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ДОЗАТОР С КОМПЕНСИРУЮЩЕЙ КАМЕРОЙ ДЛЯ ВНЕСЕНИЯ МИНЕРАЛЬНЫХ УДОБРЕНИЙ
A DOSING DEVICE WITH A COMPENSATIVE CHAMBER FOR A FERTILIZER APPLYING MACHINE

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Abstract

In order to improve soil fertility and to increase the yield of agricultural products, the soil should be regularly enriched with mineral fertilizers. Famous machines and implements for soil mineral fertilizers differ in their insufficient measuring devices. The new structure of a seeding device with a compensating chamber for inserting fertilizers is considered in this article. A scheme of a seeding device and a 3D model of the seeding device are provided. This performance of the seeding device ensures uniform distribution of the fertilizers in the soil, by the width of the machine, thereby increasing the quality of the process implementation.

Key words: mineral fertilizers, applying device, chamber, dosing device, vibration.

INTRODUCTION

The most important task of agricultural production of Kazakhstan is creation of grain resources in the amounts necessary to fully provide the population with food, livestock with feed, agro-industry – raw materials. The solution to this problem is primarily due to the improvement of quality of field work.

One of the promising directions of development of fundamentally new universal fertilizer applying facility (machine) is the use of vibration in their processes. When fertilizer vibrates at a certain frequency and amplitude frictional forces are reduced between the particles, it becomes loosened, movable and “yielding”.

The purpose of this paper is to offer a design solution to the vibrator operation control.

MATERIALS AND METHODS

Many studies and many years of experience have shown that damp fertilizer, especially powdered, because of its hygroscopic properties, convert into a viscous mass and lose the ability to outflow. Drying is converted to lumps of various sizes. They congregate at the outlets of hoppers and form the arches, which prevent entry of fertilizer in the metering device which leads to disruption of the entire process.

To resolve this problem, one must develops an effective metering and distribution devices and justify their parameters. As a result of analytical work at the Department of Technical Mechanics of S. Seifullin KATU the fertilizer applying facility with a chamber has been developed. A positive decision on granting an innovative patent for the application No. 2014/1425.1.

Fig. 1 shows a part of fertilizer applying facility (machine). Under a hopper 1 with loosener 2 the dosing device is situated. It comprises a body 3 of rectangular shape, with outlet 9 at the bottom 4 and flaps 7 opened/closed by screw 6 and bearings 5 (fixed at the bottom) and nuts 8 (fixed ah the flaps). The ends of the screw 6 are with left and right thread, providing simultaneous and opposite movement of flaps 7 at opening and closing of the outlet 9. Under the outlet 9 in the vertical guide supports attached to the walls of a special, lining chamber 10, a vibration plate 11 with rod 12 (mounted to the glass support 13), is placed. The rod 12 and plate 11 vibrate under the action of an electromagnet 16. Under the chamber 10 a conveyor belt 17 is placed. It receives and transports fertilizer to the distributing device of applying machine.

The device operates as follows. With the loading and delivery of mineral fertilizers its preliminary loosening and transportation is done by agitator and afterwards 2 enters the dispenser 3. The rate of supply of fertilizers is regulated by opening or closing of the valves 7, which is provided by the rotation of the roller 6 mounted in supports 8 with a threaded connection. To eliminate the resulting domes of fertilizers, align of their density distribution across the width and ensuring their uniform distribution on the conveyor belt 17, in the area of the outflow the vibration plate 11, receiving vibrations from the tappet 12 which interacts with the electromagnetic 16, is enabled. Its purpose is to maintain the fertilizer chamber stable excited state, so that the particles are distributed uniformly in a given volume. As a result of a uniform distribution of particles in the chamber, the conveyor belt brings from it the fertilizer uniformly expanded by its width. On the surface of the conveyor belt the pins 8 are placed. The fertilizer derived from the stabilization chamber by the conveyor belt enters the receiver 9 the width of which is divided into equal sections A, B, C .... They are connected with the openers burying fertilizer in the soil.

