Annex 2

**DESCRIPTION OF THE OBJECT**

**AUCTION:**

Licensing or sale of intellectual property created as a result of research at the University of Latvia (UL) takes place in accordance with Article 39.5 of the Scientific Activity Law.

UL announces a written auction of the intellectual property "Method for manufacturing cylindrical magnetic dipoles of large diameter and volume".

**SUMMARY OF THE INVENTION:**

**The object of the auction** – license of the intellectual property of the invention "Method for manufacturing cylindrical magnetic dipoles of large diameter and volume", according to Latvian patent application no. LVP2022000058 and the right to use the technology "Method for manufacturing cylindrical magnetic dipoles of large diameter and volume" (hereinafter - Intellectual property).

More detailed information about the invention and initial commercialization strategy can be provided by the project manager: Jurijs Gelfgats, [jurijs.gelfgats@lu.lv](mailto:jurijs.gelfgats@lu.lv) or by Toms Beinerts, [toms.beinerts@lu.lv](mailto:toms.beinerts@lu.lv)

* Price range: according to the offer of the applicant
* Keywords: alloys, aluminum
* The research was carried out by: UL Institute of Physics
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The intellectual property was created under the operational program "Growth and employment" 1.2.1. of the specific support objective "Increase private sector investments" R&D 1.2.1.2. event "Support for the improvement of the technology transfer system" within the framework of project no. KC-PI-2020/54 "System of rotating magnetic dipoles for efficient transport of liquid aluminum".

**Invention and Technology "METHOD FOR MAKING CYLINDRICAL MAGNETIC DIPOLES OF LARGE DIAMETER AND VOLUME" (hereinafter - invention) brief description**

**PRODUCT OF THE INVENTION**: patented technology and its description for the manufacture of an electromagnetic device with permanent magnets that can be used to act on liquid electrically conductive media to electromagnetically influence their hydrodynamic characteristics and heat transfer, in particular in liquid metals, melts of semiconductor materials, etc.

**SUMMARY**: The invention relates to technologies for manufacturing cylindrical permanent magnets of large size and volume, which are magnetized perpendicular to their longitudinal axis, thus forming cylindrical magnetic dipoles oriented in the direction of their diameters. Such permanent magnets can be used in various industrial units designed, for example, to act on liquid electrically conductive media to electromagnetically influence their hydrodynamic characteristics and heat transfer, especially in liquid metals, melts of semiconductor materials, etc.

**INDUSTRY**: This invention relates to the metallurgical industry, particularly to manufacturers of aluminum production equipment.

**OBJECTIVE AND ESSENCE OF THE INVENTION:** The purpose of this invention is to offer the manufacturing technology and/or to reduce the cost of manufacturing equipment for large-scale cylindrical magnetic dipoles made of permanent magnets.

The set goal is achieved with the proposed technique, which provides that:

- the total length of the magnetic dipole is assembled from separate cylindrical sections (mini-dipoles), which are located close to each other and are oriented so that the magnetic field intensity vectors in all mini-dipoles point in the same direction;

- mini-dipoles are made of separate elements of permanent magnets of the appropriate shape, combined in a cylindrical shell, and are symmetrically arranged with respect to the axes of symmetry of the cross-section of the mini-dipole and generally form the necessary configuration of the overall cross-section of the cylindrical dipole and the general direction of its magnetization vector;

- in one mini-dipole, its cross-section can be divided into two or more parts by a cross-wall located along the diameter of the mini-dipole and made of non-magnetic material;

- during the general assembly of the cylindrical dipole along its entire length, mini-dipoles are oriented in the required direction of the magnetization vector using guides installed parallel to the axis of the cylindrical dipole;

- in order to achieve the required orientation of the mini-dipoles in the common magnetic system of the cylindrical dipole, each mini-dipole is provided with a centering element that ensures their position is parallel to the common longitudinal axis of the magnetic dipole.

- the assembly process of mini-dipoles from small individual permanent magnets can be performed on a sheet of ferromagnetic material by dividing the magnets into symmetrical groups with respect to its cross-sectional diameter, then they are pushed close to each other, locked, and surrounded from the outside with an ring shaped shell;

- the total length of the cylindrical dipole is assembled from a set of mini-dipoles, properly oriented in the direction of their magnetization vector, bringing them into full contact with each other and locking them in their final position with means of fixation.

The proposed technique for manufacturing cylindrical magnetic dipoles of large diameter and volume is shown in Figures 1-7.

Fig. 1. Schematics of a cylindrical dipole - a cylindrical permanent magnet magnetized along its cross-sectional diameter and made either from a one-piece blank (Fig. 1a) or consisting of several separate blanks (Fig. 1b) - and the magnetic field induction distribution is outside its circumference (Fig. 1c);

Fig. 2. The general process scheme of assembling a cylindrical dipole from mini-dipoles is shown, where fig. 2a. – formation of one magnetic row from small, industrially produced permanent magnets; fig. 2b - mechanical sliding of the inner rows of the mini-dipole together and fixing; Fig. 2c – placing the next rows of magnets and mechanically pushing them to the previous ones until a complete mini-dipole assembly is obtained; Fig. 2d - securing the end of composite magnetic rows by covering them with a non-magnetic enclosure; Fig. 2e - placement of minidipoles on the guides and Fig. 2f. - mechanical compression in a single dipole;

Fig. 3. A diagram of an assembled cylindrical magnetic dipole is shown, where fig. 3a. – cross section, Fig. 3b. - assembled mini-dipoles in one single dipole - overview;

Fig. 4. The results of the numerical calculation of the magnetic field induction distribution for a cylindrical dipole made of continuous material and analogous experimental data for a dipole assembled from individual small permanent magnets are presented.

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| **Fig. 1.a.** | **Fig. 1.b.** | **Fig. 1.c.** |

**Fig. 1.**



**Fig. 2.**



**Fig. 3.**

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**Fig. 4.**

**INTELLECTUAL PROPERTY PROTECTION:**

Latvian patent application no. LVP2022000058 "Method for manufacturing cylindrical magnetic dipoles of large diameter and volume" (hereinafter - patent application).

**ADDITIONAL INFORMATION:**

• Product – large-scale system of cylindrical magnetic dipoles;

• The cost of manufacturing one product (prime cost) starts from 80035,00 euros for a small-sized machine, which could be designed for, for example, 500 kg-1 ton furnace; cost of larger equipment up to 500 000 EUR (scale systems for 50-100t furnaces with wall thickness 45-55cm);

• The potential selling price of the equipment is not less than 84 500,00 euros.

**INTELLECTUAL PROPERTY DOCUMENTATION**, which includes the rights of use of the Patent application and technical documentation.