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FROM THE WORLD PRESS

MORE ON NEW FRENCH TRACKING RADAR. The new French tracking radar reported in the March issue of Space Intelligence Notes is shown in Fig. 1. As can be seen from the photograph, the unit is completely sealed from the elements. In addition to the already announced plans to use it at the French missile range at Colomb-Bechar in North Africa, plans have been made to use it at the missile range at Biscarrosse on the west coast of Southern France and the French Cape Canaveral at Leucate on the east coast of Southern France.

FIG. 1

(Source: Information Supplied by Thomson Houston)

SOVIET GENERATORS TO USE WIND POWER. A plan has been submitted to the Department of Energetics and Electrification of USSR concerning the utilization of wind at high altitudes. Wind-driven, balloon-carried electric generators are to be anchored to the Earth by lightweight polypropylene filament ropes. The authors of the project feel that by placing the power stations at altitudes of from 10 to 12 km (6 to 7 mi) where the wind velocities reach 25 to 30 m (80 to 100 ft) per sec, they can generate from 1.5 to 2 megawatts.

The project has been examined by the Technical and Economical Council of the State Committee of the Council of Ministers USSR for Automation and Machine Construction headed by Academician A. I. Berg as well as by a meeting of the Technical Council of the Department of Energetics and Electrification.

The Soviet news agency Tass said "the power they generate will be five to six times cheaper than at existing rural electric stations."

Although the project was reviewed more than a year ago, no action has been taken. (Source: Izvestia, December 9, 1963, The Chicago Tribune, February 12, 1963)

SOVIET SPACEMEN LOST CALCIUM. Lt. Col. Stanley C. White of the Manned Spacecraft Center in Houston reported on February 6 that Russian scientists had voiced concern to him over loss of calcium by their spacemen during prolonged flight. Lt. Col. White had opportunity to converse with the Russian scientists during a conference in Paris recently.

The cases talked about were Adrian G. Nikolayev and Pavel R. Popovich, spacemen in the dual orbits of last August. Nikolayev stayed in orbit for 94 hr and 35 min and Popovich 70 hr.

This is a potentially serious problem because prolonged loss of calcium weakens bones. Lack of exercise has caused patients confined to bed to suffer the same symptoms after about 10 days. Nothing was reported as to why men in orbit apparently suffer the losses much quicker. No such symptoms have been reported with the US. (Source: St. Louis Post Dispatch, February 11, 1963)

US AND USSR JOINT SPACE EFFORT A REALITY. After several days of negotiations, agreement was reached on March 20 for a joint effort in several phases of space research between the Soviet Union and the United States.

The agreements, announced in a joint news conference by Hugh L. Dryden of the US National Aeronautics and Space Administration and Anatoly A. Blagonravov of the Soviet Academy of Sciences, were reached after 10 days of negotiations in Rome, Italy. The program includes a joint weather satellite study and joint communications tests.

The groundwork was laid for further talks--probably at Geneva in May. The agreement becomes effective after 60 days during which either nation may propose changes. (Source: The Washington Daily News, March 21, 1963, The Washington Post, March 21, 1963)

FROM THE SEMITECHNICAL LITERATURE

MANNED SPACE FLIGHT EXPERIENCE--US AND USSR. According to Aviation Week and Space Technology, March 11, 1963, the Soviets, in 4 Vostok flights, have accumulated 192 hr and 6 min of manned space flight versus 19 hr and 6 min for the US in two suborbital flights and two orbital flights. This information is derived from the following table.

Pilot	No. Orbits	Flight Time
Shepard	...	0 hr 15 min*
Grissom	...	0 hr 15 min*
Glenn	3	4 hr 56 min
Carpenter	3	4 hr 56 min
Schirra	6	9 hr 14 min
Totals	12	19 hr 06 min
Gagarin	1	1 hr 29 min
Titov	17	25 hr 18 min
Nikolayev	64	94 hr 22 min+
Popovich	48	70 hr 57 min+
Totals	130	192 hr 06 min

*Suborbital ballistic flights.

+Group flight--total orbits, 112; total flight time 165 hr 19 min.

(Source: Aviation Week and Space Technology, March 11, 1963)

PHYSICAL CONDITIONING DURING SPACE FLIGHT. Professor Erich Müller of the Max-Planck-Institut für Arbeitsphysiologic, Dormunt, West Germany has already given his ideas on physical fitness during space flight.

The general biological law that any functional unit in our body involving physical and chemical reactions loses its functional capacity when inactive has definite application to astronauts during space flights. Muscles obtained their energy from two sources: a steady process of oxidation, supplied by a sufficient transport of oxygen to the muscles by the blood, and the anaerobic breakdown of fuel already stored in the muscle which is re-supplied from the blood stream. The latter reservoir may add as much as 40 times to the energy available by steady supply for a work-time of 10 sec but would be of no benefit in an eight-hour period.

The capacity for sustained occupational work is not necessarily correlated with the capacity for maximum effort. During childhood and adolescence, both levels of work capacity are well correlated, but after thirty years of age they drastically change. Although the sustained work capacity remains fairly steady, the capacity for maximum work begins to decrease. The latter may also be affected by inactivity.

This indicates that the preservation of a high work capacity for a short-term maximum output is dependent upon special exercise or training which quickly removes the acids formed by heavy work from the blood and also builds up a capability to tolerate a rather acid concentration in the blood without exhaustion.

A final determining factor in work capacity is the utilization of oxygen in the blood. During inactivity the muscles utilize only a third of the available oxygen in the blood. If this percentage is doubled, each heart beat can, in effect, double the oxygen supply to a muscle and thus furnish twice the mechanical energy by oxidation.

The physical power and endurance of a cosmonaut under the confined, motionless, and weightless conditions of space flight are dependent upon four factors: muscle strength, supply of blood and oxygen to the muscles during activity, ability to tolerate a high acidity in the blood and to dispose of the condition rapidly, and the skill factor in the activity.

To maintain muscle strength, a minimum of muscle contraction is obviously required. The simplest muscle exercise, called isometric contraction, requires the muscle to be tensed but not shortened by exerting it against an immovable object.

The minimum isometric contraction sufficient to prevent atrophy is one single, brief contraction daily which corresponds to 20 per cent of the maximum strength. One short maximum contraction of each main muscle group weekly can sustain maximum strength. Incidentally, the maximum strength can be attained through a single daily maximum contraction which exceeds the strength of more than 80 per cent of the normal population. Additional strength may be gotten by a 5 to 6 sec maximum daily contraction. Astronauts may train under weightless conditions, on a narrow stool, or inside a closed jacket by exerting isometric contractions against any fixed point in reach, or even by contracting one muscle against another.

However, weightlessness makes it difficult to preserve a sufficiently high oxygen intake in the body in order to maintain its ability to supply the muscles with large amounts of oxygen. Earth gravitational exercise, such as jumping, running, or knee bending, cannot be replaced by static contractions that require a very limited oxygen intake. It is likewise not beneficial to use springs that are stretched by feet or arms because these springs hold the muscles under tension during the activity, which hinders an ample flow of blood.

