Contribution of Professor Veniamin Goldfarb to Promotion of Gearing Science and International Cooperation

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Abstract. The MMS community knows Professor Veniamin Goldfarb mostly for his activity in 2000–2015 within IFToMM – as a Gearing TC member and Chair and then IFToMM Vice-President. He had an exciting diversified life of scientist and active leader with a wide range of interests, skills and events. This paper presents a survey of his way of becoming a scientist, organizing his own scientific school, foundation of the Institute of Mechanics as a scientific department of Kalashnikov Izhevsk State Technical University, starting a unique for Russia scientific production enterprise "Mechanik", and his multifaceted university activity with his publications and patents. In this paper we would like to present Veniamin Goldfarb as a man of the world and outline mainly his educational and international activity – editing and publishing efforts, promoting the integration of the Russian gearing science into the international community, and his contribution to all-Russian and international cooperation in the field of MMS, especially in gears and transmissions.

Keywords: Veniamin Goldfarb · Gears · Gearbox production · Institute of Mechanics of Kalashnikov ISTU · IFToMM

1 Biographical Notes

Veniamin Iosifovich Goldfarb was born on February 01, 1941 in Izhevsk (Russia) in the family of medical doctors. But he chose to become an engineer and in 1962 he graduated from the Department of Instrument Design of Izhevsk Mechanical Institute - IMI (now Kalashnikov Izhevsk State Technical University - ISTU. The issues of instruments and everything connected with them, including computers and their programming were not just popular, but super popular that time. The future professor Veniamin Goldfarb was one of the best and most notable in this community. It should be said that even then he was distinguished not only by his intellect and quick wit – his charisma and leadership qualities were evident to everybody. After graduation in 1962 he started his scientific

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and educational activity. Since 1962 till 2019 the university IMI/ISTU was his only affiliation. Veniamin Goldfarb devoted his whole life to this university where he made a respectful career from the assistant, associate professor to the full professor, head of Mechanical Engineering department, director of the scientific department "Institute of Mechanics" and the head of the scientific production enterprise "Mechanik":

1957 - 1962 – Student at Izhevsk Mechanical Institute (now Kalashnikov ISTu)
1962 - Assistant of "MMS and Theoretical Mechanics" Department
1963 - Assistant of "Gyroscopic devices" Department
1965 - Senior Lecturer of "Gyroscopic devices" Department
1968 - Postgraduate course
1969 - PhD thesis on Engineering
1970 - Associate Professor of "Instrumentation parts" Department
1986 – Doctor of Engineering Science thesis
1987 - Professor of "Devices and methods of quality control" Department
1991 - Professor of "Technology of robotized production" Department
1994…2019 - Head of the newly organized scientific department "Institute of Mechanics"
1995…2014 - Head of "Design and manufacturing preparation of mechanical engineering production" Department
2014…2016 - Professor of "Design and manufacturing preparation of mechanical engineering production" Department

These biographical notes are expanded in [1].

Professor Veniamin Goldfarb was a Doctor of Technical Sciences, Professor, Honored Scientist of the Russian Federation, Director of the Scientific department "Institute of Mechanics" of Kalashnikov Izhevsk State Technical University, member of the International Federation for the Promotion of Mechanism and Machine Science (IFToMM), Chairman of the Technical Committee for Gearing and Transmissions from 1998 to 2005, member of the Executive Council from 2007 to 2011, Vice President of the Federation from 2011 to 2015, member of the International Organization for Standardization (ISO), Honorary Member of the Slovak Union of Mechanical Engineers and the Bulgarian Union of Mechanical Engineers, New York Academy of Sciences, Academician of the International Informatization Academy and the Russian Academy of Natural Sciences. Professor Veniamin Goldfarb was the Prize winner of the State Prize in the field of science and technology, Honorary Worker of Higher Professional Education of the Russian Federation, Honorary Professor of ISTU. He was awarded the Medal of Academician V.I. Vernadsky, Medal of Academician S.P. Kapitsa "To the author of a scientific invention" by the St. George Cross of the Russian Academy of Natural Sciences and the medal "Inventor of the USSR" for his merits in economics and science.

Prof. V. I. Goldfarb was the author of more than 300 scientific publications, including 10 monographs in the field of research, development and implementation of gears. For more than a quarter of a century, he led a scientific school "Institute of Mechanics" - the creative community of talented and successful, young scientists, where 16 Dr.Sc. and 38 Ph.D. theses were completed, more than 30 patents of the USSR and Russian Federation were obtained. He was a supervisor of 16 Ph.D. students and consulted 5 Doctors of

Science. A large number of gear scientists from other scientific schools got the support of Professor Goldfarb.

