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► **To cite this version:**

Marina Smolevitskaya. The Engineering Heritage of Bashir Rameev at the Polytechnic Museum: Honoring the 100th Anniversary of His Birth. IFIP International Conference on the History of Computing (HC), Sep 2018, Poznan, Poland. pp.317-341, 10.1007/978-3-030-29160-0_17 . hal-02386536

HAL Id: hal-02386536

<https://inria.hal.science/hal-02386536v1>

Submitted on 29 Nov 2019

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The Engineering Heritage of Bashir Rameev at the Polytechnic Museum: Honoring the 100th Anniversary of His Birth

Marina Smolevitskaya[✉]

Researcher, Computer Collection Curator
Polytechnic Museum, Moscow, Russia

`msmolevitskaya@yandex.ru`

Abstract. Bashir Iskandarovich Rameev fulfilled one of the main roles in the informatization of Russia as the developer of Ural computer. In English publications, information about him and his contribution to science is practically absent. Nevertheless, he left a valuable legacy in the form of his developments of the family of universal automatic digital computing machines “Ural” with advanced software. The engineering heritage of B. I. Rameev is kept at the Polytechnic Museum in Moscow. The tube automatic digital machine “Ural-1” takes a special place in the computer collection at the Museum. The personal documentary collection of B.I. Rameev is voluminous and unique in its content. The documents of his collection reflect the entire history of the creation and development of domestic electronic computing machines. Among these documents the project “Automatic Digital Computing Machine” of I. S. Brook and B. I. Rameev and patent No 10475 (USSR author’s certificate) on 4 December 1948 are preserved. This patent was the first officially registered invention in the field of electronic digital computers in the USSR. On the suggestion of the Polytechnic Museum, 4 of December 1948 is considered (not yet officially) to be the birthday of Russian informatics. It is impossible to overestimate the contribution of B. I. Rameev to domestic electronic computing equipment. His name should be preserved in the history of Russia.

Keywords: B. I. Rameev, URAL, Electronic Digital Computing Machine, Museum, Archive

1 Introduction

In the Soviet Union, the engineer and chief designer of the computer family “Ural” B. I. Rameev together with scientists such as academicians S. A. Lebedev and V. M. Glushkov, corresponding members A. A. Lyapunov and I. S. Brook stood at the origins of the creation of domestic electronic computers. The merits of Lebedev, Glushkov and Lyapunov were recognized by the international scientific community. They received the rank “Computer Pioneer” from the IEEE Computer Society. These scientists created

their computers in the system of academic science; they themselves took part in international conferences. Therefore, their names are better known abroad. For example, only the computers of Academician Lebedev are mentioned in the dissertation of Peter Wolcott “Soviet advanced technology: The case of high-performance computing” [1]. Furthermore, Wolcott only mentions the *Institute of Precision Mechanics and Computer Technology* in Moscow and the *Computer Center of the Siberian Department of the USSR Academy of Sciences/Institute of Informatics Systems* in Novosibirsk as organizations that developed computers in the Soviet Union. In parallel with Lebedev, the work on the creation of the very first computers was carried out at the *Laboratory of Electrosystems of the Energy Institute of the Academy of Sciences of the USSR*, headed by I. S. Brook, and in the *Special Design Bureau SDB-245*, formed at the *Moscow Plant of Counting -Analytical Machines*. Rameev first worked with Brook, and then together with Yu. Bazilevskiy in SDB-245.

Likewise, almost nothing is known about Brook’s computers and the computers developed in SDB-245 in the international literature. Alex Bochanek, a researcher of the *Computer History Museum in California*, showed in his paper [2] that information about general computing work done in the Soviet Union was available in unclassified environments. The merits of Brook and Rameev in this area are almost unknown abroad, while they are not less significant. Rameev is one of the founders of electronic computers in the Soviet Union. The merits of Rameev in the field of creating digital computers are recognized by all domestic scientific schools unconditionally. Representatives of various organizations that created computers in the Soviet Union regularly meet in the *Virtual Computer Museum* [3] and all they agreed that Rameev’s contribution to domestic electronic computing was significant.

An attempt to present Rameev’s contribution to the creation of computers in Eastern Europe is done in this article. The collections of the *Polytechnic Museum* can serve as sources for further research by historians of computer technology [4, 5, 6].

As known, at the turn of the 1950s the development of the first electronic computers was conducted in the USA, England, Germany and France. Since the machines were developed mainly for military purposes, the publications on them were very terse. Most machines were built on electromechanical relays, not electronic tubes. Rameev received his knowledge of electronics working at the Institute of Electronics No 108, and also he was fond of radio amateurs. Once he heard the BBC broadcasts that the electronic computer ENIAC was produced in the USA [7], interest in this new technology led Rameev to correspond with academy member I. Brook. Brook was interested in computing and was engaged in the development of analog computers already before the second World War. He was happy to find such an able assistant. In May 1948, Rameev received a position as computer engineer in the *Laboratory of Electrical Systems* at the *Power Engineering Institute of USSR Academy of Sciences*.

In the collection of Polytechnic Museum in Moscow, electronic digital computing machines of domestic production from the 1950s to 1990s are presented together with the developments of leading scientific schools, research institutes and plants, that created them. This collection is the only one in the whole territory of the former Soviet Union. All the exhibits that make up the collection are unique: from the operative memory device on the cathode-ray tubes of the first domestic serial computer “Strela”

to the onboard computer complex “Argon-16,” which controlled flights of space vehicles. The tube computer “Ural-1” is given a special place in the collection (Fig. 1). Its chief constructor was B.I. Rameev (Fig. 2).



Fig. 1. The Small Automatic Universal Electronic Computer “Ural-1” at the Polytechnic Museum, 2014

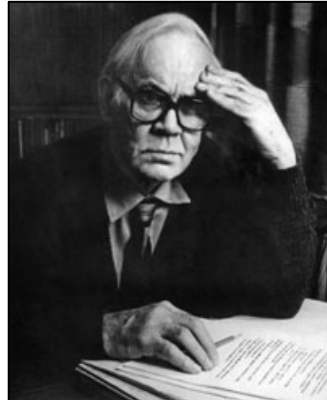


Fig. 2. A photo of Bashir Rameev of the 1950s (left) and one of his last pictures, December 1993 (right). Polytechnic Museum, *Personal Documentary Collection of B. Rameev* No 221.

On the suggestion of the Polytechnic Museum, 4 December 1948 is considered to be the birthday of Russian informatics. Although in Russia this holiday is not yet official, it is noted by all those who are related to computer science. This date on December 4

was chosen not accidentally. In August 1948, Corresponding Member of the *USSR Academy of Sciences for the Department of Technical Sciences* I. S. Brook, along with his collaborator, the young engineer B. Rameev, presented the project “Automatic Digital Computing Machine.” The Flowchart of the projected Automatic Digital Computing Machine and Rameev’s manuscripts are shown in Fig. 3 and Fig. 4. In October of the same year, they presented detailed proposals on the organization of the laboratory for the development and construction of such computer in the *USSR Academy of Sciences*. On the 4th of December 1948, I. S. Brook and B. Rameev received patent No 10475 (USSR author’s certificate) (Fig. 5). It was the first officially registered invention in the field of electronic digital computers in the USSR. All these documents are preserved in the documentary collection of B. Rameev at the *Polytechnic Museum*.