The sole method of satisfying the requirement is through the utilization of an ergometer which consists of a braked fly wheel cranked over a speed-reduction gear. Exercise on such a device with an intensity of about 1/7 horsepower with the legs and half that amount on the arms for 10-20 min each, would maintain a high capability for oxygen utilization during work. Maximal activity on the same device until exhaustion for 30 sec daily would suffice in keeping the heart strong and in maintaining the ability of the body to dispose of acids. At the same time it would maintain a high haemoglobin content in the blood which would help in the transport of oxygen. (Source: <u>New Scientist</u>, No. 323, January 24, 1963)

SOVIET LUNAR SCIENTISTS SAY MOON GLOW AS WELL AS MOON SHINE POSSIBLE. Soviet scientists have uncovered evidence which seems to support the beliefs that lunar rocks are luminescent and that active volcanoes on the Moon are possible. Collected data indicate some basis for assuming that lunar rocks in areas of deep Moon faults, especially near the crater known as Tycho, contain petroleum bitumens, rare earth minerals, or perhaps both. It is therefore believed possible that a small quantity of gas adequate for the life of microorganisms may exist at the bottom of craters and in fissures.

Professor Vsevolod Sharonov of the Soviet Central Asian Observatory at Alma Alta is credited with the observation that the entire surface of the Moon is dark--almost a brownish black resembling a chocolate color. According to him the darkest parts of the Moon reflect not more than 5 per cent of the sunlight and the brightest parts up to 15 per cent. The dark terrestrial rocks such as basalt and diabose are considerably more reflective in comparison. Since temperature measurements of the lunar surface indicate that the surface covering is sponge-like or similar to terrestrial slags, it would serve as an efficient heat insulator.

According to one theory the dust cover evolves from the fracturing and pulverizing effect of temperature changes and other factors and has such a fine texture that it can be moved great distances and accumulate to depths of 1000 m. On the other hand, photometric data support the theory of Leningrad Professor Nadezhnaya Sytinshaya who feels that the Moon's surface is similar to slag and that its present condition is due to meteor impacts and not weathering. She states that computations demonstrate that the impact of an ordinary stony meteor causes an explosion on the Moon with an energy comparable to an atomic bomb. Subsequently the lunar rocks boil under the high temperatures and are converted into a porous black slag covering.

Scientists are desirous of establishing an astronomical observatory on the Moon because it is believed that there is very little or no atmosphere on the Moon that would interfere with solar observations. However, this advantage would, in reality, present great dangers because the lack of an atmosphere would prevent the knowledge of a meteor's approach since its glowing trail would not be visible. Thus the initial knowledge of a meteor hitting the Moon's surface would be a soundless explosion comparable to an atomic bomb blast. (Source: The Baltimore Sun, March 3, 1963)

SOVIET RADIO TELESCOPE. The radio telescope shown in Fig. 2 is reported to be the newest and most powerful of the Ukrainian Academy of Sciences. Soviet scientists claim to have received signals from constellation Cygnus (300 million light years away) by using it.

FIG. 2

(Source: Pravda, November 25, 1963)

FROM THE TECHNICAL LITERATURE

ASTROGEOLOGY

CANALS ON MARS CLAIMED TO BE NATURAL PHENOMENA. On January 20 Sovetskaya Belorossiya reported that Yu. Mudrov, staff member of the Department of Geography of Polar Countries at Moscow State University, claims the canals on Mars to be natural phenomena.

Mudrov bases his opinion on the theory of gradient-volumetric stress formulated for the Earth by Professor B. Dostovalov, which states that under the effect of physical or chemical processes influencing changes in volume, Earth masses suffer complex stressing: elongation, compression and shear, or bending.

This results in the formation of deep, crisscrossed rupture zones and linear dislocations. Mudrov states that such stresses created the canals on Mars; these canals are rectilinear with relatively parallel walls. The alternation of depressions and peaks of Africa resembles closely the polygonal network on Mars. The gigantic fractures ("rifts") of Africa are also the result of gradient-volumetric stresses. (Source: Library of Congress, A.I.D. Press, February 4, 1963)

LASERS

ENERGY IN A LIGHT BEAM. V. Vyenikov, Doctor of Technical Sciences, reports that at the present time power energy transmission is no longer a dream. This is accomplished by means of a light beam, emitted by an optical quantum generator (laser). It was reported in the press that quantum generators, with an impulse force on the order of several megawatt, have been designed. An auxiliary optical system can focus the laser beam in such a way that the diameter of its cross-section reaches values of 1 micron. This is approximately 60 times smaller than the thickness of a human hair. A similar beam, directed toward the Moon, illuminated on its surface a region less than 4 km (2.5 mi). This experiment proves that theoretically it is possible to transmit energy from Earth to future participants of lunar expeditions.

Mr. Vyenikov believes that it is considerably more difficult to transmit great quantities of energy by means of such a beam within the limit of the Earth's atmosphere. This is due to the fact that a light beam penetrates the atmosphere very poorly. In addition, the profile and the Earth's curvature may create difficulties. In order to eliminate the effects of atmospheric conditions, some authors suggest the transmission of light beams from one point on Earth to another, over lines resembling conduits. A vacuum must be created inside the light conductor in order to increase the efficiency of such a transmission. The influence of the local profile and the Earth's curvature can be eliminated by installing inside the light conductors mirrors which would change the direction of the beam.

He feels that it should be mentioned that long distance light conductors can only be constructed when materials of a very low light energy absorption coefficient will be designed. Otherwise this method will be of no significance because of the great losses of beam energy in the light conductor. It is quite possible that the progress of these scientific technological concepts will make these ideas a reality in the near future.

It is difficult to predict how and when the numerous problems related to wireless energy transmission will be solved. At the present rate of discovery, Mr. Vyenikov thinks it will not be long. (Source: Russian News Brief, Publication of the Electro-Optical Systems, Inc., March 21, 1963)

MATERIALS ENGINEERING

ALUMINUM TO STEEL FRICTION WELDING. The December 1962 issue of Svarochnoye proizvodstvo (The Welding Industry) contained information by S. K. Ginzburg, S. N. Prokof'yev, and L. A. Shternin. The authors asserted that the All-Union Research Institute of Electric Welding Equipment has tested the friction welding of aluminum to steels C_T-3 (0.14-0.22 per cent C) and 1X18H9T (AISI 321), using bars 20 mm (6.6 ft) in diameter.

It was found that the ductility of the welded joint depends primarily on rpm and pressure, increasing with lower rpm and pressures. Forging, i.e., compression of the still-plastic weld, brings about a further improvement. Joints welded at 3000 rpm and a pressure of 3 kg/mm^2 (.45 lb/in.^{2}), or at 6000 rpm and 1 kg/mm^2 (.14 lb/in.^{2}), and forged at a pressure of 12 kg/mm^2 (1.7 lb/in.^{2}) failed in the bend test at an angle of 20 to 35° or 40 to 50°, respectively, while joints welded at 3000 or 1500 rpm and a pressure of 1 kg/mm^2 and forged as above did not fail even at a bend angle of 180°

Unforged joints were extremely brittle, even when welded with low rpm and pressures. Under all welding conditions tested, a brittle interlayer, consisting mainly of an Al_3Fe compound, formed between the steel and aluminum. Its thickness varied between 1.5 μ at low rpm and pressures to 14 μ at high rpm and was a decisive factor for weld ductility: the thinner the layer, the better the ductility. In joints between aluminum and stainless steel the layer was thinner than in joints between aluminum and carbon steel; therefore, a more severe welding condition could be applied in welding aluminum to stainless steel.