While working at Kalashnikov Izhevsk State Technical University, professor Goldfarb combined several activities in teaching, research, design, and technological transfer (Fig. 1).

Fig. 1. Professor Veniamin Goldfarb (1941–2019)

First of all, he was a teacher at the Mechanical Engineering department. In spite of the fact that he graduated from the Instrumentation Engineering faculty, his focus of design and research was switched to the mechanical engineering, namely, MMS and gears, immediately after the graduation. Professor Goldfarb used to present the most difficult and serious MMS issues with the help of his deep understanding of the question united with the natural skill of public speaking and extraordinary sense of humour.

The academic courses of professor Goldfarb varied much with time and academic level. His courses for future Engineers and Bachelors involved the Theory of Machines and Mechanisms (MMS), Applied Mechanics, Mechanisms and Instrument's Parts, CAD of gears. As for Master and post-graduate programs, he lectured on the Theory of Gearing, Theory of Design and Manufacturing of Spiroid Gearing, Accuracy of Mechanisms, Theory of Helical Surfaces, Applied Differential Geometry, etc.

He was so unique in his way of lecturing, addressing students and dealing with various problems that many of his students became deeply involved in the scientific research, often making then their own careers of scientists and university teachers in different engineering areas. Professor Goldfarb supervised dozens of BS and MS graduation works, 16 Ph.D. students and 5 Dr.Sc. applicants. He was a member of numerous

certification committees that awarded the degrees of engineers, BS, MS, PhD and Dr. Sc. in different engineering and scientific areas.

His main scientific interests were in the field MMS-related areas including and theory of gearing, and theory and practice of design, manufacture, testing and application of gears, gearboxes, and gearmotors [2]. Being a graduate of the Instrumentation engineering department, Professor Goldfarb introduced CAD into gear research in the early 1970s which was a new trend and unstudied area in the USSR that time.

The main type of gears to be studied and further produced under the leadership of Prof. Goldfarb was spiroid gears (Fig. 2). The first information about spiroid gears appeared in the USA. Their inventor is a talented American engineer Oliver Saari (1914–2003), who got the first patent for "Speed-Reduction Gearing" in 1954 [3, 4]. Beginning from 1955 the well-known publications by F. Bohle [5, 6] and W.D. Nelson [7, 8] appeared, where the attractive name "spiroid" was mentioned for the first time, meaning the new type of a hyperboloid gear. Later the American company Illinois Tools Works (ITW) Inc., where the mentioned authors were working and which was the pioneer of mastering the manufacture and introduction of these gears into different engineering areas, patented the names SPIROID and HELICON (the variety of a spiroid gear with cylindrical worm, also invented by O. Saari) which became the trademarks of ITW [7, 8]. That is why many other companies and authors deeply engaged into investigations and manufacture of these gears began calling them other names in order to avoid conflict with ITW: face worm gear, spiroid worm gear, spirodrive, hypoid-worm gear, spiral-type gear and others.

Prof. Goldfarb's Ph.D. thesis in 1969 was devoted to studying the varieties of special and complicated for analysis spiroid gears, and DSc. thesis in 1986 was about the fundamentals of the theory of automated geometrical analysis and synthesis of general type worm gears [9], where he stated the basic results obtained by him. The main scientific developments of Professor Goldfarb consisted in the classification and study of spatial gear schemes [10] (Fig. 3), rational structuring of the process of computer-aided design of worm gears, the development of a "non-differential" method for finding surfaces formed by enveloping, and the research of a variety of spiroid gears [11, 12].

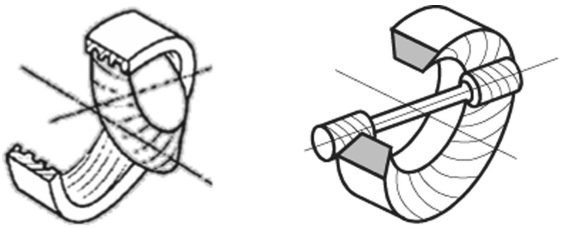

Fig. 2. Spiroid gears invented by Prof. Goldfarb: (a) with internal meshing - Patent RU № 806935 and (b) non-orthogonal gear with two meshing zones - Patent RU № 2101582.

In the last two decades of his career, Professor Goldfarb focused on the practical implementation and improvement of worm-type gears and gearboxes in pipeline valves. Under his leadership, it became possible to create a large number of competitive products

and to establish their efficient production (Fig. 4, 5). The production became and in many respects remains a unique example of implementation of scientific, technical and technological developments directly by the scientific department of the University in the small innovative enterprise "Mechanik" in Izhevsk [13]. It deserves a more detailed acquaintance, which can be done according to publications made by Prof. Goldfarb and his colleagues such as [9, 13–15].

