

## Study on Spiral Mechanism of Crop Particle Cleaner

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*Abstract: In recent years, with the continuous improvement of China's machinery manufacturing technology, the research and development of screw conveyor has been deepened, and good results have been achieved. There are various types of screw conveyors, new products with large Angle and long spacing also emerge, providing a strong technical foundation for the development of screw conveyors. The granule crop cleaning machine has the functions of washing crops and removing impurities. It can be used to clean and remove miscellaneous grains such as beans and grains. It is also used to clean raw materials of food factories such as flour mills. Particle crop cleaner has a good development prospect, among which screw mechanism is the key part of the cleaner, so it is very meaningful to study the screw mechanism of grain crop cleaner.*

*Keywords: cleaning machine; screw conveyor; grain.*

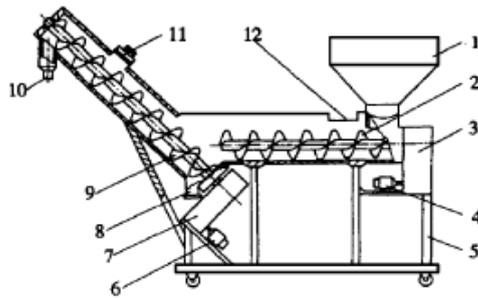
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### 1. INTRODUCTION

With the continuous improvement of crop yield in China, export volume is increasing, and clean and high-quality products are becoming more and more important. A large number of crops will be contaminated with impurities such as soil, gravel and other impurities due to unavoidable factors in mining and harvesting. Therefore, various problems will occur in cleaning and use, which will inevitably waste a large amount of human resources. Hence the need for convenient and efficient crop cleaning devices. At present, grain crop cleaning machine is not widely used in China, mainly because of its low starting point. However, at present, China's mechanical manufacturing technology has been advancing by leaps and bounds, and this kind of crop cleaning machine will get rapid development. In some large and medium-sized cities, the grain crop cleaner is slightly used, but is still large machinery. In the catering center where the demand is concentrated, large restaurants and other places have not made progress, or rely on manpower to wash the crops in the birdbath, which not only wastes human resources, but also cannot guarantee the quality of cleaning. With the rapid development of science and technology and the gradual improvement of the requirement of mechanization, the development of this daily tool has become imperative.

### 2. WORKING PRINCIPLE of GRAIN CROP CLEANER

Grain crop cleaner is mainly composed of feeding device, transporting mechanism, decelerating structure, overflow device and water inlet device.



1 - into the mouth;2- horizontal helix;3- horizontal speed reducer;4 - motor;5 - rack;6 - motor;7- tilting reducer;8- debris deposit trough;9- inclined screw;10 - discharging mouth;11-waterflood plant;12-overflow device

Fig 1. Schematic diagram of unit structure

Analysis on the work of grain crop cleaning machine: the material is added from the inlet and cleaned by spiral transportation. The floating material in the material is cleaned out and the dirty water is discharged from the overflow device. Then, the material is transported upward along with the cleaning of the screw transport. Then, it is discharged from the discharge port via the asphalt section above the water injection device to complete the cleaning operation. When washing, the water flow enters from the upper part of the inclined spiral, and reverses the direction of material movement in the body, which ensures a good cleaning effect.

Unit design features: the material transport direction is opposite to the flow direction, more convenient to flush out the impurities in the material; after two times of screw transportation, the material is cleaned and cleaned twice to achieve better washing effect. The overflow device makes floating impurities emerge, and the debris deposit trough makes the impurity with high density settle down, which can well handle the impurity going.