A postwelding heat treatment was found to have no beneficial effect; at temperatures over 300°C (572°F) for aluminum and carbon steel joints and of 600°C (1112°F) and over for aluminum and stainless steel joints, the brittle interlayer begins to grow rapidly and ductility decreases sharply. The beneficial effect of forging is apparently due to the fact that part of the brittle interlayer is squeezed out. (Source: Library of Congress, A.I.D. Press, No. 904, February 20, 1963)

CZECHOSLOVAKIAN WATER PLASMA TORCH. The Czechoslovak State Scientific Institute of High-Current Electrical Engineering has designed and built a transferred arc plasma torch that operates with water plasma and graphite or carbon electrodes 13 mm (.51 in.) in diameter. Water also serves as a collant for torch parts exposed to heat. The torch produces a plasma jet with a temperature in the jet center varying from 28,000°K (50,000 R) immediately at the nozzle edge to 18,800°K (33,000 R) at a distance of 34 mm (1.3 in.) from the nozzle. The main advantage of this torch is the low cost of electrodes and of plasma-forming material.

The torch was used successfully in cutting aluminum, aluminum alloys, copper, structural steel, and chromium-nickel and chromium-manganese stainless steels. Under correctly selected conditions, smooth, high-quality cuts can be obtained. The cut is only slightly wider than the nozzle diameter. The heat-affected zone, which is very narrow, did not exceed 1.2 mm (.047 in.) for chromium-nickel stainless steel 60 mm (2.4 in.) thick, 0.7 to 0.8 mm (.028 to .031 in.) for chromium-manganese stainless steel 24 mm (.94 in.) thick, and 0.3 to 0.6 mm (.012 to .016 in.) for aluminum and copper. The cutting speed was found to vary from 200 cm/min (7.9 in./min) for aluminum 6 mm (.24 in.) thick to ~18 cm/min (.71 in./min) for stainless steel 70 mm (2.8 in.) thick. (Source: Library of Congress, A.I.D. Press, No. 883, January 23, 1963)

ULTRASONIC WELDING OF HONEYCOMB STRUCTURES. The December issue of Svarochnoye proizdodstvo (Welding Industry) gave an account, by B. V. Savchenko and V. A. Kuznetsov, of work being done in the Soviet Union with ultrasonic welding of honeycomb structures (Fig. 3).

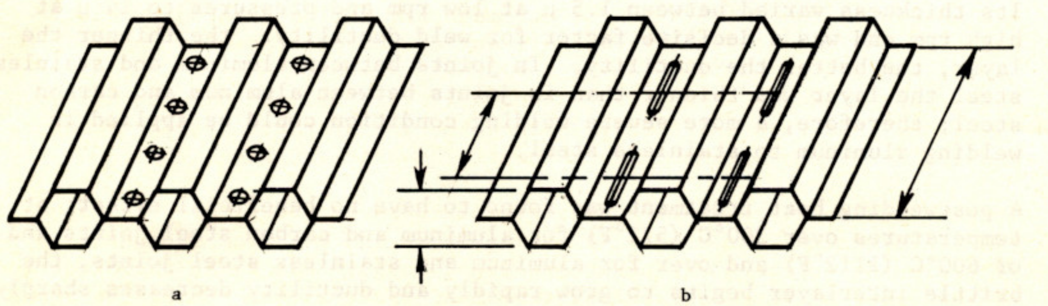


FIG. 3

These experiments, conducted with sheets of АД1Н aluminum and Д16АМ (AA 2024) aluminum alloy 0.1 mm (.0039 in.) thick, have been done with the use of an УЗШ-1 welder having a ПМС-15 magnetostriction transducer. The illustration shows the two types of welds tested: spots 2 to 2.5 mm (.079 to .098 in.) in diameter (a) and elongated spots 20 mm (.79 in.) long and 1.15 mm (.005 in.) wide (b). It was found that the latter type are more effective, producing stronger joints and reducing the total number of spots. The optimum welding conditions were as follows: welding time, 0.3 sec; pressure, 25 kg (55 lb), amplitude, 12 μ. Under these conditions strong elongated welds with good surface quality were obtained. In tests, failure always occurred in the sheet.

It appears that for welding thin sections, small, 400 to 600-w transducers are most suitable. An ultrasonic welder with several small transducers connected to one common generator can be easily adjusted to the required welding conditions. The ultrasonic welding of honeycombs is particularly advantageous for parts which rotate in service, since welded honeycombs are significantly lighter than glued ones. (Source: Library of Congress, A.I.D. Press, No. 900, February 15, 1963)

PHYSICS

MAGNETISM AND LIFE. The study of biomagnetism and radiation has a direct application to all forms of life both on Earth and in outer space. Space probes have established that ionizing radiation bands are located at a height of 600 to 55,000 kilometers and are created by the Earth's magnetic field. Microorganisms, plants, and animals--representatives of different levels of nature's kingdom--have experienced the effects of celestial and rocket forces, but much is still unknown.

The effect of ionizing radiation on an organism is very harmful, while magnetism, properly controlled, may be beneficial. Dividing cells are particularly sensitive to radiation, and therefore blood-making organs may be easily damaged by it. Electromagnetic fields created by radio waves with a frequency of 27 Mc kill animal and plant cells.

Magnetism, although a basically unknown factor, will be particularly important in future space ships, since the use of thermonuclear reactors and ion or photon engines create powerful magnetic fields.

It has been observed that various organisms react identically to magnetism. For example, microbic, amoebae, algae and even the synthetic molecules of polymers arrange themselves, when in water, in the direction of the lines of force created by a beam of radio waves. Thus, the atoms and molecules within a protoplasm such as the iron, hydrogen, and nucleic-acid molecules, which have magnetic properties, cause this reaction. Cellular life is a continuous electrical process: clouds of electrons pass through the molecules of nucleic acids and protein; charged atoms and atomic groups are in constant motion within the cell. Since electrical changes occur in magnetic fields, biochemical processes can change likewise in the cells.

Soviet scientists A. V. Krylov and G. A. Tarakanova investigated the effect of magnetism on planet fertility. The buds of wheat, maize, and pea seeds were arranged so that they faced either the south or north magnetic poles. The vigour of the growing plants whose seed buds faced the south magnetic pole demonstrated the validity of the experiment, which was further confirmed by experiments with an an artificial magnetic field.

Biomagnetic study of animal life provided such unexpected results as the experiment of Soviet scientist Yu. A. Kholodov which demonstrated that a magnetic field can produce conditional reflexes in carp. However, carp can sense only a magnetic field 15 to 50 times stronger than that of Earth. Consequently, it cannot be definitely stated as yet that fish orient themselves according to magnetic lines of force as has been hypothesized for long-range trips of animals.

The American scientist Geno Barnotti observed from experiments that the number of white corpuscles in the blood are first reduced and then increased when mice are placed in a magnetic field.

Since the effect of a magnetic field on blood-producing organisms is directly opposite to that of ionizing radiation, the question arose as to whether a magnetic field would be an effective shield against radiation disease.

Mice 9 to 40 weeks of age, which were kept for 5 to 14 days in a constant magnetic field of approximately 4,000 gauss and then irradiated with radioactive cobalt, had a better survival percentage (70 - 90 per cent) than usual. Further, mice placed in a magnetic field immediately after irradiation with radioactive cobalt, survived twice as well. It was interesting to note that old mice were rejuvenated by a magnetic field. Their fur became smooth and glossy and their skin lost its wrinkles.

Exposure to artificial magnetic fields produces an illustion of flickering lights in people. Thus the Earth's magnetic field could produce the same effect on astronauts and create a temporary disturbance in their vision.

For a long time doctors have observed the effect of magnetic storms on patients suffering from tuberculosis, cardio-vascular ailments, and leukemia. During magnetic storms the condition of high blood pressure and heart trouble patients worsens, myo-cardiac infarction deaths increase, as do hemorrhages from tuberculosis.

