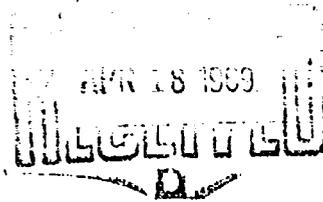


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FOREIGN TECHNOLOGY DIVISION



MEET - AEROFLOT

by

V. Gavrilenko and I. Chudakov



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# EDITED MACHINE TRANSLATION

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By: V. Gavrilenko and I. Chudakov

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**ABSTRACT**

The document is a non-technical summary of civil aviation in the USSR designed for popular reading, and contains four main sections:

Part I consists of a short history of the growth and development of civil aviation with reference to capabilities, volume of traffic, routes flown, and development of aircraft.

Part II contains more detailed information on planes currently in service on main and feeder routes. The format consists in description of planes according to the four main designers: Tupolev, Ilyushin, Antonov, and Yakovlev. A brief biography of each designer is followed by a detailed description of the planes produced by him including flight data for each of the following aircraft:

Tupolev: TU-104, 124, 114, 154, 134, 144;  
 Ilyushin: IL-14, 18, 62;  
 Antonov: AN-2, 10, 24, 22;  
 Yakovlev: YaK-18T, 40.

With the exception of the TU-144 and AN-22, each data table contains the following information: length, height, wing span, cruising speed, empty weight, payload, fuel capacity, takeoff weight, ceiling and range. For the TU-144 only cruising speed, payload, and ceiling are furnished. For the AN-22 only cruising speed, payload, takeoff weight, range, takeoff run, and landing run are listed.

This section also includes 6 photos of aircraft mentioned with 2 diagrams of interior layouts.

Part III is devoted to description of the organization of the

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aviation technical engineering service including: maintenance echelons, air base facilities, traffic control, and weather service.

Part IV is entitled "Useful information for air travellers" and appears to be a verbatim reprint of aeroflot regulations concerning: services to the passenger, tickets, stopovers, and reduced fares.

WOMP A

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## I. THE ROLE OF AEROFLOT IN THE GENERAL TRANSPORT SYSTEM OF THE USSR

Our civil air fleet has a comparatively short history. On 9 February 1923 the Council of Labor and Defense of the republic adopted a resolution regarding the creation and development of aviation in this country. The day of publication of this government resolution became the official date of formation of the Civil Air Fleet of the USSR. By this resolution the permanent Council for Civil Aviation was formed, which developed a tentative plan for development of airlines over the forthcoming three year period and conducted extensive work in coordinating the activity of then embryonic joint-stock airline companies "Dobrolet" - in RSFSR, "Ukrvozdukhput'" - in the Ukraine and "Zakavia" - in the Transcaucasus, subsequently combined into the All-Union Joint-Stock Company "Dobrolet".

The first regular passenger airline in the country Moscow - Nizhniy Novgorod (now Gor'kiy) 420 km in extent was open in 1923. On this line in one year 229 passengers and 1900 kg of cargo and mail were transported.

In 1922-1923 in the Central Aerohydrodynamic Institute [TsAGI] under the leadership of V. L. Aleksandrov and V. V. Kalinin one of the first Soviet passenger aircraft, the AK-1 was designed and built, which carried four passengers and developed speed up to 146 km/h. In these same years the experimental Soviet passenger aircraft "Komta", K-1, SUVV, and ANT-2 made their appearance.

A collective headed by aircraft designer A. N. Tupolev soon created the ANT-4 and ANT-6 aircraft and in 1929 the three-engine passenger aircraft for 9 passengers - ANT-9.

In 1931 the ANT-14 ("Pravda") aircraft for 36 passengers was flown and in 1934 the eight-engine giant aircraft ANT-20 ("Maxim Gor'kiy") with a capacity of 80 passengers made its first flight.

By the end of the first five-year plan for the airlines of civil aviation such aircraft, as the PS-9 9-seater, the K-5 6-seater, the 4-seater "Stal'-2", the P-5 mail plane and others had been placed in service.

The Soviet aviation industry during the years of the second five-year plan began releasing for civil aviation the "Stal'-3" with 6 seats, the G-2 with 16 seats, the KhAI-1 with 5 seats, PS-7 with 12 seats, the PR-5 with 4 seats, PS-89 with 12 seats, and PS-35 carrying 12 passengers and 75 kg of baggage.

Successful industrialization of the country permitted, beginning in 1935, full transition to the operation of aircraft domestically produced.

Design organizations headed by A. N. Tupolev, N. N. Polikarpov and A. I. Putilov, created domestic passenger aircraft which, in their flying and technical characteristics, were unsurpassed by aircraft of foreign firms. Before the Great Patriotic War in civil aviation the ANT-40 (PS-40), ANT-35 (PS-35), PS-89, ANT-6 (G-2) and others were in service.

In 1940 the airline routes amounted to 138.7 thousand km, 409.6 thousand passengers and 62 thousand tons of cargo and mail were transported.

From the first days of the Great Patriotic War personnel of civil aviation together with the entire Soviet people began a decisive and brave struggle against the German-Fascist aggressors.

Flying-technical, command-political personnel and the materiel section were diverted to form military air units for the execution of special missions by the Central Committee of the All-Union Communist Party, the State Defense Committee, and the Soviet government.

Pilots of civil aviation under the most complex combat and meteorological conditions, by day and by night, under fire of antiaircraft artillery and the threat of attack by enemy fighters, not infrequently with damaged aircraft accomplished flights deep in the rear of the enemy for contact with partisans, and to besieged hero-towns: Leningrad, Stalingrad, Sevastopol', and Odessa.

During the years of the Great Patriotic War, the pilots of civil aviation transported 2 million 300 thousand passengers, including 330 thousand wounded soldiers and officers, nearly 500 thousand tons of drugs, equipment, spare parts, and fuel. Forty thousand flights were accomplished in the rear of the enemy by pilots of Aeroflot, helping partisans and units of the Soviet Army which were fulfilling special command assignments.

The Soviet people had high praise for the combat valor of Aeroflot personnel. Nearly 15 thousand pilots, navigators, flight mechanics, radio operators, engineers, technicians, workers and employees of command and political components were awarded orders and medals. Twelve pilots were awarded the high rank of "Hero of the Soviet Union".

In the postwar period, civil aviation continued to develop at an even more accelerated rate. Airframe and engine inventory in the first postwar five-year plan was supplemented by the improved transport aircraft IL-12 and IL-14. These planes formed the base of the civil aviation fleet which serviced intrarepublican, union, and international air routes. Special attention was turned to the development of the most important routes linking Moscow with centers of the union republics, regional cities, regions of the north, Siberia and the far east.

In the second postwar five-year plan (1951-1955) a new stage in the development of civil aviation began. The capital of our native land — Moscow, capitals of union republics, all district and regional centers were already connected by a dense network of airlines. Technical equipment of routes was increased which permitted carrying out aircraft flights around the clock. Ground control and flight guidance systems were improved, experience in party-political work was accumulated and generalized. In Aeroflot there was created a durable material and technical base for further technical progress.

The sixth five-year plan (1956-1960) was marked by the transition of civil aviation from piston engines to jets.

Fulfilling the directive of Party and government, Soviet scientists and designers in close collaboration with engineers, technicians, pilots, and workers of the aviation industry successfully solved the problem of creating new jet aircraft with gas turbine engines. The world's first civil aviation jet transport aircraft was the Soviet airliner TU-104, created by a collective of designers under the leadership of General Designer for Aviation Technology Academician A. N. Tupolev. At the Brussels World's Fair the TU-104 was awarded a gold medal. Following the TU-104 on the skyways came the TU-104A — 70-passenger, TU-104B — 100-passenger, the turboprop multiseat passenger aircraft IL-18, a design of General Designer S. V. Il'yushin, and the AN-10 designed by General Designer O. K. Antonov, and also the TU-124 and AN-24. Regular flights began with the world's largest airliner, the TU-114, which at the Brussels World's Fair received the highest award — the "Grand Prix".

What is taking place now in civil aviation cannot fail to arouse admiration. Year in and year out, with ever increasing strides Aeroflot paces around the planet. On the boundless expanse of the air ocean — from the north pole to the Black Sea, from the Baltic to the Pacific Ocean, by day and by night, in burning heat and bitter cold, in all latitudes Soviet airliners are accomplishing their runs.

Planes and helicopters of Aeroflot with passengers or cargo on board actively support the rhythm of life of the country - a life which is busy, exuberant, and creative.

### Passenger and Cargo Air Transport in the USSR

The most important place in the united transport network of the USSR belongs to air transport. The enormous demands of the national economy in terms of high-speed air transports and the introduction of aircraft with gas turbine engines, possessing high speed and great load capacity, have ensured a high rate of development of air transport in our country.

The Order of Lenin Aeroflot - the largest air transport enterprise in the world with air routes extending almost 500 thousand km. The mighty wings of Aeroflot spread over the entire territory of the Soviet Union, servicing nearly 3.5 thousand cities and populated localities, and connecting in a single network more than 2.5 thousand air routes. In extent of air routes and rate of growth of shipments, in volume of application of aviation to national economy, the Soviet Union occupies first place in the world.

The Central Committee of the Communist Party of the Soviet Union and the Council of Ministers of the USSR in their greeting to workers of aviation and aviation industry in connection with the 40th anniversary of Aeroflot noted that in recent years the air transport of the Soviet Union has become an accessible and convenient means of communication for millions of Soviet people.

While in 1923 - the first year of its existence - the extent of internal air routes in the country equaled 420 km in all and for one year inside the country only 229 passengers were transported, now civil aviation, equipped with multiseat high-speed aircraft, on separate days airlifts 210-220 thousand passengers. 229 passengers a year and 220 thousand passengers in only twenty-four hours - this is the result of development of civil aviation in the USSR.

In a seven-year period on the air routes 190 million passengers were transported, in agriculture and forestry over 230 million hectares of kolkhoz and sovkhos fields and forests were developed.

The first and second year of a five-year plan have been completed successfully. In 1965 48 million passengers were transported, in 1967 -- more than 54 million people, and in 1968 the projected to transport 62 million. Air transport has become one of the main forms of passenger travel, and by a distance in excess of 1500 km -- this is basic.

Over internal and foreign routes yearly more than 1700 regular flights are made. Just from the four airports of the Moscow air terminal, one of the largest in the world, every day to all corners of our immense native land more than four hundred passenger planes take off.

From Moscow the most important main lines radiate to the far east, Central Asia, the Transcaucasus, and also lines of union and local significance which ensure direct communication between the capital of the USSR and approximately two hundred major cities of the country.

Passenger and cargo trips on the air routes are made by modern jet and turboprop TU-104, TU-124, TU-114, IL-18, AN-10 and AN-24 aircraft.

In the anniversary year, on our routes there emerged the new intercontinental IL-62 airliner, the TU-134 jet passenger was put into operation followed by the YaK-40 jet passenger machine for feeder airlines. In the near future, civil aviation will acquire the supersonic TU-144 aircraft with a speed of 2500 km. Such aviation materiel will allow civil aviation toward the end of 1970 to transport yearly on union and local lines up to 75 million passengers, 2.5 million tons of cargo, and 350 thousand tons of mail. Furthermore, aircraft will develop from the air nearly 110 million hectares of kolkhoz and sovkhos lands.

Our century — a century of speed. Cruising speeds of Aeroflot aircraft are from year to year increased. They grew from 120 to 900 km/h, and by many times exceed the rated speed of other forms of transport. Thus, speed of air travel exceeds the speed of railroad transport 10-15 times.

### Air Routes of the World and Friendship

The international routes in the branched network system of Aeroflot lines occupy a special place. They, in their own way, reflect the inclination of the peoples of our country toward peace and collaboration on the basis of mutual benefit and equality. Throughout the entire history of its development, Aeroflot has never pursued discriminatory goals with respect to its partners — the airlines of other countries.

Development of the international routes of the USSR has its own history beginning with the flights of aircraft on line Moscow-Koenigsberg, 1 May 1922. The opening of this air route permitted as it were "to break through a window" from the young Soviet republic into capitalistic Europe, whose reactionary governments in those years tried to conduct with respect to Red Russia a policy of isolation and nonrecognition.