Professor Goldfarb was an organizer of the widest range of scientific events, publications and activities: USSR and All-Russian scientific conferences, seminars, meetings and symposia; international conferences on gears; editing and publishing proceedings, scientific journals and books on MMS; initiating international scientific and educational cooperation between Russian and foreign universities, their examples are: SIOMMS-2011 [16, 17], development of MMS terminology [18, 19] and the International Symposium "Theory and practice of gearing" to the 100th anniversary of Prof. Faydor L. Litvin [20, 21].

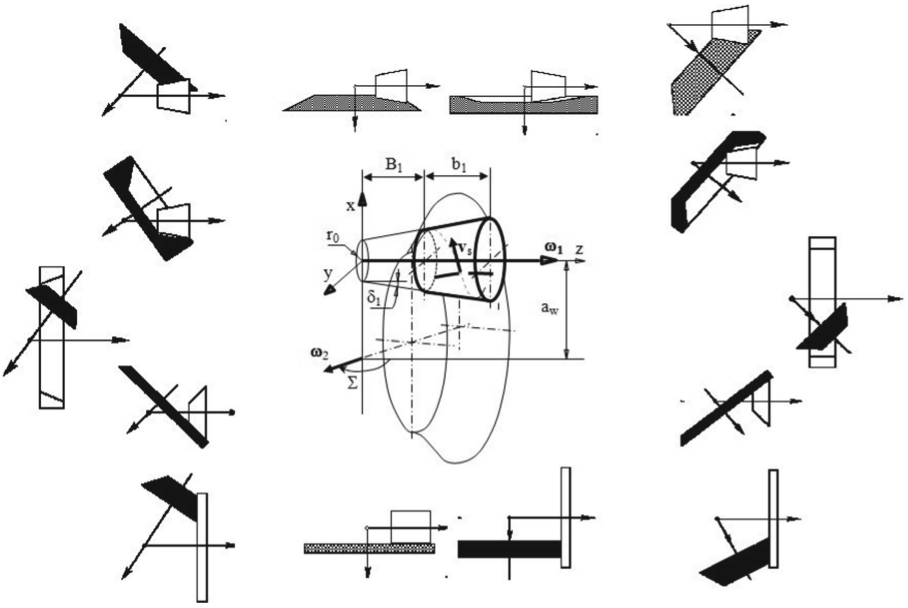

Fig. 3. Scheme of spatial gear by V. I. Goldfarb and fragment of his classification of single-stage gears [4]

We should note once again that multifaceted talents of Professor Goldfarb's personality, his leadership and unifying qualities were not limited to his professional activities. Colleagues (and many people in the world) knew him as a brilliant musician and piano player, an indispensable member of IMI/ISTU jazz ensemble, a satirical student theater of miniatures, and one of the main activists of the IMI/ISTU sports camp in on the bank of the Kama River [1]. He had an inherent depth of analysis, knowledge of a complex mathematical apparatus, the ability to single out the main scientific component, to structure new knowledge, and to formulate it clearly and beautifully, without being sprawled

out on side points, which, unfortunately, are often numerous in scientific searches. He generously shared this skill both with his students and with many colleagues from other scientific schools. His unique way from a talented student to the well-known gear scientists – from the very first glance to spiroid gears to prominent scientific results, to the successfully functioning serial gearbox production, and to the position of IFToMM Vice-President – is fully described in [1].