No special magnetically sensitive organs have been detected either in plants or in animals although it is possible that certain brain cells in animal life and growth points of plants have an increased sensitivity to magnetism. Since magnetic action can increase plant fertility, protect man from cosmic radiation, and cure some diseases the study of biomagnetism will help man conquer space. (Source: Komsomolskaya Pravda, December 18, 1960)

SPACE FLIGHT

IS RELATIVISTIC TRAVEL FEASIBLE? According to Soviet Professor S. Zonshayn the only major problem to be solved is the production of an engine capable of approaching the speed of light. S. M. Rydov, Russian professor and author of the article "What an Astronaut Will See and Meet at Velocities Close to Light" anticipates astronavigation difficulties and concludes, "what appears impossible today, may become quite feasible tomorrow."

The optimism of Professor Zonshayn is evident throughout his article "The Velocities That Are Possible in the Universe" as reflected by these statements: "The way to the cosmos has been opened. . . The present level of science already gives us reason to suppose that passing beyond the limits of the Solar System and flying to the stars are problems which can be solved."

In supporting his assertions, Zonshayn views the aviation and space industry in retrospect. Each major advance in speed and range depended on the development of new engines.

Mr. Zonshayn then turns his attention to the prospects for development of cosmic spaceships. He states that the prospects are dependent on the flight speeds attained by the various types of rocket engines, then summarizes in this manner: Liquid rocket engines operating on chemical fuels are capable of 50,000 km per hr (31,070 mi per hr) and make possible flights to the Moon, Mercury, Venus, and Mars. Thermally operated atomic jet engines and atomic-electrical (ion) rocket engines, capable of speeds up to 500,000 km per hr (310,700 mi per hr), open the way to visits to the distant planets within the Solar System. Interstellar space exploration awaits the perfection of the photon or quantum rocket.

Professor Rydov notes that problems of heat dissipation and bombardment by macroscopic as well as microscopic particles are vital problems in the design of a relativistic spaceship. His approach to the analysis of astronautical problems is presented as an imaginary trip through space at approximately the speed of light.

Taking an arbitrary speed, the Professor proceeds to calculate and to describe the appearance of approaching stars, the firmament, and the starry sky. By means of examples the problems of distortion of shape and displacement of actual position from apparent position are discussed at length. Abberation as well as variation of color become additional considerations for the relativistic navigator.

Mr. Rydov's conclusion is that "the task of developing a sufficiently effective engine is not the only important problem standing in the way of relativistic astronavigation." (Source: Literaturnaya Gazeta (Literature Gazette), May 11, 1961 and Priroda (Nature), No. 4, April 1960)

VELOCITY OF SPEEDING OBJECT AFFECTED BY ELECTRICAL CHARGE. According to Soviet Professor G. Pokrovskiy, the electric charge on the nose of a rapidly flying body changes the intensity of the body's deceleration.

Pokrovskiy points to electrically conductive meteors and dielectric meteors for proof, stating that the decelerating reactive effect is very pronounced in the case of conductive meteors and negligible in the case of dielectric meteors.

The professor offers the following explanation: The gas surrounding a meteor moving through the atmosphere becomes a plasma made up of positive ions and negative electrons. Much of the heat energy is transmitted from the air to the meteor by the electrons, and the surface of the meteor becomes negatively charged. If the meteor is composed of highly conductive matter, the charges leave the frontal surface of the meteor and are carried away by the gas flow, which generates a decelerating effect on the meteor. If, however, the meteor is dielectric, the negative charges accumulate on the frontal surface, thereby protecting the meteor from the destructive impact of the electrons, and the meteor particles do not generate a decelerating gas flow. (Source: Pokrovskiy, G., Teknika-molodezhi (Engineering-Youth), No. 1, 1961, 37T4.T2285 1961 (S/029/61/000/001))

SCIENCE AND TECHNOLOGY SECTION TRANSLATIONS. The following articles were selected and translated from current Soviet literature by the Science and Technology Section.

A Pioneer of Soviet Rocket Construction - commemorating the 75th birthday of F. A. Tsander - by A. B. Kanlon, Moscow.

In August 1962 occurred the 75th anniversary of the birth of the Soviet pioneer of rocket building, Fredrick Arturovich Tsander, who died at the peak of his creativeness in 1933.

F. A. Tsander was born in Riga (Latvia) on 23 August 1887; his father was a doctor who served as the director of a zoological museum. Frequent trips to the museum with its rich treasures of animal life aroused a curosity within the youth, while his father's discussions of the Moon, planets, and stars and his schoolteacher's remarks about K. E. Tsiolkovskiy created an interest in astronomy with a passionate dream of interplanetary travel.

In 1905 F. A. Tsander entered the Riga Polytechnical Institute. Because of participation in student riots he was arrested and excluded from the Institute. It was only after two years that he was permitted to return to his native city and re-enter the Institution in the mechanics department.

The school years in the Institute (1907-1914) strengthened the aims of young Tsander in regard to the problems of interplanetary flight. In 1908 he produced an astronautical tube (telescope), 1.5 m in length with a 10.16 cm diameter lens, and began systematically to study the stars, Moon, and planets. He not only was pleased by his personal observations, but also he resolved to gather around his similarly enthusiastic individuals into a group or society in which it would be possible to hold discussions, to present reports, and to resolve problems of aeronautics. Such a circle, entitled "First Riga Student Society for Aeronautics and Flight Techniques," was organized by him in 1909 at the Riga Polytechnical Institute.

After Tsander completed his study at the Institute, he worked in rubber plants in Riga and later in Moscow.

At the end of 1917 when the plant Provodnik (Guide) ceased its operations, Tsander devoted himself completely to theoretical calculations of flight to other plants. In February 1919 he moved to the aviation plant Motor and devoted all his spare time to his beloved labors: to construct an airplane capable of leaving the limits of the Earth's atmosphere and to develop engines which would attain cosmic speed, etc. In the middle of 1922 he became completely occupied with computations for an airplane capable of flight in the Earth's atmosphere with the aid of engines of a singular construction.

Just previous to this, Tsander presented a report concerning his plan at a district conference of inventors (December 1921).

The presentation of F. A. Tsander at a gathering at the Motor plant (April 1923), the projected presentation to the scientific-technical committee of the VSNKH (May 1923), the report to the theoretical section of the Moscow Society of Devotees of Astronomy (20 January 1924), and a series of reports and presentations produced in 1924-1925--all of this carried one thought, one idea: Man not only can but must transcend the borders of the Earth's atmosphere to visit not only the Moon but also Mars and other planets.

This period also marks the efforts and initiative of Fredrick Arturovich in the creation of a society for the study of interplanetary information, with the aim of attracting specialists and students towards these problems and the popularization of rocket technocracy and interplanetary flights.

The first article of F. A. Tsander, "Flights to Other Planets," was published in the journal, "Tekhnika i Zhizn" (Science and Life), No. 13, 1924. Some material remained for the book Flights to Other Planets and the Moon, dated 1925; likewise a large list of contents and a series of material for the book, The Theory of Interplanetary Communications, (1926-1927).

In October 1926, F. A. Tsander started to work at the Central Construction Bureau of the Aviation Combine in the capacity of a senior engineer. At the end of 1928 at the XV session of the Commission for Scientific Aerial Flights of the Moscow Aerological Observatory, he presented a report, "Preliminary Efforts in the Construction of a Reactive Apparatus." At the beginning of 1930, he prepared a report entitled, "Problems of Superaviation and Alternate Tasks in the Preparation of Interplanetary Travel." The report was translated into French and chosen to be delivered at the International Congress on Aerial Communication at The Hague (Holland).

