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AN ANTHOLOGY OF THE DISTINGUISHED ACHIEVEMENTS IN SCIENCE AND TECHNIQUE. PART 48: AIRCRAFT DESIGNER ANDREY TUPOLEV AND HIS ACCOMPLISHMENTS IN AIRPLANE DESIGN

Purpose. Preparation of a short scientifically-historical essay about one of founders of world airplane design, prominent Soviet aircraft designer A.N. Tupolev. *Methodology.* Known scientific methods of collection, analysis and analytical treatment of scientific and technical information regarding becoming and development of Soviet and world aviation and resulted in scientific monographs, journals and internet-reports. *Results.* A short scientifically-historical essay is presented about a prominent Soviet aircraft designer Andrey Nikolaevich Tupolev, becoming in the 20th century one of founders of Soviet and world aviation. Basic scientific and technical achievements of A.N. Tupolev indicated in area of airplane design, bringing Soviet military and civil aviation around to extraordinary world heights. Basic tactical and technical descriptions are described regarding created under his scientific and technical guidance of such known types of civil airplanes as ANT-25, Tu-104, Tu-134, Tu-154 and Tu-114, and also military airplanes of type Tu-2, Tu-16 and Tu-95. Short information is resulted about flying descriptions of the modern Russian supersonic strategic bomber of type Tu-160, created in 1980-th in the design bureau name after A.N. Tupolev. It is marked that under guidance of A.N. Tupolev over 100 types of airplanes of the military and civil setting were developed in the former USSR, 70 from which are produced by aviation industry of country serially. It is indicated that Doctor of Technical Sciences, Academician of the Academy of Sciences of the USSR, Colonel-General-Engineer A.N. Tupolev was a founder known in the world of aviation scientific school, preparing many famous Russian aircraft designers. Information, touching handed him domestic and foreign governmental rewards and other authoritative signs of confession of prominent merits of great aircraft designer A.N. Tupolev world scientific and technical public is resulted in airplane design. *Originality.* Certain systematization is executed known from scientific publications and other scientific and technical materials media regarding becoming and development of Soviet and world aviation and considerable scientific and technical contribution to the military and civil airplane design of prominent Soviet aircraft designer A.N. Tupolev. *Practical value.* Scientific popularization and deepening for the students of higher schools, engineering, technical and scientific workers of scientific and technical knowledge in the field of history of becoming and development of Soviet and world airplane design, extending their scientific and technical range of interests and further development of scientific and technical progress in society. References 15, figures 12.

Key words: aviation, prominent Soviet aircraft designer Andrey Tupolev, his basic achievements in airplane construction, scientifically-historical essay.

Наведено короткий науково-історичний нарис про видатного радянського авіаконструктора Андрія Миколайовича Туполева, що став одним з основоположників світового літакобудування. Описані основні науково-технічні досягнення А.М. Туполева в галузі літакобудування, що привели радянську військову і цивільну авіацію на небачені світові висоти. Показано, що А.М. Тупольє є засновником відомої в світі авіаційної наукової школи, що виховала багато видних в колишньому СРСР авіаконструкторів. Під керівництвом великого авіаконструктора 20-го сторіччя А.М. Туполева в СРСР було розроблено понад 100 типів літаків військового і цивільного призначення, 70 з яких виготовлялися авіаційною промисловістю країни серійно. Бібл. 15, рис. 12.

Ключові слова: авіація, видатний радянський авіаконструктор Андрій Тупольєв, його основні досягнення в літакобудуванні, науково-історичний нарис.

Приведен краткий научно-исторический очерк о выдающемся советском авиаконструкторе Андрее Николаевиче Туполеве, ставшем одним из основоположников мирового самолетостроения. Описаны основные научно-технические достижения А.Н. Туполева в области самолетостроения, приведшие советскую военную и гражданскую авиацию на невиданные мировые высоты. Показано, что А.Н. Тупольев является основателем известной в мире авиационной научной школы, воспитавшей многих видных в бывшем СССР авиаконструкторов. Под руководством великого авиаконструктора 20-го столетия А.Н. Туполева в СССР было разработано свыше 100 типов самолетов военного и гражданского назначения, 70 из которых изготавливались авиационной промышленностью страны серийно. Библ. 15, рис. 12.

