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Research Article

The Research and Design of the Peeling Chestnut Peng Machine

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Abstract: In order to peel the barbed fresh chestnut, the peeling chestnut Peng machine is designed. At present, peeling chestnut Peng machine has very shortcomings such as can not classify the Chinese chestnut from outside the barbed Peng and Peng is not completely cleaned, so a new peeling chestnut Peng machine is designed. Peeling the barbed Peng can be completed automatically through friction between roller and the curved tile plate, then separated the barbed Peng and the chestnut peeled Peng and classified the chestnut peeled Peng according size by 3-layer vibrating sieve. The peeled chestnut Peng machine volume is small, the structure is compact, the energy consumption is low and the efficiency is high. Then the peeled chestnut Peng experiment is done, the results show that the machine works smoothly, the barbed Peng and the chestnut peeled barbed Peng is separated completely.

Keywords: Chestnut, peeling Peng machine, roller, vibrating screens

INTRODUCTION

Chestnut, belongs to Fiancée, is a high nutritional value nuts, has "king of fruits" reputation, can be eaten raw, fried, steamed, boiled, cooking etc (Lian *et al*., 2010). Chestnut is very useful for spleen, stomach, kidney and tendons and plays a very important role in promoting physiological function and enhancing health (Lu *et al*., 2015). It is complicated to process chestnut; chestnut is wrapped in barbed Peng, so the first step of processing is peeling the barbed Peng and taking chestnut out from the barbed Peng. At present, the barbed Peng is peeled of by hand; time consuming, laborious, slow efficiency and high cost, so it is necessary to develop a machine handing chestnuts Peng. Lin and Li (2015) designed a new automatic chestnut fractionation Device, automation but poor reliability; Qin *et al*. (2015) designed auto Sheller for chestnuts, Sheller for chestnuts is subsequent process, if the effect of peeling Peng is not good, Sheller for chestnuts is not talked. Therefore it is necessary to design a machine to peel the barbed fresh chestnuts that saved time and money.

MATERIALS AND METHODS

Overall structures: The handing chestnuts Peng machine includes a frame, a feed hopper, peeling Peng device, a bolting cloth, a roller, a curved tile plate, soft layer, a blower, an electric motor and other parts. The handing chestnuts Peng machine structure as shown in Fig. 1.

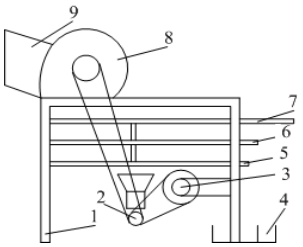

Fig. 1: The structure of the peeling chestnut Peng machine; 1: Framework; 2: Blower; 3: Motor; 4: The received box; 5: The lower vibrating screen; 6: The middle vibrating screen; 7: The upper vibrating screen; 8: The peeling Peng device; 9: Feed hopper

There have 3 layers of vibrating screens in the designed machine, not only the chestnut and the barbed Peng can be separated by vibrating screen, but also the bigger chestnut and the smaller chestnut can be separated by vibrating screen. Soft protective layer on roller is adopted in order to protect chestnut not stabbed by barbed Peng, the separation effect and separation efficiency are improved with the aid of rectangular grooves on the soft protective layer and irregular bulges on curved tile plate.

Working principle: As shown in Fig. 1, the feed hopper is located on the machine frame and then connected the peeling Peng device, the roller and

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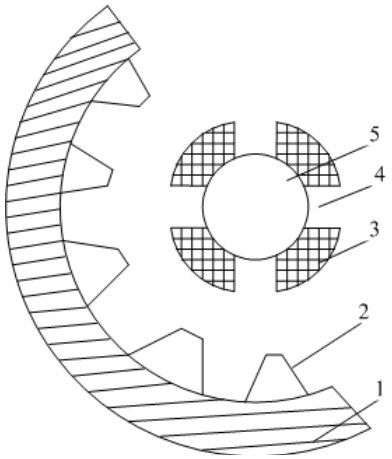

Fig. 2: The structure of the peeling Peng device;
1: The curved tile plate; 2: Groove; 3: Soft layer; 4: Bulge; 5: Roller

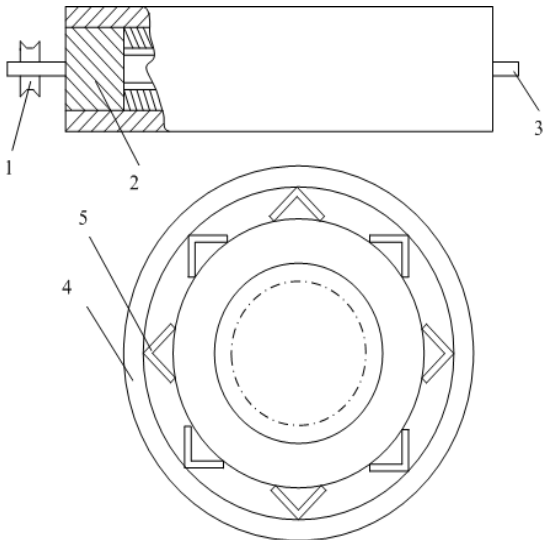

Fig. 3: The structure of the roller;
1: The belt wheel; 2: Disk; 3-shaft; 4: Cylinder; 5: Middle bracket