Later F. A. Tsander re-organized his report, and his book, entitled Problems of Flight with Rocket Apparatuses, appeared in 1932.

On 30 December 1930, F. A. Tsander transferred to the Central Institute of Motor Construction where he began tests on the first rocket engine OR-1, which operated on benezine and gaseous air. Up to July 1932, F. A. Tsander conducted more than 50 firings and numerous cold tests. Simultaneously he participated actively in the activities of the Central Soviet Osoaviakhim as a chief of the department of jet engines.

In the second half of 1931, this department was reorganized into the Central Group for the study of reactive (jet) motion (TSGIRD).

In the beginning of 1932, in the TSGIRD organization, courses on reactive (jet) motion were organized. In April of the same year, according to a decision by the Central Committee of Osoaviakhim, the TSGIRD group was transformed into a productive unit and re-named GIRD, which subsequently played a major role in the practical development of reactive (jet) technology in the USSR.

The limitation of financial resources, skeptical reaction towards the initial efforts of GIRD personnel by individuals and organizations, and the absence of manufacturing facilities delayed the growth of these activities; but nothing could stop the constant progress of the new and progressive movement in science and technology. The participation of F. A. Tsander, who transferred his efforts completely to GIRD activities, had its significance; and although the remainder of the enthusiasts of rocket science worked for the GIRD only during their spare time, progress was achieved.

Even prior to his transfer to GIRD, F. A. Tsander planned a new engine called the OR-2. He introduced a liquid-jet engine (ZHRD) that was designed to be installed as an independent engine on the glider RP-1, constructed by B. I. Cheranovski.

In actuality, F. A. Tsander achieved his life's goal, which he first mentioned in 1922-1923--the union of an aeroplane with a rocket.

In December 1932, the assembly of OR-2 was completed and was accepted by a special commission on 22 December 1932.

At the end of 1932, F. A. Tsander began the plans for a more powerful reactive (jet) engine for liquid fuel; and in January 1933, the first brigade of GIRD under Tsander's immediate leadership began developing a rocket for liquid fuels, called the GIRD-X.

Extreme over-work caused a weakening of his heart, and F. A. Tsander was compelled to leave for Kislovodsk. Here he stayed at the sanitorium in a very critical condition. His illness was diagnosed as typhus. He died on 28 March 1933.

After the death of this highly talented engineer, an obituary was published that was signed by K. E. Tsiolkovskiy together with other scientists, engineers, and constructors who rated the role of F. A. Tsander very highly in the development of the theory and practice of reactive (jet) motion.

The life and achievements of F. A. Tsander--pioneer in Soviet rocket construction--are an example of endeavor and service to his country. A true student and follower of the great Tsiolkovskiy, he fully dedicated himself to science and aerial flight engineering. His dream and his goal attained a glorious fulfillment. (Source: Priroda (Nature), December 1962)

Raising the Cavitation-Erosion and Corrosion Resistance Features in an Engine - by engineers D. M. Likhosherctor and Iu. S. Chervyakov at the Tomsk Polytechnic Institute.

One of the factors which limits the guaranteed period of engine life $64 \frac{15}{18}$ and $12 \text{ V} \frac{15}{18}$ is the low cavitation-erosion and corrosion quality of the exterior surface of the cylinder sleeves.

Destruction of the exterior surface of cylinders results from vibration in the sides of the sleeves in the zone cooled by water. This procuces cavitation bubbles in the water which burst on the surface of the sleeve and constantly corrode it. The greatest injury to the sleeve is normally found at the site of the maximum amplitude of vibration, at the plane perpendicular to the axes of the piston pin, during which it occurs on both the surface, which is cooled by the water, and along the setting belts.

In order to increase the corrosion and cavitation qualities of the exterior surface of the cylinder sleeves, zinc is used as a coating. For greater reliability a chromium lactate layer up to 25-35 mk is used. However, this does not fully prevent corrosion and cavitation damage to the sleeves.

The practical efficiency of sleeves with a zinc coating is on the order of 2000 hr and chromed sleeves achieve 3000 hr. The great labor capacity of chromium lactate, its high reliability, and its required use in numerous industrial areas necessitate a search for effective and inexpensive means of protection.

A reliable and inexpensive method of protection for the outer surface of sleeves has been developed at the plant by means of nitration. Cylinder sleeves are made from steel (38KHMIUA) and nitrated on the outer diameter to a depth of 0.5-0.8 mm. In this process it seemed expeditious to pro-both the inner and outer surfaces of the sleeves. However the excessive warping of the sleeves did not permit the accomplishment of this process. Therefore the sleeves were calorized in two stages: initially the inner surface and then the outer. The outer surface prior to the calorization was machined (∇5). To establish the most suitable conditions for the production of cylinder sleeve forms, investigations were conducted of various stages in preliminary and final mechanical processing. Simultaneously investigated was the effect of preliminary processing of the outer surface of the cylinder sleeves--parkerizing, degreasing, and sandblasting to the depth of the nitrated layer. A batch of sleeves was nitrated at 520°: the degree of dissociation of ammonia reached 25-35 per cent. Results of the nitration are shown on the following chart.

Cycle	Interval of Nitration in y (km)	Preliminary Preparation	Phases in Analysis of Layers		
			on the surface	at depths of 0.02 mm	at depths of 0.04 mm
I	6.5	Parkerizing De-greasing Sandblasting	$E + \gamma'$	$E + \gamma'$ $E + \gamma' + \alpha$ $E + \gamma'$	α
II	3	Parkerizing De-greasing Sandblasting	$E + \gamma'$	$E + \gamma'$ $\gamma' + \alpha$ $\gamma' + \alpha$	α

Under scientific conditions during the nitration of the inner surface of the cylinder sleeves, distortion is limited to 0.22 mm, conicity and elleptacity to 0.12 mm. The nitration of the exterior surface of the sleeve in the second cycle produces the maximum distortion--up to 0.1 mm--which is permissible under scientific conditions. Therefore the limits of distortion and the data for the nitration of the interior surface may be applied generally for the interior and exterior nitrations.

Phases γ' and α demonstrate a basic resistance to the cavitational breakdown [1], while the E phase breaks down during the first hours of operation of the layer.

The most favorable combination of phases occurs during the second step of nitration. This stage also insures the minimum of distortion. Sleeves, nitrated according to this procedure, were subjected to testing in the engine 12 V $\frac{15}{18}$. Simultaneously on the same engine, sleeves coated with zinc and subjected to chromium lactate processing, were also tested. After 2100 y of operation the sleeves were removed from the engine and studied. The zinc-coated and chromed sleeves exhibited partial damage. The nitrated sleeves had no traces of cavitation-erosion or corrosion damage and seemed suitable for future utilization.

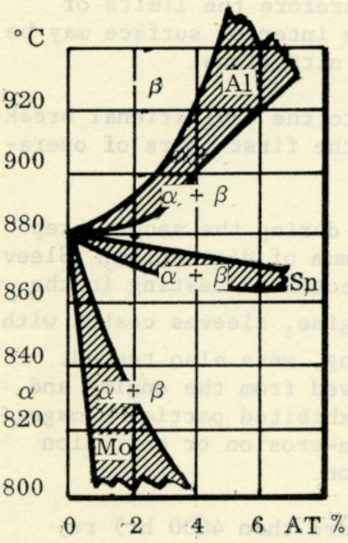
More extensive testing on the engine 12 V $\frac{15}{18}$ (more than 4000 hr) reaffirmed these results: nitrated sleeves still exhibited no traces of cavitation damage; chromed sleeves started to wear after 2000 hr of use; while sleeves coated with zinc under the same conditions were worn so badly after 1000 hr that they were unfit for further use.

