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HARROW WITH INDEPENDENT DISCS DESIGNED TO 120-220 HP TRACTORS

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Abstract: The harrow with independent discs performs a new mechanizing technology, which comprises the soil working operations through stubble ploughing and/or germinating bed preparing on fresh ploughed soil or non-ploughed soil where the summer-autumn crops are set. This technology can be applied in compliance with qualitative level suitable for agro-pedology requirements, at a reduced cost price and with little power consumption in comparison with classical harrows endowed with discs designed to wheeled tractors of 120-220 HP. The new technical equipment named GD-4 performs working depths of 6-8 cm for soil stubble and of 10-14 cm for germinating bed preparing on freshly ploughed or non-ploughed soil, the working width being of about 4m and the working capacity of approx.3ha/h.

Keywords: technical equipment, stubble ploughing and germinating bed preparation, independent discs, compact structure.

1. INTRODUCTION

About 37% out of agricultural surface is covered by soils with crops set during summer or autumn, the rest being represented by spring cultures. While for summer crops setting there are suitable agricultural equipment (combiners C26,C3.9, CPGC4, etc) , for preparing the soil to be sown, for those designed to summer-autumn crops setting the range of existing machinery is not satisfactory.

The sown plants or the plants on appropriate germinating bed develop better than plants which germinating bed is placed on clods, making difficult water's penetration . to plants roots (interrupting the capillarity)..At the present, the germinating bed preparation of summer-autumn tillage is performed by means of harrows with light discs (the most cases) designed at 65 HP tractors, with specialized hoeing machines or with heavy harrows, from abroad, aimed at big power tractors.

The germinating bed preparation with harrows with light discs has led to a high fuel consumption, manpower increase, working campaign period increment and an inappropriate germinating bed performed at a soil reduced humidity. Therefore, the aim is to manufacture a harrow endowed with (auxiliary) mincing discs and parts designed to big power tractors, in view of improving the technology above on freshly ploughed furrows where the summer-autumn crops are set. The soil works performed by heavy discs harrows have given good results in terms of soil mincing, mixing and displacing, carried out at low soil humidity. Constructively and functionally speaking the disc harrows have the advantage of easily passing over obstacles, and the active parts- as spherical discs present a low wear degree, as a result of the uniform distribution of strain on the whole blade length.

2 TECHNICAL REQUIREMENTS

2.1. Scope and constructive description

The harrow with independent discs GD-4 performs during a single pass:

- The stubble ploughing;
- The germinating bed preparation on freshly ploughed or unploughed field, where the summer-autumn crops are set for sowing straw cereals and hoeing plants at working depths within 10÷14 cm.

It is used in summer-autumn (sometimes in spring) on fresh furrows, on all types of soil, on flat or tilted fields (slope up to 6°). The ploughing must be harrowed as soon as it was were performed, because they becomes

harden, can not be minced and water losses by evaporation raise. The furrows are performed by means of disc harrows crossing the furrow direction, in order to level their crests.

It works in aggregate with wheeled tractors of 120-220HP equipped with braces and/or 3-rd category coupling bar SR ISO 730-1+C1 :2000;

The harrow with independent discs GD-4 is an agricultural trailed equipment or/and a equipment mounted on side rods (III-rd category SR ISO 730-1+C1 :2000) of wheeled tractors of 120-220 HP.



Fig.1 Side view of harrow GD4-working and transport position



Fig. 2 Rear view of harrow GD4- transport position



The harrow chassis comprises the bar and coupling hitch, a central frame and two lateral frames on which are mounted the disc set, the transport train and the rollers of soil mincing and levelling..

The traction system and the traction bar are performed as welded variant from square pipe and thick plate.. They are set on frame by means of bolts, washers and splints.. The harrow central frame is a welded structure made of rectangular shape square pipes; the rectangle is stiffed with consolidating plates. On lateral sides of the

frame are welded four bearings for setting the lateral frames and in central area are welded two bearings designed at transport train fastening.

The set of discs (front + rear) comprises a central semi-set and two lateral semi-sets, which are able to be swung open on vertical for transport position.. Each semi-set is fastened on each squared pipe by means of rubber flanges and rings. These sets comprise notched discs, ball bearings, fastening axle and supporting rod.. The discs have 660 mm external diameter and are manufactured of manganese sheet..

The harrow transport train is designed to ensure the harrow displacement on public roads and comprises a welded frame and two wheels with tyres.

The mincing and leveling roller is mounted behind the disc sets, aiming to grind , level and reset the soil worked by means of harrow's disc sets. For transport position the rollers vertically bend over till they frame within the transport size of 3 m.



2.2 OPERATION

The independent disc harrow **GD4** is an agricultural implement which processes the soil with spherical notched disc type parts, penetrating into the soil due to entering angle and traction force performed by driving tractor. During the work, the spherical discs carry out the cutting, mincing and mixing the processed soil mass, the surface soil layer loosening, the soil displacement and sometimes, even the furrow's overturning and vegetal remains burying. In comparison with other agricultural implements, the active part of disc harrows is driven into the soil as a result of friction forces appearing between soil and disc active surface. Therefore, during the working process between soil disc there is any relative movement and, thus, the soil deformation can be not produced by shearing, but the soil is simply lifted on the disc and let down by furrow' overturning..Therefore, during the working process there is not any relative movement between soil and disc, and in conclusion, the soil deformation does not produce by shearing, but simply the soil is lifted on the disc and after that let down by overturning. On the other hand, the soil particles submitted to disc action shall have different peripheral speeds (the soil particles peripheral speed increases from centre to disc edge), which lead to detachment, respectively to breaking soil particles then settled differently positioned one another. The two aspects above have led to a good mixture (which is more difficult to be performed by the active parts, acting on soil by shearing), but at the same time to irregular settling of furrows on soil. The processed soil is displaced by the working parts and then minced by the claw rollers.

