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Scientific and research work of Zaporizhzhia aircraft engine builders in the 1970's

Abstract. *On the basis of a wide base of sources, the article highlights and analyzes the development of research work of aircraft engine companies in Zaporizhzhia during the 1970s. The existence of a single system of functioning of the Zaporizhzhia production association "Motorobudivnyk" (now the Public Joint Stock Company "Motor Sich") and the Zaporizhzhia Machine-Building Design Bureau "Progress" (now the State Enterprise "Ivchenko – Progress") is taken into account. The directions of research work that were peculiar to the specified period are established. These were inventive activities, development of technological processes, increasing the reliability and durability of gas turbine engines, automation and mechanization of production, cooperation with industry firms in other countries, and cooperation with research institutions. The development of a scientific-theoretical and technical basis for the production of aircraft engines is comprehensively assessed. Its dependence on structural subdivisions, which at the aircraft engine enterprises were the department of scientific and technical information, the Information and Computing Center, the department of patenting, innovation and invention of the plant, was determined. They were engaged in the accumulation, generalization and dissemination among specialists of their own and borrowed experience of both past and present. The activity of the scientific and technical council, which included leading specialists of Zaporizhia aircraft engine companies, was monitored. Factors that contributed to the revival of research in the second half of the 1970's were identified. Among them, the leading place belongs to the creation and production of D-36 and D-18T aircraft engines. The design advantages of these engines are described. Some shortcomings and miscalculations made during their design are taken into account. Methods and measures aimed at overcoming the difficulties associated with the design, manufacture, operation and repair of aircraft engines are summarized. The research is based on the*

following methods: actualization, comparative-historical, problem-chronological, multifactor analysis, principles of historicism and objectivity.

Keywords: *research work; aircraft engine industry; gas turbine engine; Zaporizhzhia Machine-Building Design Bureau; Zaporizhzhia Production Association*

Introduction.

Specialists in the aviation industry have been continuously raising the technological level of the industry for many decades, which is impossible without research work. Ukraine is the country that has a full cycle of design, manufacture, operation and repair of aircraft. Today, the only aircraft engine capacities in Ukraine are "Motor Sich" Public Joint Stock Company and "Ivchenko-Progress" State Enterprise, which compete with such well-known companies as "General Electric", "Pratt and Whitney" (USA), and "Rolls-Royce" (UK) and "Snecma" (France). It should be noted that the main specificity of the preparation of aircraft engines is the need to combine production, research and implementation of new technologies. Zaporizhzhia aircraft engine builders have been carrying out purposeful work on putting the latest technologies into production for several decades (Boguslaev, Mozgovoj, Balushok, & Reuchenko, 2010, p. 9). The country, which has its own powerful aviation scientific developments, is able to dynamically increase national achievements, provide the market with the latest technologies and employ qualified specialists. Thus, the study of ways to implement research and production work of specialists in the field of aircraft engine construction in the 1970s are relevant in today's realities.

The subject of the study is to some extent covered in the works of the Soviet and modern periods. They mainly concern the history of "Motor Sich". They cover the ways of development and serial production of aircraft engines, from the piston to modern gas turbine engines. These are materials about aircraft on which engines were installed in different periods of the plant's formation. The works assess the contribution of specialists whose work has become a decisive factor in the development of aircraft engine company (Boguslaev & Zhemanyuk, 2000; Boguslaev, Zhemanyuk, & Malysh 2014; Koval' & Filon, 1986). The long-term relationship of Motor Sich with research and development bureaus and research institutes is reflected in the popular science publication of the enterprise (Boguslaev et al., 2001). At the same time, research activities are represented by single studies on the cooperation of Zaporizhzhia aircraft engine companies with leading scientists of Ukraine in the field of dynamic strength (Larin & Chumachenko, 2016). Some information about the mechanization and automation of production at the enterprise is contained in the articles of the daily multi-volume edition of the aircraft engine plant (Kudrya, 1972; Kry`lov, 1973).

The proposed study is based on archival documents of the State Archives of Zaporizhia region, the Central State Archive of Public Associations of Ukraine and materials of the Museum of History "Motor Sich" (Derzhavnyi arkhiv Zaporizkoi

oblasti; Muzej tekhniki "Motor Sich"; Tsentralnyi derzhavnyi arkhiv hromadskykh obiednan Ukrainy).

