

PROPOSALS

for Research and Academic Cooperation

**Department for Electrical Apparatus (DEA)
of National Technical University
“Kharkiv Polytechnic Institute” (NTU “KhPI”)**

DEPARTMENT FOR ELECTRICAL APPARATUS

Head of Department – Borys V. KLYMENKO

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Academic Speciality:

141 – Electrical Power Engineering, Electrical Engineering and Electromechanics

Academic Specializations:

- Electrical Apparatus (Switchgear and Controlgear)**
- Electrical Household Appliances**

Main Research Areas (Field of Study)

- 1. Investigation of processes in vacuum switching devices with electromagnetic actuators on the basis of high-coercive permanent magnets for medium voltage electrical networks (3.6 kV ... 52 kV)**
- 2. Investigations of electromagnetic and thermal processes in industrial and household induction heating systems**
- 3. Multiphysics modeling of contact, arcing and electromagnetic systems of electric apparatus**

PARTICIPATION IN INTERNATIONAL PROJECTS

1. **May 2016 – Alexander von Humboldt Foundation/Stiftung: Donation (EUR 20.000) for the purchase of the equipment**



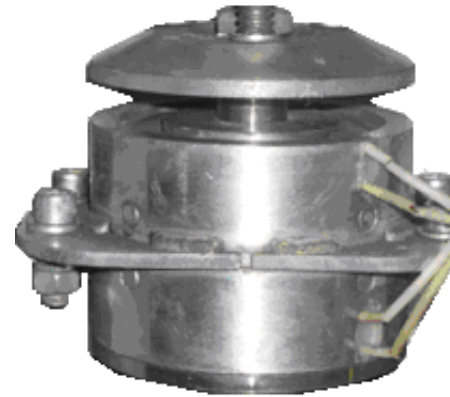
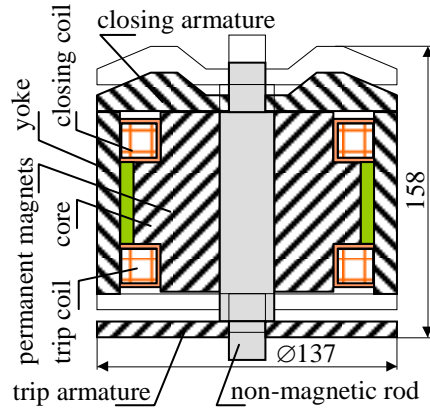
Alexander von Humboldt
Stiftung/Foundation

2. **Proposal preparation in the frame of the EU Framework Programme for Research and Innovation Horizon-2020:
“Investigations, Development and Industrial Implementation of Energy-Efficient Linear Electromagnetic Actuators for MV Switching Devices with High-Parameter Structural Elements”**
3. **Application for the ERASMUS+ Programme (at the stage of signing – Inter-institutional agreement 2016-21 between Université de Nantes, France and NTU “KhPI”)**

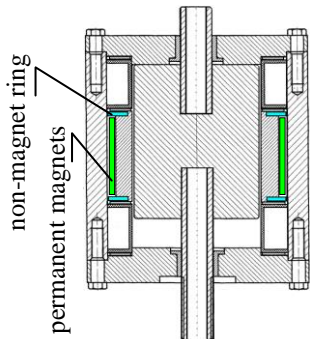
MAIN SCIENTIFIC RESULTS OBTAINED (1)

1. New innovative designs of polarized bistable electromagnetic actuators on the basis of high-coercive permanent magnets with improved weight, size, power and dynamic characteristics for vacuum switching devices

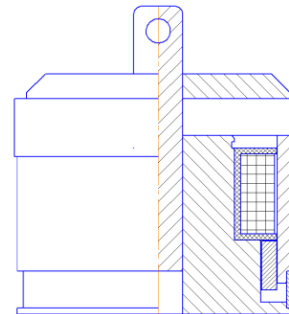
Bistable actuator with two coils and two armatures



