

**AP19675518 “Creation of a prototype of an innovative passenger pneumolift for buildings and structures” – p.m. Taranov A.V.**

***Relevance:***

The market of light passenger elevators needs modernization. In Kazakhstan there are 5,000 elevators in operation that have reached the end of their normal service life (according to ALE “National Association of Elevators of Kazakhstan”). A similar situation is observed in other CIS markets.

Domestic development of passenger pneumolifts solves this problem by providing the safest equipment on the market.

Significant advantages of pneumolifts, compared to rope elevators and other types (hydraulic, rack and pinion, etc.), are:

- simplicity of construction;
- reliability and safety in operation;
- unlimited lifting height;
- reduced manufacturing, installation and operating costs;
- small required overpressure of compressed air in the subcavity of the shaft creates favorable dynamic conditions of pneumolift operation.

The project methodology is based on the theoretical foundations of mechanical and electrical engineering, pneumatic devices and systems, mathematical statistics, methods of measurement and processing of experimental results and methods of specialized software for design work.

As a result, a package of design documentation will be developed and a prototype of a pneumatic passenger elevator will be manufactured. Potential consumers of the project are medium and high floor residential buildings, business centers and other administrative buildings. The basic operating principle and technical capabilities were successfully developed by the research group and tested on a serial cargo pneumatic elevator.

Development of pneumatic elevators for passengers makes it possible to offer the market a domestic export-oriented solution that exceeds the characteristics of foreign analogues.

***The project purpose:***

The purpose of this project is to create a prototype of a passenger pneumolift, as well as design and technological documentation

***Expected and achieved results:***

Achieved results:

1. Design and technological documentation of the multi-storey passenger pneumolift shaft, rollers and sealing devices of the multi-storey passenger pneumolift were developed. 3D models of elements of multistorey passenger pneumolift for realization of functional scale model with the help of additive technologies are developed;

2. Thrust devices for stopping the pneumatic elevator car on the corresponding floor are developed. These devices provide stopping of the car, preventing sharp jolts and oscillations during stopping, which significantly improves comfort and safety of passengers. The devices reduce operating costs and improve the overall reliability of the elevator;

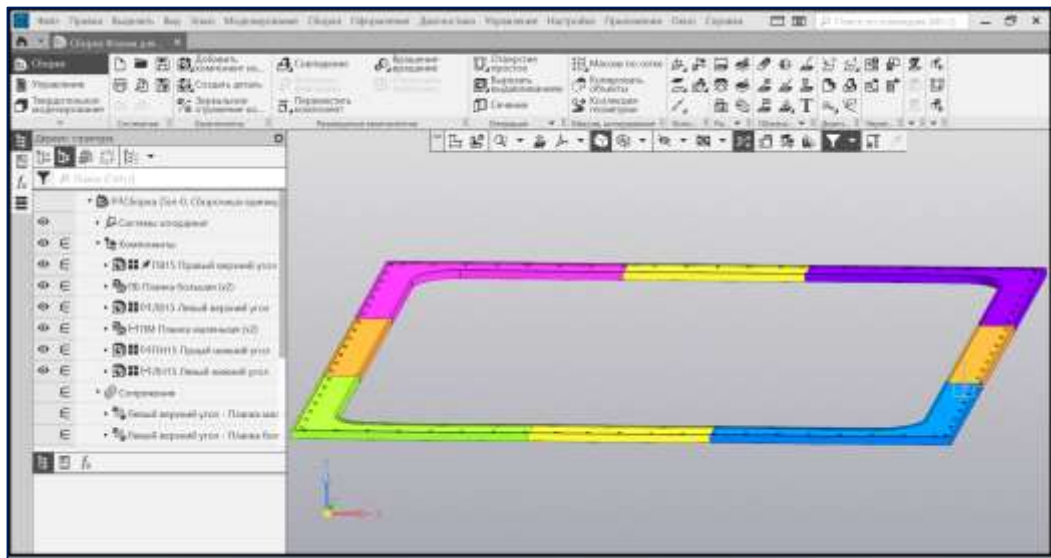
3. Boundary conditions and requirements to the characteristics of sealing elements and their design were determined. The main criteria were high wear resistance -  $10^4$ - $10^5$  bends and tensions per year, low coefficient of friction to steel - 0.05 - 0.15, hardness of 40-45 Shore units. Negotiations were held with several specialized enterprises, including the Research Institute of Elastomeric Materials and Products, which allowed access to advanced developments and materials. Several types of elastomers with optimal properties were selected for further testing. These include oil-, water-resistant rubbers, silicones, neoprene, and polyurethane. The advantages of selecting these elastomers include improved leak tightness, increased system reliability and reduced operating costs;

