**I. МАШИНОВИКОРИСТАННЯ У РОСЛИННИЦТВІ ТА ТВАРИННИЦТВІ**

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DEVELOPMENT OF MULCHERS BRANCH OF FRUIT TREES BETWEEN THE ROWS OF AN INTENSIVE GARDEN

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A constructive-technological scheme of a technical tool for shredding cut branches in the garden row spacing was developed. The promising direction of soil content in the inter-row spacing of the garden has been determined. These advantages of the mulching technology of maintaining pristvolny zones in the rows of an intensive garden: the accumulation and moisture content in the root zone of trees, enrichment with mineral and organic nutrients and accelerate the process of humification (reproduction of the fertile layer) without detriment to the environment. A hydraulic drive of the working units of the chopper-mulcher is proposed, which will make it possible to better grind the branches of fruit trees and send the chopped mass to the pristvolny zone of the garden for mulching.

Key words: intensive garden, aisle, branch, chopper-mulcher, hydraulic drive, hydraulic motor, rotor, than. Fig. 3. Ref. 10.

1. Introduction

Agricultural production requires a number of technological operations in a certain sequence, among which pruning of fruit trees plays a significant role [1]. Pruning is considered quite effective against the background of protective measures and agrotechnical methods of increasing the yield and quality of fruits. In the gardens after pruning, depending on age, density of planting trees, varieties, a large number of cut branches (up to 20 tons or more per 1 ha) remain. The wood is burned or pulled into the ravines and is thus removed from the circulation of substances, including the elements of the mineral nutrition of plants.

Cleaning and recycling of cut wood material in gardens are mandatory operations of the fruit production process. At the same time, they are associated with high material and labor costs caused by low levels of mechanization and low efficiency of the technologies used. Therefore, the development of resource-saving technologies and a complex of machines for gardening is the most important task, the complexity of the main work will be significantly shaken.

2. Formulation of the problem

In the gardens after pruning fruit trees, a large number of cut branches remain that clutter up the aisles and make it difficult to carry out further work on planting. The technological process of removing fruit trees from the rows of the garden is quite an energy-intensive operation. For the mechanization of these works, science and industry have proposed various technical means that significantly reduce manual labor, but do not completely eliminate it [2 – 5].

The existing practice of collecting (fig. 1, a) and burning wood (fig. 1, b) is associated with high costs of labor and funds, and the combustion products of the branches pose a threat of environmental pollution.

At the same time, harvesting cut branches in orchards is a mandatory operation of the fruit production process. It should be noted that the technology used for burning branches poses a threat to environmental pollution. Therefore, the problem of the rational use of alienable fruit wood becomes urgent.

The simplest, most rational and promising way of using cut branches in ground form for mulching the soil can be.

This contributes to the accumulation and preservation of moisture in the soil, enriching it with organic substances, mineral nutrients, improving the agrophysical properties and ultimately attracting alienated wood into the circulation of substances without detriment to the environment.



Domestic and foreign researchers note that the optimal size of particles used as mulch should be no more than 2 cm. Every 100 tons of ground mass can give groundwater 450 kg of nitrogen, more than 80 kg of phosphorus and about 500 kg of potassium [6].



a)



b)

**Fig. 1. Cleaning of cut branches in between rows of an intensive garden:
a) gathering between the rows of a garden, b) burning branches**

According to research data, the mulch introduced in the near-stem strip significantly reduces soil contamination near the shtambov trees. Pristvolnyh stripes showed a high effect as an alternative to the chemical method of weed control. When using mulch compared to herbicidal steam, the root system of apple trees covers a larger volume in the surface soil horizons, where microbiological processes are particularly active, as well as nutrients in sufficient quantities [6].

The main positive effect of mulching is manifested in greater stability of the soil macrostructure and better air permeability after heavy rains, as well as reduced water loss during evaporation from the soil surface during the dry season. Under the layer of mulch, productive moisture will accumulate in the soil [6].

Mulching has a positive effect on the overall physical properties of the soil (bulk density, specific gravity, duty cycle and air supply), increases soil moisture supply compared with herbicide vapor and laid down, especially in the 0-0.4 m horizon.

The use of mulch in pristvolnyh strip in intensive orchards and vineyards, due to the optimization of soil conditions, increases the yield by (19-36 %) and the average mass of fruits (by 7-17 %), as well as the growing season [6].