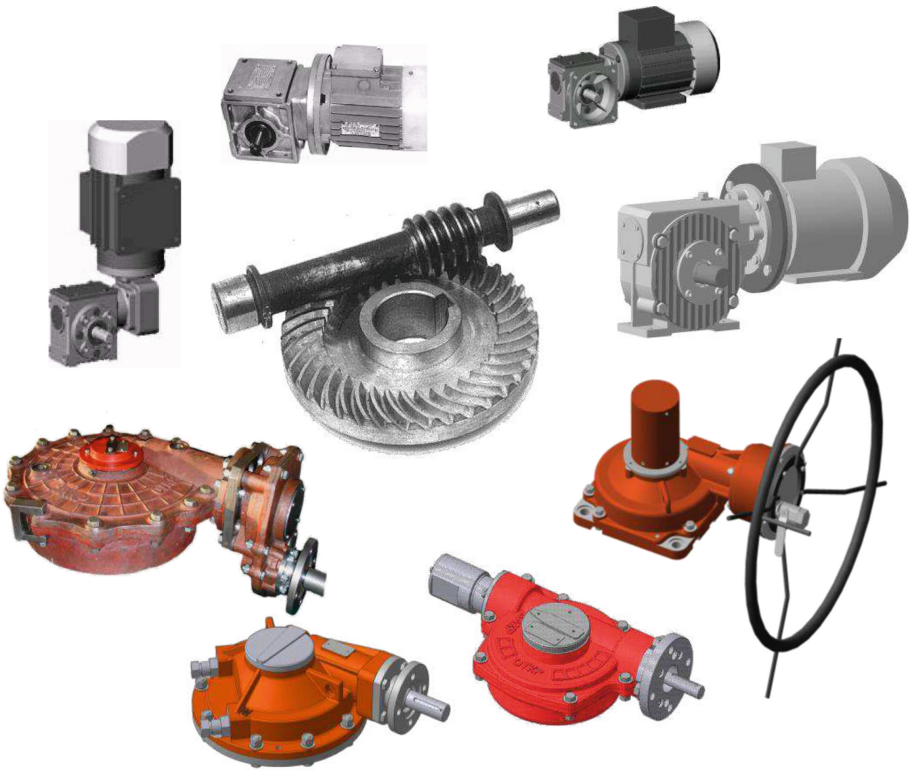

Fig. 4. Several generations of spiroid gears, gearboxes and gearmotors produced by SIE "Mechanik" at the boundary of the 20th–21st centuries [22].

2 All-Russian and International Activities

2.1 USSR and All-Russian Conferences and Joint Projects on Gears

Along with the educational activity and scientific research, Professor Goldfarb was an active participant and organizer of different conferences and symposia on gear-related issues since the early 1960s till 2017. Soviet and then Russian gear scientists felt their unity, a number of interested young scientists increased multiply, there were many locations to meet, present their results, discuss their scientific research and find support of the

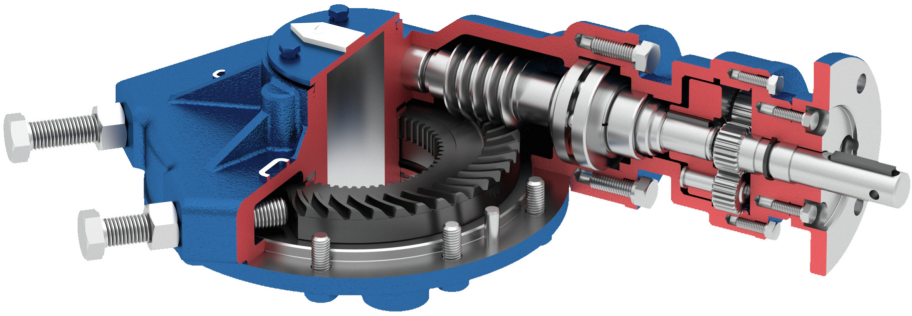

Fig. 5. Advanced version of worm-type gearboxes currently produced by SIE "Mechank" [23].

masters. Various scientific events were held in universities of the USSR with Moscow (International congress ITS-93 "Information communications, networks, systems and technologies", 1993), Saint-Petersburg (All-Russian scientific and practical conference with international participation "Gearbox engineering in Russia: state of arts, problems, prospects, 2002), Khabarovsk (Scientific conference "Problems of investigations, design and production of gears", 1974), Kurgan (The 6th international symposium "Theory of real gearing", 1997), Chelyabinsk (Scientific conference "Improvement of machine design and methods of machine parts processing", 1978), Kharkov (Scientific technical conference "Standardization and unification in the field of gearing", 1990), Odessa (All-Union scientific and technical conference "Gears: the present and progress" 1990), and Izhevsk (International conference "Theory and practice of gears", 1996) among them. Professor Goldfarb was one of the most active organizers of these events in Izhevsk. These events on the theory and practice of gears and CAD of mechanical transmissions were supported and financed by the USSR government till 1990. In spite of the fact that every scientific event was followed by the publication of a paper volume of the conference proceedings, they were all printed in Russian and with a very limited number. That is why they went practically unnoticed by the world MMS community. Unfortunately, cooperation and information exchange between Soviet and Western specialists in the mid-20th century were complicated (or too scarce), but we must say that even in the relatively young (or new) at that time Izhevsk gearing school, specialized proceedings appeared regularly starting from 1967, where works of both authoritative gear experts and young researchers were published, among whom was the future professor V.I. Goldfarb.