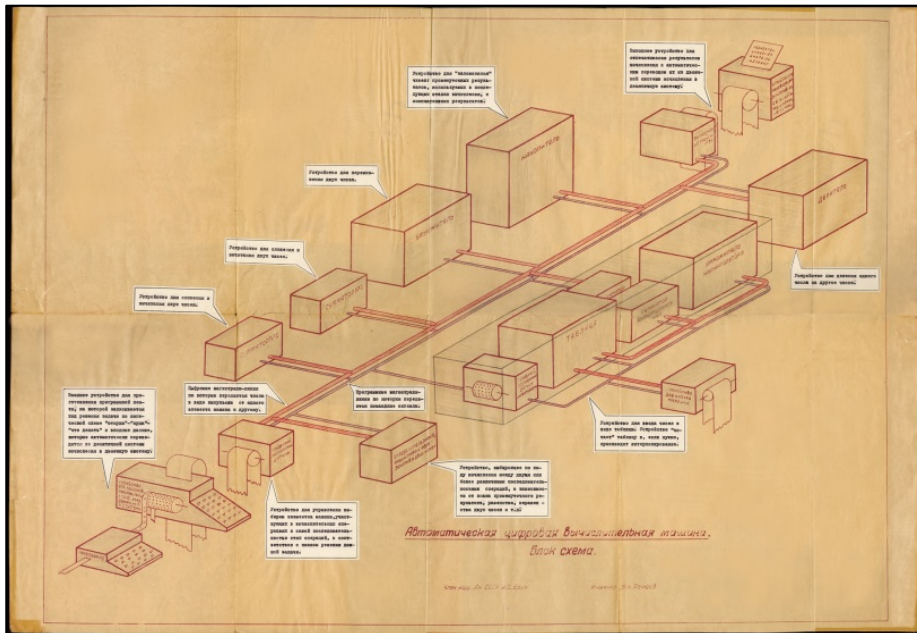


Fig. 3. The Flowchart for the Project of the Automatic Digital Computing Machine. *Polytechnic Museum, Personal Documentary Collection of B. Rameev No 221.*

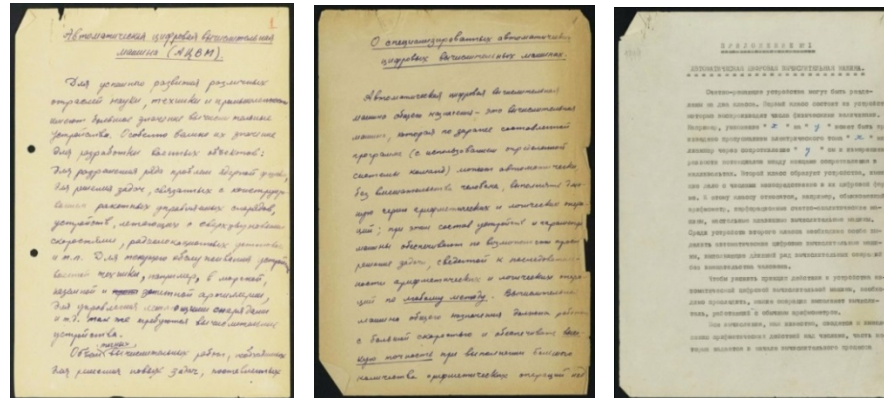


Fig. 4. The manuscripts of Rameev. Polytechnic Museum, Personal Documentary Collection of B. Rameev No 221.

2 B. Rameev's Engineering Heritage

The primary source of B. Rameev's biography and the description of his contribution to electronic computer technics is B. N. Malinovsky's book *The History of Computer Science in Persons*, published in 1995 [7]. The chapter "The son of an epoch" of this book was written by Malinovsky in many respects thanks to the materials that Rameev himself gave him. Later, there were memories about Rameev of other people who knew and worked with him. Margarita Badrutdinova, director of the museum of the Kazan's Electronic Computers Plant, not only carried out scientific research on the roots of Bashir Iskandarovich Rameev concerning his father and grandfather, but also compiled a list of his inventions (given in Appendix 5.1) [8, 9,].

Rameev's companion on the "Ural" family of computers, Gennady Smirnov, made a unique contribution to the description, study and preservation of Rameev's legacy. He wrote several books about the school of construction of Rameev [10, 11,] and compiled a bibliographic index *The Computer "Ural" in the World of Publications and Documents 1945–1972* [12].

The biography of Rameev in English is given in [13, 14,]. Also, according to Rameev's biography and his heritage in the Polytechnic Museum in Moscow, one can trace the entire history of the development of electronic computers in the Soviet Union. Almost all his conscious life since 1948 he created electronic computers, and he one of the pioneers was in this area. Rameev was an active developer of the very first computers in the Soviet Union: the first serial domestic computer "Strela" and the Small automatic digital computer "Ural-1."

2.1 The First Domestic Serial Electronic Computer, "Strela"

In 1950, another computer research and design center was established in Moscow. It was called *Special Engineering Bureau 245* (SDB-245). This center was empowered

by joining it the *Moscow Plant of Counting-Analytical Machines* that had been founded for commercial production of calculating machinery, both mechanical and electromechanical. Rameev was recommended to head one of its new laboratories [7]. He had been demobilized on the personal request of P. I. Parshin – the *USSR minister of machinery and instrumentation*. Although military authorities reacted with consent, Parshin had to provide a guarantee of his personal responsibility for Rameev's further actions. Computer development in the USSR was and remained a secret matter for a long time. Rameev submitted a draft project of a computer which integrated some ideas of his earlier work with Brook. It was confirmed by the SDB-245 technical council and taken as basis for new electronic computer “Strela” – the first soviet computer produced in series, in total seven machines. Rameev was deputy construction-general of the whole project. He headed the construction of its central arithmetic unit and magnetic drum storage. He also persuaded designers to use electron valves, not slow electromagnetic relays. Rameev proposed a symmetrical trigger on a 6H8S tube as the main element of the “Strela.”/ This device served as the main universal element for building typical computer “Strela” devices - registers, adders, decoders and others.

In 1953, the experimental model of “Strela” was tested by a state commission and recommended for serial production. In fact, the seven computers were not absolutely identical because some corrections were always implemented in each following piece after testing the previous one. They were placed in the *Applied Mathematics Institute of USSR Science Academy (USSR SA)*, the *Computing Center of USSR SA* and computer centers of some ministries. They were used mainly in tasks related to nuclear power and space research. In 1954 Rameev and other collaborators of “Strela” team were awarded the USSR State Bounty. The exposition of Polytechnic Museum devoted to B. I. Rameev, Yu. Ya. Bazilevskiyi, SDB-245 and the Electronic Computer “Strela” are shown in Fig. 6.