The purpose of the study is determined in accordance with the relevance of the chosen topic and is a comprehensive study and historical reconstruction of the development of research activities of aircraft engine companies in Zaporizhzhia during the 1970s.

Research methods.

The research is based on the following methods: actualization - the connection of the subject of work with the present is established; comparative-historical - determined the patterns of implementation of established areas of research activities in the workplace; problem-chronological - traced qualitative and quantitative changes in the structure of Zaporizhzhia aircraft engine companies as a result of inventive work; multifactor analysis - identified factors that influenced the revival of scientific and technical support of the studied enterprises; principles of historicism and objectivity - a concrete-historical approach is formed and the cooperation of Zaporizhzhia aircraft engine builders with foreign countries and research institutions of the USSR is reflected. This approach made it possible to fully reveal the features of development and interaction of research and production activities at the enterprises of the aircraft engine industry in Zaporizhzhia.

Results and discussion.

Research work was carried out at various levels of the Zaporizhzhia aircraft engine company, which in 1971 was reorganized into the Zaporizhzhia production association "Motorobudivnik". V. Omelchenko remained the director for more than a decade (Fig. 1). In the same year, the physical laboratory of the plant, represented by a team consisting of V. Bondarenko, G. Bondarenko and S. Masya, developed a thickness gauge VTP-3f. He measured the thickness of the layer of cadmium, chromium, copper and other coatings of parts (STI. Pnevmaticheskoe prisposoblenie, 1971, p. 3). In turn, the designer of the Department of Mechanization and Automation O. Vasyliuk developed a pneumatic brand, which was used to apply the brand to various parts by the individual impact of the device (STI. Pnevmaticheskij klejmitel`, 1971, p. 3).

Simultaneously, the chief designer of the Zaporizhzhia engine design bureau "Progress" V. Lotarev without the defense of the dissertation was awarded the degree of Doctor of Technical Sciences (Fig. 2). Thus, his significant contribution to the development of the Soviet aircraft engine industry and the aviation industry, in general, was confirmed. Under his leadership, scientific work was carried out to develop a family of turboprop engines AI-20 and AI-24. In addition, he led the design work to create a dual-circuit turbojet engine AI-25 (DAZO. F. R-5444. S. 1. F. 136. p. 1).

a *b*

Figure 1. General Director of the Zaporizhia Production Association "Motorobudivnyk" (1971–1988) *(a)*; The central checkpoint of the "Motor Sich" enterprise, decorated with a smaller model of the Kudashev-1 biplane *(b)* (Boguslaev & Zhemanyuk, 2000).

Recognized designer-scientist received the right to run as a corresponding member of the Academy of Sciences of the USSR Department of Mathematics, Mechanics and Cybernetics, specialty – "Mechanics" (DAZO. F. R-5444. S. 1. F. 136. p. 2).

a *b*

Figure 2. Chief Designer (1963–1968; 1968–1981) General Designer of the Zaporizhia Machine-Building Design Bureau "Progress" (1981–1989) *(a)*; the building of the central building "Ivchenko-Progress" today *(b)* (Ivchenko, 2014, p. 9).

In 1972, public patent-inventive and public design bureaus were established on the basis of the leading departments of the Zaporizhzhia Production Association. Among the tasks of organizations, the main place was occupied by technical assistance to innovators and inventors during the development and implementation of their innovations and inventions (DAZO. F. R-171. S. 5. F. 470. p. 4). Specialists of the

bureau developed a regulation on the examination of inventions, which was approved by the management of the enterprise. All documentation was sent to the Committee for Inventions and Discoveries under the Council of Ministers of the USSR. Within five years, a research team was formed, which was engaged in inventive activities (G. Dubrov, O. Mamay, A. Shabotenko, V. Konstantinovsky, A. Reitman, O. Krasnikov, P. Bakshi and G. Kudrychenko) (Kudrya, 1972, p. 1).

From 1970 to 1972, specialists of the Zaporizhzhia Engine Design Bureau "Progress" invented a method of surface hardening of parts using powerful ultrasound and designed a device for its implementation. Since 1973, the research staff of the bureau has cooperated with the Zaporizhzhia Production Association "Motorobudivnyk" and the Research Institute to improve and implement the developed technology in the industry. The main goal was to increase the strength and reliability of the operation of parts of gas turbine engines. The technology of surface plastic deformation developed by Zaporizhzhia scientists was introduced into the production of enterprises of the Ministry of Aviation Industry, the Ministry of Civil Aviation and the Ministry of Energy Turbobuilding. This innovation has increased the productivity and quality of machining of parts by 10 times.

