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STUDY OF THE CONSTRUCTION OF A SMALL-SCALE GRAIN THRESHING MACHINE

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INTRODUCTION

In Uzbekistan, extensive measures are being taken to develop resource-saving equipment and devices with low energy and metal consumption and high efficiency for livestock farms. Decree No. PF-60 of the President of the Republic of Uzbekistan of January 28, 2022 "On the development strategy of New Uzbekistan for 2022-2026" and PQ-4576 of January 29, 2020 "On additional measures of state support for the livestock industry" the tasks specified in numerous decisions and other normative-legal documents related to this activity are being implemented [1].

Providing the population with sufficient quality livestock products is one of the most urgent problems of modern agricultural production. The strategy of modernization of agriculture is directly related to the creation of the most important resource for the management of development, production and reproductive function - a solid fodder base in accordance with priority national projects and network programs [2].Providing animals and poultry with complete feed in accordance with their productivity is one of the decisive conditions for the additional production and improvement of the quality of livestock products. The quality of feed, the level of balance, as well as the feeding ration have a significant impact on the productivity of animals and the quality of the obtained products, as well as on their health [3].

Grinding is the most common and important process in feed preparation technology based on the requirements of animal physiology. As a result of grinding, many particles with a highly developed surface are formed, which helps to speed up the digestive processes and increase the absorption of nutrients. Due to grain grinding, productivity of animals increases by 10...15%. From an engineering point of view, grain milling is the most energy-intensive and expensive operation [4, 5].

The main part. Methods of crushing grain materials

Grinding is an important step in preparing food for feeding based on animal physiology. The animal body digests the feed in dissolved form, so the fast and beneficial digestion of the feed particles is proportional to the surface area of the feed. Grinding helps to increase the surface area of this feed [6].

In crushing, the material is deformed over its entire size under the influence of tension. Cracking yield occurs when the strength limit of the internal stress section increases[7].

In cracking, the material breaks down in places where there is the greatest concentration of stress transmitted by the working elements of the crusher[8].

In breaking and shearing, the material is divided into parts of a predetermined size and shape.

The quality of the finished product and the aggregate performance depend on the right grinding method and grinding machine[9].

The choice of mechanical grinding method in different types of machines depends on the physico-mechanical properties of the material being ground and various technological requirements for the ground grain. For example, in free impact crushing, the material is crushed between two working bodies of the crusher [10].

Of the eight main methods available, crushing, breaking, scraping, rubbing, and impact are widely used. The method of grinding food is selected in accordance with its physical and mechanical condition, resistance to deformation. Specific machines and mechanisms are selected based on the selected grinding method and zootechnical requirements for grinding. In some cases, one machine or mechanism works using several types of grinding [11].

Free impact grinding is used in hammer mills. The hammer grinder has different shapes and sizes depending on the function, organization of the grinding technological process. The hammers are freely suspended from the rotating rotor and grind the feed delivered to the grinding chamber during rotation, creating wind to move the ground product through the grate or, if necessary, give the feed a screw-rotating motion. Grinding of food is done not only by the impact of the hammer, but also by friction on the ribbed decks located on the inner surface of the grinding chamber. The ground feed leaves the chamber after passing through the perforated grates located below. The degree of grinding is adjusted by changing the hole grids of different diameters [12].

Corn grain is the most nutritious among grains and contains almost all essential nutrients. The nutritional unit of corn is 1.3, and 70% of its content is starch, 6-8% fat, 9-10% protein, and about 2% fiber [13].

It is advisable to feed livestock with grain feeds only after they have been specially processed. Because processing significantly increases their digestibility and assimilation by livestock [14].

There are types of grain feed processing such as grinding, cracking, extrusion, micronization, roasting, steaming and canning, of which grinding is the most commonly used.

Grinding is the simplest way to process grains and is convenient for almost all farms. In this case, the shell covering the grains is destroyed, and as a result, their absorption by livestock reaches 80-85 percent.

In addition, ground grains coagulate well, mix well with other nutrients, heat and chemical processing is easy.

Coarse grains are crushed by the following methods: crushing, crushing, grinding, rubbing, crushing, and free hammering methods (Fig. 1).