Ключевые слова: авиация, выдающийся советский авиаконструктор Андрей Тупольев, его основные достижения в самолетостроении, научно-исторический очерк.

Introduction. One of the pioneers of the Soviet helicopter industry, Academician of the Academy of Sciences of the USSR Boris Nikolayevich Yuriev believed [1]: «... *Studying the history of science and technology contributes to the development of engineers and scientists who get a broad view of the development of creative thought*». Applying this wise scientific position to such a high-tech and important area of modern engineering as aircraft design, let us turn to the outstanding scientific and technical achievements of one of the founders of world aviation, the famous Soviet aircraft designer, Academician of the Academy of Sciences of the USSR (since 1953) Andrey Nikolaevich

Tupolev (Fig. 1) which worked in aircraft engineering almost at the same time as the outstanding Ukrainian-American aircraft designer I.I. Sikorsky [2].

The goal of the paper is preparation of a brief scientific and historical essay on one of the founders of the world aircraft design, an outstanding Soviet aircraft designer A.N. Tupolev.

1. The beginning of the life and career of A.N. Tupolev. He was born on November 10, 1888 in the Russian Empire (village of Pustomazovo, Tver province) in the family of a Russian provincial notary Nikolay Ivanovich Tupolev, who came from Siberian Cossacks

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Fig. 1. Outstanding Soviet aircraft designer, three times Hero of Labor, Doctor of Technical Sciences, Academician of the Academy of Sciences of the USSR Andrey Nikolaevich Tupolev (November 10, 1888 - December 23, 1972) [3]

and studied law at St. Petersburg University (after the murder by the revolutionary populists of Tsar Alexander II he was expelled from St. Petersburg) [3]. According to his mother Anna Vasilyevna (nee Lisitsyna, who graduated from the Mariinsky Women Gymnasium in the city of Tver) he was by descent from the nobility. After graduating from the Tver gymnasium, Andrey Tupolev, showing interest in exact sciences and technology, in 1908 entered the Imperial Moscow Technical School (IMTS), which in Soviet times was called the N.E. Bauman Moscow Higher Technical School (MHTS) [3]. Later, he mentally recalled about the years of his youth [4, 5]: «... *We lived modestly. I had older brothers Sergey and Nikolay, and also sisters Natalya, Tatyana, Vera and Maria. Mother gave us all her strength, her whole soul. Our family was very big and friendly. Not patriarchal, but undoubtedly advanced.*» From October 1909, Professor Nikolay Zhukovsky, a famous Russian scientist, began to deliver lectures on aeronautics at IMTS. The acquaintance of Andrey Tupolev with N.Ye. Zhukovsky in the Aeronautical group at IMTS turned out to be fateful for him. According to A.N. Tupolev [5]: «... *From this moment on, my aviation life began.*» He quickly became one of N.Ye. Zhukovsky's active student, showing the ability of both the scientific researcher and aircraft designer. Because of the denunciation to the tsar police by the unknown person about his political unreliability in 1911, he had to leave IMTS for several years. Despite all the difficulties, in 1918 he defended with honor his diploma project at IMTS on the topic «*Experience of creating a hydroplane according to wind tunnel tests*» and became a mechanical engineer [5]. After completing his studies, he was hired as a teacher at IMTS. In the period 1919-1920 A.N. Tupolev gave lectures to students of IMTS on «*Fundamentals of aerodynamic calculation*», «*Theories of airplanes*» and «*Theory of hydroplanes*». He then went to work at the Central Aero-Hydrodynamic Institute (CAHI), which was headed by N.Ye. Zhukovsky. Here he took the position of Head of the Aviation Department, in which new Russian aircraft were investigated, developed and tested. In 1924, successful flight tests of the first in the USSR all-metal aircraft of type ANT-2 (Fig. 2), developed under the guidance of A.N. Tupolev [5] were carried out.



Fig. 2. One of the first all-metal Soviet propeller-piston aircrafts of type ANT-2 designed by the young aircraft designer A.N. Tupolev (1924) [5]

Thus, step by step, in CAHI, production and design teams were formed, aimed at creating in the USSR a new aviation technology, which the army and society as a whole needed.