The airline, after opening, functioned so successfully that a combined Soviet-German joint-stock company "Deruluft" extended it in 1926 to Berlin, and already in the following of year "Deruluft" occupied first place in volume of mail shipments among all the airlines of Western Europe. Air mail from Moscow to Berlin took 13-15 hours which was a unique record in those days. Subsequently, aircraft began regular service on the line Leningrad-Berlin.

The years passed. Industrialization of the country created a material and technical base for powerful progress in the field of domestic aviation, science, and technology. With the planes created by the hands of Soviet designers, engineers, and workers, various aviation records were established, outstanding flights were performed,

new routes were mastered. All of this created the prerequisite not only for development of intraunion, but also international air routes.

Whereas the length of the first international air line, Moscow-Koenigsberg, was only 1200 km and 5000 km was the extent of the net of international air routes before the beginning of the Great Patriotic War, now the international routes have girded all continents of the earth and their total extent is in excess of 100 thousand km.

The development of Aeroflot's international air routes progressed at a rapid rate in the postwar years. At the same time, Aeroflot rendered great help to countries headed along the path of Socialism. Soviet-Bulgarian, Soviet-Rumanian, Soviet-Hungarian, and other joint companies were organized for exploitation of air routes.

On the basis of these companies countries of the People's democracies created their own civil aviation and prepared cadres for the exploitation of aviation materiel emanating from the Soviet Union.

In the mid-fifties a new stage in the development of international lines of Aeroflot began. In 1955 the Soviet-Austrian agreement on air travel was concluded, and in a year - agreements with Denmark, Norway, Sweden, and Finland. Soon their example was followed by the West European countries - England, France, Belgium, and Holland.

In 1956 regular flights began both with Soviet aircraft to Stockholm, Copenhagen, and Helsinki, and, also with aircraft of the Scandinavian airline "SAS" and the Finnish airline "Finnair" to Moscow. On the Soviet side, these flights were performed by IL-14 aircraft and on the part of "SAS" and "Finnair" with "Scandia" and "Metropolitan" aircraft.

The first jet civil aircraft-the handsome TU-104 made its debut in September 1956 on the international Moscow-Prague route, in 1957 it accomplished the first flight to the United States over the Atlantic ocean, and beginning in 1958 our high-speed planes were flying regularly to all the countries of Western Europe.

At the end of the fifties Aeroflot began to develop air links in the direction of Asia and Africa. Routes were opened to India and the UAR: Moscow - Delhi and Moscow - Cairo. Then began the intensive development of the long, air routes to Morocco, Mali, Guinea, Ghana, Algeria, and Tunisia in Africa, Burma, Indonesia, and later Pakistan, Ceylon, Syria, and Iran - in Asia.

The Soviet Union already toward the end of 1958 had concluded agreements on the establishment of direct air service with 23 countries, and in seven years the number of countries had doubled.

A memorable date, not only in the history of Aeroflot but also in the history of two fraternal countries, was 10 July 1962 when a Soviet TU-114 airliner for the first time opened the "jet" road from Moscow to Cuba via the capital of the Republic of Guinea, Conakry. Then during the so-called Caribbean crisis the boundless expanse of ocean did not prevent the Soviet and Cuban peoples from getting still closer, from uniting still more closely.

This flight was an extraordinary event not only from a political point of view symbolizing the fraternal unity and solidarity of two socialist countries, but also purely from the point of view of aviation. The fact is that the flight to the capital of revolutionary Cuba was a serious test both for the crew and also for TU-114 aircraft. The flight via the route Moscow-Conakry-Havana-Moscow passed over an unfamiliar route along the equator and above the waters of the Atlantic. Under adverse weather conditions in the midst of tropical thunderstorms and torrential rains this air route was pioneered. On this route there was no ground radar assistance, which our pilots have in our country.

The splendid flight characteristics of the TU-114 aircraft, its perfect radar equipment, brilliant skill of the crew - all this helped to conquer the ocean wastes and distance. At that very time in Havana an agreement was concluded concerning air travel between the Soviet Union and Cuba.

On 29 December 1962 the very first nonstop flight was completed by the air-giant TU-114 from the Soviet Union to the Republic of Cuba. The trip at both ends terminated successfully exactly on schedule. On the return trip the TU-114 covered a distance of 10,900 km in 13 hours 55 min at an average speed of 800 km/h.

On 7 January 1963 Aeroflot initiated regular passenger flights via the Moscow-Havana air route. This pioneer, super-range air route, passing above the boundless expanse of northern seas and the Atlantic ocean, is the result of a number of the highest achievements of Soviet aviation materiel.

At that time, not one aviation company in the world had a passenger aircraft able to fly nonstop the distance which separates Cuba from the USSR.

Air transport draws together peoples of various countries, it is an important factor in scientific and cultural exchange, it promotes business contacts and the development of tourism. A graphic illustration of this is the aviation collaboration between the USSR and Italy. The beginning of such collaboration between the two countries was initiated precisely as a result of the activation of cultural and athletic ties - the arrival of the Milan theater "La Scala" in Moscow and the return visit of the Bolshoi theater to Italy, the playing of soccer matches for the championship of Europe, and other ventures. The TU-104 and TU-114 flights to Italy organized by Aeroflot aroused high interest in the Italian public toward these trips and resulted in the opening in May 1965 of direct air services between Moscow and Rome.

In November 1966 air traffic opened between the USSR and Canada. This air route which is a distance of 7350 km is one of the longest. The value of this line increased in April 1967 when the World's Fair opened in Montreal. Tourists via an 11.5 hour nonstop flight on TU-114 aircraft flew from Europe to America. Now with the IL-62 this 7350 km trip takes a total of 9.5 hours.

Through Montreal there will soon be opened a new air route, Moscow-New York. To service the new route, there will be the Aeroflot IL-62 and the "Boeing-727" or "DC-8" of the American company "Pan American". This air route can be used by those who must make the trip either to the United States or to Canada. Flying time between Moscow and New York will be 11 hours.

On 20 January 1967 a trade agreement was signed regarding the right of the air route which connects the Soviet Union with Japan. Direct air service between the capitals of the USSR and Japan is regarded by the Soviet public as positive act in development of economic and cultural ties between two neighboring countries. The land of the Rising Sun will be separated from Moscow by less than a 9 hour flight on an IL-62.

The route from Western Europe to Japan and back via Moscow is the most convenient for travelers since it is considerably shorter than the routes passing over the north pole or through countries of Southeast Asia. A positive factor is the fact that the route Moscow-Tokyo coincides basically with the existing well-developed network of airfields and navigational aids, and is safe.

On 17 October 1967 on the Moscow-Delhi route the first trip took place with a Soviet IL-62 passenger airliner replacing the TU-114 on this route. The flagship of Soviet civil aviation covers this distance nonstop in 6 hours - one hour faster than the TU-114.

During the last few years, passenger transport on international lines has increased so much that in Moscow it has been necessary to concentrate them in a separate airport, Sheremet'yovo Airport, where, besides the TU-104, TU-114, TU-124, IL-18 and IL-62, it is possible to see aircraft of various makes with emblems of the airlines of Europe, Africa, Asia, and America. The Moscow harbor of foreign airliners takes the French "Caravelle", the English "Comet", the American "Boeing-707" and a host of other aircraft.

International airports of the Soviet Union are also located in Irkutsk, Baku, Odessa, Kiev, Tashkent, and Alma Ata, which, just like Sheremet'yev airport, are equipped with everything needed for reception and service of Soviet and foreign aircraft.

With modern technique, experienced flying and engineering-technical personnel at its disposal, Aeroflot can ensure flights to any point on earth. Its flight crews having visited all the continents on our planet, confidently and reliably at any time of day and night and in adverse weather conditions operate airliners in 44 foreign countries: Bulgaria, Rumania, Hungary, Czechoslovakia, Yugoslavia, Finland, Austria, the German Democratic Republic, Mongolia, France, Cuba, Italy, Morocco, Mali, Ghana, Canada, India, Burma, and other countries.

Civil aviation now carries out nearly 20% of all world air transportation. Each year it dispatches by air considerably more passengers than such big European airlines as Air France, BEA, and SAS put together.

## II. AIRCRAFT OF CIVIL AVIATION

Soviet aircraft construction in the last decade has achieved unprecedented successes. This has radically changed the appearance of civil aircraft in service both on intraunion routes of medium and great length and also on international air routes. In the current five-year plan operation of a third, and on distant routes a second, "generation" aircraft with gas turbine aircraft engines will commence.

On feeder airlines, besides the planes with gas turbine engines, piston engine aircraft will still continue in service at speed of 200-300 km/h. These are the IL-2 built in 1939, the IL-12 (1946), AN-2 (1946), YaK-12 (1948), and IL-14 (1950).

From 1959 through 1966 the volume of passenger travel increased from 12 to 48 million persons a year, where 50% of this quantity was accounted for by feeder airlines. However, at the present time circumstances are such that the majority of aircraft in service on these lines can no longer meet the increasing demands and will have to be replaced. This problem will be completely solved in the current five-year plan.

An analogous situation at present has developed abroad, where by 1970 they aim to replace up to 2 thousand obsolete aircraft with piston engines. For the purpose of selecting the best designs for air routes of medium extent, in the United States there was even declared open competition. According to conditions of the competition,

the aircraft should meet the following requirements: length of runway - not more than 900 m, number of seats - from 14 to 30, cruising speed - 370 km/h, flight range - 1100 km. However, it turned out to be not that easy, and from nine projects presented not one was accepted.

In the USSR at the present time, the basic airframe and engine inventory consists of machines with gas turbine engines in which a very large share of the passengers are transported - near 80%. During a seven year period the aircraft inventory of civil aviation reached the following breakdown:

Aircraft of main routes:

long range - TU-114, IL-62;  
medium - TU-104, IL-18, AN-10;  
short - TU-124.

Aircraft of feeder airlines:

heavy - AN-24;  
medium - IL-14, IL-2;  
light - AN-2.

All these aircraft with gas turbine engines are extremely comfortable, reliable, and are long lasting. They are equipped with modern radio-navigational equipment allowing them to fly and land by day and at night under adverse weather conditions. For warning the crew about the approach of storm fronts and obstacles in their way all aircraft have radars.

Passengers are accommodated in pressurized cabins where there are comfortable soft seats with reclining backs, and curtains in restful tones. By depressing a push button on the armrest of the seat, the passenger can at will lower the back and take a position comfortable for sleeping.

For the smokers ashtrays are fitted, in the seat pockets - a detachable table, brochures and airsickness bags. Each seat is equipped with a safety belt.

Children of creche age are accomodated in suspension cradles. The passenger can put small personal things on baggage shelves attached to both sides of the salon.

Above each seat is a panel with push buttons to call the stewardess, individual reading lamps, and individual ventilation vents.

In the cabins by means of a conditioning system constant air pressure and temperature are maintained. The air entering the passenger cabin is absolutely pure and has no harmful impurities.

At night in the passenger cabins only service lights are turned on providing faint diffused light. Passengers not wishing to sleep can use the individual reading lamps, the light from which does not interfere with the persons around them.

The trim in the cabins and the partitions are made of plastic simulating expensive woods. Underlying the paneling is heat and sound insulation which muffles the noise of the engine. A low level of noise does not tire the passengers and permits conversation without effort.

Galleys are equipped with everything necessary to provide food for passengers during flight. Here there are thermoses for tea or juices, coffee makers, boiling pots, electric ovens and containers with dishes. In flight, fresh-frozen items are warmed up in 15-20 minutes.

Below we will meet with the creative leading designers of airliners, and also with a short description of the aircraft they have created for civil aviation.

### A. N. Tupolev

Aircraft bearing the emblem "TU" are well-known far beyond the borders of our country. They were the first discoverers of the most difficult air routes, in them the greatest flights were accomplished from the USSR to other countries, they accomplished the first landing at the north pole.

The creator of the brilliant "constellation" of these machines is the Experimental Design Office [OKB] directed by General Designer for Aviation Materiel, twice Hero of Socialist Labor, honored scientist and technologist, Academician Andrey Nikolayevich Tupolev.

The whole life of this 80 year old veteran of Soviet aviation science is an excellent example of patriotism and selfless service to his native land. Under his leadership more than 100 different types of aircraft have been created, a large number of which went into series production.

