SECTION 8. MECHANICAL ENGINEERING

8.1 Purpose and requirements for deep disintegration of local action

Modern laying of underground utilities by trenchless method allows to increase productivity, reduce during the stay of construction equipment in the areas of its laying, preserve the surface humus layer and in 3...5 times reduce the volume of earthworks.

Some linear – extended objects require the structuring of the soil in the zone of their laying.

Thus, the process of construction of material drainage requires loosening of the soil in the dirt zone, since effective operation of drainage systems is possible if there is a reliable hydraulic connection between the arable layer and the drainage tube. To do this, on reclamation systems, the development and processing of soils is carried out at several levels [379]. This is especially pronounced on soils of low water permeability with a filtration coefficient less than 0,3 m/day, where two-tier drainage systems are laid. In the latter, the main load falls on the drainage gaps.

The soil structure has a significant impact on the permeability of the gap.

The process of construction of material drainage requires effective loosening of the soil in the dirt zone, the permeability of which affects the efficiency of the drain. The underlying layers of soil due to technogenic influence are compacted, which leads to degradation of lands. One way to eliminate the consequences of this impact is loosening soils. In addition, the construction of thermohydraulic systems (in order to increase the efficiency of heat dissipation of the soil environment) requires thorough dusting of pipes, which is possible only with high-quality loosening of the soil in the area of their laying.

The accuracy of laying the drone is influenced by the method of stabilizing the position of pipes in the drainage line. This factor is of particular importance at a high level of groundwater standing. Here, under the influence of high water pressure in the dowry area, plastic pipes, especially those enclosed in a trenchless way without additional powder, can float. This is due to the fact that during the passage of the knife

working organ in the lower part of the gap, a free cavity is formed for a while, which is quickly filled with water. Therefore, in order to achieve high-quality fixation of pipes, laying drainage in a trenchless way requires immediate closure of the gap, which is possible if there is a well-loosened soil in the pristine zone. For normal operation of drainage pipes, their local altitude deviations from the longitudinal inclination should not exceed ± 0.02 m [379].

No less important problem is the disposal of heat waste of industrial enterprises, nuclear and thermal power plants and their use for the needs of agriculture [380]. This will increase the temperature of the fertile layer by 2...8°C and one to two weeks earlier start carrying out spring – field work. The complex thermohydrosystem is presented in Fig. 1, which includes a heating and drying - humidifying system. The main elements of the system are the underground grid block – modules of polyethylene pipelines. The depth of their laying – 0,6...0,7 m, the distance between pipelines 1,0...1,5 m.

When laying underground low pressure distribution pipelines (up to 1 MPa) it is advisable to use polyethylene pipes, which after laying must be sprinkled with soft soil 10...20 s [380].

Water erosion leads to significant losses of the fertile layer, productive moisture, fertilizers and pesticides. This not only brings losses to agriculture, but also pollutes the environment.

An effective measure of its prevention is the transfer of surface runoff water to the state of groundwater by the construction of an anti-erosion system, which is a moisture-accumulating gap formed by multi-tier tillage of the soil with its simultaneous ostructuring. In the underground horizon made mole, filled with filter material. Such a system is built in order to preserve the fertile layer of soil, the destruction and ostructuring of the heavy-water layer of soil in which the mole drone is laid, which is made in the form of a mesh shell that is filled with an organic filter material. This drain should be placed in an ostructured slit. In addition, to increase the moisture-accumulating properties of anti-erosion structures and drainage of excess water, the construction process should be carried out with the simultaneous laying of the moisture-accumulating drainage element to a depth of 0.6 m.

An important issue is also the reclamation of saline soils as underproductive agricultural lands. Their yield is 2-3 times lower compared to other lands that are under the same conditions, and in the years of drought – salt marshes practically do not yield. To eliminate this effect, stir together the salt and carbonate horizons with preservation on the surface of the fertile layer.

Effective solution of these problems will ensure local loosening of the soil, carried out simultaneously during the construction process.

Deep milling baking powders are a fundamentally new type of soil-developing organs. The term "deep milling disintegrants" in our time is an established concept and is used to define a family of tools, a distinctive feature of which is that their milling working body works in conditions of complete depth – under a layer of soil.

The effectiveness of the use of deep milling disintegrators in the anti-erosion cultivation of soils affected by wind and water erosion, as well as the reclamation of low-productive agricultural land, has been scientifically substantiated and confirmed by experiments in the operation of experimental samples.

The use of deep milling baking powders in meliorative works in comparison with other tools have excellent features that consist in the most technical process, difficult operating conditions of milling working bodies, in the inability to use traditional design solutions.

