ANNOTATION

dissertation work of doctoral student Bekbosynova Baglan Asylkhanovna on the topic: "Development of a rational design of a continuous screw mill for pressing long-length press products", submitted for the degree

of Doctor of Philosophy (PhD) in the specialty
6D071200 – Mechanical engineering

Assessment of the current state of the solved scientific and technical problem. Currently, when obtaining profiles of small cross-sections from aluminum and copper alloys, along with traditional technologies, especially for small industries, technologies of continuous conformal pressing, extralling, linex and continuous casting, rolling, pressing are used. Modular equipment for such productions is characterized by high mobility, flexibility of transition from one type of product to another, as well as relatively high productivity. Therefore, it can be concluded that the improvement of these technologies is a promising direction for the development of rolling, pressing and drawing processes. The development of industry and technology leads to an increase in the production of technological equipment, for the production of which profile products and blanks are massively required, such as balls, rings, seamless pipes, threaded fasteners. Processing of such products by processing round rods and hot-rolled pipes takes a very long time, is expensive and requires large capital expenditures and production space. The use of hot-rolled bar forming processes reduces costs. In mass production, current and capital costs remain quite large, which is largely due to the insufficiently high productivity of stamping equipment and, in some cases, the impossibility of obtaining products of complex shape, especially their grooves and long length.

Threaded calibers have no restrictions on the volume recommended when rolling parts. In the technical and operational parameters of parts, economic indicators for small batches, with large-scale and mass production, good results can be achieved.

In screw calibers, rolling screws, twisting screws in comparison with the common method of horizontal rolling, the product has the advantage that it is not processed immediately along the length, but moves along the axis of the product. Consequently, using this method, the screw can be obtained in turns of infinite length and with almost infinite pitch, which cannot be achieved with existing machines.

Due to the inevitable long-term prospect of energy resources and raw materials, the role of energy-saving technologies increases when obtaining metal products with relatively high quality characteristics, such as mechanical and physical properties of metal. One of the main directions of using energy-saving technologies in this area are technologies of intensive plastic deformation (IPD), which allow obtaining materials from sub-ultra- and ultra-microstructures (UMS)Однако рост спроса на эти материалы существенно ограничивается высокой стоимостью производства изделий из таких материалов, что обусловлено столь же высокой энергией и сложностью их производства.

Threaded rolling is another method of intensive plastic deformation, which allows you to quickly and continuously obtain a heavy-duty structure, but there are problems with the study of the central area of the rod, which has an oriented character with small grain boundaries stretched in the direction of rolling with a high-quality equivalent ultra-fine-grained structure of the peripheral part of the rod. Ensuring continuity equal-channel angular pressing, combining it with threaded rolling, allows you to solve the problem of uneven operation of the rod and radically increase overall productivity and energy efficiency.

With the help of these studies, mathematical models of the pressing process of products were developed, the stress-strain state of the processed material was determined and the parameters of the temperature-deformation modes of workpiece processing in the above-mentioned installations were reasonably selected. With the help of these studies, a number of tasks were solved to improve the equipment, optimize the parameters of the working means of continuous installations.

Scientific research on the topic of the dissertation within the framework of the grant AP05132610 was implemented for 2018-2020 on the topic "Development of a new design of a continuous radial shear mill with software control for the manufacture of rods and pipes made of non-ferrous metals".

The relevance of the work: For the first time in the work, the design of a screw machine for the combined technological process of rolling and pressing long products has been developed.

The purpose of the work. Creation of a new mill structure and increase in the production efficiency of long-length press products made of aluminum and its alloys

The object of the study The aim is to develop the design of a screw mill of a new design for an integrated technological process.

Research objectives:

1. Development of the technological process of threaded rolling of long bars made of non-ferrous metals
2. The design of a three-roll screw machine for the process of threaded rolling
3. Carrying out simulation modeling of the operation of three-roll screw units of the installation in order to determine the stress-strain state, check strength, stiffness, vibration activity
4. Design for creating a three-roll threaded installation preparation of documentation
5. Design documentation of the prototype of the screw mill of manufacture, preliminary testing and adjustment.
6. Development of a rational technology for pressing non-ferrous metal rods at a new mill.

On the basis of the above works, a screw assembly of a new design with software control for the manufacture of bars from high-quality non-ferrous metals has been calculated, assembled and manufactured.

The novelty of the work.

For the first time in the work, the design of a screw mill is being created for the combined technological process of rolling-pressing of long-length parts.

The results of the work and their novelty.

In the work of dynamic modeling, the stress-strain state of the rolled and then pressed billet was determined on a screw mill with software control, a rational technology of combined rolling and pressing of the billet was developed and this technology was tested on a screw mill of a new design.

- obtained numerical data with dynamic computer modeling and determined the main regularities of the distribution of the stress-strain state during rolling-pressing of bars on a screw mill of a new design;

- quantitative data were obtained using physical modeling and the main regularities of the formation of the structure of non-ferrous metals under hot deformation relative to the conditions of rolling-pressing bars on a screw mill were revealed;

- the dependence of the ultimate plasticity of a copper alloy on the stress state indicator, as well as the regularities of changes in the degree of use of the plasticity resource of a copper alloy and the hardening-releasing processes during rolling of rods in threaded windings of a screw mill, has been experimentally revealed;

– rational modes of deformation of non-ferrous metal workpieces with combined deformation according to the rolling-pressing scheme on a screw mill of a new design, leading to the formation of a fine-grained structure, have been determined and scientifically substantiated.

The research was carried out using theoretical methods of deformable solid mechanics, system analysis, mathematical modeling on a computer.

Practical value of the work:

A new design of a screw mill for screw rolling and pressing of blanks made of non-ferrous metals has been developed.

The main scientific provisions submitted for defense:

- creation of an experimental installation of the rolling-pressing method, providing a study of the geometric focus of deformation and conducting experimental studies of the energy parameters of the process;

- development of a simulation model for calculating the design parameters of a continuous screw mill for pressing long-length press products;

- technologies for combined rolling pressing and development of design parameters of equipment, technical and technological solutions for their implementation;

- experimental for the production of long-length press products-creation of an industrial installation.

The results of the work can be used in practice:

According to the results of the dissertation work, the installation screw mill of the new design is used for practical purposes in Zhaken Kalsha LLP. All installations of the new mill have been made, i.e. the design of the new mill has been compiled, the drive has been compiled and the strength and rigidity of the heavily loaded elements of the new mill have been calculated, the drive power of the new mill has been calculated, electric motors have been selected and working drawings of the new mill have been compiled.

Personal contribution of the author.

The dissertation consists of the presentation and justification of the research topic, the formulation of tasks and the conduct of theoretical and practical research, the presentation of scientific concepts, the argumentation of their justification, the development of methodological support for the work carried out, summing up and recommendations

Publications.

As a result of the dissertation work of Scopus, 3 articles were published in journals indexed in Web of Science databases, 4 articles in the journal Bulletin of KazNITU, 2 articles at international scientific conferences.

Structure and scope of work.

The dissertation work consists of an introduction, four chapters, a conclusion, and a list of references. The total volume of the work is 132 pages, 72 figures and 6 tables, 116 sources used.