2. The main achievements of the aircraft designer A.N. Tupolev in aircraft industry. A characteristic feature in the work of AN. Tupolev was that, relying on the personal experience of the aircraft designer, he included in his aircraft projects only the minimum amount of new, not sufficiently proven in flight work. In his design activities, he unswervingly used the principle of sequential aircraft design [5], according to which new aircraft designs were based on previously well-developed versions of aircraft designs in the «metal». With this approach, he ensured the reliability of the aircraft designs developed by him.

It is believed that one of the famous Soviet aircraft is an all-metal single-engine aircraft of type ANT-25 (Fig. 3) [5, 6]. The main designers of it were A.N. Tupolev and future outstanding Russian aircraft designer Pavel Osipovich Sukhoi (1933). This aircraft was intended to set world records in the USSR for a non-stop flight. The main tactical and technical characteristics of the aircraft of type ANT-25 [5]: flight range – 13000 km; ceiling (height) of air lift – 7850 m; maximum flight speed at an altitude – 246 km/h; maximum take-off weight – 11,500 kg; take-off weight without cargo – 4200 kg; wingspan – 34 m; wing area – 88.2 m²; one piston engine of the ПД1-M34P brand with a power of 900 hp; crew – 3 people. On this type of aircraft in 1936-1937 legendary non-stop air flights were made by the famous Soviet flight crew of V. Chkalov, G. Baidukov and A. Belyakov on the record long-distance routes Moscow – Franz-Joseph Land – Petropavlovsk-on-Kamchatka and Moscow – Portland (USA) via the North Pole [5].

In the period 1922-1936 A.N. Tupolev as the chief designer of the CAHI Design Bureau for the design and production of all-metal aircrafts of various classes, was one of the founders of the CAHI scientific and technical base. In 1937, the aircraft designer A.N. Tupolev, due to contrived reasons of that cruel time (because of the accusation of sabotage and espionage in favor of France), was suspended from work at the CAHI Design Bureau and was unreasonably arrested. This was followed by the verdict of the Military Collegium of the Supreme Court of the USSR – deprivation of liberty for 15 years with a defeat for 5 years [3]. While in prison, he worked in a special Central Design Bureau-29 of the NKVD of the USSR (later this design bureau was called «Tupolevskaya Sharaga»). It is surprising that here A.N. Tupolev and his

design team was created one of the best in the period of the Second World War front-line bombers of the Tu-2 type (Fig. 4) [3].

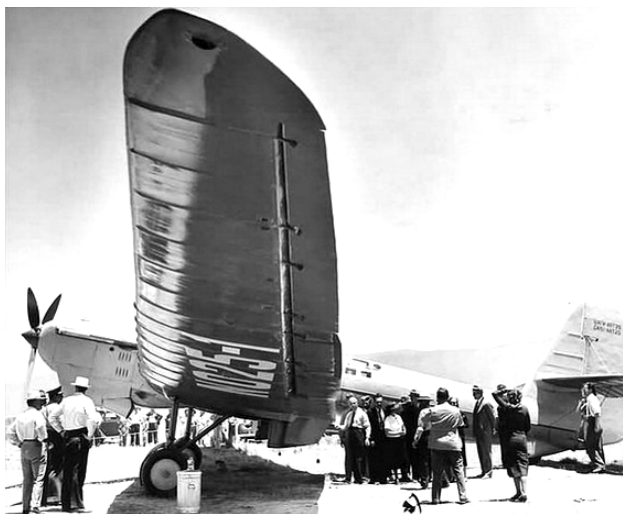


Fig. 3. Soviet screw single-engine long-range (record) aircraft ANT-25 developed by CAHI aircraft designers A.N. Tupolev and P.O. Sukhoi, in the USA (1937) [5]



Fig. 4. Soviet propeller twin-engine front dive bomber of Tu-2 type developed by A.N. Tupolev in the prison Central Design Bureau-29 of the NKVD of the USSR (1941) [5]

The main tactical and technical characteristics of the aircraft of type Tu-2 with two-tail unit [5]: flight range – 2020 km; maximum take-off weight – 11767 kg; take-off weight without combat cargo – 7601 kg; maximum flight speed at an altitude – 521 km/h; two piston air-cooled engines, brand AIII-82, with a power of 1,700 hp; lifting ceiling (height) – 9000 m; length – 14 m; crew – 3 people Tu-2 type front bomber made the first flight on January 29, 1941. The serial production of this aircraft began in 1942 and lasted until 1952. A total of 2649 units of this bomber were manufactured in the USSR [5]. This plane was one of the best machines of its time.