The peculiarity of reclamation robots with milling baking powders is more stringent agromechanical requirements for tools. Fully meet these requirements, especially, to the quality of grinding and mixing using other types of working bodies is much harder.

Of the large number of deep milling disintegrants, which differ from each other by the placement of the axis of the working body in space, the direction of its rotation, the type of milling machine, the type of milling cutters, which are included in the set, the shape of the base profile, constructive indicators, etc., existing classification schemes do not take into account the significant number of new varieties of deep milling machines that appeared in recent times.

The analysis of scientific literature [380-383] showed that today there are a number of technical solutions that are aimed at performing the operation of deep loosening of the soil during the construction of drainage in a trenchless way.

Now developed and produced a number of deep milling disintegrators [384], the working organ of which (Fig. 1) consists of a rotor with cutting elements - blades that are placed in two rows and have certain angles of cutting surfaces.

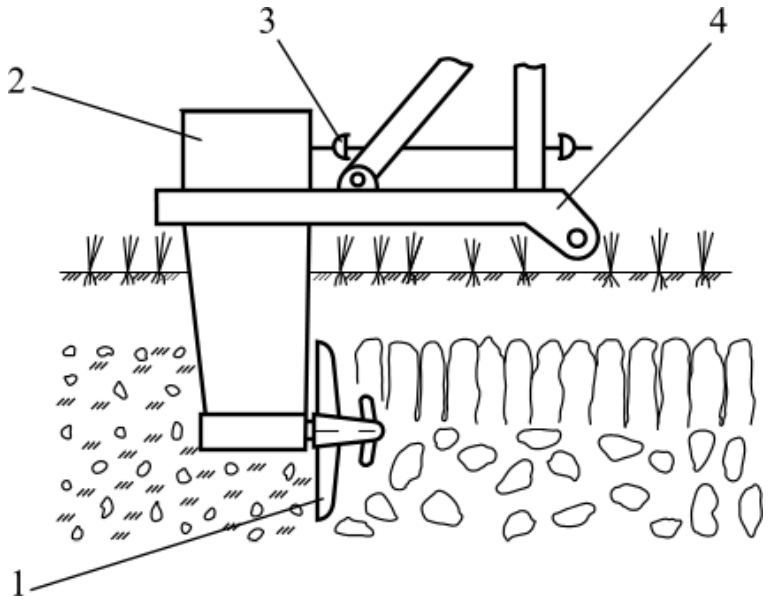

Figure 1. Milling baking powder:
1 – blades; 2 – than slit cutting; 3 – rotor drive; 4 – frame

The soil particles that fall on the rotor blades move in space. Thus, various soil horizons are mixed to create a soil horizon with averaged characteristics, and complete destruction of capillary bonds occurs.

The disadvantage of this baking powder is the need to bring the drive to the rotor with blades rotating in an aggressive environment, as well as significantly increases the metal capacity of the entire structure, complicates the structure and installation on a trenchless drain-layer, leads to additional power losses.

As a result of a thorough analysis of literary sources of information, it is concluded that the most appropriate modernization is:

1) the use of a special dryer design with destructive elements, which will have the following advantages: reduction of traction; increasing the reliability and durability of the working body during intensive use; improving the quality of tillage by forming a small-composite structure and increasing the moisture permeability of the soil, which is achieved by performing milling and slit cutting in the dimensions at which the product of the difference in the cross section of the body of the milling cutter and the projection of the knife and the cylindrical part of the mill with the coefficient of greater loosening is equal to the area of the cross section of the body of the rotation of the mill. This is quite significant because the loosening of the soil takes place in difficult conditions;

2) use as a working equipment standard hinge system according to the three-point scheme, which has the following advantages: the frame of the working equipment is connected to the slit cutting fingers-hinges, so that the slit can return to the 10... 12° from the longitudinal axis, in order to prevent breakdowns in minor turns of the base machine; at the bottom of the slit, a guide cone is installed, which serves to pre-forming the mole, which reduces the pressure on the cone of the cutter.

The proposed modernized deep milling baking powder provides the greatest porosity of the soil at the full rupture of capillary ties between layers of soil at the desired deep levels, shown in Figure 2 [380, 385].