2.3 CONSTRUCTIVE AND FUNCTIONAL CHARACTERISTICS

2.3.1. Dimensional and constructive characteristics

- Harrow type	trailed
- Necessary tractor, HP	120-220
- Working width, m	max.4
- Overall width in transport, m	3.0
- No. of discs	32
- Distance between discs, mm	220

2.3.2. Functional characteristics

- Working width, cm:	10 - 14
- Speed in transport, km/h	4 - 8

2.4. TESTS IN FIELD-LABORATORY AND EXPLOITATION CONDITIONS,

The tests in field-laboratory and exploitation conditions have been performed in aggregate with tractor ZIMBRU (T195), during July-October 2009, according to specific testing procedures PSpI-01.10.29 "Trial of disc harrows" and PSpI-01.00.33 "Determination of energetic indexes for agricultural aggregates".

For the tests performed in summer-autumn period the harrow with independent discs **GD-4**, figure 3, has carried out high qualitative works with appropriate qualitative working and energetic indexes.



Fig. 3. Aspect during the work with harrow with independent discs GD-4

The harrow with independent discs **GD-4** has shown a good stability in horizontal and vertical plane. The variation of working qualitative indexes with entering angle is presented in diagram of figure 4.

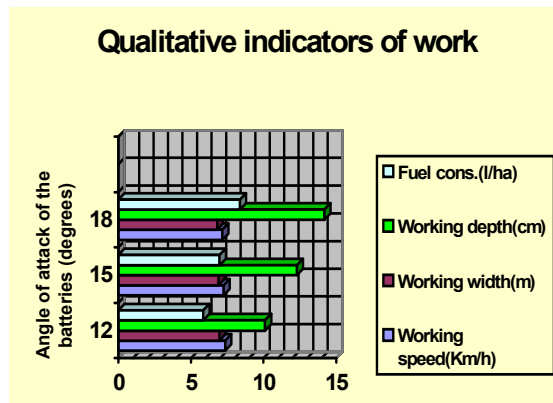


Fig. 4. Variation of qualitative index indicators with angle of attack

Soil mincing degree, G_m [%]

The main working qualitative index is given by **soil mincing degree**. In order to determine it a soil sample of 1m x 1m size has been taken (by using the metric frame and depth equal with harrow working depth). Soil fraction of less than 50 mm and more than 100 mm have been separated out of clods. The mincing degree represents the weight proportion of soil fractions of suitable mincing, respectively with clods dimensions of max.50 mm, in comparison with total mass of soil sample, calculated by the relation:

$$G_m = \frac{\sum_{i=1}^n \frac{M_{ci}}{M_{ti}}}{n} \cdot 100,$$

where: M_{ci} – measured weight of soil clods having the maximum conventional size of less than 50 mm out of soil sample, [kg];

M_{ti} – measured weight of the whole soil sample, [kg].

The weights have been performed with a portable balance, which relative admissible error is of de 1%.

The main performed working qualitative indexes and energetic indexes are :

- soil mincing degree	$G_{ms}=75.21...80.25\%$;
- degree of vegetal remains incorporating into soil	$G_v=95.23-96.61\%$;
- loosening degree	$G_{as}=20.15...26.27\%$;
-average working depth	$a_{med}=10.23...14.25$ cm ;
- average working width	$B_{med}=3.82...3.96$ cm ;
-working speed	$V_e=6.75...7.20$ km/h;
- working capacity for effective time	$W_{ef}=2.75...2.88$ ha/h;
- fuel consumption	$Q=7.32...8.49$ l/ha.
-coefficient of reliability	0.99
-hourly performant working capacity,	2.41 ha/h

3. CONCLUSIONS

As a result of data obtained during the tests, the following conclusions have been drawn:

- The harrow with independent discs **GD-4** for wheeled tractor of 120÷220HP has been conceived with two parallel sets and additional mincing parts with a working width of de 4 m;
- The harrow with independent discs **GD-4** is used in summer-autumn (in certain situations in spring) on freshly ploughed field of all types of soils on flat ground or slope field up to 6°
- GD-4 performs at a single passage:
 - Stubble ploughing;
 - Preparation of germinating bed on freshly ploughed or unploughed field, where the summer-autumn crops are set in order to sow straw cereals and hoeing plants at working depths within 10÷14 cm
- **GD-4** is este robust, simple in terms of structure and functionality, easy to manipulate and maintain and operate during the working process.;
- **GD-4** is of trailed or mounted type, the coupling operation being able to be performed by a single man (the operator);

- **GD-4** has achieved high quality works of high mincing degree of soil and vegetal remains burying. The coefficients of technical and technological safety have registered high values, avoiding, this way the time loss for remedying the operating disturbances.

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