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METHODOLOGICAL ASPECTS OF MAGNETIC SEPARATORS SEARCH DESIGN

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Summary. The paper presents the results of research on the development of search design procedures dataware based on the use of methodological instruments of genetic systematics. The possibility of use of search results for directed synthesis of patentable engineering solutions has been demonstrated.

Key words: magnetic separator, search design, basic species, genetic systematics, synthesis.

INTRODUCTION

Magnetic separators are one of the most dynamically developing classes of electromechanical energy converters (EMEC) [Obertuffer I.A. 1974]. Magnetic separators are widely used for different tasks solving in the perspective branches of industry: for extraction of uranium from sea water, for separation of spinal cord and blood cages, for clearing of foodstuff (for example, for hot chocolate filtration at the confectionery factories) [Svoboda J. 1987, Bronkala 1985, Unkelbach 1990]. It stimulates the development of principally new variants of unconventional embodiment magnetic separators and also leads to relative density increase of search design procedures. The role of these procedures in new devices design may come up to 80%.

The problem posed in this paper is to show some aspects of application of structural (genetic) electromecanics methods to solution of magnetic separators design search problems [Shinkarenko 1996].

RESEARCH OBJECT

During search design information about typical design solutions, published patents and the design object analogs, about computation methods and tests results, as well as reference and catalog information, is extensively used. Usually such information is distributed among numerous information search system data bases. Existing approaches to data bases organization are not notable for rigor, as practically always there are either unaccounted data or data allocated in several data bases simultaneously

(data redundancy). In this case search of the required data involves considerable time expenditure.

Data redundancy is caused by that the same object can belong to different classification groups. For example, a magnetic pulley can be a rejecting separator, when it is applied as a drive drum of the tape conveyor. Magnetic pulley can be also a separator for extraction of metal from a stream of a separated material in a perpendicular direction when it is used as suspended self-unloading separator. Search of the necessary data in information search system is difficult. It is caused with absence of terminological definiteness in the field of magnetic separation. So, for example, for designation of a class of magnetics separators intended for installation over tape conveyors, terms are applied: suspended, hinged and some firms-manufacturers carry magnetic pulleys to a class of drum-type magnetic separators.

In these conditions it is necessary essentially new approaches to the organization of information supply of design procedures which would guarantee completeness of giving of the information at simultaneous elimination of its redundancy. In the present work for the decision of the specified problem the new concept of information supply of search design of the magnetic separators is offered. It is based on use of methodological tools of genetic systematics – one of new scientific directions of genetic electromecanics [Shinkarenko 1996].

RESULTS OF RESEARCH

Genetic systematics as an independent trend was formed after the discovery of genetic classification (GC) of primary field sources (PFS) - spatial surfaces with the set kind and the law of distribution of an electromagnetic field [Shinkarenko 1996]. Results of structural-systematic analysis of GC periodical structure and invariant properties of PFS as integral electromagnetic structures containing genetic information were the basis for development of the theory of structural organization and genetic evolution of electromechanical systems [Shinkarenko 1996, 2009]. Direct relation between fundamental principles of preservation of electromagnetic symmetry and topology, genetic code and the principle of PFS genetic information preservation, on the one part, Species genetic nature and laws of micro- and macroevolution of real structural classes of EMEC, on the other part, was first scientifically substantiated within the new trend.

Genetic information presented by a universal PFS genetic code in GC structure acts as a peculiar transfer function in the hierarchy of complicated genetic levels of EMEC arbitrary Species structural organization. A genetic code structure consists of two parts – alphabetic and numerical ones (Fig.1). An alphabetic part denotes a contracted name of the corresponding sculpted surface geometric class to which PFS in GC structure belongs. The first big period is formed by six geometric classes: *CL* – cylindrical; *CN* – conic; *PL* – plane; *SPH* – spherical; *TP* – toroid plane; *TCL* – toroid cylindrical field sources. A genetic code numerical part represents topologic features and kind of PFS electromagnetic symmetry, i.e. points out presence or absence of PFS surface edges (dissymetrizing factors): in the direction of field wave propagation (the first code figure) and in the perpendicular direction (the second code figure). A genetic code numerical part may assume the following numerical values: *0* – absolute

electromagnetic symmetry (dissymetrizing factors or surface edges are absent); *1* – electromagnetic dissymmetry (partial dissymetry due to presence of one surface edge); *2* – electromagnetic asymmetry (absence of symmetry due to presence of two surface edges on the way of electromagnetic wave propagation). Field sources belong to the class of orientable surfaces. Every PFS geometric surface may have two possible variants of field surface wave orientation: a longitudinal (x) and a transversal (y) one which are represented in the code structure by a corresponding index.