2. Eurasian patent application filed

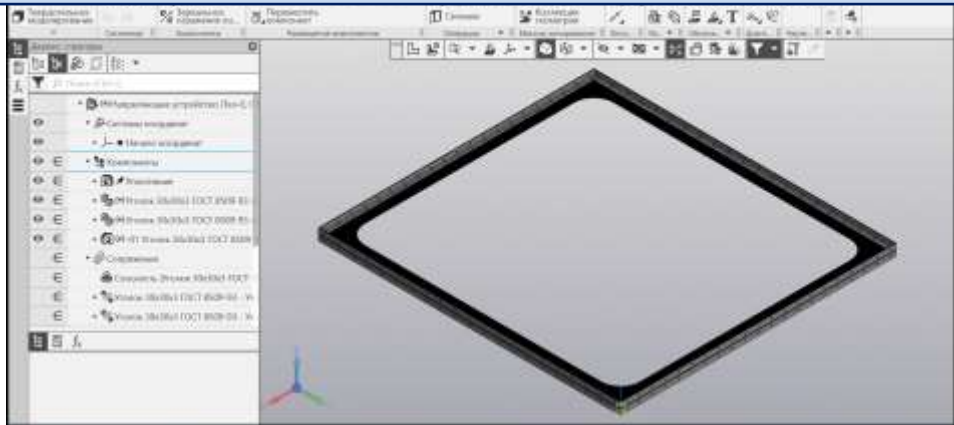
3. Equipment and software purchased
  4. An article was submitted to the journal of Scopus "International review of mechanical engineering".
  5. Published an article in the journal "Proceedings of the University" recommended by COCSON
  6. 3 papers were presented at international conferences.
- Expected results:
1. experimental and industrial sample of passenger pneumolift for residential buildings;
  2. At least 3 (three) articles and (or) reviews in peer-reviewed scientific publications indexed in Science Citation Index Expanded of Web of Science database and (or) having CiteScore percentile in Scopus database not less than 35 (thirty-five).



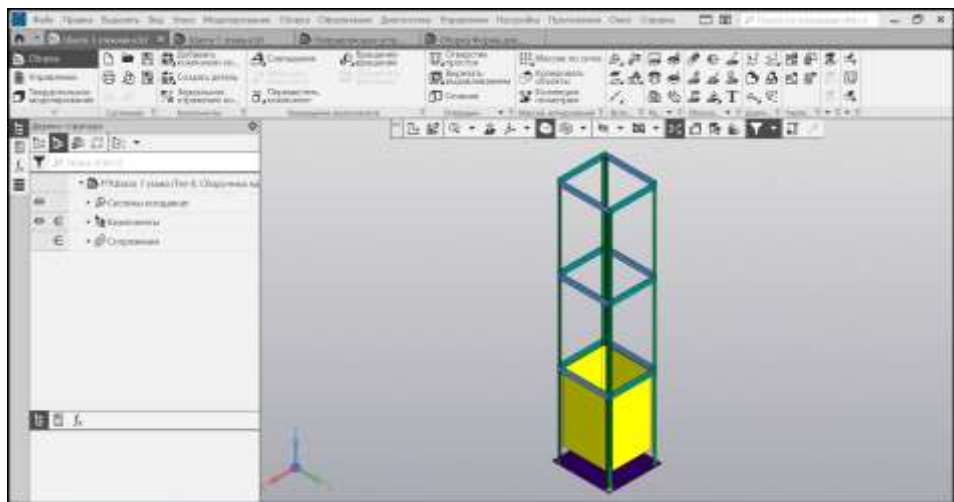
**Figure 1 - Experimental-industrial sample of cargo pneumolift for buildings and constructions**



