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IMPROVEMENT OF THE COTTON SOWING SECTION FOR LOW-GRADE SEEDING

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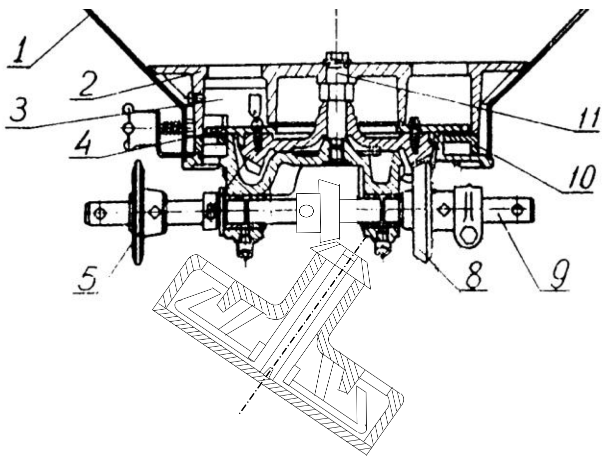
Abstract:
This article addresses the drawbacks of single-beam seeder design, parameter definitions have been developed, and a universal seeding machine is intended for hoisting lowered and exposed seeds by modifying some of their details.

Keywords: Sowing, powdered seeds, bared seeds, cotton crop, fiber, canopy, bunker, seeder.

For sowing cotton, pubescent and artificially bare seeds are used so far . When sowing is optimal, it is recommended to sow bare seeds. At very early sowing times, when the temperature is not high enough, and the soil moisture is high, it is recommended to sow pubescent seeds.

Planting cotton seeds with a low yield is one of the most important measures affecting the high cotton harvest. However, when the dried-up norms are low, the existing cotton seeding machines do not ensure sufficient uniformity of seeding due to their high fibrous and interconnectivity, and the formation of vaults in the bunker fromFor lack of activity of rattlers' loose fingers, Long seeded pipes due to the high location of the seeding frame [3].

In the single-beam seeders produced, a universal sowing apparatus is installed for sowing both seeds by changing some details. A number of drawbacks have been eliminated in the design, but due to the complexity of the sowing sections of exposed seeds are carried out with the help of a seed ruler (without nesting apparatus) only dotted-based plants are produced [2].



Pic. 1- Experimental design (Seeding section of a single beam seeder)

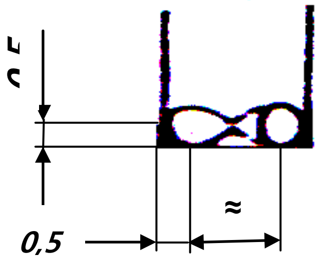
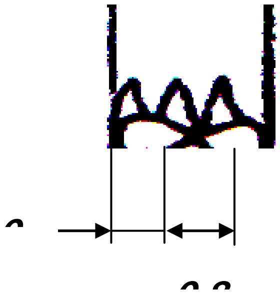
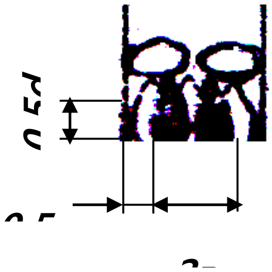
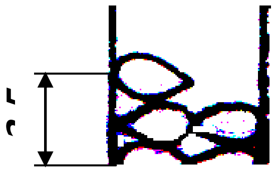
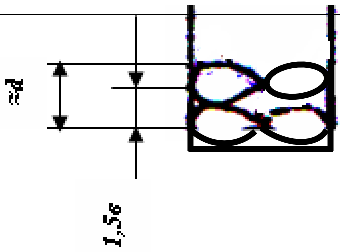
1-bunker; 2-fuse disc; 3-intermediate ring; 4-disc; 5-sprocket; 6-conical sprocket; 7-frame of the apparatus; 8-conductor sprocket; 9-shaft; 10-advanced shaft; 11-axis.

When exposed seeds are sown for the elimination of defects and in order to provide a nesting space, we propose a conical nesting apparatus (with a conical blade disc) for the sowing section of a single beam seeder, sowing bare cotton seeds (Pic. 1).

The nesting apparatus is mounted in the seed section at an angle of 450 in the direction of the assembly. At the same time, the window of the nesting apparatus shall be placed close to the high window of the outlet of the sinking apparatus [3].