In 1980s the most popular topic of scientific research and discussion was the computer-aided design of mechanical transmissions. Veniamin Goldfarb was the organizer and active participant of numerous conferences on computer-aided design of mechanical transmissions, gears and gearboxes and its introduction into mechanical production in Izhevsk in 1981 (Scientific and technical conference "Development and implementation of CAD systems"), 1982 (Scientific and technical conference "Computer-aided design of mechanical gears", 1984 (Coordination meeting "Mathematical support of CAD and FMS in mechanical engineering"), 1987 (Coordination meeting "Mathematical and software support of integrated CAD/FMS systems"), 1989 (Scientific and technical seminar "Computer-aided design of gears and gearboxes") and 1990 (Scientific

and technical conference "Development and implementation of CAD and CAM systems in mechanical engineering").

In difficult economic transition conditions in the 1990s, Russian scientific schools in the field of gears and gearbox engineering found themselves in an extremely difficult financial situation. Besides many difficulties, Prof. Goldfarb was struggling in many offices of Ministries of Industry, Science and Education for continuing financing scientific work. In these conditions, from 1991 to 2004, Professor V. I. Goldfarb achieved financing and initiated the joint participation of leading Russian scientific schools of 12 Russian technical universities in target programs of Russian state and interstate financing. These state target programs were a pioneer solution of supporting and financing MMS science and applying the results of scientific research in the real mechanical engineering production. The federal state programs included such programs as: "Transfer techniques", "Progressive gears", "New generation of mechanical drives", "Innovations in higher schools", "Integration" and so on.

For example, the program "Progressive gears" with the Institute of Mechanics headed by Professor Veniamin Goldfarb as the leading executor involved 17 projects and promoted mastering the production of progressive gears, development and manufacturing implementation of high-technology competitive products comprising various gears. It united the following Russian universities:

- Novouralsk Polytechnic Institute (Novouralsk) – project "Machines and mechanisms of compression and transfer of liquids and gases on the basis of progressive gears";
- Yaroslavl State Technical University (Yaroslavl) – project "Development and implementation of a series of progressive mechanical stepless regulated gears for machine drives";
- Kurgan State University (Kurgan) – project "Mastering the manufacturing support of gear production based on estimation of their load state and lifetime when operating according to of integral type strain gauges";
- Rostov State University (Rostov) – projects "Development of geometry and mastering the production of competitive gears with improved properties" and "Development of scientific fundamentals for design and production of unified series of gearboxes with increased load capacity for oil pumping units";
- Volgograd State Technical University (Volgograd) – project "Development of the theory, design methods, reserve-saving laser techniques providing the increase in the technical level and lifetime of highly stressed gears";
- Vladimir State Technical University (Vladimir) – projects "Development of actuating roller screw mechanisms of electromechanical steering devices of flying apparatus" and "Development of low-size electromechanical drive on the basis of gears with elongated roller and its production technique for nanotechnology equipment and autonomous orthopedical apparatus";
- Chelyabinsk State Technical University, Zlatoust Branch (Zlatoust) – project "Development of designs of power transmitting mechanisms on the basis of planetary gears with small difference in tooth numbers";
- Kolomna Branch of Moscow State Open University (Kolomna) – project "Development of the technique and means of production of high-accuracy spur and helical arc gears";

– N.E. Bauman Moscow State Technical University (Moscow) – project "Development and mastering of progressive designs and techniques of their production for new-generation wave gears";
– STANKIN Moscow State Technological University (Moscow) – project "Design expert system "Expert" for computer-aided synthesis and analysis of bevel and hypoid gears";
– Mechanical Engineering Research Institute (IMASH) of the Russian Academy of Sciences (Moscow) – projects "Development of Russian proposals on correction of ISO standards on strength analysis of gears" and "Development of heavy-loaded planetary drives for ship industry";
– and the Institute of Mechanics of Kalashnikov Izhevsk State Technical University (Izhevsk) as the leading and coordinating organization. One of its many projects was "Development of general-purpose and special low-size competitive single- and double-stage spiroid gearboxes and gearmotors".

2.2 International Cooperation and Membership in International Organizations and Committees

In 1990s the organizational talent of Professor Goldfarb showed itself very quickly in the diverse international cooperation between universities and scientific schools of different countries. It was gear experts from Great Britain, Czech Republic, Poland, and Slovakia who came to Izhevsk (ISTU) as the first foreign guests. Every year the geography of contacts and the number of new joint projects were expanding rapidly. The first agreements on international cooperation at ISTU with the universities of Slovakia (Bratislava, Trnava), Czech Republic (Brno), Poland (Warsaw), Bulgaria (Sofia), England (Nottingham), and USA (Los Angeles) were signed on the initiative of Professor Goldfarb.