The first Soviet post-war carrier of nuclear weapons was a propeller piston four-engine strategic bomber of the Tu-4 type (1947), which was an exact copy of the American B-29 type bomber, from which the United States on the 6th and the 9th of August 1945 dropped on the Japanese cities of Hiroshima and Nagasaki, respectively, uranium and plutonium atomic bombs [5, 7]. By the end of the 1940s, it became clear to Soviet aircraft designers that the future of long-range bomber aircraft would belong to aircrafts with turboprop and turbojet engines. In this regard, for A.N. Tupolev and his Design Bureau the most important task of the urgent creation of a Soviet long-range missile carrier bomber was formulated

by the directive bodies of the USSR. In 1953, this task was completed. In the USSR, the first jet strategic bomber of the Tu-16 type appeared (Fig. 5) [5, 6].

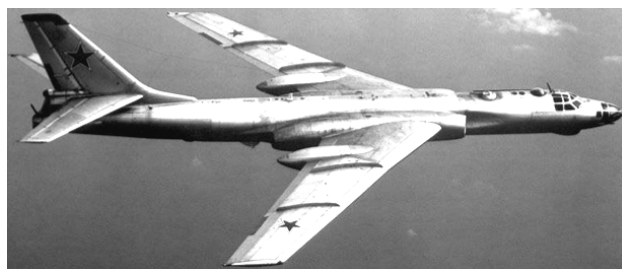


Fig. 5. Soviet jet twin-engine long-range missile-carrier bomber of the Tu-16 type («Russian badger» in the terminology of NATO countries) developed by A.N. Tupolev (1953, chief designer of the machine – D.S. Markov) [5]

Its creation is an unusual phenomenon not only in the Soviet, but also in the global aircraft industry. Combat aircrafts of the Tu-16 type with a minimum of operational modifications were used by the air forces of the USSR and Russia until 1994. They became one of the most «long-lived» military aircrafts in Soviet aviation. This was due to the exceptional reliability of their design and on-board equipment [9]. By the way, electrical equipment on Tu-16 aircraft was built using a single-wire circuit with a common «minus» on a metal case (board) made of a new at the time lightweight and durable Д16Т duralumin alloy. Four generators of the ГСР-18000 type (two for each engine) and two lead-acid batteries of the 12СAM-55 type (each battery consisted of two 6СAM-55 batteries connected in series) were used as DC sources. The plane used an electrical network with a voltage of 115 V and a frequency of 400 Hz, powered by two electric machine transducers of the ПО-4500 type [9]. It should be noted that in addition to these current sources, various electric power converters were additionally installed on various modifications of the Tu-16 to power the additional equipment installed on board. The combat aircraft of the Tu-16 type became a real pioneer in the class of heavy jet aircraft for Soviet aviation science. Only an American strategic bomber of type B-52 and a Soviet strategic bomber of type Tu-95, which will be discussed a little below, can be compared with it in terms of «longevity». Within 40 years of its combat «service», about 50 modifications of the Tu-16 type aircraft were created [9]. Its power plant contained two turbojet engines of the ПД-3М brand with a thrust of 9,500 kgf each. The main tactical and technical characteristics of the aircraft Tu-16 [9]: flight range – 6350 km; maximum take-off weight – 79,000 kg; mass without fuel and cargo – 37,200 kg; maximum flight speed at an altitude – 1050 km / h; lifting ceiling (height) – 12,300 m; length – 34.8 m; wingspan – 33 m; wing area – 164.6 m²; maximum fuel mass – 36,000 kg; crew – 6 people. According to its technical characteristics and layout, the Tu-16 combat aircraft was so successful that it allowed A.N. Tupolev and his Design Bureau without any problems, in a short time, create on its basis the first Soviet passenger jet airliner of the Tu-104 type (Fig. 6) [6, 9, 10].



