

ABSTRACT

Dissertational work on the topic: «**Investigating the prospects of applying a new design cam-screw press in industry**» submitted for the degree of Doctor of Philosophy (PhD) in the specialty **6D071200 – «Mechanical engineering»**
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Relevance of the research topic.

A new type of mechanical press is presented in the dissertation. The main mechanism of the new press is the cam-screw mechanism. Press equipment is widely used in all engineering industries. Crank presses are the most common equipment in production. However, crank presses have several disadvantages. Disadvantages of crank presses: increased probability of jamming, low efficiency, quick wear of the press clutch. The new cam-screw press presented in the dissertation will allow replacing obsolete presses in the country's enterprises, since it does not have the drawbacks of the crank presses indicated above. The work is of high relevance, as it has a number of advantages compared to crank presses, such as:

1. The wear resistance of the tool is increased;
2. The total height of the press is reduced;
3. Significantly reduced the likelihood of jamming;
4. Improved reliability of stopping the press at the end of the cycle;
5. The dynamic forces on the clutch are reduced.

Assessment of the current state of the scientific and technical problem (task) to be solved

The topic of the dissertation “Investigating the prospects of applying a new design cam-screw press in industry” into production corresponds to the State program of industrial and innovative development of the Republic of Kazakhstan for 2015-2019, the purpose of which is to increase the competitiveness of the manufacturing industry.

One of the main industries is mechanical engineering, which has a share of almost 35% of all products. The level of development of mechanical engineering determines the level of scientific and technological progress (STP) in all sectors of the national economy. Mechanical engineering makes it possible to provide all sectors with machines, technological equipment and devices. Machine tool industry is the main branch of mechanical engineering, which determines the scientific and technical progress in the modern world and requires highly qualified specialists, and mainly developed industry in the country. Forging and stamping equipment is part of the machine tool industry. Serial and mass production of shaped parts and blanks is necessary for all branches of engineering, as they have high mechanical properties and insignificant loss of materials and have a high cost.

Despite the long history, the work of thousands of scientists in this field, the press equipment has problems, especially the crank press. A study of the technical literature showed that the existing research in the field of designing press equipment is carried out mainly in the direction of improving the existing types, attempts are made to correct existing shortcomings, without changing the basic circuit diagram of the mechanism.

The task was to create a fundamentally new scheme of a mechanical press, since further attempts to improve existing press designs are unpromising. A fundamentally new design of a mechanical press is proposed, which surpasses in many respects the types of presses existing and used in production.

The dissertation is aimed at studying the technological capabilities of a new type of mechanical press - a cam-screw press and the prospects for introduction into production.

The basis and initial data for the development of the topic

The basis for the development of the topic of the dissertation is to study the technological capabilities of the cam-screw press for use in the processing of materials by pressure as a replacement for crank presses.

The following data were chosen as the initial data for the development of the research topic: a cam screw press manufactured at the Massaget-Plus engineering plant, the city of Almaty.

Rationale for the need for research work

Continuing to improve the design of presses with a lever mechanism is not advisable, since crank presses have the following disadvantages: increased likelihood of jamming, low efficiency, rapid wear of the press clutch. The German industrial dynasty “Krupp”, the Japanese company “AIDA engineering”, the German company “Schuler Group” and other CIS organizations are engaged in improving the design of the crank press, but still have not been able to achieve a significant result.

It was proposed that the shaft rotate at a variable speed to increase working time, but this reduces the efficiency of the press, since the inertial rotation of the flywheel is reduced. It was also proposed to improve and create a new coupling design, but such a proposal does not solve the main disadvantages of the crank press. In order to increase the efficiency of the crank press, designs with a mechanism of six or more links were created, but this solution significantly complicates the design of the press, thereby increasing its cost significantly. The use of a variable structure in the design of the press helps to solve the coupling problem, but the other main disadvantages of the crank press remain relevant.

In connection with the foregoing, studies aimed at improving the performance of forging equipment are necessary for conducting research work.

Information about the planned scientific and technical level of development, patent research and conclusions from them are determined by the completeness of the patent search carried out in the literature review on the operation of forge-and-press equipment, development and selection of modern research methods, system organization and conduct of experiments.

Based on the analysis of patent information available, the effectiveness of using new technological and technical solutions by methods for improving the technical characteristics of presses is considered. The dissertation presents the results of a scientific analysis of the current state of scientific and technical problems and patent research in the field of pressure processing of materials.

Information about the metrological support of the dissertation

Studies on the topic of the dissertation were conducted on the basis of Massaget Plus LLP (Almaty, Republic of Kazakhstan) and on the basis of the Technological University named after Georg Agricola (Bochum, Federal Republic of Germany) during a foreign internship.

The scientific novelty of the topic is as follows:

- a mathematical model of the cam-screw mechanism has been developed;
- algorithms for the power calculation of a cam-screw press are received taking into account various nominal efforts;
- The optimal technical and design parameters of a cam screw press with a force of 60 and 400 KN were determined

The aim of the work is to increase efficiency in the processing of metals (materials) by pressure by creating and introducing a new design of a cam screw press.

Object of research

The object of research is a new type of mechanical press - cam screw press.

Subject of study.

Factors affecting the prospects for introducing a new design of cam-screw press into production

Research objectives, their place in the implementation of research work in general

- to analyze existing presses used in the processing of materials by pressure;
- the rationale for the introduction of a cam screw press into production;
- to develop a mathematical model of the cam-screw mechanism, taking into account the design parameters and determine its permissible normal voltage;
- experimental studies of the new design of a cam screw press;

Each individual task presented above and solved in this dissertation is logically connected with other tasks among themselves and is aimed at achieving the goal of the work.

Research Methodological Base

The research methods used in this work are based on the principles of such sciences as mechanical engineering technology, mathematical modeling, theory of mechanisms and machines, the basics of part design and the theory of elastic-plastic deformation.

Provisions for the defense

- The original design of a cam screw press;
- methodology for calculating the structural and operational parameters of the new design of the cam-screw press;
- a developed mathematical model of a cam-screw mechanism, taking into account design parameters.

Approbation of work and publication

The main results of the dissertation were published in 8 publications, including 4 articles in journals recommended by the Committee for Control of Education and Science of the Ministry of Education and Science of the Republic of Kazakhstan; 3 publications at international conferences, 2 of which are foreign, of which 1 article is in the Web of science core collection database; 1 article in the scientific journal that is part of the Scopus database.

Structure and scope of work.

The dissertational work consists of an introduction, four sections and conclusion set out on 98 pages, contains 49 figures, 4 tables, 62 sources used and 2 appendices