His education was obtained in the Bauman Moscow Higher Technical School, which he entered in 1909. Even then he displayed his love of aviation. While still a student, Tupolev became one of the brightest pupils of N. Ye. Zhukovskiy, the "father of Russian aviation." In those years, Andrey Nikolayevich took an active part in the work of the aerodynamic laboratory, he designed the first wind tunnels intended for testing of aircraft. Studying in the aeronautical circle at the Moscow Higher Technical School, he designed and constructed training gliders, one of which he flew personally.

The creative biography of A. N. Tupolev as scientist and aircraft designer began in 1918, when upon completion of the Moscow Higher Technical School, jointly with N. Ye. Zhukovskiy, he participated in organizing the Central Aerohydrodynamic Institute [TsAGI] and was designated as its deputy chief. He served in this post up to 1935.

In 1922, at the Central Aerohydrodynamic Institute a design bureau was created under the leadership of Tupolev who began his own work in designing and construction of a single-place aircraft, the ANT-1, made basically from wood.

Subsequent years were marked by a search for new paths in aircraft construction, working on creation and mastering the new metal in those years - duralumin, the original solution to complex technical problems. Now we know how aircraft created from metal acquired the name of "silver bird." However in 1923 the young scientist had a hard time to prove the advantages of an all-metal aircraft. In hot discussions he had to assert the correctness of his views. Only after this did he manage to construct from metal a two-seater aircraft, the ANT-2, a hydroplane and an aerosleigh with propeller. By building metallic machines Andrey Nikolayevich proved the operational advantages of duralumin. Thus, A. N. Tupolev is the original user of metal in aircraft building in the USSR. The transition to metal, ensuring the possibility of mass manufacture of machines, demanded a radical change in the procedures for construction and technique of building aircraft.

In 1925 the ANT-3 ("Proletariate") was created. In it the crew of M. M. Gromov in September 1926 accomplished a triumphal flight across the countries of Europe: France, Italy, Austria, Czechoslovakia, and Poland. In 34 hours it conquered 7 thousand kilometers. The following year, in an ANT-3, a crew headed by S. A. Shestakov in 153 hours flew from Moscow to Tokyo and back, covering a distance of 22 thousand km. The historical significance of the ANT-3 consists in the fact that in it Soviet pilots first ventured on international air routes, demonstrating the great achievements of Soviet aircraft construction.

A great role in the history of Soviet aviation was played by the ANT-4 ("Country of the Soviets"), with a gross weight of 6600 kg. In it, pilot S. A. Shestakov in 1929 accomplished an outstanding flight from Moscow to the United States, covering a distance of 21,242 km in 142 flying hours. In those years the ANT-4 was the

basic machines in use on the routes of Siberia, the transpolar, and the far east. These aircraft participated in the rescue of the crew and passengers of the "Chelyuskin" and took part in other northern expeditions.

In 1929 the nine-seat passenger aircraft ANT-9 was built. It had comparatively high speed — 208 km/h and a flying range of 1800 km. In July 1929 this machine successfully underwent a serious test — the great West European flight. For its time, the ANT-9 marked the same stage in civil aviation which later the jet aircraft TU-104 occupied.

A great role in the history of aviation was played by the 76-passenger aircraft, the "Maxima Gor'kiy" (1934), in the construction of which questions of increasing the dimensions and tonnage of the machine were daringly solved. This aircraft was the largest in the world up to 1950.

One after another newer and more powerful aircraft came into being: the ANT-6, ANT-25, ANT-35, and others. The high flying-technical qualities of the ANT-25 were confirmed in the historical flight of V. P. Chkalov and M. M. Gromov from Moscow across the north pole to the United States. A ten-seat ANT-35 (1936) was exhibited at the International Air Show in Paris and received high acclaim there.

Besides the creation of multiseater passenger aircraft, A. N. Tupolev merits recognition in development of medium and heavy bombers, in the majority of which in flying-technical data he significantly surpassed the corresponding foreign models. During the Great Patriotic War Soviet government delegations flew from Moscow to New York (1942) in his ANT-42.

In the postwar period in the creative work of the design bureau directed by A. N. Tupolev, began the new highest stage. On 3 July 1955 on the aviation holiday in Moscow the TU-104 turbojet passenger aircraft was demonstrated for the first time. An on 15 September 1956 this airliner began regular flights on the route Moscow-Irkutsk.

Then there was created the world's largest (at that time) TU-114, and later the TU-124, TU-134, TU-154, and TU-144. Let us become familiar with the descriptions of these planes and their basic flying-technical data.

The TU-104 aircraft was the world's first jet aircraft to begin carrying out regular scheduled flights (1956). This high-speed airliner in a short while achieved general acclaim thanks to its superior flight characteristics, speed, load capacity, and comfort. In 1958 at the Brussels World's Fair air display the designer of the aircraft was awarded a gold medal.

It must be noted that American and English airlines only managed to carry out their first passenger flights on the "Boeing-707" and "Comet-IV" jet aircraft in 1958. The French "Caravelle" began scheduled flights still later - in 1959.

The TU-104 is in service both on relatively short routes, for example Moscow-Leningrad, where the flight takes 55 min in all, and also on lines of great extent - Moscow-Novosibirsk, Moscow-Irkutsk, and Moscow-Khabarovsk.

Thanks to its high speed (nearly 900 km/h) the aircraft covers the distance 10-15 times faster. Incidentally, on the TU-104 series all our astronauts received their training under conditions of weightlessness.

On the air routes at present, planes of following modifications are flying: TU-104A (70-seat) and TU-104B (100-seat). Externally they differ in no respect. The aircraft is equipped with two turbojet RD-3M-500 engines and is equipped with a deicing system enabling it to cope with in-flight icing.

Numerous automatic and navigational instruments permit accomplishing flights both by day and also by night. The on-board radar in ample time reveals storm regions, which helps the pilot to select a safe route.

In case of failure of one of the two engines, the aircraft can continue flight with only one engine.

The TU-104 is a low sweptback-wing monoplane. The landing gear consists of two main and one forward strut. The main landing gear has four wheels which retract in flight by means of a hydraulic system into special wing nacelles. On the forward strut there are two wheels, and in flight it retracts into the nose part of the fuselage.

Passengers, crew, and cargo are carried in the pressurized part of the fuselage. The aircraft has two entrance doors. The front door leads to the pilot's and passenger cabin. The other door, located in the rear part of the aircraft, connects the passenger cabin with the cloakroom.

In the nose part of the fuselage is the crew's cabin. Behind it is located the galley equipped with everything necessary for the preparation and storage of food. Food supplies are placed in special containers and thermoses.

Cargo and passenger baggage are stored in a pressurized luggage compartment located under the floor of the passenger cabin. Cargo and baggage are loaded into the aircraft through a special hatch from below.

Thanks to a powerful ventilation and air conditioning system, in the passenger salons and crew's cabin normal temperature, pressure and atmospheric humidity are maintained constant.

The entire structure of the aircraft is carried out with a considerable safety factor which ensures complete flight safety.

In conclusion, regarding the composition of the crew. It includes two pilots, a flight mechanic, navigator, and radio operator.

### Basic Data on the TU-104B Aircraft

|                                   |        |
|-----------------------------------|--------|
| Length of aircraft, m.....        | 40.06  |
| Height of the aircraft, m.....    | 11.9   |
| Wing span, m.....                 | 34.54  |
| Cruising speed, km/h.....         | 850    |
| Weight of empty aircraft, kg..... | 42,500 |
| Payload, kg.....                  | 12,000 |
| Fuel capacity, kg.....            | 26,500 |
| Takeoff weight, kg.....           | 76,000 |
| Ceiling, m.....                   | 11,500 |
| Flying range, km.....             | 3100   |

Created in 1957, the largest passenger airliner at that time, the TU-114 is intended for transport of a large number of passengers over long distances. At the Brussels World's Fair air show in 1958 this aircraft achieved the highest award — the "Grand Prix."

Since 1962 it has plied the route Moscow-Khabarovsk. In a TU-114 in 1964 the longest nonstop route of Aeroflot was pioneered: USSR-Cuba. The distance of 10,805 km was covered by the aircraft in 14 hours 30 minutes.

The TU-114, depending upon its mission, has several configurations. For example, for long transcontinental flights the aircraft consists of 120 passenger seats. For transport of passengers on internal air routes the aircraft has 170 passenger seats. In case of necessity it can be set up with 220 seats.

The machine is a low-wing monoplane. The fuselage of the aircraft is double-decked. On the lower — baggage areas, the galley, and the crew's restroom. Inasmuch as the flight is made at high altitudes, passengers and crew are placed in two pressurized compartments divided by a pressurized partition.

Aircraft is equipped with four powerful turboprop engines to ensure a high degree of flight safety even in case of failure in the air of two engines.

Passengers are accommodated in three cabins and a compartment. Between the second cabin and compartment is located the galley. Passenger areas are illuminated by overheads which shed dispersed and reflected light. The interior finishing and equipment of the cabins ensure to the passengers in flight necessary comfort, and promote reduction of fatigue in flight. The cabins and compartment are finished in decorative fiber glass, and laminated plastics simulating rare woods.

Food for passengers is prepared in the galley located in the central part of fuselage below the buffet. Food reaches the aircraft ready to serve, first dishes - in thermoses, the second - in special containers. From the galley trays with food rise on two elevators to the buffet. The galley is equipped with everything necessary for storage and preparation of food: thermoses, heating ovens, refrigerators, and electric warming utensils.

Passengers obtain in flight two free meals. For children special dishes are prepared depending upon age.

The flight crew consists of two pilots, a flight engineer, navigator, and radio operator.

#### Basic Data on the Tu-114 Aircraft

|                                   |         |
|-----------------------------------|---------|
| Length of aircraft, m.....        | 54.1    |
| Height of aircraft, m.....        | 15.5    |
| Wing span, m.....                 | 51.1    |
| Cruising speed, km/h.....         | 770-890 |
| Weight of empty aircraft, kg..... | 93,000  |
| Commercial load, kg.....          | 22,500  |
| Fuel capacity, kg.....            | 84,000  |
| Takeoff weight, kg.....           | 175,000 |
| Ceiling, m.....                   | 10,000  |
| Flying range, km.....             | 9000    |

In 1960 turbojet TU-124 was created which is frequently called the "younger brother" of the TU-104. And indeed, externally these

aircraft are very similar and are distinguished only by their dimensions. In the design of the TU-124 the design collective used the airplane design of the TU-104 which had been proven in practice.

The aircraft is intended for passenger and cargo shipments over short and medium distances. It also accomplishes international flights to Warsaw, Belgrade, Bucharest, Vienna, and other foreign capitals.

The passenger cabin of aircraft consists of three compartments and is calculated depending upon variant for 36, 44, or 56 persons. Interior finishing of the passenger cabin is carried out in light tones. All along the length of the ceiling are light panels which radiate pleasant diffused light.

In order to reduce noise and vibration, in the construction of floors ceilings and walls there are introduced soundproof layers, and the panelling is attached to the airframe on an elastic rubber base.

The aircraft is powered by two ducted turbofan engines. They are more economical, much lighter, and create less noise in flight.

The crew consists of two pilots and a flight mechanic. If necessary, a navigator and radio operator can be added.

#### Basic Data on the TU-124 Aircraft

|                                   |         |
|-----------------------------------|---------|
| Length of aircraft, m.....        | 30.58   |
| Height of aircraft, m.....        | 3.08    |
| Wing span, m.....                 | 25.55   |
| Cruising speed, km/h.....         | 800-870 |
| Weight of empty aircraft, kg..... | 22,900  |
| Payload, kg.....                  | 6000    |
| Fuel supply, kg.....              | 10,500  |
| Takeoff weight, kg.....           | 38,000  |
| Ceiling, m.....                   | 11,700  |
| Flying range, km.....             | 2100    |

All the best features of its predecessors are embodied in the TU-134 aircraft created in 1963 (Fig. 1). However, it differs from them in the unique location of engines, set at the rear of the fuselage. Due to this, cabin noise is considerably reduced which

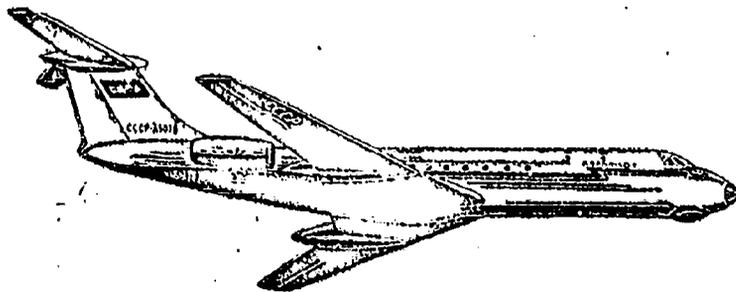


Fig. 1. TU-134 aircraft.

improves comfort in flight. In construction the TU-134 is also more nearly perfect than its predecessors and is equipped with the latest pilotage and radio navigational equipment.