In 1955, Rameev moved to Penza with a group of talented young specialists from *SDB-245*. In Penza, Rameev became chief engineer of the Penza branch of *SDB-245*, and then deputy director for research at the *Penza Scientific Research Institute of Controlling Computing Machines*, later called *Research Institute of Mathematical Machines*. In Penza, Rameev created his own computer science school. Many leading computer designers began their activity in the Penza school: V. V. Przhialkovsky, V. Ya. Pikhtin and others from the Minsk branch like V. V. Rezanov Severodonetsk [11]. There, he worked on the construction of the The Small Automatic Universal Electronic Computer “Ural-1”.

2.2 The Small Automatic Universal Electronic Computer “Ural-1”

In the years 1930 - 1940, USA, Great Britain, France and Germany imposed restrictions on the supply of a number of goods on the Soviet Union. In 1949, the Coordinating Committee on Multilateral Export Control (CoCom) was established by these countries to impose an embargo on the supply of goods to Comecon countries. So the development of the first computers was carried out in isolation from the developments that were carried out in western countries, that actually established a regime of secrecy for the

exchange of scientific and technical information.¹ According to Academician S. Lebedev, the available foreign publications that were received in those years in the USSR were of an “advertising nature.” It should be recognized that, unfortunately, later foreign publications to many Soviet specialists remained unknown. In addition, the publications of Soviet specialists were very rare. The exchange of experience occurred with the US was mainly at the level of personal meetings and visits to enterprises [10]. In October 1955, in Darmstadt (Germany) S. Lebedev and Yu. Ya. Bazilevsky presented BESM-1 as the fastest computer in Europe with RAM consisting of potentialoscopes, special cathode ray tubes. Furthermore, they presented on the Small Automatic Universal Computing Machine “Ural-1” and on mastering the serial production which had already begun [15] (see Appendix 5.1 for a technical description of the Ural-1 computer). In 1956, Rameev presented the report “Universal Automatic Digital Computer of the type Ural” at the conference “Ways of Development of Soviet Computing Engineering” [16] in Moscow. This was the first scientific conference in the Soviet Union on this subject.

One of the first samples of the “Ural-1” computer was used mainly for training specialists at the Computing Center of the USSR Sciences Academy. Since 1957, these machines have been supplied to computer centers, research institutions, military schools and other organizations. At the same time, the Computing Center of the Baikonur Cosmodrome was created on the basis of the Ural-1 computer.

By the early 1960s, “the Ural-1” computer was the most widespread machine in the USSR; it was operated in 128 cities. More than 30 machines operated abroad in 25 countries: in the GDR, Bulgaria, Hungary, Czechoslovakia, Norway, Turkey, England, Egypt and many more. Differently from bigger machines and chiefly used by large computer centers, Ural-1 was the first computer to be widely implemented by relatively small enterprises [10].

Despite the very low speed of 100 operations per second, especially by today’s standards, the research and training institutes of the country were lining up behind this machine. For many years, the “Urals” had become the main “labor force” in our computer centers. It also became a “primary school” for numerous constructors, mathematicians-programmers and maintenance specialists.

“Ural-1” was followed by universal computers with the same electron valves-based circuitry, mainly used for civil purposes: “Ural-2” (1959), “Ural-3,” “Ural-4” (1961) with ferrite cores RAM and extended ROM on magnetic drums (8x8 K words) and magnetic tapes (12x260 K words). Besides universal computers, “Ural” Rameev produced several special machines: “Weather” for meteorological calculations, “Granite” for probability characteristics of the experimental data arrays, “Crystal” for crystal structure X-ray analysis, a special computer for (geographic) bearings defined from radio detection data, etc.

In 1968, Rameev moved to Moscow and went to work at the *Scientific-Research Center of Electronic Computer Technology* to engage in a promising project: the Uni-

¹ See Leslie, “From CoCom to Dot-com,” and Schmidt, “Socialist Life of a U.S. Army Computer,” this volume.

fied Computer System. He negotiated with the English firm ICL on scientific and technical cooperation in the field of computer production. Documents on cooperation between the *State Committee of the USSR on Science and Technology*, the *Ministry of Radio Industry of the USSR* and the English firm ICL are indicating this. They are presented in the documentary collection of Rameev in the *Polytechnic Museum* [17]. Also, in this collection there are documents on Soviet-American cooperation 1972 – 1974 in the field of computer application in management within the framework of the *Meetings between the Governments of the USSR and the USA on cooperation in the field of science and technology*. These are work plans and reports of a mixed Soviet-American group. Rameev also took an active part in the discussion of the problem of copying IBM-360 machines. The minutes of the meetings concerning the copying of the IBM 360 machines from December of 1969 testify to the intensive discussions held.

Rameev did not agree on the decision of the country's leadership on copying IBM-360 machines. Notwithstanding, he went to work for the *State Committee on Science and Technology of the USSR* [7]. Here he conducted the large scientific and organizational work on the formation of the all-Union scientific and technical programs for the creation of computer hardware and software. He coordinated the construction of systems for the automation of scientific research and design work, as well as for the introduction of automated control systems into practice. Furthermore, he contributed to the creation of the State Fund for Algorithms and Programs.



Fig. 5. Author's certificates of B. Rameev. *Polytechnic Museum, Personal Documentary Collection of B. Rameev No 221.*

Since 1971, Rameev worked in the *Main Administration of Computer Technology and Control Systems of the State Committee on Science and Technology of the USSR*. He was the deputy head of the department. The *Main Department of Computer Engineering and Control Systems* had become an organization which coordinated and organized interdisciplinary complex scientific research and experimental development in the field of improvement in the national economy. They were in charge of building an extensive

system of computer facilities by organizing automated management systems for planning and processing information for various purposes and creating a state network of computer centers, united by communication channels. His next 20 years were busy with coordination and implementation of national computer design projects and the estimation of their technical level and efficiency. He was also in charge of planning the scientific development programs and cooperating with the *State Collection (Library) of Computer Algorithms and Programs*. Only the absence of a diploma on graduation did not allow him to run for a full membership in the *Academy of Sciences*, of which he would have deserved to be a member.

Rameev came from the family of the largest gold miners in Russia. Bashir's grandfather was a famous Tatar poet. His father was repressed and perished in labor camps during Stalinist purges. Bashir Rameev, who by that time was a sophomore at the *Moscow Power Engineering Institute*, was named the son of an "enemy of the people" and was expelled from the institute [7]. Many years later, in 1962, forty-four-year-old Bashir Rameev was awarded the academic degree of Doctor of Technical Sciences without defending his dissertation. Positive recommendations were given by academicians S. A. Lebedev, A. I. Berg and *Corresponding Member of the USSR Academy of Sciences* I. S. Brook [7].