Bistable actuator with closed armature



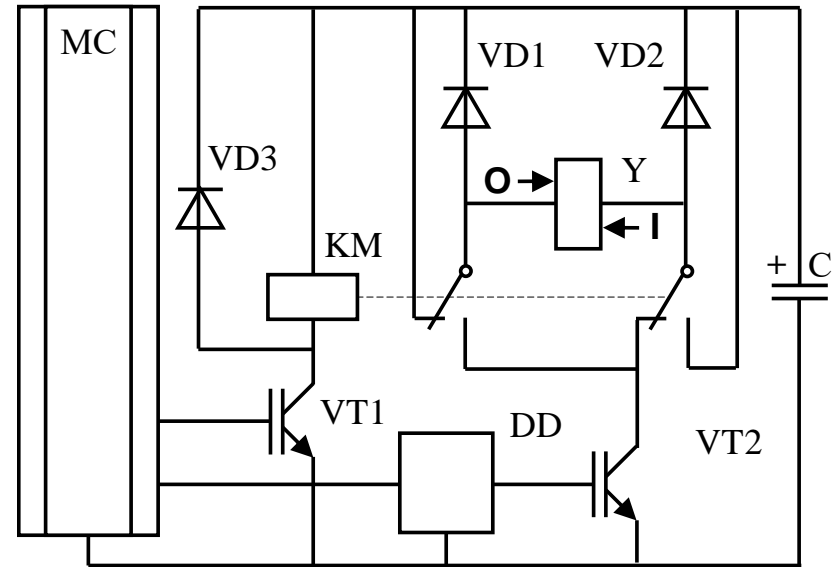
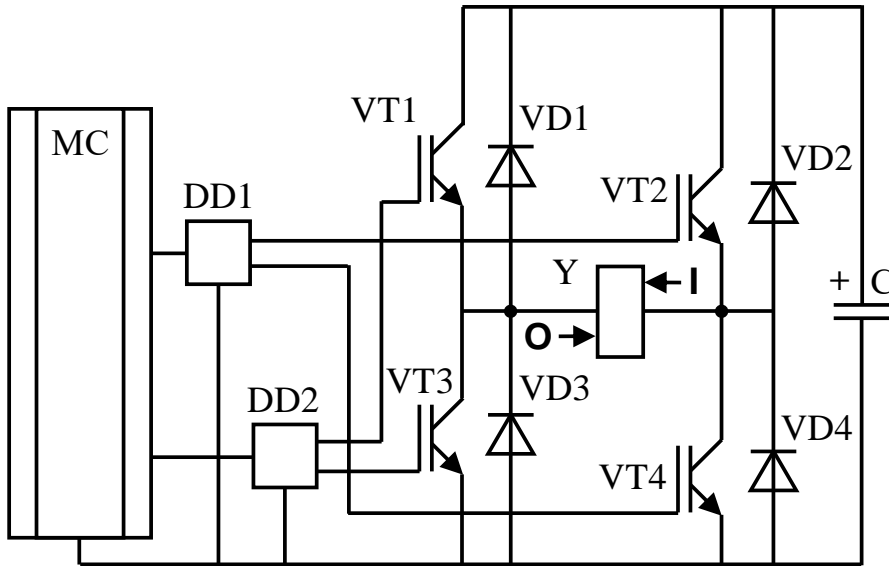
Bistable actuator with ferromagnetic shunt



MAIN SCIENTIFIC RESULTS OBTAINED (2)