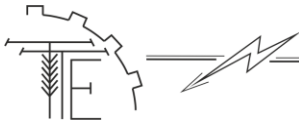
The lack of sufficient data on the processes of interaction between the working bodies of crushers with cut branches of fruit trees impedes the improvement of machines and their widespread introduction into production practice.

Therefore, the aim of the research is to develop a technical tool (shredder-mulcher) for shredding the cut branches of fruit trees and recommending a scientifically based, environmentally safe and economically viable agrotechnical method of using the wood of cut branches, for accumulating moisture and increasing soil fertility in gardens.

3. Key research results

To implement this technology of utilization of wood waste from gardening, the department of machinery and equipment for agricultural production of VNAU developed the design of a shredder-mulcher of cut branches of fruit trees (fig. 2) [5].

The shredder-mulcher for processing cut branches of fruit trees between the rows of the garden includes frame 1 with support wheels 2. The frame has three point hinged mechanism 3 for assembly with a tractor, bearing units 4, two vertical shafts 5 with rotors 6 in the form of rods with holes on cantilever ends, in which the hammer knives 7 are fastened with the help of fingers. At the lower ends of the shafts 5, fans 8 are fixed, the rotors and fans are driven by hydraulic motors 9, through the tractor's hydraulic system. Connecting the first hydraulic motor to the input, and the second to the output, provides rotation of the rotors towards each other, which creates a "pulling" mass effect of plant residues into the grinding chamber where



the mass is located until the particle sizes become such that they can escape through the lattice partition 10 or recter 11, which reduces potential material losses.

For intensification of the technological process in the grinding chamber, created by frame 1 and recteters 11, shear blades 12 are installed, which are fixed on frame 1. Direction of the crushed mass to the zone of rows of plants is carried out using air flow generated by fans 8, the grinding zone enters the grinding zone using feed the rotor 13 that rotating counterclockwise with flat fingers 14 delivers the trimmed branches into the grinding zone, where they are addicted to the rotors 6 and are ground to a given size.