In 2018, Rameev would have turned 100 years old, but there are specialists still alive who remember him very warmly, both as an outstanding scientist and as an extremely modest and talented person. They remember his kind eyes and smile, but at the same time remember his intransigence if he were convinced of anything. They remember his ability to gently convince, but firmly to achieve the ideal performance of all the necessary work. The many specialists who worked with Rameev note his attention to detail and the broadest technical intuition, the basis of which was the deep knowledge from different fields of technics. His commitment to unification, which is considered the cornerstone of effective mass production, showed a high level of computer construction. Rameev's name was often absent in the list of venerable speakers at various conferences, but this did not in the least interfere with his authority and popularity of the Penza scientific school he was leading. This holds true also thanks to the enormous creative work invested by him and his team in the development and production of universal computers.

In 2015, a technological park in the sphere of high technologies was named after Rameev to commemorate him. Technopark "Rameev" is an association of legally independent small and medium-sized innovative enterprises in Penza. The purpose of the technopark is to create favorable conditions for the development of small and medium-sized enterprises engaged in the development and implementation of innovative projects.

3 Exhibits and Documentary Collection of B. I. Rameev at the Polytechnic Museum

3.1 “Ural-1”

To date from the hundreds of UDSSR first-generation tube computers, only a single one has survived in full equipment – at the Polytechnic Museum. In 1967, the Voronezh State University gave the Small Automatic Universal Computing Machine “Ural-1” to the Polytechnic Museum (Fig. 1). Of course, the museum exhibitions in which the device is turned on and demonstrated how it worked cause the greatest interest of museum visitors. All of the authentic parts of the “Ural-1” computer are almost impossible to restore, but the processor and the RAM can be implemented on modern microchips. When studying the state of the “Ural-1” computer, it turned out that the control panel and the display panel are still working and can be used to demonstrate the operation of this machine. In 2007, two students developed the demonstration complex based on the Small Universal Automatic Electronic Computer “Ural-1” in the Polytechnic Museum. This complex along with authentic machine parts includes a number of additional blocks implemented on programmable logic microchips. This demonstration complex fully supports the command system of the computer “Ural-1” and with its help it is possible to solve any problems which were possible to solve on the original machine. The bit grids and the ways of representing numbers and operations on numbers correspond completely to the real “Ural-1” computer.

The created demonstration complex includes:

1. Power supply system of the “Ural-1” computer.
2. The control panel of the “Ural-1” computer.
3. The display panel of the “Ural-1” computer.
4. The processor, which is the full functional analog of the “Ural-1” computer processor and implemented on the Field Programmable Gate Array (FPGA) chip XC3S200-4FT256C from “Xilinx”.
5. The operative memory simulating the operation of a magnetic drum of the “Ural-1” computer, implemented on an asynchronous memory chip IS61LV25616AL-10T, manufactured by ISSI.
6. The device for long-term data storage simulating the operation of a tape and / or magnetic tape drive, implemented on the microchip M25P16, manufactured by “ST Microelectronics”.

In order to fully interface authentic devices of the “Ural-1” computer and devices simulating the operation of the processor, operative and long-term memory, the following devices were additionally developed:

7. The block of interrogation of the section of buttons and toggles of the control panel, and also the block of interrogation of keyboard sections of the control panel, realized on microchips ИР22 and ИД7.
8. The output unit implemented on the registers ИР 27, ИД 3 and ИД 7 decoders, as well as the buffer elements HCF4050BE.

9. The optoelectronic isolation block, implemented on optotriacs (triode for alternating current) MOC3041, manufactured by “Motorola”.



Fig. 6. The exposition devoted to B. Rameev, Yu. Bazilevskiy, SDB-245 and the Electronic Computer “Strela” in Polytechnic Museum, 2014.

The operation of the “Ural-1” computer was demonstrated to all categories of museum visitors until the closure of the main building of the Polytechnic Museum for major overhaul in 2014. The following mathematical problems were proposed for solving: demonstration of binary number system, demonstration of counting and displaying numbers in Gray code, demonstration of addition of small integer binary numbers, demonstration of operations of subtraction and multiplication based on addition operation, game “Guess Number,” game “Tic-Tac-Toe,” demonstration of the normalization of fractional numbers with a fixed point and obtaining floating-point numbers. The language of the intermediate presentation of the Ural-1 computer programs, called UASM’07 (Ural Assembler), was specially developed for this demonstration complex. An automatic translator of this language in the machine codes has also been developed.

3.2 Documentary Collection

The exhibits of the collection “Electronic digital computing machines” of the Polytechnic Museum were complemented and supplemented by a documentary in printed and pictorial materials [4, 5, 6,]. From 1989, the museum implemented the program “History of Engineering Thought in Russia”. One of its goals was the creation of a database on the heritage of outstanding Russian scientists. The results of this program were reflected in the series of publications “Problems of Cultural Heritage in the Field of Engineering”.

Within the framework of this program, items related to the biography, scientific and official activities of the computer creators in the Soviet Union and Russia were collected and continue to be collected. An important component of the documentary collection is the personal documentary collections of the founders of domestic computer technics.

We opened fourteen personal documentary collections on “Domestic Science and Engineering Schools in the Field of Computing and Informatics.” The Polytechnic museum holds documentary collections of academician S.A. Lebedev, academician V.M. Glushkov, corresponding member of the USSR Academy of Sciences I.S. Brook, his disciples – M. A. Kartsev and N. Ya. Matyuhin, talented creator Rameev and Yu. Ya. Bazilevskiyi, the developer of the only ternary computer in the world, N. P. Brusentsov, mathematician S. N. Mergelyan, organizer and leader of the first in our country hydraulic analogies laboratory V.S. Lukyanova, Director of the Moscow Factory Accounting Machines V. S. Petrov, founders of the national school of cybernetics A. A. Lyapunov and A. I. Kitov and academician V. S. Burtsev.

Among the above-mentioned collections, the personal collection of B. Rameev is the most voluminous and unique in its content. The documents of this collection reflected the entire history of the creation and development of domestic electronic computers. Rameev was not only the constructor of a number of domestic computers, but for more than 20 years he was engaged in coordinating the development and application of domestic computers, assessing their technical level and efficiency, the formation of scientific and technical programs, and the creation of the State Collection for Algorithms and Programs. In 1971, B. Rameev moved to the *Main Department of Computer Technology and Control Systems* of the *USSR State Committee for Science and Technology*. Because Rameev became deputy head of this department, documents related to the state policy of the development of computer technics are presented from the 1960s to the early 1990s.

In 1994, the activity of the researchers of the Polytechnic Museum on the acquisition of the Rameev personal documentary collection was timed to coincide with the anniversary date - the 40th anniversary of his basic development of the “Ural-1” computer. Rameev personally took part in the selection of documentary materials from his archive. For him, the manuscripts of academicians S. A. Lebedev or A. I. Berg and the office notes of the Penza period were equally important. Probably, due to his accuracy, discipline and careful attitude to the “memory” of the documentary, Rameev managed to keep a rich archive – both in terms of importance and volume of documents. Unfortunately, for health reasons, Rameev was unable to complete the work begun. However,

the firm decision to keep the archive exactly where his first and most important brain-child, “Ural-1,” is located, has found understanding and support of Rameev’s relatives. Until 1998, the wife of the scientist, Vera Ivanovna Rameeva, continued to work with the museum. For four years, from 1994 to 1998, 438 items of storage were transferred, and the number of sheets of the documentary collection totals about tenthousand.