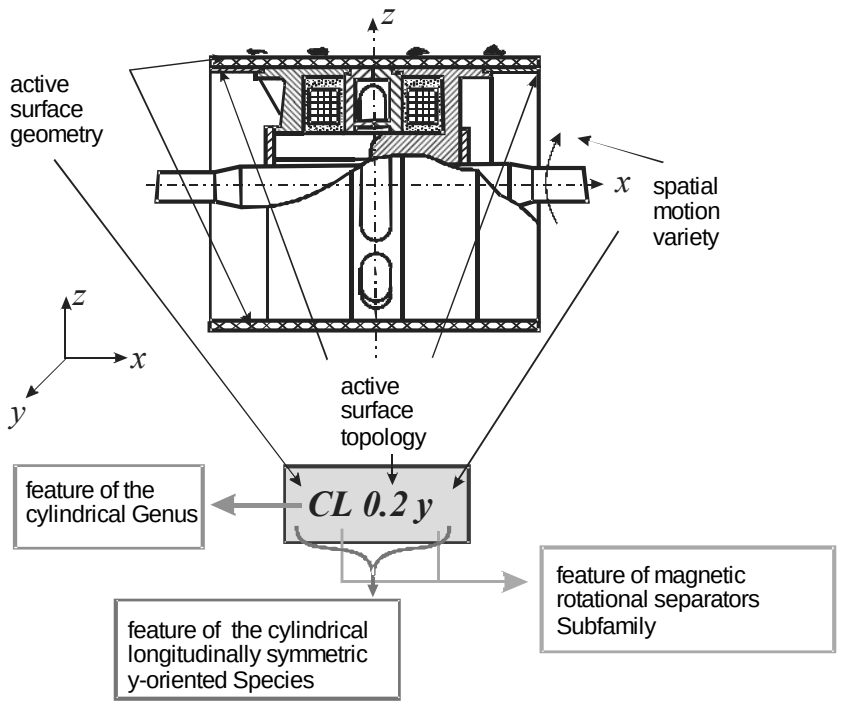

Fig.1 Relation of a genetic code and magnetic separator essential features and taxonomic categories (taking a representative of cylindrical, longitudinally symmetric, y-oriented species as an example)

The problem of development of genetic systematics of magnetic separators species implies determination of bounds, quantity and structure of complete Species composition of the device class being researched. Availability of systemized information about species structure makes it possible to determine accurate search limits and perform directed synthesis of structural variants of magnetic separators having a given objective function.

Generality of PFS and corresponding species genetic information allows one to determine species diversity of the retrieved class using the concept of generative electromagnetic structures existence domain [Shinkarenko 1996]. A primary structure whose genetic information determines evolution of a certain group (population) of

genetically related electromechanical objects or the Species as a whole is called a generative electromagnetic structure.

Availability of system information about Species number and genetic structure makes it possible to determine the class major systematic units rank structure in which the Species performs the function of the main systematic category for superspecies level taxons: "Species" → "Genus" → "Subfamily" → "Family" (Fig. 2). Rank sequence of the major systematic units is universal for electromechanical systems arbitrary functional classes, which provides methodological unity and invariance of systematics structure.

Species structural diversity is determined by the totality of genetically related species united by the common PFS spatial geometry. Historically formed classes of rotary and forward motion separators have the status of a Subfamily as they unite the corresponding separators Genus taxons according to the character of their spatial motion. The analysis of magnetic separators systematics ranking structure shows that structural diversity of rotary and forward motion magnetic separators is presented by five and four Genera, correspondingly. The Subfamily of rotary motion separators is determined by twelve basic Species with axisymmetric magnetic field sources. Species diversity of the subfamily of forward motion separators is put in order by eleven Species with traveling magnetic field sources.

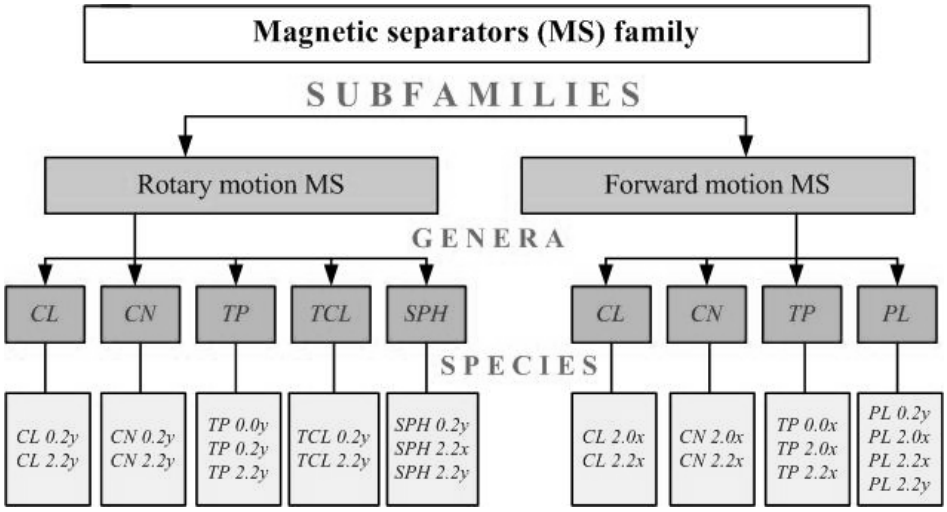

Fig. 2. Rank structure of magnetic separators systematics

Genetic systematic development and determination of innovation potential of magnetic separators with open working zone class show that all the known engineering solutions at the present evolution stage are presented by structural representatives of only ten real-informative basic species (43.5% of the potential of all the basic Species of the class). Generative structures of really-informative species were determined according to the results of patent information retrieval (the period from 1930 till 2000). Five really-informative Species (*CL 0.2y, CL 2.2y, TP 0.2y, TP 0.0y, CN 2.2y*) refer to