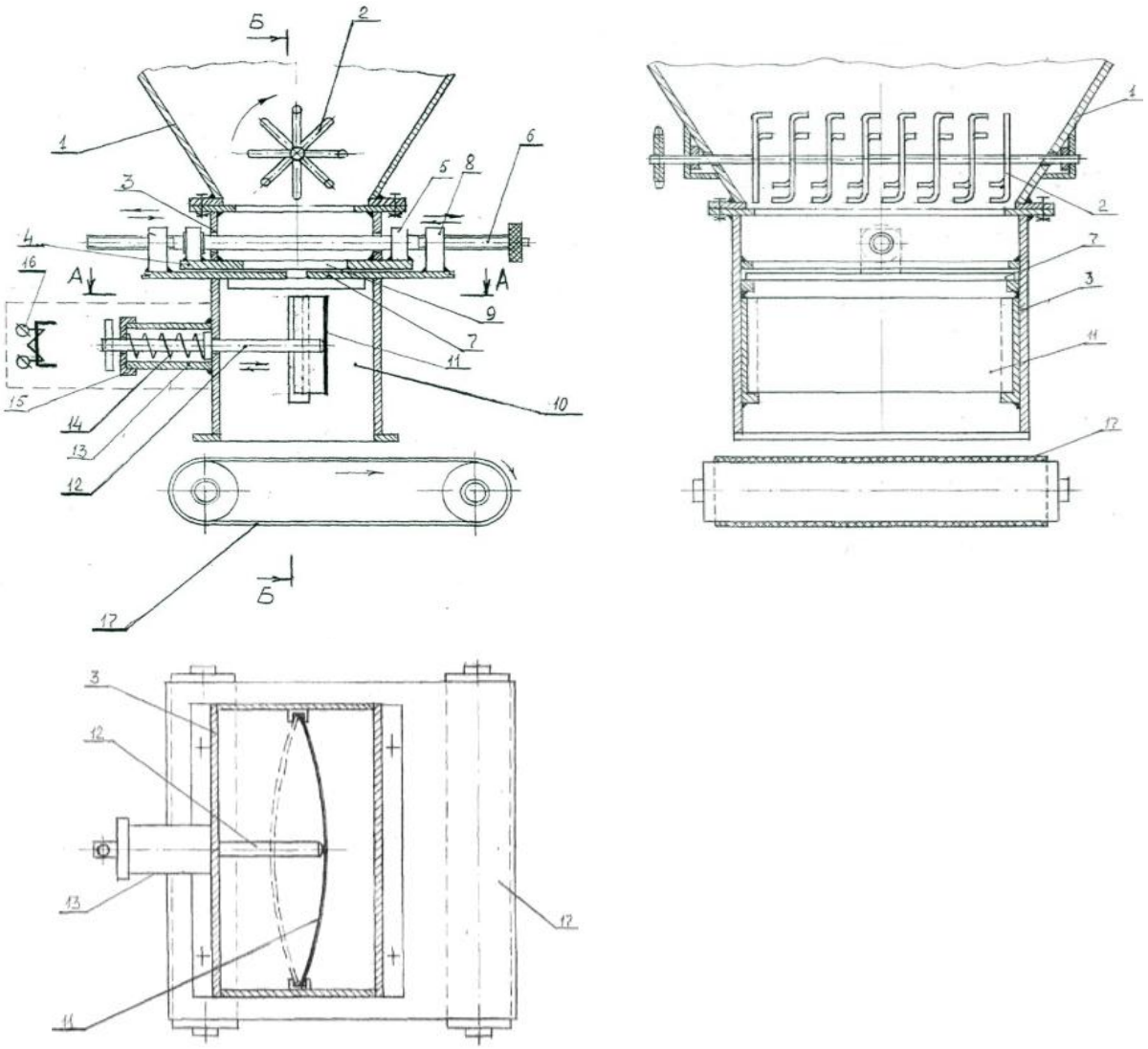

Fig. 1. *Drawing of the dosing device*
1 – hopper; 2 – loosener; 3 – body; 4 – bottom; 5 – bearing; 6 – screw; 7 – flap; 8 – nut; 9 – outlet; 10 – chamber; 11 – plate; 12 – rod; 13 – support; 14 – spring; 15 – nut; 16 – electromagnet; 17 – belt conveyor

RESULTS AND DISCUSSION

To control the operation of the vibrator the electronic switch was applied. It consists of the following elements: switch, the Hall sensor, electromagnet, a motor with a drive signal and two resistance stores. The vibrator operates as follows. When the switch VC is on the switch K and the motor M come on. The motor M drives the drive signal SD. The original signal is removed from the drive signal by the Hall sensor slot and is transmitted to the input switch. The switch controls the frequency of the reciprocating motion of the core of the electromagnet EM serving as a stem vibrator. DC electromagnet actuates plate connected with the core through the rod.