2. Novel microprocessor control systems of actuators windings with semiconductor and hybrid switching devices

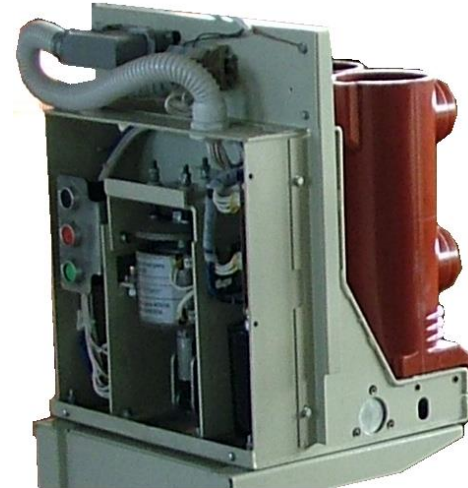
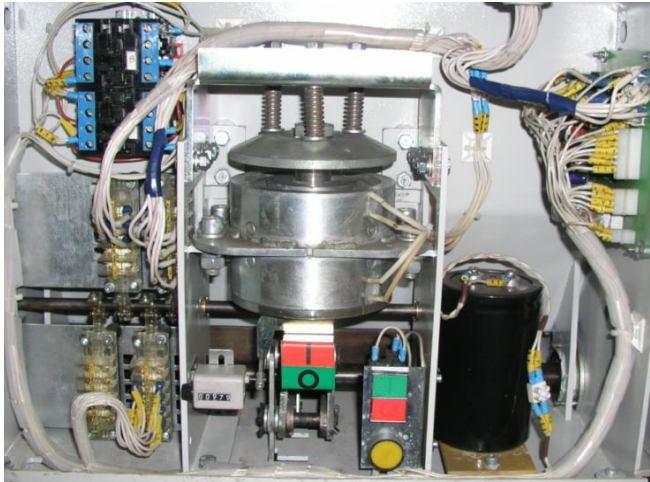
Schematic electronic circuits developed



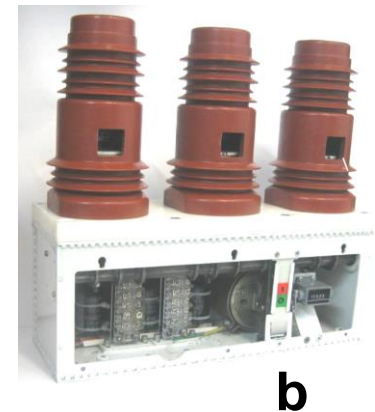
MAIN SCIENTIFIC RESULTS OBTAINED (3)

3. Prototypes of vacuum circuit breakers and contactors with backpack and vertical designs with electromechanical and microprocessor control systems

Prototypes of circuit breakers with bistable actuator with two coils



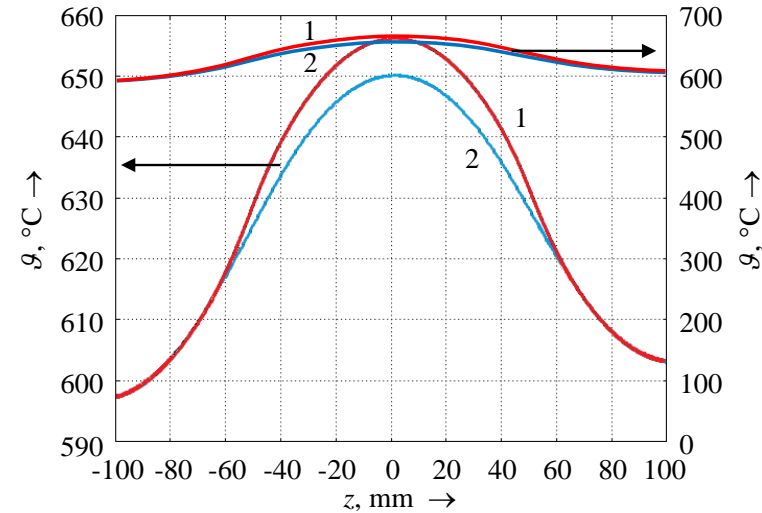
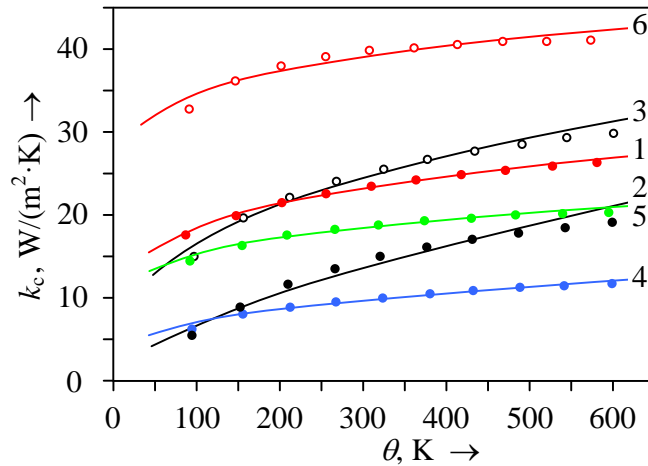
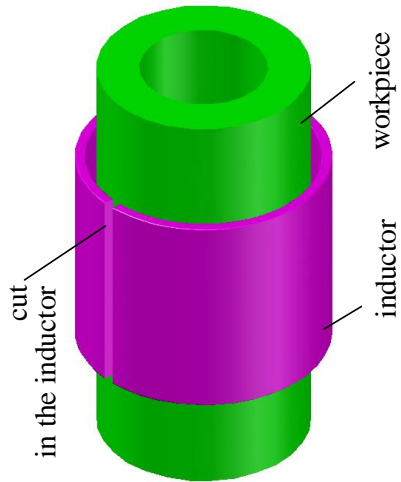
Prototypes of circuit breaker (a) and contactor (b) with microprocessor control systems