The nitration of the exterior surface of the sleeves directly provides an answer to the quest for improvement in the cavitation and corrosion qualities of setting belts. Even with small allowances, a nitrated layer with a hardness of NRA 59-60, and a sufficient cavitation and corrosion quality remains after nitrating and machining the setting belts.

The improvement in the cavitation-erosion qualities of sleeves has produced a change in the materials for the jackets, from the cast iron SCH 15-32 to the alloy AL9. The jackets of the cylinder sleeves that are made from the alloy AL9 exhibited no damage from cavitation or corrosion after extended testing (3000 hr). (Source: Metallovedenie (Metallography), No. 1, January 1963)

Modern Titanium Alloys - by S. G. Glazunov. (See translator's note, p. 24)

At the present time in the USSR and in other foreign countries an extensive nomenclature for titanium alloys has emerged. The scientific classification of these alloys is based on the manner in which the alloying additions affect temperatures in the allotropic conversion of titanium. Additions which raise the temperature are called α-stabilizers; additions which lower it--β-stabilizers, and finally, stabilizers which have little effect on the temperature are called neutral strengtheners (Fig. 4).



Alloying Additions

FIG. 4

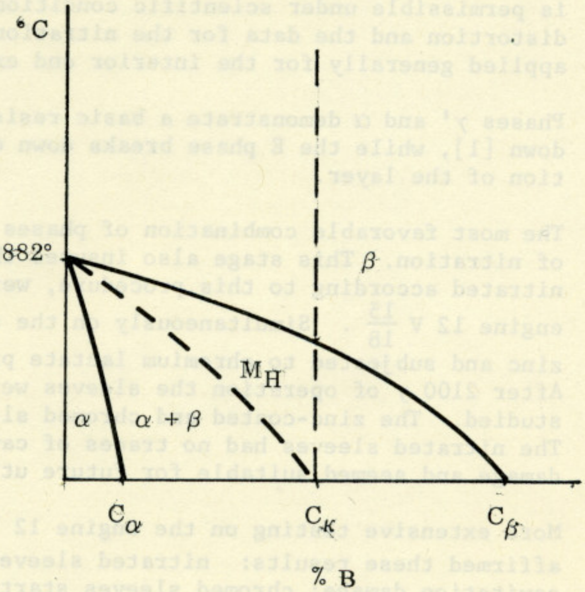


FIG. 5

The classification of alloying elements according to this criterion is represented in the diagram. Among the metals with a single practical application as an α stabilizer is aluminum, while tin and zirconium are among the group of neutral strengtheners. For industrial application the β group of stabilizers is the most important.

Alloys containing β-stabilizers have a high degree of stability and plasticity and may be effectively strengthened by thermal treatment. The mechanics of this strengthening may be understood through the use of Fig. 5. Beginning with a critical concentration of (C_B), the alloy may harden into a β structure. The second heating of the hardened alloy (aging) produces a molecular disintegration of the β hard solvent (Fig. 6), accompanied by a significant increase in stability and hardness and a decrease in plasticity.

If the concentration of β stabilizer is less than critical, then during the hardening from the β-stage, the β-phase does not become fixed but proceeds through the martensite conversion into the α'-phase, representing a supersaturated hard solvent on the base of α titanium. Therefore such alloys are also suitable for strengthening the thermal process.

If these alloys from the two-phase area $\alpha + \beta$ are hardened, then it is possible to fix certain portions of the β phase whose composition and stability will depend upon the temperature of the tempering for the given alloy.

Plan for the Classification of the Alloying Elements for Titanium

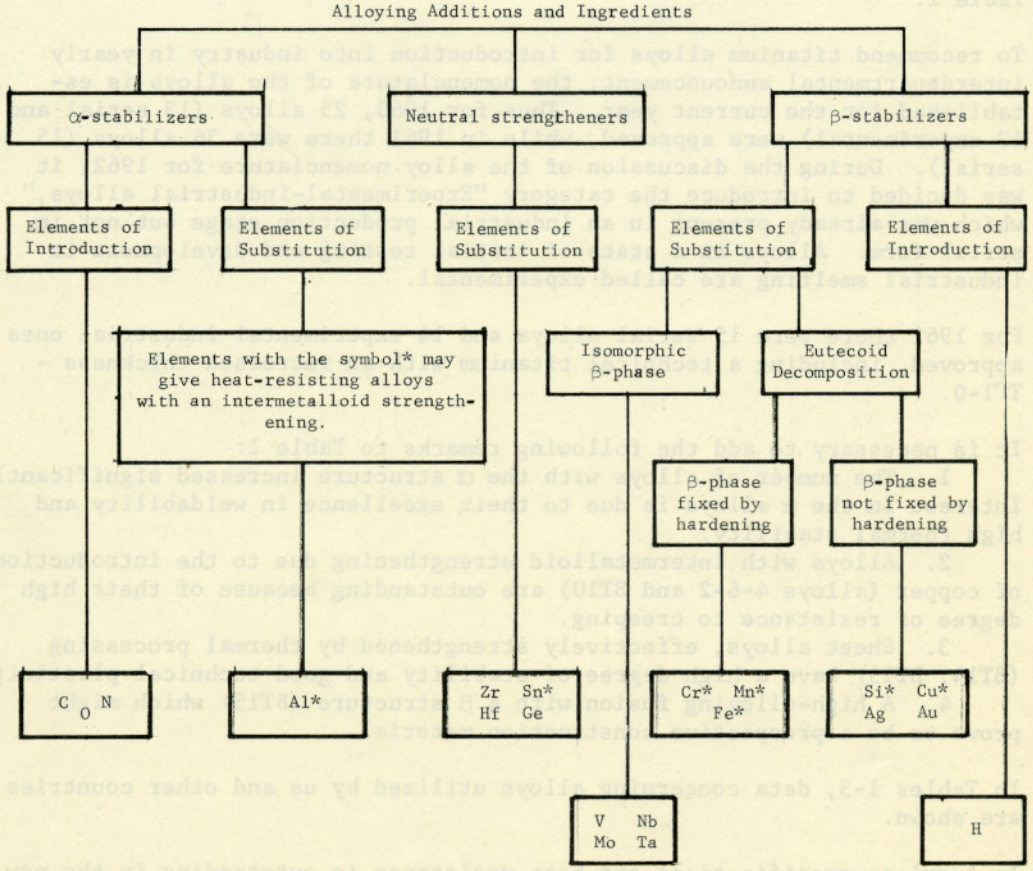


FIG. 6

Alloys which are capable of creating an unstable β phase during hardening (the quantity of such a phase is determined by the percentage of β stabilizer in the alloy and may attain 100 per cent) are especially interesting from a practical viewpoint. The unstable β phase is capable of enduring the martensite conversion under the influence of external pressure and plastic distortion. This significantly lowers the extent of fluidity but raises the characteristic of plasticity (Fig. 7) which facilitates the sheet stamping.

The nomenclature of titanium alloys in the USSR in 1962 is shown in Table 1.

To recommend titanium alloys for introduction into industry in yearly interdepartmental announcement, the nomenclature of the alloys is established for the current year. Thus for 1960, 25 alloys (13 serial and 12 experimental) were approved, while in 1961 there were 36 alloys (15 serial). During the discussion of the alloy nomenclature for 1962, it was decided to introduce the category "Experimental-industrial alloys," which was already present in an industrial production stage but not in serial form. Alloys in a state of initial testing and development in industrial smelting are called experimental.