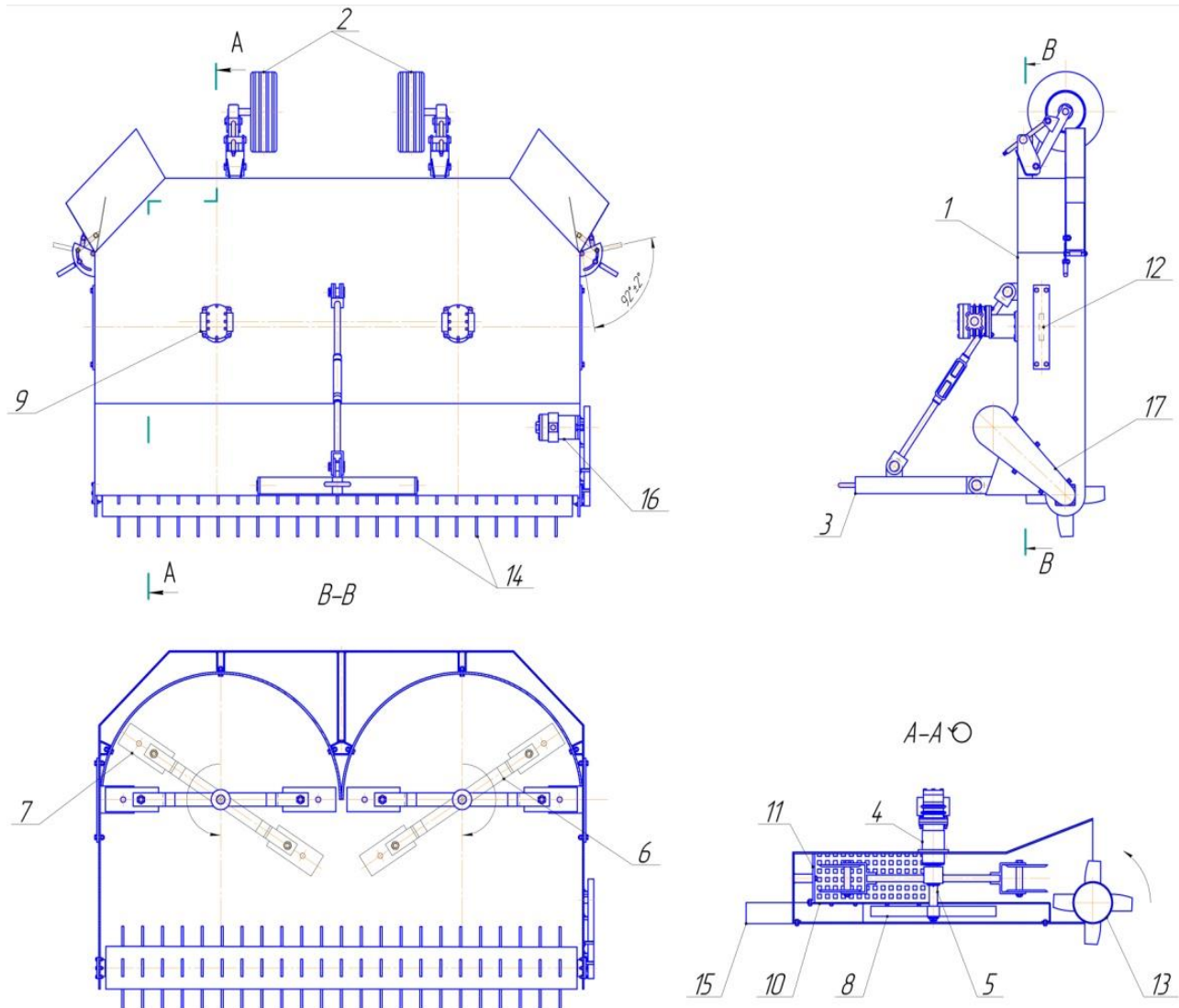


Fig. 2. Shredder-mulcher cut branches of fruit trees between the rows of an intensive garden

To remove the crushed particles from the unit where they are under the grinding zone, two shutters 15 are used, having the ability to adjust the angle of tilting of the crushed mass. The mass is removed by air flow, created by fans 8.

The shredder-mulcher of the branches of fruit trees in between the rows of an intensive garden works as a tractor mounted on a tractor when it moves along a roll with the remnants placed in the center of the aisle. During the movement of the unit, the feed rotor 13 rotates counterclockwise raises the branches of the swath fruit trees and feeds the mass into the capture zone by rotors 6, the high speed of rotation of the feed rotor provides full lifting of all branches, and the flat fingers with rounding 14 feed the mass without clogging. The drive of the feed rotor is carried out from the hydraulic motor 16 through the belt transfer 17. When rotating the rotors 6 towards each other, partial dissection takes place, the branches are seized and transferred to the chopping chamber before the shear blade 12, where the hammer blades 7 completely cut through the mass of the roll branches due to the shear knife action, the remains of the blades continue to



circulate in the closed grinding chamber until their size becomes equal to or smaller than the size of cells of the catheater 11 or lattice partition 10, after they have been crushed from the grinding zone, they fall into the lower part under the grinding zone $g e$ has two fan 8, which creates a constant air flow makes divided particles outwardly through outlet valve 15.

The shredder-mulcher of cut branches of fruit trees is equipped with a hydraulic drive of working bodies, in self-propelled machines providing a rational layout of active working bodies, the ability to use significant drive power with limited dimensions, effective protection of working bodies against overload.

In fig. 3 shows a schematic diagram of the hydraulic drive of the working parts of the chopper-mulcher, which ensures the operation of three hydraulic motors HM_1 , HM_2 , HM_3 from one hydraulic pump HP with a reversible flow of working fluid. Changing the direction of rotation of the motors is done by distributors D_1 and D_2 .