In 1974, the Zaporizhzhia plant began scientific and technical cooperation with many countries (DAZO. F. R-5705. S. 2. F. 10. p. 9). Joint work was established with enterprises in the United States, England, France, the German Democratic Republic, the Federal Republic of Germany, the Czechoslovak Socialist Republic, the Polish People's Republic, Italy, and Sweden. Already in 1975, the plant introduced some leading technologies. Cutters made of elbor-P, hexanite-P and other super hard materials based on boron nitride were used. They began to manufacture blanks and parts by the method of precise volumetric stamping, introduced electrochemical, electro erosion, ultrasonic, electron beam and light dimensional processing. In addition, the following welding processes were used: plasma, radiofrequency, electric beam, ultrasonic, diffusion and light beam, and explosion welding (DAZO. F. R-5444. S. 1. F. 296. p. 18).

An Information and Computing Center headed by V. Korotenko was opened at the enterprise. Accordingly, they increased the production area, for the purchase of which they purchased electronic equipment. For example, the new electronic computer "Minsk-22" performed 5–6 thousand operations per second. In 1974, a more progressive model was mastered – "Minsk-32", which performed more than 30 thousand operations (Kry`lov, 1973, p. 1).

The exchange of scientific and technical information accelerated the work of employees of the Department of Scientific and Technical Information, which was an independent structural unit of the plant. (DAZO. F. R-5705. S. 2. F. 15. p. 2). In order to gain technical experience and implement it in production in 1976, cooperation with foreign companies has significantly intensified. An information-analytical group was opened, the main task of which was to visit foreign companies and summarize the

obtained information. The chief engineer of the plant V. Kramny was elected the head (DAZO. F. R-5705. S. 2. F. 50. p. 1).

At the same time, the procedure for transferring the results of scientific research, invented samples of new types of materials and advanced technological solutions introduced into production to the aviation industry was regulated. Among these, the most effective were the installation for the separation of rods of cast blades in alkaline solution, the machine for feeding springs and the installation for splitting air to produce inert gases, nitrogen and oxygen. Relevant documentation on the latest achievements was systematically published in the monthly collection "Operational Information" (DAZO. F. R-5705. S. 2. F. 148. p. 3–11).

Thus, the plant was equipped with 751 units of automatic and semi-automatic equipment, including installations with software and numerical software control. The first research device of the reserve peak turbocharger TKU-400, which was constructed on the basis of an aircraft engine, was developed at the engine plant. At the same time, the technologists designed a device for processing the air assembly of the front crankcase of aircraft engines. Its application facilitated the process and transferred the work to the milling machine (DAZO. F. R-5705. S. 2. F. 59. pp. 2–7). The author's team consisting of O. Volkov, A. Peremylovsky and P. Fuchadzhi invented a method of restoring the compressor blades. It allowed updating the details rejected owing to erosion wear (DAZO. F. R-5705. S. 2. F. 69. p. 4). Introduced some new technologies that made it possible to repair the nozzle devices of the auxiliary engine AI-9. They consisted of replacing a cast diaphragm made of sheet metal and using extrusion blanks for precision stamping. The result of such innovations was a saving of 369 thousand rubles (DAZO. F. R-5705. S. 2. F. 76. p. 1).

