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Innovative Technologies of Metal Forming Based on Combination Processes of Casting, Extruding and Rolling

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Were presented a description of the innovative new technologies of production of a small cross-sectional products made from non-ferrous metals and alloys with using combined methods of casting and metal forming. Sets out the technical and technological solutions, allowing obtaining semi-finished products from compact and non-compact billets from different non-ferrous metals and alloys.

Keywords: innovation, metallurgy, combined processes, casting, rolling, extruding.

Иновационные технологии обработки металлов давлением на основе совмещения процессов разливки, прессования и прокатки

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Представлено описание новых инновационных технологий производства изделий небольшого поперечного сечения из цветных металлов и сплавов с применением совмещенных методов литья и обработки металлов давлением. Изложены технические и технологические решения, позволяющие получать полуфабрикаты из компактных и некомпактных заготовок из различных цветных металлов и сплавов.

Ключевые слова: инновационный, металлургия, совмещенные процессы, литье, прокатка, прессование.

In the world production semi-finished products from non-ferrous metals and alloys especially rapidly growing manufacturing of small cross-sectional extruded articles (rolled wire, electrical and welding wire, solid profiles of small sections, ligature rods, etc.) for industries such as construction and electro technical industry, production profiles for finishing, packaging, jewelry industry and other. In this case, used in the manufacture of such products alloys are characterized by a fairly large spread of the mechanical properties, and some of them critically handled by plastic deformation (hardly deformed and non-plastic alloys) and can be characterized only as a foundry. New technologies based on a combination of different operations and [1] application of modern casting technologies, for example, using an electromagnetic crystallizer (EMC), make it possible to expand the range of processed alloys and receive semi-finished products with a given level of plastic and strength properties. In addition, the scientific interests are the results of research to attract for their production of secondary metals and alloys in the form of chips, powders, granules, etc.

Technology for producing such products, especially long, is multicycle and includes a number of intermediate technological operations using energy-intensive and metal intensive forming equipment, main type of which are the hydraulic presses and drawing machines. These factors lead to high production costs and low competitiveness.

In world practice of metal processing has been a recent trend to create integrated mini-productions with the implementation of technologies for production of non-ferrous metals and alloys by the processing scheme in one continuous line melt-crystallization-forming. In this case, almost all schemes use processes of longitudinal rolling as one of the most widespread types of continuous metal forming. Abroad in obtaining profiles of a small section from aluminum and copper alloys for mini-productions using new generation technologies, called technologies of continuous pressing (Conform, Extrolling, Linex) and continuous casting, rolling, extruding (Castex, Caster). Modular equipment for their implementation characterized by high mobility and flexibility of the transition from one size to another and relatively high performance and can be used to create mini-productions.

In this direction for many years conducting research by scientists of Metal forming department of Krasnoyarsk institute of non-ferrous metals (currently included into Siberian Federal University). The most developed area associated with the creation of new devices and technologies for continuous casting, rolling and extrusion based on the methods of combined treatment with obvious advantages in comparison with known methods of processing of nonferrous metals and alloys and characterized by low labor and energy consumption [1]. For example, energy-power implementation costs of combined processing methods is ten times lower when receiving the same press articles than method of direct extruding on horizontal hydraulic presses, and 4-5 times lower than in the Conform extrusion method. If we go on production of press articles without ingots by method combined casting and rolling-extruding (CCRE) these costs will be even lower.

As technical solutions for the implementation of methods for continuous casting and combined rolling-extruding proposed various devices and installations protected by patents and copyright certificates (patents RF № 1667979, 1801040, 2100113, 2100136, 2200644, 29675, 67492, 68387, 70828 etc.). Thus determined design and technological parameters of the equipment, carried out necessary complex experimental and theoretical studies of a new process for various alloys of non-ferrous metals (fig.1), set up pilot installations on which tested the proposed technological schemes of receiving

news articles from aluminum alloys. Also have been patented methods of receiving press-products of special-purpose using the proposed methods, for example, ligature bars for modifying aluminum melts (patent RF № 2257419).

The most studied can be considered a process of combined rolling-extruding (CRE), because with the help of laboratory and pilot installations tested regimes of receiving rods and profiles not only from solid billets of non-ferrous metals and alloys, and from billets received from chips by briquetting (Fig. 1).

For hardly-deformable alloys of non-ferrous metals reasonable to use technological scheme using electromagnetic crystallizer (EMC) to receive cast billet. It was found that this scheme allows to obtain,

