Device for Sorting Silk Cocoons on Qualitative Signs

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ABSTRACT

A device has been developed that allows simultaneously determining seven qualitative characteristics of cocoons: silkiness, shell stiffness, degree of maturity, shell thickness, shell density, cocoon volume and specific volume. In addition, cocoons can be sorted into the following three types: normal, capercaillie (having a large specific volume) and immature (according to the degree of maturity).

Keywords: silkiness, shell stiffness, degree of maturity, shell thickness, shell density, cocoon volume, specific volume.

To improve the quality of raw silk is of great importance and it is considered necessary to control the quality at all stages of its production. The lack of the necessary technical means for the main processes in the production of grain, silkworm rearing, on the basis of the primary processing of cocoons and imperfect technology do not allow bringing the industry to a higher level. One of the important ways to increase the national economic significance of the industry is considered to be the improvement of the technology for the production of grena and silkworm cocoons on the basis of complex mechanization and automation of the main processes in sericulture.

The development of technical means and automation, the determination of technological parameters, as well as their sorting is an urgent scientific and technical problem, the solution of which will make it possible to provide silk-reeling factories with high-quality raw materials.

It is known that in the process of primary processing and in the selection of breeding cocoons, the determination of cocoons - capercaillie is of great importance.

Capercaillie are cocoons with an internal spot that protrudes or does not enter the surface of the shell, with the remains of a caterpillar or pupa, dried (glued) to the shell from the inside. They have a large specific volume and do not make a sound when shaken [1].

Currently, there is a mechanical device for identifying capercaillie cocoons, developed by TsKTPB "Shelk". The principle of operation of this device is based on the different attenuation of the harmonic components of the sinusoidal oscillations that occur when the cocoons are shaken in a rotational motion. The guides divide them into two streams according to the difference in the oscillation amplitude.

As noted, the disadvantages of this device is the low (10-20%) accuracy and complexity of the entire mechanical system.

There is a device for identifying capercaillie cocoons. The principle of operation of this device is based on the difference in the movement of normal and capercaillie cocoons during transportation along an inclined plane.

Divided by this physical feature into two streams, the cocoons are loaded along the guides into a certain container [2].

The disadvantages of this device is a large error in the separation of cocoons, due to the influence on the inclined conveyor of its uneven movement and various vibrations.

In [3], for the purpose of sorting capercaillie cocoons, twins and normal cocoons, a device based on the method of shock interaction of a cocoon with a shock-sensitive element is proposed.

The principle of operation of this device is as follows: cocoons on a belt conveyor are fed one by one. At a certain position, the entry of the cocoon into the zone is recorded using a photo sensor. According to this signal, the cocoon receives a "hit" - a click, hits a barrier - a piezoelectric sensor. Under the action of the impact force, electronic impulses are generated that are proportional to the impact force. During the passage of a normal cocoon, two pulses appear in succession, the first - the shells of the cocoon against the plates of the piezoelectric sensor, the second - the pupae against the inner wall of the cocoon. The final impact is also transmitted to the piezo sensor. These pulses are analyzed by an electronic circuit.

If the electronic circuit receives only one pulse, then such a cocoon is considered a capercaillie and is sorted out, and two cocoons are considered normal. Capercaillie cocoons and normal cocoons are separated into appropriate containers.

This device deserves further improvement in order to be implemented in the future. There are practically no devices in production that mechanize the existing manual labor to determine the silkiness of cocoons and sort them, which meet the zootechnical and agrotechnical requirements of sericulture.

The device developed by us allows you to simultaneously determine seven qualitative characteristics of cocoons: silkiness, shell stiffness, degree of maturity, shell thickness, shell density, cocoon volume and specific volume. In addition, cocoons can be sorted into the following three types: normal, capercaillie (having a large specific volume) and immature (according to the degree of maturity).

Figure 1 shows a block diagram of the proposed device for sorting cocoons by quality, which indicates: 1- electronic scales; 2- optical photodiode array; 3- computer; 4-belt conveyor; 6-hydraulic stiffness gauge; 8,10 - electromagnetic pushers; 9-receiving capacity for capercaillie cocoons; 12-receiving capacity for immature cocoons; 13-receiving capacity for normal cocoons; 14- electric drive.

The device works as follows: Individual cocoons are fed vertically to electronic scales 1, then the signal about the mass of the cocoon is transmitted to the computer 3, then the cocoon enters the measuring zone 2, where the signal of the optical photodiode matrix is also transmitted to the computer. Then the cocoon enters the conveyor 4. The conveyor is equipped with an electric drive 14. When the cocoon enters the zone 5, where the hydraulic rigid gauge 6 is compressed with a certain force. The change in the length of the cocoon is transmitted to the computer.

On a computer, using the program developed by us, qualitative parameters are determined such as silkiness, shell stiffness, degree of maturity, shell thickness, shell density, cocoon volume and specific volume [4-7]. As a result, according to qualitative parameters: if the test cocoon is a capercaillie and is in zone 7, it is sent to the receiving container 9 for capercaillie cocoons with the help of an electromagnetic pusher, if it is immature and is in zone 10, it is sent to the receiving container 12 for immature ones cocoons. And when the test cocoon is normal in terms of maturity, it enters the receiving container 13 for normal cocoons.

