

Structure optimization design of high peeling rate peeling device of corn combine

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Abstract: China is a big corn growing country. It has become an inevitable trend to replace manual picking with corn combine. The setting of peeling device of corn combine harvester is closely related to the peeling rate of bracts and leaves as well as the crushing rate of corn ears and grains. Most of the existing corn harvesters on the market have good threshing effect on dry corn, but poor threshing effect on wet corn with high water content. In this paper, the key components of the peeling device of corn harvester are designed innovatively, and the key parameters of the peeling device of corn harvester with high peeling rate are optimized.

1. Current situation of corn harvesting machinery in China

With the increase of corn planting area and yield year by year, more and more areas have introduced corn combine harvester to replace manual harvesting. In many areas of corn growing areas in China, the moisture content of corn is relatively high when it is harvested, so it is not suitable for harvesting corn directly. Therefore, in the field of mechanical harvesting, direct harvesting is basically used. The corn combine harvester can realize the one-time harvesting, peeling, straw cutting, threshing and other operations of corn ears, which effectively solves the problems of low shelling rate and high grain crushing rate in the mechanized corn harvest, and is very beneficial to the rapid development of corn harvesting machinery in China. In some areas of China, corn dehulling devices have been tested, but there are still many problems, such as the low rate of corn ear dehulling, the difficult to master the rate of grain crushing, the failure of the dehulling roller to better deal with the cut stems and leaves, etc. The peeling device is easy to block, which has a great influence on the corn harvest efficiency in China.

2. Main contents of the project

The core of the study was the peeling device. The purpose is to improve the peeling rate of bracts, reduce the breakage rate and loss rate of grains as much as possible, and design an efficient corn peeling device, including frame, sprocket, peeling roller, pressing wheel and transmission device, so as to peel and avoid "gnawing" grains and ears. The peeling device shall be installed horizontally and downward to form a certain angle with the corn combine, so as to facilitate the smooth sliding of corn ears. A stripping roller is installed under the pressing device, and there is a certain gap between the stripping roller and the pressing device. When working, the pressing device presses the corn ear on the peeling roller to increase the friction, which can effectively improve the peeling rate and push the corn ear backward.

3. Structure and working principle of peeling device

3.1 Structure composition

The peeling device of corn combine mainly consists of conveying device, feeding device, ear pressing device, peeling device, bract cleaning device and driving device (as shown in Figure 1).

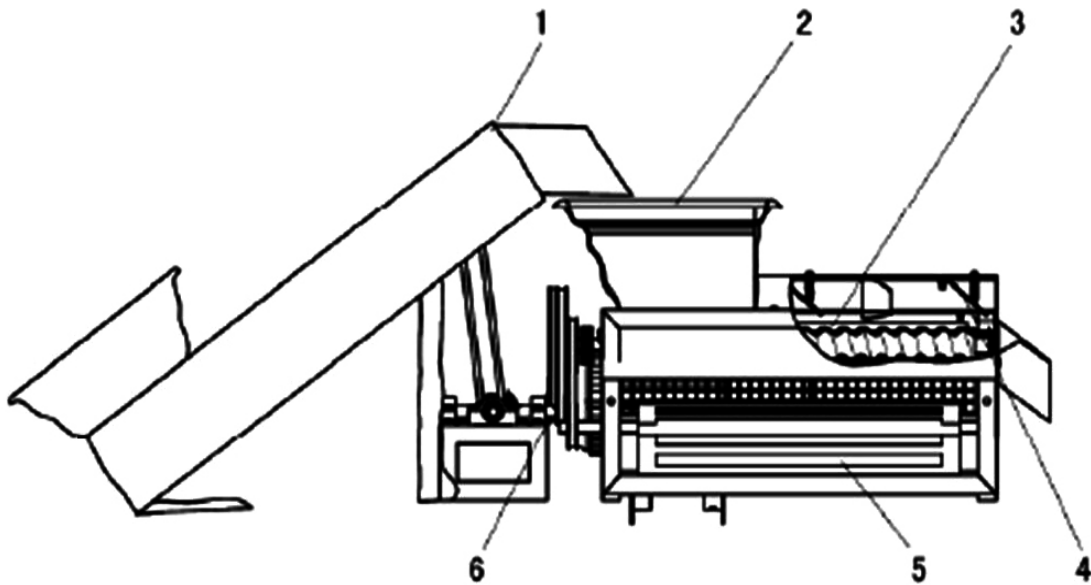


Fig. 1

Structure of peeling device

1. Conveying device; 2. Feeding device; 3. Ear pressing device; 4. Peeling device;
5. Bract cleaning device; 6. Driving device;

3.2 Working principle

The main working parts of the peeling device are two pairs of peeling rollers and pressure feed device. On the upper side of the peeling roller is placed the ear press, which comprises a fixing plate, a threaded rod, an adjusting nut, a pressing piece and a pressing spring, a fixing plate on the shell of the peeling device, one end of the fixing plate is hinged with a pressing piece, the other end of the pressing piece is connected with one end of the threaded rod, the other end of the threaded rod is connected with the other side of the fixing plate, and is connected with the adjusting nut by threads, between the fixing plate and the pressing piece A compression spring is sleeved on the threaded rod of the. The peeling roller is installed under the pressing device, and there is a certain gap between the two. When the corn ear is pressed on the peeling roller by the press device, the friction becomes larger, the corn ear is easy to push backward, and the purpose of improving the peeling rate can be achieved directly.