The frequency depends on the speed of rotation (angular velocity) of the rotor of the motor, which is regulated by a variable resistor R1.

The amplitude of the stroke is regulated by the second variable resistor R2.

The actual construction of the electromagnet and its attachment to the camera are shown in Figure 4.

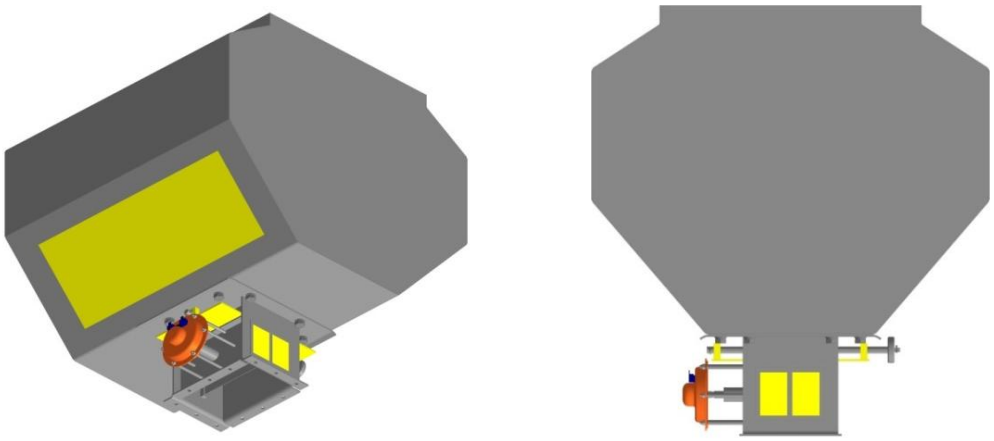