The aircraft has T-form tail structure which gives it good stability under all flight conditions.

The TU-134 is equipped with two turbofan engines. They are more powerful than those on the TU-124, but consume less fuel. Flight can be maintained on one engine in case of failure of the other. As also on all aircraft flying at high altitudes, in the passenger cabin (64-72 persons, depending upon the arrangement) temperature and air pressure are kept constant. The cabin is finished with plastic materials in light decorative tones creating coziness and comfort in flight. A mockup diagram of the plane is shown in Fig. 2.

It is important to note that the crew will consist of two less persons since there will not be a flight mechanic nor a radio operator. Their duties are shared between the two pilots and the navigator. Furthermore, some of the control functions for units of the aircraft have been transferred to automatic instruments.



The new machine is destined to replace the TU-104, AN-10 and IL-18 now flying on main air routes. In response to this problem the TU-154 will have all the positive qualities of the machines it replaces: the speed of the TU-104, the range of the IL-18 and the takeoff and landing characteristics of the AN-10. It should also be more economical, so that for 10-15 years it will ensure a profit in aviation shipments.

The TU-154 will fly at an altitude of 11-12 km. Thereby more air space will be available and flight safety will be increased, since the TU-104, IL-18, AN-10, and other aircraft occupy levels no higher than 9-10 km.

The aircraft is designed for 128-164 persons, depending upon flying range. However, in the future the designers propose to extend the fuselage and to raise the number of passengers to 250. It is planned also to create a cargo version of this machine where for the acceleration of loading from the side there will be fitted a large door.

#### Basic Data on the TU-154 Aircraft

|                                 |               |
|---------------------------------|---------------|
| Length of aircraft, m.....      | 47.9          |
| Height of aircraft, m.....      | 11.4          |
| Wing span, m.....               | 37.55         |
| Cruising speed, km/h.....       | 900           |
| Weight of empty aircraft, kg... | 40,200        |
| Payload, kg.....                | 5800-18,000   |
| Fuel capacity, kg.....          | 22,300        |
| Takeoff weight, kg.....         | 80,000-86,000 |
| Ceiling, m.....                 | 13,000        |
| Flying range, km.....           | 2850-5600     |

A new outstanding work of the Design Office of A. N. Tupolev is the development of a 120-seat passenger supersonic aircraft, the TU-144, designed for air routes of great distance. Its speed will be 2500 km/h and the distance, for example, from Moscow to Khabarovsk will be covered three times faster than the TU-114.

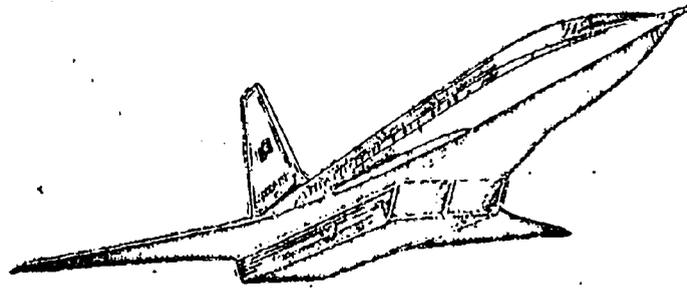


Fig. 4. TU-144 aircraft.

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Externally the TU-144 will differ considerably from machines flying at subsonic speeds (Fig. 4). For this it has been given a special aerodynamic shape: nose of machine gradually tapers to a needle-shape, and the tail assembly differs considerably from that of aircraft now in use. In order to decrease air drag and increase stability in flight, the wing is made very thin. The fuselage has a streamlined form with no protruding parts to create unnecessary drag.

The aircraft is equipped with the latest control systems and intricate complexes of various automatic devices designed to ensure high regularity and safe operation of the machine under almost any meteorological conditions. For example, instead of a navigator all information and parameters necessary in flight, will be issued by an automatic instrument.

A feature of this aircraft is the mobility of the nose unit of the fuselage, which on takeoff and during landing is lowered to permit the crew to see the surface of the airfield.

In spite of its terrific speed of flight, the noise level in the passenger cabins will be low. This is achieved by the fact that the engines have been set at the very bottom of the tail portion of the aircraft. The crew consists of two pilots and a flight engineer.

Basic Data on the TU-144 Aircraft

|                          |        |
|--------------------------|--------|
| Speed, km/h.....         | 2500   |
| Ceiling, m.....          | 20,000 |
| Flying range, km.....    | 6500   |
| Payload, kg.....         | 13,000 |
| Takeoff distance, m..... | 1900   |
| Number of engines.....   | 4      |

S. V. Il'yushin

Aircraft bearing the emblem "IL" are designed by the design bureau, directed by General Designer for Aviation Materiel, twice Hero of Socialist Labor Sergey Vladimirovich Il'yushin. He was born in 1894 to a poor peasant family. For the first time he met with aircraft in 1910, when he served at the command airfield outside of Petersburg. The work was simple: his duty was to clear the runway of the airfield for aircraft taking off. But his thought -- to dedicate his life to aviation -- came directly to him then.

With the beginning of the imperialistic war, S. V. Il'yushin was called into the army. And fate for the second time cast him upon the same airfield where he had first become aircraft mechanic, and then mastered the profession of aircraft machinist. Working here, Il'yushin never missed a chance to fly over the airfield. Gradually he mastered the technique of piloting, and in 1917 passed the tests for rank of pilot.

In 1919 S. V. Il'yushin entered the Red Army and at the end of the civil war he was sent to study aviation in the Moscow Institute of Engineers of the Red Air Force, later converted to the Air Force Engineering Academy named for N. Ye. Zhukovskiy.

Like many of our aircraft designers, the student was attracted to gliding. Studying in aeronautical circles, he independently designed and constructed training gliders which he named "Mastyazhart," "Rabfakovets," and the soaring-glider "Moscow."

S. V. Il'yushin graduated from the academy in 1926, and beginning in 1931 — engaged in responsible design work. His creative capabilities appeared especially brilliant in 1936, when he created the TsKB-30 aircraft with two engines. With it the well-known test pilot V. K. Kokkinaki established several altitude records with different loads. With the TsKB-30 there were also accomplished long-distance flights along the routes Moscow to the region of Vladivostok, and Moscow-Miscou Island (North America). A later military version of this aircraft under the name IL-4 became one of the basic long-range bombers, giving a good account of itself in the Great Patriotic War.

With great effect in the struggle with the Hitlerite army there was used the armored ground-attack IL-2 built in 1940. This new type of aircraft, created in USSR for the first time in the world, was designed for combat against ground targets at low altitudes. It had a 1600 horsepower engine, developed ground speeds of 400 km/h, and was armed with a machine gun cannon. In the first year of the war, in the battle of Moscow against the tank columns of General Guderian flew the "tigers" of Il'yushin. When the IL's struck at the fascist tanks, panic set in amidst the Hitlerites. The enemy tankmen called the ground-attack IL-2 "black death."

Even during the period of the Great Patriotic War Sergey Vladimirovich began to design passenger aircraft for civil aviation. In 1946 this work was crowned with success. The IL-12 for many years remained one of the basic planes in Aeroflot. This aircraft, and also the IL-14 created in 1950 even now still fly the air routes of the country and are in service with some air-transport enterprises of other states.

With the approach of the era of jet aviation the design bureau of S. V. Il'yushin moved on to designing turbojet aircraft. Work was completed in 1958 in creation of the IL-18, which is widely used and now both on internal, and also on international air routes.

The greatest creative success of the design collective directed by S. V. Il'yushin, and also a great victory for Soviet aircraft

construction, is the creation of the transcontinental IL-62 with a flying range of nearly 10 thousand km.

During the many years of his design activity, S. V. Il'yushin created several tens of military and civil aircraft, however we will limit ourselves to brief descriptions of the IL-14, IL-18, and IL-62, flying now over the skyways of the air ocean.

The IL-14 was created by the collective of the design bureau of S. V. Il'yushin in 1952. Until recently it was used to transport the basic mass of passengers, regardless of length of route. At the present time this machine is being used on relatively short routes.

In connection with this, the arrangements are modified somewhat: the number of passenger seats at the expense of galley and baggage spaces has been increased from 24 to 36. The aircraft is used for flights in the Arctic and Antarctic, and also for execution of missions on orders of the Ministry of Geology of the USSR.

There are also modified versions of this machine: IL-14P (32 seats) and the IL-14M (36 seats).

The IL-14 is a low-wing monoplane equipped with two piston engines. Each of them develops 1900 horsepower. This reserve of power permits continuing flight without loss of altitude in the event of loss of one engine. The machine is equipped with all necessary modern flight equipment to ensure flight at any time of day or night and under adverse weather conditions.

The IL-14 has everything needed for creation of passenger comfort. The passenger cabin is heated with warm air ducted by special vents concealed in the sides. Thanks to a reliably effective system of heating and the presence of forced ventilation fresh air constantly reaches the cabin and normal temperature is maintained. Above the seats there are located individual ventilation outlets and a pushbutton to call the stewardess.

In afterfuselage are parachute rockets which can be dropped for illumination of the landing site.

The crew consists of two pilots, and in case of necessity even a flight mechanic, radio operator, and a navigator.

Basic Data on the IL-14 Aircraft

|                                   |        |
|-----------------------------------|--------|
| Length of aircraft, m.....        | 22.3   |
| Height of aircraft, m.....        | 7.8    |
| Wing span, m.....                 | 31.7   |
| Cruising speed, km/h.....         | 320    |
| Weight of empty aircraft, kg..... | 12,700 |
| Payload, kg.....                  | 3300   |
| Fuel capacity, kg.....            | 2580   |
| Takeoff weight, kg.....           | 17,500 |
| Ceiling, m.....                   | 4000   |
| Flying range, km.....             | 1750   |

One of the most popular machines designed by S. V. Il'yushin is the IL-18, created in 1957. It emerged on the main air routes of the country during the years of intense reequipping of civil aviation and the introduction into operation of jet engineering. From the very beginning it presented the very best aspects. Already in 1964 half of the total number of passengers transported by aircraft with gas turbine engines traveled on the IL-18.

Now it is difficult to find on earth any regions where this liner has not visited. It has flown to Antarctica, Afghanistan, Mongolia, Burma, Indonesia, Algeria, Ghana, Syria, etc. The flight characteristics of the IL-18 are such that it connects Moscow with Jakarta in 22 hours. This is one of the world's most extensive air routes and passes through Afghanistan, Pakistan, India, and Burma. The distance is 11,375 km.

In 1958 at the Brussels World's Fair the IL-18 was awarded a gold medal.

The aircraft is fitted with four turboprop engines with a total of 16 thousand horsepower. Designers calculated their power so that during failure of even two engines flight will continue, only at a lower altitude -- 5 thousand meters.

Since going into operation the aircraft has had several assembly versions. Although the number of seats was increased, the construction of the aircraft was not changed. The first machines were designed for 73 persons. However, with a view toward conditions for lowering the cost of passenger tickets, the designers brought out a version with 122 seats.

The plane has a pressurized passenger and pilot's cabin. Under the paneling is a layer of heat and sound insulation consisting of layers of caproic and glass wool, muffling the noise of the engine. A low noise level does not tire the passengers and permits conversation without effort.

The crew consists of five men: two pilots, a flight mechanic, navigator, and a radio operator.

