TECHNICAL ANALYSIS OF THE DISK WORKING BODIES THAT WORK THE SOIL AND THEM WORKING BETWEEN THE GARDEN ROW

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Abstract*. The latter advantage becomes especially relevant when working in stony soils and not uprooted forest clearings. Disks with cutouts along the periphery are called "chamomile". Thus, the presence of structural elements in the form of asymmetric cutouts on the edge disk allows you to capture and fix the stems of vegetation in the soil, to ensure their cutting. Tines with convex-concave disks are fixed on front side of bars, throughout the entire width so as to define paired rows. Disks are positioned for rotation and adjusting an angle of attack. Pins of disks are inclined at an acute angle to ground plane which is closer to horizontal plane so that convex side is facing ground surface. In each subsequent row, disks are offset transverse to disks of previous row by value equal to quotient of division of distance between disks by number of rows.*

Keywords: *disk, structure, solid, furrow, soil, cutting, horizontal, lapy, row.*

ТЕХНИЧЕСКИЙ АНАЛИЗ ДИСКОВЫХ РАБОЧИХ ОРГАНОВ, ОБРАБАТЫВАЮЩИХ ПОЧВУ И МЕЖДУРЯДИЙ

Аннотация. *Последнее преимущество становится особенно актуальным при работе на каменистых почвах и не выкорчеванных лесных полянах. Диски с вырезами по периферии называются «ромашки». Так, наличие конструктивных элементов в виде асимметричных вырезов на краевом диске позволяет захватывать и фиксировать стебли растительности в почве, обеспечивать их срезание. Лапы с выпукло-вогнутыми дисками закреплены на передней стороне брусков по всей ширине так, чтобы образовать парные ряды. Диски расположены с возможностью вращения и регулировки угла атаки. Пальцы дисков наклонены под острым углом к плоскости земли, которая ближе к горизонтальной плоскости, так, чтобы выпуклая сторона была обращена к поверхности земли. В каждом последующем ряду диски смещены поперек дисков предыдущего ряда на величину, равную частному от деления расстояния между дисками на число рядов.*

Ключевые слова: *диск, конструкции, твердые, борозды, почва, резка, горизонтальный, лапы, ряду.*