The first International program "New Generation of Mechanical Drives" started already in 1996 and lasted till 2000; it involved scientific schools of universities from 7 countries (Slovakia, Bulgaria, Czech Republic, Poland, England, USA, and Russia).

Professor Veniamin Goldfarb made an invaluable contribution to the integration of Russian gearing science into the international scientific community and to the development of international scientific and technical cooperation in general and, in the field of gears and gearbox engineering, in particular.

The first international event on MMS was held in Russia already in 1993 exactly in Izhevsk [24] – it was the International Symposium "Development of Geometrical Theory of Gears" with foreign participants from Bulgaria, Poland, Slovakia and Czech Republic and then there were regular conferences in Izhevsk organized by Professor Goldfarb:

– International Symposium "Advanced Gears" in 1994;
– International Conferences "Theory and Practice of Gears" in 1996, 1998, 2004, 2008, 2017;
– International scientific seminar "Modern information technologies. Problems of Design, Research and Production of Gear Transmissions" in 2001 with about 70 participants including foreign ones from 8 countries already;

– International Symposium "Theory and Practice of Gears" in 2014 devoted to the 100th anniversary of Professor Faydor Litvin. About 100 scientists from 12 countries took part in this event.

During different periods of his scientific activity V. I. Goldfarb became an active participant of scientific communities. In particular, he was a member of Technical Committee TC-258 for Machine Parts and Gears of the Russian State Standardization Committee, and he was the initiator and Vice-President of Russian partnership "Association of Mechanical Transmission Engineers". Later on, Professor V. I. Goldfarb became a member of editorial boards of international journals "Mechanism and Machine Theory", "Machine Design", and a frequent chairman and member of scientific program and organizational committees of international conferences on gears and transmissions: "Power Transmissions" (Greece, 2009), "Power Gears and Transmissions" (Japan, 2009), "Fundamentals of Machine Design" (Bulgaria, 2009), "Gears" (Germany, 2010), "Terminology in Mechanisms and Machines Science" (Belarus, 2010), "Development and Study of Mechanical Components and Systems" (Serbia, 2011) and a member of program committees of IFToMM World Congresses on MMS (Finland-1999, China-2004, France-2007, Mexico-2011, Taiwan-2015).

2.3 Publication and Editor's Activity

At the end of the twentieth century it became obvious that a certain level of foreign language proficiency was necessary to initiate international scientific and educational cooperation. Still the problem of getting acquainted for Russian and foreign gear scientists remained urgent and in 1991 professor Goldfarb initiated a bilingual journal (English and Russian) "Gearing and Transmissions", which was published for fourteen years till 2004 mainly by the staff of the Scientific Department "Institute of Mechanics" of Kalashnikov Izhevsk State Technical University and was distributed for free among Russian and foreign technical universities and production enterprises (Fig. 6). It was a perfect solution for both English-speaking scientists to know about the fundamental and latest research results of Russian-speaking scientists and vice versa.

The Editor-in-Chief of this journal was Veniamin Goldfarb and the Editorial Board of the Journal covered many well-known foreign and Russian gear scientists: Prof. K. Arnaudov (Bulgaria), Prof. W. Oleksyuk (Poland), Prof. H. Winter (Germany), Prof. M. Grois (Czech Republic), Prof. A. Kubo (Japan), Prof. H. Linke (Germany), Prof. J. Mudrik (Slovakia), Prof. P. Parushev (Bulgaria), Prof. A. Siereg (USA), Prof. L. Slutsky (USA), Prof. B.-R. Hohn (Germany), Prof. D. Su and many others. Three foreign universities took an active part in editing and publishing of this journal within the international cooperation along with the ISTU: Technical University of Brno and Slovak University of Technology in Bratislava (both Slovakia) and Nottingham Trent University (UK) with the hardest contribution of Prof. Daizhong Su from the UK and Prof. J. Mudrik and Prof. S. Kral from Slovakia. After Professor Goldfarb joined IFToMM community, this journal became its official publication and was fully supported by the IFToMM Gearing and Transmission Technical Committee. It was a real breakthrough to start the international cooperation (without Internet that time!) from giving such a unique opportunity