In 1999, after systematization and scientific processing, the personal collection of B. Rameev was opened at the Polytechnic Museum [17]. It included items of clothing stock – the student’s briefcase, the logarithmic ruler, the folder for papers, the Badge of Honored Inventor of the Russian Soviet Federated Socialist Republic, the Medal of the Exhibition of Achievements of the National Economy, etc. The most valuable items are the badge of the USSR State Prize and the Order of the Labor Red Banner.

The first textbooks on electronic digital machines by A. I Kitov and programming by V. N. Bondarenko, I. T. Plotnikov and P. P. Polozov were included in the collection of printed publications. They mainly document operational experience of “Ural” series computers and the development of their software. Also, famous domestic scientists and designers M. A. Kartsev, N. P. Brusentsov, and others are among the authors of the books of the Rameev’s collection. The most unique printed publications include the materials of the conference “Ways of the Development of Mathematical Engineering and Instrument Making” (1956) and the abstracts of the reports of the Vth All-Union meeting of users of the “Ural” computers (1966). The individual books have the stamp with the inscription “From the books of B. I. Rameev”. The publications with the dedications from authors and users of the “Ural” computers are of great interest. They testify the wide scientific, business and friendly contacts between specialists (Fig. 7).

For an unknown reason, Rameev handed over a small part of his documents about himself to the *State Museum of Political History of Russia* in St. Petersburg. In the collections of this museum items like: a leaflet of a candidate for deputy of the Penza Regional Industrial Council of Workers’ Deputies (1963), a membership card of the All-Union Society of Inventors (1935), Rameev’s letter to chief of the Office for Inventions and Discoveries of the USSR Council of Ministers with a request for the resumption and revision of the case of a high-speed digital computer for the integration of differential equations (1950), and some others are stored.

Throughout his professional life, Rameev actively communicated with the leading developers of electronic computers in the Soviet Union. In particular, Rameev worked with Academician A. P. Ershov [18] on software issues. The archive of this scientist is stored in the *Institute of Informatics Systems of the Siberian Branch of the Russian Academy of Sciences* [19]. It contained documents on the AutoCode project for a number of “Ural” computers, a single programming language for the “Ural” family of computers; on the draft technical specification of the software systems of the Unified Computer System “Ryad-3”; documents related to the work of the *Interdepartmental Scientific and Technical Commission on Software of the State Committee of the Council of Ministers of the USSR on Science and Technology*; documents on the reception of the delegation from the United States and so on.

Rameev’s documentary archive, together with pictorial sources, was collected and formed personally by scientist throughout his creative work. The main custodian of the sources of Rameev’s creative heritage in Russia is the Polytechnic Museum [17]. A

brief description of his personal documental fund is given in the Appendix. Rameev's granddaughter Anna Belkina-Tentler was doing a cartoon about him and published an article entitled "System Preferences: Animated Documentary about B. I. Rameev" [20]

4 Conclusion

Bashir Rameev fulfilled one of the key roles in the creation of domestic electronic computers and in the computerization of the Soviet Union. He left valuable legacy in the form of his developments of the family of universal automatic machines "Ural," a whole computer family with advanced software.

The main features of the new generation of computers embodied in the new series of "Ural," briefly boil down to the following. The machines of different capacities must be constructive, schematic and software compatible with each other. They should have a flexible block structure and a wide range of devices with a standard connection method, which allows selecting the computers package most suitable for a particular application and maintain the machine parameters in the process of operation at the level of changing customer needs and new device developments.

The exceptional merit of Rameev was the creation in the USSR not of individual computers, but of a whole family of computers compatible with software, the production of which he put on an industrial basis. Later, the institute created by Rameev in Penza was the "forge of cadres" for many institutes of computer technology in a number of cities of the Soviet Union. At the *Main Administration of Computer Technology and Control Systems of the State Committee on Science and Technology of the USSR* he was in charge of building an extensive system of computer facilities by organizing automated management systems for planning and processing information for various purposes and creating a state network of computer centers, united by communication channels. It is impossible to overestimate the contribution of Rameev to domestic electronic computing equipment. His name should be preserved in the history of Russia.

5 Appendix

5.1 Rameev's Inventions

1935	Rameev constructed the radio-controlled model of an armored train that moved along rails, shot a cannon, created a smoke screen. He presented it at a contest in Moscow. At the age of 17, he became a member of the All-Union Society of Inventors.
1940–41	Rameev proposed the method for detecting darkened objects from an airplane by infrared radiation passing through the curtained windows. He also invented a relay device for turning on loudspeakers in case of an air alarm.
1945–46	Rameev invented the device for accelerating charged particles (USSR author's certificate No. 74398).

1948–49	Together with I. S. Brook, Rameev submitted more than 50 patents for inventions of various Automatic Digital Computing Machines, part of which were issued USSR author's certificates. He proposed the project of the "Electronic Digital Analyzer" (USSR author's certificate No. 15153).
1948	Together with I.S. Brook, Rameev received the first USSR author's certificate No. 10475 from 4.12.1948 on the Automatic Digital Computing Machine.
1950	Rameev developed a draft design electronic computer "Strela".
1949–54	Rameev participated in the development of the first domestic serial electronic computer "Strela" in SDB-245 (Special Engineering Bureau).
1951	Rameev began to give lectures on digital computer technology to the fifth-year students of the Moscow Institute of Mechanics.
1953	Rameev chose a key method for developing small universal digital machines for engineering calculations: unification of circuit, constructive and technological solutions. The symmetrical trigger on a 6H8S tube, tested as the main element of the "Strela," became the basis for all new machines. Rameev made new decisions on the construction of panels, frames-corpuses, on the power supply and cooling systems of machines and others decisions [7, 8, 9].
1954	A team of developers, including B. Rameev, received the State Bounty for the first domestic serial electronic computer "Strela".
1955–68	In Penza under the leadership of B. I. Rameev, universal electronic computers "Ural-1-4," (1955–1961), specialized machines "Weather," "Crystal," "Granite," M-17, M-27, M-30, M-46, M-56 (1954 - 1961) and universal computers "Ural - 11, 14, 16" (1964 – 1969) were developed. The main characteristics of the universal electronic computers "Ural" and the number of machines produced by year are given in Appendices 5.1 and 5.2.
1963	For the first time in the USSR, Rameev proposed the principle of building computers and computer systems in the form of a number of software and information compatible machines. They were of various performance and completeness, built on the single element base with standardly connected peripheral devices. This principle was implemented in the models "Ural - 11, 14, 16" and the digital computers of subsequent generations.
1965–68	He participated in the creation of systems for collective use and computer networks, as well as in the creation of automatized control system (ACS): "Bank", "Stroitel", "Lotus".