Fig. 2. *3D model of hopper and chamber with a vibrating device attached to it*

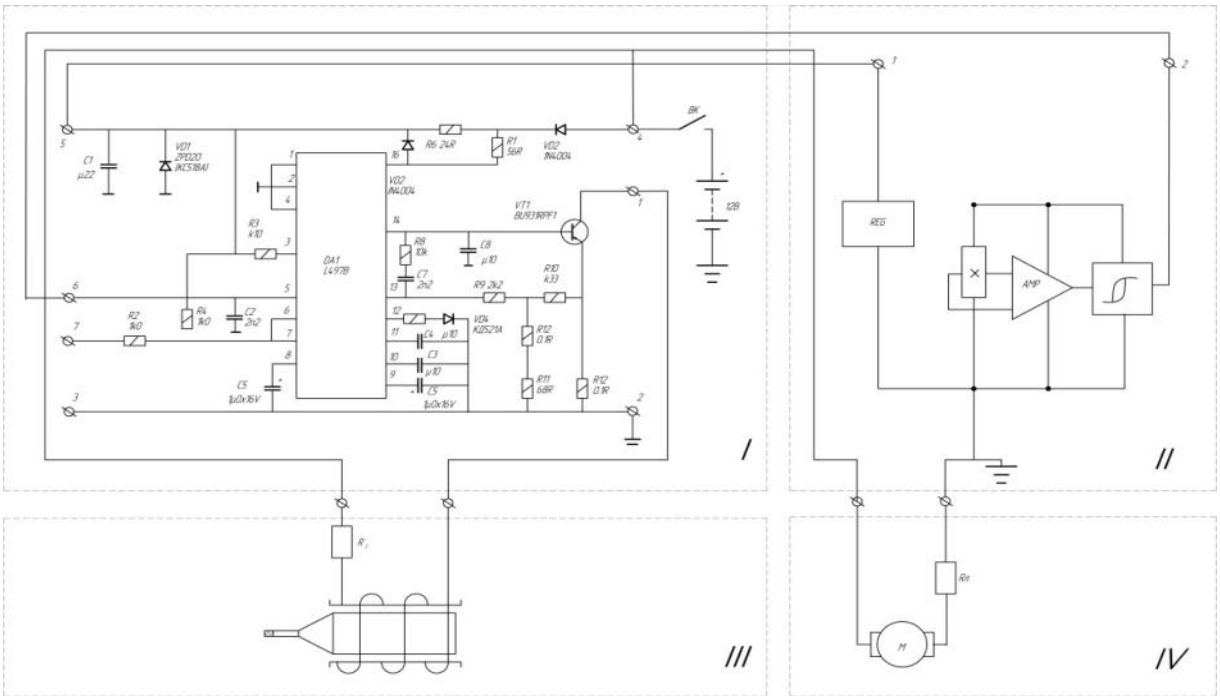

Fig. 3. *Block diagram of the vibratory system*
I – electronic switch; II – Hall effect sensor; III – electromagnet; IV – motor

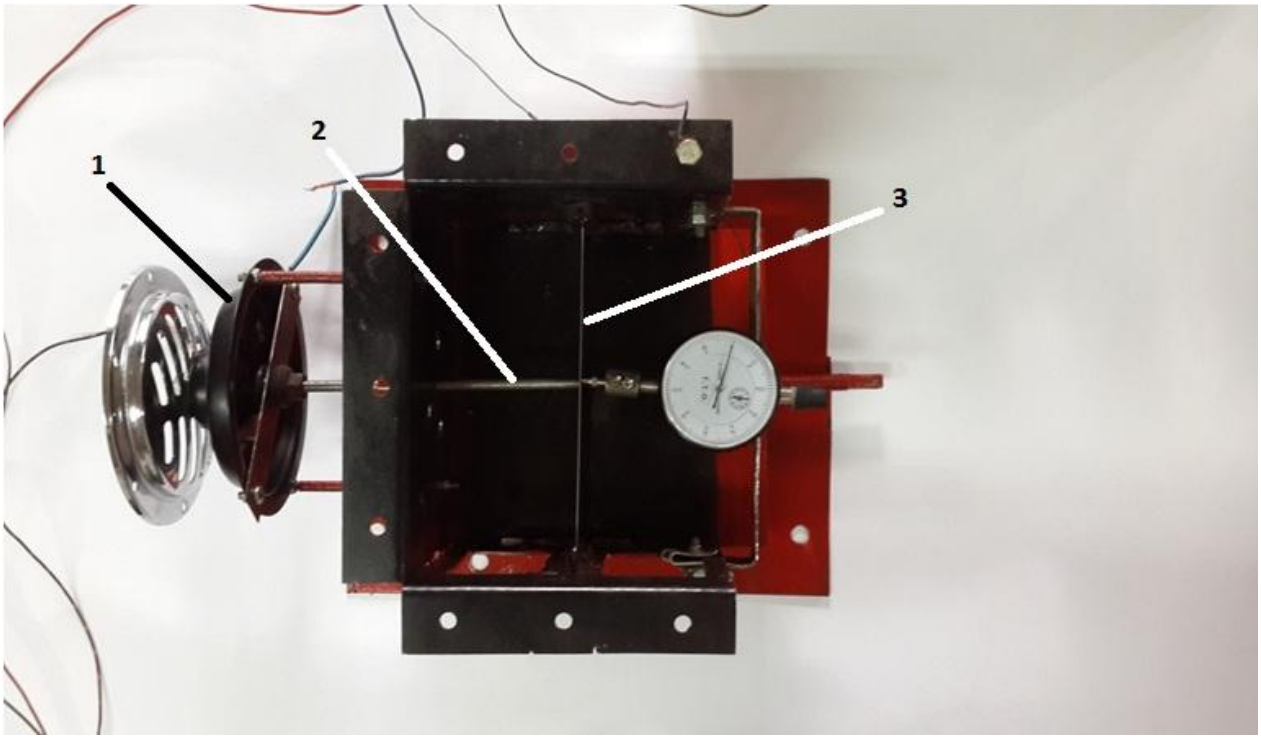

Fig. 4. *Attaching (Joining) of the electromagnet to the camera*
1 – electromagnet, 2 – rod; 3 – plate