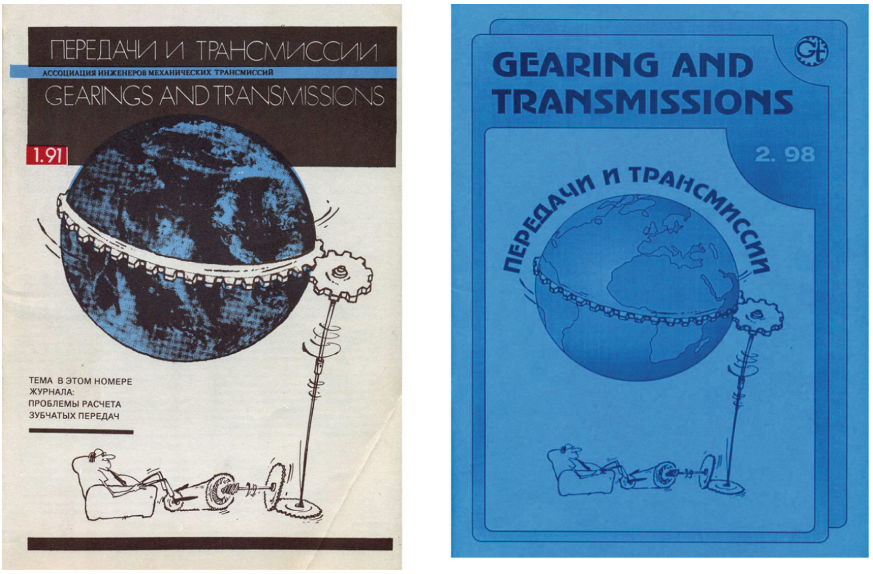

Fig. 6. Journals "Gearing and Transmissions".

for foreign and Russian scientists to know about each other and get in contact with each other.

In 2014, by the initiative of Professor M. Ceccarelli (at that time - IFToMM Past President), Professor Goldfarb started a new project - regular publication of contributed volumes on gears in the series "Mechanisms and Machine Science" in the large European publishing house "Springer". As the editor-in-chief of these books, he united fundamental and latest manuscripts of the leading gear scientists from Russia, China, the United States, Japan, Italy, Germany, Canada, Bulgaria, Belarus, and other countries. Now, with the electronic version accessible all over the world, this special series on gears is of great importance and promotes the gearing science (thousand of these books are read and sold, in accordance with the Springer statistics), encourages young researchers and skilled gear masters to go on their studies and communications and to improve their knowledge. Three contributed volumes have already been published in 2016, 2018, 2020 with Veniamin Goldfarb as the chief editor of these books and the fourth one was published in 2021 as a tribute to Professor Goldfarb after his passing away (Fig. 7) [21, 25–27].

2.4 Initiating International Student Olympiads on MMS

The first-ever international student subject Olympiad on MMS was held in Kalashnikov ISTU on April 19–21, 2011. The idea to organize the Student International Olympiad on MMS (SIOMMS) was proposed by Veniamin Goldfarb in 2009 in Mexico at the IFToMM conference. IFToMM Executive Council made a decision to organize the International Student Olympiad (SIOMMS) in 2011 in Izhevsk State Technical University, Izhevsk, Russia (Fig. 8, 9). SIOMMS-2011 was held on April 19–21, 2011 [14–16]. 17 student

Fig. 7. Contributed volumes on gears edited by Prof. Goldfarb within MMS series in Springer Publishing House [21, 25–27].

teams from 8 countries took part in this competition. This Olympiad initiated regular Students International Olympiads on MMS which are held every two or three years in different parts of the world: 2011 (Izhevsk, Russia), 2013 (Shanghai, China), 2016 (Madrid, Spain) and 2018 (Lima, Peru).

Fig. 8. Professor Goldfarb – organizer of SIOMMS-2011 [16].

2.5 IFToMM Membership and Initiatives

The Technical Committees for Gearing and Transmissions (TC) within the International Federation for the Promotion of Mechanism and Machine Science (IFToMM) was founded in 1976 by the Initiative of the Secretary General Prof. A. Morecki (Poland).

Fig. 9. Chair persons at the opening of SIOMMS-2011 in Izhevsk, Russia.

The first Chairman of the Gearing TC was Prof. D. Dudley (USA). In 1986 he resigned and Prof. K. Stolzle (Germany) became the TC Chair till 1993. After that Prof. A. Kubo (Japan) was elected to be the new Chairman. As for Russian participation in the IFToMM, it was not very active because of the mentioned above language barriers. In 1994 Prof. Veniamin Goldfarb joined the IFToMM and was the second Russian to join the TC for Gearing and Transmissions. His main goals within the Gearing TC were as follows:

- to continue publishing the bilingual journal "Gearing and Transmissions" already with the support of IFToMM community and to distribute it among gear scientists, manufacturers and technical universities all over the world;
- to promote the knowledge and raise the authority of IFToMM among Russian scientists;
- to continue carrying out the scientific research on gears at the highest international level, presenting the results at international conferences on gears;
- to intensify communications between foreign and international gear scientists, to promote mutual design projects and participation in scientific events, etc.