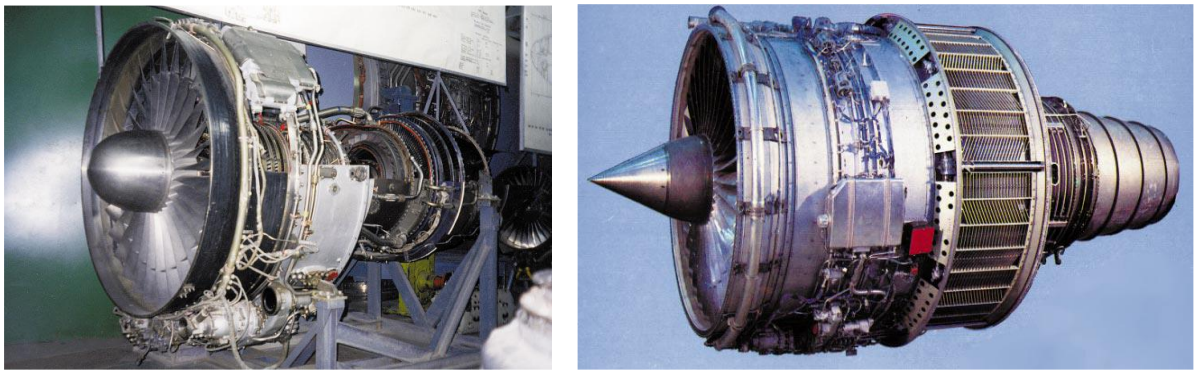
In 1976, at a meeting of the Scientific and Technical Council of the company, the developers presented the work that was nominated for the State Prize – "Creation, implementation in serial production, and operation of passenger aircraft An-24, its variants and modifications". The team of authors included Deputy Chief Designer of the Zaporizhzhia Bureau "Progress", Candidate of Technical Sciences V. Chuyko. As a result of his scientific and research activities, an automatic launch system was tested and put into serial production. It was carried out when using high voltage to power the starting equipment. This allowed to obtain high system parameters and ensure reliable engine start in all operating conditions (DAZO. F. R-5444. S. 1. F. 211. pp. 1–4).

The work of the department of patenting, innovation, and invention of the plant continued. In 1979, 10 copyright certificates were issued. Thus, the proposal of A. Zhurbin, O. Sidun, and O. Pedan was to change the design of the container for hardening carbon molds. This significantly reduced electricity costs and increased productivity at the plant (DAZO. F. R-5705. S. 2. F. 91. p. 6).

At the end of the 1970s, research work was revived due to the creation and production of D-36 and D-18T aircraft engines (Fig. 3).

Thus, serial production of the D-36 engine began in 1977. At that time, its warranty life was 300 hours, which was not enough. Specialists of the chief designer's

department have started research work aimed at increasing engine power. As a result, the author's team consisting of I. Berim, B. Kovaltsov, V. Lviv, G. Taran, F. Arslanov and O. Rakitin managed to increase the reliability of important engine components (compressor, turbine, combustion chamber, etc.). As a result, the warranty life of the engine reached 9 thousand hours. A large set of design and research works was carried out to increase the fuel efficiency of the engine, which reduced the specific fuel consumption on takeoff - from 0.375 to 0358 kg/kgf (Boguslaev & Zhemanyuk, 2000, p. 97).



a *b*

Figure 3. Aviation turbojet engine D-36 *(a)*;
Aviation turbojet engine D-18T *(b)* (Boguslaev & Zhemanyuk, 2000).

In its final form, the D-36 was a complex structure with the sixth degree of double-circuit on takeoff mode. The engine is made of a long-term system with an annular combustion chamber, axial 14-stage compressor, five-stage turbine and intermediate housing. In the standard version, its takeoff mode was 6500 kgf, and the mass was 1100 kg (Muzej tekhniki "Motor Sich". F. IX. F. 1556. p. 1). In order to increase the reliability of the engine, the design team conducted a number of technological measures. Among them, a significant place was occupied by the introduction of the casting of nozzles and turbine blades on smelted models. There was no allowance for machining of the profile. This solution made it possible to reduce the complexity of the engine kit by 800 hours. Another invented technical measure of electron beam welding has reduced the weight of the engine and reduced the use of metal in the manufacture of compressor rotors for it (TsDAHOU. F. 1. S. 25. F. 710. p. 148).

Note that work on the design of the D-36 engine lasted several years. It was necessary to eliminate all the shortcomings and miscalculations that are possible at the stage of design and manufacture of parts of the prototype. That is why a meeting was held with the participation of representatives of the Central Institute of Aviation Engine Building, the All-Union Institute of Aviation Materials, and the Zaporizhzhia Machine-Building Design Bureau "Progress". It discussed the possible causes of the destruction of the rotor shell of the high-pressure compressor of the D-36 engine. Thus, it was found that the reason was a decrease in the strength and ductility of the alloy VT-9 in those places where there was contact with the molten refractory material. In addition,

the complication was the effect of operating voltage and temperature on the material. As a result of the discussion, it was decided to develop technological measures that will further prevent a similar situation (DAZO. F. R-5444. S. 1. F. 149. p. 19).

