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Theoretical premises of determination of power characteristics of drill boot with gear disk on vibration suspender

The purpose. To determine analytically in the de· veloped new construction of multiple-purpose com· bined drill boot of selection seeder possibilities of decreasing power characteristics of its drill boot unit. **Methods.** Theoretical rules of agricultural mechanics on interaction of end-effector of a seeder (universal combined drill boot, mounted on vibration suspender) with soil are submitted for consideration. The given structure of mathematical model of the process of interaction is based on the differential equations and considers action of forces of weight of structural ele-ments, gains of springs and soil reactions on gear disk, anchor seed-pipe and covering roller.

Results. New theory is developed of horizontal and vertical forward oscillations of longeron of the combined drill boot unit with gear cutting disk and system of spring gears with pressure spring and a spring of vibrator for study of effect of vibration influence on draught resistance of drill boot.

Conclusions. The elaborated mathematical model enables to determine range and frequency of forward oscillations of the assembly unit depending on structural parameters and kinematic modes of operation with the purpose of determination of their effect on production process that will allow to evaluate the state of system and to optimize power characteristics of all-crop drill.

Key words: seeder, combined drill boot, gear disk, spring, soil reaction, force, oscillations, sinusoidal law, range, frequency.

Formulation of the problem. In today's conditions of intensive implementation of energy-saving technologies for growing cereals and other crops, the need for agrotechnical experiments with the help of breeding and seeding seeders according to these technologies is relevant. The structural features of the coulter for the selected technology are key to sowing with minimal soil treatment and without prior cultivation. The selective seed seed hole drill with the mechanical seeding machine SS-16 (CH-16) is widely used for sowing seeds of grain, leguminous crops and herbs for preliminary and competitive variety testing, agricultural experiments, as well as for private seeding in farms. The imperfect cochlea group does not allow it to be used for energy-saving seeding technologies. The development of universal joint drills for a drill, the justification of structural and kinematic parameters and the assessment of their energy performance has a practical and theoretical significance. Analysis of recent research. For direct seeding technology, the well-known breeder-seed manufacturer, Wintersteiger, offers the use of an enhanced seedbed

system for continuous seeding Plotseed XXL and seeders: two-disc ACRA Plan t with spaced spacings of 19 cm; Double Plain Great Plains with intermediate rows of 15 cm; Two-Disc Sunflower; geared Horwood Bagshaw [1]. A prototype sample of a special device with active working organs - blade discs installed in the inter-shaft space was developed. It was tested on the basis of a selection seeder of the type SCS-6-10, the design of the VIM [2]. At the same time, two-disk, pin and anchor coulters, which are equipped with the most common selective seed seeders in the former Soviet Union, in particular the type CH-16 [3 - 5], do not allow the hanging of seeds in mulched plant residues of soil due to imperfect design of the combustion unit. One of the ways to expand the scope of application of seed drills and the possibilities of different types of cultivate groups is to provide high quality hanging grain crops for different soil tillage systems and, accordingly, the quality of pre-planting, the drills with solid disk knives: turbo discs, wave and grooved cutting discs [6, 7]. The results of research in the Crimea of the Dristechnik DST-6000 of Agrisem (France) with unified crop modules Disk-0-Sem, consisting of 2 rows of toothed discs, fixed on spring racks, showed the promise of these aggregates. In addition to the disadvantages of seeding depths, since seeding is carried out using a ground stream created by discs of 560 mm in diameter, there are advantages: during the work, the discs vibrate, creating a shock wave effect, to ensure that the disk is engulfed even on heavier soils with less (on 20%) resistance [8]. Thanks to vibrational oscillations, reducing the coefficient of internal friction between soil particles, the vibrating body and soil, the traction resistance of a beet combine is reduced by 26 - 53% [9].

The reduction of the resistance force during cutting into the ground with a toothed blade is relatively solid by the bionic directions of working out the working bodies of soil-working machines [10]. For the development and research of cones for direct sowing with a cutting disc-knife, which has no own drive, a stable-seed-line, the end of which is located in the underside of the paw, a tunic, whose lower end moves along the slit created by a disk knife, reduced sowing rates grain crops by 25 - 30% compared to disk seeders [11]. Increasing the speed from 1.94 m / s to 2.67 m / s does not significantly affect the uniformity of seed earnings. For seeding of grains to a depth of 0.07 m, the resistance of the coil section is 72 N without fertilizing and 89 N for fertilizing to a depth of 0.12 m. The consolidation of soil with a pot only over the seed lines allows to reduce the resistance to 188 N, or 3.3 times [12].

Theoretical investigations of the change of deeper force, which creates a mechanism of a spring suspension, are carried out depending on the position of the working area of the lever of the coil suspension bracket [13]. The design of the movement, the angle of the tooth arrangement and the shape of the blade are determined, mathematical models of calculations are given for determining the optimal parameters [14]. However, in well-known studies, the energy component that occurs due to vibrational oscillations in the technological process is not taken into account. The purpose of the research is to expand the technological capabilities of the selection seed seeder, reducing energy consumption by using the vibrational effect of the interaction of the working body with the soil through the definition of rational structural parameters and kinematic modes of the unit operation. Materials and methods of research. The research used analytical, statistical methods, as well as the method of mathematical modeling of machines and technological operations using the laws of mechanics.

Conclusions

A new design of a coil unit with working bodies installed on a spring-lever suspension, which is completed depending on the chosen technology for the breeding and seeding seeder, has been created. A system of differential equations of forward vibrations of a sowing aggregate that arises under the influence of a perturbing force generated by irregularities of the soil surface during a uniform movement of the unit along the field is made. The solution of this

system of differential equations, which characterizes the law of oscillatory motion of the unit along the axes of the Cartesian coordinate system, is obtained. Analytical expressions have been found to determine the amplitude and frequency of these vibrations, depending on the structural parameters and kinematic operating modes of the unit. The obtained mathematical model will allow to evaluate the state of the system and optimize the energy characteristics of a universal seeder.

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