1968	Rameev suggested creating a number of software and constructively compatible computers based on the architecture of the System 4 family of the English firm ICL (International Computers Limited).
1971-94	Rameev was engaged in assessing the technical level of domestic digital computers, the formation of scientific and technic computerization programs in Russia and the creation of the State Collection for Algorithms and Programs.

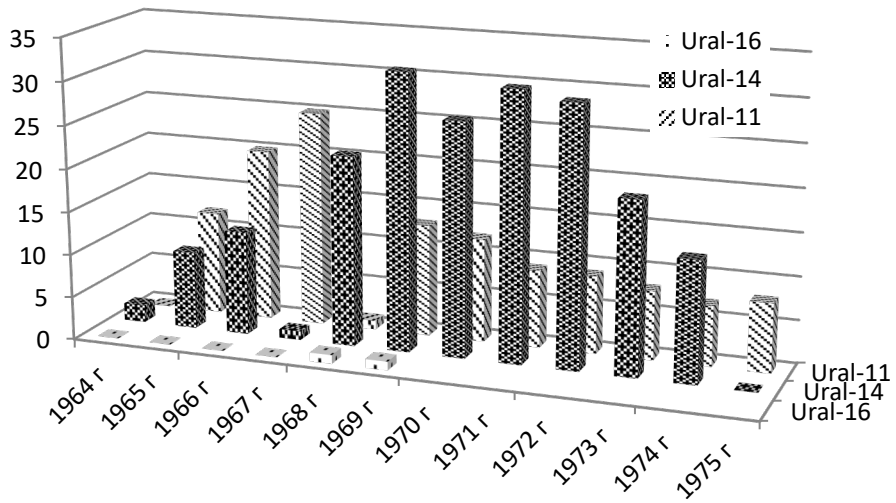
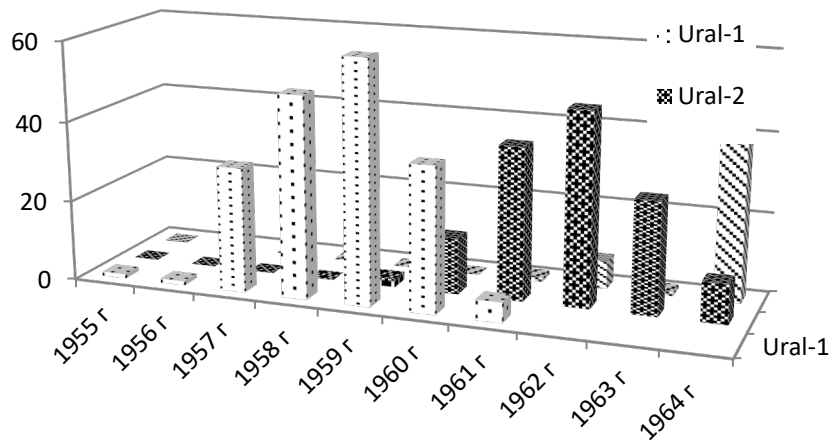
5.2 Main Characteristics of Universal Electronic Computers “Ural”

With an occupied area of about 70 square meters, the Ural-1 machine contained more than 838 electron tubes, consumed about 7 kW of power and was able to perform 100 operations per second: addition, subtraction, transition and multiplication. The division operation was performed four times slower. The operative memory was realized on a magnetic drum. Its capacity was 1024 machine words or about 4.5 kB. A punched tape drive and a magnetic tape drive were used for data input and output of programs and data. The usual medium at that time was punched tape. An engineering control panel was used to control the machine. The machine printed the solution of a problem on a narrow strip of paper. A detailed technical description of the Small Universal Automatic Electronic Computer “Ural-1” can be found on the Virtual Computer Museum website [21].

	Ural-1	Ural-2	Ural-3-4
Components	electron valve circuits and diode-resistor gates		
Arithmetic	one-address binary arithmetic with a fixed and floating point		
Performance	100 op/sec	5 000–6 000 op/sec	5 000–10,000 op/sec
Memory	RAM: magnetic drum (1024 36-bit codes), magnetic tape storage ROM: punched tape storage	RAM: ferrite core memory (2048 40-36-bit codes), sampling time – 30 microseconds ROM: magnetic tape and magnetic drum storage	RAM: ferrite core memory (2048 40-36-bit codes), sampling time – 15 microseconds ROM: magnetic tape and 8 magnetic drum storage
Peripherals	perforated film tape unit, printer	perforated film tape unit, printer	perforated card unit, alphanumeric printer, telegraph tape unit
Software	testing programs and control tasks		

	Ural-11 (6 modifications)	Ural-14 (some modifications)	Ural-16
Components	unified complex of logical components "URAL-10" - semiconductor circuits-modules		
Arithmetic	one-address binary and decimal arithmetic with a fixed point		one-address binary arithmetic with a fixed and floating point
Performance range for various tasks	14,000–50,000 o/sec	2 900–45,000 o/sec	30,000–80,000 o/sec
Memory	RAM: ferrite core memory (4096 – 16384 24-bit codes); ROM: magnetic tape and magnetic drum storage	RAM: ferrite core memory (8192 – 65536 24-bit codes); ROM: magnetic tape and magnetic drum storage	RAM: ferrite core memory (8192 – 65536 48-bit codes); ROM: magnetic tape and magnetic drum storage
Peripherals	Devices for preparation of punched cards, tapes and their control, devices for reading punched cards and tapes, devices for printing, device for converting continuous quantities into discrete, magnetic drum and tape, communication channels, sensors of continuous quantities, printing devices and recorders		
Software	Special translator from ALGAMS language to ARMU (Automatic-code Row (line) of URAL computers), testing, library and debugging programs for the ARMU language		

5.3 Issuance of Universal Electronic Computers “Ural”



5.4 The Rameev Documentary and Visual Materials Collection in the Polytechnic Museum

The Rameev documentary and visual materials collection (numbers on the Polytechnic Museum Book of receipts: No. 27108 / 115-438), after studying and systematizing, was divided into the following sections:

I. Rameev Biographical Materials.

- I.1. Documents on education (1933-1963 years, No. 27108 / 115-128): certificates from the place of study, test books, certificates, etc. The documents of school years are unique: the account card about academic achievement, the school certificate, the characteristic. One of the valuable documents is the Diploma of Doctor of Science MTH No. 000627.
- I.2. Service certificates and badges (1951-1991 years, No 27108 / 129-141): the certificate of a lecturer, the certificate of the deputy of the Penza Regional Council of Working People's Deputies; the certificates of the Chief Engineer of the Scientific Research Institute of Control Computers, the Deputy Head of the State Committee for Radio Electronics, the Deputy Chairman of the Scientific and Technical Council of the USSR State Committee for Computer Science and Informatics, etc.
- I.3. The characteristics and the references from the place of work, the documents for conferring the title "Honored Inventor of the Russian Soviet Federated Socialist Republic (RSFSR)," for the degree of Doctor of Technical Sciences, documents for nomination to corresponding members of the USSR Academy of Sciences, for the receipt of the certificate of the participant in the war (1951-1991 years, No. 27108 / 142-148) - letters of application, lists of inventions and scientific papers, certificates of scientific activity, comments, testimonials, etc. The manuscripts and autographs of academicians S.A. Lebedeva, M.V. Keldysh, A.I. Berg, Corr. I.S. Brook, D.Sc. A.A. Lyapunov are of great interest.