curved tile plate are located in the peeling Peng device, chestnut and Peng is separated by friction and squeezing between roller and the curved tile plate. There have 3 layers of vibrating screens under the peeling Peng device and connected with motor by swing rod. The mesh diameter of the upper screen is greater than the maximum size of chestnut, so chestnut fall on the middle screen and Peng fall on the ground from the discharge end of the upper screen; The mesh diameter of the middle screen is between the maximum size and the minimum size of chestnut, the chestnut that size is greater than the mesh diameter fall on receiving hopper by vibration from the discharge end of the middle screen, the chestnut that size is less than the mesh diameter of the middle screen and fragment of Peng fall on the lower screen; The mesh diameter of the lower screen is less than the minimum size of chestnut, the small chestnut fall on receiving hopper by vibration from the discharge end of the lower screen, the fragment of Peng fall on the ground. The blower is located in the lower screen and connected with motor, blowing combined with screen vibration, the chestnut and the barbed Peng could be better separated.

Design of the peeling Peng device structure: The peeling Peng device is the core part of the removed chestnut Peng machine, the effect of the peeling Peng is directly related to the follow-up work can precede smoothly or not, so the reasonable and reliable design is essential. According to the characteristics of mature chestnut and combined method of the chestnuts and the barbed Peng, the principle of corn thresher is employed, the structure of the peeling Peng is shown in Fig. 2.

Peeling Peng device comprises the curved tile plate and the roller; there is a soft layer on the curved tile plate face at the roller side, four rectangular grooves are distributed on soft layer symmetrically and the bulges are distributed on the curved tile plate irregularly. The barbed Peng is peeled by friction and squeezing between roller and the curved tile plate. The soft layer can protect the chestnut to avoid stabbing by the barbed Peng. The bulges on the curved tile plate are blunt and not to damage the peeled chestnut. The bulges and the grooves are coordinated each other and can improve effect and efficiency of the peeling Peng.

Design and calculation of the roller: The roller is hollow, which can reduce the mass and benefit for energy saving. Figure 3 is structure diagram of the roller.

As shown in Fig. 3, the roller main comprises a belt wheel, disc, shaft, cylinder, intermediate supporter and etc. there are two discs at each end of the roller, they are connected by bracket through welding and cylinder is welded on the bracket, there is a hole on the center of the disc, the discs and the shaft are connected by welding, the bearings are installed at each end of the shaft, a belt wheel is installed at one end of the shaft, this is the roller.

The roller shaft is an important part of the peeling chestnut Peng machine and mainly bears torque, moment and supports rotary parts on shaft, the instantaneous impact is large. The designed shaft must have enough strength, rigidity and fatigue strength, No. 45 steel is adapted; torque is the main force for the rotary shaft, the minimum diameter of the shaft is calculated according to torsional strength, the empirical formula as follows:

$$d \geq A_0 \sqrt[3]{\frac{P}{n}}$$

Table 1: The performance experiment results of the peeling chestnut Peng machine

Item	diameter/cm	The percent of the peeled chestnut number to the total/%
Result 1	7	99
Result 2	6	98.8
Result 3	5.5	98.5
Result 4	4	98.3
Result 5	3.5	98.1

where, the value of A_0 is 120 by checking table, P is the power of the shaft transformed, the value of P is 1.5kW, the designed speed of the shaft is 750 rpm, so:

$$d_{\min} = 120\sqrt[3]{\frac{1.5}{750}} \approx 15\text{mm}$$

The minimum diameter of the shaft should be greater than 15 mm, in order to ensure reliable, the diameter of the shaft is 20 mm.

Design of the vibrating screens: The vibrating screen is a device that is working using vibration. The vibrating screen function is that separating the chestnut and Peng and dividing different size, linear vibrating screen is adopted according to the principle of screening (Wang *et al*., 2015), vibration motor is used as vibration source of the linear vibrating screen. The chestnut of peeled Peng and Peng fall on the vibrating screen from the peeling Peng device, after the 3-layer vibrating screen, the barbed Peng and the chestnut are separated and classified the chestnut according to different size.

The main technical parameters of the vibrating screen: the length is 1000 mm (upper) and 900 mm (middle), 700 mm (lower), the width is 450 mm; the number of screen surface layer is 3; inclination angle of screen surface is 0; the vibration frequency is from 10 to 20 Hz; the amplitude is from 0 to 7 mm; the design power is 0. 25 kW.

Selection of blower: The blower function is blowing the bits of Peng and make the chestnut and Peng separated effectively; the ordinary centrifugal blower can be OK according to the testing results. The screen width is 450 mm, is more than the general blower outlet width, the blower is adopted that the outlet width and mesh width is consistent in order to blow the entire screen.

RESULTS AND DISCUSSION

Chestnuts with different diameters are selected as experimental object. Performance requirements: all the chestnuts with different diameters can be realized that the barbed Peng can be peeled and the chestnuts can not be damaged, the percent of the peeled chestnut number to the total chestnut number is 98%. The diameter of the selected chestnut is 3.5-7 cm and 5 different experiments were conducted, each experiment mass is 5 kg, the experiment result is shown in Table 1.

CONCLUSION

The experiment results prove that the design of the peeling chestnut Peng machine is practical. The structure is compact, reasonable and reliable; the different diameter chestnuts can be peeled the barbed Peng and separated the peeled chestnuts according to different diameter; the labor intensity is reduced and the production efficiency is improved.

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