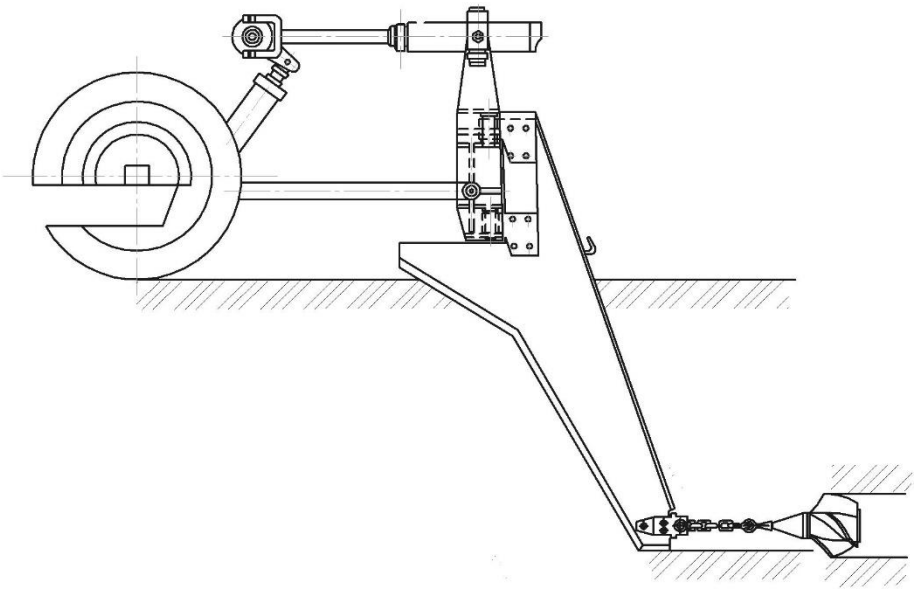

Figure 2. Upgraded deep milling baking powder

The baking powder consists of a tractor, on the standard nachipnogo system of which a frame is attached, which is designed for mounting on it working bodies, hydraulic cylinder of lifting of the working body, a depth indicator and a baking powder blocker.

The shape and parameters of slit cutters and cutters are selected depending on soil conditions and technological tasks.

The cutter consists of a 7 cylinder to which 6 destructive elements are rigidly attached, made in the form of a screw surface, the step of which increases in the direction of the opposite motion of the baking powder to the magnitude determined by the angle between the tangent at the initial and final point of the surface turning, the 2 cone to which the 1 fastening and the 3 traction shafts are attached (Fig. 3). The latter is installed in the 7 cylinder housing on two 5 radial-stop bearings. The cylindrical part of the cutter behind is closed with an 8 lid. To prevent soil from entering the middle of the cylinder, which in turn will lead to deterioration of the bearings, and as a consequence of the jamming of the working body, a rubber sealing ring 4 is installed between the cone and the cylinder.

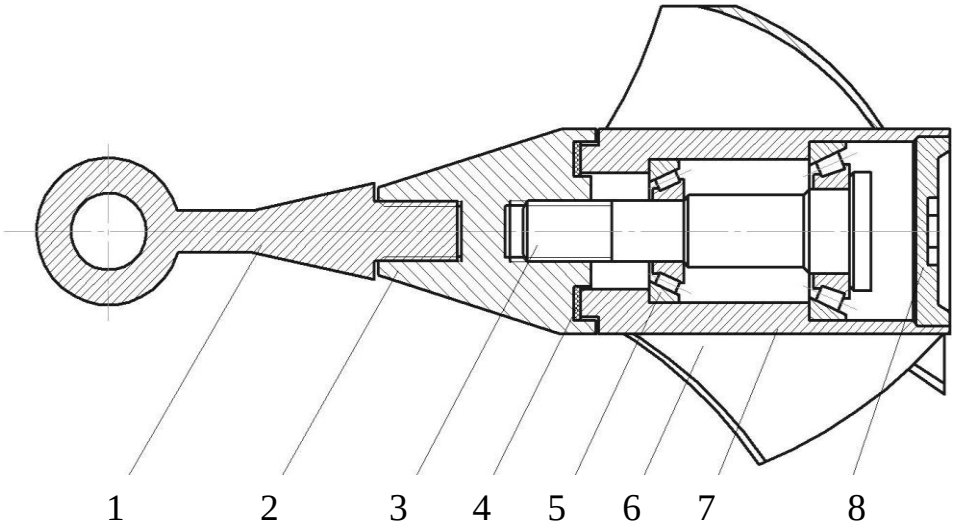

Figure 3. Baking powder mill

The following basic requirements should be set for local loosening of the soil:

1. Minimization of traction resistance of the machine engine.

2. The operating speeds of the base machine should not exceed 2 m/s.

3. Loosening the soil with the coefficient of bulk loosening of the 1,3...1,45 with its ostructuring, complete destruction of capillary bonds, leaving unchanged the properties of untreated soils.

Thus, during the execution of modern earthworks, including during construction, there is a need to create the design of a driverless deep baking powder of local action, which would be easy to manufacture and routine maintenance, mounted on the slit, loosened the soil by self-rotation under the influence of the transverse component of the resistance to displacement and met the requirements for construction.