Fig. 7. The books on programming for the “Ural” computers. *Polytechnic Museum, Personal Documentary Collection of B. Rameev No 221.*

- I.4. The work book, the personal pensioner’s book, the autobiographies, the questionnaires, the achievement list, the service record, the visiting card (1939 – 1986 years, No. 27108 / 149-156) - the documents those written by B.I. Rameev are the most valuable.
- I.5. Certificates, award documents, lists of awards (1938 – 1994 years, No 27108 / 157-170) – the certificates of awarding medals of the Exhibition of Achievements of the National Economy, diploma of awarding the USSR State Prize laureate, order book of The Labor Red Banner, the certificate of Honored Inventor of the Russian Soviet Federated Socialist Republic (Fig. 8.), the application to the Commemorative Medal in honor of the successful completion of the “Intercosmos” program, the certificate of the Honorary Citizen of New Orleans (USA). The history of obtaining the title “Honorary Citizen of New Orleans” by Rameev would have been clarified.
- I.6. The materials of anniversaries (1968 – 1988 years, No 27108 / 171-182) – the congratulatory addresses in honor of 50-, 60- and 70-year anniversaries from the leading institutes and enterprises of the industry. The congratulations on the 50th anniversary of the 111 employees of the Department No. 5 of the Penza Research Institute of Mathematical Machines with their autographs (the calculation and printing on the “Ural-14” computer) is the most original.

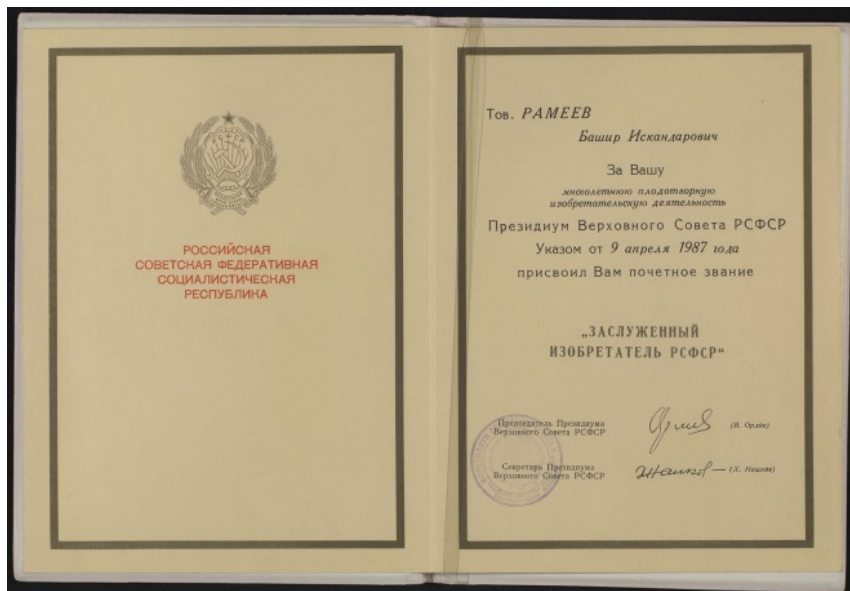


Fig. 8. The certificate of Rameev “Honored Inventor of the RSFSR” of the Supreme Soviet Presidium of the RSFSR. *Polytechnic Museum, Personal Documentary Collection of B. Rameev No 221.*

- I.7. Other documents (1947–1988, No. 27108 / 183-189): references, applications, medical insurance, etc. The note by Academician A.I. Berg with recommendations, what medicines you need to have with you is of interest.

II. Creative Materials

- II.1. Monographs, articles, texts of speeches (1946-1991 years, No. 27108 / 190-215). Among the above documents it is necessary, first of all, to single out the project “Automatic digital computer,” carried out in conjunction with I.S. Brook, as well as “Project considerations for the organization of a special design bureau for the development and construction of the Automatic Digital Computing Machine. The Advance project of the family of Ural-type automatic digital computers (“Ural-11,” “Ural-12,” “Ural-13,” “Ural-14,” “Ural-15”) in five parts and the “Ural project -25” are of unconditional interest. These documents reflected the genius of B. Rameev, as the general designer of computers.

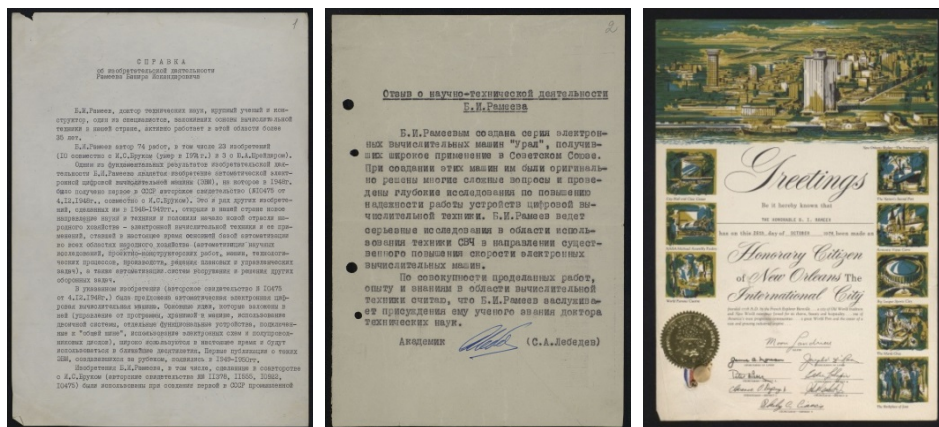


Fig. 9. The documents from Rameev's collection at Polytechnic Museum, No 221.

- II.2. The descriptions of Rameev's inventions (1947 – 195 years, No. 27108 / 216-218) – the mostly manuscripts, with author's diagrams and drawings, with autographs.
- II.3. Documents on inventive activity (1940 – 1949 years, No 27108 / 219-230) – the acts, the conclusions, the letters of the Department for Inventions and Discoveries with descriptions of inventions, expert opinions; there are manuscripts and autographs on 11 inventions.
- II.4. The applications for the receipt of USSR author's certificate (1957 - 1958 years, № 27108/231) – the materials on 7 inventions.
- II.5. Author's certificates, certificates of registration of inventions (1941 – 1963 years, No. 27108 / 232-233) - 23 copyright certificates of B. Rameev (on “Automatic Digital Computing Machine,” separate devices, blocks, nodes, etc.) and 5 certificates of registration of inventions (“Ural-1,” “Ural-2,” “Kristall” computers, etc.).