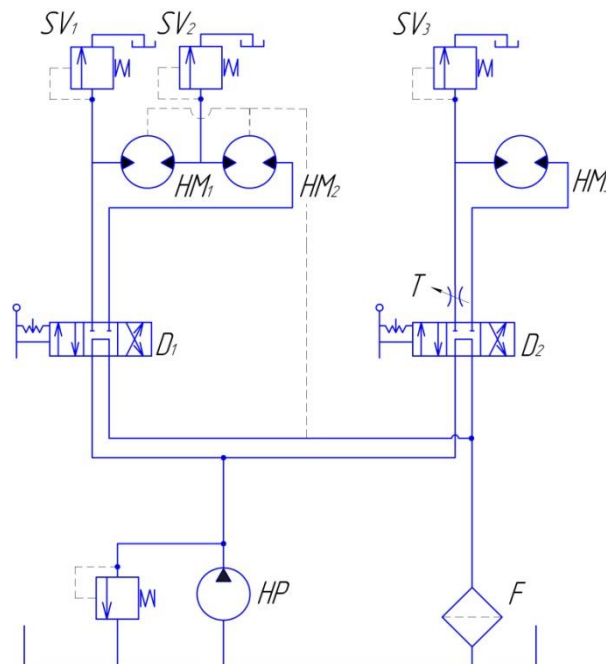


Fig. 3. Principle diagram of a hydraulic drive of working organs mulch

The safety valves SV_1 , SV_2 , SV_3 protect the hydraulic system from overloads. The presence of an adjustable choke T in the hydraulic line of the discharge, allows you to adjust the frequency of rotation of the feed rotor 13 (fig. 2) of the chopper-mulcher.

The use of the proposed shredder-mulcher for processing the cut branches of fruit trees in between the rows of an intensive garden will increase the efficiency of grinding the branches of fruit trees, reduce their losses, and increase the degree of their rational use.

4. Conclusion

For the further development of the horticulture industry, besides activating organizational, technological and economic factors, it is necessary to technically re-equip the industry with machines of a modern technical level, which will save energy, labor and financial resources, increase industry productivity and competitiveness of products. The introduction of modern technical means of mechanization of technological processes in the gardening technology will not only increase labor productivity, profitability of the industry, increase production and reduce production costs, but also make production attractive for highly qualified specialists and create conditions for securing labor resources in rural areas.

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РОЗРОБКА ПОДРІБНЮВАЧА-МУЛЬЧУВАЧА ДЛЯ ПЕРЕРОБКИ ЗРІЗАНИХ ГІЛОК ПЛОДОВИХ ДЕРЕВ У МІЖРЯДДЯХ ІНТЕНСИВНОГО САДУ

Розроблено конструктивно-технологічну схему технічного засобу для подрібнення зрізаних гілок у міжрядді саду. Визначено перспективний напрям утримання ґрунту в міжряддях саду. Зазначені переваги мульчуючої технології утримання пристовбурових зон в міжряддях інтенсивного саду: накопичення та утримання вологи у кореневій зоні дерев, збагаченням мінеральними та органічними елементами живлення та прискорення процесу гуміфікації (відтворення родючого шару) без шкоди для екології. Запропоновано гідравлічний привод робочих органів подрібнювача-мульчувача, що дозволить більш якісно подрібнити гілля плодкових дерев та направити подрібнену масу у пристовбурову зону саду для мульчування.

Ключові слова: інтенсивний сад, міжряддя, гілка, подрібнювач-мульчувач, гідропривод, гідромотор, ротор, ніж.

Рис. 3. Літ. 10.

РАЗРАБОТКА ИЗМЕЛЬЧИТЕЛЯ-МУЛЬЧИРОВАТЕЛЯ ДЛЯ ПЕРЕРАБОТКИ СРЕЗАННЫХ ВЕТВЕЙ ПЛОДОВЫХ ДЕРЕВЬЕВ У МЕЖДУРЯДЬЕВ ИНТЕНСИВНОГО САДА

Разработано конструктивно-технологическую схему технического средства для измельчения срезанных ветвей в междурядье сада. Определено перспективное направление содержания почвы в междурядьях сада. Указано преимущество мульчирующей технологии содержания приствольных зон в междурядьях интенсивного сада: накопление и содержание влаги в корневой зоне деревьев, обогащением минеральными и органическими элементами питания и ускорения процесса гумификации (воспроизведение плодородного слоя) без ущерба для экологии. Предложено гидравлический привод рабочих органов измельчителя-мульчирователя, что позволит более качественно измельчить ветви плодовых деревьев и направить измельченную массу в приствольных зону сада для мульчирования.

Ключевые слова: интенсивный сад, междурядье, ветка, измельчитель-мульчирователь, гидропривод, гидромотор, ротор, нож.

Рис. 3. Лит. 10.

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