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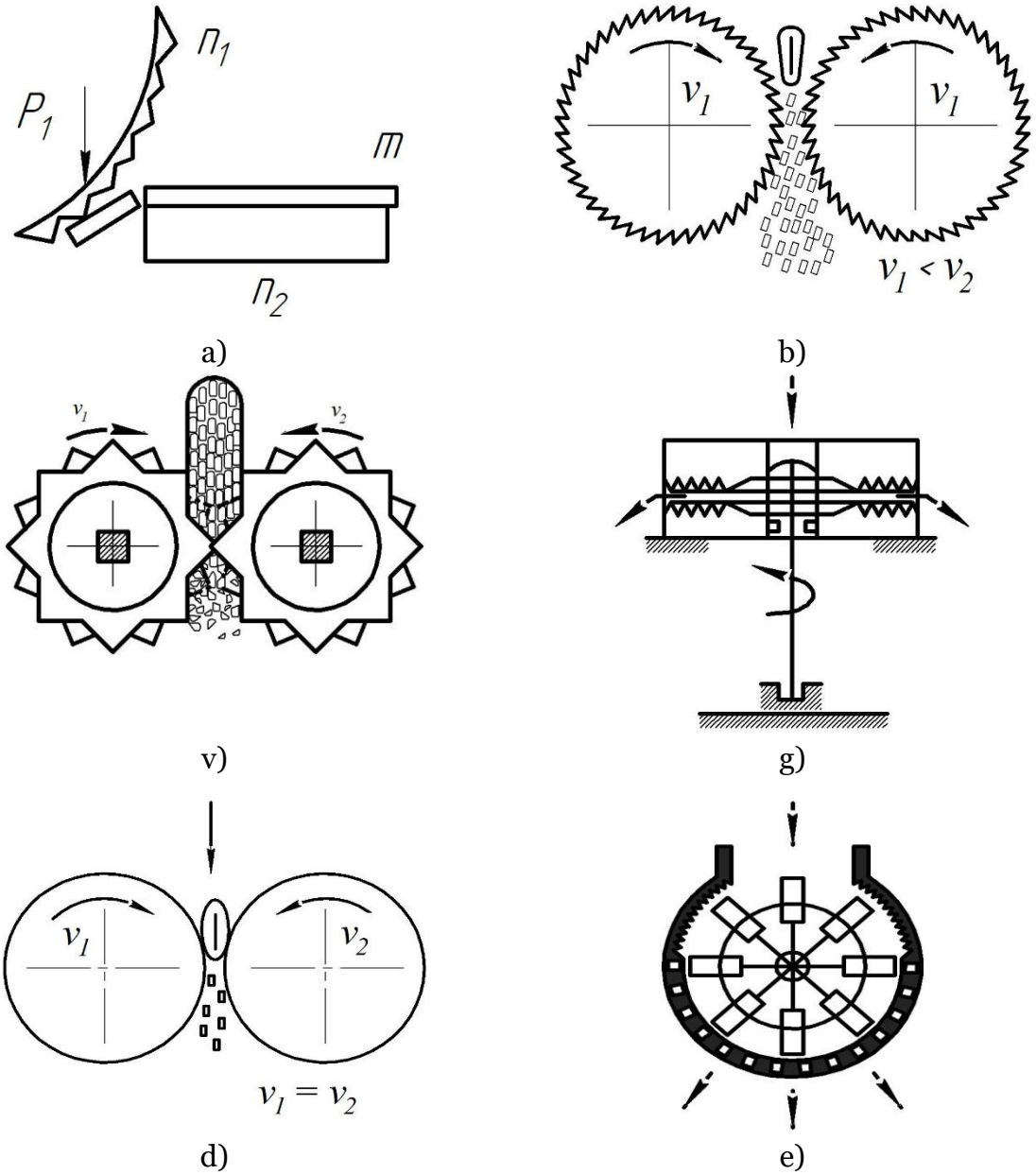
The cutting method (Fig. 1, a) is carried out by radially transferring the crushed material m to the rotating working body n_1 using the base n_2. From this, the level of grinding is changed by choosing the ratio of the movement speed of the working bodies n_1 and n_2. This grinding method is used to grind kunjara and other similar agricultural wastes.

In the milling and shredding methods, the grain to be ground is ground as a result of passing between the working surfaces of two riffles (Fig. 1, b) and teeth (Fig. 1, v) rotating at different speeds v_1 and v_2. These grinding methods are applied to mills and milling processes.



a – reduction; b - grinding; v – breaking up; g - rubbing;
d – crushing; e -a free stroke.

Figure 1. Methods of grinding grains

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In this case, the speed of rotation of one beam must be greater than the speed of rotation of the second beam, i.e. $v_1 < v_2$. The desired degree of grinding is achieved by changing the rotation speed of the grains and the gap between them.