Fig. 6. One of the first in the world Soviet jet multi-passenger aircraft of the Tu-104 type («Russian camel» in the terminology of the NATO countries) developed by A.N. Tupolev (1956) based on a Tu-16 type combat aircraft [6]

On July 17, 1955, the test pilot Yu. Alashev lifted into the air a prototype of a civilian Tu-104 aircraft, and from next year the USSR began mass production of this machine at the Kharkiv aircraft factory [10]. In 1956, the USSR, thanks to the creation of a Tu-104 type aircraft, managed to hit the western world when, during the visit of its leader N.S. Khrushchev to England last with a government delegation flew to London on this airliner. The main tactical and technical characteristics of the aircraft Tu-104 with two turbojet engines AM-3 (with a load of 8750 kgf) [10]: maximum take-off weight – 74,500 kg; empty machine weight – 42,800 kg; payload – 9,000 kg; fuel reserve – 26,500 kg; maximum range with a commercial load – 2,120 km; maximum flight speed at an altitude – 950 km/h; lifting ceiling (height) – 11,500 m; the number of passengers on board – 50-110; length – 38.9 m; wingspan – 34.5 m; wing area – 174.4 m²; crew – 5 people. The onboard equipment of the Tu-104 passenger aircraft was in many respects similar to the equipment of the Tu-16 combat aircraft. It consisted of [10]: autopilot АП-5-2 or АП-6; variometer ВАР-30-3; altimeter ВД-20; speed indicator КУС-1200; radio altimeter РВ-2; astrocompass АК-49; short-range radio navigation system РСВН-2; airborne radar РВП-4Г; radio compass АРК-5; gyrohalfcompass ГПК-52; remote gyromagnetic compass ДГМК-7; course-glide path system СП-50 «Mainland», course-glide path system ИЛС (course radio receiver КРП-Ф, glissad radio receiver ГРП-2, marker radio receiver МРП-48 or МРП-56П); communication radio station (receiver УС-9, transmitter 1-РСБ-70).

The appearance of the passenger plane Tu-104 allowed the USSR to reach the international level of air transportation as soon as possible. Aeroflot, a civilian user, carried international and domestic medium-haul flights on it. The operation of the Tu-104 type aircraft by Aeroflot was completed in December 1979. The experience of creating this passenger aircraft was used by A.N. Tupolev and his Design Bureau when designing a new Soviet airliner of the Tu-134 type (Fig. 7) [10].

The mid-range passenger aircraft of the Tu-134 type was a very successful long-lived airliner, which operates in Russia from 1967 to the present day (more than 50 years!) [10]. Note that before the creation of the Tu-134

A.N. Tupolev, appointed in 1956 as the General Designer of the Design Bureau-156 of the Ministry of Aviation Industry of the USSR, developed short-haul jet passenger aircrafts such as the Tu-110 (1957) and Tu-124 (1960), as well as a supersonic jet bomber of the Tu-22 type (1959) [5]. Then A.N. Tupolev and his colleagues at the Design Bureau actively continued work on the development of a turboprop strategic bomber of the Tu-95 type for long-range aviation (Fig. 8), which became a separate bright «page» in the scientific and technical biography of this scientist [11].



Fig. 7. Soviet mid-range twin-engine jet passenger aircraft of the Tu-134 type developed by A.N. Tupolev (1967) [6]



Fig. 8. Soviet turboprop four-engine strategic bomber of the Tu-95 type («Atomic Bear» in the terminology of NATO countries) developed by A.N. Tupolev and his fellow aircraft designers at the Design Bureau-156 (1956) [7, 8]

A surprising fact about aviation is the fact that a strategic bomber of the Tu-95 type (this «flying fortress» with several thermonuclear charges on board [7, 8]), developed and created under the guidance of A.N. Tupolev, more than 60 years ago, is still in the combat «ranks» of the Russian Air Force and provides its defenses in the airspace. Such examples of «longevity» in aviation technology are extremely few. In this regard, only our domestic passenger single-engine propeller airplane type AN-2 with a piston engine, developed in 1947 by the outstanding Ukrainian aircraft designer Oleg Konstantinovich Antonov [5], can compare with the military Tu-95.