#### Basic Data on the IL-18 Aircraft

|                                   |        |
|-----------------------------------|--------|
| Length of aircraft, m.....        | 35.9   |
| Height of aircraft, m.....        | 10.2   |
| Wing span, m.....                 | 37.4   |
| Cruising speed, km/h.....         | 650    |
| Weight of empty aircraft, kg..... | 32,940 |
| Payload, kg.....                  | 13,500 |
| Fuel capacity, kg.....            | 23,000 |
| Takeoff weight, kg.....           | 64,000 |
| Ceiling, m.....                   | 8000   |
| Flying range, km.....             | 6500   |

The greatest achievement of the collective of the design bureau directed by S. V. Il'yushin is the creation in 1962 of the transcontinental IL-62 airliner (Fig. 5). The aircraft has several assembly versions: deluxe (85 seats), first class (115), tourist (168) -- Fig. 6, economy class (186).

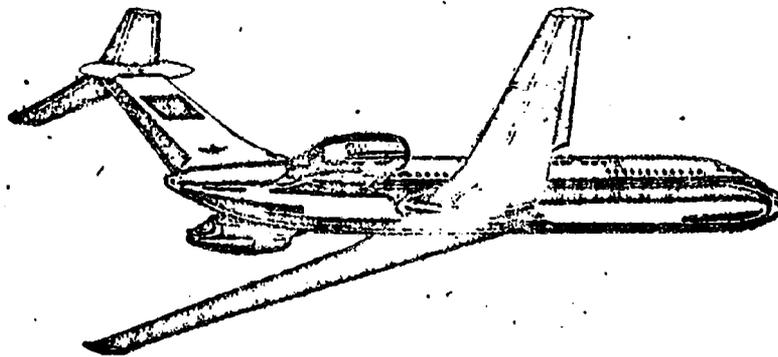


Fig. 5. IL-62 aircraft.

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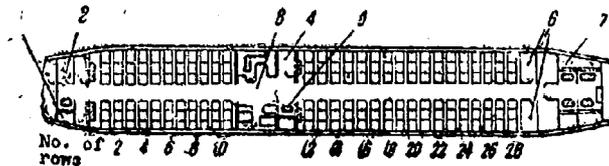


Fig. 6. Mockup plan of the IL-62 (tourist version): 1 -- front cloakroom; 2 -- lavatory; 3 -- galley; 4 -- lavatory; 5 -- amidship cloakroom; 6 -- lavatory; 7 -- rear cloakroom.

At first sight this ship strikes one with the perfection of its aerodynamic shape and harmony of lines. In contrast to many of our turbojet machines it is equipped with four engines, i.e., they are larger than those on the TU-104, TU-124, and many other aircraft. Furthermore, on the IL-62 they are located by the tail assembly. Such a location creates the best flight conditions since in the passenger cabin the engines are almost inaudible.

Each of the four engines develops 10,500 kg of thrust. This makes it possible to maintain normal flight in the event of failure of two engines. However one should note that a case of engine failure is a very rare phenomenon.

In construction the IL-62 is a low-wing monoplane with T-shaped tail assembly. The aircraft is equipped with a soft landing system,

which ensures smooth contact with the ground without disturbing the passengers.

The new aircraft has already appeared on the transcontinental routes of the world. Its routes are Montreal (9 h 50 min), Paris (3 h 50 min), Rome (3 h 45 min), and Delhi (6 h 05 min). Everything here is designed for pleasant service and a restful flight. The seats are upholstered in synthetic materials of soft tones. For illuminators - beautifully embroidered shutters. In the ceiling are concealed electric lights emitting diffused, restful light. In the passenger cabin pressure and temperature are constant and there is clean air conditioning.

A feature of construction of the new airliner is the accommodation of all the most important equipment within the pressurized part of the fuselage, eliminating the possibility of formation of ice and corrosion in the units. And those places in the structure which, in operation are subject to great loads, have reinforced supporting members.

Windows are double, each of which can support the total pressure. The fuselage is heat and sound insulated by special fiber glass.

Inasmuch as flight safety in many respects depends on the working conditions of the crew and its health in flight, in designing the IL-62 the location of all instruments and elements for control of the machine were reexamined. The same approach was made in determining the form and slope of the seats.

Air navigation is carried out by means of a complex automatic system.

In flight a constant temperature is maintained - near 20°C, where the air changes up to 30 times per hour. Furthermore, individual ventilation is provided for.

The plane has three baggage-cargo compartments with a total volume of 48 m<sup>3</sup>. Loading is carried out by containers on a mechanized

line. Inside the compartments loads are shifted by means of on-board mechanization. The entire loading is done in 10-15 min, in consequence of which turnaround of aircraft is accelerated considerably and its profit is increased.

The crew consists of five men: two pilots, a flight engineer (all other aircraft, besides the TU-114, have only a flight mechanic), a navigator and a radio operator.

Basic Data on the IL-62 Aircraft

|                                   |         |
|-----------------------------------|---------|
| Length of aircraft, m.....        | 53.1    |
| Height of aircraft, m.....        | 12.3    |
| Wing span, m.....                 | 43.3    |
| Cruising speed, km/h.....         | 850-900 |
| Weight of empty aircraft, kg..... | 66,700  |
| Payload, kg.....                  | 23,000  |
| Fuel capacity, kg.....            | 82,500  |
| Takeoff weight, kg.....           | 157,500 |
| Ceiling, m.....                   | 13,000  |
| Flight range, km.....             | 9200    |

O. K. Antonov

The name of General Designer for Aviation Materiel, Doctor of Technical Sciences, correspondent member of the Academy of Sciences of the Ukrainian SSR, Hero of Socialist Labor Oleg Konstantinovich Antonov has been famous for a long time for his contributions to our country. He was born 7 February 1906 in the village of Troitsy in Moscow province. His road to aviation began with enthusiasm for gliding. Even as a 17-year old youth he independently designed and constructed his own first glider, appropriately bearing the poetic name of "Dove." And in two years, while still a student, he created in Saratov the glider "Oka-2."

Upon completion of the institute in 1930, he was sent to Moscow with a responsible assignment to organize a central design bureau for gliders. And so the 25-year old engineer became the chief designer of the glider plant.

The excellent gliders created by the young designer rendered great service at the front during the years of the Great Patriotic War. With them weapons, ammunition, drugs, and food were delivered to the partisans. In this difficult time, Oleg Konstantinovich was designated first deputy of the chief designer A. S. Yakovlev, together with whom he created formidable combat machines for fighter aviation.

In 1946 O. K. Antonov became chief designer of the newly formed General Design Bureau. And within two years the young collective released into the sky the remarkable biplane, the AN-2, a true servant of the national economy even to this day.

In 10 years time under the leadership of O. K. Antonov the turboprop AN-10 was built, and based on it -- the cargo version AN-12. For use on medium range air routes in 1959 the AN-24 was built to replace the piston planes LI-2, IL-12, and IL-14.

The small AN-14 designed by O. K. Antonov was named "Little Bee." He designed it for flights between points which lack landing strips. Its "specialty" -- transport of passengers, mail, and cargoes.

The outstanding work of the design collective was the creation in 1965 of the gigantic AN-22 ("Antaeus"), to which there is no equal in the world. The demonstration of this aircraft at the XXVI International Salon of Aeronautics and Space in Paris was a triumph for Soviet aircraft building and enhanced the glory of the USSR as a great aviation power.

It is necessary to mention the distinctive features of all of the O. K. Antonov aircraft, high takeoff and landing characteristics, the ability to take off from unpaved airfields, the lowness to the ground of the body of the fuselage, the high location of wings and engines.

In his General Design Bureau Oleg Konstantinovich devotes great attention to the introduction of the latest achievements of science and technology, the use of new materials and advanced labor methods,

in particular the use of gluwelded structures for the fuselage, which last longer than riveted.

In 1966 O. K. Antonov became 60. Yet he is full of strength and energy, his circle of interest is not limited to aviation. He mentions this in his book "For All and For Self," dedicated to questions of planning and economics and which received high acclaim from the Soviet public.

In the 25-year period of creative activity under the leadership of O. K. Antonov tens of types of aircraft were created, the most famous of which are the AN-2, AN-24, AN-10, AN-12, and AN-22.

The AN-2, created in 1947, was the beginning of the "AN family." Its basic mission - transport of passengers (12 seats), cargo, aerial photography, and geophysical works, forestry protection, and quenching of fires. The AN-2's share 85% of the overall total of aerial chemical operations in agriculture.

The crew consists of two pilots.

#### Basic Data on the AN-2 Aircraft

|                                   |         |
|-----------------------------------|---------|
| Length of aircraft, m.....        | 12.4    |
| Height of aircraft, m.....        | 4.13    |
| Upper wing span, m.....           | 18.18   |
| Cruising speed, km/h.....         | 160-185 |
| Weight of empty aircraft, kg..... | 3430    |
| Payload, kg.....                  | 1500    |
| Fuel capacity, kg.....            | 900     |
| Takeoff weight, kg.....           | 5550    |
| Ceiling, m.....                   | 4500    |
| Flying range, km.....             | 2000    |

The creation in 1956 by O. K. Antonov of the turboprop AN-10 brought him deserved fame and acknowledgement throughout the whole aviation world: at the 1958 Brussels exhibition the aircraft was

honored with a gold medal. This machine differs considerably from other aircraft of civil aviation. It has a high fuselage, high wing location, and very little clearance between the lower surface of the fuselage and the ground. The landing gear of the AN-10 bears lightly on the ground, in consequence of which it is not limited to concrete runways, and can land on unimproved airfields.

Basically the AN-10's are used for intraunion shipments. There are two assembly versions: AN-10 with 85 seats and AN-10A with 100 seats. The cargo version of this machine - the AN-12 is used for transportation of cargoes, including those of large dimensions. Since 1966 it has been making constant trips on the Moscow-Paris route.

The AN-10 is equipped with four turboprop engines with a total of 16 thousand horsepower. Thanks to its great weight-to-power ratio, high lift-drag ratios, and great reserve of stability and good controllability, with this aircraft normal flight is ensured even if two engines fail. In the lower part of the fuselage beneath the floor are two pressurized cargo compartments to accommodate 4 thousand kg of cargo and 350 kg of baggage.

The air intended for maintaining normal pressure in the cabins comes from the compressors of the engines. At an altitude of 5 thousand m in the cabins the pressure is the same as on the ground. Also from the compressors of the engines comes the warm air for heating the passenger cabin. The aircraft is supplied with oxygen equipment consisting of oxygen masks (for the crew) and portable instruments (for the passengers).

The crew consists of two pilots, a flight mechanic, navigator and radio operator.

#### Basic Data on the AN-10 Aircraft

|                            |     |
|----------------------------|-----|
| Length of aircraft, m..... | 34  |
| Height of aircraft, m..... | 9.8 |
| Wing span, m.....          | 38  |
| Cruising speed, km/h.....  | 650 |

|                                   |        |
|-----------------------------------|--------|
| Weight of empty aircraft, kg..... | 32,000 |
| Payload, kg.....                  | 14,500 |
| Fuel capacity, kg.....            | 11,040 |
| Takeoff weight, kg.....           | 54,000 |
| Ceiling, m.....                   | 11,000 |
| Flying range, km.....             | 3000   |

For flights on air routes up to 1500 km O. K. Antonov in 1959 created the turboprop AN-24. It is designed for 50 passengers or 5 t of cargo. The aircraft went into mass production and was widely introduced on local and main routes. At present it services more than 120 air routes and is exported to other countries.

Slightly different versions of this machine have been developed: the basic, economy, tourist, two-cabin, and cargo versions.

The machine in external appearance is very much like its "older brother" — the AN-10, only smaller. The AN-24 is also a high-wing monoplane on which is mounted two turboprop engines. The reserve of power of each engine ensures safe single-engine flight.

In the process of creating aircraft important problems have been solved in reduction in the number of component parts. This is achieved thanks to the use of large monolithic panels. A method has been developed for application of resistance welding to aircraft building. All these innovations have improved the lift-drag ratio of the aircraft and increased the pressurized sealing of cabins and the strength of the entire structure.

Crew: two pilots and a flight mechanic.