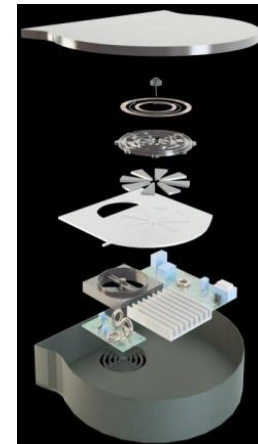
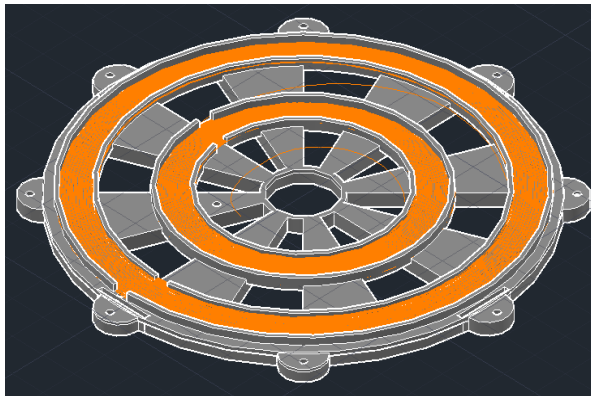
MAIN SCIENTIFIC RESULTS OBTAINED (4)

4. Investigations of electromagnetic and thermal processes in industrial and household induction heating systems

Examples of computational models and numerical results (industrial appl.)



Cookers' inductor and conceptual designs (household appl.)



PROPOSALS FOR JOINT INVESTIGATIONS (1)

Development and Investigation of Polarized Bistable Electromagnetic Actuators on the Basis of High-Coercive Permanent Magnets with Improved Weight, Size, Power and Dynamic Characteristics for Vacuum Switching Devices

- 1 Multiphysics modeling, development and production of prototypes of improved designs of bistable polarized electromagnetic actuators for switching devices of medium voltage networks**
- 2 Testing prototypes developed**
- 3 Finalization of prototypes based on the results of experimental and numerical investigations**
- 4 Development and manufacturing of experimental stands**
- 5 Preparation of samples of the objects to the experimental studies**
- 6 Experimental investigations of manufactured actuators at various operation modes**
- 7 Comparison of technical (in statics and dynamics) and economic characteristics of bistable actuators of various designs based on the results of mathematical modeling and experimental investigations**
- 8 Analysis of obtained results and development of recommendations on the practical application of the developed actuators in medium voltage switching devices**
- 9 Development of design documentation, organization of short-series manufacturing**
- 10 Tests at certified European laboratories**
- 11 Preparation for large-series manufacturing**