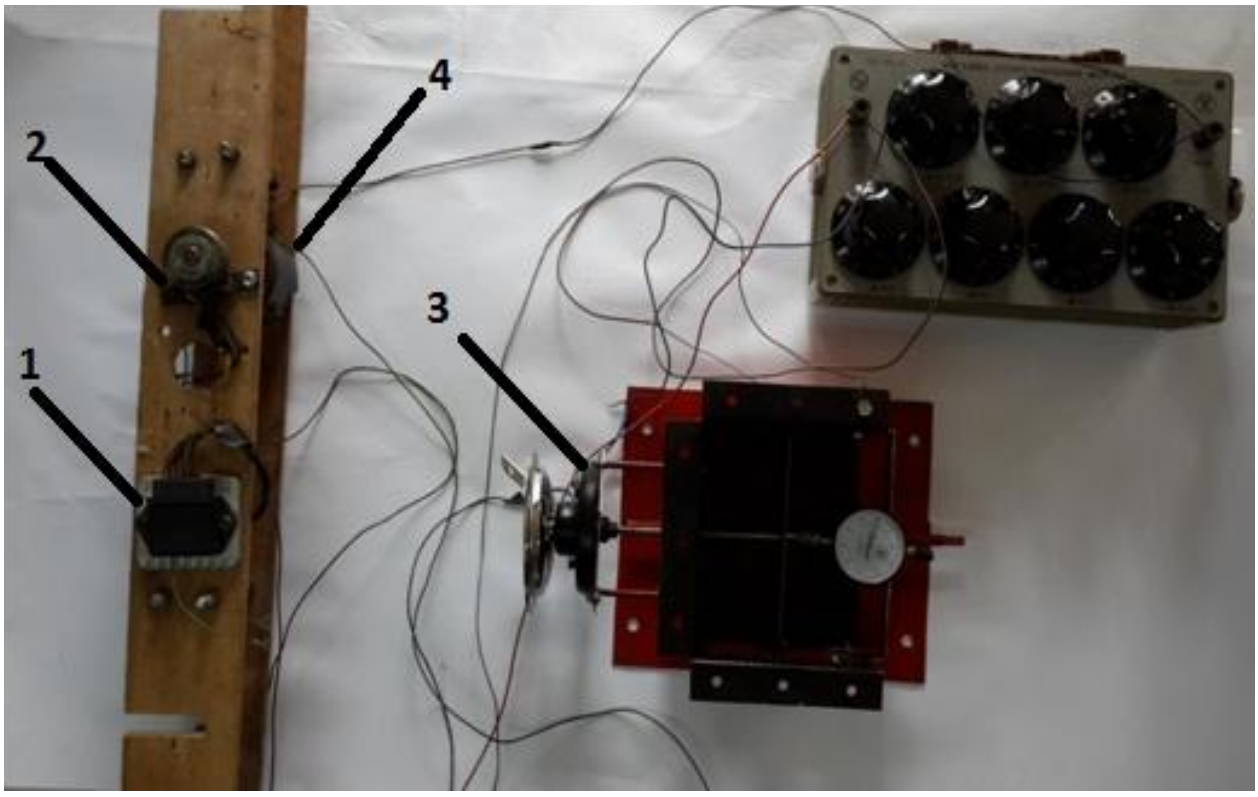

Fig. 5. *The actual construction of the control unit of the vibration device*
1 – electronic switch, 2 – Hall effect sensor, 3 – electromagnet, 4 – motor

Fig. 6. *Experimental fertilizer applying machine at the field test*

CONCLUSIONS

Laboratory and field tests of the dosing device with a chamber for fertilizer applying machine were conducted. This performance of the dosing device ensures uniform distribution of fertilizer in the soil, by the width of the machine, thereby increasing the quality of the implementation of the process.

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