We point out that in adulthood the main direction of the scientific and technical creativity of the aircraft designer A.N. Tupolev were heavy aircrafts with high payload. Taking the Tu-95 type combat aircraft as a basic design, in 1958 he created at his Design Bureau a unique passenger aircraft of the Tu-114 type (Fig. 9), well ahead of its time [5]. A reliable ultra-long-haul airbus won the leadership on long-haul lines for many years, having no analogues in the world in terms of economic efficiency.

During the years of operation, Tu-114 aircraft delivered 32 world records and there is no data in the column of flight incidents with these aircraft [5].



Fig. 9. Soviet long-distance (intercontinental) turboprop four-engine passenger aircraft of the type Tu-114 developed by A.N. Tupolev (1958) [6]

On December 31, 1968, the first in the world supersonic passenger aircraft of the Tu-144 type developed by A.N. Tupolev and his son A.A. Tupolev first flew [5]. Currently, this type of aircraft has been decommissioned in Russia due to a number of reasons.

In 1971, on the lines of the Soviet «Aeroflot», a medium-range jet three-engine passenger aircraft Airbus Tu-154 appeared, which is still in the Russian flight system [11].

The personification of the Russian aviation power is currently the supersonic jet strategic bomber-missile carrier of the Tu-160 type (Fig. 10), developed in the 1980s in the Design Bureau named after A.N. Tupolev [12]. This aircraft is equipped with a variable sweep wing. It is able to carry cruise missiles with a thermonuclear charge. The aircraft of the Tu-160 type has been in service since 1984. A total of 35 such aircrafts were built. As of 2013, the Russian Air Force contained 16 Tu-160 type aircrafts [12]. It became Russia's response to the US military program AMSA within which the famous American strategic bomber of type B-1 «Lancer» was created [6, 12].



Fig. 10. Russian jet four-engine strategic bomber of the Tu-160 type («White Swan» in NATO countries terminology) developed by the Design Bureau named after A.N. Tupolev (1984, chief designer – V.I. Bliznyuk) [6]

The Tu-160 supersonic bomber carrier was launched into serial production in 1984 at the Kazan Aviation Plant. The long-range Tu-160 missile bomber is an expensive military product with unique technical characteristics. The cost of manufacturing one Tu-160 missile carrier is about USD 250 million. We indicate some tactical and technical characteristics of the Tu-160 with turbojet engines of the type HK-32 [12]: maximum range of flight is 12,300 km; maximum flight speed – 2,200 km/h; cruising flight speed

– 960 km/h; machine length – 54 m; wingspan – 56 m. It is the only military product in Russia that has received its own name. These airplanes are named after famous Russian warriors (for example, «Ilya Muromets»), designers (for example, «Vitaly Kopylov»), pilots (for example, «Valery Chkalov») and others.

The great aviation designer of the 20th century, Doctor of Technical Sciences, Academician of the Academy of Sciences of the USSR, Colonel-General A.N. Tupolev established the world famous aviation scientific school, which brought up such prominent Russian aircraft designers as [5]: V.M. Petlyakov, P.O. Sukhoi, V.M. Myasishchev, A.I. Putilov, V.A. Chizhevsky, A.A. Arkhangelsky, M.L. Miles, A.P. Golubkov, I.F. Nezval, S.A. Lavochkin and A.A. Tupolev. He was the only aircraft designer in the USSR who solved the tasks of creating heavy subsonic and supersonic airplanes of various purposes [11].

