JUSTIFICATION OF THE IMPULSE DRIVE OF AIR BREAKERS OF PROGRESSIVE DESIGNS OF ENGINEERING MACHINES

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Abstract: *one of the most promising and developing directions for creating means of mechanizing the development of hard soils in confined conditions is the equipping of engineering machines, in particular, hydraulic single-bucket excavators, with replaceable working bodies that ensure the direct development of such soils without preliminary loosening.*
The article discusses the advantages and disadvantages of hydraulic and pneumatic percussion units equipped with buckets of active action of excavator backhoes, as well as the requirements for impulse drives of these machines.
Keywords: *bucket of active action, pulse drive, strong soil, increased strength, active action, work, dynamic action, soil development, number of teeth.*

ОБОСНОВАНИЕ ИМПУЛЬСНОГО ПРИВОДА ПНЕВМОМОЛОТОВ ПРОГРЕССИВНЫХ КОНСТРУКЦИЙ ИНЖЕНЕРНЫХ МАШИН

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Аннотация: *одним из наиболее перспективных и развивающихся направлений создания средств механизации разработки твердых грунтов в стесненных условиях является оснащение инженерных машин, в частности гидравлических одноковшовых экскаваторов, сменными рабочими органами, обеспечивающими непосредственную разработку таких почв без предварительного рыхления.*
В статье рассматриваются преимущества и недостатки гидравлических и пневматических ударных блоков, оснащенных ковшей активного действия обратных лопат экскаватора, а также требований к импульсным приводам этих машин.
Ключевые слова: *ковш активного действия, импульсный привод, прочный грунт повышенная прочность, активное действие, работа, динамическое действие, разработка грунтов, число зубьев*.

One of the most promising and developing directions in the creation of mechanization tools for the development of solid soils in confined conditions is the equipping of engineering machines, in particular, hydraulic single-bucket excavators, with replaceable working bodies that ensure the direct development of such soils without preliminary loosening [1].

The creation of replaceable working bodies for single-bucket hydraulic excavators contributes to an increase

in the area of their efficiency and to an increase in the productivity of these machines in certain types of work. The use of a special replaceable working body for each type of work makes it possible to better use the energy resources and weight parameters of the machine, to more fully mechanize the performance of a number of works. Specialization of machinery and equipment, bringing into more complete compliance with the used technique and the specifics of construction conditions are important factors in the intensification of construction production [2].

The most fully meet the requirements for the working bodies of an excavator for the development of high-strength soils, is the equipment of buckets of active action of back shovels.

The preference for one or the other of the competing types of impulse exciters for active action buckets of hydraulic excavators requires appropriate justifications, and first of all, an assessment of the advantages and disadvantages of their energy carriers in specific designs of shock blocks.

The compressed air used in pneumatic impact blocks has the following advantages: it is elastic; transmits vibrations and pressures quickly enough; not deficient; successfully used in dusty and humid environments, at high and low temperatures; safe in its properties for workers; transported over considerable distances.

Liquid working fluids are used with high working parameters (pressure), and therefore the energy contained in a unit volume of this energy carrier is much higher than that of compressed air. The efficiency of the hydraulic drive is also significantly higher. The liquid is practically incompressible, it transfers vibrations and pressures quickly enough. The use of hydraulics makes it possible to vary the energy and frequency of hammer blows within a fairly wide range.

Along with this, both considered working fluids (air and oil) have a number of disadvantages. The pneumatic actuator has a low efficiency and transfers, at operating parameters per unit volume, less energy than a liquid. When transporting compressed air over long distances, large losses in the distribution network are inevitable.

Liquid working fluids require special production and availability in the workplace in sufficient quantities. Liquids do not always work reliably and are not comfortable enough at high and low temperatures, in dusty environments; often unsafe in its properties for workers; heat up during operation; the pressures generated by them are not transmitted over long distances.

From the general analysis carried out, it is difficult to give preference to one of the considered working bodies. In this regard, it is necessary to qualitatively compare the impact blocks themselves, used to drive the working bodies of the active action of excavators.

One of the important advantages of pneumatic impact blocks is the reduced recoil and "soft" nature of the work (due to the presence of an air cushion), which allows the use of basic excavators of lower power. Operation at relatively low pressures does not require special seals, and sometimes even allows them to be eliminated in the main moving parts, which undoubtedly contributes to the reliability, durability and lower cost of pneumatic impact devices. An important factor is the simplicity of the device, which does not require highly qualified personnel for maintenance and repair. Along with the advantages of pneumatic impact devices, they also have disadvantages, the most significant of which is the need for a compressor, a system for supplying compressed air and a decrease in mobility in this regard. The range of energy and frequency adjustment of pneumatic impact devices is much worse than that of hydraulic hammers. Hydraulic impact units, when attached to hydraulic excavators, allow for highly mobile installations. The absence of a compressor and compressed air exhaust reduces the noise level in the environment. Due to the possibility of varying the energy and frequency of blows of hydraulic hammers, it is easier to adapt them to the required parameters of the destruction mode.

For normal operation of the hammer, the existing hydraulic system of the base machine must have certain parameters, which often do not coincide with the required ones. This entails overheating of the oil, a decrease in the power of the hammers and, in practice, often requires the use of a special additional hydraulic system.

Hydraulic hammers are characterized by a significant value and rigidity of recoil during the reverse stroke of the striker, in connection with which it is necessary to use a basic machine of high weight and cost. With the same impact energy as a pneumatic hammer, the base machine for a hydraulic hammer should usually be 1-2 sizes larger.

In the event of a malfunction of the hydropercussion blocks, the laboriousness of their repair and the average time for it are high. According to foreign firms, most of the malfunctions cannot be eliminated by the personnel operating the machines, but require the involvement of the company's employees - the manufacture of hydraulic hammers. The cost of the current repair of hydraulic breakers can reach 35-40% of their initial cost per year. It should be added that hydraulic shock devices are structurally and technologically much more complicated than pneumatic ones [3].

The analysis of the technical indicators of hydraulic and pneumatic percussion units carried out by the researcher [3] shows that the value of the impact power, for the bulk of both hydraulic and pneumatic hammers, ranges from 5-15 kW. Taking into account that the impact energy introduced into the destroyed object characterizes the productivity of the crushing process, then, according to this indicator, the types of impact blocks under consideration are practically equivalent.

The efficiency of pneumatic impact blocks ranges from 7-25%, and its average value is 11%. The efficiency

value for hydropercussion blocks ranges from 14-69% with an average value of 42%. Таким образом, КПД гидравлических ударных блоков в среднем почти в 4 раза выше, чем пневматических.

As an indicator of the structural perfection of impact blocks, the amount of impact energy per unit of their mass is taken. The value of this indicator for pneumatic shock blocks ranges from 2.0-4.0, for hydropercussion blocks 1.7-4.45 J / kg, i.e., practically the same, with equal impact power, hydraulic breakers are heavier than pneumatic ones by an average of 22% due to a relatively lower frequency of impacts.

The design parameters of excavator buckets also pose a number of limitations and requirements for impulse drives. They limit the overall dimensions and weight of impulse drives and require maximum values of impact energy and power per unit mass of impulse drives.

Thus, taking into account these restrictions and requirements indicates the advisability of using progressive designs as an impulse drive for pneumatic hammers, including in active buckets for hydraulic excavators.

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