#### Basic Data on the AN-24 Aircraft

|                            |         |
|----------------------------|---------|
| Length of aircraft, m..... | 23.53   |
| Height of aircraft, m..... | 8.32    |
| Wing span, m.....          | 29.2    |
| Cruising speed, km/h.....  | 450-500 |

|                                   |           |
|-----------------------------------|-----------|
| Weight of empty aircraft, kg..... | 13,750    |
| Payload, kg.....                  | 5500-5700 |
| Fuel capacity, kg.....            | 4800      |
| Takeoff weight, kg.....           | 21,000    |
| Ceiling, m.....                   | 8400      |
| Flying range, km.....             | 660-1960. |

The AN-22, named by the designers because of its unusual dimensions for the hero of Greek mythology "Antaeus," was created in 1965 (Fig. 7). In that same year the International Salon of

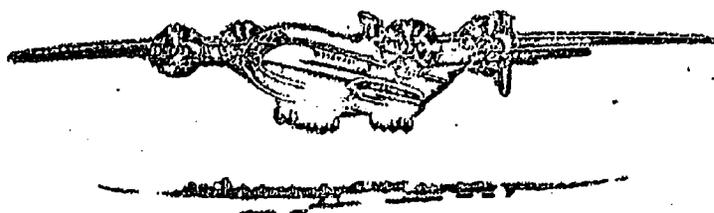


Fig. 7. AN-22 aircraft "Antaeus."

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Aeronautics and Space took place, at which the aircraft IL-62, TU-134, and model of the TU-144 were demonstrated evoking enthusiasm. And when it came time to close the exhibition, over the Paris airport appeared the "Antaeus" — an aircraft, the like of which had never been seen on our planet. Since then, from the pages of the world press there has been no letup in description of this gigantic ship.

At the present time a cargo version of the machine is being developed. In order to comprehend its dimensions, it sufficient to state that it can simultaneously accommodate up to 12 "Belarus" excavators. For loading and unloading operations, the aircraft is equipped with special equipment facilitating and mechanizing manual labor. Aircraft is designed for transport of the most unusual large cargoes: machines, tractors, small river craft, construction and excavating machines, bridge trusses, boring mechanisms, etc. From the list quoted it is clear that even by railroad not all of them could be transported.

It is important to remark on a valuable quality of "Antaeus": with such unusual dimensions its takeoff and landing characteristics are as follows: takeoff run on an uncemented strip - 1100-1300 m, landing run - 800 m, i.e., this airliner can be used on the same airfields as all our other aircraft.

The plane is equipped with four engines of 15,000 horsepower each, in other words, the power of one such engine is almost equal to that of all four engines of the AN-10.

In 1966, in one flight "Antaeus" established simultaneously several world records, including climbing to an altitude of 6500 m with a load weighing 88,103 kg.

The crew: two pilots, a flight engineer, navigator, and radio operator.

#### Basic Data on the AN-22 Aircraft

|                               |         |
|-------------------------------|---------|
| Cruising speed, km/h.....     | 740     |
| Payload, kg.....              | 80,000  |
| Takeoff weight, kg.....       | 250,000 |
| Flying range, km:             |         |
| with a load of 80,000 kg..... | 5000    |
| with a load of 45,000 kg..... | 11,000  |
| Takeoff run, m.....           | 1100    |
| Landing run, m.....           | 800     |

## A. S. Yakovlev

Colonel General of Engineering-Technical Service, corresponding member of the Academy of Sciences of the USSR, twice Hero of Socialist Labor, Aleksandr Sergeyevich Yakovlev was born 1 April 1906. He traveled the road from aircraft mechanic to outstanding designer of aircraft and for more than forty years has served Soviet aviation science, creating during those years aircraft of the most varied purpose.

The first aircraft designed by A. S. Yakovlev took to the air in 1927. In 1932 he created the Ya-6, distinctive for its specially conceived construction, and with a speed (185 km/h), load capacity (150 kg), and flying range (850 km) exceeding all domestic machines which had the same engines.

Then he developed the two-seater Ya-7 aircraft, appearing like the first swallow of Soviet high-speed machines. At the end of 1932, in this aircraft, test pilot Yu. I. Piontkovskiy developed a speed of 332 km/h. Up to this time, not one fighter in the world possessed such speed.

In 1935-1936 the design collective of A. S. Yakovlev created the YaK-4 bomber and the UT-2 training aircraft. Its flight characteristics were proven, in a flight organized by "Pravda" and Osoaviakhim (the start was made 2 September 1935). On a route extending 5 thousand km the victor was the UT-2.

After the UT-2 the UT-1 training aircraft was created. In competitions over the route Moscow-Sevastopol'-Moscow (2815 km), in which 19 aircraft of different designs participated, the first two prize places were taken by the UT-1, and third place by the UT-2. After that the UT-1 was put into series production.

In 1940 the design bureau directed by A. S. Yakovlev created simple design easy to pilot fighter, the YaK-1. Its speed (585 km/h) was 135 km/h higher than that possessed by I-16 fighter designed by

N. N. Polikarpov. An especially great role was played by the aircraft of A. S. Yakovlev, the YaK-3 and YaK-9, during the years of the Great Patriotic War. They permitted us to successfully smash the Hitlerite air armies.

In postwar years, on the base of the UT-2 aircraft was designed the YaK-18. With this aircraft which is still in service today, about twenty All-Union and world records were established.

Simultaneously there appeared the YaK-11 training plane having a speed of up to 450 km/h. It served as the transition link to the creation of high-speed fighters.

A. S. Yakovlev progressed to designing jet fighters even during the period of the war. As early as the autumn of 1945 the new YaK-15 fighter passed the government tests, and in the summer of 1946 participated in Aviation Day. This was the first Soviet jet aircraft accepted for equipping the Soviet Air Force. It was followed by the YaK-17, YaK-23, and the YaK-12 flying auto.

In 1958 the YaK-12 training aircraft was created. It was mass produced and flies now both in the USSR and also abroad. Then came out the "aerial acrobat" YaK-18P, the cabin of which is adjusted for inverted flights. With this machine All-Union and world speed records were set - 275 km/h over a 15-25 km base.

In 1965 in the III World's Championship in aerobatics in Spain, Soviet pilots competing with the YaK-18P secured the team first place and won the Nesterov Cup. But the YaK-18P was further improved and in 1966 in Moscow for the championship of the world Soviet sportsmen in YaK-18PM aircraft scored a triumphal victory: they took first places in the men's, women's, and also in the team tests.

The latest version of the YaK-18 family created in 1966, received the designation YaK-18T. Its sphere of application is the most diverse. Here are its basic versions: training (three students with instructor); navigational pilotage-training (student and

instructor); passenger (pilot and three passengers with baggage); ambulance (the sick on a stretcher with a medical worker); liaison (mail and cargo up to a weight of 250 kg).

The YaK-18T is a low-wing monoplane. The aircraft is equipped with one piston engine of 300 horsepower. Fuselage is all-metal with a duralumin skin. Large windows and a front window in the cabin provide a good view in flight. Automobile type doors open against the direction of flight which precludes their opening and tearing off in flight.

The cabin is equipped with a heating and ventilation system. Seat pads can be removed and replaced by parachutes. The aircraft has navigational and communications equipment: a gyro horizon radio compass, radio altimeter, a landing system for adverse weather conditions, and other equipment.

#### Basic Data on the YaK-18T Aircraft

|                                   |       |
|-----------------------------------|-------|
| Length of aircraft, m.....        | 8.35  |
| Height of aircraft, m.....        | 3.2   |
| Wing span, m.....                 | 11.16 |
| Cruising speed, km/h.....         | 300   |
| Weight of empty aircraft, kg..... | 1200  |
| Payload, kg.....                  | 250   |
| Fuel capacity, kg.....            | 150   |
| Takeoff weight, kg.....           | 1620  |
| Ceiling, m.....                   | 5000  |
| Flying range, km.....             | 1000  |

At present, the design bureau under the leadership of A. S. Yakovlev has created a new jet passenger 24-seat aircraft, the YaK-40 (Fig. 8). Its basic mission - to connect district and regional points by air transport, i.e., it will be used on airfields not having concreted runways.

A distinctive feature of the new machine is a combination of the simplicity and unpretentiousness in operation of the LI-2 and Il-14 and the flight characteristics of aircraft equipped with gas turbine engines.

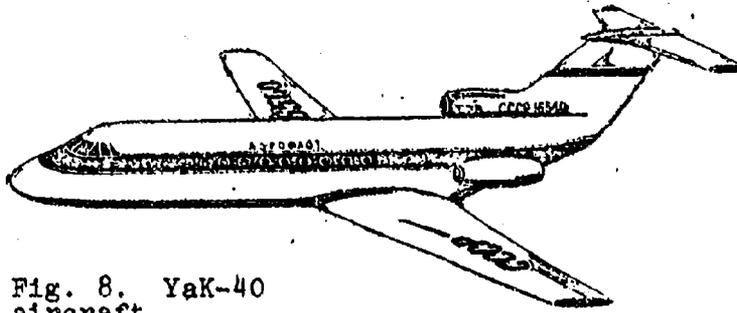


Fig. 8. Yak-40  
aircraft.

The aircraft is an all-metal straight-wing monoplane with T-shaped tail section. In the aftersection of the fuselage are located three ducted-fan engines: two on each side, and the third inside afterpart of the fuselage. In the event of accidental failure of one engine, flight will be maintained. Even with a failure of two engines flight continues at the same altitude. This is the first aircraft on feeder airlines having such high flight characteristics.

The passenger cabin is located in the central part of the fuselage and together with the crew's cabin forms a pressurized compartment. The air conditioning system automatically maintains cabin air temperature at 15-25°C. Provision is also made for individual ventilation. Windows have double panes with air removed. In the evening, the cabin is illuminated by soft light from lateral panels.

The aircraft is equipped with navigational and radio equipment located basically in the pressurized compartment. This creates the best conditions for reliability in operation of equipment.

On the aircraft there are radiotechnical devices to permit carrying out air navigation in response to broadcasting stations and radio beacons and to perform automatic landing approach with a ceiling 50 m and visibility of 500 m, and also at night.

It is especially important to note that for the first time on an aircraft of feeder airlines there is radar. With this navigation will be facilitated under adverse weather conditions and during a storm situation.

The crew consists of two pilots.

Basic Data on the YaK-40 Aircraft

|                            |           |
|----------------------------|-----------|
| Length of aircraft, m..... | 20        |
| Height of aircraft, m..... | 6.38      |
| Wing span, m.....          | 25        |
| Cruising speed, km/h.....  | 600       |
| Payload, kg.....           | 2300-2800 |
| Fuel capacity, kg.....     | 1800-3000 |
| Takeoff weight, kg.....    | 13150     |
| Ceiling, m.....            | 10000     |
| Flying range, km.....      | 600-1600  |

### III. ORGANIZATION OF AVIATION ENGINEERING SERVICE AND TECHNICAL SERVICING OF AIRCRAFT IN CIVIL AVIATION

In the operational organizational structure of the Ministry of Civil Aviation, one of the central places is occupied by the aviation-engineering service to ensure the proper operating condition of aircraft, engines, component units, instruments, radio equipment and other aircraft equipment in flight and their maintenance on the ground. This service is responsible for timely readiness of aircraft to perform flights, and also for the observance of maintenance periods of aircraft, engines, instruments, radio- and electrical equipment. In other words, on the aviation-engineering service is placed the burden of maintaining flight safety, preservation of the flight characteristics of the aircraft and economy in their technical service.

Air transport operation is subdivided into technical and flying. Technical operation of aircraft, helicopters, and aircraft engines - this is a process of maintenance on the ground, and also control over the propulsion equipment and systems in the air. Flying operation - this is piloting and navigation of the aircraft.

In industry and in transportation there is a system of routine repairs, preventing inspections, current, medium and major overhauls. In civil aviation this system is implemented by means of carrying out of maintenance and overhauls.

The modern aircraft is a complex machine consisting of whole series of structural elements, units, instruments, and communications, and to service such aircraft - that means to perform a huge complex of operations.

These we distinguish as operational, periodic, and preventive maintenance of aircraft.

Operational maintenance is subdivided into preflight, short halt, and postflight, and consists in correcting minor defects, tidying the cabins, servicing all systems, checking on proper condition and readiness of the aircraft to fulfill its flight. This form of service is performed at local stops or at air terminal platforms which go to make up the composition of the airport section of an aviation engineering base.