At the same time, under the leadership of O. Antonov, an operational-strategic aircraft An-124 "Ruslan" was created, which bypassed the American competitor Lockheed S-5A "Galaxy" (Zayarin, 1992, p. 8). The Ministry of Aviation Industry commissioned the Zaporizhia Machine-Building Design Bureau "Progress", headed by V. Lotarev, to design the engine for this aircraft. The design documentation of the components and systems of the engine, named D-18T, was mainly completed in 1977. The first batch of D-18T was created as a result of joint work with the Production Association "Motorobudivnyk", which later engaged in serial production of the engine (Muzej tekhniki "Motor Sich". F. IX. F. 1556. p. 7)

The D-18T engine, like its predecessor D-36, was made according to a long scheme. It was equipped with a thrust reversing device. The structure was a system of cascades with gas-dynamic connections between them. The fan stage consisted of a single-stage fan and a four-stage turbine. The medium pressure cascade had a seven-stage turbine. The next stage (high pressure) is a seven-stage axial compressor and a single-stage turbine. Each of the presented cascades was installed on only two supports. In all respects, the D-18T engine was at the level of the best world models. Yes, it was not inferior to the English engine RB.211 company "Rolls-Royce". More than 40 original technical solutions used in the design of engine components and parts, made at the level of inventions and protected by the copyright of the USSR (Boguslaev & Zhemanyuk, 2000, p 101).

Significant assistance in resolving scientific and technological issues came from specialists of research institutes. Thus, cooperation with the Institute of Problems of Materials Science has solved the problem of using high-strength steel in the construction of a new engine. The director of the institution, academician, doctor of physical and mathematical sciences V. Trofimov formed an experimental collaboration with the National Institute of Aviation Technologies, the Institute of Non-Metallic Materials, the Institute of Metal Physics, and the Academy of Sciences of the USSR. Based on the methods invented by the academician, new heat treatment technologies were developed. As a result of their introduction, Zaporizhzhia aircraft engine builders managed to overcome the problems that arose during the production of the D-18T engine (DAZO. F. R-5444. S. 1. F. 261. pp. 1–15).

In general, Zaporizhzhia aircraft engine builders established cooperation with many scientific organizations of the USSR. Among them, an important place was occupied by Zaporizhia Machine-Building Institute, Dnipropetrovsk Institute of Chemical Technology, Dnipropetrovsk Metallurgical Institute, Kharkiv Polytechnic Institute, Kharkiv Aviation Institute, Ukrainian Research Institute of Special Steel, State Research Institute of Plastics, Research Institute of Operation and Repair of Air Force Equipment, National Institute of Aviation Technologies, Central Research

Institute Institute of Heavy Engineering, State Research Institute of Civil Aviation, etc. (Koval' & Filon, 1986, p. 71; Boguslaev et al., 2001, p. 221).

In 1978, at a meeting of the Scientific and Technical Council heard a report made by M. Tsofin on the topic: "Study of the reliability of aircraft gas turbine engines in maintenance". The method of engine maintenance was one of the main gaps in the 1970s. Solving this problem should have significantly increased the efficiency of aircraft engines. One of the key aspects of the method was considered in M. Tsofin's research. Based on the materials of the Zaporizhzhia Machine-Building Design Bureau "Progress", the author reflected the process of creation and mass operation in civil aviation engines (AI-20, AI-24, AI-25). Existing methods of ensuring the reliability of the gas turbine engine of modular design D-36 were also involved. As a result of the study, a method was proposed for the gradual increase of the permitted operating time of aircraft engines based on the results of their operation (DAZO. F. R-5444. S. 1. F. 247. p. 12).

In the late 1970s, the company implemented the task of designing drawings of blade stamps and their manufacture. To overcome the problem of end-to-end transmission of a large amount of information on machine media developed by the Zaporizhzhia Design Bureau to machines with numerical program control at the plant created a system "Stamp". In addition, Zaporizhzhia aircraft engine builders have improved the quality of materials used for next-generation aircraft engines. The consequence of this was the introduction of carbon fiber-reinforced fan housing for D- 36 and D-18T engines (K novy`m sversheniyam gotovy`, 2008, p. 3).