The range of individual seed from the portion, therefore, and the dispersion of the trajectories may vary for the following reasons (only maximum differences in seed emission conditions are taken into account:

Table 1- Positions of seeds in front of the blade of the nesting apparatus

№	name seed location	seed arrangement
1	in one layer "lying" - the largest number of cases	
2	some of the seeds are located "lying", some "standing", also in one layer - frequent case	
3	in two layers "lying" - frequent case	
4	in two layers, and some of them, located in the upper layer, "stand" - a frequent case	
5	all seeds "stand" in one layer - a very rare case	

When the rotary disk is rotated, the seed-filled cells approach the high window above which the reflector is mounted and remove the excess seeds. The seeds fall out of the cells through the window under the action of their own weight and also with the aid of an ejector. The seed piles that fall out the window catch the nesting disk with a blade and throw it into the plough cavity. The jointing bodies then produce closed grooves and the rolling roller forms a convex roll from the soil above the seeds [4]. The nesting apparatus must provide for the mounting of compact, uncoupled nests located at specified distances along the length of the row. To do this it is necessary to choose the correct modes of operation and parameters of the nesting apparatus. The movement of the seed pile into the housing of the nesting apparatus and the flight of the seed within the pile should be investigated. Consider the case of a seed arranged at the outer end of the blade and at the wall of the apparatus [5].

According to G.M.Rudakova, The location of a group of 5 seeds by the moving blade of the nesting disc made it possible to establish the following most common siting cases (Table 1). Taking into account the frequent case of seed arrangement, and agreeing to indicate the coordinates of the group of seeds by conditional seed sizes (a-length, b-average thickness and width), the following dimensions of the pepper blade portion can be determined:

The height of the portion ranges from 0.5b to 1 a;

Length (normal to the blade)-from 1.5b to 2.5b;

Width (along the blade)-2b or 0.8a.

The distances of the separated seeds from the portion and the dispersion of the trajectories may therefore vary for the following reasons (only maximum differences in the conditions of seed emission are taken into account):

a) because of the difference in emission time, which can be taken into account by the angle α, by which the first seed exceeds the last seed (the last seed [6]. According to this, during the rotation of the blade by an angle α, equal to $t = \frac{\alpha}{\omega}$, the nesting apparatus will advance by a distance

$$\Delta L_1 = V_м t = V_м \frac{\alpha}{\omega}$$

where,

$$\omega = \frac{2\pi V_м}{mz}$$

In this way,

$$\Delta L_1 = \frac{\alpha mz}{2\pi}$$

where the angle $\alpha \cong \arcsin\frac{2,5в}{r_л}$;

б) due to the arrangement of seeds at different disk radii (in most cases), which can be taken into account by the value $\Delta r_л$ by which the radius of the nesting disk decreases.

$$L_1 = V_м \left[1 - \frac{2\pi(r_л - \Delta r_л)}{mz}\right]\sqrt{\frac{2H}{g}} \qquad (1)$$

In this way,

$$\Delta L_2 = L - L_1 = \frac{2\pi \Delta r_л V_м}{mz}\sqrt{\frac{2H}{g}} \qquad (2)$$

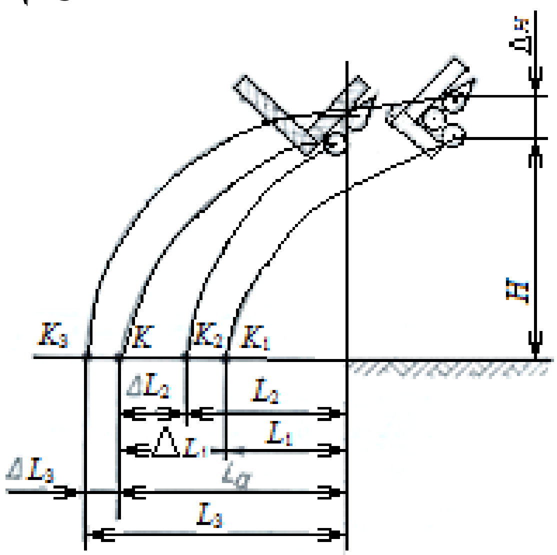


Figure: 2-Diagram of the formation of a nest at different times of seed ejection.

v) due to the different arrangement of seeds in height (ΔH), which can be taken into account in the formula (1) :

$$L_2 = V_м \left(1 - \frac{2\pi r_л}{mz}\right)\sqrt{\frac{2(H + \Delta H)}{g}} \qquad (3)$$

here

$$\Delta L_3 = L_2 - L = V_м \left(1 - \frac{2\pi r_л}{mz}\right)\left[\sqrt{\frac{2(H + \Delta H)}{g}} - \sqrt{\frac{2H}{g}}\right] \qquad (4)$$

Thus, substituting the numerical values for the nesting apparatus of the cotton seeder (m=25 см; z=4 см; $r_л$=8,4 см; $\Delta r_л$ =2b=1,0 см; H=10,5 см; ΔH =a=1,0 см):

For machine speed $V_м$=5 км/h, ΔL_1 =2,24 см; ΔL_2 =2,27 см; ΔL_3 =0,51см;

For machine speed $V_м$=10 км/h, ΔL_1 =2,24 см; ΔL_2 =2,54 см; ΔL_3 =1,02 см.