- II.6. The materials on the computer series “Ural” (1956 – 1973 years, No. 27108 / 234-259) – the documents related to the development, production and practical use of a computer series “Ural,” the comparative author’s analysis of the computers “Ural” with foreign similar computers, the prospects for the development of the “Ural-25” computer. The acts of interdepartmental testing of computer software systems for Ural-14 and Ural-16 computers and Ural-14 and Ural-16 machines (1970-1971), calculations for the Ural-14 computer the forecast of the game of hockey players in the world championships and Europe (1973) are of interest.
- II.7. Reviews and reviews B. Rameev on the work of other persons (1962-1965 years, No. 27108/260).
- II.8. Working drawings (1948, No. 27108 / 261-262) – The flowchart of the “Automatic Digital Computing Machine” is unique. It is author’s drawing.
- II.9. Notebooks, working scientific diaries (1955-1989, No. 27108 / 263-309) - contain manuscripts related to official and scientific activities, information on cooperation with International Computer Limited, entries in English, sketches of diagrams, drawings and so on.

III. Materials of Official, Pedagogical, Scientific and Public Activities

- III.1. Disposal documents, plans, schedules, memos, working certificates, etc. (1952-1980 years, No. 27108 / 310-338) are concerned with the official activities of B. Rameev, beginning with the post of head of the Laboratory No. 31 SDB-245 (Moscow) to the Chief Engineer of the Research Institute of Mathematical Machines (Penza), with autographs of B. Rameev, Y.Ya. Bazilevskiyi, M.A. Lesechko and other persons (Fig. 9.).
- III.2. Materials on the creation of the Unified Computer System (UCS) and the problem of copying IBM-360 (1968-1993, No. 27108 / 339-348) - documents (draft decisions, minutes of meetings, certificates, etc.) with comments and notes of B. Rameev. The Minutes of Meetings Concerning the Copy of IBM 360 Machines dated December 4, 1969 and December 18, 1969, written down by B. Rameev, as well as the Terms of Reference for the development of hardware and software for the UCS (manuscript V.K. Levin with a note of B. Rameev from 15.02.93 after his stroke) are of interest.
- III.3. Materials on the cooperation of the State Committee of the USSR Council of Ministers for Science and Technology with the Ministry of Radio Industry of the USSR and the English firm International Computers Limited (ICL) (1969-1970 years, No. 27108 / 349-350) - protocols of meetings, policy directives, cooperation agreement , working translations, etc.
- III.4. Materials on Soviet-American cooperation in the use of computers in management (1972-1974 years, No. 27108/351) - work plan and report on the activities of the Joint Soviet-American Working Group.
- III.5. Materials on the creation and development of the computer such as Iskra-226 (1981, No. 27108/352) - the protocol of the technical meeting, letters, computer distribution plan, reference.

- III.6. Materials on the concepts “Informatization of society” and “Development of personal computers” (1987-1989, No. 27108 / 373-386) - regulations, resolutions and minutes of the sessions of the USSR State Committee on Computer Science, reports of the Interbranch Science and Technology Complex “Personal computers.”
- III.7. Materials transmitted by B.I. Rameyev for work (1958-1992, No. 27108 / 361-373), - instructions, recommendations, suggestions, concepts, solutions, photocopies of documents, express information, references, reports, articles by G.I. Marchuk and other persons.
- III.8. Pedagogical activity (1951-1953, No 27108 / 381-385) - programs of lectures, abstracts, exam cards on the course “Automatic computing devices of discrete action” in Moscow Institute of Physics and Technology (mostly manuscript).

IV. Correspondence

Correspondence is systematized according to the following headings: letters to B.I.Rameev (1957-1967, No. 27108 / 386-394), letters from B.I. Rameev (1951–1966, No. 27108 / 395-399), correspondence between the responsible persons related to Rameev (1953–1985, No. 27108 / 400–404). There are letters of official and creative nature, among the correspondents of Academician V.M. Glushkov and N.P. Fedorenko, Professor N. Panin, and others, as well as the Glavtochmash enterprise, Numbered plant 732-a, The Plant of Counting and Analytical Machines, SDB-245, and others. The letter from Numbered plant M-5539 with the report on use of “Ural- 11” and “Ural-14” under the program “Soyuz-Apollo” and “Rainbow” is interest of particular.

V. Fine Materials

Pencil black and white and color drawings:

- B. Rameev in the school years (1930–1935) (Fig 10).
- Friendly cartoon and congratulations on the occasion of awarding Rameev the title of Doctor of Technical Sciences with poems (1963) (Fig 10).

Black-and-white photographs are included (1930–1987 years, No. 27108 / 405–434):

- B. Rameev for adjusting the Ural-1 computer, at the meeting of the Council for Mutual Economic Assistance (CMEA), in the Mission Control Center, in the staff of the State Committee for Computing Engineering, portraits of different years (1952–1997).
- The team of developers of the computer “Strela” (1955).
- Portraits of the staff of the Penza Research Institute of Mathematical Machines, the creators of the “Ural” series computer (1970 year).
- General view of the computer series “Ural” (1955–1978), etc.

VI. Materials Collected by the Collection Maker

Booklets, books, documents, etc., concerning memorable facts and events in the life of Rameev are included (1951-1982 years, No. 27108 / 435-437):

- The jubilee collection for the 100th anniversary of the New York Times (in English).
- The flight program of the “Soyuz T-6” spacecraft (June 24, 1982), etc.

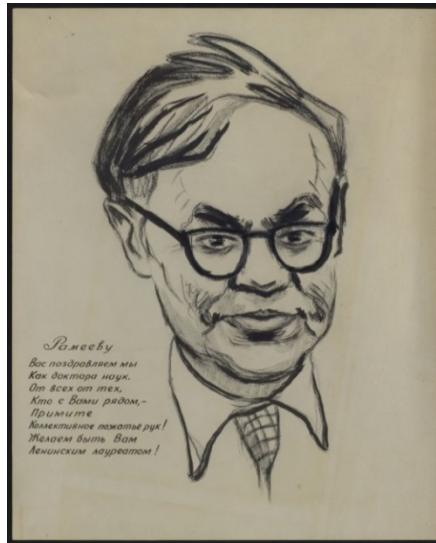


Fig. 10. The friendly cartoon on the occasion of awarding Rameev the title of Doctor of Technical Sciences, with poems. The black and white drawing: Rameev in school years. *Polytechnic Museum, Personal Documentary Collection of B. Rameev No 221.*

VII. Materials of Other Persons

The album of poems with the dedication inscribed by the author - an employee of the Penza Research Institute of Mathematical Machines V.I. Burkov, who for many years worked together with B. Rameev and participated in the development of a series of computers "Ural" (1979 year, № 27108/438).

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