) is used for mincing finished chicken breasts.

2.3 Implementation mode of delivery device As shown in Fig.5, there are two delivery sections (24) with different states. The conveying part (27) comprises a transmission rod and a rotating motor that drives the rotation of transmission rod. The transmission rod is connected with the rotating part (26), which moves forward and backward along the length direction of the transmission rod when the rotating motor starts.

The rotating part (26) comprises a rotating motor, a rotating gear and a rotating rod. The rotating rod is engaged with the rotating gear, and the clamping part (25) is arranged on the rotating rod. When the rotating motor drives the rotation of rotating gear, the clamping part (25) rotates with its rotation. The clamping part (25) is a flexible clamp.



Note: 2. Chicken stirring device; 21. Feeding section; 211. Meat grinder; 212. Flavor seasoning box; 213. Control end; 22. Stirring section; 23. Discharging section; 24. Delivery section; 3. Delivery device. The same as Fig.4.

Fig.3 Frontal three-dimensional structure diagram of chicken stirring device

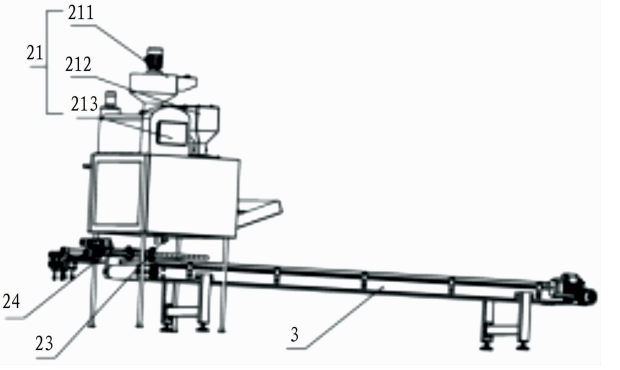
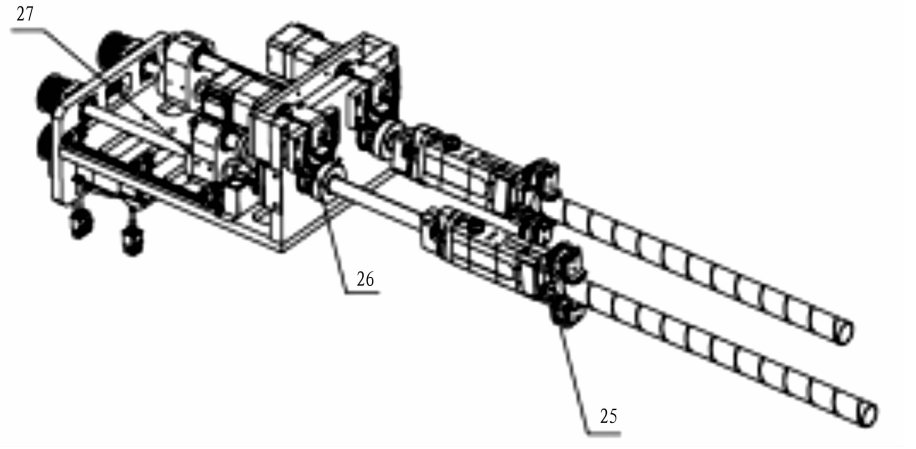


Fig.4 Dorsal three-dimensional structure diagram of chicken stirring device



Note: 25. Clamping part; 26. Rotating part; 27. Conveying part.

Fig.5 Three-dimensional structure diagram of delivery section

2.4 Implementation mode of other devices The cutting unit is mainly to cut the cowhide roll that completes the winding of chicken, and the length of cowhide rolls is detected by an infrared rangefinder. For example, when the cowhide roll moves to the specified point, the cutting operation is carried out, so as to cut equal length of dog chews.

In addition, the weighing unit, weight increasing unit and counting unit are used

to weigh the dog chews, respectively. Secondary winding is carried out for the dog chews below the standard chicken. The final product quantity is calculated.

Besides, the device also includes high temperature cooking and packaging, which all achieve automatic production. Because this step has large number of similarities with other food processing processes, it will not be described here.

3 Conclusions

Through the simulation of screw shaft conveying performance and motor driving speed of meat grinder, the device adopts empirical design method to study the effect of hole diameter and motor driving speed on yield and sensory quality and the station selection of intermittent dividing Cam mechanism, mainly considering the actual working torque of cam indexer. The selected cam indexer works stably in practice and can achieve the efficiency and accuracy required by dog chew, which lays a foundation for the design and development of new types of meat food. Meantime, it can also achieve diversification of product specifications and varieties, and the machine can produce products with more stable quality, and save both time and labor.

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