Sorting out more specifically the maintenance during short-term stops of the aircraft, one should say that it is performed directly after each landing. Let us take for instance an AN-24 aircraft. When the plane has taxied to the parking area, technical ground personnel set chocks under the wheels of the main landing gear grounding the aircraft, making sure that the brushes of the ground connection touch the ground. In the event of frost, snowfall, drifting, snow or dust storm plugs are set in the air inlets of the engines.

The servicing ground technical personnel obtain information from the crew regarding operation of materiel in flight and are aware of the notations in the flight log. Going further, they perform an external inspection (from the ground) of the skin of the fuselage, wing, and tail assembly, in order to be convinced that there are no damages, leaks of fuel, oil, etc. In case of necessity the skin is cleaned of contaminations. Then they inspect propeller blades and hub fairings of the propellers. They turn over the propellers in turn, to check on the ease with which they rotate.

Aircraft technicians make inspection on the outside of cowlings and engine nacelles, and also the wheels of the main and nose landing gear, etc. In case of necessity or at the request of the crew, they service the passenger cabin, galley, cargo and baggage compartments.

After servicing the aircraft with fuel the technical personnel make sure there is no leakage of fuel, and in case of necessity remove hoarfrost, snow, or ice from the surface of the aircraft, propellers, and windows of the pilot's cabin, they check lightness and fullness of deflection of the rudder, ailerons, and tabs.

At an external air temperature higher than +25°C or lower than +5°C cooling or preheating of cabins of the aircraft is performed.

After embarking the passengers the ground connection cable is removed and also the chocks from under wheels of the main landing gear. The aircraft is towed (by special auto-tug) to a preliminary start, and the technicians watch the starting and the operation of the engines and taxiing of aircraft on start.

Here is a far from complete list of those duties which are performed during a short halt.

Periodic maintenance is performed after so many hours have accumulated at intervals of 100, 500, and 1000, and is the basic type of service, ensuring the maintenance in good condition of the aircraft and its equipment during the entire period between repairs.

With this servicing operations are performed which are performed during operational service, but in more detail. Furthermore, checking for defects is performed and repairs made to structural elements of the aircraft, and also replacement of engines, units, detachable subassemblies and equipment, improving their resources.

To ensure the capability of full output of the resources of detachable articles the period for carrying out this service can, in individual cases vary within limits of 20% on this side or that.

For example, the 500 hour servicing in practice can be performed after 400 or 600 hours.

Periodic maintenance is performed by the maintenance workshops of the aviation engineering base, in hangars or in areas in front of the hangars. Subassemblies, units, and equipment taken from the aircraft are repaired in the operational repair workshop complex of the aviation engineering base (ATB), and the units and equipment are tested in the ATB laboratories.

Preventive maintenance is performed after 2.5-3 thousand hours. In this way, besides those operations which are prescribed by operational and periodic types of servicing, more serious operations are carried out. For example, inspection and repair is made on the construction of the frames, the engine nacelles, the frame of the baggage-cargo compartments and other sections where in process of operation, weak places were discovered. They wash, repair, or replace the paneling of the passenger cabins, and also repair seats and other everyday elements of equipment. Varnish and paint coverings are restored and exterior paint is applied to the airframe. Stabilizing shock absorbers, levers of the landing gear cart, exhaust shields and other subassemblies are repaired or replaced by new ones.

Preventive maintenance at present is performed, as a rule, at repair plants. The repair plant consists of a complex combine for repair of articles of three independent complexes of the aviation industry - aircraft building, engine construction and the industry producing special aircraft equipment (radio electronic, instrumentation, and electrical equipment).

During the maintenance of aircraft and helicopters, inspection and repair is made on different units and systems as well as operational technical service, by specialized brigades well versed in the construction and operational features of the aircraft.

Each operation of the work performed and its quality are controlled by engineering personnel.

The general sequence and methods of aircraft maintenance are closely interconnected with other services, for example with traffic service, airport services, etc.

A modern airliner differs not only in power of turbines, high speeds, but also rather considerably in linear dimensions. Nonetheless in the sky it appears light and delicate, as if the law of gravity had lost control over it. On the ground the aircraft undergoes a reverse metamorphosis. It suddenly gains "flesh," becomes heavy, with wide spreading wings. It weighs tens of tons, and from this vantage point it would never be called an airplane.

During maintenance, the aircraft is not approached with bare hands. To help the people - the aircraft technicians and repair men, whose vocation it is to maintain the airplane in good condition, to watch out for exactitude in the beat of the pulse of its turbines, special machines appear. Among them are those used only at repair plants, and those that are in the hangars of aviation engineering bases, and those that are on the field - whether near or far from the flight line.

These are the refueling units, electric power units, heating machines, autoconveyers, motor transport, fork-lifts and the self-propelled passenger gangways of various systems.

The loading and unloading machines, the various mechanisms and units have reduced manual labor to a minimum. For example, for washing and blowoff of the aircraft engines a washing unit is used mounted on a cart. The liquid which washes mud and oil off the surface of the engine gushes into a service tank with a capacity of several tens of liters. In the washing pistol it proceeds through hoses under pressure of compressed nitrogen. From the engine the liquid flows into a collector, fitted with spray catching flaps and then passes through a filter into an overflow tank. The height to which the collector rises can be regulated, depending upon the type of aircraft, with help of a hydraulic lifting mechanism. The unit ensures rapid and high quality washing and conserves washing liquid, which after purification, can be used repeatedly. The operation of

the unit also has a fire-fighting device.

At airports where low temperatures predominate and where an air-conditioner proves to be ineffective, machine-heaters are used. With the help of such a machine there is carried out preheating of the aircraft engines, passenger cabins, and also the protective enclosures in which engineering-technical personnel work. Through two tarpaulin sleeves, 8 m long each heater delivers up to 140 thousand kilocalories per hour at an outside air temperature of  $-40^{\circ}\text{C}$ . In so doing, not more than 15 kilograms of fuel is expended.

A whole series of other special machines and units are used to service aircraft.

In civil aviation there has occurred great reconstruction and construction of new buildings and structures necessary for maintenance and repair of modern and future aircraft. There have also been built several tens of new airport buildings, hotels, and air terminals, which differ not only strictly in beauty of architectural forms, but also provide maximum convenience to the passengers.

#### Organization and Control of Air Traffic

Air traffic control appeared at a much later stage than other forms of aviation service, such as maintenance of materiel, weather support, navigational safeguards to flight, provision of communications, etc.

When flights were few and far between and their density was insignificant, traffic control service was limited just to control of the aircraft's flight. The mastering of flights at night and in adverse weather conditions, and also the mass introduction of high-speed passenger aircraft caused an essential growth in the density of traffic on air routes of the USSR. Then the necessity arose to coordinate flights and to control their movements to ensure safety at all stages of the flight.

For a successful solution of this problem there was created the special traffic service and at airports reorganization of the technique of guiding flights and landings was effected.

The nerve center of the airport is the control tower. Once the entire equipment of such a point consisted of a table, and a dispatcher with a microphone, but now along walls there are banks of radio sets, various switching installations, and the indicators of radars and automatic direction finders. No matter how many aircraft are in the air, the dispatcher is in radio contact with each one, transmits to each the necessary information, tracks each one on the radar screen and if the luminescent dot - the mark of the aircraft - suddenly begins to stray from its assigned limits he will help correct the error.

Hence the communications men control the homing beacon stations, the course and glide path beacons, and the technical lighting means - in a word, everything that ensures the landing. Each of these objects is fully automated. Technicians or engineers are there only for performance of preventive servicing or to correct malfunctioning.

In a spacious well-lit location, reminding one of a laboratory, is located the radar point. Here are located the transmitter-receiver stands and the control indicators of all the radars of the airport.

Work at the airport never ceases neither by day nor by night - aircraft fly, motor vehicles move, and the aviation technicians work. In clear weather from the control tower (KP) it is possible to see everything that occurs on the airfield. But when fog descends or thick snow falls, survey from the control tower, naturally, narrows.

How, under such conditions can we ensure 24-hour observation of the airfield? What way is there to expand field of view of those whose duty it is to direct air traffic and motor transport?

These goals are served by the airfield survey radar. It was initiated - to help conduct observation under adverse weather conditions, by day and by night over the aircraft, motor vehicles, and platform trucks moving within the limits of the airfield. In the field of its "sight" are the platform, the aircraft stands, runway, and taxiways. The airfield survey radar (RLS OLP) possesses high resolving power and is as it were the all-seeing eye of the airport.

In traffic service nothing is secondary, since even the least mistake can lead to irreparable consequences. It operates in close interaction and agreement with the flight service and solves the same problems - protecting the safety, regularity, and economy of every flight, where safety always comes first.

Actions of the flight crew and dispatcher staff of the traffic service are completely interconnected in the organization and executing of aircraft takeoff, flight enroute, and the landing approach.

Problems of traffic service are very diverse and include a whole number of questions, including traffic planning, realization of the planned traffic schedule (timetable) and guaranteeing the safety of flights.

Traffic service coordinates the twenty-four hour traffic plans with the dispatching units of corresponding departments, controls the readiness of basic and alternate airfields, and the readiness of radiotechnical means to safeguard the flights. It checks on the timely preparation of the aircraft for the trip and the readiness of crew for the flight. It estimates weather conditions from the point of view of safeguarding the flights. By means of organization of the control and regulation of movement of aircraft in the air at all stages of the flight, the traffic service prevents planes from approaching each other at intervals less than those assigned according to conditions of safety.

Clear control of air traffic, founded on the timely receipt of reliable information, is the basis of flight safety.

Traffic control is carried out basically by changing the speed of flight or length of route of the aircraft, and also by changing the altitude of the flight or route to be followed. Application of each type of control depends on the zone the flight of the aircraft is being carried out in and the specifications for this zone.

To ensure air traffic control, the air space is divided into zones. Each zone has its own borders in range and height. Within the limits of the established zone traffic is controlled only by the dispatcher for this zone. Thus, for example, in the airfield approach zone control is carried out by the dispatcher of this zone, and in the landing zone - by the landing approach controller, etc.

On the air routes of our country together with the high-speed turbojet and turboprop aircraft there have been widely introduced the latest radiotechnical means, with help of which flight control is carried out, air traffic control, and transmission to crew of necessary information on flight safety and other matters.

To solve the problem of automation of the means of air traffic control, especially during the landing approach, the State Scientific Research Institute of Civil Aviation and other institutes conducted a great amount of research, as a result of which the question of semiautomatic landing was solved.

This system in combination with aircraft equipment, with ground radiotechnical means and with the means of airfield lighting equipment makes it possible to carry out the landing of modern aircraft under conditions of bad visibility and low ceiling.

On the basis of the achievements of domestic radio-electronics and computer techniques many problems are being solved which are connected with traffic control and dispatching service on the air routes of civil aviation.

In the airport there is also ramp service which ensures the timely preparation of aircraft for departure. Maintenance of the aircraft has been completed - this will be reported from here by the dispatcher of the aviation engineering base. Then they will accomplish refueling, loading of baggage, warming the cabins of the aircraft - the corresponding information will be relayed to ramp service. As soon as everything is ready for departure, ramp service will report this to the airport-dispatch point. After that the command follows to embark passengers. And only when the aircraft melts into the clouds will ramp service release it from control. But if delay occurs - to the appropriate address an alarm signal will fly and there will be found a possibility for removal of a "narrow" space. Or, let us say, an aircraft has just landed at the airport. Immediately a yellow and white "jeep" hurries up to it with the inscription on its body "Follow me." The jeep as pilot, will lead the aircraft to its stop. This also is a part of the duty of ramp service.

#### Climatic Features of the Air Routes of Civil Aviation and Meteorological Conditions of Flight

Climatic features of civil aviation air routes vary greatly. After all, airliners with the emblem "Aeroflot" fly thousands of kilometers, as they say, to the ends of the earth. The territory of our country is vast, it extends from hot subtropics to eternally frozen Arctic. Descriptions of climatic features of the various regions of the USSR are given in aeronavigational handbooks, and data concerning climatic features of a region or airfields are at the meteorological stations.

Civil aviation is serviced by organs of the Main Administration of Hydrometeorological Service through its local administrations the network of air weather stations, which are to be found at each airport.