When sowing with pubescent seeds, in order to eliminate the shortcomings, the classical design of the seeding apparatus for pubescent soaked cotton seeds was adopted, containing a bottom, a toothed feeder-feeder, a toothed sowing wheel and an adjusting flap (Fig. 3).

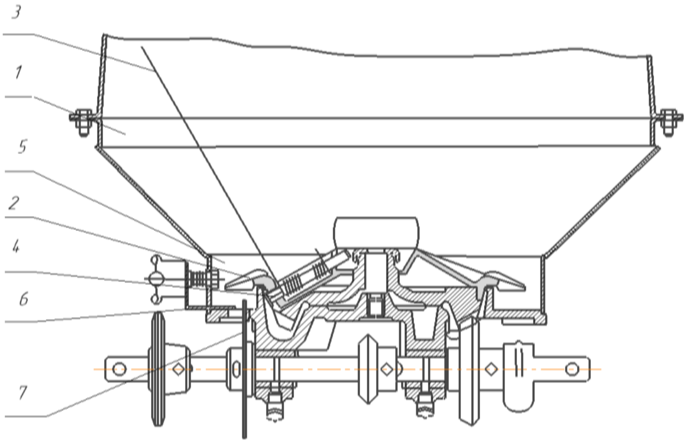


Fig. 3- Experimental metering unit:
1-bunker; 2-tedder - feeder; 3-turner; 4-axis; 5-bottom;
6-coil; 7- damper.

An axis (4) is installed in the feeder crown (2), on which the agitator spring (3) is fixed, with one end abutting against the feeder crown body, and the other end is free, moving in the mass of seeds and is actually a flexible elastic agitator [3].

The length of the axis on which the turner spring is located is structurally determined by the feeder crown. According to the diameter of the feed ring ($d_{вп}$ = 200 мм) длину пружины принимаем $1np \leq$ 50 мм.

When calculating a spring, you first need to select the length of the rod, the stiffness of the spring, the number of turns, the diameter of the springs and the diameter of the rod.

In the process of operation, the elastic agitator rod creates a certain pressure on the cotton seeds located in the hopper during the rotation of the feeder agitator, on which the lower end of the spring rod is fixed, and the rod itself experiences resistance from the seeds. With a large depression of cotton seeds and their moisture, the height of the loosened layer should be greater, and therefore there should be a greater moment required for tedding the seeds, which can lead to slipping of the support wheel and a violation of the sowing pattern.

When the agitator-feeder rotates and point 0 deflects forward by an angle α, the rod deviates from the initial position tangentially at point 0 by an angle β due to wedging of seeds near the hopper wall (Fig. 3). With a sufficiently large length of the agitator rod of weak rigidity and a deviation of 0 from the AO1 axis, the end of the rod (B) will take a stable position of the vertical axis passing through point 01, forming a cone over the feeder with a gear ring that promotes bridging.

The formation of a conical vault is most undesirable, because the vault has the greatest stability, in which case the turner will practically be inactive. The formation of a conical vault is most undesirable, because the vault is the most stable, and in this case the turner will practically be inactive.

Fig.4-Trajectory of movement of the end of the rod "B" in the mass of seeds (top view); B_0, B_1, B_2 - sequential position of the rod end.

From the analysis of Fig. 4 it follows that to prevent the formation of such a cone, it is necessary:

a) either increase the rigidity of the agitator spring to eliminate the deflection of the rod by an angle α, but this can in turn lead to an increase in the required torque and damage to the seeds;

b) either reduce the length of the rod to a certain size with a constant spring [6].

To calculate the length of the agitator, we take the path of reducing its length at a constant spring rate.

From the condition of eliminating the formation of a conical arch, the length of the turner rod should be within

$r \leq 1 \leq Z_{кр}$ or 100мм $\leq 1 \leq$ 200мм

where $Z_{кр}$ – minimum height of the cylinder formed by the turner rod.

r – feeder rim radius, r = 100мм

$$Z_{кр} = \frac{r}{\cos\alpha}$$

where, α- angle at the base of the tine feeder α = 35^0……60^0
in this way,

$$Z_{кр1} = \frac{r}{\cos\alpha_1} = \frac{100}{\cos 35^0} = 122 \text{ мм}$$

$$Z_{кр2} = \frac{r}{\cos\alpha_2} = \frac{100}{\cos 60^0} = 200 \text{ мм}$$

For experimental verification, the length of the turner rod is taken equal in terms of redistribution is 120….200мм.