Subfamily of rotary motion magnetic separators and five (*PL 2.2x, PL 2.2y,TP 2.0x, PL 0.2y, CN 2.0x*) – to Subfamily of forward motion magnetic separators. Species *CL 2.2y, CL 0.2y, PL 2.2x(y)* are dominant really-informative basic Species for magnetic separators class.

Information about the number $N_{really-inf\ ormative}$ of really-informative Species and information about species diversity (number N) of "ideal" class provides the possibility to determine innovation potential of the class representing the information about number $N_{implicit}$ of implicit Species, i.e. about the class structural representatives which are absent at the present evolution stage (were not found in the course of patent information retrieval).

$$N_{implicit} = N - N_{really-inf\ ormative} \tag{1}$$

For the devices class being researched the innovation potential is represented by thirteen ($N_{implicit} = 23 - 10$) implicit Species, which makes 56.5% of the total species number. Thus, first of all, implicit species and not numerous really-informative Species *CN 2.0x, TP 2.0x, TP 0.0y* (Fig. 2) are peculiar reference points showing the direction of the search for new patentable engineering solutions. At the present moment there are a number of patent pending engineering solutions obtained with application of systematics anticipation function.

Genetic systematics rank structure is the basis for development of new system concept of search design dataware. This concept implies structured information supply in the form of catalogs and electronic databases about both existing (really-informative) and potentially possible (implicit) magnetic separators species. The rank structure of genetic systematics acts as the guarantor of completeness of giving of the information and solves a problem of redundancy of the data.

The electronic database was developed in MySQL medium using PHP programming language. MySQL and PHP systems are cross-platform and free, which was the basic reason for their choice. MySQL system provides high-speed data access, makes it possible to carry out storage, completion, regulation, retrieval and data exchange functions most efficiently and also provides the possibility for several users to work with the data in the network simultaneously.

A catalog of magnetic separators species has been developed within the adopted concept. The catalog contains information about species genetic nature with indication of their complete names and genetic codes, as well as information about species objects system properties genetically conditioned: the character of movable elements motion, active zone geometry and topology. Information about Species genetic nature and their system specific features is invariable.

Systemized information from the catalog was used for development of electronic database "Systematics of magnetic separators family species" with description of both really-informative and implicit magnetic separators species in Russian and English. In this case genetic systematics rank structure is a guarantor of information supply completeness and solves the problem of data redundancy.

The proposed electronic database contains information from the catalog about species genetic nature, system and additional information useful during search design. System information is presented by the data about species status (really-informative or implicit) and about their evolution level, about species generative structures, fields of practical application and geography of the species objects manufacturers. Additional information is presented by description of Species structural representatives contained in patents.

The offered form of information supply in the mentioned electronic database includes all the necessary information characterizing species of the Family of rotary and forward motion magnetic separators. The database can be constantly augmented with new information without disturbance of its structure.

Information about really-informative and implicit species of the Family of magnetic separators, which is included into the electronic database, may be used as informational-innovation basis for magnetic separators search design.

CONCLUSION

Using genetic systematics results, a system concept of innovation dataware of magnetic separators search design has been developed. It has been ascertained that species diversity of the family of electromagnetic separators is determined by 23 basic level Species.

Quantitative and qualitative composition of magnetic separators implicit species has been determined on the basis of application of genetic systematics anticipation function, which provided the possibility of carrying out a directed synthesis of patentable engineering solutions and realizing innovational potential of magnetic separators class.

Applying the results of the research, a systemized catalog of magnetic separators Species diversity has been developed for the first time. It includes information about both known and potentially possible species. Practical application of the catalog and the electronic database made it possible to improve search procedures efficiency significantly and thereby to decrease unavoidable time and resources expenditure.

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МЕТОДОЛОГИЧЕСКИЕ АСПЕКТЫ ПОИСКОВОГО ПРОЕКТИРОВАНИЯ МАГНИТНЫХ СЕПАРАТОРОВ

Захарчук А.С., Шведчикова И.А.

Аннотация. В статье представлены результаты исследований по разработке информационного обеспечения поискового проектирования магнитных сепараторов, основанного на использовании методологических инструментов генетической систематики. Показана возможность использования полученных результатов для направленного синтеза патентоспособных технических решений.

Ключевые слова: магнитный сепаратор, поисковое проектирование, базовый вид, систематика, синтез.