

The Design and Research of Cutter and Cutter Disc in Branch Grinder

Yapeng Zheng ^a, Peng Yang ^b and Tantan Li ^c

School of Shandong University of Science and Technology, Qingdao 266590, China

^a735093200@qq.com, ^b1500541791@qq.com, ^c1327196992@qq.com

Abstract: The development status of small and medium sized branch crushers at home and abroad is described. The working principle of the branch grinder and the function and use of cutter and cutter disc are discussed. Based on the principle of small and medium branch crusher, the design and research of cutter disc and cutter are carried out. To satisfy individual use.

Keywords: cutter, cutter disc, cutting.

1. INTRODUCTION

So far, most of the branch crushers in our country have evolved from the wood crushers long ago. It's basically the same thing. As a whole, it is not simple and effective. But these devices are expensive and generally suitable for large plantations. For small enterprises and families, it is very inconvenient to use. Therefore, a small and inexpensive device is needed to meet current needs. The cutting knife and knife disc are the core parts. Therefore, the research on the cutter and the cutter disc is helpful to the development of the branch crusher.

This paper analyzes and designs the cutter and cutter disc on the base of the small branch crusher. And based on the working principle and grinding principle of the garden hybrid crusher. The purpose of this paper is to promote the development of small branch crusher. We aim to reduce the burning of branches and protect our ecological environment.

2. DESIGN and RESEARCH

2.1 The Working Principle of Branch Crusher.

The crusher can be divided into three types according to working principle. The first one is to be treated directly with pulverization, and the second is the pulverization of the drum and the hammer pieces. Among them, the structure is simple, the maintenance is convenient, the effect is good, the efficiency is high is the characteristic that the dish type cuts up the hammer piece to smash the form, thus obtained the more extensive application.

When the power is switched on, the motor starts to turn. The main shaft of the grinder operates at high speed through the belt connection. The blades on the main shaft and the hammers also work. At this point the branch is fed from the feed inlet.

The cutting knife cuts on the blade when it encounters a high-speed rotating blade. The branch that had been cut off fell to the breaking room. The high - speed hammers also hit the broken branches. The crushed branches collide and rub against each other, and then they are crushed and released from the sieve under the action of force.

The small pieces of wood can be thrown by the air flow generated by the high-speed rotation after being machined and smashed. And other because the size is unqualified did not throw to continue to remain inside processing, until can through the sieve net.

By changing different sizes of screen mesh, you can get different sizes of wood chips. The length of the cuttings can be adjusted by changing the size of the blade. The principle of feeding is gravitation, which is supplied by its own gravity and the feeding force of the blade to the branches.

The grinder consists of three parts: screening device, crushing device and cutting device. Gardening miscellaneous branch mill work, the first to be processed items from the material into the mouth, and then by cutting parts to cut off the branches so that further processing, after crushing part will block and fragmental logs slam into powder. Shattered after the elastic plate by the wind to blow it to the power of the equipment outside, not through the screen mesh in the equipment is to remain in the continuing impact crushing part, until can through the screening part of the equipment. This paper mainly analyzes and studies the cutting device which is very important in the grinder.

2.2 Design and Research of Cutter Disc

The maximum cutting diameter of the device is 30mm. In order to ensure that the knife disc has a certain inertia, the thickness of the blade should be moderate, too large or too small to be suitable. Thus, it can have enough cutting force to cut branches. The cutter plate not only can cut wood, but also must have the storage function of energy [1]. Therefore, the weight of the cutter should also be required, so the material of the cutter should be made of cast iron.

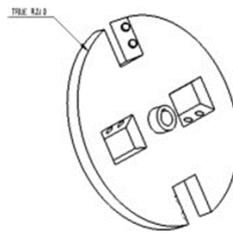


Fig.1 cutter disc

2.3 The Design and Research of Cutter.

The cutter is fixed on the knife plate evenly. Because the frequency of the impact is too high, the requirement for cutting tool material is high. The materials with good impact toughness and quenching properties are selected. Design of 65 Mn steel, the blade Angle of 35 °, thickness of 10 mm, 45 ~ 50 quenching hardness (HRC).

Determine the size of the external blade unit of the machine and the operation of the energy level force of the productivity. It is very important to design rational unit cutting force. The cutter also refers to the cutting force of the blade, which is a very important part of the design parameters of the horticultural composite branch mill. When cutting branches, the force of each unit length is cut, which

is the most basic and important parameter. Unit cutting force is the most basic parameter in cutting tool and strength checking. The cutting power can be calculated by unit cutting force, which is a large part of the power required in the whole machine.