In the rubbing method (Fig. 1, g), the grain is thrown from above between two fixed or movable working surfaces. Grains falling into the working gap are crushed by the friction created between the working surfaces. The crushed mass moves centrifugally and leaves the working space.

This method of grinding grains was used in disc grinders and stone mills. In this case, the desired degree of grinding is achieved by changing the gap between the working surfaces.

The grinding method (Fig. 1, d) is carried out by passing the grains through the grooves with a flat working surface rotating at the same speed towards each other. In this case, the grains are not very crushed, but to a certain extent they are divided into pieces.

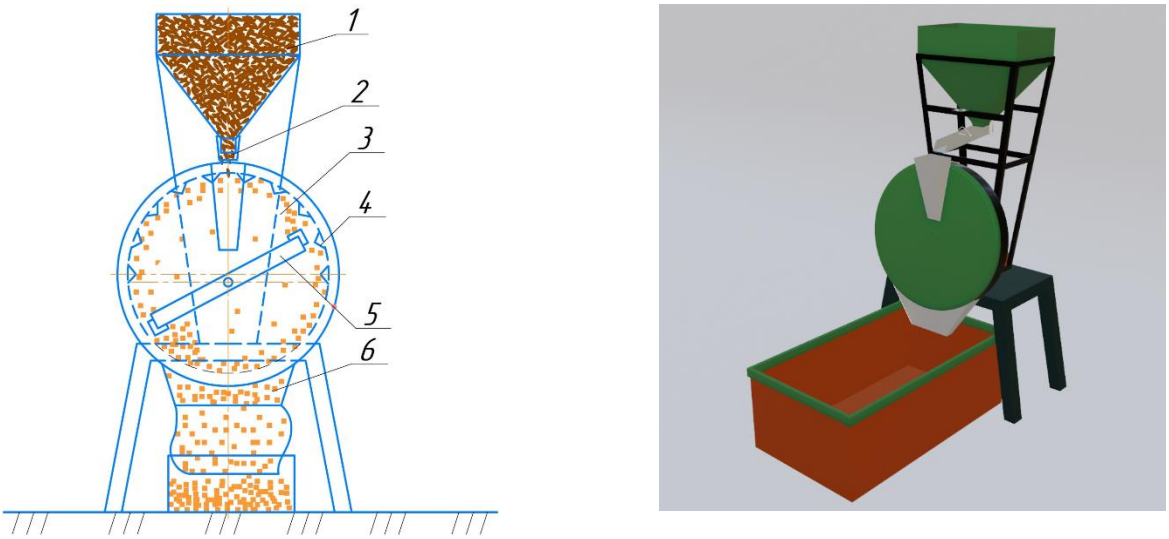
The method of crushing is carried out during the period of ripening of more grains. After that, the milled grains are processed by soaking or conservation.

The essence of the free hammering method (Fig. 1, e) is that the working bodies of the hammer, which are rigidly or hinged to their axles, rotate at high speed, strike the grains and break them into pieces. In addition, the crushed grains fly away and hit the grinder body or deck, resulting in even more grinding. The crushed fraction passes through the openings of the deck and goes out of the crushing chamber.

When grinding grains by impact, the desired level of grinding is achieved by changing the size of the holes of the working chamber deck.

This method of grain grinding is the most convenient and effective method of grinding, which is used in the process of hammer grinders. In addition, this method is universal and allows grinding material of different shapes and sizes. For this reason, grinders working in this way are the most widely used. According to the analysis of grain grinding methods presented above, we will apply this grinding method to the grain crusher-crusher technological work process, which is developed because the impact grinding method is universal, convenient and effective compared to other methods.

With this in mind, we have analyzed existing grain grinding devices and developed a schematic and 3-D view of a small grain grinding device used in grain grinding for small farms (Figure 2).



a) schematic view b) 3-D view

Figure 2. Technological and 3-D scheme of the grain grinder

The developed device consists of a grain hopper 1, a grading chute 2, a grinding chamber 3, a rector attached to a circular body 4, hammer hammers 5, and a chute for grinding grain feed 6 (Fig. 2 a). During the operation of the device, grains are placed in the hopper 1, and they are thrown into the grinding chamber 3 in a uniform manner through the standard transfer chute 2. In the grinding chamber, grains are crushed using hammers attached to the propeller 5, and the crushed grain passes through the sieve installed at the bottom of the grinding chamber and falls into the container through the output chute 6 (Fig. 2 b). The grain grinder is powered by an electric motor.

According to the above technological scheme and 3-D view of the grain grinder, a natural copy of it was made. The height of the device is 1170 mm, length 500 mm and width 700 mm.

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