

## DEVELOPMENT OF PNEUMATIC SEEDER FOR SOWING GRAIN CROPS

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**Abstract:** One of the main ways of obtaining high yields is a method of sowing and technology for its implementation. At present in the world practice, the creation of high-performance and adapted to certain soil-climatic conditions, sowing units is moving in two directions: increasing the degree of combination (versatility) of sowing machines and the use of centralized tanks for seeds and fertilizers, and pneumatic sowing systems.

However, models of seeders with CVS do not fully meet agro technical requirements for uniformity of sowing between coulters and are aggregated only with a specific tractor class, while having a high cost and low annual load.

In this connection, the creation of high-performance and adapted to certain soil and climatic conditions of Kazakhstan is very relevant.

**KEY WORDS:** SEEDER, COMBINED, COULTERS, SOWING MACHINE, WIDE-SPREADING, SOWING, PROCESSING.

Pneumatic grain seeders with centralized dosing and pneumatic transportation of seeds to the coulters are most effective in wide-span seeders. The use of one centralized bunker significantly reduces the time for refilling and servicing the unit, which creates prerequisites for an increase in labor productivity at sowing.

Pneumatic drills are produced by many firms in Canada, Europe, USA, Australia and Russia. Most seeders use original sowing systems, differing in design and process flow diagrams [1,2,3].

The development of sowing units (complexes) are engaged in many firms from near and far abroad (John Deere, Morris, Flexi, TechArtCom, etc.) [4].

The basis of foreign CVS is based on the Accord pneumatic seeding scheme, which cannot provide the necessary uniformity of seed distribution between coulters  $\pm 3\%$  and fertilizers  $\pm 10\%$ . Pneumatic conveying and distribution of sowing materials in the above drills on the coulters are random processes and depend on many uncontrollable factors: variation of the speed of the air carrier medium, difference in the length of the pneumatic conductor, various physical and mechanical and aerodynamic properties of seeds and fertilizers, etc.

The same sowing complexes with the Central Vacuum System were developed in Russia: "Uralets" - PPA-5.4; PPA-7.3; PBRA-14.7; "Yaroslavich" - PPA-7,2P; Kuzbass - PK-4,2 [5].

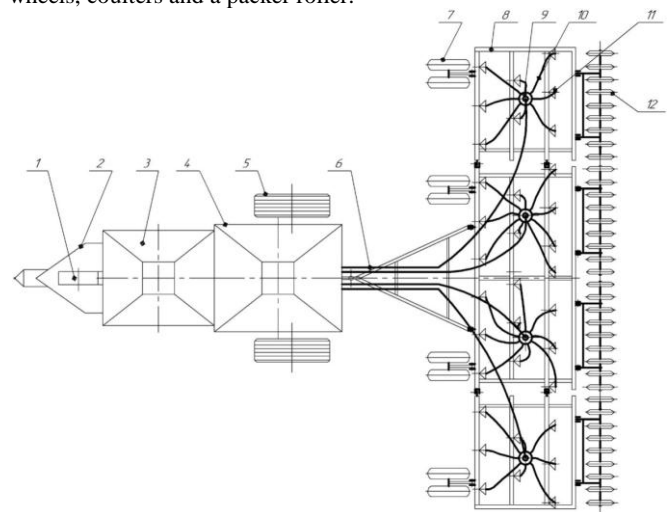
The leaders in the development and production of such seeding machines in the world are the firms Accord, Amazonen, Horsch (Germany), John Deere (USA), Flexi-Coil (Canada), POTTINGER (Austria), etc. [2, 3]. None of these models of seed drills with CVS did not fully meet agro technical requirements: it did not provide the necessary uniformity of seeding between the coulters. Due to the design features of the tillage part, these complexes are aggregated only with a specific tractor class, have a high cost and low annual load.

In this regard, there is a need to create a high-tech, wide-gripping, pneumatic seed drill for sowing crops, adapted to the soil-climatic, organizational and economic conditions of Kazakhstan, ensuring high quality of both sowing and tillage and, a reduction in comparison with similar operating costs.

Based on the analysis, we selected the following constructive-technological scheme of the seeder: central coil metering unit, pneumatic distribution over the coulters, three-section frame with coulters, drive of the metering units from the pneumatic wheel, hydraulic drive of the fan, figure 1.

The wide-area pneumatic seeder for sowing crops with automated control of the technological process consists of sowing and embedding parts. The sowing part consists of a frame with support wheels, a hydraulically driven fan, bunkers for seeds and fertilizers,

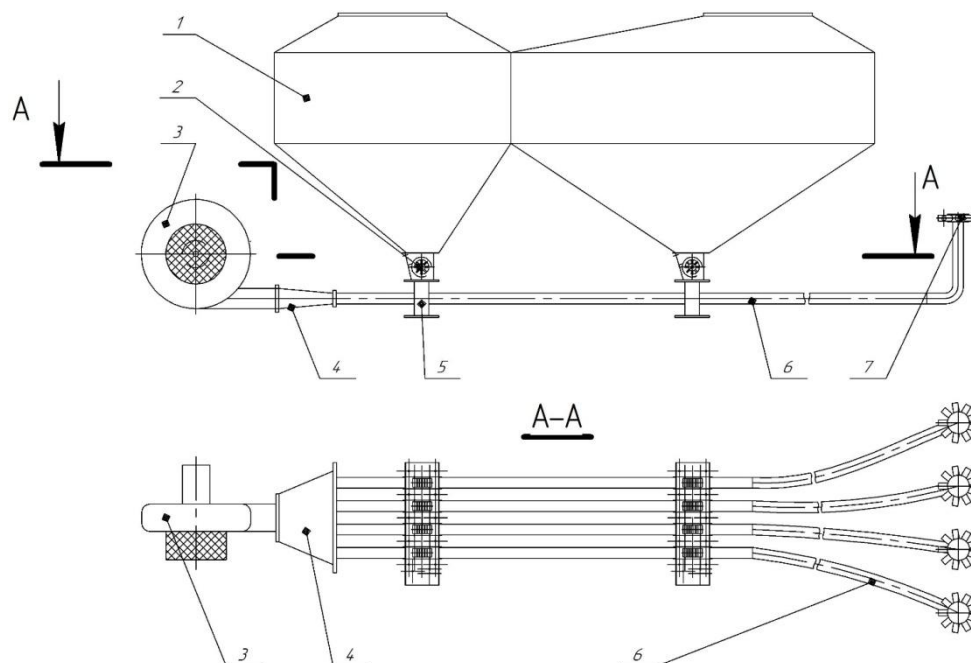
a sowing unit, pneumatic materials ducts, distribution heads and seed tubes. The lining part consists of a three-section frame, support wheels, coulters and a packer roller.