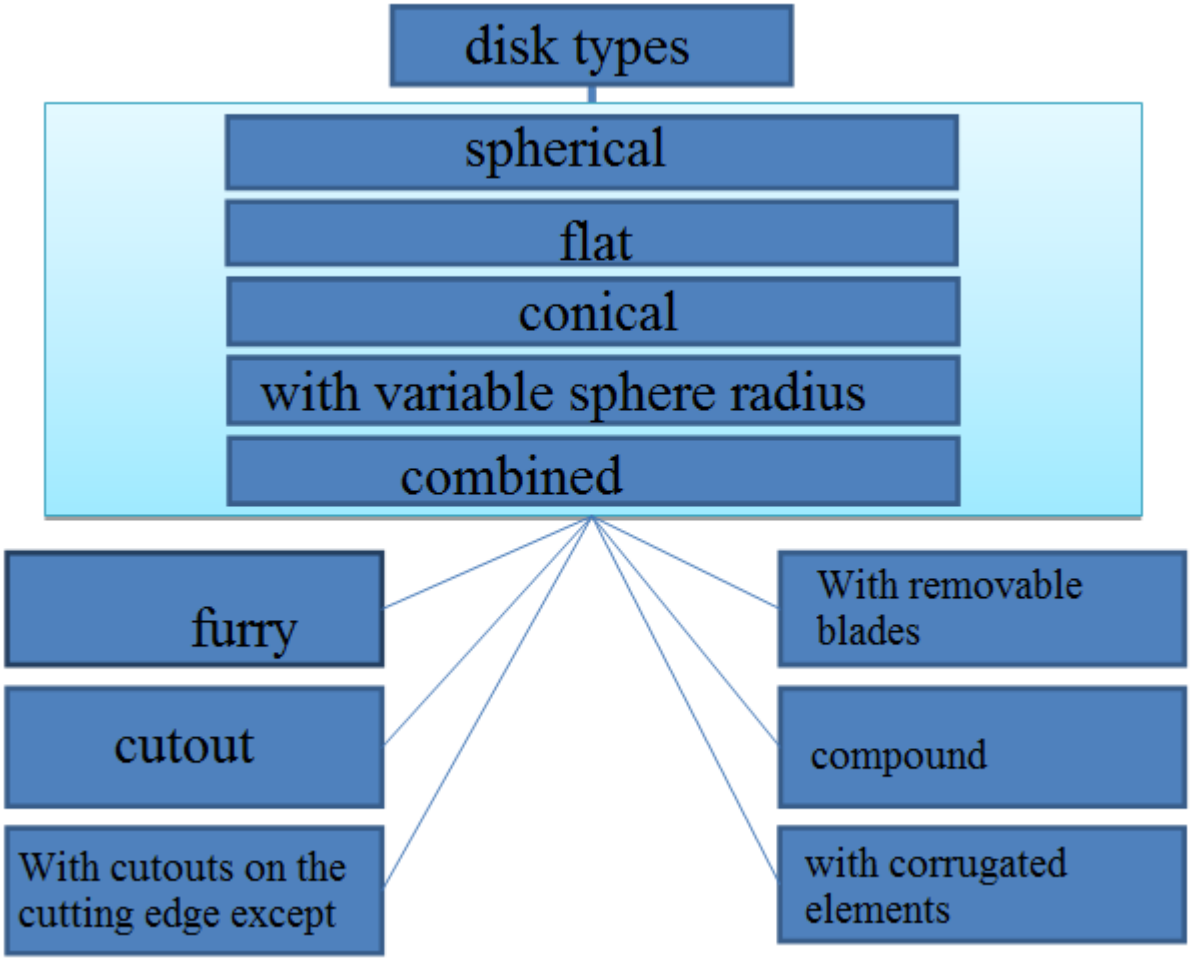
INTRODUCTION

Soil-cultivating tools with disc working bodies are widely used in both agriculture and forestry. This is due to the fact that the discs provide intensive cutting of plant residues located on the soil surface, have low clogging, provide intensive crumbling of the soil layer and high permeability in the presence of obstacles. The latter advantage becomes especially relevant when working in stony soils and not uprooted forest clearings. Fully high permeability of disk working bodies can be realized only with their elastic individual fastening to the implement frame, by means of safety mechanisms.

MATERIALS AND METHODS

However, when choosing disc working bodies for working in stony soils and unuprooted forest clearings, the following questions arise: what types of discs are best adapted to such conditions, what types of discs can be installed on individual racks, and what types of discs provide the required quality indicators. To do this, we analyze the designs of disk working bodies in order to identify the most acceptable options for equipping tools operated in such conditions.

We classify disk working bodies according to their type (Fig. 1).