For 1962 there were 15 serial alloys and 14 experimental industrial ones approved, including a technical titanium with an increased thickness - TΓ1-0.

It is necessary to add the following remarks to Table 1:

1. The number of alloys with the α structure increased significantly. Interest in the α alloys is due to their excellence in weldability and high thermal stability.

2. Alloys with intermetalloid strengthening due to the introduction of copper (alloys 4-6-2 and BT10) are outstanding because of their high degree of resistance to creeping.

3. Sheet alloys, effectively strengthened by thermal processing (BT14, BT15) have a high degree of stability and good technical plasticity.

4. A high-alloying fusion with a β structure (BT15) which might prove to be a prospective construction material.

In Tables 1-3, data concerning alloys utilized by us and other countries are shown.

In American specifications the heat resistance is outstanding in the new alloys of the α structure. All new alloys contain no more than 1-2 per cent of one or two isomorphic β stabilizers (vanodium, molybdenum, niobate or tantalum) while three of them have a high aluminum content that was not seen in earlier industrial alloys. Isomorphic β stabilizers in a given instance not only raise the technological plasticity but also prevent the conversion of the α_2-phase which produces a reaction in both alloys containing more than 7 per cent Al.

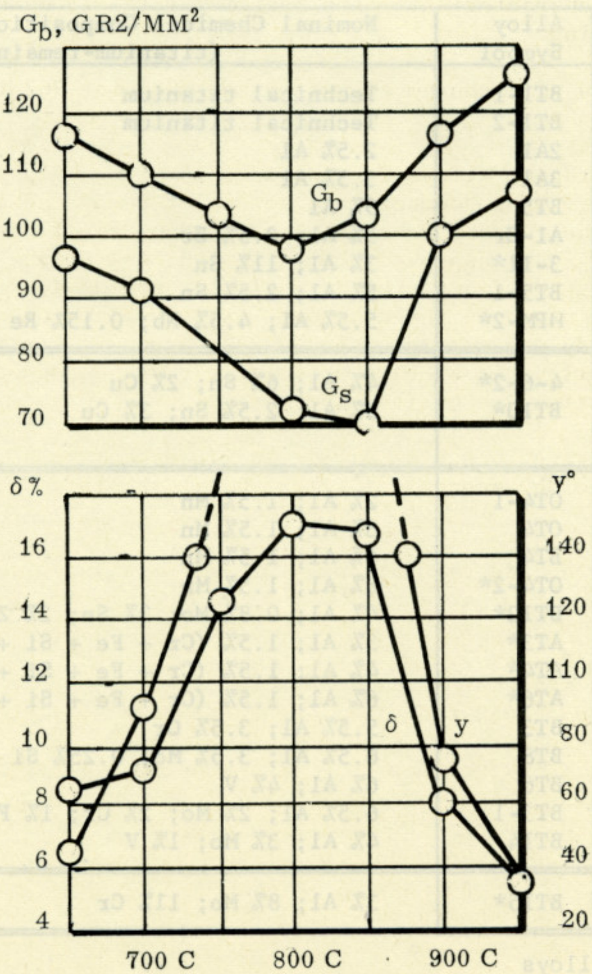


FIG. 7. Change in the mechanical elements of alloy BT14 in relation to the temperature of the hardening (Moiseer)

Table 1

Chemical Composition of Serial and Several Titanium Alloys Adopted in the USSR in 1961

Structure of the Alloy	Alloy Symbol	Nominal Chemical Composition in Per Cent (titanium-remainder)
α	BT1-1	Technical titanium
	BT1-2	Technical titanium
	2Al	2.5% Al
	3Al	3.5% Al
	BT5	5% Al
	Al-Zr	3% Al; 2.5% Zr
	3-11*	3% Al; 11% Sn
	BT5-1	5% Al; 2.5% Sn
	ИPM-2*	5.5% Al; 4.5% Nb; 0.15% Re
α + inter-metalloid phase	4-6-2*	4% Al; 6% Sn; 2% Cu
	BT10*	5% Al; 2.5% Sn; 3% Cu
α + β	OT4-1	2% Al; 1.5% Mn
	OT4	3% Al; 1.5% Mn
	BT4	4% Al; 1.5% Mn
	OT4-2*	6% Al; 1.5% Mn
	BT12*	4% Al; 0.8% Mo; 3% Sn; 2% Zr
	AT3*	3% Al; 1.5% (Cr + Fe + Si + B)
	AT4*	4% Al; 1.5% (Cr + Fe + Si + B)
	AT6*	6% Al; 1.5% (Cr + Fe + Si + B)
	BT3	5.5% Al; 3.5% Cr
	BT8	6.5% Al; 3.5% Mo; 0.25% Si
	BT6	6% Al; 4% V
	BT3-1	6.5% Al; 2% Mo; 2% Cr; 1% Fe
	BT14	4% Al; 3% Mo; 1% V
β	BT15*	3% Al; 8% Mo; 11% Cr

*Experimental alloys

Translator's note: The Russian letters B, H, И, P, C, X, Y, Г may resemble English letters but are equivalent to V, N, I, R, S. Kh, U, g respectively. It is not known whether the above letters refer to the Russian or the English alphabet in all specific cases. This distinction is left to the discretion and/or knowledge of the chemist or scientist concerned with this type of information.

Table 2

Chemical Composition of American Titanium Alloys
(According to data from the Defense Metals Information Center,
Battelle Institute, 1959)

Structure of the Alloy	Alloy Symbol	Nominal Chemical Composition in Per Cent (titanium-remainder)
α	Ti-35A; Ti-45A; Ti-55A	Technical titanium (99.2%)
	Ti-65A; Ti-75A	Technical titanium (99.0%)
	Ti-100A	
	Ti-5Al-2.5 Sn	5% Al; 2.5% Sn
	Ti-6Al-4Zr-1V	6% Al; 4% Zr; 1% V
	Ti-8Al-1Mo-1V	8% Al; 1% Mo; 1% V
	MST 821*	8% Al; 2% Nb; 1% Ta
	MST 881*	8% Al; 8% Zr; 1% (Nb + Ta)
α + β	MST-8Mn	8% Mn
	Ti-140A	2% Fe; 2% Cr; 2% Mo
	MST-2, 5Al-16V*	2.5% Al; 16% V
	MST-3Al-2.5V*	3% Al; 2.5% V
	MST-3Al-5Cr	3% Al; 5% Cr
	MST-4Al-4Mn	4% Al; 4% Mn
	Ti-4Al-3Mo-1V*	4% Al; 3% Mo; 1% V
	Ti-4Al-4Mo-4V*	4% Al; 4% Mo; 4% V
	RS-140	5% Al; 2.75% Cr; 1.25% Fe
	Ti-155A	5% Al; 1.5% Fe; 1.4% Cr; 1.2% Mo
	Ti-6Al-4V	6% Al; 4% V
	Ti-7Al-4Mo*	7% Al; 4% Mo
β	B-120 VCA*	3% Al; 13% V; 11% Cr

*Experimental or newly introduced into production of alloys

Table 3

Chemical Composition of English Titanium Alloys
(According to the prospectus from the firm 1.C.1 for 1961)

Structure of the Alloy	Alloy Symbol	Nominal Chemical Composition in Per Cent (Titanium-remainder)
α	Ti-115 Ti-120 Ti-130 Ti-150 Ti-160	Technical titanium
	Ti-317	5% Al; 2.5% Sn
α + inter-metalloid phase	Ti-230 Ti-679	2% Cu 11% Sn; 5% Zr, in a smaller quantity of Al, Mo, Si
α + β; percentage of β stabilizers up to 2%	Ti-314 C	2% Al; 2% Mn
α + β; percentage of β stabilizers more than 2%	Ti-314A Ti-317A	4% Al; 4% Mn 6% Al; 4% V

Evoking interest is the alloy containing 8 per cent Al, 1 per cent Mo, and 1 per cent V, which is considered the basic material for the covering of planes flying at supersonic speeds. In order to obtain sheets from such an alloy it is necessary to have powerful and rigid mills for cold rolling of the type "Sendzimer."