**Figure 1-** Constructive and technological scheme of the pneumatic seeder

1-fan; 2-frame; 3-bunker for fertilizers; 4-bunker for seeds; 5,7-support wheels; 6-pipelines; 8-embedding part frame; 9-distribution head; 10-seed tubes; 11-coulters; 12-rollers

The pneumatic sowing system includes a hopper 1, a central coil sowing device 2 consisting of a coil, a shaft and a framework with supports; the material pipe 4, where the bulk material enters and acquires speed from the air flow generated by the fan 5; air distributor 6, where the air flow from the fan is distributed through the main material pipelines; distribution head 7, where the division of the transported air flow of seed material along the seed tube to the coulters. The device works as follows. When you turn on the drive mechanism, the coil makes a rotational movement. Bulk material from the hopper 1 by gravity enters the sowing unit 2, i.e. in the grooves, which captures the seed, and a continuous stream sends (transports) to the four main material lines 4, the air flow generated by the fan 5, and by distributing the air flow in the air distributor 6 on three main material lines, picking up the seed, transports the seed to distributor head, where the seed distributed over the seed tube goes to the coulters.



**Figure 2** - General view of a seed metering system with a central coil feeder

1 – bunker; 2 – coil seeding machine; 3 – fan; 4 – air distributor; 5 – intake chamber; 6 – trunk pipelines; 7 – vertical distribution head.

The sowing machine must create a uniform and continuous flow of seeds, ensure a stable sowing of the established norm regardless of the speed of the seeder, degree of filling, tilting, and vibrations of the box when moving across the field, not damaging the seeds. Sowing devices must be universal, simple in design and have reliable and convenient adjustment of the seeding rate.

It is established that the optimal diameter of the coil is  $d_k = 5 \text{ } 0''$ ,  $5 - 7 \text{ } 0''$  mm [6]. Taking  $d_k = 7 \text{ } 0''$  mm and the thickness of the dike between adjacent grooves  $\Delta b = 1.5$ mm, based on the known expressions [6] we get the number of grooves equal to 8 and the length of the coil  $L_c = 50$ mm. The remaining dimensions of the coil apparatus are taken constructively.

In pneumatic sowing systems high pressure centrifugal fans are used. The initial data for the selection of the fan are the air velocity at the outlet of the neck, the required mass of air supplied to the channel, and the total pressure that the fan must create. Having calculated these parameters [7], we determine the loss factor  $K_v$  and select the fan with the following design parameters [7] by the dimensionless characteristic of the fans: a blade wheel diameter of 300mm; internal diameter of a wheel is 102 mm; blade length 40mm; diameter of the outlet 150mm.

The diameter of the main material pipeline is assumed to be 63.5 mm [7], the dimensions of the distribution channel are  $21.5 * 21.5$  mm, and the diameter of the seed tube is 26 mm.

The analysis of the arrangement of the coulters and the size of the drill frame: AGROMASTER and Kuzbass (Russia), 424 Massey-Ferguson, USA, TC-3, CD-4 Hestair, Bamlett, Vel, Amazone (Germany), "Kuhn" (France), "Morris", "Bourgault" (Canada), "Great Plains", "John Deere", "Sunflower" (USA), "Dolbi", "Crucianelli" (Argentina) made it possible for us to choose the following planter frame scheme: a cultivator with a width of 8.25 m, consisting of three sections - the central and two side.

Cultivator with a width of 8.25 m, consisting of three sections: the central and two sides. All frame sizes are defined. The distance between the rows made up 550 mm and between the coulters in the rows is 700 mm. The length of the side section is 1976 mm and width is 1715 mm. The length of the central section is 3890 mm and the width is 1715 mm.

In the developing planter, the cultivator undercarriage has a width of 8.25 m and includes eight pneumatic support wheels, which make up four pairs. The hitch of a seeder-cultivator with a width of 8.25 m includes two side and two transverse beams and a tab.

From the analysis of the technological schemes of the packing organs of the seeders of the near and far abroad, the scheme of the packing organ, the wedge-shaped roller of the seeder was chosen. Wedge-shaped rollers using spacers are assembled on the shaft in the battery, two spacer rollers have bearing assemblies. The battery of rollers is installed in a frame that has a hinge for mounting the transport wheel and is attached to the main frame of the drill. The diameter of the roller is 550 mm, the width of the roller is 122 mm and the distance between them is 22.8 cm. The width of the battery is 2.05 m.

At present, a prototype model of the planter has been manufactured, which in laboratory tests showed high quality indicators: uniform distribution of seeds over the area and uniform depth of seed embedding that meets agrotechnical requirements presented to sowing machines.

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