Picture 1. Classification of disk working bodies of tillage implements

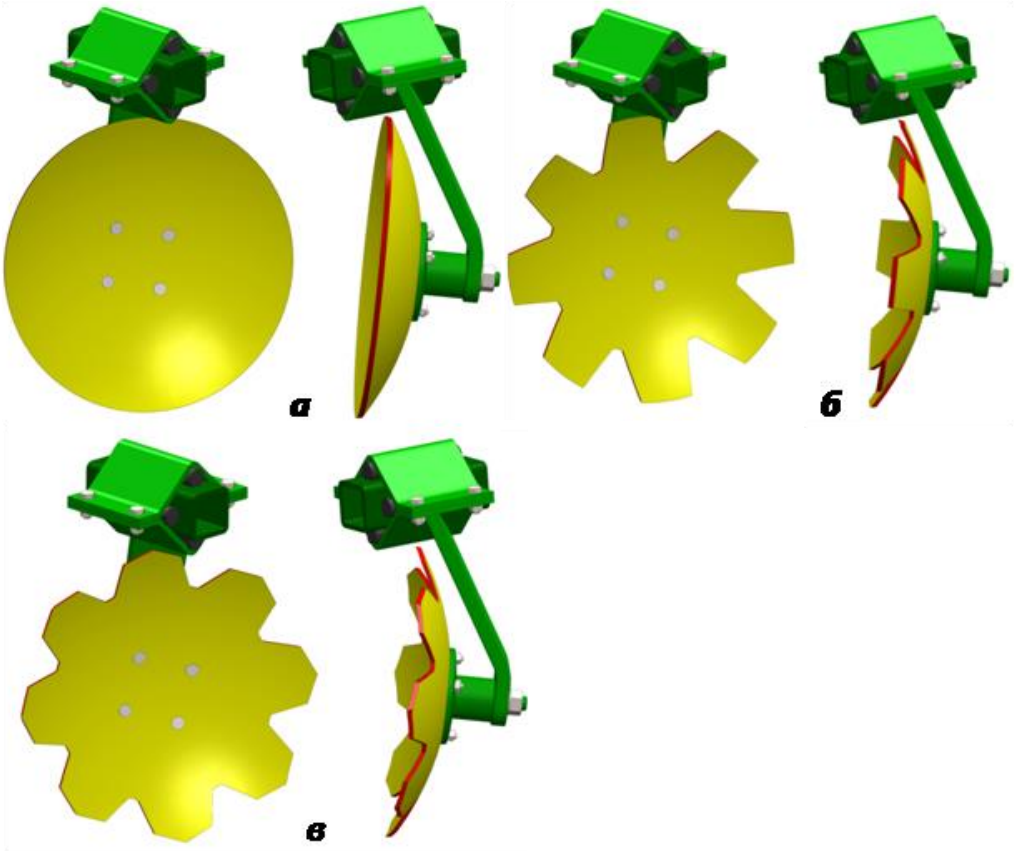
The most common and versatile type of discs are spherical discs. Consider the main options for their implementation.

Disks with a solid blade most completely cut through plant residues, but under certain conditions (increased moisture and depth of tillage) they clog more easily due to the appearance of the phenomenon of dragging with a loss of revolutions (Fig. 2, a).

Cut-out discs, even with relatively small diameters, more reliably capture plant stems and cut them or step over them, penetrate the soil more easily and are more constantly engaged with the dense bottom of the furrow, which helps to maintain disc revolutions and, therefore, eliminate the phenomenon of dragging and clogging of tools. soil and plant debris. The shape and size of disc cutouts are different depending on the operating conditions .

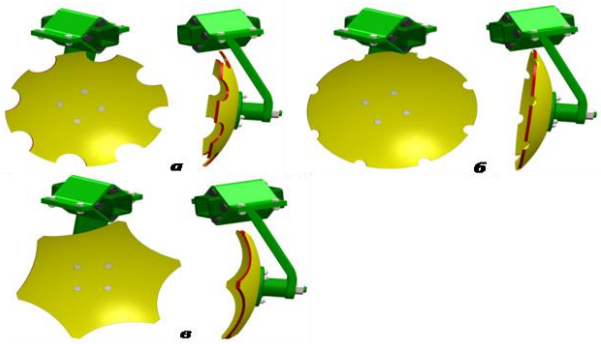
Disks with cutouts along the periphery are called "chamomile". The first discs of the "chamomile" type were installed on battery-type harrows BDT-7, BDT-3, etc. and had trapezoidal cutouts (Fig. 2, b).

A further development of the design of a disc with trapezoidal cuts along the cutting edge is a crowned disc (Fig. 2, c). Its geothermal provides deeper penetration into the soil and improves vegetation cutting by increasing slip [5].