The alloy B-120 VCA with a mechanical stability of the β structure possesses a different chemical composition than alloy BT15 and contains vanadium instead of molybdenum. However in respect to their mechanical qualities and technical parameters, both alloys are basically similar as shown by comparative examination.

Alloys with a β structure in the USA have a great importance and are quickly adopted for aviation and rocket technology. Recently an American publication announced that the rocket motor bodies for solid fuels made from alloy B-120 VCA achieved a constructional stability higher than 200 kg/mm^2. This was attained by the wrapping of the model with two exterior layers of contoured wire with a channel iron cross section and one inner wire layer with an I-cross section.

English specifications for titanium alloys include not two but six types of technical titanium with various levels of stability. As a result only the first two types can be called unalloyed titanium--the other types are titanium alloys with oxygen that is introduced in calculated quantities in respect to dioxides of titanium in the process of melting out of ingots. This permits the maintenance of very rigid standards for mechanical characteristics. The use of oxygen in the refinement of alloyed additions is not new; however, in domestic practice it is never used for technical titanium. Besides this, double low-alloy Ti-Cu, which has been introduced very recently, is also interesting. Obviously, this is the first English sheet titanium alloy with a intermetalloid type of strengthening. With regard to temper, it possesses an outstanding technical plasticity, but after hardening and aging, it strengthens substantially but not to a very high degree of stability.

English specifications show that the new heat-resistant alloy of the system Ti-Sn-Cu-Al-Mo may be considered as a further development of the alloy Ti 371 (13 per cent Sn and 3 per cent Al). According to its components the new alloy with copper is basically equal to the alloys BT9 and BT10.

The value of titanium as a construction material for various outgrowths of modern machine building is increasing constantly.

For example, it seemed that owing to chemical activity under high temperatures, titanium is outstanding for welding with ceramics and glass, which makes it a valuable material for electronic lamps.

The capability of titanium to absorb gases during heating determined its application for use in deep vacuum pumps and likewise for radio-electronics.

Titanium does not emit long-life radioactive isotopes that in conjunction with a high corrosive resistance allow it to be utilized in atomic energetics.

Conclusions:

1. Modern titanium alloys are characterized by great diversity in structure and quality such that industrial utilization was primarily occupied with the two-phase alloys with the structure $\alpha + \beta$.

2. It is necessary to observe the appearance of highly stable alloys with an α-structure, of thermal strengthened alloys with the unstable β phase, and of intermetalloid strengthened alloys.

3. There is a noticeable tendency to raise the degree of alloy age and to lower the content of harmful ingredients in the entire field of titanium alloys.

(Source: Metallovedenie (Metallography), No. 2, February 1963)

BOOKS. The following book reviews have been selected from publications as noted.

Chernyi, G. G., Introduction to Hypersonic Flow. Translated and edited by R. F. Probstein. Published by Academic Press, Inc., New York and London, 1961. Price $8.00.

The linearized theories of low-speed supersonic flows are inadequate for calculating aerodynamic characteristics of bodies with speed between 3-10 km/sec (2 to 6 mi/sec), inasmuch as speed perturbations, negligible with respect to missile speeds, can no longer be disregarded with respect to acoustic speeds. The author reviews historically the work up to $M \approx 3.5$ and then formulates the problem of the flow of an inviscid gas with constant specific heats. He considers carefully hypersonic flows past slender bodies with sharp leading edges.

The remaining chapters are limited to various methods of calculating surface pressures for bodies of sharp leading edges with attached bow waves and also for bodies of slightly blunted leading edges. The author stresses approximate methods, with which he has had considerable first-hand experience.

This book, clearly written and illustrated, is particularly of interest to Americans in that it indicates the Soviet work in this field, including some unpublished material.

Physics students would probably prefer more attention to the physical aspects of hypersonic flows, namely, high temperature phenomena (molecular excitation, dissociation, ionization, chemical reactions). For example, diffusion processes at 6000-8000°K (11,000°-14,000°R) which occurs behind a strong bow shockwave, are important for skin friction and heat transfer--not to mention surface effects. Unfortunately, while the author discusses these matters generally, he neglects them in his approximations. (Source: American Journal of Physics, December 1962)

Uskov, A. A. and others, Technical Progress in the USSR 1959-1965. Published by the Foreign Languages Publishing House, Moscow/Central Books and contains 237 pages.

The opening paragraphs of the foreword to this interesting paper-backed book read:

"In the Soviet national economy technical progress is the principal determining factor in the creation of the material and technical basis of communist society.

"A feature of technical progress in the USSR is that old machinery and techniques are replaced by new machinery and techniques and these, in their turn, are replaced by the latest, and that machines supplant manual work making labour lighter and the productivity of social labour higher. In all branches of the national economy new machinery and techniques are indispensible for the triumph of socialism in the economic competition with capitalism.

"Lenin taught that he who possesses the most perfect technology, organization and discipline and the best machines has the upper hand. . . We must appreciate the fact that in modern society it is impossible to live without machines, without discipline."

It is perhaps unfortunate, though understandable, that the compilers should have found it necessary to invoke political doctrine in several places within a statement of achievement.

The title and subject matter of the first chapter are significant because, in addition to the comprensive statement given in it of the progress in mechanization and automation, this theme pervades all the later, sectional statements. Unfortunately it is not possible to judge the degree of sophistication to which automation has progressed in the various industries. Nevertheless, such statements as "The Soviet instrument making industry has begun the serial production of instruments for a pneumatic unit system designed to automate entire technological processes in the chemical, iron and steel, and oil industries. . . A unified electronic block system is at present being developed for the same purpose. . . Provision has been made for the further development of . . . high speed electronic computing and scanning systems for centralizing the control and recording of large numbers of technological parameters" are indicative of trends, if not of present achievement.

A few examples drawn from the several chapters will serve to illustrate the rate of progress already achieved and intended by 1965 and beyond. The output of electrical energy increased from 1945 by a factor of about eight to 327 x 10^9 kw in 1961, and is to be increased to 520 x 10^9 kw by 1965, to 1000 x 10^9 kw by 1970, and to 2700-3000 x 10^9 kw by 1980; and it is stated "while in 1929 the USA produced 19.4 times more electrical energy than the USSR and its power output per head of population was 25 times greater, in 1958 these figures dropped to 3.3 and 3.9 respectively. In 1965 the output of electric power per head of population will be only about 1.2-1.5 times below the USA output." The size, operating steam conditions and the overall thermal efficiency of the individual generators seem not so advanced as the most modern units in the USA or this country, but this is hardly a matter of great significance compared with the creation of 1965 of "power grids (at 350-500 kv) in the European and Central parts of the USSR and in Central Siberia, and also amalgamated grids in the West and North West, Transcaucasus, Kazakhstan and Central Asia." (Source: New Scientist, November 1962)

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