In accordance with the national instructions for research, in 1979 the company set up a commission to inspect secret cases and documentation. She considered the achievements of the author's team of specialists, which included P. Zima, V. Omelchenko, A. Roitman, V. Tomila, G. Shentyabin and S. Rzhavin. Many years of work "Development, research, and implementation of methods for diagnosing and improving the vibration reliability of aircraft gas turbine engines" was nominated for the State Prize, so it was considered urgent to check its effectiveness by the newly established commission. The practical application of the invention has increased the budget of the enterprise by 14, 6 million rubles. (DAZO. F. R-5705. S. 2. F. 115. p. 4).

The study was classified as a top-secret due to a number of issues covered in it. The authors analyzed the defects of engines AI-24, AI-20M, TV3-117 and proved their direct impact on the destruction of engines, which led to plane crashes. In addition, the methods developed by the authors of vibration diagnostics of aircraft engines were introduced at the Zaporizhzhia Production Association. At the same time, the researchers found patterns of damage to the engine blades during operation. They developed a method for predicting the durability of the blades of gas turbine engines AI-20, AI-25 and AI-25TL. This significantly reduced the testing time of the blades to establish their operational reliability. Scientists have proposed new methods for determining the characteristics of oscillations that occur in engines. For the first time, new construction materials and structural details were used. Based on the study,

recommendations were formed, which were used to increase the vibration reliability of the blades of AI-20D, AI-20M, AI-25 and AI-25TL engines. The study submitted to the Secret Investigation Commission was of great importance for the aviation industry of the Soviet Union, as defects in the strength of gas turbine engines were one of the greatest threats of malfunction during their operation (DAZO. F. R-5705. S. 2. F. 115. pp. 10–11).

Conclusions.

Thus, the Zaporizhzhia Production Association "Motorobudivnyk" under the long-term leadership of V. Omelchenko and the Zaporizhzhia Machine-Building Design Bureau "Progress", which was headed by V. Lotarev during the period under study, continued close cooperation. Research work at Zaporizhzhia aircraft engine companies in the 1970 s underwent qualitative and quantitative changes. It is necessary to highlight the main vectors to which it was directed. Thus, the inventive activity was separated into an independent system, in which the key place was occupied by the formed team of authors. Public patent-inventive and public design bureaus were established, whose specialists developed regulations on the examination of inventions. The second area of research was to develop technological processes that could improve the level of production. The next vector is research activities aimed at improving the reliability and durability of gas turbine engines. Some projects developed by Zaporizhzhia scientists were implemented by the Ministry of Aviation Industry, the Ministry of Civil Aviation, and the Ministry of Energy Turbobuilding. To ensure the confidentiality of information at the company created a commission to verify cases and documentation. The fourth direction was the comprehensive automation and mechanization of enterprises. An information and computer center was opened at the plant. For a long time there was a Department of Scientific and Technical Information, which was a separate structural unit. The fifth vector was to establish scientific and technical cooperation of Zaporizhzhia aircraft engine builders with other countries. An information-analytical group was created, the main task of which was to visit foreign companies and summarize the information obtained. Finally, the sixth direction concerned the interaction with research institutions, collaboration with which allowed to perform tasks, the solution of which would be impossible without the intervention of industry scientists. At the end of the 1970s, research was revived thanks to the creation and production of D-36 and D-18T aircraft engines, the latter of which was not inferior to the English-made RB.211 engine from "Rolls-Royce".

It is known that the scientific and technical potential of any field of activity is the basis for ensuring the quality production of final products. The aviation industry is no exception - it is an industry that is constantly improving its technological level and gives a powerful impetus to the development of other areas of the economic sector. Taking into account all the achievements and miscalculations of the previous decades, during which the formation of the Ukrainian aircraft engine industry took place, it is possible to make significant profits and become a competitive state in the current

geopolitical situation. Such research helps to understand the existing problems and find ways to solve them.

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The author declare no conflict of interest.