Meteorological service to flights of aircraft and helicopters of civil aviation is provided by air weather stations of the airport, which conduct constant observation of atmospheric pressure,

temperature and atmospheric humidity, speed and direction of wind on the ground and aloft, the state of cloud cover and precipitation, horizontal visibility and other weather phenomena.

At airports equipped with landing systems, such observations are conducted in direct proximity to the working start (where the planes takeoff and land). These observations are conducted at prescribed time intervals and during adverse weather conditions the interval between them is reduced to 6 minutes. In case of severe worsening of the weather, the weather station immediately reports a storm warning to the flight director and to all control towers of the traffic service.

An especially important role in weather safety is played by information about the weather from on board the flying aircraft, the crew of which at the request of the dispatcher, and during encounter with dangerous weather phenomena and without request immediately reports the weather for that region where the aircraft is flying. On board the aircraft weather data are received by an automatic weather transmission system or from the dispatcher of traffic service.

Over different communication channels the air weather stations of the airports obtain comprehensive and voluminous information about the state of the weather, and graphically depict it on the map.

Before departure, the aircrew obtains a meteorological briefing to become acquainted with the weather forecasts for the flight route, the landing point and alternate airfields. The air weather station provides the crew with meteorological documentation, and an air weather forecast map, on which is traced the flight route and separate regions (sections of the route), on which they may meet thunderstorms, hail, icing, moderate and severe bumps and other unfavorable phenomena.

If flight of the aircraft is to be over a mountainous route, height of the lower border of overcast along the route is indicated

on the forecast map by sections of route above highest point showing the route in relief.

For the benefit of the meteorologists ever more perfect equipment is being issued. In many sections human labor is being replaced by automatic instruments, computers, and other constantly improved technology which determines both the height of the lower edge of the clouds, and range of horizontal visibility, and a whole series of other weather phenomena. For simplifying forecasting at present meteorological satellites are being used. And there is no doubt of the fact that with the passing of time people will at last solve all the puzzles of weather and will be able not only to predict it unerringly but also to change it at their own discretion.

#### IV. USEFUL INFORMATION FOR THE AIR TRAVELLER

##### Services Provided by Aeroflot

Aeroflot without charge provides passengers with the following services:

1) delivers baggage from the air terminal to the aircraft and back, and also provides loading of baggage on the aircraft and its unloading;

2) accomodates passengers at night in hotels or other places of rest in the event of forced delay of the aircraft;

3) provides motor transport from the airport to hotel and back in those cases when the hotel is provided without charge;

4) provides in-flight meals, in accordance with established norms.

##### Passenger Tickets

The ticket is valid only on the trip specified and for that person to whom it was issued.

Resale and transfer of the ticket to another person is prohibited. In the event that the fact of resale or transfer of the ticket is established it will be cancelled and the cost of it will not be refunded.

Tickets at the counters are sold on a first come first served basis. The following are entitled to special priority:

1) deputies of the Supreme Soviet of the USSR, of Supreme Soviets of Union and Autonomous Republics, Heroes of the Soviet Union, Heroes of Socialist Labor, and persons awarded the orders of Glory, of the three degrees;

2) persons responding to a confirmed telegram connected with an unfortunate accident;

3) passengers with children up to 5 years of age;

4) employees of the Ministry of Civil Aviation of the USSR and its enterprises, organizations, and establishments, holding tickets based on official documents;

5) persons to whom such a right has been given by special authority.

In selling tickets for a trip which includes intermediate landings along the way, passengers going to the terminus of this trip have preferential right to obtain tickets.

Tickets for "one way" transport are sold only with a guaranteed date of departure.

Tickets for transport of a passenger with stopovers (transfers) enroute, and also in "return" direction are sold both with guaranteed and also with open data from the airports of stopover (transfer).

A ticket for transport in "return" direction can be sold only under condition of simultaneous purchase of ticket for transport in the "to" direction.

A ticket with guaranteed date gives the right to a flight from the initial airport shown thereon, airports of stopovers (transfers) or airport of return departure only on the date and on the flight so specified.

A ticket with an open data gives the right to a flight from the corresponding airport only after the date of departure and flight number have been entered on it.

Registration of tickets and collection of baggage for transport begin at the airport one hour prior to and are terminated 30 min prior to taxiing of the aircraft.

Embarkation of passengers on jet and turboprop aircraft is completed 15 min prior to, and on piston aircraft - 10 min prior to taxiing of the aircraft.

#### Periods of Validity of Tickets

A ticket is valid for flight during the following periods:

- 1) a ticket for "one way" transport without transfers or stopovers of the passenger enroute - throughout the entire period shown on the ticket;
- 2) a ticket for "one way" transport with transfers or stopovers of the passenger enroute - for 45 days from the date of departure of the passenger from the airport of origin shown on the ticket.
- 3) a ticket for transport in "return" direction - for 6 months, counted from the date of sale of the ticket.

Aeroflot extends the period of validity of a ticket for the time necessary to reach the point of destination, if the ticket was not used within the prescribed period for the following reasons:

- 1) illness of the passenger, verified by the statement of a medical establishment;

- 2) failure of the aircraft to land at the airport shown on the ticket;
- 3) return of aircraft, without completing the trip, to the airport of departure;
- 4) interruption of the trip due to forced landing of the aircraft;
- 5) failure to accomplish flight connection at the airport of passenger transfer;
- 6) removal of the passenger from the flight due to replacement of the type of aircraft shown on the ticket, by other aircraft;
- 7) failure to provide the transit passenger with the seat reserved for him.

In all cases of extension of period of validity of the ticket a special mark is made on it.

In the event of loss of ticket it is not renewed and cost is not refunded to the passenger.

#### Stopover of Passenger Enroute

A passenger can stopover at any intermediate airport where a scheduled landing is provided for. The passenger must declare intention to make a stop enroute when purchasing the ticket, and a notation to this effect is made on the ticket. Period of stopover must not exceed the established period of validity of the ticket.

If at the time of purchasing the ticket, the passenger fails to state his intention to stop at an intermediate airport, but does make such a stop then he can continue the trip only after additional payment of a set sum stipulated in case of failure to complete the flight.

If the passenger misses his plane at an intermediate airport through the fault of Aeroflot, then the latter is obliged without additional charge to dispatch this passenger by the next flight and to take measures to safeguard his baggage left aboard the aircraft.

#### Transport of Children

Children under 12 years are transported only when accompanied by adult passengers.

A passenger can transport free of charge one child under 5 years without assignment of a separate seat to the child. Other children under 5 years accompanying the passenger, and also children between the ages of 5 and 12 years are transported on children's tickets with assignment of separate seats.

The passenger accompanying a child is obliged to present documents confirming the age of the child.

#### Transport of Transit Passengers

In the case of impossibility to dispatch a transit passenger within 24 hours, the airport is obliged to offer him another possible date of departure or, at the request of the passenger, to refund his money for the uncompleted portion of the trip.

Passengers holding tickets with a guaranteed date of departure from point of stopover or from point of return must register their tickets at the airport of arrival within 1 hour after arrival at the given airport. Upon the expiration of this period the seat reserved for further flight can be cancelled.

#### Cancellation of Flight by the Passenger

A passenger has the right to cancel flight at the initial or any enroute airport and to obtain a refund of the sum paid by him for the transport or the unused portion. Refund is made by the airport (agency) where the event serving as the basis for termination of flight occurred.

Return of the ticket more than 24 hours prior to takeoff entitles the passenger to full refund of the cost of the ticket. In the event of cancellation of flight less than 24 hours prior to the takeoff time shown on the ticket, the passenger is assessed a penalty in the following amounts:

1) 10% of the tariff or corresponding sum subject to refund, if the passenger gives notice of cancellation of flight less than 24 hours, but no later than 3 hours prior to takeoff of the aircraft.

2) 25% of the tariff or corresponding sum subject to refund, if the passenger gives notice of cancellation of flight less than 3 hours prior to takeoff of the aircraft or arrival late to register the ticket.

#### Reduced Fares on Aeroflot

Yearly between 15 October and 15 June, Aeroflot reduces fares for students, graduate students, students attending technical schools and colleges, servicemen, organized groups of Soviet and foreign tourists who are following an itinerary arranged by the international travel bureau "Sputnik."

Reduced fares for students are offered on flights of the following aircraft with gas turbine engines: TU-114, IL-62, TU-104, TU-124, TU-134, IL-18, AN-10, AN-24 and with transfers to piston aircraft, and also with transfers from piston aircraft to gas turbine.

If the flight is performed only on piston aircraft or helicopters, then no discount is given.

Reduced fares are offered only on those routes which are lightly traveled. Reduced fare tickets are placed on sale 2 days prior to departure at established places.

A discount of 50% is given to:

1) students of day, evening, and correspondence divisions of higher educational institutions and to students of intermediate special educational institutions;

2) students of vocational and technical schools;

3) graduate students, including those enrolled in correspondence courses;

4) students of the higher party schools;

5) students of secondary schools, secondary musical and art schools who are over 12 years of age;

6) students at military academies and schools, Suvorov Military Academy students, and Nakhimov Naval Academy students;

7) auditing students and students of military educational institutions of the Soviet Army and the Ministry for Maintenance of Public Order, below officer rank;

8) students of foreign countries, studying in the USSR, on flights on domestic routes in the USSR.

A discount of 30% is given to:

1) soldiers, sailors, sergeants, master sergeants and chief petty officers on extended service, officers, with rank from junior lieutenant to major;

2) members of families of servicemen traveling with the head of the family for sanatorium therapy, to a new duty station, or to their place of residence on separation from the ranks of the Soviet Army into the reserve or retirement.

A discount of 60% is given to:

1) soldiers, sailors, master sergeants and chief petty officers of normal service term (their children are given a discount of 50% of the cost of an adult reduced fare ticket).

Reduced fares are offered on flights on aircraft with gas turbine engines and on transfers to piston aircraft between 15 October and 15 June.

If the flight is made by a group of 15 persons on a group reservation and travel is by aircraft with gas turbine engines a 30% discount is given. This discount applies only on flights on lightly traveled routes.

Soviet and foreign tourists traveling under the auspices of "Sputnik" travel bureau during flights on aircraft with gas turbine engines all year round obtain a discount of 25%, and between 15 October and 15 June - a 50% discount from the air tariff.

U. S. BOARD ON GEOGRAPHIC NAMES TRANSLITERATION SYSTEM

| Block | Italic   | Transliteration | Block | Italic   | Transliteration |
|-------|----------|-----------------|-------|----------|-----------------|
| А     | <i>А</i> | A, а            | Р     | <i>Р</i> | R, r            |
| Б     | <i>Б</i> | B, b            | С     | <i>С</i> | S, s            |
| В     | <i>В</i> | V, v            | Т     | <i>Т</i> | T, t            |
| Г     | <i>Г</i> | G, g            | У     | <i>У</i> | U, u            |
| Д     | <i>Д</i> | D, d            | Ф     | <i>Ф</i> | F, f            |
| Е     | <i>Е</i> | Ye, ye; E, e*   | Х     | <i>Х</i> | Kh, kh          |
| Ж     | <i>Ж</i> | Zh, zh          | Ц     | <i>Ц</i> | Ts, ts          |
| З     | <i>З</i> | Z, z            | Ч     | <i>Ч</i> | Ch, ch          |
| И     | <i>И</i> | I, i            | Ш     | <i>Ш</i> | Sh, sh          |
| Я     | <i>Я</i> | Y, y            | Щ     | <i>Щ</i> | Shch, shch      |
| К     | <i>К</i> | K, k            | Ъ     | <i>Ъ</i> | "               |
| Л     | <i>Л</i> | L, l            | Ы     | <i>Ы</i> | Y, y            |
| М     | <i>М</i> | M, m            | Ь     | <i>Ь</i> | '               |
| Н     | <i>Н</i> | N, n            | Э     | <i>Э</i> | E, e            |
| О     | <i>О</i> | O, o            | Ю     | <i>Ю</i> | Yu, yu          |
| П     | <i>П</i> | P, p            | Я     | <i>Я</i> | Ya, ya          |

\* ye initially, after vowels, and after ъ, ь; e elsewhere.  
 When written as ѐ in Russian, transliterate as yě or ě.  
 The use of diacritical marks is preferred, but such marks  
 may be omitted when expediency dictates.