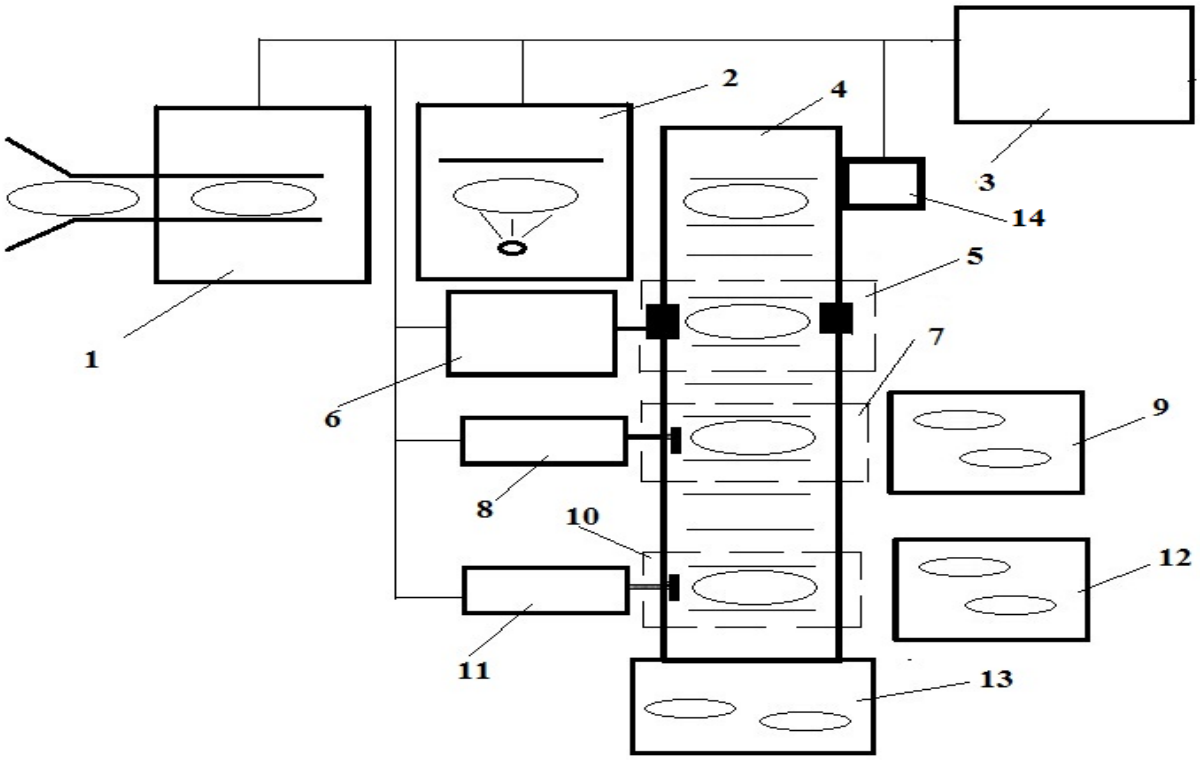

Figure 1. Device for sorting silk cocoons by quality.

The results of determining the silkiness of silk cocoons and assessing the uncertainty of experimental studies are given in Table. 1.

Table. 1.

The results of determining the silkiness of silk cocoons and assessing the uncertainty of experimental studies

δx=	**0,01**	**0,01**		**0,1**			
n	**M(cocoon), g**	**M(shell), g**	**Ш(cut-in),%**	**P, paskal**	**к**	**b**	***Ш=к·Р+ в***
1	**1,33**	**0,27**	**20,30**	**13000**	**0,0014**	**2,6433**	**20,31**
2	**1,32**	**0,26**	**19,70**	**13200**	**0,0014**	**2,6433**	**20,59**
3	**1,34**	**0,27**	**20,15**	**13000**	**0,0014**	**2,6433**	**20,31**
4	**1,35**	**0,28**	**20,74**	**13200**	**0,0014**	**2,6433**	**20,59**
5	**1,31**	**0,27**	**20,61**	**13100**	**0,0014**	**2,6433**	**20,45**
6	**1,31**	**0,28**	**21,37**	**13200**	**0,0014**	**2,6433**	**20,59**
7	**1,32**	**0,27**	**20,45**	**13200**	**0,0014**	**2,6433**	**20,59**
8	**1,36**	**0,28**	**20,59**	**13100**	**0,0014**	**2,6433**	**20,45**
9	**1,36**	**0,28**	**20,59**	**13200**	**0,0014**	**2,6433**	**20,59**

10	**1,34**	**0,27**	**20,15**	**13200**	**0,0014**	**2,6433**	**20,59**
Average	**1,33**	**0,27**	**20,47**	**13140**	**0,0014**	**2,6433**	**20,50**
u_A	**0,006**	**0,002**	**0,140**	**26,667**	**0,000**	**0,000**	**0,036**
u_B	**0,00289**	**0,00289**	**0,00**	**0,029**	**0,000**	**0,000**	**0,000**
u(x)	**0,007**	**0,004**	**0,140**	**26,667**	**0,000**	**0,000**	**0,036**
M.Л value			**20,46**				**20,50**
c_{x1}			**74,963**				**0,0014**
c_{x2}			**-15,341**				
u_B			**0,004**				**0,0289**
u_c			**0,288**				**0,0362**
U			**0,58**				**0,072**
Result Y			**20,46 ± 0,58**				**20,50 ± 0,072**

Thus, a device for sorting cocoons according to quality features has been developed. The proposed device allows you to simultaneously determine seven qualitative characteristics of cocoons: silkiness, shell stiffness, degree of maturity, shell thickness, shell density, volume and specific volume of the cocoon. And also they can be divided into the following three types: normal, capercaillie (having a large specific volume) and immature (according to the degree of maturity).

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