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Науково-дослідна робота запорізьких авіадвигунобудівників у 1970-х роках

Анотація. *У статті на основі широкої бази джерел висвітлено та проаналізовано розвиток науково-дослідної робота авіадвигунобудівних підприємств м. Запоріжжя протягом 1970-х рр. Враховано існування єдиної системи функціювання Запорізького виробничого об’єднання “Моторобудівник” (нині Публічне акціонерне товариство “Мотор Січ”) та Запорізького машинобудівного конструкторського бюро “Прогрес” (на сьогодні Державне підприємство “Івченко-Прогрес”). Встановлені напрями науково-дослідної роботи, які були властиві зазначеному періоду. Такими виявилися винахідницька діяльність, розроблення технологічних процесів, підвищення надійності та міцності газотурбінних двигунів, автоматизація та механізація виробництва, співпраця з галузевими фірмами інших країн та взаємодія з науково-дослідними установами. Комплексно оцінено розвиток науково-теоретичного та технічного підґрунтя виробництва авіаційних двигунів. Визначено його залежність від структурних підрозділів, якими на авіадвигунобудівних підприємствах були відділ науково-технічної інформації, Інформаційно-обчислювальний центр, відділ патентування, раціоналізаторства та винахідництва заводу. Вони займалися накопиченням, узагальненням та розповсюдженням серед спеціалістів власного та запозиченого досвіду як минулих років, так і сучасності. Відстежено діяльність науково-технічної ради, до складу якої входили провідні спеціалісти запорізьких авіадвигунобудівних підприємств. Виявлено фактори, які сприяли пожвавленню науково-дослідної діяльності в другій половині 1970-х рр. Серед них провідне місце належить створенню та виробництву авіаційних двигунів Д-36 та Д-18Т. Охарактеризовано конструкторські переваги зазначених двигунів. Враховано окремі недоліки та прорахунки, допущені під час їх проєктування. Узагальнено методи та заходи, спрямовані на подолання труднощів, пов’язаних із конструюванням, виробництвом, експлуатацією та ремонтуванням авіаційних двигунів. Дослідження базується на таких методах: актуалізації, порівняльно-історичному, проблемно-хронологічному, багатофакторного аналізу, принципів історизму та об’єктивності.*

Ключові слова: *науково-дослідна робота; галузь авіадвигунобудування; газотурбінний двигун; Запорізьке машинобудівне конструкторське бюро; Запорізьке виробниче об’єднання*

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Научно-исследовательская работа запорожских авиадвигателестроителей в 1970-х годах

Аннотация. *В статье на основе широкой базы источников раскрыты и проанализированы развитие научно-исследовательской работы авиадвигателестроительных предприятий г. Запорожья в период 1970-х гг. Учтено существование единой системы функционирования Запорожского производственного объединения “Моторостроитель” (ныне Публичное акционерное общество “Мотор Сич”) и Запорожского машиностроительного конструкторского бюро «Прогресс» (в настоящее время Государственное предприятие “Ивченко-Прогресс”). Установлены направления научно-исследовательской работы, присущей в указанный период. Такими являются изобретательская деятельность, разработка технологических процессов, повышение надежности и прочности газотурбинных двигателей, автоматизация и механизация производства, сотрудничество с отраслевыми фирмами других стран и взаимодействие с научно-исследовательскими учреждениями. Комплексно оценено развитие научно-теоретической и технической базы производства авиационных двигателей. Определена его зависимость от структурных подразделений, которыми на авиадвигателестроительных предприятиях были отдел научно-технической информации, Информационно-вычислительный центр, отдел патентования, рационализаторства и изобретательства завода. Они занимались накоплением, обобщением и распространением среди специалистов собственного и заимствованного опыта как прошлых лет, так и современности. Отслежена деятельность научно-технического совета, в состав которого входили ведущие специалисты запорожских авиадвигателестроительных предприятий. Выявлены факторы, которые способствовали оживлению научно-исследовательской деятельности во второй половине 1970-х гг. Среди них ведущее место принадлежит созданию и производству авиационных двигателей Д-36 и Д-18Т. Охарактеризованы конструкторские преимущества указанных двигателей. Учтены отдельные недостатки и просчеты, допущенные при их проектировании. Обобщены методы и меры, направленные на преодоление трудностей, связанных с конструированием, производством, эксплуатацией и ремонтом авиационных двигателей. Исследование базируется на таких методах: актуализации, сравнительно-историческому, проблемно-хронологическом, многофакторного анализа, принципов историзма и объективности.*

Ключевые слова: *научно-исследовательская работа; отрасль авиационных двигателей; газотурбинный двигатель; Запорожское машиностроительное конструкторское бюро; Запорожское производственное объединение*

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