3. The human qualities of the aircraft designer A.N. Tupolev. What kind of person in life was this outstanding Russian aircraft designer? Being a major scientist and designer, the head of a huge, many thousands team of engineers, technologists, test pilots, technicians and workers, Andrey Nikolaevich always remained a very simple and friendly person [5, 13]. He loved his family, valued his loved ones, adored nature, a group of friends and delicious food. In everyday life, he was extremely conservative: he preferred to wear old, but comfortable clothes. He loved to travel. In business trips abroad, he studied not only foreign science and technology, but also local nature, people and their customs. On vacation in the Moscow suburbs, he preferred hunting, fishing and playing volleyball. Before going to bed he regularly read fiction. His speech was short and capacious. His many phrases became aphorisms among colleagues. Andrey Nikolaevich maintained friendly relations with I.V. Kurchatov, A.P. Vinogradov, A.T. Tvardovsky, M.V. Keldysh, P.L. Kapitsa and many other prominent people of the time in which he lived and worked. Sergey Pavlovich Korolev, who had become an outstanding Soviet and world-renowned designer of rocket and space technology, often came to see him at work. Later S.P. Korolev in his memoirs about those meetings with A.N. Tupolev said that «*he studied with Andrey Nikolaevich style of work*» [5, 13]. By the way, under the guidance of Andrey Nikolaevich, Sergey Korolev completed his diploma project and became a mechanical engineer. Until his last days of life, he was interested in production issues at the Design Bureau. He was buried at the Novodevichy cemetery (Fig. 11) [3, 5].

In 2001, on one of the walls of the world-famous Moscow State Technical University (formerly MHTS) named after N.E. Bauman bronze memorial plaque (Fig. 12), installed in honor of his outstanding student appeared [15].

4. Awards and recognition signs of A.N. Tupolev. For his outstanding achievements in aircraft construction, Andrey Nikolayevich Tupolev was awarded three gold medals of the Hero of Labor «Sickle and Hammer» (1945, 1957, 1972), 14 Soviet (1933, 1936, 1944, 1945, 1947, 1949, 1953, 1957, 1958, 1968, 1971, 1972) and one foreign (1964) orders. He is the Laureate of five State Prizes



Fig. 11. The tombstone of the great aircraft designer of the 20th century, three times Hero of Labor A.N. Tupolev (Novodevichy cemetery, Moscow, 2012; sculptor – G. Toidze) [14]



Fig. 12. Bronze plaque in honor of A.N. Tupolev on the building of Moscow State Technical University named after N.E. Bauman, where A.N. Tupolev studied (opened on May 17, 2001; sculptor – G. Meshinev) [15]

of the USSR (1943, 1948, 1949, 1952, 1972) and one Lenin Prize of the USSR (1957). He became an honorary citizen of Paris (1964), New York (1964) and Zhukovskiy (Moscow region, 1968). He was awarded the prize named after N.E. Zhukovskiy of the Academy of Sciences of the USSR (1958), the gold medal of the International Aviation Federation of FAI (1958), the Leonardo da Vinci international award (1971) and the gold medal of the Society of the founders of French aviation (1971). He was elected Honorary Member of the Royal Aviation Society of Great Britain (1970) and the American Institute of Aeronautics and Astronautics (1971). His bronze bust of the Hero in the city of Kimry (Tver region, Russia) was installed. In the name of A.N. Tupolev the embankment in Moscow, streets in St. Petersburg, Kyiv, Ulyanovsk, Kimry and Zhukovskiy were named. The name of the aircraft designer A.N. Tupolev is currently given to Russian Aviation Scientific-Technical Complex, Moscow, which is well-known in the world (the successor to the traditions of the legendary A.N. Tupolev Design Bureau). His name is given to the Kazan Aviation Institute. One of the islands of Russia in the Kara Sea was named after him [3, 5].

Conclusions. An outstanding aircraft designer of the 20th century, AN. Tupolev left a significant «trace» in the Russian and world aircraft design. Under his scientific and technical guidance, over 100 types of military and civil aircrafts were developed, 70 of which were mass-produced by the USSR aviation industry. He made a huge personal contribution to the defense of the Soviet country. In the national memory, Academician of the Academy of Sciences of the USSR A.N. Tupolev remains one of the

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creators of a wide range of aircrafts in the passenger aircraft fleet. Its turbojet passenger aircrafts, as well as heavy turboprop and turbojet strategic bombers, still «plow» world airspace and carry out civil and combat tasks assigned to them.

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