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«Research of interaction process of shanks of concave disc springs of tillage machines»

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Problem statement

Presents the results of theoretical and experimental studies of new solution of the applied research task that consists in mathematical modelling of the interaction process of concave disk spring shanks and a soil medium, taking into account the random nature of soil response, in the form of a non-linear dynamic movement model. It has allowed for determining the optimal dynamic characteristics and the design parameters of the spring shanks of a disk operating element: rigidity, reduced mass, frequency and amplitude of oscillations. A structural diagram of the interaction process of a concave disk and the soil, where oscillations of an operating element on a spring shank with a certain amplitude and frequency create a feedback in the system “soil – disk – spring shank”, has been suggested. A mathematical model has been developed and a theoretical investigation on the change in the drag forces of a disk operating element on a spring shank has been conducted. The dynamic characteristics of a spring shank in the course of unit operation have been determined within the range of the rigidity variation limits from 20 kN/m to 40 kN/m, the reduced mass limits from 100 N to 300 N, the draft force variation limits from 200 N до 2000 N.
Solution methods

**Figure 1.** Computational scheme of the dynamic model

**Figure 2.** The movement of the oscillating system “soil – disk – spring shank”.

**Figure 3.** Change of the generalized coordinate depending on the value of the reduced mass and the rigidity of a spring shank.

**Figure 4.** Change of the generalized coordinate depending on load value.
Conclusions

Results, implementation

- The structural diagram of the interaction process of a concave disk and the soil, where oscillations of an operating element on a spring shank with a certain amplitude and frequency create a feedback in the system “soil – disk – spring shank”, has been suggested.

- The mathematical model has been developed and a theoretical investigation on the change in the drag forces of a disk operating element on a spring shank has been conducted. The dynamic characteristics of a spring shank in the course of unit operation have been determined within the range of the rigidity variation limits from 20 kN/m to 40 kN/m, the reduced mass limits from 100 N to 300 N, the draft force variation limits from 200 N до 2000 N.
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