PROPOSALS FOR JOINT INVESTIGATIONS (2)

Investigations of Dynamic Processes in New Improved Designs of Vacuum Switching Devices

- 1 Substantiation and prototyping of vacuum switching devices of various types (contactors and circuit breakers). Experimental study of dynamic characteristics of new and improved designs of vacuum switching devices**
- 2 Carrying out complex of numerical and experimental investigations aimed to develop recommendations on the improvement of dynamic parameters of vacuum switching devices of various types (contactors and circuit breakers) in particular on the reduce of the velocity of moving contacts as well as on the reduce of the number and duration of contact bounces in vacuum interrupters at on operations to acceptable levels**
- 3 Development, manufacturing and conducting standard tests at certified European laboratories (in accordance with the requirements of the IEC Standards) of improved prototypes of vacuum switching devices of various types (contactors and circuit breakers) intended for industrial implementation at small and medium enterprises of Ukraine and the European Union**
- 4 Development of design documentation**
- 5 Organization of short-series manufacturing at small and medium enterprises of Ukraine and the European Union**
- 6 Preparation for large-series manufacturing at small and medium enterprises of Ukraine and the European Union**

PROPOSALS FOR JOINT INVESTIGATIONS (3)

Development and Investigation of Microprocessor Control Systems of Actuators Windings with Semiconductor and Hybrid Switching Devices

- 1 Development and production of prototypes of improved designs of microprocessor systems with semiconductor and hybrid switching elements for the control of bistable actuators windings of medium voltage vacuum switching devices**
- 2 Comparison of the technical and economic characteristics of the manufactured prototypes of advanced designs of microprocessor systems with semiconductor and hybrid switching devices for controlling the coils of bistable actuators of medium voltage vacuum switchgear, based on the results of mathematical modelling and experimental investigations**
- 3 Analysis of obtained results and development of recommendations on the practical application of the developed improved designs of microprocessor systems with semiconductor and hybrid switching devices for controlling the coils of bistable actuators of medium voltage vacuum switchgear of various types (contactors and circuit breakers)**
- 4 Development of design documentation**
- 5 Organization of short-series manufacturing at small and medium enterprises of Ukraine and the European Union**
- 6 Preparation for large-series manufacturing at small and medium enterprises of Ukraine and the European Union**

PROPOSALS FOR JOINT INVESTIGATIONS (4)

Multiphysics Modeling of Contact, Arcing and Electromagnetic Systems of Electric Apparatus

- 1 Development, validation, experimental verification and refinement of novel techniques for computer simulation of coupled (multiphysics) processes in contact, arcing and electromagnetic systems of electrical apparatus (switchgear and controlgear) developed at the DEA**
- 2 Carrying out the complex of numerical and experimental investigations aimed to making recommendations on the selection of rational structural parameters and operation modes of electrical apparatus (switchgear and controlgear) developed at the DEA**
- 3 Comparison of the results of experimental investigations and computer modeling**
- 4 Comparison of technical (in statics and dynamics) characteristics of bistable actuators of various designs based on the results of mathematical modeling**
- 5 Computer simulation of dynamic characteristics of new and improved designs of vacuum switching devices**

PROPOSALS FOR JOINT INVESTIGATIONS (5)

Joint Participation in International Projects

The Department for Electrical Apparatus (DEA), NTU “KhPI” invites Institute of Electrical Systems (IESY), Otto von Guericke University Magdeburg to consider a possibility to participate in the following International projects:

- 1 To join the prospective consortium in the frame of the EU Framework Programme for Research and Innovation Horizon-2020**
- 2 To prepare and submit an Inter-institutional agreement in the frame of the ERASMUS+ Programme**



**THANK YOU SO MUCH
FOR YOUR ATTENTION**

DSA