2.4 The Effect of Tree Species on Unit Cutting Force.

According to the reference [2], the tree species also has some influence on the power when the power meets the Angle of 45 degrees. Because the cutting force and the wood mechanical physical performance relation is relatively large, the wood mechanical physical property and the unit cutting force is proportional relation. If the shear limit and the compressive strength limit are 7.65 MPa and 41.10 MPa, the unit cutting force is 31.20 N/mm. For white elm with high strength, its unit cutting force reaches 84.80 N/mm. A large number of experiments show that the magnitude of the power encounter Angle is proportional to the distance of the longitudinal cut.

2.5 The Effect of The Extension of The Blade on The Unit Cutting Force.

The extension of the blade is also related to the unit cutting force. Generally speaking, the outreaching amount is proportional to the unit cutting force. But it shouldn't be too big. Because the fan machine must also be considered for easy cutting, it should be less than 10 mm. The design of the machine is 5mm.

In the design of the machine, four cutting knives are used to interlock and set on the knife plate. The installation Angle and number of the cutter also have certain influence on the working efficiency. In the process of cutting, the blade has time interval for cutting wood. Basically, who says that the first knife and the last knife are discontinuous at work and should have a certain time interval. The interval should be appropriate, not too large or too small. Discontinuous cutting will cause the device to vibrate and the productivity will drop. Therefore, to increase the productivity, we should meet the requirement of continuous cutting, and we should increase the speed of the cutter [3].

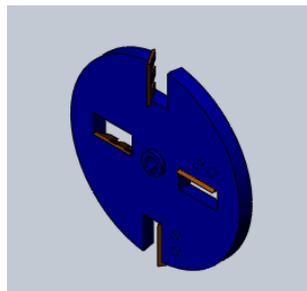


Fig.1 Cutter and cutter disc

2.6 The Overall Design and Research of Knife Disc and Cutter.

It can be seen that when cutting, the flying knife can apply the traction to the wood, so that it can complete the automatic feed. Under the action of traction, the cutting face of the blade and the wood are pressed together, and the two are in the same direction, so that the machine can make continuous cutting [4]. Therefore, the posterior Angle of the flying knife, that is, the Angle between the cutting plane and the rotating plane of the knife must have a reasonable value, namely:

$$\tan \alpha = \frac{h}{L - l \sin \alpha_1}$$

In the formula, L is the mean distance between two adjacent knives (mm)

$$L \approx \frac{2\pi R}{z}$$

In the formula, Z is the total number of blades on the knife plate; R is the distance (mm) from the center of the blade edge to the center of the cutter. H is the elongation of the blade (mm); L is length of wood (mm). α_1 is the inclination Angle of the feeding trough.

To realize even cutting, it must be satisfied:

$$2\pi R \cos \alpha_1 \leq Z d$$

In the formula, d is the diameter of the branch.

We can conclude from the above analysis that if the dip Angle of the feeding trough and the average diameter of the required knife number are known, then the diameter of the cutter plate can be determined. Reasonable design adjusting device, thus realizing the adjustment of the extension of the knife plate, can realize the crushing of the branches of different sizes. The blade must have a certain thickness and quality because we must take into account the flywheel of the cutter disc, increasing its moment of inertia in the same speed. The design of the machine is due to take into account the individual, is for the repairs to the small garden, so the diameter of the branches is allowed to build the biggest desirable for 30 mm to 40 mm, so the single plate thickness of 30 mm, radius of 210 mm.

3. SUMMARY

With the continuous development of society, environmental awareness is becoming more and more important in people's minds. The need for small - and medium-sized branch crushers will also increase. However, for the small branch crusher, due to the low investment in the research of the crusher in the early stage, the gap between China and other leading countries in related fields is too large. So we have a lot of research and development to do. Similarly, small branch crushers will face more problems to solve.

REFERENCES

- [1] Xiaohua Niu, Zhaoqian Wu, Tao Fan et al. The Design of The Branch Grinder. Forestry Machinery & Woodworking Equipment. Vol. 12 (2010) No. 11, p.38-40.
- [2] Sihong Zhu, Dongli FU, Xiaohon Xiaohua Niu, Zhaoqian Wu, Tao Fan et al. g Miu et al. The Development of Branch Crusher. Journal of Nanjing Agricultural University. Vol. 19 (2004) No. 3, p.111-112.
- [3] Xiaohua Niu, Zhaoqian Wu, Tao Fan et al. The Design of The Wooden Material Grinder. Forestry Labour Safety. Vol. 7 (2008) No. 3, p.14-17.
- [4] Youlin Wang. Design Essentials and Analysis of Branch Crusher. Forestry Construction. Vol. 5 (2008) No. 2, p.31-33.