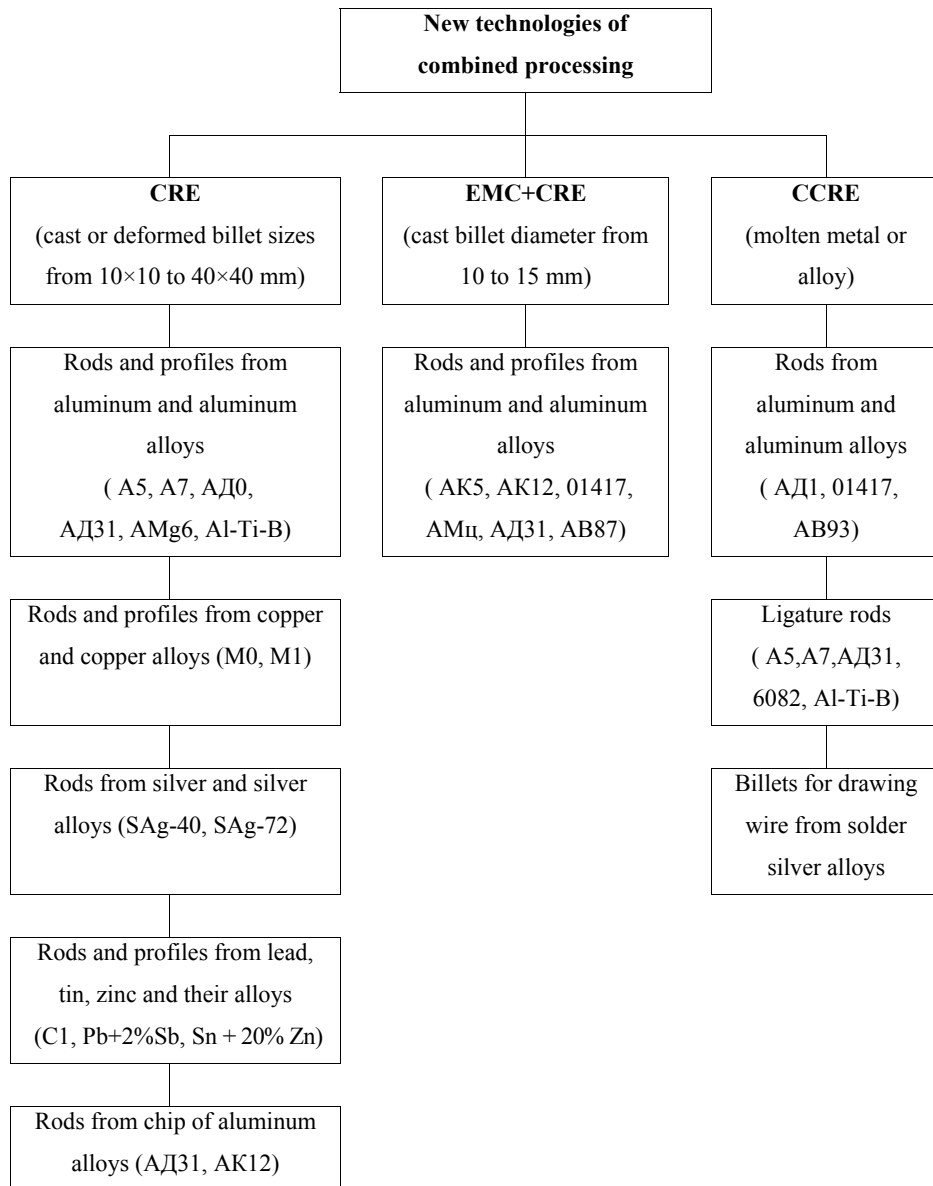


Fig. 1. Schemes of obtaining production of non-ferrous metals and alloys

for example, welding wire from alloys AK5 and AK12 (silumin) with high plastic properties that are required for the deformation by drawing to obtain thin size.

Application of the method combined casting and rolling-extruding (CCRE) most advantageous, because it reduces not only the number metallurgical conversions, but also energy consumption required to produce cast billet. This method can become the base for the creation of innovative developments in the production of small batches on specialized enterprises, as well as in the manufacture of products from low-temperature alloys of precious metals.

The practical implementation technological regimes of receiving rods of aluminum and its alloys are carried out on JSC «VSMFA» (c. Verhnyaya Salda) [2] and «TC «Segal» Ltd. (c. Krasnoyarsk) [3]. Carried out in industrial conditions studies have approved, that the proposed processing methods provide controlled structure and properties of news press-articles for a given temperature-velocity and deformation parameters of the process by state standard.

Currently, according to the agreement Russian Ministry of Education №13.G25.31.0083, performed jointly with Siberian Federal University and «RUSAL ETC» Ltd. by Decree RF №218 and related with high-tech production, developed technology for producing electrotechnical rolled wire by method of combined casting and rolling-extruding for new aluminum alloys with different content of rare-earth and transition metals [4]. Thus, created and patented new aluminum alloys system Al-Zr and Al-Ce, carried out experimental studies on processing of technological regimes of their combined treatment, received deformed semi-finished products of which have assessed their structure and properties. Equipment and technology developed for this project will be implemented in 2012-2013 years at the Irkutsk Aluminum factory.

Each of the above described areas of research is characterized by significant perspectives, science-based and supporting by materials of candidate and doctoral dissertations, protected by teachers, post-graduate students and employees of the Department of Metal forming at the Institute of Non-Ferrous Metals and Metallurgy SFU between 2005-2012 years, as well as technical solutions protected by 20 RF patents.

Thus, have been developed new innovation technologies combined processing of non-ferrous metals and alloys, implementation of which will significantly improve the technical and economic parameters in the production of lengthy production of a small cross section.

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