The operation of the rod-agitator can occur under real conditions when the rod experiences a suddenly concentrated load, equally distributed and constant (Fig. 3).

We believe that from the point of view of long-term performance from the condition, a suddenly applied concentrated load on the free lower turner [3].

The concentrated load Pα is calculated according to the equation

$P_q = q_1 h_1 = 337,5 * 0,016 = 5,4$ H

where, $q_1 = H_6 * 1_0 * g * \gamma_{сем} = 0,5*0,15*10*450 = 337,5$N /м

H_6- seed hopper height m

1_0 – rod length m

h_1 – height of the layer to be loosened h_1 = 0,16 м

Choosing the ratio between the dimensions of the spring $\frac{D}{d} = 12/2,5 = 4,8$

The diameter of the spider's rod is determined according to the formula $d = \sqrt[3]{\frac{M_p * K}{0,1(\tau)}}$

where $K = \frac{4D/d - 1}{4D/d - 4} = \frac{4*4,8-1}{4*4,8-1} = 1,28$

(τ) - Permissible torsional stress (τ) = 0,45 MPa

For bar length l_{01}=150 мм

D_1 =2,8мм

And with l_{02}= 200 мм and l_{03} = 250мм respectively d_2=3,1 мм и d_3=3,38мм

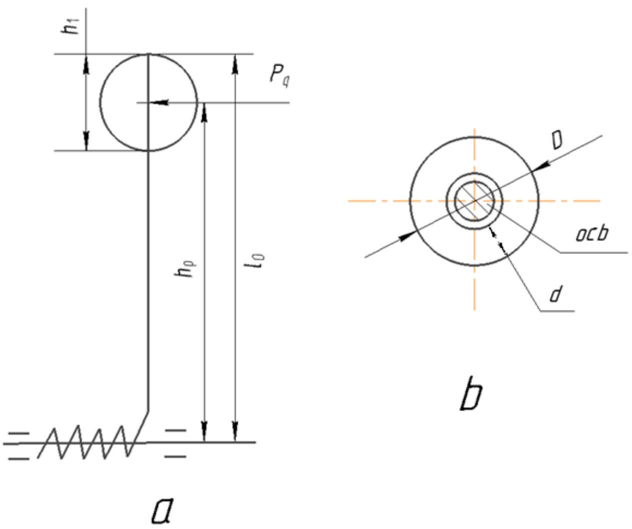


Figure: 5- Scheme for calculating the diameter of the rod and spring
a) side view; b) spring profile.

Let's make the calculation of the bar in conditions of the maximum amplitude of vibration of the end of the wire using the expression

$U_{max} = 2q_m/a^2 \sin пZ/2l_0$ мм

where, $2\ q_m = 2q_1/\mu$, м/с$^{2.}$

$a^2 = c^2\ п^4/16l_0^4 = EJп^4/\ \mu 16l_0^4$, 1/с$^{2.}$

here, $$U_{max} = \frac{2048 * q_1 * l_0^4}{\pi^4 * E * d_0^4}$$

where, $l\pi^4$ the estimated length of the spring involved in the vibrations of the end section of the spreader,

$l_n = l_0 + 3l_b = 0{,}31$ м

l_b – length of one spring coil $l_b = 0{,}05$ м

on

$$U_{max} = l_0 = (125 * q_1 * l_0^4) / \pi^4 * E * d_0^4$$

$$d = \sqrt[4]{53{,}9(150 * 10^{12})} = 0{,}0024м$$

According to the performed theoretical studies, to ensure sufficient rigidity of the rod, we accept for further research a spurger rod with a diameter for critical analysis

d = 2,4…..3,5 мм

M_p - maximum torque M_p = 810 Н мм

$C_п$ - spring rate

$C_п = M_p/\ \beta$ H mm / grad

The minimum torque is accepted

$M_{мин}$ = 0,16 *810 = 130 Н мм

Under $\beta = 90^0$ $C_п$ =130/90 =1,45 Н мм / град

Thus, the predetermined basic parameters of the rod of the grower, the diameter is in the redistribution is d_0 =2,5 …3,5 мм. The spring rate is not more than 1.45 N mm / grad, which must be clarified in the process of experimental studies.

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