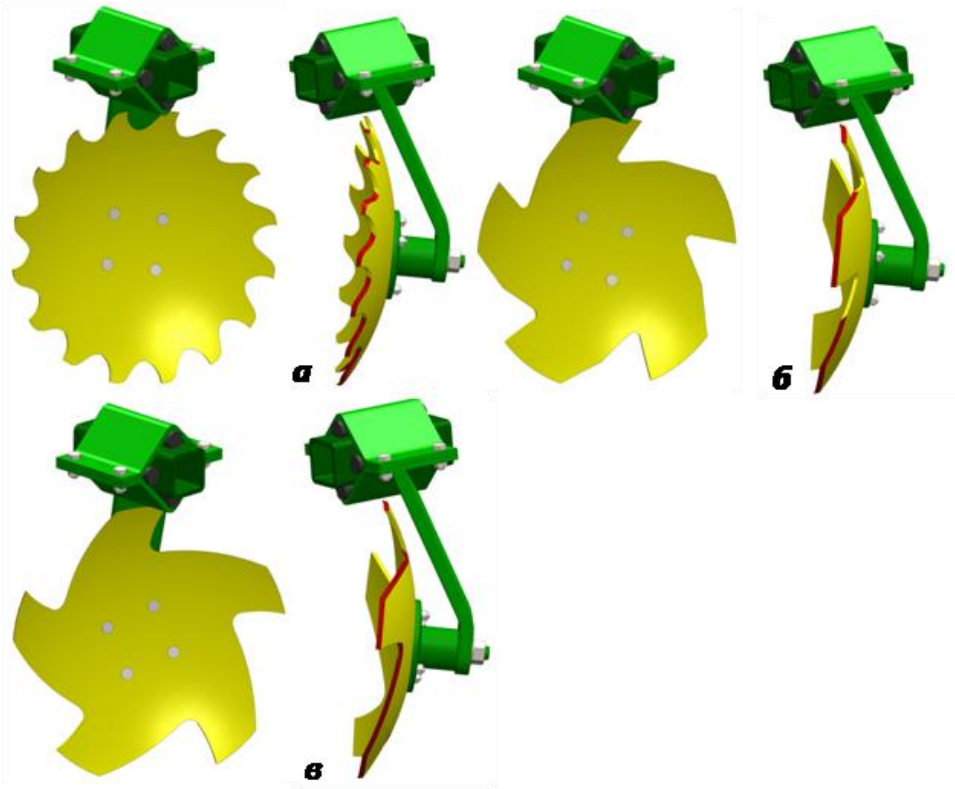
Picture 2. Spherical disks: a - with a smooth cutting edge; b - with trapezoidal cutouts; c - with crowned cutouts

Subsequently, discs with semicircular cutouts of various sizes appeared. Discs with cutouts of a larger size with a recess in the disc up to 40 ... 70 mm (Fig. 3, a) are designed to grind plant residues and provide more reliable adhesion to the soil. Notches on disks up to 30 mm deep (Fig. 3b) are designed to ensure more reliable disk rotation . Disks with a large cut-out radius (Fig. 3, c) provide a reliable capture of plant residues, but their cutting is carried out with a small slip, which increases the percentage of "stepping over" .



Picture 3. Spherical discs with semicircular cutouts along the cutting edge: a - with cutouts up to 70 mm deep; b - with cutouts up to 40 mm deep; c - with large diameter cutouts

In order to ensure more reliable rotation of the disc in accordance with the translational speed of the unit and cutting the stems of vegetation (herbaceous plants, young trees, etc.), the discs must have asymmetric cutouts that provide cutting with sliding (Fig. 4) . These disks have cutouts oriented towards the center of the disk, and one side of the cutout to its top is made radially in a straight line, the other part of the cutout, mating with the radius of the disk, forms a line that provides sliding cutting of plant stems falling into the cutout. Thus, the presence of structural elements in the form of asymmetric cutouts on the edge disk allows you to capture and fix the stems of vegetation in the soil, to ensure their cutting (Fig. 4, a) .



Picture 4. Spherical discs with asymmetric cutouts: a - with small cutouts; b - chopping disc; c - FLEO-FLEO disc