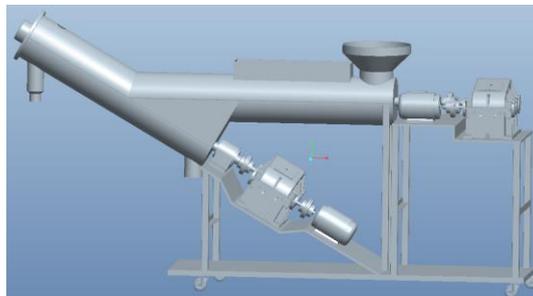


Fig 2. Three-dimensional diagram of a crop particle cleaner

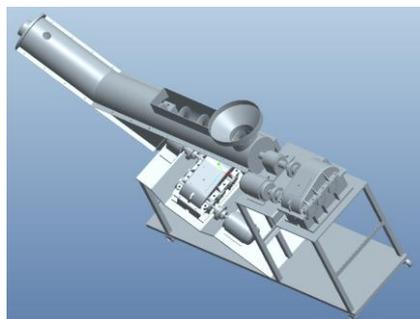


Fig 3. Three-dimensional diagram of a crop particle cleaner

### 3. DESIGN CALCULATION OF HORIZONTAL SCREW AND INCLINED SCREW

#### 3.1 Flat Spin

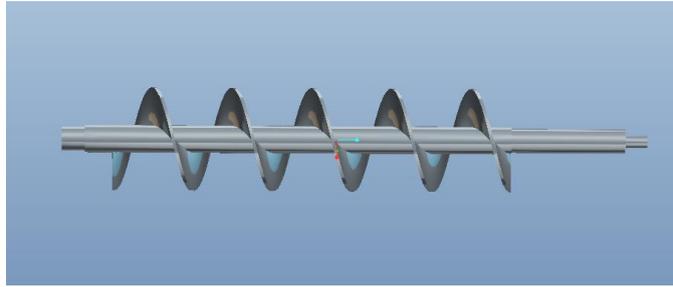


Fig 4. Three dimensional horizontal helix

The diameter of the horizontal helix is  $D_1$ , rotate speed is  $n_1$  and length is  $L_1$ , the calculation formula of diameter and speed is as follows

$$D_1 = K^{2.5} \sqrt{\frac{G}{\phi_1 \cdot \rho \cdot c}}$$

$$n_1 = \frac{A}{\sqrt{D_1}}$$

$D_1$ -- Diameter of horizontal screw, in units of m;

$G$  -- Production capacity, in units of T/h;

$K$ -- Material comprehensive characteristic coefficient;

$\phi_1$  --The coefficient of material filling;

$\rho$  --The bulk density of material, in units of T/m<sup>3</sup>;

$c$ --The coefficient associated with the transport inclination;

$n_1$ --Horizontal screw speed

The values are shown in the table:

Table 1. The parameters of the horizontal helix

| Parameters | $K$   | $\phi_1$ | $\rho (T / m^3)$ | $c$ | $A (rpm)$ |
|------------|-------|----------|------------------|-----|-----------|
| value      | 0.049 | 0.20     | 0.8              | 1.0 | 50        |

$$D_1 = 150mm$$

$$n_1 = 120rpm$$

$$s \text{ is screw pitch, } s = 0.8D$$

$$\phi_1 = 0.13$$

Because  $\phi_1 = 0.13$ , Smaller than the primary  $\phi_1 = 0.2$ , So in order to reduce the friction we have to decrease the speed of the shaft,  $n_1 = 80rpm$ ,  $\phi_1 = 0.195 < 0.2$ .

Therefore, the selected horizontal screw data is:

$$D_1 = 150mm, n_1 = 80rpm$$

Based on relevant experience, the horizontal helix length is obtained considering its size is  $L_1 = 600mm$ .

### 3.2 Tilting Screw

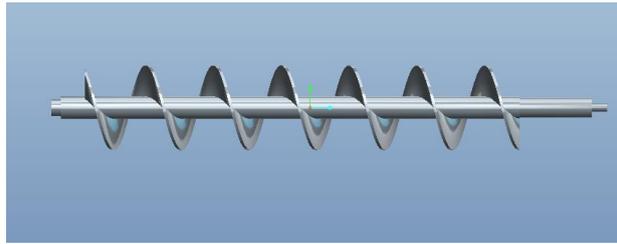


Fig 5. Oblique spiral three-dimensional diagram

Make the flow of water and materials flow in reverse, and also facilitate the discharge of materials, so the inclined Angle of inclined spiral and horizontal direction is  $\beta = 30^\circ$ . The calculation process is the same as above.

The rotational speed and length of tilt screw diameter were calculated as shown in the table below:

Table 2. The parameters of the tilt screw

| parameters | $D_2 (mm)$ | $n_2 (rpm)$ | $\varphi_2$ | $L_2 (mm)$ |
|------------|------------|-------------|-------------|------------|
| value      | 150        | 100         | 0.26        | 800        |

### 4. CONCLUSION

Firstly, the composition, function and principle of the cleaning machine are analyzed, and the two-dimensional and three-dimensional model of the simple grain crop cleaning machine is established. The key spiral part in washing machine is analyzed and studied. A suitable spiral mechanism is designed.

Hope that this article can play a role in attracting jade, for the general readers to provide a design idea.

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