**Figure 2 - Form for sealing devices**



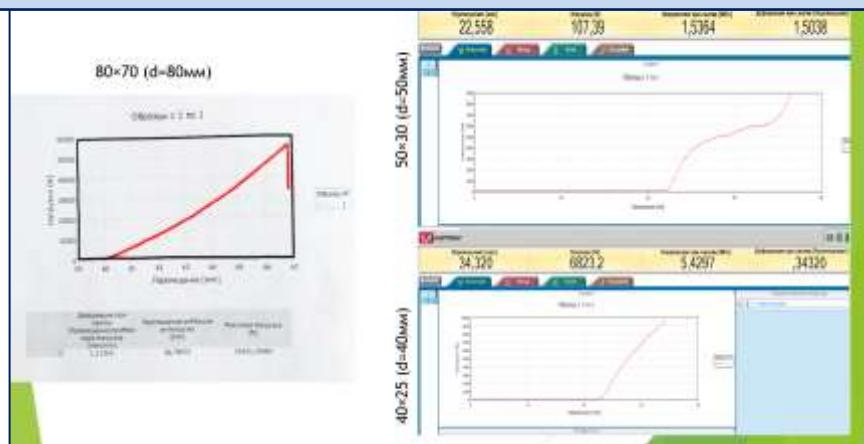
**Figure 3 - Sealing device**



**Figure 4 - Elevator shaft**



**Figure 5 - Testing of guiding devices**



**Figure 6 - Load plots of guiding devices**

**Research team:**

Composition of the research team to conduct scientific research

N o.	Full name (if any), education, degree, academic title	Main place of work, position	Hirsch Index, ResearcherID, ORCID, Scopus Author ID (if available)	Role in the project or program and the nature of the work performed	Brief rationale for participation
1	Taranov Alexander Viktorovich, Candidate of Technical Sciences, no	Non-commercial joint-stock company “Abylkas Saginov Karaganda Technical University”, Associate Professor of “Power Engineering	Hirsch Index 3, ORCID - 0000-0002-1534-9737, Scopus Author ID - 56669560400	Project manager General management, strategic planning. Managing the progress and analyzing the results of project decisions	Experience of research work for 24 years. Experience in creation of cargo pneumolifts of three modifications.

		Systems” Department			
2	Suleymanov Seidamet Rishadovich, postgraduate study, no	Kaztekhavtomatika Limited Liability Partnership, Project Manager	Hirsch Index 1, ORCID - 0000-0001-5753-3789, Scopus Author ID - 56669831600, ResearcherID - ADZ-1365-2022	Executor Responsible executor. Development of technology, its adaptation to market needs, participation in the preparation of patents and publications.	Research experience of 11 years. Experience in development and commercialization of innovative technologies. Understanding of market needs. Was the leader of a successfully implemented commercialization project
3	Bulatbaev Felix Nazymovich, Candidate of Technical Sciences, Associate Professor	Non-commercial joint-stock company “Abylkas Saginov Karaganda Technical University”, Professor at the Power Engineering Systems Department	Hirsch Index 7, ORCID - 0000-0002-3574-1189, Scopus Author ID - 56669831600	Executor Development of technology, preparation of publications and patents, performance of theoretical and practical research.	Research experience of 23 years. Experience in development of mining machines.
4	Brazhanova Dana Korabaevna, Master of Technical Sciences	Non-commercial joint-stock company “Abylkas Saginov Karaganda Technical University”, teacher	Hirsch Index 1, ORCID - 0000-0002-1241-6279, Scopus Author ID - 57220805586	Executor Participation in all stages of the project. Preparation of reports, articles, patents, preparation of technical documentation.	Master's degree in instrumentation engineering, 8 years of research experience. Experience in the development of intelligent systems.
5	Baidyusenov Galym Nurzhanovich, Master's student	Non-commercial joint-stock company “Abylkas Saginov Karaganda Technical University”, senior lecturer	h-index 0, ORCID 0000-0001-6145-7117, Scopus Author ID 57541025100	Executor Participation in all stages of the project. Preparation of reports, articles, patents. Mathematical, computer modeling, preparation of technical documentation	Graduated from AUPEC doctoral program, has 5 years of experience in the study of thermal insulation, heat network operation modes. Author of 7 scientific articles.
6	Balandin Vitaly Sergeevich, holder of a master's degree	Non-commercial joint-stock company “Abylkas Saginov Karaganda Technical	ORCID - 0000-0002-6593-1864, Scopus Author ID - 57215332448	Executor Participation in all stages of the project. Preparation of reports, articles, patents. Mathematical, computer modeling, preparation of	Engineer with a specialization in electric power engineering. Scientific and pedagogical experience of 17 years. Published