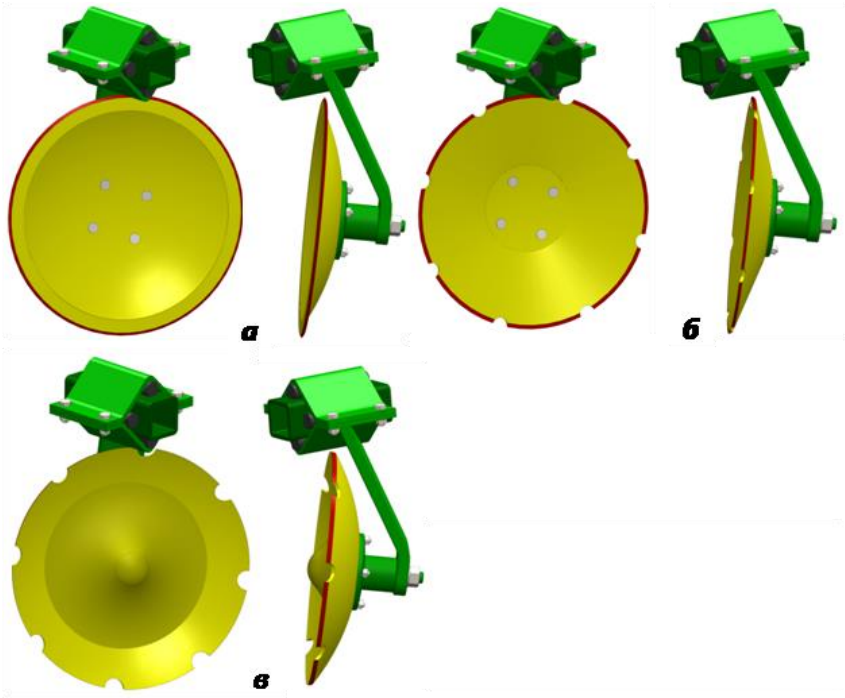
With such large cutouts, sickle-shaped discs for the BDT heavy harrow are made (Fig. 4, b) .

The design of the FLEO-FLEO discs by the Quivogne company is similar to those used for tilling the soil to a depth of 20 cm and crushing coarse crop residues and shrubs (Fig. 4, c) .

RESULTS

Let us consider several types of disks with a geometry different from a sphere. Disks with a flat cutting edge (Fig. 5, a) reduce the occipital pressure of the posterior surface of the disk on the furrow, which has a positive effect on the quality of work, but only at low angles of attack. A change in geometry leads to a complication of the manufacturing process and some decrease in strength .

Of interest are conical discs (Fig. 5b). They always maintain a working angle (the angle of inclination to the horizontal of the tangent to the surface of the disk) when worn. Such discs penetrate the soil easily, but crumble the soil poorly as the depthof its cultivation increases. Therefore, conical discs in combination with other working bodies with increased crumbling properties show good results. Discs with a diameter of 430 mm are widely used on Carrier disc harrows and in combined units from Vaderstad (Sweden), as well as on Qualidisk harrows from Kverneland Group with a diameter of 573 mm.



Picture 5. Discs with geometry other than a sphere:
a - with a flat cutting edge; b - conical; c - with a variable radius of the sphere

Another option to reduce the occipital pressure of the convex surface of the disk on the furrow with a simultaneous increase in the degree of crumbling of the soil is the use of disks with a sphere radius varying from the blade of the disk to its center (Fig. 5, c).In such a disk, on the inside, the peripheral part of the disk sphere in the area of maximum penetration into the soil is made along a large radius, and then decreases towards the center. At the same time, the outer surface of the sphere is made along a larger radius, which makes it possible to reduce the occipital pressure.

DISCUSSION

The use of such a design makes it possible to provide high quality indicators of tillage, but at the same time leads to a complication of the design and an increase in its weight .The use of discs of a similar design is aimed at solving the problem of high occipital pressure of the convex surface of the disc on the furrow at low angles of attack. However, with individual elastic fastening of the working bodies to the tool frame, significant angles of attack of 20 ... 35 ° are used to ensure the overlap of the working bodies, which in itself removes this problem. Large angles of attack are most characteristic of forestry tools, since, due to the specific conditions of use, the arrangement of working bodies in more than two rows is not used.

CONCLUSIONS

Based on the analysis of the designs of disk working bodies, it can be concluded that spherical disks will be the most suitable for implements with individual elastic fastening of working bodies to the frame, operated in difficult conditions of stony soils and clearings. At the same time, in the conditions of the predominance of grassy vegetation, it is rational to use discs with a solid blade and semicircular cutouts up to 30 mm deep, since they have high strength and simplicity of design. When it is necessary to suppress shrub vegetation and overgrowth of woody plants, discs with a crowned tooth shape and discs with an asymmetric cutout shape are most applicable, since they provide the most effective cutting of unwanted vegetation stems and ensure stable rotation of the spherical disc.

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