4. Structure optimization

4.1 Determination of peeling roll diameter

The principle for determining the diameter of the peeling roller is: the ear will not be stuck, the ear will not be squeezed, at the same time, the ear can be grabbed and the bracts can be peeled off smoothly. The most suitable outer diameter of peeling roller is generally 60-80mm. When the peeler with smaller diameter is used, the ability of the ear to be grabbed becomes weaker, the speed of peeling off the bracts is significantly reduced, and the loss rate and grain damage rate are smaller; when the peeler with larger diameter is used, the ability of the ear to be grabbed is stronger, and the speed of peeling off the bracts is significantly enhanced, but at the same time, the grain damage rate and grain loss rate are also increased. The diameter of peeling roller used in most corn combine harvesters at home and abroad is 70mm

4.2 Determination of peeling roller length

The selection of stripping roller length can affect the stripping rate, grain loss rate and grain damage rate of corn ears. In most of the peeling devices of corn combine harvester at home and abroad, the effective length range of peeling roller is 800mm-1150mm. The effective length of the peeling roller is finally determined to be 1040mm by considering the peeling rate, grain breakage rate, loss rate and the installation size limit of the peeling device on the corn harvester.

4.3 Determination of the inclination angle of the peeling roller

The installation angle of the peeling roller is related to many factors, such as the operation quality, working efficiency and the type of press device. For example, when the inclination angle of the peeling roller is large, the corn ear can slide down quickly, and the working efficiency is increased correspondingly, and then the peeling rate of the bracts will be reduced; for example, when the inclination angle of the peeling roller is small, the falling rate of the corn ear will be significantly slower, and the contact time between the corn ear and the peeling roller will be significantly longer during the whole peeling process, and the peeling rate of the bracts will be increased. The effect is very obvious, and the breakage rate and loss rate of corn grain have been increased correspondingly. Through the test, combined with the design requirements of the whole machine, the installation angle between the peeling roller and the horizontal angle is determined to be 10° - 15° .

4.4 Change of peeling roller structure

In this study, the combination form of peeling roller is rubber roller and cast iron roller. The rubber roller is composed of a steel core and a rubber band arranged on it. The rubber ring is made of rubber with good wear resistance and its surface has a longitudinal groove 10-15 mm deep. The axial height of each pair of peeling rolls is different and is set to groove type. (arrangement of peeling roller is as shown in Fig. 2) corn ear is pressed by press device, which exists in the gap between rubber roller and cast iron roller. Due to the great friction between corn and rubber roller, when corn contacts with cast iron roller, leaves are forcibly pulled down under the joint action of cast iron roller and rubber roller.

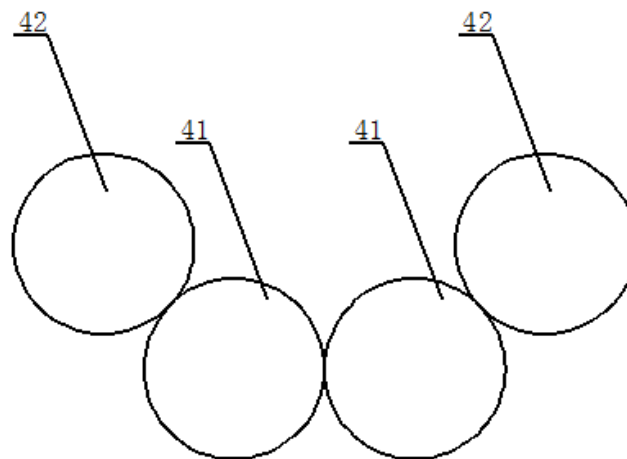


Fig. 2 Arrangement of peeling roller

4.5 Design of feeding device

The feeding device is composed of a shell, a partition and a circular sliding plate (the structure is shown in Fig. 3). When the slide plate is designed, it has a certain tilt angle and ensures that the slope is within the required range, so that the corn ears can smoothly enter the feeding inlet without blocking; after the crops enter the feeding inlet, they are separated under the function of the partition plate, when the ears pass through the circular slide plate, the arrangement direction of the ears can be changed, and the position of the ears can be set as required as much as possible, so as to reduce the possibility that the ears are stuck in the peeling roller. So, so that the ear can be smoothly discharged through the outlet.