		University”, senior lecturer		technical documentation.	more than 50 scientific papers.
7	Bilichenko Arkady Petrovich, , no	Non-commercial joint-stock company “Abylkas Saginov Karaganda Technical University”, senior lecturer	ORCID - 0000-0002-2132-7016	Executor Participation in all stages of the project. Preparation of reports, articles, patents, performance of theoretical and practical research. Mathematical, computer modeling.	Engineer with a specialization in electric power engineering. Scientific and pedagogical experience of 17 years. Published more than 50 scientific papers.

***List of publications:***

1) Taranov A.V. // Methodology of factory tests of pneumolifts for buildings and structures // International Scientific and Practical Conference “XV Toraiyrov Readings”, Pavlodar, 2023, p.203-207.

2) Taranov A.V. // Influence of compressed air leakage on the skip pneumatic lifting unit operation // International Scientific and Practical Conference “Integration of Science, Education and Production - the basis for the realization of the Plan of the Nation” (Saginov Readings No.15), Karaganda, 2023, p.525-526.

3) Taranov A.V. // Experimental study of the skip pneumatic hoisting plant model // Труды университета, №3 (92), 2023, с.513-518 (DOI 10.52209/1609-1825\_2023\_3\_513).

4) Testing of guiding devices of passenger pneumolifts. Taranov A.V., Lukin D.A. International Scientific and Practical Conference “Integration of Science, Education and Production” (Saginov Readings No.16), Karaganda, 2024, p.699-701.

5) F.N. Bulatbayev, V.S. Balandin, A.V. Taranov // Studying energy parameters of freight pneumatic elevator PPG-100 // International review of mechanical engineering, 2024.

6) Taranov A.V., Suleymanov S.R., Bulatbayev F.N., Brazhanova D.K., Isaev V.L., Kyzyrov K.B., Isaev I.V., Kalytka V.A. // Piston pump // Application for Eurasian Patent No.298471 dated 01.07.2024.

7) Taranov A.V., Suleymanov S.R., Bulatbaev F.N., Brazhanova D.K., Isaev V.L., Kyzyrov K.B., Isaev I.V., Kalytka V.A. // Gear hydraulic motor // Eurasian Patent Application, 2024

***Information for potential users:***

Technical and economic calculations have shown that simplification of pneumolift design has led to a reduction in the cost of its manufacture, installation, maintenance, operating costs, exclusion of costs for construction, installation and adjustment works in 2-3 times (depending on the type of elevator). This, in turn, makes the pneumolift competitive with existing rope and other types of freight elevators, eliminates Kazakhstan's dependence on foreign suppliers of similar equipment.

***Scope:***

Scope of science - Lifting and transportation engineering. Potential consumers of the project are residential buildings of medium and high storey, business centers and other administrative buildings. The development of pneumatic elevators for passengers allows to offer the market a domestic export-oriented solution that exceeds the characteristics of foreign analogues.

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