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Perspective construction of hydraulic impact device

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Abstract

Article describes a design and the principle of operation of the hydraulic impact device, with automatic control for a new operating mode, depending on loading on the working tool. The idea is based on the analysis of various schemes of management of hydraulic hammers taking into account requirements for their control and regulation for various industries. Article contains the general description of structural and hydro- kinematical schemes of a hydraulic hammer with automatic control of frequency of influences depending on loading on the working tool. The objectives have to be achieved by introduction of the regulator of a stream of working liquid in the control unit. The main element of such regulator has to be connected with the shock block on the special channel. It will provide rotation of the internal valve with various speed depending on loading on the working tool of the shock block.

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Introduction

Breaking of rocks of increased rock hardness ($\sigma \geq 60$ MPa) with mechanical impact was recognized as one of the most promising directions when developing machinery, providing given performance at the lowest energy consumption during mine workings in complicated mining and geological conditions.

In present-day hydraulic actuator of mining machines the mechanical impacts is implemented, using hydraulic devices of impact action (hydraulic hammers and hydraulic air hammers). At present time such devices are sufficiently mastered, including the issues of identifying of structural dimensions and output parameters that allows

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inferring about the prospectivity of their applications in the mining machines and in particular in narrow mine workings. To do this, compact hydraulic hammers with under metal consumption and high impact capability. The last condition allows usage of them in operating devices of tunneling machines, for the purpose to extend the scope of their application according to the rock hardness. However, we know that the load on the work tool of operating devices of tunneling machines varies in wide range. This is stipulated by the flow chart of bottom hole processing with operating device, the variation of the thickness of the separated layer of rock (strip) in the course of one revolution of the work disk, frequency of contact of work tool with solid mass, anisotropic structure of the rock, the alternation of the tool operation in the mode of fine crushing of rock and fracture of chunks [1-3].

So, the specificity of hydraulic hammer operation as a part of group of hammers, with which the operating device of the tunneling machine equipped, is that its impact capability shall vary in wide range, depending on the load on the work tool, in what connection this process shall occur in automatic mode. However, the existing basic diagrams of hydraulic hammers do not allow varying the impact frequency in wide range and consequently impact capability, and the main thing changing the one depending on the load on work tool.

As a result of operating experience of production machines with impact-shearing operating device the following wide field of their application was determined: mining one (construction, expansion and scalling of mine workings, crushing of boulders, access ways in open-cut mining); metallurgical one (slag cleaning, moving of old lining of converters in hot state); construction one (destruction of the coatings at reconstruction of highways, airfields, as well as brick and concrete at demolition of buildings), and other industries.

Domestic and foreign specialists have developed dozens of models of production machines of impact action. The result is that the nomenclature of special-purpose and multiple-function machines that corresponds to a wide range of their applications was formed.

On the basis of carried out analysis and comparison of parameters of hydraulic hammers, developed by foreign and domestic companies and organizations it was established the following:

1. The defining trend in both design and construction of impulse mining technique is the development of parametric series of hydraulic hammers on the basis of energy-saving hydro-kinematical schemes.

2. The overwhelming number of hammers was created on the basis of hydro- kinematical scheme with controllable chamber of operational stroke with differential actuation of anvil block and the switching of the power distributor according to position of anvil block.

3. Output parameters of hydraulic hammers, agreed with technological application, therefore they are distributed in wide range according to energy from 120 J (manual air hammers and rock drilling machines) to 10,000 J and impacts frequency from 8 to 3000, per minute.

4. Parametric series hydraulic hammers of number of foreign companies cover the range of the energy of one impact from 140 to 9000 J.

5. Specific Gravity (metal consumption), of the most of the reviewed models is from 0.3 to 0.45 kg/J.

6. The performance factor of present-day hydraulic hammers is 0.6 ... 0.7, and at the presence of a stabilizing system - is up to 0.8.

7. Power of 40% of hydraulic hammers is less than 10 kW, thus at the individual models reaches up to 40 kW.

8. Energy density in work tool mainly is kept in the range of 0.12 ... 0.3 J/mm^2;

Purpose of Research

The issues of varying of both frequency and impact energy are solved in the construction of various manufacturers. It is achieved due to changing of parameters of the power-plant. However, the possibility of automatic regulation of impact frequency, depending on the load on work tool as a result of internal processes that occur at hydraulic impulse system, has not been implemented in known constructions of hydraulic hammers [4-10].

On the basis of analysis of various control schemes of hydraulic hammers the requirements for systems with their control and regulation for various fields of application were formulated; structural (fig. 1) and principal (fig. 2) scheme of hydraulic hammer with automatic regulation of impacts frequency depending on the load on work tool was developed.