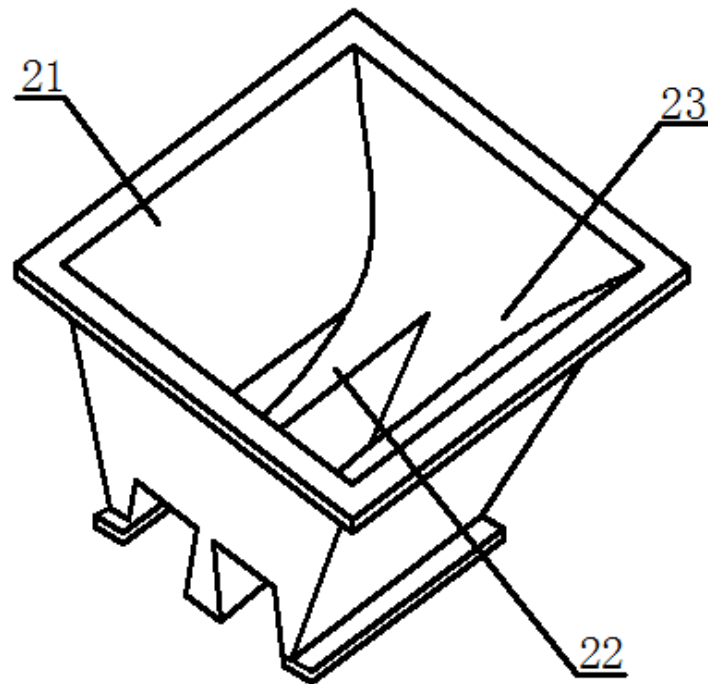


Fig. 3 Feeding device structure

4.6 Design of press device

The main working principle of the pressing device is: the ear of corn is pressed on the stripping roller by the pressing device, and the friction between the ear of corn and the stripping roller is increased, so that the stripping roller can effectively grasp the bracts and peel them off under the effect of friction, and at the same time rotate with the rotation of the stripping roller, the bracts around the ear of corn are fully contacted with the stripping roller, and the concave between the two stripping rollers is formed. The groove slides, and the bracts are peeled off through the kneading effect of the peeling roller. In addition, under the pressure of the press device, the ears are not easy to turn up when peeling, the grain loss at the end of the ears is significantly reduced, and the peeling rate is improved, so the main factor of the mirror peeling effect is the press device.

In this project, the pressure feeder is connected with the peeling machine frame and set on the upper side of the peeling roller. Its main components are: screw rod, fixed plate, compression spring, pressing plate and adjusting nut. (as shown in Figure 4)

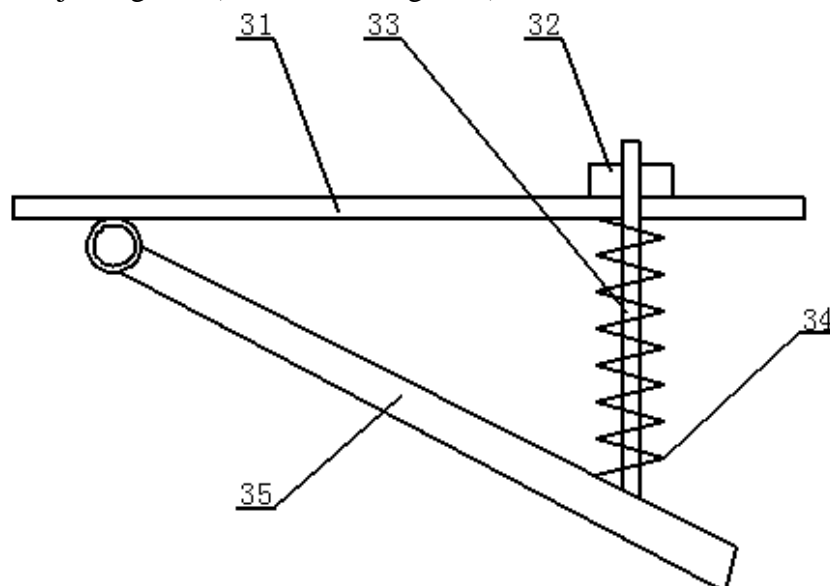


Fig. 4 Structure diagram of pressure feeder

5. Summary

Through the analysis and Research on the parameters of the corn combine harvester, the structure and parameters of the peeling device of the corn harvester in this project have been innovated and optimized.

5.1 Innovative design of key components of corn harvester peeling device

The model and data analysis of the contact and collision process between the peeling roller and the ear were carried out to calculate the strength of the corn ear during the stripping process. Through the study of the force on the ear and the quality of the fruit itself, the radius of the peeling roller, the dynamic friction coefficient between the surface of the peeling roller and the bract, the angle formed by the connection between the cross section of the ear and the cross section center of the peeling roller and the center of the peeling roller, and the branches on the ear were studied. The overall structure of the peeling device and the arrangement of the peeling roller were preliminarily determined.

5.2 Optimize the key parameters of the peeling device of high peeling rate corn harvester

This paper studies the working process of ear picking from plant to transporting to peeling roller, analyzes various factors that may affect the rate of grain dropping and peeling at the end of ear during transporting, preliminarily determines the composition and layout of the press device to ensure that the ear can reach the position of peeling roller smoothly, and the ear is not easy to turn over and turn up when peeling, the situation of grain dropping at the end of ear is obviously reduced, and the rate of peeling is obtained. In order to improve.

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