In 1998, Prof. V. I. Goldfarb was elected to be the Chairman of this TC, and in 2001, after the report meeting of the Committee, his chair term was extended for 4 more years. The General Concept of the TC for Gearing and Transmissions activity within the framework of IFToMM, its main objectives, tasks, priorities were published in two languages in the international journal "Gearing and Transmissions", No.1, 1998 [28]. The Chair of the TC, Prof. Veniamin Goldfarb, outlined the urgent problems specific to this TC activities that time. This Concept was the plan which helped the Chair rationally manage the efforts to solve various problems. The Concept had been developed and first

sent to all TC members after Prof. V. Goldfarb had started his activity as the Chair on Jan.1st, 1998 and approved on April 20th, 1998 in Thun, Switzerland at the Gearing TC meeting within ISO TC meeting. The Concept met the main objectives of IFToMM's activities defined in the Constitution. 7 main directions of activities were proposed: organization of international scientific technical programs in various fields of the gearing science; organization of the cooperation with TCs and PCs of IFToMM, with national and international associations of gearing specialists; publishing activity; educational activity; organization of scientific conferences; expertise; and organization of databases and informational exchange.

Professor Goldfarb regularly organized Gearing TC meetings within different international scientific events with the thorough discussion of all possible progressive international ways of cooperation between gear scientists. Numerous research and development projects were actively discussed there with initiators from Slovakia, Belarus and Russia, including the following projects:

- Development of Acoustic Emission (AE) Techniques for early diagnostics of gear failures.
- Development of transmission elements' life evaluation method with the aid of integral strain gauges.
- Development of a complex methodical and informational provision of gear and mechanical transmission reliability prediction.
- Development of simulation methods and experimental equipment for analysis of machine aggregates with new types of gears.
- Setting up Virtual Institutions.
- Development of a Multilingual Glossary of Gearing Terms.

Achievements of Gearing and Transmission TC activity stated by Professor Veniamin Goldfarb as a part of his Chairman report:

1. The committee unites the scientific potential of many countries according to one of important directions of MMS – theory and practice of gearing and transmissions;
2. Large international conference on gears are held annually with active participation of TC members as reporters and organizers;
3. National and international R&D projects are successfully implemented within the TC activity.
4. Cooperation with ISO and national associations in the field of gears is carried out, it unites scientists and practical engineers of many countries;
5. The experience was implemented of organizing scientific programs inside the committee with attraction of financial possibilities of institutions, participating in programs;
6. The precedent has been created of interaction with Reliability TC within the program "Creation of methods of diagnostics and evaluation of gearbox systems".
7. Gearing section is one of the most active in all World Congresses of IFToMM.

Prof. Goldfarb's active work in this Technical Committee was appreciated by the Executive Council of the Federation and since 2008 he became one of three Russians

in the history of the Federation who was a member of IFToMM Executive Council. In 2011 Professor Goldfarb was elected as the Chairman of the Permanent Commission for Communications, Publications and Archiving (IFToMM PC CPA). The crowning achievement of Prof. V. I. Goldfarb's international activities was his election as Vice-President of this organization for the period from 2012 till 2015. Besides publication and archiving activities, during this period he was firstly dealing with promotion, administrating and updating the IFToMM webpage as the most efficient means of communication for scientists all over the world.

The main results of Prof. Goldfarb's international activity within IFToMM were also reported in many publications [16–21, 28–31], the complete list of his publications is presented in [1].

3 Conclusion

There is a famous phrase by Lion Feuchtwanger "A talented person is talented in everything". Besides being a well-known MMS scientist and researcher, a brilliant teacher and leader, a musician and sportsman, Professor Veniamin Goldfarb was a brilliant organizer who initiated a lot of interesting publications, cooperation and events. Many of these results and events seem obvious and common now (joint R&D projects, publication of scientific journals, international cooperation of Russian and foreign gear scientists, etc.), but 20–30 years ago it was professor Goldfarb who initiated this novel activity and contributed much to make it ordinary now in the Russian MMS community. In 2020 the Scientific Department "Institute of Mechanics" of Kalashnikov Izhevsk State Technical University (Udmurt Republic, Russia) was renamed into the "Institute of Mechanics named after Professor V. I. Goldfarb" to recognize his figure with his outstanding achievements.

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